City of Kwinana

Climate Change Mitigation and Adaptation Plan **(2015-2020)**

100kW photovoltaic power system on the Darius Wells Library and Resource Centre

Review September 2018

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Introduction

In 2015, the City of Kwinana (the City) adopted the Climate Change Mitigation and Adaptation Plan 2015-2020 (the plan) with the aim of reducing the City's greenhouse gas emissions and adapting to the impacts of climate change. Since this time a lot has been learnt through the practical implementation of the plan. There has also been advances in renewable energy and energy efficiency technologies and urban forestry practice. Given the City is half way through the implementation of the plan it was important to review the plan in light of these changes.

The objectives of the review are to:

- Assess how the City is progressing towards the objectives of the plan.
- Determine whether the plan needs to be updated to reflect learnings, changes in the sector and advances in technology.

The City has undertaken the following tasks as part of the review:

- collated the City's latest carbon emission data;
- assessed whether the measures proposed have been completed or are still practical.
- considered new goals and actions in consultation with relevant City Officers.

This document presents the City's carbon emissions data and progress towards its goals. It also presents a new set of actions for implementation over the coming two years until the plan expires. The actions from the previous plan are listed in Appendix A along with notes explaining the City's progress towards their implementation.

Why act on climate change?

The Intergovernmental Panel on Climate Change released its most recent report on climate change, in November 2014. The report synthesised 30,000 research papers; 830 authors contributed to the report and it took 5 years to complete. The report stated that;

"Human influence on the climate system is clear, and recent anthropogenic emissions of greenhouse gases are the highest in history. Recent climate changes have had widespread impacts on human and natural systems." "In most scenarios without additional mitigation efforts warming is more likely than not to exceed 4°C above pre-industrial levels by 2100. The risks associated with temperatures at or above 4°C include substantial species extinction, global and regional food insecurity, consequential constraints on common human activities, and limited potential for adaptation in some cases." (IPCC, 2014)

The need to act on climate change is now very clear and local governments have an important role to play in the global response to this problem.

The City has recognised its responsibility to act on Climate Change. The latest review of the Strategic Community Plan (2017) includes the following objectives concerning energy consumption and climate change:

- Objective 3.3 - Promote the use of renewable energy with the City of Kwinana and reduce energy use where possible.
- Objective 3.5 Understand the impacts of climate change and take a risk management approach to addressing these effects in future planning.

The City also joined the Cities Power Partnership in February 2018. This program is a local government climate change initiative run by the Climate Council, a non-profit independent organisation which aims to provide clear, independent information on climate change to the Australian community (Climate Council, 2018). As part of this program the City is required to select six pledges from a list provided by the Climate Council and report on them annually (the full list of pledges is provided in Appendix B).

The City has chosen seven pledges which are:

a) **Renewable Energy - 2.** Provide council resources to educate and support the uptake of renewable energy, such as by hiring an internal renewable energy support officer or establishing an independent body (such as the Moreland and Yarra Energy Foundations).

b) **Renewable Energy - 3.** Install renewable energy (solar PV and battery storage) on council buildings for example childcare facilities, libraries, street lighting, recreation centres, sporting grounds, and council offices.

c) **Renewable Energy – 6.** Encourage local businesses and residents to take up solar PV, battery storage and solar hot water heating. This can be done through providing incentives (such as solar bulk buy schemes or flexible payment options) or streamlining approval processes (such as removing planning and heritage barriers to solar PV).

d) **Energy Efficiency - 2.** Adopt best practice energy efficiency measures across all council buildings, and support community facilities to adopt these measures

e) **Energy Efficiency - 3.** Public lighting can use a large proportion of a city's energy budget. Roll out energy efficient lighting (particularly street lighting) across the municipality

f) **Sustainable Transport - 1.** Ensure Council fleet purchases meet strict greenhouse gas emissions requirements and support the uptake of electric vehicles.

g) **Work Together and Influence - 4.** Implement an education and behaviour change program to influence the behaviour of council officers, local residents and businesses within the municipality to drive the shift to renewable energy, energy efficiency and sustainable transport.

The City has already completed actions towards a number of these pledges. For example the City has a Sustainability Officer (Renewable Energy – 2), has installed 163kW of solar panels and implemented building energy efficiency measures (Renewable Energy – 3 and Energy Efficiency - 2) and participates in the Switch Your Thinking environmental education program (Work Together and Influence – 4). This program also offers discounts on solar panels and batteries to residents and businesses (Renewable Energy – 6).

City Officers have selected more detailed new actions within each of these pledges. These have been listed in the Implementation Table.

Climate change impacts in the City of Kwinana

When considering mitigation and adaptation actions it is important to first consider the risks posed by climate change in the region. This information was collated in 2009 by GHD and the Southern Metropolitan Regional Council for the southern metropolitan councils (including the City of Kwinana) as part of the Local Adaptation Pathways program (GHD & SMRC 2009). City Officers are of the view that these risks are still considered to be the greatest of the direct risks to the City.

The major risks and their relevance to the City's operations are described below.

TEMPERATURE CHANGE

The average annual global temperature has already risen by 0.8 degree Celsius over the past century and it is predicted to rise by 0.6 to 1 degree Celsius by 2030 (Climate Commission, 2011; GHD & SMRC, 2009).

This increase in temperature has, and will, result in an increase in the number and severity of heat waves. This, in turn, has increased heat stress related deaths through heart attack, stroke and heat exhaustion. Heat wave deaths are less prominent than some of the other effects of climate change but are currently the most deadly of the natural disasters in Australia (Climate Council, 2014).

The other major result of an increase in temperature is an increase in high fire risk days and potential severe bush fires.

The impact of temperature change has direct relevance to the City's business operations with respect to;

- the approval of new subdivisions, as heat islands can be significantly reduced by retaining vegetation;
- the operation of the City's two residential independent living facilities as the elderly are a sector of the community at high risk from heat waves;
- heat stress and lost productivity amongst outdoor employees;
- preventing and responding to bushfires as well as protecting natural and constructed assets; and
- Increased evaporation from sports fields and play grounds.

REDUCED RAINFALL

The southwest corner of the State has become markedly drier, with a 15% reduction in rainfall since the mid-1970s. There is strong evidence in southwest Western Australia that climate change is making a significant contribution to the drying trend. (Climate Commission, 2011; GHD & SMRC, 2009).

Combined with increased evaporation due to increased temperatures, the drying climate has reduced the availability of water for use in the City's buildings, parks and gardens. The City will need to continue to become more efficient in its use of water if parks and gardens are to be maintained to the current standards. The City has developed a Sustainable Water Management Plan (City of Kwinana, 2013) to address these challenges.

The combination of increasing temperatures and reduced rainfall is also likely to have a significant impact on the City's biodiversity. Drought deaths of trees and drying wetlands have already been observed in many reserves and parks. Changing climatic conditions may mean that the ecological communities that currently exist, which are already under pressure from land clearing, will be unable to adapt and survive.

RISING SEA LEVEL

Sea levels along the west coast of Australia have been rising between 7.1 and 7.4mm per year since the early 90's, approximately double the global average. Global sea levels are predicted to rise a further 0.5 to 1 metre this century. A sea level rise of 50cm will lead to very large increases in the frequency of coastal flooding, flooding that is currently considered to be a 1 in 100 year event would occur every year (Climate Commission, 2011).

The City of Kwinana manages a relatively small area of coastline but the financial impact of rising sea levels to the City will be significant. Sea level rise is already threatening millions of dollars worth of infrastructure at Kwinana Beach and Challenger Beach including sea walls, boat ramps, offshore breakwaters, roads, toilet blocks and car parking.

The City participated in the Cockburn Sound Coastal Vulnerability Study to assess sea level rise impacts and determine the best course of action. The final stage of this project was the completion of the Kwinana Coastal Adaptation Plan in 2016 (the Plan) (GHD, 2016). This comprehensive report includes sea level rise predictions and recommended adaptation actions for the entire Kwinana coastline. The coastline was divided into management units and there are two that are managed by the City, Wells Park and Challenger Beach. Both sites have been identified as vulnerable to erosion and loss of beach area from coastal actions and sea level rise (GHD, 2016).

The recommended action at Wells Park is a staged retreat of facilities. Challenger Beach is part of the coastal unit that includes some of the industrial area. Interim protection measures such as a sea wall were recommended to protect the industrial facilities along the coast rather than the beach itself. Any protection measures would therefore have to be undertaken together with industry (GHD, 2016).

The Plan also recommends the incorporation of a special control area and development controls in the City's Local Planning Strategy to avoid development that will be adversely affected by sea level rise (GHD, 2016). In addition the City is considering a Sea Level Rise Policy along with accompanying advocacy and education.

EXTREME WEATHER EVENTS

In addition to the above risks extreme weather events have increased even since the adoption of the original plan (Climate Council, 2017). In particular two very large summer rainfall events which occurred in 2017 and 2018 being the first and fourth wettest Perth rainfall days on record respectively (WA Today, 2018). While identified in the 2009 Climate Change Risk Assessment Report (GHD, 2009), extreme weather events were assessed as being one of the lower priority risks possibly due to the fact that local governments only play a part role in emergency management and other impacts like reduced water availability are currently more disruptive and pressing. However this impact should continue to be monitored and future revisions of the plans consider specific adaptation measures to extreme weather events.

PROGRESS TO DATE

Since the original Climate Change Mitigation and Adaptation Plan was adopted in 2015 a number of initiatives have been implemented to address these impacts. These are listed below.

- Developed and adopted Local Planning Policy No.1 Landscape Feature and Tree Retention. September 2016.
- Continued to participate in the Cockburn Sound Coastal Alliance.
- Continued implementing the Sustainable Water Management Plan.
- Planted 219 advanced street trees in the Industrial area and 106 along Johnson Road in Bertram in 2016/17. In May 2018 the City will be planting 205 street trees in Bertram and 234 in the Industrial Area. Forty-eight new street trees were planted on request by residents.
- Implemented a policy of replacing trees that have died in public areas.
- Delivered a local native Seedling Subsidy Scheme along with an Adopt a Verge program to encourage urban greening.
- Tree planting in reserves.

Emissions baseline data

The City collates and analyses data on its greenhouse gas emissions annually. This data allows the City to set appropriate carbon abatement goals, identify high consuming sites (and therefore target these sites for action) and track improvements over time. To date, the City's reporting has focused on emissions from energy consumption and does not include waste to landfill emissions. Further detail on how the emissions baseline data was collected is provided in Appendix C.

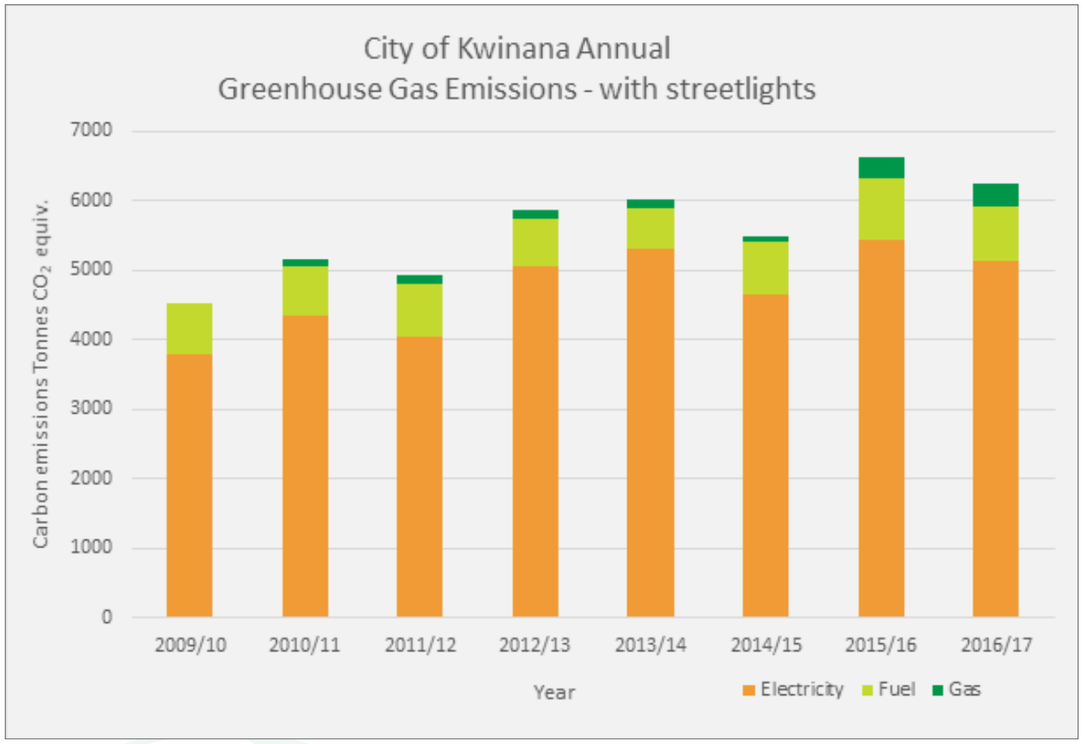

Figure 1. City of Kwinana annual carbon emissions 2009/10-2016/17

Figure 1 above demonstrates that the City's emissions are gradually increasing due to the growth of the City. Step increases can be seen in 2012/13 when the Darius Wells Library and Resource Centre was constructed. The dip in emissions in 2014/15 may have been due to the closure of the Recquatic for refurbishment.

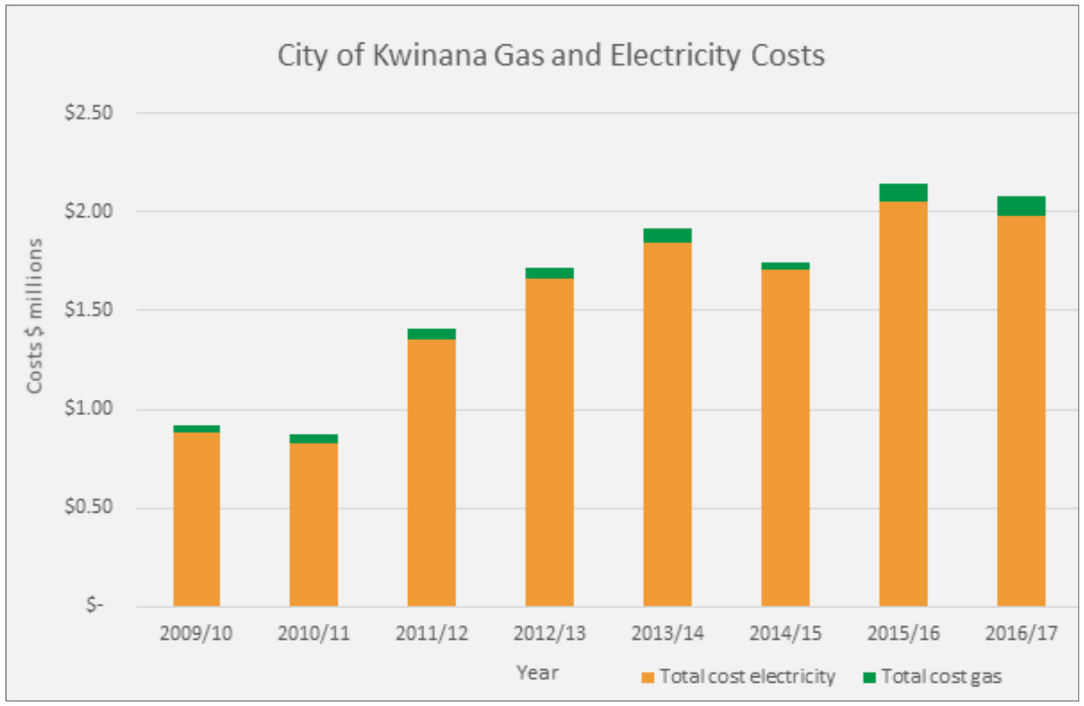

Figure 2. Energy cost 2009/10-2016/17

Figure 2 demonstrates that the City's energy costs are continuing to rise and are now just over $2 million a year. Reducing the City's emissions will therefore not just reduce the City's contribution to climate change, it also has the potential to save the City a significant amount of money. Increasing electricity prices and decreasing cost of energy efficient technologies now means many actions are financially attractive and are quickly becoming a mainstream approach to reducing operating costs.

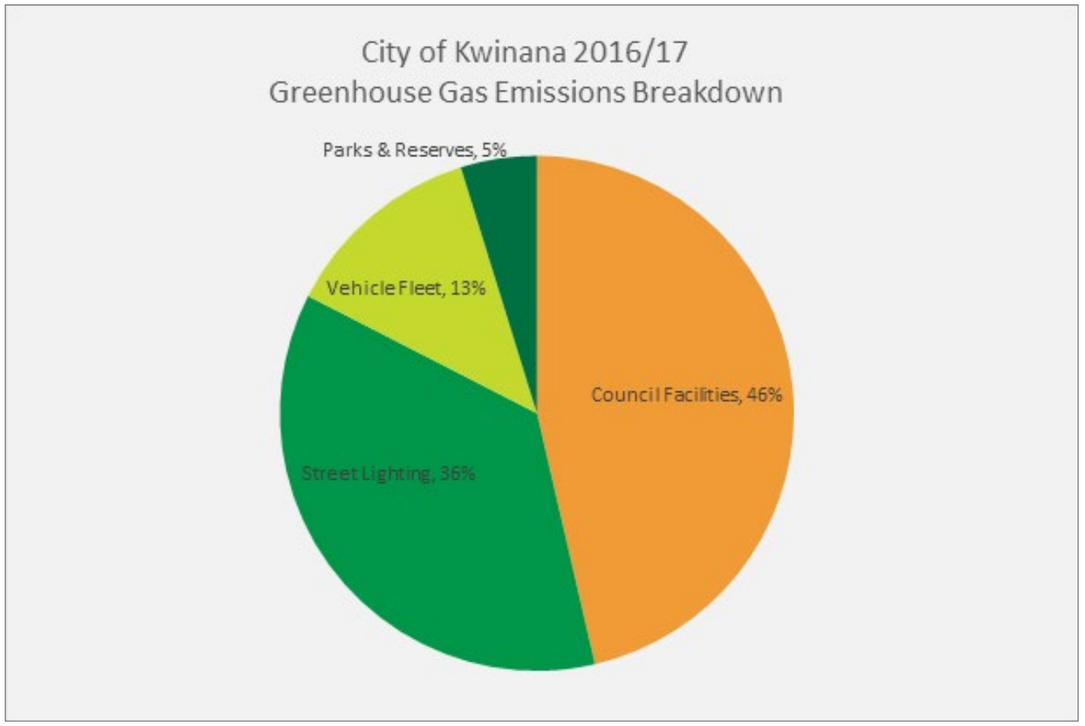

Figure 3. Emissions breakdown by facility type

Figure 3 above demonstrates that Council facilities and Streetlights are the major energy consumers in the City highlighting the need to focus action on these areas.

The City's Street Vision Agreement for streetlights is the second highest emitter. In the past the City has had limited ability to reduce the energy consumption of these lights as Western Power owns them and there were no approved LED lighting types the City could use. Streetlight consumption had therefore been excluded from the City's greenhouse gas inventory.

This has recently changed, with energy efficient lighting types being investigated by Western Power. The City will be able to pay to have these installed and receive a lower tariff from Synergy. It is anticipated that Synergy will release these new tariffs at the end of 2018. This is a significant opportunity to reduce the City's greenhouse gas emissions and energy costs. As part of this plan the business case for paying to change these lights will be prepared when these new tariffs are released. To account for this, streetlight consumption has now been included in the inventory.

The majority of electricity consumption in City buildings is from the Recquatic Centre and the Darius Wells Library and Resource Centre as can be seen in Figure 4 below. This plan therefore focuses on these sites. All of the sites below are contestable or potentially contestable in the near future[1]. These sites will therefore be monitored to ensure we are receiving the best tariff.

1 Contestable means the City is not required to use Synergy as a supplier and is able to take the supply of the electricity to market potentially getting a cheaper tariff. Sites with consumption over 50,000kWh per year are contestable.

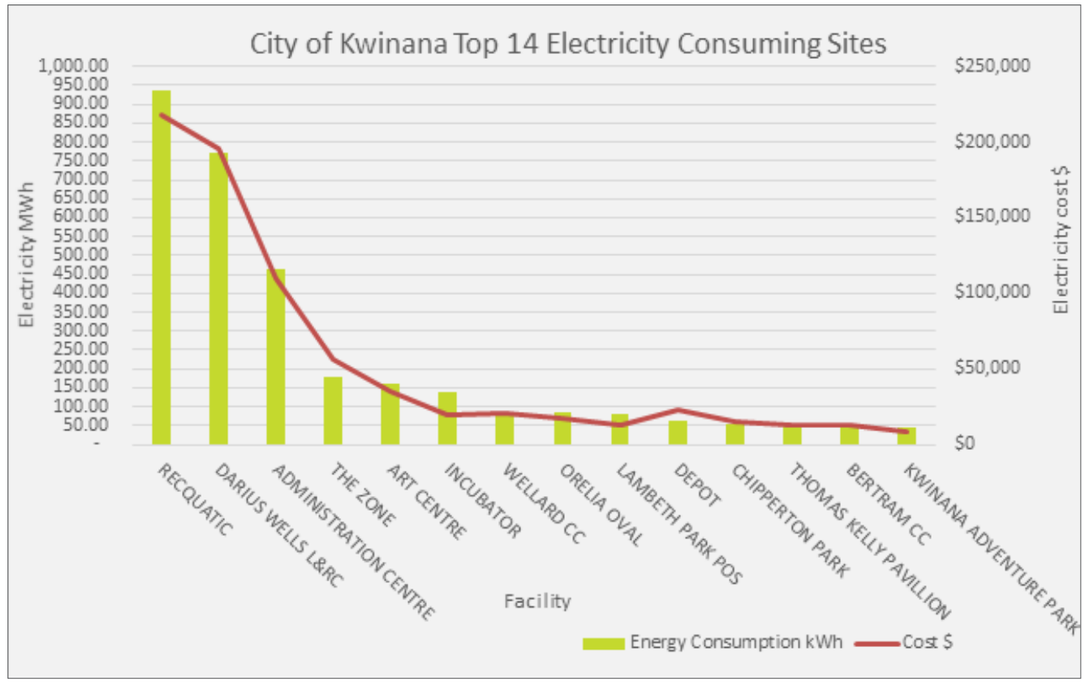

Figure 4. Top 14 City facilities by electricity consumption

PROGRESS TO DATE

Since the original plan was adopted in 2015 different departments have implemented a number of the actions within this plan to reduce carbon emissions in the City's operations. These are listed below.

Installed solar panels on the Darius Wells Library and Resource Centre (100kW), Adventure Park (8kW), Business Incubator (15kW) and Bertram Community Centre (10kW). In total the City now has 163kW of solar capacity installed on a variety of buildings which save approximately $58,000 in electricity costs every year.

- Completed installation of real time energy monitoring on the Recquatic.
- Conducted energy audits at the Administration Building, Koorliny Arts Centre and the Incubator.
- Installed a Building Management System at the Darius Wells Library and Resource Centre which allowed air conditioning system timers to be altered and therefore their energy use to be drastically reduced. This is saving approximately $15,000 in electricity costs a year and significantly reduced maintenance costs as the old system required frequent maintenance call outs.
- Implemented an office food waste recycling system and rationalised under desk bins.
- Purchased two pool bikes for staff use.
- Developed and adopted a Green Building Policy (new and renovated Council buildings) January 2018.
- Developed a draft Bike and Walk Plan.
- Implemented the 'Paper Cut' system of printing which requires staff to release print jobs using their security cards. This system has been found to significantly reduce wasted printing.

Community Education and Engagement

The City can also play a role in educating the community about climate change issues by delivering education and engagement programs. Existing initiatives include;

- Living Smart Sustainable Living Courses – a seven week sustainable living course for residents has been delivered annually for the past 3 years. This course includes modules on home energy efficiency and renewable energy.
- Switch Your Thinking – The City recently joined Switch Your Thinking, a regional organisation of Councils that delivers sustainability programs to the public. As part of this the City receives public education workshops, access to the Rewards for Residents and Rewards for Businesses program, recognition programs like Switched on Schools and Switched on Businesses, Competitions such as the Young Reinventor of the Year program as well as other grant funded projects.

An environmental education strategy will be completed by the City in the 2018/19 financial year. This will incorporate broader sustainability issues, not just climate change. These existing education initiatives may be included and expanded on in this strategy.

Climate change mitigation goals

The following goals were selected when the Climate Change Mitigation and Adaptation Plan (2015) was prepared.

a) The City of Kwinana will reduce carbon dioxide equivalent emissions by 10% below 2009/10 levels by 2020.

This goal was felt to be ambitious but achievable. The IPCC estimates that we need to reduce global anthropogenic greenhouse gas emissions by 40% to 70% by 2050 compared to 2010 (IPCC, 2014). The goal was chosen to align with this broader objective.

However, we now have 3 additional years of carbon emission data which is demonstrating the rate of growth of the City and just how difficult it will be to achieve this goal. In addition streetlight emissions have now been included in the data and carbon emissions increase each time a new development is handed over for the City to manage. By projecting this growth to 2020 the City would need to achieve an annual reduction of approximately 3424 tonnes per

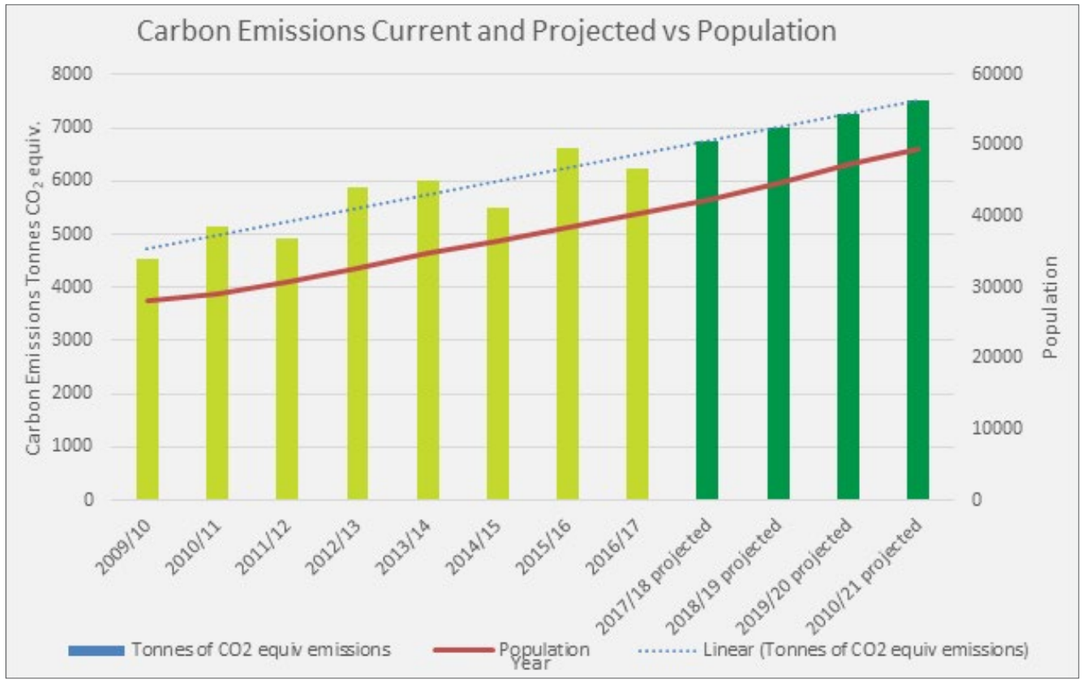

Figure 5. City of Kwinana (own operations) greenhouse gas emissions (current and projected) vs population

Figure 5 above demonstrates that there is a close relationship between carbon emission growth and population growth and therefore a per capita goal would be a valid approach to goal setting.

Business as usual emissions per capita are provided in Figure 6 below and this indicates a slight decline in emissions per capita over that time. A 10% reduction in per capita emissions does therefore seem to be a more achievable goal. This would require a carbon reduction of approximately 293 tonnes per annum.

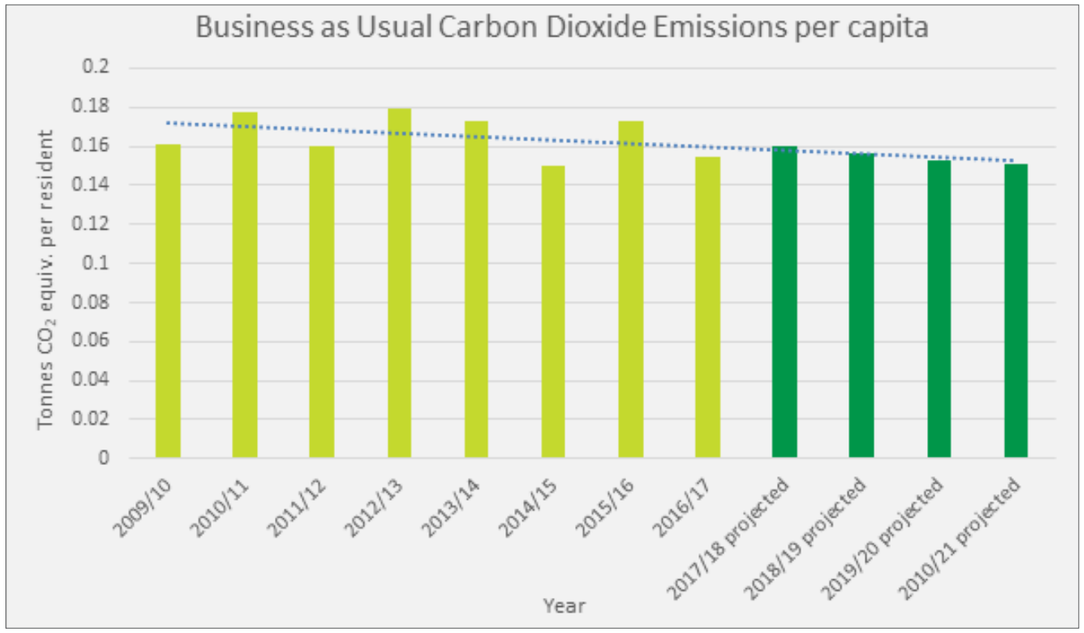

Figure 6. City of Kwinana (own operations) carbon dioxide emissions (current and projected) per capita.

Further details on how this data was collated and the emission reductions required to achieve the goal are provided in Appendix D.

The City's new carbon reduction goal is therefore;

- The City of Kwinana will reduce carbon dioxide equivalent emissions from our own facilities by 10% per capita of resident population below 2009/10 levels by 2020.

Climate change adaptation goals and actions

Climate change impacts are wide ranging and our ability to adapt to the impacts is difficult to quantify. Setting an overall goal to adapt to climate change is therefore very difficult.

The major threats from climate change were discussed at the review meeting on the 22 March 2018 and it was agreed that the major threats that are most relevant to the City are;

1. Rising sea levels;
2. Reduced water availability; and
3. Temperature change (heat waves and bushfire risk)

Rising sea levels are being addressed through the City's Coastal Adaptation Plan. The recommendation actions from this report have been included in this review.

Reduced water availability is being addressed through the City's new Sustainable Water Management Plan which was developed at the same time as this review. The following goals for water use reductions were set as part of this plan.

- To reduce scheme water consumption by 5% on 2016/17 levels by 2023.
- Maintain groundwater abstraction at 2016/17 levels until 2023.

Bushfire risk is addressed through the City's Essential Services team and also through reducing fuel in the City's reserves.

The remaining impact which has not been substantially addressed by the City is heat waves. The major action a local government can take to reduce the impact of heat waves is to increase trees in urban areas. Trees can provide a cooling effect of up to 8 degrees in urban areas as well as providing many other benefits (Moore, 2009). The major proposed climate change adaptation action in this strategy therefore relates to an accelerated street tree planting program, particularly in areas which currently have a very low street tree canopy coverage, such as Bertram. The original strategy adopted the aspirational street tree planting goal of - The City of Kwinana will establish a street tree in front of every house. Where this is not possible the tree will instead be planted in another public area.

Given the industrial nature of Kwinana and the fact that there are large areas that are non-residential a minor amendment to this goal has been suggested. It is therefore proposed that the Council adopt a goal of;

- The City of Kwinana will establish a street tree in front of every property. Where this is not possible the tree will instead be planted in another public area.

This recognises the work the City has done planting street trees in the industrial areas. The feasibility of achieving this goal will depend on the results of a full street tree survey which is included in this plan and is currently underway. This will determine how many street trees are required to meet this goal and therefore what the costs of the initiative will be. The timeframe, costs and strategy for doing this will be further explored through this survey. A lack of data should not prevent action and in the meantime the City has invested in an annual program of street tree planting in Bertram and the Kwinana Industrial Area.

Implementation Plan

Below is a list of revised actions to abate the City's carbon emissions or adapt to climate change. The actions and priorities in this list may vary as circumstances and technologies change and funding opportunities become available. Each action is identified as new or existing to identify actions that have been carried forward from the previous version of the plan. Actions that relate to Cities Power Partnership (CPP) pledges are noted under the relevant action. The full list of pledges is provided in Appendix B.

No.	Mitigation (M) or Adaptation (A)	Action	Responsibility	Timeframe	Budget and source	Measure of success	Projected tonnes CO^2 abated and cost savings per annum
		Existing Progressively install solar panels on council buildings including (but not limited to); John Wellard Community Centre (30kW) Pergola at Parkfield Lake to assist with pumping costs (5kW). (Cost does not include pergola). Fiona Harris Pavilion (10kW) Family Day Care (5kW) Medina Hall (5kW) Wellard Pavilion (10kW) Casuarina Fire Station (5kW) Mandogalup Fire Station (5kW) CPP Renewable Energy Pledge 3	Environment	2020	$75,000 Council budget and/ or loans	Renewable energy generated	John Wellard (30kW) – 32 tonnes CO^2 $8,300 p/a Fiona Harris and Wellard Pavillions (10 kW each) – 11 tonnes CO^2 and $2,800 pa each. Family Day Care, Medina Hall, Casuarina Fire Station, Mandogalup Fire Station, Parkfield Lake (5kW each) – 5 tonnes CO^2 and $1,200 pa each. Total - 76 tonnes of CO^2 and $26,000 per year.
	M	*New* As part of the Administration Building re-furbishment – Investigate the upgrade of the HVAC system. Install a Building Management System. Redesign lighting to meet AS lighting levels and replace luminaires with efficient types such as fluorescent or LED. Install solar panels on the Administration building and Koorliny Arts Centre to offset power use. CPP Energy Efficiency Pledge 2	Environment/ Building/Assets	2020	$90,000 (solar panels) $830,000 (HVAC) Council budget and/ or loans	Renewable energy generated (solar panels). Energy saved	Solar panels - 97 tonnes of CO^2 and $31,000 per year (90kW system). HVAC upgrade – 70 tonnes CO^2 and $100,000 per year (saved electricity and maintenance costs)
	M	*New* When a new Depot is constructed - Construct as a 5 star Greenstar rated (or equivalent) building according to the Green Building Policy. CPP Energy Efficiency Pledge 2	Environment/ Building/Assets	Timing to be determined.	N/A	Reduced energy consumption compared to a "standard" building.	To be quantified when buildings designed
	M	*New* Consider LED sports lighting for oval lighting renewal or installation projects. CPP Energy Efficiency Pledge 3	Engineering	2020	To be determined at the time of the project.	Reduced energy use.	LED lighting uses at least 50% less energy than standard lighting.
	M	Include green vehicle and life cycle costing in procurement requirements for vehicles. CPP Sustainable Transport Pledge 1	Environment/ Procurement	2020	$0 Likely to be cost neutral depending on cars selected.	Reduced fuel consumption	Dependent on cars selected.

No.	Mitigation (M) or Adaptation (A)	Action	Responsibility	Timeframe	Budget and source	Measure of success	Projected tonnes CO^2 abated and cost savings per annum
6	M and A	*New* Develop and adopt an Urban Forest Plan. This includes; Collecting urban tree asset data. Collecting remote sensing tree canopy and coverage and health data. Targeted projects to improve canopy cover in areas with low canopy cover at the moment. Avoiding urban canopy loss through land clearing. Education of the public about the value of tree assets.	Engineering/ Environment	2020	Street trees are likely to cost approx $400 per tree (includes a 45L tree, planting and two years of watering)[2]	Number of new trees planted in the urban forest.	N/A
7	M and A	*Existing* Continue the current street tree infill program in the Kwinana Industrial Area and Bertram.	Engineering	Annual	$100,000 per year	Approximately 400 street trees planted per year.	66 tonnes. Approx 1 tonne for 6 trees planted.
8	M	*Existing* Investigate the use of recycled materials in road base.	Environmental Health/ Engineering	2020	To be determined if feasible.	Tonnes of waste recycled.	Changes to be quantified when exact site and volume of recycled material is known.
	M	*Existing* Investigate a public transport subsidy as an incentive for staff to take public transport.	Environment	2020	To be determined if feasible.	Number of staff participating and number of car kilometres avoided.	To be quantified at completion of project.
9	M	*New* Investigate working with tenants through building up grade finance to improve the energy efficiency of the buildings they occupy. CPP Renewable Energy Pledge 6	Environment/ Building Managers	2020	To be determined if feasible.	Reduction in electricity use	To be quantified at completion of project.
10	M and A	*New* Work with residents of Callistemon Court and Banksia Park Retirement Estate to support the installation of solar panels through direct purchase (for lease for life tenants) or through building upgrade finance for tenants. CPP Renewable Energy Pledge 6	Environment/ Retirement Villages	2020	$0	Number of solar panels installed.	Each 3KW system will save about $570 a year for the resident and 4.3 tonnes of CO^2.

2 Street tree costs were estimated by Engineering Services

No.	Mitigation (M) or Adaptation (A)	Action	Responsibility	Timeframe	Budget and source	Measure of success	Projected tonnes CO^2 abated and cost savings per annum
		New Conduct a Australian Standards Level 3 energy audit and renewable energy feasibility study at the Recquatic This may include; Establishing an energy performance contract to reduce energy use at the building. Installing further sub-metering and monitoring. Installing further solar panels or a co-generation system. Refining current pump and HVAC system settings to improve system performance. CPP Energy Efficiency Pledge 2					To be determined by audit. Savings identified are usually significantly more than the audit cost and enable money to be spent on the most effective projects.
		New Conduct an Australian Standards Level 3 energy audit at the Darius Wells Library and Resource Centre This may include; Establishing an energy performance contract to reduce energy use at the building. Installing further sub-metering and monitoring. Refining current HVAC system settings to improve system performance. CPP Energy Efficiency Pledge 2					To be determined by audit. Savings identified are usually significantly more than the audit cost and enable money to be spent on the most effective projects.
		New Install Real Time Monitoring at the Darius Wells Library and Resource Centre and refine HVAC system settings based on this data. CPP Energy Efficiency Pledge 2					
		New Prepare a business case for retrofitting Western Power Streetlights with LED's from their range of approved luminaires. (Once Synergy tariffs are made available for these lighting types which is expected to be in December 2018). If favorable, begin a streetlight replacement program. CPP Energy Efficiency Pledge 3	Environment	2020	Costs will be established as part of the business case. Currently replacement costs are estimated at $500 per light.	Reduction in energy use.	To be quantified as part of business case. LED streetlights typically use at least 50% less energy than the existing streetlights.

No.	Mitigation (M) or Adaptation (A)	Action	Responsibility	Timeframe	Budget and source	Measure of success	Projected tonnes CO^2 abated and cost savings per annum
17	A	*New* Attach a street tree education program to the current Adopt a Verge program to encourage ratepayers to value and look after their street trees.	Environment/ Engineering	2020	$500 (small promotion budget)	Reduction in requests to remove street trees. More street trees requested.	N/A
18	A	*New* Develop a Sea Level Rise Policy incorporating the projections completed as part of the Cockburn Sound Coastal Alliance project. Incorporate special control areas and development controls into the review of the Local Planning Strategy.	Planning/ Environment	2020	Officer time	Policy and Strategy Adopted and implemented.	N/A
19	M and A	*Existing* Deliver an annual seven week sustainable living course. CPP Work Together and Influence Pledge 4	Environment/ Darius Wells Library and Resource Centre	2020	$6,500 Council budget	Participation rates, Feedback from participants.	Feedback from participants on changes they have made and the reductions in carbon emissions as a result of this.
20	M and A	*New* Engage with schools, local businesses and sporting groups to encourage them to consider energy efficiency and renewable energy. CPP Work Together and Influence Pledge 4	Environment	2020	$0	Uptake of technologies by schools and businesses.	Reduction in energy use.

No.	Mitigation (M) or Adaptation (A)	Action	Responsibility	Timeframe	Budget and source	Measure of success	Projected tonnes CO^2 abated and cost savings per annum

PROGRAMS AND ONGOING PROJECTS

		Existing Continue to collate a carbon inventory each year and work towards collecting Scope 3 data such as paper use and waste. (see Appendix C) .	Environment	Annual	$5,000 per year for software costs.	Ability to identify high priority sectors of the City and track changes over time.	N/A

GOVERNANCE

25	M	*Existing* Continue to use a cross-functional environmental team to consider Council environmental initiatives.	All staff	2020	Dependent on initiatives proposed by the group.	Participation and input from staff.	N/A

Financial implications of the Climate Change Mitigation and Adaptation Plan

Financial analysis is completed on all renewable energy and energy efficiency projects that deliver costs savings. The financial measures calculated include;

- Net Present Value (NPV) - the amount of money that will be returned to the City through the project in today's dollars.
- Internal Rate of Return (IRR) – The rate of return equivalent to investing money in the bank.
- Pay back period – how long it will take for the project's savings to cover the upfront cost.

This is to ensure that the projects present value for money.

As an example Action 1 in the action table above proposes the installation of 70KW of solar panels on a variety of buildings. The financial analysis revealed that this would return to the City a Net Present Value of $344,000, an Internal Rate of Return of 33% and pay back period of 4 years. This is an excellent return on investment.

The impressive financial returns on solar panels allow the City to access low interest loans to fund the implementation costs if they can not be funded out of the budget although paying interest on a loan will reduce the Net Present Value.

Solar panels generally offer the best returns but other energy efficiency measures also offer good returns. For example replacing the HVAC system in the Administration building would deliver a Net Present Value of approximately $222,000 and 8% Internal Rate of Return.

There are a number of reasons why the system should be replaced as soon as possible as part of a re-furbishment of the Administration Building;

1. The system is reaching the end of its serviceable life and requires significant reactive maintenance. In 2015/16 this was approximately $96,000 when expected maintenance costs should be about $17,000 per annum.

2. If the current system fails suddenly, a replacement will be required at short notice. An energy audit undertaken in 2016 states that;

   - "Replacement should be scheduled in the next 2 to 3 years, as after that a major failure could be very disruptive as it would involve replacing BOTH the indoor and outdoor unit in each case which may take several weeks, seriously disrupting council" (Councillor Lounge and Council Chambers) (Healey Engineering, 2016) and;
   - "Being large ducted units replacement of a failed unit will be highly disruptive unless planned ahead. A direct replacement unit may not be available on short notice , and the process of recommissioning the complex control systems will take several days at least. The replacement should be planned and decided in advance"(Council offices) (Healey Engineering, 2016)

   An unplanned replacement would also be unbudgeted and could be more expensive than a planned replacement due to potential supplier issues with sourcing equipment at short notice and expediting installation.

4. Replacing the system as part of the Administration Building re-furbishment will allow the systems to effectively and easily interface with any building management system that is installed allowing further reductions in energy consumption (and avoiding costs associated with trying to match the systems later).

5. Several of the systems use the refrigerant R22 which is being phased out of use and is no longer manufactured under the Montreal protocol. This refrigerant is becoming more difficult and expensive to source (Healey Engineering, 2016). Therefore these systems are likely to need to be replaced in the near term anyway.

Given these issues, a planned replacement should occur as part of the Administration Building re-furbishment. This would allow the City time to investigate the most cost effective option for a piece of equipment that will affect the City's energy consumption, maintenance costs and occupant comfort for 10-15 years. The NPV calculation also demonstrates that this is by far the most cost-effective option rather than carrying on with the current system.

The cost to the City of formally offsetting any remaining carbon emissions required to achieve the City's goal is currently anticipated to be based on approximately 87 tonnes. The additional solar panels, if installed, would save about 70 tonnes. Replacing the HVAC in the Administration Building would save 55 tonnes. If both of these projects are implemented, then there should be no need for offsetting. If there was to be an offset, the cost for offsetting is likely to be about $20 a tonne. For example, if the City had to offset 50 tonnes the likely cost would be approximately $1000 which could be funded from the City's Revolving Energy Fund.

The cost of the delivery of the entire plan will vary depending on when and how the projects are implemented. For example if the business case for replacing streetlights is favorable this will be an upfront capital cost that is not included in this plan and would need to be included in future budgets based on the business case. Likewise, if it is decided that a full renovation of the Administration Building is to be completed the cost of the HVAC replacement and lighting re-furbishment would likely be included in the renovation costs. Energy audits may also provide suggestions for actions which will be submitted for endorsement with a business case.

Monitoring and review

The City's Climate Change Mitigation and Adaptation Plan will be reviewed at the end of 2020, when a new plan will be drafted.

References

Climate Commission, 2011, The Critical Decade: Western Australian Climate Change Impacts. www.climatecouncil.org.au/uploads/e0d4e50478b96d1a50c821b7b2c022a4.pdf

Climate Council, 2018, About us, website www.climatecouncil.org.au/about-us

Climate Council, 2014, Heatwaves: Hotter, Longer, More Often www.climatecouncil.org.au/uploads/9901f6614a2cac7b2b888f55b4dff9cc.pdf

Climate Council, 2017, Angry Summer 2016/17: Climate Change Super-Charging Extreme Weather, www.climatecouncil.org.au/resources/angry-summer-report/

City of Kwinana, 2013, Sustainable Water Management Plan www.kwinana.wa.gov.au/Documents/Publications/D13-54830--Sustainable-Water-Management-Plan-FINAL

City of Kwinana, 2017, Strategic Community Plan 2017-2027, www.kwinana.wa.gov.au/our-council/publications-reports/Publications/Strategic%20Community%20Plan%202017-2027.pdf

Cities Power Partnership, 2018, website - citiespowerpartnership.org.au/what-is-the-partnership/

Dr Moore, Gregory, 2009, People, Trees, Landscapes and Climate Change, Climate Change: On for Young and Old, Future Leaders.

EPA Victoria, 2013, Greenhouse Gas Emission Factors for Office Copy Paper www.epa.vic.gov.au/~/media/Publications/1374%201.pdf

GHD & Southern Metropolitan Regional Council, 2009, Climate Change Risk Assessment and Adaptation Action Plan for the Southern Metropolitan Councilshttp: www.coastaladaptationresources.org/PDF-files/1387-FINAL-env_Climate-Change-Risk-Management-and-Adaptation-Action-Plan-Report_ps061009.pdf

GHD, 2016, Kwinana Coastal Adaptation Plan

Healey Engineering, 2016, Energy Audit Report of City Administration Building and Kooriliny Arts Centre for City of Kwinana, WA

IPCC, 2014, Fifth Assessment Synthesis Report Approved Summary for Policymakers www.ipcc.ch/pdf/assessment-report/ar5/syr/SYR_AR5_SPM.pdf

WA Today, 2018, Summer rain smashes Perth weather records with wettest January in 18 years, www.watoday.com.au/national/western-australia/summer-rain-smashes-perth-weather-records-with-wettest-january-in-18-years-20180116-h0ite4.html

Appendix A Climate Change Mitigation and Adaptation Plan. Actions from original plan and notes on progress.

No.	Mitigation (M) or Adaptation (A)	Action	Notes on progress
1	M	Progressively install solar panels (or wind power if financially preferable) on council buildings including (but not limited to); Darius Wells Library and Resource Centre (100kw) Business Incubator (approx 15kw) John Wellard Community Centre (approx 30kw) Bertram Community Centre (5kw) Fiona Harris Pavilion (5kw) Family Day Care (5kw) Medina Hall (5kw) Thomas Kelly Pavilion (26 kw) Feilman Centre (20kw) (when renovated and tenanted) Koorliny Arts Centre (20kw) (when re-wired) Administration Building (5kw) Depot (30kw) (when the use of the building is known)	Yellow highlighted installations have been completed. Red highlighted installations have been removed as their consumption profile is not suitable or they are now tenanted. Blue highlighted systems have been on hold until the future of the buildings was determined. The John Wellard Community Centre system is planned to proceed in the 2018/19 financial year. The sizing of some of the systems has changed slightly as more detailed planning has progressed and the consumption profile and roof area available has been more accurately determined (eg Bertram Community Centre now has a 10kW system rather than a 5kW system). The cost of solar panels has come down significantly since the report was originally adopted. Wind power is now no longer likely to be a financially preferable option.
2	M&A	Investigate green building options when planning new Council buildings.	Complete – A Green Building Policy for new and renovated buildings has now been adopted. It is being used for the refurbishment of the Administration Building.
3	M&A	Develop and adopt a Landscape Strategy which addresses the development and maintenance of an "urban forest". This includes; Surveying and valuing urban trees. Targeted projects to improve canopy cover in certain areas with low canopy cover at the moment. Replacing dead trees after removal Education of the public about the value of tree assets. Using new plantings as carbon offsets.	This has evolved into an "Urban Forest Strategy" in this review and will now likely involve aerial capture of data.
4	M	Form a green office team as a working group to consider a range of office environmental initiatives including; Composting of Council office building kitchen scraps. Reducing the use of disposables. Rationalising under desk bins.	The Waste Management department have completed these initiatives. It did not require the formation of a green office team.
5	M	Investigate the use of recycled materials in road base.	Not yet complete. Carried over into this review.

6	M	Investigate working with sporting clubs to reduce their electricity use in the City's sporting facilities.	Not yet complete. Carried over into this review.
7	M	Develop a triple bottom line planning policy which includes measures to reduce the carbon emissions of new developments by supporting retention of vegetation, active transport and passive solar design.	A planning policy to support the retention of vegetation has been adopted. The remaining items are addressed by Liveable Neighborhoods.
8	M	Investigate a public transport subsidy as an incentive for staff to take public transport to work.	Not yet complete. Carried over into this review.
9	M&A	Conduct a green wall demonstration project.	Further research has indicated that other actions such as street tree planting may provide greater value for money for urban greening. This has been removed from the action list.
10	M	Conduct an energy audit at the Recquatic centre to determine any power savings from the pool plant refit, real time monitoring and air curtain as well as identify any further savings that can be made. Conduct energy audits at other high consuming sites and implement recommendations where cost effective.	Not yet complete. Budgeted for 2018/19.
11	M	Install LED lighting in 3 major facilities. For example, the Administration Building, Feilman Centre and the Koorliny Arts Centre. This can only be done at the Feilman Centre once it has been renovated and tenanted and the Koorliny Arts Centre once it is rewired.	Energy audits conducted at the Administration Building, Incubator and Koorliny Arts Centre indicated that this was not a cost effective option unless a refurbishment was taking place. LED lighting requirements have been incorporated into planning for the Administration building refurbishment.
12	M	Conduct a survey of timer use for air conditioning in buildings and install timers or adjust settings where necessary.	Complete for Darius Wells Library and Resource Centre. The energy audit will inform this for the Recquatic.
13	M	Commence collecting key scope 3 data for the City's carbon inventory.	Re-worded to include completing a full carbon inventory each year.
14	M&A	Expand the City's tree planting program in reserves to act as offsets for our emissions.	Re-worded to clarify. Now states that we will assess the carbon offsets of our own plantings using certified methods.
15	M	Investigate the business cases for: taking over maintenance of Western Power street lights in order to install efficient lighting types, switching to CFL street lights under Western Power's current rules, Taking over LED street lighting in new developments.	Not yet complete. Will be conducted when the new tariffs for LED streetlights are released in late 2018.
16	M&A	Amend the Town Planning Scheme to allow zoning concessions for sustainable design.	Not yet complete. The Town Planning Scheme is unlikely to be reviewed in the remaining two years of this strategy so it has been removed from the action list.
17	M&A	Investigate supporting the establishment of a sustainable building or development demonstration site within the City.	The Economic Development officer felt this would be extremely difficult to achieve at this stage so it has been removed from the action list.
18	M&A	Investigate trialing an off grid or hybrid power system at a Council facility (new building).	This is being considered alongside a diesel generator for back up power for the City's servers as part of the Administration Building refurbishment.
19	M	Examine the City's Business Continuity Plan to see if climate change impacts have been adequately considered.	It was decided that this is not a priority for the coming two years.

20	M&A	Establish an Environmental Reference Group comprised of members of the public, to guide the environmental activities of the City.	It was decided that this is not a priority for the coming two years.
21	M	Progressively install power data loggers on Council buildings to quickly identify spikes in energy usage.	Synergy now provides interval data for sites with certain meters on its website for free so this action is not necessary.
22	M&A	Deliver seminars and events with an environmental theme as part of the Darius Wells term program.	Complete and ongoing – Living Smart, Green Building seminar, Energy Cut for Businesses seminar, Cutting Kitchen Waste seminar.
23	M&A	Deliver an annual 7 week "Living Smart" sustainable living course	Complete and ongoing.
24	M	Install real time electricity monitoring and an air curtain at the Recquatic Centre.	Complete
25	A	Continue implementation of the City's Sustainable Water Management Plan.	Ongoing
26	M	Purchase fleet bikes for staff use.	Complete
27	A	Continue to participate in the Cockburn Sound Coastal Vulnerability Project.	Complete
28	M	Support WALGA's advocacy efforts to improve adoption of energy efficient lighting in street lights.	Ongoing

Appendix B Cities Power Partnership Pledges

Pledges were taken from the Cities Power Partnership website - http://citiespowerpartnership.org.au/what-is-the-partnership/

RENEWABLE ENERGY

1 Use strategic and statutory planning processes to promote renewable energy – both at the residential, commercial and larger scale.

2 Provide council resources to educate and support the uptake of renewable energy, such as by hiring an internal renewable energy support officer or establishing an independent body (such as the Moreland and Yarra Energy Foundations).

3 Install renewable energy (solar PV and battery storage) on council buildings for example childcare facilities, libraries, street lighting, recreation centres, sporting grounds, and council offices.

4 Support community facilities accessing renewable energy through incentives, support or grants.

5 Power council operations by renewables, directly (with solar PV or wind), or by purchasing Greenpower (from electricity retailers). Set targets to increase the level of renewable power for council operations over time.

6 Encourage local businesses and residents to take up solar PV, battery storage and solar hot water heating. This can be done through providing incentives (such as solar bulk buy schemes or flexible payment options) or streamlining approval processes (such as removing planning and heritage barriers to solar PV).

7 Support community energy projects (with location and planning support) so that residents (such as renters) can band together and invest in community renewable energy projects.

8 Opening up unused council managed land for renewable energy, for example land fills, and road reserves.

9 Facilitate large energy users collectively tendering and purchasing renewable energy at a low cost.

10 Set minimum renewable energy benchmarks for new developments, for example Denman Prospect, ACT requires every new house to install a minimum solar PV system.

11 Electrify public transport systems (for example buses operated by council) and fleet vehicles and power these by 100% renewable energy.

12 Lobby electricity providers and state government to address barriers to renewable energy take up at the local level (whether these be planning, technical, economic or policy related).

13 Identify opportunities to turn waste to energy.

14 Implement landfill gas methane flaring or capture for electricity generation.

15 Create a revolving green energy fund to finance renewable energy projects and receive $ savings.

ENERGY EFFICIENCY

1 Set minimum energy efficiency benchmarks for all planning applications.

2 Adopt best practice energy efficiency measures across all council buildings, and support community facilities to adopt these measures.

3 Public lighting can use a large proportion of a city's energy budget – roll out energy efficient lighting (particularly street lighting) across the municipality.

4 Provide incentives (for example rate reductions) for best practice developments such as streamlined planning processes, and support for retrofitting energy efficiency measures for existing buildings.

5 Incentivise the deployment of energy efficient heating and cooling technologies.

6 Create a revolving green energy fund to finance energy efficiency projects and receive $ savings.

SUSTAINABLE TRANSPORT

1 Ensure Council fleet purchases meet strict greenhouse gas emissions requirements and support the uptake of electric vehicles

2 Provide fast-charging infrastructure throughout the city at key locations for electric vehicles.

3 Encourage sustainable transport use (public transport, walking and cycling) through Council transport planning and design. Substantial savings in transport energy use can be achieved by designing more compact cities with access to high quality public and active transport services and facilities.

4 Ensure that new developments are designed to maximize public and active transport use, and are designed to support electric vehicle uptake.

5 Providing for adequate cycle lanes (both space and connectivity) in road design and supporting cyclists through providing parking, and end-of-ride facilities (covered, secure bike storage, showers, bicycle maintenance and incentives).

6 Reduce or remove minimum car parking requirements for new housing and commercial developments where suitable public transport alternatives exist.

7 Lobby state and federal governments for improvements to planning legislation to promote sustainable transport options, and increased investment in and provision of public transport services.

8 Consider disincentives for driving high emitting vehicles such as congestion pricing, or a tiered payment system for residential car parking permits where high emitting vehicles pay more.

9 Waste collection fleet conversion to hydrogen fuelled or electric power.

WORK TOGETHER AND INFLUENCE

1 Set city-level renewable energy or emissions reduction targets and sustainable energy policies to provide a common goal and shared expectations for local residents and businesses.

2 Lobby state and federal government to address barriers to the take up of renewable energy, energy efficiency and/or sustainable transport, and to support increased ambition. For example working to lobby on the Smart Energy Communities policy.

3 Set up meetings and attend events, such as the Community Energy Congress or the Cities Power Partnership Summit, where like-minded cities can address common concerns and learn from others' experience.

4 Implement an education and behavior change program to influence the behavior of council officers, local residents and businesses within the municipality to drive the shift to renewable energy, energy efficiency and sustainable transport.

5 For communities reliant on a local coal industry, local government can support the transition away from fossil fuels, by lobbying for state and federal support for a just transition for workers, families and the community and encouraging local economic development and opportunities based on a low carbon economy.

6 Ensure that the practices of local government contractors and financing such as banking, insurance and super are aligned with council goals relating to renewable energy, energy efficiency and sustainable transport. Set appropriate criteria for council procurement.

7 Promote knowledge sharing and strengthen the local community's capacity and skills in renewable energy, energy efficiency and sustainable transport.

8 Support local community energy groups with their community energy initiatives.

Appendix C Background information on baseline emissions data collection.

The City of Kwinana's CO^2 emissions inventory is completed every year. The inventory is broken down in to four main sectors:

Council Facilities: Emissions resulting from energy use (mainly electricity) of Council operated buildings.

Parks and Reserves: Emissions resulting from energy use (mainly electricity) for parks and gardens operation (mostly bore pumps).

Street Lighting: Emissions resulting from the electricity use of streetlights.

Vehicle Fleet: Emissions resulting from the energy use (unleaded petrol, LPG, & diesel) of Council operated vehicles and machinery.

All energy use is equated into a common measure of CO^2-e. This is the measure of equivalent carbon dioxide produced from each energy source. For example, methane is 21 times more potent than carbon dioxide in terms of global warming potential. Therefore, 1 unit of methane is calculated to be the equivalent of 21 units of CO^2.

Greenhouse gas inventories can be divided into 3 operational boundaries, essentially based on how closely related the activity is to the operations of the City. These boundaries are standard definitions used by the National Greenhouse Gas Emissions Reporting (NGER) standards. These are;

Scope 1 – (Direct) Fuel combustion ie company owned vehicles

Scope 2 – (Indirect) Purchased electricity for own use

Scope3 – (Indirect) Production, use and disposal of purchased materials – eg procurement, waste disposal, travel, outsourced activities, etc

Currently the City only collects Scope 1 and 2 data. Should the City ever wish to complete Carbon Neutral certification, Scope 3 emission sources are required to be calculated. Carbon Neutral certification essentially certifies that the City has zero net emissions, which is achieved through

Appendix D Explanation of mitigation goal

This strategy proposes the following carbon emission mitigation goal;

THE CITY OF KWINANA WILL REDUCE CARBON DIOXIDE EQUIVALENT EMISSIONS BY 10% PER CAPITA BELOW 2009/10 LEVELS, BY 2020.

The reduction required to achieve 10% per capita less than 2009/10 emissions is approximately 293 tonnes of CO^2. This is based on base year emissions of 4529 tonnes (including streetlighting) and factors in the projected emissions decrease of 16.1kg/person from the base year to 2020.

The City has already achieved 207 tonnes of CO^2 abatement since 2009/10 as shown in Table 1 below. This does not include any offsets from tree planting. Given the planned projects, 293 tonnes per annum appears to be an achievable goal.

Table 1. Annual CO^2 abatement achieved since base year[1].

Completed actions (towards goal)	Annual Savings $	Annual CO^2 equiv. tonnes.
Darius Wells (100kW) Solar	$35,000	111
Business Incubator (15kW)	$4,958	16
William Bertram Community Centre (10kW)	$2,814	11
Recquatic (30kW)	$9,915	33
Thomas Oval (4kW)	$2,357	6
Adventure Playground (8kW)	$3,220	9
Ventilation Fans at the Zone	$5,812	15
Air curtain at the Recquatic	$1,209	6
Running total	$65,285	207

1 Solar cost and carbon savings have been calculated based on the size of the solar system, a suppliers estimate of electricity generation and expected time of use. Savings assume a 4% increase in electricity costs per year and inverters are replaced every 10 years. Estimated savings for the ventilation fans and air curtains were provided by an electrical engineering consultant who conducted an audit of the Recquatic and Zone.

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