100% renewables

Inner West Council

100% carbon neutral and renewable roadmap – Stage 1

Final report

Date: October 2018

Contents

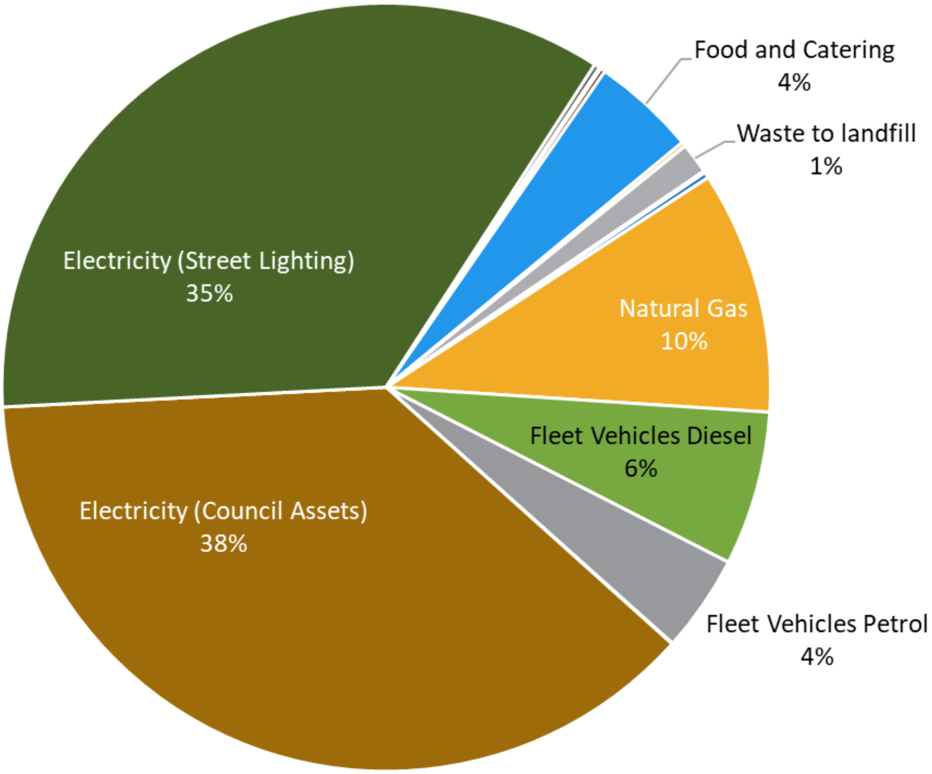
Table of figures

Table of tables

Executive summary

Inner West Council commissioned this report to undertake technical investigations and engagement to commence the development of a roadmap for Council to become carbon neutral and 100% renewable. The project is divided into two stages. This report is the result of stage 1 and provides research into available options and initial feasibility studies. Stage 2 will be about the development of a roadmap.

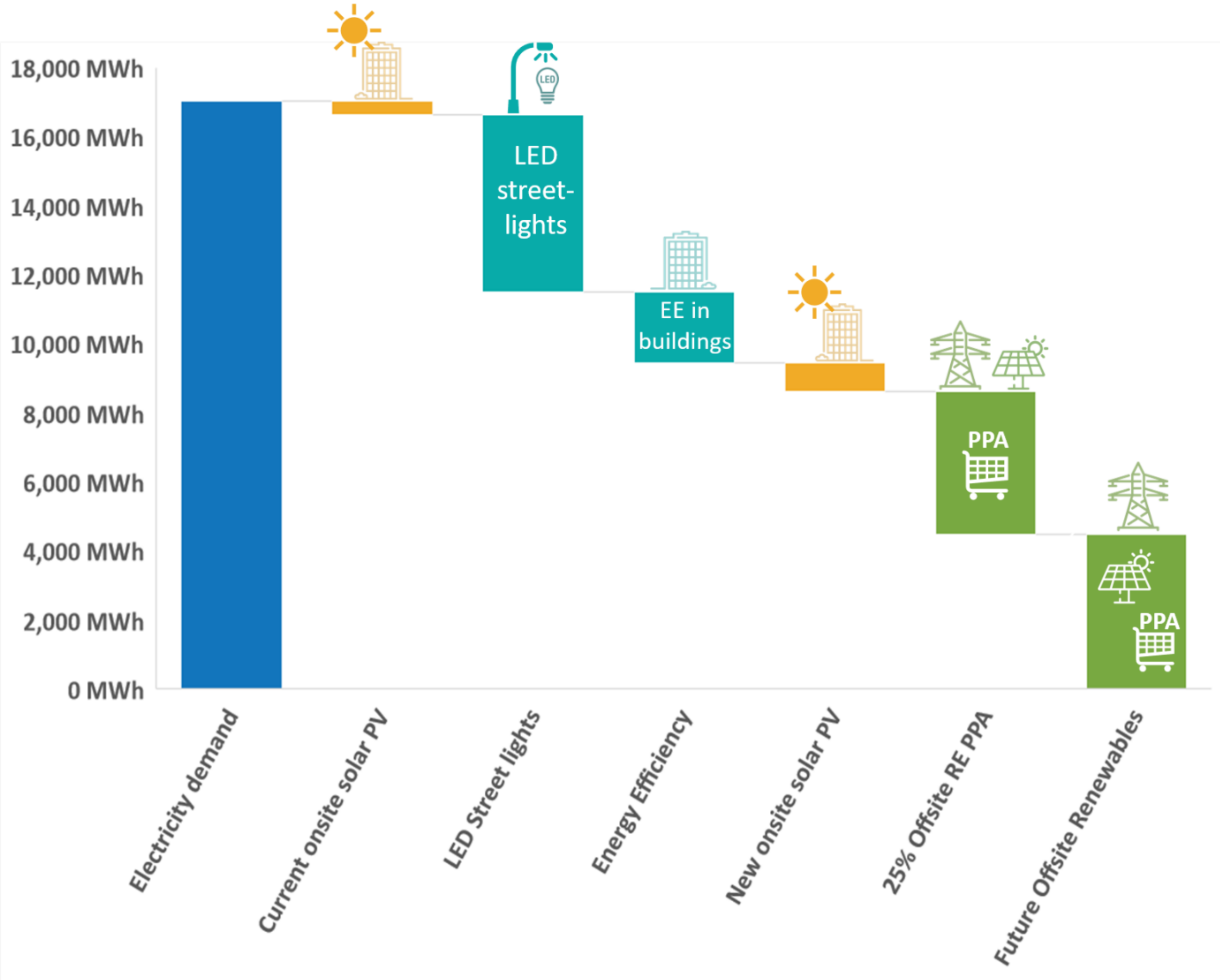
Council's carbon footprint for 2016/2017 is 21.8 kilotonnes (kt) of CO_2-e. As can be seen in the pie chart below, over 93% of emissions come from consumption of fuel and electricity in Council operations and street lighting.



Given that electricity is the main contributor to Council's carbon impact, it is a major focus of this report and the area in which the most gains can be made in terms of consumption and supply. In 2016/17, Council used approximately 16,650 MWh of grid electricity, which is equivalent to the electricity that would be generated by an 11.9 megawatt solar farm or a 5.8 megawatt wind farm[1].

A review of the options to reduce this over the near term has been undertaken, which has identified a series of steps shown in the following waterfall chart. The progression from the current electricity consumption to 100% renewable energy is illustrated, based on energy efficiency, onsite and offsite renewable energy measures.

[1] Solar PV farm at 16% capacity factor, wind farm at 33% capacity factor



Energy efficiency

Inner West Council can reduce its demand for electricity by over 7,200 MWh per year through the implementation of measures that improve energy efficiency. Efficiency potential is dominated by the savings achievable by upgrading street lighting to Light Emitting Diode (LED) technology.

This potential saving represents 43% of Council's 2016/17 electricity consumption, not including any future growth in energy demand. With growth expected to be small, savings in electricity will be in the order of 40% of future demand.

Savings in natural gas are modest, with cogeneration fuel use dominating consumption. Potential gas savings in buildings are estimated to be just 2.15% of total gas consumption.

Onsite solar PV

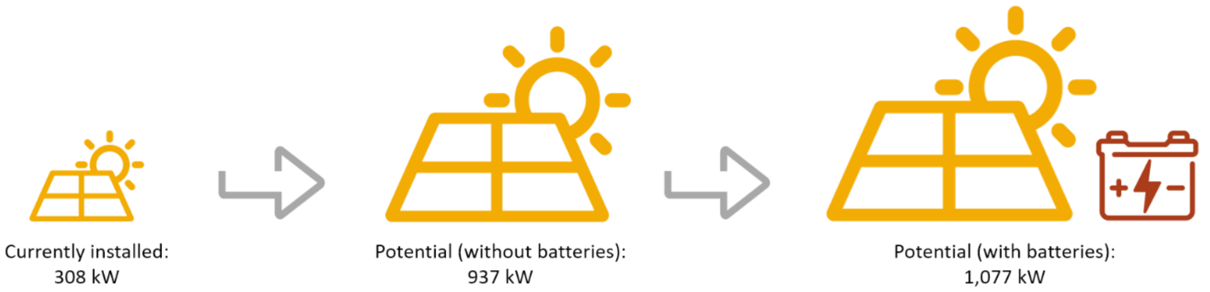
For many of IWC's assets, installing solar panels is an excellent fit, as operating hours and sunshine hours are often the same. That means that the energy generated by solar panels can be used instantly instead of buying electricity from the grid. In recent years, Inner West Council has implemented 29 solar PV systems at its sites, with 308 kWp installed that could generate 431 MWh of clean energy per year.

However, solar panels cannot be installed on every roof. Sometimes, a roof is shaded, too small, oriented to the south, structurally unsound, used for other equipment like air conditioning, or otherwise unsuitable or sub-optimal. In other cases, there might be enough roof space, but not enough electricity load in the building.

There are also network and regulatory constraints to solar energy sharing and distribution. For instance, it is not currently possible to cost-effectively have the solar generation from one site credited to another site close by. Peer-to-peer sharing of surplus solar energy with another energy user is also not feasible at this time, though limited trials are progressing to develop this idea.

These constraints mean that it is not feasible or practical at this time for Council to seek out innovative renewable energy solutions with businesses in the Inner West community, such as energy sharing or Council buying power from rooftop solar systems.

Nonetheless, site investigations carried out as part of this stage 1 work have identified the potential for a number of additional systems that can see Council's installed PV capacity rise to 937 kWp without battery energy storage, and up to 1,077 kWp of PV plus 640 kWh of storage.



Transport emissions

Council operates a fleet of heavy and light vehicles for general transport and for services such as garbage collection. The fleet is mostly located at the St Peter's depot, with smaller fleets at Leichhardt and Balmain depots and Council offices.

Current measures to reduce carbon emissions from the fleet include IWC's passenger fleet leaseback policy, which provides incentives for the uptake of more efficient vehicles and making sure that the most recent emissions standards are selected for the heavy fleet. Also, 12% of all diesel purchased is biodiesel. Future transport fuel abatement opportunities include an increase of biodiesel and ethanol purchases, hybrid, electric and hydrogen vehicles.

Offsite renewables – current PEERS program

In order to source 100% of Council's electricity from renewables, it is necessary to look outside of Council's operations, at options for sourcing renewables from 'offsite' projects. Offsite projects refer here to renewable energy projects that are owned by Council, but located outside of the Council's operations. They deliver electricity into the grid, which is then purchased by IWC for use by IWC's facilities.

Council already has experience purchasing renewables from offsite projects through the Program for Energy and Environmental Risk Solutions (PEERS) Power Purchase Agreement (PPA) buying group coordinated by SSROC. From mid-2019, IWC will purchase 4,127 MWh renewable electricity per year. As measures such as onsite solar, building efficiency and street lighting upgrades are implemented, the proportion of Council's demand that will be met by the PPA will increase. If cost-effective, there is also an option to increase Council's level of renewable energy purchasing in 2022 when the balancing electricity contract is due for renewal.

With Council's identified, planned and in-progress measures, it is feasible for its fossil fuel reliance for electricity to be reduced by 68%. If all measures are successful, just 5,311 MWh of electricity will need to be sourced in future from additional renewable energy projects, which could be generated by 3.8 MWp of solar PV capacity or 1.8 MW of wind energy capacity.

Offsite renewables - building or buying

Broadly there are two options available to Council to source the remaining amount of renewables. These include building its own renewable energy generation project or by entering into a new PPA in 2022 or beyond.

Building an offsite renewable energy project requires buying or leasing land or partnering with other parties. Due to the current regulatory framework, the energy generated needs to be bought by Council via a licensed retailer.

The current PEERS Power Purchase Agreement (PPA) covers most of Council's daytime demand, which means that Council would either need to develop a wind project or a solar and battery storage plant to be able to source 100% renewables. This is because as a NSW council, it needs to match its load with renewable energy supply – it is not possible to enter into a Contract for Difference.

There are a number of steps involved in developing a renewable energy project, and it can take many years for a project to come online. In addition, there are many risks in Council becoming a generator, especially in the current political environment with the resulting uncertainty, and the lack of experience with building, owning, operating and maintaining a large renewable energy plant.

The second option is to source the balance of the electricity demand from renewables via a second PPA, which could commence when the current PPA's balancing retail electricity contract expires in 2022. The PPA market is evolving rapidly in Australia due to increased appetite of consumers for renewable energy, ongoing energy market uncertainty and volatility, and the cost differential between regular grid power and long-term PPA prices.

Setting up a PPA does not involve Council building a renewable energy plant. Consequently, Council's main focus would be to carry out appropriate due diligence on a projects' technical and financial performance, while ensuring that the project meets Council's needs.

The required time to develop a PPA depends on whether renewables are being sourced from a new or existing project. If Council's goal is to source from new projects, then it is necessary to allow for the build phase. If existing projects are suitable, then the time frame will be much shorter.

While signing a PPA will help Council reach its carbon neutral goal while achieving an attractive financial outcome, it exposes Council to some risks that it would not otherwise have under a standard retail contract. These risks include performance, policy and market value impacts.

Recommendation for the preferred approach

The balance of evidence suggests that the current PEERS PPA and the investigation and development of a new PPA in 2022 to meet most or all of the balance of IWC's electricity demand from renewable energy is the preferred approach to meet a 100% renewable energy (electricity) goal. It is recommended that this be the main focus of Council's efforts once the new PPA agreement is entered into.

Becoming carbon neutral

Council will need to evaluate its residual carbon footprint after implementing carbon reduction measures such as energy efficiency, sustainable fleet management and procurement practices, onsite solar and offsite renewable energy solutions. Once the residual carbon footprint is known, reputable carbon offsets can be purchased to reach zero net emissions.

1

Introduction

1 Introduction

1.1 Background

Inner West Council (IWC, or Council) commissioned this report from 100% Renewables in April 2018 to undertake technical investigations and engagement to commence the development of a roadmap for Council to become 100% carbon neutral and a leader in renewable energy.

Inner West Council is a new Council formed by the merger of Leichhardt, Ashfield and Marrickville councils. Three resolutions relating to renewable energy and climate leadership were passed within the first months of the elected Council coming on board, demonstrating the importance to Council of transitioning to a low carbon future. This reflects the views of the Inner West community as expressed through the Community Strategy Plan (Our Inner West 2036).

The Council Meeting of 24 October 2017 resolved to make the Inner West region a leader in renewable energy. The resolution covered carbon emissions both in Council's operations and the broader community. The scope of this report is Council's own operations and services, and the components of the resolution relating to this scope instructed staff to provide report/s to Council on:

i. How to make the Inner West Council 100% carbon neutral by the earliest possible date, while balancing immediate actions with the need for more impactful, longer-term solutions.
ii. Making the Inner West Council a leader in solar photovoltaic (PV) energy by:
    a. Ensuring all new Council-owned developments are fitted with Solar PV cells.
    b. Working towards the retrofitting of all Council-owned buildings with appropriately sized Solar PV cells.
iii. Prioritising a solar innovation pilot, which may include a Council/Commercial Solar Power Purchase Agreement, investment in a regional solar farm partnership, and/or a local solar farm pilot.
iv. Investigating the viability of transitioning the Inner West Council vehicle fleet to an electric fleet.

Following, Council then resolved at its meeting of 12 December 2017 to investigate the feasibility of an Inner West Council Solar Farm including:

i. The business case for Inner West Council to invest in a solar farm to offset Council's electricity consumption across facilities and operations;
ii. Options to share investment and return/savings with the community, including direct community investment and/or savings passed on through rates discounts.

1.2 Project brief

Council has divided the work on the carbon neutral roadmap into two stages:

- Stage 1 - research into available options and undertake technical assessments and initial feasibility (financial/technical);
- Stage 2 - development of a roadmap containing feasible, costed, site-specific and time-bound actions for Council to become 100% carbon neutral/renewable.

Following Stage 1, Council indicated it may seek further support to pull together the information from Stage 1 into a 100% Carbon Neutral and Renewable Roadmap. Council anticipates the Roadmap would include actions over a four and ten-year period for:

- Energy efficiency and fuel substitution projects at Council facilities
- Onsite renewable energy projects at Council facilities
- Energy storage projects at Council facilities
- Sustainable fleet at Council facilities
- Offsite renewable energy projects to supply Council energy requirements
- Offsetting scope 3 emissions

The Project Brief indicated that Stage 1 should involve the following:

1. Communications and Engagement Plan
    - Preparation of a communications and engagement plan detailing the milestones, decision points, and methods of engagement with councillors, staff, Strategic Reference Group and other key stakeholders.
    - Meetings and presentations with Councillors, the Strategic Reference Group, senior staff, and project steering committee at key decision points and milestones
    - Records of engagements and summary reports of outcomes

2. Onsite Renewable Energy and Energy Efficiency Projects
    - Identify renewable energy and energy efficiency opportunities with the greatest potential to contribute to the 100% carbon neutral and renewable target via onsite technical assessments and desktop reviews
    - Site-specific recommendations for the installation of solar PV, battery storage, interpretive displays, expansion of existing solar PV at Council facilities including:
        - System and battery size,
        - Capital cost,
        - Return on investment,
        - Energy and greenhouse gas savings potential.
    - Site-specific recommendations for energy efficiency opportunities including details on:
        - Technology
        - Capital cost
        - Return on investment
        - Energy and greenhouse gas reduction potential.
    - The Consultant was not required to make recommendations in relation to Ausgrid owned street lighting but was to liaise with Council and SSROC to include projected energy savings from Council's participation in the SSROC street lighting improvement program.

3. Sustainable Fleet Assessment
    - Outline of the options, business case and practicalities for transition to a sustainable fleet
    - Discussion on feasible options with estimated costs towards a 100% renewable fleet.

4. Off-site Renewable Energy Options
    - Investigate, high-level initial feasibility and financial case for range of off-site solutions for addressing remaining Council renewable energy demand, including offsetting scope 3 emissions

- Description of initial off-site renewable options and a discussion of the pros and cons to enable Council to make initial decisions as to the preferred option/s for further investigation following Stage 1. Description of options should include:
    - Technical feasibility
    - Initial financial implications (capital costs/recurrent costs)
    - Risk/materiality of risks
    - Legal and governance issues
    - Any other issues the Consultant deems significant
- Offsite options for investigation will include
    - Feasibility and initial discussion for a business case for IWC to invest in a solar farm to offset Council's electricity consumption across facilities and operations;
    - Opportunities to share investment and return savings with the community / businesses, including direct community investment and / or savings passed on via rates discounts;
    - Council direct investment/ownership in another type of renewable technology e.g. a wind farm
    - Renewable Energy Power Purchase Agreement (PPA);
    - Any other viable renewable energy option or business model not included above
    - NCOS compliant offsetting of scope 3 emissions

1.3 Report scope and objectives

The objective of this report is to respond to the Stage 1 brief, therefore developing advice for Council on technical and commercial feasibility of carbon reduction options relating to Council's own operations and services in terms of:

- Energy efficiency projects at Council facilities
- Onsite renewable energy projects at Council facilities
- Energy storage projects at Council facilities
- Sustainable fleet at Council facilities
- Offsite renewable energy projects to supply Council energy requirements
- Offsetting residual carbon emissions

Council is undertaking separate work relating to carbon reduction in the broader community.

1.4 Project approach

The report was developed through the following broad steps:

- An Inception Meeting with Council staff in the Environment & Sustainability team;
- Meetings with Councillors to discuss the scope of work;
- Review of energy and other data supplied by Council staff and utilities organisations;
- Review of relevant current and historical reports undertaken by and for Council;
- Development of a carbon baseline using data supplied by Council staff;
- Site visits to Council facilities (with higher energy use) to assess solar and energy efficiency opportunities;
- Meetings with Council asset owners to confirm the feasibility of the identified solar and energy efficiency opportunities;
- Two workshops with Council Environment & Sustainability staff on off-site renewable options;

- Presentation with Council staff to the Environment Strategic Reference Group, which is a committee of community members with an interest in sustainability;
- Briefings for various internal stakeholders by Council staff;
- A briefing for Councillors on the key elements of the roadmap by Council staff and 100%Renewables;
- Drafting of this report.

Further detail on the methodology for various elements of work is provided in the relevant chapters.

1.5 What do 100% renewables and carbon neutrality mean for IWC?

The brief and scope highlight carbon neutrality and 100% renewables as goals of Council, but what are these terms and what are the differences between them?

- An **energy footprint** relates to energy consumption. For most organisations, 'energy' encompasses not only electricity but also stationary fuels and transport fuels. Examples of stationary fuels are natural gas, diesel for generators, and LPG for forklifts. Examples of transport fuels include diesel, petrol, and LPG that power your fleet.
- A **carbon footprint** is the sum of all greenhouse gas emission sources, a large part of which is typically energy consumption. For an organisation, a carbon footprint will typically cover emissions that happen at the places of business (Scope 1), emissions associated with electricity consumption (Scope 2), and emissions that occur in the supply chain (Scope 3), which could include upstream and downstream emissions. Many upstream emissions, such as those associated with the mining and manufacture of goods and materials, are complex to determine.

As shown in Figure 1, an energy footprint is a subset of a carbon footprint.

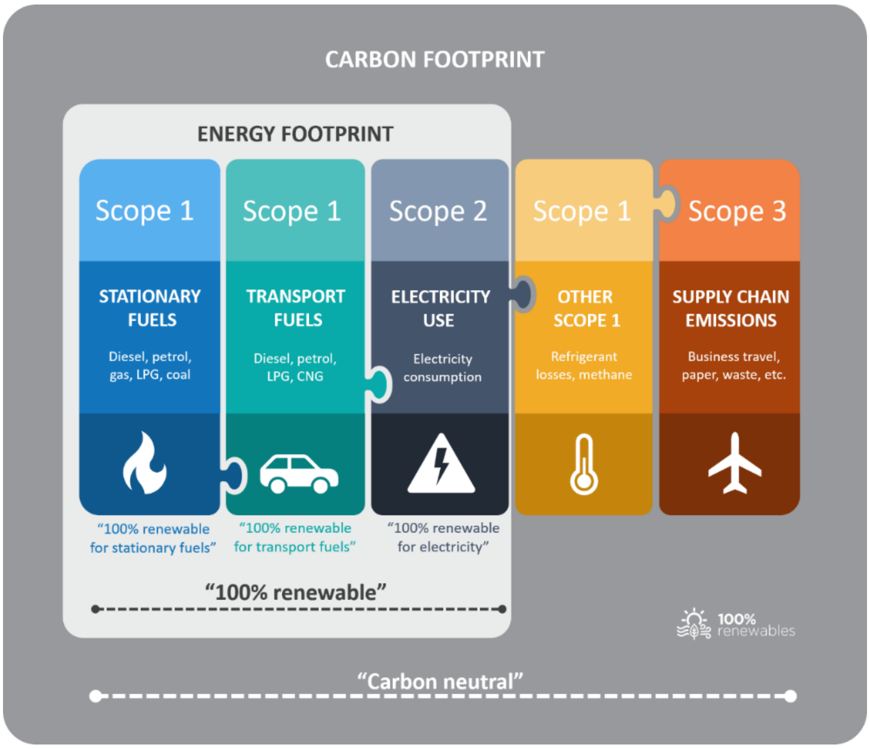


FIGURE 1: TYPICAL 100% RENEWABLES & CARBON FOOTPRINT BOUNDARIES

1.5.1 What is carbon neutrality?

Carbon neutrality (or zero net emissions) is reached when net CO_2-e[2] emissions in an organisation's defined boundary are zero.

Ideally, the defined carbon footprint boundary encompasses as many emission sources as possible so that claims for carbon neutrality are more credible. Carbon neutrality can typically be reached by:

1. reducing emissions onsite through energy efficiency or by installing solar PV
2. building or purchasing renewables offsite, and by
3. offsetting the balance of emissions through the purchase of carbon offsets.

For Inner West Council, Scope 3 emissions exclude a range of sources that are complex to measure or estimate, or for which there is little or no data at this time (refer to Section 2 below). These include, for example upstream sources related to the mining and manufacture of goods and materials used by Council.

1.5.2 What is 100% renewable energy?

An organisation will be 100% renewable when the amount of renewable energy produced or purchased is equal to or more than what is consumed. In many cases, people associate only electricity with '100% renewable'. However, 'energy' can encompass stationary and transport fuels as well. So, to be truly 100% renewable, these fuels would also be included. While it is relatively straightforward to reach 100% renewable electricity, it is more difficult to achieve 100% renewable energy for stationary and transport fuels.

To avoid doubt if the real objective is to green the electricity supply, the target can be defined to be '100% renewable electricity'. This goal can be reached by:

1. Implementing onsite solar PV, and/or
2. building or purchasing renewables offsite.

[2] CO_2-e means carbon dioxide equivalent. This is a unit of measurement that is used to standardise the climate effects of various greenhouse gases, such as carbon dioxide, methane, nitrous oxide. These gases do not have the same influence on the greenhouse effect and stay in the atmosphere for different amounts of time. In order to make the various greenhouse gases comparable with one another, the expert panel of the UN, the IPCC, has defined an index called "global warming potential" (GWP). This index expresses the warming effect of a certain amount of a greenhouse gas over a set period of time (usually 100 years) in comparison to carbon dioxide. In this way, greenhouse gases can be calculated as carbon dioxide equivalents.

2

Council’s carbon impact

2 Council's carbon impact

2.1 Council's carbon footprint

Council's carbon footprint has been estimated for 2016/2017 using the **National Carbon Offset Standard (NCOS)**. The Standard provides a benchmark for organisations voluntarily seeking to be carbon neutral for their operations, products, services or events. The Standard sets out requirements for achieving carbon neutrality, using a rigorous and transparent framework that is based on international standards and tailored to the Australian context. The Standard and associated Carbon Neutral Program are administered by the Department of the Environment and Energy.

Under the NCOS, an organisation has to account for emissions not only under its direct control but also for emissions from the supply chain. Broad categories of such emissions sources are:

1. Purchased goods and services
2. Capital goods
3. Fuel- and energy-related activities
4. Upstream transportation and distribution
5. Waste generated in operations
6. Business travel
7. Employee commuting
8. Upstream leased assets
9. Downstream transportation and distribution
10. Processing of sold products
11. Use of sold products
12. End-of-life treatment of sold products
13. Downstream leased assets
14. Franchises
15. Investments

Not all of these categories above are material for IWC, and in some cases there is limited data available to calculate these emissions. A likely boundary for Inner West Council NCOS accreditation can be seen in Figure 2~~Figure 2~~. All emissions for which Council is directly responsible are included, like transport fuels, natural gas consumption, refrigerant losses and electricity consumption for facilities and streetlighting. Supply chain emissions like water, paper and IT equipment consumption, food and catering expenses, the generation of waste from council operations, third-party travel like taxis, as well as expenses for postage and couriers also form part of the carbon footprint.

At this stage, employee commuting, outsourced printing, stationery, advertising, IWC's investments, capital investment in equipment, contractor emissions, cleaning services and expenses for telecommunication equipment have been excluded[3].

Based on this boundary, Council's activities generate approximately 21.8 kilotonnes (kt) of CO_2-e each year. The vast majority of Council's carbon footprint relates to the consumption of fuel and electricity in Council operations and street lighting, which together accounts for over 93% of emissions. The

[3] More information about the method, limitations and assumptions of the carbon footprint calculation can be found in Annex B.

footprint is detailed in Table 1~~Table 1~~, and the contribution of various activities is shown in Figure 2~~Figure 2~~.

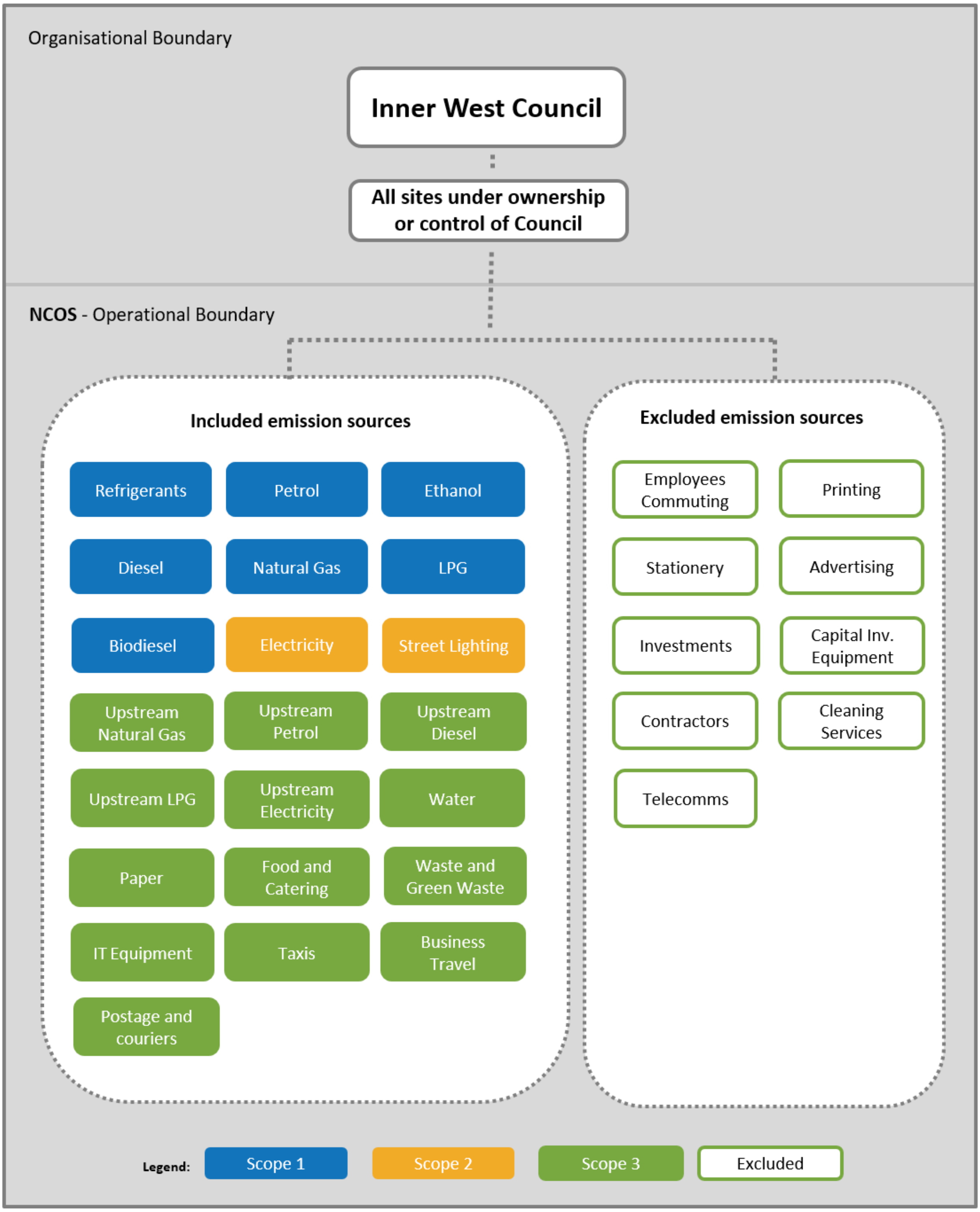


FIGURE 2: EMISSION SOURCES INCLUDED UNDER AN NCOS-COMPLIANT CARBON FOOTPRINT

TABLE 1: INNER WEST COUNCIL: CARBON FOOTPRINT FY2016/17

Emission Source	Amount Used (over FY17)	Unit	Total (t CO2e)	Percentage of total CO2e
Refrigerants	30.00	kg	**54.2**	0.25%
Natural Gas	34,714.09	GJ	**2,233.2**	10.23%
Fleet Vehicles Diesel	509.16	kL	**1,417.2**	6.49%
Fleet Vehicles Petrol	366.76	kL	**893.3**	4.09%
Fleet Vehicles Ethanol	20.59	kL	**0.2**	0.00%
Fleet Vehicles Biodiesel	70.67	kL	**6.4**	0.03%
Fleet Vehicles LPG	0	kL	**0.0**	0.00%
Electricity (Council Assets)	8,620,837.02	kWh	**8,189.8**	37.52%
Electricity (Street Lighting)	8,030,540.97	kWh	**7,629.0**	34.95%
Water	235,448.18	kL	**50.2**	0.23%
Paper	12,565.00	kg	**16.1**	0.07%
Equipment	149,874.70	$	**43.5**	0.20%
Food and Catering	222,227.88	$	**953.3**	4.37%
Postage	251,291.96	$	**40.2**	0.18%
Taxis, Uber and other services	14,652.54	$	**1.0**	0.00%
Waste to landfill	236.04	t	**283.2**	1.30%
Green waste	135.53	t	**12.8**	0.06%
Air travel	10,147.06	km	**2.3**	0.01%
Totals			**21,825.8**	**100.00%**

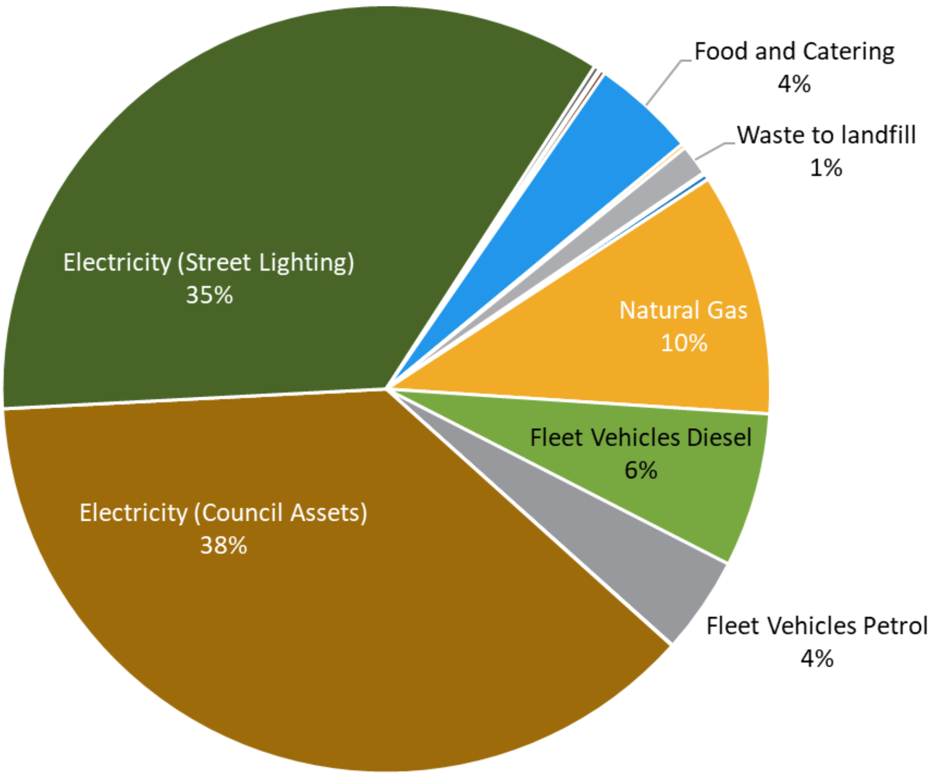


FIGURE 3: INNER WEST COUNCIL CARBON FOOTPRINT FY2016/17

2.2 Factors affecting Council's carbon footprint

2.2.1 Planned changes to IWC assets

Changes will occur to IWC's assets over time, leading to 'business-as-usual' adjustments to Council's energy demand and carbon inventory. This will impact the effort and cost required to achieve carbon neutrality and/or 100% renewable energy. The main known or potential changes are described in Table 2~~Table 2~~.

Table 2: Inner West Council asset changes underway and planned

Project	Date	Impact on energy demand
Ashfield Aquatic Centre redevelopment	2018-19	Possible decreased energy demand for IWC
LPAC main pool upgrade and widening	TBC	Increased energy demand for IWC
Petersham administration building HVAC upgrade (TBC)	2-5 years	Opportunity to significantly reduce building energy demand
Marrickville library relocation to former hospital site	2-5 years	Impact unknown as existing location will continue to be used by Council
GreenWay lighting from Iron Cove to Cooks River	2018 -	This will increase demand as new lighting is being installed. Increases are limited as LED technology and controls are being specified
Small new community buildings (e.g. Steel Park community centre)	Underway	Small increase in demand

The net impact of the changes above will be to increase Council's energy demand by a modest amount. While modelling of future energy demand has not been performed the increase is unlikely to exceed 2-3% of Council's current demand. However, the amalgamation of the three former Councils may also result in future changes to staff locations. For example, staff are currently located in various offices - should these be consolidated into one location, the carbon footprint associated with staff travel (currently excluded) and building electricity use would most likely reduce. Hence the net impact may be negligible.

2.2.2 Changes in population

Population changes may drive an increase in Council's energy consumption.

The Inner West LGA population is estimated to be 195,113 people in 2017[4]. Annual growth rates over the past several years are around 1.3%.

As residential growth is likely to be accommodated using infill releases (not new land) the number of additional street lights is unlikely to be high. Public lighting and aquatic centre changes are already established and there are no medium-term plans to add major new facilities.

Changes to energy demand from population changes are likely to be small, and may be limited to:

- Increased garbage collection leading to modest increases in fuel use,
- Increased lighting of sporting fields,
- Increased demand for services provided such as child care, libraries and community buildings

[4] https://profile.id.com.au/inner-west/population

2.3 Achieving carbon neutrality in the most cost-effective way

Significant carbon emissions can be saved by being more efficient operationally. This entails not undertaking unnecessary activities like driving to a meeting when a teleconference suffices or switching off lights or equipment when not needed. It also means undertaking the same activities, but more efficiently. An example would be to use energy efficient lighting rather than having inefficient lamps that consume more energy than what is needed to achieve the same light level. Another example is using more energy efficient vehicles, like hybrid cars.

Every carbon reduction strategy should begin with being more efficient, not only because carbon emissions can be saved, but also because these measures often come with an attractive payback period. Energy efficiency lowers an organisation's energy demand. This means that renewable energy generation, be it on- or off-site can be smaller and thus less expensive to source. For an illustration of the carbon management hierarchy, please see Figure 4~~Figure 4~~ below.

Council currently undertakes a range of activities to reduce its carbon impact, as detailed in subsequent chapters and summarised in Annex C - Council's carbon and energy achievements. Without these measures, the current carbon footprint would be much higher.

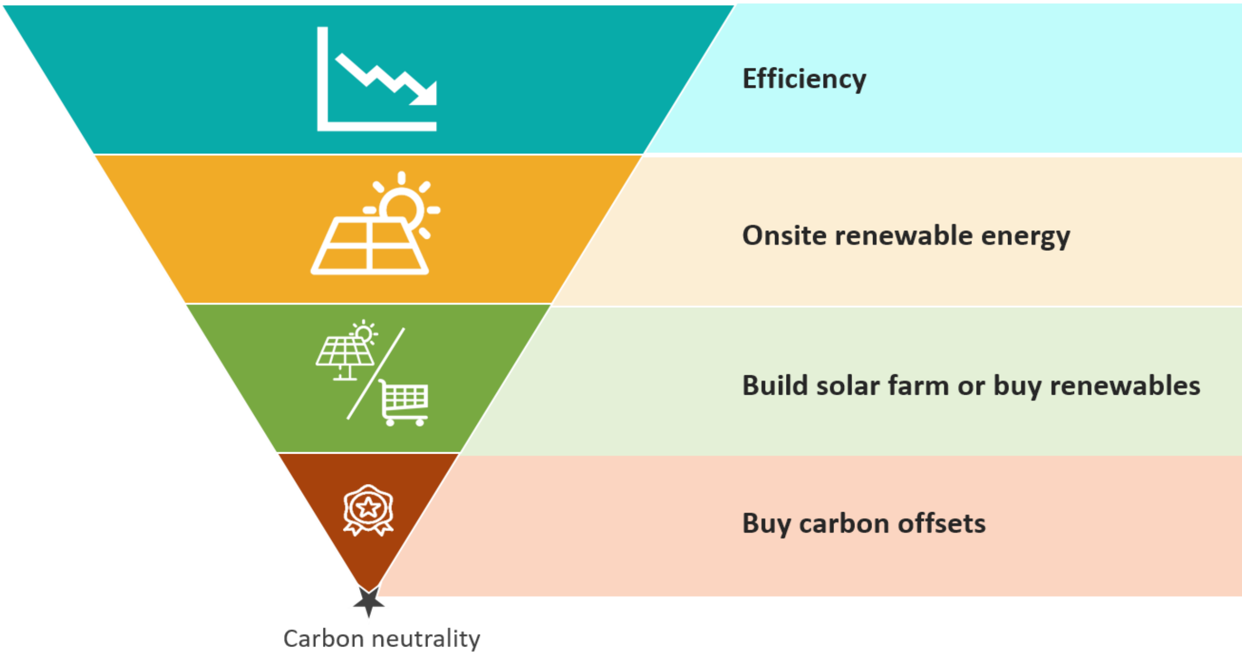


FIGURE 4: CARBON MANAGEMENT HIERARCHY FOR REACHING CARBON NEUTRALITY

In parallel to pursuing an efficiency strategy, organisations should implement onsite renewable energy where possible, which usually means installing solar panels on roofs. Energy that the solar panels produce replaces energy bought from the grid, which in Australia is primarily based on fossil fuels (85%). In future batteries will enable more solar energy to be produced and used on Council's facilities.

Having onsite renewables also means that electricity is produced locally, at the point of consumption which means that no electricity is lost in the transmission and distribution from a remote power plant to the point of consumption. Onsite renewable energy without batteries is also very beneficial from a cost perspective. IWC currently has 30 solar PV systems installed across its facilities.

Unfortunately, onsite solar systems can only be installed where a suitable roof or ground space is available, to which there is a natural limit for organisations. Typically, only 5 to 30% of all electricity consumption can be met from onsite solar production. This is why organisations need to look outside their own boundaries if they want to meet their electricity demand with 100% renewables.

Some organisations have land available and can evaluate the business case for building their own solar or wind farm without the need to buy or lease land. Others are land-constrained, like Inner West Council. In these cases, renewable energy may have to be bought from offsite projects developed by others, or an investment made in land to support a council development.

It is possible for 100% of electricity demand to be met with renewable energy. However, it won't be possible to reach carbon neutrality solely based on an efficiency and renewables strategy. This is because renewable electricity purchases can only be used to offset Council's electricity consumption, and cannot be used to offset other emission sources like natural gas, diesel or petrol emissions, or supply chain emissions like paper consumption. For these emission sources, carbon offsets may need to be purchased until renewable energy alternatives are widely available.

While most abatement measures in the carbon management hierarchy can be positive investments that return monetary and carbon savings, the purchase of carbon offsets will always be a financial cost to a business. However, a carbon offset purchase is necessary to achieve the status of 'carbon neutrality' or 'zero net emissions'.

2.4 The representation of carbon reduction strategies in this report

This report sets out options for achieving carbon neutrality. Subsequent chapters are organised according to the order, as well as the colour scheme used in the carbon management hierarchy introduced in Figure 4~~Figure 4~~.

The first carbon reduction strategies focus on efficiency improvements. Because streetlighting is such a big contributor to the energy consumption and the carbon footprint in general, it is discussed in its own chapter (Chapter 3). This is followed by energy efficiency improvements for facilities, both for electricity as well as natural gas (Chapter 4).

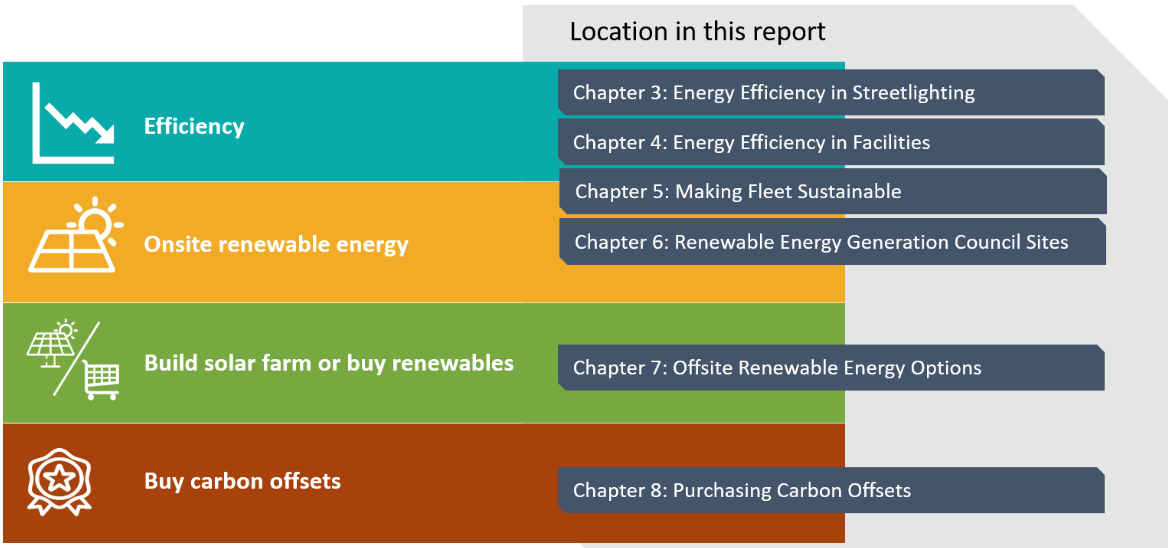


FIGURE 5: CARBON MANAGEMENT HIERARCHY FOR REACHING CARBON NEUTRALITY

Sustainable fleet management is discussed in Chapter 5. It is a cross-over of efficiency measures as well as onsite renewable energy (e.g. charging an Electric Vehicle from an onsite solar installation).

Chapter 6 highlights Council's current solar PV installations, as well as the potential for further installations. Chapter 7 introduces the concepts of Council either building its own solar farm or buying renewables from renewables facilities managed by others. Substituting all standard power grid purchases with renewables can enable Council to claim 100% renewable energy.

Chapter 8 discusses purchasing carbon offsets, which will allow Council to claim carbon neutrality for its operations.

2.5 Electricity as a focal point

Electricity is a major focus of this report, given that it is the main contributor to Council's carbon impact, and potentially the area in which the most gains can be made in terms of consumption and supply.

Council used approximately 16,650 MWh of grid electricity in 2016/17. A review of the options to reduce this over the near term has been undertaken, which has identified a series of steps that can be taken. Similar to the carbon management hierarchy introduced in the previous sections, an indicative waterfall chart has been produced, which shows a progression from the current electricity consumption to 100% renewable energy, based on energy efficiency, onsite and offsite renewable energy measures.

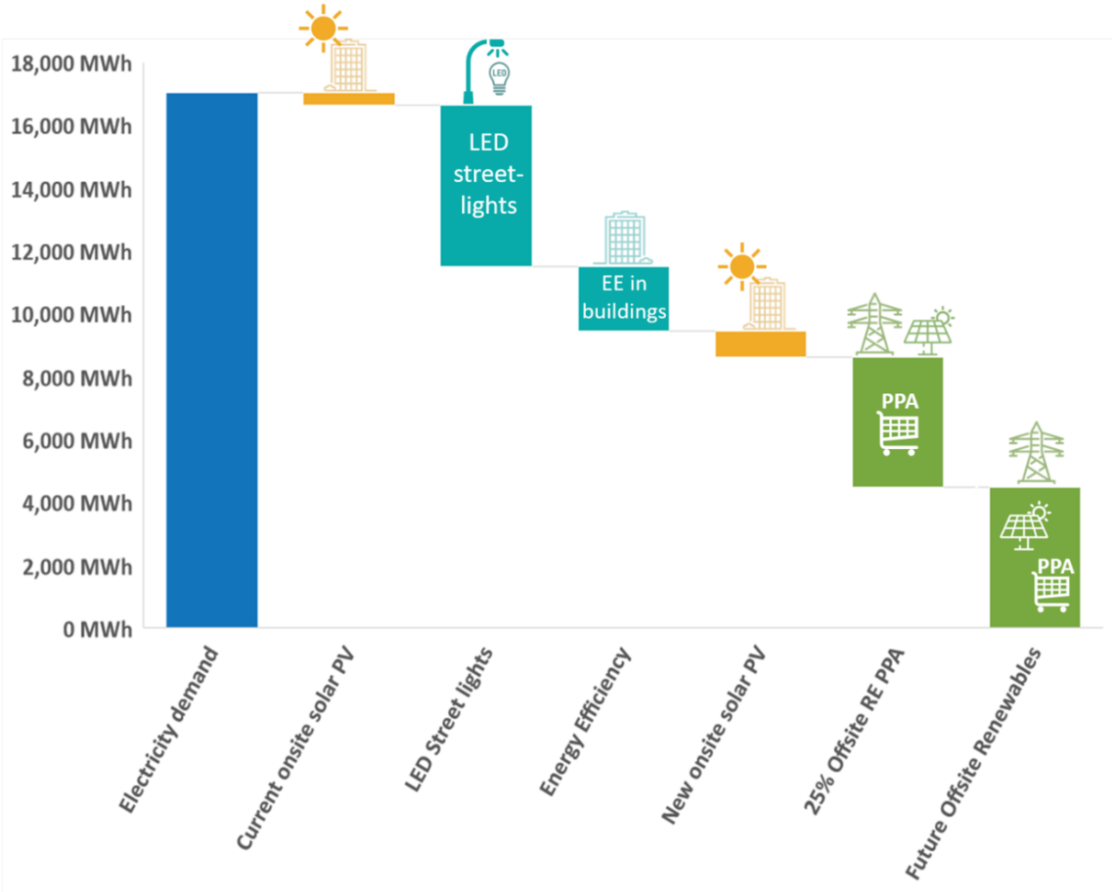
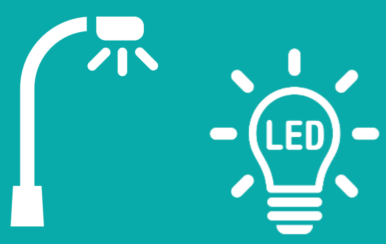


FIGURE 6: ELECTRICITY REDUCTION AND RENEWABLE OPTIONS WHICH CAN LEAD TO 100% RENEWABLE ENERGY

3

Energy efficiency in streetlighting



3 Carbon reduction strategy 1: Energy efficiency in street lighting

3.1 Street lighting is a major electricity user

Looking at IWC's electricity use, it can be seen that 79% is consumed by just three types of asset – street lights, aquatic centres and Council's administration buildings, with street lights accounting for close to half of all IWC electricity usage. The pie chart in Figure 7 highlights this point further.

TABLE 3: INNER WEST COUNCIL: ELECTRICITY CONSUMPTION BY ASSET TYPE 2016/17

Asset type	**Electricity consumption** (kWh in FY17)	**Percent of total consumption**
Street Lighting	**8,030,541**	**48.2%**
Pool - Aquatic Leisure Centres	3,061,075	18.4%
Administration Buildings	2,068,126	12.4%
Works Depots	745,092	4.5%
Sporting Ovals	636,629	3.8%
Libraries	579,045	3.5%
Parks and Reserves	524,524	3.2%
Council Public Lighting	167,486	1.0%
Car Parks	159,552	1.0%
Town Halls	147,915	0.9%
Child Care Centres	142,238	0.9%
Community/Neighbourhood Centres	109,613	0.7%
Miscellaneous	86,951	0.5%
Sporting and Recreational Centres	79,125	0.5%
Community Buildings	50,825	0.3%
Community Halls	25,816	0.2%
Baby Health Care Centres	14,215	0.1%
Toilets/Amenities/Clubs	10,556	0.1%
Emergency Services	6,039	0.0%
Investment Properties	6,012	0.0%
Total	**16,651,378**	100.0%

Electricity consumption is skewed towards night-time and off-peak periods, due to the fact that street lights and other public lighting operates mainly at night. In addition, sporting field lights and irrigation operate in the evenings and at night, and facilities such as aquatic centres have high night time demand to maintain pool temperatures when ambient temperatures are lower.

This is illustrated in Council's electricity load profile shown below in Figure 8~~Figure 8~~. Council's electricity use has been analysed and arranged into 24-hour load profiles for 2016/17. The chart below shows Council's profile for a number of characteristic days across all four seasons. The high night-time use has implications for transitioning to renewables, as discussed in Chapter 7 Carbon reduction strategy 5: Offsite renewable energy options~~Carbon reduction strategy 5: Offsite renewable energy options~~.

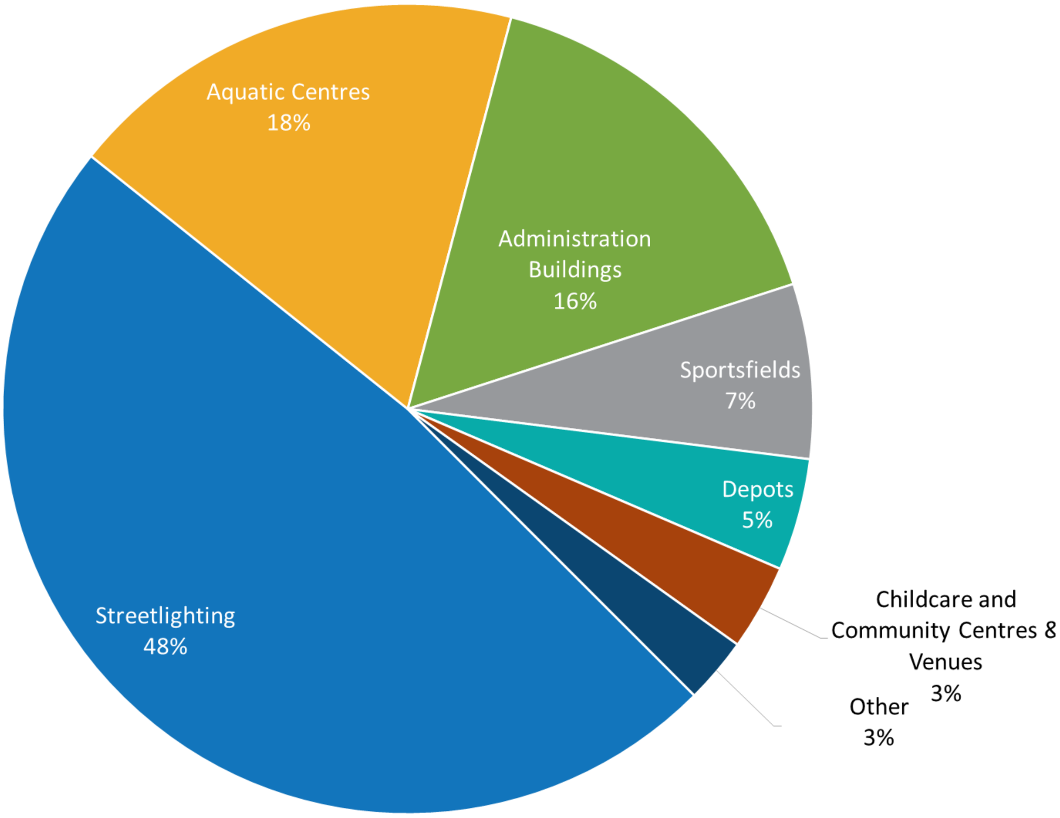


FIGURE 7 - INNER WEST COUNCIL ELECTRICITY USAGE BY ASSET TYPE

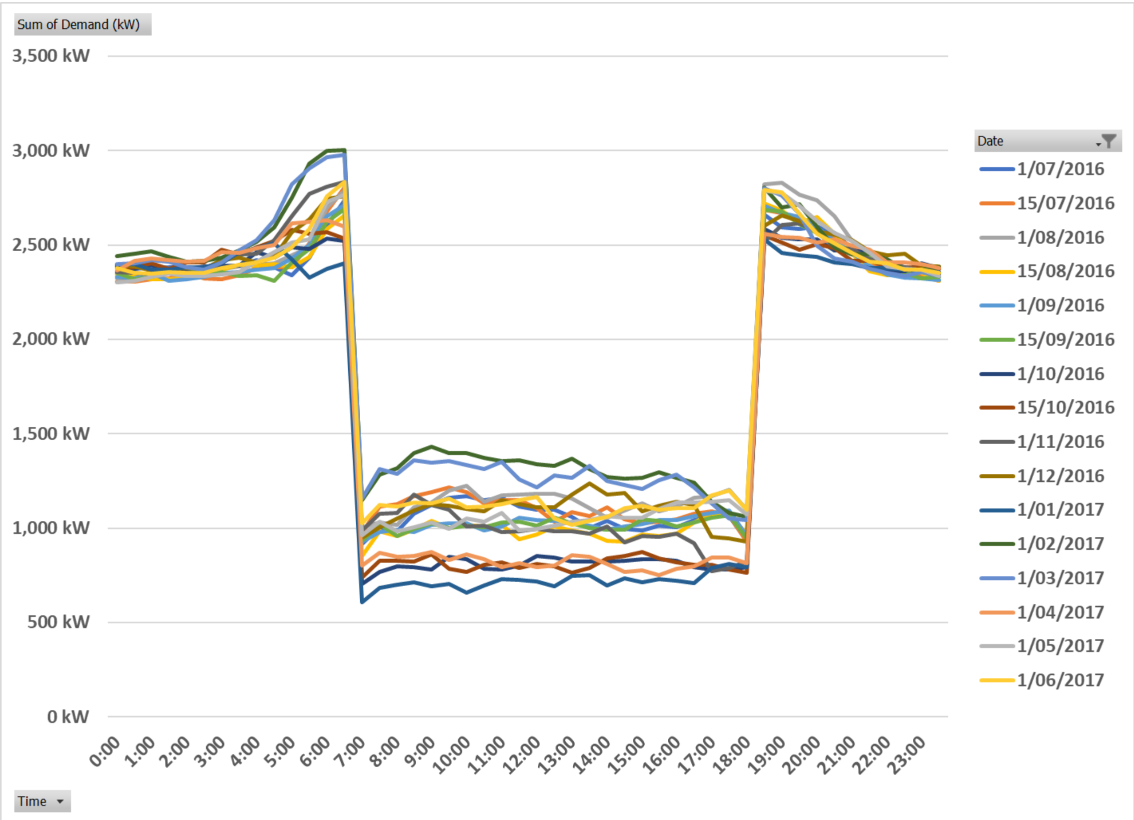


FIGURE 8: INNER WEST COUNCIL DAILY ELECTRICITY LOAD PROFILES FOR SAMPLE DAYS 2016/17 – ALL ASSETS

3.2 Overview of the case for LED street lighting

Street lighting is an essential service across the Inner West LGA. The street lighting infrastructure is owned by Ausgrid but funded by Councils. The process for making changes to the quality of lighting and the technologies and controls used to provide lighting is complex, involving multiple parties. Streetlighting on local (residential), intermediate and main roads[5] is mainly funded by Councils through payment for:

- electricity consumed
- maintenance of luminaires (undertaken by Ausgrid)
- maintenance of lamp posts (undertaken by councils)

LED technology uses much less electricity and lasts much longer than conventional lighting technologies used in street lighting, such as Mercury Vapour, High Pressure Sodium and Fluorescent lamps. Replacement of these old technologies with LED lighting has significant financial, environmental and public safety benefits including:

- Reduced electricity bills for Council due to lower consumption
- Carbon reductions due to lower electricity use
- Reduced maintenance bills from Ausgrid as LED lights are expected to require less upkeep
- Whiter, brighter lighting on streets resulting in improved public safety
- Reduction in upwards light pollution as LEDs are more directional
- Removal of lamps containing mercury leading to improved public safety

A long-established objective and direction of national policy and local councils has been to transition towards better and more efficient street and public lighting. Improvements to street lighting technology are being progressed on behalf of IWC and other Councils by Southern Sydney Regional Organisation of Councils (SSROC), via the Street Lighting Improvement Program (SLIP), in consultation with the electricity distributor Ausgrid. SSROC initiated the project several years ago, with the main focus being on Public Lighting Code compliance, pricing, grants and technology change (which for several years now has largely been towards LED and smart controls).

LED lighting was trialled on residential streets by Ausgrid (2013) and was found to be effective[6]. Building from this there is now an agreement in place to adopt LED lighting as the default for residential and intermediate roads, with trials progressing on main roads and smart control trials to commence soon[7].

---

[5] Local roads refer to residential streets. Main roads refer for example to larger roads including major arterial roads. Councils pay for most lights on main roads including State and Regional roads for which RMS pays a subsidy. Intermediate roads are in between these categories, and for planned upgrades are included with residential roads.

[6] Ausgrid (2013), LED streetlight trial
https://www.ausgrid.com.au/~/media/Files/About%20Us/Newsroom/Discussions/130530%20LED%20Streetlight%20Trial%20Report%20FINAL.pdf

[7] http://ssroc.nsw.gov.au/projects/

3.3 Work has already started on reducing the street lighting load

Since Ausgrid commenced LED installations in 2013 more than 1600 residential road street lights in IWC have been upgraded to LED technology. Older compact fluorescent lamps and mercury vapour lights have been replaced with newer 22W and 29W LED technology resulting in energy savings of over 60% per light. This work has been implemented by Ausgrid on a spot replacement basis – i.e. when older residential road lights fail the standard replacement technology is LED. This has resulted in lower energy and maintenance costs to Council compared with older lamps.

3.4 Further streetlighting improvements will have a significant impact

Ausgrid's policy for a number of years has been to replace any broken streetlights with energy-efficient LEDs. The SLIP project essentially accelerates replacement of older lights and will see most of the street lighting network powered by energy-efficient LED technology over the next few years.

The SLIP project has taken some time to establish between the various parties due to the complex nature of lighting safety specifications, establishing supply chains for suitable luminaires, agreeing on funding arrangements and, recently, managing around Ausgrid restructuring following the partial sale to the private sector. However, many of the barriers to LED street lighting have now been overcome. Further streetlighting upgrades are now planned in the near future and the longer term, focused around an accelerated bulk replacement program to transition councils' street lights to LED.

Ausgrid has now provided a funding model to councils for residential roads. The model allows councils to either directly fund the programmes, or to allow Ausgrid to fund and then recharge councils through their street lighting bills. Inner West Council has decided to directly fund the residential road program.

For the purpose of this report the programme to transition to LED lighting is split into two parts:

- Stage 1 – upgrading eligible[8] lights in local residential and intermediate roads to LED
- Stage 2 – upgrading eligible lights on main roads to LED

Timing for installations is not yet confirmed as it will depend on Ausgrid's programme of works, which extends to other local government areas in Sydney. It is understood that the bulk of the residential programme will be undertaken over the next five years.

Table 4~~Table 4~~ below shows the estimated cost, savings on electricity and maintenance, and carbon reduction for both stages of work. The carbon reduction is substantial and represents 16% of Council's current footprint, while Council's electricity use will be reduced by 26%.

TABLE 4: STREET LIGHTING PROGRAM

Scope	Capital cost ($ total)	Electricity cost savings ($ per annum)	Maintenance savings ($ per annum)	Payback (years)	Electricity saving (kWh pa)	Carbon saving (t CO_2-e pa)
Stage 1: Local roads	$2,502,203	$234,117	$351,176	4.28	1,560,781	1,295
Stage 2: Main roads	$5,526,325	$409,503	$614,255	5.40	2,730,023	2,266
Total	**$7,875,710**	**$763,761**	**$1,145,641**	**4.12**	**4,290,803**	**3,561**

[8] Not all lights may be eligible – for example decorative lights may not have a ready LED replacement option

This assessment is high-level and has been derived from a recent inventory of IWC's street lights. The following assumptions are made in this assessment:

- Local residential and intermediate road lights under 250W are assumed to be upgraded in Stage 1; some higher wattage lamps may also be upgraded, though these will be in the minority.
- Capital costs of $2.8 million were advised by IWC for Stage 1. It is assumed that energy savings are eligible to claim Energy Saving Certificates (ESCs) under the NSW Energy Savings Scheme (ESS). A discount has been applied to the capital cost for Stage 1 to reflect the value of ESCs, based on $15/ESC and forward claim for savings of 12 years under the Scheme's Public Lighting Method.
- Electricity savings are taken to be valued at $0.15/kWh.
- Maintenance savings are assumed to be 150% of electricity cost savings.
- For intermediate roads it is assumed that each eligible replacement LED is three times more expensive on a per-luminaire basis than residential road lights. Lighting on main roads is typically 250W to 400W, compared with 46W to 150W lamps on residential roads.

3.5 More streetlighting innovation is expected in the future

The LED upgrade is not the end of innovation and energy saving opportunities in street lighting, with further potential gains in technology and current trials of smart controls that will lead to greater savings over time[9]. The main goal for streetlighting in the next ten years is for LEDs and smart controls to reach near-full deployment in Australia, which could see energy demand fall by 60-70% compared with now.

Traditional street lighting control methods are limited to timers or daylight sensors that turn street lights on and off, with sensors the typical method of control. This provides a simple means of 'deeming' the energy demand of unmetered street lights based on known operating hours and electricity demand. However more sophisticated smart control solutions are now available that offer:

- Programmable LED driver control to allow luminaire-level configuration,
- A range of Central Management System (CMS) controls over radio frequency and mobile phone networks to control lighting over a wider area

The ability to use smart controls to dim lights at off-peak times – initially in main road trials but in future at residential road level – is what underpins further energy saving potential. Further benefits include improved fault monitoring and billing of actual consumption (versus estimated consumption). Sensor controls will evolve over time, with camera-based sensing, self-learning control systems and precise light-on-demand controls potentially delivering higher levels of energy savings.

Installation of such technologies requires changes to numerous aspects of the electricity network. SSROC is therefore currently advocating with key parties such as the Federal Government and Ausgrid to make the necessary changes[10].

---

[9] Future innovation is being delivered via the Street Lighting and Smart Controls (SLSC) Programme, an initiative of the Institute of Public Works Engineering Australasia (IPWEA). A strategic roadmap for the SLSC was developed by IPWEA with the Australian Government's Department of the Environment & Energy (DEE), and aligns with energy, safety and infrastructure management policy objectives. SSROC is a member of the SLSC Technical Advisory Group, and current and continuing advocacy for change through this forum is the preferred way for IWC to pursue efficiency in street lighting. The summary provided here is sourced from the SLSC Programme Roadmap.

[10] SSROC (March 2018), Small Load Metering Submission to the Commonwealth Department of the Environment and Energy

Ausgrid is currently trialling smart controls on main roads, and has indicated that the LED replacements on main roads undertaken through SLIP will be “smart control” ready (i.e. equipped to be retrofitted)[11].

This is a rapidly changing area with further advances in the technologies expected in the near term. For example, a streetlighting network can be transformed into an ‘Internet of Things’ (IoT) network that also delivers smart parking, air quality monitoring, vehicle charging and traffic management. It will be necessary to balance gains with issues such as:

- data security (some smart meters have capability to collect phone data, or can potentially be hacked)
- personal security (for example, dimmable lighting may highlight solo walkers)
- amenity (the colour of LED lighting is considered by some to be more ”clinical” especially in residential areas).

3.6 Streetlighting actions for Inner West Council

Upgrading street lighting to LED technology, and later integration of smart controls represents the single largest source of energy savings available to IWC. Significant work via SSROC has led to the point where bulk replacement with LED technology can now begin. This will see Council’s electricity demand drop by up to 50% in the medium term (influenced by whether the programme is rolled out to main roads as well, and the number of lights already upgraded to LED). The savings estimated in Table 4~~Table 4~~ above are based on Ausgrid’s LED program being fully implemented. Additional savings from the deployment of smart controls is not included as savings potential, timing and costs are not known at this time.

Actions to be taken on this issue over the next few years are:

- Work with Ausgrid to expedite the rollout of the residential road SLIP project
- Agree funding of the main roads SLIP project within Council
- Work with SSROC on the streetlight smart controls project

[11] Ausgrid (29 June 2018), letter to SSROC CEO from Ausgrid CEO

4

Energy efficiency in facilities

4 Carbon reduction strategy 2: Energy efficiency and fuel substitution in facilities

4.1 Objective and approach

An assessment of the energy efficiency opportunities at Council facilities was made through:

- Review of energy audits and energy plans developed by others for numerous Council facilities
- Site visits with IWC staff to numerous facilities across Council
- Consultation with Council asset managers

Details, including report and site listings, and consultation with IWC staff are provided in Annex D. A summary of efficiency measures that IWC has previously implemented is shown in Annex C.

4.2 Improving efficiency of lighting in facilities

Lighting energy efficiency is one of the main energy saving opportunities available to IWC, primarily through replacement of current lighting with LED technology. Lighting across the IWC portfolio is generally older and less efficient than LED technology. Upgrades have been undertaken in some locations; however further efficiency opportunities exist at most of the facilities assessed.

Savings from LED technology are significant, including typical savings of:

- 60% in facilities where linear fluorescent, compact fluorescent, mercury vapour, metal halide and halogen lamps are in use,
- 50% savings in public lighting (based on the overall savings potential in street lighting)

Lighting energy efficiency opportunities are listed in Table 5~~Table 5~~ below. The costs provided are initial only, based on the following assumptions:

- Where audit reports were available the estimated savings, capital costs and energy savings were used, as well as maintenance savings where these were estimated,
- Where there were no audit reports for facilities:
  - energy costs/rates were taken to be 15¢/kWh for larger facilities and 20¢/kWh for small sites,
  - lighting was assumed to account for 20-33% of electricity use, with lower estimates for sites with large refrigeration or air conditioning load,
  - savings of 60% in lighting were estimated by changing to LED technology, and maintenance savings of an additional 20% on top of energy cost savings were estimated,
  - a simple payback of 7 years was estimated based on experience with LED lighting upgrades
- The State Government offers financial incentives for certain lighting upgrades under the Energy Savings Scheme (ESS)[12]. The ESS incentives (Energy Saving Certificates, or ESCs) have not been included in cost-benefit estimates – the price for ESCs is set by the market, and while it is typically in the range $15-25/ESC, it can be lower than this. In addition the number of ESCs eligible to be created varies from activity to activity. A conservative approach is taken here to omit this incentive; as such the payback for lighting projects may be a little better than indicated.

[12] https://www.ess.nsw.gov.au/Home/

Most facilities' lighting will be cost effective to retrofit with LEDs. As such this could be implemented as a program of work in a relatively short period – e.g. 2-3 years. Outdoor lighting including parks, walkways and ovals is generally more cost effective to upgrade at the end of its life, partly due to low run hours (e.g. ovals) and partly due to luminaires (i.e. the whole fixture including lamp, control gear and housing) rather than just lamps requiring replacement (e.g. parks, pathways). In addition LED lighting is only now becoming more common as a technology of choice for ovals as the technology has improved and pricing has fallen, however in some cases it will still be cost effective to use older technology due to low run hours. This means that a 10-20 year program to transition to LED technology will be required for these assets.

The table below includes estimates of savings, costs and paybacks to retrofit facilities' lighting with LED technology based on the assumptions noted above. Savings potential for public / oval lighting is included in a separate section below that discusses end-of-life upgrades.

TABLE 5: FACILITY LED LIGHTING UPGRADE OPPORTUNITIES

Site	**Capital cost** ($ total)	**Electricity cost savings** ($ per annum)	**Maintenance cost savings** ($ per annum)	**Payback**[13] (years)	**Electricity saving** (kWh pa)	**Carbon saving** (t CO_2-e pa)
St Peters Depot	$140,000	$19,255	$0	7.3	172,511	143
Petersham Service Centre	$91,534	$12,866	$2,573	5.9	60,000	50
Ashfield Service Centre	$45,000	$6,000	$1,200	6.3	40,000	33
Petersham Town Hall	$28,856	$5,700	$1,140	4.2	37,778	31
Tempe – Robyn Webster building (not reserve lighting)	$45,433	$5,409	$1,082	7.0	36,058	30
Marrickville Town Hall	$59,411	$6,198	$1,341	7.9	34,858	29
Leichhardt Administration	$17,556	$3,244	$649	4.5	24,124	20
Balmain Library	$20,685	$3,321	$664	5.2	19,980	17
Brown St Basement Carpark	$15,000	$2,700	$540	4.6	18,000	15
Summer Hill Depot	$12,037	$1,433	$287	7.0	7,165	6
Balmain Depot	$3,055	$1,273	$255	2.0	6,364	5
Tom Foster Community Centre	$7,610	$906	$181	7.0	6,040	5
Tillman Park Early Learning Centre	$9,000	$1,071	$214	7.0	5,357	4
Deborah Little ELC	$8,799	$1,047	$209	7.0	5,237	4
Hannaford Centre	$8,275	$985	$197	7.0	4,925	4

[13] Not including ESS incentives

Site	Capital cost ($ total)	Electricity cost savings ($ per annum)	Maintenance cost savings ($ per annum)	Payback[13] (years)	Electricity saving (kWh pa)	Carbon saving (t CO_2-e pa)
Enmore Road ELC	$7,770	$925	$185	7.0	4,625	4
Leichhardt Children's Centre	$6,750	$804	$161	7.0	4,018	3
Leichhardt Depot	$6,200	$738	$148	7.0	3,691	3
Annandale Child Care Centre	$6,179	$736	$147	7.0	3,678	3
Annandale Neighbourhood Centre	$5,091	$606	$121	7.0	3,030	3
Sydenham / St Peter's Library	$4,484	$534	$107	7.0	2,669	2
Foster St Family Day Care	$3,197	$381	$76	7.0	1,903	2
Mervyn Fletcher House	$3,200	$381	$76	7.0	1,905	2
Jimmy Little Community Centre	$3,156	$376	$75	7.0	1,878	2
Leichhardt Library	$3,000	$250	$50	10.0	1,500	1
May Murray Child Care Centre	$2,336	$278	$56	7.0	1,390	1
Stanmore Library	$1,009	$120	$24	7.0	600	0
Total	**$564,623**	**$77,537**	**$11,758**	**6.3 years**	**509,284**	**422**

4.3 Non-lighting energy efficiency in facilities

Non-lighting energy use at IWC facilities is mainly associated with Heating Ventilation and Air Conditioning (HVAC) systems, but also includes appliances and office equipment. Energy efficiency for this equipment is typically a function of several factors, including:

- The efficiency of the technology installed, which is often a function of the age of equipment as well as the procurement policies of the organisation (i.e. whether Council specified a minimum level of efficiency and is willing to pay a premium for equipment with lower running costs).
- The type, age and functionality of the control systems that are in place to manage HVAC equipment. Fully integrated digital building management systems (BMS) can help a building's HVAC systems to perform optimally. Older BMS' may not have the range of energy-saving functionality of a modern system, or may have simply drifted from design settings through age and low maintenance. For smaller buildings localised air conditioning controls are common.
- The practices and behaviours of occupants/users. This may refer to equipment (e.g. computers, printers, etc) that is left running at night, air conditioners that are not on a central control system or are not turned off each night, or cleaners/security staff who are not instructed to turn off lights in areas after they have completed their work.

Site visits and in particular a review of past energy audit reports (in particular measures that have not yet been implemented) highlights a number of opportunities for improved energy efficiency. These are summarised below. This does not include end-of-life equipment replacement which is addressed in section 4.3.

TABLE 6: FACILITY HVAC AND OTHER POWER EFFICIENCY OPPORTUNITIES

Site	Scope	Capital cost $	Annual savings $	Payback (Years)	Electricity saving (kWh p.a.)	Gas saving (MJ p.a)	Carbon saving t CO_2-e pa
Ashfield Civic Centre	Optimise HVAC system controls including winter and summer settings, install 'smart' powerboards for IT equipment, replace hot water boiler with an instant gas-boost system (Pangolin audit).	$133,000	$51,872	2.6	284,985	547,000	265
Petersham Administration	Target discrete efficiency measures – e.g. base load reduction, window tinting for energy + space comfort.	$30,000	$5,000	6.0	50,000		42
Leichhardt Administration	Implement effective base load reduction practices, implement temperature control of exhaust fans (Huxham audit).	$2,784	$4,125	0.7	47,157		39
Ashfield Civic Centre	Retrofit solar film to West wall	$50,000	$6,000	8.3	40,000		33
St Peters Depot	Implement effective base load reduction practices.	$0	$2,000	0.0	30,000		25
Leichhardt Administration	Upgrade HVAC controls	$12,000	$3,300	3.6	30,000		25
Brown St Basement Carpark	Upgrade ventilation controls & VSDs	$15,000	$3,750	4.0	25,000		21
Leichhardt Oval #1	Multiple individually small measures (Huxham audit)	$2,406	$4,270	0.6	23,700		20
Balmain Library	Implement base demand and appliance control measures (from Huxham audit)	$2,985	$1,129	2.6	10,737		9
Petersham Town Hall	Reduce night time baseload	$0	$600	0.0	10,000		8
Balmain Library	Upgrade HVAC controls (365-day timer)	$1,000	$75	13.3	1,500		1
ALL SITES		**$249,175**	**$82,121**	**3.2 years**	**553,079 kWh**	**547,000 MJ**	**488 t CO_2-e**

4.4 Improving efficiency during end-of-life equipment replacement

Opportunities arise to make step-change improvements in energy efficiency of capital-intensive equipment when it reaches the end of its serviceable life and needs to be replaced. Examples include chillers, whole HVAC systems, lifts, park & oval lighting and central boilers.

Ordinarily, there is not a financial business case for replacing this equipment while it is still serviceable, as the capital cost for replacement equipment usually far outweighs the annual cost savings that can result. However, when being replaced at the end of its operational life, spending a little added capital on a more energy efficient solution can see significant savings achieved and a rapid payback on this marginal cost.

Inner West Council has a number of opportunities for efficiency gains in this manner. The costs for some of these have been estimated in consultant reports, while in other cases technology trends are simply making efficient technologies the default choice when equipment is being upgraded. The following opportunities are noted:

- Public park lighting: LED lighting is gradually emerging as the default technology here. Some parks already use LED technology (e.g. Camperdown Oval park), and as parks are upgraded this will continue to be the preferred technology, integrated with controls where feasible/practical. In addition to energy savings, longer life and lower maintenance costs are incurred.
- Sporting oval lighting: some councils have started to select LED as the default technology for new sporting oval lighting (e.g. Oxley Oval in Port Macquarie Hastings Council, Strathfield Park synthetic turf field), and more suppliers of both LED and traditional sporting oval lighting technologies are giving equal prominence to both solutions. Ovals have relatively few operating hours so the technology cost and warranties need to more closely match those for existing technologies to make a compelling case for changing to LED. Longer life, energy savings, lower lamp lumen depreciation and lower maintenance requirements also apply for oval LED lighting.
    - Most prominent of the sporting ovals in Leichhardt Oval, which hosts several televised rugby league NRL) fixtures annually and may host football fixtures in coming years as Allianz Stadium is rebuilt. LED lighting for the floodlights at this stadium would follow the growing trend of major stadia changing to LED technology[14].
- A building audit of the Petersham Administration building provided a scope and costing for a major HVAC upgrade, with a cost of $1.87 million required to replace the whole system. The payback on energy savings alone exceeds 40 years, so this opportunity is only feasible if Council elects to refurbish the building's energy services owing to their age.
- An upgrade to the Haberfield Library, including HVAC replacement, commenced during the course of this work.
- Site visits included Leichhardt Library, with advice received that some packaged air conditioning systems have been replaced but the majority date from the original construction over 15 years ago. As such these systems will be nearing the end of their life and may be upgraded piecemeal as units fail or as an upgrade project that could see efficiencies gained through a whole-facility strategy. An upgrade of all remaining units could cost around $150,000.

---

[14] Documents relating to the current lighting suggest that an LED upgrade would cost around $400,000, hence a payback of around 16 years would result. Hence replacement with LED at end of life will produce a more acceptable payback, with just the added cost of LED compared with metal halide technology needing to be taken into account.

- The energy audit report by Pangolin of the Ashfield Civic Centre noted that the old chiller in this building would require replacement in time, and could cost in the order of $100,000.
- The SHARE out-of-hours school care facility in Summer Hill is being upgraded, including upgrade to the air conditioning system, with associated opportunities to ensure the facility's energy efficiency is significantly improved.

The table below summarises the potential energy savings for these upgrades to illustrate the potentially significant contribution these can make to Council's overall efforts to reduce its carbon footprint. Costs are excluded (other than as noted above). The timing for these is also not noted – discrete building HVAC upgrades (stand-alone or part of a larger upgrade) will happen from time to time. Parks and oval lighting upgrades will happen over a 10-20 year period.

TABLE 7: POTENTIAL ENERGY AND COST SAVINGS FOR IDENTIFIED BUILDING HVAC & PUBLIC LIGHTING UPGRADES

Site(s)	Upgrade	Electricity cost savings ($ pa)	Electricity saving (kWh pa)	Gas saving (MJ p.a)	Carbon saving (t CO_2e pa)
Leichhardt Library	Energy-efficient packaged HVAC system(s)	$10,000	35,000		29
Haberfield Library	Energy-efficient packaged HVAC system	$2,625	17,500		15
Ashfield Civic Centre	Energy efficient chiller	$1,500	10,000		8
Parks & ovals	LED lighting in ovals, parks, IWC street lights, White Way lighting	$98,019	653,461		542
Leichhardt Oval #1	LED floodlighting at end of life replacement	$25,000	14,000		12
Petersham Administration	Replace HVAC system ($1.87 million capex estimate by consultant)	$35,000	220,000	200,000	193
SHARE OOSH	Refurbishment works including air conditioning system upgrade	$2,194	10,971		9
Total		**$174,338**	**960,932 kWh**	**200,000 MJ**	**808 t CO_2-e**

4.5 Reducing natural gas consumption

4.5.1 Council's natural gas consumption

Natural gas is a fossil fuel and is not renewable. However, its chemical structure is quite different to coal, meaning its carbon (and other) emissions are lower.

The majority of Council's natural gas consumption (93%) is for its aquatic centres at Annette Kellerman, Leichhardt Park, Ashfield and Fanny Durack. The AKAC and LPAC facilities both have cogeneration plants with waste heat recovery and supplementary gas-fired boilers for pool heating. Co-generation plants increase the efficiency of energy use and reduce carbon impact. AAC is currently undergoing redevelopment, and it is understood that the new pool will use electricity rather than gas, thus reducing the consumption of gas here. Gas consumption at Fanny Durack pool is small, as pool heating is mostly supplied by electric heat pumps with a small gas boiler providing supplementary heating only when the heat pumps cannot maintain the pool's set temperature.

Key features of the cogeneration plants are provided in Table 8~~Table 8~~.

Table 8: Existing IWC Cogeneration Plants

Annette Kellerman Aquatic Centre (AKAC)	Implemented, operates during the daytime 7 days a week	337 kWe/525 kWth[15] system, feed-in-tariff received for grid export
Leichhardt Park Aquatic Centre	Implemented, operates during the daytime 7 days a week, expanded to provide heating to the new Program Pool	60 kWe microturbines, all output is consumed on site with no export

The Petersham and Ashfield administration centres are the only other notable gas users, where gas is mainly used for space heating via boilers. The Leichhardt administration building has a small gas demand by comparison, and all administration centres together consume just 5.3% of IWC's gas usage.

All other buildings are small gas users and account for just 1.6% of Council's demand.

The charts below show the split of gas consumption by asset category and by major site for 2016/17.

[15] Energy input to a cogeneration system (typically natural gas) has two energy outputs; firstly electricity is created (kWe) in the cogeneration plant's prime mover (an internal combustion engine or turbine). Secondly waste heat is captured from the combustion process and is converted into useful thermal energy (kWth). The sum of kWe + kWth is usually around 80% of the total energy input to a cogeneration plant, making this an energy-efficient way to utilise energy.

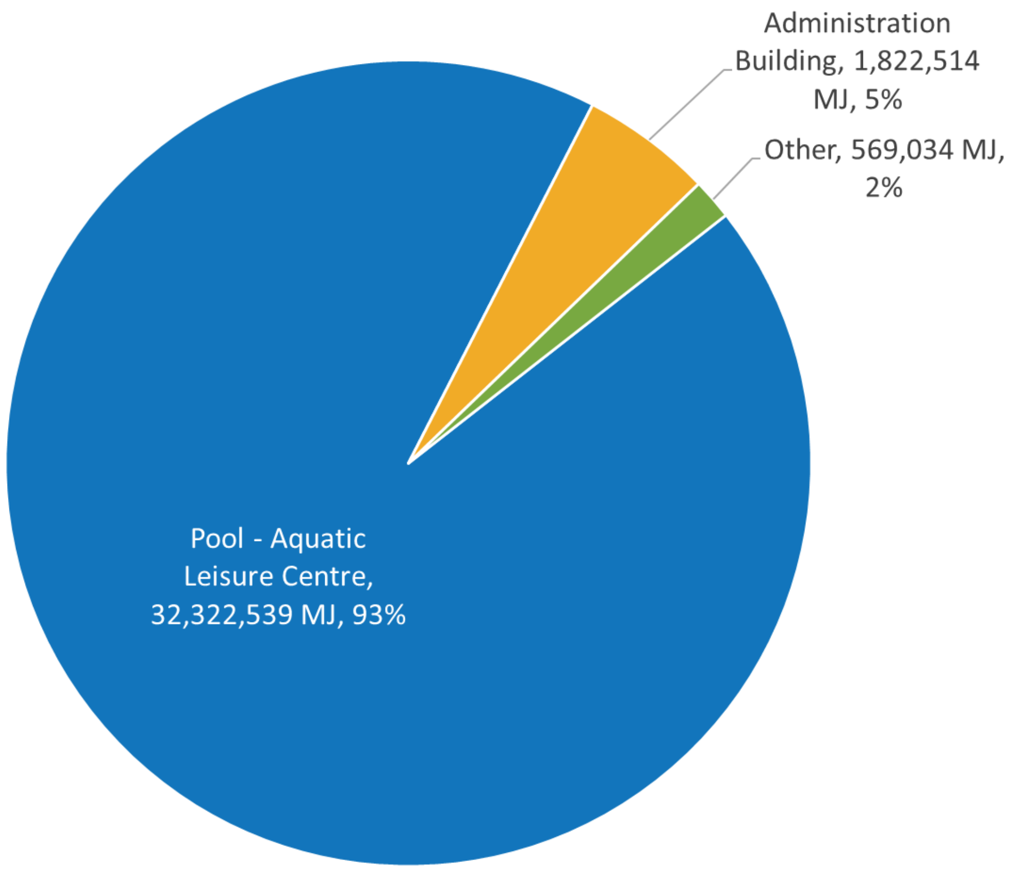


Figure 9: Inner West Council gas consumption by asset category 2016/17

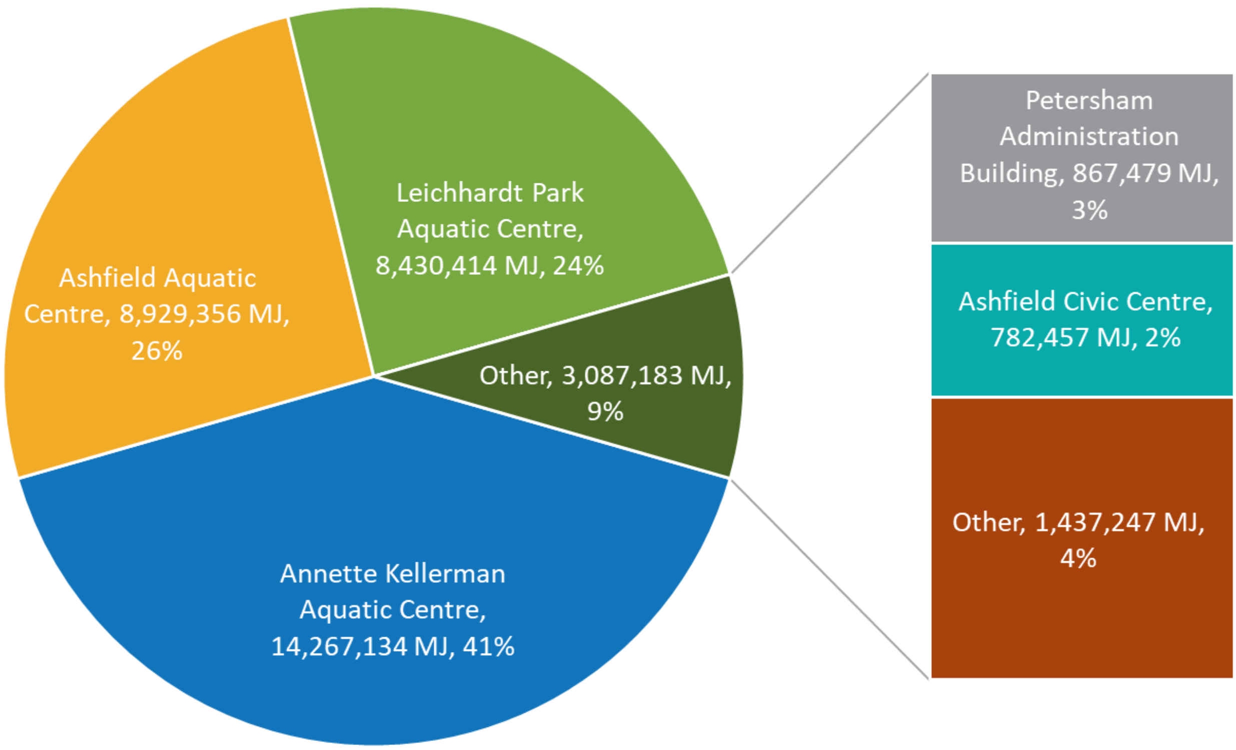


Figure 10: Inner West Council gas consumption by site 2016/17

4.5.2 Options for decreasing natural gas consumption

Energy audits have identified some modest savings in natural gas consumption at Council's administration building, and these have been noted in the above sections on energy efficiency in Council's facilities. For completeness these savings are summarised again below.

TABLE 9: SUMMARY OF BUILDING NATURAL GAS REDUCTION OPPORTUNITIES

Site	Scope	Capital cost ($)	Power savings ($ pa)	Maint-enance savings ($ pa)	Pay-back (yrs)	Electricity saving (kWh p.a.)	Gas saving (MJ p.a.)	Carbon saving (t CO_2-e p.a.)
Ashfield Civic Centre	(a) HVAC system optimisation (b) replacement of old gas boiler	$133,000	$51,872	$0	2.6	284,985	547,000	265
Petersham Service Centre	Capital upgrade, (energy savings being part of a larger project)	$1,870,000	$35,000	$7,000	44.5	220,000	200,000	193

It is not proposed at this time to implement measures aimed at substantially reducing energy use by the two cogeneration plants. The purpose of building these systems was in part to reduce greenhouse gas emissions, which has been successfully achieved. Given the age of the two cogeneration systems, and that they can be expected to have at least 10 years of continued operation, it is recommended that these be operated to deliver the best value to Council in terms of pool heating and energy costs. Their continued use as a primary means of heating these pools should continue for the foreseeable future. The site visits did highlight that there may be an opportunity to optimise the time of use of the cogeneration system at AKAC to better align with Peak and Shoulder charge periods. This is aimed at optimising the cost savings from the system, and it does not appear that a change in total weekly operating hours is warranted.

4.5.3 Longer-term alternatives to natural gas ~~Future opportunities for heat pump technology~~ for pool heating

As Council moves towards a 100% renewable energy future, pool heating options ~~the case for cogeneration (and supplementary gas boilers) as part of the fuel mix~~ should be re-evaluated. ~~; in particular, the e~~Electrification of pool heating ~~–~~ (for example using heat pumps~~,~~) and powering ~~this~~ from renewables is a strategy that some organisations are pursuing (e.g. Monash University). Modern heat pump technologies are more energy efficient, and through the use of refrigerants such as carbon dioxide, greenhouse gas emissions can be further reduced. As aquatic centres often have large roof areas (including AKAC), the implementation of heat pumps in future may also make rooftop solar PV more economically attractive.

4.6 Building design and sustainable procurement policies

Council also has opportunities to influence its energy use through design of new facilities and through equipment procurement policies and practices. The above section highlights several prominent examples of equipment efficiencies that can achieved at the point of replacement. Some of the building upgrades (e.g. OOSH, Haberfield Library) have opportunities for improved efficiency through passive design measures such as shading, ceiling, wall and floor insulation, window performance or treatment (e.g. solar film). Similarly, efficiencies in equipment purchasing can extend to all office equipment, appliances, IT systems, emergency lighting and the like.

Efficient energy use outcomes can be achieved by IWC through regular review of its design and procurement policies to align with current best practice, and through the rigorous implementation of these policies. The main developments to be considered by Council in this regard are summarised below.

4.6.1 Changes to the BCA will improve energy efficiency in new builds

The National Construction Code is a uniform set of technical provisions for the design, construction and performance of buildings throughout Australia. It is published and maintained by the Australian Building Codes Board, on behalf of and in collaboration with the Australian Government and each State and Territory Government. The National Construction Code is made up of the:

- Building Code of Australia (BCA), and the
- Plumbing Code of Australia

Energy efficiency performance requirements are set out in Section J of the BCA. This section is currently undergoing a review, with proposed changes likely to come into effect in mid-2019 (NCC2019). Both residential and commercial building changes will be affected. Changes are expected to include:

- quantification of the mandatory Performance Requirements
- introducing a NABERS Energy Commitment Agreement Verification Method
- introducing a Green Star Verification Method
- introducing commissioning requirements
- improved consideration of on-site renewables such as solar power
- improved thermal bridging requirements, and simpler Deemed-to-Satisfy Provisions

The changes will be released in February 2019, and come into effect on 1 May 2019. The measures expected to be introduced under NCC2019 would deliver energy and carbon savings of at least 25% compared with the provisions of the 2016 NCC.

4.6.1.1 Sustainable Building Design Guide

It is understood from Council staff that a Sustainable Building Design Guide will be developed by Environment & Sustainability for use by Council Groups, particularly Capital Projects and Facilities. This Guide will be informed by the outcomes of the NCC2019 process. The Guide will identify a range of sustainability options when building or upgrading Council properties. The Guide will focus on options with good financial and environmental benefits that go beyond the compliance requirements set out in the Building Code of Australia. The Guide will include discussion of energy efficiency and solar generation.

4.6.2 Sustainable procurement

4.6.2.1 NSW Local Government Guide

*"Sustainable procurement takes into consideration responsibility for the **economic**, **environmental**, **social** and **governance** impacts of any purchase – products or services. These four factors are referred to as the quadruple bottom line and relate to a total purchase cost, and not just the upfront dollar expense.*

Sustainable procurement, applied to NSW councils' spending, represents a significant opportunity to drive social and environmental change throughout a wide range of not only direct suppliers, but also the associated supply chains[16]".

The 2017 Sustainable Procurement Guide for NSW local governments aims to help Councils develop and embed sustainable procurement practices in their organisation. The guide presents information on key concepts, certifications, standards and processes and is designed for all council staff involved in any purchasing. The Guide is applicable from major tenders through to one-off equipment purchases.

Council should examine the guide to identify key areas within its procurement processes where this can add value and lead to more informed and better procurement decisions.

Complementing a Guide such as this, Council has access to a wide range of information and data that can help it take decisions on equipment purchases. A prominent resource is the Equipment Energy Efficiency (E3) program.

- The Equipment Energy Efficiency (E3) program[17], through which Australian jurisdictions (and New Zealand) collaborate to deliver nationally consistent mandated energy efficiency standards and energy labelling for equipment and appliances. Procurement policies and practices that routinely ensure that high star-rated appliances (motors, air conditioning units, kitchen appliances) are selected when replacing or buying new equipment will help Council's energy footprint decline over time.

4.6.2.2 ISO 20400 – Sustainable Procurement Guide

Council can also review and consider the international standard ISO20400 for sustainable procurement.

Sustainable procurement is the process of making purchasing decisions that meet an organization's needs for goods and services in a way that benefits not only the organization but society as a whole, while minimizing its impact on the environment.

ISO 20400 provides guidelines for integrating sustainability into an organization's procurement processes. Aimed at top managers and directors of the purchasing function, it covers the political and strategic aspects of the purchasing process, namely how to align procurement with an organization's goals and objectives and create a culture of sustainability. The standard defines the principles of sustainable procurement, including accountability, transparency, respect for human rights and ethical behaviour, and highlights key considerations such as risk management and priority setting. It also covers

[16] Sustainable Procurement Guide for Local Governments in NSW, 2017: https://www.lgnsw.org.au/files/imce-uploads/127/esstam-sustainable-procurement-guide-30.05.17.pdf

[17] http://www.energyrating.gov.au/

various stages of the procurement process, outlining the steps required to integrate social responsibility into the purchasing function[18].

There are four key clauses of the Standard that provide guidance to assist organisations to meet social and environmental responsibility.

1. Clause 4 Understanding the Fundamentals is a generalist clause which discusses what sustainable procurement involves and its strategic goals. It also outlines fundamental practices such as due diligence, risk management and priority setting.
2. Clause 5 Integrating Sustainability into the Organisation's Procurement Policy and Strategy provides guidance to top-tier management on bridging the gap between sustainable procurement strategy and organisational policy. This clause clarifies the importance of mandating sustainability objectives within the organisation at all levels and in particular, stresses the importance of accountability and sustainable supply chains.
3. Clause 6 Organising the Procurement Function towards Sustainability is most applicable for people engaged in procurement management and outlines the techniques to be employed to enable successful implementation, namely enabling people, engaging stakeholders, setting priorities and measuring performance.
4. Clause 7 Integrating Sustainability into the Procurement Process is directed towards individuals managing sourcing activities and contracts. It provides practical guidance regarding implementing sustainable procurement at each stage of the process including planning, supplier selection and contract management and review.

It is recommended that Inner West Council, facilitated by Environment & Sustainability, examine Council’s procurement policies and practices to test alignment with these guidelines, and to identify and progress improvements that will lead to improved quadruple bottom-line outcomes that are aligned with Council’s objectives.

[18] https://www.iso.org/files/live/sites/isoorg/files/store/en/ISO%2020400_Sustainable_procur.pdf

5

Renewable energy generation at Council sites

5 Carbon reduction strategy 3: Renewable energy generation at Council sites

5.1 The benefits of onsite solar generation

For many council assets like administration buildings, child care centres or libraries, installing solar panels is an excellent fit, as operating hours and sunshine hours are often the same. That means that the energy generated by solar panels can be used instantly instead of buying electricity from the grid. Where suitable, onsite solar generation is the cheapest form of clean energy available for councils.

5.2 Financial incentives for onsite solar generation

Currently in Australia, there are financial incentives offered by the Commonwealth Government for renewable energy installations. The most common incentive is Small-Scale Technology Certificates (STCs). STCs are like an upfront subsidy when solar PV systems smaller than 100 kW in size are installed. STCs make a business case for solar much more beneficial.

Also, under Australian carbon accounting rules, it is possible to get the upfront subsidy of the STCs and still claim the carbon reduction that comes from small-scale solar PV systems.

Where there are large roof spaces that allow for the installation of solar PV systems greater than 100 kW, a different incentive scheme exists: Large-Scale Generation Certificates (LGCs). Unlike the STCs, LGCs are not paid upfront. Instead, they accumulate for every megawatt hour a large solar PV system generates. It is up to the organisation to decide what to do with these LGCs. Generally speaking, there are three basic options:

1. Sell the LGCs and reap the financial rewards. This means that the carbon reduction cannot be claimed.
2. 'Retire' the LGCs and forego the financial reward. This means that Council can claim the carbon reduction.
3. Bank the LGCs and decide later what to do with them. Neither the financial benefit nor the carbon reduction eventuate so long as they are merely held in an account.

LGCs are discussed further in Chapter 7 in the context of sourcing Council's electricity from offsite renewable energy generation. In this chapter, the specific options for Council are discussed, which are to sell all LGCs, retire all LGCs, sell excess LGCs and retire excess LGCs.

5.3 The limits of onsite solar generation

Unfortunately, solar panels cannot be installed on every roof. Sometimes, a roof is shaded, too small, oriented to the south, structurally unsound, used for other equipment like air conditioning, or otherwise unsuitable or sub-optimal. In other cases, there might be enough roof space, but not enough electricity demand in the building (especially during the daytime if batteries are not installed). There is thus a natural limit on how many solar panels can be implemented in an organisation. For many metropolitan councils this limit is often around 5-10% of electricity consumption.

There are also network and regulatory constraints to solar energy sharing and distribution. For instance, it is not currently possible to cost-effectively credit solar generation from one site to another site close by (for example crediting output from a larger solar array on Leichhardt Oval's grandstand to the adjacent aquatic centre). Regardless of whether the electricity travels just a few metres or hundreds of kilometres, the full network charges (for poles and wires) are still incurred, so the savings to the final user are limited to the usage charges only.

Peer-to-peer sharing of surplus solar energy with another energy user is also not feasible at this time, though limited trials are progressing to develop this idea.

These constraints mean that it is not feasible or practical at this time for Council to seek out innovative renewable energy solutions with businesses in the Inner West community, such as energy sharing or Council buying power from rooftop solar systems (beyond what would be beneficial to businesses themselves). This situation may change in time, however for this assessment the focus has been on Council-owned facilities only for estimating solar PV generation potential.

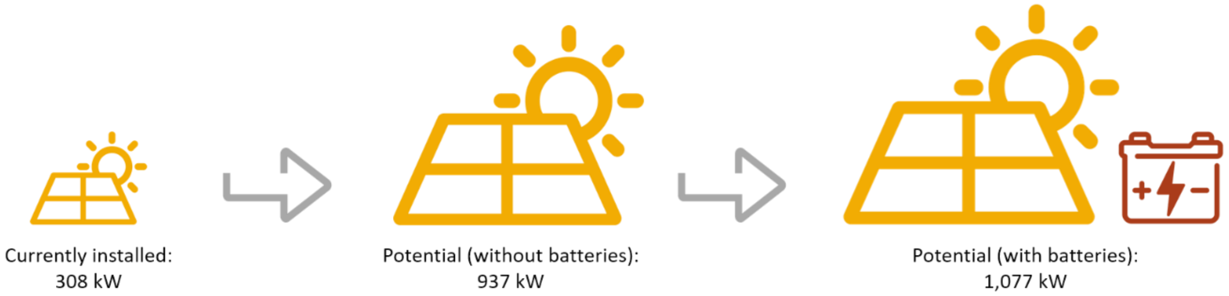
5.4 Battery energy storage systems

Sometimes, energy demand can be outside sunshine hours, like for a community centre. In other cases, energy demand can be intermittent. This is where battery storage comes in. Renewable electricity from solar panels is sent to the battery when not needed. Once the sun is down, or when there is extra demand for electricity, the building draws on the renewable energy stored in the battery.

Battery energy storage systems are still expensive, but prices are falling. Once cost-effective, they will enable Council to increase its onsite renewable energy production.

5.5 Current and potential future installations

Inner West Council has implemented a number of solar PV systems at its sites in recent years, with 308 kWp installed. Site investigations carried out as part of this Stage 1 work have identified the potential for a number of additional systems that can see Council's installed PV capacity rise to 937 kWp without battery energy storage, and up to 1,077 kWp of PV with 640 kWh of storage.



These additional systems could be implemented over the medium term, and in some cases will rely on PV and battery costs continuing to decline, making the case for solar more cost-effective.

Three solar energy initiatives are summarised below with further details in Annex D.

5.6 Improving the yield from existing solar PV systems

As noted above, Inner West Council has installed 308 kWp of solar PV across 30 systems.

An estimated 381 MWh of electricity is generated by these solar PV systems, giving an average yield of 1,238 kWh per kWp installed each year.

Taking 1,400 kWh/kWp per year as an indicative expected yield for Sydney (equivalent to >3.8 kWh/kW per day), data for each installed system is assessed, and any shortfall compared with nominal expected yield is calculated.

Table 10: Inner West Council solar PV system performance (existing IWC systems)

Site	**Installed Capacity** (kWp)	**Recorded Annual generation (kWh pa)**	**Calculated Performance (kWh/kW pa)**	**% of expected**	**Lost power (kWh pa under 100% of expected)**
Annette Kellerman AC	30	45,630	1,521	109%	0
Leichhardt Depot	7.42	11,641	1,569	112%	0
Leichhardt Oval #1	9.88	14,496	1,467	105%	0
~~Leichhardt Park Children's~~[19]	~~4.2~~	~~-~~	~~-~~	~~0%~~	~~0~~
Petersham Administration	20	28,622	1,431	102%	0
Summer Hill Works Depot	15.7	22,616	1,441	103%	0
John McMahon CCC	1.85	2,495	1,349	96%	95
Chrissie Cotter Gallery	1.5	1,662	1,108	79%	438
St Peters Depot (Bldg B)	30	41,553	1,385	99%	447
Leichhardt Pk Playground	1.04	908	873	62%	548
Balmain Library	13	17,600	1,354	97%	600
Foster Street FDC	1.21	975.185	806	58%	719
Cavendish ELC	5	6,251	1,250	89%	749
Dulwich Hill Library	2	2,029	1,015	72%	771
Deborah Little ELC	2	1,805	903	64%	995
Hannaford Centre	3.15	3403.98	1,081	77%	1,006
Rozelle Bay Community Native Nursery	1.7	1,249	735	52%	1,131
Jimmy Little Comm Centre	2.7	2,578	955	68%	1,202
Leichhardt Children's	3.25	3,048	938	67%	1,502
Leichhardt Admin Building	4.965	5,336	1,075	77%	1,615
Annandale Comm Centre	2.42	1,670	690	49%	1,718
Tom Foster Comm Centre	25	32,921	1,317	94%	2,079
Balmain Depot	13	15,121	1,163	83%	3,079
Tillman Park ELC	4.8	2,400	500	36%	4,320
Haberfield library	10	9,205	921	66%	4,795
Leichhardt Town Hall	20.09	22,654	1,128	81%	5,472
Blackmore Oval	10.35	6,818	659	47%	7,672
LPAC Gym	35.5	30,889	870	62%	18,811
LPAC Program Pool	30	23,000	767	55%	19,000[20]
ALL EXISTING SOLAR PV	**311.725**	**358,577**	**1,150**		**78,763**

[19] There is a new array at Leichhardt Park Children's Centre with Installed Capacity of 4.20kWp however as the system is recently installed, there is no reliable performance data as yet.

[20] This system is new and less than 12 months of data were available. This system is omitted from estimates of under-generation by solar PV systems

There appear to be a number of underperforming solar installations. There are a number of possible reasons for this including:

- System age (panels deteriorate over time and inverters need to be replaced every 7-10 years)
- Damage to the system
- Overshadowing (due to trees, building plant such as aerials, air conditioning plant or nearby structures)
- Incorrect data

Data quality, inverter outputs, communications, meter records of export and self-consumption, and database data quality should all be investigated as well as the physical condition of the existing systems. In addition, as noted above, the LPAC Program Pool system is new and data are incomplete. Taking this into account the **estimated loss in solar generation is 59,763 kWh per year**, equivalent to 49 t CO2-e at current grid carbon intensity, and potential lost savings of $11,953 per year if we take the value of energy savings to be 20¢/kWh (noting that most of the above shortfalls are at small sites).

It is understood that Council staff plan to investigate the underperforming systems to assess the actions that need to be taken to rectify faults and improve their performance.

5.7 Installing solar PV on additional Council buildings

Additional opportunities for solar generation were assessed through visits to selected Council sites. The potential for solar PV without battery storage was assessed for all sites visited as part of this work.

More detailed analysis / modelling and prioritisation is recommended in order to develop a costed and staged program of work. The cost-benefit analysis at this stage is based on the following assumptions:

- Estimation of the capacity for solar PV at each site that can be largely self-consumed without need for storage,
- Estimation of the fraction that is likely to be consumed on site vs exported, with reference to load profiles where available or based on advised/known operating times,
- Costs for small-scale rooftop solar PV systems (less than 100 kWp) are taken at an average $1.30/watt installed. For many systems with easy installation (mounted directly to a sloped roof and with relatively easy electrical and metering connection) a cost of around $1.10/watt is often possible, while systems requiring tilt frames may cost more than this. A figure of $1.30/watt is therefore used as a typical average cost for small-scale rooftop systems,
- For large-scale systems (greater than 100 kWp) a cost of $1.90/watt is assumed, while for custom solutions such as carpark or private wire opportunities higher costs reflect the expected higher complexity, approvals and materials required for these projects,
- The value of solar PV savings is taken to be 12¢/kWh for large sites, 15¢/kWh for medium sized sites, 20¢/kWh for small sites, and the value of feed-in-tariff exports is taken to be 6¢/kWh[21],
- Sites where the combined total of all PV systems exceeds 100 kW are assumed to retire and not sell LGCs (i.e. claim the GHG abatement)

Based on these assumptions and site assessments Table 11 summarises the potential for new solar PV on Council facilities.

[21] Some retailers do offer better feed-in rates of up to 10¢/kWh, however 6¢/kWh reflects Council's current rate

TABLE 11: POTENTIAL FOR ADDITIONAL SOLAR PV SYSTEMS (WITHOUT BATTERY STORAGE)

Site	Solar PV (kWp)	Generation (MWh pa)	Consumed (MWh pa)	Exported (MWh pa)	Capital Cost ($)	Savings ($ p.a)	Payback (years)	Carbon savings (t CO_2-e)
Annette Kellerman Aquatic Centre	100	140.0	0.0	140.0	$190,000	$8,400	22.6	116.2
Ashfield Civic Centre	100	140.0	133.0	7.0	$130,000	$16,380	7.9	110.4
Fanny Durack Aquatic Centre	20	28.0	19.6	8.4	$26,000	$2,856	9.1	16.3
Haberfield Library	10	14.0	9.8	4.2	$13,000	$1,428	9.1	8.1
Leichhardt Oval #1	10	14.0	9.8	4.2	$15,000	$1,428	10.5	8.1
Leichhardt Service Centre (from carpark behind if permitted)[22]	75	105.0	89.3	15.8	$150,000	$11,655	12.9	74.1
Leichhardt Park Aquatic Centre	20	28.0	28.0	0.0	$26,000	$3,360	7.7	23.2
Leichhardt Park Aquatic Centre (private wire from #1 Oval if permitted)[23]	60	84.0	84.0	0.0	$180,000	$10,080	17.9	69.7
Leichhardt Park Aquatic Centre (from carpark adjacent if permitted)[24]	75	105.0	105.0	0.0	$225,000	$12,600	17.9	87.2
Petersham Service Centre	5	7.0	7.0	0.0	$6,500	$840	7.7	5.8

[22] This proposal would see a covered structure with a solar array built in the carpark at the administration centre, provided this is permitted – e.g. via consultation with Ausgrid, reference to future site plans, and zoning

[23] As a case example a private wire transports power from the solar farm on Westfield Chatswood carpark to the Council community centre across the road. Discussions with Ausgrid would be required in the first instance to explore whether this would be permitted in this case (refer to 3rd dot point below this table)

[24] This proposal would see a covered structure with a solar array built in the carpark at the aquatic centre, provided this is permitted – e.g. via consultation with Ausgrid, reference to future site plans, and zoning

Site	Solar PV (kWp)	Generation (MWh pa)	Consumed (MWh pa)	Exported (MWh pa)	Capital Cost ($)	Savings ($ p.a)	Payback (years)	Carbon savings (t CO_2-e)
Petersham Town Hall	15	21.0	17.9	3.2	$19,500	$2,331	8.4	14.8
St Peters Depot	70	98.0	83.3	14.7	$91,000	$10,878	8.4	69.1
May Murray Child Care	2	2.8	2.4	0.4	$2,600	$501	5.2	2.0
Sydenham / St Peter's Library	10	14.0	9.8	4.2	$13,000	$2,212	5.9	8.1
Marrickville Town Hall	25	35.0	35.0	0.0	$32,500	$5,250	6.2	29.1
Deborah Little Early Learning Centre	3	4.2	3.6	0.6	$3,900	$752	5.2	3.0
Leichhardt Children's Centre	2	2.8	2.2	0.6	$2,600	$482	5.4	1.9
Foster St Family Day Care	2	2.8	2.0	0.8	$2,600	$442	5.9	1.6
Mervyn Fletcher House	3	4.2	3.6	0.6	$3,900	$752	5.2	3.0
SHARE OOSH & Carlton Crescent Community Centre	10	14.0	11.9	2.1	$13,000	$2,506	5.2	9.9
Summer Hill Depot	10	14.0	9.8	4.2	$13,000	$2,212	5.9	8.1
Enmore Road Early Learning Centre	2	2.1	1.8	0.3	$2,600	$376	6.9	1.5
ALL NEW PV	**629**	**879.9**	**668.8**	**211.3**	**$1,161,700**	**$97,721**	**11.9**	**671.2**

On the face of it the payback for these investments is relatively long in aggregate. However, works would be staged with longer payback systems held back until solar PV costs and/or energy costs and/or energy market rules favour these systems. For example:

- Installation of a further 100 kWp at AKAC would not be cost effective at this time as the only revenue from the project would be a feed-in-tariff, and potentially LGC revenue if IWC decided not to retire the abatement. However future energy sharing, virtual net metering with local distribution tariffs, or a virtual power plant system with battery storage could unlock this potential,
- Carpark PV systems carry added costs as they require more infrastructure, civil works and the like. Declining PV costs and design / EPC processes will make these initiatives more affordable in future. In these cases assessment of the feasibility of supplying power from the carparks to the administration building and LPAC main switch respectively would also be required,
- Further investigation would be needed to determine if any of the potential private wire transportation of power are permitted under the energy market rules

Further analysis in Stage 2 will help to refine and prioritise the sites to be implemented initially and those to be implemented in the medium to long-term, taking into account the impact on emissions, cost-effectiveness, regulations, as well the impact in the community of Council's actions.

5.8 Installing solar PV and battery energy storage on Council buildings

Many of the sites assessed for solar PV have no need of battery storage as their roof capacity for generation is less than the daytime load of the facilities. However, in several cases battery storage will help to increase the level of solar PV that can be installed and the abatement that can be achieved.

A summary of solar and storage opportunities is shown in Table 12 below. Assumptions in addition to those made above are that battery costs are $750/kWh. This reflects current costs which are declining and may halve over the next 3-5 years.

As shown, inclusion of batteries on some sites could allow evening use of power stored from larger solar arrays. Some sites do not warrant batteries and are listed below with "0" in the Battery (kWh) column.

Note Table 12 (solar-with-batteries-where-warranted) is not *additional* to Table 11 (solar-without-batteries) – it shows the same facilities with and without batteries.

The summary including batteries provides additional information about battery opportunities at this time, and is intended to assist IWC in its prioritisation of future solar and battery storage opportunities.

5.9 Summary of all onsite solar PV opportunities

In summary, greenhouse gas emissions savings of 49 t CO_2-e from improving the yield from existing solar PV systems, plus 806 t CO_2-e savings from implementation of all new solar and storage opportunities represents 4% of Inner West Council's carbon footprint for 2016/17.

Table 12: Potential for additional solar PV systems (with battery storage)

Site	Solar PV (kWp)	Battery (kWh)	Generation (MWh pa)	On-site consumption (MWh pa)	Excess power exported (MWh pa)	Capital Cost (total $)	Savings ($ pa)	Payback (years)	Carbon savings (t CO_2-e pa)
Annette Kellerman Aquatic Centre	100	0	140.0	0.0	140.0	$190,000	$8,400	22.6	116.2
Ashfield Civic Centre	100	0	140.0	133.0	7.0	$130,000	$16,380	7.9	110.4
Fanny Durack Aquatic Centre	20	0	28.0	19.6	8.4	$26,000	$2,856	9.1	16.3
Haberfield Library	20	40	28.0	25.2	2.8	$56,000	$3,192	17.5	20.9
Leichhardt Oval #1	60	180	84.0	67.2	16.8	$225,000	$9,072	24.8	55.8
Leichhardt Administration carpark	75	0	105.0	89.3	15.8	$150,000	$11,655	12.9	74.1
Leichhardt Park Aquatic Centre	20	0	28.0	28.0	0.0	$26,000	$3,360	7.7	23.2
Leichhardt Park Aquatic Centre carpark	75	0	105.0	105.0	0.0	$225,000	$12,600	17.9	87.2
Petersham Administration	5	0	7.0	7.0	0.0	$6,500	$840	7.7	5.8
Petersham Town Hall	30	50	42.0	37.8	4.2	$76,500	$4,788	16.0	31.4
St Peters Depot	70	0	98.0	83.3	14.7	$91,000	$10,878	8.4	69.1
May Murray Child Care Centre	5	10	7.0	6.3	0.7	$14,000	$1,302	10.8	5.2
Sydenham / St Peter's Library	16	25	22.4	17.9	4.5	$39,550	$3,853	10.3	14.9

Site	Solar PV (kWp)	Battery (kWh)	Generation (MWh pa)	On-site consumption (MWh pa)	Excess power exported (MWh pa)	Capital Cost (total $)	Savings ($ pa)	Payback (years)	Carbon savings (t CO_2-e pa)
Tillman Park Early Learning Centre	8	0	9.0	7.6	1.3	$12,480	$1,604	7.8	6.3
Marrickville Town Hall	50	50	70.0	63.0	7.0	$102,500	$9,870	10.4	52.3
Deborah Little ELC	10	20	14.0	12.6	1.4	$28,000	$2,604	10.8	10.5
Hannaford Centre	7	0	9.8	7.8	2.0	$9,100	$1,686	5.4	6.5
Jimmy Little Community Centre	6	15	8.4	7.6	0.8	$19,050	$1,562	12.2	6.3
Leichhardt Children's Centre	5	0	7.0	4.2	2.8	$6,500	$1,008	6.4	3.5
Foster St Family Day Care	5	10	7.0	6.3	0.7	$14,000	$1,302	10.8	5.2
Mervyn Fletcher House	7	20	9.8	8.8	1.0	$24,100	$1,823	13.2	7.3
SHARE OOSH & Carlton Crescent Community Centre	25	50	35.0	31.5	3.5	$70,000	$6,510	10.8	26.1
Summer Hill depot	42	150	58.8	52.9	5.9	$167,100	$10,937	15.3	43.9
Enmore Road ELC	2	0	2.1	1.8	0.3	$2,600	$376	6.9	1.5
Annandale Neighbourhood Centre	3	10	4.2	3.8	0.4	$11,400	$781	14.6	3.1
Cavendish ELC	3	10	4.2	3.8	0.4	$11,400	$781	14.6	3.1
TOTAL	**769**	**640**	**1073.7**	**831.3**	**242.4**	**$1,733,780**	**$130,020**	**13.3**	**806.1**

6

Making fleet more sustainable

6 Carbon reduction strategy 4: Making fleet more sustainable

6.1 Objective and approach

The brief sought information on the following issues in relation to Council's fleet of vehicles:

- Outline of the options, business case and practicalities for transition to a sustainable fleet
- Discussion on feasible options with estimated costs towards a 100% renewable fleet.

An initial assessment of transport abatement potential was made via discussion with fleet management, focussing on vehicle efficiency, emissions intensity of vehicles and demand management.

6.2 Fleet characteristics and fuel use

Council operates a fleet of heavy and light vehicles, mostly located at the St Peter's depot, with smaller fleets at Leichhardt depot, Balmain depot and Council offices. Fleet includes:

- 108 road, traffic and stormwater services vehicles
- 26 garbage compactors
- 5 community buses
- 169 leaseback vehicles, including operational vehicles

Council uses petrol for its passenger vehicle fleet and some light commercial vehicles. Both regular and E10 ethanol blend petrol products are purchased (petrol containing 10% ethanol arguably has a lower carbon footprint than standard petrol).

Diesel is used for some commercial fleet and all heavy fleet (trucks, road plant, and garbage collection). Council aims to use a B20 biodiesel blend in much of its heavy fleet, with amounts of B20 purchased subject to availability (supply reliability has been limited in recent months). B20 biodiesel has a lower carbon footprint than standard diesel, and consists of standard diesel blended with up to 20% biodiesel, which is a renewable, biodegradable fuel manufactured from vegetable oil, animal fats or recycled restaurant grease. Inner West Council is one of the few local government areas using this proportion of biodiesel. Inner West Council represents a reliable customer base for the supplier.

Fuel consumption and associated carbon emissions are shown in Table 13~~Table 13~~ and Figure 11. As shown, fuel accounted for less than 11% of IWC's greenhouse gas emissions in 2016/17.

TABLE 13: CARBON FOOTPRINT FROM TRANSPORT FUEL 2016/17

Fuel used in Fleet[25]	Fuel Quantity (kL in FY17)	Total (tCO_2e in FY17)	Percentage of total IWC carbon footprint
Diesel	509.2	1,417.2	6.5%
Petrol	366.8	893.3	4.1%
Ethanol	20.6	0.2	0.0%
Biodiesel	70.7	6.4	0.0%
LPG	0	0.0	0.0%
Total	**967.30**	**2,317**	**10.60%**

[25] Diesel fuel includes regular diesel plus the regular diesel fraction of purchased B20. Biodiesel refers to the renewable fraction of B20. Petrol refers to regular ULP plus the regular ULP fraction of purchased E10. Ethanol refers to the renewable fraction of purchased E10.

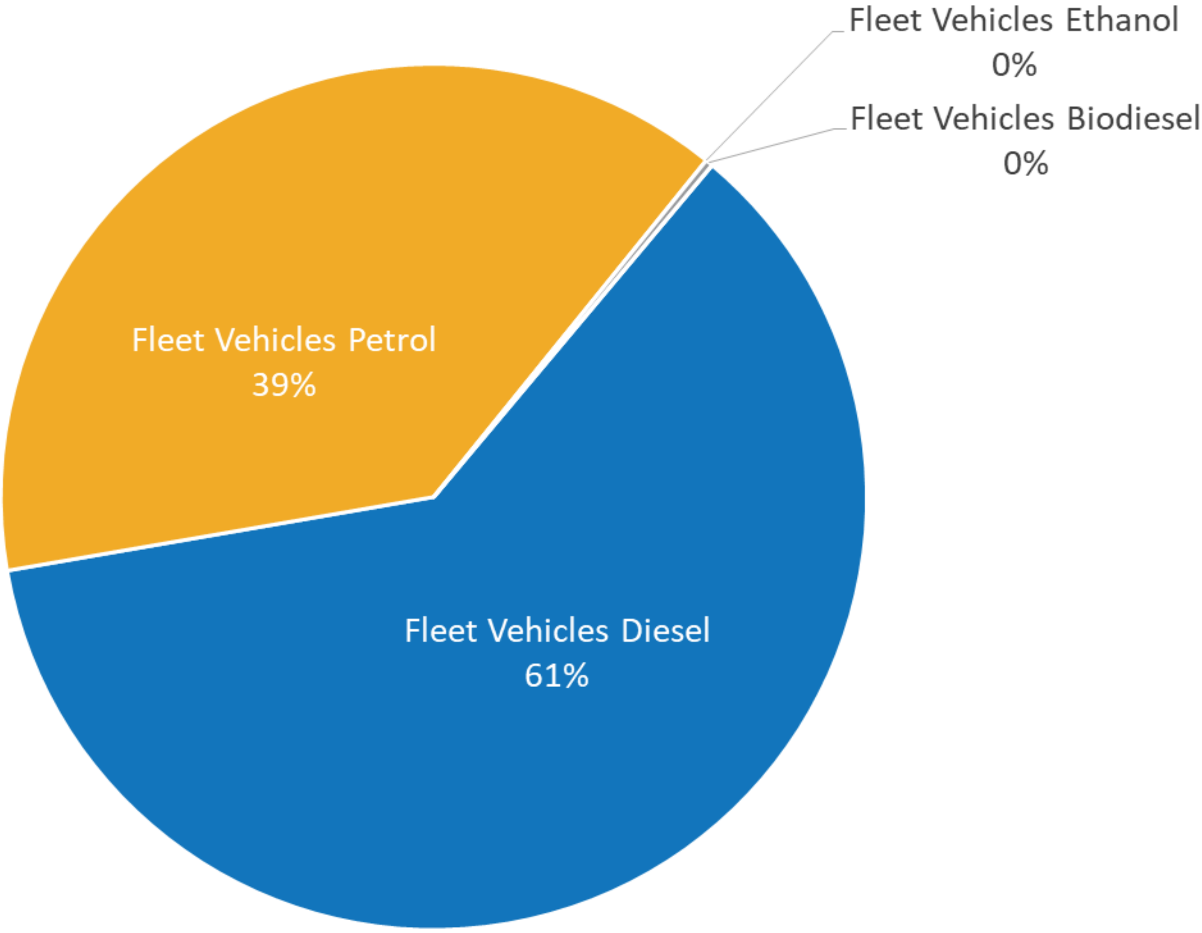


FIGURE 11: PIE CHART OF COUNCIL FLEET EMISSIONS BY FUEL TYPE

6.3 Current measures to reduce carbon from fuel

6.3.1 Vehicle efficiency incentives

Council's passenger fleet leaseback policy provides an incentive for uptake of more efficient vehicles by:

- Providing subsidies for fuel efficient and low emissions vehicles
- Avoiding 6-cylinder vehicles and banning 8-cylinder vehicles

Road plant and other heavy vehicle purchasing seeks to ensure that the most recent emissions standards are selected, such as euro v.

6.3.2 Emissions intensity of vehicles

A range of measures are in place that reduce the emissions intensity of Council vehicles:

- Under the leaseback policy, higher subsidies are in place for hybrid vehicles compared with other types, with around 13 hybrid vehicles currently in the fleet of 169 leaseback vehicles,
- A little over 5% of all petrol fuel purchased is Ethanol, while 12% of all diesel purchased is biodiesel. Ethanol is purchased as an E10 blend while diesel is purchased as a B20 blend,
- The St Peter's depot truck fleet operates on B20, and it is intended that diesel vehicles across all depots use B20 when supply is secure,

- B50 was trialled in some vehicles in the former Leichhardt Council but was found to be unsuitable,
- Council staff are remaining abreast of developments in electric vehicles, but at this time Council has not purchased any EVs for its own fleet

6.3.3 Demand management

Demand management measures can include driver behaviour, reducing trip distances and back-hauling, ride sharing/car-pooling, and smart controls such as for idling.

Currently, there are no major demand management policies in place that would have a material impact on emissions from IWC's fuel use. There are limitations on Council's ability to manage demand given that diesel for operational vehicles is the major fuel used by IWC.. For example, Council has limited influence on trip distances for transport of garbage or recycling to a transfer station or landfill.

Council operates a bicycle fleet for staff use, which allows personnel to temporarily use a bicycle to move around the LGA during the work day. The Sustainability team provides cycling training to interested staff, and manages the maintenance of the bike fleet. Council's bike fleet consists of 6 standard bikes and 7 electric bikes, all located at various offices. Council has purchased an electric bike for the Resource Recovery Officer Apartments. The officer uses the bike to conduct site visits required by the role.

Council also encourages car-pooling and use of public transport for work activities where feasible. For example, leased vehicles are frequently used for car-pooling and some Council groups have share-car subscriptions.

6.4 Future transport fuel abatement opportunities

6.4.1 Electric Vehicles

Electric Vehicles (EVs) do not generate carbon emissions when driven, **however they cannot be considered zero emission vehicles unless their batteries are charged from renewable energy sources**. This is an important consideration when comparing electric vehicles with conventional internal combustion engine vehicles.

Figure 12 compares the emissions per km of the top 10 selling internal combustion engines (ICE) vehicles, hybrids (with ICE) and electric vehicles that are charged from the grid in different Australian states. In Australia, electricity from the grid varies in emissions intensity depending upon which state the electricity is sourced from.

The figure shows that:

- On average, EVs have lower emissions than the average internal combustion engine vehicle however not by a significant amount,
- States with a higher renewable energy uptake will result in lower emissions per km for EVs.

Inner West Council's incentivisation of low emissions vehicles, in particular hybrids, is likely to be the most environmentally beneficial action where electricity is not supplied from renewables. If electric vehicles are charged either from solar panels directly, or from the grid with all of IWC's electricity sourced from renewables, then the emissions per km will be zero.

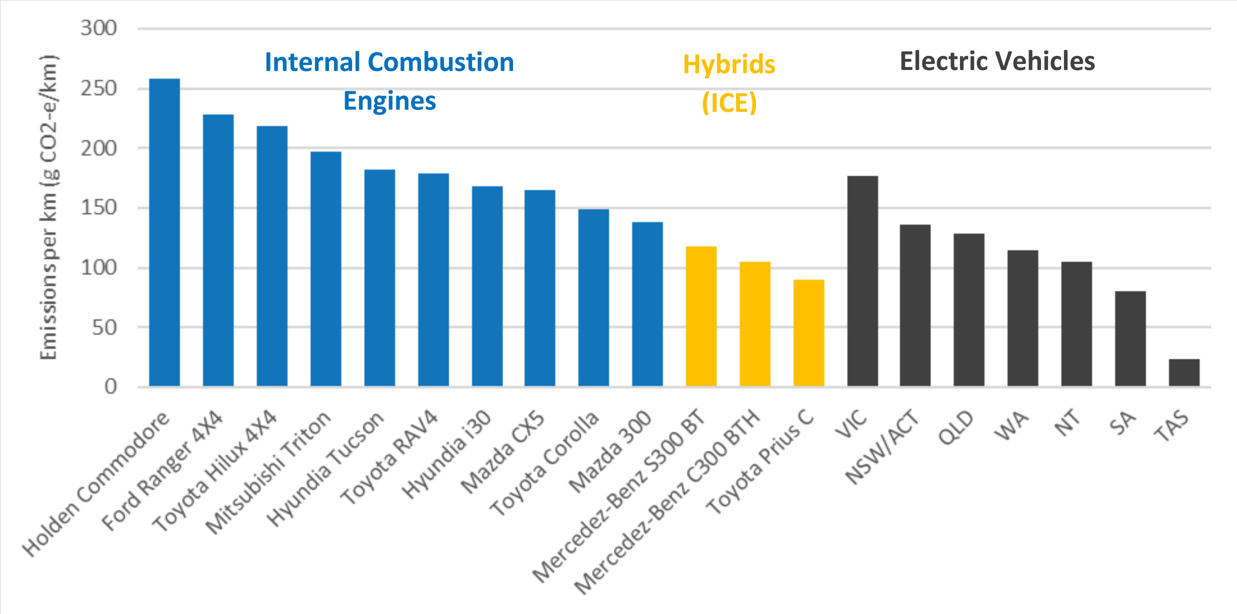


FIGURE 12: COMPARISON OF EMISSIONS PER KILOMETRE FROM MOTOR VEHICLES IN AUSTRALIA[26]

From a cost perspective, electric vehicles are still much more expensive than conventional internal combustion engine vehicles, however, this gap is gradually getting smaller. As more companies develop and compete in the manufacture of electric vehicles, costs will decline further. Furthermore, electric vehicles have fewer moving parts when compared to internal combustion engine vehicles thus resulting in lower maintenance costs.

Currently, electric vehicles do not have the flexibility that ICE vehicles have when travelling long distances as they have a lower range and [a less developed charging] infrastructure. However, steps are being taken to develop a charging infrastructure in Australia, which will remove this limitation. The NRMA is rolling out a regional fast-charge network[27] involving $10m to build 40 EV charging stations in regional locations in NSW and the ACT, in order to build a network allowing drivers to travel long distances.

The NRMA is also calling for governments across Australia to adopt EVs more widely, including 10% targets by 2021 and 25% by 2026[28]. It is understood that IWC officers have contacted the NRMA to discuss the potential for EV charging stations in the IWC LGA, and opportunities are being explored.

The ACT Government[29] recently announced plans for the government's passenger fleet to be EV by 2021 via the *Transition to Zero Emissions Vehicles Action Plan 2018-2021*. This builds on the Territory's leadership in legislating that all electricity supply to the ACT be from renewables by 2020. It is understood that IWC officers have contacted the ACT Government to discuss the potential for a buying group arrangement. However, the ACT's work is at an early stage.

---

[26] http://www.arnhem.com.au/how-green-are-electric-vehicles/
https://www.ntc.gov.au/Media/Reports/(F4FA79EA-9A15-11F3-67D8-582BF9D39780).pdf
[27] https://www.mynrma.com.au/community/news-and-media-centre/nrma-to-build-ev-fast-charging-network
[28] https://www.mynrma.com.au/-/media/documents/advocacy/the-future-is-electric.pdf?la=en
[29] https://www.cmtedd.act.gov.au/open_government/inform/act_government_media_releases/rattenbury/2018/new-action-plan-to-drive-growth-in-electric-vehicles

As most of IWC's fuel is consumed by trucks, there is also an interest in electric vehicle developments in this area. At this time numerous trials of electric vehicles are reported for utility vehicles, buses, garbage trucks; for example:

- Woolworths is trialing electric delivery trucks among its food truck fleet in Victoria.
- BHP has implemented one light commercial vehicle EV in its mining fleet at Olympic Dam, and Tesla has committed to begin production of light commercial EVs by 2020[30].
- Waste Management Ltd, a NZ company, is implementing electric vehicle garbage trucks in its fleet with a view to expanding EVs in future[31]. It is understood that IWC similarly had an EV garbage truck on trial, which was unsuccessful, however, continued commercial implementation by others should be monitored. For example, East Waste in South Australia is planning an assessment of the case for powering electric garbage trucks with renewables in 2018/19[32].

6.4.2 Hydrogen Vehicles

Hydrogen vehicles have zero carbon emissions in the expenditure of fuel. The only emissions that arise from hydrogen vehicles is water vapour. However, it is very energy intensive to produce hydrogen, and so it depends on the energy source as to whether the hydrogen *production* can be considered renewable.

Hydrogen is stored and used in a fuel cell, making it an on-demand energy source and a complementary technology to battery storage. Given the difficulties with making heavy vehicles like trucks electric, it may also be a good fuel option for heavier vehicles. Toyota has been trialling hydrogen-powered trucks[33]. Hydrogen-powered trucks are also being developed and built by Scania on behalf of a Norwegian wholesaler[34]. The hydrogen is being produced using electricity from solar panels on the wholesaler's roof.

Hydrogen cars are not widely available in Australia, though they are expected to arrive later this year with vehicles such as the Hyundai Nexo. It is expected that they will be priced significantly higher than ICE vehicles in the first instance.[35] They also currently lack refuelling stations in Australia. As at 2018, there is only one at Hyundai's head office in Sydney[36]. However, once hydrogen cars become widely available in Australia, it is likely that the refuelling infrastructure will follow.

---

[30] https://www.news.com.au/technology/innovation/motoring/motoring-news/genius-aussie-plan-to-make-underground-mining-greener/news-story/bfc2563baa522902ad26609158cc8fe1

[31] https://orders.wastemanagement.co.nz/site/sustainability

[32] https://www.news.com.au/national/south-australia/east-waste-looking-at-electric-garbage-trucks-powered-by-renewable-energy-to-slash-costs-and-reduce-emissions/news-story/d2dda62d10a5b94ddb6095d73671fb46

[33] https://www.digitaltrends.com/cars/toyota-project-portal-hydrogen-semi-ride-along/

[34] https://fuelcellsworks.com/news/the-first-hydrogen-powered-truck-in-northern-europe-to-create-new-norwegian-industry

[35] https://rac.com.au/car-motoring/info/future_hydrogen-cars

[36] https://www.news.com.au/technology/innovation/motoring/hitech/toyota-to-bring-hydrogen-fuelcell-car-to-australia/news-story/a10ead64fda1a413f4146b26b8f8e4ef

The ACT Government recently purchased 20 hydrogen cars as part of their Renewable Transport Fuels project, where the hydrogen will be sourced from the electricity generated from a wind farm.[37] The initiative will also include a refuelling station and service centre[38]

6.4.3 Recommended direction on sustainable fleet for IWC

Based on the current market for electric and hydrogen vehicles as described above, and IWC's fleet and fuel consumption mix, Council's current policies and processes for transport are appropriate and will help to lower emissions for the same demand/work performed. Measures that Council can progress include:

- Implement B20 across the diesel fleet if this fuel supply becomes firmer. If all diesel was B20 then biodiesel would account for 116 kL per year compared with 71 kL in 2016/17, an increase of 63%.
- Review the policies incentivising low emissions vehicles such as 4-cylinder, diesel and hybrids at regular intervals to assess potential to improve incentives or tighten requirements for fuel economy. Selection of hybrids currently delivers the lowest emissions (excepting where EVs are supplied with renewables).
- Review policies such as the former Leichhardt Council's incentives for bicycles and Opal cards for staff and assess benefits, including reduced fuel use.
- Monitor trends in, and evaluate opportunities for electric vehicle technology that may have application for Council's fleet; for example:
  - Continue discussions with the NRMA and ACT Government to progress potential opportunities for EV charging infrastructure and electric vehicle purchasing
  - Review the case for EVs to be included in leaseback policy at ~~review~~ regular intervals
  - Review vehicle utilisation to identify high-use vehicles that could be replaced with electric vehicles on replacement on a cost-benefit basis
  - Monitor developments in electric and hydrogen vehicle technology, infrastructure and price, as well as funding or finance opportunities to accelerate their adoption by IWC
  - Link future efforts to shift Council's vehicle fleet to electric or hydrogen technology with Council's ongoing work to make its electricity supply 100% renewable, since this will ensure that significant abatement is achieved to this part of Council's carbon footprint.

[37] https://www.news.com.au/technology/innovation/motoring/hitech/toyota-to-bring-hydrogen-fuelcell-car-to-australia/news-story/a10ead64fda1a413f4146b26b8f8e4ef

[38] http://www.cmd.act.gov.au/open_government/inform/act_government_media_releases/corbell/2016/act-government-brings-hydrogen-energy-storage-to-canberra

7

Offsite renewable energy options

7 Carbon reduction strategy 5: Offsite renewable energy options

7.1 Overview of Council's offsite renewable energy task

The impact of proposed measures such as LED street lighting, energy efficiency, and solar and batteries on Council facilities could be significant, with more than 7,200 MWh pa of savings possible with all measures implemented (43% of Council's grid electricity consumption). Note that the bulk of these savings would come from Ausgrid's program to upgrade street lights to LEDs. More savings may be possible in the future – for example, smart controls for street lights, IoT technologies to control building environments, more energy-efficient LED lighting. However, the 7,200 MWh pa in non-renewable electricity savings is at the upper end of what these measures can achieve at this time.

In order to source 100% of Council's electricity from renewables, it is necessary therefore to look outside of Council's operations, and investigate options for sourcing renewables from 'offsite' projects. Offsite projects have the following characteristics:

- Any one of a mix of solar, wind, hydro or bioenergy projects,
- Owned by Council and/or others,
- Located outside of Council's operations,
- Delivering electricity into the grid,
- To be purchased for use by IWC's facilities.

This section presents a high-level initial feasibility and financial review of a range of offsite solutions for meeting Council's remaining energy demand with renewables, with the objective of informing Council's decisions on the preferred approach to meet its objectives. Firstly it is helpful to understand what Council has already been doing in this area.

7.1.1 Renewable Energy Buying Group coordinated by SSROC

Over the last 18 months, Inner West Council has been working with a buying group of around 18 councils to source a proportion of its electricity from renewables. The buying group has been led and coordinated by the Southern Sydney Regional Organisation of Councils (SSROC)[39].

The project is aimed at helping councils to control rising and volatile energy costs[40], as well as meeting environmental goals regarding renewable energy and carbon emissions.

[39] In addition to SSROC's project there is precedent for local governments in Australia sourcing renewable energy through PPAs. This includes the Melbourne Renewable Energy Project (MREP), which involved several Councils led by City of Melbourne. From January 2019, MREP will purchase 88 GWh per year from Crowlands Wind farm in Western Victoria. A recent University of Melbourne report also examines local government renewable energy purchasing (Hadfield P (2018) Local Government Renewables Group Purchasing. Resilient Melbourne and University of Melbourne, September, https://resilientmelbourne.com.au/wp- content/uploads/2018/09/18-09-20-LGRGP-report- Resilient-Melbourne-Unimelb-Hadfield.pdf)

[40] http://ssroc.nsw.gov.au/program-for-energy-and-environmental-risk-solutions-peers-project-update-6-february/

At the time of writing, an agreement with a regional solar farm has been announced, meaning that from mid-2019 IWC will see the following benefits:

- 4,127 MWh per year of Council's electricity supplied from solar energy. As measures such as onsite solar, building efficiency and street lighting upgrades are implemented, the proportion of Council's demand that will be met by the solar power purchase will increase,
- Large-scale Generation Certificates (LGCs) in excess of Council's mandated liability under the Renewable Energy Target (RET), which IWC can use to meet its carbon abatement goals,
- A fixed price for renewable power that provides some protection against volatile electricity prices,
- The option – if cost effective – to increase Council's level of renewable energy purchasing in 2022 when the balancing electricity contract is due for renewal.

This is a substantial achievement. The buying group joins selected councils, universities, governments and corporates in proactively pursuing opportunities in renewable energy that are changing the way energy is generated and sourced in the electricity market.

For the purpose of this section, the buying group agreement is referred to as the Power Purchase Agreement under the SSROC Program for Energy and Environmental Risk Solutions **(the PEERS PPA).**

7.1.2 Council's residual electricity demand after onsite measures and PEERS PPA

The potential onsite measures and the PEERS PPA could significantly lower Council's grid electricity demand. The potential balance of demand is summarised below in Table 14~~Table 14~~.

TABLE 14: COUNCIL'S RESIDUAL GRID DEMAND AFTER REDUCTION MEASURES

Action	Energy (kWh p.a.)	% reduction
Current position (2016/17)	**16,651,378**	**N/A**
LED Street Lighting	4,290,803	25.8%
Renewable energy buying group (PEERS PPA)	4,127,000	24.8%
Energy efficiency	2,091,685	12.6%
New solar PV & batteries	831,271	5.0%
Total	**11,340,759**	**68.1%**
Residual electricity load	**5,310,619**	**31.9%**

It is therefore feasible that, over time, Council's identified, planned and in-progress measures will reduce its non-renewable electricity consumption by 68%. Under this scenario, just 5,311 MWh p.a. of electricity will need to be sourced from additional renewable energy projects in the future.

If one or more of the identified measures do not proceed or are not implemented in full, and/or if Council's underlying energy demand grows, then the balance of demand to be met by new renewables would increase.

The options for meeting the balance of Council's electricity demand from renewables are evaluated below.

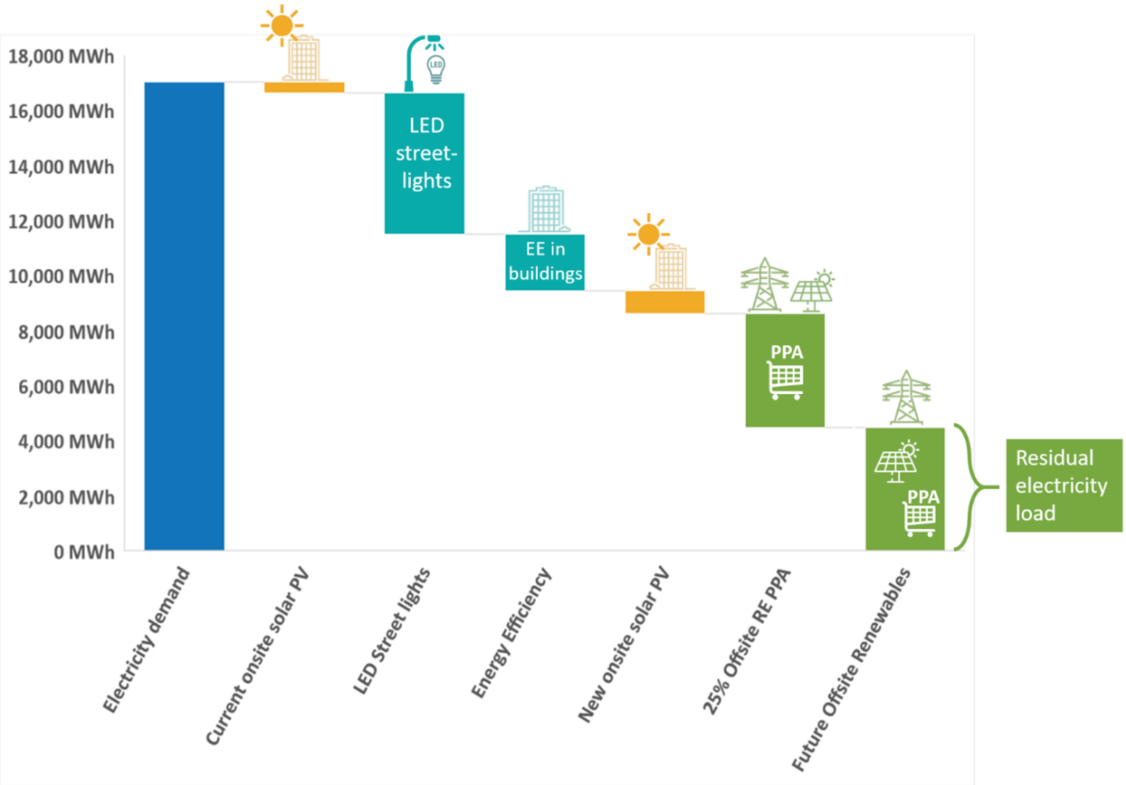


FIGURE 13: COUNCIL'S RESIDUAL ELECTRICITY LOAD AFTER ENERGY EFFICIENCY, ONSITE SOLAR AND THE PEERS PPA

7.1.3 Summary of evaluation approach

Broadly there are two options available to Council to source renewables. These include:

- **The "build" option**: Build Council's own renewable energy generation project, either by buying/leasing land and being a sole developer/owner, or by partnering with another organisation such as a regional council, or
- **The "buy" option**: Enter into a new power purchase agreement (PPA) in 2022 (or beyond) to source additional renewable energy, potentially in another buying group.

Both approaches are complex, and require an understanding of: electricity markets; emerging models for renewable energy contracting; Australia's Renewable Energy Target (RET); and the emerging policy environment. The following structure is used to construct the case for the two options:

- Background on the electricity market, LGCs and renewable energy policy,
- Building an offsite renewable energy project to meet Council's demand,
- Sourcing renewables via an agreement with a third-party renewables facility,
- Comparing build and buy options for IWC's situation.

For both approaches a description of several models that have been employed in renewable energy projects are provided in Annex E. These are most useful to consider once a preferred approach has been settled on. Several key terms are explained in the Glossary at Section 10. In this section the options are assessed at a higher level, taking into account issues including technical feasibility, financial implications (such as capital, recurrent and decommissioning costs), major risks, and legal and governance issues.

7.2 Electricity markets, renewable energy certificates and energy policy

Any business case for renewable energy sourcing, whether "build" or "buy", requires that a comparison be carried out with business as usual i.e. entering into a standard Council electricity contract using a standard procurement approach. This comparison allows Council to see whether it will be financially better off by sourcing renewables (in addition to reducing carbon).

Electricity markets are complex, made more so by changing policy environments and mechanisms that require the development of more renewables. The following overview is provided as background context to the evaluation of the two broad options for sourcing renewables.

- The electricity supply chain
- How retailers buy electricity in the national electricity market (NEM)
- Forecasting electricity prices
- Australia's Renewable Energy Target (RET)
- Renewable Energy Certificates (RECs)/Large-Scale Generation Certificates (LGCs)
- Surrendering LGCs to meet the RET
- LGC strategies for Council
- The National Energy Guarantee (NEG)

7.2.1 The electricity supply chain

A simplified overview of the Australian electricity supply chain is shown below in Figure 14~~Figure 14~~.

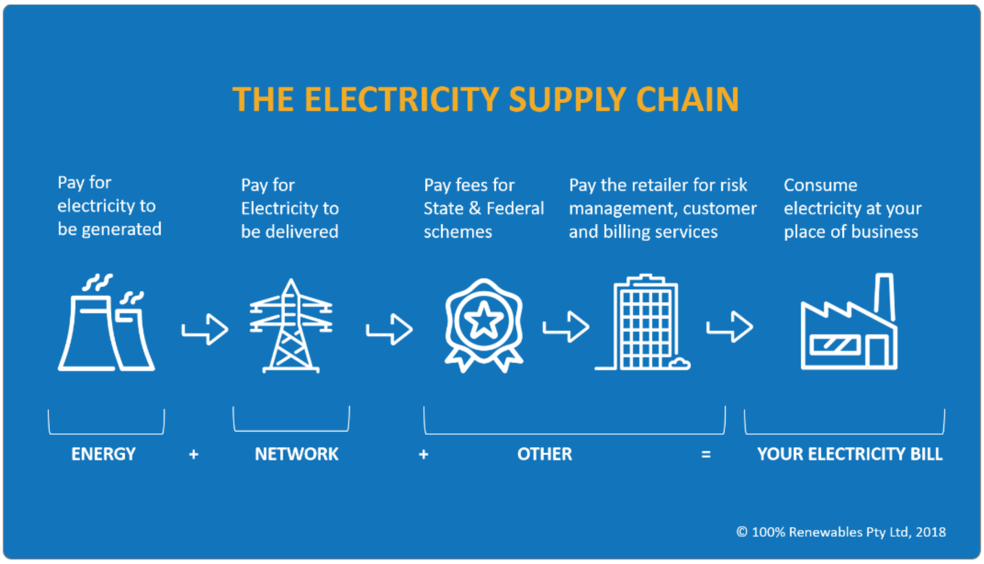


FIGURE 14: ELECTRICITY SUPPLY CHAIN

When Council pays its electricity bills, it is made up of the discrete components in Figure 14~~Figure 14~~, including:

- Electricity generation (contestable and typically negotiated every few years)
- Electricity transmission and distribution (network charges, regulated and re-set annually)
- State and Commonwealth environmental levies, metering charges and market fees
- Retailer fees and margin

7.2.2 How retailers buy electricity in the National Electricity Market

Most electricity in Australia is generated, bought, sold and transported in markets that need to match supply and demand in real time. Electricity cannot be easily stored, so it is crucial that sufficient electricity generation is always available to meet demand. Coordination of supply and demand is therefore required.

The National Electricity Market (NEM) fills this role for the east coast and southern states. The NEM is one of the largest interconnected electricity systems in the world. It covers around 40,000 km of transmission lines and cables, supplying around 9 million customers. The NEM is a wholesale market through which generators and retailers trade electricity in Australia. It interconnects the six eastern and southern states and territories and delivers around 80% of all electricity consumption in Australia. Western Australia and the Northern Territory are not connected to the NEM. They have their own electricity systems and separate regulatory arrangements.

The NEM is managed by the Australian Energy Market Operator (AEMO). The supply of electricity from generators to consumers is facilitated through a 'pool', or spot market, where the output from all generators is aggregated and scheduled to meet demand for electricity from consumers.

The spot price of electricity is settled each half-hour and can be very volatile. For instance, in each half-hour period the spot price can vary from as much as $14,200 per MWh (cap) to as low as -$1,000 per MWh (floor). Electricity is bought in this market by energy retailers, who pay AEMO the spot price and then on-sell the electricity plus their retail margin to their customers, homes and businesses, under commercial agreements. To manage price volatility, retailers and generators often enter into hedging contracts to fix the price for future electricity sales.

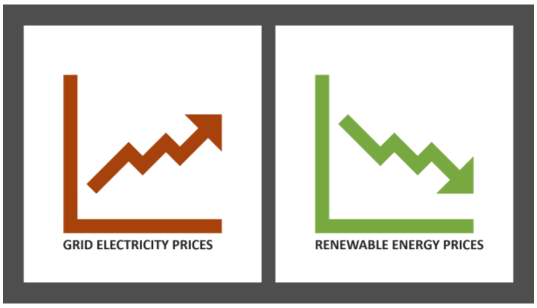
The majority of customers such as IWC simply purchase their electricity through a licensed electricity retailer. Only the very largest industrial users tend to participate directly in the market i.e. purchase electricity directly from generators.

This is important in the context of the "build" or "buy" options – in both cases, it is important to separate out the electricity generation and the electricity purchasing tasks. Most importantly Council could not generate and then simply sell or allocate the renewable energy to its facilities. A licensed energy retailer would be required as per electricity market rules to buy the generation and then re-sell it to Council under a purchase agreement. As a result, whether Council "builds" or "buys", a PPA will form part of the arrangement.

7.2.3 Forecasting electricity prices

Future electricity market prices provide one of the key trends against which the financial business case for a renewable energy project should be compared.

The electricity market in 2017 saw significant volatility and unprecedented high pricing. Many of the price drivers at play will continue to influence power costs in future years.



By comparison, renewable energy prices have continued to fall as technologies improve and large renewable energy projects have enabled economies of scale to be achieved. The lower prices and price stability of renewable energy relative to the recent volatility and high prices seen in the NEM has prompted increased interest from consumers as they explore how to purchase renewable energy.

However, large-scale projects that often take over 18 months to begin generating and then operate for 30+ years require an assessment beyond the contemporary market. These projects require assessment against long-term forecasts.

Owing to recent electricity market volatility, even energy industry experts are finding it difficult to develop a reliable case. What is clear is that over time the cost of renewable energy technology is declining and that for the first time in the NSW market, there appears to be a consistent price differential favouring renewable energy over standard grid power.

Using the AEMO's forecasts of demand and supply in the electricity market, the following price trajectory for *wholesale*[41] power is a possible outcome.

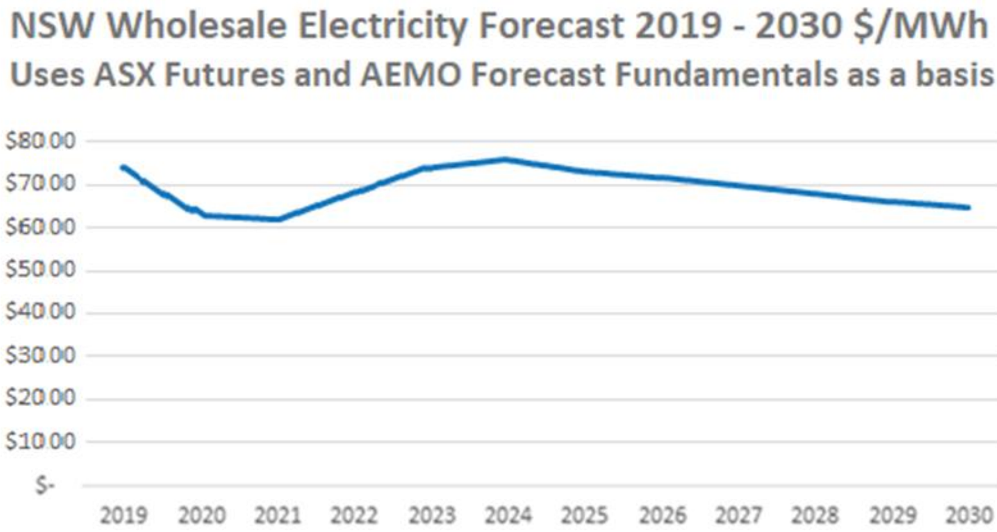


FIGURE 15: FORECAST AEMO-BASED PRICE TRAJECTORY FOR WHOLESALE POWER (SUPPLIED BY SOURCED ENERGY)

Underlying this price path are the following drivers and assumptions:

- The retirement of the Liddell coal-fired power station in 2022 increasing prices before exit,
- Declining gas pricing as a result of new entrant supply available from 2019,
- Completion of Snowy Hydro 2 and potentially more generation from Tasmania providing additional supply in the order of 3,500 to 4,500 MW from 2024,
- Increased proliferation of renewable generation with reducing technology costs and greater output.

Forecasts are not always accurate, and a wide range of factors could result in different trajectories. To illustrate this, in 2017 forecasts of future prices were quite different (higher and more volatile) than they are now. As a result, a business case prepared for a larger-scale renewable energy project in 2018 is likely to be significantly more marginal than an evaluation carried out in 2017 (when there was much greater uncertainty about future pricing and industry experts were forecasting steeper price rises over time).

---

[41] Wholesale means the price of electricity from the generator (as set by the NEM spot market). This is the price before the network costs and retailer margins are added, and before environmental fees are included.

Pricing trends are very important for decision makers considering a build option who want to know how their proposed renewable energy project will deliver returns over a 30+ year life. At present, pricing trends are unpredictable.

7.2.4 Australia's Renewable Energy Target and Renewable Energy Certificates (RECs)

7.2.4.1 Renewable Energy Target

The Renewable Energy Target (RET) is an Australian Government scheme that commits Australia to source 33,000 GWh of its electricity[42] from eligible renewable energy sources by 2020 (and stays at this level through to 2030).

The Large-scale Renewable Energy Target is designed to deliver the 2020 target, while the Small-scale Renewable Energy Scheme supports the installation of small-scale renewables, such as household solar rooftop panels and solar hot water systems and is additional to LRET.

7.2.4.2 Renewable Energy Certificates

The RET is implemented through Renewable Energy Certificates (RECs), which were created to spur the development of renewable energy generation through a market-based mechanism of supply and demand.

A REC embodies the environmental attributes of renewable energy generation and has a financial value attached to it, which fluctuates depending on prevailing market conditions. RECs are traded in a market which is managed by the Australian Government's Clean Energy Regulator.

Once electricity from renewable sources enters the grid, it mixes with electrons from multiple sources, like coal-fired power plants, and becomes indistinguishable. To track renewable energy, RECs are assigned for every megawatt-hour of electricity created from renewables.

Each REC receives its own unique number to track the ownership of the environmental (and social) benefits of the renewable energy. They can be traded separately from the underlying electricity.

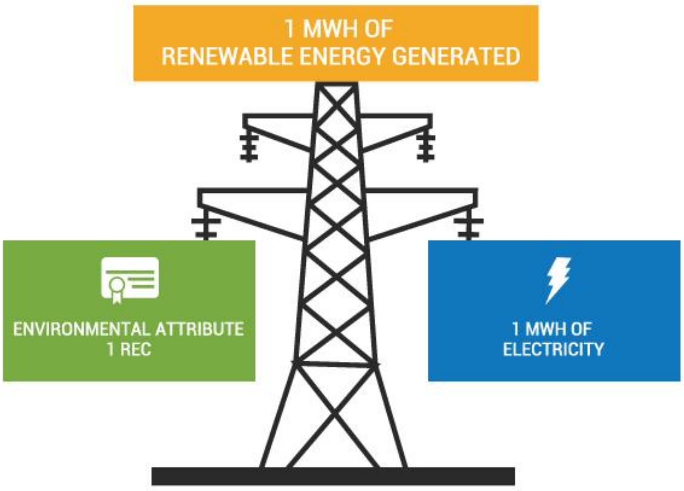


Figure 16: Renewable electricity and the generation of RECs

[42] 33,000 GWh p.a. or about 23% of Australia's electricity demand

The party that owns the REC owns the claim to that MWh of renewable energy and to the associated carbon reduction once it is retired. In Australia, the Clean Energy Regulator distinguishes between small-scale and large-scale systems (over 100 kW), and the RECs have different names according to their underlying system size:

- **Small-scale systems** attract Small-Scale Technology Certificates (**STCs**), further explained in Chapter 5.
- **Large-scale systems** attract Large-Scale Generation Certificates (**LGCs**). These are of interest here as the size of any system to meet the balance of IWC's electricity demand from renewables will exceed 100 kW.

Demand is created for RECs in the market because retailers are obligated under the *Renewable Energy (Electricity) Act 2000* to ensure that a percentage of their electricity sold to customers is sourced from renewable energy generation. The retailer does this by obtaining sufficient RECs each year to meet that year's Renewable Energy Target, and then surrendering those RECs to the Clean Energy Regulator. In 2018, for example, the required percentage RET is 16.06%[43]. By 2020, retailers need to surrender certificates equivalent to 20% of their load under management. The cost to retailers purchasing these certificates is passed on to consumers via their electricity bills[44]. LGCs make up around 8 to 10% of electricity costs to consumers.

Generators of renewable energy have several options for the LGCs that they create:

1. **Sell all LGCs**. Sell all LGCs on the market to get income. No carbon claims can be made.
2. **Retire all LGCs**. Forego the financial value of the LGCs and claim the carbon reduction.

Purchasers of renewable energy who are simultaneously purchasing LGCs from the generator have the options above plus two more:

3. **Sell excess LGCs**. Use some of the LGCs to meet the RET obligation and sell the rest on the market. This provides income, but no carbon claims can be made.
4. **Retire excess LGCs**. Use some of the LGCs to meet the RET obligation and retire the rest. Make a carbon and renewable energy claim for the excess LGCs that are retired.

The decisions above affect the business case for "build" or "buy", as does the value of the LGCs. This is discussed for each option in further detail below.

7.2.5 Federal Energy Policy Uncertainty

Under the Turnbull Government, a new policy initiative known as the National Energy Guarantee (NEG) was developed during 2017 and 2018. The stated objectives of the policy were reliable and affordable electricity; and emissions reductions aimed at meeting Australia's international commitments. Under the new Morrison Government it appears that this policy has been abandoned, and a focus on emissions has been taken out of the narrative[45].

---

[43] http://www.cleanenergyregulator.gov.au/RET/Scheme-participants-and-industry/the-renewable-power-percentage

[44] Excepting large industrial consumers who are exempt

[45] Sourced from https://www.energy.gov.au/government-priorities/better-energy-future-australia

The next Australian federal election must be called in 2019 (and is expected in mid-2019). National energy policy is therefore in a state of transition and is highly unpredictable.

This is very important for decision makers considering a build option who want to know how their proposed renewable energy project will deliver returns over a 30+ year life. At present energy policy cannot be predicted and there is significant financial uncertainty particularly around the "build" option.

7.3 "Build" option: building and operating an offsite renewable energy project

One option to meet the balance of IWC's electricity demand is to build a renewable energy plant. As Council is not an owner of large amounts of land, it would need to buy or lease land or would need to partner with other parties to use or acquire land to build a project, for example with a regional council or with a private developer.

As noted above, if Council becomes a generator, the electricity output would be sent to the grid, Council would then need to enter into an agreement to buy the power via a licensed retailer. Alternatively, IWC can use the plant to earn spot market revenue for the output.

A high-level analysis of the feasibility of building a renewable energy project is provided below that takes into account the main factors that should be considered given the current market, including;

- Selecting a suitable renewables technology
- Finding a suitable site
- Assessing whether a grid connection can be established
- Timeframe until renewable power is generated
- Timing
- Financial inputs and returns
- Risks
- Legal/governance issues

7.3.1 Selecting a suitable renewables technology

There are a number of technologies that can provide renewable power (e.g. solar, wind, hydro, and a range of emerging technologies). It is important to select a technology that suits an organisation's energy demand and load profile, especially if the organisation is not able to enter into a contract that allows supply and demand to be decoupled[46].

If Council chose to build its own renewables farm, it would need to consider a portfolio of technologies that could meet its demand, whether it develops a small project or forms part of a larger project which meets the needs of multiple consumers.

The impact of the PEERS PPA solar purchase as well as other measures will mean that Council's load profile will change substantially over the next couple of years. This is illustrated below in Figure

[46] Even if Council develops its own renewable energy project, the energy has to be delivered back to Council via the National Electricity Market. This can happen via a fixed price agreement with a retailer, an agreed Feed-in-Tariff or by selling the electricity on the spot market. Contracts for Difference (that allow decoupling of supply and demand) appear not to be an option for NSW Councils as discussed in section 7.4.1. Instead, Council would need to meet its demand on a time-of-use basis if seeking to source 100% from renewables.

17~~Figure 17~~, which indicates that the PPA will largely eliminate daytime demand for non-renewable electricity.

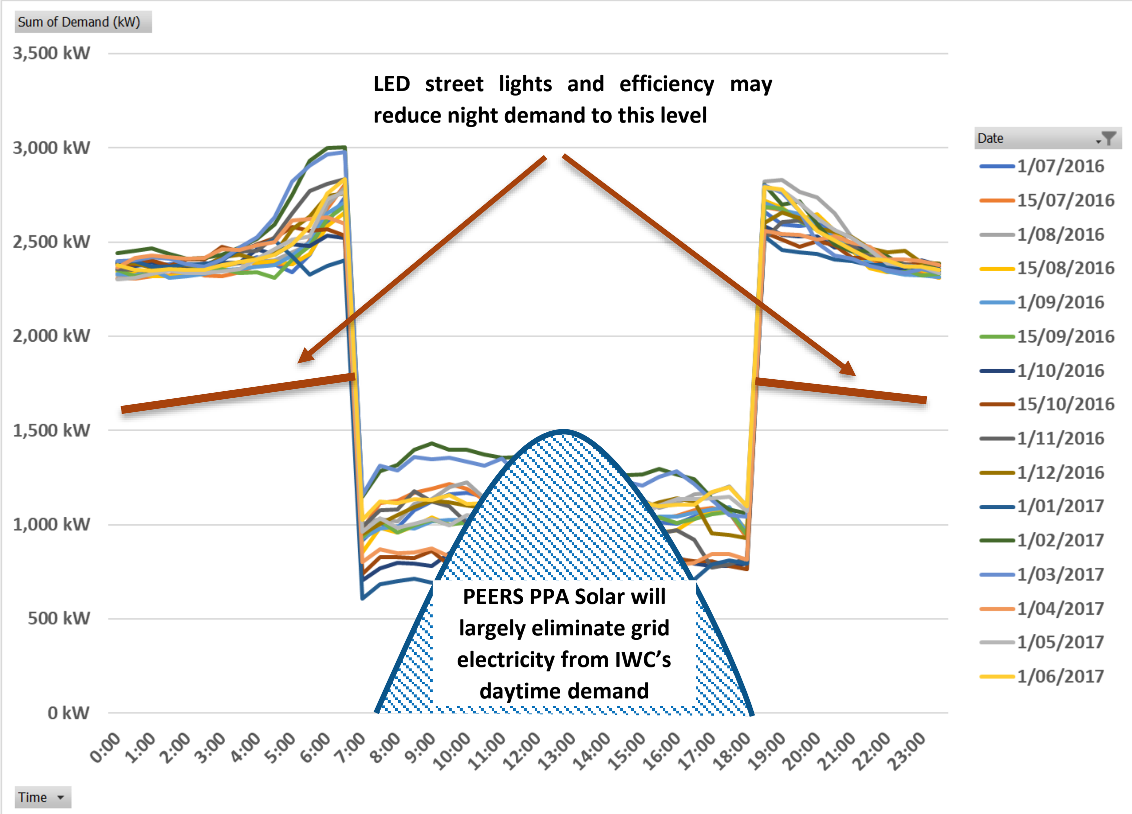


FIGURE 17: IWC LOAD PROFILE ILLUSTRATING POSSIBLE IMPACT OF THE PEERS PPA SOLAR FARM AGREEMENT

A solar farm may not be a feasible technology option if Council has limited residual day-time demand.

If Council chose to build its own renewables farm, Figure 17~~Figure 17~~ tends to suggest that wind power - and potentially some added solar with battery storage technologies - would be best suited if Council was seeking to achieve 100% renewables. In turn, this would tend to imply investment in much larger build options with other organisations, since Council's demand is not large enough to warrant building its own wind farm.

A solar farm may not be the best technology for IWC at present, assuming Council needs to match supply and demand. However the renewables sector is changing rapidly – for example, battery storage technologies are a negligible part of the supply mix at this time but will become a much greater part of the mix in time, and this may mean that solar becomes a more viable option for the residual load.

7.3.2 Finding a suitable site

The required size of a potential renewable energy project will depend on whether Council is able to reduce its energy use, and whether Council chooses to build a renewables project with other parties that also require power supply (that is, a bigger project). It also depends on the technology chosen, as wind, solar and other technologies have different footprints.

Table 15~~Table 15~~ below provides an indicative solar farm and wind farm land footprint for three scenarios:

1. IWC develops a project on its own for the potential residual load of around 5,000 MWh pa; or

2. IWC develops a project for all of its current load; or
3. IWC develops a project as part of a larger project with others (say 100,000 MWh pa).

TABLE 15: INDICATIVE SOLAR AND WIND FARM SIZES TO MEET SELECTED ELECTRICITY DEMAND

Scenario	**Energy Demand** (kWh p.a.)	**Solar farm scale** (16% capacity factor, no tracking)[47]		**Wind farm scale** (33% capacity factor on average)[48]	
		Capacity (MWp)	**Land Area** (assuming 3 ha/MW)	**Capacity** (MW)	**Land Area** (assuming 35 ha/MW)
Residual IWC demand after measures	5,310,619	~ 4	12 Ha	~1.8 (single turbine)	60 Ha
Current IWC demand	16,651,378	~ 12	36 Ha	~5.8 (3 to 4 turbines)	200 Ha
Larger demand for multiple users	100,000,000	~ 70	210 Ha	~35 (19-22 turbines)	1,225 Ha

7.3.3 Assessing whether a grid connection can be established

The feasibility of grid connection at any proposed site should be evaluated early, as an inability to achieve a connection will immediately stop a project from going further.

In the case of mid and large-scale generation, electricity networks are currently being swamped by applications to connect. This can result in the connection process being drawn out for many months or in some cases, a refusal to connect where the network is at capacity (e.g. in some regions of the Essential Energy Network in country NSW). It is therefore important to address connection issues early.

With the increase in large-scale and behind the meter solar, there is a future risk (within the 30-year life of a solar project) that the grid may become saturated during peak solar production times, and there will be constraints placed on generators or negative pricing (i.e. wholesale prices of less than $0/MWh). This could particularly be the case if the asset is a semi-scheduled generator (typically a wind or solar farm up to 30 MW capacity, see Glossary) as these can be directed by AEMO to limit output due to network constraints.

[47] Figures are indicative, with 1400 kWh/kWp per year without tracking representing a typical yield for a solar farm

[48] Wind farm capacity factor of 33% is a typical performance level, though will vary depending on location to more than 40% in some cases. The size of a wind farm will vary and will depend on topography, swept volume of each turbine and good practice for distance between turbines. The figure used is representative of areas for a range of wind energy projects

7.3.4 Timeframe until renewable power is generated

It takes time to get a renewable energy asset built.

Currently, the renewable energy generation that can be deployed the fastest is a solar farm. 100% Renewables has liaised with the City of Newcastle to find out more about the timelines for developing a mid-scale solar farm of 5 MW. As can be seen in the picture below, it can take about three years from inception to a solar farm that is fully commissioned, in a situation where the Council already had access to a large parcel of land that it controlled within its own LGA. Additional time would be required for land-constrained local governments such as IWC. Larger projects (utility-scale) for both wind and solar energy may take longer, particularly for steps such as land acquisition, approvals and stakeholder / community consultation. It would not be unusual for a major project to take five or more years to develop.

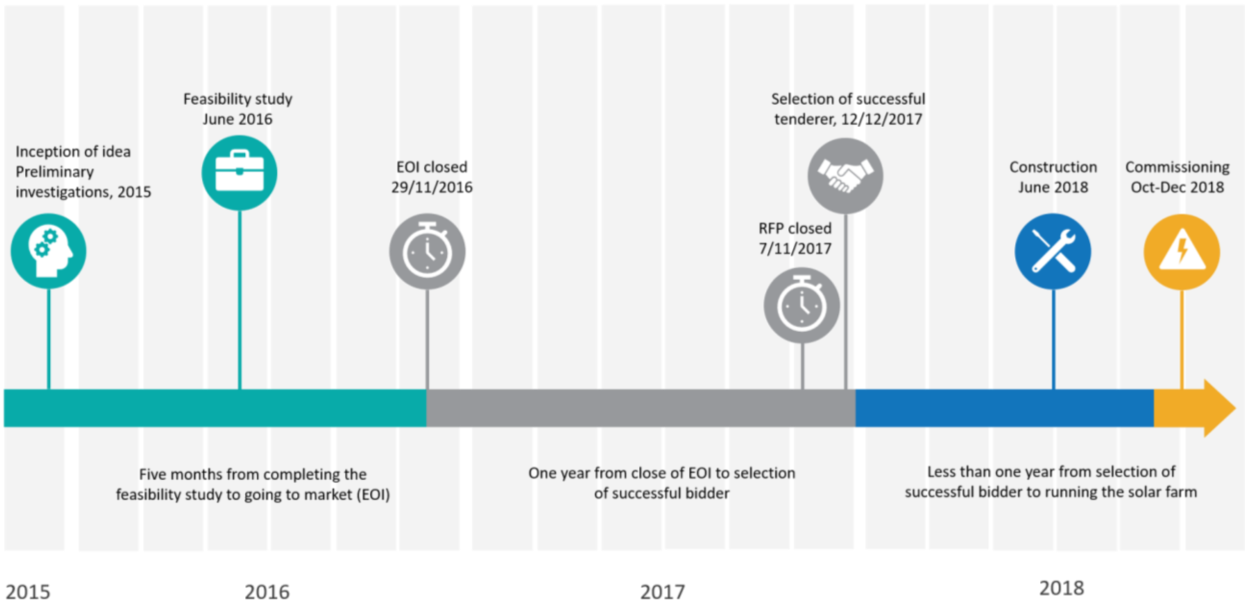


FIGURE 18: TIMELINE FOR THE DEVELOPMENT OF THE NEWCASTLE SUMMERHILL 5MW SOLAR FARM

7.3.5 Timing

The most important timing issues to consider are:

- The duration of Council's current retail electricity agreement which lasts through to mid 2022, and
- Anticipated changes to the Renewable Energy Target (and associated LGC market) over time

It is best to wait until the current retail electricity agreement has expired before commencing a new power supply arrangement. This is because penalties may apply if the load changes too greatly - most large market retail agreements have clauses that limit a customer's ability to deviate from the nominated power consumption. Typically a +/-20% variation clause is applied, together with restrictions on changes in the load profile (the "shape" of the load). The upgrade of street lighting over the next several years will see a large reduction in IWC's electricity demand, and other efficiency and onsite solar projects may reduce this further. From a timing perspective, a new-build renewable energy project should aim to commence supplying as an existing 3-year retail agreement comes to an end. In this case that would be in mid-2022 or later in 2025.

In relation to the LGC market, much of the activity in renewable energy generation in the past two years has been by developers seeking to connect and generate by 2020 when the RET must be achieved. Beyond 2020 most forecasts have LGC pricing falling away sharply. Projects that are connecting in or beyond 2020 could expect to see low or no income from LGCs. Given the lead time to develop a new project from scratch (for IWC finding suitable partner/s and/or land and proving the viability of the site/s), it is unlikely that a connection would be achieved before 2020, and the value of LGCs in any financial analysis will be low, which would adversely affect the business case for IWC to build a solar farm should IWC wish to support the business case by selling the LGCs rather than retiring them.

7.3.6 Financial inputs and returns

As illustrated in Figure 19, the business case for developing a solar or wind farm is mainly influenced by the following four factors:

1. Energy yield of the project
2. The price that can be achieved for the generated electricity (either via an offtake agreement, on the spot market, or sleeved into a retail electricity supply agreement (refer to Annex E for a more detailed explanation)
3. The price that can be achieved for the renewables certificates (LGCs) if these are sold
4. The cost to build and operate the plant

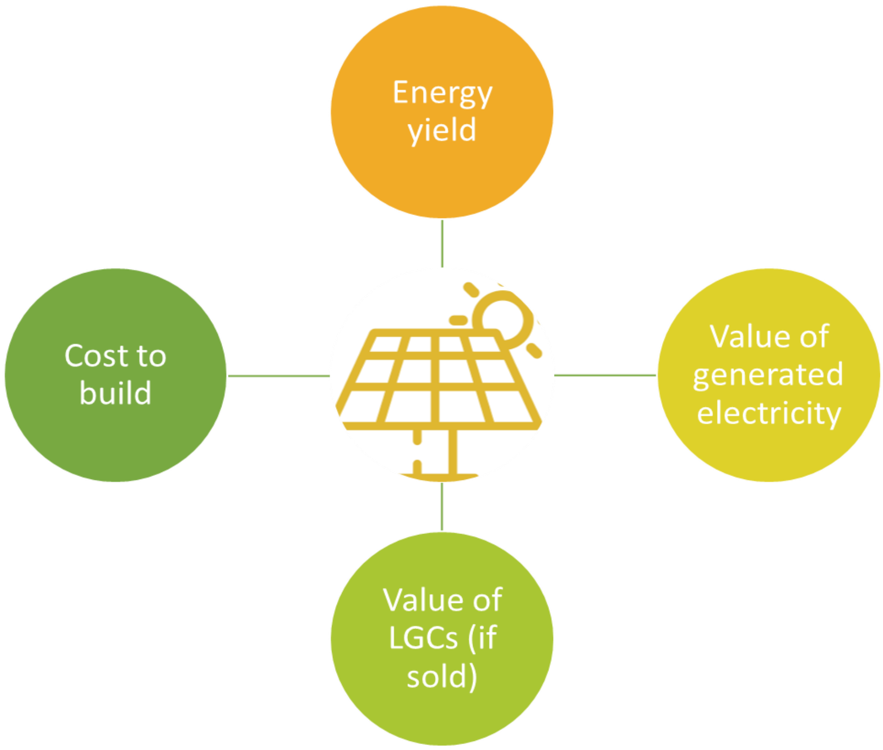


FIGURE 19: MAJOR FACTORS INFLUENCING THE BUSINESS CASE OF A SOLAR FARM

7.3.6.1 Yield

The higher the yield of the renewable energy project, the more favourable the business case will become, as there is more electricity to sell, and more customer demand that can be met at lower prices compared to the market.

Yields vary between sites, so the choice of site is an important consideration. The choice of technology will also affect yield e.g. whether or not solar tracking is used (as tracking will increase the amount of sunlight captured and, therefore, yield). As technology costs continue to decline this may become less important.

7.3.6.2 Value of electricity generated and purchased

The business case also depends on offtake and re-sell electricity pricing compared with the wholesale market trends with retailer margins applied.

Moderating trends in wholesale electricity prices have meant that the financial returns for some recent mid-scale build proposals have been in low single-digits. An assessment when the market trends were much higher in early 2017 would have indicated higher returns.

In any build project, once all costs/borrowings are paid off the asset would become Council's and the costs to operate and maintain would be low for the remaining life of the asset.

7.3.6.3 Value of renewable certificates if sold

As outlined in Section 7.2.4, accredited renewables facilities generate renewables certificates that have a monetary and carbon value.

Should Council decide to obtain the financial value of the LGCS, the forecast for LGC pricing after 2020 declines rapidly towards a low base, with many projects assuming zero value after 2020. As such, a feasibility study for an IWC build would likely assume no LGC value given the lead time to generation. However the value of LGCs is entirely dependent on federal energy policy and is therefore very uncertain as discussed in Section 7.2.4.

Many recent renewables projects were built while LGC values were comparatively high, and assumed that the LGCs would be sold (which does not allow the generator to claim the carbon reduction).

If IWC wishes to generate renewable energy and make the carbon reduction, the LGCs would not be sold and would not be factored into the business case.

7.3.6.4 Build and operating costs

If IWC were to build a solar/wind farm to meet its electricity demand, there would be capital and operating costs over time.

- Initial capital costs for smaller/mid-scale projects to meet Council's demand only would be higher (on a per-watt basis) than larger projects where Council is a part-owner.
- Mid-scale solar project capital costs from a number of 2017/18 assessments were around $1.60/W to commissioning, so a 4 MWp solar farm could cost $6.4 million.
- A part-investment in a larger solar farm would cost less than this, based on the low offtake prices seen for recent utility-scale solar projects. The average capital cost for many utility-scale wind energy projects has been around $2/W, so for a part-ownership of 1.8 MW in a larger wind farm, IWC would invest $3.6 million.

Finance and opportunity costs would be additional costs to Council over the term of any loan.

Declining renewable energy technology costs would restore returns to higher levels against the current wholesale market trends.

Ongoing operating and maintenance costs, potentially land lease costs, plus periodic replacement of inverters, would also be required, though these costs are small compared with the initial capital investment.

Depending on the scale of the renewable energy project and on the entity established to operate it, other costs may also be incurred for plant registration and operation of the entity who owns the plant. These costs would all be taken into account in developing the financial case for a project.

The analysis of a number of mid-scale solar farm proposals in the last 12 months contrasts with announced offtake deals for utility-scale solar and wind farms.

Mid-scale solar projects are showing single-digit returns in part due to lack of scale, with better (4-6%) returns where land costs are nil, and current electricity contract rates are high, and lower (2-4%) returns where land costs and low electricity prices make the business case more difficult.

Conversely, utility-scale projects have announced low offtake prices in the $54-65/MWh range, indicating much lower build costs at this scale.

7.3.7 Risks

The above narrative highlights some of the main risks that would be associated with Council becoming a generator. However, these would be addressed in the development of a business case for such an investment and inform any decision on technology, timing and whether to build or not. In addition to these, other high-level risk factors that would be taken into account include:

- **Retailer interest:** some retailers have shown a level of interest in buying the output from mid-scale renewable energy projects and sleeve these into retail electricity agreements. However, Council (and other part-owners) would need to find interested retailers to perform this function from time to time over the life of the asset. Lack of interest would likely mean that output would have to be sold on the spot market, but re-purchasing the electricity to meet Council's demand may not be feasible.
- **Political**: the current environment and in particular the debate on energy policy will make investment decisions on renewable energy projects built after 2020 and/or when the RET has already been met challenging. This debate, together with a Federal election in 2019, may mean continuing uncertainty in the short to medium term.
- **Renewable sector construction and operation skills**: Council does not have experience with building, owning, operating and maintaining a renewable energy plant, so the expertise to manage this project will have to be acquired. The question of whether the acquisition of these skills is a strategic fit for Council would be a key part in assessing this risk (compared with meeting Council's objectives via its pre-existing procurement skill-set). Alternatively, Council needs to be prepared to pay for advice from appropriately qualified consultants. Generally, professional consulting fees for a large capital project can run at 10-15% of total capital costs.

7.3.8 Legal/governance issues

From a contractual perspective, a range of agreements may need to be in place, with associated costs to develop and manage over the life of the project, including:

- Retail agreements for renewable energy to Council as the end user
- Land lease or sale agreement
- Engineering Procurement Construction (Maintenance) (EPC(M) agreement)
- Off-take agreement
- Registration as generator (potentially)
- Agreements with other entities if built as a joint investment with multiple parties

The nature of a joint development is also important and all proposed arrangements would need to be examined to understand legal and governance requirements.

For example a Public Private Partnership (PPP) to develop a renewable energy project would need to meet any requirements set out under the Local Government Amendment (Public–Private Partnerships) Act 2004. Essentially any council entering into a PPP must submit an assessment of the project to be carried out under the PPP to the Department before they enter an arrangement. The General Manager must certify that this assessment has been carried out in accordance with the PPP guidelines.

7.3.9 Requirements for a Feasibility Study

As mentioned in Chapter 1, Inner West Council resolved that Council "investigate the requirements for a feasibility study into the business case for Inner West Council to invest in a solar farm to offset Council's electricity consumption across facilities and operations". The requirements for a feasibility study include the issues discussed above, as well as a range of other tasks required to confirm the viability of the project before commencing detailed design, finance and procurement.

The preliminary feasibility study would typically include further investigation into the issues raised above:

- **Technology selection:** Identify the technology/ies that suits Council's load profile at the time a build option is being considered – for example, if this is within the term of the existing solar purchase agreement then wind energy is likely to a better fit; beyond that period a combined wind / solar project may be a best fit, potentially with storage
- **Site selection:** Preliminary investigations – find a regional council or partner organisation, identify suitable regions and land. Some developers have approached councils in regional areas looking to identify council and private land that could host renewable energy projects, while some local councils have carried out their own investigations on land they own. Local government forums or an expression of interest process could be used to elicit information about potential partners and areas suitable to develop renewable energy projects.
- **Preliminary grid connection enquiry**: with many projects looking to connect, and a need for new transmission infrastructure in some locations to support the growth of renewables, a first task must be to identify whether a connection is feasible in the locations identified. If it is not, then the project cannot proceed.

Once a site has been identified, a detailed feasibility study and business case analysis would typically be undertaken including:

- Review of land area, ideal locations for plant, access, grid connection, constraints
- Vegetation management / habitat assessment, other environmental issues
- Preliminary design of the solar or wind farm and modelling of yield for the selected technology/ies; for solar this may include assessing fixed and tracking systems
- Further preliminary investigations with the network to identify connection options
- Initial geotech investigations to confirm suitability of the land and possible fixing solutions
- Financial analysis that examines the build costs and recurrent costs to operate and register a plant, income streams including offtake pricing, LGC sales and savings on electricity bills, as well as finance and opportunity costs
- Potential commercial arrangements and structures to manage risk and achieve an acceptable return on investment

When progressing from feasibility to project development, additional steps will include:

- Land purchase or lease (if applicable)
- Tender for detailed design
- Detailed design
- Connection agreement with network provider
- Development Approval (DA)
- Tender for retailer (off-take agreement)
- Commercial agreements
- Legal agreements
- Tender for construction
- Site preparation and construction
- Commissioning
- Operations and maintenance

7.4 "Buy" option: Sourcing renewable energy via an offsite purchase agreement

Another option available to Council to source the balance of its electricity demand from renewables is to enter into a second agreement with a third-party renewables facility for the remainder of IWC's electricity load, likely as part of another buying group for scale. For the purpose of this section, such an agreement is referred to as a Power Purchase Agreement, or PPA.

The PPA market is evolving rapidly in Australia due to increased appetite of consumers for renewable energy, ongoing energy market uncertainty and volatility, and the cost differential between regular grid power and long-term PPA prices.

In the 'traditional' electricity market only large energy retailers and a small handful of very large energy users bought power directly from generators. However, in the emerging renewable energy market corporates and groups of businesses are seeking to engage directly with projects. They do this to secure the type and quantity of renewable energy supply that they require at prices comparable to the traditional energy market. They are also seeking price stability in uncertain times.

New business models by innovative energy retailers are emerging to facilitate these transactions, with more traditional energy retailers also now beginning to engage with these business-led models.

The key steps to set up a PPA include:

- Understand your own electricity demand profiles and future demand
- Test the market to understand interest and likely pricing and trends, based on your particular circumstance and load
- Develop a procurement plan which allows negotiation with parties
- Understand the key risks you want to manage
- Develop contract (or key contractual points)
- Develop tender/RFQ documentation
- Go to the market and select/negotiate with preferred retailer/s
- Engage appropriate legal advisors to advise on contract terms and conditions

7.4.1 Current renewable energy purchasing models

A number of PPA models have been developed to enable the purchase of renewables in recent years and months, including:

Virtual PPA (often using a Contract for Difference)

A Contract for Difference (CFD) is an arrangement between a generator and customer for sharing the revenue (or shortfall in expected revenue) from electricity sold on the electricity spot market. It provides the generator with a guaranteed revenue stream should spot market revenues fall below the contracted price. Similarly, it also provides the customer with a guaranteed contract price as well as revenue when the spot price goes *above* the contract price. Contracts for difference were adopted by the Australian Capital Territory and Victorian Governments in their recent renewable energy auctions.[49]

Some of the high profile corporate PPA deals that have been discussed in the media over the last two years use the CFD approach to purchase renewable energy. However, this essentially is a financial hedging model which does not involve supplying renewable energy to specific locations.

In the context of renewable energy power purchasing a CFD model may use the following approach, as shown in Figure 20:

- Typically, a contract is between a renewable energy project developer and another party (e.g. a corporation) seeking to source 100% renewable energy .
- Both parties agree on a price level the corporation will pay. This price is usually set at a cost per MWh that the renewable energy project requires to finance its development and achieve a return on investment.
- When the renewable project generates electricity and sells it into the market, it receives the wholesale/spot market price.
- If the wholesale/spot price it receives is above the agreed price, then the other party will be paid the difference by the project.
- If the wholesale price is below the agreed price, then the other party will pay the project the difference. This ensures that the project is guaranteed revenue for generated electricity at the agreed price.
- CFDs are commonly used as the basis of a "virtual PPA" where no actual electricity is delivered to the customer, instead only a financial transaction occurs, completely separate to any agreement for electricity supply.

[49] Hadfield P (2018) Local Government Renewables Group Purchasing. Resilient Melbourne and University of Melbourne, September, https://resilientmelbourne.com.au/wp- content/uploads/2018/09/18-09-20-LGRGP-report- Resilient-Melbourne-Unimelb-Hadfield.pdf

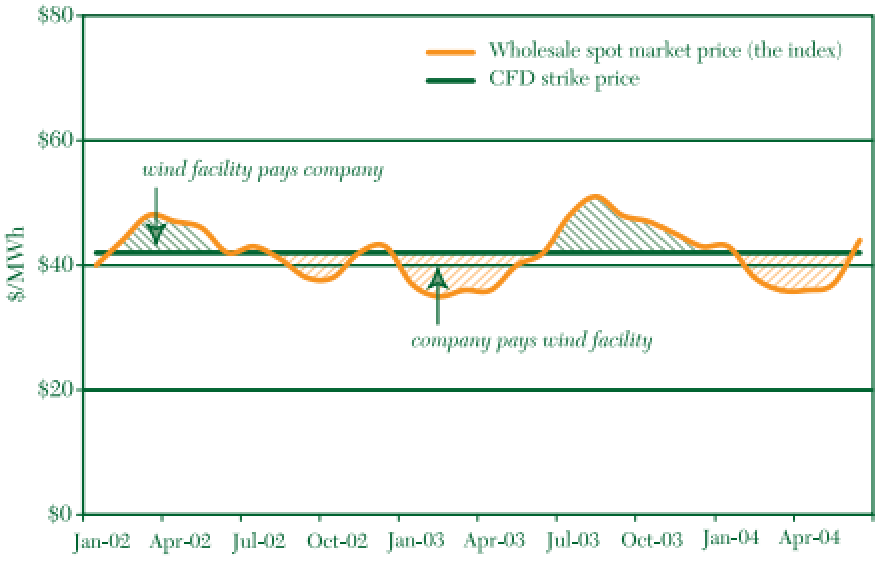


FIGURE 20: ILLUSTRATION OF CONTRACTS FOR DIFFERENCE FOR RENEWABLE ENERGY[50]

The contract for difference approach may suit customers with large energy portfolios and sophisticated energy management teams, or who already have hedging arrangements in place (such as for vehicle fuel) or other forms of derivative contracts.

Under a current Ministerial Order, however, SSROC has advised that Councils in NSW are not allowed to enter into derivative financial products such as CFDs. Consequently, based on current available information, it appears that IWC cannot enter into a CFD. Any renewable agreement must, therefore, deliver power, involve a retailer and will have to be load matched to Council's energy demand.

Supply-linked PPA - Purchase LGCs only

In an LGC-only PPA, Council would only purchase the LGCs (i.e. the emission reduction attributes of renewable energy generation) and not the electricity from a renewable energy plant. Purchasing LGCS only is comparable to purchasing carbon offsets, except that LGCs can only offset electricity use and are currently more expensive than other carbon offsets. However, purchasing enough LGCs would enable Council to claim 100% renewable energy and would assist Council to go some way towards meeting its carbon neutral objective.

Under an LGC-only PPA Council would not need to be concerned with balancing energy demand with the output from a renewable energy generator (i.e. load matching), as no electricity is purchased. There is little risk in matching the number of LGCs purchased to the electricity consumed in any given year as it is easy to source LGCs.

[50] Graphic taken from WRI Corporate Guide to Green Power Markets at http://pdf.wri.org/corporate_guide_6.pdf

There would also be little or no change to Council's standard retail electricity agreements, which would basically sit alongside the purchase of LGCs. However, Council may be able to achieve a better price through a bundled PPA as striking a deal with a renewable energy generator for LGCs-only may not be sufficient for a new renewable energy project to get off the ground.

Supply-linked PPA – LGCs, renewable power and balancing retail contract

A "bundled" contract involves buying both the electricity and the LGCs. Where Council purchases electricity and LGCs together, a retailer is involved in actually supplying electricity to individual facilities.

If LGCs are on-sold or used to offset the compliance obligation, a bundled contract is a more comprehensive hedge against future price volatility. A bundled contract hedges against both electricity and LGC pricing.

It also enables Council to identify a specific renewable energy project as the source of their renewable energy, which will make it easier to communicate the renewable energy purchase. The downside is that it involves a more complex contracting structure as opposed to LGC-only contracts.

NSW councils can use this structure as there is no CFD signed directly between Council and another party. Under a PPA with a balancing contract, two general structures tend to be used (refer to Annex E for more detailed explanations of these structures):

Option 1: Sleeved PPA

The retailer enters into a contract with the renewable energy developer and sleeves this contract under the retail contract with Council. Done in this way, the contracting for renewable energy is embedded in the retail agreement.

The term will likely be ~10 years for the renewable component of the sleeved PPA. If the retail agreement is a separate agreement, the retail component may be of shorter duration. This then requires entering subsequent retail agreements until the end of the PPA term.

This is the type of PPA contract being used for the SSROC buying group.

Option 2: Direct PPA

Council enters into a direct relationship with the renewable energy developer for supply of power (and LGCs if desired) and has a separate contract with a retailer who agrees to pass through the terms of the PPA. The term for the PPA agreement is typically 7 to 15 years. The term for the retail electricity agreement is usually shorter. Each retail agreement will be subject to market pricing when renewed periodically.

7.4.2 Emerging renewable energy purchasing models

Renewable energy generation has ramped up in response to the Renewable Energy Target. The price of renewables continues to fall, and businesses and emerging energy retailers are increasingly looking to disrupt the traditional way of doing business in the electricity market. This is making renewable energy purchasing more readily available and more cost-competitive compared with traditional electricity procurement.

At the same time, renewable energy project developers are highly motivated to achieve off-take agreements to satisfy financing needs and take advantage of current market pricing for electricity and LGCs. These market conditions and the fact that there are more projects in planning than there is load in NSW suggests that there is competitive pressure driving agreement negotiations. Innovative contracting models that are beneficial to energy users are emerging.

Retailers, many of whom have taken out long-term off-take agreements with very large renewable energy projects at low prices, are also actively seeking longer-term supply agreements with their customers. These deals benefit from having pre-existing generation assets and reduced counterparty risk. They also potentially offer good blended pricing of retail and renewable energy.

Renewable energy brokers are emerging who are seeking to match customer's loads with renewable energy projects that provide a best fit and project 'firming' capabilities. This reduces risk for the retailer in pricing and may offer cheaper outcomes for customers.

Since market highs in 2017, wholesale pricing is forecast to stabilise and even decline over the longer term. This makes for a more competitive market in which renewable energy must compete, especially if there is a requirement for a longer term commitment that may have more market risk for a purchaser.

Customers are thus more demanding of project developers to reduce delivery and price risk, and where possible make their PPA more like a regular electricity supply agreement. This has seen the development of innovations that assist in reducing exposure to declines in market pricing through market matching or indexing clauses in agreements, caps and floors around price levels and ability to renegotiate retail portions of load during a PPA term.

These rapid developments are most likely pointing towards simplified future renewable energy purchasing that is little or no different from current 'standard' electricity retail procurement.

7.4.3 Technical feasibility

It is necessary for Council to understand the size and shape of its electricity load and how this may change over the term of a PPA contract which could be up to 10 years. For instance, most of IWC's daytime load is likely to be met under the existing PEERS PPA as the energy will be sourced from a solar farm. Consequently, adding wind energy and/or storage to a future PPA/retail electricity tender may be a suitable way for IWC to grow its renewable energy contribution. Some PPA offers are emerging that combine wind and solar to reflect 24-hour operations.

The potential long-term decline in battery costs (despite a recent upwards trend in costs) may mean that future PPAs can be sculpted using any renewable energy technologies to meet the energy requirements of end users with 24/7 operations, such as councils. According to Bloomberg New Energy Outlook 2018, battery prices are continuing to decline, and batteries combined with cheaper solar and wind energy technologies will become increasingly cost competitive.

Much of the 'technical feasibility' work would focus around this aspect – shaping renewable energy solutions (potentially with storage) to fit Council's profile and targets.

The required time to develop a PPA depends on whether renewables are being sourced from a new or existing project. If Council's goal is to source from new projects that grow the overall renewable energy generation sector, then it is necessary to allow for the build phase which could be 2-3 years. If existing projects are suitable, then the time frame will be much shorter. If continuing to buy with an existing buying group such as SSROC then this timeframe may be shorter still, since electricity contracts are aligning in terms of start and end dates for councils in the PPA, potentially making future group buying easier.

7.4.4 Initial financial implications (capital/recurrent costs)

As can be seen in the picture below, the price for a PPA is influenced by the following factors:

1. Technology mix (wind, solar, other) and associated costs to build and run
2. Duration of the contract
3. Size of the contract
4. Value of the generated electricity
5. Value of the LGCs

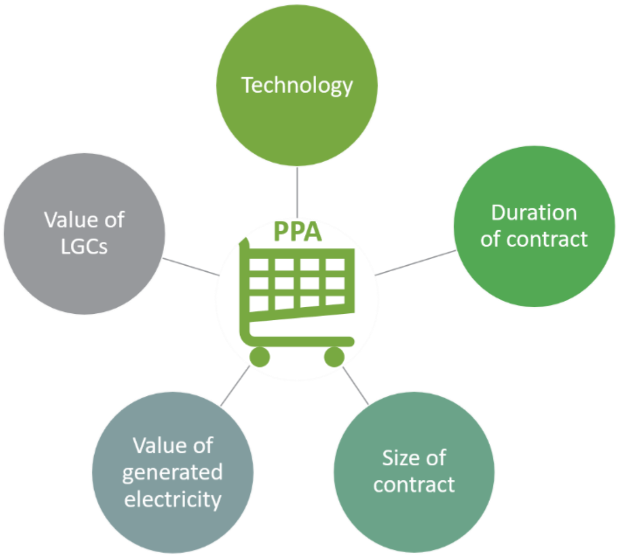


FIGURE 21: MAJOR FACTORS INFLUENCING THE PRICE FOR POWER PURCHASE AGREEMENTS

Generally speaking, wind used to be cheaper than solar farms, but with falling PV prices this is changing fast[51]. As mentioned previously, Council may need to consider renewable energy technologies that can supply the bulk of electricity during offpeak times, particularly if building on the PEERS PPA.

Prices achieved (i.e. $/MWh) for a future PPA are likely to be better for longer contract durations and larger electricity loads. Given that Council is reducing its remaining load through energy efficiency, onsite solar installations and through the current PPA, Council may need to enter into an aggregated PPA for its residual load with other partners in order to have a large enough load to obtain competitive prices.

Like with the 'build' case described above, the price per MWh is influenced by the value of generated electricity and the LGCs, both of which are in turn influenced by supply and demand and the regulatory infrastructure that is in place. Currently, it is a buyers' market for electricity, as there is excess renewable supply in the market. LGC prices are trading at $77 as at the beginning of August 2018, but are projected to fall steeply in coming years. This will make it cheaper for Council to procure them in future.

[51] The price of solar technology is reducing as it is mostly electronic componentry, and improvements in generation capacity are still being made. Wind technology is slowing in its ability to generate further output and is therefore now slower in reducing cost. Wind is often large-scale and as such has to compete against non-renewable forms of energy, often during offpeak times so its cost has to be very cheap to get dispatched. Solar, while in the past, has been competing in peak and shoulder times, will also need to compete in times of low pricing during the middle of the day due to new projects coming online. This will drive solar pricing down further.

7.4.5 Risk factors

While signing a PPA will help Council reach its carbon neutral goal while achieving an attractive financial outcome, it exposes Council to some risks that it would not otherwise have under a standard retail contract. These include:

- **Construction/operation/maintenance risk.** Setting up a PPA does not involve Council building a renewable energy plant. Consequently, compared to the "build" option, there is less need to address technical/construction/operational matters beyond carrying out appropriate due diligence on the generation performance, financial soundness, readiness and longevity of the third-party renewable project(s).
- **Contractual complexity**. Compared to standard electricity purchasing, negotiations can be time-consuming or costly due to the complexities involved. Compared to the "build" option, there are fewer major contracts involved.
- **Performance.** There is a risk that the renewable energy project does not perform as expected, which could result in an under-supply of electricity or LGCs.
- **Policy risks** need to be considered before Council enters into a future additional long-term PPA. The current National energy policy uncertainty may affect the construction of renewable energy plants or the sale of renewable energy into the electricity market after 2020.
- **Government policy.** The market value of LGCs, and therefore renewable energy, is linked to the Federal or State government's carbon and emission reduction policies. These policies may have an impact on the secondary market value of LGCs which Council will need to take into account when modelling the cost of a future PPA and the LGCs.
- **Energy market unpredictability.** Another risk is that Council is locking in energy prices for part of its demand for a longer term than usual. If wholesale electricity prices increase, then Council benefits from a locked-in energy price. If wholesale prices decrease, then Council could potentially face a higher cost for electricity than would have been the case. It is important to note that energy market forecasts are imperfect. Modelling complex systems relies on many assumptions, and it cannot be predicted for sure what the electricity and LGC price will be in the future.

7.4.6 Legal/governance issues

From a contractual arrangements perspective, the following agreements will need to be in place:

- Sleeved PPA:
  - Retail Electricity Agreement to supply balance of load and cover retail invoicing of renewable power, inclusive of a sleeved PPA between the retailer and Council
  - Underlying agreement between retailer and renewable energy project (typically a CFD)
  - The retailer holds both contracts – with the Council and with the renewable energy project
- Direct PPA:
  - Direct PPA Agreement between Council and a renewable energy project
  - Retail agreement to supply balance of load and cover retail invoicing of renewable power
- LGC-only PPA:
  - LGC Purchase Agreement between Council and LGC Owner (Likely a renewable energy project or aggregator)
  - A standard Retail Electricity Agreement to supply balance of load and cover retail invoicing

Unless Council is only purchasing LGCs, the actual electricity from a renewable energy asset needs to be passed through by a retailer. As a result, the length of the PPA contract is likely to be different to that of the balancing retail contract. Council would need to ensure that the contractual arrangements are beneficial to Council and meet all Local Government legal and procurement requirements.

For instance, under a sleeved PPA, the retail agreement and the PPA contract are held by the same retailer. When it comes time to renew the balancing retail contract, Councils need to ensure there is a robust process in place to ensure they are not beholden to renew with the same retailer because that retailer holds the PPA supply contract with the renewable energy generator.

7.4.7 The possibility of extending the existing PPA

Inner West Council, together with 17 other councils, will enter into an 11.5-year PPA to supply 25% of its electricity from renewable energy (solar) from July 2019, sleeved with a three-year retail supply agreement for the 75% balance of Council’s load.

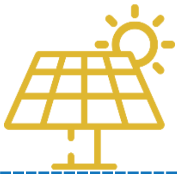
When Council’s retail agreement falls due for renewal in mid-2022, there may be an opportunity to increase the proportion of renewable energy purchased via a new PPA for additional renewable energy. As noted above, there are market and policy factors that are as yet unknown in terms of their impact on future electricity supply and pricing in the electricity market.

7.5 To “build and buy”, or to “buy”?

The following table summarises the major points to consider between Council building an offsite renewable energy project/s or sourcing more renewables via PPAs.

Table 16: Major considerations for the build or buy decision

Consideration	**Build**	**Buy** PPA
Time from decision to contract signing/commitment	Potentially 3 years (for organisations with suitable land) or more.	1-3 years depending on procurement process (i.e. RFT, negotiation, etc.)
Time from contract signing/commitment to supply	Solar – 1 or 2 years Wind - Minimum 3 years or more	Existing project – nil New project – 1-3 years depending on technology mix
Who bears the technical risk?	Council/partners would take on the technical risk in developing and operating a renewable energy plant.	The renewable energy project developer takes on the bulk of these risks (noting that some operational risks may be passed back to purchasers via the contract).
Decision will impact Council for how many years	~30 years (lifetime of project) plus decommissioning costs.	Duration of the PPA (typically around 10 years)

Consideration	**Build** 	**Buy** 
Council becomes a renewable energy generator	Yes. Scale of generation would depend on the approach. For IWC-only a small wind or solar farm of 2-4 MW would likely generate the equivalent of IWC's remaining load. If a partnership with other offtakers were developed the project size would be larger.	No. Council would simply go to the market to seek renewable energy PPA offers from time to time in order to source renewables for its electricity supply.
Prior in-house experience	No. Council has no prior experience in the development of large-scale energy generation and would need to develop and/or hire this expertise.	Yes. Council has prior experience in both traditional energy procurement and PPAs via the SSROC buying group.
Allows upgrading to newer technology	No. Council is locked into the developed technology for the long term, although there may be opportunities depending on the site/s to expand or add battery storage.	Yes. A new PPA to meet the balance of IWC's demand could be sourced from more and/or different renewable energy projects. At the end of each PPA new technologies and projects can be chosen to meet Council's demand.
Upfront capital required	Yes. Current mid-scale solar projects are around $150-1.70 per Watt installed. For a 4 MWp solar farm this could cost $6.4 million. An investment in 1.8 MW of wind energy could cost Council $3.6 million at $2/W.	No. Zero upfront capital outlay, costs would be limited to internal time and contracted expertise, which would also be required under a build option.
Financial returns	For small / mid-scale build projects low single-digit returns are predicted for recent project evaluations, higher returns where projects have operated when the wholesale market prices have been very high.	Modest savings compared with existing energy costs and compared with forecast energy costs. If LGCs are voluntarily retired to meet environmental goals, then modest additional costs may result.
Maintenance requirements	Yes. Regular maintenance costs as well as periodic replacement of inverters would be required.	No. All plant build and operating costs would be reflected in the PPA rate in $/MWh.
Administration effort	High. Substantial time and expertise required to manage the project or the entity that runs the project/s.	Medium. Some ongoing time required to monitor performance and manage LGCs
Complexity	Very high.	Medium, but models are simplifying.

7.5.1 Recommendation on "build" versus "buy" options

The balance of evidence suggests that the current PEERS PPA and the investigation and development of a new PPA in 2022 to meet most or all of the balance of IWC's electricity demand from renewable energy is the preferred approach to meet a 100% renewable energy (electricity) goal. It is recommended that this be the main focus of Council's efforts.

This does not preclude a build option from being part of Council's future electricity supply strategy. In the current market and political environment this does not appear to be the best course of action. However a watch should be kept on policy developments, technology changes and price trends to inform a future re-assessment of this option.

Council should also review the barrier to councils entering into contracts involving derivative financial products and establish if there is a case to be made for this to be permitted – this could potentially be pursued via SSROC.

8

Purchasing Carbon Offsets

8 Carbon reduction strategy 6: Purchasing carbon offsets

8.1 Council's residual carbon footprint

Even after undertaking various actions to reduce carbon emissions, most organisations find that there is still an amount of residual carbon that cannot be eliminated, usually because suitable replacement technologies do not yet exist (or have a prohibitive price tag attached). In this situation, organisations that wish to be 100% carbon neutral generally purchase carbon offsets. This is also likely to be the case for Inner West Council.

As discussed in previous chapters, a portion of Council's carbon footprint can be reduced by energy efficiency, onsite solar and purchasing renewables from off-site facilities (where LGCs are retired). Sustainable fleet management, sustainable procurement practices and other carbon reduction measures will also reduce Council's carbon footprint.

Council's residual carbon footprint will be a function of the actions undertaken, their impact in reducing emissions, and their timing, as well as changes to the carbon intensity of energy and other supplies included in Council's carbon footprint.

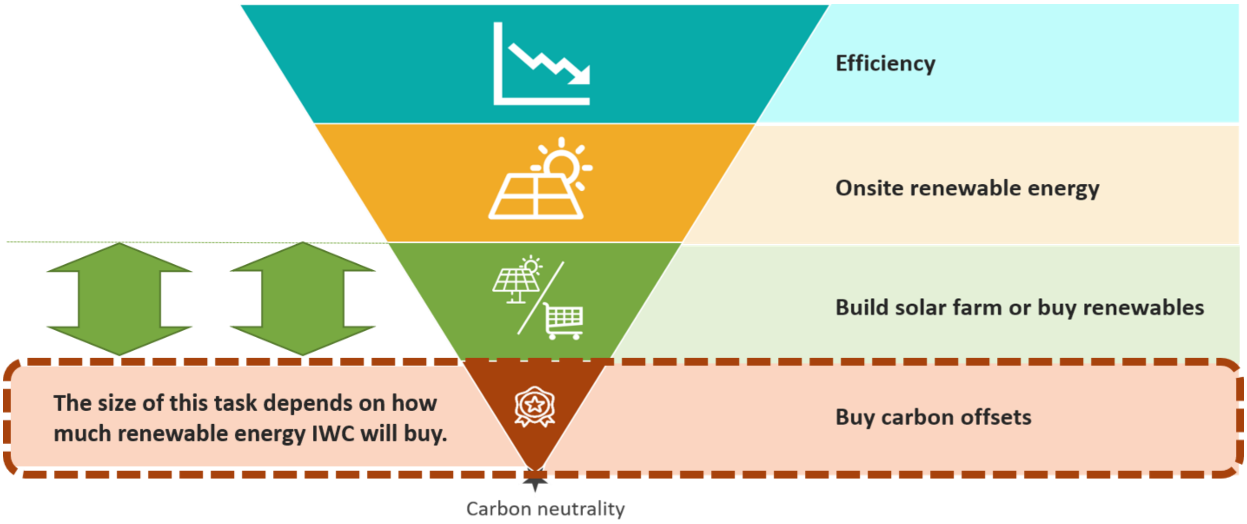


FIGURE 22: THE SIZE OF THE CARBON OFFSET TASK

Organisations can 'offset' their carbon emissions by purchasing the carbon abatement achieved by efficiency, renewable energy or carbon sequestration projects implemented **by other organisations**. The carbon benefit is transferred to the owner of the offset (it cannot also be claimed by the organisation undertaking the abatement project). Offsets are often purchased from jurisdictions and projects where the cost of abatement is significantly lower than the cost of abatement in an organisation's own facilities.

To reach carbon neutrality, Inner West Council will have to invest in carbon offset projects, which can be used to meet Council's residual carbon footprint after all other measures have been exhausted.

8.2 What are carbon offsets?

One carbon offset means compensating for emitting one tonne of carbon emissions (CO_2-e) into the atmosphere by preventing a tonne of CO_2-e from entering the atmosphere elsewhere on Earth.

Many carbon offset projects are only possible because other organisations purchase the projects' carbon offsets. Offsets are therefore a market-based mechanism for encouraging carbon reduction. For example, if organisations like IWC invest in wind farms in China that would not otherwise have been financially viable, IWC is adding to the overall worldwide supply of renewables. To be regarded as a valid offset, a project must be proven to be 'additional' to what would have occurred anyway without the encouragement of offsets. If such a project is accredited under a recognised offset scheme, then IWC could claim the carbon offsets against its own carbon footprint.

Many carbon offset projects also deliver a range of other positive outcomes in addition to emission reductions. By purchasing offset units that have been independently assessed for these outcomes, organisations can support social, environmental or economic benefits, i.e.:

- Environmental co-benefits include supporting the maintenance of habitat for native animal and plant species, avoiding clearing of vegetation and re-establishing vegetation on previously cleared areas.
- Social co-benefits include employment for local people through managing the project, reduced social welfare, and providing health and educational improvements.
- Economic co-benefits arise from income generated from the sale of offset credits, which is delivered to the communities where the project is located through employment and community support.

8.3 Difference between 100% renewable and carbon neutrality

Carbon neutrality, or zero net emissions, is reached when the net carbon emissions of an organisation are equal to zero. To become carbon neutral, an organisation must measure its greenhouse gas emissions, reduce these emissions as much as possible and offset the residual carbon footprint by purchasing offsets.

An organisation is **100% renewable** when its annual energy consumption is met, or exceeded, by an equal amount of renewable energy. It depends on what forms part of the boundary, but usually, people tend to think in terms of renewable energy as relating to electricity. However, in future it may be also possible to substitute renewable fuels (i.e. fuels made with renewable energy) for natural gas, petrol and diesel.

In the case of Inner West Council, Council's resolutions relate to 'carbon neutrality' and being a 'leader in renewables'. In theory, all of IWC's emissions could be offset by the purchase of carbon offsets. However, to become a 'leader in renewables', it would also be necessary to have a high level of renewable energy supplying Council (100% renewable electricity is an example of such a goal).

To achieve 100% renewable energy, Council would not only need to retire 1 LGC for every MWh consumed, but also need to meet the RET LGC obligation, which in 2020 is 33,000 GWh. Consequently, Council would need to retire LGCs equivalent to 100% of IWC's electricity consumption plus their RET obligation). The RET obligation can either be met directly by Council, or through a charge via the retailer.

From a cost perspective, it is much cheaper to achieve carbon neutrality using carbon offsets rather than LGCs. Carbon offsets can cost between $1.50 and $20 per tonne of carbon emissions, depending on the type of carbon offset being purchased. This is in contrast to offsetting 100% of the electricity supply renewable using LGCs at current prices (i.e. $77/LGC in early August 2018).

- 1 t CO_2-e = $1.50-$20
- 1 LGC ≈ 1 t CO_2-e[52] = $77 (cap: $90)

However this is changing as the RET nears being reached by 2020, after which the value of LGCs is expected to fall.

8.4 How can 100% renewable energy or carbon neutrality be met?

Despite the fact that Council wishes to become a leader in renewables, not all emission sources can be 'offset' by renewables. LGCs, for instance, can only be used against electricity consumption. They cannot be used to offset the emissions from waste, as an example. On the other hand, carbon offsets can be used to offset carbon from any emission source.

The following helps to clarify which offset mechanism can be used against which emission source. It also shows what emissions sources carbon neutrality and achieving 100% renewable energy relate to.

TABLE 17: REACHING CARBON NEUTRALITY OR 100% RENEWABLE ENERGY AND ALLOWABLE OFFSET MECHANISMS

Emission Source	Can carbon offsets be used to 'offset'?	Can LGCs be used to 'offset'?	Part of 100% carbon neutral goal?	Potential mechanism for carbon neutrality		Part of 100% renewable goal?	Potential mechanism for 100% renewable?
				Short-term:	Longer-term:		
Refrigerants	✓	×	✓	offset	replacement	N/A	N/A
Natural Gas	✓	×	✓	offset	replacement	Possibly	only with biogas
Fleet Vehicles Diesel	✓	×	✓	offset	replacement	Possibly	only with renewable fuels
Fleet Vehicles Petrol	✓	×	✓	offset	replacement	Possibly	only with renewable fuels
Fleet Vehicles Ethanol	✓	×	✓			Possibly	Already renewable
Fleet Vehicles Biodiesel	✓	×	✓			Possibly	Already renewable
Fleet Vehicles LPG	✓	×	✓	offset	replacement	Possibly	only with renewable fuels
Electricity	✓	✓	✓	reduce use, go	N/A	Yes	renewable

[52] In August 2018, 1 MWh consumed in NSW equals 820 kg (Scope 2) plus 100 kg (Scope 3) in carbon emissions

Emission Source	Can carbon offsets be used to 'offset'?	Can LGCs be used to 'offset'?	Part of 100% carbon neutral goal?	Potential mechanism for carbon neutrality		Part of 100% renewable goal?	Potential mechanism for 100% renewable?
				Short-term:	Longer-term:		
(Council Assets)				renewable			electricity (underway)
Electricity (Street Lighting)	✓	✓	✓	reduce use, go renewable	N/A	Yes	renewable electricity (underway)
Water	✓	✗	✓	offset	reduce use, offset	Possibly	Only if Sydney Water is entirely powered by renewables
Paper	✓	✗	✓	procurement, offset	N/A	N/A	N/A
Equipment	✓	✗	✓	procurement, offset	N/A	N/A	N/A
Food and Catering	✓	✗	✓	procurement, offset	N/A	N/A	N/A
Postage	✓	✗	✓	offset	Offset	N/A	N/A
Taxis, Uber and other services	✓	✗	✓	behaviour change, offset	behaviour change, offset	Possibly	Only if third-party organisation has fleet powered by renewables
Waste to landfill	✓	✗	✓	reduce, offset	reduce, offset		N/A
Green waste	✓	✗	✓	compost, offset	compost, offset	N/A	N/A
Air travel	✓	✗	✓	reduce, offset	reduce, offset	Possibly	Only if planes are powered from renewable source

8.5 Credible carbon offsets

Most organisations wishing to demonstrate credible "carbon neutral" credentials seek independent assessment of their carbon status against the Australian National Carbon Offset Standard (NCOS).

If Council wishes to be accredited to the NCOS to certify its carbon neutral status, only high-quality carbon offsets are allowed. There are a wide range of carbon offsets available, and not all have been independently assessed as delivering real carbon and other benefits. NCOS therefore restricts the types of offsets that are accepted to the following:

- Australian Carbon Credit Units (**ACCUs**) issued by the Clean Energy Regulator in accordance with the framework established by the Carbon Credits (Carbon Farming Initiative) Act 2011.
- Certified Emissions Reductions (CERs) issued as per the rules of the Kyoto Protocol from Clean Development Mechanism (**CDM**) projects, with some exceptions.
- Removal Units (**RMUs**) issued by a Kyoto Protocol country on the basis of land use, land-use change and forestry activities under article 3.3 or 3.4 of the Kyoto Protocol.
- Voluntary Emissions Reductions (VERs) issued by the **Gold Standard**.
- Verified Carbon Units (VCUs) issued by the **Verified Carbon Standard** (VCS).

As of 1 November 2018, all units must have a vintage year later than 2012.

Regardless of whether an organisation is accredited to NCOS, it is best to only purchase highly credible carbon offsets to avoid reputational risks.

8.6 The current offset market

8.6.1 Compliance and voluntary carbon offset markets

The carbon offset market can be divided into the compliance and the voluntary market.

The Australian Government has ratified the international Paris Agreement on climate change and has adopted a range of carbon reduction targets. One of the mechanisms to achieve these targets is the generation of carbon offsets through the Emissions Reduction Fund managed by the Clean Energy Regulator. The Emissions Reduction Fund allows various organisations to earn Australian Carbon Credit Units (ACCUs) through approved carbon reduction activities. ACCUs can be sold via the Clean Energy Regulator to large emitters offsetting emissions over their facility baselines, which were established under Australian carbon legislation (the “compliance market”).

The “voluntary market” in Australia is dominated by organisations who voluntarily set a goal to become carbon neutral, like IWC. In the voluntary carbon market, it is possible to buy Australian or international carbon offsets (including ACCUs). There are many carbon offset brokers providing NCOS-compliant carbon offsets, and as part of this project, 100% Renewables established contact with four providers to investigate current drivers of the carbon offset market-and inform this report.

8.6.2 Supply of carbon offsets

The supply and price of domestic and international carbon offsets is mainly driven by policy objectives. Currently, non-Annex I countries[53] under the Kyoto Agreement sell carbon offset projects to organisations and individuals from developed countries. However, going forward, developed nations may use their carbon offsets to meet their own obligations under their Nationally Determined Contributions (NDCs) first.

NDCs are at the heart of the Paris Agreement and the achievement of these long-term goals. NDCs embody efforts by each country to reduce national emissions and adapt to the impacts of climate change. The Paris Agreement requires each Party to prepare, communicate and maintain successive NDCs that it intends to achieve. This may mean that traditionally cheap carbon credits from non-Annex I nations may be used towards the NDCs of those nations rather than being exported to developed nations to meet their obligations.

[53] Non-Annex I countries are developing countries

In Australia, the supply of Australian offsets available to NCOS buyers is largely comprised of ACCUs. There are small parcels of Australian offsets verified under international standards such as the Verified Carbon Standard (VCS). For instance, some providers hold credits from a group of Tasmanian native forest protection projects, with these credits selling at a discount to the secondary market price for ACCUs above certain volume thresholds.

International carbon offsets, on the other hand, are much cheaper than Australian ones. Given the price differential (further discussed in Section 8.7), it is likely that IWC would purchase a mixture of Australian and international offsets.

8.6.2.1 Should IWC develop their own carbon offsets?

The question was raised whether IWC should consider developing its own carbon offset project. To develop NCOS-compliant carbon offset projects is complicated, time-consuming and resource-intensive. Council would need to develop a carbon offset project in accordance with requirements laid out by a third-party standard like the Verified Carbon Standard (VCS).

All voluntary standards require that offsets be:

- Real: there will be evidence that the project actually removes or prevents emissions;
- Additional: the emissions reductions would not occur without those project activities;
- Measurable: the volume of emissions reductions can be accurately measured; and
- Verifiable: a neutral, third-party auditor has verified the emissions reductions.

Carbon offset projects can range from agriculture (no-till farming, reducing chemical fertiliser use, etc.), forestry and land use (afforestation, avoided deforestation, etc.) to energy efficiency, renewable energy to reducing emissions from waste, to name a few.

To prove that real emissions reductions have taken place, Council would need to pay auditors a fee to assess the project's integrity and then to verify the emissions reduced once the project is operational. When an offset is issued, it is assigned a unique serial number. IWC's project would have to be listed on carbon registries, where offsets could be sold to anyone who would like to buy them.

8.6.3 Demand for carbon offsets

From a demand perspective, the market for voluntary offsets has grown slowly. More organisations are seeking to become carbon neutral, and these businesses increase the pressure on their supply chain to become carbon neutral as well. However, in the current market, there is still enough supply for prices to remain stable. According to the main offset providers, there have not been major fluctuations in the price for carbon offsets in the last eight to ten years.

Policy uncertainty around the NEG means that it is not yet clear whether the NEG will allow the use of offsets to meet the emissions reduction component. If carbon offsets are allowed under the NEG, it will create additional demand for carbon offsets.

8.7 Likely costs to offset

It is recommended Inner West Council map out future emissions scenarios that vary the scope, timing and scale of abatement initiatives so that varying requirements for offsets can be developed and discussed.

Table 18 below estimates potential costs to offset indicative carbon volumes of 10,000 t CO2-e, 15,000 t CO2-e and 20,000 t CO2-e to achieve carbon neutrality. These levels would reflect low, moderate and significant levels of implementation of carbon abatement measures by Inner West Council.

The costs are based on a 2017[54] paper for Inner West Council that sets out the process for and options relating to the sourcing of carbon offsets from local and international projects. Cost estimates were predicated on an assumed carbon footprint of 23,002 tonnes of CO_2-e on an NCOS-basis. This draws on the range of costs seen for:

- local Australian projects (more expensive and low supply, but may be more acceptable by the community, for example VCS credits for Tasmanian native forest protection can be bought from $9.50),
- international projects (for example, VCS carbon offsets from wind farm projects in China or India from $1.50 per tonne[55]),
- carbon offset projects with social benefits (for example REDD projects that reduce emissions from deforestation and forest degradation in developing countries and start at $4.50).

At the moment, ACCUs are trading around $16 per tonne on the secondary market.

Table 18: Potential range of costs for offsets for different carbon emissions and offset source scenarios

Type of offsets sourced	**Australian offset**		**International low cost**		**International social benefit**	
Scenario	Low cost	High cost	Low cost	High cost	Low cost	High cost
Offset price per tonne	$9.50	$20	$1.50	$5	$4.50	$15
10,000 t CO_2-e	$95,000	$200,000	$15,000	$50,000	$45,000	$150,000
OR 15,000 t CO_2-e	$142,500	$300,000	$22,500	$75,000	$67,500	$225,000
OR 20,000 t CO_2-e	$190,000	$400,000	$30,000	$100,000	$90,000	$300,000

Should Council wish to become NCOS-certified, additional costs would involve inventory development (unless carried out internally), third-party verification fees every two years, and NCOS license fees, currently at $18,000 per year. Total additional costs could be from $20,000 to $50,000 per year.

[54] *IWC Baseline GHG Inventory and Reporting Options - 100%RE 19 June 2017 final*

[55] A recent project (Dec-17) sourced VCS offsets from a wind project in India at $3/offset – i.e. mid-range of international low-cost offset prices noted above.

9

Options for community involvement

9 Options for community involvement

9.1 Objective

As noted in Chapter 1, Council has resolved to investigate the feasibility of an Inner West Council Solar Farm including:

i. The business case for Inner West Council to invest in a solar farm to offset Council's electricity consumption across facilities and operations;
ii. Options to share investment and return/savings with the community, including direct community investment and/or savings passed on through rates discounts

The brief for this report requested investigation of both points, and this chapter addresses the second.

9.2 Background on community energy projects

Community energy projects enable communities to participate actively in the response to climate change. They are renewable energy initiatives which may be:

- instigated by the local community;
- scaled to the community's own energy needs;
- funded and owned by the community;
- welcomed within the community;
- accountable to their host community; and /or
- built and managed to maximise local jobs.

Community energy can involve energy supply projects such as renewable energy installations and storage, and energy reduction projects such as energy efficiency and demand management. Community energy can even include community-based approaches to selling or distributing energy.

Interest in community energy is high and in nearly all cases there are more subscribers than available shares. Current trends are an increasing focus on community projects where the host site is the user to maximise the value of solar generated.

9.3 Direct community investment in a solar farm

If Inner West Council built its own solar farm, it would be a large investment. Utility-scale solar farms are usually funded by major banks and private equity firms due to the scale of the investment and the need for reliable funding in order to support a major construction project.

However partial funding by the community is a possibility. For example, Sapphire Wind Farm in NSW near Inverell is currently assessing whether there is community interest in direct investment in the facility. Sapphire Wind Farm is a commercial enterprise, and obtained financing for construction from a global investment manager and a global renewables firm. The wind farm does not appear to be relying on community investment for construction funding, but rather providing this as an opportunity for community engagement.

If Council chose to build its own renewables plant, it is likely that funding from traditional sources (banks, private equity, Council reserves) would be required in order to provide the level of security required to enter into major construction projects. However some level of community funding may be possible and in order to assess the viability of this approach, Council would need to assess:

- The legal structures that would need to be set up to manage the investment process;

- The administrative effort that would be required to manage the investors' capital and returns;
- The scale of investment that would be acceptable while retaining management of the facility;
- The likely investor returns (to assess whether these would be attractive to the community);
- The costs associated with community funding as this would change the business case for the renewables facility.

It is important to understand that community funding may be more expensive than traditional funding due to the complexity of managing such a scheme.

9.4 Sharing solar farm returns with the community

If Council chose to build its own renewables plant, and if the power generated is less expensive than grid electricity, it may be feasible to share the savings with the community. This could be done in several ways:

- By reducing the cost pressure on Council's community facilities, therefore reducing increases in costs to community users over time;
- By offering a discount on rates paid by property owners, who may or may not live in the Inner West.

It is understood that Council already employs the first option above. In order to assess the viability of the second option, Council would need to assess:

- The administrative and legal arrangements that would need to be set up to manage the rate return;
- The costs associated with returns as this would change the business case for the renewables facility;
- The scale of likely returns to assess whether these would be attractive to the community;
- Equity issues associated with providing benefits to property owners as opposed to service users.

It is important to note that the scale of the return is likely to be very minor when shared amongst all residential and business property-owners. Preliminary estimates suggest that returns are likely to be less than $20 per year per property, minus the administrative costs of the scheme. It is considered unlikely that rates returns are the most effective mechanism for supporting the community's interest in renewables, however this would require further assessment.

9.5 Supplying solar to the community

If Council chose to build its own renewables plant, it may be feasible to supply some sections of the community. This would involve building a larger solar farm, which would change the business case for the facility.

As noted previously, Council would not be able to supply the community directly as this requires an accredited retailer. Supply would be managed as follows:

- The solar farm would generate power;
- The power would be fed into the grid and would be managed by AEMO;
- Residents would purchase power from the retailer who holds the offtake agreement with Council;
- The retailer would bill residents, adding network charges (for the grid poles and wires) and retailer administrative fees.

While Council may be able to increase the size of the solar farm to also supply a proportion of residents and/or businesses, it would not be feasible to supply the entire Inner West. The annual electricity demand from residents in the Inner West is approximately 360,000MWh each year. While Inner West residents are typically low-intensity electricity–users, the number of households means that consumption is significant. In aggregate, Inner West residents use approximately 22 times the amount of electricity used by Inner West Council.

If Inner West Council doubled the size of a solar farm designed to supply Council's residual load and used the excess to supply residents, the solar farm would be able to supply approximately 1% of the Inner West's households.

In order to assess the viability of this option, Council would need to assess:

- Equity issues associated with supplying power, noting that not all residents could be supplied;
- The administrative and legal arrangements that would need to be set up to manage supply;
- Costs associated with supply as this would change the business case for the renewables facility;
- The scale of likely savings to assess whether these would be attractive to the community.

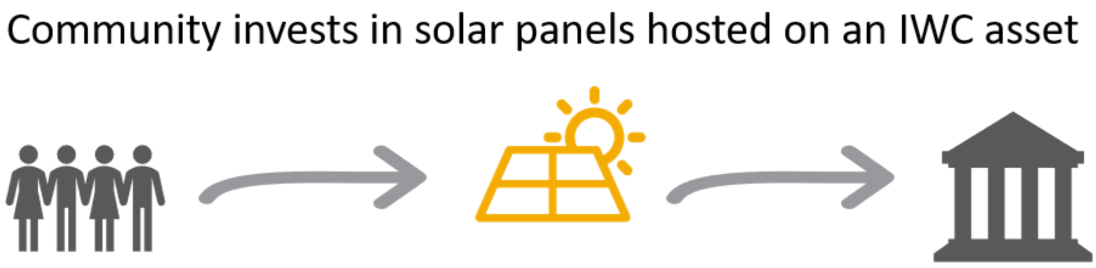
9.6 Options for community involvement

Based on information currently available, community benefits should not be considered as the main driver for development of a solar farm given the constraints and limitations noted above. More detailed analysis is recommended should Council wish to pursue this further.

There are a number of other ways in which Council could become involved in community energy, and this might include options such as:

1. **Council allowing community energy projects to be developed on Council-owned buildings**, where Council consumes the generated power and the community invests to receive a financial return. This approach is now common, with established guidance covering various approaches.
2. **Council-owned properties where (surplus) electricity exported to the grid can be purchased by the community** (e.g. Enova's Community Renewable 100 product offer, not currently operating in Sydney).
3. **Energy sharing**, e.g. Peer to Peer with surplus electricity from rooftop solar PV systems shared/sold to the community – at this time trials of P2P are underway in several jurisdictions.

The most common type of community involvement that is readily available now is community energy projects where the generated electricity is consumed on the host site and the community is the investor i.e. number 1 in the list above. The relationship between the community and Council is demonstrated in the diagram below.



Inner West Council staff advised that a separate program of work is currently underway to explore Council's role in supporting community energy projects in the Inner West.

10

Glossary

10 Glossary – acronyms and key terms

Acronym	Definition
ACCU	Australian Carbon Credit Unit
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AER	Australian Energy Regulator
B20, B50	Diesel blends with 20% and 50% biodiesel
BCA	Building Code of Australia
BEEC	Building Energy Efficiency Certificate
BMS	Building Management System
CBD	Commercial Building Disclosure
CDM	Clean Development Mechanism
CER	Certified Emissions Reductions (offsets)
CFD	Contract for Difference
CMS	Central Management System (for smart street lighting)
COAG	Council of Australian Governments
COP21	Conference of the Parties in Paris at which the Paris Agreement in relation to climate was reached
E3	Equipment Energy Efficiency program
EPC(M)	Engineer, Procure, Construct (Maintain)
ERF	Emissions Reduction Fund
ESB	Energy Security Board
ESC	Energy Saving Certificates
ESS	NSW Energy Savings Scheme
EUA	Environmental Upgrade Agreement
EV	Electric Vehicle
HVAC	Heating Ventilation and Air Conditioning
ICE	Internal combustion engine
kWh, MWh, GWh	Units of energy – usually used for electricity
LED	Light Emitting Diode (lighting technology)
LGC	Large-scale Generation Certificate
MJ, GJ	Units of energy – usually used for gas
NABERS	National Australian Built Environment Rating System
NDC	Nationally Determined Contributions by countries to meet their Paris commitments
NEM	National Electricity Market
NCC	National Construction Code
NEG	National Energy Guarantee
NCOS	National Carbon Offset Standard
NGA Factors	National Greenhouse Accounts Factors
OEH	NSW Office of Environment and Heritage
O&M	Operation and maintenance
P2P	Peer to Peer trading of renewable energy
PEERS	Program for Energy and Environmental Risk Solutions
PPA	Power Purchase Agreement
PPP	Public Private Partnership
PV	Solar photovoltaic technology

RET	Australia's Renewable Energy Target
RMU	Removal Units (offsets)
SLIP	Street Lighting Improvement Program
SRES	Small-scale Renewable Energy Scheme
SSROC	Southern Sydney Regional Organisation of Councils
STC	Small-Scale Technology Certificates
tCO_2-e	Abatement equivalent to one tonne of carbon dioxide
VCS	Verified Carbon Standard
VGA	Virtual Generation Agreement
W, kW, MW	Units of power – usually used for electricity

Key Term	**Meaning/description in the context of renewable energy projects**
Australian Energy Market Operator (AEMO)	AEMO plays multiple roles in the NEM including: • Monitoring electricity consumption and the flow of energy across the power system, and making adjustments or intervening to resolve system limitations or risks to supply. • Monitoring of electricity voltage and frequency to make sure the system stays secure, including monitoring the impact of planned power outages to make sure the system can accommodate any subsequent loss of generation or transmission capacity. • Protection of the power system via instructions to network service providers to cut off supply to some customers if required as a last resort when supply in a NEM region cannot meet demand. • Operation of the retail electricity markets across the NEM.
Capacity factor	Refers to the ratio of actual electricity produced over time to the maximum possible electricity generation over that time based on the nameplate rating. For example, a 2 MW solar PV installation could generate 17,520 MWh in a year at full rated continuous output, however it will usually produce around 2,800 MWh due to sunshine hours, seasonal factors, etc. This system therefore has a capacity factor of 2,800 / 17,520, which gives a 16% capacity factor.
Contract for Difference	A financial derivative contract in that its value is derived from another market. In the case of renewable energy, this means the wholesale electricity market. Typically, a contract is between a renewable energy project developer and another party. Both parties agree on a price level that is usually set at a cost per MWh that the renewable energy project requires to finance its development and achieve a return on investment. When the renewable project generates electricity into the market, it receives the wholesale spot market price. If the wholesale spot market price it receives is above the agreed price, then the other party will be paid the difference by the project. If the wholesale spot market price is below the agreed price, then the other party will pay the project the difference. This ensures that the project is guaranteed revenue for generated electricity at the agreed price. CFDs are commonly used as the basis of a "virtual PPA" where no actual electricity is delivered to the customer. Instead only a financial transaction occurs, completely separate to any agreement for electricity supply. A Ministerial order prohibits Councils in NSW from entering into such an agreement (for a derivative product), hence NSW councils are seeking alternate power purchase solutions.
Counterparty	The other party in any financial transaction or agreement. Typically, there will be a buying counterparty or entity that is paired with a selling counterparty or

	entity. Both parties will have obligations for delivery outlined in an agreement or contractual transaction.
Counterparty risk	The risk that a counterparty cannot meet its obligations for delivery in a financial transaction or agreement. Often based on creditworthiness of a party. Government entities such as state governments, government agencies, departments and councils, will typically present a low counterparty risk compared to commercial organisations.
Distribution Network Service Provider (DNSP)	Electricity and natural gas distributors own and maintain the distribution networks, including substations, transformers, electricity power lines and power poles ('poles and wires'), and natural gas pipelines that carry electricity and natural gas to houses and businesses. For Inner West Council the local DNSP for electricity is Ausgrid. DNSPs build and maintain poles and wires to ensure reliable and safe delivery of power to homes and businesses. Their charges for pass-through of electricity are regulated by the Australian Energy Regulator (AER), and are passed through on electricity bills by an organisation's electricity retailer. Regulated charges are published annually in tariff pricing plans, with the tariff applicable to a particular business or home dependent on their level of electricity consumption.
Engineer Procure and Construct	Typical agreement underpinning the implementation of a renewable energy project.
Feed-in-Tariff	A rate in $/MWh offered by a retailer for renewable energy exported to the grid, typical in many retail energy supply agreements.
Firming	Firming is the mechanism by which an intermittent or fluctuating electricity load can be made firm in terms of volume. Typically, this volume will be specific to consumption of the energy user (which may also fluctuate) but can also be a fixed MWh amount. Renewable projects can use financial or physical firming products to guarantee delivery of a set amount of MWh of electricity even in times of low or no generation. A financial product may be a derivative or simply enable a substitute energy purchase from the wholesale market or another renewable project. A physical product could be pumped hydro generation or gas-fired generation that could be deployed at short notice to physically deliver against a shortfall in renewable generation. Retailers can offer a firming service by directly purchasing the balance of grid power from the wholesale market if a customer wishes to integrate renewable energy into their energy mix. Retailers will charge a premium for this service as they will not know how much electricity to buy in advance, for example on a day that is windy versus a day of no wind where a customer has wind generation incorporated into their electricity purchases.
Grid Connection Agreement	Application must be made, and agreement reached with the distributor to connect a renewable energy generator to the grid.
Hedging	A risk management technique involving investing to reduce adverse price movements in a commodity or asset.
Large-scale Generation Certificate (LGC)	An LGC represents one MWh of electricity generated from an eligible renewable energy plant under the Renewable Energy Target. Liable parties such as electricity retailers must purchase and surrender LGCs in proportion to their market share.
Merchant Projects	Projects that sell their output either totally or in part into the wholesale market without having an offtake agreement with an end user customer.
National Energy	A new policy initiative, the National Energy Guarantee (NEG) was developed

Guarantee (NEG)	during 2017 and 2018, and was a policy to support the provision of reliable, secure and affordable electricity with a focus on ensuring: • the reliability of the system is maintained • electricity sector emissions reductions needed to meet Australia's international commitments are achieved • the above objectives are met at the lowest overall costs Following recent political uncertainty it appears that this policy may be scrapped or changed, and a focus on emissions has certainly been taken out of the narrative. At the time the proposed NEG was developed, summary modelling released by the Energy Security Board (ESB) suggested that the scheme would have only marginally increased energy generation from renewables compared with a no-policy scenario after the RET. Sources: https://www.energy.gov.au/government-priorities/better-energy-future-australia http://www.coagenergycouncil.gov.au/publications/energy-security-board-%E2%80%93-final-detailed-design-national-energy-guarantee
Offtake Agreement	An agreement between a renewable energy generator and an electricity retailer to buy the power generated by a renewable energy project.
Power Purchase Agreement	An agreement between an electricity retailer and an energy user to purchase renewable energy.
Renewable Energy Target (RET)	The RET is a Commonwealth legislated target to ensure that 20% (expressed as a quantity equal to 33,000 GWh) of electricity supply in Australia comes from eligible renewable energy sources by 2020. This target is the driver of large-scale solar and wind projects that have been developing rapidly in Australia in recent years, and also the rise in small and commercial scale rooftop solar PV systems.
Semi-scheduled generator	A generating system with intermittent output (such as a wind or solar farm), and an aggregate nameplate capacity of 30 MW or more is usually classified as a semischeduled unless AEMO approves its classification as a scheduled or non-scheduled generating unit. AEMO can limit a semi-scheduled generator's output in response to network constraints, but at other times the generator can supply up to its maximum registered capacity (source: http://www.aemo.com.au/-/media/Files/Electricity/NEM/Participant_Information/Participant-Categories-in-the-NEM.pdf).
Spot Market	A spot market trades commodities like energy for immediate delivery i.e. they trade on the spot immediately. The National Electricity Market (NEM) facilitates the exchange of electricity between generators and retailers. All electricity supplied to the market is sold at the 'spot' price. Generators are paid for the electricity they produce, and retailers pay for the electricity their customers consume. Power supply and demand is matched instantaneously. Where intra-day electricity consumption increases above the expected 'baseload', more generators are brought on selling at higher and higher prices to instantly satisfy demand.
Wholesale prices	Prices without retailer margins. In Australia in the National Electricity Market there is a wholesale market for each state and territory. Wholesale pricing is available for registered market participants to purchase on the Spot Market or on the Futures or Forward Market.

Annexes

Annex A – Policy context

This chapter sets out the global, national and state-level policy context for acting on climate change and increasing the proportion of energy from renewables.

Global context

To address climate change, signatory countries adopted the Paris Agreement at the COP21 in Paris on 12 December 2015. The Agreement entered into force less than a year later. In the agreement, signatory countries agreed to work to limit global temperature rise to well below 2 degrees Celsius, and given the grave risks, to strive for 1.5 degrees Celsius[56].

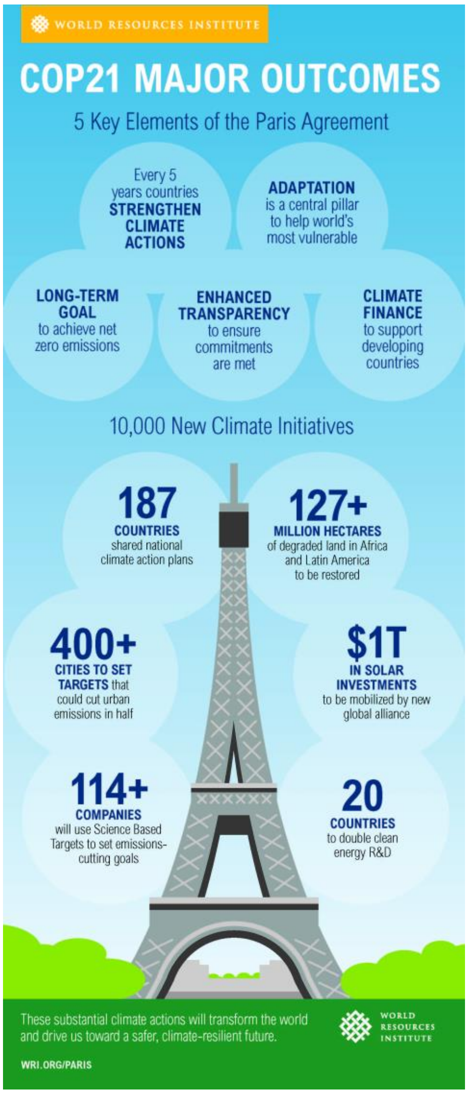


FIGURE 23: KEY ASPECTS OF THE PARIS CLIMATE AGREEMENT[57]

[56] Sourced from https://www.un.org/sustainabledevelopment/climatechange/

[57] Sourced from https://www.connect4climate.org/infographics/paris-agreement-turning-point-climate-solution

National context

At a national level, Australia's response to the Paris Agreement has been to set a goal for GHG emissions of 5% below 2000 levels by 2020 and GHG emissions that are 26% to 28% below 2005 levels by 2030. A major policy that currently underpins this is the Renewable Energy Target (RET). This commits Australia to source 20% of its electricity (33,000 GWh p.a., estimated to equate to a real 23% of electricity) from eligible renewable energy sources by 2020. The scheme runs to 2030. These two key targets are illustrated below.

FIGURE 24: AUSTRALIA'S RENEWABLE ENERGY AND CARBON GOALS

An added scheme underpinning Australia's national targets is the Emissions Reduction Fund (ERF). This fund provides incentives to businesses, farmers, landfill operators, landholders and others to reduce GHG emissions. Projects are funded on an auction basis with proponents bidding for the lowest cost (incentives) required to abate GHG emissions. To date, six auctions have been held with the most recent being in December 2017.

A new policy initiative, the National Energy Guarantee (NEG) was developed during 2017 and 2018, and was a policy to support the provision of reliable, secure and affordable electricity with a focus on ensuring:

- the reliability of the system is maintained
- electricity sector emissions reductions needed to meet Australia's international commitments are achieved
- the above objectives are met at the lowest overall costs

Following recent political uncertainty it appears that this policy may be scrapped or changed, and a focus on emissions has certainly been taken out of the narrative[58].

At the time the proposed NEG was developed, summary modelling released by the Energy Security Board (ESB)[59] suggested that the scheme would have only marginally increased energy generation from renewables compared with a no-policy scenario after the RET.

[58] Sourced from https://www.energy.gov.au/government-priorities/better-energy-future-australia

[59] http://www.coagenergycouncil.gov.au/publications/energy-security-board-%E2%80%93-final-detailed-design-national-energy-guarantee

Energy management

As well as the RET the Commonwealth works to improve energy efficiency in collaboration with the States and Territories via the Council of Australian Governments (COAG). Major initiatives that are led by the Commonwealth and which can have impacts on energy use by IWC include:

- The Equipment Energy Efficiency (E3) program, through which Australian jurisdictions (and New Zealand) collaborate to deliver nationally consistent mandated energy efficiency standards and energy labelling for equipment and appliances. Procurement policies and practices that routinely ensure that high star-rated appliances (motors, air conditioning units, kitchen appliances) are selected when replacing or buying new equipment will help Council's energy footprint decline over time.
- Periodic review and update of the National Construction Code as it relates to efficiency (Section J). This section is currently undergoing a review, with proposed changes likely to come into effect in mid-2019. Both residential and commercial building changes will be targeted. The commercial building changes are aiming via increased stringency requirements to target savings in buildings of 23-53%. Among other measures the changes will target improvement via improved consideration of on-site renewable energy such as solar PV[60]. Any building upgrades or new facilities may need to comply with these requirements after mid-2019.
- Support for voluntary / market-based schemes such as Green Star and NABERS, and the implementation of the mandatory Commercial Building Disclosure (CBD) program. The CBD Program is a regulatory program that requires energy efficiency information to be provided in most cases when commercial office space of 1000 square metres or more is offered for sale or lease. The CBD Program requires most sellers and lessors of office space of 1000 square metres or more to have an up-to-date Building Energy Efficiency Certificate (BEEC), which includes a NABERS certificate and a CBD Tenancy Lighting Assessment (TLA) for the area of the building that is being sold, leased or subleased (http://cbd.gov.au/get-and-use-a-rating/what-is-a-beec).

At a national level, the Commonwealth is also a periodic provider of programs, funds and incentives aimed at helping governments, homes and businesses become more energy efficient.

Sustainable transport

National initiatives to encourage sustainable transport include:

- Information resources are provided, such as the Green Vehicle Guide produced by Infrastructure Australia for consumers choosing light vehicles, and the Truck Buyers Guide, produced by a number of agencies for heavy vehicle purchasers;
- The federal Department of Infrastructure and Regional Development manages policy and standards development on vehicle emissions, vehicle noise and fuel consumption labelling. Fuel consumption labelling applies to all light vehicles sold in Australia, indicating fuel consumption and GHG emissions data
- The Clean Energy Finance Corporation provides financing to drive uptake of low emissions vehicles
- The Department of the Environment and Energy is responsible for fuel quality standards

[60] http://www.abcb.gov.au/Connect/Articles/2017/03/09/Section-J-Overhaul-big-changes-are-coming-your-way

As reported by ClimateWorks Australia in 2017[61], there are relatively few incentives or policies in place at a Commonwealth level relating to electric vehicles, and most of the effort to promote, incentivise and support the uptake of EVs is occurring in the private sector and by motoring associations, and to an extent at State and Territory levels. A new report by the Climate Council highlights that Australia's efforts to address carbon pollution from transport continues to lag other OECD countries[62].

NSW State context

The NSW Climate Change Policy Framework[63] outlines the State's target of reaching net-zero emissions by 2050. This is an aspirational objective and helps to set expectations about future GHG emissions pathways to help others to plan and act. The current policy framework will be reviewed in 2020.

In 2016 the NSW Government announced a $500 million funding package and consulted on two draft plans to help implement the Policy (Climate Change Fund Draft Strategic Plan and A Draft Plan to Save NSW Energy and Money). At this time these initiatives have not been finalised.

Through the Office of Environment and Heritage, the NSW Government provides support to local governments to assess climate change risks.

The NSW Renewable Energy Action plan has helped to drive the growth of renewables in the State through its three key goals:

- Goal 1 – Attract renewable energy investment
- Goal 2 – Build community support, including the establishment of the Renewable Energy Advocate
- Goal 3 – Attract and grow renewable energy expertise

Energy management

The NSW Government runs a number of initiatives aimed at promoting and increasing the uptake of energy efficiency and sustainable practices. Many of these initiatives are led by the NSW Department of Planning and Environment, and by the Office of Environment and Heritage within this Department. Initiatives that help local governments include:

- Sustainability Advantage program, which helps local governments commit to, plan, implement and be recognised for sustainability practices in their operations and supply chains
- Energy Savings Scheme – information and resources that help organisations get access to financial incentives by implementing verifiable energy savings initiatives, such as building retrofits, plant upgrades and lighting upgrades to LED
- In 2018 the government completed a panel of renewable energy Power Purchase Agreement (PPA) providers, which local governments can access to implement onsite solar PV solutions. The advantage of an onsite PPA is that the solar PV can be installed and deliver cost savings

---

[61] https://climateworksaustralia.org/sites/default/files/documents/publications/state_of_evs_final.pdf

[62] https://www.climatecouncil.org.au/wp-content/uploads/2018/09/CC_MVSA0154-Report-Transport_V5-FA_Low-Res_Single-Pages.pdf

[63] http://www.environment.nsw.gov.au/topics/climate-change/policy-framework

from renewables at no upfront cost. However, cost savings are not as great compared to paying for a solar PV system using your own capital. This initiative is useful where access to capital is not available or limited.

- Community renewable energy guides and resources e.g. http://c4ce.net.au/.
- A wide range of tools, guides, case studies, training courses and other materials is available to businesses through OEH, covering a wide range of sectors, technology types and energy forms
- Environmental Upgrade Agreements (EUA), which can help organisations and participating Councils overcome some traditional barriers to implementing and benefitting from environmental upgrades
- Clean Energy for Business – a program that ran in 2017 and helped businesses and local governments plan for a net-zero / 100% renewable energy future. Case studies from this program will help other organisations plan similar clean energy pathways.

Sustainable transport

There are few initiatives or incentives available to NSW motorists to switch to electric vehicles at this time. A report by ClimateWorks Australia in 2017[64] indicates that a stamp duty and registration discount of <$250 is available for a $60,000 electric vehicle. There are efforts to promote uptake of EVs in government fleets, though not to the extent of the ACT Government[65], which recently announced plans for all government fleet to be EV by 2021 via the *Transition to Zero Emissions Vehicles Action Plan 2018-2021*.

Much of the work being done in NSW to prepare for future EV growth is by private sector (e.g. charging stations at Westfield Chatswood), motoring bodies (NRMA[66] has a $10m plan to roll out over 40 EV charging stations in NSW and the ACT) and peak bodies such as the Electric Vehicle Council.

[64] https://climateworks.com.au/sites/default/files/documents/publications/state_of_evs_final.pdf

[65] https://www.cmtedd.act.gov.au/open_government/inform/act_government_media_releases/rattenbury/2018/new-action-plan-to-drive-growth-in-electric-vehicles

[66] https://www.mynrma.com.au/community/news-and-media-centre/nrma-to-build-ev-fast-charging-network

Annex B – Carbon footprint methodology

Method

The NCOS carbon footprint calculation follows on from the previous work undertaken by 100% Renewables Pty Ltd, which looked at the carbon inventory for FY15/16. FY15/16 was the first financial year following the amalgamation of the three former councils. In that year, financial and carbon accounting systems had not been merged yet. It was thus decided to re-calculate the carbon footprint for the new baseline year FY16/17.

Data for the main emission sources of electricity, natural gas, transport fuels, refrigerant losses and water consumption were all taken from IWC's carbon accounting platform Envizi. For emission sources like IT equipment, food and catering, postage and couriers, taxis and other third-party transport, an extract of General Ledger accounts (GST-deducted) was obtained from Finance.

Expenses for food and catering were supplemented with data from Staples (tea and coffee purchases).

For 'paper consumption', WINC reports were analysed and summed up into paper purchases by domestic/imported, virgin/recycled. Emissions for NCOS-accredited paper have not been counted as per the NCOS methodology.

Emissions for 'taxis and other third-party transport' have been calculated by getting an extract from Finance and disregarding entries like 'parking fees'. The resulting dollar figure was divided by the average fare per taxi kilometre travelled ($/km) as per the latest available statistic from http://www.atia.com.au/taxi-statistics/. Fuel efficiency for LPG vehicles (assumed to be 65% of taxi fleet) was obtained from https://www.ato.gov.au/Business/Small-business-benchmarks/In-detail/Benchmarks-A-Z/R-Z/Taxi-drivers-and-operators/. Emissions for the community bus where the bus was hired was obtained through internal staff discussions. Three quarters of the 2016/17 Seniors Community events calendar was done with another organisation's bus. The remaining quarter was done with an IWC bus and driver, the fuel consumption of which is captured in Envizi and falls under Scope 1. The fuel consumption for GoGet vehicles was calculated by IWC staff (All GoGet vehicles are latest model, automatic - fuel consumption based on combined cycle economy).

Main sources for emission factors used for the FY16/17 baseline were from the National Greenhouse Accounts (NGA) factors from August 2017, EPA Victoria, UK DEFRA 2017 emission factors, and UK DEFRA Environmental Reporting Guidelines from 2013 (converted to AUD and inflation-adjusted).

Assumptions

There was no new information for waste and green waste from IWC operations, so it was decided to carry over the emission data from FY15/16 due to the very small contribution this waste makes to IWC's carbon footprint.

It was also decided to carry over air travel emissions from FY15/16 because of the small contribution (0.01%) to the overall carbon footprint.

Limitations

The following emission sources were excluded from the carbon inventory:

- Outsourced Printing
- Business accommodation
- Telecommunications

- Stationery
- Advertising
- Investments
- Capital investment equipment
- Contractors
- Cleaning services

It is possible that some of these emission sources will have to be analysed in greater detail should an NCOS accreditation be sought. Over the last two years, the NCOS team at the Department of Energy and the Environment have been encouraging organisations to account for more emission sources like business accommodation, telecommunications, advertising and cleaning services.

For emission source ‘food and catering’, no data was available for FY16/17. Data from FY17/18 was applied instead.

Annex C - Council's carbon and energy achievements

Over the last several years Inner West Council and its three constituent former councils have investigated and implemented a wide range of energy efficiency and renewable energy initiatives to limit greenhouse gas emissions. These range from small-scale efficiency and rooftop solar PV systems on child care centres, to commercial-scale cogeneration systems at aquatic centres.

Council's achievements in recent years are summarised below.

TABLE 19: INNER WEST COUNCIL: IMPLEMENTED EFFICIENCY AND RENEWABLE ENERGY INITIATIVES

Description of initiative	Status	Capacity and/or grid savings
Cogeneration at Annette Kellerman aquatic centre (AKAC)	Implemented, operates during the daytime 7 days a week	337 kWe/525 kWth system, feed-in-tariff received for grid export
Cogeneration at Leichhardt Park aquatic centre (LPAC)	Implemented, operates during the daytime 7 days a week, expanded to provide heating to the new Program Pool	60 kWe microturbines, all output is consumed on site with no export
Energy efficiency at AKAC	Variable speed drives are used for all major pumps and fans, louvres allow natural ventilation instead of air conditioning, energy efficient chiller, pool blankets	30-40% savings typical in pump and fan energy with VSD control
Energy efficiency at LPAC	Louvres allow natural ventilation instead of air conditioning for the gym, heat recovery heat pump system for Program Pool heating and space conditioning, solar pre-heating of Hydrotherapy pool, energy efficient heat pumps for hydro pool and amenities, pool blankets	Solar pre-heating saves 50-70 MWh per year, while the Program pool heat pump is more energy efficient than separate systems for water and space heating
Solar PV across IWC facilities	308 kWp of solar PV is installed across 30 sites, ranging from 65.5 kWp installed over two systems at LPAC down to 14 sites with systems of 5 kWp or smaller	An estimated 381 MWh of electricity is generated by all solar PV systems, at 1,238 kWh per kWp installed each year. This represents 2% of IWC's electricity demand
Energy efficiency across IWC facilities	Several initiatives from prior audits and facilities management approach have been completed, including night time energy use reduction, some lighting upgrades and controls	The impact of past efficiency measures was not quantified
Street lighting	More than 1600 local road street lights have been upgraded to 22W and 29W LED technology, replacing older CFL or mercury vapour technology	Savings of 60% to 80% compared with older technology has been achieved for lights upgraded to LED
Public, park and oval lighting	GreenWay (Iron Cove to Cooks River along light rail corridor) will	Savings will be 60-80% compared with older

Description of initiative	Status	Capacity and/or grid savings
	use LED technology with integrated controls ('flow' lighting) to provide high quality and low-energy lighting to this public walkway / cycleway. Active reactor metal halide lighting was implemented in a 2016 upgrade at Henson Park	technologies such as CFL and metal halide lighting
Staff bicycle fleet	Council operates a bicycle fleet for staff for use during the work day.	Impact not measured.
Share car fleet	Council manages a share car fleet for work activities during the day, including a supplementary Go Get fleet.	Impact not measured.

Annex D – Methodology for assessing efficiency and solar opportunities

As described in Chapter 4 and Chapter 5, the energy efficiency and solar generation opportunities at Council facilities were identified through a review of existing information, brief site visits and discussion with Council asset owners. Details are provided in this annex.

Existing documents supplied by Inner West Council and reviewed by 100% Renewables are provided in Table 20~~Table 20~~:

TABLE 20: INNER WEST COUNCIL PAST ENERGY AND RENEWABLE ENERGY INFORMATION PROVIDED

Facility	Document(s)
Ashfield Civic Centre	• HVAC & BMS Assessment (Pangolin 2015) • Energy Audit (Pangolin 2013)
Ashfield Aquatic Centre	• Lighting Audit (Pangolin 2013)
Summer Hill Depot	• Colbry Systems (2010)
Leichhardt Park Aquatic Centre	• LPAC Energy Management Plan (Sustainable Business Consulting 2015)
Marrickville Town Hall and Library	• Marrickville Town Hall and Library - Lighting Audit (EnergyAction 2016)
Petersham Town Hall	• Petersham Town Hall - Lighting Audit (EnergyAction 2016)
Petersham Administration Building	• Petersham Administration Building - Lighting Audit (EnergyAction 2016) • Energy Efficiency Assessment Review (VDM 2012)
Tillman Park Early Learning Centre	• Tillman Park Early Learning Centre - Lighting Audit (EnergyAction 2016)
St Peters Depot	• St Peters Depot - Lighting Audit (EnergyAction 2016)
Former Leichhardt Council sites	• Standby Power Audits of 13 sites (Huxham Energy Consulting 2017) (excludes Leichhardt Depot) • Energy Audits of 14 Sites (Huxham Energy Consulting 2015)
Former Marrickville Council sites	• Marrickville Council Greenhouse Gas Emission Management Strategy (Kinesis 2013)

The energy efficiency and solar generation opportunities at Council facilities were then identified through brief visits to the facilities listed below. Facilities were chosen because they:

- Fall into the top 40 energy using properties for Council; and/or
- Are representative examples of Council's assets; and/or
- Are high-energy-use heritage buildings potentially suitable for an OEH Heritage Energy Efficiency grants.

The visits involved 100% Renewables and Inner West Council staff, who met with the facility personnel. Visits were undertaken over May and June 2018.

TABLE 21: INNER WEST COUNCIL SITES VISITED FOR STAGE 1[67]

Annandale Child Care Centre	Enmore Road Early Learning Centre	Marrickville Town Hall
Annandale Community Centre	Fanny Durack Aquatic Centre	May Murray Early Learning Centre
Annette Kellerman Aquatic Centre	Foster Street Family Day Care Centre	Mervyn Fletcher Hall
Ashfield Civic Centre	Haberfield Library	Petersham Administration Building
Balmain Depot	Hannaford Community Centre	Petersham Town Hall
Balmain Town Hall	Henson Park	St Peters Branch Library & Town Hall
Brown St Carpark - Basement	Jimmy Little Lilyfield Community Centre	St Peters Depot
Camperdown Park Oval	Leichhardt Administration Building	Stanmore Branch Library
Carlton Crescent Community Centre - SHARE Building	Leichhardt Child Care Centre	Summer Hill Community Centre
Cavendish Street Early Learning Centre	Leichhardt Depot	Summer Hill Depot
Debbie & Abbey Borgia Community Recreation Centre	Leichhardt Park Aquatic Centre	Tempe Reserve - Path lights
Deborah Little Early Learning Centre	Library - Balmain	Tempe Reserve - Robyn Webster Building
Elkington Park	Library - Leichhardt	Tillman Park - Early Learning Centre
Emanuel Tsardoulias Community Library	Marrickville Library	Tom Foster Community Centre

Site Reports were then prepared for each facility by 100% Renewables, as presented in Annex F. Meetings were held with Council asset owners tabulated below to identify any potential barriers to implementation of the opportunities.

TABLE 22: INNER WEST COUNCIL ASSET OWNER MEETINGS

Team	Issue
Footpaths, Roads, Traffic, Stormwater	Street and public lighting
Children and Family Services	Child care centres
Facilities	Community buildings

[67] The Newtown Neighbourhood Centre was also visited, however energy billing goes directly to tenants and as such these accounts are outside of Council's energy and carbon footprint

Parks and ovals visited are representative of a large number of sites in Council. Opportunities at these sites are generally limited to LED lighting technology and control, and are captured as one opportunity that applies across these sites

Library and History Services	Libraries
Recreation and Aquatics	Aquatic centres
Procurement and Fleet	Depots
Trees, Parks and Sportsfields	Sporting fields and parks

Following meetings with the Council asset owners, the Site Reports were updated and discussed with the teams tabulated below to understand implementation processes.

TABLE 23: INNER WEST COUNCIL IMPLEMENTATION MEETINGS HELD IN JUNE 2018

Team	Roles
Properties	Manager - Property and Assets
Major Projects	Manager - Capital Projects
Facilities	Manager - Facilities Management
Finance	

Annex E – Offsite renewable energy models

Whether a renewable energy generation project is solar, wind or either of these with battery storage, the requirements for the build case and the agreements for the "build" and "buy" cases won't be much different. Below are set out the main characteristics and models of two approaches, including:

1. Building, owning and operating a renewable energy project, say in partnership with a regional council, with IWC as an offtaker
2. Contracting renewable energy directly via a Power Purchase Agreement, looking at several models including a sleeved PPA

The models examined reflect the range of renewable energy generation and procurement options for mid-sized corporates that we have observed in the last 6-12 months, and numerous other options may be feasible.

The options are set out from the perspective that they could be implemented 'now' – thereby considering LGCs as a potential source of revenue in "build" cases. In 2022 when IWC may be seeking to increase their level of renewables, the value of LGCs and the existence of other incentives may alter the case for each option. Similarly, however, market forecasts and the cost to develop and implement renewable energy projects will be different.

Building, owning, operating a renewable energy project - EPC model

Building and owning a renewable energy project may involve various approaches such as:

- direct design, construction and maintenance model where IWC undertakes the engineering, the building and the maintenance of the renewable energy project. As IWC does not have the in-house capability for such a project, this option is not considered further, or
- an **Engineer, Procure, Construct (EPC) model** where Inner West Council (IWC) invests capital, engages an EPC company to undertake the design and construction, then directly or indirectly project manages the construction of the renewable energy asset.

An EPC*M* model adds maintenance of the asset to the project characterisation; for the purpose of this report, EPC is used.

As IWC is 'land-poor' a partnership with a regional council or group of councils may be a preferred approach. For simplicity the description below simply refers to "Council' as the owner.

Compared to the "buy" option, under a "build" EPC model, there is greater interest in the technical aspects as ownership is transferred to Council upon commissioning or after an agreed period of operation. Generally risks encountered during construction are transferred to the EPC contractor via the contract, however this is not absolute. Council subsequently takes on the management and risk of ongoing performance.

While there are many styles of EPC contracting, here we outline two that cover the majority of currently used approaches.

Build via EPC and sell fixed-price off-take including LGCs

Model Name	Build via EPC and sell fixed-price off-take including LGCs
Basic Description	Construction agreement is EPC. Generation from the plant is exported to market to supply a third party offtaker. Generation is sold through a separate agreement at an agreed fixed price per megawatt hour as council cannot offer a contract for difference (CFD). A retailer needs to pass through or sleeve this separate agreement. Typically, the offtake price will be at a discount to market. LGCs would be optional to sell/purchase. If not sold IWC can use the LGCs to offset obligations or retire them to claim the carbon reduction and renewable energy generation. Depending on the size of the project (e.g. if >5 MW AC), the project may need to be registered as a generator with AEMO.
Agreements	• Land lease Agreement • EPC Agreement • Off-Take Agreement • Registration as generator (potentially)
Agreements and counterparties	**Lease Agreement:** Council and land owner (could be other council) **EPC Agreement:** EPC Company and Council. **Off-Take agreement:** Council as generator. Off-taker could be a corporate, a retailer or an aggregator (another council and/or IWC itself could be offtakers but only through a retailer otherwise model would involve a CFD). **Registration as generator:** Council and AEMO, if required
Duration	EPC contract open until construction and defects/initial maintenance complete. Off-take agreement will be aligned with financing where possible i.e. if the underlying financing is 15 years then ideally the off-take agreement will be for 15 years. Registration as a generator with AEMO is an annual renewal if required. The project life will be 30 years or more and will require inverter upgrades at periodic intervals (say 14 and 28 years).
Costs	• Capital cost • Inverter replacement cost • O&M cost • AEMO registration (if applicable) • Retailer pass through margin $/MWh • Loan finance (if applicable) • Land leasing (or purchase) costs
Carbon Reduction for Council?	• Depends on LGCs. If LGCs are sold, carbon reduction claim belongs to the purchaser of the LGCs. However carbon reduction could belong to Council if LGCs are retired to Clean Energy Regulator rather than sold to the market.
Benefits	• Sale of RE output to offtaker • Reduction in electricity prices compared with standard retail agreement • Reduced LGC obligation • Surplus LGCs if LGCs created exceed the obligation amount

Model Name	Build via EPC and sell fixed-price off-take including LGCs
Risks	1. Retailers may not want to be party to off-take. 2. AEMO increases fees for generators. 3. Wholesale market prices increase significantly and agreed off-take price is at a significant discount to market thereby Council foregoes revenue 4. Off-take term is shorter than financing if applicable 5. Regular retail price or competing off-take price falls below off-take price – no one takes up off-take or off-take needs to operate at a loss
Mitigants (that respond to the identified risks)	1. As market matures more retailers will want to participate. Legislation may drive obligations for retailers. Alternative is to take spot market revenue until off-take can be achieved. 2. Calculation of breakeven point will inform when this makes project unprofitable. Incorporate change in law clause. 3. Build in sufficient buffer when offering fixed for floating prices. 4. Negotiate longest duration possible and offer discounts for longer terms. Negotiate multiple offtake deals. 5. Get robust market pricing advice, and don't proceed if this is a likely outcome. Sell project if already constructed.
Case example	Majority of PPAs in market. Announced Project off-take agreements. Newcastle Council, City of Fremantle
Suitable for councils	Yes
Cost benefit	Recent analysis of mid-scale projects forecast fairly low returns of 4-6% IRR for mid-scale solar projects, with moderated wholesale market forecasts, declining LGC revenue and project capital costs still in the order of $1.50-$1.60/W (a 5 MW solar plant would likely cost around $8 million to develop). Consideration of whether a social cost of carbon (SCoC) warrants inclusion – this would significantly improve the business case.

Build via EPC and receive spot market revenue

Model Name	Build via EPC and receive spot market revenue
Basic Description	This model requires that Council registers as a generator, e.g. a semi-scheduled market generator (less than 30 MW generation) market participant. Generation will be sent to market via an export meter. Spot market revenue will be received from AEMO.
Agreements	• EPC Agreement • Registration as semi-scheduled market generator
Agreements and counterparties	**Lease Agreement:** Council and land owner (may be another council) **EPC Agreement:** EPC Company and Council. **Registration as semi-scheduled market generator:** Council and AEMO
Duration	EPC open until construction and defects/initial maintenance complete. Registration as semi-scheduled market generator is an annual renewal. The project life will be 30 years or more and will require inverter upgrades at periodic intervals (say 14 and 28 years).
Costs	• Capital cost • Inverter replacement cost • O&M cost • AEMO registration as a semi-scheduled market generator (currently

Model Name	Build via EPC and receive spot market revenue
	$20,000 pa) • Loan finance (if applicable) • Lease costs
Carbon Reduction for Council?	• Depends on LGCs. If LGCs are sold, carbon reduction claim belongs to the purchaser of the LGCs. However carbon reduction could belong to Council if LGCs are retired to Clean Energy Regulator rather than sold to the market.
Benefits	• Spot price revenue • LGC revenue
Risks	1. AEMO increases registration fees for semi-scheduled market generators. 2. Market price is low and provides lower than expected revenue for daytime generation. 3. Project finance may be difficult if there are no off-takers.
Mitigants (that respond to the identified risks)	1. Review viability of other models and cost to change. If viable make change. 2. Review viability of other models with long-term fixed pricing.
Case example	All merchant sellers of renewable energy
Suitable for councils	Yes
Cost benefit	Very similar to the EPC + offtake model with comparable prices offered for offtake v spot market at this time.

Offsite Power Purchase Agreements

Below are outlined PPA models that are prevalent in this evolving marketplace, but this is not an exhaustive list. Most models endeavour to give price surety and tenure to developers to satisfy their financing needs and most also ensure delivery of as firm a load as possible for customers.

Sleeved PPA (as per SSROC approach)

Model Name	**Sleeved PPA**
Basic Description	A sleeved PPA is similar to a regular grid power agreement, but instead of regular generation from coal-fired and other sources, the underlying electricity generation is from a specific renewable energy project. The customer has an agreement with the retailer for both renewable and standard grid power. Underlying this agreement, the retailer has a renewable energy supply agreement with a project developer either at a fixed rate or using a contract for difference. The retailer then sells the electricity including a margin to the customer and manages the risk of fluctuations in generation of the project. The customer typically pays either a risk included rate for all power or separate rates for renewably generated electricity and regular grid power.
Agreements	Retail Electricity Agreement inclusive of a sleeved PPA
Agreements and counterparties	**Sleeved PPA Agreement**: Retailer and Council (Typically combined with retail agreement). There is also an underlying agreement **between project developer and retailer, typically a CFD**, to which the Council would not be a party.
Duration	Term will likely be 10 or 15 years for the renewable component of the sleeved PPA. If the retail agreement is a separate agreement, the term for the retail component may not necessarily be ten years. The retailer may agree to a shorter term for the retail component. This then requires entering subsequent retail agreements until the end of the PPA term.
Costs	No upfront costs but each retail agreement will be subject to market pricing, so cost will not be known for the retail component unless there is a fixed price for ten years.
Carbon Reduction for Council?	• Depends on LGCs. If LGCs are sold, carbon reduction claim belongs to the purchaser of the LGCs. However carbon reduction could belong to Council if LGCs are retired to Clean Energy Regulator rather than sold to the market.
Benefits	Lower cost for power than traditional retail agreement.
Risks	Retailers may not be interested in taking on a sleeved PPA after the initial retail term.
Mitigants (that respond to the identified risks)	Lock in a longer-term retail agreement potentially with a transparent market matching clause
Case example	City of Melbourne, SSROC Buying Group
Suitable for councils	Yes

Direct (or 'sell side') PPA

Model Name	Direct (or 'sell side') PPA
Basic Description	A direct PPA involves a customer buying electricity directly from a renewable energy project developer (typically at a fixed price) over a term of 7, 10 or 15 years. This kind of PPA requires a retailer to pass through the terms of the agreement between the developer and customer and then also risk-manage any fluctuations in generation against a required amount of megawatt hours of electricity. Typically, the agreement will incorporate a performance guarantee or 'firming' clause that reduces the risk management required by the retailer. Retailers have in the past agreed to this type of PPA where the volume of renewable energy is only a small part of the customer's overall electricity load. This is because, in effect, they are receiving no margin on the small amount of renewable energy and are still making a margin on most of the overall load supplied by regular grid power. The retailer also must reconcile and bill for the renewably generated electricity.
Agreements	Direct PPA Agreement (assumes a retail agreement will be in place to supply balance of load and to cover retail invoicing of renewable power)
Agreements and counterparties	**Direct PPA Agreement**: Project developer and customer **Retail electricity agreement**: (incorporates PPA price) Retailer and Council.
Duration	PPA agreement: 7-15 years, typically ten years. Retail electricity agreement: 1-10 years
Costs	No upfront costs but each retail agreement will be subject to market pricing, so cost will not be known for the retail component unless there is a fixed price for ten years.
Carbon Reduction for Council?	• Depends on LGCs. If LGCs are sold, carbon reduction claim belongs to the purchaser of the LGCs. However carbon reduction could belong to Council if LGCs are retired to Clean Energy Regulator rather than sold to the market.
Benefits	Lower cost for power than traditional retail agreement.
Risks	Retailers may not be interested in taking on a Direct PPA.
Mitigants (that respond to the identified risks)	Request that projects provide PPA offers that incorporate a retailer offer and that they are willing to work with any retailer.
Case example	Sun Metals, Nectar Farms, Westpork
Suitable for councils	Yes

Virtual PPA

Model Name	Virtual PPA
Basic Description	A virtual PPA decouples the link between a grid power supply agreement and renewable energy generation in that a virtual PPA does not require the physical delivery of electricity. A virtual PPA is a stand-alone financial derivative agreement that guarantees a fixed price return for the project developer. The customer and the developer agree on a 'strike price' and agree to settle the difference between that strike price and the spot electricity market. If the spot market price rises above the strike price, then the customer receives a payment from the project developer (who would have sold the generated power into the spot market and received revenue for it). If the spot market price falls below the strike price, then the customer would be required to pay the difference. This payment would guarantee that the project developer would receive the strike price for every megawatt hour generated. It also offers income opportunities for the customer of up to the market cap of $14,200 per megawatt hour, less the strike price value. This form of contract is also known as a contract for difference and may require Australian Financial Services Licence to deal in this derivative product. There is a Ministerial Order for preventing councils from directly investing in derivatives and so Council would need to take a position on whether this form of PPA or a variation of it would be acceptable for investment. If a virtual PPA was to be used to meet 100% renewable energy target, the PPA would need to be "bundled" i.e. include LGCs. Alternatively, a separate additional PPA for LGCs only could be undertaken.
Agreements	PPA Agreement (financial-only, no retail agreement)
Agreements and counterparties	**PPA Agreement** (financial-only): Project developer and customer
Duration	PPA agreement: 7-15 years, typically ten years.
Costs	Difference between strike price and market price (when strike price is above market price) multiplied by consumption
Carbon Reduction for Council?	• Depends on LGCs. If LGCs are sold, carbon reduction claim belongs to the purchaser of the LGCs. However carbon reduction could belong to Council if LGCs are retired to Clean Energy Regulator rather than sold to the market.
Benefits	No Retailer is required Income available when market price is above strike price
Risks	1. Exposure to low-value spot market pricing 2. Reputational and financial penalty of breaching ministerial order if a council
Mitigants (that respond to the identified risks)	1. May be possible to purchase a further hedging derivative that increases in value as price drops below strike. 2. Councils should not use this model unless they receive legal advice that suggests it is possible to enter this form of contract.
Case example	UNSW, UTS
Suitable for councils	No, and also not suitable for meeting 100% renewable energy unless LGCs are included.

LGC-only Purchase Agreement

Model Name	LGC-only Purchase Agreement
Basic Description	An LGC-only PPA is relatively simple because Council would only purchase the green attributes of renewable energy generation and would not be concerned with balancing energy demand with the output from a renewable energy generator. There is little risk in matching the number of LGCs purchased to the electricity consumed in any given year. It also means that there will be little or no change to the retail electricity agreement. However, Council may be able to achieve a better price for LGCs through a bundled PPA. Also, striking a deal with a renewable energy generator for LGCs-only may not be sufficient for a new renewable energy project to obtain development finance.
Agreements	LGC Purchase Agreement
Agreements and counterparties	**LGC Purchase Agreement:** Council and LGC Owner (Likely a renewable energy project or aggregator)
Duration	Single transaction or ongoing quarterly or annual purchase
Costs	Negotiable, typically referenced to forward market pricing
Carbon Reduction for Council?	Depends on LGCs. If LGCs are sold, carbon reduction claim belongs to the purchaser of the LGCs. However carbon reduction could belong to Council if LGCs are retired to Clean Energy Regulator rather than sold to the market.
Benefits	Easy to operate, can be GreenPower®-accredited, achieve renewable energy targets at low cost with straightforward investment
Risks	1. Market volatility and likely rapid price decline 2. Fine print clauses in retail agreements and retail appetite for small amounts of LGCs surrendered. (if retiring LGCs this is not applicable)
Mitigants (that respond to the identified risks)	1. After 2020, it is likely to be a buyer's market and IWC would be able to aggressively negotiate on price. Assumption can be made that costs will be very low, and this should be verified by professional advice and market pricing when agreeing price levels. 2. Ensure review of existing and upcoming retail contracts prior to any transaction. If tendering/negotiating for electricity, ensure LGC surrender is a supply requirement
Case example	Two models exist in terms of surrendering LGCs: 1. retire them and achieve gains towards renewable energy goals 2. offset retailer RET cost obligations as a result of energy consumption
Suitable for councils	Yes

Virtual Generation Agreement

Model Name	Virtual Generation Agreement
Basic Description	Refers to offers of electricity pricing from "Virtual Generation Agreements" (VGAs) with renewable energy projects combined with hedges against wholesale price volatility for the supply of electricity when the projects are not generating. For example, a combined wind and solar PPA may be offered for a defined portion of IWC's total load. Outside of solar or wind generation hours, the retailer procures the remaining energy needs from the wholesale market on IWC's behalf and charge IWC the wholesale rate. Any excess generation not consumed can be sold back to the wholesale market or sold to the retailer at a fixed rate. If the generation asset is operating, i.e. the wind is blowing and the sun is shining, then it should be possible to cover a high % of the required load. However, if there is a lack of wind and light, e.g., a cloudy day with no wind, then more electricity will need to be bought on the wholesale market. If this happens to be a highly priced peak demand day, then this could prove to be very expensive. To balance this risk somewhat, the generated renewable energy will at other times be surplus to the customer's consumption and the excess would be sold into the market. To further manage exposure to spot market risk, a hedging product could be used to place a cap on spot pricing paid by the customer but would come at a price in $/MWh which may impact the business case. As IWC would essentially be operating as a wholesale market participant, the retailer would also have to charge a security deposit based on their deposit requirements from AEMO. This is currently estimated at over $125,000 and would need to be paid up front (typically in the form of a Bank Guarantee).
Agreements	Power Purchase Agreement (with VGA and underlying hedges)
Agreements and counterparties	**Power Purchase Agreement:** IWC and retailer
Duration	Typically 10 years
Costs	• VGA Rates (may incl LGC costs) • Variable Wholesale electricity costs • Hedging Costs • Security Deposit • Legal/advice costs
Carbon Reduction for Council?	• Depends on LGCs. If LGCs are sold, carbon reduction claim belongs to the purchaser of the LGCs. However carbon reduction could belong to Council if LGCs are retired to Clean Energy Regulator rather than sold to the market.
Benefits	• Large percentage of renewable energy • De-escalating renewable energy costs • Potential electricity cost savings over standard grid power

Model Name	**Virtual Generation Agreement**
Risks	• Retail market declining below VGA pricing within 10-year term • Exposure to wholesale market pricing • Intermittent generation • Considered as investing in a derivative
Mitigants (that respond to the identified risks)	• Negotiate best possible terms and pricing • Hedge without using derivatives • More accurately model peak and offpeak load matching • Use a different form of PPA
Case example	
Suitable for councils	Yes

Annex F – Site inspection summary reports

Level 32, 101 Miller Street
North Sydney 2060

www.100percentrenewables.com.au