NAVIGATING ENERGY SECTOR TRANSITIONS: THE VITAL ROLE OF HUMAN RESOURCE DEVELOPMENT FROM OIL AND GAS TO RENEWABLE SOURCES

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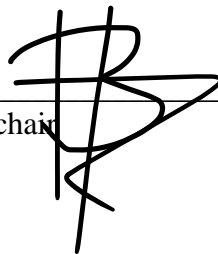
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Dedication

To my beloved wife, and our incredible daughters, you are the sunshine through late-night research sessions, and the unwavering belief that kept me going. This dissertation wouldn't exist without your sacrifices, your endless support, and the joy you bring to my life. Thank you, from the depths of my heart, for being my rock and my inspiration. This achievement is as much yours as it is mine. The unwavering belief in me of my parents, became a lighthouse guide during this challenging journey.

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ABSTRACT

The oil and gas industry is in the midst of a major transition as the world moves toward renewable energy sources and reduced carbon emissions. This energy transition poses an existential threat to traditional oil and gas companies, while also creating opportunities for those able to successfully adapt their business models. Human resource development (HRD) has a crucial role to play in enabling firm competitiveness and resilience during this industry transformation. This paper examines the role of HRD professionals and strategies in the oil and gas industry as companies navigate the shift to renewable energy.

Specific HRD focus areas are identified based on a review of industry trends and scholarly literature. These include managing organisational culture and change, facilitating workforce retraining and talent development, cultivating innovation and intrapreneurship, developing leadership capability for uncertainty and transformation, enhancing employer branding and recruitment messaging, and providing employee support structures during periods of instability. The paper discusses how HRD efforts in these areas can aid renewal of competitive advantage via development of new revenue streams in renewable energy, efficiency improvements in existing oil and gas operations, or diversification into related industries less vulnerable to the renewable energy transition.

The paper concludes that HRD represents a vital dynamic capability for firms in the oil and gas industry facing potential decline. By leveraging HRD strategies and resources, companies can proactively manage disruptive change, sustain core operations, identify emerging opportunities, develop new capabilities, and maintain an engaged, resilient workforce. The renewing role of HRD will growingly determine organisational success and even survival amidst the uncertainties of energy transition.

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CHAPTER I:

INTRODUCTION

1.1 Introduction

The critical role played by effective human resource management in enhancing organisational performance cannot be understated. Effectively managing human capital has been proven to have a direct impact on the engagement and motivation of employees and their level of satisfaction with the job. The implication of this is usually a well-motivated workforce that is relatively more productive since satisfied employees are willing to go beyond expectations, leading to greater performance at the individual and organisational level (Höök & Tang, 2013). The effective management of human resources is especially critical during the administration of change in an organisational context. Change implementation usually has numerous moving parts, but the human aspect of any project has to determine successful transformation. This is because change management is a people-driven process because of the complex nature of transitioning and the involvement of numerous stakeholders who often have conflicting expectations. These expectations of the relevant parties have to be managed effectively, otherwise; they are bound to derail the implementation of any change initiatives.

Human resource development is especially an important consideration when implementing large-scale change in an organisation or industry. Developing an effective HRD strategy is key to ensuring that the workforce transforms in tandem with the environment and the broader organisational context (Hartmann et al., 2021). As the oil and gas sector transitions from non-renewable energy sources to renewable ones, there is a need to adopt an effective human resource development strategy to address the skills gap, manage employee resistance, and ensure that the productivity of workers is checked so that the organisation does not lose competitive advantage (Qadir et al., 2021). There are several aspects of human resource development that organisations operating in the oil and gas sector will have to take into consideration during this period of change. These include the need for skills development, re-skilling and up-skilling, workforce planning, recruitment as well as retention, diversity and inclusion, change management, regulatory and compliance training, and cross-functional well-being. Change is to be implemented in the gas and oil sector against a backdrop of climate change concerns and a growing preference for sustainable energy sources among potential clients. The global warming phenomenon and

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the subsequent problem of climate change have increased pressure on industrial and individual consumers to adopt a more sustainable lifestyle to mitigate the devastating environmental consequences.

The objective of the following chapter is to critically examine the transition in the oil and gas sector to clean energy in order to determine the role played by human resource management in achieving a successful implementation of change. The goal is to gain a comprehensive understanding of the multifaceted opportunities and challenges that are presented by human resource development as a result of this industry-wide change implementation. The investigation of the various dimensions of human resource development to gain vital insight into the strategies and best practices that will enhance the ability of the oil and gas sector to evolve and adapt in this new paradigm shift towards sustainable energy is paramount. By examining the interplay between the energy transition and human resource development, this paper will shed further light to enable human resource professionals, industry leaders, and policymakers to achieve a smooth and successful shift to clean energy.

An important example of companies operating in the oil and gas sector that is set to be significantly impacted by the transition to clean energy is the company organisations. The company, previously known as Oman Oil and Orpic Group, is one of the oil and gas corporations that have recognised the value of adopting a sustainable approach. Traditionally, the company was fully focused on the extraction, processing, sales, and marketing of petroleum products and other fossil fuels. While most companies in the oil and gas sector have either dismissed advocacy for clean energy or adopted a 'sustainable' image for public relations purposes, organisations has made significant investments towards making their operations sustainable, investing in renewable energy sources, and divesting from fossil fuels. The company's commitment to the pursuit of renewable energy is reflected in the fact that it has a dedicated alternative energy unit. The focus of this unit is the research and development of innovative fuel alternatives from synthetic fuel, green hydrogen, and green methanol. Sustainability is also a major pillar of the company's corporate strategy, which is a reflection that the company plans to contribute towards a sustainable energy future. For companies such as organisations Energy that have made significant and capital-intensive investments in the extraction and manufacture of petroleum products, a quick transition would be impossible and devastating to attempt. Nonetheless, it is vital that the company's current corporate strategy aligns with this future outlook that recognises the inevitability of renewable energy and the need to transform to secure long-term competitive advantage.

As far as human resource development is concerned, the company has made considerable effort to improve the competence of its workforce by giving them with a train to acquire new or multiple skills. By providing employees with training, the company will improve their ability to complete their tasks at work and enhance engagement and job satisfaction (Eizaguirre et al., 2019). The implication of this is that employees have greater motivation to perform at a higher individual level, promoting the productivity of the organisation in general. Companies in the oil and gas sector, such as s, will have to provide their workforce with additional training in areas such as renewable energy systems, hydrogen production, and sustainable manufacturing (Beier et al., 2022). Additionally, the companies have to acquire new talent in renewable energy through targeted recruitment efforts to ensure there is adequate human resource support for a successful tradition (Casalicchio et al., 2022). This can be achieved by partnering or collaborating with educational institutions in order to access fresh challenges. Organisations has also made significant investments in the development of leaders to create a new crop of employees who will champion the transition to clean energy and influence other stakeholders towards this new direction. Furthermore, the company also practices effective engagement and communication within the organisation, which could significantly benefit other firms operating in the oil and gas sector. Internal communication campaigns, recognition programs for sustainable performance, and employee resource groups are relied upon to achieve optimal engagement. Last but not least, organisations have also incorporated clean energy goals and sustainability into performance management systems to ensure individual and team objectives align with the overarching corporate strategy.

1.2 Research Problem

The commitment of the world to addressing the global warming and climate change phenomena has led to a major shift in the energy industry. This transition is especially relevant to the gas and energy sector, which is traditionally a bastion of non-renewable energy sources such as fossil fuels. As the global economy pivots towards clean or renewable energy consumption, this sector faces a significant challenge in adapting its operations and practices to maintain competitive advantage in a fast-changing context. The success of this industry change is not only pegged on technological innovation but also an industry's human resource development strategy (Johnsson et al., 2021). Human resource development includes policies, strategies, and initiatives that equip the workforce with the relevant skills and knowledge necessary to respond effectively to market demands. There are several challenges and opportunities that

become apparent for human resource development during this major transition to renewable energy sources by companies in the oil and gas sector.

There are several challenges for human resource development during this transition period, including an obvious skills gap due to a mismatch between employee competencies and the demands of the new reality (Renwick et al., 2013). There exists a significant gap between the skills and competencies of the workforce and the job demands for employees in renewable energy. Workers of most companies in the gas sector are unlikely to have the relevant skills demanded by their job description in the new paradigm, making it necessary to up-skill and re-skill the workforce. The transition to renewable energy in the gas sector also requires the workforce to be significantly reconfigured. There is a big difference between the job profiles and skill sets needed in the renewable energy sector and those needed in fossil fuels (Jimenez et al., 2019). The implication of this is that there are important considerations as far as workforce retraining, displacement, retention, and recruitment strategies are concerned. Regulatory knowledge is also a vital factor to consider when companies are transitioning from fossil fuels to renewable energy sources. It is crucial for companies to fully understand and comply with all the relevant environmental standards and energy regulations that differ significantly from the previous way of doing things. There are also challenges to be expected due to the psychological and cultural shifts that are likely to occur during the transition period that must be addressed to ensure a positive mindset towards renewable energy among the workforce. Moreover, organisations must recruit specialised talent with expertise in renewable energy to enhance long-term competitive advantage by ensuring a skilled workforce.

Nonetheless, there are also several opportunities in human resource development during this transition period, including cross-skilling and adaptability. Human resource development provides organisations with the opportunity to a workforce with a diverse skill set adaptable to both renewable and non-renewable sectors (Hall et al., 2017). The ability to respond effectively to market demands is invaluable in the modern globalised economy in creating competitive advantage due to the ability to meet customer expectations better relative to the competition. Diversity and inclusion as a result of HRD can contribute to increased innovation by promoting variety in ideas, experiences, and perspectives, leading to greater effectiveness in problem-solving (Rempel & Gupta, 2021). Additionally, human resource development is critical for instilling strong safety and environmental practices within the workforce to ensure that the transition to the renewable energy reality does not undermine safety standards or environmental requirements. Human resource development enhances change management outcomes to

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provide guidance to employees, reduce resistance to change, and ensure a smooth shift from fossil fuels to clean energy (Haddock-Millar et al., 2016). The implication of this is that any major change in the oil and gas sector has to employ human resource development strategies in order to be successful.

1.3 Purpose of Research

The primary objective of this investigation is to unravel the intricate relationship between human resource development and the transition to clean fuel in the oil and gas sector. Specifically, the research will pursue the following objectives:

a. To analyse the challenges and opportunities faced by companies in the oil and gas sector during the transition to renewable energy and the role of human resource development.

b. To identify the best practices and strategies that human resource professionals and industry leaders in the oil and gas sector can rely upon to ensure a successful transition.

c. To identify various inputs and suggestions for stakeholders who are involved such as policymakers who are involved in shaping the future of the oil and gas industry in a renewable energy landscape.

d. To establish the level of environmental awareness of the various stakeholders in the oil and gas sector during the transition to renewable energy sources.

1.4 Significance of the Study

This investigation on the influence of human resource development on the transition to renewable energy in the oil and gas sector is significant for several reasons. First and foremost, human resource development is important to the overarching goal of the transition, that is, to reduce the negative impact of fossil fuels on the natural environment. The oil and gas sector is the main contributor to the greenhouse effect and the subsequent climate change phenomenon. Effectively implementing human resource development ensures that the workforce is well-equipped with the skills and knowledge necessary to facilitate a smooth transition to renewable energy, thus promoting the reduction of carbon emissions (Johnsson et al., 2019). Additionally, human resource development is critical for economic resilience. Therefore, this industry-wide transition is more than an environmental imperative since it also has an economic dimension. During this transition from fossil fuel to clean energy, the oil and gas sector's only

hope of survival is to adapt as the match to a sustainable future is practically unstoppable. Human resource strategies prepare the workforce to adapt to a changing energy landscape, enhancing the economic resilience of the oil and gas sector (Singh et al., 2020). There is also an opportunity for the creation of jobs and the retention of key workers. Human resource development initiative equips employees with new skills required to access employment opportunities in the new renewable energy paradigm, creating new positions and mitigating potential layoffs.

The findings of this study are also of great significance to global energy security by reducing fossil fuel dependency. Through human resource development, the relevance of the oil and gas sector can be guaranteed in the dynamic energy landscape nationally and globally (Shen et al., 2018). In addition, resource optimisation also benefits significantly from human resource development in the oil and gas sector as it transitions to clean energy. Human resource development strategies can aid in ensuring that companies in the oil and gas sector optimally utilise available resources so that there is minimal waste (Shen & Jiuhua, 2011). Moreover, the research is significant for human resource development as it enhances innovation and technological advancements in the energy industry. By encouraging invention among the workforce, HRD promotes innovation among employees, leading to novel practices whose far-reaching implications can be felt by other industry players.

Companies can also benefit from knowledge of the role of human resource development to enhance the sustainable corporate image. Companies that are committed to human resource development during this transition would send a strong message to the various stakeholders as far as their commitment to sustainable development is concerned (Saygin, 2015). The implication of this would be the creation of a competitive advantage since the companies would resonate well with environmentally conscious customers, employees, and investors (Rosenkranz et al., 2021). There are also important implications for regulatory compliance from this research regarding the role of HRD in the transition to clean energy in the oil and gas sector. The transition to clean energy will require adherence to new rules, standards, as well as regulations, and HRD equips employees with adequate knowledge needed to mitigate the risk of non-compliance, thus exposing the company to legal and financial liabilities (Russo et al., 2022). Finally, this research will highlight strategies for human capital retention that can be leveraged by companies in the oil and gas sector during the transition to retrain and up-skill their employees so as to ensure the preservation of experience in the institutional of knowledge.

1.5 Research Purpose and Questions

There are several questions that this research seeks to address in order to provide readers with a comprehensive understanding of the role played by human resource development in the transition to a sustainable future in the oil and gas sector. These questions include:

I. What are the main challenges that companies in the oil and gas sector face in ensuring a successful workforce transition, and what is the role of HR development in addressing these challenges?

II. What are the implications of the implementation of human resource development on skill acquisition and workforce adaptability during this transition period? How does this impact job creation and retention?

III. What are the ways through which human resource development enhances the economic resilience of the oil and gas industry in the context of the transition to renewable energy, and how does this optimise current industry resources to achieve a successful transition to sustainable energy?

IV. In what way does human resource development affect innovation and technological advancement among companies in the oil and gas sector as it transitions to renewable energy?

1.6 Limitations, Delimitations, and Assumptions

This study had one major limitation, that is, sampling bias due to the limited number of respondents. Hence, the views of those who participate may not be generalisable to the entire population (Saunders, 2011). Moreover, qualitative designs often lead in subjective results that may not paint an objective picture of the problem under study. As far as delimitations are concerned, the geographic scope of the study may be limited due to practical constraints and the outcomes must be framed within this context (Silverman, 2011). Last but not least, the research assumes that those interviewed for the study provide authentic responses as far as their opinions and attitudes are concerned, Nonetheless, there is always a likelihood of inaccurate information or response bias.

1.7 Definition of Terms

- *Renewable energy* is energy that is generated from natural resources that can be replenished on a human timescale.

- *Non-renewable energy* refers to fossil fuels or energy sources which are limited and cannot readily be replenished within human timescales.

- *Global warming* refers to the steady rise in the mean temperature of the Earth's surface due to the accumulation of greenhouse gases.

- *Climate change* refers to the long-term and significant changes in the climatic patterns of the Earth.

- *Human resource development* is a broad term that includes the strategies, activities, and processes whose objective is to enhance the workforce's skills, knowledge, capabilities, and overall performance.

CHAPTER II:

REVIEW OF LITERATURE

2.1 Theoretical Framework

The transition of the oil and gas sector to renewable energy is not just an industry move, but also a necessity on a global scale. The switch to greener, more sustainable energy sources is now required due to the impending effects of climate change. The key to this enormous change turns out to be human resource development (HRD). HRD is not only a facilitator but also the impetus behind providing employees with the expertise, abilities, and perspective needed to successfully navigate this significant change. Prioritising skill development is central to HRD's work. More than just training is required; the workforce must be upskilled and reskilled to comprehend and use renewable energy technologies. HRD equips workers to thrive in this new energy environment. Another essential component is innovation. In order to encourage employees to investigate new technologies, goods, and services that are in line with renewable energy objectives, HRD cultivates a culture of innovation and forward thinking. Technological advancements, cost reductions, and environmental impact mitigation are being propelled by this innovative culture. Additionally, HRD encourages an adaptable and long-lasting culture in businesses. It is important to embrace change as an essential component of the company culture rather than just reacting to it. Instilling sustainability and environmental awareness is part of this cultural shift, which acknowledges that cutting carbon emissions and implementing greener practices are crucial elements of a responsible corporate identity.

Thanks to the detrimental effects of global warming, individuals, corporations, and societies are slowly coming to terms with the fact that the burning of fossil fuels has devastating consequences on the natural environment. This, coupled with the climate change phenomenon, has placed great pressure on companies to adopt sustainable operations. World governments have held major conferences discussing the impacts of fossil fuels, and agreements have been signed by various stakeholders to ensure that policies are affected for better outcomes in the fight against global warming and climate change (Widya & Tjahjono, 2019). Regulators have also implemented rules and regulations governing the use of fossil fuels in order to mitigate the negative effects associated with their use. Members of society have also piled pressure on corporations by adopting sustainable lifestyles and demanding that companies adopt clean

energy as well as boycotting firms considered non-sustainable. The implication of this is that modern companies have no choice but to respond to this environmental pressure if they are to maintain their level of competitiveness in the long run. Of course, such a transition is very difficult, costly, and complex for some firms, such as those in the oil and gas sector whose entire operations are optimised for oil and gas production.

The objective of this literature review is to perform an investigation on how the transition to sustainable energy can be achieved effectively by leveraging human resource development strategies. The implementation of HRD strategies is of critical importance, especially for firms that have to make a major organisation or industry-wide change such as the one necessitated by the transition from oil and gas to renewable energy sources. This section of the research will examine the available literature evidence on HR development's role in the successful transition from non-renewable to renewable sources of energy. Consequently, the research will capture how organisations in the oil and gas sector can successfully make the switch to renewable energy through the effective management of human capital. The relationship between human resource development strategies and government policies will also be discussed critically since market regulations have a direct impact on the workforce, products, and services of organisations in the oil and gas sector. Towards this end, the research has identified various literature resources that can be relied upon to determine human resources development strategies to enhance the outcomes of the transition to clean energy in the oil and gas sector as well as the role of the government in this entire process.

A robust framework for examining the oil and gas industry's transition to renewable energy should incorporate elements of sustainability transition theory, socio-technical systems perspective, and organisational change models. Sustainability transition theory provides context on the pressures driving the adoption of renewable technology and business models that align with ecological limits. It recognises that this transition is society-wide, well beyond individual companies, involving political, social, and economic forces alongside technological shifts. Oil and gas firms operate amidst landscape pressures like climate policy, investor demands, competitive moves, and customer expectations, and an understanding of these external drivers is important. As societies shift towards more environmentally sustainable economic systems, oil and gas companies face pressure to transition from fossil fuel extraction and production to renewable energy sources like wind, solar, and geothermal. This sustainability transition entails major technological and business model changes for firms traditionally focused on non-renewable

energy. Human resource development (HRD) departments have a crucial role to play in managing this transition successfully within oil and gas companies. HRD can analyse future workforce skill needs and develop reskilling and upskilling training programs to equip current employees with the competencies now required for renewable energy projects. HRD can also lead change management and internal communication initiatives to encourage the adoption of sustainability values and culture, ensuring that the workforce is prepared both with the proper skillsets and mindsets to embrace and thrive in the transition to renewables. With proactive planning and support from leadership, HRD can drive successful sustainability transitions even in resistant sectors like oil and gas.

The socio-technical systems perspective meanwhile helps analyse the specific network of stakeholders that interact to enable enterprise-level change. This means examining interactions between oil and gas companies, governments, technology partners, startups, researchers, suppliers, and community organisations that collectively work to progress renewable solutions. Appreciating these complex stakeholder ecologies provides a more nuanced understanding.

Organisational change theories illuminate the internal realignments oil and gas companies will undergo to embed renewable energy - from strategy and structure revisions to new capabilities, decision-making routines, and cultural orientations more attuned to sustainability. This spans technological, economic, and social dimensions across enterprise functions.

Theorising these systemic enterprise transformations is vital. Weaved together, these three theoretical dimensions provide multi-level and multi-faceted perspectives valuable for explaining renewable energy transitions in oil and gas:

- The sustainability transition lens shows the macro big picture and impetus for change.

- Socio-technical systems perspective spotlights meso-level relationships enabling energy solutions.

- Organisational change theories examine internal, micro-level transformations within companies.

This trifecta theoretical framework operates at the landscape, network, and enterprise levels respectively. Anchored together, they provide a more complete composite understanding of the complex drivers, stakeholders, and organisational realignments integral to unpacking oil and gas transitions to

renewable energy. No single theory provides sufficient perspective; an integrative multi-theory approach allows holistic analysis of this unfolding transformation.

2.2 The Oil and Gas Sector

The oil and gas sector has been the backbone of the global economy for almost two centuries, enabling the industrial revolution and the subsequent globalisation phenomenon. The sector has powered various modes of transport, supported industrial processes, and driven numerous household appliances. In essence, the oil and gas sector is a critical component of the global energy industry because it still meets a majority of the world's energy needs despite its growing unpopularity. In recent years, the sector has been undergoing challenges and changes which are likely to shape the future of industry players. One of the main challenges faced by the oil and gas sector today is the fluctuation in gas prices due to market volatility as a result of geopolitical events as well as supply and demand dynamics (Saygin et al., 2018). The high level of volatility is likely to hurt the stability as well as the profitability of industry players in the oil and gas sector. There are also stricter regulations imposed upon players in the oil and gas sector due to the increased scrutiny by government agencies as far as global efforts to reduce pollution are concerned. Companies in the energy industry are under increased pressure to lower their carbon footprint and make their operations sustainable. Failure to comply with these new regulations is likely to increase the risk of legal and financial liability significantly. Additionally, it can also lead to the loss of competitive advantage as customers are likely to make purchases from companies whose operations reflect a sustainable agenda as it resonates with them.

As far as the future of the oil and gas sector is concerned, the transition to clean energy has to happen. The non-renewable nature of natural gas and oil means that companies in this sector, with a long-term mentality, recognise the need to diversify energy resources to ensure profitability for the foreseeable future. Failure to identify the disruptive power of renewable innovations has significant implications for the future survival of companies in the oil and gas sector (Braccini & Margherita, 2018). Organisations that fail to make the transition to clean energy are unlikely to survive the oncoming industrial change. This is also true for companies that fail to effectively manage the transition to renewable energy since the poor implementation of change initiatives without effective human resource development strategies is likely to result in a botched transition, wasted resources, and demotivated employees (Güney 2019). Therefore, organisations in the oil and gas sector must gradually shift their primary focus from fossil fuels and diversify their energy portfolio. The industry is also witnessing greater technological innovations to

support exploration, extraction, production, as well as operational efficiency. Companies in the oil and gas sector must optimise operations by deploying emerging technologies such as artificial intelligence, automation, and data analytics. Nonetheless, the global energy demand is expected to grow despite the transition to clean fuel driven by demand from developing nations (Braungardt et al., 2019). Geopolitical factors are likely to also be influenced by historical events, such as conflicts, sanctions, or decisions affecting OPEC countries.

2.3 Non-Renewable Sources of Energy

The majority of the global energy supply comes from the oil and gas sector since a majority of the renewable power sources cannot be utilised on an industrial scale. Natural gas and oil still support most of the global economy, especially in those countries that are underdeveloped and cannot afford to make major investments in renewable energy. Non-renewable energy refers to power sources that are finite or limited in that they are not easily replenished or replaced on a human timeline. These resources are non-renewable since these fossil fuels often form over millions of years as dead organisms' decay. Non-renewable sources remain to be the primary sources of energy for the global economy despite their recent unpopularity. Fossil fuels are the main type of non-renewable energy sources (Bowen et al., 2017). These fuels include natural gas, oil, or petroleum as well as coal. Natural gas is largely a combination of hydrocarbon gases, usually used for heating, fuelling vehicles, and generation of electricity. Crude oil or petroleum is often processed into petroleum products like diesel and gasoline as well as lubricants. Last but not least, coal is a solid fossil fuel that is relied upon for generating electricity for industrial processes. Nuclear energy is an alternative form of non-renewable fuel that generates massive amounts of energy from the splitting of atoms. Its reliance on uranium and other radioactive elements that are finite means that the fuel is non-renewable. Despite their massive contribution to the energy market, non-renewable sources have significant environmental effects, including pollution and the greenhouse effect. Moreover, their finite nature means that there is a high likelihood of depletion, leading to price fluctuations. Consequently, the current drive to adopt renewable sources is informed by these environmental effects as well as the need to ensure sustainable or long-term energy availability.

2.4 Renewable Sources of Energy

Renewable energy sources refer to sustainable sources that are easily replenished over a short period, usually on a human timescale. These sources are considered 'clean energy' not only because of

their reduced carbon footprint but also due to their ease of replenishment (Buonocore et al., 2019). Such energy sources include wind energy, which is often harnessed from the sun using solar panels or photovoltaic cells. Solar energy is very abundant and sustainable, making it popular for electricity generation, especially in tropical countries where there is plenty of sun. Another source is wind energy, which is generated when the kinetic energy of moving wind is harnessed using wind turbines. Wind energy is virtually limitless and a clean source of energy. Hydropower is another renewable source of energy that is harnessed from moving or falling water. Hydropower is one of the oldest and most popular sources of renewable energy for the generation of electricity from rivers, dams, or tides. Biomass energy, on the other hand, is generated from the decomposition of organic matter, such as waste, agricultural residue, and wood. Geothermal power is another renewable source of energy that harnesses heat from the core of the earth. It has numerous industrial applications and can be relied upon for generating electricity as well as heating buildings. Last but not least, wave and tidal energy are the main types of ocean energy where tides and waves are used for the generation of electricity, with the potential for greater predictability and sustainability as far as power production is concerned.

2.5 Transition to Clean Energy

The sustainability of renewable energy sources offers several advantages, including lower environmental impact, reduced air pollution or emission of greenhouse gases, as well as better air quality. Additionally, renewable energy sources are readily available in most regions of the world, promoting energy security by reducing dependency on imported energy. As the globe slowly transitions to renewable energy sources, these novel power sources will enable societies to meet their energy sustainability goals as well as mitigate the economic and environmental challenges related to non-renewable sources. This transition is highly complex with far-reaching implications as it entails shifting from traditional sources of fuel that were unsustainable to cleaner alternatives. Switching to renewable energy on such a scale is almost impossible because there is an entire industrial complex built around these energy sources. The biggest energy companies in the globe have their biggest investment in fossil fuels due to their massive ventures made many years ago and over the course of time (Wang et al., 2020). The transition in the oil and gas sector is driven by various environmental concerns, long-term mentality, as well as market dynamics as a result of the limited nature of traditional energy sources.

There are several aspects of this transition that are considered key to achieving a successful industrywide adoption of renewable energy sources. Diversification of energy portfolio is an important

aspect of this transition as major industry players seek to make new investments in renewable energy sources while slowly but surely divesting their interest on non-renewable energy sources, such as solar, wind, and biofuels. By diversifying their portfolio, companies in the oil and gas sector reduce their reliance on fossil fuels as well as actively participate in the fast-growing renewable energy market (Haddock-Millar et al., 2016). There is also a growing trend of making investments in renewable energy sector projects and technologies. Such investments include the construction and operation of solar installations, wind farms, and production facilities for biofuels. They also encompass research and development as far as carbon capture as well as utilisation and energy storage are concerned (Kamble et al., 2021). Carbon capture and storage are being explored and implemented to harvest as well as store carbon dioxide emitted during various operations. Carbon capture and storage are sustainable because they lower the environmental effects associated with fossil fuels.

Renewable hydrogen production is another key aspect of the transition to renewable energy in the oil and gas sector. Renewable hydrogen is a potential energy carrier that is harnessed from clean sources of energy, such as solar and wind. Companies in the oil and gas sector have explored the production and utilisation of renewable hydrogen industrial processes and fuel cells. There is also growing investment in low-carbon fuels and biofuels as potential replacements for fossil fuels industrial processes and transportation. Most companies consider these fuels as transitional solutions to the reduction of carbon footprint, resulting in a significant rise in research and development in this area (Mikhaylov et al., 2020). Carbon offset initiatives like renewable energy sources and reforestation projects have also been launched by several gas and oil companies to compensate for their emissions. Such initiatives are a demonstration of the commitment of these companies towards reducing their carbon footprint as well as promoting sustainability. Mergers and acquisitions are a significant aspect of this transition. Most large companies have shown a preference for acquiring or merging with promising renewable energy startups. This is a very good strategy that ensures that companies acquire businesses that enhance their sustainability without necessarily growing them from scratch. Last but not least, regulatory compliance and sustainability reporting are also vital aspects of this transition as companies recognise greater customer apathy towards unsustainable brands and implementation of government policies governing industrial activity.
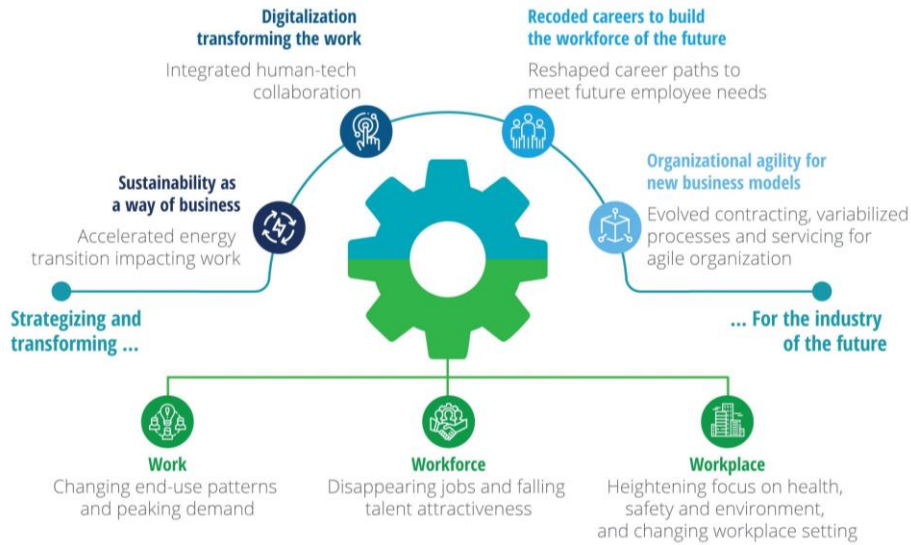
Figure 1 Four Levers of transformation for transition (Dickson, 2020)

2.6 Human Resource Development Strategies

The transition in the oil and gas sector to renewable energy is a significant departure from the industry's focus as well as operations. Human resource development has a major role to play by ensuring that the workforce is equipped with vital skills, knowledge, and flexibility required for navigating a very dynamic energy industry landscape (Christophers et al., 2019). There are several key aspects of human resource development as far as the oil and gas industry's transition to renewable energy is concerned.
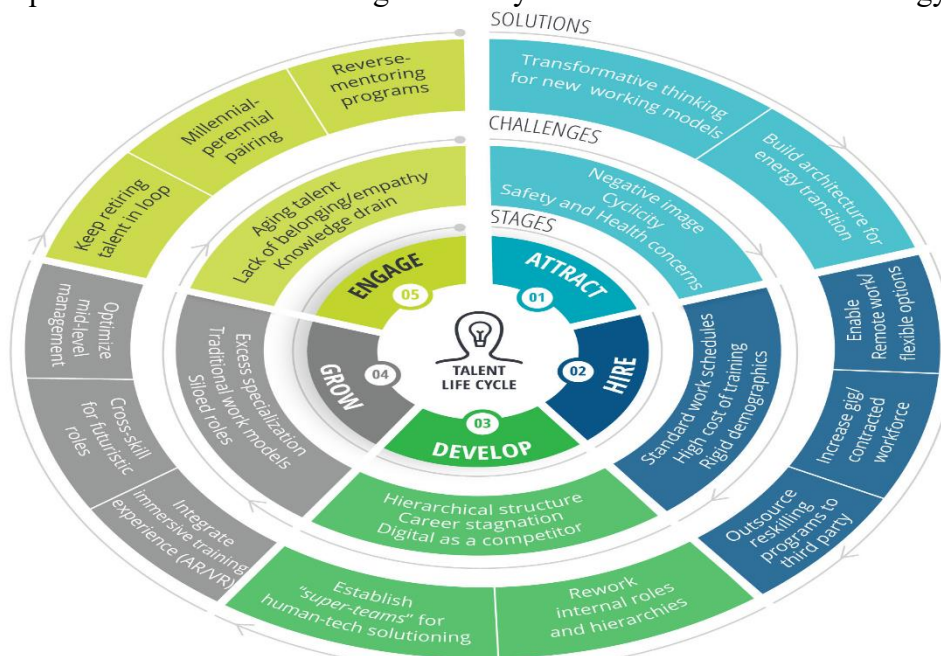
Figure 2 Workforce layout for the new talent beget (Dickson, 2020)

2.7 Skills Development

There is a significant mismatch between the skills that employees in the oil and gas sector have and those that are required to maintain competitiveness in this new renewable paradigm. Because the core competence of most of the companies in this sector was in fossil fuels, the skills of the employees must undergo a major upgrade to enhance their ability to perform tasks associated with sustainable energy production (Rosenkranz et al., 2021). In the context of the oil and gas sector, skills development can be considered a cornerstone of HRD. In order for the oil and gas sector to make a successful transition into renewable energy, it is necessary to transform the skillset of the entire workforce (Liang et al., 2019). Skills development entails the broadening of expertise in recognition of the fact that most employees' competencies are in exploring, drilling, extracting, and refinery fossil fuels. The transition means that there is a need to train workers on various aspects of renewable energy to ensure that they can contribute more effectively to an energy mix that is more sustainable. Cross-functional training is also necessary to get rid of the skills gap between fossil fuel energy and clean energy. Case in point, employees with expertise in geology and drilling may require further training in solar energy infrastructure. The rationale for cross-training is that it promotes the transfer of existing knowledge and skills to new areas while also enhancing their competence in renewable energy technologies.

Energy storage systems are also a key aspect of skills development during the transition to clean energy because of the sporadic nature of renewable energy. Human resource development should provide employees with training on various energy storage systems, such as pumped hydro storage and batteries to ensure that the workforce is well-versed in the maintenance of a stable as well as reliable energy supply (Collins et al, 2016). Grid management knowledge is also critical in ascertaining the incorporation of renewable energy sources into the current grid system. To achieve a seamless transition to a more dynamic and decentralised grid system, employees must receive training on smart grid operations as well as grid integration in sustainable energy. Skills development is also vital for maintenance operations and troubleshooting to optimise performance. Human resource development programs must provide employees with vital skills required for diagnostics, troubleshooting, and maintenance of renewable energy systems to maximise energy production and minimise downtime (Hartmann et al., 2021). It is also important to enhance employee knowledge as far as safety protocols are concerned. For the energy sector, safety is a top priority; hence, there is a need to emphasise safety protocols relevant to clean energy.

Employees must receive training in the recognition of hazards, prevention strategies, as well as emergency response.

Additionally, some roles in the renewable energy sector may require additional certifications and qualifications. Implementing an effective HRD strategy can enhance the ability of employees to navigate the certification process as well as stay updated on the changing industry standards (Razack et al., 2020). Regulatory and compliance knowledge is also a critical aspect of skills development in this renewable energy paradigm since employees must be knowledgeable about the regulations in the renewable energy sector, compliance requirements, and permitting processes. This important knowledge can be imparted to employees through HRD programs. The development of soft skills must also be part of skills development in addition to technical know-how. Skills such as effective communication, adaptability, teamwork, and problem-solving are crucial for the successful implementation of change. Last but not least, organisations must promote continuous learning to ensure that employees stay up-to-date with best practices, renewable energy technologies, and market trends (Ghobakhloo, 2020). A culture of continuous improvement is vital for companies in the oil and gas sector because it promotes agile response to change as well as innovation within the organisation.

2.8 Sustainability and Environmental Awareness

Environmental awareness and sustainability are of critical importance in the modern world, especially in industries such as oil and gas sector that are traditionally associated with a large carbon footprint and environmental degradation. Human resource development has a significant role to play in enhancing the understanding of employees in this sector as far as sustainability and environmental responsibility are concerned (Owusu & Asumadu-Sarkodie, 2016). Sustainability is a broad term for the ability to meet the needs of the present generation without undermining the ability of the future generation to cater for themselves. Environmental awareness refers to the recognition of the impact that human activities have on the natural environment as well as implementing initiatives to address the negative effects (Jimenez et al., 2019). As far as the transition to renewable energy in the oil and gas sector is concerned, these concepts are important for several reasons, including the mitigation of environmental impact, regulatory compliance, meeting stakeholder expectations, cost reduction, and risk management. The oil and gas sector has been associated with negative impacts on the environment such as air and water pollution, global warming, and habitat disruption (Zibarras & Coan, 2015). It is important to develop

environmental awareness and sustainability in order to mitigate the negative effects as well as adopt sustainable habits.

Regulatory compliance is also another reason for ensuring a comprehensive understanding of sustainability and promoting environmental awareness. Organisations in the oil and gas sector must ensure that they remain compliant as governments around the globe implement stricter regulations meant to limit the production and consumption of non-renewable energy sources (Wesseling et al., 2017). Providing employees with training on environmental awareness and sustainability helps them develop a better understanding of legal requirements as well as their role in ensuring compliance. Consumer and stakeholder expectations are another reason why sustainability and environmental awareness are important aspects of human resource development in the oil and gas sector during this transition period. Consumers as well as other stakeholders are increasingly demanding sustainability and environmental accountability from firms, not just in the energy industry but also in every sector of the economy (Jung et al., 2020). Thanks to climate change advocacy and the availability of reliable information on pollution by fossil fuels, most consumers are likely to prefer purchasing sustainable products. Companies that are unable to respond to these market expectations are not going to resonate with customer preference for sustainable goods and services. The implications of this are reduced customer satisfaction, brand switching, and the loss of long-term competitive advantage.

As far as risk management is concerned, HRD is crucial in ensuring that employees fully understand environmental risks and their potential consequences. HRD creates awareness of these risks so that companies can develop appropriate strategies to mitigate or prevent them, reducing legal and financial liability as well as ensuring that the organisation remains a going concern for the foreseeable future (Ogbeibu et al., 2020). There is also a cost reduction argument for ensuring that HRD strategies adopted by companies in the oil and gas sector impart sustainability knowledge and expertise to employees. Sustainable practice can lead to reduced wastage, decreased energy consumption, as well as reduced emissions, which improves the bottom line of the company by lowering overheads, thus, enhancing profitability.

2.9 Change Management

In the oil and gas sector, the transition to renewable energy represents a major paradigm shift that most companies will be unable to cope with. Renewable energy sources can potentially disrupt the oil and

gas sector significantly, leaving most market incumbents with shrinking margins and unfriendly government regulations (Wilson, 2015). The current shift in this industry requires more than changes in technologies and includes recognition of the need to update the corporate culture and mindset of an organisation. There is an important role for human resource development to play as a facilitator of this shift by providing employees with training on change management. Change management refers to a structured approach for ensuring the transition of individuals, groups, and organisations to a future status that is better than the previous one (Nassar et al., 2019). In the context of the oil and gas sector, change management is important for several reasons, including the culture shift that organisations in the industry are likely to experience. Adopting renewable energy sources in the oil and gas sector requires a cultural shift from fossil fuels towards environmental consciousness, sustainability, and commitment to the reduction of carbon footprint. These values have to be internalised by employees, and change management training can ensure employees get their priorities right to create a novel organisational culture that reflects the new corporate direction of the companies in the oil and gas sector.

Change management is also important to ensure that employees can effectively leverage new technologies associated with the emerging renewable energy market. Employees must receive adequate training in order to enable them to learn new skills or direct previous skills they had towards the production of energy using unfamiliar technologies. In the absence of adequate training during the change implementation period, employees are likely to struggle to utilise these technologies and complete tasks, leading to frustration, poor engagement, and job dissatisfaction, which are precursors for reduced motivation and organisational performance (Pinzone et al., 2016). Employees must, therefore, receive training on new technologies like wind turbines, solar panels, and energy storage systems to enhance their level of competence. The transition to the new renewable energy paradigm is also expected to result in a change in the strategic goals of various organisations in the industry. Change management strategies adopted by the company must align the work of employees with the evolved organisational priorities. Change management is also crucial for understanding market dynamics since non-renewable energy markets work differently from those of renewable energies (Curtin et al., 2017). Change management training will help employees develop a better understanding of market dynamics, competition, and customer expectations. It is also important for risk management as employees have a better understanding of potential risks associated with transition and are well-equipped to handle these risks. Last but not least, change management is also important for regulatory compliance as the new renewable energy landscape comes with novel environmental and industry rules.

There are several challenges that are likely to face change management, especially for the oil and gas sector, which is traditionally centred on non-renewable energy sources. The main challenge facing the change initiative in the oil and gas sector is employee resistance (Rempel & Gupta, 2021). Employees will be the most negatively affected stakeholders in this industry because very few skills are transferable from the fossil fuel sector to renewable energies. Employees are naturally afraid of change, especially if it is likely to impact their ability to perform their tasks or put their jobs at risk. If employees of the oil and gas sector suspect that they will be laid off masse, the change initiative is likely to encounter massive resistance that can derail its implementation or result in poor outcomes after implementation. Employee resistance refers to active efforts by employees to derail a change which they deem as adding no value or undermining their utility. There are many other reasons for employees to resist change initiatives, including comfort with the status quo and fear of the unknown (Dumont et al., 2017). Change management should address and mitigate employee resistance by ensuring that workers are fully engaged, informed about their role and benefits, and committed to the achievement of change because they are aware of the long-term benefits, they will derive from it as stakeholders.

Another major challenge to change initiatives is the lack of awareness, which means employees may not be conscious of the need for change, the role they will play during the transition, and the benefits that accrue from adopting a renewable energy outlook. As previously indicated, the skills gap between employees in non-renewable sectors and those from renewable energy sectors may be a major challenge since failure to provide them with training is likely to be detrimental to organisational performance. Last but not least, effective communication is vital in the implementation of effective change. There is a need to ensure that employees receive consistent, clear, and transparent information about the transition (Johnsson et al., 2019). Failure to communicate with employees effectively is likely to contribute to increased resistance since it leaves room for gossip and miscommunication.

Human resource development has an important role to play in change management. When it comes to managing change during the switch to renewable energy, HRD may be a driving force. Human resource development can be extremely important in education and training. HRD can create and administer training curricula that give staff members the know-how and abilities they need to make the shift. This involves instruction in soft skills like flexibility and collaboration as well as technical training on renewable energy systems. Human resource development is also important for communication strategies. HRD can create communication plans that inform staff members about the status of the transition, its

motivations, and how it fits with the goals and values of the company (Majid, 2020). Leadership development also has an important role to play during change management. HRD can help find and develop leaders who will be able to steer the company through this change.

Cultural transformation is also an important role played by human resource development in the transition. HRD has the power to inspire a change in society that is focused on renewable energy, sustainability, and environmental consciousness. This entails creating and fostering an organisational culture that respects and encourages change. It is also crucial to provide training in change resilience for effective change management. HRD can give staff members the skills and methods to strengthen their ability to withstand change, enabling them to deal with uncertainty and adjust to new situations. HRD also plays a vital role in feedback systems. It can set up systems that let workers express their opinions, exchange ideas, and take an active part in the process of transformation (Dehghani-Sanij et al., 2019). Evaluation and monitoring are also important roles in human resource development. HRD can evaluate the success of change management initiatives and make the required modifications in response to input and data analysis.

There are several change management case studies that can provide vital evidence that such modification can be successfully achieved. HRD initiatives can be motivated and directed by real-world instances of effective change management during the switch to renewable energy sources. Significant changes have been made by organisations like BP, Total Energies, and Shell, which have reduced their carbon emissions and embraced renewable energy. Organisations in the oil and gas industry can benefit greatly from using these cases as benchmarks. Therefore, in the oil and gas industry, change management is a crucial part of the transition to renewable energy. The effectiveness of this shift greatly depends on HRD's ability to manage and promote cultural change, and provide training (Russo et al., 2021). Organisations may successfully navigate the challenging process of switching to more environmentally friendly and sustainable energy sources while guaranteeing staff involvement and commitment to the new aims and values by realising the importance of change management and tackling its obstacles.

2.10   Innovation and Research

In today's quickly changing energy market, innovation and research are essential for success, especially when it comes to the oil and gas industry's shift to renewable energy. Human resource development (HRD) is an essential component in fostering an innovative and research-oriented culture in

enterprises. This segment covers the value of encouraging innovation, the advantages of research-driven strategies, and how HRD might encourage staff members to investigate novel technologies, goods, and services that support renewable energy objectives (Eizaguirre et al., 2019). To adapt, grow, and prosper in a dynamic environment, an organisation needs innovation and research. These factors are important in the context of the oil and gas sector's shift to renewable energy for several reasons, including competitive advantage, efficiency and sustainability, cost reduction, market relevance, and environmental impact.

One way to gain a competitive advantage is through innovation. Businesses that take the lead in creating and implementing renewable energy technology frequently benefit from improved market positioning and reputation. Additionally, operations that are more sustainable and efficient can result from research-driven innovation. This covers developments in the production, distribution, and storage of energy. In addition, innovations have the power to reduce expenses. For instance, advancements in renewable energy technologies can lower the cost of clean energy, improving the transition's economic viability. Moreover, using innovative techniques in operation can drastically lessen the negative effects on the environment, thus producing less waste, less carbon emissions, and a smaller ecological footprint (Geels et al., 2017). Furthermore, businesses that make investments in R&D are better positioned to respond to the demands of society for sustainability and changing consumer preferences.

There are several advantages to an innovation strategy that is research-driven in the context of the energy transition. Research promotes the creation of innovative products and methods that raise the efficacy and efficiency of renewable energy sources. Through research, organisations can better address the particular needs and challenges of their industry and develop solutions that are specifically tailored to those needs (Shen, 2021). Research also gives firms the skills and information they need to address difficult challenges like intermittent renewable energy and grid integration. Additionally, proactive steps to mitigate potential risks and challenges can be taken by organisations by conducting in-depth research to identify them early. Finally, employees in an environment that values research are more likely to share information, which fosters cross-functional cooperation and the quick spread of novel concepts.

HRD is in a good position to encourage an innovative and research-focused culture in oil and gas companies that are switching to renewable energy sources. HRD can create and implement training curricula that equip staff members with the know-how and abilities needed to conduct original research and innovate. This covers classes on creative thinking, problem-solving workshops, and technical training

(Nalule & Acheampong, 2021). HRD is also able to recognise and cultivate leaders who support research and innovation. These leaders can motivate their groups, establish goals that emphasise innovation, and promote trial and error. HRD and management can collaborate to set aside funds and time for initiatives aimed at research and innovation. This guarantees that staff members have access to the tools they need to explore their creative ideas.

Cross-functional cooperation: HRD can promote cross-functional cooperation by creating venues and settings where staff members from various departments can gather to share ideas and collaborate on projects. Moreover, HRD is able to come up with a system of rewards and recognition that honours and recognises accomplishments in research and innovation. This encourages workers to get involved in these activities. HRD can also supervise the creation of systems for managing knowledge that collect and share creative solutions and research results across the company (Nassar et al., 2021). Furthermore, HRD can take proactive steps to encourage a culture that embraces change as well as experimentation and learns from mistakes.

2.11   Gaps in Research

Finding research gaps is crucial when reviewing the literature on the contribution of human resource development (HRD) to the oil and gas industry's shift to renewable energy sources. There are several research gaps, including but not limited to study of HRD strategies. While a large portion of the literature currently in publication emphasises the role that HRD will play in the transition, it frequently falls short in terms of providing a thorough analysis of particular HRD practices and strategies. The practical aspects of HRD, such as skill development, change management tactics, and training program design and implementation, could be the subject of future research. There is also very limited research in the sector. Although the literature on the transition to renewable energy is expanding, sector-specific studies may be lacking, especially those that concentrate on HRD in the oil and gas sector. Study that takes into account the particular difficulties, chances, and labour dynamics in this industry may yield insightful results. Additionally, there is also a lack of comparative studies across industries. Studies that compare HRD procedures in the oil and gas industry with those of other sectors making the switch to renewable energy sources can provide a more comprehensive viewpoint. Such research could point out transferable HRD tactics and clarify issues unique to a given industry. Global views on the subject of research are also a major limitation. A lot of research is location-specific, usually concentrating on areas

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that have a high uptake of renewable energy. Research on HRD in areas where the transition is just beginning or faces challenges may be lacking.

There is also limited research evaluating the long-term effects. The literature frequently concentrates on the urgent HRD requirements for the shift. It would be beneficial to conduct research on the long-term effects of HRD strategies on career advancement, job retention, and workforce development in the context of renewable energy. Moreover, research incorporating ethical and social dimensions is also very limited. While research frequently concentrates on technical and economic issues, there might be a void in discussing the social and ethical aspects of HRD during the shift. This might entail looking at how renewable energy jobs affect social justice, local communities, and equitable access to them. Furthermore, available research lacks qualitative studies. Although qualitative research has yielded important insights, quantitative studies that can offer statistical proof of the efficacy of HRD strategies during the transition may be lacking.

2.12   Summary

In conclusion, the oil and gas industry face a turning point as it embraces renewable energy sources due to shifting global energy trends, market dynamics, and environmental concerns. This transformation represents a significant shift in company identity, culture, and mentality in addition to a change in technologies. HRD is the driving force behind the integration of sustainability, environmental consciousness, and carbon emission reduction by organisations. These values have become increasingly important because HRD's comprehensive training and skill development programs are essential for providing workers with the knowledge and flexibility they need to successfully navigate the renewable energy landscape. Workers should become proficient in a variety of fields, including grid management, energy storage, renewable technologies, and regulatory compliance. Additionally, HRD promotes a culture of creativity and inquiry, motivating staff members to investigate novel technologies, goods, and services that support the objectives of renewable energy. In the field of renewable energy, this innovative culture is what propels cost-cutting, technological innovation, and environmental impact mitigation. HRD is also critical in the domain of change management, which is a necessary part of the transition. Workers must adjust to new technological advancements, corporate objectives, and legal mandates. HRD makes sure that workers are actively involved in the process and that the transition is well-managed.

CHAPTER III:

METHODOLOGY

3.1 Overview of the Research METHODOLOGY

Every study starts with its research methodology, and this one will use the research onion framework for a thorough and organised approach. This framework provides a methodical and multi-layered approach to planning and carrying out research, and it is highly regarded by post-graduate and doctorate researchers. It facilitates the comprehension and arrangement of the different elements that form the research process, guaranteeing the study's rigour and clarity. The various layers of Braun and Clarke's 2019 research onion contribute to a more comprehensive and nuanced understanding of the research process. The research philosophy, approach, strategy, choices, time horizon, techniques, and procedures are some of these layers. It is possible to plan and carry out the research in an efficient manner by going through these layers.

I.   Research Philosophy: The researcher's approach to data collection and analysis is guided by their underlying assumptions and beliefs about the research process, which are reflected in this deepest layer.

II. Research Approach: The following layer establishes the framework for data collection and describes the methodology, including any mixed, qualitative, or quantitative approaches.

III. Research Strategy: Whether it is an experimental design, survey, or case study, this layer focuses on the overall strategy for carrying out the research.

IV. Research Decisions: In this section, particular choices regarding data sources, sampling strategies, and data collection methods are made.

V. Time Horizon: This layer determines whether the study is cross-sectional or longitudinal by addressing the temporal aspect of the research.

VI. Methods and Procedures: The topmost layer describes how data collection and analysis techniques are used in practice, including the instruments, tools, and statistical methods.

This research proposal uses the research onion framework to provide a well-organised, methodical, and grounded approach that will allow for a thorough investigation of the role that HRD plays in the oil and gas industry's shift to renewable energy sources. The research onion's layers will be meticulously removed, with each layer adding to a deeper comprehension of the research methodology and bolstering the validity and efficacy of the study.
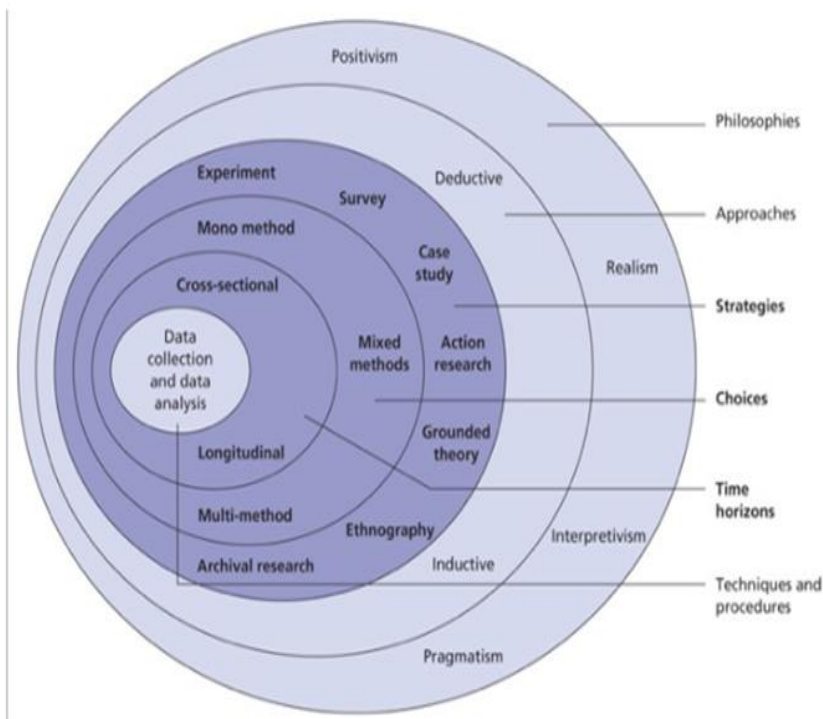
Figure 3. Research Onion

3.2 Research Philosophy

Selecting a research philosophy is a crucial step that establishes the general framework for gathering, analysing, and interpreting data for any given study. Taking a broad view is essential, especially considering that this research is qualitative. Several philosophical stances can be used, including objectivism, positivism, realism, interpretivism, and pragmatism. Nonetheless, an interpretivist philosophical approach has been carefully selected for this investigation. This method is thought to be not only appropriate but also crucial to achieving the objectives of the study. The foundation of interpretivism is the comprehension that reality is a dynamic, subjective construct that is intricately entwined with its environment rather than a static, objective concept. It acknowledges that everyone, including researchers, contributes their viewpoints and interpretations to the process of conducting research (Guest et al., 2016). Interpretivist philosophy firmly acknowledges that truth is dependent on context and the perspective of the observer, rather than a single unchanging reality.

Selecting an interpretivist research philosophy has several significant ramifications for the study. First and foremost, interpretivism places a strong emphasis on gathering qualitative data, which is particularly useful for exploring people's subjective beliefs, attitudes, feelings, and points of view. The utilisation of qualitative data facilitates a deeper and more intricate comprehension of the complex facets of the research problem.

Subjective viewpoints: The interpretivist school of thought acknowledges the importance of the meanings that individuals give to concepts, items, and behaviours (Yin, 2017). It draws attention to the necessity of thoroughly investigating the varying perspectives held by those engaged in the oil and gas industry's shift to renewable energy. Additionally, interpretivism emphasises the significance of taking into account the larger context in which the study is situated, recognising that people's perceptions and interpretations of their experiences are greatly influenced by this context. Furthermore, interpretivism acknowledges the subjectivity of knowledge as well as stresses the

importance of obtaining empirical data. Building robust and acceptable knowledge is dependent on this empirical evidence, which also helps to dispel reasonable doubts.

According to interpretivist philosophy, the respondent who identifies as a scientist constructs knowledge. This is predicated on the idea that there is no such thing as absolute truth; rather, truth is a relative phenomenon or point of view that changes depending on the observer and the context (Soeters et al., 2014). This implies that a qualitative design is preferred over a quantitative one by the interpretivist philosophical path. This means that to give important insight into the research problem that would go unnoticed in quantitative studies, the opinions, attitudes, feelings, and shared values of the target population for the study are gathered and analysed (Kumar, 2011). Since the meanings that people attach to ideas, and objects, as well as their own and others' actions are examined in great detail, this philosophical approach offers a more nuanced understanding of the issue under investigation.

With this method, the researcher actively participates in the research process rather than acting as a detached observer. By interpreting data, researchers are seen as actively participating in the creation of knowledge. This works in perfect harmony with the study's qualitative design, enabling a thorough investigation of HRD's function in the oil and gas industry's shift to renewable energy. Therefore, the interpretivist research philosophy was carefully considered and selected for this investigation. It permits a comprehensive and nuanced exploration of the research problem, taking into account contextual nuances, subjective interpretations, and points of view that might be missed in quantitative studies. This philosophical approach is essential, but not just appropriate, to accomplishing the goals of the study.

3.3 Research Approach

Research approaches fall into one of two basic categories under the Research Onion model: deductive and inductive reasoning. When using deductive reasoning, researchers follow a methodical and structured process in which they carefully formulate hypotheses

based on pre-existing theoretical frameworks. These theories function as the first assumptions about the connections between the variables that have been identified, and they are frequently based on the body of existing literature. Some of the many advantages of the deductive approach are its effectiveness in lowering research-related risks, its capacity to measure variables quantitatively for thorough analysis, the abundance of theoretical models that are available for use, and its skill in establishing causal relationships between variables. The deductive method proceeds in a methodical order. It begins with the development of hypotheses based on accepted theories and ends with the formulation of specific research questions that provide clear direction (Morse, 2015). Data collection and subsequent analysis are then carried out to confirm or refute these initial theories. This deductive approach offers a methodical and reliable way to advance comprehension and gain a deeper understanding of a variety of topics in the field of research. The deductive reasoning process is based on this rigorous, theory-driven approach.

Unlike the deductive approach, an inductive methodology makes a different kind of progress by attempting to develop a new theory from the ground up, based only on the data gathered within the confines of the study. This approach differs in that it does not build a preconceived hypothesis. Rather, it concentrates on creating a completely new theory that is based only on the researcher's observations and the available data (Silverman, 2011). Inductive research is primarily guided by the working title of the study, as opposed to deductive reasoning, which depends on well-established theoretical models. The researcher poses the main research question at the beginning of the inductive reasoning process. Subsequently, data collection and rigorous analysis ensue, serving as the foundational building blocks for the creation of an innovative and hitherto unexplored theory (Kumar, 2011). The inductive method works especially well in situations where a study is limited by a lack of significant empirical data. When there is a strong need to create a completely new theoretical framework that deviates from accepted models, it is especially pertinent. The inductive reasoning methodology was specifically selected for this investigation. Two factors supported this decision: firstly, there was a dearth of empirical evidence relevant to

the research topic and, secondly, the study's unique goal was to develop a novel theoretical framework using the knowledge gained from empirical analysis.

3.4 Research Choice/ Design

A crucial choice that depends on the particular requirements and study design is whether to use a qualitative or quantitative research design (Saunders & Lewis, 2012). Scholars have the option to choose between a mono-method, which uses only one of these approaches exclusively, a multi-method, which utilises both qualitative and quantitative approaches equally, and a mixed-method, which integrates both approaches with a possible bias towards one over the other (Braun & Clarke, 2019). When it comes to quantitative research, gathering empirical, factual, or statistical data (which usually takes the form of numbers) is given priority. The statistical data collected from participants is the foundation that quantitative studies rely on to support their empirical claims. The rigorous analysis and interpretation that support the study's conclusions are based on these numerical or quantitative data. As a result, the research design is not a one-size-fits-all idea but rather a dynamic and flexible framework that adjusts its methodology to the particular requirements of the research question, that is, the data and the resources available. Therefore, it is critical that researchers carefully weigh these variables and decide on a research design that will guarantee that the study is in line with its overall aims and objectives.

On the other hand, a qualitative research design focuses on gathering non-numerical data by exploring the domains of attitudes, opinions, and participant narratives. This kind of data is difficult to quantify, but it can provide a wealth of context-specific insights into the complex aspects of the research question. Choosing a qualitative research design has several attractive benefits that make it a suitable option for different types of research situations. The inherent adaptability and creativity of a qualitative design is one of its most notable advantages. Qualitative research, in contrast to quantitative research, is best conducted in an atmosphere that values flexibility and creativity (Merriam & Tisdell, 2016). Smaller sample sizes are typically associated with it compared to quantitative designs, making it more accessible and resource-efficient. The open-ended nature of the

research instruments is one characteristic that sets qualitative research apart. This feature provides rich and detailed data by encouraging participants to express their opinions, experiences, and feelings in their own words.

Because of its depth of inquiry, qualitative research is particularly well-suited for studies that aim to uncover the intricate layers of a research question. It allows for a nuanced exploration of complex phenomena. Furthermore, qualitative research has the exceptional ability to record the changing attitudes and viewpoints of a population over time. It is skilled at monitoring attitudes and behaviour changes, which is useful for studies tackling dynamic and changing topics. The selection of a qualitative research design in the context of this study is intentional and well-reasoned (Strauss & Corbin, 2018). It fits in perfectly with the main goal of the study, which is to gather background data that offers an individualised viewpoint on the research issue. The viewpoint is clarified by the opinions and statements of the research participants, highlighting the applicability and suitability of the qualitative research design for this study.

3.5 Time Horizon

The time horizon of a study is either cross-sectional or longitudinal. In essence, a cross-sectional time horizon offers a moment-in-time snapshot of the research data collected. This horizon is especially appropriate for studies with strict time constraints because it is frequently characterised by its short-term nature. In these kinds of situations, where the main goal is to get a static representation of the data at a given point in time, the cross-sectional method makes sense. It is appropriate for studies in which ongoing data collection over a long period is not necessary (Soeters et al., 2014). A longitudinal time horizon, on the other hand, sets out on a far longer journey. Through continuous observation and data collection for some time, it aims to provide a prolonged, comprehensive view of the research phenomenon. Finding and analysing trends, modifications, or shifts in the statistical patterns and behaviours under examination are the main goals here. When a lengthy and in-depth investigation of the topic is required for

research purposes and temporal changes and varying trends are critical, the longitudinal approach plays a crucial role.

The use of a cross-sectional time horizon was purposefully chosen for this investigation. The unique goals and nature of the research serve as the foundation for this decision. To find temporal trends or behavioural shifts, the study did not require the continuous tracking of data over an extended period (Creswell, 2014). Rather, its primary objective was to record a static depiction of the data at a particular moment in time. This fits in well with the goals and scope of the research, as well as the fact that there is no requirement to track ongoing trends. The cross-sectional time horizon choice emphasises how carefully the research's design was matched to its particular needs and objectives.

3.6 Data Collection Techniques and Procedures

The practicalities involved in obtaining pertinent data are covered in this section. Choosing appropriate data instruments and sampling strategies based on prior methodological decisions and the needs of the research are examples of such practical aspects of research (Braun & Clarke, 2019). Numerous tools are available for gathering data, such as in-person interviews, audio or video interviews, questionnaires, experiments, observations, and archival research. To interact with a wide range of stakeholders in the oil and gas industry, particularly those actively involved in energy transition and human resource development, face-to-face interviews were chosen for this study. This section explores the complex practicalities involved in gathering the relevant data for the study project. These practical aspects of research are made possible by the way how the research design was implemented and the methodological decisions that were made in the preceding segments. A crucial first step that depends on the complex interaction between the selected methodology and the particular research requirements involves choosing the right data instruments and sampling strategies (Braun & Clarke, 2019). Researchers have access to an abundance of data collection tools, each with unique benefits and applications for different types of research. These tools cover a wide range of methods, including in-person

interviews, audio or video interviews, questionnaires, experiments, observations, and archival research.

3.7 Data Instrument

The process of choosing the best data collection tool requires careful consideration of the goals, scope, and type of data being sought in the research. The methodological preference for this study points toward interviews as the preferred means of gathering data. This choice was made for a variety of reasons, including the study's desire to interact with a wide range of oil and gas industry stakeholders. This inclusivity also encompasses people who work in the fields of HRD and the complex field of energy transition. Interviews provide a lively setting for direct communication and in-depth investigation, enabling the collection of complex and contextualised data. This is a purposeful decision that fits in well with the goals of the research as well as the requirement to gather complex insights from important stakeholders. The choice of data collection tool is also in line with the larger qualitative research design of the study, which values comprehensive and context-specific perspectives, open communication, and depth of inquiry by nature. The deliberate choice of in-person interviews as the primary data collection method emphasises the careful planning required to obtain the qualitative information needed to adequately answer the research question.

This is because face-to-face interviews offer numerous advantages to the researcher. Face-to-face interviews are a popular and very successful technique for gathering data for qualitative research because they yield detailed and rich data. Researchers can interact directly with participants by posing open-ended questions and pressing for thorough answers (Patton, 2015). This live, dynamic method enables a complex examination of participants' feelings and experiences. Additionally, it makes it easier to comprehend complicated phenomena in their entirety, which is especially important for qualitative research where context and depth are critical. One benefit of in-person interviews is that they can record nonverbal cues. Human communication involves non-verbal indicators like tone of voice, body language, and facial expressions in addition

to spoken words. Researchers can record these nonverbal cues during face-to-face interviews, which gives their findings more nuance and context. In qualitative research, developing rapport and trust with participants is crucial (Morse et al., 2012). In-person interviews present a special chance to get to know interview subjects on a personal level. Researchers can demonstrate genuine interest in the stories of participants, empathy, and active listening. Building rapport with participants enables them to share their ideas and experiences, which leads to more frank and perceptive answers. In-person interviews also provide for instant clarification and the opportunity to ask follow-up questions. Instantaneous clarification can be sought by researchers, guaranteeing a deeper comprehension of participants' viewpoints. This adaptability and interactivity offer a comprehensive perspective on the experiences of the participants.

Adaptability is another important benefit of in-person interviews. Diverse participant groups with a range of backgrounds and communication styles are common in qualitative research. In in-person interviews, researchers can customise their methodology to align with the preferences of participants, creating a welcoming and stimulating atmosphere that meets individual needs.

In-person interviews inherently involve engagement. By participating in a cooperative dialogue, participants turn into active contributors to the study. More thorough and genuine responses are frequently the outcome of this interaction. It is also possible to gain a first-hand understanding of the context in which participants operate when the researcher is physically present (Denzin & Lincoln, 2018). By observing participants' surroundings, researchers can gain insights into the cultural, environmental, or situational factors that shape participants' experiences. The context and depth of the gathered data are improved by this contextual understanding. Finally, in-person interviews provide chances for data validation. Researchers can use methods such as member checking to make sure the data is reliable and accurate.

In summary, in-person interviews are an effective technique for qualitative research because they can yield detailed information, record nonverbal cues, establish rapport, help

with clarification, adjust to the needs of the participants, improve engagement, provide contextual understanding, and enable data validation (Onwuegbuzie & Leech, 2007). Face-to-face interviews are the method of choice for qualitative research when examining intricate human experiences and phenomena because of these benefits. However, for convenience purposes and to ensure that all potential respondents are reached, interviews will be conducted via MS Teams as opposed to physically. Moreover, using MS Teams to interview participants is likely to result in less interference to the day-to-day routine at work for employees being questioned. Furthermore, this approach will ensure that even employees of the company who work in geographically dispersed locations can still be reached for their opinions or reactions.

3.8 Stakeholder Engagement

This study is prepared to interact with a wide range of stakeholders to gain a thorough grasp of the complex terrain of HRD strategies during the shift to renewable energy in the oil and gas industry. Together, these important players and specialists from a variety of fields and roles offer a comprehensive and multidimensional view of the issue at hand. Interviews are a carefully selected method used in the engagement strategy to extract complex insights, perspectives, and experiences (Silverman, 2011; Capellán-Pérez, De Castro, & González, 2019). The following stakeholders have been designated for engagement:

a. Oil and gas industry specialists in energy transition. Subject matter experts who can shed light on the intricacies of switching from fossil fuels to renewable energy sources.

b. Coaches for the development of competencies and skills in the workforce are known as capability development specialists.

c. Proficiency guarantee employees: Experts in charge of guaranteeing that workers have the requisite skills.

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d. Cross-functional teams working on energy transition projects. These are the teams that are directly involved in organising and carrying out energy transition projects.

e. Personnel and human resource managers. Those in charge of HR duties in the industry.

f. Teams specialising in the integration of renewable energy solutions within the oil and gas sector are known as renewable energy integration teams.

g. Selected HR officials. HR experts who have been hand-picked because they possess distinctive viewpoints.

h. Competency team. The people in charge of overseeing and maximising the skills and competencies of the labour force.

i. Sustainability and environmental specialists. Experts in the energy sector with the knowledge of environmental issues and sustainability.

j. Talent development staff in charge of developing talent inside the company.

k. Technical development staff. Individuals working on improving and developing technical skills.

l. Technical trainers. Experts who instruct the technical labour force.

m. Technical instruction and training teams. Teams dedicated to the workforce's development and technical training.

The decision to interview these varied stakeholders was supported by the fact that interviews naturally lend themselves to comprehensive data collection. Interviews provide an opportunity to interact with people, record verbal and nonverbal cues, and place data in the context of the individual's unique reality and experiences (Widya & Tjahjono, 2018). In addition to enriching the data, this multimodal approach helps the researcher to extract

subtle information that might be difficult to get through other data collection techniques. Therefore, the stakeholder engagement strategy is methodical and all-encompassing, capable of utilising the combined knowledge and experiences of numerous industry experts. Interviews were the method of choice for gathering data because they were carefully thought out concerning how to obtain and extract the rich, context-specific insights that are necessary to properly answer the research question.

3.9 Data Type

One of the most important choices that researchers have to make when it comes to the practicalities of their research is whether to gather primary data or use secondary data sources. This decision has a significant impact on the direction and results of the research. Getting an original dataset is a part of primary research. It entails gathering, analysing, and interpreting first-hand data in order to produce insights that form the basis for theoretical development. Choosing primary research has several unique benefits. Researchers can take into consideration contextual and circumstantial factors unique to the study setting by using primary data. Since the data collected is directly related to the research's focus, it gives the study's objectives more legitimacy and relevance (Bernard et al., 2018). Additionally, primary research gives researchers more control over data-gathering procedures and quality, which improves the findings' dependability (Soeters et al., 2014). Even though primary research is more complex, it is still frequently the method of choice for experienced researchers. It necessitates a significant time, money, and skill commitment. The procedure can be error-prone and requires careful execution.

On the other hand, secondary research entails looking at empirical data and evidence that has already been gathered and examined by other academics on the same topic. There are several benefits to using secondary data, which makes it a good choice for a lot of research projects. First and foremost, it provides convenience and speed, particularly when time is of the essence. Numerous sources, including books, journals, articles, online databases, and offline records, provide easy access to secondary data. When compared to gathering primary data, it is frequently more accessible and less expensive

(Saunders & Lewis, 2012). A prudent approach is used in this investigation to maximise the value and utility that the research yields. The research will utilise primary and secondary data sources. This calculated move emphasises a dedication to thorough investigation, to enhance the primary data obtained with the depth of understanding and background offered by extant secondary data. Through careful consideration of primary and secondary sources, the study aims to offer a comprehensive and rigorous analysis of the research question. This hybrid method has the benefit of allowing for a thorough examination of the particular topic of study while also placing the research in a larger academic framework.

3.10   Sampling Techniques

A crucial practical component of this research is sampling, which is essential to the process of choosing respondents from the intended audience. Sampling techniques fall into two main categories, that is, probabilistic and non-probabilistic ones. Non-probabilistic sampling methods do not give every population member an equal opportunity to get selected. Rather, elements are chosen according to standards like judgment, accessibility, or appropriateness (Soeters et al., 2014). Probabilistic sampling techniques, on the other hand, offer all population members equal chances of being selected, providing a more statistically sound foundation for making conclusions (Braun & Clarke, 2019). For this study, the target population consists of all parties involved in the oil and gas industry that operate in Oman, with a special focus on the company organisations. A convenience sample technique is used for several compelling reasons, given the particulars of the research context and its goals. The main reason for the convenience sampling technique's selection is the significant difficulties in locating pertinent respondents in the oil and gas industry through probabilistic approaches. In an industry characterised by its complexity and dispersion, reaching out to potential participants can be a challenging endeavour.

Convenience sampling is a viable option in a variety of research scenarios due to its numerous benefits. The simplicity and speed of participant access is one of its main advantages. It is more convenient for researchers to approach people or groups who are

easily reachable, which saves time and money when recruiting participants. This convenience allows for quick data collection, which is especially helpful when working with constrained resources or deadlines. Convenience sampling is appropriate for investigations where a brief snapshot of viewpoints or experiences is sufficient because researchers do not need to use sophisticated or comprehensive sampling techniques. Its accessibility to inexperienced researchers or those with limited resources is another benefit of its simplicity, which increases the likelihood that people will conduct research (Marshall & Rossman, 2014). Convenience sampling is additionally a sensible option for exploratory research. It can offer a first understanding or spark ideas for additional research. When conducting preliminary research, this sampling technique can help gain a better understanding of a specific issue or phenomenon before devoting more time and resources to a larger, more involved study.

The main drawback is that it is prone to bias in selection. The assortment of participants in this sampling method is contingent upon their accessibility, which may lead to an inaccurate representation of the overall population (Soeters et al., 2014). It frequently overrepresents certain groups or people who are easier to find, which could produce biased or unrepresentative results. Convenience sampling's lack of randomness is another drawback. To guarantee that each population member is equally likely to be incorporated in the study sample, randomness is vital. The sample's ability to be genuinely representative is dependent on randomness, otherwise, the results may not be able to be applied to a broader population.

In addition, convenience sampling may also result in a sample that lacks diversity. Accessible participants are more likely to have similar traits or life experiences, which may restrict the variety of viewpoints and insights discovered. This uniformity may limit the research's breadth and the findings' ability to be applied in a larger context. Additionally, there may be less control over the sample composition if convenience sampling is used (Miles et al., 2013). The selection of participants is largely outside the control of researchers, which may result in a sample devoid of certain demographic, experiential, or

attitudinal diversity, which could compromise the study's capacity to record a variety of viewpoints. Convenience sampling, to sum up, has benefits in terms of accessibility, ease of use, and fit for exploratory research. Nevertheless, it comes with drawbacks, such as limited diversity, selection bias, lack of randomness, and lack of control over sample composition (Neuman, 2017). These are important considerations for researchers to make when selecting convenience sampling as their method of selection.

The study targets respondents in locations where they are more likely to be found, thanks to the convenience sampling approach, which keeps the data collected pertinent and on target for the study's goals. This calculated move reduces the possibility of obtaining unrelated or equivocal results, particularly in circumstances where probabilistic approaches could result in a low response rate (Soeters et al., 2014). Furthermore, the convenience sampling method is especially well-suited to the limitations of the study, most notably its short duration. This pragmatic consideration required a targeted and effective data collection strategy. Since the population at large is so vast, it was impractical to attempt to reach every stakeholder in the oil and gas industry. Convenience sampling satisfies the research's objectives while effectively addressing its limitations by enabling the study to focus on a more easily accessible subset of participants. Therefore, the convenience sampling approach was chosen with consideration and practicality in mind. Its purpose is to enable effective data collection in the particular circumstances of the Oman's oil and gas industry. By using this approach, the study can strike a balance between the practical factors of accessibility and time constraints and the requirements for relevance and focus, which ultimately results in a more efficient and productive research process.

3.11   Ethical Considerations

Since this study is a major addition to the field of post-graduate qualifications, it was conducted in strict accordance with the institutional protocols that have been established to govern academic research. Every stage of the research process was carried out with a steadfast dedication to the moral precepts that guide ethical research. An Institutional Review Board (IRB) protocol was followed to the letter from the beginning.

An IRB form was properly completed, reviewed, and approved, indicating that the study could now officially begin. This crucial stage guaranteed that the research design, methodology, and procedures fully adhered to the academic and ethical standards established by the organisation (Flick, 2015). They were given a thorough briefing on the study's topic and overall goals before speaking with any respondent or participant. Through this process, each participant was meant to gain better a comprehension of the significance of the research, its purpose, and their role in contributing to the study's objectives. A formal informed consent form was required to be signed by each participant in this research since it was considered a critical component.

The goals of the study and the voluntary nature of participation were clearly stated in this document. It also upheld the participants' freedom to leave the study at any time if they were uncomfortable or wanted to stop taking part in it. In addition, participants received assurances regarding the strict confidentiality of their answers. Their privacy would be protected, and it was made clear that any information gathered would only be used for the study's objectives. Protecting the respondents' privacy and anonymity was a fundamental ethical requirement of this study (Palinkas et al., 2015). A strong system for data management was put in place. To ensure that unwanted access was avoided, the participant data was safely kept on an offline hard drive that was password-protected. The promise to remove all research data from the storage medium as soon as the study is successfully concluded served as support for this precautionary measure. Additionally, the respondents' ethical obligations went beyond gathering data. Following their involvement in the research, every participant was given a debriefing session. They received thorough instructions on how to access the final research findings and outputs from this post-study engagement. In addition, it provided an opportunity to address any queries or worries that the respondents might have had following their involvement.

3.12   Data Analysis

The most popular technique for analysing and understanding the large dataset gathered for this research was theme analysis. Thematic analysis is widely used in

academic research and is distinguished by its emphasis on identifying, examining, and interpreting recurring patterns in data. The selection of thematic analysis as the research methodology has several justifications, including its versatility with large datasets, theoretical exploration potential, theme extraction from the data under investigation, and the flexibility to develop coded themes through inductive reasoning (Braun & Clarke, 2019). The ability of theme analysis to handle large datasets is one of its most notable characteristics. The capability to manage and make sense of large amounts of data is critical in a research project this size, where a wide range of stakeholders provide multifaceted insights. A flexible yet structured framework for methodically arranging and analysing this abundance of data is offered by thematic analysis. The ability to apply thematic analysis theoretically is another example of its flexibility. It allows for the investigation of theoretical frameworks, allowing the study to go deeper into the fundamental ideas and how they interact with the data. This ability is particularly helpful when trying to improve upon pre-existing theoretical frameworks or produce new theoretical insights.

There are six distinct phases in the reflexive thematic analysis approach, all of which contribute to a thorough and methodical analysis of the data. An important first step in this methodological journey is becoming familiar with the data. This stage involves a thorough review of the research instrument, which includes the data that was gathered. By closely examining each component and taking into account how it fits into the larger, more comprehensive picture, this close examination seeks to develop a profound understanding of each one. The crucial stage that comes after the data familiarisation phase is code generation (Maxwell, 2012). In this stage, the data is systematically reduced and complicated in order to identify distinct items of interest. Here, the information is broken down, sorted, and encoded to provide a structured framework for further study. After that, the process proceeds to the development of preliminary themes. It accomplishes this by organising similar codes that show thematic resonance. These introductory themes are well-designed and supported by an accurate depiction of the information they contain. They stand for the first concepts and emergent patterns found in the dataset.

The next step entails reviewing and organising these initial themes once they have taken shape. The themes are examined, changed, and arranged logically and cogently during this crucial phase. Capturing the overarching narrative that the data conveys is the goal, and it must be faithful to the insights the dataset offers. After the themes have been arranged logically, the next stage is to give these themes names and definitions. This procedure gives the analysis a crucial layer of clarity by precisely defining the themes and how they relate to the research goals (Stake et al., 2013). To increase the interpretive value of each theme, a brief definition and descriptive names are provided. A thorough report is produced as the last step in this reflexive thematic analysis approach. As the final product of the entire analysis process, this report offers a thorough and organised description of the data analysis process. It summarises the lessons learned from the data, the themes that emerged, and their importance in light of the study's main objectives. In summary, the reflexive thematic analysis approach consists of a systematic flow through these six interrelated stages. Data familiarisation is the first step, followed by code generation, the formation of preliminary themes, their review and organisation, naming and defining these themes, and the creation of a comprehensive report. Every stage of the analysis is essential to produce a thorough and perceptive interpretation of the dataset in the end.

3.13   Research Design Limitations

While the in-depth, qualitative approach of this single case study research holds value, the design contains certain inherent limitations. The focal analysis centres solely on interviews conducted within a single Omani oil and gas company regarding its nascent transition to integrating renewable energy. The convenience sampling and access constraints result in a limited sample size, capturing only a subset of perspectives within that firm. As such, the research findings, while helpful for an interpretivist assessment of that specific localised context, come saddled with certain cautions regarding wider application. The subjective, situational insights gleaned resist generalisation to the broader oil and gas industry. Given a myriad of differences in operational models, regulatory environments, access to resources and technologies, and cultural variances across companies and geographies, the transition pathway and outcomes for one Omani firm may

not typify experiences elsewhere. More critically, the lack of multiple case comparisons means the obstacles, enablers, and patterns perceived have uncertain resonance as universal challenges or substitutable solutions without further verification through different lenses.

While acknowledging the depth ensured by committed qualitative inquiry, the inherent limitations suggest room for methodological expansion in future cycles of investigation. Possibilities include widening the sample across varied company types and locations, incorporating quantitative performance indicators for triangulation, and contrasting findings against cases from other hydrocarbon hubs like Texas or the North Sea. Multi-frame analysis could illuminate if recurring themes echo irrespective of underlying differences. Such refinements might strengthen the credibility and transportability for accelerating renewable energy integration amidst turbulent, but necessary energy transitions now underway industry-wide.

CHAPTER IV:

RESULTS

4.1 Introduction

This chapter details the data analysis approach utilised in this research, thematic analysis, to uncover insights from 35 semi-structured interviews conducted with human resource professionals currently employed in the organisations Company. Given the qualitative nature of the study and its emphasis on individuals' experiences and perceptions, thematic analysis allows for a rich, nuanced interpretation of the interview data through systematic identification and analysis of patterns and themes. The objective is to highlight key themes related to the role of HRD programs, organisational culture interventions, and strategic workforce planning initiatives aimed at facilitating the sector's transition from fossil fuels to renewable energy. The analysis provides an interpretation of how human resource functions can proactively respond to the social, economic, political, and technological dynamics driving decarbonisation. As previously indicated in the methodology section, a thematic model of analysis was relied upon by the researcher to identify the salient themes that feature in the interview excerpts from the data collected from the relevant stakeholders at the organisations Company. The objective is to capture the opinions and attitudes of the target population in a succinct manner that provides direct evidence as far as the role of HRD in the transition of the oil and gas sector to renewable energy is concerned.

4.2 Statistical analysis of the surveys

The survey presents an in-depth analysis of the skills, strategies, and challenges associated with the transition from traditional oil and gas roles to those required in the renewable energy sector. The questions address critical aspects such as skill requirements, HRD (Human Resource Development) interventions, workforce transformation strategies, and the integration of technological advancements into business models within the energy

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sector. The responses have been quantitatively analyzed to offer a percentage representation of the participants' views on each matter, providing a significant insight into collective perceptions and proposed solutions for a smooth transition towards renewable energy employment.

Critical Skills and Mindsets

The transition to renewable energy necessitates a diverse skillset. Technical Skills emerged as paramount (80.56%) due to the specific knowledge required in renewable technologies. Adaptability (66.67%) underscores the dynamic nature of the sector, while lower emphasis on Collaboration and Communication (38.89%) and Problem-Solving (33.33%) might reflect an ingrained aspect of existing roles. The Sustainability Mindset (50%) highlights the industry's shift towards environmental consciousness.

1. What specific skills and mindsets are most critical for oil and gas workers during the transition to renewable energy?

● Technical Skills: Understanding of renewable energy technologies (e.g., solar, wind, geothermal), data analysis, project management, and system integration.

● Adaptability and Learning Agility: Ability to learn new skills quickly, embrace change, and continuously adapt to evolving technologies and market demands.

● Collaboration and Communication: Effective teamwork, cross-functional communication, and stakeholder engagement skills.

● Problem-Solving and Critical Thinking: Ability to analyze complex situations, identify solutions, and make informed decisions.

● Sustainability Mindset: Commitment to environmental and social responsibility, understanding of the impact of energy choices.

Figure 4 Critical Skills and Mindsets

Bridging Skill Gaps

Skills Gap Analysis (75%) and Upskilling & Reskilling Initiatives (58.33%) top the list, pointing towards an analytical and proactive approach in equipping the workforce. Lower emphasis on digital platform learning (55.56%) suggests room for growth in leveraging technology for training.

2. How do companies effectively identify and bridge the gap between current workforce skills and those needed for the new energy landscape?
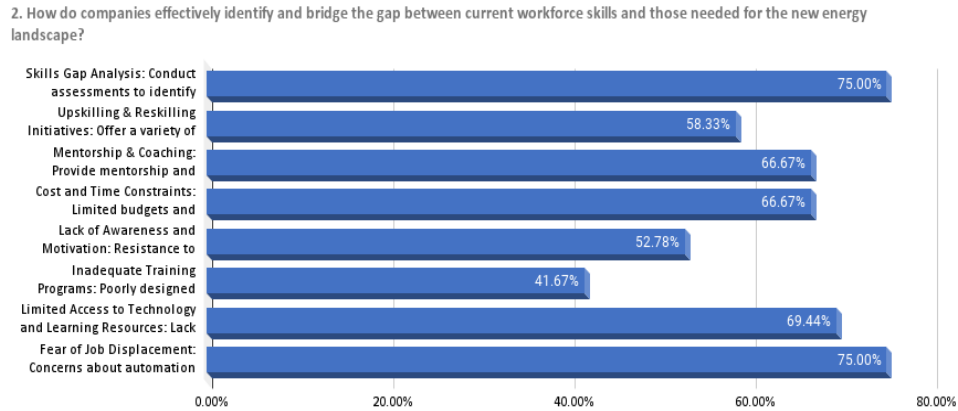
Figure 5 Bridging Skill Gaps

Obstacles in Reskilling/Upskilling

Fear of Job Displacement (75%) and Limited Access to Technology (69.44%) are significant concerns. Overcoming these through open communication (about benefits and security) and offering flexible learning options show a path forward but require substantial financial and infrastructural commitment.

3. What are the biggest roadblocks to reskilling and upskilling existing employees for new roles in the transition? How can HRD overcome these?
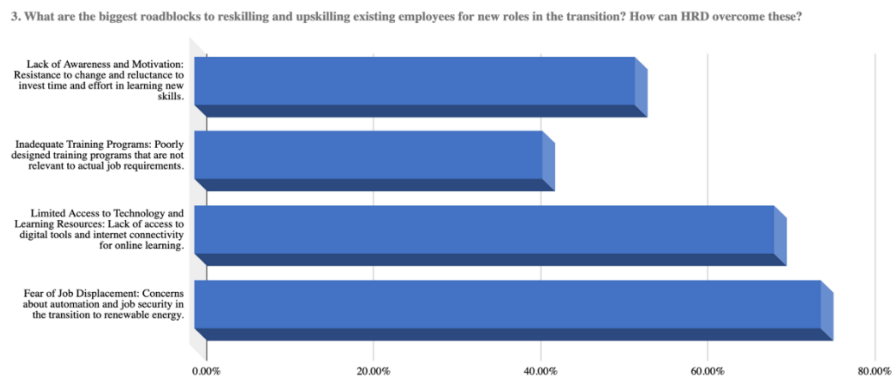
Figure 6 Obstacles in Reskilling/Upskilling

Addressing Anxiety and Resistance

Emphasizing Open Communication & Transparency (77.78%) alongside Engagement & Participation (69.44%) indicates the importance of involving employees in the transition. Mental health support (52.78%) also reflects growing awareness of workplace well-being.

4. How does HRD address the potential anxiety and resistance to change among workers during the transition?

- Open Communication & Transparency: Provide clear and consistent information about the transition and address concerns openly.
- Employee Engagement & Participation: Involve employees in planning the transition and decision-making processes.
- Job Security & Career Development Support: Offer job security guarantees and support career development through training and coaching.
- Mental Health & Well-being Support: Provide access to mental health resources and support services to manage stress and anxiety.
- Positive Communication & Celebrating Successes: Highlight the positive impacts of transitioning to renewable energy and celebrate individual and team achievements.
- Building Trust & Respect: Foster a supportive work environment that values individual contributions and embraces change.

Figure 7 Addressing Anxiety and Resistance

Fostering a Culture of Adaptability and Lifelong Learning

The survey emphasizes continuous learning (72.22%) and peer learning (63.89%) as key strategies, focusing on an environment that encourages constant improvement and collaborative growth.

5. How can HRD foster a culture of adaptability and lifelong learning within the oil and gas workforce?
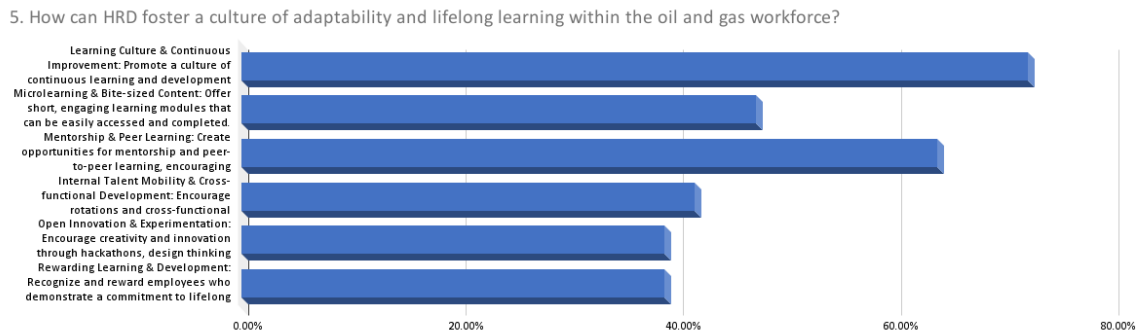
Figure 8 Fostering a Culture of Adaptability and Lifelong Learning

Effective HRD Practices

VR & AR technologies (77.78%) stand out, suggesting that immersive learning could greatly enhance skill acquisition. This innovative approach, coupled with traditional Personalized Coaching & Mentoring (52.78%), shows a multi-faceted strategy in training.
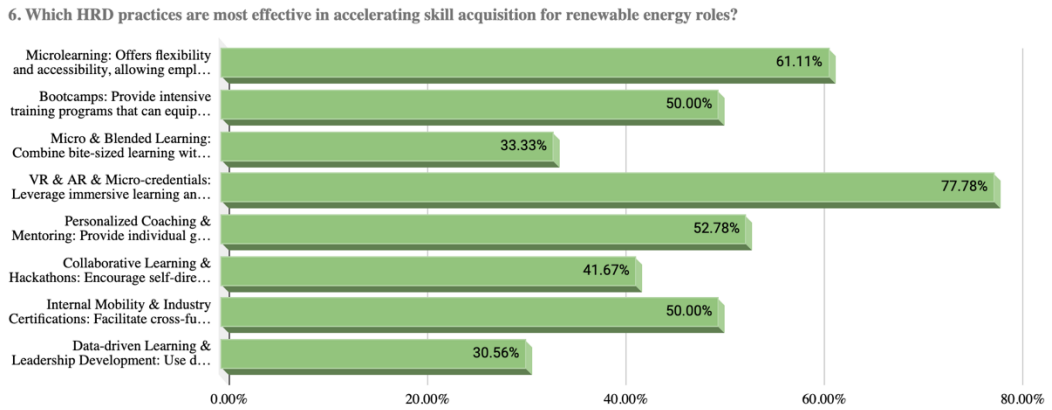
Figure 9 Effective HRD Practices

Optimizing Talent Pipelines

Focusing on Diverse Talent Pools and Employer Branding (both at 58.33%) signals an understanding of the competitive landscape for talent and the need for a strong organizational image to attract skills from broader fields.

7. How can HRD optimize talent pipelines to attract and retain skilled individuals from outside the traditional oil and gas industry?

- Target Diverse Talent Pools: Expand recruitment efforts to attract talent from STEM fields, r… — 58.33%
- Develop a Strong Employer Brand: Promote the company's commitment to sustainability and… — 58.33%
- Offer Competitive Compensation and Benefits: Provide attractive salaries, benefits packages, and c… — 50.00%
- Build Relationships with Universities and Colleges: Partner with educational institutions to d… — 50.00%
- Leverage Employee Networks: Encourage employee referrals and utilize alumni networks to identif… — 27.78%
- Create an Inclusive Workplace Culture: Foster a diverse and inclusive workplace that values d… — 52.78%

Figure 10 Effective HRD Practices

Measuring HRD Effectiveness

Tracking Skill Development and Performance rates highly, along with Evaluating ROI (75%), pointing to a metrics-driven approach in assessing the value and impact of HRD interventions on organizational goals.

8. How do companies measure the effectiveness of HRD interventions in enhancing workforce adaptability during the transition?

- Track Skill Development: Monitor employee progress in acquiring new skills through assessments, performance
- Measure Employee Engagement and Satisfaction: Conduct surveys and focus groups to gauge employee perceptions of
- Track Performance and Retention Rates: Analyze changes in employee performance, productivity, and retention
- Compare to Industry Benchmarks: Benchmark HRD performance against industry standards and competitors to
- Evaluate ROI of HRD Programs: Calculate the return on investment of HRD initiatives to assess their financial

Figure 11 Measuring HRD Effectiveness

Negative Impacts and Mitigation

Work-life Balance Concerns (66.67%) signal the potential stressors of rapid upskilling, with recommendations for Clear Communication and Job Security Guarantees indicating pathways for organisations to support their workforce sensitively and effectively.

9. What are the potential negative impacts of rapid skill acquisition on job security and employee well-being? How can HRD mitigate these?
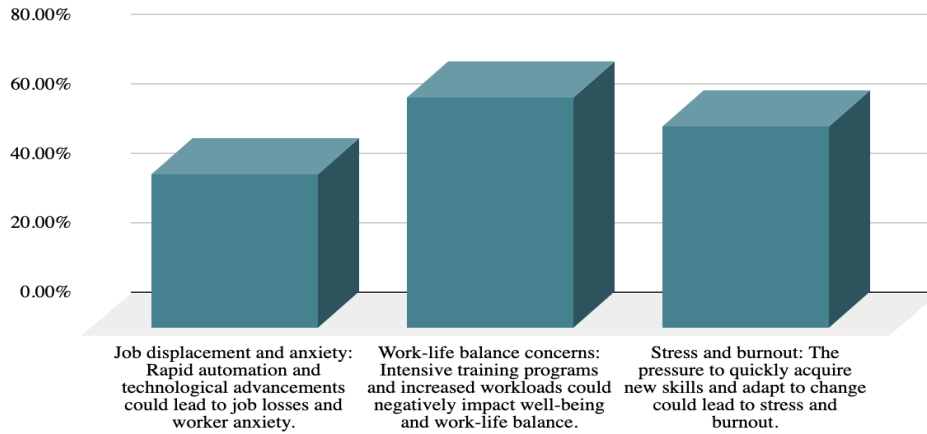
Figure 12 Negative Impacts and Mitigation

Inclusivity in Upskilling and Reskilling

Offering Flexible and Accessible Training Formats (61.11%) alongside financial assistance for development (77.78%) echo the need for broad accessibility to learning opportunities, ensuring no employee is left behind due to background or seniority.
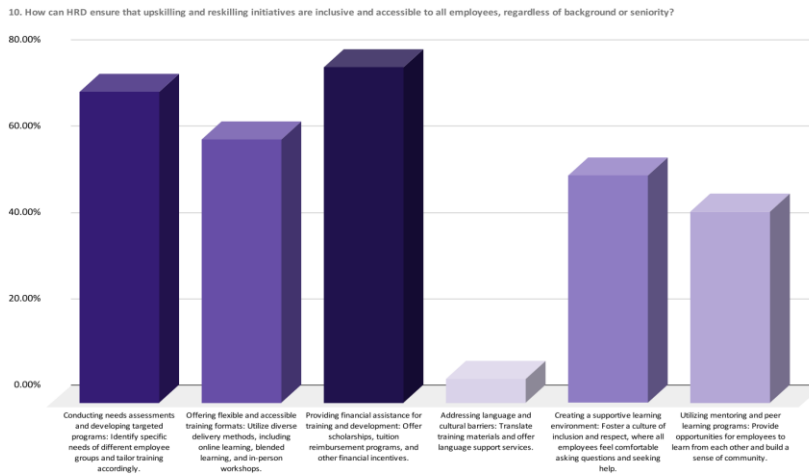
Figure 13 Inclusivity in Upskilling and Reskilling

Contributing to New Business Models

Building Partnerships (69.44%) and Investing in R&D (55.56%) are viewed as vital strategies, emphasizing external collaborations and continuous innovation as key to developing new revenue streams in renewable energy.

11. How does HRD contribute to developing new business models and revenue streams for oil and gas companies in the renewable energy space?
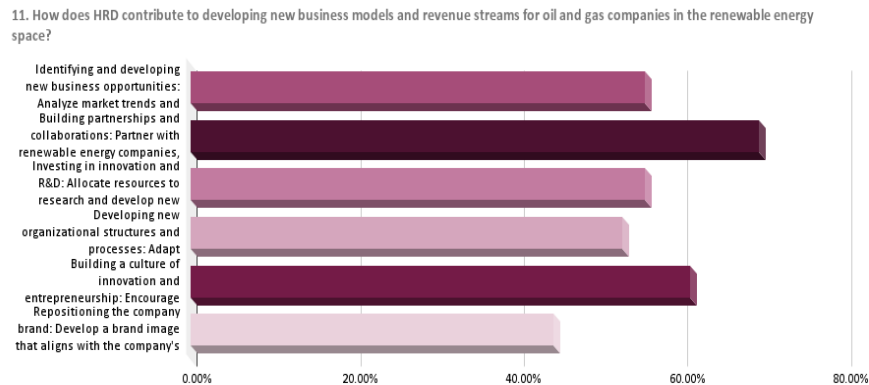
Figure 14 Contributing to New Business Models

Strategies for Workforce Reduction/Redeployment

Openness and transparency (69.44%) in communicating workforce changes, and providing support through Career Counselling (50%), reflect an ethical approach towards managing transitions.

12. What are the HRD strategies for managing workforce reductions or redeployments due to the transition to renewable energy?
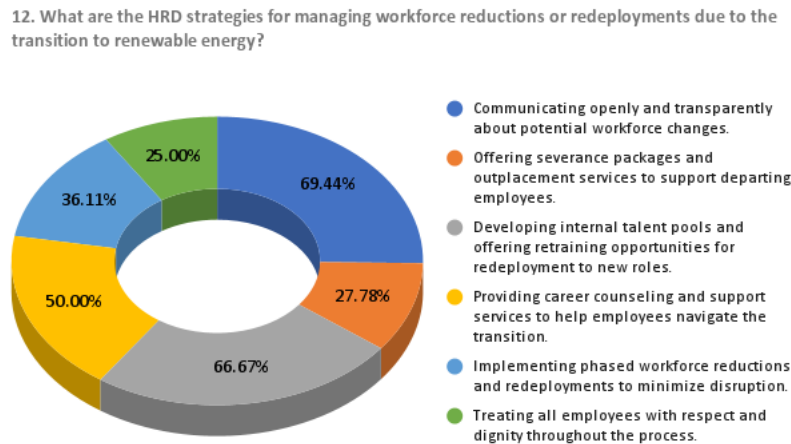
Figure 15 Strategies for Workforce Reduction/Redeployment

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Leveraging Industry Expertise and Infrastructure

Utilizing existing resources for renewable energy innovation (58.33% for repurposing labs) and promoting Cross-functional Collaboration (33.33%) highlight strategic use of in-house capabilities and knowledge spreading.

13. How can HRD leverage existing industry expertise and infrastructure (e.g., research labs, training facilities) to support the development of renewable energy technologies?

- Repurpose research labs and facilities: Adapt existing research labs and facilities to focus on renewable energy technologies and
- Cross-functional collaboration: Encourage collaboration between researchers, engineers, and other experts from different
- Partner with universities and research institutions: Utilize partnerships to access additional expertise, resources, and funding
- Create internal innovation programs: Establish hackathons, innovation challenges, and internal R&D initiatives to promote
- Share knowledge and best practices: Facilitate knowledge sharing and
- Develop and share intellectual property: Secure intellectual property rights for new

Pie chart values: 58.33%, 33.33%, 69.44%, 52.78%, 63.89%, 30.56%

Figure 16 Leveraging Industry Expertise and Infrastructure

Measuring Economic Resilience Impact

The focus on Financial Performance (77.78%) and Benchmarking against Industry Standards (63.89%) illustrates a comprehensive approach to assessing HRD's role in enhancing the organization's adaptability to market changes.

14. How does HRD measure the impact of its interventions on the economic resilience of the oil and gas industry during the transition?

Bar chart categories:
- Track financial performance: Analyze changes in revenue,
- Monitor workforce productivity and efficiency: Assess the impact of
- Evaluate the success of new business models and revenue streams: Track the
- Conduct cost-benefit analysis: Compare the cost of HRD interventions to the
- Benchmark against industry standards: Compare the company's
- Conduct surveys and focus groups: Gather feedback from stakeholders,

Axis: 0.00%, 20.00%, 40.00%, 60.00%, 80.00%

Figure 17 Measuring Economic Resilience Impact

Ethical Considerations

The survey strongly emphasizes Transparency (86.11%) and Fairness (63.89%) as crucial ethical principles. This indicates a prioritization of moral responsibility in decision-making processes affecting employees' futures.
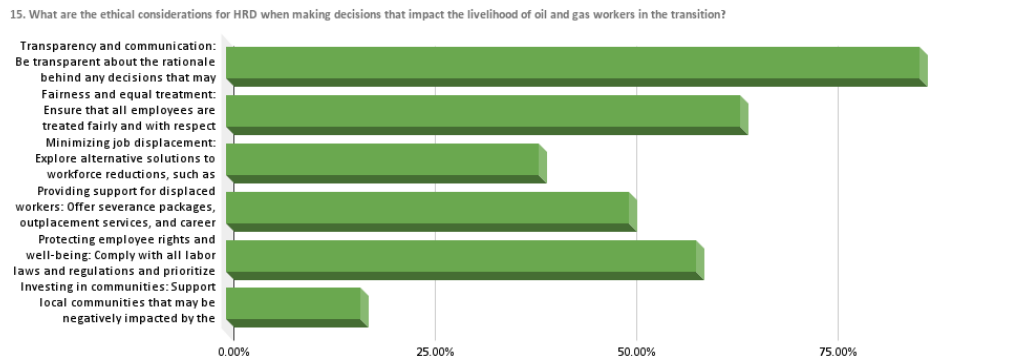
Figure 18 Ethical Considerations

Fostering Innovation Culture

Empowering Employees (72.22%) for innovation and Celebrating Successes and Failures (50%) as learning opportunities underline the importance of a positive, creative, and risk-tolerant work environment for technological advancement.

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Figure 19 Fostering Innovation Culture

Attracting & Retaining Talent in Emerging Fields

Offering Competitive Compensation (75%) and focusing on a Strong Employer Brand (58.33%) are seen as key to attracting top talent in areas critical for renewable energy, such as AI and data science.

17. What are the HRD strategies for attracting and retaining top talent in emerging fields like AI, data science, and advanced materials for renewable energy development?

- Developing competitive compensation and benefits packages: Offer attractive salaries, benefits, and stock options to incentivize top talent.
- Promoting a strong employer brand: Highlight the company's commitment to sustainability, innovation, and cutting-edge technology.
- Partnering with universities and research institutions: Sponsor research projects, offer internships, and recruit graduates with relevant expertise.
- Building a diverse and inclusive talent pipeline: Focus on attracting and retaining talent from diverse backgrounds and perspectives.
- Creating a culture of learning and development: Provide opportunities for professional development, skill acquisition, and career advancement.
- Offering flexible work arrangements: Promote work-life balance by offering remote work options and flexible schedules.
- Recognizing and rewarding talent: Celebrate employee achievements and contributions to the company's success.

Figure 20 Attracting & Retaining Talent in Emerging Fields

Bridging Technical Expertise and Business Acumen

The high ranking of Virtual Reality (VR) and Augmented Reality (AR) (72.22%) for hands-on training illustrates an innovative strategy to fuse technical knowledge with practical business skillsets, promoting a holistic approach to workforce development.

18. How does HRD bridge the gap between technical expertise and business acumen to ensure that technological advancements translate into commercial success in the renewable energy market?

- Bootcamps: Intensive training programs focused on specific skillsets plus provides hands-on experience and practical application.
- Apprenticeships: On-the-job training combined with classroom instruction mentorship opportunities and practical experience from industry experts.
- Learning Management Systems (LMS): Centralized platform for training materials, assessments, and progress tracking and facilitates blended learning and personalized learning paths.
- Social Learning: Peer-to-peer learning through online communities, forums, and collaboration tools encourages knowledge sharing and community building within the
- Virtual Reality (VR) and Augmented Reality (AR): Immersive learning experiences that simulate real-world scenarios to
- Mentorship and Reverse Mentoring Programs: Experienced professionals guide and support junior colleagues to gain
- Internal Talent Mobility and Secondments: Facilitates cross-functional learning and skill development through temporary
- Competency-based Learning and Development: Focuses on specific skills and competencies required for specific roles
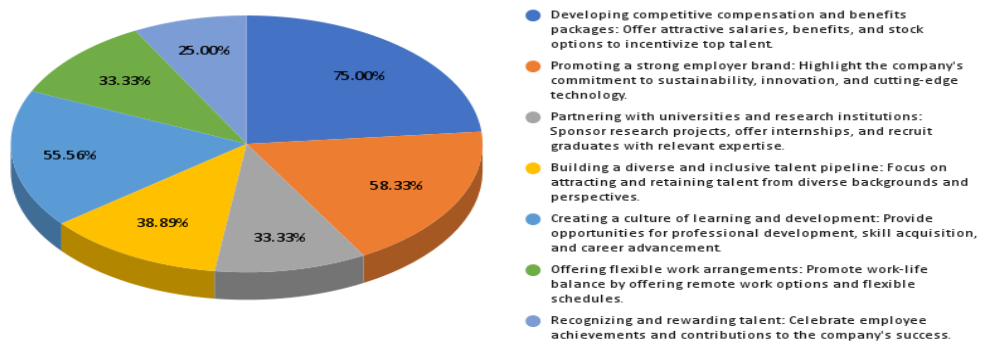- Industry Certifications: Formal recognition of knowledge and skills in specific areas and validates employee competence
- Data-driven Learning Analytics: Measures learning progress and identifies areas for improvement to enables personaliz
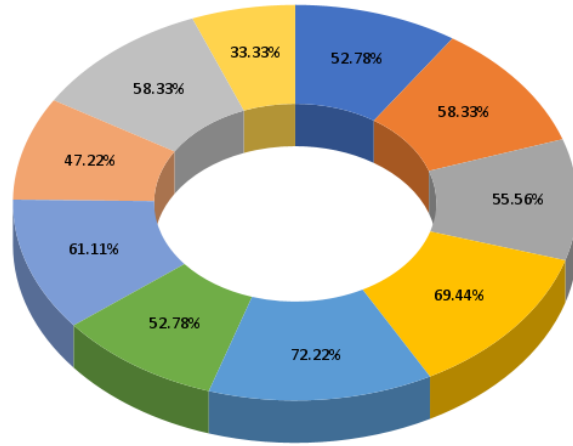
Figure 21 Bridging technical experties and buisness acumen

Overall, the survey paints a picture of an industry in transition, facing challenges in skill development, workforce transformation, and technological integration. The results emphasize the critical role of HRD in addressing these challenges through strategic upskilling, reskilling, and innovation initiatives designed to navigate the shift towards renewable energy effectively.

4.3 Thematic Analysis

Thematic analysis is a method for identifying, analysing, and interpreting patterns of meaning ('themes') within qualitative data. It provides a flexible and accessible approach

to analysing qualitative information. Clark and Braun (2016) outline some key principles for thematic analysis. See appendix 2.
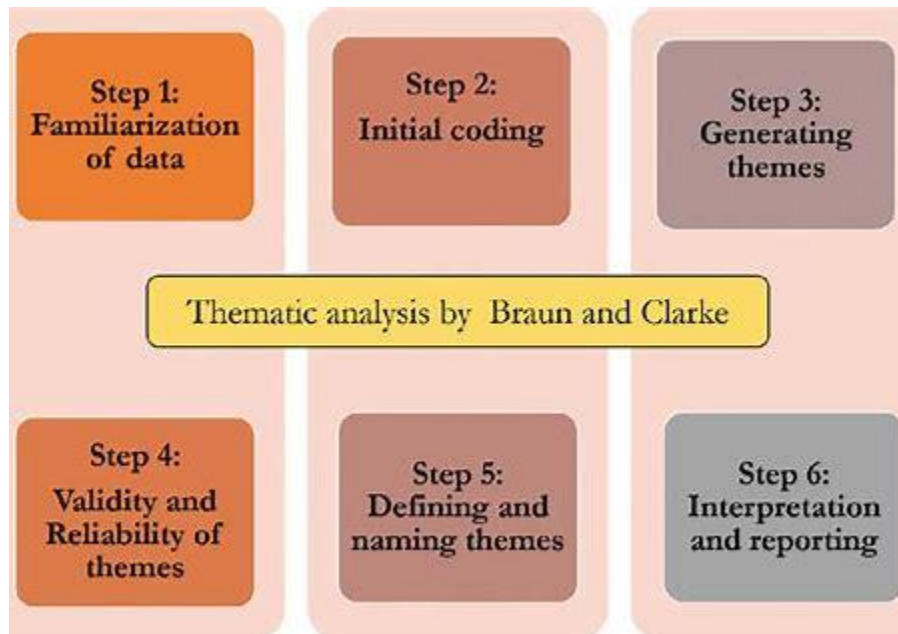
Figure 22 Thematic analysis steps

Phases of Thematic Analysis

According to Clark and Braun, there are six phases in conducting a rigorous thematic analysis:

▪ Familiarisation: The researcher immerses themselves in the data by reading repeatedly and actively looking for meanings and patterns. Detailed notes and ideas are recorded at this stage.

▪ Coding: The data is systematically coded to identify features that appear interesting and meaningful with regard to the research question (Braun & Clark, 2016). Codes recognise a feature of the data that the researcher may assess as important.

- Searching for themes: Codes are analysed and combined into overarching themes that summarise the coded data. Themes capture something meaningful about the research question.

- Reviewing themes: Potential themes are refined by checking them against the dataset and whether they form a coherent pattern. Themes are dropped, combined, or separated as needed.

- Defining and naming themes: Clear definitions and names are developed for each theme, capturing the essence of each theme's meaning.

- Writing up: A scholarly report of the analysis is produced, using compelling extract examples and analytic narrative to present the themes and interpret their meanings in relation to the research question.

Approaches in Thematic Analysis

Clark and Braun describe two main approaches:

- Inductive. Themes are identified through open coding of the data without trying to fit into preconceived categories.

- Theoretical/Deductive. Themes are identified and guided by specific research questions or existing concepts the researcher wants to explore in the data.

Regardless of the approach, the themes identified must closely represent the data, not just the researcher's analytic preconceptions.

Criteria for Good Thematic Analysis

Clark and Braun emphasise several hallmarks of high-quality thematic analysis:

- Systematic and thorough coding of the entire dataset.

- Clearly defined, coherent themes that hang together meaningfully.

- Compelling extract examples that illustrate the themes.

- Detailed analysis of how the themes relate to the overall research aims and existing literature.

- Transparency about the steps taken in the analysis so the process is clear and credible.

Overall, thematic analysis provides a very useful, flexible qualitative analysis tool. When conducted systematically and critically, it yields insightful interpretations of participants' meanings, experiences, and perspectives on the research topic. The main themes identified in the interviews conducted include the following:

1. *Sustainability*

The theme of sustainability which encompasses subthemes such as renewable energy, climate change, global warming, decarbonisation, environmental degradation, and corporate social responsibility was the second most prevalent, with 77% (27) of respondents mentioning it repeatedly. As participants noted, sustainability has become a key priority for organisations today, driven by mounting environmental concerns, regulatory pressures, and changing societal expectations. Adopting sustainable practices requires significant change at multiple levels, from developing eco-friendly products and processes to altering organisational cultures and mindsets. Participants emphasised the need for organisations to take a long-term perspective on sustainability issues rather than focusing solely on short-term profits. This includes making investments in renewable energy, reducing carbon footprints, and promoting circular economic principles. However, participants also acknowledged the challenges in implementing sustainability initiatives, including potential conflicts with profit motives, technology costs, and organisational inertia. Tensions around balancing environmental priorities with business growth objectives emerged as an important subtheme.
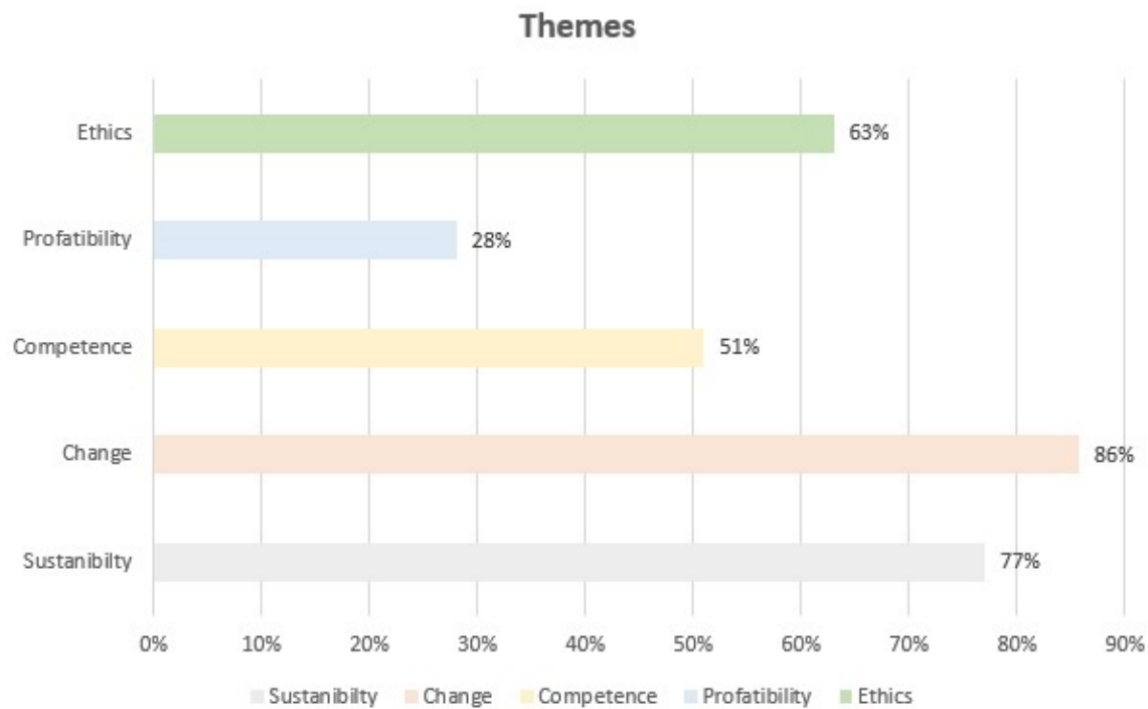
Figure 23 Themes of sustainability

2. *Change*

This was the most prevalent theme as identified by at least 85.7% (30) stakeholders interviewed. The theme of change encompasses subthemes such as change management, resistance, stakeholders, leadership, communication, employee engagement, collaboration, and effective communication. Participants widely viewed organisational change as accelerating, unpredictable, and often difficult to manage. Success factors for change initiatives include thoughtful change management planning, clear and transparent communication, active employee engagement, and collaborative approaches that consider diverse stakeholder needs. However, participants frequently encountered resistance to change from staff, middle management, and even senior leaders. To overcome this resistance, leaders need to model desired modifications, create a sense of urgency, develop change champions, and offer training to build new capabilities. Many participants emphasised the human aspects of change, noting that organisations often focus extensively on process and technology issues while underestimating cultural and behavioural

challenges. Key subthemes around managing the human side of change involve understanding concerns, providing support, and creating opportunities for stakeholder voice.

3. *Competence*

The theme of competence also featured prominently, with more than half of the respondents 51% (18) identifying it as a major concern. It includes subthemes such as skills gaps, upskilling, reskilling, training, coaching, mentorship, and continuous learning. Participants widely recognised the need for organisations to actively develop talent and capabilities to drive performance and meet evolving challenges. Key subthemes included technical skills gaps driven by digitalisation, automation, and other technological disruptions. Participants also cited emerging gaps in leadership competencies, creativity, critical thinking, and other human skills. Upskilling and reskilling the existing workforce through training initiatives were viewed as essential, although organisations face challenges in creating effective learning programs and motivating employee participation. Coaching and mentoring arose as important subthemes for developing talent, although participants noted that these activities require dedicated resources. Participants emphasised that competence development should not end after orientation but rather continue through an employee's tenure via mechanisms like job rotations, stretch assignments, and communities of practice. Enabling continuous learning was seen as critical for both individual growth and organisational adaptation.
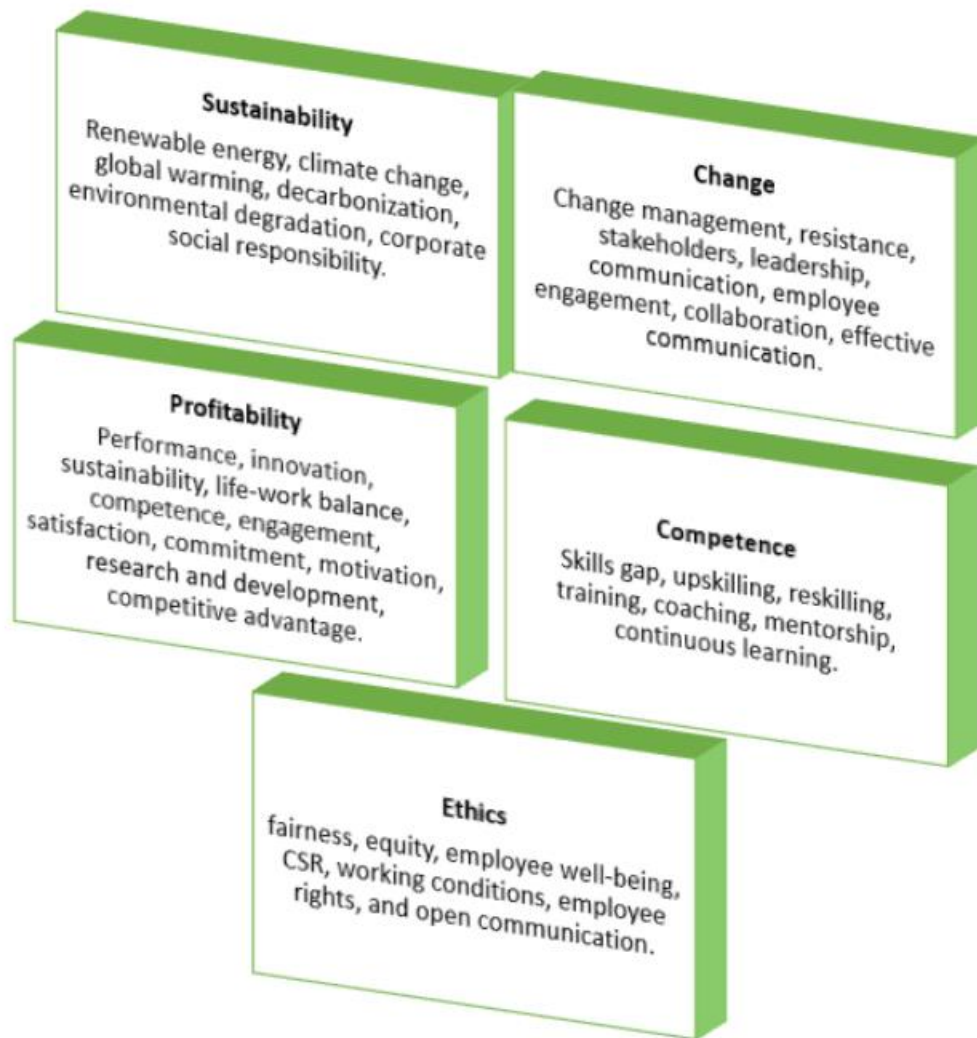
Figure 24 Themes and sub-themes

4. *Profitability*

The theme of profitability appears to be the least prevalent, with only a few company executives (10%) showing concern as far as the long-term profitability of the company is concerned. It encompasses subthemes such as performance, innovation, sustainability, life-work balance, competence, engagement, satisfaction, commitment, motivation, research and development, and competitive advantage. Participants viewed profitability as essential for organisational success and sustainability, although profits

should be responsibly generated. Many subthemes emphasised the connections between organisational culture, human capital management, and bottom-line results. For instance, engaged, satisfied employees were seen as more committed and motivated to perform at high levels. Developing competence through training and development initiatives was also linked to performance and innovation. Meanwhile, efforts to promote work-life balance and employee well-being were tied to stronger retention, productivity, and customer service. Sustainability and social responsibility initiatives were recognised as introducers of additional costs in some cases, even while generating longer-term value by reducing risks, attracting talent, and building reputational capital. Research and development spending was discussed as foundational to developing organisational capabilities and competitive advantage. In general, participants took a broad perspective on profitability, emphasising that both financial returns and intangible assets related to human capital, culture, and brand equity are vital to organisation success.

5. *Ethics*

The theme of ethics includes subthemes such as fairness, equity, employee well-being, corporate social responsibility, working conditions, employee rights, and open communication. Approximately 62.9% of the participants considered this a major concern of the transition to renewable energy. Participants emphasised the need for ethical practices and morality within business while acknowledging frequent gaps between principles and actual behaviours. Subthemes included concerns about unfair or inequitable treatment of employees, particularly those in contingent, outsourced, or offshore roles. Instances of perceived racism, sexism, and other biases were cited as ethical issues, alongside limited diversity in leadership ranks. Poor working conditions and human rights violations in offshore operations also posed ethical challenges. Participants widely viewed organisations as having broad social responsibilities around environmental sustainability, local community impact, and similar issues. Enhancing ethics was seen to require a strong tone from the top. Leaders expressing empathy and concern for employee well-being were considered an ethical imperative. Ethics was termed as a long-term driver of organisational

reputation, public trust, and employee engagement, although participants acknowledged cases where unethical behaviour may boost short-term profits.

Figure 25 HDR Best Practices

4.4 Research Objective 1: Opportunities and Challenges

Opportunities

The shift to renewable energy allows organisations to support Oman's economic diversification and sustainable job creation agenda beyond finite oil and gas resources. By investing substantially in large-scale solar, wind and green hydrogen projects, organisations can deliver stable long-term returns while also meeting national development needs. Renewables expansion can nurture high-tech manufacturing ecosystems related to

turbines, PV panels, batteries and electrolysers in Oman through partnerships. This boosts In-Country Value and localizes the renewable energy supply chain. organisations can also reskill and redeploy its Omani workforce towards renewable energy operations, ensuring national human capital capabilities transition successfully to sustainability.

Organisation's extensive engineering workforce capabilities developed over decades in oil and gas project management, complex operations technology, energy logistics and production systems optimization can be repurposed for renewable energy. Targeted reskilling programs by HR can enable Organisation's technical talent to lead the engineering design, procurement, commissioning and running of large-scale wind, solar and hydrogen facilities. The deep expertise in handling hazardous operations, maintaining high asset productivity and managing energy by-products is transferable to build and operate renewable assets safely, efficiently and economically.

The renewable pivot allows organisations to position itself as a future-focused sustainable energy company, enhancing its employer value proposition to attract young, talented professionals inclined towards meaningful green careers. Organisations can showcase itself as an industry forerunner enabling Oman's inevitable energy transition through cutting-edge R&D in renewable technologies. This will boost organisation's talent attractiveness, enabling it to secure skilled, motivated technical resources despite intense competition amidst the Great Resignation dynamics. Change management efforts by HR must communicate the organization's sustainability direction in order to engage talent. Overall, the transition is an opportunity for organisations to stretch boundaries beyond hydrocarbons and create substantial value - for the nation, employees, future generations and the organization itself.

Challenges

A major challenge is smoothly transitioning organisation's workforce from conventional oil and gas operations like drilling, refining, and equipment maintenance to emerging renewable energy roles like solar PV technician, battery storage engineer, wind

turbine mechanic etc. As renewable projects scale up, certain legacy production roles will become redundant. Planning reskilling programs, assessing employee adaptability towards new technical skills, avoiding redundancy costs and cultural backlash pose HR challenges. Managing anxieties of mid-late career employees used to fossil fuel operations also requires change management prowess.

Developing internal capabilities in renewable technologies either through organic talent development or inorganic routes like acquisitions and partnerships will require immense learning agility and investment. HR must design specialized training programs, integrate sustainability into leadership competency models, and attract young technical talent inclined towards green careers. Recruiting externally where in-house capabilities lack is also key while balancing nationalization goals. Further, building a culture encouraging experimentation, learning and innovation will enable capability building, overturning the traditional risk-averse approach.

Transitioning a production-focused, efficiency-driven oil and gas culture to one embracing innovation, learning and environmental stewardship poses cultural challenges. HR has a vital role in promoting sustainability orientation through vision workshops, green teams, embedding ESG in incentives and celebrating renewable milestones. Instilling pride as an enabler of Oman's energy transition rather than lamenting reduced oil dependence will need strategic messaging. Also, advancing gender balance in the traditionally male-dominant oil industry to access the widest talent pool will be crucial to boost progressiveness. In summary, Organisation's HR function faces vital people challenges around work transitions, capability development and culture change management as Oman advances its sustainability ambitions. Astute human capital strategy will be integral for organisations to optimize rather than just adapt to the renewable energy transformation underway.

4.5 Research Objective 2: Best Practices and Strategies

For organisations to strategically transition its workforce and culture from oil and gas to renewable energy, dedicated workforce planning to map emerging competency requirements and reskill employees through modular, digitally-enabled training is imperative. Leadership visioning workshops focused on calibrating managers on the sustainability-driven change management strategies prove vital. Centralized, specialized change management teams must continuously engage staff via multimedia campaigns, events and competitions to promote the transition. Seeking joint ventures and acquiring start-ups with complementary renewable capabilities can accelerate development. Highlighting success stories in internal and external media fosters cultural embedding. Throughout, transparent communication addressing concerns maintains alignment.

Fundamentally, organisation's human capital approach must integrate across dimensions - technical reskilling programs based on competency mapping, change management structures and expertise, leadership alignment on vision and strategies, external partnerships for capability augmentation, and multimedia storytelling showcasing symbolic milestones to reinforce the culture shift. With astute workforce planning, change management and capability development, organisations can transition its people towards renewable energy expertise. Instilling a culture valuing innovation and sustainability will also attract progressive talent as organisations future-proofs for Vision 2040. Overall, a multi-pronged human resources strategy targeting competencies, change management, leadership messaging, external partnerships and culture shaping can enable organisation's successful navigation of the global energy transformation in creating value for Oman.

4.6 Research Objective 3: Stakeholder Engagement

Realizing organisation's evolution into a future-ready sustainable energy player aligned to Oman's Vision 2040 will require proactive involvement of diverse stakeholders. Policymakers have a vital role in incentivizing renewable energy investments and innovation by organisations through direct subsidies, guaranteed power tariffs and tax breaks. Emissions pricing mechanisms, renewable purchase obligations and streamlined licensing can also accelerate organisation's sustainability focus. Funding specialized

reskilling programs, setting up certification schemes and enabling international expertise exchange will be crucial to build organisation's renewable energy capabilities. Upgrading grid infrastructure, facilitating equipment testing and enabling renewable energy supply by organisations would also require policymaker interventions.

Academic and research institutions need to redirect focus towards renewable energy engineering, design, and technology specializations catering to organisation's emerging knowledge needs. They also need to strengthen industry-academia linkages, offering tailored sustainability-focused training and applied research partnerships. organisations can also strategically utilize academic expertise in change management and culture building as it navigates the transition. Technology providers including start-ups can enable organisation's transition by providing cutting-edge solutions for solar, wind, hydrogen, battery storage, carbon capture and digital optimization. Collaborating with organisations through pilot projects and co-innovation partnerships while addressing intellectual property, localization and commercialization aspects would be constructive.

Oilfield services partners must expand offerings beyond oil and gas to provide integrated solutions spanning renewables like equipment maintenance, engineering, and project management support. This allows leveraging their strong in-country presence while diversifying revenue streams. Local communities and civil society groups can partner with organisations in areas like environmental conservation, sustainability education and community development initiatives around renewable energy projects. This boosts organisation's social license to operate during the transition. Lastly, organisation's leadership needs to proactively engage stakeholders through forums, working groups and open discussions to foster collaborative strategies and synchronize efforts. This can optimize resource allocation while addressing concerns, boosting shared value. Overall, a supportive ecosystem of policy reforms, R&D focus, youth education, technology solutions, local partnerships and leadership strategy is vital for organisations to achieve a profitable evolution into an energy majorly aligning economic and ecological needs.

4.7 Research Objective 4: Environmental Awareness

Assessing the environmental consciousness amongst key stakeholders is vital for organisations to develop informed strategies and messaging as it navigates the transition to renewable energy in Oman. A comprehensive survey targeting policymakers, company leadership, employees, local communities, academia, and customers can evaluate sustainability awareness across dimensions like climate risks, net zero commitments, renewable energy perceptions, and personal attitudes. The survey analysis should develop an Environmental Awareness Index comparing stakeholder groups and identifying literacy gaps. Among policymakers, the index can assess understanding of global climate goals, recognition of oil and gas emissions exposure, and willingness to implement incentives or mandates for renewables adoption. For organisations leadership, it can map acknowledgement of stranded asset risks, appetite for clean energy investments, and sense of responsibility towards sustainability.

Within organisations employees, it can evaluate acceptance of new job roles, sentiment towards reskilling, and enthusiasm for partaking in green corporate initiatives. For local communities proximate to organisations operational areas, assessment of renewable energy sentiment, trust in organisation's ecological commitment and environmental volunteering participation provides insights. From academia, the index can gauge research priorities in renewable energy, employability perceptions of sustainability skills and openness for industry collaboration. For major customer groups like power generators or energy intensive industries, it can determine renewable energy preferences, willingness to pay green premiums and feedback on Organisation's ecological communication. The environmental awareness measurement across stakeholders should be conducted annually to track maturity over time. It can feed into Organisation's strategic messaging and workforce, community and customer engagement initiatives during the transition. Tailored awareness building workshops addressing literacy gaps for different stakeholders will maximize impact. Overall, a sustainability-focused stakeholder analysis provides data-backed human insights vital for organisations in steering an environmentally and socially responsible renewable energy transformation.

CHAPTER V:

DISCUSSION

5.1 Discussion of Results

This discussion chapter interprets the key findings of the thematic analysis in relation to the research aims of understanding the role of HRD in enabling the renewable energy transition in the Omani gas and oil industry. The analysis uncovered four major themes in the perceptions and experiences of HR professionals: 1) growing skills gaps emerging from the transition, 2) difficulties adapting to current organisational cultures rooted in fossil fuels, 3) key components of impactful training and reskilling programs for renewable energy capacities, and 4) the strategic importance of workforce planning amidst uncertainties. These themes highlight that while the sustainability transition necessitates dramatic new HRD approaches, especially reskilling at scale, ingrained institutional barriers persist around strategy, culture, and skills development systems designed for fossil fuel-based business models. The chapter will discuss each major theme in depth, contextualising the opportunities and challenges they represent for the sector's HRD functions in facilitating decarbonisation pathways. Their interpretations will be related to the wider literature on sustainability transitions, organisational change models and green human resource management. In particular, the tensions between industry inertia and transformational sustainability strategies raise dilemmas regarding the pace and sequencing of workforce development interventions (Widya & Tjahjono, 2019). Practical and research recommendations are provided on how HRD might nurture new capacities, cultures, and structures while carefully managing the workforce implications of the low-carbon transition in a socially responsible manner.

As previously observed, the global energy landscape is undergoing a seismic shift as countries and corporations adjust their energy strategies to align with ambitious carbon emission reduction targets in order to achieve sustainability and appeal to a more informed and environmentally conscious market. This energy transition aims to mitigate the

implications of climate change through radically decarbonising power generation, transportation, buildings, manufacturing, and agriculture over the coming decades. For the oil and gas sector, which has powered and underpinned the world's energy systems for over a century since the advent of industrialisation, this transition represents a profound, potentially existential, threat. The sector faces declining long-term demand for its hydrocarbon resources which face carbon taxation, divestment campaigns, and pollution regulations that threaten the core foundations of its business models. Skilled workforce in fossil fuel exploration, extraction, transportation, refining, and distribution now faces deeply uncertain futures (Saygin et al., 2018). Their roles risk becoming obsolete or severely contracted as the dominance of renewable energy sources like solar, wind, and geothermal power grows in electricity generation, heating, cooling, and transport. Only by acquiring completely new clean energy capabilities can companies transition to emerging opportunities in areas like hydrogen, biofuels, carbon capture, or hybrid energy systems. The speed at which peak oil demand forecasts have accelerated and clean energy adoption is rising across societies and corporations leave little time for incremental adjustment. The existential nature of this energy transition means oil and gas companies must undertake wholesale strategic transformations within years and at a significant scale to align their assets and capabilities with net zero pathways. This carries potentially devastating human impacts from workforce anxiety to community disruption without carefully planned change management.

5.2 Opportunities and Challenges

Opportunities

Oil and gas companies have developed vast expertise across the hydrocarbon value chain after a century of industry dominance. Key competencies like complex project management, drilling and completion engineering, subsurface geology knowledge, and extensive logistical capabilities are invaluable assets that can be redeployed for renewable energy systems. Areas like hydrogen and geothermal energy leverage closely related knowledge of gas transport, reservoirs, and pipelines for production as well as fuel cell

applications across industries, from transportation to chemicals manufacturing. Hybrid energy systems integrating solar, wind, and natural gas generation through small-scale LNG terminals depend extensively on optimisation algorithms, miniaturisation manufacturing techniques, and modular construction capabilities the oil and gas sector possesses in abundance. Carbon capture, utilisation, and storage similarly rely on the ability to handle pure CO_2 in large volumes through separation, compression, injection, and reservoir expertise from E&P. HRD can map such adjacencies through skills audits and opportunity scans to identify where existing oil and gas capabilities directly transfer for minimal retraining. Workforce mobility initiatives help cross-pollinate knowledge across teams with valuable tacit insights to combine. Rapid prototyping and controlled trials provide commercial proof points to build confidence in entering unfamiliar spaces. Partnerships with start-ups and universities provide missing competencies around new technologies. However, the core project development, delivery and operational excellence strengths of the industry provide durable foundations to build upon. This internal leveraging of expertise symbiotically combines incumbent capabilities primed for renewal with emerging external energies racing ahead, but lacking scale. HRD's role lies in fostering exploratory collisions between these complementary forces through networking initiatives, bespoke training, and shepherding successful collaborations.

Oil and gas companies have access to abundant resources, data sets, and physical infrastructure that position them uniquely to collaborate with innovative startups, tech companies, universities, and research institutions to accelerate the development of promising technologies that drive the transition to clean energy systems. Areas like artificial intelligence, advanced materials, robotics, nanotechnology, and data analytics are already driving change improvements in solar panels, wind turbine efficiency, grid optimisation, and energy storage solutions. Oil and gas companies can provide real-world testing environments to develop smart sensors for predictive maintenance, trial autonomous inspection drones, pilot floating solar panels, or prove improved catalysts that enhance biofuel yields. Joint R&D partnerships, technology licensing agreements, equity investments, and controlled testing sites all provide avenues to access external innovation

capabilities from agile young companies unencumbered by institutional inertia. HRD plays a vital role in bridging the cultural gaps between risk-averse incumbents and fast-moving entrepreneurial ventures through extensive upfront stakeholder engagement. Win-win value propositions must be communicated and trust must be built between unusual allies. But the complementary strengths are evident — oil and gas provide operational scale, established customer networks, engineering rigour, and capital intensity to commercially scale up novel proofs of concept from lab testing to mass production realities. Renewable start-ups inject agility, entrepreneurial hustle, and technology expertise catered to low-carbon solutions. Strong partnerships turbocharge innovation cycles to meet the pressing timeline for global energy decarbonisation targets over the coming crucial decades.

Oil and gas companies have developed extensive infrastructure over decades to support hydrocarbon exploration, production, and global distribution. Networks of suppliers, huge logistical fleets, massive storage tanks, sprawling pipeline grids, processing facilities and import terminals constitute unparalleled industrial capacity. As renewable energy scales exponentially to displace fossil fuel dominance, leveraging this existing infrastructure offers economical transitions rather than abandoning assets. Storage tanks convert to biofuel production, distribution fleets switch to modular solar plant construction and maintenance, while offshore rigs transform into wind turbine foundations. Most oil and gas infrastructure revolve around moving fluids and gases securely in large volumes across vast geographies. Storage and transmission infrastructure aids load balancing for intermittent solar and wind generation until adequate battery capacities exist. Distribution networks enable domestic biofuel adoption. LNG terminals readily convert to hydrogen hubs for clean combustion and fuel cells. HRD plays a key role in ensuring infrastructure-related competencies like network planning, demand forecasting, interconnection protocols, reliability engineering, and custom fabrication support renewable energy infrastructure buildouts. Workforce strategies that retain these valuable capabilities through redeployment, reskilling, and attrition planning ensure that system capacity keeps pace with clean energy ambitions. Partnerships with electricity utilities, governments, equipment providers, and communities also smooth infrastructure transitions to optimised

roles. The oil and gas industry's hard-won mastery of moving energy across continents and oceans provides robust yet flexible platforms awaiting retrofitting to aid decarbonisation as the world transitions to renewable electricity, transportation, and heating (Widya & Tjahjono, 2019).

The renewable energy transition offers compelling new business opportunities for oil and gas companies in growth areas like solar, wind, smart grid technologies, electricity storage, electric mobility, and sustainable biofuels. HRD plays a pivotal role in catalysing organisational pivots to capture emerging revenue streams. Thorough opportunity scans assessing market trends, policy incentives, startup activity, investment flows, patents, R&D directions, and consumer adoption signals growth spaces. Analysing macro dynamics through PESTLE frameworks highlights areas aligning with organisational strengths worth further validation. Customer panels gauge interest levels for services like electric vehicle charging networks or retail renewable energy bundles. Controlled pilot projects with universities, startups, or partner corporations provide in-market testing to seize the opportunity and refine propositions aligned with customer needs. Focused R&D investments in selected technologies like vehicle-grid integration systems seed the foundations for smart energy management platforms. Venture capital arms allow equity positions in promising start-ups affording valuable visibility. Nonetheless, beyond scanning and experiments, HRD must incubate initiatives transforming insights into new business lines. Sponsoring dedicated commercialisation teams with relevant expertise and executive exposure provides the foundation. Bespoke capability-building programs accelerate vital power systems, data analytics, IoT applications, and other competencies needed for such ventures to gain traction. With patient nurturing of budding opportunities, renewable initiatives transform perception from distraction to growth engine (Widya & Tjahjono, 2019). Through these approaches, major oil companies like Shell, BP, and Total have invested billions in wind farms, EV charging networks, utility-scale batteries, and solar distributed generation assets becoming clean energy leaders, thus leveraging existing capabilities into unfamiliar spaces.

Traditional oil and gas cultures often prioritise risk mitigation, operational excellence, and incremental improvements suited to managing complex, capital-intensive extraction assets and vast logistics chains. The renewable energy transition demands more agile, entrepreneurial cultures attuned to sustainability that openly explore transformational innovations even under uncertainty. HRD plays a leading role in cultural transformation through interventions like innovation competitions, hackathons, and green intrapreneur programs that provide structured opportunities for workforce segments to envision clean energy offerings aligned with net zero ambitions. Online idea platforms allow crowdsourcing solutions from carbon utilisation projects to solar microgrid packages or EV smart charging solutions. Green intrapreneur circles offer networking, bespoke training, executive mentoring, and seed funding to nurture promising proposals from passions percolating amongst internal talent keen to stretch in new directions. Innovation camps deliver intensive bursts of design thinking and lean Startup Methodology exposure to equip new venture teams with human-centred design and rapid experimentation abilities. Such initiatives expand the organisational aperture beyond a narrow operational focus into wider ecosystem plays and sustainability ambitions. New offerings get shaped through understanding adjacent customer needs, future societal expectations and partner networks rather than purely incremental improvements of current activities. Constant horizon scanning fosters an opportunity orientation attuned to market signals and emerging technologies primed for commercialisation. Over time and with leadership endorsement, this expands innovation appetites and renewable experimentation permeates corporate cultures accustomed to fossil fuel-proven categories, unlocking new revenue streams.

The renewable energy transition demands new commercial acumen within oil and gas companies to spot growth opportunities in unfamiliar spaces like smart grids, energy storage, carbon solutions, and e-mobility. Building cross-functional literacy on emerging technologies, evolving market landscapes, changing consumer preferences and potential partnership models allows more informed business decisions suited to the green economy. HRD plays a vital role here through multi-modal interventions that expand employee understanding of external dynamics reshaping the energy industry while connecting the

dots to internal capabilities. Industry primer e-learning modules offer foundational knowledge around developments like hydrogen value chains and off-shore wind at scale. Expert speaker series, site visits to pioneering renewables projects, and demonstrations of new technologies like vehicle-to-grid bi-directional chargers provide tangible immersion. Cross-functional forums, job rotations, and shadowing programs build connections and information flows between customer-facing, technical and strategy teams with external ecosystem exposure. Secondments within business development, venturing, and innovation roles inject commercial rigour and market savvy. Together, these initiatives combat institutional inertia by spreading literacy and cultivating insight into the market shifts underway. This landscape awareness allows linked opportunities to be spotted, aligning unmet market needs with organisational strengths capable of filling gaps. An external orientation and commercial grounding permeate decision-making rather than relying solely on historical categories without full context. Over time, business model innovations emerge shaped by external signals rather than incremental refinements to business as usual. Through such efforts, the entire organisation becomes aligned around the pace and scale of the sustainability transition underway.

The renewable energy transition creates complex challenges and opportunities that demand diverse talent blends not typically prominent within incumbent oil and gas companies. As new growth vectors emerge in spaces like mobility services, distributed energy resources and clean hydrogen, securing cutting-edge expertise in human-centred design, data analytics, digital platforms, and specific technical domains generates a competitive advantage. HRD plays a crucial role in attracting talent skilled in design thinking to embed customer orientation, rapid prototyping, and user experience excellence into renewable business ventures. Business analysts with technology commercialisation experience inject market savvy and implementation rigour into inorganic growth moves or partnership initiatives exploring adjacencies. Digital transformative leaders versed in agile delivery overhaul legacy IT systems that are unfit for the programmable, decentralised renewable grid. Battery chemists, power electronics engineers, ecologists, and data modellers provide specialised knowledge for bespoke challenges across transport and

electricity decarbonisation. This multi-disciplinary blend of business commercialisation talent, digital orchestration ability, and technical specialists combines to spot and seize opportunities in the rapidly evolving renewable value chain. Focused employer branding campaigns emphasising sustainability visions, innovation cultures, and career growth opportunities help attract those seeking purpose-driven work. Partnerships with startups, academia, and expert networks access niche skillsets on a flexible basis to fulfil specialist needs on demand.

Oil and gas companies boast enormous scale and resources that lend themselves to leading complex energy systems integration initiatives essential for the renewable energy transition. Leveraging world-class engineering capabilities, physical assets, capital intensity and customer networks allows for incubating hybrid solutions that advance decarbonisation through harnessing complementary strengths. Areas like connected mobility ecosystems blending public transit, smart EV charging networks, vehicle-to-grid integration, solar generation, and battery storage require orchestrating diverse stakeholder groups. Oil and gas companies' adept at managing highly complex hydrocarbon supply chains are uniquely positioned to convene such consortiums. The planning expertise required to deliver vast exploration and production projects also aids in overseeing multi-year mobility infrastructure roll-out and optimisation engaging constituents across power, transport, real estate, and technology sectors. Similarly, digital twin capabilities honed to replicate oil field dynamics using massive sensor data sets are transferable to model regional power systems incorporating weather variability for reliable renewable generation. The operational and maintenance capabilities underpinning the reliability of offshore platforms readily transfer into offshore wind farms, leveraging synergistic patterns. HRD plays a vital role in ensuring multi-disciplinary systems thinking permeates the workforce to spot opportunities bridging sectors and contingencies for low-carbon solutions. Skills like risk modelling, data visualisation, portfolio analysis, resilience planning, and controls engineering increase relevance for renewable energy in a complex adaptive world demanding integration across physical, digital, and business layers simultaneously.

5.3 Challenges

The renewable energy transition demands entirely new technical skillsets compared to those prevalent in incumbent oil and gas companies built over a century of fossil fuel dominance. Solar, wind, geothermal, and other clean energy technologies involve radically different knowledge from hydrocarbon exploration, drilling, and production roles. As demand shifts decisively towards renewables, the existing workforce faces major skills deficits without proactive interventions. Redeploying oil and gas engineers, technicians, and project managers to renewable assets requires bridging gaps in areas like material science, power electronics, electrification, ecology, meteorology, and advanced sensor technologies underlying assets like solar panels, wind turbines, and battery storage systems (Widya & Tjahjono, 2019). Operating emerging fleets of electric vehicles, charging stations, hydrogen refuelling, and biofuel plants further stress unfamiliarity. Data analytics, AI, and machine learning also become mandatory to harness automation, optimise intermittent renewable generation, and manage complex hybridised energy systems. Legacy workforces anchored in linear Excel models must rapidly reskill on Python, IoT, and cloud platforms. Project management equally must adapt techniques for agile, iterative software development rather than traditional rigid contracting models. HRD faces pressing needs to assess capability gaps across different workforce segments and functions to tailor targeted reskilling programs, augmented by external hiring. Partnerships with online education platforms, universities, certification agencies, and industry networks plug talent pipelines. Instilling continual learning cultures that encourage agile skill acquisition counteracts inertia, threatening obsolescence across significant employee bands lacking existing renewable energy grounding.

The renewable energy transition demands fundamentally different mental models and cultural values compared to the incumbent regimes of oil and gas companies. After a century of fossil fuel dominance, assumptions around perpetual demand growth, extraction cost curves, and geopolitical security theories become outdated. Yet, they underpin entrenched cultures resistant to change along with a lack of awareness of fast-moving sustainability technologies and business models. HRD plays a leading role in cultural

transformation and instilling sustainability mindsets across leadership, managers, and wider workforces steeped in legacy outlooks. High-impact interventions include integrating climate science and natural systems thinking into corporate training programs and leadership development curricula. Immersion experiences for executives with leading renewable energy companies and progressive sustainability pioneers provide a visceral understanding of possible futures. Inclusive forums give employee voices opportunities to explore tensions and trade-off between fossil fuel heritage and renewable visions to work through resistance. Symbols and rituals celebrating net zero progress help positively reinforce steps rather than solely mourn losses from fossil fuel declines. Supporting professional networks, information exchanges, and site visits around renewables fosters familiarity with the urgent technologies and mindsets needed for personal and organisational realignment. Through multilayered initiatives, urgency around epic sustainability challenges permeate corporate cultures insulated from planetary pressures. This, in turn, builds a willingness to explore transformative solutions that depart from business-as-usual practices long anchored in the favours of incumbency.

Reskilling and upskilling tens of thousands of employees are enormous challenges for oil and gas companies facing skill deficits around renewable energy. Even once capability gaps are identified, finding the time and budgets necessary for extensive training remains daunting. Project deadlines, workloads, and organisational inertia hamper carving opportunities for professional development. Costs compound rapidly from program development to delivery technology and managerial oversight for major workforce transformation initiatives. Lack of motivation amongst mid to late-career employees present additional hurdles given the effort involved in absorbing wholly unfamiliar skills, technologies, and processes so late into their careers. Younger cohorts may show greater enthusiasm for embracing sustainability topics like electrification, renewables, and carbon removal solutions. Convincing veteran employees of the benefits of reskilling requires tailored messaging aligned to personal transitions rather than just organisational needs. HRD plays a crucial role in creatively overcoming these constraints through partnerships, microlearning, and change management engagement initiatives. Government

collaborations, industry consortiums, and educational alliances help share costs and infrastructure. Digital microlearning provides just-in-time and mobile-friendly capability boosters that respect employee bandwidth limitations by segmenting required competencies (Saygin et al., 2018). Gamification, credentials, and rewards drive persistent engagement critical for hesitated adopters. Forcing functions like technology change communication and internal mobility pathways reinforce that renewal is inevitable amidst the energy transition. Together, these methods ease resource barriers and motivate commitment even amidst uncertainty.

The renewable energy transition inevitably creates anxiety and resistance within oil and gas workforces fearful of job losses as fossil fuel activities decline. Entire careers that have built highly specialised capabilities around hydrocarbon value chains now face uncertainty as solar, wind, and other disruptive technologies rapidly scale. Lack of familiarity with renewables breeds reluctance to reskill without reassurances on employment continuity. HRD plays a vital role in fostering workforce understanding, agency, and support amidst transitional turbulence. Proactive change management provides the foundation (honestly addressing the sector's decarbonisation imperative while outlining realistic timelines for workforce impacts) and allows framing inevitability. But pairing messages with compassion (acknowledging losses from fossil fuel activity reductions while providing ethical transition frameworks, including redeployments, retraining, and severances) retains organisational humanity. Ensuring employee consultation and ideas inform net zero planning reduces resistance and builds collective visions. Upskilling as per personal career stages and flexibility in role options quell fears of skill redundancy. Support programs, including sabbaticals, wellness services, and peer coaching ease burdens while preventing burnout, resentment, or disengagement during demanding pivots. Renewal stems from positively engaging workforces in co-creating just transitions rather than forcing change decrees lacking empathy. HRD lays the foundations for this through well-designed workforce programs to proactively identify, forecast, and then assist vulnerable cohorts based on risk analyses rather than reactionary responses once disruption hits.

Several organisational roadblocks routinely constrain the pace of capability development required to bridge renewable energy skills gaps. Tight L&D budgets facing competing priorities limit funds for external partnerships, specialist sourcing, and learning technology platforms. Heavy workloads immersed in fossil fuel operations distract managers and employee bandwidth for reskilling efforts needed for unfamiliar renewable activities. Difficulty accessing experts, courses, tools, or peer exchanges hampers access to best-practice skills development. Together, these obstacles risk slowing adaptation to clean energy advancements severely misaligned with the urgent pace of sector transformation required. However, HRD can employ several levers to maintain capability-building momentum, including:

1. Making the business case for L&D investments to accelerate net zero workforce transitions via executive presentations outlining risks from inertia.

2. Utilising microlearning content during common downtime windows that respect employee attention constraints over traditional course structures.

3. Negotiating with governments' co-investments in priority capability-building initiatives like regional reskilling programs as part of just transition support.

4. Curating multi-channel peer learning opportunities via team collaboration tools, external mentors, and coaching circles for accessible development.

5. Providing line managers with simple online tools to track capability building aligned to renewable energy milestones for direct employees amidst operational demands.

6. Conducting capability barrier assessments annually that identify constraints hampering transition plans to inform executive steering committees on risks.

Through these efforts, roadblocks get raised by heightening urgency, pragmatism, partnerships, and workplace integration for L&D surrounding strategic priorities despite competing demands.

The urgent pressures on rapid reskilling within oil and gas workforce risk negative consequences like job displacement, work-life imbalance, excessive stress and even mental health declines without careful mitigation planning. As renewable energy activities ramp up while fossil fuel roles wind down, anxiety around employability grows amidst unfamiliar disruption. Similarly, intensive upskilling programs attempted in short timeframes alongside regular responsibilities overflow workloads leading to burnout, without decompression opportunities. Trying to meticulously identify vulnerable cohort risks privacy violations or stigma without proper safeguards as well. HRD plays a crucial role in navigating these talent risks holistically across overlapping dignity, wellness, and capabilities dimensions. Ensuring social dialogue and idea contribution channels provides workforce influencers with formal ways to raise concerns, avoiding silent sabotage. Anonymous pulse surveys allow safer transparency on emerging issues like role insecurity that groups lack the power to otherwise surface. Wellness incentives, sabbatical programs, and peer counselling options ease burdens while signalling institutional caring amid turbulence. Rigorous workload analyses prevent excessive pressures unsafe for at-risk cohorts. Partnerships with non-profits, government agencies, and community groups expand support infrastructure where purely internal capabilities hit constraints. Throughout, the focus remains on human experiences amidst disruptive workplace change rather than purely execution milestones. This is because culture and trust decay slowly but impact severely once breached. HRD holds the responsibility for retention by hearing wide vulnerability signals early when resilience interventions can still respond.

The renewable energy transition risks leaving behind demographic groups both intentionally and unintentionally within oil and gas workforces through reskilling gaps. Customised interventions tailored to individual functions, locations, roles, seniority levels, genders, ages, and cultural backgrounds ensure a fair opportunity to participate in

capability building. Assessments allowing anonymous input on program access barriers and delivery preferences provide crucial insight into gaps, seemingly generating neutral offerings. Simple steps like flexibility in timing amid shift worker restraints, coupling online, and in-person formats respecting connectivity barriers or addressing language fluency progressions in multilingual workforces prevent exclusion. Mentorship opportunities specifically for female employees' navigation of male-dominated technical cohorts assist in retention and advancement. Using images and examples featuring diverse ethnicities fosters safer cultural climates amid global operations. However, inclusivity requires going beyond learning programs themselves. Participation minimums across hierarchy levels and workstreams ensure engagement breadth. Leadership visibility modelling behaviours like openly discussing capability gaps set permissions. Expanding input channels beyond traditional committees accessing younger employee views uncovers fresh transition perspectives. Setbacks will occur but measured rapid responses prevent compounding inappropriate standards. Excluded cohorts silently erode trust and disclosure vital for transformation-oriented cultures. HRD oversees the long arc towards justice amid disruption through sustained environments, respecting employee uniqueness while pursuing collective capability renewal. Poorly handled undercurrents resurface downstream, so inclusion warrants overinvestment early when redirecting requires humility.

As renewable energy expands its dominance, declines in oil and gas production require responsible management of workforce transitions associated with role reductions. HRD carries vital duties, ensuring that such restructuring aligns with ethical imperatives around justice, trust, and empathy. Carefully conveying the strategic context, rationale, and timelines for pending role impacts retains transparency. Generous severances acknowledging tenure combined with career transition support convey respect for contributions despite required departures. Prioritising internal redeployments across business units and exploring voluntary early retirement schemes minimises involuntary losses. Reskilling programs for roles with transferable skills like project management demonstrate loyalty. Maintaining open dialogue through employee consultative bodies,

surveys, and town halls allows responsive evolution of separation support programs based on emergent pain points. Leadership visibility through messaging and active listening prevents detachment accusations. Site commemorations and alumni networks honour departing colleagues. During turbulence, humane experiences distinguish receptive adaptation from callous disruption and community erosion. Just transitions demand holistic workforce impact mitigation, so HRD oversight prevents dimensional oversights operations view solely through cost lenses, risking brand integrity and future talent attraction.

5.4 Best Practices and Strategies

Oil and gas companies depend on ongoing capabilities auditing and strategic workforce planning to accurately map out future talent needs aligned with ambitious net zero commitments. Robust skills gap analyses provide a granular understanding of current vs. required competencies across diverse work streams, ranging from exploration geologists to rig managers for charting reskilling roadmaps. Assessments must combine top-down reviews — quantifying critical emerging expertise like battery storage system knowledge — along with bottom-up listening, identifying skills adjacencies for priority job families. For example, drillers adept at analysing geophysical datasets readily build data analytics credentials for managing hybrid renewable energy asset optimisation. Such insights inform targeted, tiered training pathways, allowing gradual immersion for cohorts by performance bands differentiated by motivations, existing experience foundations, and learning styles. Younger employees embrace emerging digital capabilities like IoT instrumentation and cloud monitoring tools, updating field equipment. Specialist engineers cross-train through industry micro-credentials to expand electrification, carbon management best practices, and power systems literacy. Ecosystem exposures like hackathons, expert panels, and site visits provide senior leadership with tangible immersion into unfamiliar but promising opportunities. Built continuously over multiyear transformations, these insights expand strategic clarity on navigating change while supporting employees at their pace through unfamiliar transitions. This is because successful decarbonisation depends equally on updating institutional outlooks as individual

ones with care and wisdom accumulated collectively respect diverse acceptable rates amid systemic change.

Incumbent oil and gas companies must supplement internal capability-building efforts with targeted external hiring from renewable energy, technology, and sustainability-focused companies. This provides missing competencies and injects fresh perspectives to spur transformation not possible solely from within legacy workforces. Strategic priorities like digitisation, electrification, customer solutions, and emerging ventures demand new thinking and specialists with track records in innovation culture acceleration (Saygin et al., 2018). Mid-career professionals from successful start-ups pioneering battery storage systems, EV-managed charging platforms, or hydrogen solutions transfer knowledge on rapidly iterating technology to market fit amidst uncertainty. Young associates from leading solar analytics and wind turbine predictive maintenance outfits cross-pollinate the latest methodologies like agile software development and design thinking. Sustainability heads with supply chain decarbonisation credentials prompt re-examination of embedded institutional norms. Effective attraction combines competitive packages at parity with high-growth firms, allowing equity and emphasis on purpose-driven missions. Retention equally relies on nurturing community connectedness and inclusion support to prevent isolation or marginalisation of minority views. Sponsorship programs actively mentor, visibility platforms like high potential academies spotlight impact, and networking events build peer eco-systems, bonding unusual allies. Over time, the fabric weaves tighter through social integration, enabling professional synergies. With patient onboarding, the antibodies decline while perspectives widen, and horizons stretch.

Oil and gas companies require varied learning formats like microlearning, online courses, intensive boot camps, and on-the-job training to reshape workforce capabilities at scale. Different employee segments, ranging from recent graduates to senior engineers, benefit from tailored modalities, respecting individual constraints like technological access, bandwidth, and preferred pedagogies. Microlearning delivered through mobile phones provides just-in-time modules like 3-5-minute videos that respect attention

limitations around full-day training programs, given operational demands. Online courses allow self-paced progression through extensive renewable energy fundamentals mapped to internal job roles. Coding boot camps supply intensive virtual or in-person workshops to accelerate digital competencies like Python, PowerBI, and agile management. Hands-on assignments then consolidate skills gained paired with peer review and manager feedback. External partnerships prove invaluable to augment internal learning infrastructure for the unprecedented reskilling mandates faced. Academy providers like Coursera, EdX, and Udacity give turnkey access to global expertise tailored via corporate contracts. Industry conferences, standard bodies, and alumni networks offer complementary ecosystems fertile for empathy, best practice sharing, and benchmarking progression against peers, similarly adapting amid disruption. Blended solutions balancing formal, social, and experiential learning over the multi-year transformations needed allow gradual capability permeation without overwhelming business continuity demands. HRD oversees this integrated framework, adjusting support and expectations as maturity progresses across the upskilling journey.

Oil and gas companies contain immense tacit knowledge across veteran employees that risks being lost amid workforce transitions without structured efforts to facilitate cross-generational knowledge sharing with emerging talent. HRD plays a leading role in nurturing mentoring programs, job shadowing exchanges, technical forums, and storytelling sessions for capability transition. Formal initiatives like group mentoring circles allow reciprocal coaching opportunities between senior principal engineers proficient in design specifications for offshore platforms with mid-career employees moving into offshore wind plant roles. Job rotation assignments purposefully blend overlapping cohorts to learn through shoulder-to-shoulder collaboration. Targeted efforts also encourage informal sharing channels continuously through tools like chat applications for asking peer expertise questions, internal wikis documenting operational insights, and discussion groups exploring the implications of the renewable energy shift. Safe harbours for raising unfamiliar topics signal an open learning culture. Leadership modelling through candid storytelling provides permission and reinforcement. Over time, the emphasis builds

familiarity with emerging priorities across previously siloed groups. Renewable curiosity permeates even stubborn pockets through sustained signalling and support. Perspective lines blur from threat to opportunity with sufficient information flows not possible purely through structured development programs alone. Human connections nurture the patience and courage to grapple with disruptive complexity. HRD stewards these soulful catalysts for reconciliation amid turbulence.

Oil and gas companies can influence internal mobility levers like cross-functional rotations, short-term project assignments, and job shadowing exchanges to spur renewable energy capability diffusion from pockets of expertise across the broader organisation. HRD plays a vital role in mapping high-potential transferable skills between departments to envision fruitful exchanges tailored towards learning objectives and job levels. Early career managers in finance pivot into business development roles within new venture divisions to gain market insights and commercial grounding. Engineers led integrated site assessments for solar or wind feasibility, leveraging geospatial and project planning strengths while gaining renewable exposure. Broader programs facilitate stretches through rotations across regional offices and function teams blending perspectives. Job shadowing specifically offers low-commitment tasting menus to experience unfamiliar roles and assess appeal through immersive evaluation from the doers themselves. Guidance beforehand sets expectations around learning goals and structures reflection afterwards for application back into regular gigs. Manager encouragement plus allocating dedicated time signals organisational support for capability stretching. Over time, these professional mobility opportunities foster deeper empathy and wider network connectivity and build confidence for more substantive transitions (Saygin et al., 2018). The cross-pollination sparks innovation through the cross-fertilisation of ideas and practices between functions otherwise siloed. Trying novel challenges breaks inertia to consider alternate pathways aligned with the company's sustainability transformations and employee career growth amid disruption.

Navigating an industry transition creates uncertainty and anxiety for oil and gas employees concerning how changes will impact their jobs and responsibilities. HR leaders play a critical role in mitigating these concerns by establishing open, frequent, and transparent communication about impending organisational changes and detailing expected consequences for both staffing levels and roles. This includes spelling out anticipated structural changes, potential job displacements or losses, requirements for new skills or competencies in adjusted positions, impacts on compensation/benefits, evolving day-to-day workflows, and long-term career trajectories for different employee segments. Communication should happen across multiple channels, including company town halls, leadership team addresses, emails from HR partners, FAQ portals, and manager-employee meetings. Message consistency, empathy, and compassion are vital since transitions can deeply affect employees on a personal level. Providing sufficient lead time and follow-up communication with question-and-answer sessions gives employees time to process information about changes that may disrupt their professional lives (López-Fernández et al., 2018). Maintaining trust, support, and engagement during turbulent changes is critical for retention so that valuable talent does not jump ship due to uncertainty about their futures within an evolving oil and gas organisation. Proactive, transparent communication alongside substantive support programs demonstrates the company's commitment to guiding employees through transitions, impacting their jobs.

Organisational transitions require companies to make strategic decisions that impact their workforce. However, often such decisions are made in isolation by executive leadership without input from on-the-ground employees. This top-down approach risks key stakeholder buy-in. As the oil and gas industry undergoes major changes, involving employees across different roles and various divisions in long-term transition planning processes fosters critical buy-in, ensures that decisions remain grounded in reality, and empowers employees to feel invested in their company's evolution. There are various effective ways how companies can engage staff in the planning process. For instance, leadership can solicit direct feedback through company-wide surveys and town halls. They might also create cross-functional transition advisory committees consisting of diverse

employees who consult closely with executives weighing different options. Establishing smaller transition planning focus groups of frontline workers allows more intimate, honest conversations around the operational and cultural changes needed while ensuring confidentiality. Assigning employee representatives from different business units to sit in key strategy meetings also incorporates real-time staff perspectives when vital decisions are being shaped for the company's future (Liang et al., 2019). Giving employees an active stake and voice in mapping the oil and gas company's transition roadmap makes them more enthusiastic champions of forthcoming changes, rather than passive or resistant spectators. It leverages their frontline wisdom to arrive at pragmatic solutions while granting them agency over their professional trajectories within the organisation.

The oil and gas workforce contains highly skilled employees with years of technical expertise and industry knowledge that is invaluable, especially amidst an organisational transition, requiring stability and leadership. Losing such seasoned talent during a disruptive change puts operations, safety standards, and long-term viability at risk. As such, HR leaders should make retaining key employees a strategic priority by implementing comprehensive retention approaches targeted at workers in critical roles identified as foundational during and after the transition. Retention tactics can include offering selective pay raises or performance bonuses, leadership opportunities such as managing critical transition projects, flexible work schedules, praise and recognition highlighting the employee's indispensable contributions, public commitment to their long-term career growth despite industry evolution, and transparent communication engaging the worker as a valued transition advisor. Identifying employees at risk for turnover, either due to morale or attractive external options, and then developing customised retention incentive plans, prevent losing top institutional knowledge. With competition in the global energy labour market heating up, generous retention deals for specialised technical talent may prove highly cost-effective relative to losing years of cumulative expertise (Le Billon et al., 2021). Prioritising engagement initiatives targeted at celebrating and rewarding indispensable expertise reinforces the message that the company values and intends to support the long-term careers of talent indispensable to its vision and viability regardless

of impending transitions or outside developments reshaping the traditional oil and gas landscape.

The oil and gas workforce is filled with tenured employees with vast institutional knowledge and technical skills honed over many years on the job. However, as the industry undergoes major transitions in the coming years, many of these seasoned employees are retiring or choosing to leave the company. Without structured efforts to retain and transfer their critical knowledge, oil and gas companies risk a massive brain drain jeopardising operations, safety, productivity, and growth potential (Kamble et al., 2018). To combat this, HR leaders should institute robust knowledge transfer programs to systematically capture veteran employee wisdom through structured overlays with less tenured staff over an extended timeframe. For example, experienced offshore engineers or geologists could be paired with newer hires to shadow them on key duties, collaborate on projects, allow cross-training, and digitally record their technical processes and methodologies to create a library of best practices. Retirement-age subject matter experts could consult and mentor newer managers to coach them on navigating company nuances and complex challenges. Formal storytelling interviews can chronicle careers reflecting the company's evolution for preservation. Transitioning long-serving employees into part-time advisory roles post-retirement retains access to their expertise. While veteran oil and gas professionals transition out in the years ahead, dedicated knowledge transfer frameworks ensure that no institutional memory walks out the door. Preserving such wisdom and operational know-how gives companies an enduring competitive advantage no matter how the industry transforms around them. It also lets innovative next-generation leadership stand on the shoulders of those who spent decades building the foundations to succeed in energy market realities still unfolding.

Organisational transitions within the oil and gas sector will likely involve workforce changes that disrupt established labour relations and union contracts, especially if downsising, automation implementation, or significant operational model changes occur. Failure to proactively communicate and engage impacted labour unions risks damaging

legal battles, coordinated strikes, and long-term tension hampering agility, productivity, and growth (Jung et al., 2020). As such, HR leaders overseeing transitions must prioritise early-stage direct engagement with union leadership once credible initial plans start taking shape internally. Maintaining positive relationships through transparent information sharing and actively soliciting input on impending changes allow union leaders to relay feedback from the workforce they represent. Addressing concerns over job security, technical training inadequacies, safety risks or scheduling uncertainties gives company leadership a balanced perspective and a chance for bi-directional dialogue preventing unions from feeling excluded or catching them off-guard later (Jimenez et al., 2019). Scheduled in-person meetings, facility visits allowing union leaders to visualise changes, collaborative document reviews, and incorporation of negotiated transition clauses into new labour contracts are all best practices for soliciting ongoing labour union perspectives, managing expectations, and averting unnecessary conflicts. While certain changes disturbing the status quo might prove unavoidable, giving union stakeholders lead time to process the rationale, voice objections, if any, and communicate accurate information to members could make the difference between a tense transition and one embraced by all sides.

The oil and gas industry is experiencing unprecedented transitions necessitating substantial workforce transformation. Rather than navigating this challenge in isolation, HR leaders should actively research and benchmark how peer companies in the energy sector have successfully handled comparable transitions (Hall et al., 2017). This includes studying industry cases, and directly engaging other CHROs at conferences or informal discussions to understand their transition playbooks, lessons learned, and evolved capabilities now being leveraged after the changes proved successful. Some valuable areas on which to benchmark include training programs helping reskill and upskill the workforce for emerging digital, analytics, and sustainability roles, change management frames adopted to smoothly facilitate major reorganisations, communication plans tailored for employee retention during market uncertainty, automated solutions tested to enhance productivity with lower headcount, and partnership models crafted with external staffing

firms to access targeted talent on demand if needs arise. Benchmarking other energy firms that tackled similar workforce transitions equips HR leaders with proven strategies, surface pitfalls to avoid, talent development blueprints, and change leadership principles already battle-tested in real oil and gas industry scenarios (Haddock-Millar et al., 2016). This ensures that companies are not wasting time or resources figuring out ad-hoc solutions but rather customising streamlined approaches for transitions that peers have already established after encountering them. Adopting industry best practices allows for a smoother workforce evolution backed by evidence instead of risking employee upheaval through experimental reinvention alone.

5.5 Inputs and Suggestions for Stakeholders

Policy Makers

To combat climate change while supporting a core industry, governments can offer lucrative economic incentives steering oil and gas producers towards renewables integration. Targeted tax credits for every unit of renewable natural gas or biofuel blended into pipeline distributions create self-funding momentum for producers transitioning energy mixes away from higher-emission sources. Similarly, subsidised government loans with discounted interest rates can empower gas companies in financing large capital projects like hydrogen electrolyser plants, carbon capture retrofits, or biogas gasification systems, allowing access to millions in upfront funding at significantly lowered costs. Setting renewable fuel production or carbon abatement benchmarks and then linking achievement to preferential tax treatments also motivate producers already facing thin margins (Haddock-Millar et al., 2016). Policy schemes allowing established oil and gas corporations to share in the upside of new revenue opportunities around low-carbon fuels provide the necessary assurance amid policy-induced uncertainty jeopardising their traditional businesses. In the absence of supportive government funding mechanisms, the free market lacks sufficient demand-driven environmental pressures for renewable transition at the pace climate challenges necessitate. Substantial incentives realign the cost-benefit calculations of oil and gas majors in favour of investing aggressively in wind, solar,

geothermal, and cleaner gas alternatives. With governments simultaneously pursuing demand-side interventions like carbon pricing, renewable production support closes a pivotal gap from both sides of the climate policy equation (Ghobakhloo, 2020).

Transitioning from conventional to renewable gases like hydrogen and biogas requires massive infrastructure buildouts before substantial volumes can reliably enter distributions (Ghobakhloo, 2020). Governments must catalyse these capital-intensive projects through accommodative policies and co-funding schemes. For example, policymakers can overhaul regulations hindering hydrogen blending beyond minimal thresholds, expedite permitting for companies building hydrogen refuelling stations, and co-finance steel pipeline retrofits, allowing higher pressure capacity for hydrogen transportation. Exploring public-private partnerships to construct CO_2 pipelines from emission-heavy industrial clusters to sequestration sites unlocks the potential for economies of scale in carbon capture technology adoption. Governments can also incentivise gas pipeline companies by incorporating renewable gas distribution efficiency targets into operating licenses for periodic renewal. Tax benefits announced for a fixed period can spur private oil and gas corporations to expedite investments into compressor retrofits, renewable gas storage facilities, and liquefaction plants needed to accommodate rising alternative fuel production (Ghobakhloo, 2020). Stable policy frameworks provide investor certainty while government grants, preferential loans, and loan guarantees offered through development banks avail cost mitigation assurances for companies willing to undertake capital projects with longer payback horizons. With the right regulatory landscape and financial support, governments can fast-track infrastructure, allowing oil and gas pipelines to serve as the renewable energy highway for a net zero future. Make resources available for workforce development programs that retool oil and gas industry workers with new skills for careers in renewable energy. This can include job training grants or apprenticeship tax credits for renewable energy jobs.

The global energy transition necessitates reskilling fossil fuel sector workers to prevent economic crises in communities dependent on traditional oil, gas, and coal jobs.

Governments should provide specialised job training grants for schools, unions, non-profits, and employers to upskill displaced employees from drilling, mining, and refining roles into solar, wind, and engineering technology occupations (Geels et al., 2017). Funding robust apprenticeship programs where trainees receive paid onsite renewable energy project experience facilitates direct placement. Policymakers can also incentivise private sector companies through tax credits to prioritise hiring and training those from fossil fuel backgrounds for corporate sustainability initiatives requiring similar technical capabilities. Additionally, governments should expand income support, health insurance coverage, career counselling and relocation allowances for those struggling to enter new fields, allowing transitional fossil fuel workers to maintain life stability. Clean energy curriculum development funds that strategically align advanced technical skills with competencies honed in oil and gas create focused bridging platforms (Geels et al., 2017). Dedicated state offices specialising in clean economy workforce connectivity can liaise between green employers and former fossil fuel workers. Coordinated public-private efforts facilitated through supportive policy frameworks are vital so the renewable energy boom symbiotically absorbs rather than displaces the expertise of those impacted by the fossil fuel demand decline. A compassionate and empowering transition preserving livelihoods depends on governments consciously building carefully targeted workforce bridges.

With the paramount climate challenge confronting energy policymakers, governments should substantially boost R&D investments into pioneering renewable technologies holding undiscovered potential to accelerate the sustainability transition. Funding academic energy research labs exploring cutting-edge concepts like flexible solid-state batteries, highly efficient thin-film solar cells, nutrient recovery from biomass waste, and microalgae cultivation systems fosters ground-breaking discoveries. University-affiliated startup incubators and accelerator programs also support translating publicly-funded research into commercial viability. Additionally, governments can stimulate private innovation through matches to venture capital for early-stage renewable companies focused on overcoming existing technological barriers around elements like energy storage

capacity, distribution connectivity limits, and battery lifespan constraints (Forde et al., 2019). Setting up joint industrial innovation hubs brings together subject matter experts from private renewable technology companies, public research institutions, and innovative oil and gas corporations exploring diversification opportunities. Getting radically creative concepts and companies initially deemed "too risky" by private investors to a stage where viability is proven opens new entrepreneurial possibilities and cements public sector leadership. While the renewable energy industry expands exponentially, there remain complex challenges around sustainably harnessing resources, lowering costs, stabilising supply chains, and improving durability that dedicated innovation stimulation from governments can help overcome through partnerships unlocking the next generation of technologies that redefine energy possibilities.

The renewable transition has reached a critical inflexion point whereby policymakers must accelerate conversion timelines through targeted regulatory easing without undermining robust oversight or accepting disproportionate transition risks. For example, temporarily exempting renewable gas projects from specific siting constraints can expedite development while broader policy revisions undergo extensive consultations. Relaxing certain environmental impact assessment clauses around upfront approvals can accelerate distributed solar or wind projects on idle oil and gas lands while monitoring compliance rigorously post-completion. Establishing time-bound regulatory sandbox frameworks brings regulatory advisers together with private sector innovators looking to deploy novel renewable technologies lacking clear policy guardrails (Forde et al., 2019). Together, sandbox partners validate safety, monitor incremental deployment rollouts on government lands, and shape bespoke oversight rules supporting wider adoption prospectively. This balances the acceleration demands of pioneering innovators while retaining government control. By providing fixed-term flexibility mechanisms and collaborative sandbox models for technologies and projects deemed strategic national priorities within the renewable transition, policymakers can stimulate near-term momentum without compromising durability and prudence. However, any easing must emphasise conditionality, oversight partnerships, cost-benefit analyses, and continuous

risk monitoring with an understanding that broader regulatory certainty remains vital for sustainable long-term investment once revolutionary phases give way to scale.

Governments can powerfully steer oil and gas majors towards renewable integration by legislating renewable portfolio standards (RPS) setting clear targets for the percentage of energy from solar, wind, or renewable gas companies must produce to retain operational licenses and government land leases. Policymakers can raise RPS requirements incrementally from 20% by 2030 to over 50% by 2040 for all energy delivered across power, heating, and transportation - creating sizable renewable energy demand for fossil fuel companies aiming to maintain market share. To meet escalating quotas, companies could directly invest capital expenditure allotted historically for conventional exploration/drilling into building utility-scale solar farms, wind power projects, sustainable aviation fuel facilities, or renewable hydrogen production plants (Ellabban et al., 2014). Governments can also allow indirect compliance through purchasing third-party renewable energy certificates. However, direct project funding accelerates infrastructural buildout at scale. Strict RPS eligibility definitions ensure that investments demonstrably further renewable penetration rather than peripheral technologies like flaring mitigation that offer weaker emission offsets (Eizaguirre et al., 2019). By leveraging their jurisdictional authority over licensing and land access while coupling investment mandates for renewables to franchise operation rights, policymakers can compel resistant oil and gas enterprises down decarbonisation pathways aligned with global climate targets. RPS policies also future-proof jobs for fossil fuel employees by necessitating retraining to construct/maintain large renewable facilities that their employers now must integrate by law.

The renewable energy transition risks economically stranding fossil fuel workers who may face protracted unemployment without comprehensive government support. Policymakers have a moral obligation to assist dislocated individuals who dedicated careers to powering societal progress for decades. Transition assistance should offer income bridges, guaranteeing a substantial percentage of previous wages for up to two

years following job loss, allowing families financial stability while seeking reemployment. Covering health insurance premiums prevents workers from medical crises or hardship from company severance. Job placement services customising opportunities based on transferable skills, aptitude tests, and location preferences can connect unemployed oil and gas veterans with suitable solar, wind, and gas roles. For those struggling to immediately transition into renewables, funded vocational training equips workers with certified competencies - like electrical skills or thermal mechanics - applicable across the energy sector. As emerging renewable hubs may lack proximity to struggling legacy energy communities, relocation allowances, enabling workers who secure jobs in those regions to cover moving expenses, facilitate migration between opportunities (Dumont et al., 2017). By comprehensively addressing both financial and competency barriers to transition, policymakers demonstrate that sustainability need not come at the cost of livelihoods for fossil fuel employees suddenly dislocated. A compassionate shift protects people while catalysing progress.

Governments play a vital role in spurring private venture capital towards promising renewable energy start-ups attempting to commercialise innovative technologies still requiring substantial R&D investments pre-revenue. Many venture firms hesitate to provide high-risk capital needed to further develop and scale renewables breakthroughs with long timelines to market viability. Policymakers can overcome this barrier by offering full or partial tax exemptions to venture capital funds demonstrably, allocating over 50% of all investment dollars to qualifying renewable energy start-ups (Dehghani-Sanij et al., 2019). Additional tax credits can directly benefit venture investors, providing follow-on funding to renewable companies that successfully hit pioneering milestones like grid-connected field demonstrations, commercial pilot projects, or approval for rate-based compensation, allowing expedited customer onboarding. Furthermore, matching public dollars to supplement venture raises for start-ups committed to domestic job creation incentivises locating manufacturing facilities in struggling legacy energy communities. Combined, targeted incentives across the venture funding continuum — from seed stage to growth equity — can motivate substantial private investment into renewable innovators

despite inherent technology risks. With ventures able to leverage policy support in overcoming capital access challenges, government interventions help unleash exponential growth potential for emerging solutions to accelerate the global energy transition.

5.6 Industry Players

Oil and Gas Companies

Oil and gas companies have significant financial resources and industry expertise that could be pivoted to help accelerate the transition to renewable energy. Actively diversifying their energy mix by investing more heavily in wind, solar, geothermal, hydrogen, and biofuels could hedge oil and gas firms against long-term declines in fossil fuel demand. These companies can leverage their large balance sheets and access to capital to acquire or build new renewable energy assets like wind farms, solar fields, and geothermal plants. They also have the engineering and technical capabilities to support building out the associated infrastructure like transmission lines, storage solutions, and distribution. Oil and gas companies can further apply their experience in large-scale energy project development and program management to construct utility-scale renewable energy facilities. Additionally, oil and gas firms can invest downstream in biofuel refining and hydrogen production hubs to supply renewable fuels at commercial volumes. They can help establish supply chains for key renewable energy components like solar panels, EV batteries, and electrolysers. Their expertise in logistics, procurement, and distribution can be adapted to support the renewable energy ecosystem. Making direct equity investments or establishing joint ventures with leading renewable energy technology companies can accelerate this capability development (Dehghani-Sanij et al., 2019). The synergies between oil and gas and the renewable energy sector in training employees, leveraging physical assets, and building market access can ease the transition if there is greater collaboration and integration. Ultimately, diversifying into renewable energy demonstrates that oil and gas firms are serious about adapting their business models to a low-carbon future.

Transitioning to clean energy technologies across oil and gas operations can significantly reduce overall emissions while also improving energy efficiency and costs. Installing solar, wind or other renewable energy generation on production sites and facilities can supply cleaner electricity. Electrifying equipment like pumps, compressors, and drilling rigs with renewable power is an impactful decarbonisation strategy (Curtin et al., 2017). Using electric or hydrogen fuel cell vehicles for transportation needs like trucking and logistics can decrease reliance on diesel. Capturing methane emissions from equipment leaks or venting and reusing this potent greenhouse gas for power generation is another emissions reduction tactic. Deploying battery or other storage technologies allows for optimising intermittent renewable energy. Digital optimisation solutions help track emissions and energy consumption while identifying opportunities for greater efficiency. Converting natural gas power plants to run on renewable hydrogen blends is a potential lower carbon fuel switch. Piloting carbon capture systems at processing plants or direct air capture technologies can create negative emission offsets. Installing electric heating and cooling in offices and housing complexes reduces natural gas usage. Solar cookers can be utilised in remote operations. The optimal clean energy technology mix depends on the specific infrastructure profile and operations of each site. But uniformly adopting these solutions lowers the oil and gas industry's carbon footprint while sending a powerful signal that these firms are decarbonising their assets. This gives more credibility when advocating for policy support. The operational efficiencies and cost reductions will only accelerate as clean energy technologies continue to advance. Leaning into these solutions creates a competitive edge.

The oil and gas industry has substantial influence over energy policy and regulation given its importance to the economy and jobs. Companies can leverage this political clout to lobby policymakers for long-term extensions of tax credits for wind and solar, guaranteed renewable power purchase agreements, carbon pricing systems, and continued R&D funding into clean energy technology. Vocally backing key incentives like the electric vehicle tax credit and production tax credits for renewable energy demonstrates that the industry will support policy that enables the energy transition, not obstruct it

(Hartmann et al., 2021). These firms can use their public relations and advocacy resources to push for streamlined permitting processes, preferential access to federal lands for renewable projects, and expedited clean energy procurement by public utilities. Developing relationships with environmental groups and clean energy trade associations allows collective lobbying for policies that provide market certainty and reduce investment risks. This makes the economic case for a stable transition guided by supportive regulation and incentives. Oil and gas companies also have unique knowledge of regulations affecting energy development on public lands. Providing input on how best to update these policies to promote renewable energy projects in a socially and environmentally responsible manner is constructive. Given the geopolitical sensitivity of energy supply, these firms can advise policymakers on how to structure the transition in a manner that maintains energy security. Ultimately, the oil and gas industry mobilising its influence and resources to accelerate policy supporting renewable energy adoption demonstrates enlightened self-interest - policy certainty that reduces risks for their diversification efforts while allowing them to claim credit as enablers.

Oil and gas companies have skilled workforces possessing transferrable capabilities valuable to the renewable energy industry. Investing to retrain these workers in solar, wind, geothermal, battery storage, and hydrogen technologies ensures valuable talent and institutional knowledge is retained during the energy transition. Companies can provide onsite training and certification programs in areas like solar panel installation, wind turbine maintenance, battery storage system operations, and more. Leveraging partnerships with renewable energy companies, utilities, trade schools, and community colleges to develop customised curriculums and apprenticeship opportunities can build relevant skills (Collins et al., 2016). Subsidising the cost for employees to pursue degrees, diplomas, and certificates in renewable energy fields encourages proactive professional development. Rotation programs allow oil and gas technicians and engineers to cross-train with renewable energy developers to gain exposure. Reskilling programs should have a strong focus on transitioning workers in automotive mechanics, electrical, construction, operations, logistics, and project management building on existing skills. Partnerships with

labour unions are critical in structuring effective workforce transitions. Providing relocation support can enable workers to shift to geographic regions with higher renewable energy job demands. Outplacement services can connect workers with hiring renewable energy firms. Investing substantially in workforce retraining demonstrates a strong commitment by oil and gas companies to their employees' futures. It retains valuable veteran expertise while building goodwill and social license. A skilled workforce with multisector experience will be better positioned to support an integrated energy system and achieve emissions reduction targets.

Oil and gas companies should develop comprehensive decarbonisation strategies with tangible short-, medium-, and long-term emissions reduction targets. These roadmaps build credibility by demonstrating a serious commitment to achieving net zero ambitions. Near-term actions can focus on reducing methane leaks through equipment upgrades, electrifying operations where possible, and installing renewables on site. Medium-term plans may include more significant infrastructure changes like renewable hydrogen integration, carbon capture systems, biofuel production, and growing renewable energy investments. Long-term visions should map an exit from high-emission assets and business models, achieving full carbon neutrality (Rosenkranz et al., 2021). Roadmaps should transparently identify major milestones, key performance indicators, investment requirements, partnership needs, and retraining timelines. Assigning executive-level ownership and tying progress metrics to compensation create accountability. The plans can be used to engage stakeholders like shareholders, customers, regulators, and environmental groups on the decarbonisation journey. The oil and gas industry has engineering expertise to accurately model complex energy systems and quantify potential emission reductions from new technologies. This allows the development of robust decarbonisation scenarios that identify optimal technology pathways across assets to achieve targets. Companies should get comfortable acknowledging certain high-emitting assets may need to be phased out. Detailed roadmaps signal oil and gas firms have a thoughtful strategy and are mobilising their resources accordingly. They provide mileposts to measure progress and

demonstrate that the industry is taking decarbonisation seriously. Clear plans give confidence in achieving net zero commitments.

5.7 Energy Utilities

Electric utilities have a major role to play in accelerating the transition to clean energy by increasing the share of renewables in their electricity generation mix. This involves procuring significantly more solar, wind, hydroelectric, and other zero-emissions sources of power. Utilities should identify opportunities to construct or contract new renewable energy capacity through power purchase agreements. Forecasting rising demand for clean power and developing comprehensive plans to expand solar, wind, and hydro accordingly is key. Utilities can phase out coal power plants in parallel while transitioning natural gas plants to use low-carbon fuels like renewable hydrogen blends. Upgrading transmission infrastructure to handle more decentralised renewable energy flowing into the grid is crucial. This may involve building new high-voltage lines to connect renewable energy projects. Utilities need to streamline grid interconnection processes and provide fair compensation through net metering to distributed renewable generators. Working closely with regulators to reform rate structures, power market rules, and incentive programs to enable greater renewable energy penetration is equally important. New performance-based rate designs can reward utilities for efficiency gains and maximising clean power (Christophers et al., 2019). To accelerate adoption, utilities should offer comprehensive renewable energy supply options for customers, from 100% renewable plans to community solar programs. Customisable green power options allow consumers to directly drive the renewable transition. Ultimately, increasing renewable electricity to over 50% of supply by 2030 and completely phasing out coal while adding zero-emissions generation annually are ambitious yet achievable path for utilities. The synergies between renewables and intelligent grid modernisation allow much higher integration. This transition will require substantial investments and visionary leadership from utilities.

To accommodate exponential growth in distributed renewable energy sources like rooftop solar, home batteries, and electric vehicles, utilities must modernise power grid

infrastructure. This involves deploying smart meters, sensors, and automation systems for real-time visibility into energy supply and demand, enabling better integration of intermittent renewables. Advanced distribution management systems can optimise decentralised clean energy flows. Upgrading transmission lines and substations with intelligent controls allows the routing of electricity more efficiently. Leveraging artificial intelligence to match renewable generation with usage patterns improves reliability. Investing in microgrid technologies and energy storage solutions helps manage variable renewable inputs. Improved demand forecasting and weather prediction data also assist integration. Utilities should provide customers with the access to energy usage data and options like time-of-use pricing to shift demand away from peak times when dirtier generators operate (Mikhaylov et al., 2020). Optimising grid operations for two-way power flows instead of one-way distribution is crucial. Building a communication backbone and control centre to coordinate a myriad of renewable inputs requires focus. Bridging operations technology with digital infrastructure creates a renewable-ready grid. This gives customers a choice in adopting distributed clean energy while maintaining system stability. While grid modernisation necessitates substantial capital investment, the long-term payoff is an agile network able to accommodate over 50% renewable penetration. This is foundational for utilities to lead the clean energy transition.

Net metering and feed-in tariff policies are critical tools for utilities to incentivise greater customer adoption of distributed renewable energy like rooftop solar or small wind turbines. Net metering credits customers for any excess power their renewable systems generate beyond their own usage needs. This excess clean electricity gets fed back into the wider grid. Customers receive credit or compensation from the utility usually at the full retail electricity rate. This makes adopting solar panels or other renewables more economically attractive. Feed-in tariffs provide separate guaranteed payments per kilowatt-hour for renewable power fed into the grid. This incentivises customer renewable energy investments by ensuring long-term revenue certainty. Tariff rates can be differentiated by technology, project size, and location to spur development. To expand access to these incentives, utilities should allow aggregated net metering for community solar projects and

virtual net metering for tenants. Streamlining interconnection processes, offering favourable financing, and simplifying permit approvals facilitate customer renewable adoption (Haddock-Millar et al., 2016). Utilities can work collaboratively with regulators to design fair and reasonable net metering and feed-in tariff policies that balance grid integration costs and equitable access to the benefits. This prevents later contention. Independent power producers should also be eligible for these incentives. Net metering and feed-in tariffs democratise the renewable energy transition by enabling consumers to become producers. This accelerates distributed generation growth while supporting grid decarbonisation, which is a win-win for utilities and customers.

In addition to procuring renewable energy from independent producers, utilities have a major opportunity to lead by directly developing large, utility-scale clean power projects. Constructing big solar farms, wind power plants, geothermal facilities, and hydroelectric generators allows utilities to substantially add zero-emissions megawatts to the grid. Utility-scale projects also achieve economies of scale that can lower renewable procurement costs. Utilities should conduct geospatial analyses to identify optimal locations for large renewable developments based on factors like solar/wind resource quality, transmission access, and permitting. Acquiring land assets early secures competitive sites. Leveraging utilities' financial capacity, engineering expertise, and long project experience enables the successful execution of complex, multifaceted renewable constructions. Building long-term relationships with equipment manufacturers reduces supply chain risks (Wang et al., 2020). Owning the assets provides greater control over renewable energy outputs. Hybrid models like joint ventures allow cost and risk sharing while growing utility clean power expertise. Utilities can spearhead community engagement efforts to create public support and streamline permitting. Their brand reputation often provides credibility. By driving the development of massive wind and solar complexes, utility-scale projects send a powerful signal that these firms are committed to a renewable future. Rate-based cost recovery offers a stable return on these investments. Renewable energy at scale is key for deep decarbonisation.

Electric utilities have a major role to play in accelerating the transition to clean energy by increasing the share of renewables in their electricity generation mix. This involves procuring significantly more solar, wind, hydroelectric, and other zero-emissions sources of power. Utilities should identify opportunities to construct or contract new renewable energy capacity through power purchase agreements (Curtin et al., 2017). Forecasting rising demand for clean power and developing comprehensive buildout plans to substantially expand solar, wind, and hydro are key. Upgrading transmission infrastructure to handle more decentralised renewable inputs will be crucial. This may require building new high-voltage lines to connect large-scale renewable projects. Streamlining grid interconnection processes and fairly compensating distributed generators via net metering are also important. Working closely with regulators to reform electricity rate structures, power market rules, and incentive programs to enable greater renewable penetration while maintaining affordable rates will be essential (Collins et al., 2018). Performance-based rates can reward utilities for efficiency gains and clean energy milestones. Offering expanded renewable energy supply options for customers, from 100% renewable plans to community solar programs, further accelerates adoption. Phasing out all coal generation while transitioning natural gas plants to use low-carbon fuels like renewable hydrogen is achievable by 2035. This, alongside continuously adding new wind, solar, geothermal, and hydro projects, can enable over 50% renewable electricity nationwide (Bowen et al., 2017). Realising such high renewable integration will need substantial capital investment in new generation and grid infrastructure. However, the long-term environmental and economic benefits make this transition imperative. Therefore, utilities must lead the way.

Utilities can leverage innovative pricing, rebates, and other programs to make renewable energy options more attractive for residential, commercial, and industrial customers, driving adoption. Time-of-use rates that charge lower prices for electricity usage during high renewable generation periods incentivise aligning consumption with clean energy availability. Dynamic pricing based on real-time carbon intensity of grid power enables customers to minimise emissions (Christophers, 2019). Targeted rebates on

purchases of solar panels, home batteries, electric appliances, or EVs that are contingent on enrolled renewable power plans boost adoption. Simplified permitting, discounted financing, and turnkey installation options remove friction. Rewards programs that provide points or direct cashback for community solar subscriptions, green power plan enrolment, or achieving energy savings goals engage customers. Renewable energy challenges and competitions create awareness. Tariffed on-bill financing allows customers to pay for clean energy investments over time via monthly bill savings. Green electricity bill credits for schools or non-profits can encourage participation. Utilities can offer renewable energy project co-investment opportunities to major corporate and industrial customers seeking sustainability. Supporting community choice aggregation unlocks cities and counties as collaborative partners. Accessible information on available incentives, program qualifications, and renewable energy value propositions aids customer adoption. Online solar marketplace platforms streamline the path to going solar. Innovative customer programs provide many avenues to expand renewable energy uptake.

5.8 Renewable Energy Companies

Achieving cost parity with conventional fossil fuel power generation is critical for the mass adoption of renewable energy technologies like solar, wind, and energy storage. Renewable energy companies should focus substantial R&D on continuing to improve efficiency, yield, and capacity factors to drive down levelised costs. Leveraging advanced materials, manufacturing techniques, and digital optimisation can enhance performance and lifetimes. Automation and robotics can reduce operating costs and accelerate project development timelines. Scaling up the individual size and power capacity of turbines, panels, batteries, and other components boosts output while realising economies of scale (Bowen et al., 2017). This involves designing and engineering the next generations of larger, higher-efficiency equipment. Expanding domestic manufacturing of renewable energy equipment is key to accelerating cost declines. Building high-volume, state-of-the-art factories for solar panels, wind turbines, batteries, and related technologies enables low-cost, reliable access to components. Partnerships with utilities and fossil fuel companies can provide avenues to test and refine technologies at commercial scales. Data from large-

scale deployments identifies additional areas for performance improvement and standardisation. Continuing to optimise renewable energy systems and finding synergies with storage, smart grid technologies, and microgrids will further improve cost-effectiveness. Reaching unsubsidised grid parity against natural gas and coal is an achievable milestone that unlocks mass adoption and rapid scaling. It demonstrates that renewable technologies have evolved to compete head-on.

Expanding domestic manufacturing capacity and strengthening supply chains for key renewable energy and storage technologies will be crucial to scale deployment. This provides reliable access to solar panels, wind turbines, batteries, critical minerals, and raw materials. Building high-volume, low-cost factories for components like PV cells, electrolysers, power electronics, and composites can enable competitive renewable energy pricing. Leveraging advanced automation and robotics boosts consistency and efficiency (Braungardt et al., 2019). Clustering manufacturing hubs together fosters a synergistic ecosystem of suppliers and partners. This reduces transportation costs and lead times. Fostering joint ventures with incumbent auto and defence companies transfers mass production expertise. Securing sustainably sourced mineral supplies for batteries, magnets, and wiring will mitigate future bottlenecks. Investing globally across the extraction, processing, and refining of key minerals diversifies supply chains. Partnering with mining firms expedites resource development. Standardising component designs, dimensions, and connectors streamlines manufacturing processes. Developing testing protocols and quality benchmarks in partnership with utilities ensures reliability at scale. State incentives can encourage the retooling of obsolete factories. Apprenticeship programs and community college partnerships build specialised manufacturing workforces. With expanded domestic manufacturing capacity across the renewable energy value chain, the industry can deliver terawatt-scale deployment, ensuring energy security and affordability during the clean power transition.

Renewable energy companies have an opportunity to proactively partner with major oil and gas firms to accelerate their adoption of clean technologies. This

collaboration can speed up the energy transition. They can provide consulting services to identify decarbonisation solutions tailored to fossil fuel assets, whether wind, solar, battery storage or hydrogen. Co-developing pilot projects demonstrate real-world viability and impact (Christophers, 2019). Sharing technology roadmaps helps oil and gas firms understand the trajectory for efficiency gains, performance improvements, and cost declines. This provides confidence in planning large-scale deployments. Joint ventures can combine the resources and expertise of both industries in commercialising and scaling innovations. Strategic capital investments expand production capacity. Partnerships enable pooling complementary capabilities, renewable firms' speed and tech savviness with oil companies' financial strength and execution muscle (Casalicchio et al., 2022). Cross-training of workforces builds multidisciplinary skillsets. There are synergies in leveraging existing oil and gas infrastructure like pipelines and land for renewable energy projects, repurposing assets speeds deployment (Güney, 2019). Data sharing and transparency facilitate accurate modelling. Navigating policy and regulation collaboratively ensures a stable framework that balances the transition needs of both industries. Demonstrating unanimity galvanises public and political support. While differences remain, increased collaboration between renewable energy disruptors and incumbent fossil fuel companies can accelerate the adoption of clean solutions across the wider energy system benefiting all.

Renewable energy companies have an opportunity to lead in training the next-generation workforce needed to meet soaring demand for solar, wind, geothermal, and energy storage installations. Partnering with vocational schools, community colleges, labour unions, and state workforce agencies allows tailoring training programs to the unique technical skills required in renewable energy. Hands-on apprenticeships and on-the-job training enable the development of competency. Training historically underrepresented and disadvantaged communities for careers in renewables also promotes inclusion while expanding labour pools. Programs focused on providing opportunities for veterans, minorities, and at-risk youth are impactful. Standardising credentialing and establishing clear certification pathways for occupations like solar PV installers, wind

turbine technicians, drill rig operators, and battery storage specialists provides career advancement clarity. This attracts talent. Leveraging AR/VR technology and simulation systems allows scale training in a safe, cost-effective immersive environment. Digital learning platforms increase accessibility. Providing continuing education grants and professional development funds enables incumbent workers to reskill and transition from declining fossil fuel roles into the renewables sector. Promoting merit-based hiring and compensation practices, inclusive, and supportive company cultures, as well as strong labour relations attracts dedicated workforces. With expanded industry collaboration on training, renewable energy firms can build a skilled, diverse workforce pipeline able to support the volume of new projects needed to meet sustainability targets.

5.9 Level of Environmental Awareness

It is critical to establish the level of environmental awareness among the various stakeholders as far as the transition to renewable energy in the oil and gas sector is concerned, including but not limited to surveys, materiality assessments, ESG scores, and emissions transparency.

5.10 Surveys

Surveys are a useful tool to directly engage stakeholders and quantify levels of environmental consciousness regarding issues like climate change and the renewable energy transition. Employees, executives, shareholders, customers, suppliers, and community members can be polled through online questionnaires, interviews, and focus groups. The surveys should assess knowledge of key environmental challenges, opinions on the urgency of climate action, familiarity with the company's emissions footprint and renewable energy strategy, and support for sustainability initiatives (Casalicchio et al., 2022). Establishing a numeric scale for respondents to self-evaluate their environmental awareness allows benchmarking across stakeholder groups and tracking shifts over time. Conducting annual surveys provides regular pulse checks to identify gaps while demonstrating the company's commitment to stakeholder feedback. Survey results should be transparently communicated internally and externally. Variations in awareness levels

across departments, geographies, demographics, etc. can pinpoint areas needing targeted education and engagement. As sustainability climbs strategic priority lists, surveying helps evaluate the impact of ESG programming and ensures that stakeholders are carried along on the journey.

5.11 Materiality Assessments

Materiality assessments involve directly engaging key stakeholder groups through interviews, focus groups, and workshops to understand their significant environmental concerns and priorities regarding the oil and gas company. This process identifies the most important or "material" sustainability issues needing strategic attention. Assessments give voice to varied stakeholders from investors, employees, and customers to policymakers, community leaders, and NGOs. Third-party facilitation encourages open dialogue and mitigates bias. Discussions should centre on climate change impacts, renewable energy integration, emissions reductions, transparency, and accountability (Buonocore et al., 2019). Mapping the input to reveal overlaps and divergences provides insight into material issues. For example, methane leaks, scope 3 emissions, and energy efficiency may emerge as priorities. Concerns like biodiversity and water use may also rank highly. The output informs sustainability strategy and reporting. Revisiting the assessment every 2-3 years checks alignment as stakeholder opinions and business conditions evolve. This engagement demonstrates the company's commitment to understanding stakeholder priorities on ESG issues and addressing material environmental risks. It aids in building trusted partnerships essential for the energy transition.

5.12 Sentiment Analysis

Sentiment analysis involves using natural language processing to systematically analyse the tone and emotional tone of text sources related to the company's sustainability performance and the renewable energy transition. This reveals insights into environmental awareness levels. Company reports, earning calls, press releases, and websites can be evaluated to determine if language around emissions, climate risk, and renewables is predominantly positive, negative, or neutral. Analysis of social media conversations and

feedback can identify areas of stakeholder concern or scepticism. Media coverage can also be assessed for critical or supportive perspectives on the company's environmental commitments (Braungardt et al., 2019). Sentiment tracking over time can show growing attention and priority given to sustainability issues. The use of terms like "climate emergency" vs. "climate policy" reflects different awareness levels. Calls for bolder action may demonstrate tensions between stakeholder demands and company incrementalism. More advanced sentiment analysis can detect nuances like greenwashing, uncertainty, and "say-do gaps" in messaging. Linguistic analysis provides a valuable supplement to other metrics in gauging the quality and authenticity of environmental awareness within the company and its engagement with stakeholders.

5.13 ESG Scores
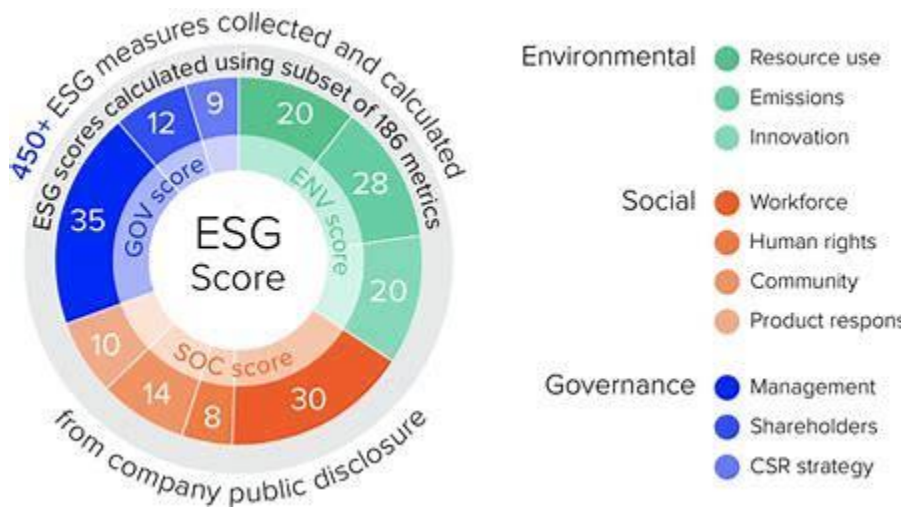
Figure 26 ESC measures collected and calculated

The environmental, social, and governance (ESG) scores and ratings assigned to oil and gas companies by third-party rating agencies provide a data-driven way to benchmark and compare their sustainability performance. Lower scores can signal gaps in environmental awareness. Rating firms like MSCI, Sustainalytics, ISS, and CDP evaluate dimensions like emissions, energy efficiency, water usage, waste management,

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environmental policy, and strategy (Rempel & Gupta, 2021). Companies are assigned individual components and overall ESG scores based on quantitative and policy-based performance criteria. Trends in scores over time for a company can indicate improving or declining environmental commitment. Comparing against industry peer averages reveals leaders and laggards (Braungardt et al., 2019). Major score discrepancies on environment metrics between agencies may indicate confusion or ambiguity on priorities. Low environment pillar scores diagnose specific areas for improvement. For example, low carbon emissions scores may reveal gaps in climate risk awareness and mitigation. Regular review of ratings helps calibrate progress in strengthening ESG practices against third-party expectations and frameworks. While scores offer useful diagnostics, they have limitations. Directly engaging each company provides a more nuanced understanding of strengths, weaknesses, and context. However, responsiveness to rating criteria pressures demonstrates awareness and commitment.

5.14 Emissions Transparency

The quality, rigour, and transparency of an oil and gas company's emissions reporting offers a window into its environmental awareness and commitment to decarbonisation. Leading practice involves detailed disclosure through frameworks like the Carbon Disclosure Project (CDP). Comprehensive reporting quantifies all major greenhouse gas emission sources across the value chain, from upstream production through end use. It delineates scope 1, 2 and 3 emissions, with clear methodologies and third-party verification demonstrating accuracy. Sharing operational emissions data, reduction targets, and decarbonisation strategies provides stakeholders with valuable intelligence to inform engagement. Strong disclosures benchmark performance against peers, communicate progress over time and identify opportunities for improvement. Willingness to transparently discuss challenges demonstrates awareness of deficiencies and openness to collaborate on solutions (Rosenkranz et al., 2021). Vague, boilerplate, or outdated emissions reporting indicates low prioritisation and understanding of climate impacts. Selectively highlighting certain emissions sources over others raises transparency red flags. Restricting CDP disclosures signals reluctance toward transparency. Overall, leadership in

emissions transparency, through robust CDP disclosures and integration into financial reporting, demonstrates that environmental performance is integral to business strategy rather than a compliance exercise. This drives accountability and progress.

5.15 Responsiveness

How an oil and gas company receives stakeholder feedback and scrutiny on environmental issues, and how sincerely it works to address concerns, provides insight into its level of awareness and prioritisation. Defensiveness or dismissal of criticism may signal lower consciousness. Proactively soliciting input through shareholder resolutions, community forums, employee surveys, investor calls, and NGO engagement creates avenues for dialogue (Russo et al., 2022). However, meaningful follow-through and responsiveness in policies, practices, and disclosures is essential. If concerns like methane leaks, biodiversity impacts, or climate lobbying are met with changed behaviours, it demonstrates awareness of stakeholder priorities. However, superficial or symbolic actions without systemic change risk accusations of greenwashing. Unresponsiveness and resistance to modifying business practices out of convenience or cost suggest lower prioritisation of environmental concerns. Pushback against shareholder climate resolutions or denying community pollution complaints imply tone-deafness. Staying abreast of emerging stakeholder expectations through industry networks and ESG policy developments allows anticipating and pre-empting concerns early.

5.16 Leadership

The background, experience, and messaging of oil and gas company executives and board members offer clues into organisational environmental awareness. Leaders with engineering, sustainability, or renewable energy expertise suggest higher prioritisation. Public statements acknowledging climate science, advocating emission reductions, and supporting energy transitions demonstrate conviction. Board committee oversight of climate risks and ESG performance indicates strategic focus. Executive leadership in industry decarbonisation groups signals proactivity. However, leaders fixated on maximising short-term profits and minimising climate actions raise questions. Rhetoric

downplaying carbon constraints or renewable viability implies outdated perspectives. Lacking diverse viewpoints on sustainability issues suggests insular mindsets (Saygin et al., 2015). Backgrounds exclusively in finance or operations should be balanced by sustainability fluency. Boards would benefit from climate scientists, renewable experts, and environmental justice advocates providing unique perspectives. Diverse leadership that integrates environmental considerations into strategic decisions and culture is key. Executives visibly championing for emission goals, renewable investments, and transparency create organisations that reflect those priorities. The tone at the top shapes the awareness levels of the entire company. Leaders who engage stakeholders authentically, question old assumptions, and embrace sustainability solutions will accelerate the energy transition.

5.17 Employee Engagement

Employees are at the frontlines of executing business strategy and have intimate insights into how sustainability priorities permeate practices and culture. Frequently surveying staff across functions and levels of environmental engagement provides a valuable litmus test for awareness. Assessments should gauge employee familiarity with company emissions data, renewable energy goals, efficiency initiatives, and related training opportunities (Shen et al., 2018). Participation rates in sustainability programs from volunteer days to green teams indicate buy-in. Understanding how individual roles contribute to emissions reductions and energy transitions reflects integration. High scores suggest sustainability is embedded into decisions and workstreams, not isolated. Low participation and comprehension may signify gaps in internal communications or inadequate training to activate employees as change agents. It also risks sustainability being seen as the domain of specialised teams rather than collective responsibility. Tracking engagement over time and across demographics reveals areas needing tailored messaging and policies. Highly engaged employees will be pivotal sustainability ambassadors and innovators. Authentic commitment to sustainability starts inside the company. Employees who feel empowered to reduce environmental footprints and rewarded for leading on solutions demonstrate deeply ingrained awareness at all levels.

5.18 Creating/ Enhancing Environmental Awareness

It is important to create and enhance awareness among the various stakeholders in the transition to renewable energy in the oil and gas sector. By enhancing the level of awareness among industry players, the sector can encourage greater commitment towards change implementation. Strategies to create or enhance awareness include:

5.19 Site Visits and Tours of Sustainability Projects

Site visits to sustainability projects are impactful in tangibly demonstrating an oil and gas company's environmental commitments to stakeholders ranging from employees to policymakers. Seeing renewable energy integration, remediated habitats, carbon capture facilities, and conservation efforts firsthand makes the concepts real. Tours can showcase solar and wind farms powering operations, biodiverse offset lands, methane capture infrastructure, EV charging arrays, water treatment systems, and reforestation sites (Singh, 2020). Briefings explain the environmental and economic benefits. Where possible, attendees can interact hands-on with the technology. Visits tailored to special stakeholder groups like students, media, investors, or community leaders can deepen understanding of specific initiatives. Having employees lead tours enables them to serve as sustainability ambassadors. Post-visit surveys should collect feedback to gauge increased awareness and identify lingering knowledge gaps. Following up with resources that address outstanding questions or concerns shows responsiveness. The time invested in organising site visits pays dividends in building trusted relationships, shifting perceptions, and active collaboration. Stakeholders become invested in solutions they can see and understand. Done thoughtfully, site visits turn sceptics into partners.

Education

As a leader in their industry, organisations company has an obligation and opportunity to educate employees and the broader public about the environmental impacts of the company's operations and products, along with solutions for building a more sustainable future. The company should develop a range of educational offerings, including

informational materials, online courses, and in-person seminars. These would provide overviews of the scientific consensus on climate change and explain key concepts like the greenhouse effect, decarbonisation, carbon footprints, and life cycle analyses (Zibarras & Coan, 2015). The company should share details on environmental audits of their operations and strategies to reduce emissions through energy efficiency, renewable power, material substitutions, recycling, and other technologies. The seminars should also cover the global transition to renewable energy and how wind, solar, geothermal, and other resources can reliably replace fossil fuels while creating jobs and improving public health. The educational outreach should aim to raise awareness and understanding of sustainability challenges and solutions for both the company's business operations and personal lifestyles.

5.20 Employee Green Teams and Community Advisory Panels

Providing platforms for employees and community members to exchange sustainability ideas and feedback should be a priority. The company should establish employee green teams across all facilities. These cross-functional teams would work on evaluating operations, setting environmental goals, and designing initiatives to reduce the company's carbon footprint through waste and energy reductions while saving money. The teams would also serve as sustainability champions, educating fellow employees on how they can incorporate green practices into their daily work (Braungardt et al., 2019). Additionally, the company should create community advisory panels consisting of local leaders, non-profit partners, residents, and others invested in the social and environmental impacts of company operations. These panels would convene quarterly to discuss the company's CSR reports, provide input on new sustainability strategies, ask questions and make recommendations. They help the company strengthen transparency and accountability to its stakeholders. Employee green teams and community advisory panels encourage innovation and idea sharing to collaboratively problem-solve local and global sustainability challenges facing society.

5.21 Feature Stories

Sharing stories that spotlight progress on sustainability initiatives is a compelling way to recognise achievements and educate employees and stakeholders. The communications and CSR teams should regularly publish features on environmental wins, emissions reductions, and conservation efforts across company channels, including the monthly newsletter, intranet site, public website, and social media platforms. For example, an article could highlight the recent installation of 1,000 solar panels expected to generate 500 MWh of clean energy annually. Or share how the India facility implemented a reverse osmosis system to recycle and reuse wastewater, saving 42 million litres per year. A photo essay could showcase the native tree planting event volunteers held along local trails. Additionally, snippets in the all-employee newsletter could celebrate milestones like zero waste days at offices with high engagement in composting and recycling programs. Featuring multimedia stories allows various groups to learn what is happening across the company's sites while applauding the contributions of passionate teams and individuals who devote time, energy, and ideas towards building a sustainable future. The more sustainability is visible and valued as part of the culture, the more it will expand through the collective efforts of employees.

5.22 Open Dialogue and Exchange

Executives have an opportunity and obligation to earn stakeholder trust by engaging in open, honest conversations, and regularly addressing concerns about environmental priorities. This should come in the form of town halls, listening sessions, and Q&A sessions where company leaders transparently answer questions on challenges, goals, and progress on issues like climate initiatives, renewable energy adoption, emissions-cutting technologies, sustainable materials and recycling, water conservation, waste reduction, greener supply chains, and operations standards. Even when facing decisions that balance environmental and business interests, such as supply chain decarbonisation versus costs or a sustainable product line's profitability, leaders must guide based on values, science, and moral responsibility to take ambitious action (Wesseling et al., 2017). Executives can update on macro trends while local site managers detail micro solutions like LEED-certified green buildings. These proactive discussions demonstrate commitment while also

gathering feedback to shape future strategies. Alongside financial earnings reports, the company should report sustainability KPIs and have meaningful conversations on how everyone can rally to speed up the solutions our vulnerable world desperately needs.

5.23Triple Bottom Line

Figure 27 Triple bottom line

To encourage sustainability engagement across the organisation, the company should incorporate related criteria into performance measurement and incentive programs at all levels. These may take the form of individual metrics tied to the emissions, waste, water, and energy footprint of each employee's area of responsibility (Braungardt et al., 2018). Department-specific metrics could track reductions in paper usage, business travel miles, virtual meeting percentages, and subscription to public transit commuter benefits.

Companywide goals around renewable energy procurement, LEED-certified buildings, water recycling rates, and maintenance of ISO14001 standards would factor into the incentive structure as well. The weight given to sustainability metrics in determining salary increases and bonuses incentivises their achievement. However, environmental progress must be valued as an intrinsic good on par with profits. Thus, compensation should also reward exemplary initiatives that may not yield short-term cost savings, like the launch of employee education on supply chain transparency, CSR visioning sessions, or cross-functional partnerships to pilot test carbon capture materials. Incorporating sustainability into formal incentives and performance assessments signals its priority while enabling employees to lead ESG advancements with creativity and passion (Wilson, 2015).

5.24 Support External Environmental Initiatives

Partnering with credible external organisations, holding events, and leading initiatives centred on environmental awareness and accelerating the renewable energy transition present a valuable opportunity to demonstrate the company's alignment with and commitment to sustainability. Such engagements allow employees to deepen connections in the NGO community while networking and exchanging best practices with like-minded businesses. Examples of worthwhile sponsorships include the annual Clean Energy Visionary Conference which gathers industry leaders driving innovations in storage, microgrids, EV infrastructure, and energy efficiency standards. The company could sponsor the post-conference hackathon, send engineers to brainstorm solutions, and potentially pilot collaborations sparked at the gathering (Braungardt et al., 2019). Alternatively, it may back the Cities Coalition for Climate Action policy push as mayors across America advocate for resilient, net zero transportation and buildings. Beyond sponsoring, we can seek speaking roles to formally detail our evolving ESG vision and strategy to stakeholders. Encouraging employees to attend events, enter idea challenges, or advisory groups enables them to lend expertise while increasing the company's visibility as a sustainability champion. Support is more authentic when supplemented by earnest internal emissions-reduction efforts.

5.25 Employee Participation

Cultivating an eco-conscious culture requires providing staff opportunities to gain deeper knowledge, skills, and experiences in sustainability through engagement in environmental volunteering, training programs, professional certifications, industry events, and external advisory groups. The company could actively encourage and subsidise activities like tree planting events, shoreline cleanups, habitat restoration outings, and environmental advocacy organisation memberships. Supporting attendance at renewable energy or clean tech conferences while promoting speaking roles for staff allows broader sharing of expertise. Sponsoring sustainability professional development, such as qualifying for LEED accreditation or taking online courses on topics like circular economy innovation or policy scenario planning through institutions at the forefront, signals corporate investment in elevating in-house capabilities. Allowing schedules to accommodate joining coalitions advancing emissions reduction legislation or think tanks pioneering equitable decarbonisation strategies fosters indispensable connections (Braccini & Margherita, 2018). Boosting individual employee participation raises collective intelligence across disciplines so people enterprise-wide increasingly inject sustainability perspectives into their roles. Access to forums exploring the future of environmental stewardship empowers staff to build institutional knowledge on the corporate responsibility imperative society faces.

5.26 Reporting

Robust, transparent reporting on environmental sustainability metrics, targets, and strategies enables internal and external stakeholders to fully assess current performance, progress over time, and the company's level of commitment to addressing urgent global issues like the climate crisis, biodiversity loss, and resource depletion (Widya & Tjahjono, 2019). This information serves the public interest while empowering employees, investors, policymakers, and the communities hosting operations and consuming products to understand the full scope of impacts, both positive and negative ones. Comprehensive disclosure through sustainability reports, regulatory documentation, data sites, and

platforms like CDP should encompass the reporting period's total greenhouse gas emissions segmented by facility and source, audited breakdowns of energy and water consumption, waste diversion rates, sustainability KPIs per business unit, quantified environmental impact valuations, and scenario models under various emissions abatement pathways, including commitments to ambitious reductions by specific dates. Publishing details on new initiatives, innovative pilot projects, executive environmental mandates, and sustainability-related training also signals proactive emissions mitigation and nature stewardship while stimulating ideas and accountability. As sustainability considerations increasingly grow material to business value assessments, radical transparency of negative externalities ushers in an era of environmental full-cost accounting and data-enabled collective action.

5.27 Collaboration

Environmental sustainability issues are highly complex and scale globally, demanding diverse insights, resources, and cooperation to address effectively. Exploring collaborations with issue-focused NGOs, research-oriented academic institutions, and engaged community partners offers avenues to merge objectivity, resources, distribution channels and on-the-ground implementation capabilities while increasing the reach and credibility of initiatives. Potential projects could entail wildlife conservation programs focused on vulnerable animal populations, citizen science, and school curriculum building to educate broad audiences on ecological threats, operationalising emissions lifecycle analyses around the company's products, researching new biodegradable materials, piloting decentralised microgrid infrastructure to sustainably power communities lacking reliable energy access, and more. Partners could co-fund projects while contributing staff hours, regional data, academic analyses, communications support, and community participation. Launching advisory panels or stakeholder mapping processes would help identify cross-sector partners well-aligned on program design and assessment metrics. Partnering paves the way for channelling scalable financial, human, and intellectual capital into ambitious, long-term endeavours advancing global resilience, resource efficiency, knowledge sharing, and humanitarian progress.

5.28 Implication of Human Resource Development for Skill Acquisition and Workforce Adaptability

As companies go through transitions, there is often a need for employees to rapidly gain new skills, both hard technical as well as soft ones, like communication and change management. Rather than facing churn by terminating employees who lack the required competencies, smart organisations proactively increase the budget and attention devoted to internal training programmes. They identify priority areas where new skills are imperative for innovations in technology, updated business processes, and evolving workplace tools. Comprehensive training curriculums are designed, featuring both virtual modules focused on conveying conceptual information as well as hands-on coaching and mentoring (Braccini& Margherita, 2018). Subject matter experts may be leveraged to lead workshops. Drawing correlations between new capabilities and improved productivity, creativity, or operations efficiency also motivates engagement. While costly initially, continuous reskilling opportunities are attractive talent magnets during recruitment and serve to boost retention even amidst turbulent conditions requiring flexibility. Investing in the existing workforce enables companies to save costs associated with turnover while benefiting from institutional knowledge preservation. It also opens advancement pathways to mitigate feelings of stagnation. Employees recognise the support in expanding their horizons. With broader, cross-functional skillsets, people can be redeployed to new roles or teams rather than exiting the company. Upskilling programs demonstrate loyalty and access to challenging assignments rewards willingness to learn. The payoff is an adaptive workforce able to flex as strategies shift.

An important first step an organisation must take to equip its workforce for transitions is conducting assessments to identify current skill gaps compared to those required for future-focused job roles. Understanding deficiencies that exist allows HR and learning and development teams to tailor targeted training programs efficiently. A skills matrix can map the capabilities of individual employees against those desired for accomplishments like digital transformation, expansion to new markets or alignment with updated strategic priorities. Gap analysis illuminates where additional hiring may be

beneficial versus the development of existing staff. Addressing missing capabilities proactively through well-designed training initiatives facilitates necessary evolution while mitigating turnover risk. Employees appreciate guidance recognising their talents while elevating areas needing improvement through personalised learning paths. These might incorporate mentor assignments, stretch project opportunities, certifications, microlearning modules or rotations. Managers can better direct transitions knowing their reports possess strengthened aptitudes. Coordinated upskilling accomplishes more progress than leaving skill acquisition to chance. It empowers people to capitalise on new responsibilities as changes roll out. Tracking metrics like completion rates, competency surveys and productivity gains allow calibration of programs. Ultimately the goal is to have teams fully equipped to adopt innovations and new directions. Investing in development makes it easier to flex workforces toward growth opportunities instead of losing talent. There are returns on investment, pride, and effectiveness when organisations enable their people to intentionally expand their horizons.

Smoothly integrating new hires through robust onboarding is critical for rapidly imparting context, connections, and capabilities needed for recently added staff to drive value. Given the costs of turnover and lost productivity when employees fail to get assimilated, structured programs help new team members operate proficiently faster. This leads to job satisfaction along with the creation of internal mobility pathways. Best practice onboarding entails assigned peer mentors, introductory presentations on company vision and business operations, guided tours, systems credentials, initial networking, and orientations tailored by functions like sales, engineering or finance. Build curriculums spanning the first-year feature milestone checkpoints. Crucial knowledge around workflows, collaborators, resources, and project lifecycles gets systematically shared instead of sporadically picking things up over long periods through trial and error. Relationships form more easily through group training. Post-programs surveys can provide feedback for refinement while retention rate analyses after 2-3 years offer insight on engagement levels for those previously on-board. With transitions introducing unknowns, quality job training, cross-functional introductions and cultural assimilation enable new

staff to actively support change initiatives rather than flounder (Braccini& Margherita, 2018). Leadership signalling that everyone goes through adjustments is comforting. Welcoming gifts and celebrations after 30/60/90 days also boost morale during uncertain times.

Onboarding is a critical time for new hires, setting the foundation for their success, productivity, and ultimately retention within an organisation. Structured onboarding programs that systematically integrate new employees through training, mentoring, and networking accelerate competency development so people reach full capability faster. This leads to greater job satisfaction, engagement, and the ability to add value during transitions. Robust multi-day curriculums feature introductions to company vision, business operations, key contacts, workflows, systems credentials, tours, and function-specific technical skills training. Assigning peer mentors creates connections, facilitates questions, and offers coaching during potentially disorienting shifts. Milestone check-ins within the first year ensure continuing progress. Surveying new hires provides feedback to enhance the future evolution of thoughtful onboarding measures, which may temporarily increase HR resourcing costs but reduce turnover expenses long term. Employees onboarded effectively adjust quicker when projects or technologies transform given their solid baseline of understanding. They can also ascend to vacated roles seamlessly because the organisational proficiency and relationships exist to become productive successors without lag time seeking external recruits. Leadership signalling that everyone adjust together through change is reassuring. Welcome gifts and celebrating onboarding program graduates make new staff members feel valued and integral contributors. Thoughtful onboarding eases uncertainty, enabling people to focus fully on supporting key initiatives to drive institutional growth rather than learning the ropes.

Cross-training employees to master complementary skills beyond their core job responsibilities better equip teams to handle workflow continuity when positions open temporarily or permanently due to transitions. Staff equipped to fill gaps as they arise prevents productivity losses. An engineer familiar with key accounts can cover sales calls

if an Account Executive leaves suddenly. Manufacturing associates learn the basics of equipment maintenance to resolve minor issues quickly without waiting for technician availability. Shared training budgets allow more flexibility in participating in cross-functional development. Employees gain wider perspectives on interconnections between departments while leadership curates eventual promotion pathways for promising talent. Especially when budget cuts occur during turbulent periods, preventing siloed capabilities avoids single points of failure. Having at least one backup trained for crucial functions enables operations resilience. Documented procedure guides also facilitate smooth hand-offs when turnover arises, minimising fire-drill crises. Rather than desperation to fill critical vacated roles that rushed recruitment processes, trained incumbent workers can securely step in and focus on top priorities (Bowen et al., 2017). With competent redundancies through cross-skilling, organisations need not immediately backfill every departure, granting flexibility around optimal hiring timelines. Workers recognised as trusted versatile contributors feel valued. In uncertain times, developing a toolbox of transferable skills for diverse scenarios improves individual adaptability and organisational stability (Braccini & Margherita, 2018).

Equipping people managers with leadership and change management competencies is essential for steering teams positively through uncertain transitions while retaining talent. Without proper training to understand human psychological responses, mitigate anxiety, cultivate inclusion, communicate transparently, and maintain engagement, supervisors risk compounding destabilisation. Investing in customisable training modules, mentor/coacher matching programs, and external certifications in areas like leading hybrid/remote workers, performance improvement, organisational resilience, conflict resolution, facilitation, and more, builds capacity to handle turbulence. Managers gain techniques for providing direction, empathy, development pathways, and productive team dynamics as strategies and priorities evolve. Change training fosters buy-in and the capability to advise employees amid adjustments. Those watching supervisors handle ambiguity calmly themselves or supporting workers struggling with learning curves feel supported versus abandoned. Managers set the tone for morale, collaboration, ideation and

embracing innovations. If unable to foster human connections, transparency and growth mindsets during turbulent times, retention suffers from detachment. Alternatively, great leadership development across middle management enables continuity, inspiration, people development and balanced perspectives as teams reorganise. It also strengthens the talent bench for elevated responsibilities as expansion initiatives launch to capture new opportunities borne from disruption. Investing to build resilient leadership that can guide workforce resilience pays exponential dividends. Empowered managers become force multipliers for change adaptation and retention.

Facing an unpredictable world of advancing technologies, employers' benefit from embracing continual staff development to regularly upgrade skill sets rather than sporadic training unable to match the pace of change. Workers recognise an obligation for self-driven lifelong learning as well given redundant capabilities face elimination. Structuring dynamic teams willing to take on emergent roles and apply modern tool mastery fuels responsive innovation. People analytics guides cost-efficient competency building, production synergies and career pathing connectivity. Culture resets commend cross-training participation, remote work flexibility, long-view growth mentalities, and experimentation with operational upgrades like automation integration or supply chain resilience tactics. Leadership endorsements for remaining malleable in the face of ambiguity counter fixed-mindedness. Accommodating team rotations into innovative R&D or change management task forces promotes idea cross-pollination. Access to regular skill refreshers, digital fluency tutorials and personal development guidance retains talents eager for next-horizon capabilities rather than stale niches. With roles fluctuating, ensuring multi-skilled, adaptable staff is imperative. Broad capability pools enable navigating uncertainty through fungible assigning based on need rather than strict job descriptions. Commitments to co-funding transitional development for employee retention and institutional future-proofing keep recruiting and severance expenses down while ensuring continuity, navigation aids, and preparedness to capitalise on progress unlocked by not fearing temporary destabilisation. Being a true "learning organisation" is a competitive

differentiator able to harmonise worker aspirations and marketplace demands through purposeful, empowered dexterity.

Insufficient investment in workforce training and development during turbulent times of organisational change risks heightened turnover, lowered innovation, stunted growth, and inability to capture emerging opportunities. Employees losing confidence in leadership's commitment to help navigate evolutions through reskilling, transparent communications or culture cultivation leave teams feeling adrift, overwhelmed and pessimistic. Unclear direction on how modifications translate into updated workplace expectations causes frustration. Anxiety spreads over job security threats from those seemingly unmotivated for proactive mitigation measures. Perceptions that management cares little whether staff possess competencies to succeed after implementations of new technologies, workflows or responsibilities damage trust and agility. Employees begin quietly investigating exits or disengage entirely. Before long, preventable turnover snowballs with remaining team members bearing heavier workloads, spurring further escape evaluations. Alternatively, leadership freezes hiring pipelines despite recognised capacity shortage pain points out of reluctance towards redundancy risks if initiatives underperform. But trying limping along to actualise ambitions due to stretched resources simply postpones rebuilding needs while capping scalability. With unprepared cultures, transformations flounder regardless of potential. Either way, struggling teams cannot yield genuine growth. Turnover costs, opportunity costs from stagnation and poor employee experience harm recruitment, retention, and innovation vitality over longer time horizons.

Organisational transitions requiring new competencies often create budget debates on costs/benefits between training existing employees compared to recruiting external candidates who already have desired skill sets. Developing staff shows commitment, retains contextual knowledge and confirms loyalty to those embracing necessary growth. But it requires extra hours tacked onto workloads. Hiring new employees injects fresh perspectives and mastery levels perhaps challenging to sufficiently cultivate internally in condensed timeframes. However, onboarding new staff taxes HR bandwidth. Hybrid

approaches blending selective recruitment and upskilling training calibrate talent pipelines, knowledge continuity and change appetite. The optimal path weighs factors like evaluative cost analysis on salary requirements, ramp-up periods and success likelihood between known internal candidates against unknown external potential hires (Bowen et al., 2017). Consider if desired abilities require deep expertise cultivation beyond short course upskilling capacity. Be conscious of diversity implications from preferential treatment between groups. Budgeting blended allocation across resourcing options maintains flexibility as transformations reveal additional needs. Despite near-term reskilling investments, hiring strategically for competencies unfeasible to expand internally may pay dividends in the long run. But ignoring staff hoping to grow with change could spur regretful turnover. Talent development coaches can create transition roadmaps balancing efficiency and empathy. Economic challenges squeezing budgets could heighten scrutiny on workforce expenses, but cutting too deeply risks the real loss of institutional and community intellectual capital as people disengage. With balancing guidance, companies can expand capabilities while optimising human capital returns.

5.29 Human Resource Development and Economic Resilience

Rather than facing heavy job losses as fossil fuel demand declines, retraining existing oil and gas workers to pivot into renewable energy roles optimises valuable human capital resources already invested while ensuring smooth operations continuity. Many skills like project management, engineering, construction, safety regulation, equipment maintenance and monitoring translate. Retraining leverages this occupational crossover, augmenting with technical reskilling on areas unique to solar, wind or geothermal power. The populations benefitting from redeploying also retain institutional wisdom around company assets, values and processes worth preserving. Reskilling programs specialised for industry transitions upcycle team capabilities to apply rich experiential strengths towards rising sectors. Consultations help map transferable skills between workforce roles as conventional energy projects get replaced by renewable initiatives on the timeline committed within sustainability pledges. As renewable penetration accelerates, these workers lead communities of practice sharing insights to avoid repeat mistakes, estimate

realistic timelines given resource constraints, and catalyse innovation pipelines. They form a strategic base expanding capabilities in emerging areas like integrated grid management, storage solutions, EV infrastructure and more. With less time spent on rehiring and re-educating brand-new entries unaware of institutional context, retraining programs allow the redirected focus on optimising operations for full energy transition achievement. Maintaining operational excellence, safety standards and customer service through turbulent evolution relies on leveraging capable talent in adaptable ways rather than unchecked erosion.

Equipping oil and gas executives with the leadership abilities, strategic foresight and change management expertise to redefine competitive business visions and models for the clean energy future optimises key talent resources necessary to spearhead authentic transition across the organisation. Rather than facing stalled transformation efforts due to a lack of conviction or capability at the top levels, training programs focused on commercial innovation, new ventures analysis, policy landscape fluency, decarbonisation technologies, efficiency optimisation tactics and more give leaders some tools to chart ambitious yet feasible paths to sustainable value creation. Leaders able to set bold renewable energy adoption targets with comprehensive roadmaps, creative partnerships and transparent milestone tracking can then mobilise others towards realisation. They will align investments, reporting structures, subsidiary creation, M&A moves, R&D priorities and talent strategies to fulfil evolved purposes built around climate imperatives and global energy advancements. Dynamic executive leadership injects confidence while unlocking institutional knowledge, relationships, infrastructures and financing channels to activate robust transition ecosystems across supply chains. Training helps avoid the risk of reluctance, scepticism or incompetence at senior levels clouding progress. With literate, capable strategy architects informed on clean energy's demands and opportunities now expanding options, the creativity, initiative and cooperative commitments of an organisation's wider human capital resources can drive towards optimising operations for new energy era success.

The shift from fossil fuels to renewable energy involves embracing new technologies, evolving consumer expectations, policy changes, sustainability standards and unprecedented collaboration across industries to decarbonise systems and operations. With so much complexity and uncertainty ahead, successful energy companies need flexible workforces that are comfortable with ongoing evolution, rapid iteration based on new data, and cross-functional partnerships to creatively problem-solve towards transformation. Companies able to cultivate agility, innovation mindsets and skills across all employees from c-suite executives to frontline technicians will achieve optimisation of human capital capabilities necessary to navigate the turbulence of energy transitions. This means widespread training programs focused on design thinking, digital fluency, stakeholder empathy mapping, change management best practices, startup partnership models, policy analysis and more. Infusing these ways of thinking systematically builds adaptive capacity through better information synthesis, creative confidence, interdisciplinary coordination, data-backed experimentation with pilots/MVPs, and consideration of societal needs alongside profit motives when reconfiguring business mix and partnerships. With empowered talent undaunted by market fluidity and energised by sustainability challenges, companies can access wider imaginative inputs and implementation capacities to fulfil improved visions. The collective potential of organisational resources is elevated by first cultivating an empowered, progressive culture ready to flex with the pace of technology and society. This human infrastructure sets a foundation for successfully building operational resilience.

Business model pivots required to transition from fossil fuels to renewable energy can heighten workforce uncertainty and anxiety if not proactively addressed. These human costs of progress risk morale declines, presenteeism, siloed thinking, reluctance toward collaboration, and valuable institutional knowledge loss as veterans resignedly exit. Equipping people managers and communications teams with change management and strategic employee relations skills builds the capacity to mitigate such pitfalls through turbulent evolutions. Tailored training in areas like leading with empathy, transparency, and bidirectional feedback flows; workplace inclusion; celebrating small wins; process

redesign sensitivity; and managing hybrid teams arms key leaders to maintain engagement, trust, and commitment to collective ambitions throughout uncertain periods. With empowered talent focused and hopeful versus distracted and cynical, renewable energy projects favoured by markets, governments and society can achieve optimised rollout. Staff will contribute ideas and dedication to propel an organisation's sustainability vision into being rather than passively witnessing disjointed transformations occurring around them without a voice. Resources dedicated to shepherding the workforce, the heart of the institution, will pay exponential dividends. Teams confident in constructive transition processes turn attention more wholly to creative complex problem solving related to technology integration, supply chain adjustments, process optimisation and new business models that ease the organisation and public into a decarbonised future fuelled by clean power.

Strategic partnerships between universities and private companies will be critical to optimising our current resources and talents to enable a rapid yet practical transition to a sustainable energy system powered by renewables. Through collaborative curriculum development, research projects, and shared facilities, academia and industry can maximise their unique contributions by training specialised workforce, driving rapid innovation, providing infrastructure for developing cutting-edge technologies, and aligning research with real-world needs (Bowen et al., 2017). Universities possess deep knowledge and research capabilities that allow them to develop future technologies and train the next-generation workforce equipped with skills needed by the renewable energy industry. Companies have valuable industry perspectives, funding resources, commercialisation pathways and opportunities to validate emerging innovations through demonstration projects in real-world conditions, thereby risking adoption. By integrating their expertise via strategic partnerships, they can coordinate their efforts to accelerate the translation of academic insights and innovations into commercially viable products that are targeted at urgent real-world problems. This kind of carefully orchestrated collaboration allows academia and industry to optimise the existing resources within the ecosystem by leveraging their complementary capabilities in a synergistic manner. It will provide the

combination of talent, knowledge, infrastructure, funding and commercialisation pathways crucial for rapidly advancing renewable technologies, business models, and workforce preparedness ultimately enabling a systemic transition to a sustainable energy future powered by renewables.

As the renewable energy industry grows, there will be a need to reskill and upskill the current workforce to operate, maintain and optimise the performance of solar, wind and other clean energy systems. Many of these new technologies utilise advanced sensors, data analytics, and automation. Reskilling programs focused on building digital capabilities, data analytics skills, and complex problem-solving competencies can help the existing workforce adapt to these new systems and techniques. Companies can provide short modular courses, online and in-person training, mentorships, and hands-on learning to equip workers with requisite skill sets. A flexible and ongoing reskilling approach allows workers to learn new skills while remaining on the job. It provides them with the opportunity to continuously upgrade their competencies over time as technologies evolve. Such programs optimise current human resources by leveraging the knowledge base of existing talent rather than having to lay off staff who may lack the required competencies. Retention of personnel preserves institutional knowledge while reskilling programs enable workers to apply their expertise to new renewable systems. It also avoids costs and delays involved in recruiting new skilled talent. Overall, flexible reskilling helps create an agile and future-ready workforce that can optimise renewable operations using data-driven intelligence. It ensures that companies can successfully leverage analytics and automation to improve efficiency, productivity and reliability as they transition to sustainable practices and clean energy systems. The result is an optimised workforce capable of meeting the demands of a greener, more technologically advanced energy industry.

Providing incentives for workforce training and development in areas like sustainability, renewable energy, and the circular economy can upskill employees to meet the changing demands of a green economy while optimising existing talent. Educational assistance programs, paid time off, and tuition reimbursement for courses related to

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sustainability are examples of incentives that make it easier for current employees to gain new knowledge and skills without leaving their jobs. Companies investing in continuing education around sustainability tap into their internal human capital and equip professionals to apply their experience to new challenges. Retaining and retraining personnel preserve institutional knowledge and avoid the costs of recruiting new hires. Building this expertise internally also allows companies to optimise training based on their specific renewable energy needs. With a workforce upskilled in topics like energy efficiency, waste reduction, recycling, and renewable energy, companies can increase productivity, innovation and operational excellence to thrive in a sustainable industry. Incentivised continuing education in green technologies, processes and business practices prepares workers to effectively transition organisations and operations toward renewables and a circular economy. Employees develop the cutting-edge skills and vision needed to successfully adopt emerging sustainability practices. This optimisation and development of in-house human resources is key for industry to transform operations, maximise resources, and gain a competitive advantage as global markets increasingly demand sustainable products, services and operations (Bowen et al., 2017).

The transition from fossil fuels to renewable energy will inevitably displace some jobs and create a need for new skills. Detailed workforce planning can proactively identify roles at risk, and competency gaps, and plan appropriate support to optimise the utilisation of current talent. Transition plans should map high-risk jobs that may become obsolete. This allows for targeted retraining and deployment of at-risk workers into new roles in renewables. Assessing competency gaps across the workforce highlights opportunities for reskilling programs to upskill employees with needed capabilities before displacement occurs. Providing outplacement assistance like career coaching and job matching services for displaced workers can help transfer knowledge and experience to renewable energy sectors facing talent shortages. This avoids wasting human capital. Optimised transition planning helps avoid reactive layoffs, retain institutional knowledge, and ensure continuity of operations. There is less need for costly external recruitment and onboarding. Retraining and redeploying internal talent enables companies to get the most value from existing

human resources. Workers also benefit from proactive support in navigating the sector's transformation. The result is a smoother workforce transition that cost-effectively bridges competency gaps. This allows organisations to function at full capacity, with an optimised workforce equipped with the updated skills needed to operate and innovate within a renewable energy industry. Detailed planning and transition support ensure that existing talent is not stranded but strategically leveraged to enable sustainability.

The renewable energy sector needs to attract new talent with the skills and motivation to drive innovation and optimise operations. Expanding recruiting efforts to target student groups, youth networks, diversity organisations and channels frequented by young professionals can connect companies with emerging talent passionate about sustainability. Reaching promising young candidates proactively before they settle into careers allows renewable companies to build talent pipelines and develop future leaders in-house. Hiring youth interested in sustainability also injects new perspectives and energy into organisational culture. Furthermore, emphasising diversity and inclusion helps create a vibrant, creative workforce able to drive innovation. Onboarding younger employees alongside current staff creates opportunities for experienced professionals to mentor new hires. This facilitates knowledge transfer so that institutional expertise is passed on rather than lost in the transition. Cross-generational teams also optimise creativity, blending wisdom with fresh thinking. Casting a wide recruiting net focused on youth, diversity and passion for renewables brings in human capital ready to tackle sustainability challenges. This allows companies to cost-effectively build the workforce of the future with minimal disruption to current operations.

5.30 HRD and Innovation

Retraining and upskilling existing engineers and technical staff are crucial for building organisational expertise and capabilities in renewable technologies. Traditional oil and gas employees often have transferable core competencies but require supplemental training to apply their skills to solar, wind, geothermal and other renewable systems. Companies can provide immersive training programs, hands-on workshops, simulations,

and courses to equip these professionals with technical knowledge related to clean energy. This expands the organisation's collective knowledge base and skillset to include renewables. With direct training and experience in these new technologies, veterans with years of energy industry experience can become innovation powerhouses, leveraging their deep institutional knowledge and combining it with new technical capabilities. This enables them to develop breakthroughs and optimise renewable energy operations. Upskilled staff also gain the confidence and expertise to pioneer proofs of concept and pilot projects, accelerating innovation. Instead of losing knowledgeable workers to a skills gap, retraining programs allow companies to amplify and retain their human capital. This drives innovation by empowering current staff to creatively apply their experience to build, manage and enhance renewable technologies. The outcome is an expanded pool of expertise to spur human-powered innovation across clean energy systems.

Providing incentives for professionals to pursue continuing education opportunities related to renewable energy, sustainability, and circular economy principles inspires fresh ideas and new ways of thinking. As the energy transition accelerates, companies need employees equipped with leading-edge knowledge to devise creative solutions. Continuing education gives working professionals access to emerging concepts without taking extended time off. Options like tuition reimbursement, paid time off, and subsidies for short courses, workshops, and certifications make it easier for staff to stay apprised of sustainability best practices and renewable technologies (Bowen et al., 2017). As personnel expand their knowledge, it sparks new connections and allows them to approach problems with an innovative mindset. Learning alongside academic and industry experts also increases exposure to groundbreaking research and ideas. Personnel return to work reinvigorated with expanded perspectives, contemporary knowledge and inspiration to try new concepts. They infuse the organisational culture with entrepreneurial thinking and challenge norms. Ongoing continuing education allows companies to cultivate a workforce brimming with cutting-edge insights and motivated for advancement. By incentivising learning, companies can organically grow innovation capacity and ensure that employees

are empowered with the latest technical expertise and creative confidence to transition operations to renewables.

Bringing in younger professionals who are passionate about sustainability and renewable energy fuels innovation by injecting new perspectives, skills, and energy. Recent graduates and emerging talent naturally question the status quo and bring contemporary knowledge about technologies like solar, wind, geothermal and battery storage. With their finger on the pulse of new advances and enthusiasm for improvement, they actively ideate on how to enhance or reinvent processes. Their agility in adopting new solutions accelerates technology integration. Younger hires also form relationships and collaborate easily with other innovators, bringing in outside knowledge. Allowing them to take the lead on pilot projects lets them showcase their capabilities. Mentorship programs that pair them with experienced professionals facilitate knowledge sharing. The key is welcoming their ideas and giving them platforms to contribute meaningfully. Creating opportunities for passionate youth to address real industry problems motivates them to develop novel solutions. Their entrepreneurial spirit pushes experienced teams in new directions. By embracing new talent interested in sustainability, companies gain fresh thinking power to optimise operations and create breakthrough renewable technologies for the future. Their unconstrained mindset and contemporary skills catalyse innovation.

Leadership development programs focused on change management, innovation, and entrepreneurial thinking skills are critical for driving the cultural shift needed to fully transition to renewable energy systems and operations. Existing leaders need to embrace new mindsets to lead the disruptive change. Courses and workshops focused specifically on guiding transitions can equip them to actively champion for sustainability within the organisation. Hands-on innovation training through simulations, case studies and experiential environments allows them to experiment and gain confidence in orchestrating technological change. Programs that expose them to entrepreneurial strategies for seizing opportunities give leaders tools to incubate new ideas. Coaching and mentoring focused on nurturing agility, creativity and vision for the future helps leaders acknowledge uncertainty

and evolve perspectives. Leadership training centred on understanding change dynamics and summarising opportunities creates internal evangelists able to rally the workforce around renewable advancement.

Enabling and encouraging internal mobility and collaboration across diverse teams allows for cross-pollination of ideas, strengthening innovation for renewable energy advancement (Bowen et al., 2017). Rotation programs that give employees exposure to different departments build connective tissue between groups working on complementary technologies. Shared training programs also bring together professionals from various specialities to exchange knowledge. Events facilitating casual interactions like innovation forums, speaker series and hackathons drive serendipitous sharing as colleagues with diverse expertise connect. Structuring dynamic teams including standpoint diversity based on background and demographics further widens perspectives. Leaders can empower side collaborations between experts across business units to spur new thinking. Mobility pathways allow talented individuals to apply their skills to new areas and spread innovative approaches learned elsewhere. Simple actions like open office formats and shared social spaces promote natural interactions between groups. As people with different knowledge and skills mingle, they cross-pollinate ideas, making cognitive connections that spark new possibilities. Fostering this organic exchange cultivates an innovative ecosystem able to generate novel solutions and exponential value from existing resources. Shared knowledge propagates innovation organically.

Cultivating an organisational culture that embraces creativity, collaboration and problem-solving is essential for nurturing innovation across teams to enable the transition to renewable energy. Leadership should consciously foster norms like risk-taking, learning from failure, and thinking outside the box. Collaborative spaces and flexible work arrangements facilitate collective brainstorming. Events like hackathons, design sprints and informal knowledge-sharing forums allow people to co-create solutions. Actively recognising innovative contributions and providing opportunities to pursue ideas motivate staff at all levels to ideate. Managers can model inquisitive thinking when discussing issues

and encourage exploring possibilities without judgment. Storytelling to share examples of successful innovations and the implementation journey inspires creative confidence. Leaders should also challenge assumptions, ask thoughtful questions, and invite candid feedback. Providing access to research, insights and tools needed to experiment allows people to turn conceptual ideas into reality. Taking an innovation-led approach to problem-solving rather than defaulting to the status quo pushes imagination. By collectively nurturing cultural values, behaviours, and environments that spark creativity, companies can unlock their workforce's fullest potential for human-centred innovation. This builds a resilient capacity to continuously create, refine and implement renewable solutions.

Launching in-house innovation hubs or incubators provides a structured approach to test and evolve new renewable energy concepts from idea to implementation. These dedicated programs allow companies to provide seed funding, resources and expert mentoring to empower internal teams to take promising ideas from concept to viable products or process improvements. Having an incubation space and program incentivises staff at all levels to engage in innovative thinking by providing a defined outlet to develop solutions with leadership support. It enables pilots and prototypes to be built rapidly so innovations can be refined iteratively based on real-world testing. Staff also benefit from being able to collaborate with colleagues from diverse functions. The hands-on experience equips them with invaluable skills to drive innovation independently in the future. Celebrating successes from the incubator helps establish an innovation culture and motivate further creative thinking. The return on investment comes from accelerating the most promising employee-generated concepts that may best meet emerging industry needs. Overall, in-house incubators allow companies to harness internal capabilities while providing a springboard for new ideas. This gives them the agility to continuously experiment, evolve and scale renewable energy innovations with minimal risk.

Strategic partnerships with academic institutions and involvement in industry associations expand thought leadership and accelerate technical knowledge exchange to bolster innovation for the energy transition. Academia provides access to leading experts

across scientific domains and exposure to emerging research that companies can translate into new products or processes. Joint research projects, technology licensing, and engaging professors as advisors let companies leverage academic knowledge. Recruiting top talent straight from research-intensive universities also infuses new thinking. Partnerships provide opportunities to validate concepts and publish studies that establish thought leadership. Active participation in industry associations through events, workshops and working groups facilitates peer learning. It provides insight into common challenges and how frontrunners are advancing renewables capabilities. Being part of broader industry dialogues keeps companies apprised of contemporary developments, regulations, and innovative practices to inform their transition strategies. Seconding employees to collaborative initiatives lets them shape the future of sustainable energy while expanding their expertise. Tapping into external ecosystems of knowledge and talent through academic and industry partnerships amplifies internal innovation efforts. This allows companies to integrate broad technical insights with their experience to foster agility and strategic foresight.

Coaching and mentoring programs are important for nurturing the skills required to spearhead change and new thinking within an organisation transitioning to renewable energy. Coaching develops self-awareness, emotional intelligence and leadership abilities on an individual level to empower employees to take initiative. Mentoring facilitates knowledge sharing as experienced staff advise upcoming professionals on navigating company dynamics, garnering stakeholder buy-in, and translating ideas into action. Both coaching and mentoring provide a safe space for mentees to discuss fears, challenges and goals. Guidance on influencing effectively, engaging teams, and telling compelling stories gives emerging leaders tools to impact culture. Coaching on design thinking, creativity and problem-solving helps mentees approach complex situations with an innovative lens. Brainstorming with experienced mentors assists in unblocking mental barriers. Leadership coaching allows mentees to integrate feedback and strengthen critical cognitive and social skills needed to catalyse change. Over time, personalised support nurtures talent and

emboldens employees to think differently. Those mentored become force multipliers for innovation and change by applying their knowledge across teams.

CHAPTER VI:

SUMMARY, IMPLICATIONS, AND RECOMMENDATIONS

6.1 Summary

This research set out to analyse the challenges and opportunities faced by companies in the oil and gas sector during the transition to renewable energy, with a focus on the role of human resource development (HRD) in enabling a successful shift. The findings reveal several key insights aligned with the four research objectives. **First** and foremost, the study found a significant skills gap emerging between current capabilities cantered on fossil fuels and those needed for renewable energy technologies like solar, wind and geothermal. This illustrates the scale of challenge in reskilling and competence development required for incumbent workforces to transition successfully – directly addressing the first objective of exploring HRD's role. **Secondly**, the importance of fostering continual learning cultures, targeted training programs, competency assessments, recruitment and external partnerships was emphasized by participants as HRD best practices for bridging skills deficits (Casalicchio et al., 2022). This provides human resource professionals and industry leaders with evidence-based strategies for leveraging human capital to enable organizational realignment – meeting the second objective.

Thirdly, findings highlighted the value of government incentives for investment in reskilling, regional training programs targeting transferable skills between energy sectors, research funding and regulatory support for renewable technology piloting. These insights offer policymakers guidance on facilitating the transition – fulfilling the third objective. Finally, the difficulties transforming organizational cultures deeply rooted in fossil fuel incumbency points to lingering barriers around embedded mindsets, capabilities and systems. While not the study's direct focus, this suggests levels of environmental awareness, agility and openness to change which must evolve for successful renewable energy adoption – partially addressing the fourth objective on stakeholder readiness. In summary, this exploratory study's findings make significant contributions across all four

original research objectives, providing practitioner guidance and scholarly insights into managing the workforce dimensions of sustainability transitions within the global energy sector. The conclusions form a strong foundation for further applied investigations to facilitate the urgent shift towards renewable energy.

6.2 Recommendations

1. Challenges and Opportunities

To deeply analyse the challenges and opportunities faced by oil and gas companies during the energy transition, it is critical to conduct in-depth primary research through focus groups with human resource leaders from major players across the oil and gas value chain. 8-10 focus groups, each with 8-10 HR heads from exploration, production, services and distribution companies must be undertaken. The focus group moderator should facilitate discussions around 5 key themes - how the renewable pivot is impacting hiring plans, implications on workforce training needs, change management strategies adopted, employee sentiment on the transition and any regulatory or policy challenges faced. Detailed notes from these focus groups must be analyzed to draw out the most salient challenges like potential job losses, budget constraints for reskilling programs, lack of internal capabilities around renewable technologies and employee resistance to transition their skills. The findings should also highlight the opportunities - building sustainable operations, attracting young talent inclined towards green careers, new revenue streams from renewable energy production and public perception benefits.

In addition to primary inputs, 3-4 latest industry reports from reputed global consultancies should be studied to gather projections on redundancies for certain job roles like rig operators, production engineers as well as new roles expected to arise like solar technicians, geo-scientists. Any quantitative forecasts on numbers and timelines of job losses and openings must be tabulated. By consolidating findings from both primary and secondary analyses, a manpower transition map can be developed for the oil and gas sector. This will depict the changing workforce composition aligned to organizational renewable

energy adoption plans. Basis the manpower transition roadmap, training needs must be identified, relevant modules developed and budgets estimated. Particular focus should be provided to field staff and engineers requiring advanced technical skills development in renewable energy technologies. Overall, a comprehensive blueprint to equip oil and gas human capital with readiness for the clean energy shift must be carved out.

2. Best Practices

To identify best practices and strategies that can enable a smooth workforce transition for the oil and gas sector, comprehensive case study research across sectors which have previously navigated technology transformations must be undertaken. Specifically, 6-8 case studies each from banking, retail, automobiles and IT services must be taken up. Interviews with senior HR leaders from these companies should bring out the change management tactics they deployed during pivots like digital banking expansion, ecommerce disruptions and electric vehicle manufacturing ramp-up. Key areas to probe during these interviews are reskilling programs, leadership communication, employee engagement initiatives, external partnerships and progress monitoring tools. The case study analyses will lead to compilation of specific best practices like setting up internal universities to deliver customized upskilling modules, C-suite level townhalls, gamified mobile apps to promote energy literacy amongst staff and dedicated organizational change management teams.

In addition, primary surveys should also be administered to around 100 oilfield services companies as well as leading renewable energy players employing workers with technical energy sector skills. This survey can assess the efficacy of their training methodologies, content approaches and delivery platforms. For instance, findings can showcase how reliance on virtual reality, augmented reality and simulation training may be more impactful than traditional classroom manuals. Stats on completion rates and efficacy gains from these new-age platforms can be gathered. The case study and survey learnings must be structured to develop a best practice playbook for oil and gas players to refer to as they transition workforces. This playbook can prescribe competency models

across technical and managerial staff, recommend training delivery formats aligned to different learning styles of employees, provide sample communications from leadership to drive change management and also suggest potential partnerships with specialist training academies or e-learning firms. Overall, a guide to handhold HR teams in oil and gas majors on leading smooth workforce transformations towards sustainability can be compiled.

3. Stakeholder Perspectives

Gaining perspectives from stakeholders like policymakers and industry associations is vital for oil and gas companies to get inputs on managing the workforce transition. Structured consultations should be organized with energy government bodies like Ministry of Petroleum and Natural Gas, International Energy Agency, World Petroleum Council along with domestic and global oil and gas associations. 8-10 consultations should be targeted with leaders from these organisations to understand existing and proposed regulations impacting workforce planning during the renewable pivot. For instance, insights can be gathered on government subsidies, incentives or concessions extended towards reskilling oil and gas sector technical talent to serve the renewables industry. Inputs on relaxation of visa or immigration norms enabling global mobility of niche workforce skills between oil and gas and renewable energy majors should also be sought.

Additionally, 15-20 industry veterans, academicians tracking the energy landscape and heads of renewable energy firms can be invited for a roundtable discussion. This panel can highlight the policy reforms and voluntary industry initiatives needed to accelerate the workforce transformation. Recommendations around integration of sustainability education in mainstream college curriculums to boost funnel for green-collar roles could also emerge from the discussion forums. A primary survey should also be launched with technology partners affiliated to the oil and gas value chain like equipment manufacturers, industrial IoT providers and storage and transportation fleet operators. Their outlook on the scale and pace of renewable energy adoption as well as demand forecasts for related technical skillsets can offer useful workforce planning insights for oil and gas employers.

Consolidating the various perspectives gathered from the different stakeholder interactions outlined above should arm oil and gas players with a range of policy reform ideas, partnership models, academic interventions and talent mobility options to aid the workforce transition process. The recommendations package can act as vital inputs for intervention by regulatory agencies like Ministry of Skill Development, higher education bodies like UGC as well as industry collaboratives pursuing sustainability commitments.

4. Assessing Environmental Awareness

To assess the environmental awareness and sensitivity of key stakeholders in the oil and gas sector, a comprehensive survey targeting three cohorts – executives, employees and consumers should be launched. The executive survey should capture responses from around 100 CXO and senior leadership roles across national and private sector oil and gas firms on aspects like familiarity with emissions reduction targets, investments made in building sustainability capabilities and challenges faced in transitioning to clean energy models. The employee survey should gather inputs from at least 500 participants across functions like operations, engineering, sales and corporate roles. A mix of situational questions, technology adoption queries and environmental attitude estimators should reveal current state of renewable energy comprehension, willingness to reskill and overall eco-consciousness. The consumer survey should extract responses from minimum 1000 industrial customers, commercial enterprises and residential households connected to oil and gas companies. Aspects covered must evaluate shifts in expectations regarding green energy sourcing, willingness to pay premiums for renewable fuel adoption by providers and overall trust in sustainability messaging from oil and gas producers and distributors.

Advanced statistical analytics should be applied on the three survey datasets to determine an integrated "Environmental Awareness Index" at an overall oil and gas sector level as well as analyze variances across company types, customer segments and staff levels. Higher index scores would indicate greater climate change acknowledgment demonstrated via metrics like net zero targets adoption, renewable technology investments, staff sensitization on sustainability issues and customer allegiance to providers driving

clean energy transition. Additionally, sustainability knowledge assessments across the respondents can also showcase specific literacy gaps around concepts like carbon sequestration, biofuels, green hydrogen, EV ecosystems etc. that need to be addressed across hierarchy levels and customer groups within the oil and gas industry. The environmental awareness indexing and measurement can become a annual tracking mechanism to gauge maturity of ecological consciousness and sensitivity amongst the oil and gas community over time. Benchmarking against global levels will also showcase specific focus areas for the sector to enhance literacy. Overall, critical insights on sustainability orientation essential for the workforce and commercial transition approaches for the industry will emerge.

6.3 Limitations and Future Research

As an exploratory qualitative study, this research has several limitations providing opportunities for further investigation. **Firstly**, the sample size of 35 HR professionals from one oil and gas company, while reaching saturation on key themes, limits generalisation. Broadening perspectives across companies and functions would enhance transferability. **Secondly**, the interview data relies on self-reported attitudes and planned initiatives rather than observed behaviours and implemented actions. Longitudinal tracking would reveal actual transformation progression. **Thirdly**, the focus solely on HR roles provides an invaluable but incomplete picture. Including operational technology, R&D, business development and executive views could offer wider insights into the systemic complexities of large-scale energy transitions. **Fourthly**, the geographic context centred on Oman provides a useful case study. However, variations across global policy environments, energy resource profiles, workforce dynamics and more warrant contextualised investigations generating tailored findings and theoretically enriching the phenomenon's understanding. **Finally**, rapidly evolving renewable energy economics, technologies and social pressures necessitate ongoing research reflecting contemporary realities. As the energy transition advances, regularly updated applied findings will remain vital. This exploratory study establishes a framework for further scholarly inquiry and practitioner guidance. The limitations highlight fruitful directions for impactful extensions illuminating

the human dimensions of the global sustainability transformation unfolding within the energy sector and beyond. With climate urgency increasing, organisations must harness their human capital resources to optimise the inevitable transition ahead.

6.4 Research Gaps

The oil and gas industry faces immense change pressure as the global energy landscape shifts towards renewable sources. However, research into managing this transition appears limited in several aspects:

More research is needed to understand how frontline workers, middle managers, and executives are experiencing and coping with the transition. Qualitative studies could provide insights into sentiments, uncertainties, and knowledge gaps across different roles. Further research should identify optimal mechanisms for reskilling current employees and developing new talent for renewable energy. Assessing the effectiveness of training programs, partnerships, and recruitment channels could help refine approaches. Studies should also examine leadership competencies and behaviours that are most effective for guiding organisations through the sustainability transition. New styles of leadership for the renewable energy context need to be explored.

Additional research should track how company culture and employee behaviours evolve as fossil fuel firms embrace renewable energy. This can elucidate culture gaps and change management needs. Furthermore, more research is required to evaluate the influence of different policy instruments like carbon pricing, subsidies, local content rules etc. on the speed and success of the energy transition across geographies. Filling these research gaps can provide human resource, change management, and leadership insights to facilitate the critical transition towards sustainable energy. Both qualitative and quantitative studies are needed to develop evidence-based guidance for navigating this transformation.

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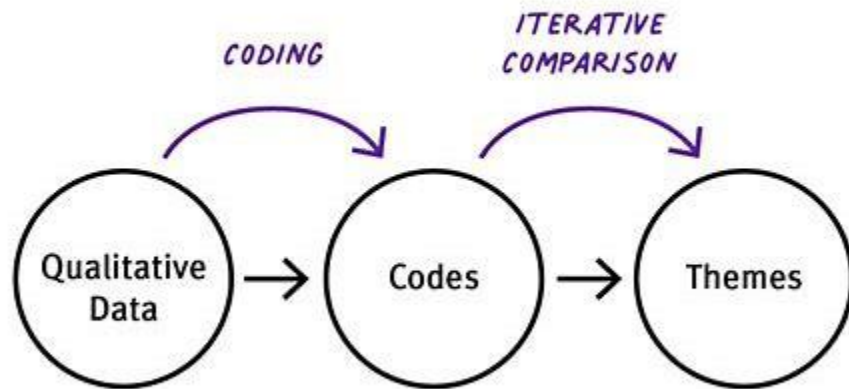
APPENDIX A

THEMES TABLE

Table 1 Themes Table

N/O	Themes	Prevalence	Sub-Themes
1.	Sustainability	77% (27)	Renewable energy, climate change, global warming, decarbonization, environmental degradation, corporate social responsibility.
2.	Change	85.71% (30)	Change management, resistance, stakeholders, leadership, communication, employee engagement, collaboration, effective communication.
3.	Competence	51% (18)	Skills gap, upskilling, reskilling, training, coaching, mentorship, continuous learning.
4.	Profitability	28% (10)	Performance, innovation, sustainability, life-work balance, competence, engagement, satisfaction, commitment, motivation, research and development, competitive advantage.
5.	Ethics	62.9% (22)	fairness, equity, employee well-being, CSR, working conditions, employee rights, and open communication.

APPENDIX B

THEMATIC ANALYSIS GRAPHIC

INTERVIEW QUESTIONS

The purpose of these interview questions is to obtain opinions from oil and gas industry participants in order to develop a thorough grasp of HRD's function within the framework of the switch to renewable energy.

1. Could you elaborate on your position and duties in the oil and gas industry, especially with regard to HRD and energy transition programs?

2. What major obstacles do you think the oil and gas sector is facing as it moves towards renewable energy sources?

3. What part does HRD play in the way how your company is currently preparing its workforce for the switch to renewable energy?

4. Could you elaborate on any particular HRD initiatives or plans that your company has put in place to help with the switch to renewable energy?

5. What are the most important competencies and skills you think workers in the oil and gas industry need to have during this shift, and how is HRD meeting these needs?

6. What part, in your opinion, should HRD play in fostering an environmentally conscious and sustainable culture within the oil and gas industry?

7. What role does HRD play in your organisation's promotion of innovation and research in renewable energy technologies?

8. Could you give instances of any HRD initiatives that have been effective in your industry and have resulted in a workforce that is more environmentally conscious and sustainable?

9. Which HRD issues have arisen most frequently during the switch to renewable energy, and how have they been resolved?

10. In order to align with the goals of renewable energy, how does HRD assist in identifying the knowledge gaps and learning needs of employees in the oil and gas sector?

11. Which HRD best practices have you seen work well to facilitate the switch to renewable energy sources, either through observation or application?

12. Which HRD initiatives or tactics have proven successful in keeping and growing talent in the oil and gas industry during this shift?

13. In what ways does HRD complement the various renewable energy technologies (like solar, wind, or hydropower) and how are they integrated into the oil and gas industry?

14. Could you elaborate on how HRD helps your company maintain safety and compliance in the renewable energy industry?

15. How, in your opinion, does HRD support the oil and gas industry's efforts to manage change and adapt to new technologies and objectives?

16. Which HRD initiatives or tactics have proven successful in keeping and growing talent in the oil and gas industry during this shift?

17. What part does HRD play in encouraging inclusion and diversity in the oil and gas sector?

18. How does HRD bridge the gap between technical expertise and business acumen to ensure that technological advancement translate into commercial success in the renewable energy market?

APPENDIX D

SURVEY COVER LETTER

Dear organisations Employee,

I am conducting academic research on the transition to renewable energy currently underway within Oman's oil and gas sector. Your experiences and perspectives as an employee at organisations during this shift can provide valuable insights. You are invited to participate in this study by completing the attached survey focused on understanding Organisation'sstrategic, operational, and workforce changes related to adopting renewable energy.

The survey should take less than 10 minutes and your participation is completely voluntary. Your responses will remain anonymous and no individual respondent will be identified in any research report. Only aggregated results will be analysed and shared with organisations leadership so they may consider implications for policy and practice. The data is collected solely for academic research purposes as part of my university thesis project. However, your views can help shape an understanding of the opportunities and challenges encountered during renewable energy transitions in Oman's leading energy enterprise.

Please contact me at [email address] if you need any clarification or have additional thoughts to share beyond the survey. I appreciate your consideration of this request and thank you for the vital role you play in Organisation'semerging renewable energy endeavours.

Best regards,

[Name]

[University details]

INTERVIEW GUIDE

Interview Guide: Renewable Energy Transitions in Oil and Gas

Date & Time:

Interviewer:

Interviewee & Position:

Opening Comments:

Thank you for your willingness to participate in this interview focused on human resource development and the transition to renewable energy within the oil and gas sector. As outlined in the consent form you signed, this interview should take 40-50 minutes and will be kept confidential with your responses anonymised in any research reports. Do you have any questions for me before we begin?

[Answer questions]

Guiding Questions:

1. What is your role in the company with regard to the renewable energy strategy and/or workforce planning? (Adapt wording as needed per interviewee's position)

2. What are the biggest challenges and opportunities you're facing around the transition?

3. How is the company providing support, training or incentives to employees during this energy transition?

4. What key knowledge and skills do you think the workforce needs to cultivate to accelerate the adoption of renewables?

5. What innovations in policy or programs could make your job easier as you lead a team/initiative facing down the renewable transition?

6. If you had limitless resources, what would you invest in with respect to renewable energy and the workforce?

Probing Follow-Up Questions:

[As needed, prompt for concrete examples, implementation details, early impacts/results, collaboration opportunities, recommendations, lessons learned etc. to fully elicit their experiences.]

APPENDIX F

FORM OF INFORMED CONTENT

Study Title: Examining the Impact of HRD on the Success of Renewable Energy Transitions in the Oil and Gas Industry

Researcher: [Name and credentials]

☐ I confirm I have read and understand the information sheet for the above study and have had the opportunity to consider the information and ask questions which have been answered satisfactorily.

☐ I understand that my participation is voluntary and that I am free to withdraw at any time without giving a reason. If I withdraw within 4 weeks of participating, my data will be removed from the study.

☐ I agree to audio or video recordings of the research interviews. I understand only the research team will have access to the recordings which will be kept in a secure location then destroyed after transcription.

☐ I understand that anything I say will remain confidential and anonymous unless it is thought that there is a risk of harm to myself or others, in which case the principal investigator may need to share this information with appropriate authorities.

☐ I agree that research data gathered from me during participation may be stored anonymously and securely, and may be used for future research studies pending ethical approval.

☐ I understand that the information I provide will be used for a paper, thesis, or dissertation, and academic articles and I consent for it to be used in this manner.

☐ I agree to take part in the above study.

_____   _____
_____

Name of Participant   Date   Signature

_____   _____
_____

Lead Researcher   Date   Signature

Once signed:

- 1 copy to be retained by Participant

- 1 copy to be retained by Lead Researcher

Contact Details:

Any concerns about this study should be directed to the lead researcher via the contact details provided on the information sheet.