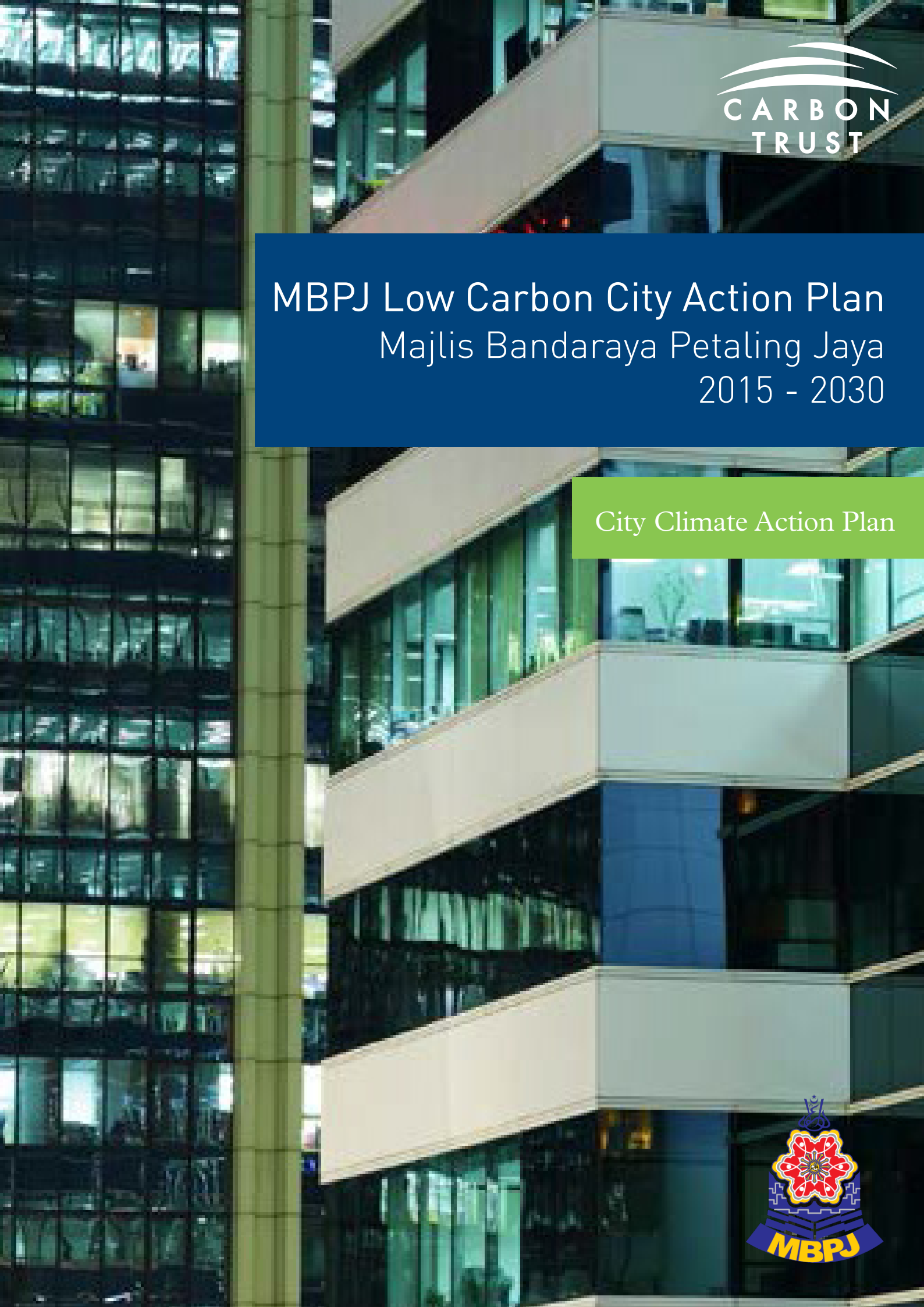

CARBON TRUST

MBPJ Low Carbon City Action Plan

Majlis Bandaraya Petaling Jaya

2015 - 2030

City Climate Action Plan

MBPJ

Foreword

Low Carbon City Action Plan

Cutting carbon emissions to fight climate change should be a key priority for all cities. Preventing global temperature increases by more than two degrees over preindustrial averages is crucial. Local government action is a key enabler of this. Municipalities hold many planning, housing, community engagement, taxation and transport powers necessary to bring about a prosperous low carbon transition. A clear mitigation strategy for a city is vital - it helps to save money whilst also reducing the risk of dangerous climate change.

In 2014 MBPJ worked with Carbon Trust UK to identify the carbon footprint of their own estate and ways in which they can reduce it. From this MBPJ set an ambitious target to reduce that footprint by 25% by 2020. This is underpinned by robust technical analysis and well developed methods and technologies.

MBPJ have now developed a city carbon action plan through to 2030. This action plan commits the city to a target of reducing CO_2 by 30% by 2030 against business as usual, and supports potential carbon savings of approximately 36 million tonnes of carbon dioxide between now and then. Clearly the city has a lot of work to do but this document will assist in moving forward towards low carbon and sustainable future.

There are those that can and those that do. Public bodies can contribute to reducing CO_2 emissions. The Carbon Trust is proud to support MBPJ in their on-going carbon management efforts and city climate planning.

Tim Pryce
Head of Public Sector, Carbon Trust

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Aims of this plan

This document sets our vision for transforming our municipality into a sustainable city. We will build on international commitments Malaysia has made to tackling climate change. This document defines our low carbon city activities for the next 15 years. It sets the strategic context and the 'case for action'. Here we present our current carbon emissions and proposed actions to reduce our emissions. We also make estimates on costs and savings and the arrangements to track progress.

AIMS OF THE PLAN

- **Achieve a reduction in emissions of 30% from a 2014 baseline.**
- **Become a leading low carbon city**
- **Provide an integrated, coherent approach to carbon management**
- **Motivate and inspire a common goal of reducing carbon.**
- **Deliver long term financial savings**

In line with GPC BASIC city level reporting our footprint is estimated to be almost 3,500 kilo tons of carbon dioxide. Left unchecked it is likely this will double by 2030. This is due to business as usual (BAU) growth and population increase. We hope to de-couple our growth from carbon emissions and reduce our footprint in context of the BAU forecasting. We aim to reduce this footprint by 30% by 2030. This will create cumulative savings of 36,000 kilo tCO_2 and cost savings of RM1.4 billion for the businesses and residents of our city. To achieve our goals we have set interim targets of reducing emissions by 10% by 2020 and 20% by 2025.

We must reduce the amount of energy we use and generate our own renewable energy. Principle actions include:

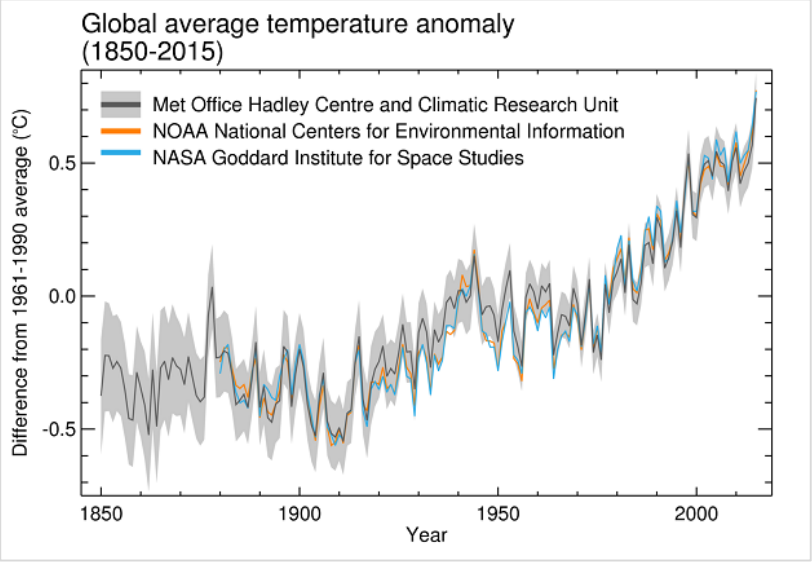
- Reduce residential electricity footprint
- Reduce industrial and commercial electricity footprint
- More efficient new building developments
- Install more renewable technology
- Decrease the number of private vehicles on our roads
- Increase the number of hybrid and electric vehicles on our roads

Additionally we aim to reduce the amount solid waste we send to landfill, plant more trees across our city and begin to adapt to the irreversible effects of climate change already in motion.

Introduction

Low Carbon City Action Plan

Overview



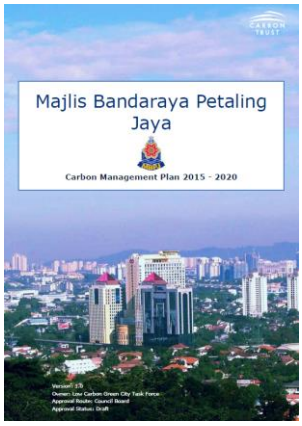
Secretary General Ban Ki Moon of the United Nations has called climate change "the defining challenge of our age". Human activities have released large amounts of greenhouse gases during the past century. The majority of these emissions have come from burning fossil fuels to produce energy. Other significant emission sources include industrial processes, deforestation and agricultural practices (see Appendix 1).

Scientists agree that anthropogenic emissions are causing climate patterns to destabilise. Environmental damage is already manifesting. Global temperatures have risen by 1°C over the last century and sea levels by 20cm. Each of the last three decades has been successively warmer than the last. Arctic sea ice has reduced by 40% since 1980 and glaciers around the world are receding. The oceans are becoming acidic and heat-waves and intense rainfall events have increased. The Inter-Governmental Panel on Climate Change (IPCC) warn that climate change will damage human health, agriculture, transport and infrastructure.

Cities must play their part - urban activities are major sources of greenhouse gas. Estimates suggest that cities are responsible for 75% of carbon dioxide emissions. Energy and transport are the largest contributors. It is crucial that cities lead the way to a successful and prosperous low carbon future.

On 20th June 2006 Petaling Jaya Municipal Council was upgraded to a City Council (MBPJ). Our city has an estimated population of 619,925 people. The administrative area of the city is 97.2 square kilometres. Petaling Jaya is now known as the leading growth centre in Selangor. We have oversight and administration of planning, housing, community engagement, and taxation and transport services. The way in which services are managed will be crucial to the transition to a low carbon economy. The population served by our council is set to increase at a rate of 2.7% per year. This poses a significant threat to our efforts in attempting to reduce carbon. We must continue to provide high quality services whilst decoupling growth from carbon emissions.

To date, we have taken a leading role with the development of a Carbon Management Plan for our own estate. The Plan commits us to a target of reducing carbon by 25% between 2014 and 2020 (see section 12). This provides us with a platform from which we can extend our focus. We now aim to catalyse action on carbon reduction in the wider city region. A city that uses resources in a sustainable manner creates economic growth that is fair for all. A low carbon city will enhance the quality of life for our residents. To do this we must reduce pollution, cut waste and avoid inefficient use of natural resources. Additionally we must protect biodiversity and strengthen the security of our energy supply.



This document details actions required to achieve a 30% reduction in emissions by 2030. These actions are not intended to be an exhaustive list but are high priority goals for the next 15 years. We have an important role to play but wider collaboration will be required. We therefore need to engage the businesses and individual residents of our city.

Drivers for Action

As a major local authority in Malaysia it is imperative we reduce carbon emissions. Below we set out the main drivers for taking action.

Climate Change

The 21st Conference of the Parties in December 2015 resulted in an historical agreement. This saw the world's nations agree to limit temperatures below dangerous levels. Recent natural disasters in Malaysia have been linked to the use of fossil fuels. The sultan of Kelantan has called on the people of Malaysia to be environmentally friendly. It is likely that anthropogenic emissions have contributed to recent flooding. Transportation, urban planning and energy security are also all linked to emissions. Since the 1980s the number of cars on the roads have increased due to the Malaysian National Car project. Klang Valley Public bus services have been consolidated. Our roads have become increasingly polluted and congested. All these factors have contributed to domestic and national carbon emissions.

Legislation

The Malaysian government has committed the country to a reduction target by 2020; to reduce 2005 levels by 40% by 2020 (per GDP). A number of policies have been introduced to help in meet this ambitious target. At COP21, Malaysia submitted an INDC (intended nationally determined contribution) pledge to reduce its greenhouse gas emissions intensity of GDP by 45% by 2030 from base year 2005 of emission intensity of 0.531 tons CO_2eq per thousand Ringgit Malaysia (Emissions: 288,663 Gg CO_2eq; GDP of constant price at 2005: RM 543.578 billion).

A number of initiatives have been developed to encourage the deployment of low carbon technologies. The national Policy on Climate change was the first of the key policies.

- National Policy on Climate Change
- National Green Technology Policy
- Renewable Energy Act
- National Energy Efficiency Plan

The stated aim of The National Policy on Climate Change (2009) is to:

"Ensure climate-resilient development to fulfil national aspirations for sustainability".

The National Green Technology Policy (2010) aims to accelerate technology deployment through training. The Renewable Energy Act (2011) aims to increase the uptake of renewables. The National Energy Efficiency Action Plan (2014), presents a strategy for the implementation of energy efficiency measures. In some cases the policies are lacking in certain deliverable actions. Renewed support to plan and implement objectives across the key policy instruments is required.

Economic Transformation programme

The Economic Transformation Programme (ETP) was formulated as part of Malaysia's National Transformation Programme. Its goal is to elevate the country to developed-nation status by 2020. Sustainability has been incorporated as part of the economic growth strategies. The ETP's targets for 2020 will be achieved through the implementation of 12 National Key Economic Areas (NKEAs). Whilst the NKEAs are growth based, there are strands of sustainability within the areas/sectors. These include:

- KL/Klang Valley - more sustainable transport, green spaces improved amenities
- Oil, gas, energy - promotion of energy efficiency and utilisation of renewable energy
- Business services - accelerate green technologies
- Palm oil programme - development of biogas potential at milling facilities

11th Malaysia Plan

The 11th Malaysia Plan (11MP) includes Malaysia's keen interest in its long-term sustainability goals. "Green growth" has been identified as one of the key thrusts in the plan running from 2016 – 2020. It is hoped that green development will be part of the 2020 vision; "to become a high income and developed nation". The strategy focuses on achieving the country's development agenda. It is anticipated however that Malaysia will embark on a low carbon development pathway. In doing so existing sectors will be transformed and the natural environment enhanced.

Sustainability Initiatives

We strive for our city to be an attractive and liveable place. We aim to include the best features of the natural and built environment within Petaling Jaya. Via local agenda 21 (1992 Rio de Janeiro Earth summit) we developed a 2030 sustainability vision is to become a:

"Livable and sustainable city that has a good image and good governance with a harmonious and healthy environment"

Low Carbon Cities Framework

The Low Carbon Cities Framework (LCCF) was developed in recognition that cities are imperative to low carbon growth. The key aims of the framework are the promotion of sustainable development and the reduction of carbon emissions. By following the key actions in this Plan we hope to meet our 2030 vision whilst achieving LCCF key objectives.

Green Technology Application for Low Carbon Cities

The Green Technology Application for Low Carbon Cities (GTALCC) is an important new relevant program. National and sub national low carbon city initiatives have been established in recent years. The programs have however been developed in an independent and somewhat theoretical manner. With that in mind a focused implementation project has been developed. Key objectives are:

- Facilitate implementation of low carbon initiatives in at least 5 cities in Malaysia (including Petaling Jaya)
- Showcase a clear and integrated approach to successful low carbon urban developments

We welcome the GTALCC program and hope to develop plans and utilize available resources. This will help us achieve the objectives set out in this document whilst aligning with GTALCC's key priorities.

Other

The cost of fossil fuels are volatile and projected to rise. The nature of our city's wide ranging activities means we are an intensive user of energy. It is important we minimise financial liabilities associated with energy and transport costs. Historically electricity and fuel prices have been kept artificially low due to subsidies. Unit costs have not reflected the real cost of production and supply of energy. The situation is now changing. We must act now to reduce costs whilst decreasing our energy and carbon footprint.

Our duties in providing city services offer opportunities for us to drive reductions. Part of our role is to develop and put in place plans that meet the challenges of climate change. As a trusted leader and employer we are well placed to deliver emission reductions. However, we recognise the need to reach out to the wider community and businesses. We believe the organisations and people of our city are crucial in helping us to achieve lasting reductions. We recognise that our ambitions align with other cities in Malaysia. We welcome future collaborative work with key partner cities/regions. These include Putrajaya, Georgetown, Iskandar and Melaka.

Carbon Emissions

Low Carbon Action Plan

In order to design an effective plan it is critical that we understand our current emissions: how much they are, where they come from and who is responsible for them. This section provides an inventory of our greenhouse gas emissions in 2014. This will be used to monitor and measure changes in emissions resulting from initiatives identified in here.

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GPC Protocol

We have chosen to report on our emissions in line with the Global Protocol for Community–Scale Greenhouse Gas Emissions (GPC). The GPC sets out guidance for reporting on city-wide emissions using principles from the GHG protocol. The GPC requires cities to report emissions by scope and sector using two distinct (but complementary) approaches:

- **Scopes framework**: Emissions by scope 1, 2 and 3. Scope 1 allows for the separate accounting of GHG emissions produced within the geographic boundary of the city consistent with national-level GHG reporting

- **City-induced framework**: Emissions attributable to activities taking place within the geographic boundary of the city. It covers selected emission sources representing the key emissions occurring in most cities

Inventory Boundary

The inventory boundary identifies the emissions temporal and spatial extent. By using a distinct boundary to group emissions we hope to take action to reduce carbon in our city.

Geographical boundary and period

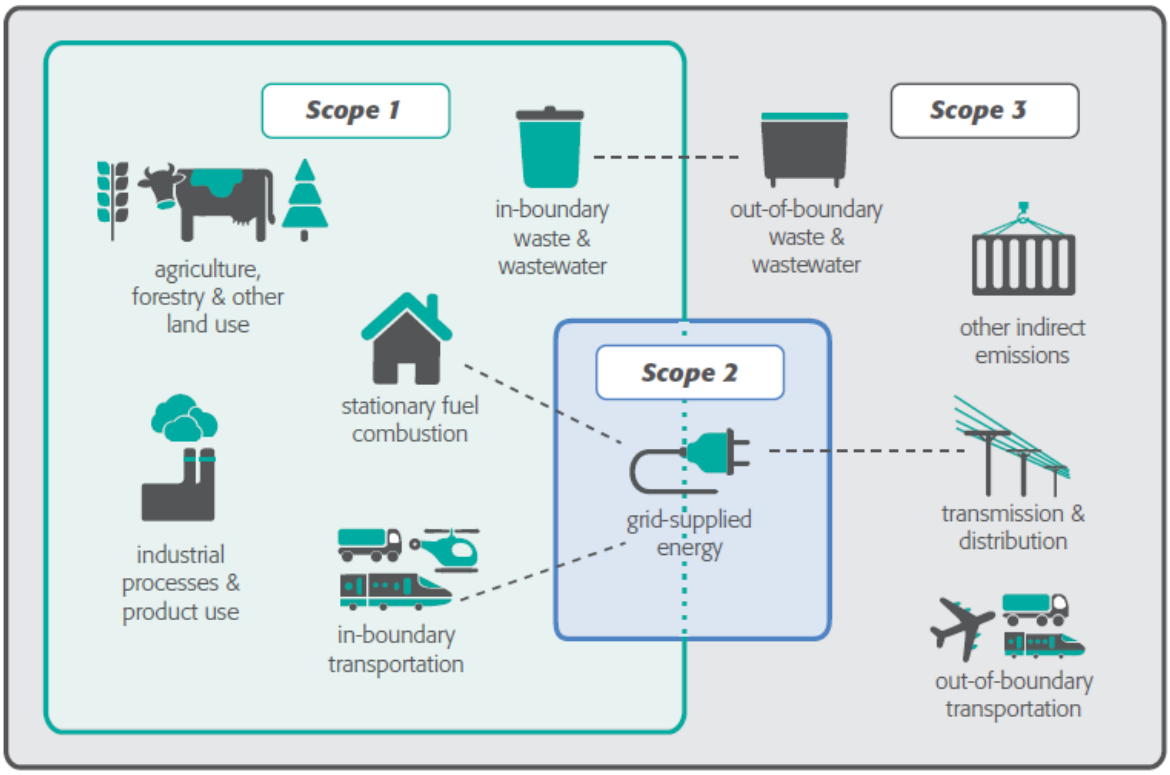
The GPC states "cities should establish a geographical boundary that identifies the spatial dimension or physical parameter of the inventory boundary". We have chosen to use the administrative boundary of MBPJ as the geographical boundary. The GPC is designed to account for city GHG emissions within a single reporting year. We have chosen the calendar year 2014. This aligns with national energy balance reporting and the council's own carbon management plan.

GHG Emission Sources

Scope Framework

Emission sources can be categorised into primary sectors. These include emissions found in most cities under scope 1 and 2 categories. For the purpose of our inventory we will report on the following categories:

- **Stationary Energy – Buildings electricity, LPG and natural gas use**
- **Transportation – Private and public vehicles and transport**
- **Waste & Wastewater – Private and public waste and water**



The sectors include further potential sub-divisions according to, or defined by data availability. A key difference in reporting between the GPC and the GHG protocols is the definition of scopes. Under the GPC scope 1, emissions are produced exclusively within the boundary. Emissions known as "scope 3" under the GHG are known as scope 1 under the GPC (e.g. waste generated and treated inside the city boundary). Those that occur outside of the boundary but driven by activities within the boundary are scope 3. Activities arising from the use of grid electricity are defined as scope 2.

Reporting level

For purposes of aligning with the *city induced framework* method, the *BASIC* level of reporting will be used to account for our emissions. The GPC requires reporting for one of two reporting levels: *BASIC* or *BASIC+*. The *BASIC* level covers emissions from *Stationary Energy, Transportation* and in-boundary generated *Waste and Wastewater*. *BASIC+* requires a much more challenging level of data acquisition and emissions calculation. At this juncture, requirements for *BASIC+* are beyond what could realistically be determined for our city. Thus, the *BASIC* level of reporting has been opted for.

Emission sources and scopes included in BASIC total are:

- All scope 1 emissions from *Stationary Energy* sources (excluding energy production supplied to the grid)
- All scope 1 emissions from *Transportation* sources
- All scope 1 emissions from *Waste* sources (excluding emissions from imported waste)
- All scope 2 emissions from *Stationary Energy* sources and *Transportation*
- Scope 3 emissions from treatment of exported waste

Inventory Boundary	City Information
Name of City	Petaling Jaya
Country	Malaysia
Inventory Year	2014
Geographic Boundary	Administrative
Land Area (km^2)	97.2
Resident Population	619,925
GDP (US$)	Unknown
Composition of Economy	Commercial / Industrial
Climate	Tropical

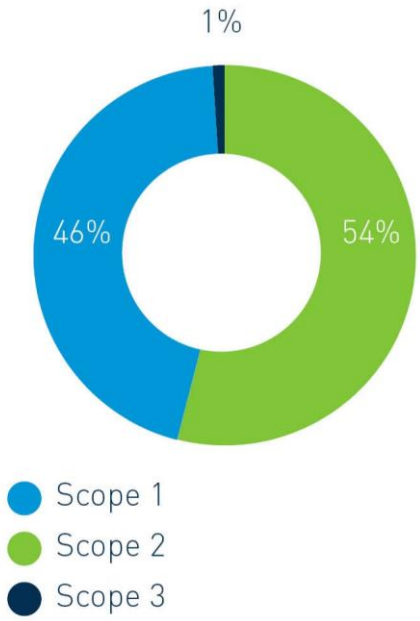
Our Carbon Inventory

Data quality for this 2014 is considered to be of reasonable standard. Undertakings and operations across the city during this year are comparable to current activities. It is recognised that the national 40% reduction target uses 2005 as a baseline. However, it is believed that using a 2005 baseline would not be appropriate or reflective of current city activities.

"In 2014 Petaling Jaya generated carbon emissions estimated to be 3,496 kilotons CO_2e"

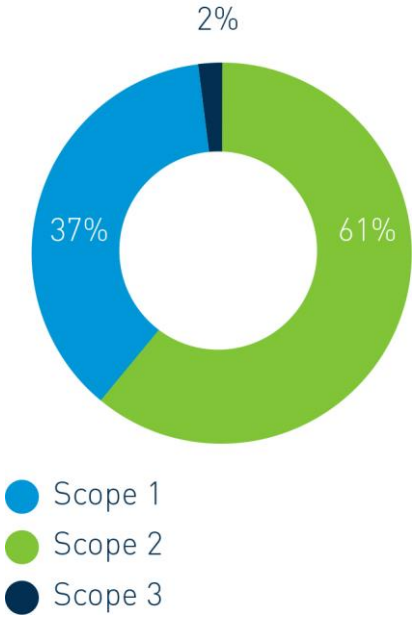
Our estimated carbon emissions inventory is summarised in the tables and charts below. The charts and tables are taken from the Carbon Trust baseline calculation tool which utilise 2014 UK Defra/DECC conversion factors (Malaysia specific where applicable) and follow guidelines set out by the GPC as explained above.

Carbon emissions by scope



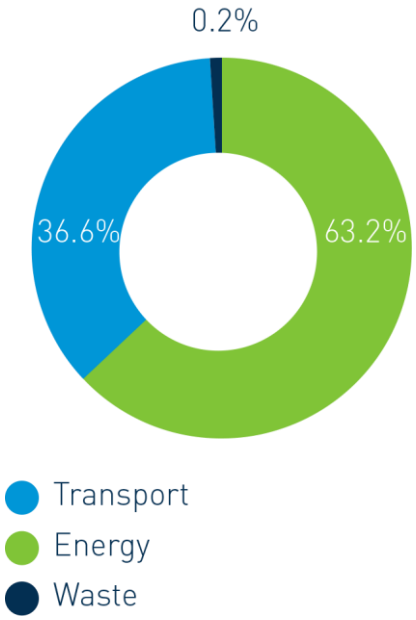
	CO_2 (kilo tons)	%
Scope 1	1,588	45%
Scope 2	1,900	54%
Scope 3	8	1%
Total	3,496	100%

Carbon costs by scope



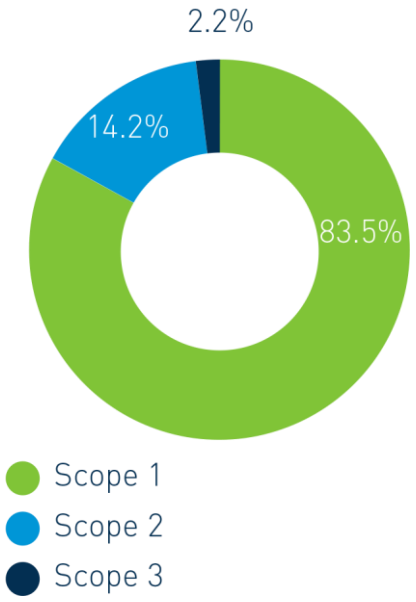
	Cost (RM)	%
Scope 1	771m	37%
Scope 2	1,282m	61%
Scope 3	47m	2%
Total	2,100m	100%

Carbon emissions by source



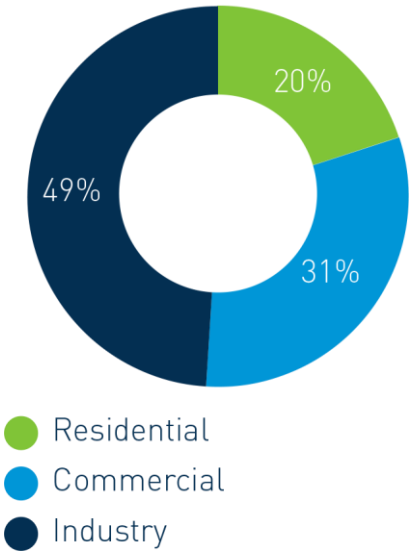
	CO_2 (kilo tons)	%
Energy	2,210	63.2%
Transport	1,278	36.6%
Waste	8	0.2%
Total	3,496	100%

Carbon costs by source



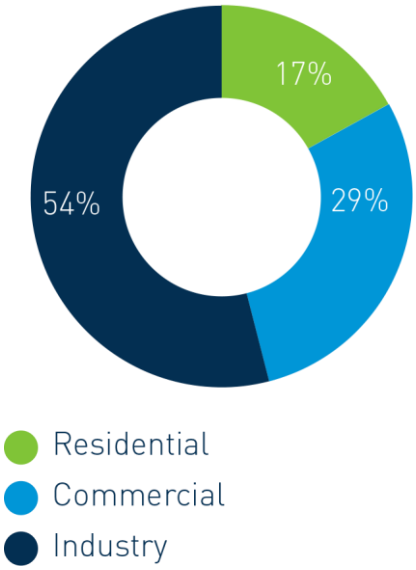
	Cost (RM)	%
Scope 1	1,754m	83.5%
Scope 2	299m	14.2%
Scope 3	47m	2.2%
Total	2,100m	100%

Building emissions by site



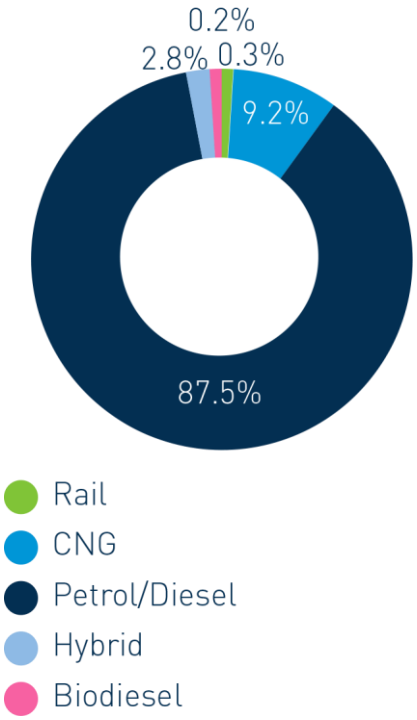
	CO_2 (kilo tons)	%
Residential	450	20%
Commercial	690	31%
Industry	1,070	49%
Total	2,210	100%

Building costs by site



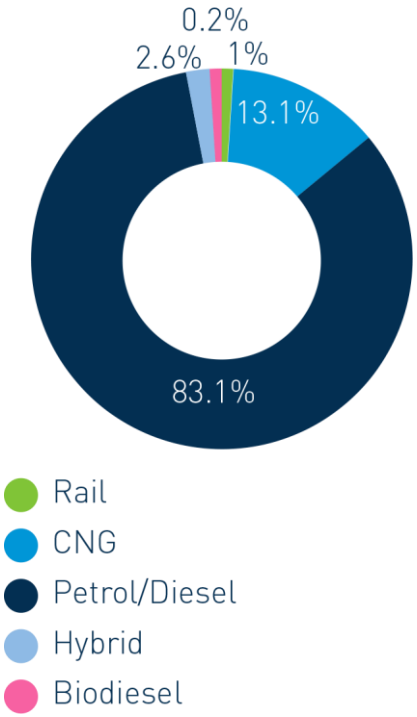
	Cost (RM)	%
Residential	289m	17%
Commercial	506m	29%
Industry	955m	54%
Total	1,750m	100%

Transport emissions by fuel



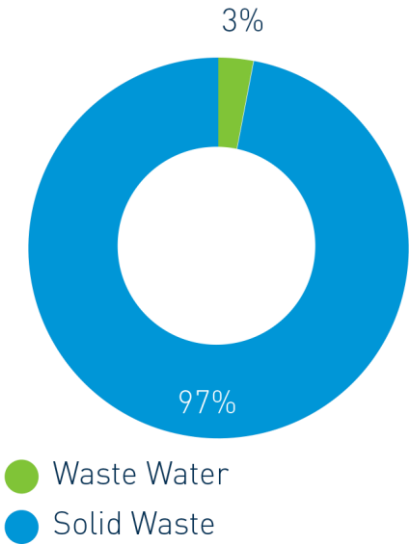
	CO_2 (kilo tons)	%
Rail	4	0.3%
CNG	117	9.2%
Petrol/Diesel	1,119	87.5%
Hybrid	35	2.8%
Biodiesel	3	0.2%
Total	1,278	100%

Transport costs by fuel type



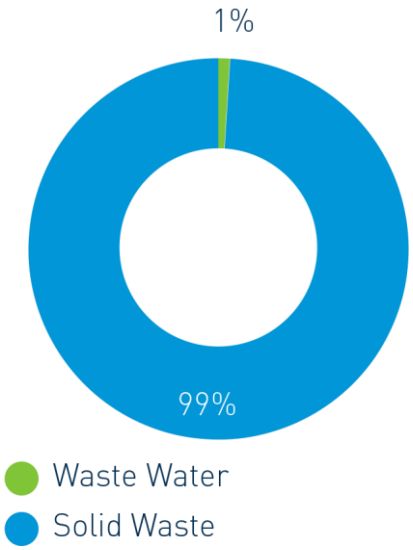
	Cost (RM)	%
Rail	2m	1.0%
CNG	39m	13.1%
Petrol/Diesel	248m	83.1%
Hybrid	8m	2.6%
Biodiesel	1m	0.2%
Total	298m	100%

Waste emissions by source



	CO_2 (kilo tons)	%
Waste Water	0.2	3
Solid Waste	7.6	97%
Total	7.8	100%

Waste costs by source



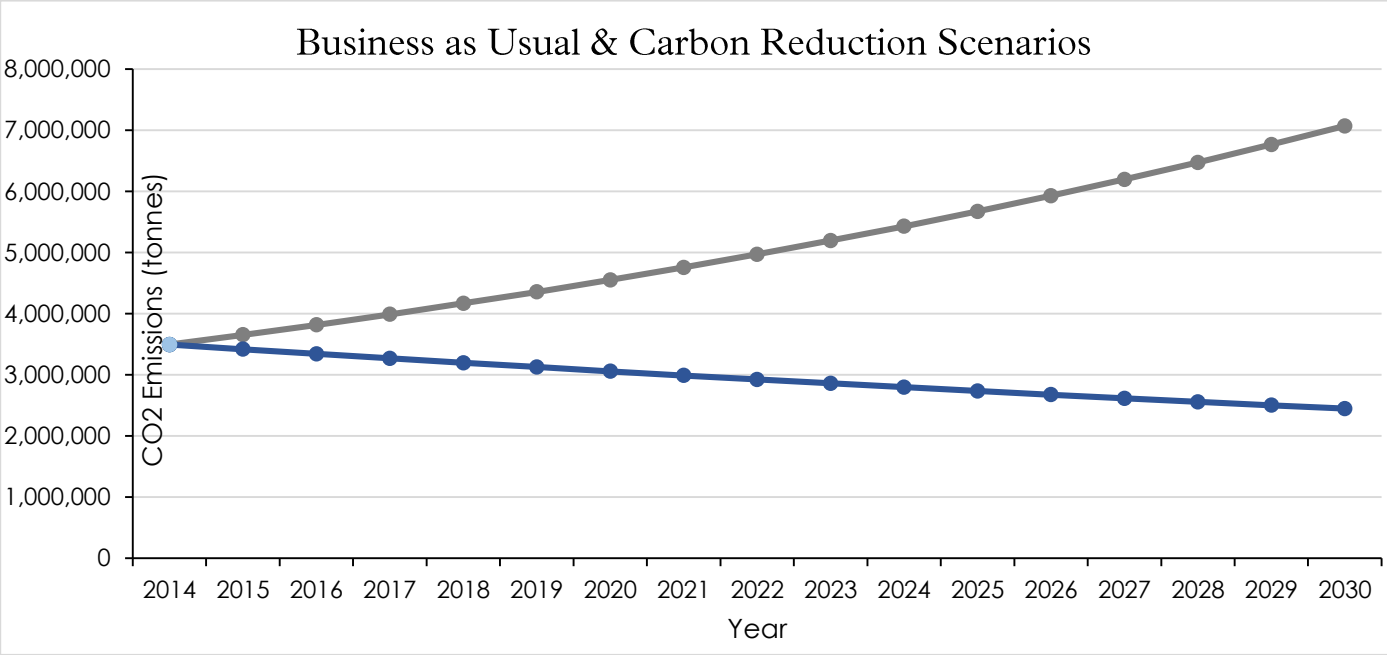
	Cost (RM)	%
Waste Water	0.4m	1
Solid Waste	46.6m	99%
Total	47m	100%

The Target

Low Carbon City Action Plan

The Value at Stake (VAS) is the year-on-year difference between the Business As Usual (BAU) scenario (grey line) and the Reduced Emissions Scenario (blue line). The VAS shows the cumulative potential savings, or avoidable carbon emissions, associated with implementing our plan and achieving our target against the alternative of doing nothing, i.e. BAU.

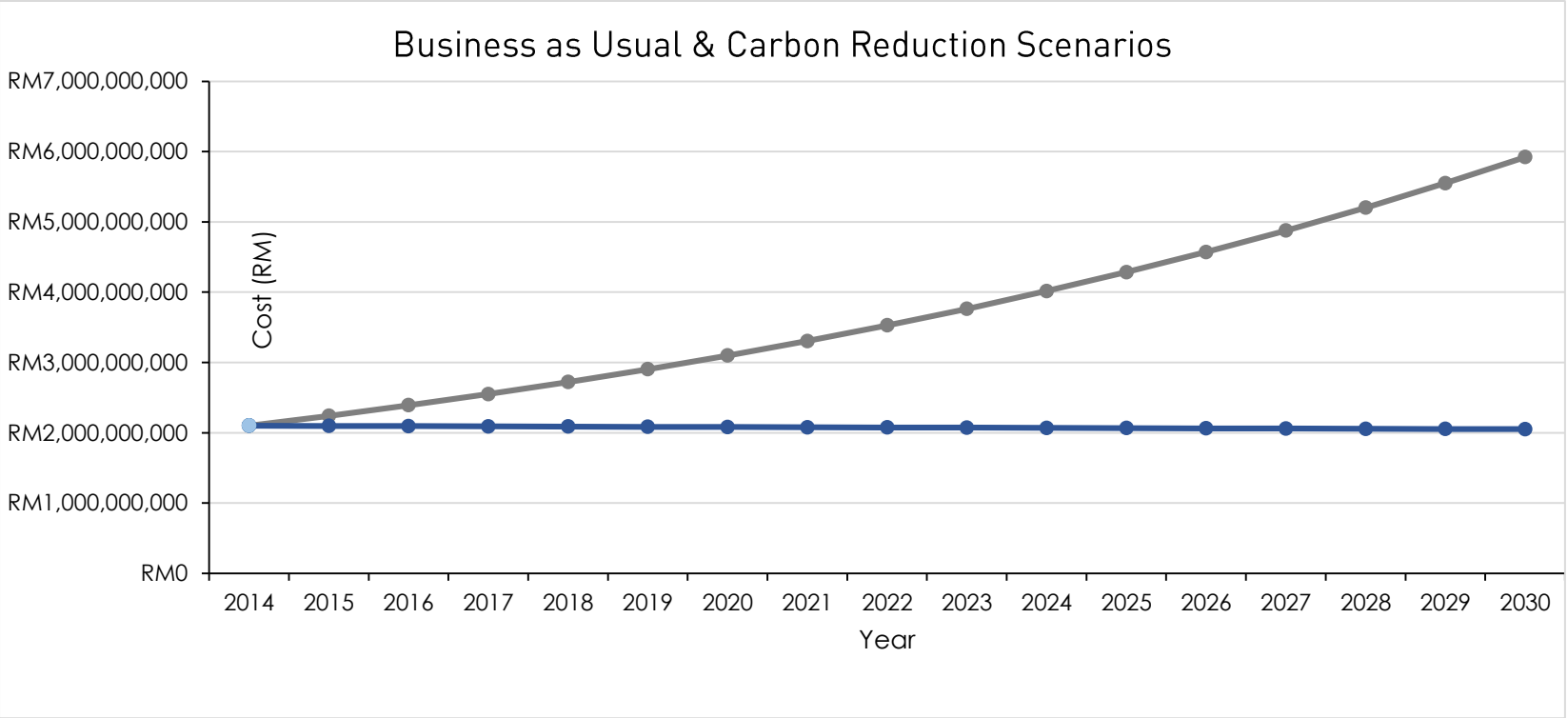
Achieving a 30% reduction in carbon emissions from our baseline over this period will result in final year emissions savings of 4,600 kilo tCO_2 and cumulative savings of 36,000 kilo tCO_2 by 2030. Our interim targets are to reduce emissions by 10% by 2020 and 20% by 2025.



TARGET FOR 2030

We will reduce carbon emissions from our activities by 30% by 2030, from a 2014 baseline of 3,496 kilo tonnes CO_2.

With no action on carbon, annual energy costs could increase from RM2.1 billion to almost RM6 billion by 2030. Achieving a 30% reduction in carbon emissions could result in gross cumulative savings to the businesses, communities and people of Petaling Jaya of RM28 billion by 2030. This of course needs to be set in context to the investment costs required to meet the target. Net savings are however estimated to be at least RM1.4 billion.



BENEFITS OF ACHIEVING THE TARGET

- Cost savings
- Compliance with legislation
- Raised awareness of climate change amongst businesses and residents
- Positive community leadership
- Contribute towards Government and international targets

Goal One: Buildings and Energy

Objective1

Residential Emissions: reduce by 4 kilo tCO_2/yr

Action: property tax rebate scheme

Objective 2

Industrial & Commercial: reduce emssions by 33 kilo tCO_2/yr

Action: energy management and monitoring & targeting

Action: LED lighting

Action:energy efficient motors & drives

Objective 3

New Devlopment: reduce emissions by 15 kilo tCO_2/yr

Action: continue to support and promote Green building Index lead redutions

Objective 4

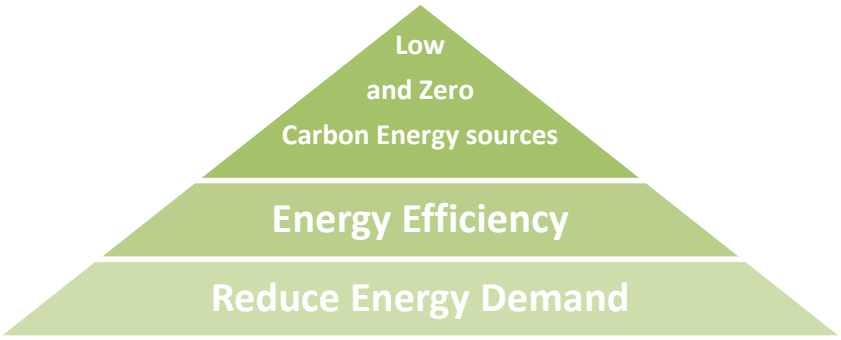
Renewable Energy: target 10% generation against 2030 BAU forecast

Action: install Solar PV to generate 10% of 2030 forecasted requirements

Energy Efficiency

Building energy use is the largest contributor to carbon emissions in Petaling Jaya. This accounts for 63% of the measured footprint. Improving the energy efficiency of our buildings will reduce carbon. We will do this by using less energy to provide the same needs and only using energy when necessary. Carbon can also be reduced via the supply mix. In Malaysia only a small percentage of energy is currently generated from non-renewable sources. This is not likely to significantly change anytime soon. To meet our reduction targets, we must primarily focus on reducing the level of energy we currently consume.

We must reduce carbon through improved energy use following the energy reduction hierarchy. In this way we will meet our targets in a cost effective manner. Firstly we must reduce the need for energy: only use what is required. Secondly we must use energy more efficiently: use less energy to provide the same needs. The final level of the hierarchy is to source our energy from non-renewable resources such as solar power.



There are many options to reduce and optimise energy use in our city. This includes taking action in both existing and new buildings.

2030 Objective: Reduce residential emissions by 4 kilo tCO_2 per year

Action: Property Tax Rebate Scheme

Our low carbon tax assessment scheme began in 2011. It incentivises building retrofit measures and lifestyle changes that reduce carbon. A tax rebate is provided to residents for installing measures such as:

- Installation of LED lights
- Solar PV
- Solar HW
- 5* Star electrical appliances
- Roof insulation
- Ownership of hybrid/electric vehicles
- Water efficiency and biodiversity measures

To date, the scheme has achieved reductions estimated to 200 tCO_2e per annum. Given that emissions from residential properties have been calculated to be in the region of 450 kilo tCO_2e there is more work to do. By taking a few simple steps residential properties in PJ can reduce carbon emissions by 20%. We believe greater awareness and encourage through incentives will help to drive reductions. We will carry out a targeted campaign to increase in the number of residents implementing measures. We aim for a 5% annual increase in rebate uptake create annual savings of over 4 kilo tonnes in carbon emissions. By 2030 this will have saved almost 60 kilo tons tCO_2e. Taking into account BAU growth forecasting this will reduce absolute total city emissions by at least 1%. The cost to MBPJ of reducing 1 tCO_2e via the rebate scheme is approximately RM800. A 5% annual increase in uptake will cost RM2.9m / year.

Other actions:

Motivate residents to change behaviour in ways that reduce carbon emissions by:

I. Developing further community wide public engagement campaigns to promote carbon emissions reductions
II. Establish and publicize climate action metrics by neighbourhood, including measures such as household energy use, vehicle miles travelled, walkability and bicycle commute rates.
III. Expand opportunities for residents to learn how to track and mange energy use, improve efficiency and adapt to climate change.

IV. Carry out free installation of residential external LED lighting (http://www.sustainablepj2030.com/environment/articleDetails.php?cat=3&article=4)
V. Carry out a programme of residential energy audits
VI. Seek national/international funding and assistance to support the above

2030 Objective: Reduce Industrial & Commercial emissions by 33 kilo tCO_2 per year

80% of all building related emissions arise from the commercial and industrial sectors in Petaling Jaya. However as of yet there has been no overarching polices, practices or effective measures that focus on these emissions. We must begin to tackle this area if we are to be successful.

Action: Promote energy management & metering monitoring & targeting

The absence of formal energy policies and action plans for these sectors are a major weakness in reducing energy. Creating policies, procedures and practices and encouraging better behaviour will avoid waste. This can be achieved through improved standards of housekeeping and operational practices. The adoption of standards such as ISO 50001 (Energy management standard) will incorporate best practice energy management. Many individuals in these sectors are not aware of how their management of systems impact on energy consumption. The provision of well-designed Metering Monitoring & Targeting (MM&T) systems will provide the necessary feedback to optimise control strategies and settings. Increased use of smart meters and reporting will inform building operators and owners of ways to reduce and optimise energy use. Such operational procedures and practises are advanced in many other countries and well-documented savings of 10%+ are known to be achievable. We will encourage the implementation of energy management practices and MM&T systems and target a reduction of 5% of energy use by 2025 and a further 5% by 2030.

Action: Encourage LED lighting

Lighting is currently estimated to consume 20% of commercial electricity use and 10% of industrial electricity use. The provision of lighting in all sectors is almost exclusively provided by fluorescent and halogen/halide fixtures. These fixture do not represent best practice. Energy savings of at least 50% can be made by implementing well designed LED-based lighting systems that deploy high efficacy luminaires under automatic control (occupancy based and photocell control where appropriate). Through the drivers of energy efficiency programmes, legislation and market forces we expect lighting energy consumption from these sectors to reduce by at least 50% by 2030. We therefore target a 25% reduction in industrial/commercial energy use by 2025 and a further 25% by 2030.

Action: Encourage purchasing of efficient motors & drives

Motors, pumps and fans (in HVAC systems) are estimated to use at least 25% of electricity in the commercial sector and 15% of energy in the industrial sector. The majority of motors however are thought to be standard efficiency without modern drive controls that can save large amounts of energy. High efficiency motors and variable speed drives are mature technologies in many other countries and it is estimated that this equipment can greatly reduce energy use. Through the drivers of energy efficiency programmes, legislation and market forces we expect HVAC energy consumption from these sectors to reduce by at least 50% by 2030. We therefore target a 25% reduction in industrial/commercial energy use by 2025 and a further 25% by 2030.

By achieving savings via the actions above we could encourage savings of 33 kilo tCO_2 per year.

Supplementary actions:

Motivate businesses to change behaviour in ways that reduce carbon emissions by:

I. Establish a business leadership council to catalyse carbon reductions in the business community
II. Bring together academia, businesses and government to foster policy development, best practices and collaboration to address carbon reductions in the commercial and industrial sectors
III. Seek national and international funding for assistance and support with the above

2030 Objective: Reduce new development emissions by 15 kilo tCO_2 per year

Action: Green Building Index

According to '*Opportunities and Risks Arising from Climate Change for Malaysia*' (Khazanah, 2012) approximately 44% of Malaysian building stock will be 'new' by 2020. Therefore, to meet targets laid out in this document it will be crucial that many new buildings meet a minimum green standard. The Green building Index (GBI) has been created to promote sustainability in the built environment and raise awareness of environmental issues among developers, and designers. The GBI is a rating tool for to facilitate the construction of green sustainable buildings that use less resource and promote wider sustainability objectives. The scheme specifically designed for Malaysia uses a point based system to classify developments to platinum, gold, silver and certified levels under the following categories:

1. Energy efficiency
2. Indoor environmental quality
3. Sustainable site planning and management
4. Materials & resources
5. Water efficiency
6. Innovation

As of the beginning of 2016 the GBI scheme had certified over 1.7 million m^2 of building area in Petaling Jaya. Through the drivers of increased awareness and market forces we estimate that the GBI will continue to reduce carbon emissions against a baseline of standard developments. GBI related yearly carbon reduction from developments in our city equalled over 80 kilo tCO_2 by the end of 2015. Current trends and forecasting indicate GBI will save at least an additional 15 kilo tCO_2 per year until 2030. This is likely to be higher. We conservatively estimate that by 2030 the GBI scheme will have certified an additional 230 kilo tCO_2 of annual reductions. Cumulatively that will have reduced CO_2 by more than 1,830 kilo tCO_2 by 2030. This would equal a 27% reduction against the final year 2030 forecasted BAU footprint (not cumulative).

On average GBI developments cost approximately 2% extra than uncertified (non-green) developments. It has been estimated that the average marginal additional cost of new major developments (Non-Residential New Construction and Residential New Construction) is RM20m. These costs do not consider reduction in ongoing operating costs however. For example with a more efficient facade, the total cooling load will be reduced and hence the cooling plant capacity is reduced. Additionally, reduction in cooling plant also means reduction in supplementary systems the creation of extra space. This means that the 'payback' whilst difficult determine at a high level is likely to be very attractive.

2030 Objective: Generate 10% electricity locally

Action: Generate 10% of 2030 electricity requirements from Solar PV

It is estimated that approximately 2,750GWh of electricity are required to power our city. Based on current growth forecasts this figure could increase by 150% by 2030 or approximately 6,777GWh (Left unchecked - BAU). The amount of renewable energy installed in PJ currently is very low. The potential to produce electricity locally from renewable sources should be utilised. Harnessing solar energy in our city is an effective zero carbon method of utilising the high solar irradiance we receive. We aim to produce 10% of 2030's (BAU) electricity requirements from solar PV. Current estimates show that Malaysia as a whole is set to reach 2000MW of installed Solar PV capacity by 2020. With the support from government incentives, a developing market and decreasing costs of equipment we believe the above target is achievable.

District Energy

District cooling is a cooperative effort to provide cooling for a number of buildings within a given area. Such systems have significantly reduced consumption of fossil fuel in many countries around the world. We aim to complete a feasibility analysis of district energy in Petaling Jaya by 2018. This will allow us to understand whether such systems are economically viable and indicate the amount of carbon that can be saved.

Goal Two: Transportation

Objective

Private Vehicle Emissions: reduce by 30 kilo tCO2/yr

Action: increase the size of our bus fleet

Action: encourage public transport use through better links and scaled up Park N Ride scheme

Objective

Hybrid Vehicles

Action: encourage uptake through free parking scheme

Objective

Electric Vehicles

Action: install supporting infrastruture via govenrmt assitance and target 1000 EVs by 2020

Objective

Cyling & Pedestrians

Action: master plan for main lane PJ cycling project

Approximately 17% of our city land area is dedicated to transportation infrastructure (2010 figures). This doesn't include the LRT and KTM lines which run in part through our city. These are electrified rail systems that we see as positive parts of our public transport infrastructure. Petaling Jaya experience's a high amount of on road traffic congestion. This is particularly prevalent during peak hours. The Level of service, LOS is defined as the saturation level of the road. This is the ratio between volume of vehicles and the road capacity. Roads > 1.00 (or LOS F), are deemed not functional or in a state of bad congestion. The LOS at most major intersections in Petaling Jaya is well above 1.00 for extended periods of time. In line with Local Agenda 21 aims, we plan to guide development of PJ into a connected and sustainable city. Part of this is the ability to cope with population growth and traffic congestion.

Some of the initiatives implemented by MBPJ under Petaling Jaya's Local Agenda 21 – Sustainable PJ 2030 include:

1. PJ City Cycleway Network
   - Currently, there are 5.1km cycle route in Taman Jaya Cycleway area and 5.6km cycle route in Damansara Damai Urban Park Cycleway. Total = 10.7km.
   - Under the "Master plan for Main Lane PJ City Cycling Project", there is plan for provision of 56km bicycle route network to connect main parks in Petaling Jaya.
2. PJ City Free Bus
   - MBPJ has provided free bus service for PJ residents daily. Currently, 22 public buses running from 6.00am to 9.00pm daily covering 4 routes.
3. Park 'N' Ride
   - Plans to increase another 0.25km^2 for 2,488 parking space within 400 meters of the 5 existing LRT rail stations to encourage reduction of miles travelled by private vehicles.
4. Transportation Master Plan

Also known as PIP (Pelan Induk Pengangkutan). A development masterplan for PJ city's transportation base on 3 main pillars:

PUBLIC TRANSPORTATION PLANNING	TRANSPORTATION PLANNING INFORMATION SYSTEM	LAND USE PLANNING AND INTEGRATED TRANSPORTATION
➢ Study of Transportation Master Plan (PIP) based Department of Engineering's terms of reference 2014 ➢ Bus Rapid Transit (BRT) Direct Route ➢ Bus Transit (BT) Route ➢ "PJ City Bus" Free Bus Route (Additional routes to school) ➢ Feeder Bus • Hospital • Library • Market • Transit Station ➢ Pedestrian Walkway ➢ Bicycle way to Transit Station ➢ Provision of "Park N Ride" ➢ Rail Routes (MRT/LRT/Komuter) ➢ Tram ➢ "Bike Share Rental" ➢ Public Transportation Trust Fund ➢ Taxy ➢ Adoption of "Universal Design Guidelines" (UDG) ➢ Bus stops ➢ Car parking areas	➢ Visum dan Vissim Software System • Transportation and Traffic Simulation • Transportation and Traffic Model • Analysis of Traffic Impact Study • "Traffic Sign & Public Transport Data" • "Traffic & Incident Management System" ➢ Provision of "Integrated Transport Information System" (ITIS) ➢ GIS ➢ Traffic Light Control ➢ CCTV ➢ "Intelligent Road Network" ➢ E-Transport ➢ E-Routing	➢ "Walkable City" ➢ "Transit Oriented Development" (TOD) ➢ "Smart City" ➢ "Compact City" ➢ "Green City" ➢ "Safe City" ➢ Bicycle Way ➢ Pedestrian Walkway ➢ Adoption of "Universal Design Guideline" Application ➢ Development Intensity ➢ Plot Ration ➢ Density Control ➢ Height Restriction ➢ GBI ➢ "Mix Development" ➢ "Urban Renewal"

As Petaling Jaya city is a city with a large number of car owners, the suggested area of focus is to shift the non-public transport users to using public transport. We aim to dis-incentivize the use of private vehicles by encouraging the use public transport. For example:

- Increase the availability of 'Park N Ride' parking space.
- Increase accessibility of public transportation
- Reduce parking space available in public places except for areas allotted for Park N Ride.

2030 Objective: Public transport

Action: Triple the size of our bus fleet

Private vehicles using petrol/diesel make up the largest portion of the transportation footprint. Annual emissions are estimated to exceed 2,000 kilo tCO2eq by 2017. At a growth rate of almost 5% per annum, car ownerships and related emissions will continue to be the largest portion of this sector.

To tackle the heavy use of private gasoline fuelled vehicles, abundant and easily accessible public transport is critical. Dedicated bus lanes, easy access and disincentives for private cars (congestion charges, carbon tax etc.) must be put in place to encourage a transition. This is particularly important for commuting journeys. Between 2016 and 2020, by securing dedicated bus lanes and providing more bus routes and increasing bus numbers, a 15% reduction in private (petrol/diesel) vehicles is expected to bring a 270 kilo tCO_2 annual reduction. This would represent an 18% reduction in transport carbon emissions. This will expand the current bus capacity by 1.5x from current levels. We aim for public transport to represent close to 30% of overall transport usage in PJ. Furthermore, by 2030 we aim to at least double the bus capacity. Further private transportation restrictions therefore need to be implemented. We aim for a 25% reduction by 2025 and 33% reduction by 2030. This will bring a final year carbon reduction of 830 kilo tCO_2. This means over half (54%) of carbon emission will be saved from current levels. This is equivalent to 45% of today's commuters using public transport.

To fulfil the reduction target, an estimated investment of 822 million RM is needed for buses and infrastructures to enable bus prioritised transportation. Among which, 272 million RM is required for purchasing buses (based on the assumption of bus price 0.15 million RM per vehicle, purchasing 1810 buses). 550 million RM will cover 200 km two way roads (assuming 2 million RM per km), 200 km bus lanes and monitoring equipment. Additional 105 million RM is needed to staff, run and maintain the buses every year.

2030 Objective: Hybrid Vehicles

Action: Scale up free parking for Hybrid cars

We will also extend our free parking for hybrids scheme. Hybrid vehicle have a much lower emissions intensity than standard vehicles. Anyone who buys a hybrid car in Petaling Jaya will be eligible to receive free parking in the city for a year. We hope this measure will incentivise new hybrid car owners. Through increased public awareness we hope that a greater number hybrid vehicles will be seen on our roads. Additionally increased parking costs and decreased spaces will help promote this scheme.

2030 Objective: Electric Vehicles

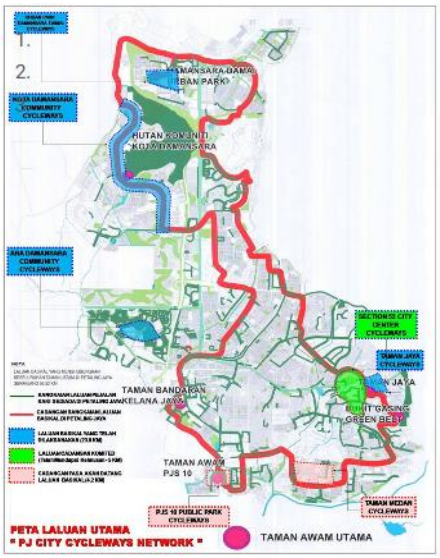
Action: Support electric vehicle/infrastructure roll out.

Via assistance from KeTTHA and Green Tech. Malaysia, we will encourage a switch to electric vehicles (EV) in our city. A national target of 25,000 charging point by 2020 is currently in place. We are currently working closely with Green Tech. Malaysia to make sure that our city receives a fair proportion of charging points which are a crucial part of EV infrastructure. Analysis indicates that each electric vehicle saves 3.2tCO_2 per year. Through help from government incentives, support with infrastructure and increasing awareness we target a minimum of 1000 electric vehicles owned by PJ residents by 2020. Post 2020 we will assess potential future uptake and set a new target. During the first phase of development, Green Tech. are offering the ChargEV package to interested premise owners free-of-charge – the cost of the package and installation, which ranges between RM10,000 to RM25,000, will be borne by GreenTech Malaysia/KeTTHA.

2030 Objective: Cycling and Pedestrians

Action: Master Plan for Main Lane PJ City Cycling Project

We are currently planning for a major cycling pathway project in our city. We will provide a comprehensive 56 kilometres bicycle route network that connects PJ's main parks. We will also extend this network into neighbourhood areas. We aim to build bicycle routes utilizing existing pedestrian ways, public parks and reserved utilities.



The development of this pioneer cycleway was started in 2012 at Taman Jaya and Damansara Damai. The bicycle route which involves Taman Jaya Cycleway area (5.1 kilometres) and Damansara Damai Urban Park Cycleway (5.6 kilometres) connects four urban parks which are amongst the main parks in Petaling Jaya.

The aim is that by creating well linked comprehensive cycle routes we will encourage people to take reduce the amount of car journeys they are taking. Better connected cycling and pedestrian routes are a key priority of our 2030 sustainability vision.

Goal Three: Waste Management

Currently over 23,000 tonnes of waste is produced each day in Malaysia and this is expected to rise to 30,000 tonnes by 2020 (Sreenivasan, 2012). The amount of waste generated continues to increase due to the increasing population. Less than 5% of the waste is being recycled. Despite the amount of waste produced the standards of waste management in Malaysia are still poor.

We produce a large variety of waste in our city. The amount of we generate waste can seem like an inevitable result of how we live our lives. It doesn't have to be that way. Although our GPC defined waste emissions footprint is relatively low (due to landfill in Shah Alam) we are still responsible to for production of an estimated 360,000 tonnes of waste per year. This has an impact on national and global carbon emissions. Additionally, the negative effects of landfill go beyond equivalent carbon emissions. We must do more to reduce, reuse and recycle more waste in Petaling Jaya. These are three key primary pillars of the waste reduction hierarchy. The current waste hierarchy follows the credo that reduction followed by re-use and then recycling should occur. Prevention is at the pinnacle of the Waste Management Hierarchy and is at the core of many other countries waste strategy including European and UK legislation. It is crucial that we reduce our dependence on landfills. Waste needs to be dealt with in a sustainable way and practices should be considered to ensure that waste is disposed of in a manner that is in line with our objectives but also demonstrates best practice as an example to other cities.

2030 Objective: Reduce

The most effective way to reduce waste is to not create it in the first place. This can be done by using less material in design and manufacture, keeping products for longer and using less hazardous materials. Our main objective is to improve our waste minimisation strategy. By prompting awareness and utilising supporting government legislation we aim to reduce the total amount of waste produced in Petaling Jaya by 10% by 2025 and 25% by 2030 (against growth estimates).

Tips for effective practice of 3R's

- Avoid purchasing items that are over packed
- Reduce the amount of waste created by the household by shopping smartly
- Reuse items around your home
- Recycle paper, cardboard, rigid plastic, aluminium, steel cans and glass bottles and jars
- Compost the household's green and organic waste

2030 Objective: Reuse

To re-use an item is to make use of it more than once. By checking, cleaning, repairing and refurbishing items we can decrease the amount of waste produced. Through increased awareness, legislation and tax we aim to re-use as much waste as possible in our city.

2030 Objective: Recycle

According a 2003 study (Fauziah, 2003) around 50% of our waste comes from plastics, glass and cardboards that could be easily recycled. Recycling is a very important part of a waste strategy, as it allows us to extract materials and recover value from them. Recyclables such as paper, card, cans and plastic bottles which we receive via kerbside collection schemes will be sorted at a materials recovery facility and sent for reprocessing into new products.

Pilot programme

A recent study of 1000 households in our city suggests that at least two thirds of residents are positively engaged with recycling. The pilot also reached out to approximately 500 commercial properties. Currently recycling is voluntary but in the future we hope this will become mandatory. The cost to benefit ratio has been calculated to be very favourable. The effect of less landfill means less transportation and less emissions from vehicles. The pilot suggested that the model could be easily replicated across our city but resource is required. Through a future scheme via the GTALCC we aim to roll out recycling (and home composting) on a much larger scale.

Domestic Composting

Home composting is a small-scale process where food and garden waste generated are biologically degraded into useful compost material. Significant waste reduction is achieved by utilising the resulting material in gardens and green areas. In February 2007, MBPJ gained funding from the Danish International Development Assistance (DANIDA) to support a household home composting programme. MBPJ are one of the pioneers of household waste composting. In 2008 we carried out a pilot programme involving 50 homes in Petaling Jaya aims to educate participants to reduce kitchen waste through several composting techniques in accordance with Chapter 21, Agenda 21. We hope to continue to create awareness amongst the communities of Petaling Jaya of the importance of composting. We also aim to promote composting in the commercials sectors as we believe there is a cost effective case to do so.

Goal Four: Urban Forestry

2030 Objective: Increase Urban Forestry

A city abundant with trees and greenery offers a wide range of benefits; improved air quality, provision of recreational areas, refreshment/revitalisation, enhancing aesthetics of neighbourhoods and higher property values. Trees are just one example of the important role natural systems play in addressing climate change – by sequestering carbon dioxide and reducing energy use through natural cooling and shading.

Objective: Expand the urban forest canopy by planting 100,000 large-coverage trees by 2030

Our neighbours Dewan Bandaraya Kuala Lumpur have recently achieved a target of planting 100,000 trees in Kuala Lumpur. We hope to emulate this feat and plant a similar number of trees across our city with interim targets of 25,000 trees by 2020 and 75,000 trees by 2025.

Supplementary actions

To encourage the expansion of tree planting and other urban greenery projects we will also:

I. Expand public and private programs to encourage planting, preserving and maintaining trees and shrubs.
II. Encourage the restoration of natural resources through acquisition programmes
III. Develop and implement an outreach campaign to provide educational resources to residents about the benefit of trees
IV. Recognise trees, shrubs and natural landscapes as assets of the city.
V. Clarify codes and practices to maximize the preservation of natural resources

Goal Five: Climate Change Adaptation

2030 Objective: Climate risk Assessment

Cities are considered high risk from the hazards of climate change. This is due to a city's urban economic and social importance. Rapid urbanisation and population growth in Petaling Jaya is leading to increased vulnerability. This creates additional pressures on our ability to respond to extreme weather events (Revi *et al.*, 2014). Climate change risks are increasing due to heat stress, flooding, drought, water scarcity and air pollution. This has negative impacts on the economy, health and infrastructure systems that are vital to our city (C40 and Arup, 2014; Aggarwala *et al.*, 2011). Adapting to climate change will encourage socio-economic development and reduce vulnerabilities of people and our city infrastructure (The World Bank, 2011).

We are well placed to influence and implement adaptation measures. We need to identify local climate risks through a climate risk assessment and use this to develop an adaptation strategy and implementation plan. Synergies should also be made with new development projects to find ways of incorporating and integrating adaptation and resilience initiatives (Godfrey and Savage, 2012).

Objective: conduct a climate risk assessment

Based on the outcome of our climate risk assessment we expect to conduct a number of actions. These will be determined by the findings of the report.

Examples of city level adaptation measures:

I. Buildings – increasing resilience to flooding, overheating and high winds through design or retrofitting, planning and zoning
II. Energy Supply – increasing resilience of infrastructure and emergency plans for supply disruption
III. Water Supply –optimising delivery mode, water efficiency incentives, water recycling/reclamation, water use metering
IV. Flood resilience – Defences, increasing green infrastructure (green spaces, green roofs, tree planting), flood mapping, SuDs
V. Crisis planning – improving public health infrastructure, early warning systems

Goal Six: Local Government Operations

Objective: Reduce MBPJ footprint by 25% by 2020

The cost of providing electricity, water and transport fuel to our own estate is high. In 2014 we spent RM8.5m on these activities and emitted over 11 kilo tonnes of CO_2e.

In 2014 we created a strategy to reduce these emissions. The Carbon Management Plan sets out our strategy and action plan for reducing emissions until 2020. It identifies the tangible and intangible benefits of Carbon Management and describes the governance arrangements to keep the programme on track. MBPJ has already implemented successful carbon management initiatives in the past and we will continue to build on this success. Reducing the energy consumption and carbon under out control not only reduces harmful greenhouse gas emissions, but also delivers tangible cost savings. This programme contributes directly to our goals of using our resources efficiently and keeping our energy costs as low as possible. We have set an ambitious carbon reduction target, supported by concrete technical projects and embedded actions.

MBPJ will reduce the carbon emissions from our own estate and operations by 25%, from a 2014 baseline of 11,030 tonnes CO_2e by December 2020

We have identified carbon reduction projects and activities in the following areas:

- Good housekeeping – improving our energy data metering and monitoring, campaigns to change staff behaviour
- Invest-to-save projects, such as lighting replacement, installing motion detectors, improving control and the efficiency of our cooling systems and upgrading our building insulation
- Investing in Solar PV where cost effective to do so

Post 2020

After 2020 we will revise our carbon management plan and set a new ambitious target to drive further reductions. This will be a minimum of 40% against 2014 levels (by 2030), though we hope to go much further. As a trusted leader and major employer, we are well placed to deliver emissions reductions in our own buildings, street lighting and transport and will continue to raise awareness about the ways to reduce city-wide emissions.

Monitoring and Reporting

Robust data will provide us the basis to monitor and report on the results of our action. At present our carbon emissions inventory is measured primarily from national statistical data (see appendix 2). Whilst it is recognised that this is currently the only feasible way to measure emissions in our city we must develop a more robust measurement of our inventory.

A key objective is to re-asses our cities footprint with primary locally sourced data. We will do this in line with GPC protocol reporting and review certain targets and actions as required. By de-coupling our own cities footprint measurement from national statistics we will be able to much more accurately measure and mange down our carbon emissions. The following actions will be conducted to allow us to measure our footprint via local data sources:

- Engage with TNB to investigate ways to source primary electricity supply data
- Engage with Petronas (and other fuel companies) to investigate ways to source city fuel purchasing data
- Engage private waste contractors to open discussion on sharing tonnage data
- Conduct physical measurements, sampling activities, or surveys where data does not exist

New data will be collected on an annual (or more frequent) basis to update our emissions inventory. This information will feed into annual reports to senior city (council) figures to assess whether we are on track. Emissions values are the key performance indicator (KPI). An annual emissions inventory will be compiled by updating and comparing with the original baseline data (and adjusted as per the above if necessary). This process should become more simplified and streamlined over time. In this way it will be possible to track progress against our targets.

It may also be necessary to adjust data to take into account differing temperatures using degree day data and track exceptional activities that may affect our city. It is also crucial to measure the savings for each project/action implemented. This information will be important for the overall monitoring and review process. The difference between the previous and current position can be used to produce a summary document identifying all the differences – positive and negative – between the accounting periods.

Barriers to action

By understanding the key barriers to achieving our aims we hope to be able to manage down the risks. Some of the key risks associated with the plan are set out below:

- Resources unavailable to achieve actions identified.
- Reputational risk for not pursuing or meeting carbon reduction targets.
- Carbon reduction becomes a non-strategic priority for the city.
- Lack of buy-in by people reduces participation in relevant carbon reduction projects/programmes
- Potential for an increase in energy demand by rapid development

Appendix 1: Climate Change

Climate change refers to significant and long lasting changes to the weather systems of our planet. Evidence for these changes can be seen across our climate system. Including increasing temperatures, shrinking glaciers and reducing Artic sea ice. There is growing evidence that climate change is influencing the frequency of extreme events such as flooding and heat-waves. Our planet is only able to support life as we know it because of the greenhouse effect which is a natural process that traps heat lost from the earth surface in the atmosphere. Energy from the sun is the main driver for our climate system. About half of the energy coming in from the sun is absorbed at the earth's surface. The earth then radiates energy back towards space. Some of this is absorbed by greenhouse gasses (GHG's) in the atmosphere. These gases then re-emit the absorbed heat which then goes out to space. But some goes back down to heat the surface again. Well established physics tells us that as concentrations of GHG's increase more heat is trapped in our atmosphere. Our planet is now warming. Since the start of the industrial age we've been putting more GHG's such as carbon dioxide into the atmosphere. The gases are trapping more and more heat.

A number of human activities can change the amount of GHG's in the atmosphere. This includes agriculture, deforestation and biggest one: the burning of fossil fuels such as gas, coal and oil. We do this to fuel transportation and power our homes and business's. Carbon dioxide is just one GHG but it is significant because it stays in the atmosphere for a very long time. Whilst it is naturally occurring we add to the global amount by burning fossil fuels such as gasoline. As GHGs increase our land and oceans get warmer. Evidence suggests that changes to our climate can have number of effects. These include rising sea levels, melting glaciers and extreme weather events. According to the intergovernmental panel on climate change (IPCC) it is extremely likely that human activities have caused over half of the global temperature increase in the last 65 years.

There is still time to avoid the worst impacts of climate change, if we take strong action now.

Economics of climate change: Stern Review Extract

Climate change will affect the basic elements of life for people around the world – access to water, food production, health and the environment. Hundreds of millions of people could suffer hunger, water shortage and coastal flooding as the world warms. The review estimates that if we don't act, the overall costs and risks of climate will be equivalent to losing at least 5% of global GDP each year, now and forever. If a wider range of risks and impacts is taken into account, the estimates of damage could rise to 20% of GDP or more. In contrast, the costs of action – reducing GHGs to avoid the worst impacts of climate change can be limited to around 1% of global GDP each year.

The investment that takes place in the next 10-20 years will have a profound effect on the climate in the second half of this century and in the next. Our action now and over the coming decades could create risks of major disruption to economic and social activity, on a scale similar to those associated with the great wars and the economic depression of the first half of the 20th century. And it will be difficult or impossible to reverse these changes. So prompt and strong action is clearly warranted. Because climate change is a global problem, the response to it must be international. It must be based on a shared vision of long-term goals and agreement on frameworks that will accelerate action over the next decade, and it must build on mutually reinforcing approaches at national, regional and international level.

Appendix 2: Calculations and assumptions

Emissions Inventory

The methodology for calculating our city emissions closely follows the global protocol for community-scale GHG emissions (GPC) http://www.ghgprotocol.org/city-accounting. Our primary source of data has been national statistics with local data used where possible. Including in our inventory is:

- Stationary Energy – Buildings electricity, LPG and natural gas use
- Transportation – Private and public vehicles and transport
- Waste & Wastewater – Private and public waste and water

The estimation of carbon emissions from the above areas follows the BASIC level of reporting as per the GPC. We have calculated stationary energy footprint using government statistics on primary fuel sources from the National Energy Balance Report 2013 (2014 figures are not publicly available). These figures have been scaled by population and converted to kWh (where necessary) to arrive at figures that can be converted in tonnes of carbon dioxide equivalent. The table below show the primary stationary energy data.

Electricity per sector	Total Electricity consumption (kWh)	kWh/person	PJ electricity consumption (kWh)
Residential	22,904,000,000	965	598,447,366
Commercial	36,098,000,000	1,521	943,186,911
Industrial	46,243,000,000	1,949	1,208,260,633
Transport	241,000,000	10	6,296,971

Natural gas per sector	Peninsular Malaysia Total consumption in SCF	Peninsular Malaysia Total consumption in kWh	PJ Natural gas consumption in kWh
Residential	32,000,000	9,280,000	242,473
Commercial	832,000,000	241,280,000	6,304,287
Industrial	163,846,000,000	47,515,340,000	1,241,504,980

LPG by sector	Tonnes of oil equivalent	kWh	kWh/person in PJ
Residential	735,000	8,548,050,000	176,207,485
Commercial	693,000	8,059,590,000	166,138,486
Industrial	179,000	2,081,770,000	42,913,115

Malaysia specific carbon emissions factors have been used where available. UK published carbon emissions factors have been used where country specific factors were not available (http://www.ukconversionfactorscarbonsmart.co.uk/)

Carbon emissions from vehicles in PJ is approximately 1,200 kilo tonnes CO_2eq. This is based on 2010 level of traffic in PJ. Over 80% of commuters in Petaling Jaya are estimated to be using private vehicle as their mode of transport. From a study (Onn Chiu Chuen et al. 2014) completed in 2010 on Klang Valley, daily mode of choice of transportation is as below:

Type of transport	%
Private transport	83
Buses	8.3
LRT (light rail transit)	5.5
KTM commuter	1.4
Taxis	1.0
Monorail	0.5
ERL (express airport rail link connecting to the KLIA airport)	0.3

Emissions have been calculated on the basis of weekday and weekend on-road travel using car volumes at major intersections in Petaling Jaya. The following tables illustrate the figures used. Daily estimates have been scaled up to annual amounts and emissions factors applied according to percentage estimates of vehicle type i.e. 80% conventional gasoline, 14% CNG, 5% Hybrid etc.

Location	Time of the day	Volume (vehicle/hour)(*)	Peak (vehicle)	Non Peak (vehicle)	Total vehicle
PJS 1	am	13494	33735	119960	179940
	pm	10498	26245		
Mentari Business Park	am	4289	10722.5	42765	64147.5
	pm	4264	10660		
Kelana Jaya	am	5014	12535	51245	76867.5
	pm	5235	13087.5		
SS2	am	4312	10780	53520	80280
	pm	6392	15980		
SS3	am	3022	7555	31645	47467.5
	pm	3307	8267.5		
SPRINT highway	am	7792	19480	72265	108397.5
	pm	6661	16652.5		
Damansara Utama	am	8388	20970	86940	130410
	pm	9000	22500		
Kota Damansara	am	5952	14880	61730	92595
	pm	6394	15985		
Mutiara Damansara	am	3202	8005	42180	63270
	pm	5234	13085		
Bandar Sri Damansara	am	6985	17462.5	61715	92572.5
	pm	5358	13395		

Location	Total during Weekdays	Total during Weekends
PJS 1	179,940	53,982
Mentari Business Park	64,148	19,244
Kelana Jaya	76,868	23,060
SS2	80,280	24,084
SS3	47,468	14,240
SPRINT highway	108,398	32,519
Damansara Utama	130,410	39,123
Kota Damansara	92,595	27,779
Mutiara Damansara	63,270	18,981
Bandar Sri Damansara	92,573	27,772

Value at Stake

The following figures have been used to assist with forecasting future emissions and cost scenarios:

- Business as usual increase = 4.5% in line with GDP forecasts (http://www.focus-economics.com/countries/malaysia)
- Energy price inflation = 2.1% (http://www.dbs.com/insights/article/low-energy-prices-to-limit-malaysian-inflation.html)
- Transport Price Inflation = 2.1% (http://www.dbs.com/insights/article/low-energy-prices-to-limit-malaysian-inflation.html)
- Waste/Water price inflation = 1% (assumption)
- CPI inflation = 2.0% (http://www.dbs.com/insights/article/low-energy-prices-to-limit-malaysian-inflation.html)

Projects

A number of assumptions have been to calculate emissions reduction potential for certain projects. The key assumptions can be seen below:

- Residents can save 20% of electricity through basic energy efficiency measures
- Lighting makes up 20% of commercial electricity consumption and 10% of industrial
- Installing more efficient motors and variable speed drives (where appropriate and cost effective) can save 50% energy against base case of standard efficiency motors under fixed speed control
- 10% of solar PV generation against an electricity demand of 6777GWh
- GBI approved developments save an average of 0.044tCO_2 per m^2
- Transportation

Appendix 3 – References

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