

DISCUSSION PAPER



Leveraging Opportunities through Local Initiatives to Achieve Net Zero Emissions by 2050: A Case Study of Da Nang City, Vietnam

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Executive Summary

Approximately 140 countries have committed to achieving net zero emissions by the middle of the century under the United Nations Framework Convention on Climate Change. To attain this target, local governments can play a pivotal role in coordinating decarbonisation efforts across multiple sectors, in collaboration with citizens, companies, and other stakeholders.

This Discussion Paper aims to highlight key policies and approaches for developing a city's decarbonisation plan, using Da Nang city in Vietnam as an example. To this end, strategies and plans for decarbonising three cities in Yokohama and Kitakyushu City in Japan, and Kuala Lumpur city in ASEAN region are reviewed as good examples.

The following actions have been recommended for Da Nang city, based on our investigations, including: (1) increase the ambition of the city's targets for energy savings to align with the updated national commitments; (2) setting ambitious targets for solar PV would significantly accelerate decarbonisation in the city; (3) setting ambitious targets for electric vehicles would help steer the greening of the transport sector; (4) increase and contribute to the country's carbon sequestration via forest and marine protection; (5) develop the necessary expertise related to GHG inventories, and it is suggested that Da Nang city should consider to establish a 'local government operations (LGO) for GHG inventory'. Furthermore, Da Nang should also consider to set a target to become a leading city in designing and implementing net zero emission initiatives at the city level, not only in Vietnam but also across the ASEAN region.

1. Introduction

During the UN Climate Change Conference in Glasgow (COP26) held in November 2021, the Government of Vietnam made a pledge to phase out coal power generation by the 2040s, or as soon as possible thereafter, and to achieve net zero carbon emissions by 2050. The government followed up on this pledge on 26 July, 2022, by issuing the National Climate Change Strategy to 2050, which demonstrates a firm commitment to reducing greenhouse gas (GHG) emissions. The strategy aims to lower emissions by 43.5% by 2030, compared to a business-as-usual scenario, peak carbon emissions in 2035, and achieve net zero emissions by 2050. Without successful implementation of decarbonisation policies, Vietnam's emissions are predicted to quadruple by 2050 (Table 1) (Vietnam NCCS 2022).

Table 1: Vietnam's estimated greenhouse gas emissions 2014-2050 (Million ton CO₂eq)

Emission sources	Year							
	2014	2020	2025	2030	2035	2040	2045	2050
Manufacturing & constructions	49.4	66.9	114.2	257.5	301.4	359.9	407.4	455.8
Transport	33.2	47.7	65.1	89.1	118.4	152.7	192.5	241.4
Commercials, Agriculture & Services	13.6	18.1	25.1	41.2	56.1	73.3	89.5	109.3
Energy Industry	75.4	214.8	296.3	290.6	355.2	386.8	413.0	403.8
TOTAL EMISSIONS	171.6	347.5	500.7	678.4	833.8	972.7	1102.4	1210.3

(Source: Vietnam NCCS 2022)

Meanwhile, it has become apparent that local governments, whether cities or provinces, are well positioned to contribute to the national commitment. Achieving net zero GHG emissions

(decarbonisation) requires the combination and synergy of decarbonisation actions across multiple sectors through local initiatives. Crucially, such actions can be implemented in collaboration with citizens, companies and other stakeholders.

Da Nang City has established a solid foundation for decarbonisation through the successful implementation of its "Building Da Nang into an Environmentally Friendly City" plan, which was initiated in 2008. The city has also made a commitment to reduce GHG emissions through a recently approved "Action Plan on response to Climate Change of Da Nang City/Da Nang City Climate Action Plan" in 2021. Additionally, Da Nang City has established a strong partnership with Yokohama City since 2013 through various cooperation activities and projects aimed at advancing the city's environmental sustainability and decarbonisation.

Da Nang City has expressed interest in developing a decarbonisation plan, building on its efforts and experiences in environmental protection and climate change response. This paper aims to highlight key policies, strategies and approaches that could inform the development of the city's decarbonisation plan.

The paper is organised as follows. Followed an introduction in Section 1, Section 2 provides updates on Vietnam's commitment to carbon neutrality. Section 3 draws on examples from other cities, including Yokohama and Kitakyushu in Japan, as well as Kuala Lumpur City in Malaysia, to offer useful information and lessons learned for Da Nang. Specifically, it discusses how these cities have established relevant policies and basic plans for decarbonisation. Section 4 presents Da Nang City's strategies and action plan on climate change and explains how the city can contribute to the national net zero goals. The last section proposes key policy recommendations for realising net zero carbon emissions in Da Nang City through its local initiatives.

2. Updates on Vietnam's COP 26 Net Zero Commitment

At the 26th Conference of the Parties (COP26) to the United Nations Framework Convention on Climate Change, Vietnam's Prime Minister Pham Minh Chinh announced that the country would aim for a net zero emissions target by 2050. With this move, Vietnam has joined the group of about 140 countries that have pledged to achieve net zero emissions by the middle of the century. In addition to the net zero emissions commitment, Vietnam pledged to phase out unabated coal power by the

2040s or as soon as possible thereafter, reduce methane by 30% by 2030 compared to the emissions level in 2020, and stop deforestation by 2030.

Vietnam has established a National Steering Commission on Realising the COP26 Commitments, chaired by the Prime Minister and coordinated by the Ministry of Natural Resources and Environment (MONRE). The Government of Vietnam has issued several legal instruments to guide the implementation of these commitments. These documents include:

- Government Decree 06/2022/ND-CP, which regulates the reduction of greenhouse gas emissions and the protection of the ozone layer.
- Prime Minister's Decision 876/QD-TTg dated 22 July 2022, which outlines an action plan for the transition to green energy and reducing carbon and methane in the transport sector.
- Prime Minister's Decision 882/QD-TTg dated 22 July 2022, which outlines the National Action Plan on Green Growth 2021-2030.
- Prime Minister's Decision 888/QD-TTg dated 25 July 2022, which outlines an action plan for COP26 implementation.
- Prime Minister's Decision 896/QD-TTg dated 26 July 2022, which outlines the National Strategy on Climate Change.
- Prime Minister's Decision 942/QD-TTg dated 5 August 2022, which outlines an action plan for reducing methane by 2030.
- Government's Resolution 148/NQ-CP dated 11 November 2022, which outlines the Government's programme for implementing the Political Bureau's Resolution 06/NQ-TW dated 24 January 2022 on Planning, Construction, Management, and Sustainable Development of Urban Areas to 2030, visions to 2050.

Notably, Vietnam joined the Just Energy Transition Partnership (JETP) led by the Group of Seven (G7) industrialised nations in December 2022. Under the JETP, Vietnam will receive USD15.5 billion to

accelerate the decarbonisation of its electricity system, with the goal of peaking electricity sector emissions at no more than 170 million tCO₂ emissions by 2030. The planned coal power capacity peak will also reduce from 37 GW to about 30 GW). Under the JETP, Vietnam has committed to aiming for its GHG emissions peak by 2030, five years earlier than the target in the National Strategy on Climate Change (Do and Burke, 2023). This sets an important foundation for achieving the target of net-zero emissions by 2050.

3. How Local Initiatives Can Advance Decarbonisation – Experience from Other Cities

This section explores valuable lessons learned in developing decarbonisation policies and plans at the city level, using examples from Yokohama and Kitakyushu cities in Japan and Kuala Lumpur city in Malaysia. All three cities have committed to achieving net zero carbon emissions by 2050 and have developed specific implementation plans.

Yokohama is a port city, much like Da Nang. However, Da Nang is mainly centered on manufacturing industries, while Yokohama's focus is on commercial and service industries. Nevertheless, GHG emissions from transportation and commercial & household activities occupy a relatively large share in both cities. Kitakyushu city is the 13th largest city in Japan and was developed as one of the country's largest industrial zones. However, its rapid development in the 1950s and 1960s led to serious air and water pollution. Kitakyushu has received international recognition for its successful efforts to overcome these environmental problems. Since Kitakyushu's GHG reduction efforts are mainly directed at the manufacturing industry, its approach may be useful for Da Nang city. Kuala Lumpur issued its "Climate Action Plan 2050" in December 2021 to achieve both net zero carbon emissions and resilience to climate impacts. GHG emissions in the city are mainly generated by transportation and commercial services. The approach to prioritising climate actions in Kuala Lumpur's "Climate Action Plan 2050" may also be helpful for Da Nang. The table below shows a comparison of the urban structure of the four cities from the standpoint of GHG emissions.

Table 2: Comparison of urban structure of the four cities from the standpoint of GHG emissions

Feature	Da Nang	Yokohama	Kitakyushu	Kuala Lumpur
Area	1,283 km ²	438 km ²	492 km ²	243km ²
Population (2020)	1,200,000	3,770,000	940,000	1,900,000
Population density	945/km ²	8,616/km ²	1,910/km ²	8,159/km ²
Ratio of urban population	86.9%	80%	90.8%	N.A.
Industrial structure	Manufacturing (machinery, electronics, shipbuilding, chemicals, textiles), Tourism	Commercial and service sectors (nearly 80%), Manufacturing	Commercial and service sectors (70%), Manufacturing (steel, chemicals, ceramic)	Commercial and service sectors (nearly 80%), Manufacturing and Construction
Total GHG emissions (t-CO₂ eq.)	2.67 mil./year (2013)	16.47 mil./year (2020)	14.47 mil./year (2019)	25.09 mil./year (2017)
Major GHG emitting sectors (higher to lower)	Industry, Transportation, Households	Household, Transportation, Commercial buildings, Waste	Industry, Transportation, Commercial buildings, Households	Transportation, Commercial buildings, Households
Per capita GHG emissions	2.7 ton/year	4.4 tonnes/year	15.4 tonnes/year	14.0 tonnes/year

(**Source:** Da Nang city: Wikipedia, "A study on Da Nang low carbon city, 2016", Yokohama city: "Yokohama open data portal", Kitakyushu city: Kitakyushu open data", Kuala Lumpur: World data atlas, "Climate Action Plan 2050")

3.1. Yokohama City

The "Yokohama City Action Plan for Global Warming Countermeasures" (revised in 2018) sets the goal of achieving net zero greenhouse gas emissions (decarbonisation) by 2050 as the city's approach to combating global warming. The plan outlines eight basic policies to achieve this goal, namely: 1) Promotion of initiatives based on the efforts of citizens and collaboration with businesses, 2) Realisation of a state-of-the-art smart city, 3) Creating a virtuous cycle between the environment and economy, 4) Inter-city cooperation and international communication, 5) Comprehensive energy conservation, 6) Sustainable urban planning, 7) Maximising adoption of renewable energy and realisation of a hydrogen society, and 8) Strengthening of adaptation measures.

The Yokohama City Action Plan stresses that decarbonisation actions should link with, or generate co-benefits with sustainable development. For example, sustainable urban planning contains actions that establish systems that harmonise low-carbon transport with smooth mobility, promote efficiency improvements for the port and logistics by reducing GHG emissions from ships and introducing renewable energy, strengthen measures on GHG sinks and adaptation based on the conservation and utilisation of forests and agricultural land, promote a low-carbon transition at all stages of waste collection, transport and disposal, and so forth.

In order to support the implementation of the "Yokohama City Action Plan for Global Warming Countermeasures", Yokohama city prepared the "City Strategy on the Use of Renewable Energy" in 2019, and enacted the "City Ordinance for Promotion of Formulating Carbon Neutral Society" in 2021. The "City Strategy on the Use of Renewable Energy" addresses three points, each with targets and measures: (1) Realisation of maximum energy savings, (2) Strategic expansion of renewable energy, and (3) Leading actions at Yokohama City Hall, including the introduction of renewable energy facilities for new construction, expansion and rehabilitation of public facilities. The "City Ordinance for Promotion of Formulating Carbon Neutral Society" clarifies the responsibilities of the municipal government, businesses and citizens, and sets out the basic matters for necessary measures to promote the formulation of a decarbonised society in Yokohama. The Ordinance addresses the need to consume and make effective use of renewable energy produced within the city limits while increasing the introduction of renewable energy produced outside the city limits. It also stresses the importance of providing relevant information to businesses and citizens to promote GHG reductions through the development and conservation of forests that absorb equivalent amounts of GHGs

elsewhere in cases where the reduction of GHG emissions is difficult.

Some of the above points summarising Yokohama city's policies and plans for decarbonisation could be useful to Da Nang City, including the following:

- Make every attempt to carry out maximum energy savings while promoting the introduction of renewable energies. If unable to supply enough renewable energy to meet total energy demand in the city, consider introducing renewable energy from other municipalities and returning the profits to them.
- Ensure that decarbonisation efforts are linked to sustainable urban development, including comfortable urban living, convenient transportation, and resource recycling, including waste management.
- Work closely with citizens, businesses, and universities in the development and implementation of decarbonisation plans. Consider awareness-raising, learning, and events to encourage behavioural change (including lifestyle changes) towards decarbonisation.
- The city government should take the lead in implementing decarbonisation measures and make them visible to citizens and businesses. For example, by targeting city-owned facilities, ambitious energy-saving measures, solar power, conversion of waste to energy, and resource recycling should be introduced.

To provide more specific details on the above points, let us examine a model decarbonisation project undertaken by Yokohama city.

As part of its policies and plans to promote decarbonisation, Yokohama city has implemented a model project in a selected area to lead in decarbonisation efforts. The project concentrates human and financial resources in the area, and aims to expand to other parts of the city based on the results achieved. The model project is called the "Urban Decarbonisation Model in Minato Mirai 21 District based on public-private partnership". This project focuses on the household, business and transportation sectors, which could be useful as these sectors also have relatively high GHG emissions in Da Nang City.

The Minato Mirai 21 (MM21) district, located in the city's waterfront area, is a designated decarbonisation leading area. Besides its offices, commercial and residential facilities, MM21 is a district where a diverse range of functions have come together, including corporate headquarters, R&D facilities, music halls, universities, and international event sites. Approximately 10% of the city's energy consumption for the business sector is concentrated in the district. The model project targets 32 out of the 64 facilities in MM21.

Table 3: Facts & figures about Minato Mirai 21 District

	MM21 District	【Reference】	Yokohama overall
Area	1.86 km ²		437 km ²
No. of businesses	1,820		155,000
No. of employees	117,000		1,690,000
GHG emissions	286,000 tonnes/year		16,470,000 tonnes/year

(Source: Proposal by Yokohama city on "Urban Decarbonisation Model in Minato Mirai 21 District based on public-private partnership")

Some of the points related to decarbonisation approaches in MM21 may be useful for Da Nang as follows:

(1) The area has limited space for solar power installations, partly due to the large number of high-rise buildings. Although many companies are seeking additional renewable energy sources, the potential for renewable energy in the area is low. Therefore, in addition to comprehensive energy-saving measures to reduce energy consumption to the maximum extent possible, the city aims to partner with suburban districts within the city limits and other local governments. The goal is to create a mechanism to return profits to these areas. For example, when using electricity from renewable energy generated in suburban areas of Yokohama and outside the city (including other municipalities) for

municipal housing in the central city, returning a portion of the electricity fees to suburban and outlying areas is expected to contribute to their regional revitalisation activities.

(2) Advance initiatives to encourage behavioural change among workers, visitors, and residents to reduce GHG emissions by reducing the large volume of waste generated (e.g. food residue, plastic bottles), engaging in resource circulation initiatives based on recycling. For example, the reduction of food waste generated by restaurants, hotels, etc. can be achieved by using it for biomass power generation and composting. Additionally, the compost can be used by farmers in Yokohama, and the fruit and vegetables produced can be consumed at restaurants in the MM21 district and other parts of the city. This will contribute to achieving a circular economy.

(3) Aim for decarbonisation efforts along with improved disaster preparedness by securing power sources in the event of blackouts by utilising Electric Vehicles (EV) and power sources owned by some companies in the district for the purposes of disaster preparedness. From this perspective, efforts will be made to encourage the spread of EVs by improving electricity charging infrastructure, introducing EV car sharing, and promoting the use of storage batteries.

(4) Make existing public transport (railways and buses) low-carbon and employ digital solutions to increase the convenience of travel within the city and surrounding districts. One example is MaaS, Mobility as a Service. MaaS provides consolidated search, reservation, and payment services by optimally combining multiple public transport and other mobility services to meet the trip-based mobility needs of individual local residents and travellers

3.2 Kitakyushu City

Kitakyushu city has revised its existing "Kitakyushu Action Plan for Global Warming Countermeasures and Kitakyushu Eco-Model City Action Plan." The revised action plan sets reduction targets for GHG emissions in anticipation of a decarbonised society, and defines specific measures for mitigation and adaptation to counter global warming.

In 2017, the industry sector contributed approximately 60% of the city's 15 million tonnes of GHG emissions, with transportation and households following at 10% and 7%, respectively. Kitakyushu aims to become a decarbonised society by 2050 and has developed a Kitakyushu model to achieve

this goal while promoting innovation, transforming lifestyles, and developing a resilient city capable of adapting to climate change. By extending this model to other areas in Japan and abroad, Kitakyushu hopes to contribute to the global society.

With the industrial sector accounting for nearly 60% of the city's GHG emissions, Kitakyushu's Green Growth Strategy focuses on the energy sector and innovation. The strategy is a sectoral plan that aims to strategically secure sources of decarbonised energy and accelerate innovation in the future.

In terms of decarbonised energy, Kitakyushu is moving away from a dependence on fossil fuels by promoting greater energy savings and electrification across all areas, such as electricity, heat, and transportation, while maximising the use of renewable energy and CO₂-free hydrogen. Electrification is an essential strategy for climate action as it offers an alternative to polluting fossil fuels used in heating and cooling, transportation, and industrial applications. By promoting renewable energy and energy savings along with electrification, Kitakyushu hopes to accelerate and broaden further GHG reductions.

Kitakyushu has developed a strategic vision for the future of energy in the city, which comprises three main areas: 1) a sophisticated energy storage system base, 2) a growing wind power base, and 3) a hydrogen production and supply base. Under the first area, Kitakyushu will develop stable renewable energy sources and produce electricity from them through the widespread use of photovoltaic power generation (PV) and storage batteries, minimise the impacts of power outages during disasters, and establish reuse and recycling systems for production materials used in PV and storage batteries. Given the optimal wind conditions for wind power in the area adjacent to the sea, designated promotional zones will be developed as a comprehensive hub for wind power industries, accelerating the introduction of offshore wind power as local renewable energy for local consumption. Additionally, hydrogen will be produced using surplus energy, serving as an alternative energy source to thermal power and fuel cells. It can also be used to respond to demand for high-temperature heat when electrification is not feasible.

Kitakyushu's efforts to promote electrification across various sectors, including industry, and establish a renewable energy development base that is strategically located, can serve as a reference for Da Nang city, where GHG emissions from the industrial sector are the highest.

3.3. Kuala Lumpur City

Kuala Lumpur city issued its "Climate Action Plan 2050" in December 2021 to establish a clear roadmap towards carbon neutrality and climate resilience by 2050. This plan is based on the "Kuala Lumpur Low Carbon Society Blueprint 2030" published in 2017, which contains 245 actions to achieve a 70% reduction in carbon emissions per unit of GDP by 2030.

In 2017, Kuala Lumpur recorded emissions of approximately 25 million tonnes of CO₂e. The transportation sector is the largest contributor to emissions, accounting for 56% of the total emissions. Within the transportation sector, on-road transportation is the dominant source of emissions (99.4%), mainly due to the combustion of petrol, diesel, biodiesel, and natural gas by vehicles such as private vehicles, taxis, motorcycles, buses, and trucks. Emissions from commercial and institutional buildings are the second-largest source, accounting for 24%, followed by residential buildings at about 10%, mainly due to electricity consumption.

The "Climate Action Plan 2050" prioritises 15 key climate actions in five strategic areas, with a roadmap toward 2030 and 2050. To prioritise these actions, the city authority first assessed Kuala Lumpur's socioeconomic context, carbon emission profile, climate hazards and ongoing climate actions. Then, they carried out a detailed review of the 245 climate actions in the "Kuala Lumpur Low Carbon Society Blueprint 2030" to identify and prioritise actions that needed further development. The evaluation criteria used to prioritise or select among the climate actions were:

- Potential for emissions reduction and/or climate risk reduction
- Potential for generating wider social benefits, particularly for vulnerable communities
- Synergies with other actions on the list
- Feasibility of implementation
- Potential risk of poor investment

Through the evaluation process, a final list of 15 key climate actions across five strategic areas was

developed. These areas, which were selected following stakeholder consultation, are: 1) Mobility & Infrastructure, 2) Energy Efficient & Climate-Proof Buildings, 3) Smart Waste Management, 4) Green Adaptive City, and 5) Disaster Management. The 15 climate actions were explored in greater detail, examining elements from design to implementation with each roadmap. The roadmap sets out targets, milestones and activities.

For example, under the area of 1) Mobility & Infrastructure, priority climate actions include shifting fossil fuel motor cars to EV, designing streets for active mobility (to reduce traffic congestion), creating comfortable and safe pedestrian networks, providing affordable housing accessible to public transport, and developing a dedicated bus lane network. These actions are expected to encourage residents and tourists to shift to public transportation, while also providing opportunities for rainwater storage and urban greening as co-benefits by giving more space to pedestrians and cyclists.

Under the area of 2) Energy Efficient & Climate-Proof Buildings, priority actions include validating a low carbon building checklist, benchmarking and rating building performance, and developing a near zero emissions building roadmap.

To monitor, evaluate and report on the progress of implementation, the city of Kuala Lumpur has established prime indicators for each of the 15 priority climate actions. The table below shows some examples of the indicators.

Table 4. Example of prioritised climate actions and prime indicators formulated by Kuala Lumpur city

Prioritised climate action	Prime indicators
Street design for active mobility	<ul style="list-style-type: none"> ▪ Total emissions from motorised transport (t CO₂e) ▪ PM_{2.5} and PM₁₀ concentrations
Low carbon building checklist validation	<ul style="list-style-type: none"> ▪ % of all building floor area complying to climate-related policies ▪ % of all new buildings applying to benchmarking policy
Protect parks and increase biodiverse areas	<ul style="list-style-type: none"> ▪ Area of shaded cover created (m²) ▪ % of zoning changes to open space (focused on emissions reductions or climate vulnerability)

(Source: "Kuala Lumpur Climate Action Plan 2050")

Approaches used to prioritise climate actions in Kuala Lumpur's "Climate Action Plan 2050" could be useful for Da Nang city in enhancing synergy among selected climate actions for both GHG emission reduction and climate resilience. These social benefits should be shared with vulnerable communities, in particular.

3.4. Summary

In summarising the experiences of three cities on strategies and plans for decarbonised city development, the following points could be useful for Da Nang:

- 1) *Setting ambitious targets for energy savings and renewable & clean energy supply, along with advancing electrification to reduce the use of fossil fuels.*

When setting the GHG reduction target for 2035 to 2050, priority should be given to promoting energy savings and shifting to renewable & clean energy. Potential areas for electrification should be identified across various sectors, including manufacturing, transport, and buildings, to replace fossil fuel energy for industrial processes, power sources, heating, and cooling.

Targets for renewable & clean energy supply should be set after clarifying the maximum capacity to produce such energy within the city. If the target cannot be met by the maximum supply capacity, one option is to procure renewable or clean energy from another city or municipality. If the cost of the procured energy is less than that produced in Da Nang city, the surplus is expected to be returned as development funds to the city or municipality supplying renewable & clean energy to Da Nang.

2) Prioritising climate actions taking into account co- benefits including for vulnerable communities

It is important to prioritise climate actions to implement under limited resources and achieve effective results. When prioritising among climate actions, it is important to consider not only the expected impacts of GHG reduction and climate resilience but also the social benefits or co-benefits generated from such actions that contribute to sustainable city development.

For example, the electrification of industry, transport, and buildings will reduce air pollution along with GHG emissions by replacing fossil fuels with clean electricity. Biomass, biogas energy, or compost production utilising organic waste from the food processing industry, food markets, restaurants, and households in the city will reduce waste to the landfill site where GHGs are emitted. Decentralised renewable energy production and supply systems in the city are resilient against emergent situations where the national power grid is interrupted by disasters, including typhoons or floods. Green parks or green spaces in the city function not only as a carbon sink but also help to reduce heat waves, absorb rainwater, and provide comfort for citizens.

“Da Nang City Climate Action Plan - A conceptual framework for sectoral climate actions”, which was published by IGES, suggests various climate actions that can generate co-benefits for sustainable city development in energy, transport, food & agriculture, and so forth.

In addition to such co-benefits, it is also important to consider how such benefits will be shared with vulnerable people or communities in the city

3) Strengthening measures to guide changes in lifestyle contributing to Net Zero

A decarbonised society requires a change in lifestyle by city residents. For example, many city

residents ride motorbikes or cars with fossil fuel engines. How can we shift to public transportation and EVs? First of all, citizens should understand why a decarbonised society is important, and then they should know what their options are. Such options should, of course, be acceptable for the users. In the case of bus public transportation, better services at a reasonable cost are critical to attracting more users. This requires secured bus lanes to avoid traffic congestion, better access to bus stops, and efficient connectivity with other means of transport so that passengers can reach their final destination smoothly.

Other areas of lifestyle changes include the purchase of lower carbon products, reduction of food loss or waste, and conservation of nature contributing to GHG reduction. These lifestyle changes will also lead to changes in businesses that provide products and services to end-users.

Therefore, a net zero action plan should address tangible measures to guide such lifestyle changes by the city residents

4) Demonstrating a model decarbonisation project in a target area

Generally, through implementing a model project in a target area, technology innovation, new business models, private and public cooperation, public participation, finance schemes, and required regulations can be examined, and lessons can be learned. The model project can also visualise what a decarbonisation project is and its impact on society.

In Da Nang, an industrial zone would be a suitable location to start a model decarbonisation project consisting of high carbon-intensive factories and buildings. One critical aspect for the successful execution of such a model project is the existence of an entity responsible for managing the target area, which can play a role in coordinating among the stakeholders. The Da Nang High-Tech Park and Industry Zones Authority is responsible for the industrial zones and high-tech parks in the city and has built good partnerships with the companies and other stakeholders located in and around the zones. In addition, since the Authority manages advanced technology companies in high-tech parks, they may be able to mobilise such technologies for the decarbonisation demonstration project.

4. A Case Study in Da Nang City

4.1. Background

Da Nang has multiple special features. It falls under the administration of the central government, which means that its jurisdiction is equivalent to that of a province (Da Nang PPC, 2022). It encompasses various ecosystems, including mountains, forests, urban and rural areas, and coastal zones. Additionally, it serves as a gateway to the sea of Vietnam's central highland as well as the land-locked neighbouring country of Lao PDR. Da Nang plays a crucial role as a seaport and economic hub in central Vietnam.

A previous study conducted by the Institute for Global Environmental Strategies (IGES) in 2016, in collaboration with Kyoto University, E-konzal, the National Institute for Environmental Studies (NIES), the Mizuho Information and Research Institute (MHIR), the Institute of Strategy and Policy on Natural Resources & Environment (ISPONRE), and the Da Nang Climate Change Coordination Office (CCCCO), indicated that under the business-as-usual scenario, total GHG emissions would increase roughly fourfold, from 2,665 ktCO₂eq in 2013 to 13,563 ktCO₂eq in 2030. However, total GHG emissions could be reduced by 16%, or about 2,226 ktCO₂eq, under the countermeasure scenario simulated by the Asian-Pacific Integrated Model (AIM) if the city implements climate action initiatives. The initiatives can be grouped into five categories: smart buildings (such as the diffusion of low-energy houses, using solar-water heaters, and buildings), smart industry (such as the promotion of energy-efficient equipment and fuel shift), energy efficiency (such as promoting energy-efficient devices and appliances like lighting and air conditioners for houses and buildings), smart transport (such as improving the fuel efficiency of vehicles, promoting modal shift to public transportation, and deploying buses using compressed natural gas), and green energy (such as promoting renewable energy such as photovoltaic power, wind power, and small-scale hydropower) (Hoa and Ochi, 2016).

This analysis indicates that the five climate action groups could contribute to a GHG reduction of 2,226 ktCO₂eq in 2030, with the following breakdown: Smart transport: 954 ktCO₂eq (42.9% of 2,226 ktCO₂eq), Smart industry: 829 ktCO₂eq (37.2%), Energy efficiency: 298 ktCO₂eq (13.4%), Smart buildings: 106 ktCO₂eq (4.8%), and Green energy: 36 ktCO₂eq (1.6%). These findings suggest that the transport and industry sectors in Da Nang have a greater potential for GHG emission reduction, and that energy efficiency and green energy could further enhance GHG reduction in those sectors.

As a fast-growing city, Da Nang faces significant challenges in meeting increasing energy demands and decarbonising its energy system. Currently, Da Nang relies on imported electricity from neighbouring provinces such as Quang Nam (for hydropower) and Quang Tri (for coal power) (Da Nang PPC, 2022), as it has no large-scale power plants. The state-owned utility Electricity of Vietnam (EVN) manages the distribution and retail sale of electricity for the entire nation, including cities like Da Nang (Do et al., 2020). Thus, Da Nang currently has limited control over the type of electricity it consumes.

However, Da Nang could increase its electricity self-sufficiency by developing solar PV, as the city has significant solar PV potential, including 1,138 MW rooftop, 394 MW ground-mounted, and 163 MW floating (Da Nang PPC, 2022). Of the potential ground-mounted solar PV, 250 MW can come from mineral mines that have been closed after operation. Thanks to national feed-in tariffs (FIT) (Do et al., 2021), Da Nang had reached 81 MW of solar PV by the end of 2020 (Da Nang PPC, 2022). Other renewable energies, such as biomass, solid waste and biogas, have smaller potentials, approximately 15 MW, 36 MW, and 6 MW respectively (Da Nang PPC, 2022), but could still contribute to powering Da Nang in an environmentally friendly way.

4.2. Da Nang city's strategies and action plan on climate mitigation by 2050

Da Nang has issued several documents related to climate mitigation, including:

- The People's Committee Decision 4929/QD-UBND dated 16 December, 2020, on enhancing the implementation of energy saving and efficiency (Da Nang PPC, 2020).
- The People's Committee Decision 104/QD-UBND dated 12 January, 2021, on the rooftop solar PV programme for Da Nang until 2025, with visions to 2035 (Da Nang PPC, 2021a).
- The People's Committee Decision 1099/QD-UBND dated 2 April, 2021, on the programme for developing Da Nang as an environmental city for the period 2021-2030 (Da Nang PPC, 2021b).
- The People's Committee Decision 1737/QD-UBND dated 20 May, 2021, on renewable and clean energy (Da Nang PPC, 2021c).

- The People's Committee Decision 2609/QĐ-UBND dated 28 July, 2021, on an action plan for responding to climate change during 2021-2030, with visions to 2050 (Da Nang PPC, 2021d).

However, since these documents were issued before COP26, their targets are unambitious compared to updated national targets. For instance, Da Nang's renewable and clean energy targets for 2025 and 2050 are only 9.71% and 9.69% of the total primary energy supply, respectively, as set in Decision 1737 (Da Nang PPC, 2021c). Only solar PV and biomass energy have specific targets, accounting for about 9% of Da Nang's electricity mix by 2035 (Da Nang PPC, 2021c). In contrast, the national target for renewable electricity is set at 47% of the power generation mix by 2030, according to Vietnam's commitment to the Just Energy Transition Partnership (JETP) announced in December 2022 (Do and Burke, 2023).

Solar PV targets remain modest compared with their technical potential. The rooftop solar PV targets are 170 MW (contributing to about 4% of the electricity mix), 293 MW (5%), and 402 MW (5%) in 2025, 2030 and 2035, respectively. The targets for ground-mounted solar PV are also modest, with Decision 1737 setting the targets of only 75 MW and 175 MW of ground-mounted solar PV by 2025 and 2035, respectively (Da Nang PPC, 2021a). There are no targets for floating solar PV, although Da Nang has a vast water surface suitable for it. The solar PV target is set at only about 577 MW by 2035, which is 34% of its potential (Da Nang PPC, 2021a). The targets for solar PV could be more ambitious by increasing the targets for ground-mounted solar and setting ambitious targets for floating solar PV.

Incentives for renewable energy development have not been specified yet. The City Council's Resolution 149/2019/NQ-HĐND, dated 12 July, 2018, on policies for interest rate support for important investment projects appears insufficient to incentivise investment in solar PV, particularly after the national FITs for solar PV ended in 2020 (Do et al., 2021). A generous FIT using a net metering mechanism has the potential to promote solar PV prosumers, which would increase electricity self-sufficiency and reduce the need for expanding transmission grids.

In addition, from a policy cycle perspective, ambitious targets can only be meaningful if they are backed by city-level plans, policies, strategies and monitoring tools, such as a city-level GHG inventory. In fact, under Government Decree No. 06/2022/ND-CP and the related Decision No. 01/2022/QĐ-TTg, specific high-energy consumption entities/facilities from the transport, industrial and waste

sectors are required to conduct GHG inventories and prepare emission reduction actions to be reported periodically to the Ministry of Natural Resources and Environment. Since the city government's interests are deeply intertwined with these regulated entities/facilities, Da Nang has been enhancing the necessary expertise and institutional capacity to facilitate the implementation of these regulations regarding GHG inventory reporting, as well as private sector plans to reduce GHG emissions.

5. Key Policies and Strategies Recommendations for Achieving Net-Zero Emissions Da Nang

Da Nang is well-positioned to contribute to national net zero goals. Firstly, it could increase the ambition of targets for energy savings to align with the updated national commitments. To gain public support for increasing electricity tariffs, consultations and improved public awareness about energy savings will be necessary. Increased electricity tariffs would incentivise improved energy efficiency.

Secondly, setting ambitious targets for solar PV would significantly accelerate decarbonisation in the city. Da Nang could consider negotiating with EVN to apply its own FIT to promote solar PV in the city. In addition, mechanisms such as direct power purchase agreements (DPPA) could enable large-scale electricity consumers located in Da Nang to purchase solar and wind power from other provinces. For example, Da Nang could buy solar power from Gia Lai Province and offshore wind power from Binh Dinh Province. To apply DPPA in Da Nang as a pilot project, discussions with EVN and MOIT would be necessary, given that this mechanism is being tested on an ad hoc basis only (Do et al., 2022). Upgrading transmission grids connecting with neighbouring provinces is necessary to facilitate imports of solar and wind power. Da Nang has over 30 potential sites of 2 GWH-6 hour pumped hydro energy storage within a 50 km diameter (Blakers et al., 2019), which would help address the intermittency of solar and wind power and enhance their penetration (Lu et al., 2021).

Thirdly, setting ambitious targets for electric vehicles would help steer the greening of the transport sector. Electrification could start with government vehicles and public transport means, including taxis. The current target of 25% electric buses by 2030 (Da Nang PPC, 2021b) could be more ambitious. Setting a target of 100% of government vehicles and public transport fleet being electric by 2030 is desirable.

Fourthly, Da Nang is in a position to increase the country's carbon sequestration via forest protection and afforestation. The city has approximately 64,000 hectares of forest, accounting for about 47% of its area. It could consider increasing the forest coverage to boost negative emissions. Marine ecosystem conservation would also contribute to carbon sequestration. Specific targets for terrestrial and maritime conservation could be set in a separate guiding document or integrated into current legal documents, such as the action plan for responding to climate change. For example, a target could be set for expanding marine protected areas. It is also important to control pollution from inland industrial and municipal wastewater and solid waste. In particular, reducing marine plastic waste should be given high priority. Da Nang is the only city in Vietnam that has the potential for carbon sequestration via both terrestrial and maritime ecosystems.

Fifthly, to develop the necessary expertise related to GHG inventories, it is suggested that Da Nang city start by establishing a 'local government operations (LGO) GHG inventory.' This inventory would cover emissions arising only from government operations (typically only 3–7% of total citywide emissions) to monitor its GHG reduction progress. One important benefit of an LGO inventory is to help identify problems and opportunities for improving efficiencies within urban services. For example, in its low-carbon city pilot project, the Shah Alam City Council (Malaysia) first conducted a baseline energy audit (costing USD13,000) of its main office building in 2015. That provided the basis for introducing saving/efficiency measures and retrofits to lower building GHG emissions by more than 4.4%, as well as electricity bill savings of approximately USD350,000 by 2017. Through this, city staff gained capacity on GHG inventory, building energy efficiency, and the PDCA (Plan-Do-Check-Act) project management approach.

Da Nang could set an example as a city that drives net zero emissions initiatives. It was the first city in Vietnam to start an action plan for gearing towards an environmentally friendly city in 2008. The momentum has remained, with the action plan continuing for the period of 2021-2030. The action plan could be updated to reflect the new targets that are in line with the national net zero emissions goals. Indeed, Da Nang could set a target to become a leading city in areas such as zero plastic waste and net zero emissions, not only in Vietnam but also across the ASEAN region.

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