



**Asia-Pacific  
Economic Cooperation**

**Policy Review for  
Low-Carbon Town Development Project in  
Da Nang, Viet Nam**

Final Report

May, 2014

Report for the APEC Energy Working Group

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## PREFACE

The APEC Low-Carbon Model Town (LCMT) Project seeks to promote low-carbon technologies in city planning in order to manage rapidly growing energy consumption and greenhouse gas emissions in urban areas of the APEC region.

The key objectives of the project are;

- 1) To develop “The Concept of the Low-Carbon Town in the APEC Region”, which is intended to be a guidebook to the principles and implementation of low-carbon design;
- 2) To assist in the implementation of the concepts in selected towns by providing feasibility studies and policy reviews of these planned urban development projects;
- 3) To share best practices and real-world experiences of low-carbon design with planners and policymakers throughout the APEC

This report presents the findings of Policy Review for Da Nang, Viet Nam.

The primary accountability of each policy review is shared by the economy being reviewed and the Review Team. A team of eleven experts conducted the Policy Review in Da Nang, Viet Nam (see Appendix A). They visited Da Nang from 4 to 6 December 2013.

During the visit, the Review Team held comprehensive discussions with representatives and experts from government agencies, private and state companies (see Appendix B) from Da Nang. The Review Team wishes to thank all the presenters and others that spent time with the team for discussions, especially the Peoples’ Committee of Da Nang, the Da Nang Department of Foreign Affairs and the Da Nang Department of Industry and Trade who organised the event.

## EXECUTIVE SUMMARY

Da Nang is the biggest city in central Viet Nam. It is located between Hanoi and Ho Chi Minh City at 759km and 960km respectively. As of 2011, the population of Da Nang 951,684 people, which is growing as industrialisation draws more people to the area. Da Nang is shifting its economic structure away from agriculture and toward industry and services. Its main industries are frozen fish, textiles and garments, cement, automobile tyres, and leather goods. However, more technical industries are rapidly growing in the area, which include electrical equipment, information technology component parts, machinery, ship building, manufacturing and assembling automobiles and bicycles, and beer and dairy beverages. Tourism is also a growing economic sector in Da Nang and is one of Viet Nam's national tourist sites.

Viet Nam is one of the world's most susceptible countries to climate change. It is at risk of sea level rise, temperature rise, higher rainfall in rainy seasons and lower rainfall in dry seasons, flooding, and extreme weather events (IPCC, 2013). As one of the fastest growing economies in South-East Asia it is increasing its industrialisation rate, shifting away from a central command based economy, to a more market-based economy. These combined factors make low carbon development in Da Nang essential.

Viet Nam has set national targets on emissions reductions, and Da Nang is in the process of developing targets locally. Da Nang is in the process of developing a low carbon town, with plans to develop environmental standards for buildings, facilitate the use of electric vehicles and charging stations, introducing a bus rapid transit (BRT) system, using biogas for power generation, using raw wastes for biomass power generation, and optimising and managing street light energy use (CCCO of Da Nang City, 2013).

Part 1 of the review contains background information on Da Nang City and provides context to Part 2, the review team report. The findings and recommendations in Part 2 are grouped by the following topics: institutional context; sustainable development plan; town structure; low carbon buildings; transportation; area management system; untapped energy resources; renewable energy and waste management.

The policy review offers 75 recommendations for implementation that are grouped by topic. Some recommendations will incur little expenditure and rapid implementation, while others require long term planning and external financing and so implementation could take several years.

The summary of list of recommendations groups recommendations by high, medium and low order urgency level, so policy makers can see which recommendations are the most important according to the experts. Accordingly, if the Da Nang People's Committee aims to become a leading LCMT, then it can implement short term but low cost recommendations (embodied in recommendation 2) and also high priority recommendations initially to maximise the low carbon efficacy relative to money spent. This way both residents and visitors can embrace the low-carbon concept from the beginning and receive early benefits when travelling along the pathway to a low-carbon future.

## RECOMMENDATIONS

### *INSTITUTIONAL CONTEXT*

**Recommendation 1** Maintain a long term vision and leadership for low carbon policies and programs across all sectors.

**Recommendation 2** Identify and implement short term and low cost solutions for immediate implementation.

**Recommendation 3** Seek international funding to support the LCMT concept.

**Recommendation 4** Emphasise developing human resources and environmental skills in education to promote future sustainable development.

**Recommendation 5** Seek Prime Ministerial approval for Da Nang’s LCMT plans to ensure compatibility with economy-level planning.

**Recommendation 6** Establish an ‘implementation board’ that coordinates the implementation stage of the LCMT development plan.

**Recommendation 7** Maintain close communication with the Central Government of Viet Nam.

**Recommendation 8** Involve the People’s Committee and the residents of Da Nang during the implementation stage of the LCMT development plan.

The urgency level for the recommendation is illustrated in the below table by short, medium and long term urgency.

	SHORT TERM	MID-TERM	LONG TERM
URGENCY LEVEL	Recs:2, 5, 6 & 8	Recs: 3, 4, & 7.	Recs:1

### *SUSTAINABLE DEVELOPMENT PLAN*

**Recommendation 9** Encourage urban development within and near existing communities and public transit infrastructure (for more details see section 3).

**Recommendation 10** Promote redeveloping the existing cities, suburbs and towns while limiting expanding the development footprint in the region (for more details see section 3).

**Recommendation 11** Develop balanced communities that are proximate to housing and employment opportunities (for more details see section 3).

**Recommendation 12** Encourage low carbon transport options (for more details see section 5).

**Recommendation 13** Preserve water quality, natural hydrology, habitat and biodiversity through conservation wetlands and water bodies.

**Recommendation 14** Design safe walkable streets that promote efficient transportation and walking (for more details see section 5).

**Recommendation 15** Promote compact development that conserves land and protects farmland and wildlife habits.

**Recommendation 16** Provide access to civic areas, public spaces and recreational facilities that improve physical and mental health (for more details see section 3).

**Recommendation 17** Grow tree-lined and shaded streets that reduce urban heat island effects, improve air quality and reduce cooling load in building.

**Recommendation 18** Build neighbourhood schools that promote community interaction and engagement by integrating schools and educational institutions (for more details see section 3).

**Recommendation 19** Promote Da Nang as a 'biophilic' town and join the international biophilic city network (eg Wellington, New Zealand).

**Recommendation 20** Encourage the design, construction and retrofit of buildings using green building practices.

**Recommendation 21** Use on-site renewable energy sources (solar, ground source heat pump, small wind, biomass heat such as pellets) (for more details see section 8).

**Recommendation 22** Promote the use of recycled and reclaimed materials in infrastructure.

**Recommendation 23** Reduce light pollution so that it minimises light trespass from projects, protects wildlife and people.

The urgency level for the recommendation is illustrated in the below table by short, medium and long term urgency.

	SHORT TERM	MID-TERM	LONG TERM
URGENCY LEVEL	Recs: 13, 16, 20 & 21.	Recs: 9; 10; 11 & 14.	Recs: 17; 18; 19 and 22

### **TOWN STRUCTURE**

**Recommendation 24** Foster political and citizen's consensus so Da Nang's compact spatial characteristics become a long term asset that is protected for the future prosperity of the city, and incorporate this in every long-term vision.

**Recommendation 25** Study and recognise the benefits of a compact town structure.

**Recommendation 26** Identify areas to be designated as protection areas for the green environment and wildlife.

**Recommendation 27** Monitor 'population density on urban land' and 'average trip distance'.

**Recommendation 28** Create a system that prioritises urban development on already developed urban land compared with green-field development.

**Recommendation 29** Develop a land inventory that checks current urban land availability, and tries to accommodate development within existing urban areas as much as possible by setting a target ‘re-fill rate’ that promotes inner city development by providing incentives.

**Recommendation 30** Develop the Ngu Hanh Son District as a world class resort that is attractive for local residents and businesses.

**Recommendation 31** Promote high-density development with strong urban design codes to foster value both for tourists and residents.

**Recommendation 32** Raise district specific revenue (e.g. tourist tax) which could be reinvested in the district (compensation to the residents).

The urgency level for the recommendation is illustrated in the below table by short, medium and long term urgency.

	SHORT TERM	MID-TERM	LONG TERM
URGENCY LEVEL	Recs: 24, 25, 26, 31	Recs: 28, 30, 32	Recs: 27, 29

### **LOW CARBON BUILDINGS**

**Recommendation 33** Develop an evaluation criteria for low carbon building design.

**Recommendation 34** Promote energy efficiency standards for all non-residential buildings.

**Recommendation 35** Reduce water demand in non-residential buildings.

**Recommendation 36** Construct a model low-carbon building.

**Recommendation 37** Publish a policy paper to promote low carbon building deployment and financing.

**Recommendation 38** Establish building energy metering, including sub-metering to improve data recording and analysis systems.

**Recommendation 39** In the future, use computer simulation to optimise building design.

**Recommendation 40** Develop an energy savings plan for existing buildings.

**Recommendation 41** Strengthen building energy system commissioning and maintenance.

The urgency level for the recommendation is illustrated in the below table by short, medium and long term urgency.

	SHORT TERM	MID-TERM	LONG TERM
URGENCY LEVEL	Recs: 33, 34 & 37.	Recs: 38, 40 & 41.	Recs: 35; 36 & 39.

## **TRANSPORTATION**

**Recommendation 42** Introduce dedicated cycleways for use by both tourists and local residents.

**Recommendation 43** Use locally produced renewable electricity to directly charge electric vehicles.

**Recommendation 44** Improve the existing bus service by introducing dense and frequent bus networks within the district. This should be a first step if a new BRT system is a long-term goal.

**Recommendation 45** Regain the footpaths for pedestrians in order to encourage safe, non-motorised journeys for use by all residents, young and old, and for tourists to easily access local shops and culture.

The urgency level for the recommendation is illustrated in the below table by short, medium and long term urgency.

	<b>SHORT TERM</b>	<b>MID-TERM</b>	<b>LONG TERM</b>
<b>URGENCY LEVEL</b>	Recs: 42.	Recs: 44 & 45.	Recs: 43.

## **AREA ENERGY MANAGEMENT SYSTEM**

**Recommendation 46** Implement a Demand Side Management Program that strengthens demand side management to provide data on real time profiles of peak demand, local equipment efficiency, and knowledge on energy efficiency.

**Recommendation 47** Develop diagnostic techniques and tools, and local skill training to identify and implement energy efficiency and energy management opportunities.

**Recommendation 48** Formulate an Alternative Energy Development Plan (AEDP) from 2014-2020 for Da Nang.

**Recommendation 49** Examine the potential for demand side smart systems energy storage and smart grid networks to allow consumers to manage their demand. This will complement the Alternative Energy Development Plan (AEDP).

**Recommendation 50** Review electricity pricing structures to shift energy use away from peak load periods.

**Recommendation 51** Develop a promotional scheme to raise public/tourist participation in implementing a demand-side management program, for example, the Eco Point Program (EPP).

**Recommendation 52** Ensure that local projects qualify for Certified Emissions Reductions (CERs).

The urgency level for the recommendation is illustrated in the below table by short, medium and long term urgency.

	SHORT TERM	MID-TERM	LONG TERM
URGENCY LEVEL	Recs: 48, 50 & 51.	Recs: 46 & 47.	Recs: 49 & 52.

### **UNTAPPED ENERGY RESOURCES**

**Recommendation 53** Increase the number of users connected to the waste water treatment plant.

**Recommendation 54** Develop a comprehensive waste management process.

**Recommendation 55** Develop a promotional scheme that raises public/tourist awareness and implements waste management processes, for example the Eco Point Program.

**Recommendation 56** Examine opportunities to implement a 'waste-to-energy electricity or combined heat and power (CHP) generation 'system from incinerating municipal solid waste to reduce landfill requirements and utilise heat waste in Da Nang.

**Recommendation 57** Implement heat pump or solar water heating technologies to produce hot water in hotels and hospitals.

The urgency level for the recommendation is illustrated in the below table by short, medium and long term urgency.

	SHORT TERM	MID-TERM	LONG TERM
URGENCY LEVEL	Recs: 53 & 54.	Recs: 55 & 56.	Recs: 57.

### **RENEWABLE ENERGY**

**Recommendation 58** Facilitate the planning consent process for installing renewable energy technologies in Da Nang.

**Recommendation 59** Promote solar photovoltaic systems in Da Nang.

**Recommendation 60** Design 'building-integrated photovoltaics (BIPV) materials and technology into new green buildings.

**Recommendation 61** Evaluate the potential capacity to set up a medium to long term target for photovoltaic systems.

**Recommendation 62** Monitor and survey the performance of existing photovoltaic system by collecting operation data.

**Recommendation 63** Survey the total installed prices of photovoltaic system.

**Recommendation 64** Consider the use of small scale photovoltaic systems in remote rural areas.

**Recommendation 65** Develop incentives to encourage the use of grid connected photovoltaic systems.

**Recommendation 66** Install solar hot water systems in commercial buildings and factories and expand the number of residential solar hot water heaters beyond the current 600 residential heaters.

**Recommendation 67** Study the potential for wind energy in Da Nang.

The urgency level for the recommendation is illustrated in the below table by short, medium and long term urgency.

	SHORT TERM	MID-TERM	LONG TERM
URGENCY LEVEL	Recs:62, 63 & 65.	Recs: 58, 59, 61 & 66.	Recs: 60, 64 & 67.

### **WASTE MANAGEMENT**

**Recommendation 68** Establish a master plan for solid waste management to avoid further expansion of landfill and reduce GHG emission (**see also recommendation 56**).

**Recommendation 69** Dispose of waste at the source by developing a knowledge based community driven waste management system.

**Recommendation 70** Improve the waste collection system using GPS to achieve 100% waste collection.

**Recommendation 71** Dispose of waste at the waste depot through technology-based management systems.

**Recommendation 72** Introduce grease traps and energy management in households.

**Recommendation 73** Promote grey water recycling in households for secondary purposes such as washing buildings, watering plants, cleaning vehicles.

**Recommendation 74** Develop complete treatment facilities for hazardous and non-hazardous industrial waste within each industrial zone.

**Recommendation 75** Promote urban forestry and biodiversity to operate as a buffer zone between industrial and tourism/residential zones.

The urgency level for the recommendation is illustrated in the below table by short, medium and long term urgency.

	SHORT TERM	MID-TERM	LONG TERM
URGENCY LEVEL	Recs: 68, 69 & 75.	Recs: 71, 72, 73 &74.	Recs: 70.

## **PART 1: BACKGROUND INFORMATION**

The background information contained in this report has been contributed by the Da Nang People's Committee and Departments and the Feasibility Study undertaken by NEWJEC in 2013. This information is intended to provide some context to the Policy Review Team's recommendations.

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## 1. OVERVIEW OF DA NANG

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### 1.1 Da Nang City

Da Nang is located in the middle of the economy, along the South Eastern Coast of Viet Nam, and is situated between Hanoi and Ho Chi Minh City at 759km and 960km from these cities respectively (Figure 1). From a socio-economic viewpoint, it is vital for the unification of Northern and Southern Viet Nam.



Figure 1: Location of Da Nang, Viet Nam.

## 1.2 Social Development

### 1.2.1 Area and Population

Da Nang is the largest city in the central region of Viet Nam. The administrative area of Da Nang City is composed of 6 districts and 2 suburb districts, one of these is an island suburb with an area of 305 km<sup>2</sup>. The total area of Da Nang is 1285.43 km<sup>2</sup>. The population in the city is 951,684 people, with a large number of people travelling in from other municipalities to work. The population density is 740.36 persons per km<sup>2</sup>. From 2002 to 2011 the population in Da Nang increased approximately 1.3 times.

### 1.2.2 Land Use

The Da Nang General Land-use Plan 2011-2015 outlines the primary land uses in Da Nang, which are agriculture, non-agricultural land such as tourism and trade, urban land, and conservation areas and tourism.

Currently in Da Nang City agricultural and forestry land is 55% of land use, non-agricultural land is 43%, and unused land is 2%.

Agricultural land uses, although only a small part of the city's GDP, play an important role in overall economic development through food security and satisfying agricultural demand. Agricultural land will occupy 5711.96 ha to 2020.

Non-agricultural land uses is a priority focus so as to exploit potential tourism and trade. Non-agricultural land uses will increase to 7258.69 ha by 2020.

Urban land will expand to the northwest, south and southwest from the metropolitan area. It will increase to about 1041 ha by 2020.

By 2020 land set aside for conservation and tourism will increase from 4371 ha to 22,000 ha in the Son Tra natural reserve area and from 8609.5 ha to 30,206.3 ha in the Ba Na nature reserve area. The demand for tourism land will increase to about 1881.6 ha by 2020.

## 1.3 Infrastructure

### 1.3.1 Transport System

Urban transport in Da Nang City primarily consists of road transportation. However, as the city was designated as the administrative and economic centre of Viet Nam, the suburbs possess all modes of transportation, including, rail and shipping which serve both passenger and cargo transport.

#### a. Roads

The total length of roads in Da Nang City in 2010 was 848 km and the road density was 4.72 km per km<sup>2</sup>. The National Highways 1A and 14B pass through Da Nang City. National

Highway 1A is the main connecting road between the North and the South. The highway's length across Da Nang City is 38.2 km and plays an important role in connecting other local areas. National Highway 14B connects the West and the East and its length is 32.8 km.

Urban road transportation services are mostly carried out using private transportation companies. Current conditions are characterised by the dominance of motorcycles, a fast growing number of cars and decreasing numbers of bicycles. Taxis and motorcycle taxis provide public transportation services, however their share in urban transportation is low.

#### **b. Seaway**

Da Nang City has the largest seaport in central Viet Nam and the fourth largest seaport in the economy. Da Nang Port is the only gateway port in the city and is composed of the Tien Sa Port terminal and the Han River Port terminal. Da Nang has the advantage of natural conditions conducive for developing a network of harbors and river ports along the Han River. Da Nang Port handles approximately 3 million tons of freight per year. It serves as a gateway to Japan, China, Chinese Taipei, and Korea.

#### **c. Air**

The Da Nang International Airport is located near the inner-city and it is one of the largest airports in Viet Nam. It plays an important role in the civil airport network in Viet Nam. In 2000 there were 240,000 passengers, but this drastically increased to over 1,100,000 in 2011.

#### **d. Railroad**

The North-South line of the Viet Nam railway runs 42 km across Da Nang City. Within the city, there are five railway stations including Da Nang Station, which is located in the centre of the city. Since its peak in 2005 passenger numbers at Da Nang Station are decreasing.

### 1.3.2 Electricity Supply

Da Nang City receives its electricity supply through a 110 kV transmission line provided by the national grid - the Central Region Power Company. The changes in Da Nang City's power consumption between 2002-2012 are shown in Figure 2, which shows that electricity demand is continuously increasing in Da Nang. It is expected to grow from 7-8% per year.

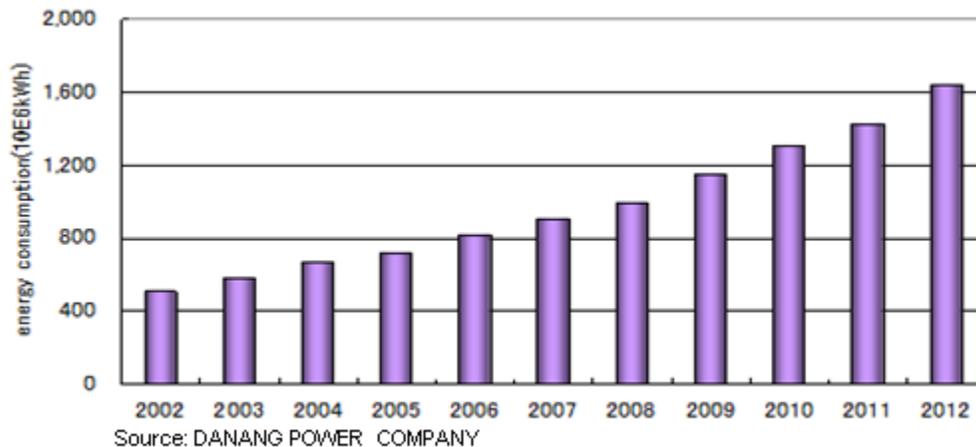


Figure 2: Da Nang City's Electricity Consumption.

### 1.3.3 Other energy and fuel sources

In 2010 the city purchased and used approximately 200,156.2 tons of oil, which was used primarily for transportation and fishing. In 2009 Da Nang used 80,000 tons of coal for various construction and industrial purposes. Da Nang has great potential for renewable energy. There are 600 water heaters using solar energy for residential homes. Da Nang International Airport has plans to install solar photovoltaic cells for use within the airport. The city has potential to develop other renewable and sustainable energy sources such as hydro-electricity and biogas (DoNRE, 2011).

## 1.4 Economic Development

### 1.4.1 Economy

Da Nang is forecast to develop socio-economically in the following ways: achieve annual average GDP growth of 12-13%; economic earnings of 4,500-5,000 USD per capita; increasing exports at a rate of 19-20% a year; and new job creation of 30,000 jobs a year (Viet Nam's Economic Research Center: Material from Da Nang's diplomatic mission in Japan). Da Nang City also plans to develop its information technology, cultural and tourism industries.

Over the last 10 years, the GDP growth rate averaged about 12%; it was 10.89% in 2011. The GDP of Da Nang City in 2002 was 4,283 Bill.VNDs and was 13,115 Bill.VNDs in 2011. This was an increase of over three fold from 2002.

The gross output of industry in Da Nang City increased by approximately 30% in the last 10 years, but the gross output of agriculture, forestry and fisheries plateaued in the same period. In 2011 the total industrial output was 87,288,991 Mill. VND, and increased approximately 1.9 times from 2008. The manufacturing and construction accounted for approximately 50% of the total output. The industrial sectors with particularly large output growth rates between 2008-2011 included real estate, public administration and requisite defence, social security, and hotels/restaurants.

The highest employing industrial sectors in Da Nang City are manufacturing, retail and wholesale, repair of automobiles, motorcycles and other types of motors, and construction. These sectors accounted for approximately 40% of total employment in Da Nang.

In recent years the number of non-state enterprises increased rapidly. The number of enterprises in 2010 was 7,004, and was approximately twice as much as in 2008. Retail and wholesale, repair of automobiles, motorcycles and other types of motors were the sectors of industries with the largest number of enterprise increase. These sectors accounted for approximately 40% of the total increase in non-state enterprises.

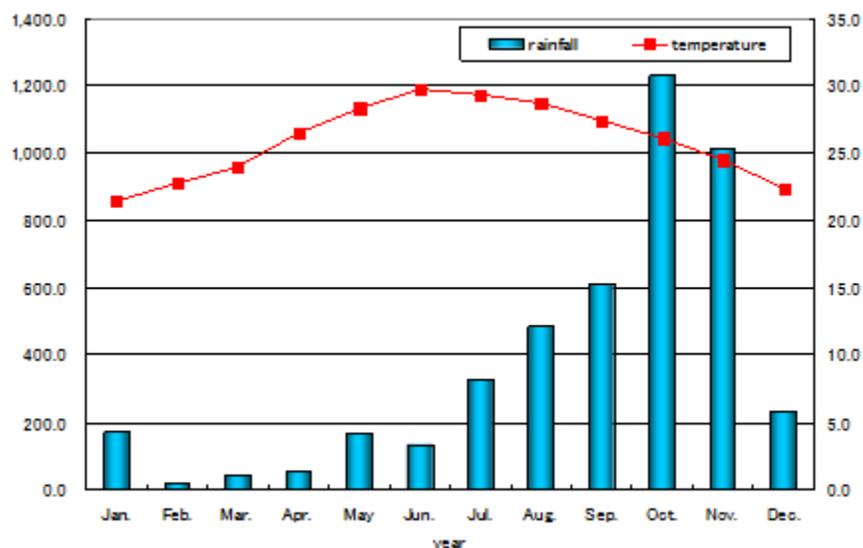
#### **1.4.2 Tourism and Cultural Development**

Da Nang City is one of Viet Nam's national tourist sites. It has diverse tourist potential in terms of its natural and cultural sites. Each year the number of tourists coming to Da Nang increases. According to the 2011 Da Nang Statistical Yearbook, the number of tourists grew from 46,133 people in 2005 to 173,660 in 2011. In 2011 tourists brought 1,256,498 million VND to Da Nang. A large number are drawn by the new resorts constructed within the Ngu Hanh Son district.

## 1.5 Natural Conditions

### 1.5.1 Climate

Da Nang City is within the tropical monsoon zone, where the climate characteristics are mixed between those of the North and the South of Viet Nam. It has two seasons a year, the rainy season between August to December, and the dry season from January to July. Over the last 10 years, average rainfall was 4.716mm and the average temperature was 25.9°C (Figure 3). Temperatures are at an average high of 33-34°C between June and August, and at an average low of 18-19°C between December and February. Humidity is high between October and December, reaching 84% and low between June and July reaching 74-75%.



**Figure 3: Monthly Rainfall and Air Temperature in Da Nang.**

SOURCE: Da Nang Statistical Yearbook 2011

Da Nang is highly prone to natural disasters, in particular typhoons from the South China Sea and sometime tsunamis triggered by earthquakes. The city is especially at risk from climate change impacts including: increased annual droughts, flash floods, typhoons, erosion, saline intrusion, rising sea levels and more variable temperatures.

### 1.5.2 Topography

70% of Da Nang is mountainous and the high mountain area lies west and northwest of the city. It is a forested area with high biodiversity and many natural resources. The Da Nang region includes a long and narrow plain which lies between the mountains and the coast. This area is dominated by agriculture, industry, military, domestic land and urban development uses per the zones of the city.

### **1.5.3 Hydrography**

The major river systems in Da Nang are the Cu De and the Han, and the two minor rivers systems are the Phu Loc and the Co Co, which all flow in the Gulf of Da Nang.

## **1.6 Environmental State**

Although the environmental quality of Da Nang City has considerably improved over the past 10 years, there are a number of environmental issues that are not fully resolved. In the meantime, urbanisation has caused the city's environment to degrade rapidly.

### **1.6.1 Water quality**

Domestic and industrial wastewater is responsible for degrading the rivers in Da Nang City due to eutrophication. The rivers are polluted from pollutants such as coliform, nitrogen and oil. In particular, the Phu Loc River has been seriously polluted by micro-organisms and heavy metals. The overall quality of coastal water is still in good condition. However, some sites in Da Nang Bay that are near discharge points for domestic wastewater are highly contaminated by coliform. There are 42 lakes and ponds in Da Nang City, and these lakes and ponds are polluted in terms of organic parameters such as Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD). The ground water in some regions, including the Hoa Khanh, Ngu Hanh Son, and Cam Le Districts, is partially polluted. Most of the ground water in the city is polluted with high levels of coliform.

### **1.6.2 Air quality**

Overall the air quality in Da Nang City is still clean. In the surrounding commercial centers, traffic interchanges and industrial zones, the concentration of dust and noise is increasing as the number traffic vehicles increases. Carbon monoxide pollution has yet to occur. However, the dust concentration at some transport intersections in the center of Da Nang City is 2-3 times higher than the Viet Nam standard.

Untreated smoke from some enterprises is directly discharged into the atmosphere and causes some environmental pollution.

### **1.6.3 Soil quality**

The rapid urbanisation of Da Nang City resulted in changes to the land area as well as the physical and chemical characteristics of the soil. Various physical impacts have resulted from soil erosion and mineral exploitation. There are chemical influences such as solid wastes, waste water, air pollutants and hazardous wastes. These wastes could accumulate inside the soil causing environmental risks, pollute the ground water and affect human health.

## 1.7 Future Development Issues for Da Nang City

The Da Nang People's Committee (DNPC) has a forecast scenario for future development in Da Nang City. This scenario indicates a modified natural population increase of 20% from immigrants from other regions. This will result in a population of 2.5 million in 2030 as shown in Figure 4. The DNPC estimates the reduction targets and BAU scenario in consideration of this fastest growth scenario.

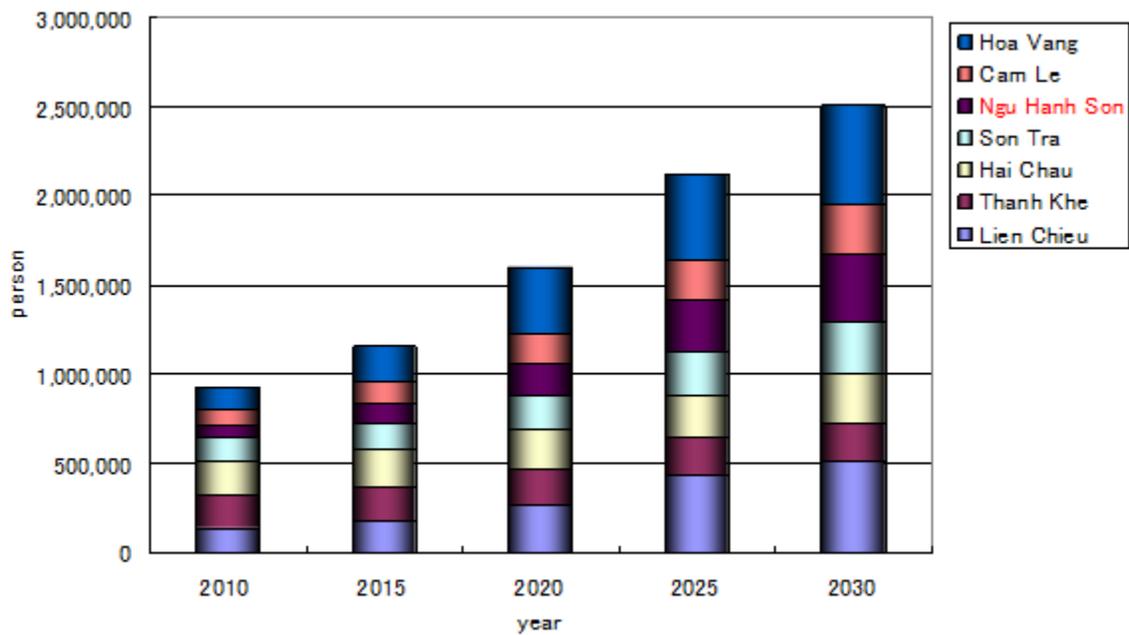


Figure 4: Population Forecast for Da Nang City.

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## 2. NGU HANH SON DISTRICT

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### 2.1 Overview

Ngu Hanh Son District (NHSD) is a long, skinny district between the East Viet Nam Sea and the Han River. It is blessed with the amazing scenery of some of the world's leading white sand beaches that stretch for 70 km to the Son Tra Peninsula (Figure 5). NHSD is 39.12 km<sup>2</sup> in area and the population is 70,667 persons. It has a population density of 1,806.52 persons per km<sup>2</sup>. NHSD has the smallest population among the citadel districts in Da Nang City.



**Figure 5: Location of Ngu Hanh Son District.**

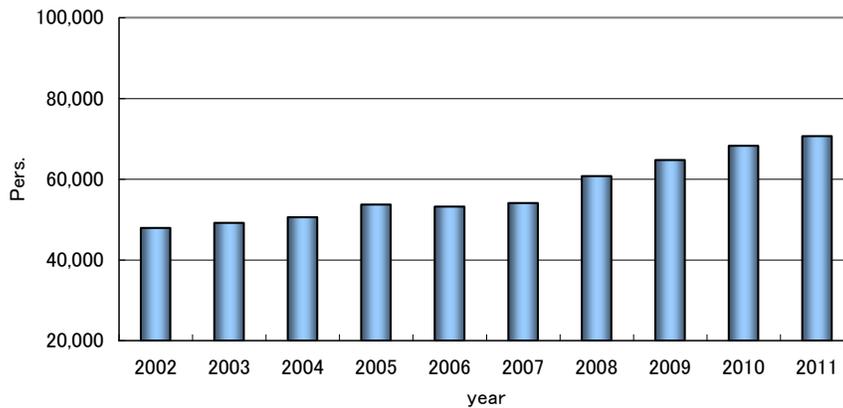
This region is the centre of Da Nang City's tourism industry. The coast's sandy beaches, large casinos, golf courses, and other recreational facilities are under construction. Additionally, the residential district school zones for middle and high schools, as well as colleges are under development. This district is predicted to have the largest population increase within Da Nang City. However, problems associated with rapid urban development are predicted in the future. These problems include: worsening landscape and environment due to a surge of new buildings founded on a vision of profitability and economic gain over environmental concerns; a shortage of waterworks and electricity; an excess of sewage and waste beyond treatment capacity; and

increases in traffic due to large numbers commuting to work from the old town across the river, as well as the increased movement from tourists. There is also concern that there will be a spread of brown fields (land that can only be used considerably below its potential value or land that is not usable).

## 2.2 Recent Socio-economic Development

### 2.2.1 Population

Up to 2011, the population of NHSD has increased approximately 1.5 times in comparison with 2002.

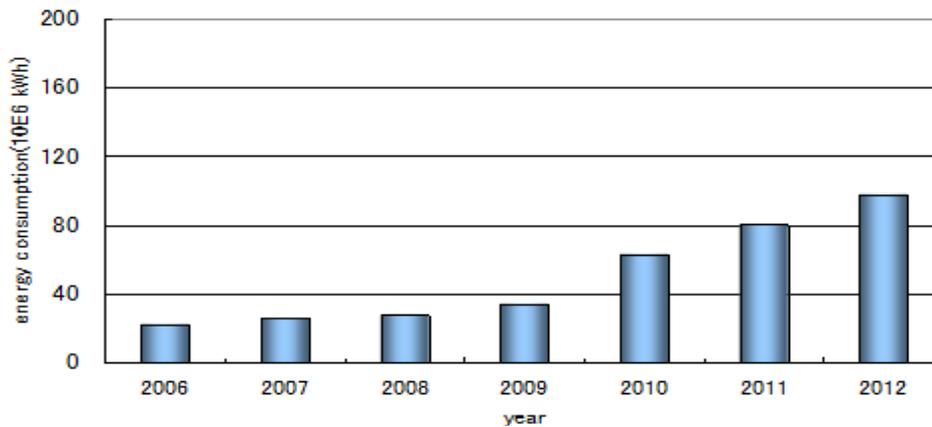


Source: Da Nang Statistical Yearbook 2005, 2006, 2009 and 2011.

**Figure 6: Population Increase in the Ngu Hanh Son District**

### 2.2.2 Electricity Supply

The change in the power consumption of NHSD from 2006 through to 2012 is shown in Figure 7. The electricity consumption of NHSD has been increasing over this period.

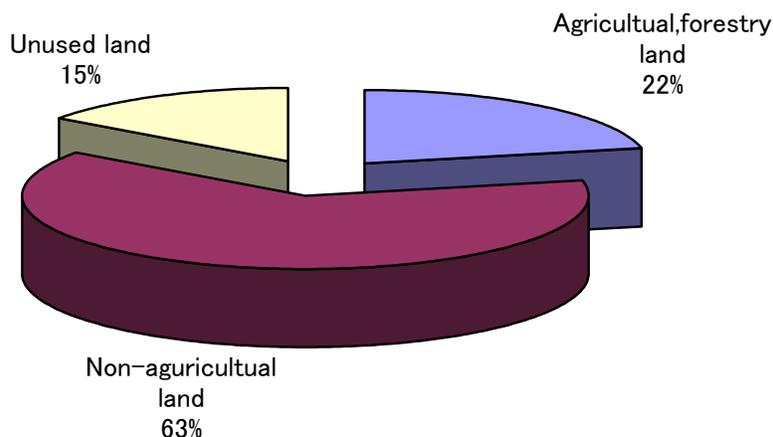


Source: Da Nang Power Company.

**Figure 7: Increase in Electricity Consumption in the Ngu Hanh Son District**

### 2.2.3 Land Use

The land use in NHSD is shown in Figure 8. NHSD's agricultural and forestry land use accounts for 22% of land use, non-agricultural land 63%, and unused land 15%. The ratio of unused land in NHSD is relatively high.

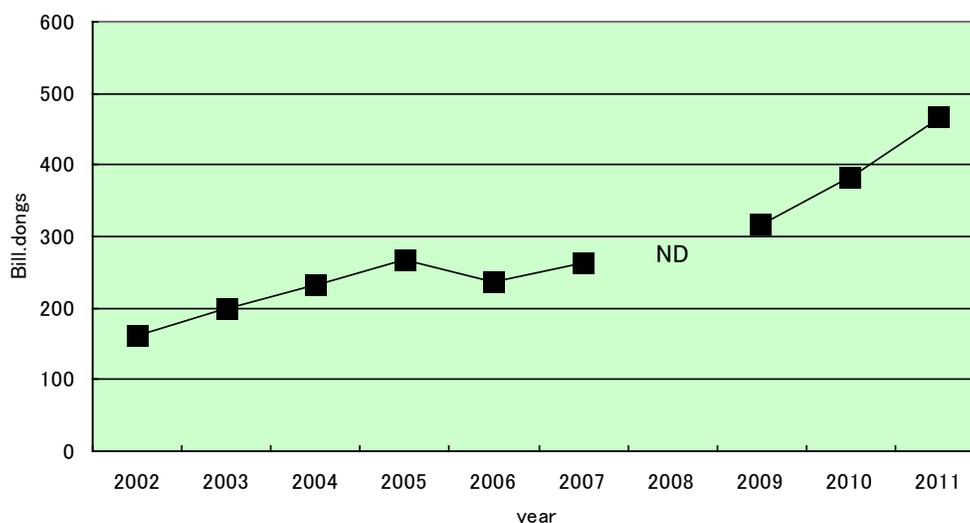


Source: Da Nang Statistical Yearbook 2011.

**Figure 8: Land Use in the Ngu Hanh Son District**

### 2.2.4 Economic Development

According to the Ngu Hanh Son District Statistical Yearbooks of 2005, 2007, 2010 and 2011, the GDP in 2011 was 467 billion VND and is approximately three times as much as it was in 2002 (Figure 9).



Source: Ngu Hanh Son District Statistical Yearbook 2005, 2007, 2010 and 2011.

**Figure 9: Gross Domestic Product in Ngu Hanh Son District from 2002-2011**

## **2.3 Future Development Issues in Ngu Hanh Son District**

### **2.3.1 Social Economic Plan with a Vision for 2020**

The DNPC will adopt the following adaptation scenario as a target and draw up a future plan as outlined below.

The scenario aims to positively introduce foreign investment by attracting an epoch-making project in the commerce and service sectors. Economic growth will then develop in a balanced way between the manufacturing and service industries, while maintaining high economic growth. The predicted population is for NHSD in 2020 is 105,656 people and the per capita GDP is US \$3,750 by 2020.

This plan specifies that tourism will be encouraged in the Ngu Han Son District as the core industry throughout the district, right up to the Son Tra peninsula. Ngu Hanh Son District aims to improve and increase tourism to reach the international standard by 2020. It will take every measure to explore a variety of resources, establishing infrastructure (hotel, commercial facilities and transportation) and personnel training.

The engineering and construction industries involved in local marble processing and marble statues will be highly encouraged as a typical local industry in the Ngu Hanh Son District, and subsequent promotion will be organised to overseas markets.

Transportation will be encouraged to expand waterways (sea, river) as well as land routes. Because of the rapid population increase over ten years, all infrastructure will be changed through industrialisation centred on tourism.

The culture park of Ngu Hanh Son will be constructed for protecting the environment and landscape around Marble hills.

### 2.3.2 Urban Development Plan with a Vision for 2030

The Urban Development Plan predicts that the population of Ngu Hanh Son District will rise to about 170,000 by year 2020 and continue to increase to 370,000 by the year 2030. The figure is based on recalculating and adding in factors from policies to immigration to the natural growth of population indicated (Figure 10).

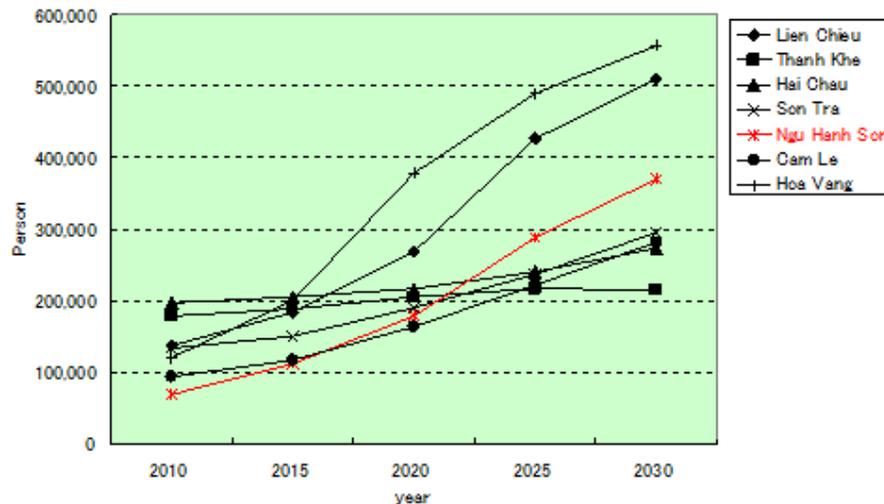


Figure 10: Population Forecast for the Ngu Hanh Son District.

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## 3. LOW CARBON STRATEGY FOR DA NANG

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### 3.1 Low Carbon Policies

#### 3.1.1 Da Nang's Master Plan for Socio-economic Development up to 2020

Da Nang's Master Plan for Socio-economic Development was implemented by the Da Nang People's Committee and the Department of Planning and Investment (DPI). It is the fundamental plan for social and economic development in Da Nang City between 2011-2020. It has a large breadth of targets involving social development, economic development, the environment, infrastructure development, and population increases.

The goal is to develop Da Nang into a major city for the economy and to make Da Nang the socio-economic centre of central Viet Nam. Especially given its role as an important strategic position in the region's national defense and security.

The plan aims to:

- Develop Da Nang into a dynamic urban centre and driving engine for regional development, to focus on spatial development which links other key economic zones in central Viet Nam.

- b. Develop Viet Nam's society and economy in a rapid and sustainable way by shifting the economic structure towards service-industry-agriculture, and utilising the city's potential and advantages.
- c. Develop urban space and invest in infrastructure.
- d. Develop health care, culture and education in order to improve people's living standard and knowledge.
- e. Integrate economic development while protecting natural resources and the ecological environment through sustainable development. To integrate economic development with the implementation of social justice, social harmony, political stability, national defense and security.

Additionally, the Master Plan states that Da Nang City shall advance to become The Environmental City by 2020 (see section 3.1.3 below).

### **3.1.2 A General Plan for 2000 - 2020 in Da Nang City**

A General Plan is an urban construction plan based on the national urban planning system and Law of Construction.

### **3.1.3 Building Da Nang City as An Environmental City**

The Da Nang People's Committee committed to and promulgated a comprehensive environmental plan for Da Nang City in August 2008 called 'Building Da Nang City as An Environmental City' (No.41/2008/QD-UBND). It sets a 2020 vision for many different environmental issues such as: air pollution reduction, waste treatment and recycling, energy conservation, and renewable energy.

The plan is based on Agenda 21 of the Viet Nam government (Prime Ministerial Decision, No 153/2004<sup>1</sup>) and Vietnamese environmental standards<sup>2</sup>, which sets 2020 as the target year and aims to promote sustainable development.

The general goals for the Environmental City Plan are to:

- Provide a safe and healthy environment for people, assuring land, water and air quality.
- Prevent environmental pollution and degradation.
- Make the people of Da Nang aware of environmental protection and Da Nang's development as an environmental city.

The specific goals divide the plan into three terms of 2008-2010, 2011-2015 and 2016-2020. The first term from 2008-2010 will focus on resolving urgent environmental problems, the

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<sup>1</sup> Prime Ministerial Decision No 153/2004/QD-TTg dated on 17 August, 2004 promulgating the orientation of the sustainable development strategy in Vietnam (the Agenda 21 of Vietnam).

<sup>2</sup> Ministry of Natural Resources and Environment Decision No 22/2006/QD-BTNMT dated 18 December 2006 guiding the application of Vietnamese Environmental Standards.

second term from 2011-2015 will achieve a reduction in environmental loads, and the third term from 2016-2020 will complete the targets. The plan formulates the quantitative targets of environmental standards in each category including transportation control, energy saving, etc. It predicts the budgets for each category.

However, concerning climate change issues, the plan for an Environmental City and other legal policies have yet to concretely indicate any scope or measure for challenging GHG emissions reductions and creating a low-carbon city.

## **3.2 Climate Change and Low Carbon City Research Projects in Da Nang**

Da Nang City is collaborating with international organisations in order to develop Da Nang into a low carbon city. These initiatives are outlined below.

### **3.2.1 Da Nang Urban Master Plan and Regional Development Strategy**

In 2010 Japan's International Cooperation Agency (JICA) completed the 'Study on Integrated Development Strategy for Da Nang City and its Neighbouring Area in Viet Nam' known as DaCRISS. The study provided a development strategy for Da Nang that identified future land uses, a transportation network, environmental concerns and priority projects. From 2009-2010 the city implemented the transportation system and the necessary infrastructure improvements for the strategy.

### **3.2.2 Carbon Emissions Situation Study at Da Nang City, Viet Nam**

In 2011 the Asian Institute of Technology (AIT) worked alongside Da Nang City to undertake 'the Carbon Emissions Situation Study at Da Nang City, Viet Nam' (DoNRE & AIT, 2011). It was the first comprehensive study of carbon emissions in Da Nang City performed by the Department of Natural Resources and Environment and the DNPC under the technical assistance and funds of the AIT in Thailand. The carbon balance was analysed using a tool named 'Bilan Carbone (Regional Module)' from the French Environment and Energy Management Agency (ADEME). The CO<sub>2</sub> emissions were estimated using 2010 as the base year and covered all sectors including energy, transportation, agriculture and industry. The project calculated total carbon emissions at about 2.0 million t-C/year (equivalent to 7.3 million t-CO<sub>2</sub>/year). The project suggested that several programs towards creating a low-carbon city including biogas, promoting electric bicycles; implementing a bus rapid transit system and developing energy management systems.

### **3.2.3 The Action Plan for Responding to Climate Change and Sea Level Rise in Da Nang by 2020**

The Da Nang Asian Cities Climate Change Resilience Network ("ACCCRN") City Team, led by the Da Nang Climate Change Working Group, the Rockefeller Foundation, ISET, NISTPASS, and Challenge to Change, developed the 'Plan for Responding to Climate Change and Sea Level Rise in Da Nang by 2020'. This plan identifies climate change impacts and potential

actions to address them (Institute for Social and Environmental Transition, 2010). It also presents a prioritised list of actions to 2020 and a timeline to implement them. It is revised annually by the Da Nang Climate Change Coordination Office (CCCCO). The goal of this action plan is to strengthen response capacities to climate change in Da Nang city by: assessing the vulnerability to climate change in the city's sectors, districts, natural resources, environment, ecology, society and sensitive population groups; and creating and implementing programs, plans and projects for responding to climate change. The project also analysed implementation measures and evaluated climate change projects in Da Nang.

#### **3.2.4 The Sustainable Urban Energy Program**

From 2011 to 2013 Da Nang's Department of Industry and Trade worked in conjunction with the Australian Department of Foreign Affairs' foreign aid division (formerly AusAID) and the World Bank to establish the current status of energy use and greenhouse gas emissions, and identify a range of policy and technical measures that will enable the DNPC to formulate long term sustainable urban energy developing strategies in the context of the city' overall development plans. The GHG emission amount was calculated on the basis of 2010 emissions covering all energy-consuming sectors and CH<sub>4</sub> emitted from biomass waste. It indicated 1.5 million tonnes of CO<sub>2</sub> per year are emitted in Da Nang. The project promoted the energy efficiency action plan and is an ongoing project.

#### **3.2.5 National Target Program Challenging Climate Change Mitigation**

From 2011 to 2013 the Asian Development Bank's (ADB) provided technical assistance to the Viet Nam Government for its 'National Target Program Challenging Climate Change Mitigation' for Viet Nam. The ADB gave technical assistance to enable the government to estimate all GHG emissions produced by each sector in Viet Nam. The second phase of the project is underway which will develop energy and transport focused action plans for the Ministry of Industry and Trade, Ministry of Transport, the People's Committees of Thanh Hoa Province, Da Nang City and Ho Chi Minh City. From 2012 to 2014 vulnerability maps for the national transport and energy sectors of Viet Nam will be developed using a climate zoning approach, and detailed climate change vulnerability assessments for the target cities and provinces.

#### **3.2.6 Da Nang Sustainable City Development**

In August 2013 the World Bank and Da Nang City People's Committee began working collaboratively on the 'Da Nang Sustainable City Development' which is a project totalling US \$272.2 million, with a commitment of US \$202.50 million and US \$69.7 million from the World Bank's International Development Assistance credit financing and Da Nang's counterpart capital respectively. The project will span six years until 30 June 2019 and consists of five stages: 1) drainage and wastewater improvement; 2) bus rapid transport development; 3) urban strategic roads to improve the connectivity of the urban arterial system; 4) technical assistance and capacity building; and 5) support completion of some major priority infrastructure, which commenced under the Priority Infrastructure Investment Project (PIIP) (World Bank, 2013).

### 3.3 High Level Low Carbon Vision for Da Nang City

#### 3.3.1 Strategy

As Da Nang City's efforts against climate change are still in their infancy, the CO<sub>2</sub> emissions reductions policies are still being formulated and have yet to be formally authorised. In this context, this APEC Policy Review could play an important role in supporting Da Nang City's introduction of low-carbon town measures into coming policies.

The recommendations provided by the experts are not exclusive to CO<sub>2</sub> and also look at the ongoing rapid development planned for NHSD. Accordingly, it is important to draft a plan for Da Nang City that contributes to increasing Da Nang's attractiveness as a tourism focused city. This plan should also increase urban amenities as well as support economic development.

Da Nang City's vision for a Da Nang as Low Carbon Model Town, is to use the recommendations to address the challenges that the region currently faces. In doing so, selecting recommendations that increase the appeal of the region, as well as reducing carbon emissions. Figure 11 illustrates the high level vision for Da Nang City combining goals to address regional challenges, improve its attractiveness and establish benchmarks for low carbon development to make Da Nang City a Low Carbon Model Town.

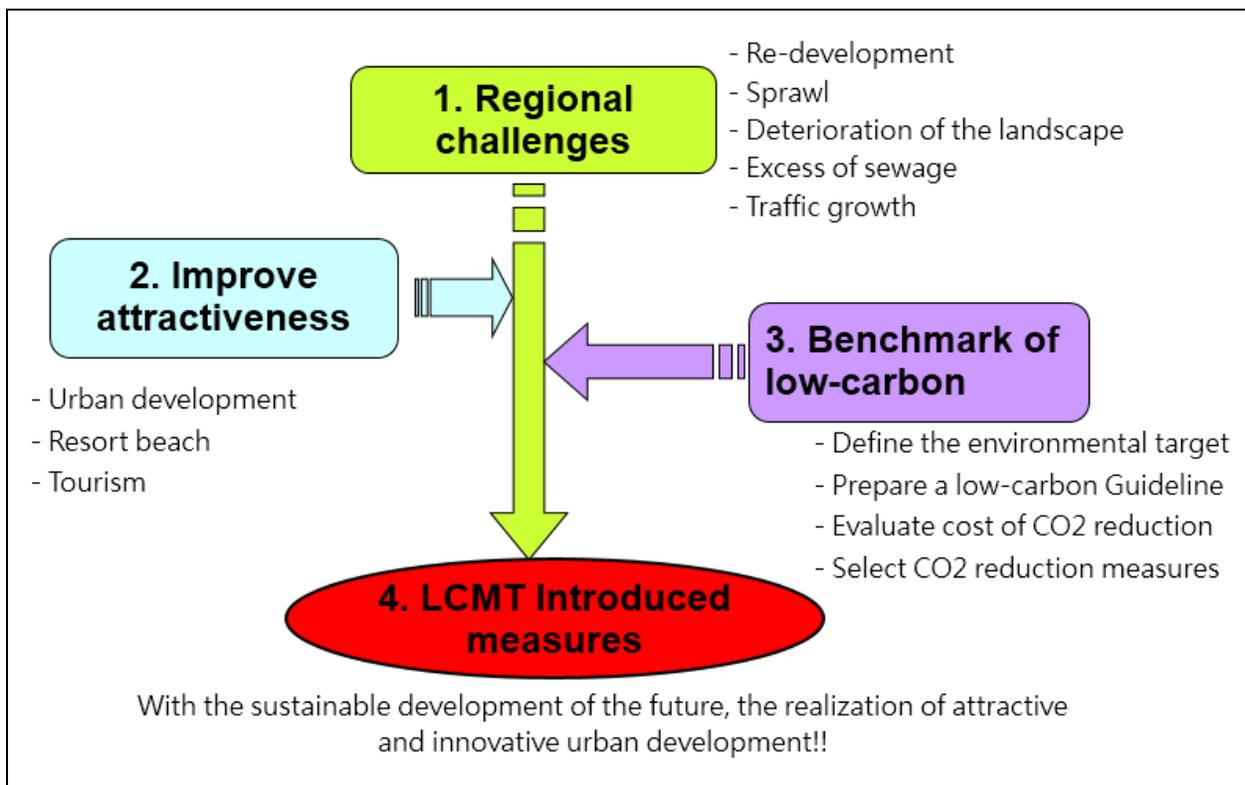


Figure 11: High Level Low Carbon vision for Da Nang City to become a LCMT.

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Da Nang City is currently proposing several policies that are aimed at the LCMT in Da Nang City. No policy should be implemented individually, but rather incorporated with one another other. A feasibility study will be carried out based on this philosophy. Figure 12 demonstrates the screening processes for introducing policies that will formulate the LCMT introduced measures in Da Nang. Figure 13 provides an artist's rendition of locations for LCMT measures in Da Nang's NHSD.

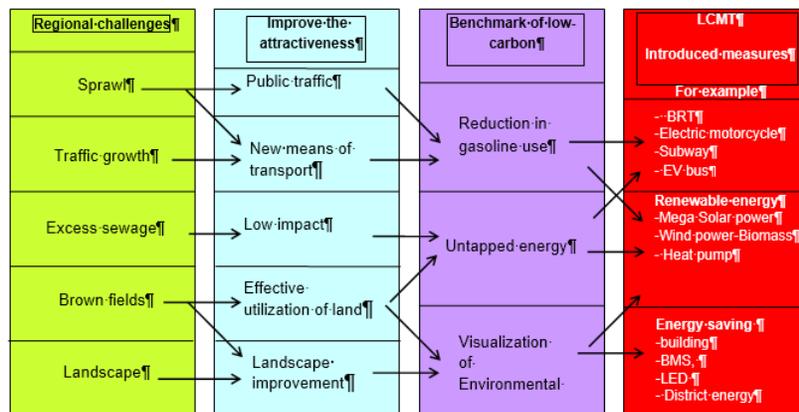


Figure 12: Screening processes for new LCMT measures in Da Nang.



Figure 13: Potential plan for LCMT measures in the NHSD.

### 3.4 Establishing Baselines and Targets for the Low Carbon Plan for Da Nang

#### 3.4.1 Setting CO<sub>2</sub> Emissions Baselines in a Business as Usual (BAU) Scenario

Figure 14 shows Da Nang's projected population increase to 2030 in a business as usual scenario with high growth (BS-H). By 2030 the city's population could go beyond 2.5 million people and NHSD could reach of 370,000 people, which a fivefold increase on the present population. Demonstrating that NHSD will grow at a faster rate than the city generally.

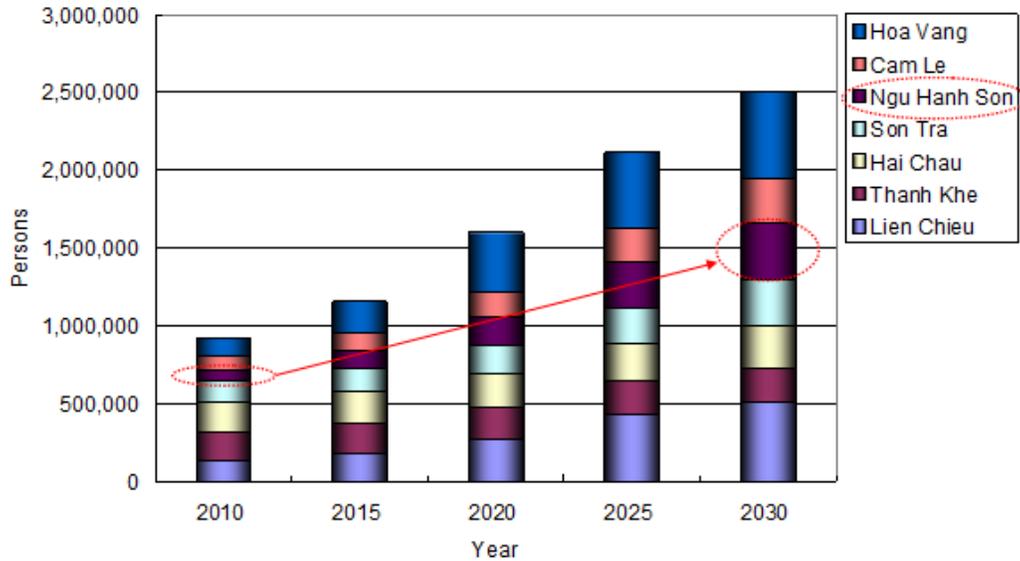


Figure 14: Projected Population Increase in Da Nang at BAU with High Growth (BS-H).

The BAU scenario for Da Nang assumes that no additional low carbon measures are introduced. The BS-H scenario assumes the BAU scenario but with high growth. Figure 15 demonstrates CO<sub>2</sub> equivalent emissions projections for the BS-H scenario within the NHSD. It indicates that estimates of emissions in BS-H may double sometime between 2020 and 2025, and that the emissions will reach 760 kilotonnes of-CO<sub>2</sub> in 2030, or 7.94 times as much as those in the 2010 base year.

<b>[Ngu Hanh Son District]</b>	<b>Emissions in CO<sub>2</sub>e [kilotonnes]</b>				
Category	2010	2015	2020	2025	2030
1. Energy	77	126	237	436	662
- Manufacturing industries	30	31	32	33	34
- Transportation	17	27	43	69	131
- Commercial/institutional	7	18	52	120	197
- Residential	23	50	110	214	300
2. Waste	18	32	45	71	98
- Solid waste	7	13	21	38	61
- Wastewater	12	19	24	33	37
Total	96	158	283	508	760
% of 2010 base year emissions	100%	165%	295%	530%	794%
Population [persons]	68,270	111,125	178,571	287,589	370,142

**Figure 15: CO<sub>2</sub> Emissions Projections by sector from 2010-2030 in NHSD according to BS-H.**

### 3.4.2 Setting a CO<sub>2</sub> Emissions Reduction Target and Approach

The 'National Green Growth Strategy' sets out GHG emissions reduction targets by the intensity of the GHG emissions and GHG reductions compared to BAU emissions, rather than by base year emissions. For example, this strategy aims to reduce annual GHG emissions by at least 1.5-2% and the reductions of GHG emissions in energy activities by 20-30% from BAU emissions by 2030. The commitment for this GHG reduction target includes the following breakdown.

- (A) Voluntary reduction (domestic effort):
    - 10% in 2020
    - 20% in 2030
  - (B) International support (depending on financing and technology from outside the country):
    - 10% in 2020
    - 10% in 2030
- 
- 20% in 2020 (Total: 10%+10%)  
 30% in 2030 (Total: 20%+10%)

In accordance with the national strategy, one approach for reaching the CO<sub>2</sub> reductions target in Da Nang City would be a voluntary reduction target (A) of 10% from the CO<sub>2</sub> emission levels of a BAU scenario for 2020 and that of 20% from the CO<sub>2</sub> emission levels of a BAU scenario for 2030. In the case of BS-H, this would require a reduction of 447kt-CO<sub>2</sub> in 2020 and 2,071kt-CO<sub>2</sub> in 2030 from the corresponding BAU emissions levels. This approach is illustrated in Figure 16.

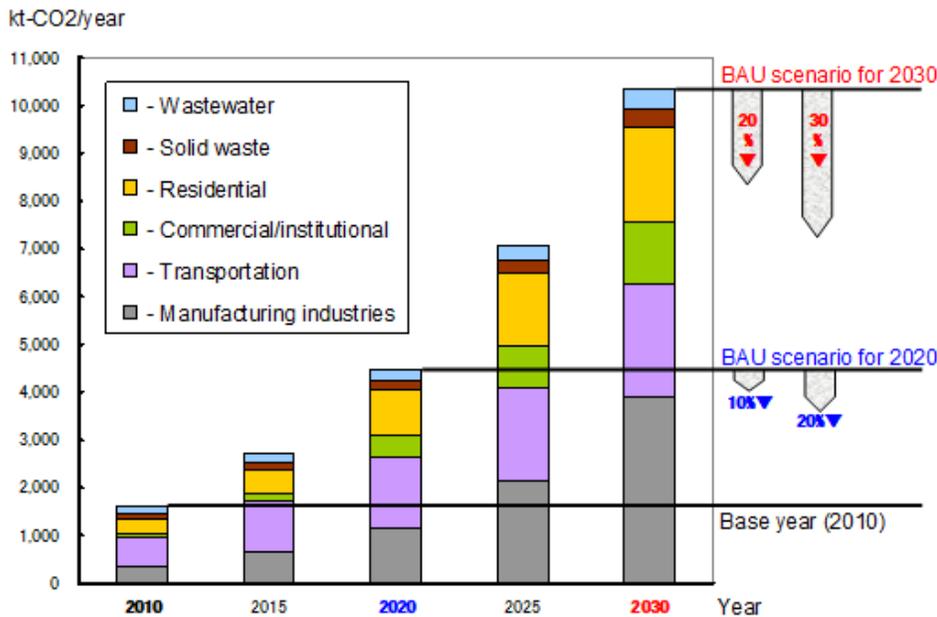


Figure 16: One approach for establishing CO<sub>2</sub> Emissions Reductions Targets to 2030

If the above reduction targets are interpreted in comparison with the base year emission level, then the targets require that emissions be kept within 151% of the base year emission level in 2020 and within 417% in 2030, respectively.

In the remaining text of this report, the BS-H BAU scenario is the working scenario unless otherwise stated.

### **3.4.3 Environmental Considerations for the Low Carbon Plan and Target**

The CO<sub>2</sub> reduction targets and the measures and policies for Da Nang City and Ngu Hanh Son District, should also be consistent with the environmental vision for Da Nang. The environmental vision is to develop Da Nang in a manner that promotes environmentally attractive urban development. For example, in order to realize the CO<sub>2</sub> reduction target in the transportation sector, the vision is not merely reduce the number of automobiles and two wheel vehicles but rather, to convert the means of transportation to more environmentally-friendly options, while increasing mobility. The environmental targets should be set along these lines.

## **PART 2: REVIEW TEAM REPORT**

This part of the report presents the Policy Review Team's conclusions and recommendations about low-carbon town development in Da Nang, Viet Nam.

The Feasibility Study focused on the Ngu Hanh Son District, however the findings and recommendations address Da Nang's low carbon policies and programs as whole to assess and make recommendations on the town as a Low Carbon Model Town.

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## 1. INSTITUTIONAL CONTEXT

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### 1.1 Findings

#### 1.1.1 Institutional Framework

The National Assembly is the highest government organisation and directs the work of ministries, government agencies and the People's Committees at all levels (ASEAN Law Association 2010). Viet Nam is divided into 58 provinces and 5 municipalities which are centrally controlled by the national government; one of those municipalities is Da Nang. Each province and municipality elects a People's Council and the People's Council appoints a People's Committee which operates as the executive arm of the province or municipality. The People's Committee is responsible for developing and implementing policies at a municipal level. Their policies must be consistent with national laws, ordinances, decrees and orders.

There are a number of national ministries that administer low carbon related laws. However, the primary ones are: the Ministry of Natural Resources and Environment, the Ministry of Industry and Trade, the Ministry of Construction, the Ministry of Transport, the Ministry of Agriculture and Rural Development, and the Ministry of Planning and Investment.

At the municipal level the Da Nang's low carbon relevant departments and agencies are: the Department of Foreign Affairs, the Department of Industry and Trade, the Department of Natural Resources and Environment, the Department of Construction, the Department of Transport, the Department of Planning and Investment, and the Department of Agriculture and Rural Development (Da Nang Portal).

#### 1.1.2 Legal Framework

Nationally, the highest legal document in Viet Nam is the Constitution, which sets out the government's structure and empowers the National Assembly to legislate. The National Assembly passes National Laws, and Ordinances are passed by the Standing Committee of the National Assembly when the National Assembly is out of session. Legislation is then enforced at both a federal and local level and supported by decrees, orders, government decisions, circulars, guidelines and Ministerial decisions.

Nationally, Viet Nam has a number of national strategies and plans to assist with low carbon development (MNRE, 2012):

- The 'National Target Program to Respond to Climate Change,' Decision No. 158 (December 2008) assesses the impact of climate change on Viet Nam. Some of the aims include developing climate change related science and technology programs, raising awareness and strengthening the capacities of organisations, institutions and policies on climate change.

- The ‘Viet Nam National Strategy on Climate Change,’ Decision No 2139 (December 2011) has a number of objectives including sustainable development goals, developing a low carbon economy, developing adaptation measures and GHG mitigation options and sustainably using national resources.
- Establish a ‘National Committee on Climate Change’, Decision No 42 (January 2012).
- The ‘Viet Nam National Green Growth Strategy’ (September 2012), which aims to promote green growth in Viet Nam by establishing a Green Growth Fund and greenhouse gas emissions reductions targets and by implementing a roadmap for development from 2012 to 2050.
- The ‘National Action Plan to Respond to Climate Change in 2012-2020’ (October 2012) carries out the objectives of the National Strategy of Climate Change and consists of 65 programs, projects and tasks, with 10 priorities.

Locally Da Nang has three city-wide plans that complement the national policies and programs. The first is ‘Da Nang’s Master Plan for Socio-economic Development up to 2020’. The second is the ‘Plan for 2000-2020 in Da Nang’, which is the city’s construction plan. The third is ‘an Environmental City’, which is an environmental plan.

In addition, there are two district-wide plans for Ngu Hanh San District (“NHSD”). The first is the ‘Socio-Economic Plan with a vision for 2020’ and the second is the ‘Urban Development Plan with a vision for 2030’.

The Feasibility Study For NHSD in Da Nang City, Viet Nam (“Feasibility Study”) presented a roadmap for reducing carbon in the NHSD. It was commissioned as one component of APEC’s Low Carbon Model Town Project in Da Nang. It presents six countermeasures for reducing GHGs in the NHSD from 2015-2013.

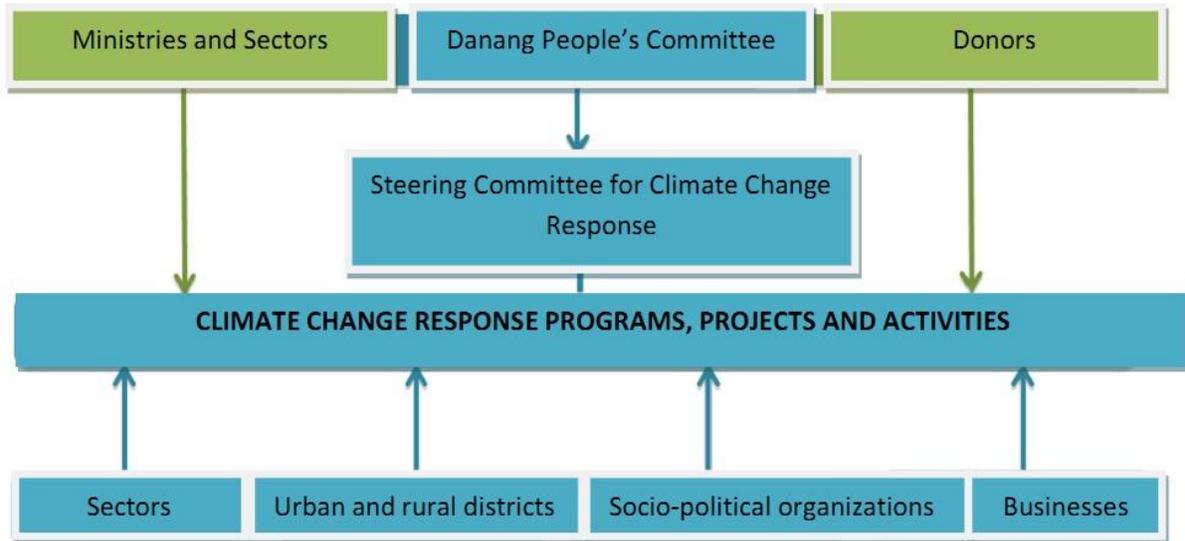
There is some discrepancy between the target years of the different plans, while most are largely forecast to 2020, some do not, such as the ‘Urban Development Plan with a vision for 2030’.

The Da Nang People’s Committee (DNPC) is in the process of revising some of the plans to from 2020 to 2030. They have submitted the revised plans to the Central Government of Viet Nam for Prime Ministerial approval.

### **1.1.3 Organisational structure**

An ‘implementation board’ was established by the Da Nang People’s Committee in the first half of 2013 as part of NEWJEC’s Feasibility Study. The ‘implementation board’ was led by the Da Nang Department of Foreign Affairs with a number of other agencies and departments also on the board. For example, the Da Nang Department of Industry and Trade administered the technical aspects. The ‘implementation board’ provided information and feedback to NEWJEC for the Feasibility Study and selected emissions reduction measures from the Feasibility Study for implementation in Da Nang.

The Standing Office of Da Nang Steering Committee for Response to Climate Change and Sea Level Rise was established under Decision No.1281/QD-UBND dated 17 February 2011 and Decision No 4995/QD-UBND dated 15 June 2011 of the People’s Committee of Da Nang. It is an interdisciplinary body that researches, proposes, guides, coordinates, collaborates and supervises climate change response programs and projects at the local, national and international level. See Figure 2 for its reporting structure and relationship to stakeholders.



**Figure 1: Relationship among stakeholders in the city’s climate change response activities. Source: CCCO Da Nang.**

The Da Nang Climate Change Coordination Office (CCCO of Da Nang) was established under Decision No. 2140/QD-UBND dated 21 March 2011 and under Decision No. 3246/QD-UBND dated 14 May 2013 of the Vice Chairman of the People’s Committee of Da Nang. The CCCO of Da Nang supports the Steering Committee for Climate Change Response and Sea Level Rise. It implements the ‘Plan for Responding to Climate Change and Sea Level Rise in Da Nang by 2020’ and it coordinates the Plan’s climate change projects in Da Nang funded by the Rockefeller Foundation, and any other duties assigned by the Chairman of the Steering Committee.

## 1.2 Recommendations

### 1.2.1 Overarching Recommendations

#### **Rec. 1. Maintain a long term vision and leadership for low carbon policies and programs across all sectors.**

For activities to become low-carbon, it is essential for decision makers to have a long term vision and foresight and show strong leadership. Low-carbon systems demonstrated in NHSD, where successful, could then be taken up throughout Da Nang city. Implementing low-carbon initiatives will improve the lives of all socio-economic levels of the community and its visitors.

The People's Committee should show true leadership by installing solar water heaters on their own buildings and reducing their energy demand beyond the legal 10% requirement (perhaps to reach more than a 20% target). It could also be achieved by the use of low fuel consuming government vehicles used in NHSD – including electric garbage-collecting trucks (as developed in New Zealand<sup>3</sup>) and electric buses as used in Adelaide, Seoul and many other cities.

#### **Rec. 2. Identify and implement short term and low cost solutions for immediate implementation.**

The Executive Summary of this Review identifies a number of recommendations from this Review that could be implemented by the DNPC in the short term.

#### **Rec. 3. Seek international funding to support the LCMT concept.**

Da Nang has already received some external funding, including from APEC, mainly to undertake feasibility studies etc. However, the city must seek international funding to implement the recommendations and actions. Some activities can be undertaken immediately for very little investment by the Da Nang People's Committee. But for developments where major investment is required, seeking funding through the Global Environment Facility (GEF) (linked with agencies such as ADB, World Bank, UNDP, UNEP etc.) could be considered to support the development of projects on the ground.

The GEF has a new strategy being proposed for the forthcoming donor country replenishment round to support multi-focal areas instead of the traditional single focus areas (such as climate change mitigation, or water, or biodiversity, or chemicals, etc). Sustainable Cities is one of the proposed 'Signature Programmes' and liaison with the Vietnamese focal point for the GEF should be made to consider funding opportunities for financing the entire LCMT project.

If green spaces, tree plantings and parks, linked with low-carbon and non-motorised transport systems could be achieved, then the local government should seek to become

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<sup>3</sup> See <http://cleantechnz.co.nz/2012/06/electric-rubbish-truck/>

a member of the newly established group of biophilic cities<sup>4</sup>. This would also be an additional attraction for tourists.

**Rec. 4.Emphasise developing human resources and environmental skills in education to promote future sustainable development.**

**4.1.1 Legal Framework Recommendations**

**Rec. 5.Seek Prime Ministerial approval for Da Nang’s LCMT plans to ensure compatibility with economy-level planning.**

**5.1.1 Organisational Structure Recommendations**

**Rec. 6.Establish an ‘implementation board’ that coordinates the implementation stage of the LCMT development plan.**

The Feasibility Study established an implementation board to assist with carrying out the Study. Accordingly, an implementation board would be very beneficial to implement the LCMT development plan. Like the implementation board for the Feasibility Study it should coordinate the various activities by related departments and consist of senior officials from those departments. Appointing the Da Nang Department of Foreign Affairs as lead agency will enable it to liaise with international and foreign organisations to encourage implementing the LCMT development plan.

**Rec. 7.Maintain close communication with the Central Government of Viet Nam.**

In particular the national Ministry of Industry and Trade, to facilitate LCMT development in Da Nang and also to disseminate the Da Nang LCMT project results to other municipalities and districts in Viet Nam.

**Rec. 8.Involve the People’s Committee and the residents of Da Nang during the implementation stage of the LCMT development plan.**

This aims to ensure community involvement that establishes an up-to-date, relevant and beneficial LCMT development.

The urgency level for the recommendation is illustrated in the below table by short, medium and long term urgency.

	<b>SHORT TERM</b>	<b>MID-TERM</b>	<b>LONG TERM</b>
<b>URGENCY LEVEL</b>	Recs:2, 5, 6 & 8	Recs: 3, 4, & 7.	Recs:1

<sup>4</sup> See <http://biophiliccities.org/>

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## 2. SUSTAINABLE DEVELOPMENT PLAN

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### 2.1 Findings

Da Nang City's population is expected to grow, and the Ngu Hanh Son District is predicted to have the largest population increase of any district. Many problems associated with rapid urban developments can be avoided through proper urban planning. Da Nang has already commenced urban planning through Da Nang's 'Master Plan for Socio-Economic Development up to 2020', which aims to develop Da Nang's society and economy in a rapid and sustainable way by shifting the economic structure towards service-industry-agriculture, and utilising the city's potential and advantages. It plans to make Da Nang an environmental city by 2020. It has a number of aims and objectives including:

- Integrating economic development while protecting natural resources and the ecological environment through sustainable development.
- Developing Da Nang into a dynamic urban centre and driving engine of regional development, to focus on spatial development which links other key economic zones in central Viet Nam.
- Developing urban space and invest in infrastructure.
- Developing health care, culture and education in order to improve people's living standard and knowledge.
- Integrating economic development while protecting natural resources and the ecological environment through sustainable development.

'Building Da Nang City as an Environmental City' (No. 41/2008/QD-UBND) is a three stage plan to 2020 that focuses on land, water and air quality, and providing a safe and healthy environment for the people of Da Nang. It also aims to make the people of Da Nang aware of environmental protection and Da Nang's development as an environmental city, and sets quantitatively determined CO2 reduction targets into concrete measures and policies for Da Nang City.

### 2.2 Recommendations

**Rec. 9. Encourage urban development within and near existing communities and public transit infrastructure** (for more details see section 3).

The urban development should occur through developing and implementing strategies that converges land-use planning with the development and reorganisation of roads, infrastructure and new and existing buildings.

**Rec. 10. Promote redeveloping the existing cities, suburbs and towns while limiting expanding the development footprint in the region** (for more details see section 3).

However, care should be taken to recover properties with potential heritage value that can be used for tourism and tours in the city.

**Rec. 11. Develop balanced communities that are proximate to housing and employment opportunities** (for more details see section 3).

Employment opportunities should also look to develop innovation and technology based businesses, which will increase the competitiveness of the community and the region. It will also encourage entrepreneurship within the community and region.

**Rec. 12. Encourage low carbon transport options** (for more details see section 5).

A secondary benefit to encouraging low carbon transports options are the public health benefits from decreased pollution.

**Rec. 13. Preserve water quality, natural hydrology, habitat and biodiversity through conservation wetlands and water bodies.**

Improve living standards by creating ecological parks in areas with natural potential for integration into the architectural design of the city.

**Rec. 14. Design safe walkable streets that promote efficient transportation and walking** (for more details see section 5).

This can be done through well designed facades and sidewalks and using ground levels for shops and restaurants.

**Rec. 15. Promote compact development that conserves land and protects farmland and wildlife habits.**

Through creating maps that shows specific ecological economic zoning and the land's development capability classification, the city can identify prime development areas or areas that are now open to re-development due to re-classification. Development can then be encouraged in areas with existing infrastructure, which will also preserve open spaces, farmland, and areas of natural beauty or environmental significance. Additionally, identifying areas with endangered flora or fauna will avoid disturbing their native habitat and protect the species from further endangerment.

**Rec. 16. Provide access to civic areas, public spaces and recreational facilities that improve physical and mental health** (for more details see section 3).

Creating green areas within cities retrieves, rehabilitates and restores public health. Green spaces are also excellent locations for community events, concerts and recreational sports. They can also become sites for scientific or cultural entertainment projects that use alternative energy sources. Natural swimming pools and ponds within the city could be considered for private or public use as well.

**Rec. 17. Grow tree-lined and shaded streets that reduce urban heat island effects, improve air quality and reduce cooling load in building.**

This will encourage urban reforestation and afforestation with native species. Green roof systems on new and existing buildings will also alleviate the urban heat island effect.

Transitioning brown field sites (for example, former industrial and commercial properties, and vacant buildings) into green buildings or green parks will put the land back into use.

**Rec. 18. Build neighbourhood schools that promote community interaction and engagement by integrating schools and educational institutions** (for more details see section 3).

A social affairs program that uses local social actors to help promote and implement low-carbon project will help to educate children about Da Nang as a low-carbon town and will also encourage community participation in greening the city. Creating an eco-tourist route to publicise could also publicise the benefits of a green city to the children and youth or the community as well.

**Rec. 19. Promote Da Nang as a ‘biophilic’ town and join the international biophilic city network (eg Wellington, New Zealand).**

Biophilic cities are a network of accredited cities which have demonstrated an abundance of nature in close proximity to urbanites. They are biodiverse cities that value, protect and actively restore biodiversity.<sup>5</sup>

**Rec. 20. Encourage the design, construction and retrofit of buildings using green building practices.**

This includes expanding the range of choices and opportunities for housing and encouraging compact building design (for more details see section 4).

**Rec. 21. Use on-site renewable energy sources** (solar, ground source heat pump, small wind, biomass heat such as pellets) (for more details see section 8).

**Rec. 22. Promote the use of recycled and reclaimed materials in infrastructure.**

**Rec. 23. Reduce light pollution** so that it minimises light trespass from projects, protects wildlife and people.

The urgency level for the recommendation is illustrated in the below table by short, medium and long term urgency.

	SHORT TERM	MID-TERM	LONG TERM
URGENCY LEVEL	Recs: 13, 16, 20 & 21.	Recs: 9; 10; 11 & 14.	Recs: 17; 18; 19 and 22

<sup>5</sup> See., <http://biophilicities.org/>

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## 3. TOWN STRUCTURE

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### 3.1 Findings

Da Nang is one of the fastest-growing cities in dynamic Asia. The rapid urbanisation creates opportunities for economic growth, but at the same time appears to create environmental risks, which may threaten the long-term value of Da Nang as a world-class tourism city.

To date, Da Nang's spatial structure remains compact and dense due to its urban infrastructure and accordingly, the work commute remains relatively short.

Da Nang will need steady economic growth but at the same time further environmental protection. To achieve this, compact city policies could play an important role for Da Nang. The current spatial strategy for Da Nang, including its spatial master plan, could incorporate the compact cities policies. Better understanding of the potential impacts of spatial structure on the city's economic and environmental performance, and a set of quick actions towards low carbon spatial structure is crucial. Strong political support is a precondition to such actions.

The Ngu Hanh Son District is a new development area and there are a lot of opportunities for it to become a LCMT. While it is expected to be a strong tourist attraction, the district's population is estimated to increase at the same time. Currently, it appears that the city's layout accommodates large-scale development (hotels, condominiums, commercial centres, etc.). Considering the strategic location of the district in the city, it is more appropriate for the city to develop the district as a place for local communities, as well as for tourists. Much more attention should be paid to neighbourhood-scale development for locals.

APEC's LCMT project is a timely opportunity to review the current town structure in Da Nang as a whole, and the Ngu Hanh Son District in particular, and to seek for effective ways to achieve a low carbon and sustainable town structure in the future. The below recommendations on the town structure of Da Nang city are mainly based on observations during the expert review in December 2013. Some of them are derived from the OECD's recent study 'Compact City Policies: A Comparative Assessment' (2012), which examined compact city examples across OECD countries – in particular in the five case study cities: Melbourne (Australia), Vancouver (Canada), Paris (France), Toyama (Japan) and Portland (United States).

### 3.2 Recommendations

**Rec. 24. Foster political and citizen's consensus** so Da Nang's compact spatial characteristics become a long term asset that is protected for the future prosperity of the city, and incorporate this in every long-term vision.

**Rec. 25. Study and recognise the benefits of a compact town structure.**

Da Nang's current compact spatial structure can be a long term asset that is protected for the future prosperity of the city. A well-planned compact city can contribute to both

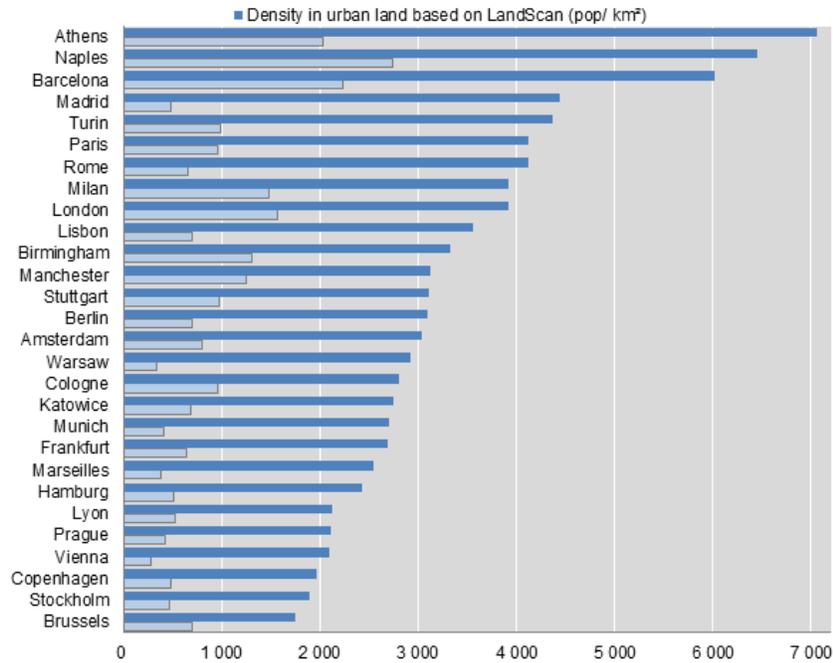
economic and environmental sustainability (OECD, 2012). It is crucial for every stakeholder in Da Nang to recognise this. In this regard, it is important for Da Nang to make effort to study and recognise the benefits of a compact town structure. It is widely recognised that it is not easy to obtain political and citizen's consensus for this long term vision without illustrating the evidence.

**Rec. 26. Identify areas to be designated as protection areas for the green environment and wildlife.**

Saving land for ecosystem functioning and management in urban areas (such as flood buffering and water filtering services around watershed areas and coastal zones) is a proactive strategy to prevent further local environmental degradation and vulnerability (OECD, 2014, forthcoming). The green environment and wildlife surrounding the city will be a long term asset for Da Nang's competitiveness and quality of life. It is important to note that land use has an irreversible character; once natural land is developed, it is almost impossible to get it back to what were there. Examining the effectiveness of their long-term vision and implementation tools to protect natural resources is urgently needed. Options include the designation of areas as protected with an effective regulatory instrument.

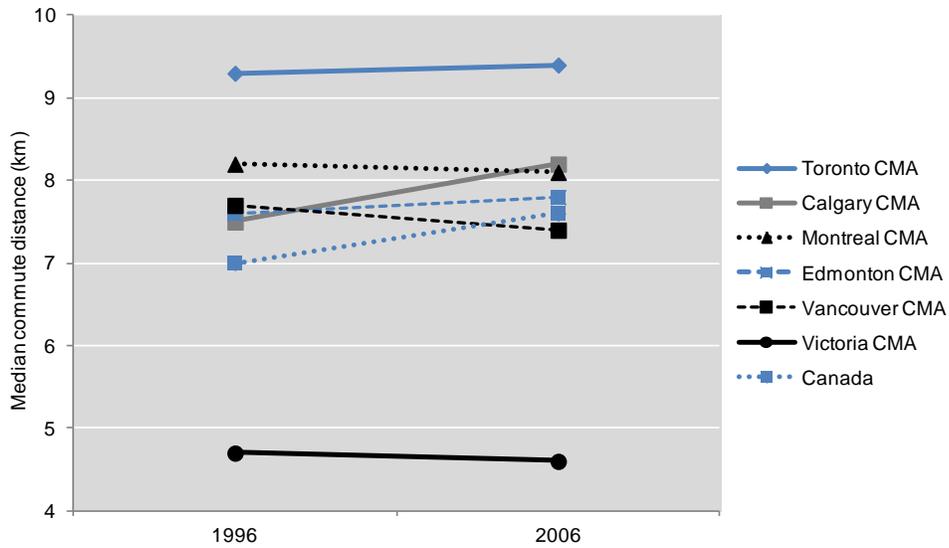
**Rec. 27. Monitor 'population density on urban land' and 'average trip distance'.**

Regular monitoring of spatial structure of Da Nang could help the city to design and implement urban policy effectively. Two options are particularly recommended. The first is density. In the fast-growing context, low-dense urban development creates huge costs for the city in the long-term urban infrastructure management (OECD, 2014, forthcoming). In this regard, monitoring the density of urban land gives a macro view of how urban land is effectively utilised. It also allows international benchmarking (Figure 1). Second, trip distance can serve as an indicator of spatial structure of cities. For example, between 1996 and 2006, the median commuting distance in the Vancouver Census Metropolitan Area (CMA) decreased from 7.7 kilometres to 7.4 kilometres, while the national average increased from 7.0 kilometres to 7.6 kilometres (Figure 2). It is important to note that both Vancouver's population and the number of commuting trips grew over the same period. This shows that in Metro Vancouver it was possible to reduce journey-to-work distances for the working population even as population and employment grew (OECD, 2012).



**Figure 2: Population density on urban land and on total land of 28 OECD large metropolitan areas in Europe.**

Source: Based on LandScan Global Population Database 2009 and CORINE Land Cover 2006.



**Figure 3: Median commute distance for selected metropolitan areas in Canada, 1996-2006. Note: CMA = Census Metropolitan Area.**

Source: Census Statistics Canada.

**Rec. 28. Create a system that prioritises urban development on already developed urban land compared with green-field development.**

While the conventional image of Asian cities is one of very high density, urban sprawl – the uncontrolled expansion of urban development characterised by low density, segregated land use and insufficient infrastructure provision – and motorisation are increasingly becoming features of Asian urban development (Jenks, M. et al., 2008). Indeed, urban sprawl can be seen in most Asian cities and needs to be tackled. As a result, the urban form of many Asian cities favours and locks them into automobile-dependency, creating huge traffic flows, and increases in congestion, air pollution and CO<sub>2</sub> emissions (OECD, 2014, forthcoming).

While urban sprawl and local and global environmental degradation is not a desirable outcome, policy options to prevent urban sprawl needs to be carefully examined. For example, a-priori commitments to urban containment in a fast-growing urban environment will likely lead planners to underestimate land and infrastructures needed for massive urban expansion, resulting in uncontrolled sprawl on urban fringes. If urban containment policies are perceived as too tight to be credible, they will fuel land speculation and may lead to unplanned or poorly planned development beyond urban growth boundaries. Policies involving generous but credible urban growth boundaries, identifying where there is scope for expansion and where it should be restricted for environmental or other reasons, reduce both these risks (OECD, 2014, forthcoming). It is also important to combine measures to promote inner-city development, in addition to regulate urban expansion.

**Rec. 29. Develop a land inventory that checks current urban land availability, and tries to accommodate development within existing urban areas as much as possible by setting a target ‘re-fill rate’ that promotes inner city development by providing incentives.**

A good solution is an institutionalised process of regular monitoring of urban growth pressures and the space available for development. In Portland, United States, the metropolitan government (Metro) has developed a detailed and sophisticated land-monitoring process to inventory vacant land and track the refill rate (OECD, 2012). These are a part of the system that prioritises urban development on already developed urban land compared with green-field development. The experience could be of help for Da Nang.

Portland’s Buildable Lands Inventory ensures periodic revisions of the boundaries by weighing the necessity of enlargement. While a state law requires Portland Metro to review the capacity of the Urban Growth Boundary (UGB) every five years to ensure a 20-year land supply, Metro has developed a detailed and sophisticated land-monitoring process to inventory vacant land and track the ‘refill rate’. This is defined as the rate at which new development occurs through ‘infill’ (when more units are constructed on an already developed lot) or ‘redevelopment’ (when a structure is removed and another is built in its place).

In 2009, Metro found that the refill rate for new industrial development was 20%. For nonindustrial use, 52% of new capacity was built on developed land (Metro, 2009). The residential refill rate has climbed steadily, from 30.4% from 1997-2001 to 33% from 2001-06 (Metro, 2009). Metro predicts the rate will rise to 38% from 2010 to 2030 (Metro, 2010). If it does, the urban growth boundary will be able to accommodate 11,300 additional dwellings without expanding. Refill rates are highest in the central city and lowest in suburban residential neighbourhoods. Most residential refill is multi-family

housing, often as part of transit-oriented development. Portland prioritises transport projects that support refill and investment in transit-oriented developments to achieve higher density and a greater mix of uses than prevailing market conditions would support in terms of developers' construction costs and income from rent or sale (Metro, 2011).

**Rec. 30. Develop the Ngu Hanh Son District as a world class resort that is attractive for local residents and businesses.**

Ngu Hanh Son District is being developed as a world class resort. It is highly recommended that this area to be developed for the residents as well. While a variety of urban amenities are going to be provided for tourists (e.g. restaurants, cafes, theatres), enhancing residential development allows the services for locals to locate in the district, which creates “diversity” and “liveability” in mixed land-use neighbourhoods and increase the long-term attractiveness of the district. It also allows more efficient use of urban infrastructure because it balances peak demand for urban facilities (transport, electricity, etc.) and reduces average commuting distances. It is also recommended to promote some business function in the district in order to further increase the diversity.

**Rec. 31. Promote high-density development with strong urban design codes to foster value both for tourists and residents.**

As one of the new urban centres and a low-carbon model town in Da Nang city, Ngu Hanh Son District needs to be developed in a comfortable high-density town structure. While high density is often associated with lower quality of life, high-quality urban design can also alleviate negative perceptions of density (OECD, 2012). High-quality urban design can also enhance the well-being of residents (Urban Taskforce, 1999). Public parks and green spaces in urban centres are an essential element to build high-density development. When public space is well designed and delivers high-quality services, density is perceived positively. Streets are another important element of the public space, and streetscape and better use of streets can also enhance quality of life even in high-density neighbourhood (OECD, 2012). Reserving land in advance for public space in cities is a proactive strategy that could be explored, as land will be much more expensive as urban development extends (Romer, 2012). Finally, there is a need for an institutional framework to assess and promote high-quality urban design, as urban design is often seen as being subjective. Portland's design commission is a good example (OECD, 2012).

**Rec. 32. Raise district specific revenue (e.g. tourist tax) which could be reinvested in the district (compensation to the residents).**

It is crucial for Da Nang to recognise Ngu Hanh Son District not just as a touristic attraction but as a neighbourhood with local citizens. Fostering a “sense of place” in urban centres is an important strategy for new neighbourhoods such as Ngu Hanh Son District, as it can encourage local residents to be committed into development of urban centres, and eventually increase the attractiveness of the district. A common feature of many successful efforts to create an attractive and lively city centre is identity-related projects that pay attention to the tradition and identity of the city and its people (OECD, 2012). In this regard, raising district specific revenue (e.g. tourist tax) could be considered as an effective policy option. The revenue could then be reinvested for the community, with the local community being involved into the decision making.

The urgency level for the recommendation is illustrated in the below table by short, medium and long term urgency.

	<b>SHORT TERM</b>	<b>MID-TERM</b>	<b>LONG TERM</b>
<b>URGENCY LEVEL</b>	Recs: 24, 25, 26, 31	Recs: 28, 30, 32	Recs: 27, 29

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## 4. LOW CARBON BUILDINGS

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### 4.1 Findings

As Da Nang rapidly develops as a city, constructing infrastructure, especially buildings will provide an excellent opportunity to help the city transition to a more low-carbon built environment.

While there are technical regulations in Da Nang City encouraging energy efficient buildings, compliance with the regulations is not a requirement for obtaining construction permits. Therefore many newly constructed buildings do not meet the technical energy efficiency regulations. Additionally, according to reviews by the experts, the technical regulations are quite complex and difficult to implement. Hence, there were not many energy efficient buildings in Da Nang at the time of the review.

The Feasibility Study surveyed 20 buildings in Da Nang and assessed the energy efficiency of these buildings in Da Nang under the Comprehensive Assessment System for Built Environment Efficiency (CASBEE) system. All of the surveyed buildings were ranked between B+ and B- or between good and slightly poor. Buildings in Da Nang therefore have great potential for energy saving through a number of energy saving technologies such as reducing thermal load through energy efficient building design, heat pump style cooling systems, waste heat re-use, and integrated management of multiple building groups.

The Da Nang Climate Change Office is collaborating with the French Agency for Development (AFD) and the French consultant Asconit, to implement the 'Da Nang Climate Change Mitigation for Buildings' Project (DaClimB). The project began in October 2013, the goals, products and action plan were determined in December 2013 and it is scheduled for completion by September 2014. The project identifies and implements high priority projects on climate change mitigation for buildings within the funds provided by the AFD. It will then capitalise on lessons learned from pilot projects to improve methodologies for replication in other cities and provinces in Viet Nam (AFD, 2013).

### 4.2 Recommendations

**Rec. 33. Develop an evaluation criteria for low carbon building design.**

The evaluation criteria for low carbon buildings should meet the requirements of local environmental factors, for example the needs of region's weather and not overly incongruent with local architectural features. For example, China's green and energy efficient must apply the national standards for buildings in addition to complying with local design and evaluation criteria.

**Rec. 34. Promote energy efficiency standards for all non-residential buildings.**

The energy efficiency standard should meet international standards such as minimum 10% over ANSI/ASHRAE/IESNA Standard 90.1 2010. This includes creating optimum conditions for use of passive and active solar strategies through building orientation

**Rec. 35. Reduce water demand in non-residential buildings.**

Water demand can be reduced in a number of ways, including recycling grey water from washing and showers in toilets. Installing water efficient fixtures such as toilets, coolers and showerheads.

**Rec. 36. Construct a model low-carbon building.**

The model low-carbon building would showcase low carbon building design, energy efficiency standards and ecologically sustainable building practices.

Build the model building in NHSD, where it can be used for educational purposes by both tourists, businesses and citizens. Monitor the building's technology to evaluate the technology's and criteria's effectiveness.

**Rec. 37. Publish a policy paper to promote low carbon building deployment and financing.**

The policy paper should outline low carbon building criteria and a technical and economic support policy. For example, under such a policy, projects can be subsidised according to how many low carbon aspects are incorporated into the building design.

**Rec. 38. Establish building energy metering, including sub-metering to improve data recording and analysis systems.**

This will help understand energy consumption within each system, and by each appliance, which will enable further identification of energy saving.

**Rec. 39. In the future, use computer simulation to optimise building design.**

Computer simulations can enhance the use of passive design tools such as promoting natural ventilation. A simulation could include aspects such as: indoor and outdoor air environment simulation; indoor and outdoor light environment simulation; whole building energy simulation; and shading, insulation and other energy-saving technologies.

**Rec. 40. Develop an energy savings plan for existing buildings.**

The energy savings plan could classify buildings by age and type of buildings to provide a step-by-step policy pathway for retrofitting buildings for improved energy performance depending on the building's classification. The initial step could be to undertake an energy audit of existing buildings and develop renovation goals for non-efficient buildings. Retrofitting steps could include: strengthening the envelope insulation; replacing energy efficient cooling and heating equipment; using renewable energy; installing energy saving lighting; and strengthening 'intelligent control' energy systems, for example, time control/sensor lighting.

**Rec. 41. Strengthen building energy system commissioning and maintenance.**

Construct new buildings that are energy efficient with inbuilt energy systems that provide the best operating point and commission trained personnel in buildings efficiency management. This building will be maintained in a way that sustains the energy efficiency of heating and cooling, lighting, control and hot water systems.

The urgency level for the recommendation is illustrated in the below table by short, medium and long term urgency.

	<b>SHORT TERM</b>	<b>MID-TERM</b>	<b>LONG TERM</b>
<b>URGENCY LEVEL</b>	Recs: 33, 34 & 37.	Recs: 38, 40 & 41.	Recs: 35; 36 & 39.

## 5. TRANSPORTATION

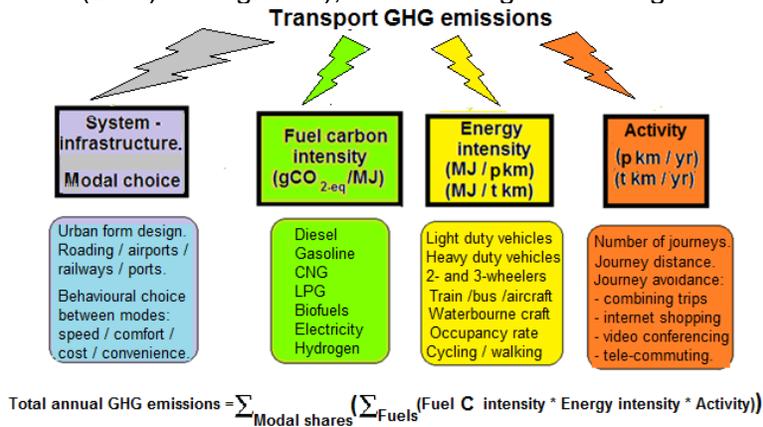
### 5.1 Findings

Demand for passenger transport and freight will increase virtually everywhere in the world. Therefore, having a vision for what this growing demand might look like in 2030 is imperative when developing a transport plan today. Urban planning and investing transport infrastructure now will lock-in transport modes of choice for the next few decades. Accordingly, long term projections are critical.

An efficient transport system involves moving people expediently between suburbs and work places, hotels and tourist attractions, and around the CBD and local communities, as well as having well-designed logistics for the movements of goods and materials between ports, manufacturers and consumers.

Reducing transport GHG emissions can be achieved by the uptake of:

- Lower carbon-intensity fuels (gCO<sub>2</sub>/MJ) such as biofuels, hydrogen and electricity, but only when these energy carriers are produced from low carbon sources.
- Selecting and operating vehicles and engines with relatively low energy intensity (MJ/passenger km or MJ/tonne-km) as achieved by the manufacturers.
- Eco-driving to gain improved fuel consumption for a vehicle journey (reduced l/100km).
- Reducing the number and length of journeys (total p-km/yr and t-km/yr).
- Encouraging a shift to lower carbon transport modes, including the non-motorised options of walking and cycling, and, where feasible, changing freight movements from road to rail or coastal shipping.
- Infrastructure development and urban planning to encourage shorter journeys, cycling and walking, the use of low-carbon mass transit systems (including dedicated bus lanes, bus rapid transit (BRT) and light rail), and avoiding traffic congestion.



**Figure 4: GHG Emissions from the Transport Sector by modal**

The second phase of the World Bank's Da Nang Sustainable City Development Project is to develop a bus rapid transport system (US \$52.30m in credit), and the third is to improve the connectivity of the urban arterial system, including constructing two new east-west connecting roads to the north-south bypass of Da Nang and the national expressway network, along with associated resettlement sites (US \$70.90m in credit) (World Bank, 2013).

The choice of transport mode for any journey undertaken is based on a combination of cost, convenience, comfort and speed. Therefore to change travel pattern to reduce GHG emissions requires improving one or more of these factors over and above the present situation in order to stimulate a shift away from gasoline and diesel vehicles to low-carbon transport systems.

Traffic density is currently relatively low in NHSD and dominated by motor bikes. At the current low traffic demand, the entire Da Nang transport system, although somewhat chaotic and dangerous, appears to work well compared with many other cities of similar population. The future problem will be that once demand increases as is projected, then it will be more difficult to change travel patterns, modal shifts and driver behaviour. It will facilitate the transition to a lower-carbon and safer travel options if changes are made now, in anticipation of greater congestion and higher GHG emissions under business-as-usual.

For children, older people and cyclists in particular, mobility in NHSD and other parts of Da Nang is hazardous. Footpaths are largely non-functional, often blocked by parked motorbikes and extensions of dwellings and businesses, and hence forcing pedestrians into the road. Cycling is also relatively dangerous since, at present, there is absolutely no separation from motorised traffic. Bus services tend to be infrequent and unreliable, and use old and uncomfortable buses. Many uncontrolled road intersections at times are chaotic and dangerous.



**Figure 5: Photo of a quieter intersection in Danang.**

Perhaps road accidents are relatively rare at the current traffic density which appears relatively low in many districts, but as the projected increase in transport demand occurs over the next few years, the risks, particularly for pedestrians and cyclists, can only increase.

Traffic lights at some junctions only function during peak hours. we assume this is an energy savings measure which is commendable. However, we do not have any statistics on traffic accidents and related injuries as a result of the “give way” yellow flashing lights when the traffic lights are turned off. If there is any evidence of such accidents occurring, then the social costs could outweigh the energy saving benefits.

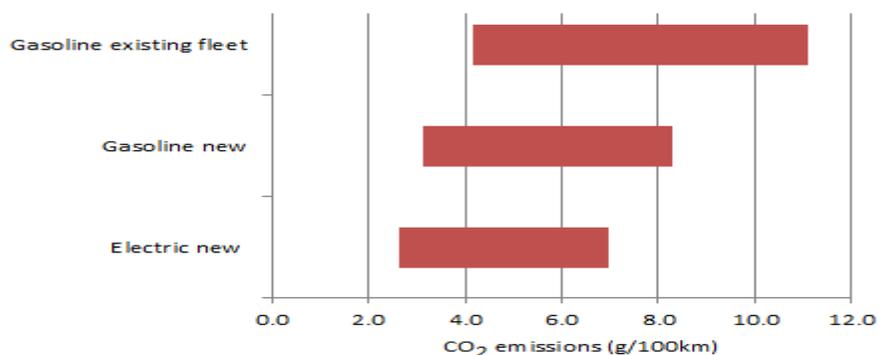
Gasoline is relatively cheap in Viet Nam by world standards at around USD 1/litre, but is relatively expensive for citizens when compared with the average wage in Da Nang of around USD 120/month. World oil prices are unlikely to rise significantly this decade (partly due to discovery of new reserves and resources, the increased use of unconventional oils, and the maturing of fracking technologies). So increased transport fuel prices are unlikely in the near future, and will not therefore drive a reduction in car or motorbike transport demand in NHSD.

Journeys in Da Nang are mainly short: 13.8% are less than 1 km and 56.4% less than 2 km. Non-motorised transport is easily possible for such journeys, though the local heat and high humidity may be deterrents for some citizens and tourists. The location of many new hotels in NHSD being a few kilometres away from restaurants, shops and tourist attractions is another barrier.

Electric motorbikes are already used by a very few people in Da Nang, mainly high school students, in part due to licence and tax exemptions rather than for saving energy or greenhouse gas emissions. Demand for these ‘E-motorbikes’ could grow, but careful analysis is needed since if the existing high-carbon grid electricity (with an emissions factor at present of 581g CO<sub>2</sub> /kWh) will be used for recharging the E-motorbikes, then the total GHG emission reductions will be far less than predicted in other reports. Reductions would be only around 10-15% lower per kilometre travelled at most.

Motorbikes	Capacity	Fuel consumption range	Specific CO <sub>2</sub> emissions	CO <sub>2</sub> emissions/ 100km	
Gasoline new	200 cc	1.125 - 1.875 l/100km	2.77 kg/l	3.1 - 5.2 kg /100km	
Gasoline existing fleet	200 cc	1.5 - 2.5 l/100km	2.77 kg/l	4.2 - 6.9 kg /100km	
Electric new	1.5 kW	4.50 kWh/km	0.581 kg/kWh	2.6 kg /100km	
Electric new	2.5 kW	7.5 kWh/km	0.581 kg/kWh	4.4 kg /100km	
<b>Assumptions</b>					
Time per 100km	3.00 hours	Average speed km/h	33.3	Average occupancy rate	1.3 people
Elec for 1.5 kW	4.50 kWh/100 km				
Elec for 2.5 kW	7.51 kWh/100 km				

**Figure 6: Emissions reductions depending on motorbike type.**



**Figure 7: CO<sub>2</sub> Emissions relative to motorbike fleet composition.**

Local air pollution and reduced noise benefits would result from displacing gasoline motorbikes with E-motorbikes, but these are not the main drivers in this instance in NHSD.

‘A developed country is not a place where the poor have cars. It’s where the rich use public transportation.’ – Gustavo Petro, Mayor of Bogota, Colombia.

## 5.2 Recommendations

### Rec. 42. Introduce dedicated cycleways for use by both tourists and local residents.

There is a global trend towards cycling with many cities in the world (eg London, England, Paris, France, and Changwon, Korea) recently installing cycleways and rental bikes, as Amsterdam, Netherlands and Copenhagen, Denmark have done for decades. In Europe in 2012, 12 million cars were sold and 20 million cycles and worldwide, cycling holidays are gaining in number rapidly<sup>6</sup>. If cycling is currently socially unacceptable by many Da Nang residents due to the hot and humid climatic conditions, then pedal-assist electric cycles could be the answer. Around 120 million of these are already used in China and elsewhere; they are cheaper than gasoline or electric motorbikes; recharging at home is simple and cheap; some models have a range of more than 70 kms; public recharging stations are not needed; and they could be attractive in NHSD for use by tourists. Riders of them would also benefit from dedicated cycleways, of which some elements exist in the Da Nang city centre. However, these appear not to be very well designed and car parking on the cycleways is not policed in order to encourage their use and improved safety.



**Figure 8: Cycleways exist but are poorly used as cars park on them. Places to park cycles and secure them could also be considered around the city.**

A tourist 'green' scenic route should be established along the coastal route near NHSD and around the peninsula with hire cycles made available. This scenic route could eventually travel over the Dragon Bridge into the old town centre and back over the Song Hanh Bridge on a circular route. In due course, kerbing will be needed to separate the cycle lanes (rather than just lines painted on the road), to avoid motorbikes or cars encroaching.

Small ferries could also be considered for transporting people, cycles and electric-cycles across the river instead of using the bridges. For example, this is accomplished

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<sup>6</sup> For example, NF Holidays, UK, offer a 13 day cycle trip from Ha Noi to Ha Long. [www.hfholidays.co.uk/vietnamcycling](http://www.hfholidays.co.uk/vietnamcycling)

very successfully in Vancouver to move both residents and tourists efficiently around the city and it has become a major tourist attraction. Da Nang could use Vancouver as a model city to replicate such a system for tourists.

**Rec. 43. Use locally produced renewable electricity to directly charge electric vehicles.**

Using the current high-carbon grid electricity does not result in lower GHG emissions (see sub-section 5.1 Findings). Local renewable energy generation, possibly backed up by grid supply when local renewable resources are low, can produce GHG mitigation benefits coupled with reduced local air pollutants arising from gasoline and diesel engines. Examples overseas include solar PV on the roof of a city bus station, public electric vehicle recharging points covered with solar roofs, biogas or landfill gas-generated electricity used for recharging city vehicles, or the methane gas used directly in vehicles designed to operate on compressed natural gas.

**Rec. 44. Improve the existing bus service by introducing dense and frequent bus networks within the district. This should be a first step if a new BRT system is a long-term goal.**

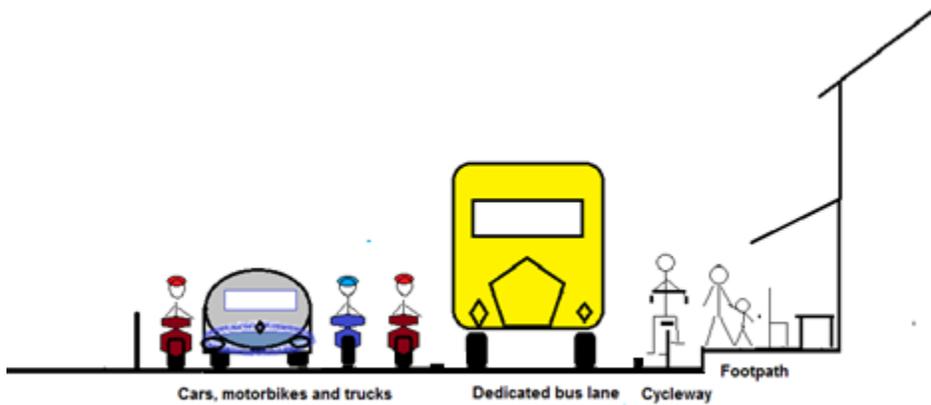
People's experiences on buses at present are fairly negative, so the perception that buses are an inferior mode of transport need to be broken by providing a fast, cheap, reliable and comfortable service. In several cities such as Seoul and Bogota, modern buses are electric-powered, have facilities for passengers to recharge cell phones and connect to the internet, are clean and comfortable, regular and reliable, and relatively cheap. Hence for many citizens, they are the preferred choice of transport. Improving bus stops with shelters that are ecologically friendly and aesthetically pleasing, for example bamboo huts, will also help to improve people's experiences with public transport.

A 24.5km bus rapid transit (BRT) system is underway in Hanoi, funded through the Global Environment Facility (GEF), World Bank and Vietnamese government for USD 339 million<sup>7</sup>. Valuable lessons could be learned from the experience gained by this project and therefore liaison should be sought with the government officials in Hanoi who are involved with designing and developing this project.

It could be that in NHSD and neighbouring districts, simple dedicated bus lanes could be developed on the existing main roads far more cheaply than constructing a BRT, and be equally as efficient in moving people.

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<sup>7</sup> See [http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2006/12/29/000104615\\_20070108100611/Rendered/PDF/HanoiOHUTDPOPID0122806.pdf](http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2006/12/29/000104615_20070108100611/Rendered/PDF/HanoiOHUTDPOPID0122806.pdf).



**Figure 9: Dedicated lanes by vehicle and mode of transport**

The existing lane separation system (bike and motor bike lane, motor bike and car, then truck and car) seems to work well and be respected by users on the major link roads where speed restrictions are imposed and policed. So expanding this concept to the main routes within the urban areas (as shown above) could prove to be a strategy worthy of investigating.

**Rec. 45. Regain the footpaths for pedestrians in order to encourage safe, non-motorised journeys for use by all residents, young and old, and for tourists to easily access local shops and culture.**

It is unclear whether or not there is a public desire by residents to use the footpaths for pedestrians rather than for parking motorbikes, extending living areas, storing building materials and setting up café tables. At present it is not possible on many roads to walk along the footpath without being forced on to the road at regular intervals and hence share it with cycles, motorbikes and cars.

If there is reasonable local support for pedestrians having improved access, then regulating the total blockage of footpaths to pedestrians along the major roads within the residential areas of NHSD (perhaps as a demonstration for all of Da Nang) could be an incentive for walking over short journeys, as well as an attraction for both tourists and residents, particularly those with limited mobility such as older citizens. A strip of at least 1 metre on the side of the footpath nearest the road could be reserved exclusively for pedestrians. This may need to be regulated and policed initially, but then it would possibly be enforced by the footpath users seeking to maintain their right-of-way whenever someone infringes.

The urgency level for the recommendation is illustrated in the below table by short, medium and long term urgency.

	SHORT TERM	MID-TERM	LONG TERM
URGENCY LEVEL	Recs: 42.	Recs: 44 & 45.	Recs: 43.

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## 6. AREA ENERGY MANAGEMENT SYSTEM

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### 6.1 Findings

Three departments are responsible for energy issues in Da Nang: the Department of Industry and Trade, the Department of Construction and the Department of Transport. Da Nang is dependent on the National Grid for electricity, with a requested capacity of 313 MW (max) and no local power generation plant in the city, beside privately owned ones within the industrial parks. Peak electricity demand in Da Nang in 2013 was 260MW and total energy consumption was 1,640,708,601kWh in 2012 and 1,717,638,453 in 2013 (11 months). The major driver for increased energy use in Da Nang is the industrial and construction sector which uses 50% of energy as a sector. The next largest is the residential sector at 35% and then the commercial, services and other sectors at 15%.

Da Nang experiences power shortages during the dry season in April and June. The Da Nang People's Committee provides guidance to consumers on saving energy during high demand times by providing manuals, brochures and leaflets on energy efficiency. The People's Committee also adjusts the public lighting system so that it decreases the load and cooperates with large energy users (31 users such as industry) to either manage their internal energy consumption or to provide energy from their private power plants.

Da Nang also plans to improve its energy security by installing a mini SCADA (supervisory control and data acquisition) system by 2017 and replacing public lighting with LED.

The Energy Development Plan for 2011-2015 was developed and approved. It includes plans for a hydroelectricity plant and plans to install solar PV for use by the international airport.

### 6.2 Recommendations

**Rec. 46. Implement a Demand Side Management Program that strengthens demand side management to provide data on real time profiles of peak demand, local equipment efficiency, and knowledge on energy efficiency.**

As electricity demand in Da Nang increases with the city's growth, a Demand Side Management Program will be crucial. A Demand Side Management Program will encourage energy consumers to consume less energy, especially to peak hours and periods. Various measures should be developed as part of the Program, including:

1. Promoting equipment energy efficiency, including a labelling scheme and Minimum Energy Performance Standards (MEPS).
2. Raising public awareness on energy efficiency through a promotional scheme focusing on training, and competitive businesses and industry.
3. Promoting Low Carbon Facilities for commercial buildings and industrial sectors.
4. Developing a financial incentive scheme to support replacing old energy inefficient machinery and equipment.

5. Studying potential implementation of an Area Energy Management System (AEMS) to manage demand and supply on a real time basis.

**Rec. 47. Develop diagnostic techniques and tools, and local skill training to identify and implement energy efficiency and energy management opportunities.**

In order to effectively implement low carbon measures for the city, stakeholder and public involvement is important. Training courses, campaigns and seminars would support raising public awareness and understanding. Developing diagnostic techniques and analysis tools would also assist in designing electing and implementing low carbon measures. Investment into low carbon technologies would help reluctant users to use and better understand why low carbon technologies are better. For example, demonstration programs, showing the actual implementation of a low carbon technologies, break down the barriers to technology uptake.

**Rec. 48. Formulate an Alternative Energy Development Plan (AEDP) from 2014-2020 for Da Nang.**

There are several potential sources of alternative energy in Da Nang such as solar energy, waste heat from industrial process, biogas and biomass. Establish a target and plan to develop and commercialise alternative energy should be formulated as part of the city development plan. A mid-term plan within the development plan would be from 2014 to 2020 and a long term plan from 2020 to 2030.

**Rec. 49. Examine the potential for demand side smart systems energy storage and smart grid networks to allow consumers to manage their demand. This will complement the Alternative Energy Development Plan (AEDP).**

Coordinating demand and supply in electricity systems is very important. This is especially the case when there are multiple energy sources (solar, biogas, or energy storage) are connected to the city grid. A smart grid system automatically monitors the city's and consumers' electricity demand, while simultaneously coordinating the supply side in order to optimise the best efficiency for the electricity system between demand and supply. A smart grid system can be used in both commercial and industrial buildings. Appropriate integration between of supply and demand side within a smart grid system, will assist in reducing demand consumption and remedy power shortage problems.

**Rec. 50. Review electricity pricing structures to shift energy use away from peak load periods.**

Energy loads in Da Nang have increased, especially during peak load period, while demand during non-peak times has remained relatively low. In order for the city to accommodate increased energy loads, pricing strategies should encourage people to shift their energy use to non-peak times.

**Rec. 51. Develop a promotional scheme to raise public/tourist participation in implementing a demand-side management program, for example, the Eco Point Program (EPP).**

There are a number of low carbon technologies available in APEC Economies. However, the consumption of these technologies is still very limited. A promotional

scheme that raises public and tourist participation in implementing a demand-side management program or low carbon technologies should be implemented such as the 'Eco Point Program' (EPP) in Koh Samui, Thailand.

The Eco Point Program aims to encourage the public and tourists to participate in low carbon activities or buy low carbon products or services which earns them specific points that can be redeemed as discounts or vouchers from participating suppliers of manufacturers.

**Rec. 52. Ensure that local projects qualify for Certified Emissions Reductions (CERs).**

CERs are a mechanism that can be used by certain developed countries to comply with their emissions target. They could be used in Da Nang to assist with low carbon measures of projects in need of financial support. A Voluntary Emissions Reductions/Verified Emission Reduction (VER) program could also be implemented in Da Nang, for example, travel related emissions from visiting tourists could be offset through a local VERs program.

The urgency level for the recommendation is illustrated in the below table by short, medium and long term urgency.

	SHORT TERM	MID-TERM	LONG TERM
URGENCY LEVEL	Recs: 48, 50 & 51.	Recs: 46 & 47.	Recs: 49 & 52.

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## 7. UNTAPPED ENERGY RESOURCES

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### 7.1 Findings

Da Nang has high potential to produce energy from waste water and waste solids. The total amount of solid waste in Da Nang is around 770 tonnes per day and in the Ngu Hanh Son District, it is around 55 tonnes per day. Kitchen and food waste accounts for the largest percentage of waste at 74.65%.

Four out of the six industrial parks in Da Nang have their own waste water treatment plants. And 22 out of 27 hospitals have their own waste water treatment plants. However, work to improve infrastructure is needed to complete sewerage connection pipes, as only 15-21% of total target users (industrial, residential and businesses) have access to completed connection pipes.

The Feasibility Study proposed two high potential sources of untapped energy: electrical power generation from biogas (digestive gas); and electrical power generation from biomass (solid waste-kitchen garbage).

### 7.2 Recommendations

**Rec. 53. Increase the number of users connected to the waste water treatment plant.**

Only 15-20% of total target users are connected to waste water treatment plants in Da Nang. Over the next few years Da Nang should make plans to increase electricity generation for waste water treatment and develop pipelines and infrastructure for users to connect to the treatment plants.

**Rec. 54. Develop a comprehensive waste management process.**

As Da Nang has grown, so has the amount of solid waste the city produces. The city should develop and implement comprehensive waste management processes from the source to the plant if it desires to increase tourism in the area. It should begin with separating waste items at the source of the waste and then separate collection for each type of waste. Followed by transferring the waste to the waste management plant and undertaking final separation and processing at the plant. Use organic waste for biogas for electricity and recycle plastic waste. For example, refuse derived oil is a potential source for alternative energy.

**Rec. 55. Develop a promotional scheme that raises public/tourist awareness and implements waste management processes, for example the Eco Point Program.**

Introduce the 'Reduce, Reuse, Recycle' strategy to encourage both the public and tourists to participate in waste management in Da Nang. A promotional scheme to encourage all users to participate in the waste management system, such as an 'Eco Point Program' can help promote waste separation as the source.

**Rec. 56. Examine opportunities to implement a 'waste-to-energy electricity or combined heat and power (CHP) generation 'system from incinerating municipal solid waste to reduce landfill requirements and utilise heat waste in Da Nang.**

While careful use waste separation strategies to convert some waste to biogas, oil or other forms of alternative energy. An incinerator may be necessary to reduce landfill in Da Nang of remaining waste. The waste heat from the incinerator could then be used to generate electricity.

**Rec. 57. Implement heat pump or solar water heating technologies to produce hot water in hotels and hospitals.**

Hospitals and hotels typically produce a large amount of heat waste from air conditioning and equipment for example. Using heat pumps to produce hot water, by sourcing heat from air and transferring it to a heat connected tank of water, can provide a viable source of hot water, especially during peak load times when air conditioning, for example, is in use and electricity prices are high.

The urgency level for the recommendation is illustrated in the below table by short, medium and long term urgency.

	<b>SHORT TERM</b>	<b>MID-TERM</b>	<b>LONG TERM</b>
<b>URGENCY LEVEL</b>	Recs: 53 & 54.	Recs: 55 & 56.	Recs: 57.

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## 8. RENEWABLE ENERGY

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### 8.1 Findings

Renewable energy use and development is already underway in Da Nang.

The 'National Master Plan for Power Development for the 2011-2020 Period with the Vision to 2030' Decision No 1208QD-TTg' (July 2011) sets a national renewable energy target. It aims, amongst other energy development initiatives, to increase total electricity production from renewable energy resources from 3.5% in 2010 to 4.5% in 2020 and 6.6% in 2030.

However, as Da Nang cannot choose the energy source bought from the national electricity grid and there are no hydroelectric nor turbo electric plants in Da Nang, it has implemented plans to install some renewable sources. Under the 'Power Generation Development Plan 2011-2015' the Da Nang People's Committee plans to install a 49.2MW hydroelectric power plant to supply electricity to Da Nang and the national grid system. A 2.8MW stand-alone photovoltaic (PV) is planned to supply electricity to Da Nang's airport. In 2008 600 solar hot water heaters were installed to residential homes in Da Nang creating 32,193,000kJ per heater per year. This was a small trial project.

Da Nang's year average solar irradiation of 4.89kWh/m<sup>2</sup>/day makes it a good site for promoting the use of PV systems. However, renewable energy, such as PV systems and wind power is still at the research and demonstration stage. As such, there is no buyback scheme or feed-in tariff for PV systems and wind power, and the costs of implementing renewable projects remains high.

### 8.2 Recommendations

**Rec. 58. Facilitate the planning consent process for installing renewable energy technologies in Da Nang.**

Da Nang has a tropical monsoon climate with two seasons, including a dry season lasting from April to June and a wet season lasting from July to March. Many typhoons hit Da Nang city during the wet seasons. In order to make installation safe and effective for renewable energy and equipment, relevant renewable energy producers should submit documents including facility plans, designs and electricity to the relevant authority according to the DNPC for a work permit. The DNPC should then assess the documents for approval or revision and construction work should not commence until the permit is granted.

**Rec. 59. Promote solar photovoltaic systems in Da Nang.**

The 2013 European Photovoltaic Industry Association (EPIA) noted that the world's cumulative installed PV capacity surpassed 100GW in 2012 and reached 102GW in May 2013. This capacity is the equivalent of producing as much annual electrical energy as 16 coal power plants or nuclear reactors of 1 GW each. Every year these PV installations save more than 53 million tons of CO<sub>2</sub>. The PV system is now, after hydro

power and wind power, the third most important renewable energy source in terms of globally installed capacity (EPIA, 2013).

Da Nang has an abundance of solar energy resources and so promoting PV systems can help Da Nang become a LCMT. Along with implementing other low carbon measures such as reducing air pollution, improving waste treatment and recycling, energy conservation and renewable energy such as installing PV systems, has the potential to reduce greenhouse gas emissions in energy activities by 20-30% from BAU emissions by 2030.

**Rec. 60. Design 'building-integrated photovoltaics (BIPV) materials and technology into new green buildings.**

Building integrated photovoltaics (BIPV) materials replace conventional building materials in parts of the building envelope such as roof, skylight, or facades. New green buildings increasingly feature BIPV materials and use them as a principal or ancillary source of electrical power. Retrofitting existing buildings is also possible with BIPV materials and technology.

The advantage of using BIPV over more common-non-integrated systems is that the initial cost can be offset by reducing the amount of spent on traditional building materials and additional labour that would be normally used to construct the part of the building that the BIPV modules replace. These advantages make BIPV one of the fastest growing segments of the photovoltaic industry. BIPV modules are available in several forms including flat roof, pitched roofs, facades and glazing.

**Rec. 61. Evaluate the potential capacity to set up a medium to long term target for photovoltaic systems.**

This should be part of the Alternative Energy Development Plan referred to in Section 6 of this Review.

Photovoltaic system installations may be ground-mounted (and sometimes integrated with farming and grazing) or built into the roof or walls of a building (either BVIP or rooftop). In general, urban areas for photovoltaic systems are not excluded when considering rooftop applications, as land availability is constrained due to protected areas, and land occupations such as agricultural and forestry areas, grasslands, or any areas assumed unsuitable due to socio-geographical reasons. Another parameter to consider when installing photovoltaic cells is the spacing between rows of PV systems to avoid overshadowing adjacent systems. After establishing land availability, then assessing technical installed capacity and energy output potential should occur.

The rating for PV systems, for example, applies to system output rating at a resource level of 1000W/m<sup>2</sup>. Thus, for an available area of 5000m<sup>2</sup>; annual solar radiation of 4.89kWh/m<sup>2</sup>/day; a PV system that operates at 12% efficiency; and performance ratio of 0.7<sup>8</sup>, then the technical installed capacity and energy output can be calculated by the formulae expressed as follows:

$$600 \text{ kW} = 5000 \text{ m}^2 \times 1 \text{ kW/m}^2 \times 12\%$$

$$\text{(Technical Installed Capacity)}_{\text{PV}} = \text{Area} \times \text{System rating condition} \times \text{Conversion efficiency}$$

$$\text{(Technical Energy Output Potential)}_{\text{PV}} = \frac{\text{Technical installed capacity} \times \text{Annual solar radiation} \times \text{Performance ratio}}{\text{System rating condition}}$$

$$749,637 \text{ kWh/year} = \frac{600\text{kW} \times (4.89 \text{ kWh/m}^2/\text{days} \times 365 \text{ days/yr}) \times 0.7}{1 \text{ W/m}^2}$$

The technical installed capacity and energy output potential are 600kW and 749,637kWh per year respectively.

There was insufficient information available for the review experts to evaluate the potential capacity at the time of this review.

**Rec. 62. Monitor and survey the performance of existing photovoltaic system by collecting operation data.**

Monitoring data can provide actual performance relative to benchmarks of quality for existing photovoltaic systems under realistic operating conditions and photovoltaic system engineering. Many photovoltaic systems provide little feedback to users as to whether they operate correctly, so failures can go undetected for long periods of time. This can undermine support for further installations. Ideally, monitoring should provide monitoring onsite and to a central point where program managers can track performance of all systems (See Section 6: Area Energy Management System regarding the importance of monitoring energy supply).

**Rec. 63. Survey the total installed prices of photovoltaic system.**

Total installed prices are composed of the sum of the module cost plus the expenses for the balance of system, including mounting structures, inverters, cabling and power management devices. Capital costs usually dominate installed prices of photovoltaic systems and are a key barrier to photovoltaic uptake.

<sup>8</sup> Feasibility Study

The installed prices are still relatively high, although they are decreasing as a result of technology improvements and economies of volume and scale. According to the 2013 US Department of Energy's SunShot Initiative, the installed photovoltaic system prices fell 6-14% from 2011-2012. In the near future analysts expect installed prices of both distributed and utility-scale systems continue to fall. Distributed and utility-scale systems are expected to reach US \$2 per watt to US \$4.75 per watt and US \$1.5 per watt to US \$3.15 per watt by 2014 respectively. As time progresses, photovoltaic technologies generally get cheaper, while fossil fuels generally get more expensive. The less installation costs, the more favourable it compares to conventional power, and the more attractive it becomes to utilities and energy users around the globe.

**Rec. 64. Consider the use of small scale photovoltaic systems in remote rural areas.**

In remote areas such as mountainous areas, islands or other places where a grid system is unavailable, a photovoltaic system can be used as a mature and mainstream source of electricity power supply because of installed prices in recent years have been dramatically reduced. A small scale photovoltaic system is capable of providing enough electricity to power a single home. In addition, small photovoltaic systems also provide a cost-effective power supply in locations where it is expensive or impossible to send electricity through conventional power lines.

**Rec. 65. Develop incentives to encourage the use of grid connected photovoltaic systems.**

The investment costs of PV systems are still relatively high and high investment costs represent the most important barrier to PV deployment today. For promoting the utilisation of PV systems, the government of Viet Nam should develop a policy mechanism designed to accelerate investment in photovoltaic technologies. Financial incentives for photovoltaic systems such as feed-in tariffs (FITs) and renewable portfolio standards (RPS) are incentives offered to electricity consumers to install and operate photovoltaic systems. The government can also offer incentives to encourage the photovoltaic industry to achieve economies of scale needed to compete where the cost of photovoltaic generated electricity is above the cost from the existing grid. Such policies are implemented to promote national or territorial energy independence, high technology job creation and reduction of carbon dioxide emissions which cause global warming.

**Rec. 66. Install solar hot water systems in commercial buildings and factories and expand the number of residential solar hot water heaters beyond the current 600 residential heaters.**

To maximise hot water operation throughout the day, use a supplementary system to enable hot water throughout the day eg a solar hot water and waste heat from industrial process system, or a solar hot water heater and heat pump system.

**Rec. 67. Study the potential for wind energy in Da Nang.**

Studying wind record speeds will enable data for a technical and financial assessment of the potential for wind energy in Da Nang.

The urgency level for the recommendation is illustrated in the below table by short, medium and long term urgency.

	<b>SHORT TERM</b>	<b>MID-TERM</b>	<b>LONG TERM</b>
<b>URGENCY LEVEL</b>	Recs:62, 63 & 65.	Recs: 58, 59, 61 & 66.	Recs: 60, 64 & 67.

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## 9. WASTE MANAGEMENT

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### 9.1 Findings

Viet Nam's National Green Growth Strategy 2011 – 2020, vision 2050 was approved on 25 September 2012 by the Prime Minister (decision no 1393/QD-TTG). It aims to:

'Achieve a low carbon economy and to enrich natural capital, [green growth] will become the national principal direction in sustainable economic development; reduction of greenhouse gases and increased capability to absorb greenhouse gas are gradually becoming essential indicators in social-economic develop.'

Its scope includes low carbon growth, greening of production and greening of lifestyles and involves 17 policy solutions and 10 priority actions. The strategy is led by the Prime Minister and the National Committee on Climate, which he heads (Nguyen & Ngo, July 2013).

In response to the National Green Growth Strategy, Da Nang has developed an Environmental City Plan that aims to:

- Prevent environmental pollution in residential, nature conservation and key tourists.
- Improve air, water and soil quality, especially air pollution from transport, treatment for wastewater and hazardous waste.
- Improve the management capacity of environmental protection; and raising public awareness on environmental pollution.
- Raise environmental protection public awareness.

From 2008-2010 the plan sought to resolve urgent environmental problems. From 2011-2015 it aims to achieve an environmental index as reasonable levels by 2015, which include in relation with waste management:

- Processing 90% of waste water from industrial zones.
- Collecting and processing waste water from 90% of households in the inner city.
- Controlling hazardous waste sources.
- Collecting and processing 90% of solid waste.
- Recycling 50% of recyclable waste.
- Provide 90% of urban residents and 70% of rural residents with access to clean water.
- Reduce air pollution levels to less than 100 Air Pollution Index (API).

From 2015-2020 Da Nang aims to reach targets to declare Da Nang as 'an environmental city' and this will include:

- Processing 100% of wastewater from industrial zones.
- Recycling 70% of solid waste.
- Reusing 25% of waste water.

In 2013 Da Nang collected 609 tonnes of solid waste each day, which went to its 40 hectare landfill. The city also plans to expand the landfill due to the city's urban development and increased population. 70% of the domestic waste in Da Nang consists of recyclable materials and 12% of that is plastics bags. However there are presently no recycling facilities in Da Nang. Da Nang is in the process of implementing recycling to reduce the amount of buried waste.

Da Nang City also plans to implement a septic waste collection and treatment to reduce buried waste. Future plans also include treating existing landfill for use as a biofuel.

There are currently no waste treatment facilities within the Ngu Hanh Son District.

Within Da Nang's six industrial zones waste is treated within the zones and waste water is treated at the industrial waste water treatment factory, which requires prior agreement between the private industry and the waste management company. Where waste industrial water is toxic, it must be treated under a specially certified process.

Da Nang is particularly susceptible to flooding from natural disasters, necessitating the city to review its flood plan and potential flood levels in consultation with the Department of Construction annually. The city has a hydraulic model of the river system in Da Nang to assist with developing a flood map, which assists with developmental approvals questioned due to potential flood risk.

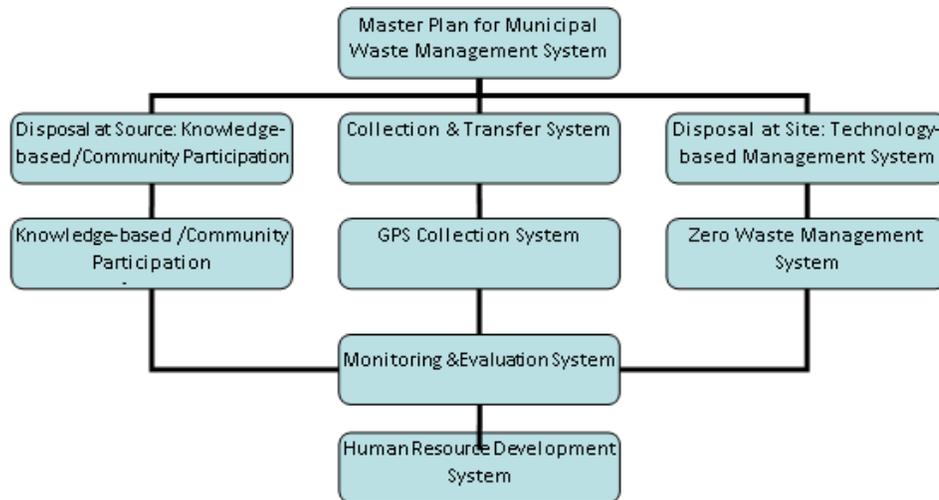
The World Bank's Danang Sustainable Development Project (SCDP) will allocate US \$92 million in credit to help Da Nang further implement a wastewater management strategy. These funds will assist Da Nang to meet its above mentioned 2030 targets. According to the World Bank the project will 'focus on improving operations and maintenance of existing preliminary treatment plants in Hoacuong, Ngh Hanh Son, and Phuloc until they reach capacity and their effluent is fully transferred to secondary treatment plants in Hoaxuan and Lienchieu (World Bank, 2011).

## 9.2 Recommendations

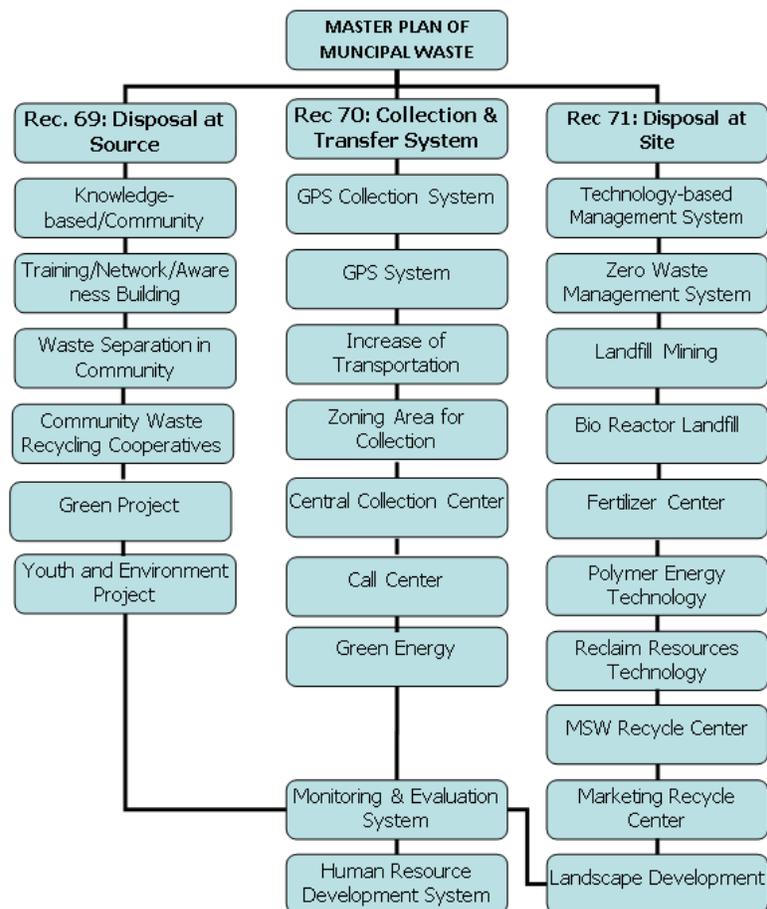
### **Rec. 68. Establish a master plan for solid waste management to avoid further expansion of landfill and reduce GHG emission (see also recommendation 56).**

The rationale behind stopping landfill includes:

1. Improving air pollution from land fill emissions such as CO, CO<sub>2</sub>, SO<sub>2</sub>, NO<sub>x</sub> and other GHGs that are major contribution of global warming and environmental problems For example, 1 tonne of municipal solid waste releases around 6 m<sup>3</sup> per year of GHGs. One of the most common is methane, which has a global warming potential of 21 times that of CO<sub>2</sub>, which means 1 Mt (mega ton of methane equals 21 Mt CO<sub>2</sub> equivalent
2. Stopping contamination to soil, ground and underground water.
3. Reducing the health risk from pollutants such as trichloroethylene and trihalomethanes, which are water and air contaminates from waste. They are environmental pollutants with carcinogenic and internal organ damaging properties.
4. Decreasing the spread of disease from carriers such as rats, birds, cockroaches that reside in landfill.
5. Preventing further expansion to landfill sites.



**Figure 10: Summary Proposed Plan for Municipal Waste Management System**



**Figure 11: Detailed Proposed Master Plan for Municipal Waste Management System**

**Rec. 69. Dispose of waste at the source by developing a knowledge based community driven waste management system.**

Figure 11 demonstrates a system for disposing of waste at the source through knowledge based community participation. The system includes an education campaign to separate household waste and promote the community's participation in waste banks. For example, school waste banks can reduce waste disposed at the landfill, while educating students and people about the importance of recycling and recovering resources. It can also provide a small income to the youths and reduce family expenses. A school waste bank can be set up by setting up a committee of teachers and students who share responsibilities among members. The committee then surveys the price of recovered materials, determining a buying rate and cooperation with a recyclable material buyer. The committee disseminates and publicises their recycling activities within the community and announces the recyclable price to members. The committee prepares a store house, implements the School Waste Bank and evaluates the success of the project.



**Figure 12: Example of a School Waste Bank in Thailand.**

**Rec. 70. Improve the waste collection system using GPS to achieve 100% waste collection.**

Implementing a GPS waste collection system can help make waste collection more efficient as vehicles and routes are tracked eliminating unauthorised use, wasted time and loss of money.

Appropriately zoned collection areas and a central collection point also allows for more efficient waste collection enabling more waste vehicles to go on rounds.

Additional measures could include implementing a call centre or hot line for waste pick up and using green fuels in the vehicles.

**Rec. 71. Dispose of waste at the waste depot through technology-based management systems.**

Requiring zero waste management policies that integrate technology can greatly reduce the quantity of refuse and harmful emissions. Methods can include:

- Producing biogas from organic waste.
- Producing crude oil from olefin based plastic packaging.
- Producing organic fertiliser from landfill compost.

- Recycling glass and non-olefin material.
- Producing refuse derived fuel for power production.
- Recycling construction material.
- Mining old landfill.
- Collection landfill gas for power production from new landfill.



Figure 13: (From left to right) Waste incinerator, Dry fermentation process and Polymer energy.

**Rec. 72. Introduce grease traps and energy management in households.**



Figure 14: Grease Tap.

**Rec. 73. Promote grey water recycling in households for secondary purposes such as washing buildings, watering plants, cleaning vehicles.**

**Rec. 74. Develop complete treatment facilities for hazardous and non-hazardous industrial waste within each industrial zone.**

Monitor shared industrial waste facilities and implement waste minimisation policies and cleaner technology policies.

**Rec. 75. Promote urban forestry and biodiversity to operate as a buffer zone between industrial and tourism/residential zones.**

This could include: promoting Da Nang as a City of Trees by motivating people to plant trees around the town. Green urban zones have the added benefit of absorbing water runoff, and decreasing the urban heat island effect. Encouraging street gardens and organic vegetable planting can also be an effective strategy.

The urgency level for the recommendation is illustrated in the below table by short, medium and long term urgency.

	<b>SHORT TERM</b>	<b>MID-TERM</b>	<b>LONG TERM</b>
<b>URGENCY LEVEL</b>	Recs: 68, 69 & 75.	Recs: 71, 72, 73 &74.	Recs: 70.

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