Collaborating for Net Zero: Driving the Climate Transition with Geothermal Energy

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Abstract

The Philippines, highly vulnerable to climate-related disasters, faces a critical need to decarbonize its energy sector, which is the leading source of national greenhouse gas (GHG) emissions. While the country has a 75% GHG reduction pledge for 2030, it lacks a national net-zero policy. This study examines the role of the private sector in this transition by exploring the awareness, strategies, and collaborative mechanisms of companies within the Net Zero Carbon Alliance (NZCA) that use geothermal energy. Using a qualitative approach with a written survey of open-ended questions, the study collected data from six NZCA members, predominantly from the manufacturing sector. The findings indicate these companies are committed to achieving net-zero emissions by 2050 or sooner. Their motivations for joining the NZCA include networking, peer learning, and cross-sector collaboration, which have significantly accelerated their decarbonization efforts. Geothermal energy is a central element of their strategies, as it provides reliable baseload power that has substantially reduced their Scope 2 emissions, allowing them to focus on more complex Scope 3 challenges. Companies highlighted that while collaboration through NZCA is vital, a supportive government policy is essential for scaling their efforts. They recommend fiscal incentives, streamlined regulations, and a clear national energy transition roadmap. The results underscore that achieving net-zero goals requires a combination of private sector commitment, technological adoption, and a strong policy environment that fully leverages the potential of geothermal energy for sustainable development.

Keywords: *climate change, cross-sector collaboration, decarbonization, geothermal energy, net zero*

1. Introduction

The Intergovernmental Panel on Climate Change (IPCC) highlighted in its 2018 special report that achieving net-zero emissions by 2050 is crucial to limiting global warming to 1.5°C, in line with the goals of the Paris Agreement, which in turn reduces the catastrophic impact of the climate crisis. This global objective is significant to the Philippines, as the country has ranked No. 1 in the World Risk Report for three consecutive years (2022–2024) as the most vulnerable nation to disaster risk from extreme natural events and the adverse effects of climate change.

As of September 2021, a total of 55 countries had pledged national net-zero emissions targets. Of these, Bhutan and Suriname had already met their targets, twelve (12) had

codified their commitments into national law, and the rest outlined their goals in policy documents. Nearly 60% of the world's 1,977 largest public companies have committed to net-zero emissions (Handayani, et al., 2022). However, the Philippines, unlike other ASEAN countries, does not have a national policy commitment to a net-zero target (Climate Action Tracker, 2023; Climate Analytics, 2023). Nevertheless, as a signatory to the Paris Agreement, the country has pledged a projected 75% reduction and avoidance of greenhouse gas (GHG) emissions by 2030, with 2.71% being unconditional and the remaining 72.29% contingent on financial and technological support from developed countries (CCC & DENR, 2023).

Recent studies indicate that the energy sector is the leading source of GHG emissions in the Philippines, responsible for around 54% of the total. The heavy dependence on fossil fuels, particularly coal and natural gas for power generation has been a major driver of rising carbon dioxide (CO_2) emissions (Tan et al., 2024; Casila et al., 2022). Decarbonizing this sector is therefore critical to achieving the country's 2021 Nationally Determined Contribution (NDC) targets (Dulce, 2024), and prioritizing renewable energy sources is key to this transition. According to Handayani et al. (2022), Southeast Asia possesses abundant renewable energy resources, yet these remain largely underutilized. Their study, using simulations from the Low Emissions Analysis Platform (LEAP), found that reaching a net-zero emissions scenario by 2050 will require ASEAN member states to rapidly harness these untapped resources. This transition involves a significant shift in the energy technology landscape, with variable renewable energy and energy storage playing central roles, alongside a halt to the construction of new fossil fuel-based power plants. Furthermore, LEAP results show that renewable energy and storage technologies are more cost-effective than carbon capture and storage in achieving long-term net-zero goals. In the LEAP model, GHG emissions rise until peaking in 2029, then steadily decline to net zero by 2050.

According to Cariaga (2024), the Philippines is the world leader in geothermal energy. Through decades of combined private investments, government support, and technical expertise, the country has successfully integrated geothermal resources into its power supply, positioning itself in 2024 as the world's third-largest producer of geothermal energy with an installed capacity of 1.952 gigawatts (GW). Despite its achievements, the Philippines' geothermal sector continues to be constrained by critical challenges, including limited stakeholder engagement, substantial financing requirements, and inadequacies in inter-island electricity grid integration (Gabo-Ratio and Fujimitsu, 2020). In 2017, the Philippines ranked as the world's second-largest geothermal power producer with an installed capacity of 1.9 GW (Agaton, 2018), positioned after the United States (2.5 GW) and ahead of Indonesia (1.5 GW) (IREA, 2017). Unfortunately, the Philippines stagnated in this for seven years.

However, according to the Philippine Energy Plan 2020–2040 by the Department of Energy (2021), the clean energy scenario aims to achieve a 35% share of renewable energy (RE) in the power generation mix by 2030, increasing to 50% by 2040. Within this framework, geothermal energy remains the country's dominant renewable source, with production projected to rise from 9.3 million tons of oil equivalent (MTOE; 1 MTOE = ~11,630 GWh) in 2020 to 13.9 MTOE by 2040. This reflects an annual growth rate of 2.1%, accounting for nearly 9% of the total primary energy supply (TPES) by 2040. To further support this trajectory, the government has enabled 100% foreign participation in large-scale geothermal exploration and development. According to the study by Shahzad et al. (2021), the

Philippines has a distinct natural advantage in geothermal resources, making this energy source potentially more cost-effective to develop compared to other renewable options. Integrating geothermal energy into the electricity mix as a substitute for fossil fuels can significantly contribute to carbon reduction and broader environmental benefits. However, it is essential to address and manage the associated externalities, including the release of mercury, hydrogen sulfide, arsenic, and selenium, which are inherent byproducts of geothermal processes. Furthermore, there is widespread recognition that the development of a low-carbon energy sector generates substantial employment, technological innovation, and economic growth through various spillover effects. In this context, it is contended that geothermal energy can play a pivotal role in advancing a sustainable, secure, and low-carbon development pathway, while simultaneously contributing to value creation in both the electricity and manufacturing industries.

Moreover, apart from addressing the impact of the energy sector on the climate crisis, other business activities and operations must be managed, especially those that undergo combustion reactions, involve industrial processes, product use, agriculture, waste management, and have the potential for fugitive emissions. Typically, these systems cannot be handled alone, which is why cross-sector collaboration will be crucial to reach one's sustainability goals. From the research of Jurmu (2021), cross-sector collaboration is formally defined as a synergistic partnership among governmental bodies, businesses, nonprofit organizations, and communities. This framework facilitates the collective sharing of information, resources, and capabilities to achieve a desired outcome that would not be attainable by any single sector independently. Through such collaborative efforts, organizations jointly address complex challenges, including economic development, community capacity building, and environmental sustainability, by strategically merging their assets to formulate comprehensive solutions to pressing social issues.

In response to the urgent need to tackle climate change and work collectively to achieve net zero in the Philippines, this study has been conducted. The results of this paper can provide information to advocates, organizations, and policymakers on the level of awareness among the Philippine private sector about the essentiality of decarbonization, the future-proofing ambitions companies are setting, how they are enabling climate action, and what mechanisms they require to achieve their targets.

2. Methodology

The type of data collection method used in this study is primarily qualitative, and a written survey with open-ended questions is employed to gather the primary data necessary for this research paper. According to Ganesha et al. (2022), surveys are a valuable methodological tool for describing and evaluating populations, phenomena, or events, as well as for measuring responses to concepts, policies, and analyses. Written surveys, in particular, are well-suited for collecting confidential data when direct interaction between the researcher and the respondent is not feasible. Furthermore, the use of open-ended questions is appropriate in an inductive research design, particularly when the researcher has limited familiarity with the phenomenon under investigation. This approach allows for the discovery of new variables and provides subjects the opportunity to express their insights in their own words, yielding a richer and more nuanced understanding of the research topic.

The data for this study were primarily derived from members of the Net Zero Carbon Alliance (NZCA) who consume geothermal energy. A total of six (6) respondents who are willing to share their knowledge, practice, and opinions comprise this paper. The researchers of this study distributed the survey form to the respondents via email.

3. Results and Discussions

Based on the answered questionnaires, the majority of the participants of this paper came from the Manufacturing sector, comprising 50% of the total respondents. Yet, their products and services differ from each other. The remainder of the distribution is illustrated in Figure 1. This also shows that the members of the Net Zero Carbon Alliance are diverse.

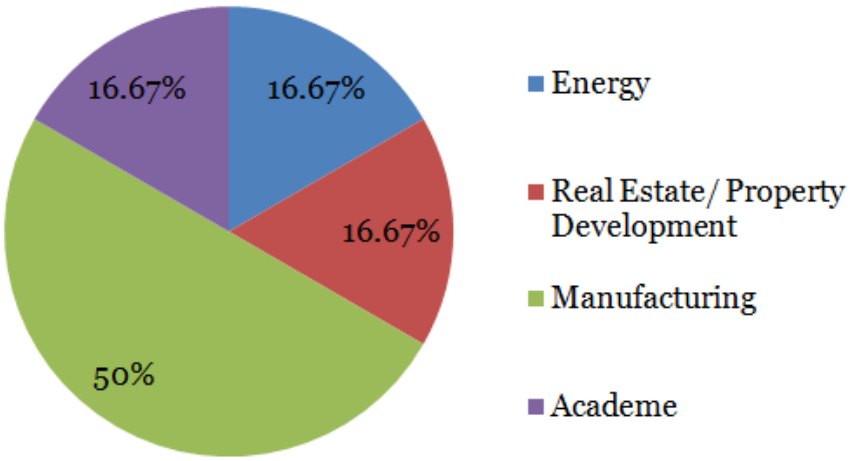


Figure 1. Distribution of the Respondents' Sector

The companies in this study are in different phases of their net zero journeys. The specific stages they are currently in are shown in Figure 2. Relating the findings to the NZCA Framework, all respondents are committed to achieving net zero by 2050, and 50% of them are currently tracking their progress towards this goal. This means that they are continuously measuring their greenhouse gas emissions, planning on how to achieve net zero, and implementing their strategies to attain their targets.

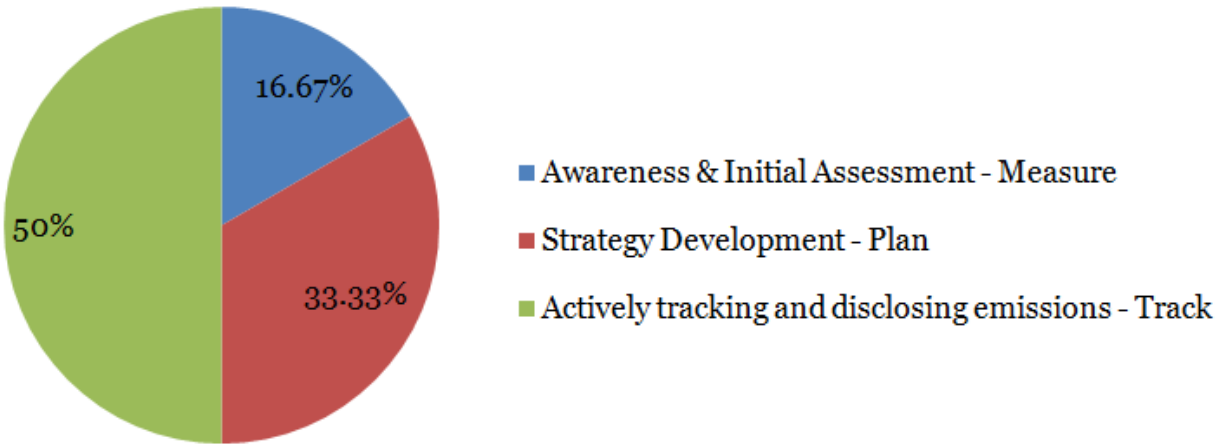


Figure 2. Distribution of the Respondent's Net Zero Journey Phase

Regarding their motivations for joining the NZCA, the majority of respondents identified "Networking and peer learning opportunities," "Demonstrating commitment to sustainability," "Influencing policy and advocacy," and "Desire for cross-sector collaboration" as their primary reasons. Additional motivations are presented in Figure 3, which highlights benefits related to access, support, and credibility. In terms of clarity on their pathways toward achieving net-zero emissions prior to joining the NZCA, 67% of respondents indicated their path was "Somewhat Clear," while 33% described it as "Very Clear" (Figure 4). These results suggest that the private sector already possesses a foundational awareness of net-zero goals and exhibits a strong readiness to act on them.

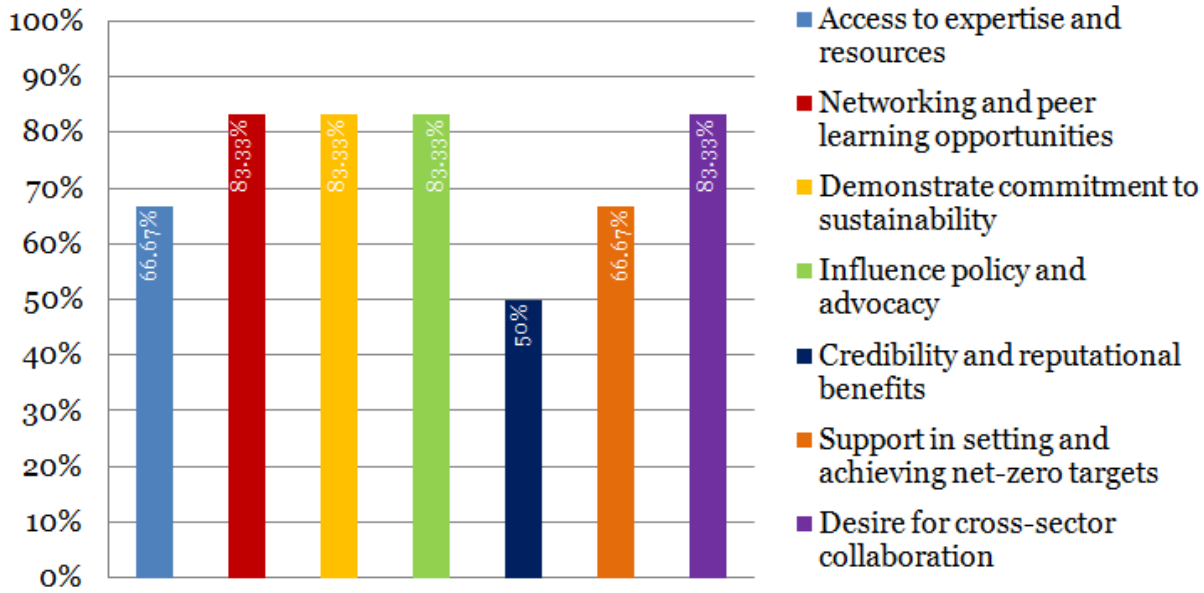


Figure 3. Reasons for Joining the Net Zero Carbon Alliance

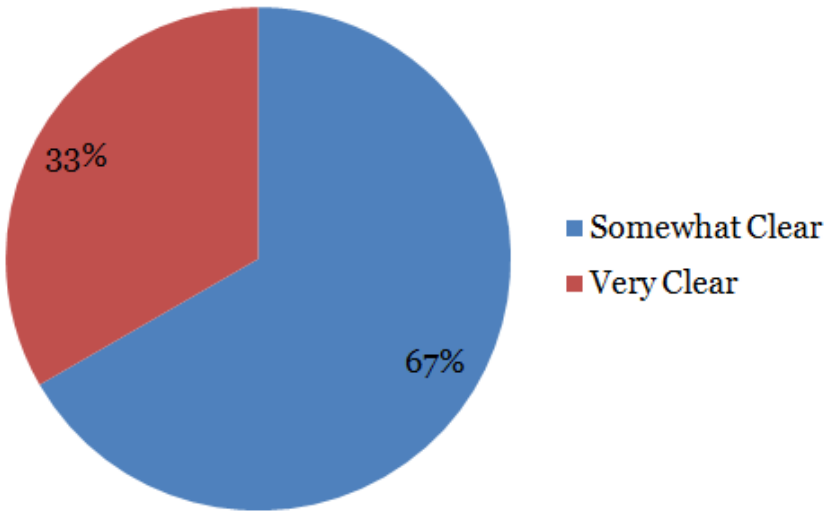


Figure 4. Respondents' Prior Level of Clarity on the Path to Achieving Net-Zero Emissions

Meanwhile, for 83.33% of the respondents, the Alliance's guidance and support have been significantly influential (Figure 5) for them to take accelerated or more confident actions towards net zero. In fact, they were empowered to improve their GHG data gathering, tracking and reporting; finalize their decarbonization roadmap; expand their onsite and offsite renewable energy use like installing solar panels on their rooftops; refine their carbon

offset strategy; advance green building certifications; strengthen internal sustainability capacity such as an institutional "Zero Waste Plan"; collaborate on advocacy and best practices; and to be active in climate action advocacy across private and public sector stakeholders, particularly to drive ambitious NDC setting. Moreover, some respondents already have initiatives towards net zero, where plans and programs have been established based on their company's mission. While their involvement in the Alliance provided valuable validation that they were on the right track, which encouraged them to proceed with a 2050 Net Zero Ambition. In addition, participating in NZCA assemblies, conferences, and workshops has also enabled them to engage their sustainability champions from various departments, fostering stronger alignment and cross-functional collaboration. The collective insights and learnings being gained from these interactions continue to inspire them and build their confidence in executing their sustainability plans effectively.

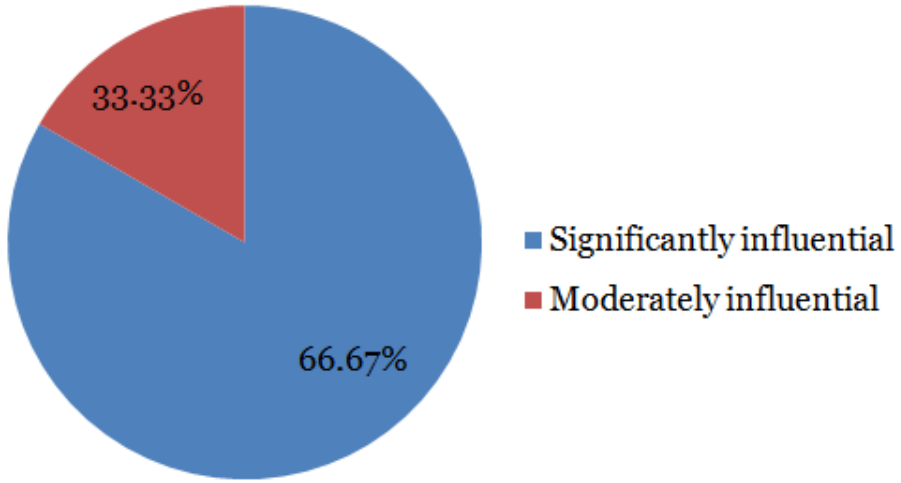


Figure 5. Influence of the Net Zero Carbon Alliance on the Respondent's Organization

The main strategies the respondents are using to reduce/remove greenhouse gas emissions involves reducing their Scope 1 emissions like through Carbon Capture and Storage (CCS) Technology in geothermal operations; reducing Scope 2 emissions by increasing the use of renewable energy in operations (ex. Solar rooftops, solar lamps), and by using low energy consuming equipment and implement energy conservation programs; conducting an assessment to come up with a EV transition plan which includes potential use of hybrid vehicles before full EV, that consists of shuttle services, forklifts and other company vehicles; engaging key suppliers to help reduce their Scope 3 emissions; developing operational efficiency by having ongoing efforts to reduce energy, water, and waste in their production operations through lean processes and 5S practices. Furthermore, some of the respondents prioritize on achieving EDGE Zero Carbon, LEED, WELL, and TRUE Zero Waste certifications; enhancing energy efficiency in building operations; having low-carbon, sustainable materials; offsetting residual emissions through verified sources; engaging employees in sustainability efforts and incorporating tools such as EDGE, GHG inventories and TRUE metrics in tracking their emissions and waste. Others also mentioned exploring renewable fuels for their boilers apart from transitioning to renewable electricity like geothermal and solar; improving process reliability, reducing energy waste, and monitoring material use to minimize food scraps which support their net-zero goals and drive more efficient, low-carbon operations; actively increasing their local sourcing of raw materials that reduces the carbon footprint associated with long-distance transportation and supports the development of more resilient, sustainable supply chains; partnering with local suppliers and

investing in local agricultural ecosystems which cut logistics-related emissions while strengthening their ties with surrounding communities and ensuring better traceability in their ingredient sourcing. Lastly, having continuous refinement in GHG emissions tracking and measurement, as well as a Climate Supplier Programme to enable their partners to commit, track, reduce, and report GHG emissions, are among the ways one of the respondents tackles decarbonization.

Next is the primary driver for adopting the geothermal energy source, which is observed to be "Environmental benefits/ Decarbonization goal," where all respondents cited it as a motive for implementation. The other purpose of the adoption is seen in Figure 6. Then, all respondents reported a total energy consumption of 76-100% from geothermal energy; however, one participant did not disclose this information. Using geothermal energy is stated to have strong alignment with one of the respondents' decarbonization goals, and two emphasized that it supports a significant decrease in GHG emissions, particularly the Scope 2 emissions, and for some, it reduces their energy cost. Although there are also challenges encountered in using geothermal energy, such as the price of geothermal power not being the same across all locations of one respondent's manufacturing facilities, another mentioned that the cost is increasing year-on-year and has limited capacity.

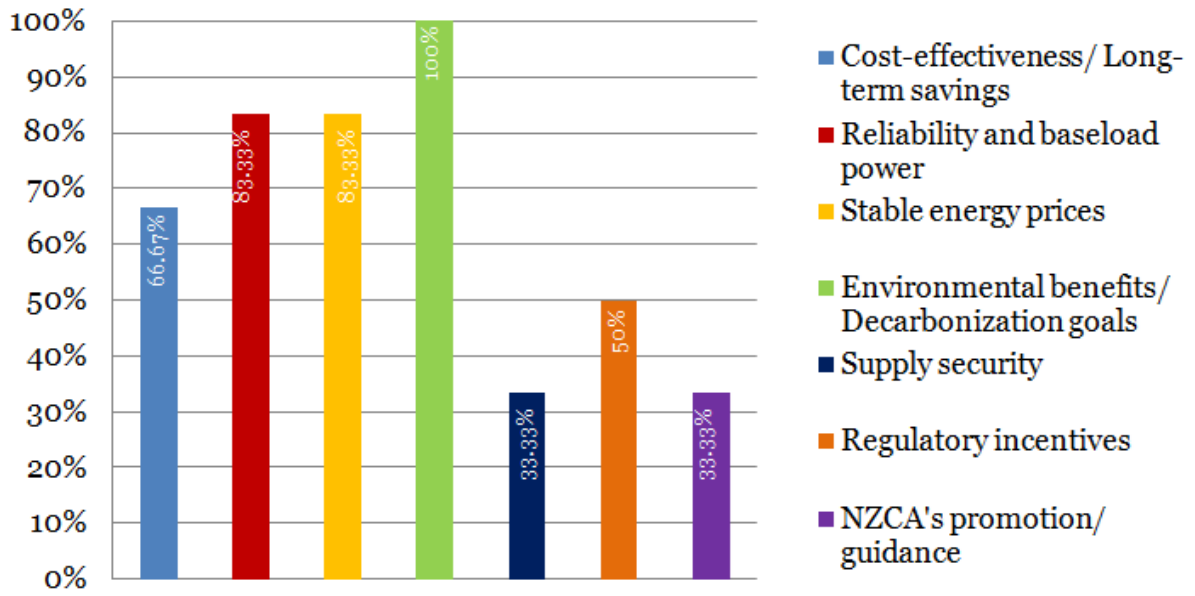


Figure 6. Primary Drivers for Geothermal Energy Source Adoption

Nevertheless, geothermal energy has been pivotal to one of the respondents' journey toward net zero. Through switching to it, they have nearly eliminated their Scope 2 emissions, allowing them to focus more on tackling Scope 3 challenges. It has given them the confidence to communicate their decarbonization progress with credibility and to influence their value chain toward greener practices. The other one stated that transitioning most of their manufacturing sites to geothermal energy since 2022 has helped them to significantly reduce their carbon footprint (vs. 2021 baseline), aligning with their sustainability goals and improving their environmental performance. Although they also recognize that transitioning to a geothermal source of electricity is just part of a broader decarbonization strategy, alongside energy efficiency initiatives, adoption of other renewables, and carbon reduction programs, to holistically lower their environmental impact. While some perceive the adoption as both encouraging and challenging, they see the need to continue and refine their

strategies. Generally, it is acknowledged that geothermal energy is significant in Philippine operations for decarbonizing its emissions and for the world. As mentioned by the World Energy Council (2016), the CO_2 reduction potential of geothermal energy largely depends on a region's energy mix. In areas where fossil fuels dominate the energy system, the use of geothermal resources offers greater opportunities to cut emissions, resulting in a higher carbon reduction factor. Globally, based on the current energy mix and the emissions profile of geothermal power plants, it is estimated that every gigawatt-hour (GWh) of electricity generated from geothermal energy can avoid approximately 380 tons of CO_2 emissions.

Some respondents also indicated that geothermal energy plays a significant role in their transition to Net Zero due to its baseload capability. Truly, one key advantage of geothermal energy over other renewable sources, such as solar and wind, is its stability, as its output is not affected by daily or seasonal variations and remains available year-round. Geothermal has recently been recognized as a high-potential energy source for displacing fossil fuels and supporting clean air and decarbonization goals. In line with this, several studies have been conducted on the development of geothermal resources and their role in reducing greenhouse gas emissions, where forecasts on global geothermal energy deployment project that nearly 195 million tons of CO_2 emissions could be avoided by 2030, assuming all countries meet their development goals and targets (Yousefi et al., 2019). Aside from it being proven clean and reliable for both heating, cooling, and electricity needs, geothermal energy enables the growth of solar and wind energy that are intermittent in nature. It enables businesses to cut carbon emissions without hurting their operations. Another said that geothermal energy provides a scalable, clean energy source, as it is locally available in the Philippines, considering we are located along the Pacific Ring of Fire (Ratio et al., 2018). This reduces reliance on imported fuels and offers a dependable path to decarbonization without compromising productivity and reliability. Overall, it is an important part of any energy transition plan – to use more renewable energy, and since it remains the most developed renewable energy source in the Philippines from the view of one of the respondents, it must be continually supported by the government, private sector, and civil society groups to fight off climate change.

Figure 7 enumerates the ways in which the members of the NZCA engage in cross-sector collaboration, with the top method, as determined by all respondents, being "Knowledge sharing sessions/ workshops". Subsequently, the respondents cited that their respective organizations have gained significant value from cross-sector collaboration through the NZCA, particularly in areas such as shared learning, peer engagement, and joint action. For instance, one respondent partnered with NZCA to set up a booth for their suppliers' conference that enabled both local and foreign vendors to directly engage with the alliance, thereby raising awareness and encouraging value chain alignment with net-zero practices. NZCA's assemblies and knowledge-sharing sessions have also provided practical insights on carbon footprint measurement, carbon accounting, renewable energy procurement, supply chain decarbonization, and credible carbon offset sourcing—learnings that informed milestones such as the EDGE Zero Carbon recertification and improved approaches to managing residual and Scope 3 emissions. Beyond technical knowledge, these collaborations opened new partnership opportunities, strengthened one's ESG initiatives, and allowed them to benchmark against peers while involving NZCA in internal activities, like EnviTalk sessions and tree planting. Altogether, NZCA has enabled the respondents to accelerate their roadmap with greater confidence, reinforcing the value of collective action in achieving net zero.

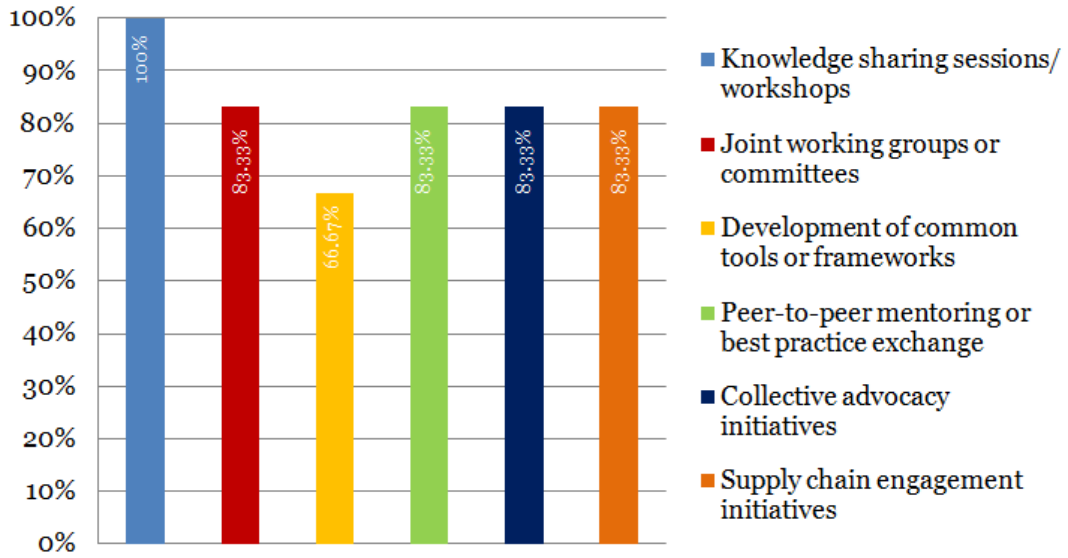


Figure 7. Forms of Engagement in Cross-Sector Collaboration through the Net Zero Carbon Alliance

According to the respondents, the most pressing policy support needed from the Philippine government to accelerate the organization's net-zero journey and promote greater adoption of geothermal energy lies in a comprehensive package of fiscal, regulatory, and institutional measures. Tax incentives for emission reduction initiatives in geothermal facilities, such as Carbon Capture and Storage (CCS) technologies, are essential to ensure economic viability while maintaining competitiveness in the electricity market. Equally critical are enhanced institutional and regulatory support to mitigate exploration risks, provide incentives for industry expansion, and streamline permitting, as also recommended by Ratio et al. (2018) in their study. The researchers indicated that to achieve the Philippines' interim targets for expanding geothermal installed capacity, the government must collaborate closely with private resource developers to fast-track permitting processes and prevent project delays, thereby enabling timely geothermal exploration and construction. Access to green financing mechanisms, alongside fiscal and non-fiscal incentives, would further enable investment in renewable energy technologies. Stronger ESG and emissions disclosure mandates would level the playing field and encourage more companies to take measurable climate action. In addition, government-led initiatives such as geothermal resource mapping, public-private partnerships for pilot projects, and recognition or funding of local and university-led initiatives can accelerate the adoption of geothermal energy. Finally, a clear national energy transition pathway, anchored in just transition principles, sectoral prioritization, and alignment with Paris Agreement goals, including carbon pricing policies, is necessary to create certainty and confidence for businesses to commit to long-term net-zero strategies.

4. Summary and Conclusions

The survey reveals that most respondents are from the manufacturing sector and are at various stages of their net-zero journey, with all committed to achieving net zero by 2050 or earlier. Key motivations for joining the NZCA include networking, peer learning, cross-sector collaboration, and sustainability advocacy, while NZCA's guidance has proven instrumental in enhancing their GHG tracking, decarbonization strategies, renewable energy adoption, and supply chain engagement. Respondents' strategies to cut emissions span reducing Scope

1–3 emissions through renewable energy, energy efficiency programs, CCS technology, sustainable materials, and carbon offsetting, alongside certifications such as EDGE Zero Carbon and LEED. Geothermal energy emerged as a pivotal driver in their decarbonization efforts, offering reliable baseload power, significant Scope 2 emissions reduction, and alignment with sustainability goals, although challenges such as cost variability and limited capacity remain. Cross-sector collaboration through NZCA has facilitated shared learning, peer benchmarking, and partnerships, empowering companies to refine their ESG initiatives and accelerate their net-zero roadmaps. Respondents emphasized that government support through tax incentives, regulatory streamlining, green financing, and a clear national energy transition roadmap is crucial to scaling geothermal adoption and strengthening private sector net-zero commitments.

The findings highlight that while Philippine companies are advancing on their net-zero pathways, strong collaboration through NZCA and decisive government policy support are vital to accelerate progress. Geothermal energy stands out as a cornerstone of corporate decarbonization strategies, but its full potential can only be realized with enabling fiscal, institutional, and regulatory frameworks. By fostering shared learning, incentivizing the adoption of renewable energy, and providing a clear national transition roadmap, both the private sector and government can drive meaningful and collective climate action. Ultimately, achieving net zero in the Philippines requires not just technological shifts but also cross-sector partnerships, policy innovation, and a shared commitment to resilience and sustainability.

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