

Towards Putrajaya Green City 2025



TOWARDS PUTRAJAYA GREEN CITY 2025

Jointly prepared by Low Carbon Society Scenarios for Asian Regions Research Team (SATREPS Program) and Putrajaya Corporation

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Published by:
Putrajaya Corporation

First Edition
October 2013



In 2009, the Prime Minister in tabling the 2010 Malaysian Budget, has made an announcement to “develop Putrajaya and Cyberjaya as Pioneer Township in Green Technology as a showcase for the development of other townships”.

Rising up to the aspiration of the Government, Perbadanan Putrajaya (Putrajaya Corporation) as the local authority for the city of Putrajaya, since then has been gearing up its efforts towards realising this vision.

We strongly believe that the planning and development concept based on sustainable development principle, incorporated in the Putrajaya Master Plan has provided a concrete path for Putrajaya to move forward. This is further reinforced in the Putrajaya Structure Plan 2025 which outlined Putrajaya's vision, direction and policies to support the transformation of Putrajaya from a City in a Garden into a Green City.

Putrajaya Green City 2025 (PGC2025): Baseline and Preliminary Study is a collaborative study by a research team from Universiti Teknologi Malaysia, Malaysia Green Technology Corporation, Putrajaya Corporation, Kyoto University, Okayama University, as well as National Institute for Environmental Studies, Japan and the Asia Pacific Integrated Model team. The study is one of the initial commitments by Putrajaya Corporation towards achieving the Malaysian government's vision for the city to become Malaysia's pioneer green city as well as being in line with the government's target to reduce carbon emissions for Malaysia as a whole.

Towards Putrajaya Green City 2025, is an updated publication comprising analysis results from PGC2025, a summary of the initiatives that has been implemented under 7 focus areas as well as an updated 2012 interim carbon emissions inventory for the city. It is an important document to Putrajaya Corporation in reviewing its existing green city initiatives and formulating new plan to ensure the achievement of the three environmental targets set for the year 2025.

Let me extend my sincere gratitude for the generosity of the research team in assisting Putrajaya Corporation in this effort and hope for their strong and continuous support for the city in realising its green vision by 2025.

A handwritten signature in black ink, reading 'Aseh' in a stylized, cursive script.

TAN SRI DATO' SERI (DR.) ASEH BIN HAJI CHE MAT
President
Putrajaya Corporation

CONTENTS	Page
INTRODUCTION	1
GREEN CITY INITIATIVES	5
Focus Area 1: Planning, Urban Design & Building	5
Focus Area 2: Integrated Nature Into The Urban Fabric	8
Focus Area 3: Transportation & Mobility	10
Focus Area 4: Energy Usage	11
Focus Area 5: Water Usage	12
Focus Area 6: Solid Waste Management	15
Focus Area 7: City Administration & Management	19
INVENTORY OF PUTRAJAYA	
GREENHOUSE GAS EMISSIONS 2012	21
Inventory Result	21
Carbon Emissions from Building Sector	23
Carbon Emissions from Transportation Sector	23
Carbon Emissions from Waste Sector	24
Conclusion	24

LIST OF FIGURES:**Page**

Figure 1 : Three Environmental Targets	2
Figure 2 : Integrated Modelling for PGC 2025	3
Figure 3 : Contribution of Each Action to GHG Emissions Reduction	4
Figure 4 : Seven Focus Areas	7
Figure 5 : Putrajaya Structure Plan 2025	8
Figure 6 : Green and Water Body	9
Figure 7 : Bird and Fish Species in Putrajaya	10
Figure 8 : Annual Number of ERL Transit Passenger	12
Figure 9 : Cross Section Gross Pollution Trap	13
Figure 10: Putrajaya Wetland	19
Figure 11: Putrajaya Corporation Online Services	21
Figure 12: GHG Emissions Comparison	21
Figure 13: GHG Emissions by Three Scopes	22
Figure 14: GHG Emissions by Source	22
Figure 15: GHG Emissions per Capita	23
Figure 16: CO ₂ Emissions from Building Sector	23
Figure 17: Building Sector CO ₂ Emissions by Source	23
Figure 18: In/ Out Persons Comparison	23
Figure 19: Transportation Sector CO ₂ Emissions by Source	24
Figure 20: GHG Emissions Comparison for Waste Sector	

LIST OF TABLES

	Page
Table 1 : Current Status of Development for Major Components	1
Table 2 : Land Use Components	1
Table 3 : CO ₂ Emissions Reduction Amount	4
Table 4 : List of Certified Green Buildings in Putrajaya	6
Table 5 : Ratio of Open Space per 1,000 Population (hectares)	8
Table 6 : Comparison of Water Quality Index	13
Table 7 : Benefits of Using Lake Water as an Alternative Water Source	14
Table 8 : Comparison in Requirements Between Manual & e-submission for Planning Permission Application	19
Table 9 : Comparison of GHG Emissions by Seven Sectors (ktCO ₂ eq)	22
Table 10 : Energy Demand (ktoe)	22

Introduction

Implementation of the Putrajaya Green City initiatives

During the tabling of the 2010 Malaysian Budget, the Prime Minister has announced to “develop Putrajaya and Cyberjaya as Pioneer Township in Green Technology as a showcase for the development of other townships” and Perbadanan Putrajaya (Putrajaya Corporation) as the local authority for the city of Putrajaya, since then has been gearing up its efforts towards realising this vision.

The planning and development concept based on sustainable development principle, incorporated in the Putrajaya Master Plan has provided a concrete path for Putrajaya to move forward.

Background of Putrajaya: The Federal Government Administrative Centre of Malaysia

The creation of a new Federal Government Administrative Centre at Putrajaya marks a new chapter in the development history of modern Malaysia. From the outset of its development, Putrajaya is planned to be a city that is environmentally, socially and economically sustainable.

The Putrajaya Master plan prepared in 1994 clearly depicts this principle. Almost 40% of the total area of 4,391 hectares is designated as green and open space, comprising of a 400 hectares of manmade lake and 200 hectares of wetlands area as well as 12 metropolitan parks

The city is planned with public transportation system to be the main travel mode within the city and a future rail based transportation system as the backbone supported by park and ride facilities, public buses and extensive networks of cycle ways and walkways.

Table 1: Current Status of Development for Major Components

Component	Planned (2025)	Current status
Population	347,700	79,400 (23%)
Housing	63,414 units	26,964 units (43%)
Government office space	2,747,794 sqm	2,367,930 sqm (86%)
Other government use	1,200,000 sqm	214,604 sqm (18%)
Commercial space	4,254,517 sqm	546,145 sqm (13%)

Source : City Planning Department PJC, 2013

Table 2: Land Use Components

Land Use	Hectares	%
Government Use	225.38	4.57
Residential	733.64	14.88
Commercial	139.41	2.83
Mixed Use	40.82	0.83
Special Use	132.92	2.70
Service Industry	11.23	0.23
Public Amenities	344.27	6.98
Parks & Open Space	1,918.66	38.91
Infrastructure & Utilities	482.57	9.79
Transportation	902.10	18.29
Total	4,931.00	100.00

Source : Putrajaya Structure Plan 2025

Putrajaya Structure Plan: Sustainable Putrajaya 2025

The Putrajaya Structure Plan prepared under the provision of the Town and Country Planning Act 1976 (Act 172) is a strategic land use planning and development plan towards 2025. The plan provides the legal setting in the process of transforming Putrajaya into a sustainable city by 2025 and in the implementation of the green city initiatives in Putrajaya.

Putrajaya Green City 2025 (PGC2025): Baseline and preliminary study

PGC2025 is a collaborative study since year 2010 by a research team namely Universiti Teknologi Malaysia, Malaysia Green Technology Corporation, Putrajaya Corporation, Kyoto University, Okayama University, as well as National Institute for Environmental Studies, Japan and the Asia Pacific Integrated Model team.

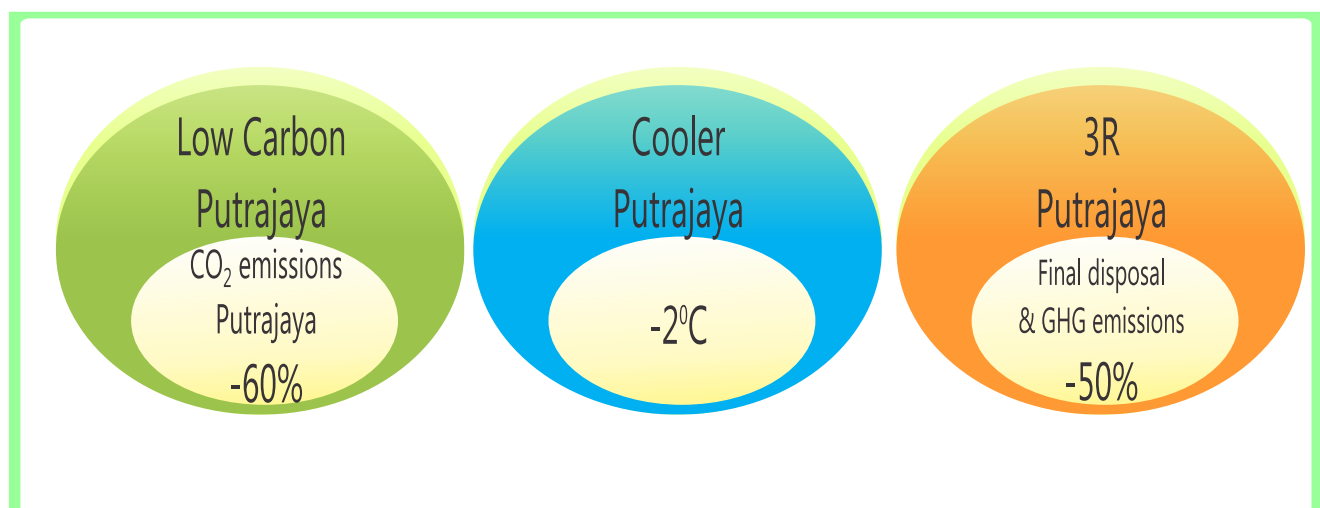
The study is one of the initial commitment by Putrajaya Corporation towards achieving the Malaysian government's vision for Putrajaya to become Malaysia's pioneer green city as well as being in line with the government's target to reduce carbon emissions for Malaysia as a whole.

PGC2025 is a study to assess the current state of the city in terms of its CO₂ emissions and to offer suggestions in terms of broad targets or counter measures to reduce emissions by 2025

The study has calculated CO₂ emissions baseline for Putrajaya for base year 2007 and the emissions level for the 'business as usual case' (BaU) for 2025. In order to reduce the emissions level by 2025, the quantitative environmental targets are outlined in three themes:

1. **Low Carbon Putrajaya:** 60% reduction in GHG emissions intensity related to energy use compared to year 2025 BaU level,
2. **Cooler Putrajaya:** reduction of peak temperature by 2°C and
3. **3R Putrajaya:** 50% reduction in final disposal of solid waste to landfill & GHG emissions compared to year 2025 BaU level.

Figure 1 :Three Environmental Targets



Integrated Modeling for PGC2025

In order to identify necessary actions, “integrated modeling” based on “back casting” approach is applied. Back casting approach describes the vision of future society as a goal, and then seeks to pathway towards the goal.

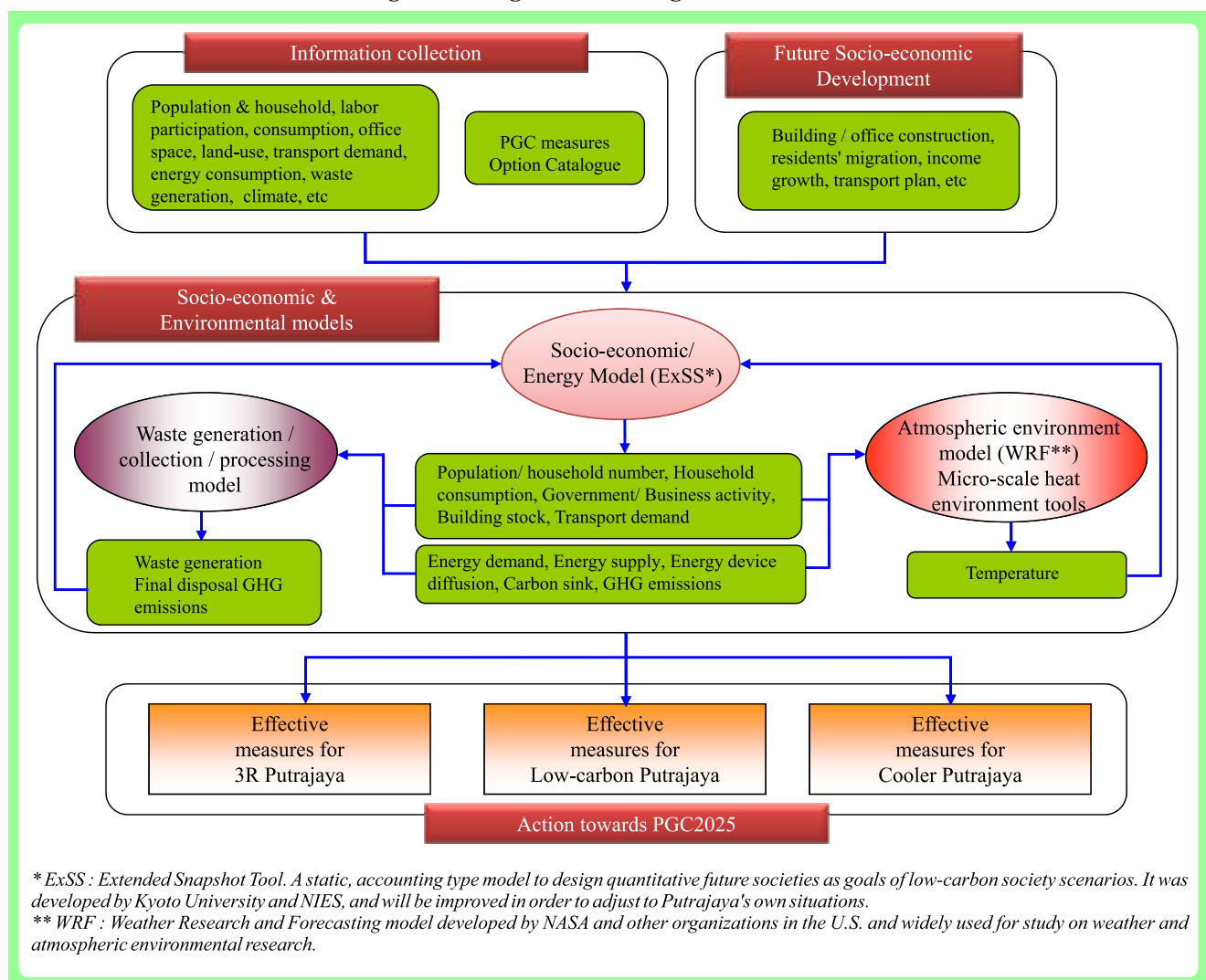
The models estimate balanced and quantitative future activity levels, environmental emissions, and measures to be implemented to achieve the targets.

Information collection is the first step in the modeling work. Socio-economic information as well as environmental information in the base year (2007) are collected and analysed, and current emissions are identified.

Besides such information, feasible options for PGC2025 are collected and a catalogue is developed based on the latest technology & policy information

For future projection, based on planned development, the models estimate socio-economic activity level including household number, consumption, land area and building stock, transport demand and other variables. Based on them, environmental loads are calculated with or without counter measures (“Options”) and necessary and effective measures are identified through iterative calculation and discussion.

Figure 2 :Integrated Modeling for PGC2025



To achieve the 3 environmental targets set, PGC2025 study has recommended 12 broad actions for implementation in Putrajaya and their respective GHG emissions reduction are estimated. The 12 actions are shown in Table 3.

Figure 3 : Contribution of Each Action to GHG Emissions Reduction

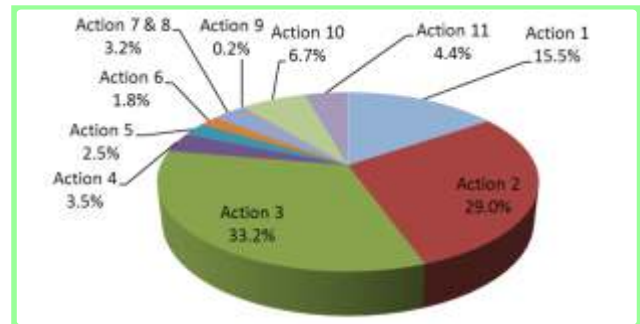


Table 3 : CO₂ Emissions Reduction Amount

Action No.	Name of actions	GHG emissions reduction [ktCO ₂ eq]	Contribution in total reduction [%]
1	Integrated City Planning & Management	312	15.5%
2	Low-carbon Transportation	582	29.0%
3	Cutting-Edge Sustainable Buildings	666	33.2%
4	Low-carbon Lifestyle	71	3.5%
5	More and More Renewable Energy	50	2.5%
6	The Green Lung of Putrajaya	35	1.8%
7	Cooler Urban Structures and Buildings	64	3.2%
8	Community and Individual Action to Reduce Urban Temperature		
9	Use Less Consume Less	3	0.2%
10	Think Before You Throw	134	6.7%
11	Integrated Waste Treatment	88	4.4%
12*	Green Incentives and Capacity Building	-	-
Total of PGC2025 Actions		2,006	100%
Others**		400	-
Total		2,405	-

*Action 12 does not have its direct emissions reduction.

**It includes contribution from freight transport (2.8 %) and central power generation (13.8 %).

Focus Areas in the Implementation of Putrajaya Green City Initiatives

As of now, the 12 actions have been implemented through various initiatives according to 7 focus areas as below:

- i. Planning, urban design and building;
- ii. Integrating nature into the urban fabric;
- iii. Transportation and mobility;
- iv. Energy usage;
- v. Water usage;
- vi. Waste management;
- vii. City administration and management.

Figure 4 : Seven Focus Areas



Green City Initiatives



Planning Principles That Contributes Towards Reduction of Carbon Emissions:

At the residential precincts, self contained integrated neighbourhood centres are planned and these centres are connected by pedestrian walkways & cycleways as a way to reduce the need for residents to use motorised transportation in their day to day activities. As such, this is expected to contribute towards reduction of carbon emissions arising from the use of motorised transportation.



Neighbourhood centre/complex in each residential precinct providing commercial, public amenities, religious and education services to the local community

Innovative Reuse of Local Resources for Construction

From the beginning of the city's development, master developer of Putrajaya has started the initiatives to reuse local resources for construction. Crushed rocks blasted from rockhills are reused in the construction of the rock-filled dam and smaller aggregates were used to pave roads. Indirectly, this has reduced the cost of construction.

During the initial site clearance stage, felled oil palm and rubber trees were collected for biomass composting. Mulching materials were produced for use in landscaping at the wetlands.



Putrajaya rock-filled Dam



Reuse of local resources for construction materials



Green Building Design and Certification

From the aspect of urban design and building design, the construction of green buildings has been emphasised in an effort to reduce carbon emissions arising from the activities and operation in buildings. As of now, 6 green buildings has been certified including the Prime Minister's Office

complex which is certified under a retrofitting programme. 6 other buildings under construction and planning are expected to be certified green buildings upon completion. Putrajaya Corporation is also taking actions to retrofit buildings under its jurisdiction.

Table 4 : List of Certified Green Buildings in Putrajaya

Building	Green Building Certification
Energy Commission	GBI rating PLATINUM (Non-Residential New Construction (NRNC)) BCAGreen Mark Award PLATINUM(New Buildings)
Ministry of Energy, Green Technology and Water (KeTTHA)	GBI rating SILVER (Non-Residential New Construction (NRNC))
Office Tower On Plot Z10, Precinct 1	GBI provisional rating CERTIFIED (Non-Residential New Construction (NRNC))
3 Star Hotel On Plot Z10, Precinct 1	GBI provisional rating CERTIFIED (Non-Residential New Construction (NRNC))
Office Complex Putrajaya Holdings Sdn Bhd (Master Developer of Putrajaya)	GBI rating GOLD (Non-Residential New Construction (NRNC))
Prime Minister's office Complex	GBI rating PLATINUM (Non-Residential Existing Building) (NREB)

Source : City Planning Department PJC



Energy Commission Building



KeTTHA Office Complex



Prime Minister's Office Complex



Putrajaya Holdings Sdn Bhd Office Complex

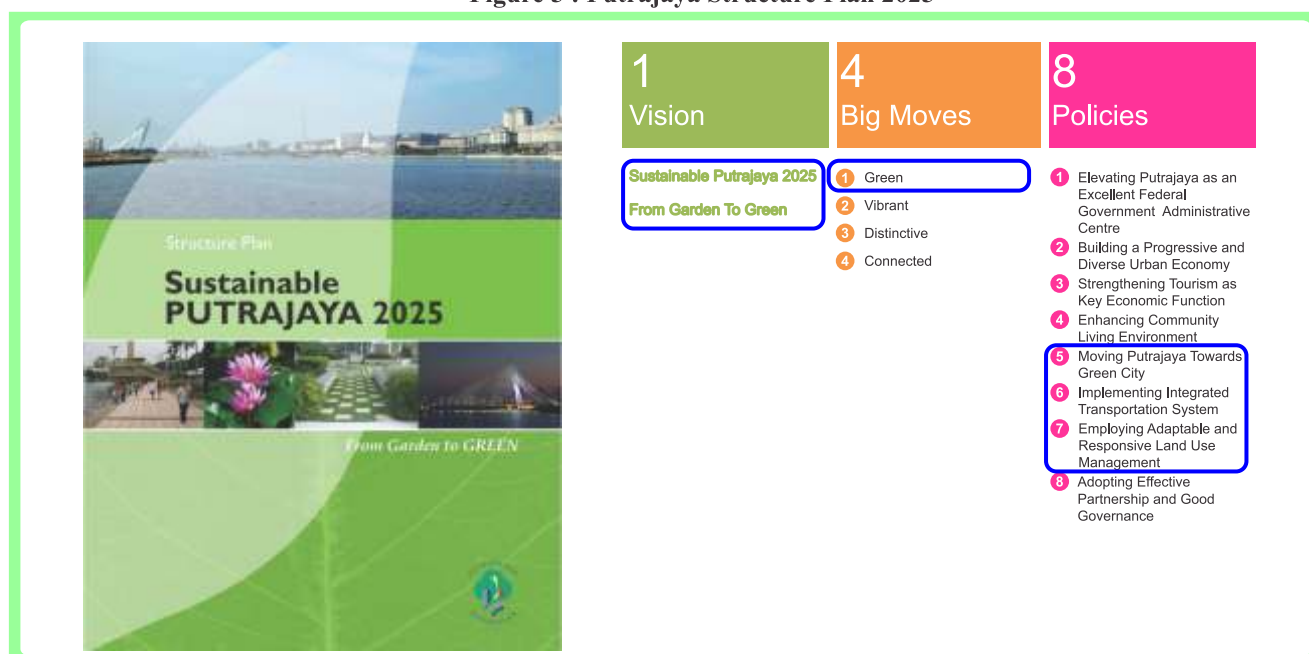


Regulatory Framework

To ensure the green city initiatives are implemented in the long term, the Putrajaya Structure Plan 2025 as the main statutory development blueprint has clearly specified the Vision, directions and policies to guide the development of Putrajaya from a city in a garden into a green city. In line with this vision, new conditions and submission requirements have been imposed during the process of development plans approval.

In Putrajaya, the use of chilled water from centralised district cooling plants for air conditioning of government office and commercial complexes has been made compulsory. In general, these has advantages in terms of controlling the sources of carbon emissions as well as being more environmental friendly.

Figure 5 : Putrajaya Structure Plan 2025



Gas District Cooling Plant



Land Use Planning for Open Spaces

Approximately 40% of the total land area of Putrajaya is designated as open spaces (including green areas and water bodies). Green spaces are expected to perform the function of green lung as well as carbon sink for the city. By allocating a large proportion for green spaces within the city area, it has helped to reintroduce nature into the urban area as well as increase biodiversity and ecological sustainability of the city.

Table 5: Ratio of Open Space (hectares) to 1000 population

	2009	2010	2011	2025
National Urbanisation Policy ⁽¹⁾	2 hectares			
Putrajaya	28.7 ⁽²⁾	28.5 ⁽³⁾	25.4 ⁽⁴⁾	5.5 ⁽⁵⁾

Source :

(1): National Urbanisation Policy, NUP9, Measures (ii)

(2),(3),(4): Putrajaya MURNInet Reports

(5): Estimation

Figure 6 : Green Areas and Water Bodies



Source : Putrajaya Structure Plan 2025

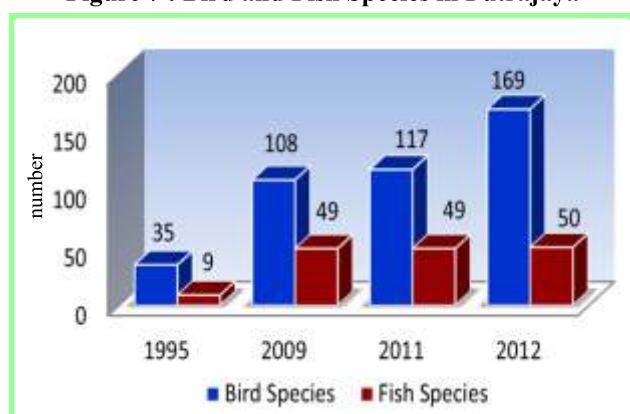




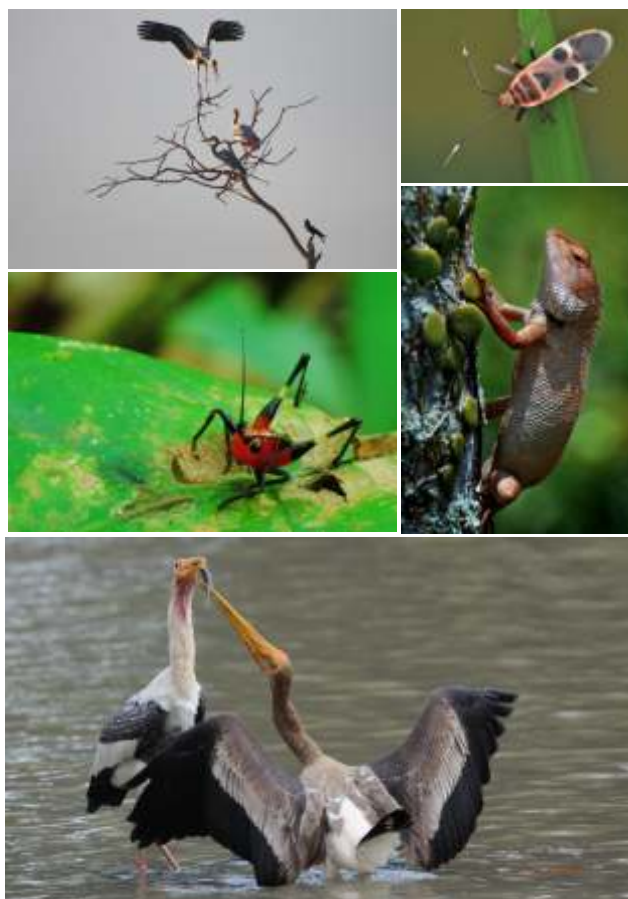
Creation of Lakes and Wetland

The creation of 400 hectares man made lake and 200 hectares constructed wetland has managed to improve the biodiversity and ecological quality of this city. The wetland has been functioning effectively as a natural filtration system for the upstream water as it flows into the Putrajaya lake system.

Figure 7 : Bird and Fish Species in Putrajaya



Source : Lake & Wetland Unit, PJC



Greening of Putrajaya Through Tree Planting Programme

Tree planting programme involving shade tree has also been intensified. It is generally acknowledged that trees planted in an urban area has influence over city temperature as well as provide shades for pedestrians and cyclists. To date, more than 670,000 trees have been planted in Putrajaya. Tree planting programme will be continued further, through the collaboration with other government agencies and private companies.



Tree planting programme sponsored by private sector.



Tree planting programme by schools.



Integrated Transportation Network

The transportation system planned for Putrajaya is based on the policy of modal split of 70:30 between public and private transportation with a rail based transportation system proposed to form the backbone supported by park and ride facilities.



Putrajaya Sentral - Integrated transportation terminal.



The increase in the number of Express Rail Link (ERL) transit passengers is expected to support the achievement of the low carbon transportation initiative.

Provision of Environmental Friendly Public Buses

In the absence of the proposed rail based transportation system at the present time, Putrajaya Corporation has taken a proactive solution to provide an alternative intra city public bus service. Currently there are 175 Nadi Putra buses running on natural gas in operation in Putrajaya.



Multi storey Park & ride facility at Putrajaya Sentral providing ample car parking spaces at affordable charge.



Comfortable intra city buses provided by Putrajaya Corporation.

Figure 8 : Annual Number of ERL Transit Passengers



Source : Express Rail Link Sdn. Bhd.



Retrofitting Programme for Buildings & Infrastructures to Improve Energy Efficiency

Putrajaya Corporation has also taken the initiatives to use green technologies in public facilities projects in Putrajaya. Energy efficient lighting fixtures such as LED and T6 Fluorescent has been used at the Putrajaya Corporation's office complex, installed in the newly constructed small businesses kiosks as well as for lighting of bridges.



T6 fluorescent light fixtures are widely used in the basement parking area



Newly constructed small businesses kiosks installed with energy efficient lighting fixtures



Meeting room installed with LED lights



Lighting fixtures of bridges in Putrajaya replaced with LED lights

Encouraging The Use of Solar Photovoltaic for Power Generation

The use of renewable energy generated from solar photovoltaic system is highly recommended in Putrajaya. Initiatives to install building integrated photovoltaic (BIPV) system have been taken during the construction of an office complex and residential units in Precinct 16. In addition, Putrajaya Corporation has also installed solar panels to generate energy for lighting of a bus stop and an emergency staircase in the office complex.



Office complex and houses using BIPV system



Solar panels installed at a bus stop and the rooftop of PJC office complex to generate the electricity for lighting purposes.



Lake Water Quality Control

The two main objectives of lake water quality control in Putrajaya is to ensure that the lake water is maintained at a minimum class of 2B (suitable for body contact) and that the discharge from the dam into the natural downstream is maintained at class II. This is important as the lake is extensively used as venues for water sports and recreation as well as ensuring the water quality at the downstream intake points is suitable to be extracted and treated for potable water usage.

In general, point source pollution control is carried out via the use of gross pollutant traps (GPT) and the control of effluent from centralised sewerage treatment plant (STP).

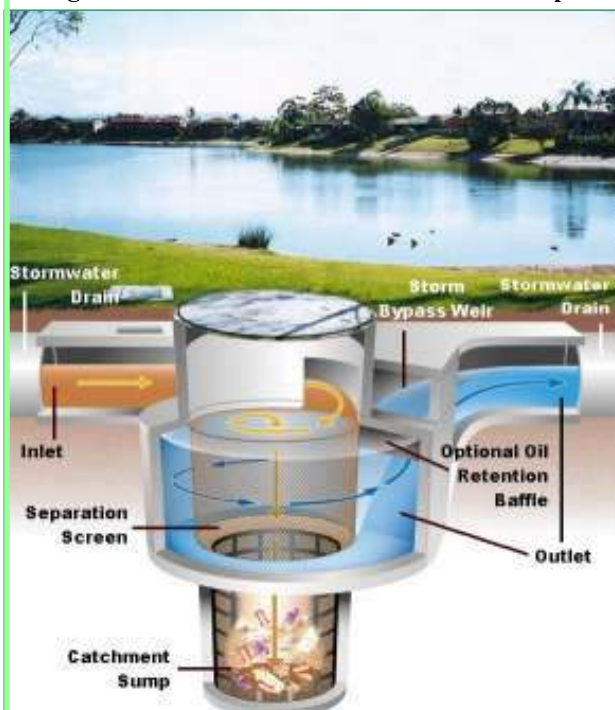


2 centralised sewerage treatment plants (STPs) are in operation in Putrajaya.



Effluents from STPs are in compliance with standard A as required in the Second Schedule, Environmental Quality (Sewage) Regulations 2009, Environmental Quality Act 1974.

Figure 9 : Cross Section Gross Pollutant Trap



4 types of GPTs use in Putrajaya:

- Conventional
- Ecosol
- Cleansall
- Continuous deflective separation (CDS)



GPTs are constructed to trap pollutants before entering the drainage system and are maintained regularly.



The 200 hectares of constructed wetland act as a natural filtration system to the existing upstream water before entering the Putrajaya lake system. The design of the Putrajaya wetland is based on 'multi-cell' and 'multi-stage' concept consisting of six arms with 24 wetland cells separated by weirs.



Wetland Cells

Figure 10 : Putrajaya Wetland



Wetland Cells separated by weirs

Table 6 : Comparison of Water Quality Index

Location	2009	2010	2011	2012
Chuaui River Inlet	81.2	82.9	83.8	83.3
Putrajaya Lake	93.4	93.9	93.5	91.5
Putrajaya Dam	83.5	83.4	85.0	83.0

Source : Environmental, Lake & Wetland Division, PJC



Alternative Water Sources

In Putrajaya, a city wide rain water harvesting programme has already been implemented through the operation of the 400 hectares man-made lake that functions as an effective large scale water retention system.

The lake water is reused for landscape irrigation, water sports and recreation, street and general cleansing at construction sites. Treated waste water from sewerage treatment plant is also reused for irrigation purposes.



Reuse of lake water for various purposes to reduce treated water consumption.

Table 7 : Benefits of Using Lake Water As an Alternative Water Source

Item	2009	2010	2011
Amount of lake water extracted (liter)	32,886,000	32,484,000	51,664,000
Yearly Permit charge for lake water extraction (RM)	RM500	RM500	RM500
Savings compared to the use of treated water (RM) ⁽¹⁾	RM52,946.46	RM52,885.28	RM83,179.04
Yearly water consumption of ⁽²⁾	444 persons	438 persons	696 persons

Source :

(1) Base on charge rate of RM1.61/m³.

(2) Estimation based on average daily domestic water consumption for Malaysia (203liter/capita) .





Provision of Various 3R Facilities

Putrajaya has not allocated for a solid waste treatment facility within the city boundary and disposes its solid waste in a landfill outside the city.

Since 2003, 3R programmes have been implemented with considerable success. At present, Putrajaya Corporation is actively seeking to reduce waste disposal through the provision of various recycling facilities.

i. Permanent Recycling Centre (buy back centre - BBC)

To date, there are four permanent recycling centres provided within the residential precincts of 8, 9, 11 and 16.



Permanent recycling centre at Precinct 9



Used clothes were donated by residents for charity sales.



Educational programme conducted at a recycling centre to create public awareness and promote 3R activities in Putrajaya

ii. Mobile Recycling Centre (MRC)

At the present time, MRC operates in the residential areas of Precincts 11 and 16 on a fixed schedule.



MRC at Precinct 11



iii. Kerbside Programme (house to house collection)

Through this programme, each house is supplied with two types of plastic bags to separate recyclable items:

- Blue plastic for paper waste
- White plastic for steel, plastics and glass waste



Weekly collection is scheduled by precincts

iv. Recycling Facilities at Apartments

Apartments are provided with two steel containers as recycling facilities. Residents are required to separate recyclable items into 2 categories:

- Paper waste
- Steel, plastics and glass waste



v. Wastewise Programme

Recycling programmes are also implemented at office complexes where recycling bins or boxes are provided. Recyclable items will be sold to the appointed waste collector on a specific collection schedule for each month.



Large recycling boxes distributed by each office floor.



Smaller recycling boxes for individual staffs



Recycle items from office complexes are sold to waste collector.



Food & Green Waste Composting

i. Food Waste Composting

Food waste composting programme using composting machine has started in March 2010 at the neighbourhood complex of Precinct 16. Food waste is collected daily from a market in Precinct 8 and a food court in Precinct 16. Each food court outlet is supplied with a bin to collect food waste.



Unwanted material is manually removed from food wastes before loaded into a composting machine where enzyme solution is added to speed up the composting process



Food wastes are turned into compost within 48 hours



Final compost product is ready for use after being stabilised for approximately 6 weeks.

ii. Garden Waste Composting

Being a city with ample landscaped areas and greeneries, Putrajaya generates a lot of garden wastes in the form of tree cuttings, dried leaves and branches. Garden wastes are then collected for composting at a designated facility located at the Wetland Park.



Composting facility at the Wetland Park



Tree branches are being shredded into smaller pieces before composting process



Solution of effective microorganism (EM) is added to garden wastes



Innovative Reuse of Waste by Local Communities And Schools

Waste reduction is also innovatively carried out in Putrajaya through programmes to reuse waste materials.

Putrajaya Local Agenda 21 Programme in collaboration with local communities, schools and private sectors have successfully produced new household products from used banner materials and used cooking oil collected in the neighbourhood areas.



Used banners are collected and reproduced into new products such as bags and folders



Used cooking oil collection programme by school children.



Hand made soaps from used cooking oil



Encouraging Green Lifestyle Through Leadership

The President of Putrajaya Corporation has initiated various programmes to encourage cycling & walking activities in Putrajaya.



Extensive Use of Online Services to Reduce The Use of Paper and The Need to Travel

Putrajaya Corporation is actively promoting extensive use of online services to its citizens and clients in the aim to reduce the use of paper as well as the need to travel to obtain its services. Among the online services provided are a variety of “e-payment” services, online booking to use public facilities as well as online application for development related approvals.

Figure 11 : Putrajaya Corporation Online Services



Various online services to reduce the trip generation to obtain services.



Less papers are used in meetings.

Table 8: Comparison in requirements between manual & e-submission for Planning Permission application

Document type	Number of hard copy required	
	Manual	e-submission
Reports	5 copies	2 copies
Plans (A1 size)	10 copies (estimate 400)	2 copies (estimate 80)



Environment Education & Public Awareness Programmes

Changes to lifestyles of all residents and communities are necessary to ensure green living is practiced as a way of life. This has to be carried out continuously through public awareness and education programmes as well as green technology demonstration programmes.



Workshops for community garden and Environmental Camp conducted by Putrajaya Corporation for school children and communities

Awards & Recognitions for Green City Initiative Efforts

Putrajaya has been acknowledged for its efforts by various awards and recognitions:

- i. Sustainable City Status in the Malaysian Urban Indicator Programme (MURNInet) 2010
- ii. ASEAN Environmentally Sustainable City Award 2011.

- iii. Putrajaya Lake & Wetlands as Ecohydrological Operational Site by UNESCO-IHP 2011
- iv. Excellence Award for Taman Wetland Putrajaya in the Green City Category by Institute of Landscape Architects Malaysia 2011.
- v. The International Awards for Liveable Communities 2012:
2nd place winner for the “Whole City Award”, 2nd place winner for the “Ecohydrology Management of Lake and Wetland in Putrajaya Urban Ecosystem”, 3rd place winners for “Community Gardens of Putrajaya” and “Healthy Parks, Healthy People” projects
- vi. Participation in the 18th Conference of the Parties (COP18) to the United Nations Framework Convention on Climate Change (UNFCCC) exhibition and side event entitled “Modeling to Bridge Science and Policy” 2012.



Inventory of Putrajaya Greenhouse Gas Emissions 2012

In PGC2025, Putrajaya has set the goal of reducing the citywide greenhouse gas emissions by 60% as compared to its 2025 'business as usual' (BaU) level. The city's first greenhouse gas inventory, released in 2011 has set 2007 as the baseline year and 2025 as the target year for greenhouse gas reduction. This report is the first interim greenhouse gas inventory update, using data of 2012.

The scope of the 2012 inventory consists of emissions from energy used by buildings, land transportation (passenger, freight and public transit) as well as GHG generated by solid waste management.

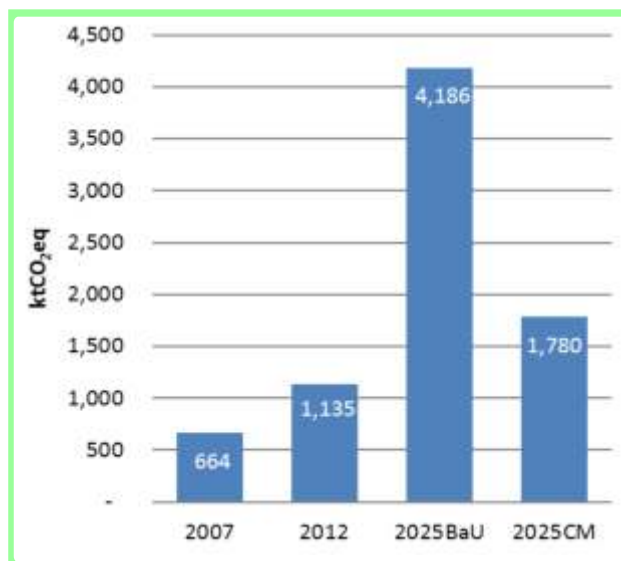
To get a clear overview of the Putrajaya emissions scenario, GHG emissions for 2012 were calculated based on seven sectors namely; residential, government departments, commercial, public amenities and facilities, passenger transport, freight transport and solid waste.

The data used in the inventory were gathered from various sources and are mainly based on consumption of citywide electricity, natural gas, LPG, petroleum use and the emissions associated with solid waste management.

Inventory Result

The city's overall greenhouse gas emissions were about 1.7 times higher in 2012 as compared to 2007. The total emissions for 2012 were 1,135ktCO₂eq as compared to 664ktCO₂eq in 2007. This is due to various factors including the increase in building floor area, increase in the number of population and employees as well as the changes in the emissions coefficient. Emissions per capita for 2012 were 12.3tCO₂eq. Figure 12 summarises the 2012 inventory result as compared to the base year 2007 and target year 2025.

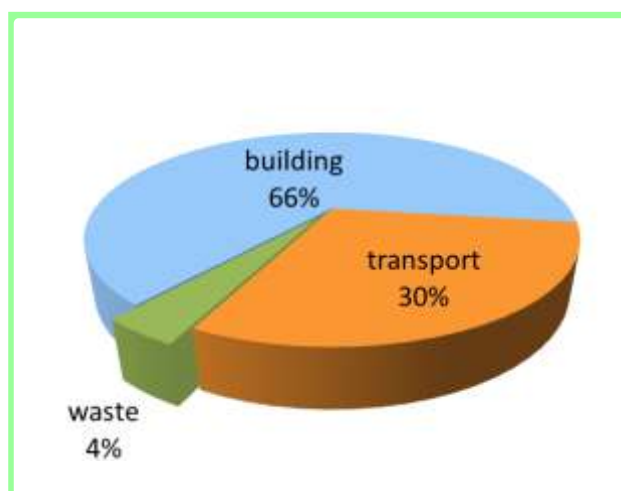
Figure 12 : GHG Emissions Comparison



The inventory result shows that highest greenhouse gas emissions is from the building sector which contributes 66%(748ktCO₂eq), followed by the transportation 30% (338ktCO₂eq) and solid waste 4% (49ktCO₂eq).

The same scenario can be observed in the 2007 inventory and this is mainly due to the increase in newly constructed government department offices, residential and commercial premises within the five years period and resulted in higher energy consumption.

Figure 13 : GHG Emissions by Three Scopes



**Table 9 : Comparison of GHG Emissions
by Seven Sectors (ktCO₂eq)**

	2007	2012	2025BaU	2025CM
Residential	23	59	266	150
Government departments	180	461	363	139
Commercial	65	207	1,435	769
Public amenities & facilities	67	21	240	112
Passenger transport	161	316	1,314	368
Freight transport	20	23	156	89
Waste	148	49	414	189
Total emissions	664	1,135	4,186	1,816
Carbon sink		-24		-25
Net emissions	664	1,087	4,186	1,780

The highest source of GHG emissions about 50% (563ktCO₂eq) is from the use of electricity, followed by petroleum 29% (333ktCO₂eq) and natural gas 16% (181ktCO₂eq). This indicates that the city wide energy sources are still dependent on non-renewable energy.

Figure 14 : GHG Emissions by Source

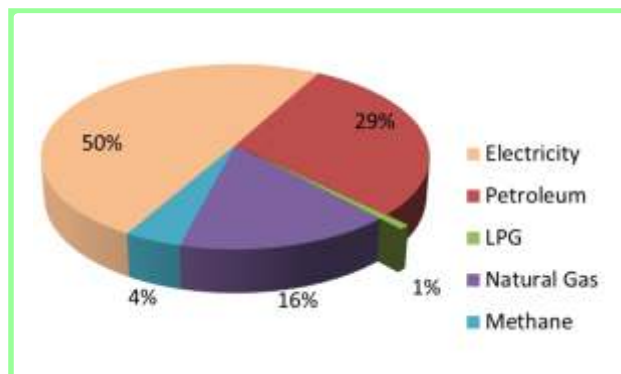


Figure 15 : GHG Emissions per Capita

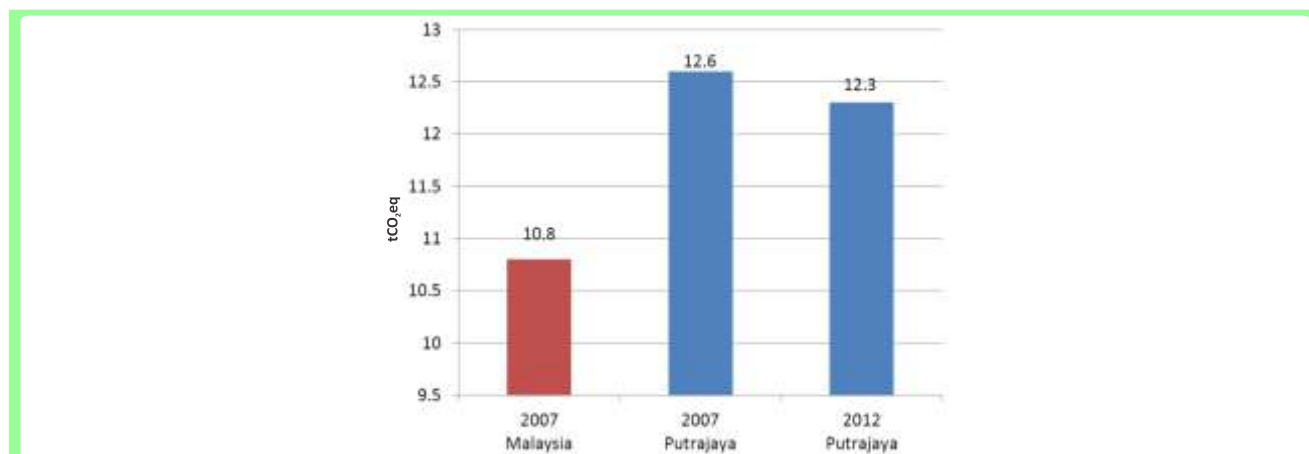


Table 10: Energy Demand (ktoe)

	2007						2012					
	Electricity	Petroleum	LPG	Natural Gas	Solar Heat	Other renewable	Electricity	Petroleum	LPG	Natural Gas	Solar Heat	Other renewable
Commercial	9.8	0.0	0.4	0.0	0.0	0.0	20.2	0.0	1.6	11.6	0.0	0.0
Public Amenities & Facilities	10.0	0.0	0.4	0.0	0.0	0.0	2.4	0.0	0.0	0.0	0.0	0.0
Government Departments	18.6	0.0	3.1	24.5	0.0	0.0	35.7	0.0	0.0	64.2	0.0	0.0
Residential	3.0	0.0	1.4	0.0	0.0	0.0	6.2	0.0	1.9	0.1	0.0	0.0
Passenger Transport	0.2	56.1	0.0	0.8	0.0	0.0	0.3	109.7	0.0	1.6	0.0	0.0
Freight Transport	0.0	7.1	0.0	0.0	0.0	0.0	0.0	8.0	0.0	0.0	0.0	0.0

Carbon Emissions from Building Sector

The building sector remains the highest sector in terms of energy consumption. The distribution of floor area by building types are as follows; 44% for residential floor area, 30% for government departments/office buildings, 7% for commercial space and 19% for public amenities/facilities.

Government department/office buildings contributed the highest in the building sector which is 61% of the total emissions of 748ktCO₂eq. Since the year 2007, the completed floor area for this building type has increased 8.63%

Figure 16: CO₂ Emissions from Building Sector

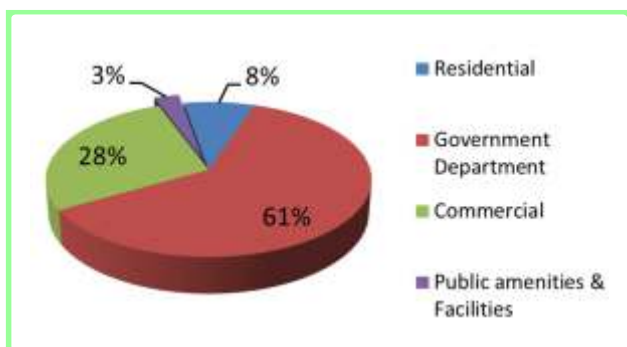
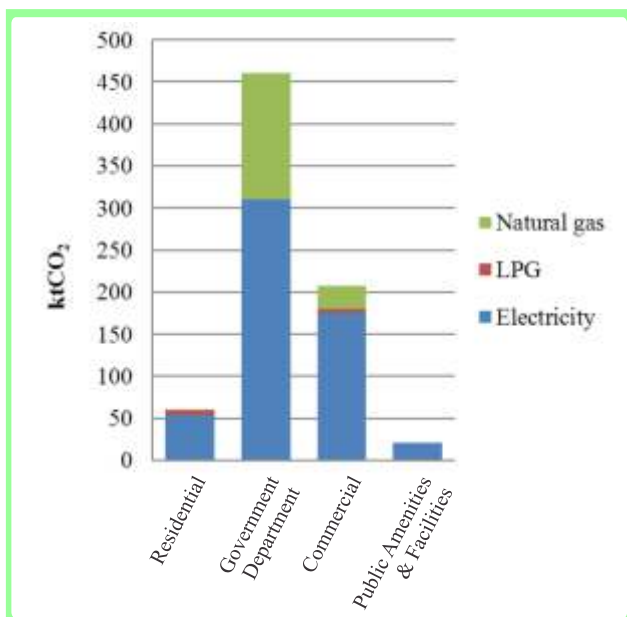


Figure 17: Building Sector CO₂ Emissions by Source



Carbon Emissions from Transportation Sector

Transportation sector was the second highest in energy consumption in Putrajaya due to the increase in population and employees resulted in higher trip generations. By end of 2011, all 22 ministries and government agencies have shifted from Kuala Lumpur to Putrajaya. This has a direct impact in terms of people commuting from neighbouring areas. Both incoming and outgoing persons have increased 3 times.

Petroleum used in the transportation sector is the main source of CO₂ emissions due to its higher percentage of consumption of 98%.

Figure 18: In/Out Persons Comparison

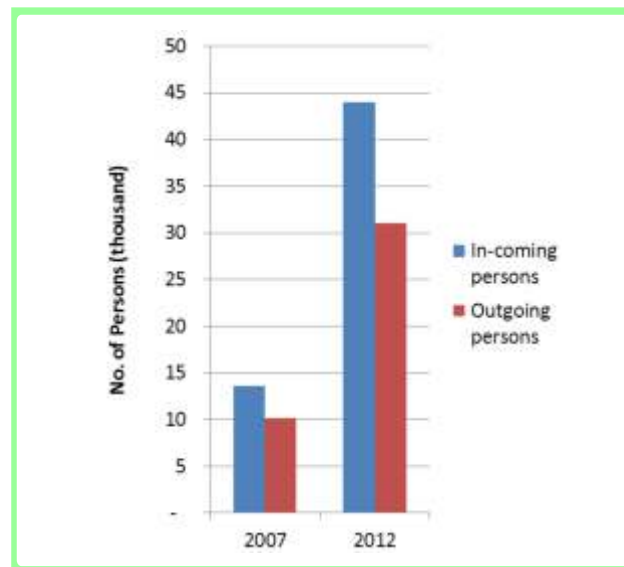
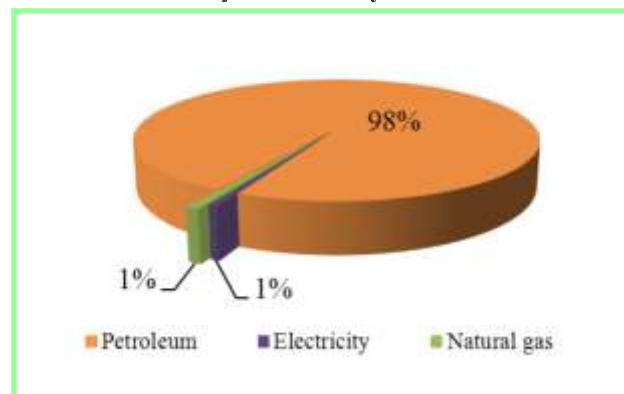


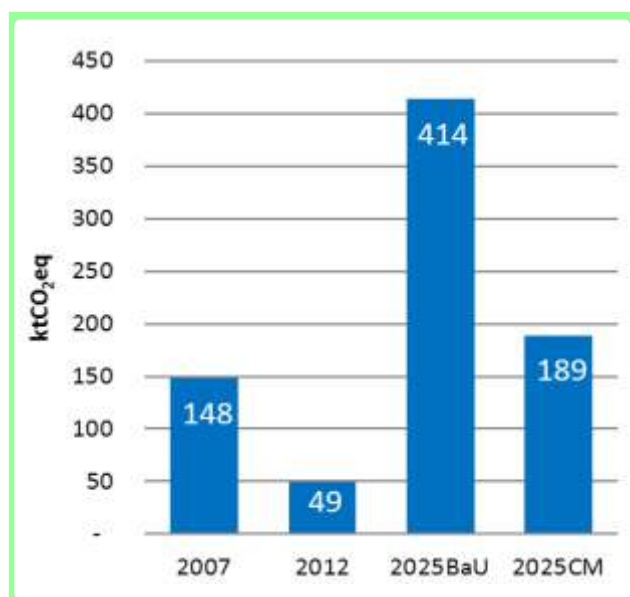
Figure 19 : Transportation Sector CO₂ Emissions by Source



Carbon Emissions from Waste Sector

In the waste sector, the result indicates a reduction of GHG emissions of 148ktCO₂eq in 2007 to 49ktCO₂eq in 2012. However, this reduction is due to the difference in methodology used in the inventory calculation.

Figure 20: GHG Emissions Comparison for Waste Sector



Conclusion

This 2012 inventory is important to guide Putrajaya Corporation in reviewing its existing green city initiatives as well as in formulating new plan to ensure the three environmental targets by 2025 are achieved.

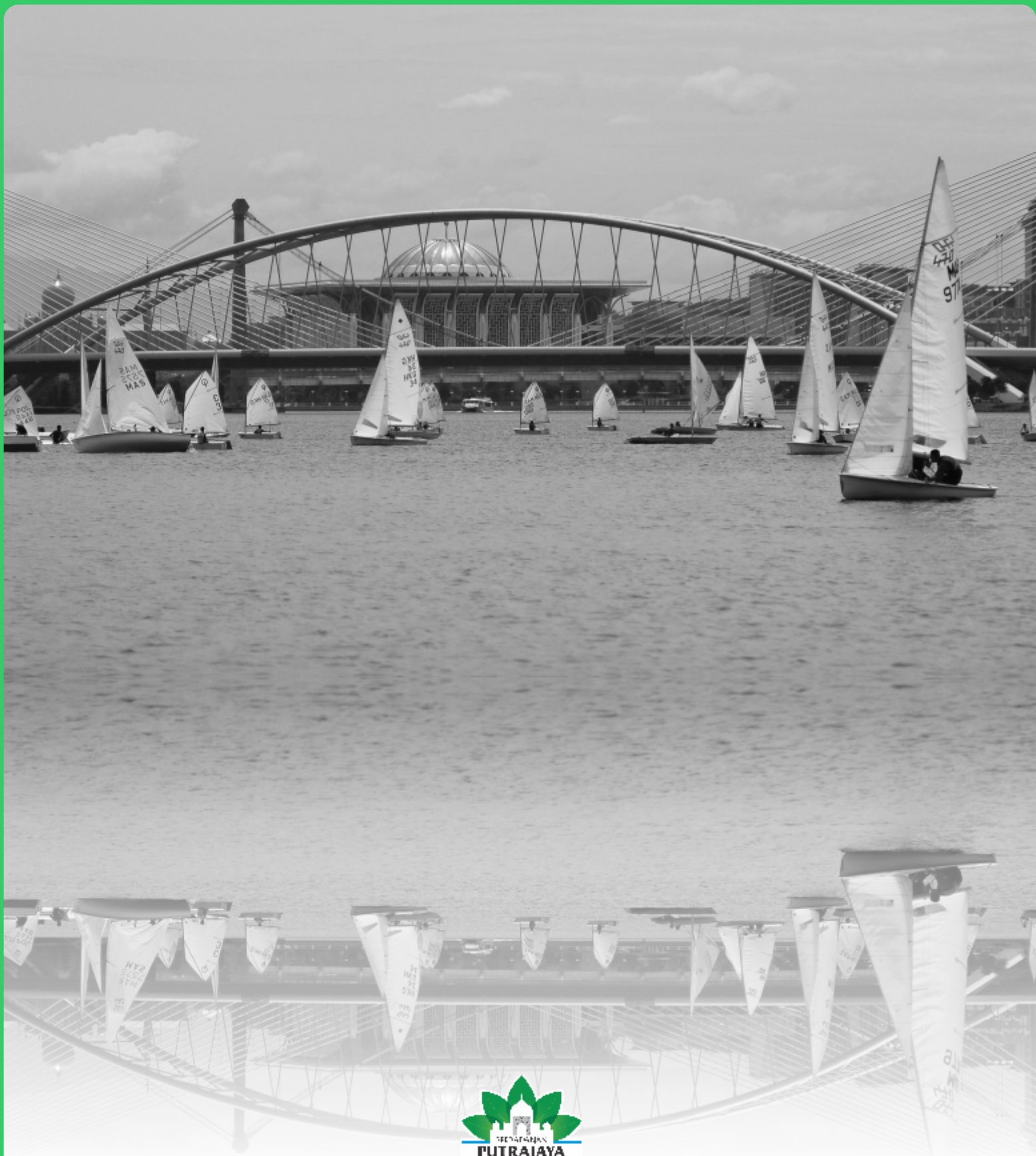
The programmes should include the means to reduce energy consumption of government offices through improvement of energy efficiency in buildings and best practices in energy management, the change of lifestyles of its communities including residents, workers and visitors, as well as to address the increase in the use of private vehicles by expediting the implementation of the planned rail system in Putrajaya.

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