Da Nang City Climate Action Plan

A conceptual framework for sectoral climate actions

Sustainable Future Pathway

Travel Guide

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Foreword

Da Nang City has become the fastest growing city in Vietnam in recent years with a projected increase in urban area and population in line with rapid economic growth. In the face of climate change, one of the greatest challenges mankind has ever faced, the government of Vietnam announced its commitment to carbon neutrality by 2050 at COP26 to meet the target set by the Paris Agreement in 2015. In line with this national vision and the recently approved Da Nang City 10 Year Environmental Plan, it is increasingly important to formulate Local Climate Change Action Plans (LCCAP) with concrete reduction targets in major sectors in Da Nang City. As Da Nang is currently in a signifi cant urban and economic transition phase, long-term visions for sustainability and carbon neutrality should be integrated into an actual development plan. The national government established its National Determined Contribution (NDC) in 2015, and this was revised in 2020 (Viet Nam NDC, 2020). Vietnam's NDC contains key mitigation and adaptation strategies and targets. Thus, Da Nang's future environmental perspective is in line with adaptation concerns, while further concrete targets for mitigation must be set in each sector and strategies developed for contributing to the national NDC targets. Moreover, as Da Nang is a growing economy with a rapidly increasing population, decisions made now will have a strong infl uence on the future direction in basic infrastructure, local economy, and well-being. The comprehensive LCCAP is part of the fundamental climate change strategy incorporating mitigation and adaptation measures and strategies aiming to support knowledge and actions by key stakeholders for tackling local climate concerns.

This report outlines the conceptual framework of Da Nang's sectoral climate actions. This conceptual framework of climate action for Da Nang City mainly focuses on mitigation and adaptation measures. Local resilience and living quality measures are further components which can also achieve socioeconomic sustainability beyond the climate mitigation targets. These are interlinked with SDGs targets such as reducing poverty and social inequality, as well as increasing health and well-being. This climate action plan aims to be oriented towards the local context, and interlinked with urban development master plans. Da Nang's sectoral climate action plan aims to communicate with local residents including young students and children who will be in charge of future socio-economic development in the next decades. Therefore, this sectoral climate action plan sets out fundamental thinking and approaches in each sector so that each citizen can take action. Feedback from Da Nang's residents and visitors would be greatly appreciated to improve the contents and suggest further real actions which can be practically implemented. Finally, this climate action plan hopes that all citizens can gain basic knowledge about the dangers facing our planet due to the threat of climate change and then understand what is urgently needed, and what we ourselves can do today.

Contents

1. Da Nang Climate Change: Long-term Strategies and Motivation

Da Nang City has become the fastest growing city in Vietnam in recent years. Da Nang is one of the five central jurisdictions, and is also the socio-economic center of Vietnam. Situated on the central coast of Vietnam, Da Nang has developed tourist attractions such as beach resorts in recent years, and its international airport also functions as a gateway to world heritage sites.

Da Nang currently has a population of 1.1 million and is home to about 270,000 households. About 88% of the population lives in urban areas, and the remaining 12% lives in rural areas. The population density is about 900 people/km2. Many citizens live in residential areas comprised of two to five storey buildings. The population density in the suburbs (rural areas) is about 180 people/km2. In Da Nang, the formulation of a master plan for the medium-to-long term (2025 to 2045) is currently underway in parallel with the 10-year environmental plan.

It is increasingly important to formulate a Local Climate Change Action Plan (LCCAP) with concrete reduction targets for major sectors in Da Nang in line with the recently approved Da Nang City 10-Year Environmental Plan. As Da Nang is currently in a significant urban and economic transition phase, long-term visions for sustainability and carbon neutrality should be integrated into the actual development plan.

The national government of Vietnam established its National Determined Contributions (NDCs) in 2015, and these were revised in 2020 (Vietnam NDC, 2020). Vietnam's NDCs contain key mitigation and adaptation strategies and targets, with a BAU (Business As Usual) scenario forecasting up to 2030 based on actual values in 2014. According to this forecast, there will be significant increases in the energy sector, and they are expected to more than triple compared to 2014. Based on this BAU forecast, the NDCs set a target of reducing GHGs by a total of 9% compared to BAU by 2030. It also aims for a 27% reduction with international support.

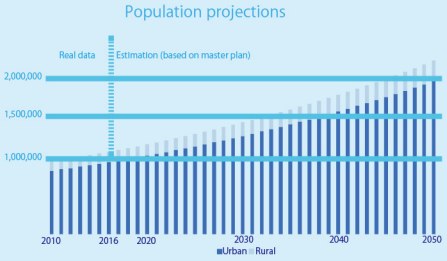
Vietnam announced ambitious national targets towards carbon neutrality at COP26 in 2021 in Glasgow, and to achieve these, comprehensive action packages for both mitigation and adaptation are significantly important specifically for cities such as Da Nang, which have seen recent growth and development. While the introduction of efficient technology and renewable energy is very promising, region-specific measures for adapting to rising sea levels and an increase in natural disasters is also a pressing issue. In particular, there is concern that the impacts of climate change may cause enormous damage to agricultural production and increase local risks to human security.

Da Nang's Sustainable Future Long-term Visions

Socioeconomic features

- Population is projected as constantly increasing by 2050 associated with the growth in both urban and rural. (BAU)

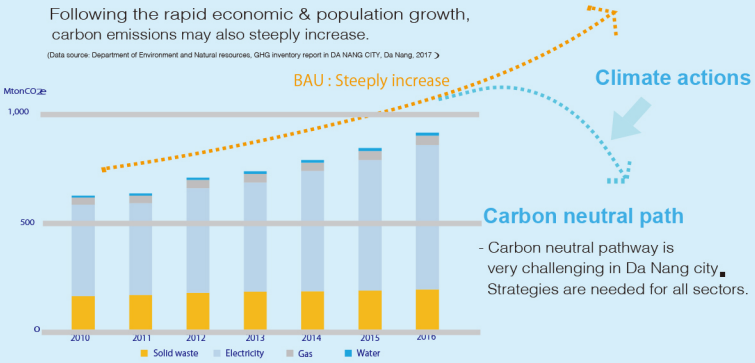
(Data source: Adjustment of the Da Nang City Master Plan to 2030, with a vision to 2045, 2020)



Carbon emissions (Graph shows carbon emissions from households)

Following the rapid economic & population growth, carbon emissions may also steeply increase.

(Data source: Department of Environment and Natural resources, GHG inventory report in DA NANG CITY, Da Nang, 2017)

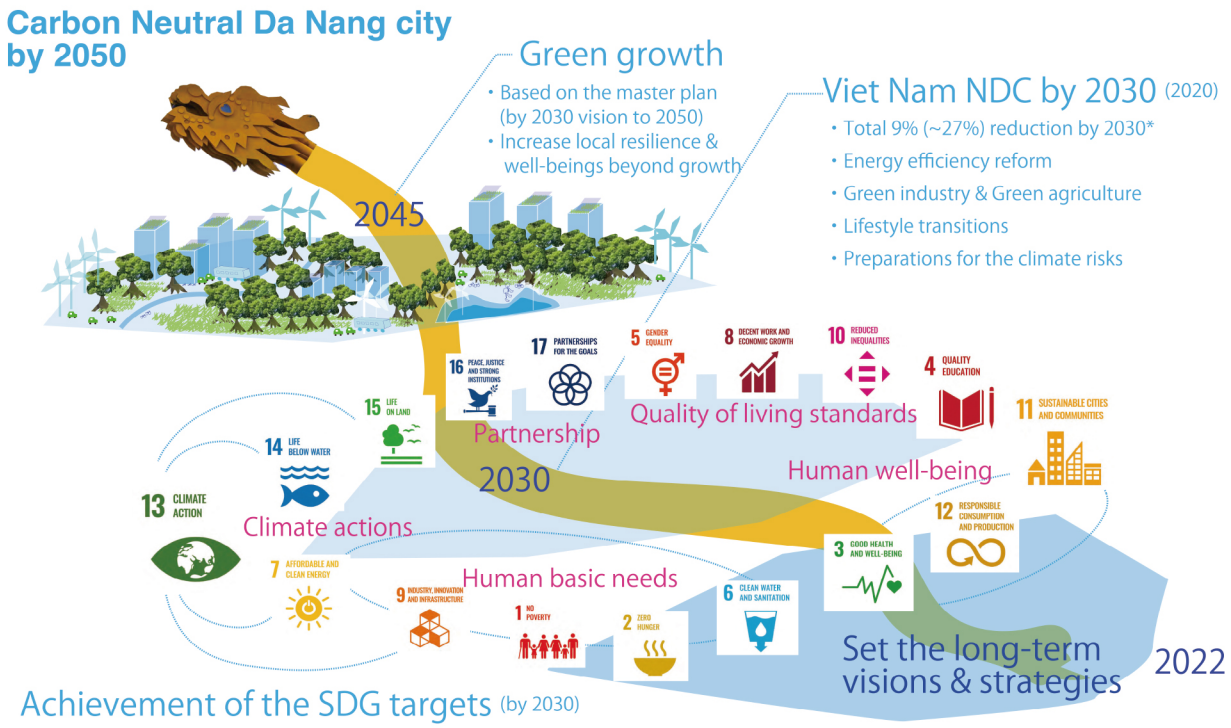


Carbon neutral path

- Carbon neutral pathway is very challenging in Da Nang city. Strategies are needed for all sectors.

Da Nang's future environmental perspective has been incorporated into adaptation concerns (Da Nang City, 2021), while further concrete targets should be set for mitigation in each sector. Strategies are required so as to fully contribute to national NDCs targets. Moreover, as Da Nang is a growing economy with a rapidly increasing population, decisions made now will have a strong influence on the future direction in basic infrastructure, local economy, and well-being. The comprehensive local climate action plan comprises a set of fundamental climate change strategies, including mitigation and adaptation measures and strategies aiming to support knowledge-sharing and actual actions by key stakeholders to tackle local climate concerns. This climate action plan for Da Nang City focuses on sectoral mitigation and adaptation measures and aims to set concrete targets and action plans specifically for the five key sectors. However, as these plans include long-term sustainable development strategies for Da Nang, all related sectors will also be integrated as key components of the overall climate action plan in the future. The achievement of SDGs targets is also an important policy target to increase overall quality living standards while maintaining the security of human basic needs and tackling social equity issues.

Carbon Neutral Da Nang city by 2050



* Viet Nam NDC (2020) states that Vietnam will reduce its total GHG emissions by 9% compared to the BAU scenario which is base year in 2014. Energy sector is expected to reduce 51.5 MtCO2e (5.5 % compared to the BAU). The total contribution 9% can be increased by up to 27% compared to the BAU with international support.

2. Current Risks

Current risks facing Da Nang include sea level rise and more frequent flooding due to an increase in rainfall in recent years. Climate change has obvious impacts in Vietnam in the form of more natural disasters which cause serious damage to local residents and their economy.

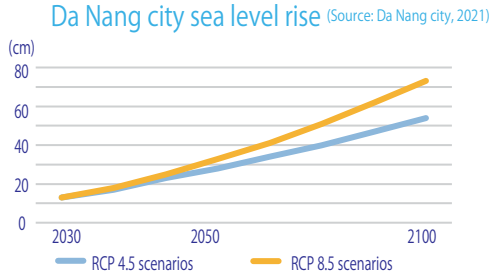
Vietnam has been heavily affected by the impacts of climate change. It is projected that the annual average temperature may increase by 1.9 – 4.0 C by the end of the 21st century according to the climate scenario. Sea levels may also rise by around 53 – 75 cm, in addition to an increase in rainfall by 5-20% (Ministry of Natural Resources and Environment, 2016). Over the past few years, due to the impact of climate change, the frequency and intensity of natural disasters has increased, causing much loss and damage to people and assets, as well as to the economic, cultural, and social infrastructure.

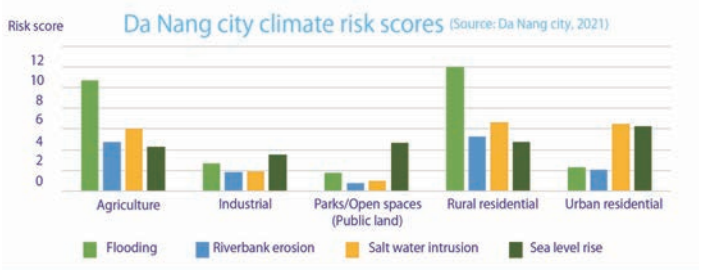
Da Nang has also been impacted by the rise in sea levels. In recent years, coastal erosion in Da Nang has become more serious. There is a more frequent threat of sea level rise to residential areas and infrastructure along the coast. Additionally, with its location downstream of the Vu Gia - Thu Bon river, Da Nang is particularly vulnerable to the effects of storms and floods in the context of climate change.

The topography of the city incorporates both coastal plain and mountainous areas. High and steep mountainous regions are concentrated in the west and northwest. There are many mountain ranges stretching to the sea, and a number of low hills interspersed with narrow coastal plains.
There are many agricultural, industrial, service, military, residential land and functional areas in the city. Near the Han River and Cu De River, the topography of the seabed is complicated and creates a number of shallow beaches (riverbeds). The offshore estuary area is generally inclined to the northeast. The distance of isometric lines is quite regular.

In recent years, floods have increased and are more difficult to predict, becoming a growing concern of local residents. The water flows rapidly and deepens, and it takes a long time to recede after a flood, as was the case in the historic flood in December 2018 in Da Nang due to heavy rains. In addition to natural disasters, there is growing pressure on the urban water supply. Drought, saline intrusion in rivers, and river water exploitation cause pressure on socio-economic areas such as tourism development, environmental sanitation, and disease outbreaks.

(All contents from 'Action Plan on response to climate change of Da Nang City', 2021)





(Both figures from 'Action Plan on response to climate change of Da Nang City', 2021)

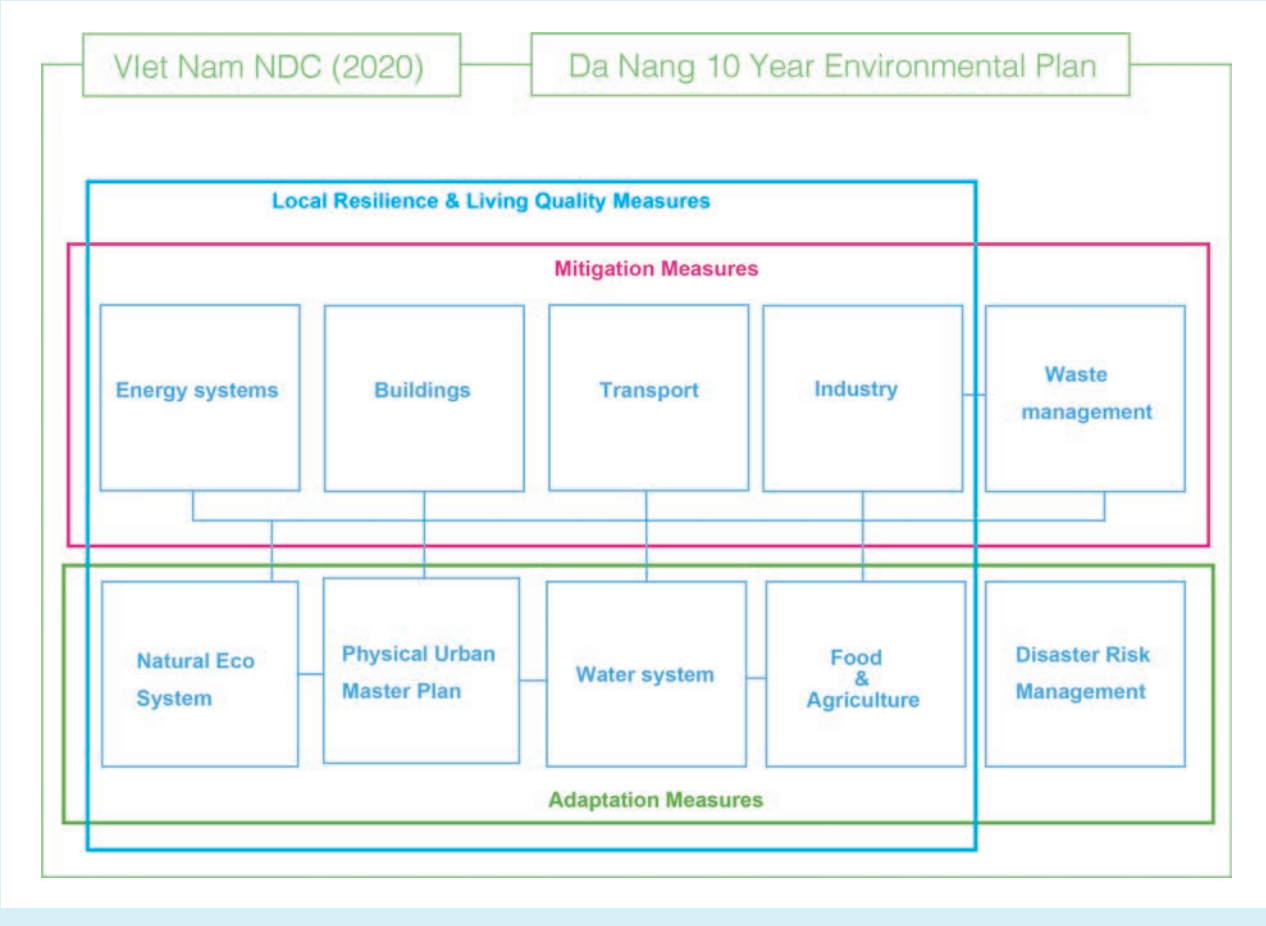
3. Climate Action Plan

Framework and Key Sectors

To realize long-term sustainable visions in Da Nang City, the climate action plan should be interlinked with comprehensive socio-economic key elements. The city's climate action plan consists of mitigation and adaptation strategies, and resilience & living quality indicators.

This report outlines the first conceptual framework of the action plan covering five key sectors: Buildings, Transport, Energy, Food & Agriculture, Water Management, and SDGs interactions. Overall key elements, however, include natural ecosystems (biodiversity), waste management, and disaster management. These elements play key roles in actions for climate mitigation and adaptati. Specifically, physical infrastructure and basic human needs, energy systems, food & agriculture, and water management are strongly interconnected with local resilience. Buildings, transport and the natural environment are also interlinked with living quality within the framework. All sectors contribute to both mitigation & adaptation measures, while the framework identifies stronger links with each measure. These key indicators should be reflected into the local development master plan to be put into place in society. This report firstly focuses on two key sectors: buildings and transport. These sectors have great potential to significantly reduce carbon emissions by 2050. In addition, energy sector also have make up a large proportion of the city's GHG emissions.

However due to the complexity and lack of inventory data, these sectors are briefly described as a potential transformation to achieve the carbon neutral society in the long-term as a first step. The food & agriculture sector and the water management sector generate fewer carbon emissions, but from a sustainable and resilience perspective, these sectors should develop long-term visions and investigate the potential changes to achieve a sustainable society. This local climate action framework has been developed in line with Vietnam's Nationally Determined Contribution (NDC) that was submitted in 2015 and revised in 2020 (Viet Nam NDC, 2020), and with reference to the Da Nang City 10-Year Environmental Plan (2021). The report also analyzes SDGs interactions and the impacts of the recent COVID-19 pandemic, by reviewing the city's policy documents and current ongoing projects. Achieving the overall SDGs targets is significantly important for Da Nang and this should be integrated into its current development master plans.



3.1 Buildings

Principles of Climate Action for Buildings

In 2016, the building sector in Da Nang emitted about 1.225 million tons of CO2 equivalent, and this amount is projected to increase 5.0-6.4% annually. Reducing carbon emissions from the building sector is key to Da Nang City meeting its carbon neutrality goal by 2050. The five principles for action on buildings are set out below.

The implementation of policy strategies is always linked to the laws, regulations and standards that are encouraged as well as mandatory. Therefore, climate actions in the building sector must be motivated by “net zero” emission standards and codes that are guided by what science demands and are consistent across jurisdictions.

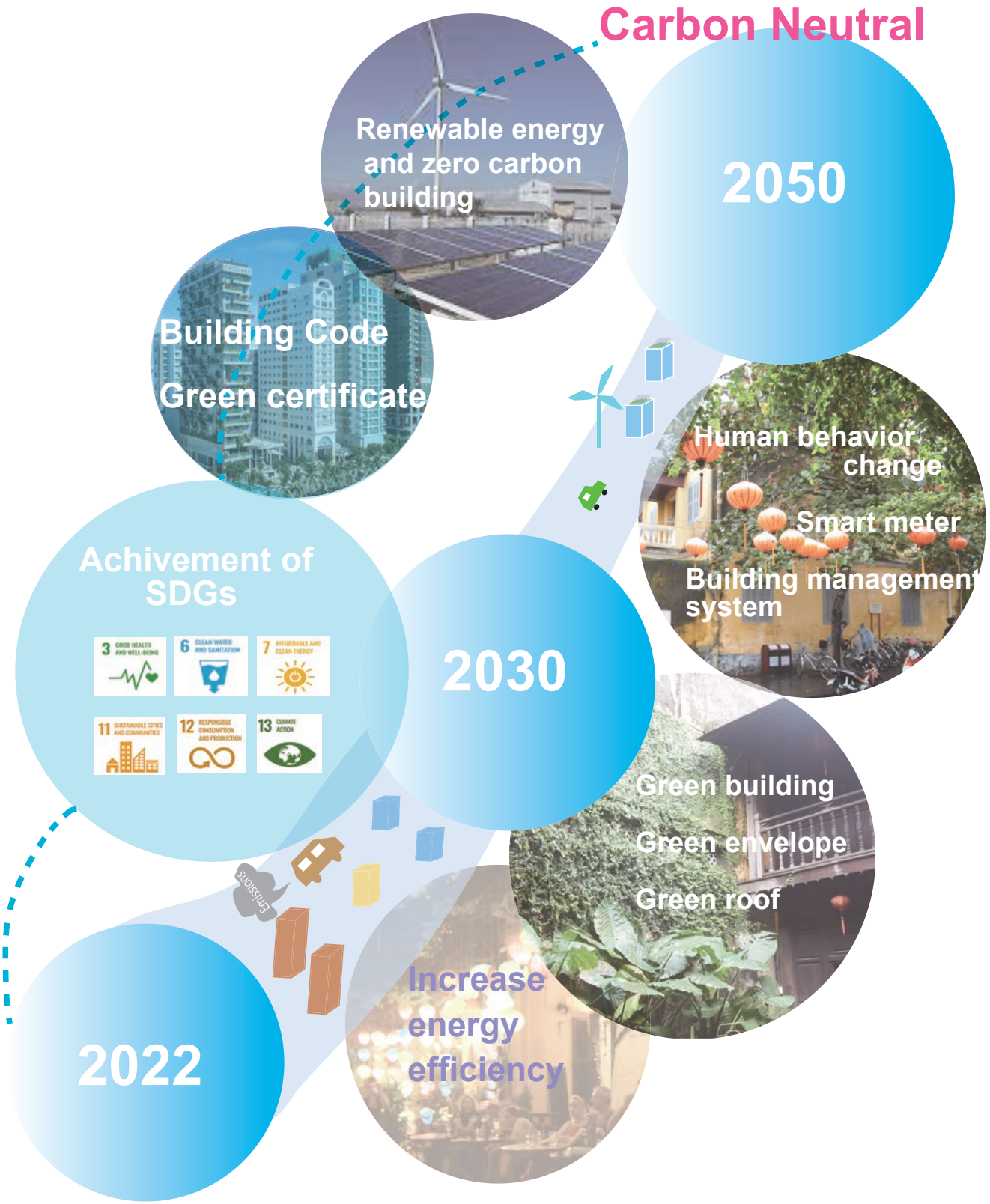
Around two-thirds of the existing buildings will still exist in 2040 and they continue to emit carbon. Therefore, achieving the zero emissions target will require efficient energy upgrades of the existing building stock (increasing energy efficiency, eliminating on-site fossil fuels, and generating and/or procuring 100% renewable energy).

The residential sector accounts for 73.7% of building energy consumption. Therefore, highly effective carbon reduction actions should be focused on this area.

Building emissions policies should be designed to allow a flexible mix of energy efficiency, renewable energy, and electrification, with the goal of enabling every building owner to pursue the solution that most effectively reduces emissions in their building or portfolio.

The process of reducing emissions needs to be linked to a revolution in information-sharing via different information avenues, through which real estate users can share and receive informational net-zero materials, such as case studies, local resources, and other updates.

Pathway to Achieve Sustainable Buildings



3.1.1 Mitigation Measures

Action 1: Reduce total energy use in existing buildings and new energy-efficient buildings

Da Nang's residential sector consumes a high proportion of energy in the building sector. Energy efficiency is recognized as a new economic opportunity as well as a resource efficiency measure to meet the sustainability and climate goals. While building technologies progressed to improve our quality of living, energy demand has steeply increased in cities. Better energy efficiency is one of the priority issues for accelerating climate action. However, enhanced indoor air quality and comfortable space for users are more recent, advanced measures that can be applied to the sustainable building concept. (Houston, 2020). By retrofitting existing building stock or establishing new guidelines for renovations, this goal can be achieved.

Action 2: Reduce climate change impact on buildings by adaptive envelope design measures

Under climate change conditions, buildings are expected to increase energy consumption for cooling to ensure biological comfort inside the buildings. Accordingly, this will increase greenhouse gas emissions, and as a result, the greenhouse effect causing global warming will be even more serious. Studies show that the increase in building energy consumption under the long-term RCP 4.5 climate change scenario will be between 6% and 12%. Meanwhile, the increase corresponding to the long-term RCP 8.5 climate change scenario will be between 12.6% and 22%. Restaurants and hotels are the types of commercial facilities with the most significant increase in emissions, while supermarkets, factories and office buildings have a lower and fairly uniform increase.

Action 3: Establish city energy regulations and benchmarks

Energy codes and regulations can set benchmarks for efficient energy use in new buildings and renovations. These regulations can demonstrate the performance criteria for design, construction, and building components that must be met by energy efficiency measures. Updated national building energy codes QCVN09:2017 (from 2013 to 2017) have increased potential energy savings from 10% to 25% for building occupants. Studies in the US show for each dollar spent on energy code enforcement, there is return on investment from energy savings. In order to achieve these savings, local-oriented benchmarks and regulations have to be established to adapt to the specific culture and climate conditions (Houston, 2020).

Action 4: Reduce energy consumption in the residential sector

The residential sector is a crucial energy consumer in Da Nang, accounting for 73.7% of building energy consumption. There is a huge number of residential buildings in the city and they are managed by the inhabitants of the city. Therefore, solutions in this area need to involve individual residents as they are the ones that will be impacted. The following key measures should be considered:

- Encourage use of natural ventilation all year. Scientists pointed out that the climate of Da Nang is naturally comfortable for 36.6% of the year, and this can be extended to 58.7% with natural ventilation (Nguyen & Reiter, 2014).
- Building smart meters for households: Consumers will be offered an In-Home Display (IHD) that will provide real time information on their energy use, both in terms of consumption and cost as well as other useful information. Smart meters can result in a reduction of household electricity consumption of between 1.1% and 2.7%. The corresponding reduction in gas consumption can be between 2.2% and 2.8% (Dromacque, et al., 2013).
- New housing should meet the energy efficiency standard and older dwellings should be retrofitted for better energy efficiency (see above-mentioned Action 1).
- Recommendations for choosing energy efficient home appliances: home appliances account for 20% of a household's total electric bill. This can be reduced by 10-50% by using energy efficient appliances (Energysage, 2021). Equipment that has a 4- to 5-star rating according to the energy label established by the Ministry of Industry and Trade should obtain a priority policy in the residential sector.

Action 5: Installing on-site renewable production systems (Rooftop PV and solar hot water systems)

The global solar energy market was valued at USD 52.5 billion in 2018 and is projected to reach USD 223.3 billion by 2026, growing at a Compound Annual Growth Rate (CAGR) of 20.5% from 2019 to 2026 (Solar energy market outlook, 2021). Residential solar PV market size is expected to expand. Rooftop PV systems and solar hot water systems may become cheaper due to the rapid increase of users. Based on an estimation from this study (Solar energy market outlook, 2021), around 50% of households and buildings in Da Nang are likely to have installed small rooftop PV systems by 2050, Da Nang could save 3 million tons of CO_2 equivalent by 2050. It is estimated that rooftop solar and power systems may contribute to more than half of Da Nang's total GHG reduction by 2050. Thus, installing on-site renewable energy will play a significant key role in decarbonization measures for Da Nang.

3.1.2 Adaptation Measures

Action 1: Train a workforce that is able to design, build, and operate buildings efficiently

Capacity development for building engineers, architects, and construction engineers is urgently needed to adapt to rapidly increasing climate risks. Flooding, for instance, may increase the risk of damage to machine operation systems which should be moved to higher floors (City of New York, 2013). Potential training opportunities should be provided to the relevant stakeholders in areas such as energy efficiency, building repair & maintenance, and high-performance building construction & design. Further training should cover a benchmarking system, building management system and renewable energy system (Houston, 2020).

Action 2: Investment in stormwater projects in buildings over the span of 20 years

Rainfall in Da Nang is expected to increase due to climate change. Experts have long warned that climate change will affect the intensity and frequency of precipitation. Warmer oceans increase the amount of water that evaporates into the air. These cycles increase the amount of annual rain specifically in coastal areas. However, these phenomena can also increase the opportunity to collect fresh rainwater (USGCRP, 2017).

Stormwater harvesting measures can also contribute to multiple objectives, such as reducing contaminated runoff to sensitive waters, promoting groundwater recharge, and non-potable applications such as toilet flushing and irrigation. Stormwater harvesting has been tested in Da Nang to address rising water demands as the population rises and to alleviate freshwater scarcity which has occured frequently in recent years. (McArdle, P; et al., 2011)

Action 3: Green building measures to reduce heat island effect and urban temperature in summer

As the annual mean air temperature of a city with one million people or more can be 1.0 – 3.0 °C warmer than its surroundings, under climate change conditions, this difference can be even higher (US EPA, 2017). Green roofs and facades reduce the heat storage capacity of urban surfaces and reduce air temperature, through increased evapotranspiration and shading. Photovoltaic panels (which provide shading for rooftops), increased building heights and outdoor water spraying were also assessed as effective ways of reducing surface temperatures. Increase of green spaces and green roads can provide comfortable shade for all local residents and mitigate the urban heat. Such land use management with nature-based solutions can also increase the local amenity space and improve human health.

Action 4: Adapt well to climate change effect by providing an Urban Adaptation Support Tool

It is necessary to develop a tool to assist cities, towns and other local authorities in developing, implementing and monitoring climate change adaptation plans (for instance, adaptation tool in EU). Such a tool can provide practical guidance and knowledge for stakeholders in Da Nang decision-makers of the city's planning authorities, and practitioners. It would also facilitate easy access to in-depth, expert knowledge and necessary updated data. Such adaptation tools should be established by the public authority with the transparency and reliability that can be maintained by citizen's direct feedback and scientific data.

3.1.3 Synergies with Other Actions and Resilience of Sustainable Buildings

Land use mix and access to public network & green spaces

Sustainable buildings should be connected with effective public transport services within a 5 ~ 15 minutes' walk. Furthermore, public open space is an important factor as a public amenity for all residents and visitors, as well as a way of maintaining local resilience in case of an emergency. Therefore, city planning authorities must be careful to develop neighborhood scale local plans to support public amenities and safe spaces for all residents. Building height, building coverage ratio, and building type (functions) should be identified, while mixed use strategies often provide effective functions for increasing local quality of living space and ensuring the efficiency of local resources (such as food and energy).

Access to local fresh food production & markets

Sustainable building management can be a part of sustainable local food production through rooftop gardens and vertical farms. There also need to be good links to local food markets (such as morning vegetable markets). Community gardens can be integrated into the local structure plan to develop better human relationships within the neighborhoods which can also enhance the local resilience.

Smart and sustainable regional planning

Smart networks and small-scale micro grid networks have been recognized as being increasingly important for energy-efficient buildings in Da Nang. As the current energy supply comes from outside of the city, one priority for sustainable building management is ensuring resilience in energy and other resources such as water . Therefore, a building mix (functional mix) and block-based area management can play a significant role in future regional sustainability in the building sector. The connection with electric vehicles (as batteries) should also be considered as a combination of localized smart energy system networks.

3.2 Transport

Principles of Climate Action for Transport

The approach to tackling transport-related problems in a city is heavily influenced by its high-level views about the type of city and transport systems that it wants to support. Dealing with climate change requires measures on both mitigation (primarily, reducing carbon emissions) and adaptation (coping with climate change consequences).

The main vision for a carbon neutral transport sector in Da Nang focuses on the increased use of public transit as one of its priorities. Public bus services will continue to play a key role, and will be powered by cleaner fuels (in the short run) and (ultimately) electricity.

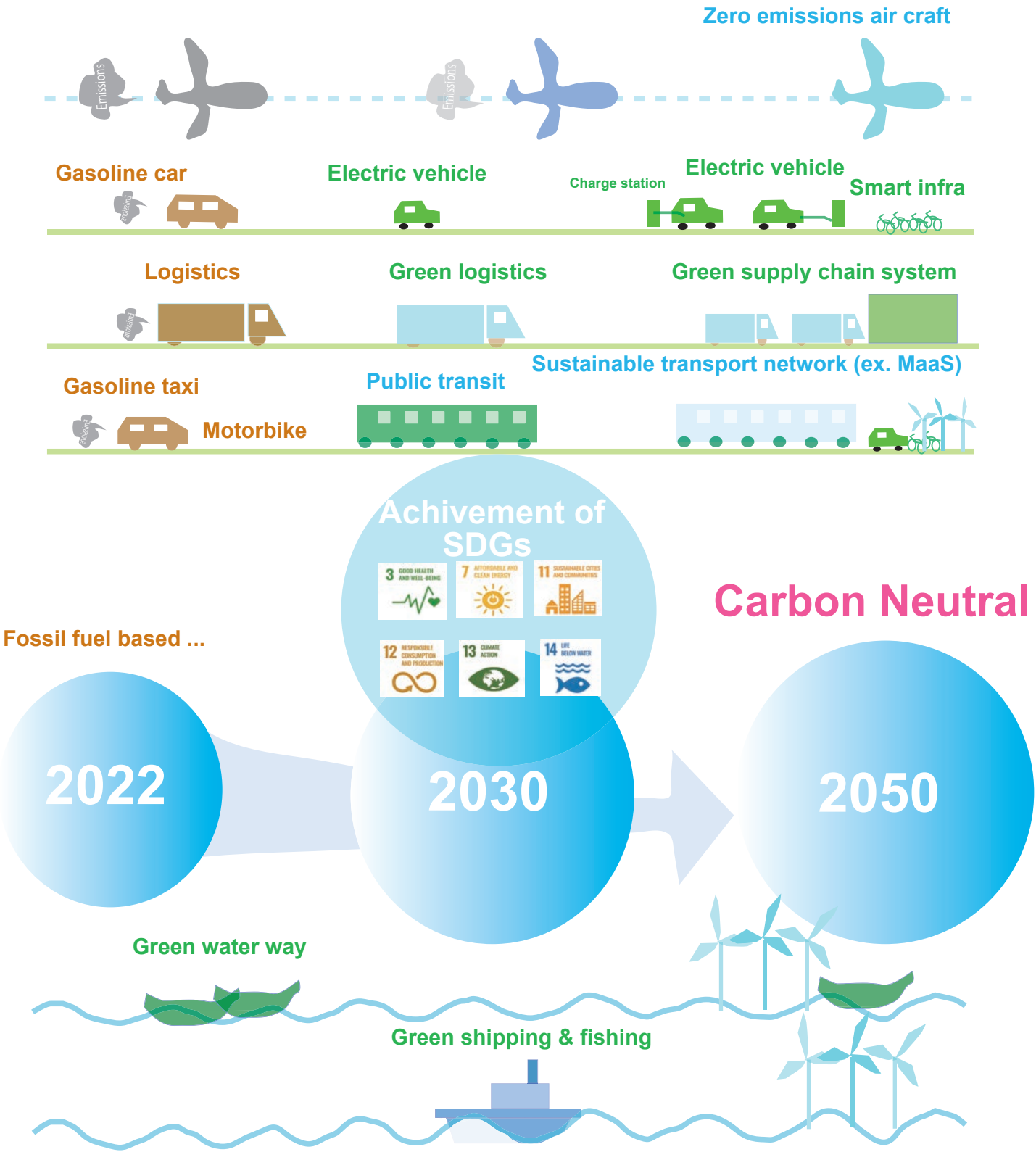
Therefore, electric vehicles (EV) for public transit (bus, taxi, tram (light rail), and water bus, Metro, Bus Rapid Transit (BRT)) should be introduced, targeting 100% of the transport fleet by 2050. Internal Combustion Engine (ICE) private cars and motorbikes should also be replaced by energy efficient electric models with the target of more than 80% by 2050.

In addition, green logistic strategies should be developed to align with national decarbonization strategies, and promote zero emission freight including longer-distance flows beyond administrative boundaries.

Walking and cycling are also significantly recommended to the communities (both in terms of carbon reduction and public health). The city should develop comfortable pedestrian routes & spaces, and safe & green cycle lane networks, thereby attracting visitors to use these facilities for their city tours in addition to their daily use by local residents.

These improved public policies should be connected with other sustainable development strategies, by effectively managing land use and local urban structure plans to achieve wider sustainability outcomes.

Pathway to Achieve Sustainable Transport



3.2.1 Mitigation Measures

Action 1: Improve and develop public transit services and create the effective network systems involving all transport modes.

In Da Nang City, around 12% of total GHG emissions comes from motorbikes. Cars and buses are emit 2.48%, 2.43% of emissions, respectively. Trucks and vans also emit relatively high emissions at around 18% of the total, contributing to the increase in air pollutions. Meanwhile, other transportation systems including railways, waterways and airways account for only 1% of the city's total GHG emissions (World Bank, 2013). Therefore, shifting to more public transport use will significantly contribute to GHG emissions reduction. However, public buses and some waterways are the main public transportation in the city. The city government should put priority on replacing these public vehicles with electric vehicles (EV), and EV charge stations should be created at all necessary points by 2040. A city bike scheme (cycling) can be a part of the green public transport program in the city for both local communities and tourists (this is included in Mitigation Action 4). All such public transport systems will be effectively networked within the city's key nodes using smart technologies (e.g. Da Nang MaaS).

Action 2: Improve traffic flow and reduce congestions

The logistic freight transport sector is one of the highest emitters of GHG at the current level in Da Nang city. Green logistics involving private businesses is one of the key priorities (this is also included in Mitigation Action 5). The city should monitor when time schedules become congested during the daytime and on week days, and the city could set a congestion charge to mitigate air pollution and GHG emissions from the city centre. In addition, an outer ring road could be developed to divert traffic that is just passing through the city areas. A smart transport network system can monitor the traffic situation and aim for a balance of safe and comfortable traffic flows.

Action 3: Increase of EV (and energy stations)

In Da Nang City, more than 30% of total emissions comes from road-based emissions (Da Nang city, 2016). Therefore, replacing vehicles with EV can generate significant GHG reductions and mitigate the air pollution levels. However, the deployment of EV requires energy chargers as a fundamental infrastructure instead of gasoline stations. Capacity of electricity grid to supply EV charging is a key concern.

Action 4: Car sharing and Bike sharing schemes (Life style changes)

Car parking spaces in the city centre are limited and the cost of EVs is still not affordable for many residents, so a car-sharing scheme can support the city's green & circular economy strategies under its carbon neutral vision. Such car-sharing and bike-sharing schemes enhance sustainable community networks and support a shift to environmentally-friendly lifestyles. These schemes should be included in local structure plans under the city's revised master plan for 2045.

Action 5: Green logistics (within and between cities)

Green logistic programs require major commitment from the private business sector, so city government needs to actively work with all related stakeholders to motivate them to move forward on smart & environmentally-friendly business by 2030. This strongly supports the achievement of SDG9 and SDG12. Cooperation and networking with other business partners beyond the city boundaries are also necessary to achieve the reduction target. This type of collaboration will create new business opportunities and sound business ecosystems beyond sectors through innovative supply chain systems.

3.2.2 Adaptation Measures

Action 1: Nature based solutions for mitigating the heat for public roads and open spaces (Green corridor)

Urban heat island effect in Da Nang city is currently not very serious, but the heat level may increase along with more urbanization and overall global temperature rises over the next few decades. Public roads can increase their green cover with green pedestrian spaces and side gardens & trees. These public trees will effectively create shade during the daytime and can serve as natural thermal barriers. These ecosystem services can also create a wind path and protect the biodiversity network even within the city centre.

Action 2: Effective buffer spaces for the flooding management

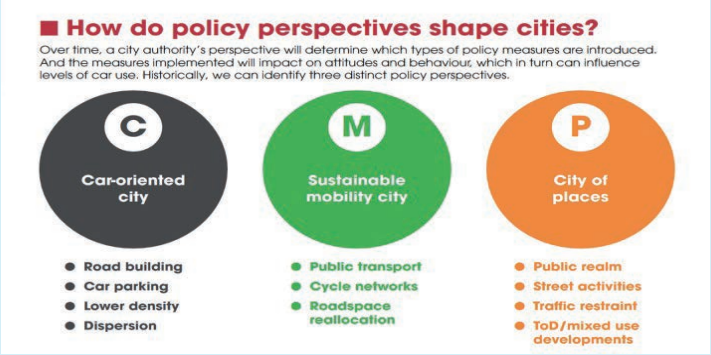
Flooding is one of the most serious natural disasters that occurs annually in Da Nang. As a coastal city, the rise in sea level is also the significant concern that can be seen in future scenario for the city (Da Nang city, 2021). Public spaces, including transport infrastructure such as coastal roads, can serve as buffer spaces to manage flooding and provide evacuation routes. Therefore, this evacuation route and buffer program should be effectively incorporated in the development master plans. Also a hazard map should be developed as an open data base for all residents.

Action 3: Maintain the traffic infrastructures (roads and pavements)

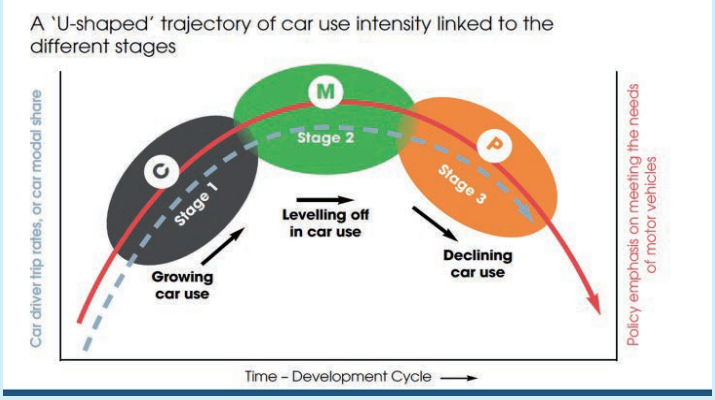
The maintenance of transport infrastructures is necessary for keeping public spaces safe and comfortable. A set of basic maintenance guidelines should be developed to maintain the quality of roads and pavements. Specifically, coastal areas suffer from salt damage due to the sea breeze and this is likely to shorten the lifetime of infrastructure and other transport facilities.

Box: Case study: The EU 'CREATE' project www.create-mobility.eu

The EU 'CREATE' project identified three perspectives that Western European Capital cities adopted at different times, over a 60-year period, each of which had major implications for their transport interventions:
In much of Europe and in parts of the USA, there has been a sequential switch in focus, from accommodating growing car use (car-oriented city), to providing sustainable alternatives (sustainable mobility city) and, most recently, to a 'city of places, involving promoting livability and active traffic restraint.



As a consequence, this has major implications for the levels of car use in cities, as shown below:



3.2.3 Synergies with Other Actions and Resilience of Sustainable Transport

AVOID Strategy
- Substitute digital for physical meetings
- Provide equipment in-home
- Localise facility provision (shorter trips)

Trip-generating sectors: education, health, leisure, retail..

SHIFT Strategy
- Support/encourage shift to sustainable modes
- Consolidation of freight

Governments, transport providers, major trip attractors

IMPROVE Strategy
- Decarbonisation of vehicle fleet
- Increase energy efficiency

Industry, utilities and transport providers

Strategies for carbon reduction are grouped by bodies such as the World Bank into three broad categories:
1.Avoiding the need to travel, by reducing trip lengths and trip numbers – while achieving intended economic and social outcomes;
2.Shifting trips to more sustainable travel modes, by encouraging the use of public transport, walking and cycling, car sharing and micro-mobility modes, and restraining car use;
3.Improving modal performance, by building more fuel efficient vehicles, and electrifying the vehicle fleet.
Some of these strategies interact with others, to support or sometimes weaken the achievement of carbon zero mobility and other high-level urban policy goals. For example, reducing trip lengths not only results in lower fuel consumption, but can make it more attractive to walk or cycle to local destinations, instead of driving. Conversely, electrification of the vehicle fleet will result in much lower operating costs and may encourage car use, thereby contributing to traffic congestion and (to some extent) poor air quality.

Implementation of most of the Avoid-Shift-Improve strategies involves collaborating with other sectors, as illustrated below. Cities rely on the vehicle and supporting industries to provide clean and – increasingly – electric vehicles. Authorities have most influence on Shift strategies, through their support for public transport, walking and cycle networks, their allocation of roadspace (e.g. provision of bus and cycle lanes) and some car restraint policies (e.g. parking controls), but most operations are under private control. Avoid strategies are strongly influenced by the major trip-generating sectors, with the possibility for cities to exercise some direct influence though their land use and spatial planning policies.
These might include polices for mixed use rather than zonal land uses and for the 15-minute city, both of which reduce trip lengths and encourage walking and cycling, and public transport use.

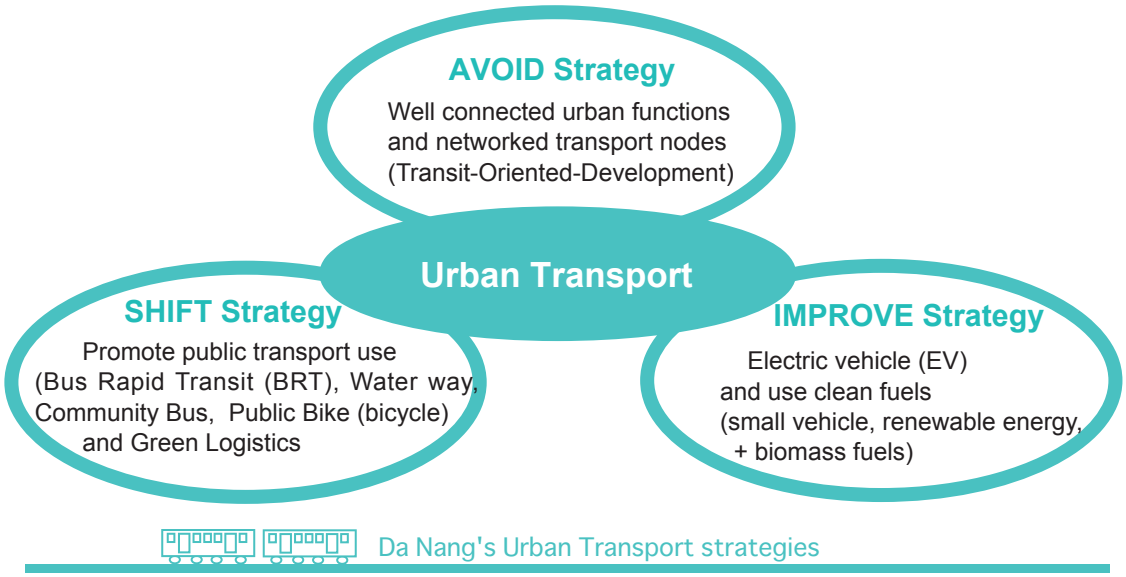


Figure 3.2.1 Transport key strategies adopting to AVOID - SHIFT- IMPROVE framework in Da Nang city
(Authors' development : the figure frame is adoped from Kainuma et al., 2017)

3.3 Energy system

Principles of Climate Action for Energy



Following a rapidly growing city population and the development of economic activities, deployment of on-site renewable energy and energy efficient reform in the industry sector are key for promoting a green economy supported by local energy production from a long-term perspective.

Da Nang City expect to achieve an average 12% GDP growth over the next few decades, which can also create more than 30,000 jobs a year. The speed of growth is higher than the national average in Vietnam. Historically Da Nang's economy was dominated by heavy industry, manufacturing, and construction. However the tourism and service industry has grown significantly and became a major sector in 2006 (World Bank, 2013; UN Habitat, 2019).

This is based on the city's priority with the vision of service-oriented industry strategy along with green growth. The tourism sector is expected to grow faster in coming decades capitalizing on the city's beaches and sea port resources as well as old heritage towns such as Hoi-An and Hue.

Current Da Nang's energy system relies almost 100% on supplies from outside the city. The transport and industry sectors are major energy consumers as well as GHG emitters. The industrial and residential sectors dominate electricity use. Therefore, a reduction in demand from factories, hotels, restaurants, offices for industry and service can make significant impacts on total energy consumption patterns.

Furthermore, the city government should develop an efficient renewable energy deployment program on a city scale, as Da Nang has great potential for utilizing solar PV electricity productions with micro grid energy demand management.

Pathway to Achieve Sustainable Energy System

3.3.1 Mitigation Measures

Action 1: End-use demand energy monitoring and efficient management system

An energy demand monitoring system should be installed in all buildings, factories, and service facilities to analyze the potential reduction, and support on-site energy balance. Building energy management systems and smart meters can also be installed in offices, restaurants, and hotels. Energy efficient appliances such as LED lighting could be installed in all factories and office buildings which woud have a major impact citywide. Installing small-scale smart grids within industrial parks is the way forward for future potential new technologies to ensure an effective balance between on-site renewable energy and local energy use.

Action 2: Fundamental energy system reform: set a target to achieve the city energy system 100% powered by renewable energy by 2050

Currently, Da Nang's energy supply is 100% imported from outside the city. The city government should set a program to increase renewable energy production within the city to increase energy self-sufficiency and maintain the energy security. The city can develop renewable production in collaboration with neighboring cities to ensure a balance in energy demand management and also adapt to disaster risks caused by climate change. National long-term strategies also highlight a major increase in renewable energy production, so Da Nang can maximize these opportunities and investments, thereby contributing to national renewable strategies and harmonize the city's green growth strategy.

Action 3: Installation of community based virtual power plant: small scale smart micro-grid and battery systems

The acceleration of electrification is one of the key components of energy transition to a sustainable energy system globally. The global annual electricity demand increased around 3.0% on average between 1990 and 2019 (IEA, 2020). An increased reliance on renewables such as solar PV and wind power can enable more flexibility of local energy generation and small-scale electricity networks, which can take advantage of decentralized energy distribution. EVs and charging points can operate in a real-time demand response system as a part of a local smart micro grid.

3.3.2 Adaptation Measures

Action 1: Small scale battery system and renewable energy can support the basic needs in case natural disasters occur.

Virtual power plants can be utilized as local energy back-up plants when the national energy grid is impacted by disaster and electric supply is stopped. Therefore, such small-scale systems have to be located in important city nodes to ensure effective planning for city-wide disaster risk management that meet human basic needs.

Action 2: Industrial park should plan basic energy backup system within the local scale

Da Nang City has planned to develop several eco industrial parks. These areas should have disaster evacuation space and facilities which can be supported by local energy production and back-up systems, as well as self-sufficient food and water facilities within the park.

Action 3: Water and heat recovery system, rain water collection

Efficient local resource recycling systems are part of a potential adaptation strategy to maintain small-scale water-food-energy management. These can also provide great support in the face of other crises, such as the COVID-19 pandemic, which would be useful in the case of strict lock-downs and the loss of connection with other areas.

3.3.3 Synergies with Other Actions and Resilience of Sustainable Energy

Sustainable energy access for resilient neighbourhoods

Increased production of on-site renewables is a priority for both Da Nang city and Viet Nam as a whole. However, new local renewable production also requires the relatively large investment of regional grid network which is connected to the national grid. Small-scale micro grids can be established with smaller initial costs compared to large scale national planning. These are more flexible and can be a closed system within the local community. These small-scale systems can function as a backup system in case of power shortage caused by disasters.

Energy-food-water and health nexus

Sustainable energy systems can also support access to human basic needs. This is a more ambitious target for Da Nang on its path to achieve the SDGs by 2030. Energy is the basis for daily lives and economic activities as well as for food production. The city should identify local mutual reliance to enhance its resilience to climate risks. Local clean production for energy- food-water systems also improves local and indoor air quality, helping to maintain good human health.

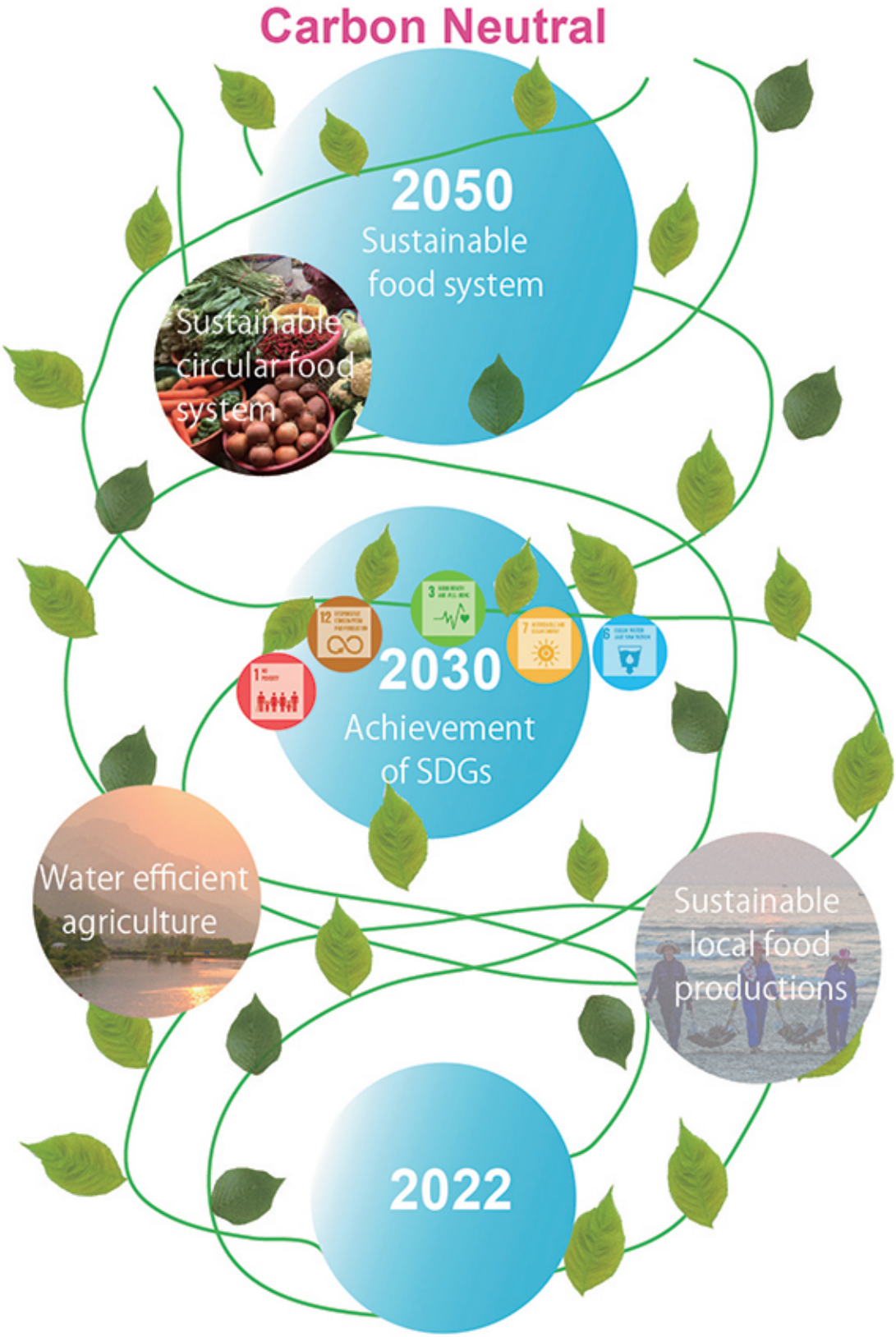
3.4 Food and Agriculture

Principles of Climate Action for Food and Agriculture

The food sector (food production, processing and distribution) is responsible for over one-quarter of the world's greenhouse gas emissions. These emissions are mostly emitted as a result of livestock rearing and crop production (58%). Food processing, packaging and transport also emit 15% of food-related GHG emissions globally. Hence, mitigation measures within the food production and processing sectors can play an important role in reducing Da Nang City's emissions. In parallel, the food sector can play an important role in achieving urban economic prosperity and human wellbeing.

For instance, urban gardens can provide urban dwellers with fresh and affordable food; while participation in maintaining the gardens plays a role in furthering physical and mental health. Urban gardens can provide employment, and play a role as a tourist attraction, thus providing revenues for the city. In environmental terms, urban and periurban gardens can provide habitat for local biodiversity (Blair, Giesecke and Sherman, 1991; Reuther and Dewar, 2006; Cianga and Popescu, 2013; Soga et al., 2017; Schram-Bijkerk et al., 2018).

Pathway to Achieve Sustainable Food & Agriculture



3.4.1 Mitigation Measures

Vietnam's greenhouse gas emissions in the agricultural (and land use) sector are due to several main factors: firstly, the emissions associated with rice production (rice is the most emitting cereal as rice soils are often submerged, which creates the right conditions for bacteria to emit methane). Secondly, enteric fermentation (digestive processes of livestock) and manure management contribute to 26% of the sector's emissions, and can be attributed to livestock rearing. Finally, the use of synthetic fertilizer (instead of relying on composting or other natural fertilization techniques, such as crop rotation) contributes to 9% of the sector's GHG emissions.

GHG emissions from the food sector have not been calculated for Da Nang City. However, it is known that the city's food and forestry production reached 34,569 tons in 2016, mainly from fishing. The crop that is mostly grown is rice, although other crops are also grown (maize, sweet potatoes, vegetables and beans). Cows, buffaloes, pigs and poultry are also reared in and around the city. In total, agricultural land represents 117km2 (9% of Da Nang total land use) (sources: GHG inventory report, Da Nang City).
Rice is grown on 5,434 hectares. Based on FAOSTAT yield and emissions intensity data for rice production in Vietnam, we can estimate that rice production in Da Nang emits 28,851 tons of CO_2 per year.
Based on this information this action plan proposes the following mitigation measures for the agricultural sector:

Action 1: Conduct a study on rice production system, to potentially switch to a more water-efficient and less GHG-emitting system.

Research has shown that alternate wetting and drying (rather than continuously wetting rice fields) can reduce rice GHG emissions up to 63% (Win et al., 2020). A study should be undertaken of Da Nang's rice production systems to check whether it can be altered to reduce associated GHG emissions.

Action 2: Encourage the substitution of synthetic fertilizers by organic fertilizers.

Organic waste (food waste and human waste) emits GHGs when they are decomposing on a landfill. Instead, processing this waste so that it can be used as fertilizer in agriculture provides a way to close the nutrient cycle and reduce dependency on synthetic fertilizers. Previous research in Da Nang has shown that producing organic biomass liquid fertilizer locally is economically viable and would reduce the use of synthetic fertilizers (Kohlbacher, 2015; Hong, Takahashi and Yabe, 2017). This should be pursued in Da Nang. Other alternatives are providing training and incentives for community groups to produce their own compost and use it in local agricultural projects, or producing compost in government-funded infrastructures (Kohlbacher, 2015).

Action 3: Consuming less meat

As meat production (and particularly red meat) plays an important role in global GHG emissions, a reduction of 50% in the consumption of red meat globally is necessary to achieve sustainable food systems (Willett et al., 2019). Vietnam's meat intake is average (38 grams / person / day of animal protein as part of the country's food supply (FAOSTAT, 2021), compared to a global average of 37 (and ranging from 6 grams in Ethiopia to 105 in Iceland). However, as meat consumption is consistently increasing across the world (Henchion et al., 2014), raising consumer awareness and providing affordable alternatives in the form of vegetarian protein will play an important role in reducing GHG emissions associated with food (Willett et al., 2019).

3.4.2 Adaptation Measures

Action 1: Resilience and food security

Food security may be affected by spikes in energy prices (energy affects both the cost of synthetic fertilizers, on which Da Nang's agriculture is currently dependent, and the cost of food transport). Encouraging an increase in local food production of different food types and at different scales (from household and community gardening to commercial farms) will play a key role in ensuring food security for Da Nang. Encouraging community gardening can play a role in enhancing local residents' physical and mental health and provide them with a livelihood and access to affordable healthy food. Besides, these gardens can play a role in making the city more attractive for tourists.

Action 2: Mitigating urban heat island

Climate change has already had an impact on urban temperatures. Modern cities in particular have much concrete and asphalt which absorbs heat during the day and emits this heat overnight. Urban green space can mitigate such urban heat effects by utilizing green shade and discharging water vapor. Increasing green rooftops and flower beds in the city will prevent a drastic rise in urban temperatures and help to avoid the impacts on human health caused by urban heat.

Action 3: Disaster risk reduction

Urban agriculture can install updated innovative technologies to alleviate the risk ofseasonal disasters such as flooding. For instance, indoor agriculture, waste water recycling, and satellite observation systems can help to minimize the impacts caused by local disasters. Adequate knowledge and capacity development for adapting these new facilities and technologies also have to be provided by local authorities.

3.4.3 Synergies with Other Actions and Resilience of Sustainable Food System

Green roofs & facades can mitigate the heat and produce the local food

Green roofs and facades are an adaptation measure for the building sector, as they can reduce the need for cooling buildings. These green roofs and facades can easily be used to produced fresh herbs and vegetables, thus contributing to local food sovereignty.

A local food system can decrease road congestion

Local food production can reduce the need for food importations and thus reduce associated road travel and freight. This is congruent with the “avoid strategy” in the transport section which entails reducing the total number of trips to reduce congestion.

Food waste for green energy production

Food waste that results from urban food growing activities (for instance, compost and green waste) can be used to produce green energy at a local scale and thus reduce dependence on external gas and fossil fuels.

A local food system can contribute to public health

Finally, urban food production can promote the consumption of fresh, healthy food by urban residents, which can decrease health problems related to diets, such as obesity or diabetes, which have been shown to worsen the consequences of COVID.

3.5 Water system

Principles of Climate Action for Water System

Da Nang currently consumes about 100 million m3 of clean water per year, and this figure is forecasted to increase by about 7.5% per year under normal conditions. The situation of supplied water loss is still not improved and the loss rate tends to increase even though it is underpinned by projects to strengthen the capacity of the water supply sector. Currently, the percentage of the population supplied with clean water through the centralized water supply system in urban areas is 98%; Hoa Vang district reached 80%. To solve the water pollution problem, the city has implemented many wastewater collection projects and invested in upgrading treatment stations.

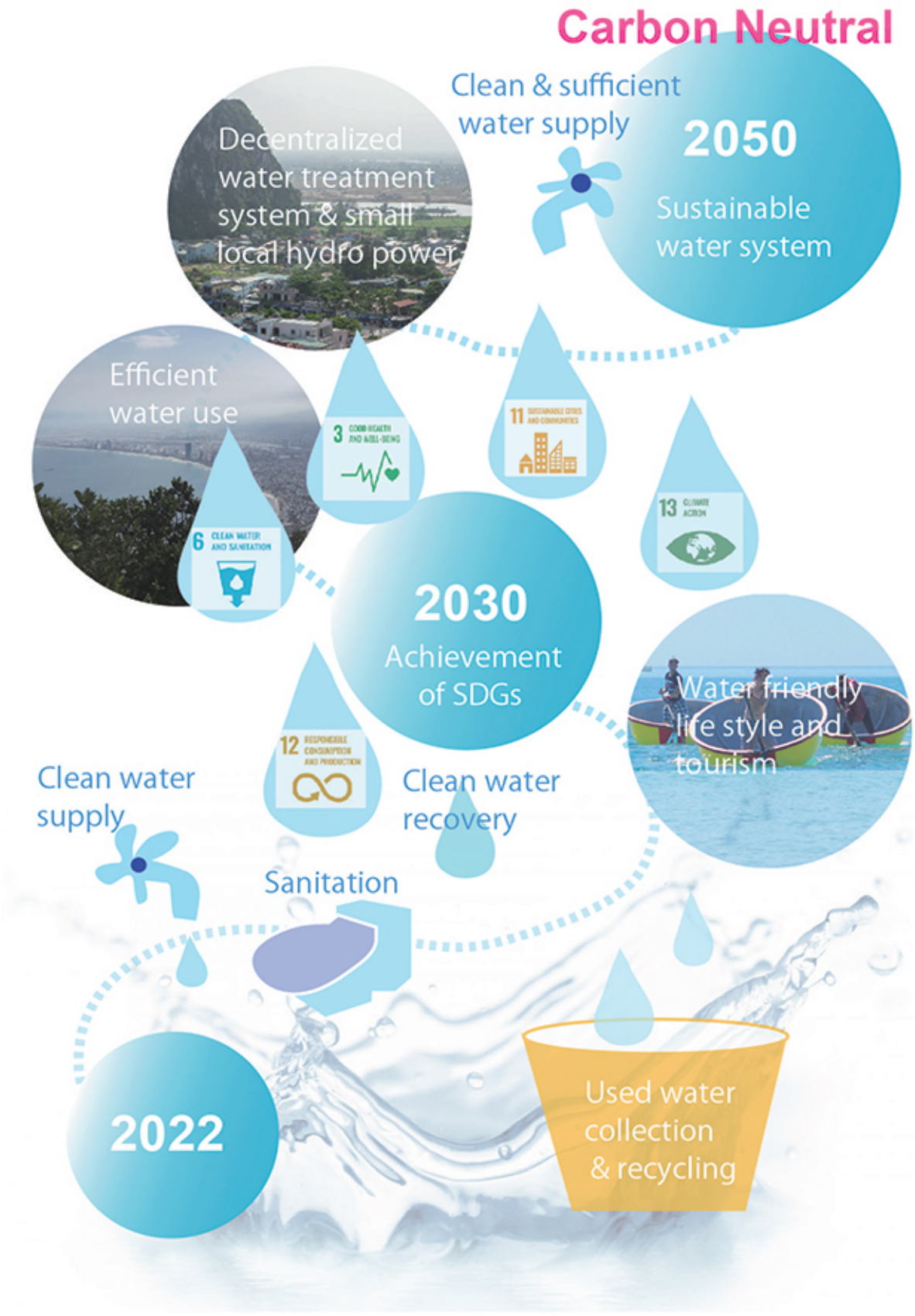
Da Nang is planning to become an environmentally-friendly city, so targets for the water industry is:

- Ensure a clean water supply for 100% of urban and rural residents by 2030; The rate of urban wastewater collected and treated up to standards and regulations as prescribed will reach 70% by 2030 and 90% by 2050;

- Put 100% of industrial parks and export processing zones into operation with a centralized wastewater treatment plant meeting environmental standards by 2030.

- Cut CO_2 emissions level in the water management sector to 80% below 2017 levels.

Pathway to Achieve Sustainable Water System



3.5.1 Mitigation Measures

Action 1: Promote water-saving devices to reduce CO2 emissions

Research on saving water has been carried out for a long time and has achieved almost "saturated" results. In Taiwan and Japan, some studies show that if water-saving devices are widely adopted. In Viet Nam, water-saving devices still have great potential. Additionally, energy consumption in Vietnam is still low compared to other developed countries, so water-saving devices can be reduced by up to 8% annual of CO_2 emissions of the water industry. In October 2021, the Government of Vietnam issued Decision 1658/QD-TTg 2021 on the National Strategy on Green Growth for 2021-2030, with a vision to 2050. This sets the goal to ensure greener lifestyles as well as promoting sustainable consumption by 2030. Therefore, saving on clean water use through water-saving equipment is a meaningful action in response to the national strategy.

Action 2: Water pipe system optimization and controlling leakage

Water supply pipelines use large amounts of electricity to operate pumps, and the longer the pipe or the higher the height of the place where the water is used, the more energy the pump consumes. Currently, there is little progress in improving pump performance because pumps are already very well manufactured, so water supply systems need to focus on optimizing the pipe network. Minimizing pressure loss is the most practical way to achieve this. With a loss of about 16%, Da Nang's system has great potential for optimization.

Leak control issues need to take into account the amount of carbon saved. Additional consideration must be taken of how much it would cost and what resources are available to control leaks and fix them, compared to replacing the entire system. Replacing the water supply system helps minimize leaks and provides long-term financial and environmental benefits, but this type of major work also generates large amounts of embodied carbon emissions. Therefore, it is necessary to carry out a comprehensive assessment of the carbon footprint of each solution before issuing a long-term management policy.

Action 3: Demand control using smart water metering

The price of domestic water in Viet Nam is currently very low, discouraging the economical and efficient use of water. If the price of water was set using an increasing tariff, this would limit excessive water consumption and encourage less wasteful behavior. Viet Nam already had a system of increasing tariffs for electricity use, and this solution should be considered for water use in Da Nang. In addition, replacing conventional water meters with smart water meters would help to better manage demand and encourages improved water efficiency in households and businesses. It is estimated that 15-20% savings over peak consumption could be achieved in this way . Most of the water meters in Da Nang are small devices like a watch, so the switch has a considerable potential. According to Parsons et al, “Savings of up to 20% should be achievable by 2050”

Action 4: Balancing portable and treating waste water standards and energy consumption

Treating water so that it meets quality standards before being discharged into the environment is energy-intensive. Environmental companies in Da Nang can take advantage of large water flows during the rainy season, which usually lasts from September to the end of December, to regulate wastewater treatment standards, corresponding to river flows: high, medium and low. Water companies should carefully consider river flows and phase dilution as an opportunity to adjust treatment standards.

For drinking water, the amount of water needed for cooking and drinking is very small, compared to the total amount of clean water used. Therefore, making good use of renewable or rainwater sources is essential to reduce clean water consumption.

In addition, the quality of the output water from treatment plants is often better quality than the clean water standard, with the aim of reducing the risk to the end user. Thus, treatment also consumes a significant amount of energy. Some companies set processing standards about 10% higher than required. This value should be considered in the case of Da Nang.

Action 5: Cross-sectional action: decarbonisation of electricity energy for water management

Possible actions to consider include: developing solutions and investing in low-carbon water industry, using more environmentally-friendly materials and technologies, and the use land for water production and water treatment facilities for the production of renewable energy. Other possible ways for industry to cooperate is for energy companies to lease land from water companies in good locations for wind turbines or PV panels.

3.5.2 Adaptation Measures

Action 1: Raw water source management

Polluted raw water sources will drastically increase water treatment costs and carbon emissions. Therefore, managing the entire watershed is a solution that has been applied by Da Nang City. Measures that may be considered include: monitoring the use of pesticides in agricultural areas, watershed forest management, coordination of hydropower companies, monitoring of watershed discharge. In the near future, Quang Nam province and Da Nang City should continue to improve the coordination mechanism for river basin management and water sharing with more sustainable and long-term solutions. In urban areas, limiting surface runoff of rainwater also contributes to reducing the processing load on wastewater treatment systems.

According to the provisions of Article 37 of the Law on Water Resources, the rainwater collection system and the wastewater system must be separated in urban areas. At the same time, according to the law on environmental protection, the company's waste discharge systems must be separated from the rainwater collection system. However, due to the current situation inherited from the past, in Da Nang these systems are still combined. This situation wastes energy in water pumping and wastewater treatment.

Action 2: Investment on Rainwater projects in the city over the span of 20 years

Rainfall in Da Nang is expected to increase due to climate change. Science has proven that climate change will warm the globe, leading to warmer oceans and more water evaporation. As a result, rainfall will increase significantly in many areas. More rain means more chances to collect fresh water. Rainwater collection and reuse by means of low/zero CO2 emissions can save 50% of clean water in households, significantly reducing CO2 emissions from operating water supply systems. According to the climate change scenarios, Da Nang needs to map out how the scenario saves clean water due to rainwater collection, with the maximum possible saving up to 20% by around 2040 . Rainwater harvesting is really meaningful in Da Nang because the recent rising population and growing tourism sector in Da Nang are causing a corresponding rise in water demand as well as freshwater scarcity which occurs frequently in recent years.

Action 3: Energy generation from water pipes

In theory, reducing flow or pressure in hydraulic lines requires the use of pressure relief valves (PRVs), and flow energy is dissipated by turbulent movements in these relief valves. Taking advantage of that principle, mini-hydraulic turbines can replace pressure relief valves and can produce a small amount of useful energy. These turbines must theoretically adapt to changes in pressure or flow during operation. The installation location of these turbines can be at the foot of the water supply pipes in high-rise buildings, or at the discharge gates of the wastewater treatment system.The application of this idea requires more practical research and application.

Action 4: Encourage people to recycle used water

As the demand for water energy and the need for environmental protection increases, water recycling is increasingly becoming an important water management strategy. Recycling not only reduces the need for clean water, but also reduces the pressure of wastewater treatment, so it brings double benefits to society. Water recycling in Da Nang desperately needs promotional strategies, awareness education and support from the business community to be effective. Water recycling models at small (household), medium (enterprise) and large (factory) scale need to be built and replicated in Da Nang in the next 30 years. Possible solutions are:

- All newly built single-family and detached houses will have multiple separate pipes or a switch valve, and install outside the washing machine's discharge outlets, to let the water drain. The washing machine can be used for direct irrigation.
- All new households will have separate gray water collection pipes for toilets, showers and tubs, and it will be separated from the collection pipes for all appliances, other plumbing, to facilitate possible installation of recycling gray water systems in the future.
- Da Nang needs to develop guidelines, then regulations for the design, construction and operation of gray water systems. Thus, licensing management plays a very important role.

3.6 SDG interactions

Climate change issues go far beyond the environmental dimension to enter the broader context of development and its sustainability. At the city level, climate challenges are strongly intertwined with other socioeconomic dynamics, such as poverty and inequality, public health, housing conditions, waste management, etc. Through the implementation of both mitigation and adaptation actions Da Nang would foster the achievement of multiple Sustainable Development Goals (SDGs).

To explore the connection between the climate actions proposed and the SDGs, we rely on the existing literature in order to make sure that the linkages are supported by scientific evidence. We first group both the mitigation and adaptation actions prosed in broader categories and then assess their linkages with each global goal, as defined by the 2030 Agenda for Sustainable Development. We assume that all actions contribute, by definition, to achieve SDG 11 on sustainable cities and SDG 13 on climate change. Results of our analysis are reported in Table 3.6.1.

		Goal 1 - Poverty	Goal 2 - Hunger	Goal 3 - Health	Goal 4 - Educat	Goal 5 - Gender	Goal 6 - Water	Goal 7 - Energy	Goal 8 - Growth	Goal 9 - Infrastruct.	Goal 10 - Inequalities	Goal 11 - Cities	Goal 12 - Sustainability	Goal 13 - Climate	Goal 14 - Life Water	Goal 15 - Land	Goal 16 - Peace	Goal 17 - Partnership	Total
Agri &Food	Irrigation efficiency (M1)																		8
	Substitution of synthetic fertilizers (M2)																		6
	Dietary changes (M3)																		6
	Local/urban agriculture (A1)																		10
Transport	Sustainable transport (M1-5, A3)																		8
	Nature based-solutions and flood buffer zones (A1-2																		9
Buildings	Energy efficiency (M1-2-4; A1)																		14
	Building standards (M3)																		8
	Renewable energy (M5)																		16
	Waste reduction and recycling (M6)																		9
	Stormwater projects, water harvest/treat/reuse (A2)																		11
	Reduce heat island effect (A3)																		7
	Information and education (A4)																		7
Total		7	7	11	5	3	8	8	6	8	4	13	8	13	6	5	5	2	119
By Sector	Agri &Food	1	4	3	1	0	4	1	1	1	0	4	2	4	1	2	1	0	30
	Transport	1	0	2	2	1	0	1	1	2	1	2	0	2	0	1	1	0	17
	Buildings	5	3	6	2	2	4	6	4	5	3	7	6	7	5	2	3	2	72
	Adaptation	5	3	6	3	2	3	5	3	4	3	7	5	7	3	3	3	1	66
	Mitigation	3	5	7	3	2	5	5	4	6	3	8	4	8	4	3	3	2	75

Table 3.6.1 Synergies between Da Nang climate change actions and the Sustainable Development Goals
(Authors analysis based on Davide et al. 2019)

Among the climate change actions proposed in this plan, those related to the building sector have the potential to unlock a higher number of sustainable development synergies. Deployment of renewable energy, improvement of energy efficiency and a more effective water management through stormwater projects provide key opportunities for Da Nang to make progress in becoming a sustainable city, contribute to the national climate change strategy and at the same time reaching other important socio-economic objectives for its citizens.

Overall, major synergies of the actions proposed in this plan are related to health, energy, growth, food security (beyond SDG11- sustainable cities and SDG13- climate change).
In particular, implementing renewable energy and energy efficiency measures would unlock potential co-benefits for the Da Nang community in terms of improved access to sustainable and clean energy sources (SDG7), better and healthier living environment (SDG3) as well as increased economic opportunities.
Energy efficiency measures in the residential sector would reduce households' energy expenditure and thus contribute to reducing exposure and alleviate poverty (SDG1). In the commercial, public and business sectors, a more efficient use of energy and resources (waste) can free up economic resources that can otherwise be invested in other productive activities. The development of renewable energy expertise may also be beneficial in terms of job creation and enterprise development (SDG8). Sustainable agriculture practices offer large potential synergies in the food (SDG2) and health sectors (SDG3), by contributing to increase sustainable food production and reduce the carbon footprint and pollution of the agricultural sector. Sustainable public transport options play a crucial role in broadening access to basic services, especially for women (SDG5), improving infrastructure services and resilience (SDG9) as well as reducing air pollution exposure and road fatalities (SDG3).

Also adaptation measures offer the opportunity for Da Nang to build a resilient and prosperous future. Green infrastructure, such as nature-based solutions and buffer zones, aimed at providing heat-proof and flood-resilient urban pathways, are in line with the targets of improving the Da Nang community health (SDG3), of developing reliable, sustainable and resilient infrastructure (SDG 9) as well as of reducing exposure and vulnerability to climate-related extreme events of the poorer citizens (SDG1). Similarly, green building improvement and technologies to control thermal comfort, including green/PV roofs and facades, can further support the achievement of these objectives. Support to local and urban agriculture is compatible with food security objectives (SDG2) as well as with an increased awareness about the benefits of a sustainable and healthier diet.

All these measures are also important to protect the natural environment and at the same time to make the city more attractive, economically stronger, and more livable.
A comprehensive assessment of the synergies connected to climate change actions must consider that cities have been on the front line in coping with the COVID-19 pandemic and its impacts. Recent studies (Nethery et al 2021) found that air quality matters in COVID-19 related mortality. By reducing both outdoor and indoor harmful pollutants, actions aimed at increasing the use of low-carbon transport modes, improving housing conditions, deploy clean energy sources can help to build a healthier urban community. Also, an efficient urban transport system may help reach people in need. Larger green spaces and protected areas can improve the coexistence and health of animals whereas sustainable agricultural practices, including those avoiding intensive animal farming, can prevent transmissions between animals and spillover into human populations. Overall, the transformations induced by both mitigation and adaptation measures would allow Da Nang to prevent future challenges, better react to external health issues and, at the same time, alleviate pressure on the health care systems.

Some of the measures outlined in the plan may also pose potential challenges for Da Nang. The development of the urban area, through improved transport services and infrastructure, could attract more people from the rural areas toward the city and therefore put under pressure key resources such as water, affect the management of surrounding forests and arable lands or impose some extra costs on the society in the short term. In the building sector, modernization and innovation technologies to improve energy efficiency or deploy renewable energy sources may sometime not be in line with the objective of preserving cultural heritage and promote tourism. However, as the Table 3.6.1 shows, the number of synergies from the climate action are well above the trade-offs and to know in advance where potential challenges may lay would allow the city administrators to prevent them and to put in place the necessary countermeasures in order to unlock long-term benefits.

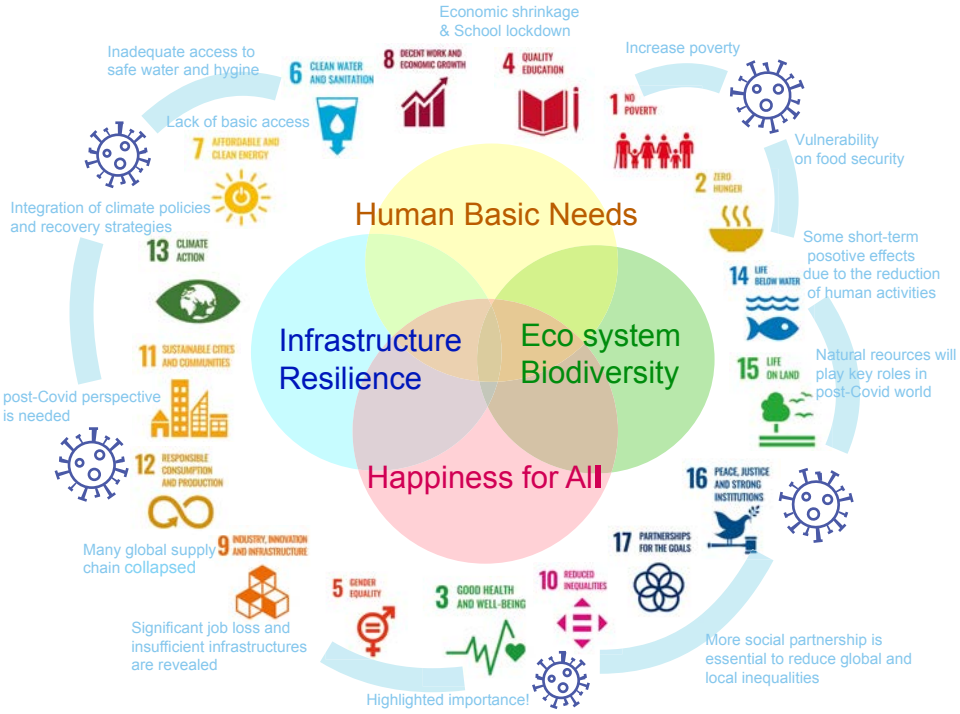


Figure 3.6.1 Covid-19 socio-economic impacts on SDGs (Developed by M.Kamei)

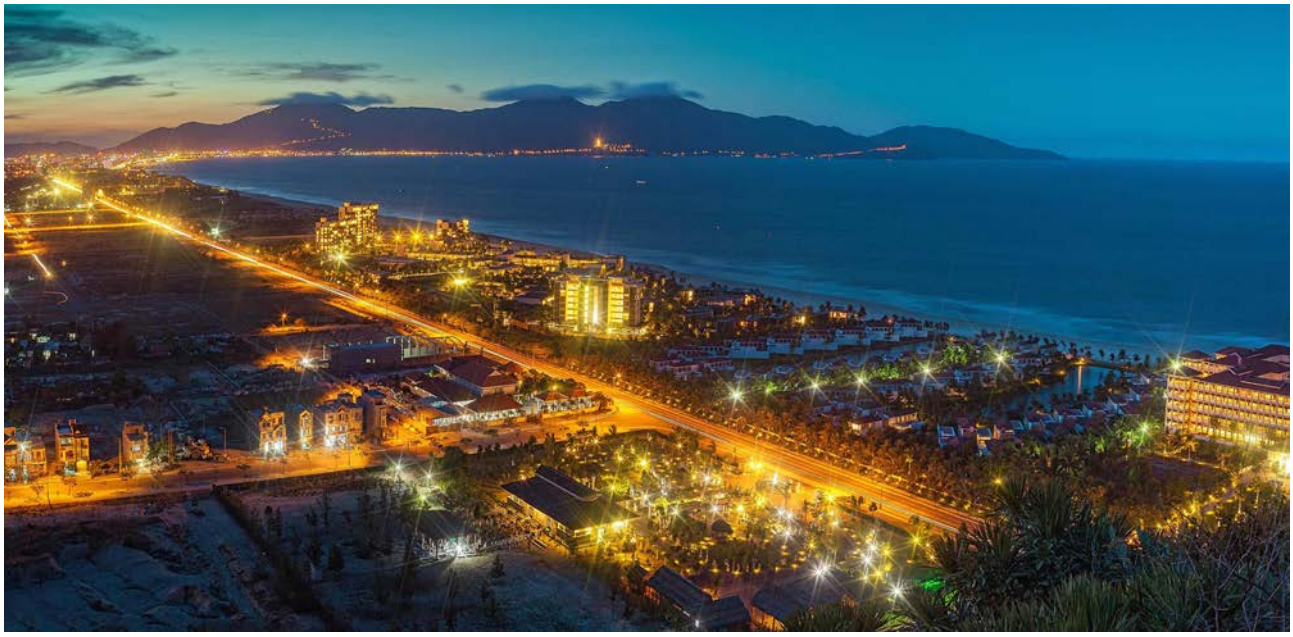
4. Moving Forward and Implementations

Da Nang City encourages its citizens to mobilize themselves. Therefore, it is essential to have an effective governance system involving all residents as well as a finance system which can realize sustainable transformation for society.

Governance system mobilizing citizens:
This climate action plan provides the first step to develop citizen's involvement and multi stakeholder discussions. The city needs to further develop an effective platform to share updated information and experiences. Digital tools can help to strengthen such a platform and coordinate a variety of collaborations. This platform should also include all stakeholders; policymakers, experts, businesses, scientists, and school children. A global platform like C40, can inform the latest global agenda on urban sustainable development issues and share updated knowledge and experiences. Climate change is not only a national and local issue, rather, global cooperation and partnership needs to be strengthened alongside local actions. Vietnam's government has already announced its Nationally Determined Contribution to realize the Paris Agreement target (Vietnam NDC, 2020). Da Nang is expected to be a national leader in making practical actions and realizing local targets. Da Nang's green growth strategy is consistent with the global and national agenda, and the city needs to promote its sustainable visions together with newly developing sectoral climate actions. To develop transparency for citizens and promote climate actions, the city needs to further develop an effective monitoring system in all related sectors, specifically building management, energy supply & demand management, and industry energy use. Policy evaluation also recognizes annual progress and identifies the gap in these targets. The planning, implementation, monitoring, evaluation processes should be coordinated under a climate action plan. Institutional arrangements, on the other hand, are also important to enable collaborations among necessary agencies within local and national contexts, and extend them to the global networks.

Innovative finance system to support sustainable transitions:
The development of a practical finance system to support climate action is essential. The city should develop incentives for industry to promote green investment and invite global green businesses to the city. Da Nang should initiate public investments for renovation of public buildings and develop a green transport system as well as deployment of renewable energy. These public actions constitute good practices and can act as a showcase to the citizens so that they can take their own actions. The city and local banks may set a priority investment areas and criteria for establishing green loan systems. EU taxonomy, for instance, has identified a list of environmentally-sustainable economic activities. These systems can motivate local businesses and steer investments in the right direction to achieve targets for carbon neutrality.

Further achievement of SDGs for Da Nang city:
Climate action comes under SDG 13. However, Da Nang City needs to work on achieving other targets to realize its comprehensive sustainable vision. Therefore, this sectoral climate action plan contains various sectoral actions which are interlinked with multiple SDG targets. Over the next 10 years, energy systems, food security, and water supply should achieve a level of sufficiency for all citizens with an increase in the city's own supply chains. This is still a very challenging agenda, however, and an increase in local resource management and circular economic systems can ensure the security of human basic needs and local resilience. Da Nang City has been impacted by the COVID-19 pandemic in the same way as other global cities, and so the development of a community resilience framework is recognized to be a significant priority for maintaining a basic quality of living standard and human health.



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