Strategic Commitment by Sultanate of Oman towards 2050 Net-Zero Emission: Current Environmental Initiatives and Future Needs

Issa Alrawahi[1], Vathana A.P Bathmanathan[2], Sultan Al Kaabi[3*], Samar Alghalebi[4]

[1]*Air Traffic Operations Manager, Etihad Airways, United Arab Emirates*

[2]*Senior Lecturer Universiti Tenaga Nasional*

[3]*Operation Base Manager, KWMS, Sultanate of Oman.*
Email: kaabisultan@hotmail.com

[4]*Energy Trainer (CEM) & Consultant United Arab Emirates*

Abstracts: Global warming is a major concern to humanity due to its massive environmental impact. Studies emphasize low-carbon issues such as emissions policy, carbon taxation, carbon emissions trading, and emissions accounting and reduction (Gao et al., 2014). This paper will cover one of the main commitments towards environmental protection, which is 2050 net zero emissions. Many countries have set this target to show a clear commitment to reducing their CO2 and other greenhouse gases (GHGs) to zero in the coming 30 years. Yet the main question here would these targets be aspirational or realistic? If the goals are aspirational, does this encourage more effort, or will it make the public and investors even more critical of the government if they fail? How does the mission to maintain average temperature increases below 2C or, preferably, 1.5C by 2100 relate to the net zero by 2050 goal? In October 2022, Oman joined the current effort to protect the environment and reach net zero by 2050. The country has already implemented many environmental measures; however, more effort is required to achieve the net-zero emission target. In addition, the paper will outline and investigate the current global efforts to meet the commitment. Also, it will cover the current environmental work conducted in Oman. The paper will also evaluate the challenges and requirements to reach net zero in Oman.

Keywords: Sustainability, Net Zero Emission, Emission Reduction, Carbon Neutrality, and Climate Change.

1. INTRODUCTION

The net-zero emission target is a significant commitment to reducing climate change's impact. However, this commitment is challenging (Ekardt et al., 2018). The United Nations (2022b) indicated that net zero emissions could only be achieved if humans transformed how they produce and consume. Many counties, organizations, and businesses joined the commitment to reach the net zero target. According to the United Nations (2022b), more than 70 countries, including the biggest polluters, have committed to meeting net zero emissions. Net zero emissions will be achieved by reducing human-made emissions dramatically through low reliance on fossil fuels, using cleaner energy, and reducing food waste (United Nations, 2022; Rogelj et al., 2022). Also, clearing the air of carbon is another key strategy to reach the net zero target. This strategy can be achieved by planting more trees and using emerging technologies to absorb the carbon from the air and store it on the ground (Gabrielli et al., 2020).

2. PROBLEM STATEMENTS

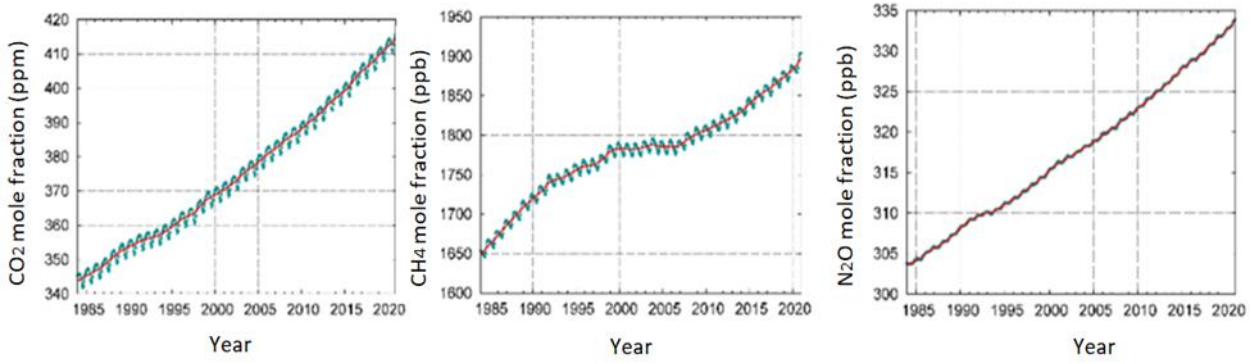
Climate change occurs due to the increased Earth temperature, mainly caused by human activities such as the high use of fossil fuels (Trenberth, 2018). The Paris Agreement created a roadmap to ensure that Earth's temperature increase does not exceed 2°C above pre-industrial levels (Arora & Mishra, 2021). Many states announced a net-zero emissions commitment in alignment with the Paris Agreement (United Nations, 2022b). Although the commitment is very promising, meeting the target by 2050 will be challenging (Deutch, 2020).

The main problem with the net-zero emission target is that the currently implemented green initiatives and committed strategies are in sufficient to meet carbon neutrality by 2050. United Nations (2022b) argued that with the currently available National Action Plan (NAP) for 193 countries, GHGs are expected to increase by around 10.6% by 2030 compared to the 2010 level. Oman recently joined the net zero emission target, which means more work, is required to gain knowledge about the requirement, identify challenges, and update its NAP to meet carbon neutrality by 2050. The high cost of shifting to green options, the lack of regulations and policies to support the

transition and possible resistance from consumers are some of the barriers that may slow the process toward net zero emissions (Environment Authority, 2022). If fully implemented, National net zero emission goals may bring the Paris Agreement temperature goal within reach by dropping best estimates of predicted global average temperature increase to 2.0-2.4 °C by 2100. 131 countries, contributing to 72% of global emissions, are considering, proposing, or adopting net zero targets. Comparing expected warming to existing policies (2.9-3.2 °C) or pledges made to the Paris Agreement (2.4-2.9 °C), these initiatives could significantly reduce it (Höhne et al., 2021)..

3. CLIMATE CHANGE

Climate change is related to long-term changes in weather and temperature (United Nations, 2022a). Human activities, mainly the high use of fossil fuels, are key contributors to climate change (Trenberth, 2018). Carbon Dioxide (CO2), Methane (CH4), and Nitrous Oxide (N2O) are emitted when burning fossil fuels (World Metrological Organization, 2021). Those GHGs increase the Earth's temperature by trapping the heat. The concentration of those gases has increased dramatically since 1985, as shown in Graph 1.



Graph 1. CO2, CH4& N2O concentration, 1985-2020.
Source: (World Metrological Organization, 2021) (https://library.wmo.int/doc_num.php?explnum_id=10859)

According to the World Meteorological Organization (2021), the Earth's temperature was 1.08 ± 0.13 °C above the 1850–1900 average. Also, between 2013 and 2021, the sea level rise rate increased and reached 4.4 mm per year. Those two elements are the main indicators of climate change. Climate change is a major threat to humanity; it can affect biodiversity and lead to natural disasters (Kumar, 2021). Currently, there is a global focus on climate change; achieving net zero emissions is one of the key commitments toward fighting climate change (Scott et al., 2016).

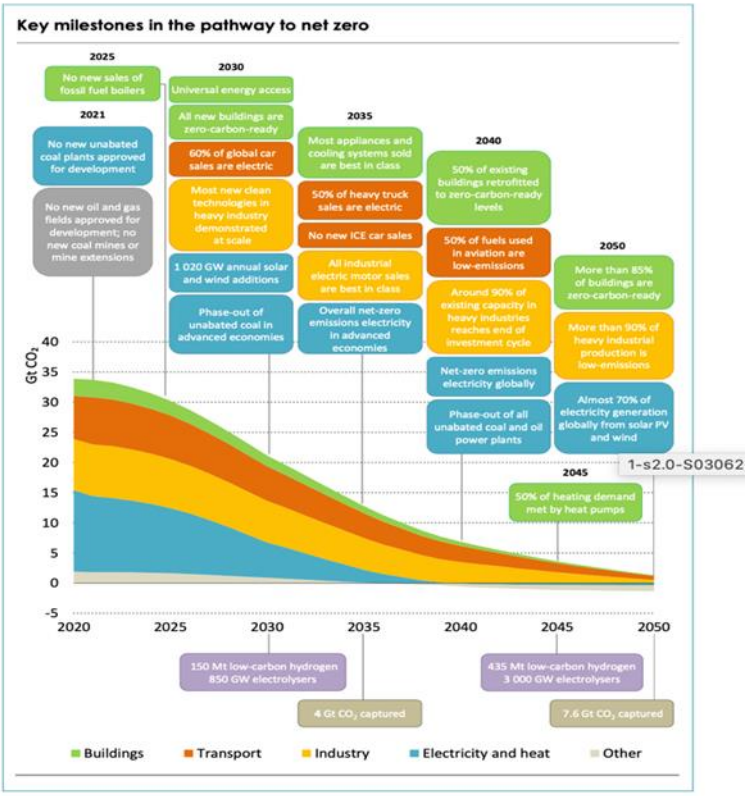
3.1. What is Net Zero?

Net zero emission: achieving a balance between greenhouse gas emissions created and emissions removed from the atmosphere. The United Nations met in Paris in 2016 to set a global warming limit (Joeri Rogelj et al., 2021; Davis et al., 2018), prompting world leaders to focus on greenhouse gas emissions to maintain net zero emissions. It has recently emerged as a hot topic, with all business sectors focusing on reducing CO2 emissions (Su et al., 2022) and other factors contributing to global warming (Davis et al., 2018). Zero carbon programs are receiving strong support from climate leaders. Leading private companies and organizations have committed to net zero by 2050.

Promoting net-zero emissions (Van Soest et al., 2021) has encouraged organizations and countries to start contributing in this field. Oman joined this commitment and started implementing it in some fields where possible, ensuring all concerned parties are progressing well. The goal of net zero is not an end. They represent significant first steps toward achieving future net-zero emissions goals. Although few targets do so directly, it is the most effective method for achieving net zero (Joeri Rogelj et al., 2021). Promoting net-zero emissions requires massive collaboration between countries and organizations to achieve such a target.

4. GLOBAL EFFORT TOWARD NET ZERO

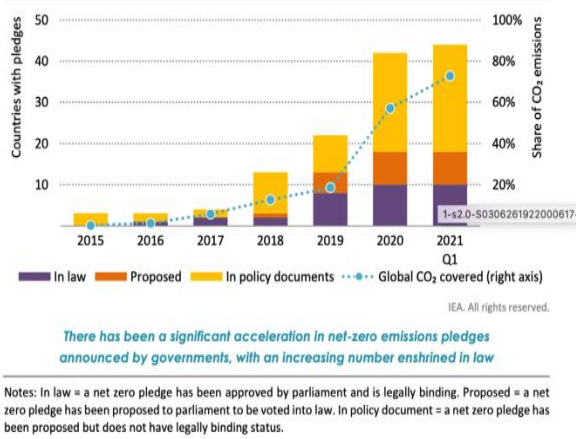
Net-zero emissions policies or neutrality have been set or are being considered in more than 100 countries around the world. Most of the data on emissions neutrality, including time information, is provided at a global scale. Recently investigate show that analyses of current promises and actions by countries to limit climate change have concluded that they are by far insufficient to meet the goal of the Paris Agreement to limit global temperature increase to well below 2°C, while pursuing efforts to limit it to 1.5 °C (Höhne et al., 2021). Some countries have already started the process toward the net-zero emission target. For example, the UK government created a clear strategy to achieve this commitment (Energy Saving Trust, 2021). The strategy focuses on reducing emissions in different sectors, removing carbon from the air, and creating awareness among the public about green choices (UK Government, 2021). Also, globally, there is a high focus on the use of electric cars to reduce CO2 emissions (Greene et al., 2020). Fossil fuel is gradually replaced by clean energy, which includes biofuels, windmills, and solar energy (Van Soest et al., 2021).

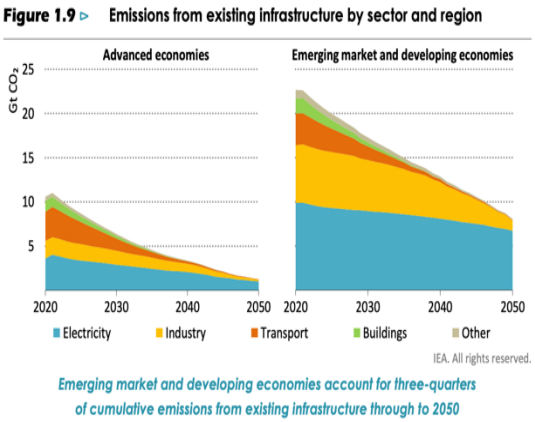


Graph 2.
Source: IEA https://www.euronuclear.org/news/iea-report-netzero-2050-roadmap-global-energy-sector/

Some nations suggest concentrating on industries or geographical regions when putting policies into place to meet their net-zero targets. For instance, Spain prioritizes a variety of topics, such as urban planning, sustainable alternative fuels for air travel, low-emission automobiles, renewable energy, and energy efficiency (Government of Spain, 2021). Iceland must reduce emissions across all sectors and increase carbon removals from the atmosphere, particularly through reforestation, revegetation, restoration, and carbon sequestration in rock formations (Government of Iceland, 2021). To reach their net-zero goal, several nations implement sectoral emissions caps or carbon budgets. For instance, Germany has set annual reduction goals for important industries (energy, transportation,(Jeudy-Hugo, 2021). The global economic and environmental pathways are significantly influenced by the rapidly expanding economies of Brazil, Russia, India, China, and South Africa (BRICS). They

have very carbon-intensive economic systems, which considerably dramatically increase global emissions of greenhouse gases (GHGs), causing climate change. BRICS have however entered the race to achieve net-zero emissions by 2050 in the pursuit of a sustainable and climate-neutral global economy. However, there are obstacles and chances along the way (Chapungu et al., 2022).





Source: IEA 2021: https://iea.blob.core.windows.net/assets/deebef5d-0c34-4539-9d0c-10b13d840027/NetZeroby2050-ARoadmapfortheGlobalEnergySector_CORR.pdf.

Following these estimates, India and Indonesia may reach domestic net zero greenhouse gas and CO2 emissions ten years after the world average, whereas Brazil and the United States will do so after. These outcomes depend on decisions like how to account for emissions from land use. The findings also demonstrate that the capability for carbon storage and afforestation, income, the proportion of non-CO2 emissions, and emissions from the transport sector all have an impact on the variation in anticipated phase-out years between nations (Van Soest et al., 2021). Recently study showed The LEAP modeling findings show that the ASEAN power sector may achieve net-zero status by utilizing nuclear power and the region's substantial renewable energy potentials alone, without the assistance of other sectors' carbon offset programs (Handayani et al., 2022).

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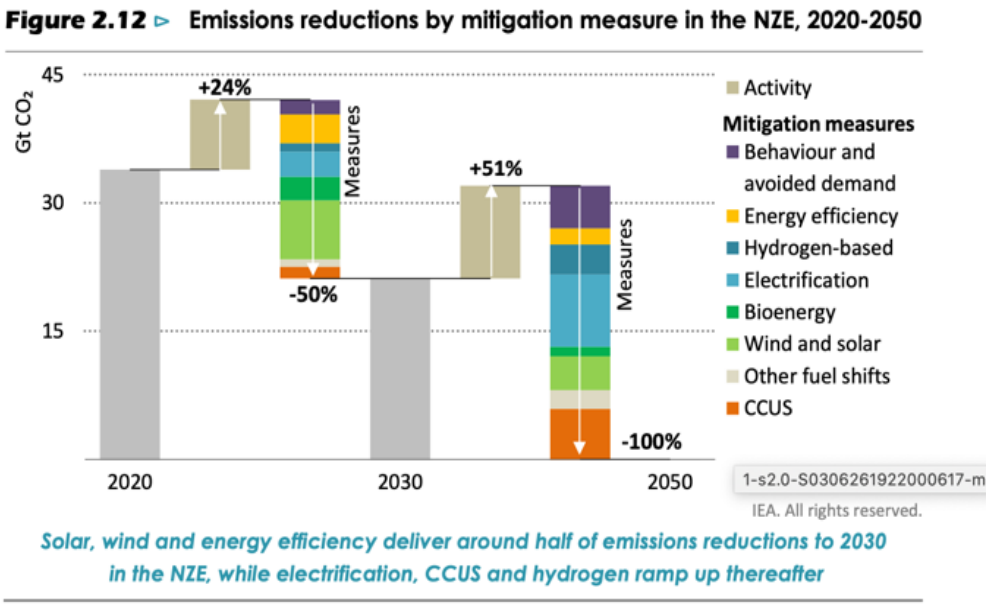

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5. OMAN GREEN COMMITMENTS

Oman is very vulnerable to climate change due to its unique location. The country is located near the Arabian Sea and the Indian Ocean; any sudden change in weather due to climate change may lead to disasters (Ahmed & Choudri, 2012). Oman's net emissions as of 2021 were over 90 Mt CO2e, with five sectors industry, oil and gas, power, transport, and buildings contributing roughly 95% of the country's net emissions. Oman's emissions are expected to rise by 16% to 104 Mt CO2e by 2050 if it doesn't act now. SLFC emissions totaled 38,268 Gg in 2015, making up 38.8% of the country's GHG emissions. These emissions are predicted to increase dramatically over the following ten years, reaching 67,777 Gg by 2030. The results of the investigation show that the major and vital economic sectors like the oil and gas industry, heavy road transportation, residential air conditioning (RAC), and industrial refrigeration are the sources of Oman's very potent SLCF emissions (Charabi, 2022).

The Omani government understands the importance of environmental protection to reduce the impact of climate change. The government committed to reducing its GHGs by 7% by 2030 and increasing the use of clean energy by 30% by 2040 (Oman Government, 2021). Also, Oman has participated in many environmental conferences and agreements to support the current global work in this area (Al Buloshi & Ramadan, 2015).

Oman has lately joined the net-zero emissions commitment. The target was announced by His Majesty Sultan Haitham in October 2022 (Aldroubi, 2022). This shows a clear commitment toward meeting net zero emissions from the top leaders in Oman. Oman's center for sustainability has been established to create a national road and ensure the implementation of required strategies to meet carbon neutrality (Ona, 2022).

By 2050, Oman might take several different routes to net zero. Oman has defined five goals for its approach to ensure a seamless and sustainable transition: environmental sustainability, energy system costs, economic impact, social impact, and supply security (The sultanate of Oman's National strategy for an orderly transition to net zero).

6. OMAN SUSTAINABLE ROADMAP TO ACHIEVE NET ZERO BY 2050

Recently, Oman has realized that a shift is required to achieve net zero. Several incentives, policies, and programs have been announced as part of the Sultanate of Oman's national strategy for an orderly transition to net-zero Oman. By 2050, Oman will really employ a variety of approaches to achieving net zero. Oman has defined five criteria for its approach to ensure a quick and sustainable transition: environmental sustainability, energy system costs, economic impact, social impact, and supply security. As variables in Oman's transformation, there are three basic archetypes: orderly, expedited, and delayed routes.

1. Orderly transition path: An orderly transition path might help Oman reduce 97 Mt CO2e by 2050 with decarbonization beginning in 2030 and 2040, which together make up 6% and 54% of the whole pathway in relation to 2021 emissions, respectively. Transportation, oil and gas, and industry would be the driving forces behind these endeavors. The six main decarbonization technologies Oman has identified in their strategy target of 2050 that would aid in a smooth transition are energy and resource efficiency, electrification and renewable energy, battery electric technology, sustainable hydrogen, carbon capture and storage, and negative-emission technologies. Through 2050, these technologies would contribute around 90% of the required decrease. Yet, achieving the decarbonization goals would need the creation of new technologies (such as long-duration energy storage), an increase in adoption levels (such as the uptake of electric vehicles), and the introduction of regulations, laws, and market mechanisms (e.g., carbon pricing). Oman's orderly transition path to net-zero greenhouse gas emissions by 2050 involves a comprehensive and integrated approach that balances economic development and environmental goals. By setting targets, developing a national framework, increasing renewable energy, improving energy efficiency, investing in carbon capture and storage, and engaging stakeholders, Oman aims to achieve its climate and sustainability goals while promoting economic growth and social well-being.

2. Delayed transition path would postpone the deployment of the most cost-effective emissions reduction measures while allowing export sectors to continue functioning for as long as possible. Two of the five objectives reduced energy system costs and a negative economic impact would be best fulfilled by sticking with this route. Yet, a postponed transition pathway may eventually result in stranded assets and missed opportunities in future green value pools. delaying the transition to a low-carbon economy could have negative impacts on Oman's environment,

economy, and society. To avoid these impacts, it is crucial for Oman to prioritize and accelerate its transition path towards a low-carbon economy by setting more ambitious targets, enhancing policy frameworks, increasing financial support, and developing partnerships.

7. OMAN DECORBINZATION AND MITGATION POLICY GAP

It is challenging to achieve the goal in the time that the government announces it, but due to the high effort from government and industry, it might be achieved if everything goes well. This section will discuss the main challenges that Oman faces in reaching net-zero emissions.

- Scaling capital: this will impact heavy industry investment and spending in this field due to the restrictions of zero emission (Davis et al., 2018). They are diametrically opposed works, and finding solutions that satisfy both parties is extremely difficult.

- Enabling policies and regulations: modifying them so that they work in tandem with economic incentives to guide and support clean energy innovation (Stern & Valero, 2021). Maintaining regulations that will force the organization to move forward with zero emissions will reduce the challenge at this part.

- Demand for low-emission products: this is one of the most challenging parts for the public, as most of the time the low-emission products are very expensive compared with the other substitutes (Ruttinger et al., 2021). Governments support that by setting taxes on other goods and implementing regulations that will lead individuals to move forward with low-emission goods.

- Infrastructure access: Changing the current structure to support net-emissions requires significant investment (Greene et al., 2020). The design of urban cities did not consider the future shift to reduce emissions or stop using current methods.

8. RECOMMENDATION

To reach net-zero emissions by 2050, governments, communities, organizations, and stakeholders must concentrate on removing the obstacles while making use of the opportunities provided by technological advancements. Governments are key players in achieving the net zero emission target (Sachs et al., 2019). Thus, Omani government needs be very active in promoting and implementing initiatives that support the commitment. Having the support of high political leaders assists in speeding the process and removing possible constraints (Sasse et al., 2020).It is critical to emphasize that the COVID-19 pandemic has delivered a message to the status quo, underscoring the importance of reconsidering and reinstating values and norms that are based on systemic sustainability considerations throughout the whole economy. The motivation to develop transformational and ambitious policy tools and initiatives that help bring in net-zero by 2050 may come from a shift in norms, attitudes, and perceptions. The policies and strategies will be positioned strategically to benefit from prospects for low carbon development following COVID-19 (Chapungu et al., 2022). The net zero commitment in Oman was signed and declared by his majesty Sultan Haitham which shows strong support from the top leader in Oman. Some of the main requirements from the Omani government to ensure that the country meets the 2050 net zero targets are:

Creating actions plan with clear timelines: Reaching net zero is a challenging task and required clear plan and contribution from all sectors (Rogelj et al., 2021). Thus, Omani Government needs to set a plan with specific timeline for sector to meet agreed milestones. *Creating new policies and regulations*: Oman government is required to set certain green standards for all industries. Also, there should be clear policies and regulations to support the required contribution of each sector.

Providing financial support: Currently, there is high reliance on fossil fuel Oman; thus, moving towards renewable energy requires a lot of investment. Also, the cost of implementing the current and new technologies will require full financial support from Omani government. *Increasing awareness:* The net zero can only be achieved if there was a clear commitment and corporation from all the related stakeholders which includes companies, regulators and public (Sasse et al., 2020). Thus, Omani government needs to increase awareness about this commitment and how each party can contribute towards the net zero targets. *Effective Coordination between different government units:*

Meeting the net zero commitment can only be achieved if all the governments' ministries and units work together. Thus, it is vital to include all unites when creating plans and strategies to meet the commitment.

8.1 Discussion of Findings

Net zero emission by 2050 is becoming a global target to reduce the impact of climate change. Global net zero calls for the total eradication of CO2 emissions as well as eventually all other GHG emissions, particularly CH4 and N2O, from all end-use sectors. It entails fundamentally reorganizing the world's energy system for all energy-related uses, including power, transportation, industrial and manufacturing processes, buildings for residential and commercial use, and forestry, agriculture, and husbandry. Due to the extent of the investment needed to implement the changes, as well as the sheer volume of the activities that account for a sizeable portion of the global GDP, it is a massive project.There are significant international trade flows that transport fuels, products, and services between all countries that have various economic, political, and social systems. The location of emissions is affected by these flows. Another challenge is sent by time. the size of the modification required; in this study we covered the current work conducted by Omani government towards environmental protection. The announcement of his Majesty Sultan Haitham in 2022 was the first step towards net zero emission in 2050. Some of the main challenges that may face the Omani government are the high cost of the environmental products, lack of policy and regulation, low awareness, and possible resistance from consumers. To have a successful implementation of the target, Omani government is required to create a clear plan with specific timeline for each sector, provide financial support, increase awareness, and ensure effective coordination between different governmental units.

8.2 Conclusions

In conclusion, all countries with various economic, political, and social systems engage in substantial international trade flows that transport fuels, goods, and services. Where emissions occur is influenced by these flows. Time presents a challenge as well. Thirty years is a very brief period at the scale required for change. However, quick little movements and acts can bring transformations. Many net-zero promises that have been proposed so far serve as positive signals of intent. However, as they are now written, net-zero aims have a wide range of features, and there is little information on the precise steps to take to realize these goals. Different results and timelines for achieving net-zero globally may result from the different approaches taken by nations to meet their net-zero targets, including the terminology used, the greenhouse gases (GHGs) and sectors covered, the timeframe, and the balance between emission reductions and removals. Individual net-zero aims run the risk of being insufficient to meet the overall goal without careful attention to such details. Oman's transformation to achieve net-zero greenhouse gas emissions by 2050 involves an orderly and comprehensive approach that balances economic development and environmental sustainability. By setting ambitious targets, developing a national framework, increasing the share of renewable energy, improving energy efficiency, investing in carbon capture and storage, and engaging stakeholders, Oman aims to achieve its climate goals while promoting economic growth and social well-being.

8.3. Future Studies

Many concerns remain unanswered, including what net-zero implies, how different actors' net-zero ambitions relate to one another, and - most importantly - what strategies, policies, and changes are required to achieve net-zero globally by about 2050. Achieving net-zero presents a variety of opportunities and difficulties for different industries and nations, as well as a variety of risks and uncertainties, such as those relating to future technologies and the availability of land.

We find the need to study on the gap between net-zero commitments and actions being implemented in the near term and more research to explores countries' net-zero emissions targets that have been adopted in law, proposed in legislation, or reflected in national policy documents to better understand their characteristics, similarities and differences.

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DOI: https://doi.org/10.15379/ijmst.v10i2.1165