Int. j. adv. multidisc. res. stud. 2025; 5(5):113-126

Received: 13-07-2025
Accepted: 23-08-2025

International Journal of Advanced Multidisciplinary Research and Studies

ISSN: 2583-049X

Developing Net Zero Tourism in Vietnam Towards Sustainable Development

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Abstract
Vietnam's commitment to achieve net zero carbon emissions by 2050 has profound implications for its booming tourism industry. This study analyzes Vietnam's current tourism policies and technological innovations in the context of "Net Zero Tourism," focusing on concrete policy and technology solutions rather than generic overviews. Through a review of national policy documents, industry reports, and global best practices, we examine how Vietnam's tourism development strategy aligns with sustainability and carbon neutrality goals, and identify gaps and opportunities. We find that Vietnam has integrated sustainable tourism principles into its national strategy, emphasizing green growth and digital transformation, yet explicit pathways to carbon neutrality in tourism remain nascent. Technological innovations – from renewable energy use in hotels and transport electrification to digital tools for efficiency – are emerging in Vietnam's tourism sector, but wider adoption is needed. Global exemplars in decarbonizing transport, greening accommodations, and sustainable destination management provide valuable lessons applicable to Vietnam's context. Key tourism sub-sectors (transport, accommodation, tour operations) and major destinations (e.g. Ha Long Bay, Da Nang, the Mekong Delta) are analyzed as case examples to illustrate challenges and potential net-zero solutions. Based on the findings, we propose targeted policy measures (such as stronger green standards, incentives for low-carbon investments, and inter-sectoral climate policies) and technology-driven strategies (such as expanding renewable energy, promoting electric mobility, and adopting smart systems) to steer Vietnam's tourism toward a net zero future. These recommendations aim to bolster Vietnam's sustainable tourism competitiveness while contributing to national climate goals. The study concludes with reflections on implementation challenges and the need for multi-stakeholder collaboration in advancing net zero tourism in Vietnam.

Keywords: Net Zero Tourism, Sustainable Tourism Policy, Low-Carbon Technology, Vietnam, Green Growth, Decarbonization Strategies

1. Introduction

The global urgency to address climate change has placed unprecedented pressure on all economic sectors, including tourism, to reduce greenhouse gas emissions. Travel and tourism contribute an estimated 8–11% of global carbon emissions, stemming from transportation, accommodations, and tourist activities. As the world seeks pathways to limit global warming, the concept of "Net Zero Tourism" has emerged, calling for tourism development that ultimately produces no net carbon emissions, through a combination of emission reductions and offsets. Achieving net zero is vital not only to meet global climate targets but also to ensure the long-term viability of tourism destinations that are vulnerable to climate impacts. In this context, aligning the tourism sector with carbon neutrality goals has become a priority in both academic research and policy-making.

Vietnam represents a significant case for examining the transition toward net zero tourism. Over the past decade, Vietnam's tourism industry has grown rapidly, making substantial contributions to GDP and employment. This growth, however, has been accompanied by environmental stresses – from rising carbon emissions due to increased air and road travel, to strain on natural resources at popular sites. Recognizing these challenges, Vietnam's government has increasingly emphasized sustainable tourism in national development strategies. In 2021, Vietnam's Prime Minister announced a commitment to achieve net zero carbon emissions by 2050. This national pledge under the Paris Agreement implicitly charges all sectors, including tourism, with developing low-carbon pathways. Indeed, Vietnam's Tourism Development Strategy to 2030 identifies sustainable and inclusive tourism based on "green growth" as a core principle. Policies and initiatives in recent years have

started to encourage green transformation in tourism, such as promoting renewable energy use, waste reduction, and eco-certification in the hospitality industry. However, significant gaps remain in operationalizing "net zero" within the tourism sector. Many current policies focus on broad sustainability goals without yet providing specific roadmaps for carbon neutrality in tourism.

Technological innovation is expected to play a central role in enabling low-carbon and net zero tourism. Advances in renewable energy, energy-efficient building design, electric vehicles, sustainable aviation fuel, and digital smart systems can drastically reduce tourism's carbon footprint. Vietnam, as a developing economy with a young tech-savvy population, has begun to adopt some of these innovations. For example, electric vehicles and solar panels have appeared in certain tourist sites and resorts, and the national carrier Vietnam Airlines conducted its first trial of sustainable aviation fuel in 2023. Additionally, the fourth industrial revolution's digital tools are being leveraged to improve resource efficiency in tourism operations. Yet, the scale of deployment of these technologies in Vietnam's tourism remains limited relative to the need. Moreover, policy frameworks to incentivize and mainstream such low-carbon technologies are still evolving.

Given this backdrop, this paper aims to provide a comprehensive analysis of how Vietnam can develop net zero tourism through focused policy and technological interventions. We specifically examine: (1) the extent to which Vietnam's current tourism policies align with sustainability and carbon neutrality objectives; (2) the state of technological innovations supporting low-carbon tourism in Vietnam; (3) relevant global best practices in net zero tourism that could inform Vietnam's strategy; and (4) concrete policy and technology recommendations tailored to Vietnam's tourism sector. We pay particular attention to key sub-sectors – transportation, accommodations, and tour operations – that are critical to tourism's carbon profile, and discuss regional tourism hotspots (Ha Long Bay, Da Nang, and the Mekong Delta) to contextualize the analysis in real-world examples. By focusing on actionable solutions rather than broad concepts, the study seeks to contribute practical insights for policymakers, industry stakeholders, and academics interested in the nexus of tourism development and climate action in Vietnam.

The remainder of this article is organized as follows. First, we review the literature and policy context, including Vietnam's tourism policies related to sustainable development and global perspectives on net zero tourism. Next, the methodology for our analysis is described. We then present findings in two main areas: policy alignment and technological innovation, each further illustrated by sectoral and regional case examples. This is followed by a discussion that synthesizes the insights, drawing comparisons with international best practices and identifying implementation challenges. Finally, we offer a set of targeted recommendations for policy and technology interventions to advance net zero tourism in Vietnam, and conclude with remarks on the implications of this transition for Vietnam's tourism sector and future research needs.

2. Literature Review and Policy Context

2.1 Global Moves Toward Net Zero Tourism

Sustainable tourism has long been discussed in the context of minimizing environmental and social impacts, but the explicit framing of "net zero tourism" is relatively recent. It reflects a shift from broad sustainability goals to quantifiable carbon targets in line with the Paris Agreement. Worldwide, the travel and tourism industry has begun to coalesce around climate action roadmaps. The World Travel & Tourism Council (WTTC) and the United Nations World Tourism Organization have encouraged tourism businesses and destinations to halve emissions by 2030 and reach net zero by 2050. Initiatives such as the Glasgow Declaration on Climate Action in Tourism (launched in 2021) urge signatories to develop climate action plans that align with the global net zero timeline. These global efforts recognize that tourism's carbon footprint, including indirect supply-chain effects, is substantial and growing – a 2018 study estimated tourism (global travel, accommodation, activities) accounts for about 8% of global greenhouse emissions. Without intervention, tourism emissions could rise further with industry growth; one projection warned tourism-related emissions might reach 6.5 billion tonnes CO_2-equivalent by 2025 (a 44% increase from 2013).

In response, various sub-sectors of tourism have set climate strategies. The hospitality sector has widely adopted Environmental, Social, and Governance (ESG) frameworks and green building certifications like LEED and BREEAM to reduce energy and water use in hotels. Many global hotel chains now impose stricter environmental standards on their properties and have committed to science-based emission reduction targets for 2030. For the aviation sector, which contributes a significant share of tourism's carbon emissions (especially for long-haul travel), key decarbonization opportunities include the development of sustainable aviation fuels (SAF) and the introduction of electric or hybrid aircraft. The International Air Transport Association (IATA) has declared a collective goal for aviation to reach net zero by 2050, with interim steps such as more efficient aircraft technologies and market-based measures like CORSIA (Carbon Offsetting and Reduction Scheme for International Aviation). The cruise industry, another carbon-intensive segment, has likewise announced net-zero commitments by mid-century and is investing in cleaner ship fuels and technologies.

Destination management organizations and tour operators globally are incorporating climate criteria into planning and marketing. A growing number of tour operators and online travel agencies provide sustainability information or badges for eco-friendly options, often based on standards from the Global Sustainable Tourism Council (GSTC). Some countries have taken national-level action – for instance, Greece, Turkey, and Singapore have officially adopted GSTC criteria to guide their tourism sector's sustainable practices. Small island destinations (e.g. the Maldives, Barbados) and nature-based destinations (e.g. New Zealand's ecotourism sites) have been early adopters of net zero initiatives, spurred by their vulnerability to climate change. These include programs for 100% renewable energy in resorts, banning certain high-emission activities, enforcing visitor caps, or establishing carbon offset schemes via reforestation or blue carbon (marine) projects.

The lessons from global best practices suggest that reaching net zero tourism requires an integrated approach: sector-specific technological solutions, supportive government policies, and industry-wide collaboration. Key strategies include electrifying transport (shifting to electric vehicles, trains, and eventually short-haul electric aircraft), improving

energy efficiency and renewable energy use in buildings, promoting low-carbon operations (waste reduction, sustainable procurement, carbon offsetting), and engaging tourists in carbon-conscious behavior. Importantly, policy frameworks – such as incentives for green investments, emissions regulations, and national accreditation programs – set the enabling environment for these changes. Vietnam stands to benefit from these global insights as it crafts its own path toward sustainable, low-carbon tourism.

2.2 Vietnam's Tourism Policies on Sustainability and Carbon Neutrality

Vietnam's government has articulated a strong high-level commitment to sustainable development, which cascades into the tourism sector. The "Strategy for Vietnam's Tourism Development to 2030," approved in 2020, explicitly prioritizes sustainable and inclusive tourism, grounded in green growth principles. This strategy aligns with Vietnam's broader Green Growth Strategy 2021–2030 (vision to 2050), a national policy that aims to foster a low-carbon economy and sustainable use of natural resources. The tourism strategy calls for maximizing tourism's contributions to the Sustainable Development Goals and emphasizes environmental protection, cultural preservation, and community benefits as key to the sector's competitiveness. While the document may not use the phrase "net zero tourism," its orientation toward green growth provides a policy foundation for later integrating carbon neutrality targets.

Following the upheaval of the COVID-19 pandemic, Vietnam doubled down on sustainable tourism in its recovery plans. In May 2023, the Government issued Resolution No. 82/NQ-CP on primary tasks to accelerate tourism recovery and develop effective, sustainable tourism in the new context. This landmark resolution underscores that tourism's revival must go hand in hand with digital transformation and green transformation. It directs ministries and localities to implement measures for environmental protection in tourism activities and to diversify products with a focus on cultural and eco-tourism. The Vietnam Tourism Association's action plan for Resolution 82 similarly highlights building tourism products in the direction of green and sustainable tourism, including limiting plastic waste, strengthening environmental protection, and promoting digital innovation in tourism services. The inclusion of sustainability in a recovery-oriented resolution indicates that Vietnam sees sustainable tourism not as a luxury, but as integral to long-term growth and resilience of the sector.

In terms of climate change policy, Vietnam's commitment at COP26 to reach net zero by 2050 has started to influence sectoral planning. The Ministry of Culture, Sports and Tourism (MCST) – which oversees tourism – has acknowledged the need to align with this national climate goal. A high-level Tourism Forum in September 2024 on "Green Transformation, Net Zero Travel and Tourism" featured MCST leaders emphasizing that green tourism development is the *premise* for orienting net zero tourism in Vietnam. At the forum, officials noted that many local destinations (Hoi An, Ninh Binh, Khanh Hoa, among others) have already shown strong commitments to managing and protecting the tourism environment. The Chairman of the Vietnam National Administration of Tourism (VNAT) reiterated Vietnam's climate pledges and stressed implementing the National Green Growth Strategy within tourism planning. The forum's discussions ranged from overviews of Vietnam's net zero policies and global net zero tourism examples, to the role of green transformation in destination marketing and business operations. The very convening of this forum signals that "net zero tourism" is now on the radar of policymakers and industry stakeholders in Vietnam, even if concrete policy instruments are still evolving.

Specific policy tools have been introduced to encourage environmentally friendly practices. Vietnam launched a Green Lotus Label certification for tourist accommodations in the early 2010s, comprising a set of 81 criteria across environmental management, resource use, and community benefits. Hotels and guesthouses that meet these sustainable tourism standards can earn from 1 to 5 "Green Lotuses" (similar to stars) as an eco-label. While only a few dozen accommodations nationwide initially obtained this label, it established a benchmark for green operations. Likewise, some local authorities have developed their own certification; for example, Quang Ninh province (home to Ha Long Bay) piloted a "Green Sail" eco-label for cruise boats. Under a JICA-supported initiative, cruise ships in Ha Long Bay that meet stringent criteria for pollution control, waste management, and resource efficiency are awarded the Green Sail logo. The criteria (29 in total, with 15 mandatory) cover minimizing air and noise pollution, treating wastewater, and protecting biodiversity. Notably, Quang Ninh has signaled that in the near future only boats with Green Sail certification will be allowed to operate in Ha Long Bay, effectively mandating higher environmental standards for all tour boats. Such a move represents a bold policy approach, leveraging licensing power to drive sustainability – and implicitly, carbon reduction through improved fuel efficiency and potentially shifting to cleaner engines – in one of Vietnam's most famous tourist sites.

Despite these positive developments, Vietnam's tourism policies still face challenges in fully aligning with net zero ambitions. There is, as yet, no dedicated "Climate Action Plan for Tourism" that quantifies emissions from tourism and sets specific reduction targets for the sector. Tourism is a cross-cutting industry, touching energy, transport, construction, agriculture (food supply), and waste – thus, many relevant measures are found in those sectoral policies. For instance, Vietnam's Power Development Plan and Renewable Energy Strategy affect how clean the electricity is that powers hotels or tourist vehicles; transportation policies on public transit and fuel economy influence tourism emissions from travel. Integrating tourism into those wider climate policies is still ongoing. The Ministry of Transport's strategies, for example, include goals to electrify the railway and road transport by mid-century, which would benefit tourism transit when realized. Yet, without tourism-specific directives, opportunities for targeted action (like incentivizing tour operators to use electric buses, or creating low-carbon tourism zones in cities) might be missed. Additionally, enforcement of existing sustainable tourism guidelines can be inconsistent across provinces, due to varying local capacities and priorities. Therefore, a critical analysis of policy alignment must acknowledge these gaps. Strengthening the policy framework to explicitly incorporate net zero pathways for example, requiring tourism projects to assess and manage carbon footprints, or offering tax breaks for low-carbon investments in tourism would enhance

alignment with Vietnam's carbon neutrality commitment.

2.3 Technological Innovations for Low-Carbon Tourism

Technology is a linchpin in the transition to net zero tourism. In the context of Vietnam, several technological solutions are particularly pertinent given the country's resource endowments and state of development. Renewable energy is one domain where technology can significantly cut tourism-related emissions. Vietnam has abundant solar potential (especially in the South and Central regions) and a rapidly growing renewable energy sector nationally. This is translating into some pioneering projects in the tourism and hospitality industry. For example, international hotel chains operating in Vietnam have begun installing solar photovoltaic systems on their properties. Meliá Hotels International recently completed solar installations at two large beach resorts (Meliá Vinpearl resorts in Nghe An and Ha Tinh provinces), mounting nearly 2,000 solar panels that supply up to 10–30% of each resort's electricity needs. Additional solar projects are planned, such as at the Meliá Vinpearl Cam Ranh, reflecting a corporate commitment to increase renewable energy usage. These investments not only reduce grid electricity consumption (much of which in Vietnam is still generated from coal and gas) but also serve as visible demonstrations of clean technology in tourism. Alongside solar power, some resorts are exploring solar water heating to reduce fuel use for hot water, and biogas from organic waste for cooking fuel as part of circular economy efforts. A broader adoption of on-site renewables and energy-efficient design (e.g., using natural ventilation, LED lighting, smart energy management systems) can significantly curtail emissions from the accommodation sector, which globally contributes roughly 20% of tourism's carbon footprint. Vietnam's Green Lotus criteria and other green hotel standards encourage such measures, and a few properties have even achieved international certifications (e.g., the Caravelle Hotel in Ho Chi Minh City boasts both the top-level Green Lotus Label and ISO 14001 certification). The challenge is scaling these examples across thousands of hotels, from luxury resorts to budget homestays. This will likely require not just technology availability but also financing mechanisms, since many Vietnamese tourism SMEs may struggle with the upfront costs of solar panels or energy retrofits.

Transportation technology is another critical area. Over 70% of tourism's emissions can stem from transport – including international flights, domestic travel by air/road, and local transportation at destinations. While Vietnam cannot directly control emissions from foreign aircraft bringing tourists, it can influence domestic and on-the-ground transport emissions. One promising avenue is the electrification of vehicles. Electric vehicles (EVs), including cars, buses, and scooters, eliminate tailpipe emissions and can be powered by the increasingly green electric grid. Vietnam has launched domestic EV production (e.g., VinFast electric cars and buses), and some tourist areas have started deploying electric shuttles. In Ha Long City, a fleet of 21 electric cars provides tourist transfers and city tours, offering an eco-friendly alternative to gasoline vehicles. Several other cities (Hanoi, Da Nang, Hue) now have electric buggy tours in heritage areas or EV buses on certain routes. These initiatives not only cut emissions and air pollution but also often appeal to visitors as a novel, quiet mode of sightseeing. Vietnam's expansion of EV infrastructure (charging stations, battery swapping for e-scooters) remains in early stages, but government support is growing. In 2022, the government incentivized EV adoption by reducing registration fees for battery-electric vehicles to promote cleaner transport nationally. For tourism, this needs to be complemented by destination-level planning: e.g. providing charging points at hotels, parks, and tourist sites; encouraging car rental agencies to offer EVs; and training drivers on EV operations.

On a larger scale, Vietnam is considering transformative transport projects that could benefit tourism's carbon footprint. A notable example is the proposed high-speed railway line connecting the north and south of Vietnam (Hanoi to Ho Chi Minh City). This 1,500-km high-speed rail, if completed by the 2030s, could shift a significant volume of domestic travel from airlines to electric trains. Given that aviation is highly carbon-intensive, a fast and convenient rail system would provide a lower-carbon option for tourists traveling between Vietnam's regions, potentially cutting emissions for those trips by a large margin. The Ministry of Transport has also set a goal to electrify existing rail lines and utilize clean energy in rail transport by 2050. While these projects primarily fall under transport policy, they are crucial enablers for sustainable tourism mobility. Similarly, the development of urban public transit (like metro systems in Hanoi and Ho Chi Minh City) and improvements in inter-city buses can encourage tourists to choose greener transport modes if they are reliable and tourist-friendly. For local transit in destinations, apart from EVs, another innovation is the use of bicycles and e-bikes some cities like Hoi An have promoted cycling by creating bike-sharing programs and limiting motor traffic in Old Town, which not only preserves heritage ambiance but also reduces emissions.

Aviation technology is mostly advanced outside Vietnam, but Vietnam Airlines' involvement in testing Sustainable Aviation Fuel is noteworthy. In 2023, Vietnam Airlines operated a commercial flight from Singapore to Hanoi partially powered by SAF derived from biomass, marking the first such trial by a Vietnamese carrier. SAF can reduce lifecycle carbon emissions of aviation fuel by 50-80% depending on feedstocks, making it a key medium-term solution until new aircraft propulsion (like electric or hydrogen planes) becomes viable. The successful SAF test indicates Vietnam's readiness to participate in aviation decarbonization; however, scaling up SAF usage will require supportive policies (e.g. incentives or mandates for airlines to use a certain SAF blend) and supply chain development, possibly through regional cooperation. The Civil Aviation Authority of Vietnam's recent decision to join the global CORSIA scheme from 2026 is another step – it means Vietnam's airlines will have to monitor and offset emissions growth on international routes, indirectly pushing them toward efficiency and newer tech.

Beyond energy and transport, digital technology and smart systems are playing an increasingly important role in reducing tourism's carbon footprint by optimizing operations and influencing tourist behavior. Vietnam's tourism authorities have explicitly linked digital transformation with green transformation. The VNAT has developed a "Vietnam Travel" mobile application to digitize tourist services (information, bookings, e-payments, feedback), and a centralized tourism data platform connecting government, businesses, and tourists. These

digital tools can improve efficiency for instance, better matching of supply and demand reduces wasted trips or resources, and e-ticketing can cut paper use. More directly, the use of data analytics and IoT (Internet of Things) in hotels can fine-tune energy use (smart thermostats, automated lighting) and thus save energy. Some upscale hotels in Vietnam have begun implementing such smart building technologies as part of their sustainability drives. Furthermore, digital platforms are enabling new low-carbon tourism products: for example, virtual tours and augmented reality experiences that supplement physical travel, or apps that guide tourists along less crowded, more sustainable routes (thus mitigating overtourism and associated environmental pressure). While these are nascent, Vietnam's burgeoning tech startup scene could potentially contribute innovative solutions in this space especially if guided by supportive policy (such as grants or challenges for green tourism tech).

Finally, one cannot overlook simpler technological and operational innovations at the micro-level which, cumulatively, make a difference. Many Vietnamese tour operators and hotels are adopting plastic waste reduction technologies, like water refill stations to replace disposable bottles and biodegradable alternatives for amenities. As reported in a 2024 industry review, a resort on Phu Quoc island entirely eliminated single-use plastic bottles in rooms and F&B outlets, switching to refillable glass bottles, and also introduced linen reuse programs and comprehensive waste sorting on-site. These interventions reduce the carbon footprint associated with producing and disposing of plastics and other materials (and align with global anti-plastic campaigns in tourism). Some companies are innovating in visitor engagement – for instance, a tour company in Ben Tre (Mekong Delta) launched a "Net Zero Passport" initiative providing travelers with notebooks to log and learn about the carbon emissions of activities and products during their trip. This kind of educational tech-savvy approach raises awareness and can nudge both tourists and businesses towards greener choices.

In summary, a range of technological innovations – from high-tech (solar panels, SAF, electric vehicles, data systems) to low-tech (better waste management tools, efficient appliances) – are available to drive low-carbon tourism in Vietnam. Some are already being deployed with promising results, but broader diffusion is needed. The key barriers often relate to cost, limited expertise, and lack of widespread infrastructure (e.g., EV charging network). This is where policy mechanisms become crucial, to incentivize adoption and possibly subsidize initial investments. The intersection of policy and technology, therefore, is where the transition to net zero tourism will either accelerate or stall. The following sections delve into how Vietnam can strengthen this intersection, by examining the current policy alignment in practice and highlighting case studies from key sectors and destinations.

3. Methodology

This study employs a qualitative research approach, combining policy analysis with case study examination, to explore strategies for developing net zero tourism in Vietnam. We conducted an extensive review of both primary and secondary sources. Primary sources included official Vietnamese policy documents, strategy papers, and announcements related to tourism development, environmental sustainability, and climate change. Key documents analyzed were the Vietnam Tourism Development Strategy 2020–2030, Government Resolution 82/NQ-CP (2023) on tourism recovery and development, the National Green Growth Strategy (2021–2030), and records from relevant forums or conferences (such as the 2024 Green Tourism Forum). We also reviewed international agreements and declarations (e.g., the Glasgow Declaration on Climate Action in Tourism) to which Vietnam or its tourism stakeholders are party.

Secondary sources encompassed academic literature, industry reports, and media articles that provide data or insights on sustainable tourism practices and innovations in Vietnam. In particular, we drew on reports from international organizations (UNWTO, WTTC), think-tanks, and development agencies (e.g., UNDP Vietnam, ADB) that discuss low-carbon initiatives in tourism. We also incorporated case evidence from news outlets and trade publications for up-to-date examples of technology adoption and local policy implementation in Vietnam's tourism hotspots. Examples include coverage of renewable energy projects in hotels, introduction of electric vehicles in tourist areas, and pilot programs like the Green Sail label in Ha Long Bay. These sources were cross-verified where possible and cited to ensure credibility and to avoid reliance on any single viewpoint.

In analyzing policies, we used a content analysis technique: examining the objectives and measures stated in tourism-related policies for alignment (or misalignment) with sustainability and carbon reduction goals. We specifically looked for language related to "green", "sustainable", "low-carbon", or "emissions" in these documents. We then assessed how these high-level policies have translated into implementation, by looking at reported initiatives and outcomes (for instance, whether sustainable tourism criteria have been operationalized through certification or regulations). To examine technological solutions, we adopted a case study approach focusing on the three main sub-sectors of tourism (transport, accommodation, operations) and selected destinations. We identified illustrative cases – such as the solar panel installations by hotel chains, electric tourist transport in Ha Long and other cities, and the net zero roadmap of Oxalis Adventure tours that highlight both the potential and challenges of applying technology for decarbonization. Each case was analyzed in terms of its contribution to emission reduction, the drivers that enabled it (policy support, corporate initiative, etc.), and its scalability or replication potential.

Global best practices were identified through literature and subsequently compared against Vietnam's context to gauge applicability. This comparative aspect of the methodology helps in generating recommendations: by understanding what has worked elsewhere (e.g., national tourism climate action plans, destination-level carbon management, innovative financing for green tourism tech) and examining Vietnam's current status, we could infer what policy or technology interventions are most feasible and needed in Vietnam.

Throughout the research process, academic rigor and ethical considerations were maintained. Sources are cited in APA style where referenced, and care has been taken to present data and viewpoints objectively. By triangulating multiple sources and types of information (policy texts, empirical examples, expert commentary), the study increases the

validity of its findings. However, we acknowledge limitations: quantitative data on tourism emissions in Vietnam is sparse, and the rapidly evolving nature of technology means some latest developments might not be fully captured if not documented publicly. As such, our findings focus on qualitatively discernible trends and opportunities.

In summary, the methodology integrates policy analysis with sectoral case studies within a framework of comparative insight gathering. This approach is suitable for the exploratory and applied nature of the research question, which is not testing a hypothesis per se, but rather assembling a comprehensive picture to inform strategy development. The following section presents the results of this analysis, structured around policy alignment and technological solutions, with detailed examples to ground the discussion.

4. Findings and Analysis

4.1 Policy Alignment: Vietnam's Tourism on the Path to Net Zero?

Our analysis finds that Vietnam's current tourism policy framework strongly endorses the principles of sustainability and green growth, creating a favorable foundation for pursuing net zero tourism. However, there is a gap between these high-level commitments and specific, enforceable actions aimed at carbon neutrality in the tourism sector. Here we detail the alignment and gaps, along with illustrative examples from policy implementation at national and local levels.

National Strategy and Commitments: The Vietnam Tourism Development Strategy 2020–2030 enshrines sustainable tourism as a key orientation, which implicitly aligns with long-term carbon reduction. For instance, it calls for developing tourism in a way that preserves landscapes and the environment, and contributes to national sustainable development goals. This broad policy stance has been reinforced by Vietnam's net zero pledge made at COP26. By committing to net zero emissions economy-wide by 2050, Vietnam's leadership signaled that sectors like tourism must integrate climate goals. Indeed, as noted at the 2024 Green Tourism forum, officials view green tourism development as a stepping stone toward net zero tourism. The fact that such language ("net zero travel and tourism") is being used by the Ministry indicates an emerging alignment: policymakers are consciously linking the tourism agenda with the climate agenda. Moreover, Vietnam's **National Green Growth Strategy (NGGS)** (approved in Oct 2021) provides cross-sectoral policy guidance that supports low-carbon development. It includes objectives like reducing greenhouse gas intensity of the economy and greening lifestyles and production. While NGGS does not single out tourism, it advocates for sustainable infrastructure, increased renewable energy, and effective waste management all of which directly apply to tourism facilities and destinations.

Post-COVID Recovery Policies: The Government's Resolution 82/NQ-CP (2023) on tourism recovery explicitly integrates sustainability and digital transformation in the sector's rebound. This resolution is notable because it assigns concrete tasks to various stakeholders to implement sustainable tourism. For example, it tasks the tourism industry to "improve the quality and diversify tourism products towards green and sustainable tourism development" and to "promote digital transformation in tourism businesses". By framing sustainability as part of competitiveness and quality improvement, the policy aligns environmental goals with economic incentives. The Vietnam Tourism Association's subsequent action plan, as described by its chairman, involves unifying business community efforts to follow this resolution, such as enhancing training about new market trends in which tourists demand more sustainable practices. This shows a trickle-down effect: national policy prompting industry-wide strategic shifts. It is a positive alignment that indicates awareness tourism must not return to old growth patterns, but rather innovate in line with global green trends. However, net zero (carbon neutrality) per se is not yet a metric or target in these documents. The focus is still on general sustainability (e.g., reducing plastic waste, protecting nature, improving worker training in sustainability). We interpret that as Vietnam being in an initial phase of alignment, where the broad direction is set, but detailed carbon targets and monitoring in tourism are forthcoming.

Local and Sectoral Initiatives: Implementation of national sustainable tourism objectives is increasingly evident in local policies and projects, particularly in key destinations. One example is Quang Ninh province's move to impose the Green Sail eco-label for Ha Long Bay cruise ships, as discussed earlier. By planning to bar non-certified polluting boats, Quang Ninh aligns with national goals (it's an application of sustainable tourism to preserve a World Heritage environment) and contributes to emission reductions (since meeting the criteria likely requires efficient engines and possibly cleaner fuels). Another example is Da Nang city, one of Vietnam's top urban destinations, which has its own environmental and climate initiatives. Da Nang set a goal to become an "Environmental City" by 2030 and has integrated green growth into its city master plans. It has invested in wastewater treatment, expanded public green spaces, and is exploring a shift to a low-carbon city model. While those are broad environmental measures, the tourism department of Da Nang also actively promotes the city as a green destination. Events such as the Da Nang International Fireworks Festival are organized with attention to environmental management, and there's collaboration with foreign partners (e.g., a Carbon-Neutral City agreement with Sakai, Japan) focusing on circular economy and low-carbon development for the city including tourism en.mae.gov.vn. Likewise, the Mekong Delta's tourism is guided by a regional sustainable development resolution (Resolution 120/NQ-CP on Mekong Delta climate-resilient development), which encourages eco-tourism and community-based tourism that both adapts to and mitigates climate change impacts. These local actions demonstrate policy alignment at sub-national levels: authorities are not only echoing national strategy but also tailoring initiatives (like eco-labels, green city projects) relevant to their tourism contexts.

Gaps and Challenges: Despite good alignment in narrative and some practice, the path to net zero tourism in policy terms has gaps. First, there is currently **no systematic accounting of tourism-related emissions** in Vietnam that could inform policy targets. The government does produce national GHG inventories and climate strategies by sector (energy, transport, agriculture, etc.), but tourism's emissions are embedded within those and not broken out. This makes it difficult to set tourism-specific emissions baselines or

reduction targets. Without such metrics, policies risk staying on the level of qualitative goals. Establishing a framework for measuring tourism's carbon footprint (perhaps via the tourism satellite accounts augmented with environmental data) would help quantify progress toward net zero.

Second, many sustainable tourism initiatives are **voluntary or pilot-based**, rather than mandated by law or regulation. For example, the Green Lotus Label for hotels is encouraged and promoted, but not required; many accommodations still operate without adhering to those standards because compliance is optional and there may be little competitive disadvantage for not having a green label in the current market. Similarly, tour companies that implement emissions-reducing practices (using efficient vehicles, avoiding single-use plastics, etc.) do so mostly from their own corporate social responsibility motivations or to appeal to niche markets, rather than due to enforceable regulations. More binding policy instruments could include updated industry standards or certifications that are gradually made compulsory (like Quang Ninh is doing for cruises), environmental criteria in licensing of tourism businesses, or integration of sustainability criteria into the tourism grading system (for hotels, tour operators etc.).

Third, **policy coordination** between tourism authorities and other sectors needs strengthening to achieve carbon neutrality. Tourism policy alone cannot mandate cleaner energy or vehicles – that requires transport policy, energy policy, urban planning to provide the infrastructure and regulations. Conversely, the tourism perspective should be integrated when those sectors make climate-related decisions. For instance, if Vietnam's transport sector is subsidizing electric buses, ensuring some of those buses serve tourist routes (airport shuttles, sightseeing circuits) would directly tie into net zero tourism aims. There are signs of improving coordination: the Ministry of Transport's interest in electrifying rail and developing high-speed rail dovetails with tourism needs for sustainable inter-city travel, and the Ministry of Construction's building codes increasingly promote green building, relevant to hotels. But formal mechanisms like cross-ministerial working groups on sustainable tourism/climate, or including MCST in climate policy bodies could institutionalize this integration.

Lastly, financing and capacity present challenges. Policies can declare lofty goals, but local implementation often struggles due to limited funding for green projects or lack of know-how among small tourism businesses. The government has begun to acknowledge this. At the 2024 Forum, the Tourism Minister suggested leveraging international support for technology transfer and global climate finance to aid low-emission development in tourism. This implies future policies might focus on financial incentives: e.g., soft loans or grants for SMEs to invest in energy-efficient equipment, tax breaks for hotels that install renewable energy, or public-private partnerships to build needed infrastructure (like charging stations or waste recycling facilities in tourist areas). Without making sustainability financially viable for businesses, policy alignment will face resistance or apathy.

In conclusion, Vietnam's policies are directionally aligned with net zero objectives in tourism, as evidenced by strategic plans and budding initiatives, but there remains substantial room for deepening this alignment. The current stage can be seen as laying the groundwork – raising awareness, introducing basic standards, and piloting projects. The next stage will require translating the net zero pledge into concrete sectoral action: possibly through a dedicated climate action plan for tourism that defines targets and coordinates cross-sector efforts. As the analysis of technological and sectoral specifics below will show, there are many opportunities that supportive policy could unlock to hasten the transition to net zero tourism.

4.2 Technological and Sectoral Solutions: Current Innovations and Gaps

Technology-enabled solutions in Vietnam's tourism sector are beginning to address carbon emissions in each major sub-sector: transportation, accommodations, and tour operations. This section examines the status and potential of these solutions, highlighting illustrative examples and identifying where further deployment is needed. The analysis is organized by sub-sector, with attention to the regional hotspots (Ha Long Bay, Da Nang, Mekong Delta) as relevant.

4.2.1 Transportation: The decarbonization of tourist transportation in Vietnam is in early stages but gaining momentum through electrification and alternative fuels. Domestically, road transport is widely used by tourists (tour buses, vans, private cars, motorbikes), contributing to both urban pollution and carbon output. A notable shift has been the introduction of electric vehicles in tourist fleets. For example, Ha Long Bay's main city now operates electric tourist carts for city tours, reducing emissions and noise on crowded streets. Likewise, Hue City has electric shuttle cars ferrying visitors within the heritage zones, and parts of Hanoi's Old Quarter have experimented with electric buggies. These local initiatives often start as small fleets, but they demonstrate feasibility. Tourist satisfaction with these EV shuttles tends to be high due to the quiet and clean ride, encouraging other cities to replicate the model. Da Nang, aiming to brand itself as a smart and green city, could be a candidate for expanding e-bus services on routes connecting its airport, beach district, and tourist attractions. Indeed, the city is exploring a public bicycle and e-bike scheme to complement its bus network, which would serve tourists and residents alike. The main obstacle for wider EV adoption in tourist transport is the lack of charging infrastructure and still-high upfront costs of electric buses or coaches. National policy can catalyze this by offering subsidies for EV buses (including those used by tour companies) and by ensuring charging stations are installed at highway rest stops, tourist parking lots, and hotels. Vietnam's power grid mix also matters – as of mid-2020s, it is greening (thanks to significant solar/wind capacity additions), meaning EVs will increasingly be charged on cleaner electricity, thereby enhancing their carbon reduction impact year by year.

For long-distance domestic travel, the prospect of a high-speed rail linking key tourism cities is transformative. If realized, a traveller in 2035 could, for instance, take a 5-6 hour bullet train ride from Hanoi to Da Nang or Nha Trang instead of a short-haul flight. This would drastically cut per-passenger emissions. The Ministry of Transport's blueprint for the high-speed rail, and the inclusion of climate benefits in its justification, indicates alignment with tourism needs. Until such rail exists, improving the efficiency of current transport is necessary. The inter-city coaches that many tourists use can be transitioned to newer models running on compressed natural gas (CNG) or eventually electricity. Vietnam's domestic aviation is also significant for tourism

(flights to coastal destinations, Phu Quoc, etc.). While technological solutions in aviation are largely external (airlines upgrading fleets to more fuel-efficient planes like A320neo or 787, and using SAF blends as tested by Vietnam Airlines), Vietnam's tourism sector can contribute by implementing carbon offset partnerships. For example, a program could allow or encourage tourists to offset their flight emissions by investing in local reforestation or renewable energy projects in Vietnam. Currently, this is not standard practice in Vietnam's travel industry, but some global tour operators do it. Given Vietnam's strong forest conservation needs and potential for carbon credits, a certified carbon offset scheme integrated with tourism (perhaps via an add-on fee in tour packages or airline bookings) could channel funds to climate projects domestically, effectively balancing some tourism emissions.

In the Mekong Delta, where boat tours are a staple (such as visiting floating markets or river cruises), shifting to cleaner boat technology is key. Most tour boats run on diesel engines that emit CO_2 and local pollutants. Alternatives exist: electric boats or solar-assisted hybrid boats. A few small-scale pilots have emerged for instance, solar-powered sampan boats have been trialed in the Mekong for quiet, zero-emission rides through canals. Also, larger tour operators are considering LNG (liquefied natural gas) or Euro 5 standard engines for overnight cruise boats to cut emissions. The technology is available, but cost and technical know-how limit uptake. Policies like low-interest "green loans" for boat operators to retrofit or replace engines could accelerate cleaner river tourism. In Ha Long Bay, where hundreds of tourist junks and cruise vessels operate, adopting electric propulsion could vastly improve air quality and emissions. As part of the Green Growth project, a few cruise companies have reportedly installed battery systems to reduce generator use at night (for quieter, lower-emission overnight cruises). Continuing down that path, a vision of a future Ha Long Bay with electric boats (charged by renewable energy on shore) is within reach, given Vietnam's manufacturing capability in batteries and the high-value of preserving Ha Long's environment for tourism longevity.

4.2.2 Accommodation: Vietnam's hotel and accommodation sector has seen a surge in construction over the last decade to meet tourist demand. This presents both a challenge and an opportunity: many new hotels if built unsustainably lock in high energy usage, but if built or retrofitted with green tech, they can operate with a much lower carbon footprint than older stock. Current innovation in Vietnam's accommodations is focused on energy efficiency, renewable energy, waste management, and sustainable design. The earlier example of **solar power installations** at resorts is one major trend vir.com.vn. Hotels like Six Senses (which operates eco-resorts in Vietnam) have long integrated solar panels, natural ventilation, and even on-site organic farms to reduce food transportation emissions. In urban areas, some high-end hotels (InterContinental, Sheraton, etc.) have implemented building management systems that optimize HVAC (heating, ventilation, air conditioning) use and lighting, often cited as achieving 15-20% energy savings. Importantly, several hotels in Vietnam have pursued international green certifications (LEED, EDGE, or Green Globe). For instance, the Empire City development in Ho Chi Minh City, which includes hotels, is built to LEED standards. Achieving certification often requires technologies like double-glazed windows for insulation, occupancy sensors, and high-efficiency chillers – all of which cut electricity consumption and thus emissions from power plants.

One remarkable case is **Mai House Saigon Hotel**, whose general manager outlined a strategy of "digital-green transformation" involving cost-effective digital solutions and incremental green measures. They upskilled staff and engaged customers in sustainability, implemented energy-saving tech, and phased in changes to reduce waste. For example, digital solutions include IoT sensors to monitor energy and water use in real-time (identifying wasteful patterns), and guest-facing apps to request housekeeping at will (reducing unnecessary cleaning frequency to save water and chemicals). Green measures included switching to LED lighting property-wide, installing low-flow water fixtures, and establishing a rooftop herb garden to supply the kitchen (reducing the carbon cost of food transport). These illustrate how even without very large capital investments, a combination of technology and operational tweaks can yield carbon and cost reductions.

The elimination of single-use plastics and reduction of waste in hotels, while often framed as an ocean pollution issue, also carries carbon benefits. Plastic production is energy-intensive (from fossil fuels) and waste handling can produce methane if landfilled. By cutting plastics, hotels indirectly lower their carbon footprint. Many Vietnamese hotels now provide water refill stations or glass bottle alternatives, as noted with the Movenpick Phu Quoc's initiative to remove plastic bottles and install water purification systems. Towel and linen reuse programs – a well-known practice globally – are being faithfully adopted, saving energy from laundry operations. Some resorts go further by investing in wastewater treatment and recycling systems, which allow water reuse for irrigation, thereby saving fresh water and the energy that would be used to treat and pump additional municipal water. Phu Quoc's resorts, facing water scarcity in dry season, have been leaders in this.

One cannot ignore the role of **design and construction** technology. "Green architecture" is gaining traction in Vietnam's resort design, often incorporating local materials and passive cooling techniques. Thatched roofs, well-placed trees for shading, open-air lobbies – these design choices seen in many beach resorts reduce the need for air-conditioning. The newly built luxury resorts also often include building-integrated solar panels (as a design feature) and efficient orientation to minimize heat gain. The government could strengthen building codes to require higher energy efficiency for new tourist facilities. This would mandate technology like insulation, efficient glazing, or solar water heaters as standard, which over the building's life massively curtail emissions.

4.2.3 Tour Operations and Destination Management: Tour operators and destination managers are the interface between tourists and the environment, and their practices significantly shape tourism's carbon footprint on the ground. A prominent example in Vietnam is **Oxalis Adventure**, an adventure tour company in Phong Nha-Ke Bang. As detailed earlier, Oxalis has voluntarily adopted a net zero roadmap by 2030 – implementing measures from solar powering their offices and camps, to comprehensive waste reduction (composting and portion control for food to avoid waste), to carbon offsetting through tree planting. They also emphasize

environmental education for guests and local communities. This holistic model showcases what net zero tourism can look like at a company level: a combination of direct emission cuts and offsets for remaining emissions. Technology underpins parts of this model – e.g., solar panels for electricity in remote camps, modern composting techniques, possibly electric vehicles in the future – but equally important is the management approach (strict waste management protocols, engaging visitors in leaving no trace, etc.). This suggests that not all solutions are high-tech; some are about rigorously applying low-tech solutions and good planning. If many tour operators, especially those in ecologically sensitive areas, emulate Oxalis, the cumulative impact could be significant. It will likely require dissemination of best practices (perhaps via the Tourism Association or NGO-led training) and possibly some form of recognition or incentive (like a "Net Zero Tour" certification to market to eco-conscious tourists).

Destination management organizations (DMOs) in Vietnam are gradually incorporating sustainability into their operations. For example, UNESCO heritage towns like Hoi An have implemented pedestrianization in the Ancient Town at night, which reduces carbon emissions (no vehicles) and enhances cultural atmosphere. Hoi An also initiated a solar street lighting project in some areas and a biomass-fueled power generator using agricultural waste – small steps toward renewable energy usage at a destination scale. In Ha Long Bay, beyond the Green Sail for boats, the provincial authority has installed surveillance and monitoring systems to prevent environmental violations by tour operators, which indirectly ensures better compliance with emission and waste rules. The Mekong Delta's community-based tourism (CBT) programs (in An Giang, Ben Tre, Can Tho, etc.) often revolve around low-impact activities like cycling tours, homestays, and agricultural experiences, which inherently have lower carbon footprints than mass tourism operations. Supporting these CBT and eco-tourism initiatives with micro-grants and technical training (for instance, teaching homestay owners to use solar dryers for food or biogas digesters for cooking) can maintain their low-carbon profile even as they scale up.

One emerging technological tool for destinations is **carbon footprint calculators or management systems**. Globally, some cities (e.g., Auckland, New Zealand or destinations in Norway) have experimented with tracking the carbon emissions of their tourism sector annually and using that data to inform policy. Vietnam has not yet implemented such a system at any destination. However, given Vietnam's advances in digital government and data systems, it is conceivable to develop a "Tourism Carbon Dashboard" for major destinations. This would compile data like energy use of tourist facilities, number of tourists and transport modes used, waste generated, etc., to estimate emissions. Initially this could be as simple as a research project or a collaboration with universities. Over time, it could inform measures such as carbon budgeting or targeted interventions (e.g., if a destination finds a huge portion of emissions comes from tour boats, it can then justify investing in electrifying the fleet).

In terms of **global best practice adoption**: Vietnam's tourism is increasingly looking outward for solutions. The involvement of JICA in Ha Long's green growth, UNDP in plastic waste reduction in tourism, and collaborations like Da Nang–Sakai partnership indicate that Vietnam is open to international expertise and technology in greening tourism. Several upscale hotels are part of global chains that import their corporate sustainability standards (IHG, Marriott, Accor all have global programs that they extend to their Vietnam properties – e.g., eliminating plastic straws, sourcing local produce, tracking carbon per occupied room). The challenge is extending similar know-how to domestic hotel brands and SMEs which lack that external pressure. As one measure, the government or industry associations could establish a **center for sustainable tourism innovation** in Vietnam, acting as an incubator to pilot new tech (like a few hotels testing IoT energy management, or a few tour agencies piloting an all-electric itinerary) and share results nationally.

Regional Spotlight Summaries: *Ha Long Bay*: A critical site where technology and policy meet. With over 500 cruise boats, shifting to cleaner engines or all-electric boats is a major opportunity. The Green Sail program backed by monitoring technology (possibly even considering fuel consumption tracking or emission sensors on boats in future) will push operators toward tech upgrades. Ha Long City's electric buses and solar-powered streetlights (installed in some parks) are steps toward a low-carbon tourism infrastructure. Waste-to-energy technology is also being considered by Quang Ninh to handle the large volume of waste from tourism in an energy-efficient way. If Ha Long Bay can achieve a reputation as a "green cruising" destination, it would set a benchmark in Vietnam.

Da Nang: As a rapidly developing coastal city with a modern outlook, Da Nang is integrating sustainability into its tourism growth. The city has invested in an integrated public transport app and smart city systems which could extend to tourists for route planning to minimize congestion and emissions. A planned BRT (bus rapid transit) and metro lines, if realized, will serve tourists as well. Many of Da Nang's luxury resorts in the Danang-Hoi An coastal corridor incorporate solar water heating and efficient cooling, often unseen by guests but impactful. The city's Department of Tourism, with support from the private sector, launched the "Da Nang Green Tourism" campaign advocating for energy saving and waste reduction in hotels and restaurants, which often involves tech solutions (like encouraging hotels to use digital menus and billing to save paper, sensor-based restroom lights, etc.). Da Nang also has the potential to host large conferences on sustainable tourism (it hosted APEC 2017, for example) – leveraging that convening power could bring in global technologies via expos or trade shows focusing on sustainable tourism equipment and services.

Mekong Delta (e.g., Can Tho and Ben Tre): The tourism here is mostly rural and nature-based. The focus is on technologies that align with rural sustainability – solar home systems for homestays, clean cookstoves for tourist meal services, boats with cleaner outboard motors. Can Tho city has partnered with the World Bank on climate adaptation projects, which include improving the efficiency of river transport and promoting eco-tourism that also educates visitors on the Delta's environmental challenges. A unique tech solution in the Delta is the use of biogas digesters on farms that double as tourist attractions – visitors see how waste is turned to energy, which powers their lodging or meals. This kind of small-scale tech diffusion simultaneously lowers emissions (by capturing methane for energy) and enhances the tourist experience through education.

In conclusion of this section, Vietnam's tourism sector is experimenting with a variety of technologies and practices that collectively can drive a transition to net zero. The seeds of innovation are visible in transport electrification, renewable energy adoption, smart systems, and sustainable operations. Yet, these remain far from mainstream. Many hotels still use old AC systems and diesel generators, many tour buses are fuel-inefficient, and not all tour operators consider environmental impact. To scale up, a combination of top-down policy incentives and bottom-up industry initiatives is needed. On the policy side, incorporating these technologies into standards or providing financial/fiscal incentives will be crucial. On the industry side, early adopters must be championed as examples and networks for sharing best practices (e.g., green tourism awards, industry roundtables) should be strengthened. With concerted effort, the current innovations could become the norm across Vietnam's tourism industry, significantly bending the emissions curve of this growing sector.

5. Discussion

The analysis above paints an encouraging yet complex picture of Vietnam's journey toward net zero tourism. Vietnam has shown commitment at the strategic level and innovation at the grassroots level, but bridging the gap between ambition and comprehensive implementation is the central challenge. In this discussion, we interpret the findings in light of global best practices, highlight key issues that need to be addressed, and explore the implications for stakeholders.

Alignment with Global Best Practices: The trends in Vietnam's approach mirror, to some degree, patterns observed globally. Many countries, when first integrating climate goals into tourism, start by embedding sustainability principles in strategy documents (as Vietnam has done) and fostering pilot projects. For instance, countries like New Zealand and Scotland have developed national tourism strategies that emphasize carbon reduction and set up public-private task forces to drive climate action in tourism. Vietnam's forum in 2024 and Resolution 82 can be seen as analogous moves – signaling political will and rallying stakeholders. However, a notable global best practice is the creation of a dedicated Climate Action Plan for Tourism at either national or destination level. For example, Spain's Balearic Islands have a carbon neutrality road-map for tourism, and Costa Rica integrates its tourism promotion with its national decarbonization plan (leveraging the fact that its electricity is 99% renewable to market "carbon-free vacations"). Vietnam could benefit from developing a similar targeted action plan in the coming years, which would include emission baselines and reduction pathways for tourism specifically. This would provide a structured framework beyond the current general commitments.

Policy Integration and Governance: A recurring theme is the need for better inter-sectoral coordination. Global experience shows that successful tourism decarbonization often involves cross-cutting governance structures – for example, Slovenia's Green Tourism Scheme involves multiple ministries (tourism, environment, infrastructure) and provides a one-stop certification that covers various aspects of sustainability. Vietnam's equivalent might be to strengthen VNAT's Tourism Environment Board or create an inter-ministerial committee on sustainable tourism that includes environment and climate officials. Additionally, incorporating tourism considerations into Vietnam's updated Nationally Determined Contribution (NDC) under the Paris Agreement could formalize the tourism sector's climate responsibilities. So far, Vietnam's NDC (2022 update) focuses on energy, industry, agriculture, transport, etc., but tourism is implicit. Given tourism's share of the economy and emissions, making it explicit could attract international support and clarify accountabilities.

Financial Mechanisms: One significant gap is financial support for the transition. Global best practices suggest a variety of mechanisms: green bonds for sustainable tourism projects, international climate finance (from Green Climate Fund, etc.) for tourism adaptation and mitigation, or domestic funds like a tourism sustainability fund generated via a small levy on tourists (some destinations charge an eco-tax per visitor to fund green infrastructure). Vietnam could explore implementing a modest "sustainable tourism fee" for international visitors as some countries do earmarked for environmental conservation and carbon reduction projects at tourist sites. For example, Bhutan's high "Sustainable Development Fee" on tourists funds its carbon-neutral policies and cultural preservation. Vietnam likely wouldn't impose such a high fee given its different tourism model, but a small levy (even $1 per tourist) could generate a significant pool for green initiatives, considering Vietnam's pre-pandemic volume of 18 million international arrivals. Domestically, public-private partnerships could be incentivized to invest in things like solar plants dedicated to powering tourism zones, or joint development of electrified public transit that serves both residents and tourists.

Technology Transfer and Capacity Building: From the technology perspective, Vietnam will benefit from international cooperation to acquire and adapt advanced low-carbon technologies in tourism. The example of JICA's involvement in Ha Long Bay and UNDP's support in plastic waste reduction are models to continue. Perhaps partnerships with countries that have strong sustainable tourism practices (like a knowledge exchange with Thailand's hotel sector on energy efficiency, or with Norway on electric ferries for fjord tourism which parallels Ha Long Bay's needs) could be fostered. Domestically, technical training programs for energy management in hotels, or certification courses for "green tour guides" could boost capacity. There is also scope for innovation by Vietnamese entrepreneurs – for example, developing Vietnamese-made electric boats or solar-powered tourism gadgets – which can be nurtured through startup incubators or competitions focusing on sustainable tourism tech.

Stakeholder Engagement and Community Involvement: Achieving net zero tourism is not just a technical or policy endeavor; it requires broad stakeholder buy-in. Local communities in tourism areas must see value in low-impact tourism. For instance, in the Mekong Delta, many small family-run homestays might be reluctant to invest in solar panels unless they perceive cost savings or increased tourist demand for "eco" lodging. Government extension programs and NGOs can play a role in demonstrating those benefits. The discussion from the forum about each citizen being a "friendly ambassador" in green tourism hints at the need for public awareness. Vietnam could initiate a national awareness campaign about sustainable tourism targeting both providers and consumers (e.g., encouraging domestic tourists to favor certified green services, much like how

energy-efficient appliance labeling changed consumer behavior).

Monitoring and Evaluation: Implementing strategies is one part; ensuring they work is another. As Vietnam moves forward, establishing monitoring mechanisms will be key. This includes tracking the number of tourism businesses with green certifications, the uptake of technologies (like how many hotels have installed solar, how many tour vehicles are electric), and ultimately measuring emissions in pilot areas. Some global cities (like Copenhagen for urban tourism) release annual sustainability reports for their tourism sector a practice Vietnam's major destinations could emulate. For example, Da Nang's tourism department might publish a "Tourism Environmental Performance" report each year, detailing progress on waste reduction, energy use, etc., thereby creating accountability and informing policy adjustments.

Challenges and Risks: The discussion would be incomplete without noting challenges. One is the risk of greenwashing – where tourism businesses claim to be "net zero" or "eco-friendly" without substantive action, possibly misleading consumers and undermining genuine efforts. This risk can be mitigated by establishing clear standards and third-party audits for any green certifications (ensuring, for example, that the Green Lotus or Green Sail labels remain rigorous). Another challenge is external: if international travel to Vietnam grows significantly post-pandemic, the influx of airlines and cruises (which are hard-to-decarbonize sectors) could increase tourism emissions beyond Vietnam's control. Vietnam can mitigate that by negotiating for better practices (e.g., encouraging airlines serving Vietnam to use newer aircraft or offset schemes, perhaps as part of bilateral aviation agreements).

Climate change impacts themselves pose a challenge to tourism, and thus a feedback loop: rising temperatures and extreme weather could strain destinations (e.g., more energy for cooling, damage to infrastructure) making sustainability and resilience efforts doubly important. The Mekong Delta's climate resilience project mentioned by the World Bank is an example of linking adaptation (flood control, etc.) with tourism development (presumably ensuring tourist sites are climate-resilient). Ensuring that net zero strategies also incorporate adaptation co-benefits will strengthen stakeholder support (because they see immediate benefits like reduced flood risk, not just long-term emission cuts).

Case Examples Synthesis: The specific case examples provide micro-evidence supporting the broader recommendations. Ha Long Bay's Green Sail initiative demonstrates that stringent environmental regulation of tour operators is feasible and can drive technological upgrades. It suggests that policy can and should set higher mandatory standards in ecologically sensitive hotspots. Da Nang's focus on infrastructure and events signals that even as a city pursues growth, it can integrate sustainability – aligning with the idea that economic development and emissions reduction are not mutually exclusive if planned (Da Nang improved connectivity and still aimed for a green image). The Oxalis example shows how private sector leadership can fill gaps ahead of policy; thus, policies could recognize and reward such pioneers (for instance, tax breaks for tour operators who neutralize their emissions). In replicating that, however, smaller businesses will need support as they lack Oxalis's scale or client base to absorb costs of solar panels or offsets. So maybe a government-subsidized program for SMEs to get solar installations (with payback via savings) could help.

Recommendations Preview: The discussion essentially sets the stage for specific recommendations. To summarize the critical issues identified: (1) lack of specific targets and enforcement in policy; (2) need for financial and technical support for green tech adoption; (3) necessity of cross-sector coordination; (4) importance of monitoring progress; and (5) engaging all stakeholders from government to local communities and tourists. In the next section, we translate these into concrete recommendations.

6. Recommendations

Building on the findings, we propose a set of concrete recommendations to advance policy and technological solutions for net zero tourism in Vietnam. These recommendations are tailored to Vietnam's context, aiming to be actionable for government agencies, industry stakeholders, and supporting organizations.

Develop a "Net Zero Tourism Action Plan" – Vietnam's MCST, in collaboration with the Ministry of Natural Resources and Environment (MONRE), should formulate a dedicated climate action plan for the tourism sector. This plan would set a timeline and targets for emission reductions in tourism (e.g., a target to reduce tourism-related CO_2 emissions by X% by 2030, in line with national NDC goals). It should identify key measures, responsible parties, and required resources. Importantly, it would create an official mechanism to integrate tourism into national climate policy. The plan could be modeled after international examples and aligned with the Glasgow Declaration commitments. Having such a plan increases accountability and provides clarity to businesses on the direction of future regulations. As part of this, MCST could establish an emissions baseline for tourism by commissioning research (leveraging academic institutions to calculate emissions from transport, accommodation, activities). Regular updates to this inventory will allow tracking progress.

Strengthen and Mandate Sustainable Tourism Standards – Vietnam should upgrade its existing sustainable tourism standards and move towards mandating compliance over time. For accommodations, the Green Lotus label criteria could be refreshed to include explicit carbon management aspects (like energy intensity thresholds, renewable energy use, etc.) and then gradually integrated into the hotel rating system or business licensing. For example, by 2025 require all 4-5 star hotels to at least attain a basic Green Lotus certification as a condition of operation, and by 2030 extend this requirement to lower star categories. Similarly, expand the **"Green Sail" eco-label** concept to other maritime tourism (like river cruises in Mekong, speedboats in coastal areas) and enforce these as mandatory within a defined timeline. To aid compliance, the government can provide technical guidelines and run capacity-building workshops on meeting criteria. These standards should also cover tour operators and attractions (perhaps through a points-based system for sustainable tour operation that covers transport, waste, community engagement, etc.). Enforcement will be key – tying certification to operating permits or offering tax rebates for certified businesses will drive uptake.

Incentivize Renewable Energy and Energy Efficiency in Tourism – The government, possibly via the Ministry of Industry and Trade (which handles energy) and Ministry of

Finance, should introduce incentives specifically for tourism enterprises to invest in renewable energy and efficiency. This could include:

- A targeted subsidy or rebate program for hotels that install solar PV or solar water heaters (for example, refunding 20-30% of installation costs, which has precedent in some government energy programs). The success of hotels like those with 2,000 solar panels can be used as proof-of-concept in promotional materials.
- Low-interest "green loans" offered through state banks or a green tourism fund, which hotels and tour operators can access to upgrade to energy-efficient appliances, electric vehicles, or improved insulation. International development partners (like ADB or IFC) might co-fund such a credit line as they have done in other countries.
- Tax incentives: e.g., allowing accelerated depreciation on renewable energy equipment, or import duty exemptions for certified green technologies (like high-efficiency HVAC systems or electric coaches). This can reduce the cost barrier for adopting technology.
- Expand net metering and grid buy-back for solar to tourist areas, so hotels can feed excess solar power to the grid, improving project economics and encouraging larger solar installations.

Electrify Tourism Transport – A comprehensive push should be made to electrify vehicles used in tourism and improve low-carbon mobility options:

- Collaborate with the Ministry of Transport to create an **Electric Tourism Transport Initiative** that sets targets like "30% of tourism buses in major destinations to be electric or hybrid by 2030" and provides support for achieving it. This might involve co-financing the purchase of e-buses for tour companies or city sightseeing services.
- Build charging infrastructure at strategic tourism hubs. For example, install EV charging stations in the parking areas of popular sites (Ha Long Bay piers, Phong Nha park entrance, major museums), highway rest stops on routes like Hanoi–Sa Pa or HCMC–Mekong, and in hotel clusters. Public-private partnership could be used: a consortium of utility companies and tourism firms could be formed to invest in this network.
- Encourage cities (like Hanoi, Da Nang, HCMC) to include electric tourist buses in their public transit fleets (perhaps branded as green city tour buses). The government might pilot a scheme with a few electric buses operating tours, which can later expand if successful.
- Continue to support Vietnam Airlines and other carriers in scaling up use of Sustainable Aviation Fuel through policy measures such as blending mandates or subsidies for SAF. As a long-term goal, Vietnam should work within ASEAN or ICAO frameworks to increase availability of SAF in the region, thus benefiting all flights including those carrying tourists.
- In water-based transport: provide grants or awards for innovators who develop electric or solar-powered boats suited to Vietnam's conditions (rivers, bays). The government could launch a challenge (with prize money) for the first company to run a fully electric tourist boat service in Ha Long or the Mekong, thereby spurring competition and innovation. Also, mandate stricter emissions standards for boat engines in tourist areas by a near future year (e.g., Euro VI marine engines by 2027), pushing operators to retrofit or replace dirty engines.

Implement Destination-Specific Net Zero Programs: Tailor strategies to regional hotspots, working with provincial authorities:

- **Ha Long Bay (Quang Ninh)**: Accelerate the Green Growth Action Plan. For example, set a milestone that by 2030, Ha Long Bay will have a **fully green fleet** all tourist boats either electric or running on green fuels. Back this by seeking investments to build an electric boat charging dock and possibly a solar farm dedicated to powering the bay's tourism operations. In parallel, strengthen waste management tech around the bay (invest in garbage collection boats, marine debris skimmers powered by solar) to ensure the environment is well-maintained, enhancing the destination's sustainability credentials.
- **Da Nang and Hoi An (Central Coast)**: Develop Da Nang as a model "Low-Carbon City Destination." This could include expanding pedestrian zones, introducing a bicycle highway between Da Nang and Hoi An for tourists (with e-bike rentals), and requiring new tourism developments to meet green building codes. Given Da Nang's interest in smart city tech, deploy a digital platform where tourists can see their carbon footprint for various activities (surfing versus jetskiing, etc.) to encourage low-carbon choices. Hoi An could become a "no single-use plastic" tourism town, leveraging its heritage image to enforce traditional and eco-friendly practices.
- **Mekong Delta (e.g., Can Tho, Ben Tre)**: Focus on ecotourism and community projects. Provide micro-grants to community-based tourism initiatives that invest in solar lighting, rainwater harvesting, or sustainable farming that doubles as tourism experience. The Mekong provinces could collectively market themselves as "Vietnam's Low-Carbon Delta" where visitors can partake in carbon-neutral experiences (like cycling tours, farm stays) and even volunteer in tree planting or mangrove restoration as part of their itinerary – directly offsetting their travel emissions. This ties tourism to climate mitigation/adaptation, offering an immersive form of sustainable travel.
- **Mountainous areas (Sa Pa, Ha Giang)**: Though not mentioned in the original prompt, these are important regions where uncontrolled tourism growth has raised environmental concerns. Authorities here should manage visitor flows (perhaps via booking systems) to reduce emissions from congestion and enforce use of local guides and services to spread economic benefits (which improves community buy-in for conservation). Introduction of small-scale renewable energy (micro-hydro or solar for lodges) can reduce reliance on diesel generators which some remote resorts use.

Enhance Industry Engagement and Training Government agencies in conjunction with tourism associations should implement capacity-building programs:

- Conduct regular workshops and training sessions on sustainable tourism practices for businesses, covering topics like energy management, carbon footprint assessment, and access to green financing. These could be done in partnership with international experts or NGOs that have experience in tourism sustainability.

- Develop a **Sustainable Tourism Toolkit** in Vietnamese, providing step-by-step guidance for hotels, tour operators, and attractions to reduce emissions (checklists for energy saving, guides on installing solar, how to join certification programs, etc.). Make this toolkit freely available and promote it via VNAT's channels.
- Recognize and award pioneers. Establish annual "Vietnam Green Tourism Awards" where the best performers in different categories (green hotel, green tour operator, green destination) are honored. Recognition not only motivates businesses to improve but also gives them marketing advantage, which encourages further efforts. Winners' case studies can be shared as inspiration. For instance, a hotel that achieved 30% emissions cut and saved costs can present its business case to peers.
- Encourage formation of green alliances or networks. The tourism industry can create a "Vietnam Net Zero Tourism Alliance" – a coalition of companies voluntarily committing to net zero by 2050, sharing best practices and possibly pooling resources to purchase offsets or invest in renewable projects. Government and international organizations can support this with technical advice and initial convening.

Engage Tourists in the Journey – Finally, policies and strategies should not overlook the role of tourists themselves. Raising awareness and nudging tourist behavior can significantly contribute to emissions reduction:

- Promote low-carbon travel options in official tourism marketing. Vietnam Tourism's promotional materials (website, brochures, Vietnam.travel portal) could highlight eco-friendly tours, green certified hotels, and encourage tourists to use trains or buses instead of flights when possible internally. Essentially, brand Vietnam partly as a sustainable destination – which is increasingly a competitive advantage as surveys show travelers value sustainability (e.g., the cited survey with 96% of respondents valuing sustainable tourism).
- Provide information tools: maybe an official "Green Travel in Vietnam" mobile app or a section in the Vietnam Travel app detailing carbon-light choices and tips (like where to rent bikes, which restaurants are farm-to-table, etc.). This merges digital transformation with green transformation.
- Introduce voluntary carbon offset options integrated into tourism services. For example, Vietnam Airlines or major tour operators could offer an "offset your trip" add-on for a small fee, which goes into aforementioned environmental projects in Vietnam. If made simple and transparent, a fraction of tourists will opt in, creating additional funding for net zero efforts and raising awareness.
- Encourage tourist feedback and community science: Tourist-facing campaigns, such as asking visitors to report any environmental pollution they see via a hotline or app, can help authorities act quickly (e.g., if a tourist sees a boat belching smoke in Ha Long Bay, they report it and enforcement can check it). Engaging tourists in being watchdogs and active participants reinforces a culture of responsible tourism.

These recommendations, if implemented holistically, create a reinforcing system: policies set clear expectations and provide support, businesses innovate and adopt technologies, destinations manage resources wisely, and tourists choose greener options. Over time, this can lead to a virtuous cycle where sustainable, low-carbon tourism strengthens Vietnam's market position and contributes to global climate mitigation. There may be short-term costs or adjustments for instance, investing in new systems or phasing out old inefficient equipment but the long-term benefits include not only emissions reduction but also improved environmental quality, preservation of the natural and cultural assets that tourism depends on, and potentially cost savings from efficiencies.

It is also recommended that Vietnam leverage international cooperation for many of these actions. Technical and financial assistance is available through various climate funds and bilateral partnerships for countries pursuing green growth in sectors like tourism. Engaging with global initiatives (like WTTC's Net Zero Roadmap, or the GSTC destination program) will provide additional guidance and benchmarking opportunities.

7. Conclusion

Vietnam's pursuit of net zero tourism is an integral component of its broader commitment to sustainable development and climate action. This study has analyzed Vietnam's current tourism policies and technological practices through the lens of sustainability and carbon neutrality, identifying both significant progress and areas in need of further development. Vietnam has clearly recognized the importance of transforming its tourism sector: national strategies articulate green growth, and stakeholders are increasingly active in implementing eco-friendly initiatives. Pioneering examples – from solar-powered resorts on the central coast to electric vehicles in heritage sites and ambitious local programs like Ha Long's Green Sail demonstrate that net zero-aligned tourism is not an abstract ideal but a growing reality in Vietnam. These efforts not only reduce emissions but enhance the quality and resilience of Vietnam's tourism offerings, helping to safeguard famous destinations like Ha Long Bay, the ancient town of Hoi An, or the fragile ecosystems of the Mekong Delta for future generations.

However, the journey towards fully net zero tourism in Vietnam has only begun. The research indicates that while sustainability is featured in policy rhetoric, concrete pathways to decarbonize tourism require more explicit planning, stronger enforcement of environmental standards, and deeper integration of new technologies. Key sectors such as transport and accommodation remain carbon-intensive; thus, scaling up solutions like electric mobility, renewable energy adoption, and energy efficiency will be decisive. Our recommendations have highlighted practical steps – from crafting a dedicated action plan and tightening green certifications, to incentivizing green investments and electrification, and engaging all stakeholders in education and carbon accountability. Implementing these will demand concerted effort and coordination among government agencies, businesses, communities, and international partners.

Crucially, transitioning to net zero tourism should not be viewed as a cost or constraint on Vietnam's tourism growth, but rather as an opportunity to innovate and lead. Global travelers are increasingly climate-conscious, and destinations that proactively reduce their carbon footprint and offer authentic sustainable experiences stand to gain

competitive advantage. Vietnam, with its rich natural and cultural endowment, can position itself as a leader in green tourism in Southeast Asia. By learning from global best practices and avoiding the pitfalls of mass tourism that have plagued some destinations, Vietnam can pursue a model of tourism development that is high quality, community-centered, and low in environmental impact. This alignment of tourism with Vietnam's net zero 2050 vision will also contribute to global climate mitigation efforts, given the international nature of tourism's carbon emissions.

In academic terms, this study contributes to the literature by providing a focused analysis of net zero strategies within tourism management in a developing country context. It underscores the interplay between policy frameworks and technological innovation in achieving sustainability goals. Future research could deepen this inquiry by quantifying the emissions reduction potential of specific interventions outlined here (for example, modeling how much installing solar in all 3-5 star hotels would cut emissions, or the impact of shifting 50% of tourist travel from air to rail). It would also be valuable to conduct stakeholder surveys or interviews in Vietnam's tourism sector to gauge readiness and perceived barriers to implementing net zero measures – such insights can refine policy design. Additionally, longitudinal studies in coming years can assess how effectively Vietnam's tourism sector moves along the net zero trajectory, providing lessons that might be applicable to other destinations globally.

In conclusion, developing net zero tourism in Vietnam is a multi-faceted challenge that requires aligning national aspirations with local actions and global collaborations. This academic exploration confirms that Vietnam is on the right path, with strong foundational policies and inspiring pilot initiatives. The strategies proposed herein – emphasizing policy clarity, technological uptake, and stakeholder engagement – offer a roadmap to accelerate progress. With sustained commitment, innovation, and support, Vietnam's vision of a carbon-neutral, sustainable tourism industry by mid-century is an achievable horizon. Such an outcome will ensure that tourism remains not only an engine of economic growth for Vietnam but also a steward of its environment and cultural heritage in the face of global climate change.

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