KINESIS

INNER WEST COUNCIL

PATHWAY TO ZERO EMISSIONS

FINAL REPORT - 7 MAY 2019

Note: This report is provided subject to some important assumptions and qualifications:

The results presented in this report are modelled estimates using mathematical calculations. The data, information and scenarios presented in this report have not been separately confirmed or verified. Accordingly, the results should be considered to be preliminary in nature and subject to such confirmation and verification.

Energy and water consumption estimates are based on local climate and utility data available to the consultant at the time of the report. These consumption demands are, where necessary, quantified in terms of primary energy and water consumptions using manufacturer's data and scientific principles.

Generic precinct-level cost estimates provided in this report are indicative only based on Kinesis's project experience and available data from published economic assessments. These have not been informed by specific building design or construction plans and should not be used for design and construct cost estimates.

The Kinesis software tool and results generated by it are not intended to be used as the sole or primary basis for making investment or financial decisions (including carbon credit trading decisions). Accordingly, the results set out in this report should not be relied on as the sole or primary source of information applicable to such decisions.

Prepared by Kinesis
Level 6, 155 Clarence Street
Sydney, 2000 NSW
P.O. Box Q164
Queen Victoria Building
NSW 1230
admin@kinesis.org

Document Version
Final

Image credits
GreenWay Masterplan

CONTENTS

GLOSSARY OF TERMS

ABS refers to the Australian Bureau of Statistics

AEMO refers to the Australian Energy Market Operator

ARENA refers to the Australian Renewable Energy Agency

BAU refers to Business As Usual

BASIX refers to Building Sustainability Index which applies to new buildings, alterations and additions and must be obtained with a development approval.

BTS refers to the Bureau of Transport Statistics (NSW)

CAGR is the Compound Annual Growth Rate

CO2-e or carbon dioxide equivalent is the standard unit for measuring greenhouse gas emissions. The unit expresses the impact of each different greenhouse gas in terms of the amount of CO2 that would induce the same amount of atmospheric warming

Consumption-based GHG emissions encompasses those associated with supply, processing, transportation and direct use of goods and services that are purchased within the city boundary

CY refers to the calendar year

DCP refers to a local government's Development Control Plans

DPE refers to the Department of Planning and Environment (NSW)

Eastern District Plan refers to Greater Sydney Commission's 20 year plan for the Eastern City Division. The Eastern District includes the Inner West LGA

FY refers to the Australian financial year (1 July to 30 June in the following year)

GHG refers to greenhouse gases

GPC BASIC refers to a minimum reporting standard of scope 1 and 2 emissions from stationary energy and transport and scope 1 and 3 from waste. Kinesis has gone beyond this minimum requirement and included scope 3 stationary emissions

GSC refers to the Greater Sydney Commission

IWC refers to the Inner West Council area

LEP refers to a local government's Local Environmental Plans

LGA refers to Local Government Area

NABERS refers to National Australian Built Environmental Rating System which measures energy efficiency, carbon emissions and water consumed

OEH refers to the Office of Environment and Heritage (NSW)

Renewable Energy Target (RET) is an Australian government scheme that sets a target on the amount of renewable energy to be delivered through the electricity grid

Sector-based GHG emissions refers to those directly associated with direct use and production of goods and services within the city boundary

Statistical Area 1 (SA1) are a spatial geography used by the Australian Bureau of Statistics (ABS) and have been designed as the smallest unit for the release of census data

Scope 1 emissions, as defined by the Greenhouse Protocol, refer to greenhouse gas emissions from sources located within the city (or other government area) boundary

Scope 2 emissions, as defined by the Greenhouse Protocol, refer to greenhouse gas emissions occurring as a consequence of the use of grid-supplied electricity, heat, steam and/or cooling within the city (or other government area) boundary

Scope 3 emissions, as defined by the Greenhouse Protocol, refer to all other greenhouse gas emissions outside the city boundary as a result of activities taking place within the city (or other government area) boundary

TFNSW refers to Transport for NSW

Travel Zones (TZ) are the spatial base of Transport for NSW data collection, transport modelling and analysis. TZs allow for detailed spatial analysis as they are smaller than local government areas, but generally larger than an ABS Statistical Areas

VPA refers to Voluntary Planning Agreements

Zero emissions refers to when a region avoids, sequesters or offsets all of its greenhouse gas emissions

EXECUTIVE SUMMARY

Inner West Council is developing a pathway towards zero emissions.

Inner West Council is committed to transitioning to a low carbon future. The Community Strategic Plan, *Our Inner West 2036*, highlights the community's aspirations for a zero emissions Inner West. To deliver on these aspirations, Council is developing a Climate and Renewables Strategy to position the Inner West as a leader in renewable energy and urban sustainability.

The purpose of this report is to assist Council in developing its Climate and Renewables Strategy by outlining potential emissions reductions opportunities and strategic directions that form a pathway towards zero emissions for the region. The report consists of three sections:

1. **Understanding our region**
   An evidence-base of current land use & consumption patterns to identify focus areas and inform emissions reduction opportunities.
2. **Model opportunities to move the Inner West towards a Zero Emissions Future**
   Model and quantify emissions reduction opportunities towards zero emissions through existing and emerging policy and technological interventions.
3. **Develop strategic directions towards Zero Emissions**
   Collaboratively prioritise strategies and develop strategic directions describing Council's next steps towards implementation.

A holistic approach to comprehensively tackle emissions.

The Inner West Council is one amongst very few organisations to adopt a holistic approach that considers both sector-based and consumption-based emissions. This approach enables Council to be a leader in sustainability by tackling the full scope of emissions the Inner West is accountable for, including those generated beyond the Inner West. The focus of this report is to measure and provide a strategy to tackle the sector-based emissions. Many of the recommended strategies are also applicable to reducing emissions related to household consumption.

Understanding our region

Understanding our region is integral to developing solutions. This section describes the Inner West's land use & consumption patterns enabling Council to identify focus areas and develop opportunities towards emissions reduction. Kinesis' analysis of disparate datasets produced five key findings:

1. In FY 2016-17, the Inner West sector-based emissions are **1.1 million tonnes of CO2-e.**
2. The residential sector is responsible for more than 60% of sector-based emissions
3. Electricity (~70%) followed by transport (20%) are the major sources of emissions.
4. Residential consumption-based emissions are **3.3 million tonnes of CO2-e**. Five areas of consumption generate 75% of the emissions – electricity use (24%), overseas goods (18%), food & drink (16%), entertainment (12%) and transport & communications (5%).
5. Rooftop solar PV take up in the region is low, with only 4% of dwellings installing solar PV compared to 18% in Sydney's outer suburbs. However, there have been more and larger installations in the Inner West in recent years due to decreasing capital costs.

Model opportunities to move the Inner West towards a Zero Emissions Future

In this section, Kinesis modelled and quantified land use growth in the Inner West alongside five classes of emission reduction opportunities: efficiencies in existing buildings, high new building standards, transport efficiencies, waste management and maximising renewable energy take up. There were five key findings:

1. Kinesis analysis of BTS data suggests that there will be a **25% growth in dwellings and over 30% growth in jobs** in the Inner West by 2036.
2. If current patterns of energy and transport use and waste production continue, the projected growth in land use will result in an **18% increase or an additional 200 kt CO2-e of GHG emissions** by 2036.
3. Under a less emissions-intensive electricity grid that would be achieved through the Renewable Energy Target to 2020, the reduction opportunities can cumulatively achieve a **42% reduction in emissions** relative to the 2036 Reference Scenario (or 31% reduction relative to the FY 2016-17 Baseline). The largest reductions are from:
   a. Increased renewables (14%), transport efficiencies (8%), retrofits to existing buildings (6%), new building standards (5%), a less carbon-intensive grid (5%) and waste management (4%)
4. AEMO predicts that the electricity grid will have a very low carbon intensity by 2036, largely driven by the closure of coal power stations and installation of large-scale renewables. Under this 'cleaner' grid, the opportunities can cumulatively deliver **80% reduction in emissions** relative to the 2036 Reference Scenario (or 75% reduction relative to the FY 2016-17 Baseline). 60% of the reduction is derived from the cleaner grid. The remainder will be delivered by efficiencies in transport (10%), waste (8%), and electrifying the economy (3%).
5. Despite the large reduction from a cleaner electricity grid, **opportunities that Council has greater influence over can deliver up to 75% of the reductions until 2028**. Furthermore, Council-led actions to increase the uptake of community renewables will play a larger role in delivering a less emissions-intensive electricity grid. As such, any interventions by Council in the short to medium term will significantly reduce emissions and deliver a cleaner electricity grid.

Developing strategic directions towards Zero Emissions

This section describes the six strategic directions developed alongside Council staff that will enable the Inner West to achieve a zero emissions future. They include:

1. **A targeted approach to renewable energy** - engage with large asset owners
2. **Moving to net zero buildings** – set high performance standards for new buildings
3. **Identify & develop standards for low emissions precincts** – as per Objective 33 of Greater Sydney Region Plan
4. **Continue innovations in waste –** Investigate opportunities for shared economy & expand current waste programs
5. **Curb private vehicle use –** encourage active & public transport, smart parking & vehicle share
6. **Support & plan for a new mobility future** – future proof for electric vehicles, autonomous vehicles and introduce a guided electric transit system for the Parramatta Road Corridor

A HOLISTIC APPROACH TO UNDERSTANDING EMISSIONS

The Inner West Council is adopting a holistic approach to understanding and responding to community emissions. Kinesis has produced a robust, *Global Protocol for Community Greenhouse Gas Emissions* (GPC) -compliant sector-based baseline emissions inventory for the Inner West region. However, Inner West Council also recognises that its community is connected to the global economy and therefore influences global greenhouse gas emissions through the supply chains of the goods and services purchased within the LGA boundary. To provide a holistic understanding of emissions associated with the region, Kinesis has included the results of an innovative Sydney University research report about the emissions impact of household consumption, otherwise known as consumption-based emissions, in the Inner West.

1. Sector based Emissions

Most cities prepare sector-based emissions inventories using established standards such as the GPC. Sector-based GHG emissions are those associated with direct use and production of goods and services within the city boundary. These include the combustion of fuels within the city's boundary (scope 1), the combustion of fuels associated with grid-supplied electricity outside the city's boundary (scope 2) and emissions from waste treatment and disposal (scope 1 or 3). Many cities use sector-based emissions to develop a comprehensive emissions inventory, set emissions reduction targets, produce an informed climate action plan, and track and compare their performance against cities globally.

However, sector-based emissions inventories have recognised limitations, the foremost of which is that they do not account for emissions generated outside of the city that are associated with the supply and processing of goods and services that are used by residents of the city. Under sector-based emissions reporting, these emissions would be attributed to the city in which the goods and services were produced.

2. Consumption based Emissions

Consumption-based GHG inventories capture GHG emissions associated with the supply, processing, transportation and direct use of goods and services (see example in Figure 1). This approach to emissions inventories allocates GHG emissions to the final consumers of goods and services, rather than to the original producers of those GHG emissions (which often includes cities in less wealthy nations). GHG emissions are reported by consumption category rather than GHG emission source category. This is an emerging and innovative approach that captures some of the wider implications of consumer behaviour in the Inner West (see Figure 2).

EXAMPLE – CONSUMPTION-BASED EMISSIONS – DAIRY

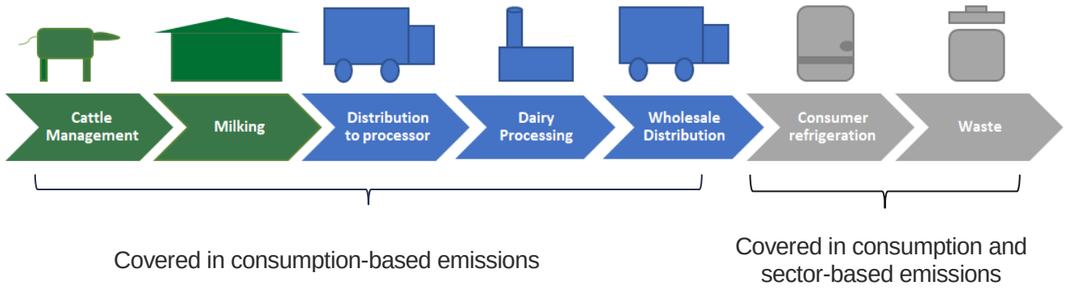


Figure 1: The supply chain of dairy as an example of what consumption and sector-based emissions encompass

SECTOR BASED & CONSUMPTION-BASED EMISSIONS

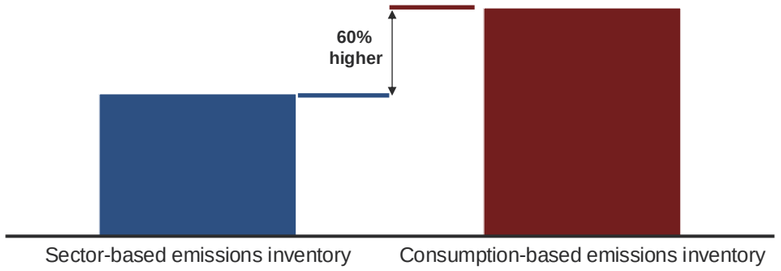


Figure 2: Based on analysis of sector-based and consumption-based GHG emissions inventories across 79 cities globally, the C40 organisation found that the consumption-based GHG emissions for these cities was approximately 60% higher than their sector-based GHG emissions. This increase reflects the incorporation of emissions associated with upstream supply chain processes of goods and services used within those cities that would not normally be captured by a sector-based emissions inventory[1]

Emissions Inventories and Strategies in this Report

The sector-based GHG emissions inventory and emissions reduction strategies explored in this report have been supplemented with information from a household consumption-based GHG emissions study conducted by the University of Sydney to provide further context and support strategies that deliver more sustainable models of consumption, such as a sharing and circular economy, environmentally-responsible supply chains and purchasing locally-made products.

[1] C40 Cities (2018), Consumption-based GHG Emissions of C40 Cities

HOW TO READ THIS REPORT

A key requirement of the project was to collaborate with Council to develop an actionable strategy that Council can own. This report is structured to reflect the collaborative process undertaken to develop a set of strategic directions to move the Inner West towards a zero emissions region:

1. **Understanding Our Region**

   - **Kinesis** - Analyse and present the baseline data to Council.
   - **Council** - Present Situation and Options Workshop for Council staff to determine focus areas and identify opportunities for a zero emissions future.

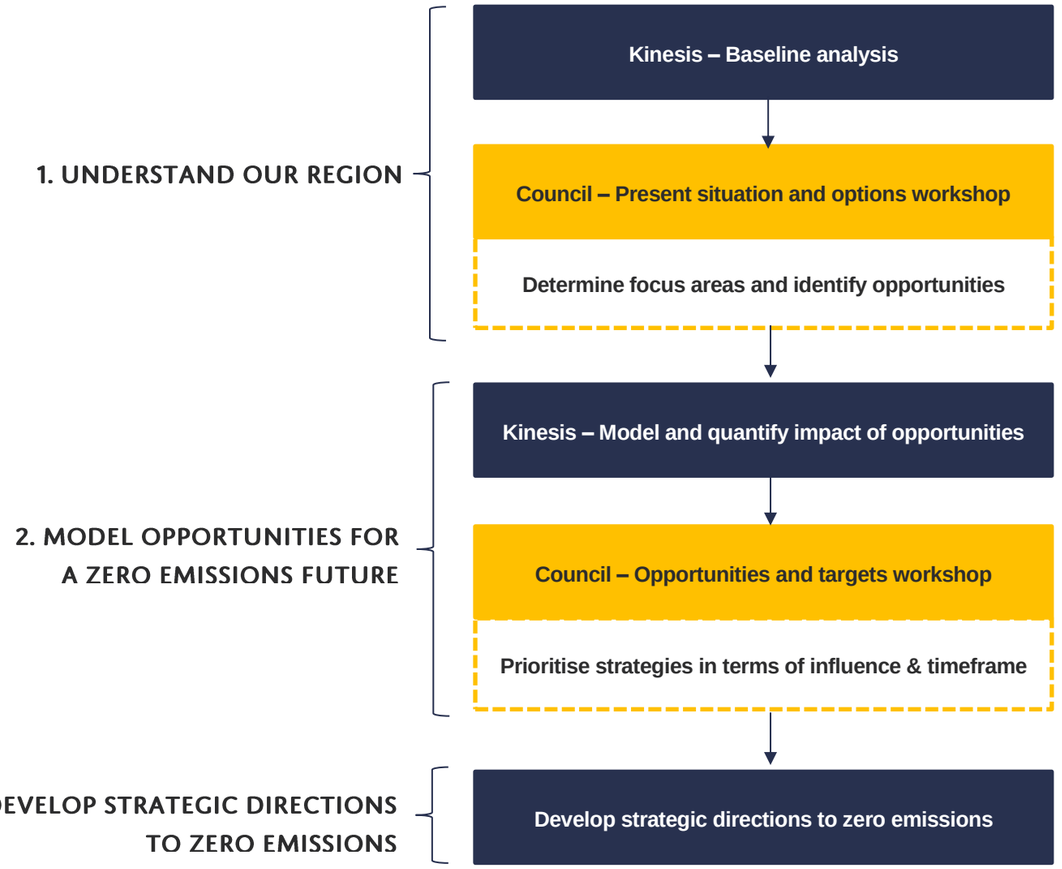
2. **Model opportunities to move the Inner West towards a Zero Emissions Future**

   - **Kinesis** - Model and quantify the impact of the opportunities identified from the Present Situation and Options Workshop.
   - **Council** - Opportunities and Targets Workshop with Council staff to review and prioritise strategies in terms of Council influence and timeframe for implementation.

3. **Develop Strategic Directions to Zero Emissions**

   - Use Council's input from the Opportunities and Targets workshop to develop a set of strategic directions for Council.

COLLABORATIVE PROCESS TO DEVELOP STRATEGY



SECTION 1

UNDERSTANDING OUR REGION

UNDERSTANDING OUR REGION

Identifying effective strategies to reduce the Inner West's emissions requires a sound understanding of current land use and resource consumption patterns in the region. Kinesis carried out a baseline analysis that identified key drivers of sector-based emissions and renewable energy generation in the Inner West.

Baseline analysis was undertaken by compiling disparate data sets from utility providers, government agencies, institutes and Council into Kinesis' web-based analytical platform – CCAP City. Greenhouse gas emissions[2], as well as trends in solar PV uptake and generation and car share data for the region, are presented and discussed in this section.

METHODOLOGY AND DATA SETS

The data presented in this report is the best available data from utility providers, government agencies, institutes and Council. Where appropriate and feasible, high-level datasets (e.g. waste generation) have been broken down (disaggregated) to a finer grain with respect to area, sector and end use based on existing land use and typical household and non-residential consumption. Table 1 outlines the data sets analysed and loaded into CCAP City, their source and any estimation and/or disaggregation that was carried out. A detailed description of the baseline analysis methodology is documented in the Appendix.

[2] GPC BASIC compliant scopes 1, 2 and 3

DATA SETS, SOURCES & METHODOLOGY – BASELINE PROFILE

Metric	Source	Notes
Dwellings	Australian Bureau of Statistics	FY 2016-17. Broken down into detached, attached and multi-unit
Jobs	Bureau of Transport Statistics	FY 2016-17. Broken down into health, education, industrial, knowledge intensive (commercial, etc.), population serving (retail, etc.)
Electricity consumption	Ausgrid	FY 2016-17. Disaggregated to sub-sector level with end-uses and scope 1 & 2 emissions
Natural gas consumption	Jemena	CY 2016-17. Disaggregated to sub-sector level with end-uses and scope 1 & 2 emissions
Renewable energy (Solar PV)	Australian PV Institute; Ausgrid; Clean Energy Regulator	Installed capacity and installations by size (monthly and cumulative) available from FY06-07 from APVI. Solar energy exported to the grid from Ausgrid for FY 2016-17.
Residential waste (including landfill and diverted)	Inner West Council	FY 2016-17. Disaggregated to sub-sector level with end-uses and scope 1 & 2 emissions
Residential transport (travel by residents)	Transport for NSW	FY 2016-17. Disaggregated to sub-sector level with end-uses and scope 1 & 2 emissions
Non-residential transport (Journey to Work)	Australian Bureau of Statistics	FY 2016-17. Data tagged by place of usual residence with scope 1 & 2 emissions
Car share pods, trips, kilometres and hours	GoGet	GoGet data available from January 2018 to July 2018
Wastewater emissions	Ironbark Sustainability	FY 2016-17

Table 1: Data sets, sources and methodology used in the baseline sector-based emissions and renewable energy analysis

CURRENT LAND USE

Analysing land use in the region is integral to uncovering and understanding current patterns of resource use and waste production and in developing greenhouse gas emission strategies that respond to local urban typologies.

Kinesis used dwellings as the key metric for residential land use and jobs as the key metric for non-residential land use. These were further divided into sub-sectors: detached, attached and multi-unit dwellings and commercial, retail, industrial, health services and education services jobs.

Figure 3 outlines the breakdown of dwellings and jobs in the Inner West down to the sub-sector level. Land use across the Inner West is summarised as follows:

- 44% of the dwellings are multi-unit, 32% are attached and 24% are detached.
- Commercial, retail and industrial jobs combined make up 80% of all jobs in the Inner West.

Figure 4 and Figure 5 show the spatial distribution of detached dwellings and industrial jobs by suburb, respectively.

- Marrickville, Dulwich Hill, Ashfield and Haberfield contain a large number of detached dwellings. Detached dwellings typically have higher household emissions but also have a greater potential for rooftop solar PV.

- Marrickville, St Peters, Leichardt, Rozelle and Balmain contain a large number of industrial jobs. Industrial sites such as warehouses typically have large roof areas, thereby making them suitable for medium to large scale rooftop solar PV installations.

FY 2016-17 DWELLINGS & JOBS – REPRESENTATION OF BASELINE LAND USE

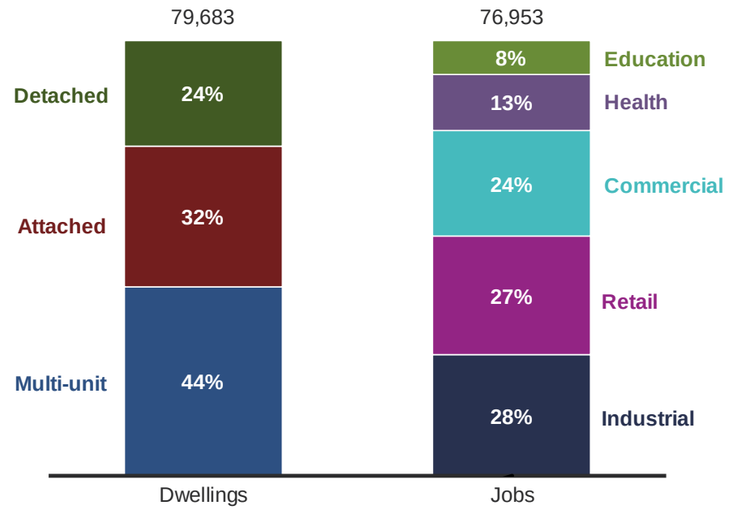


Figure 3: Dwellings and jobs by sub-sector in FY2016-17. Dwelling data was sourced from the ABS and jobs data was sourced from the BTS

DETACHED DWELLINGS BY SUBURB

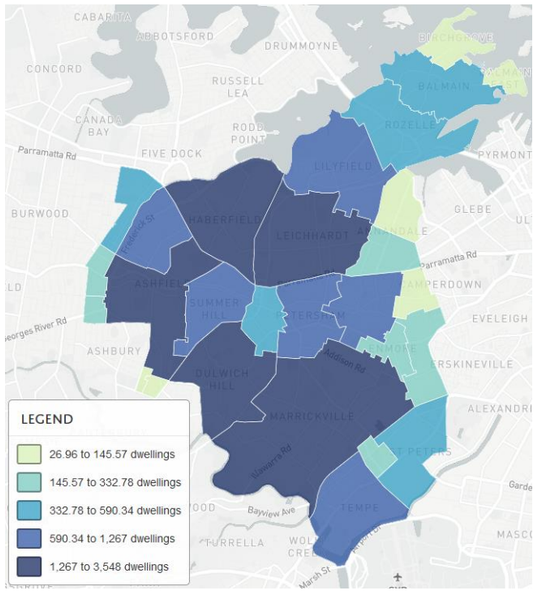


Figure 4: FY 2016-17 detached dwellings by suburb

INDUSTRIAL JOBS BY SUBURB

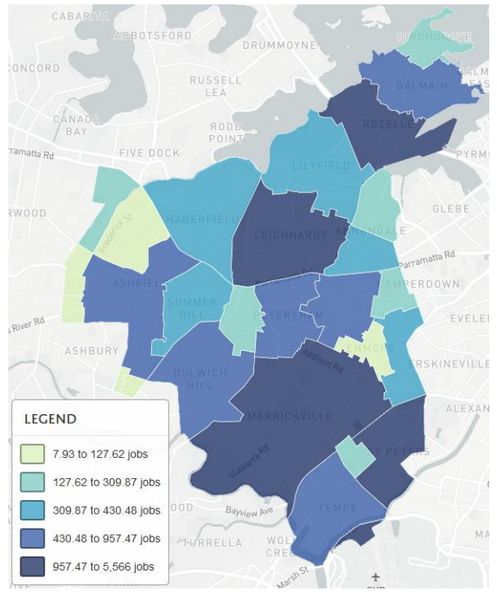


Figure 5: FY 2016-17 industrial jobs by suburb

EMISSIONS BASELINE

Establishing a baseline for Inner West's GHG emissions is important for two reasons:

1. A baseline provides a starting point for reductions pathways
2. A baseline provides a comprehensive understanding of the distribution of GHG emissions amongst sectors and end uses

We present a high-level analysis of the Inner West's sector based and consumption based GHG emissions to understand consumption patterns and identify targeted opportunities for reductions.

SECTOR-BASED EMISSIONS BASELINE

In FY 2016-17, the Inner West sector-based greenhouse gas emissions from electricity, gas, waste and transport were calculated to be **1,133,695 tonnes CO2-e[3].**

The total sector-based emissions are divided into emissions by resource type in Figure 6 and then divided further by sector and resource type in Figure 7.

The following conclusions can be drawn from the Inner West's sector-based emissions profile:

- The residential sector is responsible for more than 60% of sector-based emissions in the region
- Electricity and transportation emissions account for ~85% of total sector-based emissions in the region.

[3]GPC BASIC compliant scopes 1,2 and 3. Kinesis has also included scope 3 stationary energy emissions to provide a more thorough analysis of emissions associated with consumption in the Inner West.

SECTOR-BASED EMISSIONS BY RESOURCE TYPE

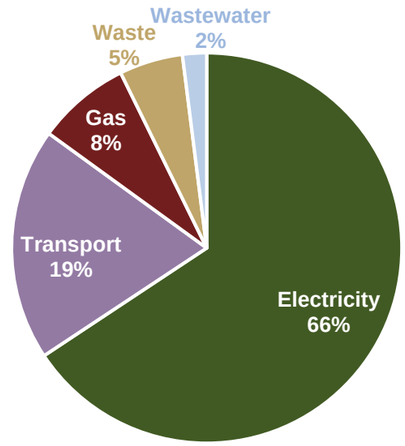


Figure 6: Sector based emissions in the Inner West by resource type

SECTOR-BASED EMISSIONS BY SECTOR & RESOURCE TYPE

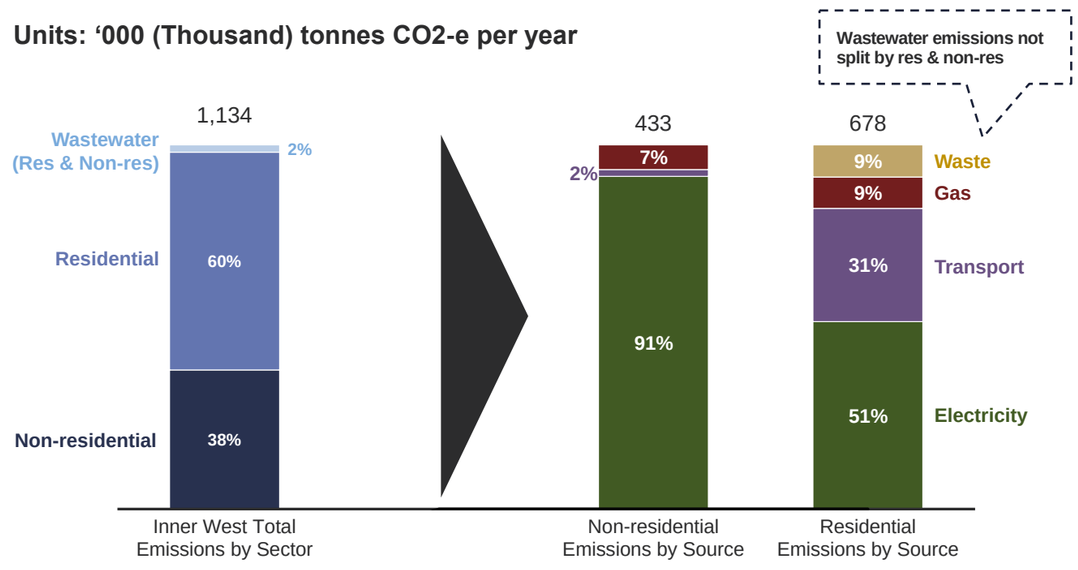


Figure 7: Sector based emissions in the Inner West by (L) sector, which has then been further subdivided into resource type (R).

Figure 8 provides spatial contextualisation of stationary residential emissions (i.e. emissions associated with electricity, gas and waste) in the region and Figure 9 ties residential land use to residential stationary emissions and highlights the importance of understanding the links between land use and resource use and waste production.

As illustrated by Figure 8, suburbs such as Haberfield and Tempe seem to account for only a small portion of the region's total residential stationary emissions. However, Figure 9 shows that the average emissions per dwelling in these suburbs are amongst the highest in the region. This is most likely due to a high proportion of inefficient dwellings in these suburbs, many of which may be older detached dwellings (refer to Figure 4).

SECTOR-BASED STATIONARY RESIDENTIAL EMISSIONS BY SUBURB

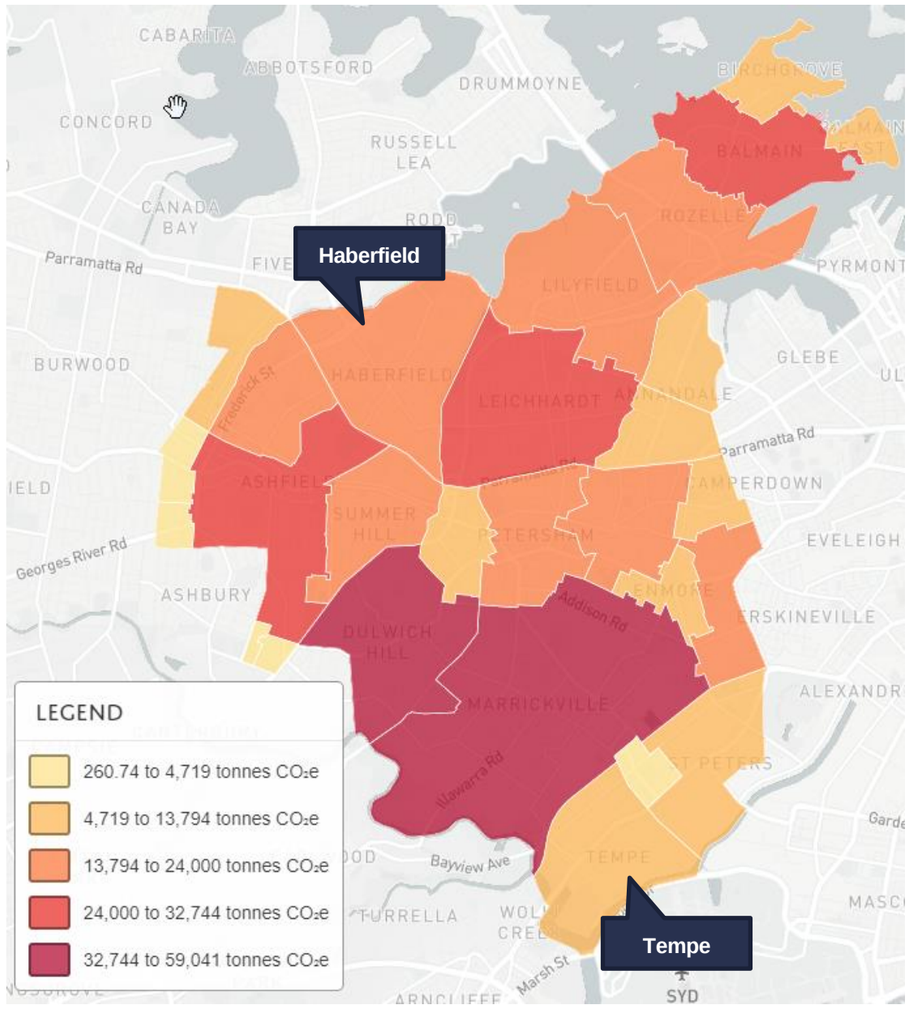


Figure 8: Sector-based stationary emissions by suburb

SECTOR-BASED STATIONARY RESIDENTIAL EMISSIONS PER DWELLING

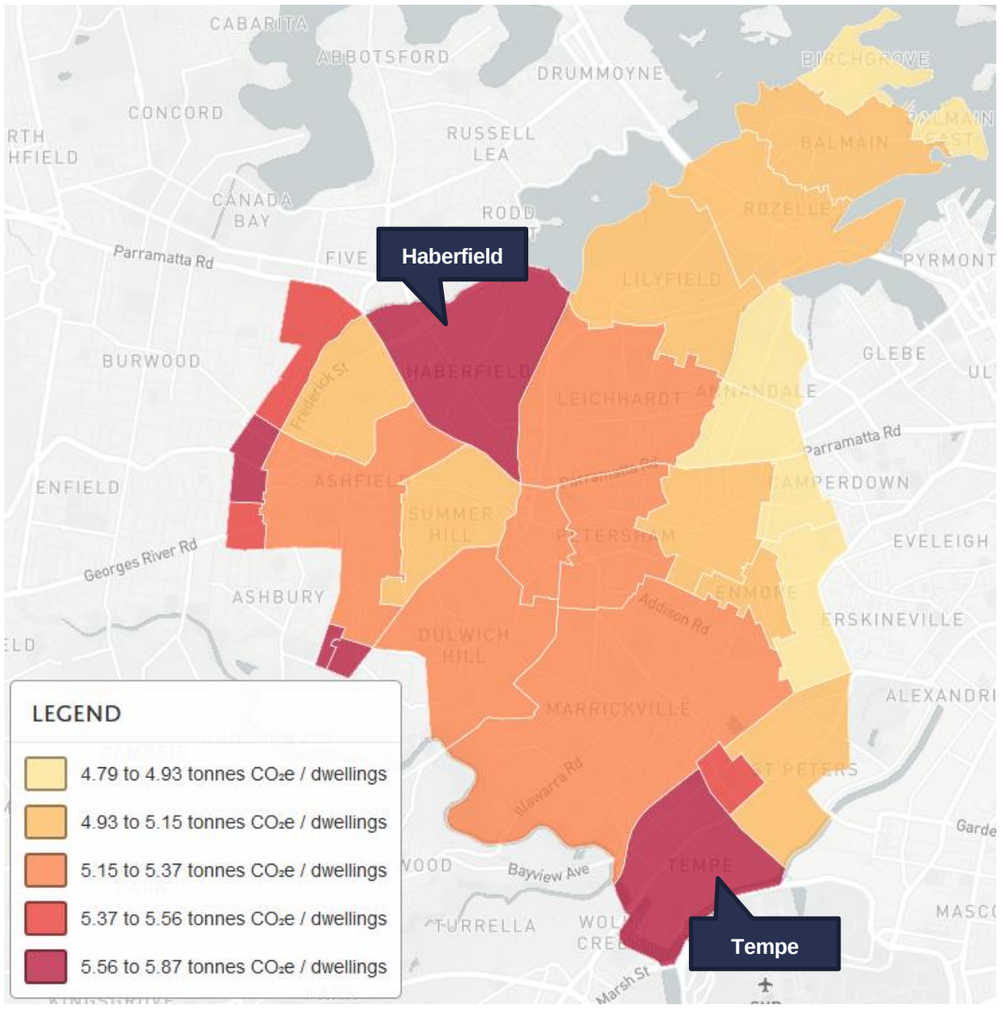


Figure 9: Sector-based stationary emissions per dwelling by suburb

UNIVERSITY OF SYDNEY – HOUSEHOLD CONSUMPTION EMISSIONS STUDY

Consumption-based emissions are emissions associated with the consumption of goods and services (such as food, clothing, electronic equipment, etc.) by residents of an area. These emissions have previously not been accounted for in cities that consume these goods and services as they are often generated outside a city boundary and are complex to measure and to address.

The Inner West, like many cities, depends on manufacturing and industry based in areas beyond its boundaries. In many cases, the industries producing goods and services for consumption by Inner West residents are in other countries. This means that most of the emissions embodied in the goods and services consumed by Inner West residents are emitted elsewhere in the world.

The Inner West Council is exhibiting sustainability leadership by understanding the impact of household consumption on global greenhouse gas emissions. Inner West Council engaged the University of Sydney to estimate the total household consumption-based emissions associated with the Inner West region based on local household expenditure data.

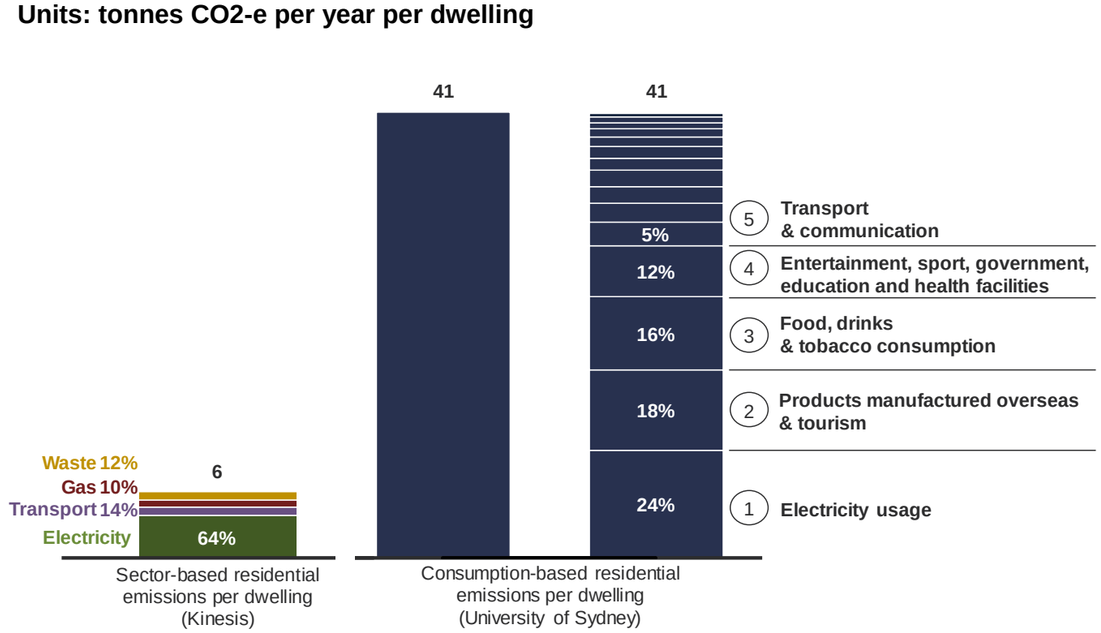


Figure 10: Consumption-based emissions in the Inner West, with the top 5 emissions-intensive goods and service categories

Unlike Kinesis' sector-based emissions analysis that looks at the GHG emissions associated with directly using and producing goods and services in the Inner West boundary, the consumption-based emissions analysis includes the upstream emissions associated with the entire supply chain of goods and services purchased in the Inner West by households. The household consumption-based emissions for the Inner West are estimated to be **3,278 thousand tonnes CO2-e.**

Based on the University of Sydney's analysis of Inner West residents' purchasing patterns, Kinesis has identified the top five emissions-intensive goods and services categories shown in Figure 10. These are outlined with example reduction strategies in Table 2.

Mechanisms to address consumption-based emissions will require collaboration with the community and other stakeholders to develop a targeted approach to reduce the Inner West's consumption-based emissions. An example of this, highlighted in Table 2, is the ability of Council to encourage alternatives to traditional vehicle ownership through the facilitation of vehicle share services (this is discussed further in Strategic Direction 4 of this report).

Category	Inclusions	Example	Reduction Mechanism
Electricity usage	Electricity consumption from the grid	Using an air conditioner in summer	Upgrading the air conditioner or reducing usage
Products manufactured overseas & tourism	Products bought directly from overseas and tourism	Travelling overseas for a holiday	Travel domestically
Food, drinks & tobacco consumption	Meat, dairy, fruit, vegetables, beverages, tobacco	A diet heavy in meat and dairy	Reducing meat and dairy consumption
Entertainment, sport, government, education and health facilities	Education, hospitals, GPs, vets, entertainment, arts, sports, government services	Building a private swimming pool	Using a public swimming pool
Transport & communication	Passenger, freight, postal and courier services, rental cars	Driving a car you own	Using vehicle share services when necessary

Table 2: What is included in the top 5 emissions intensive goods and service categories, an example of consumption pertaining to each and an associated consumption emissions reduction mechanism

RENEWABLE ENERGY BASELINE

Renewable energy will form a critical part of the Inner West's Pathway to Zero Emissions. To inform future uptake in the region and highlight key opportunity areas, Kinesis has explored the key drivers and hurdles to renewable energy take-up in the Inner West as a part of its baseline analysis.

Given the low cost and ease of installation of solar PV in urban environments, Kinesis' renewable energy baseline is focused around both residential and non-residential rooftop solar PV. At the end of FY 2016-17, ~**11,340 kW of rooftop solar PV** was installed in the Inner West region.

Figure 11 shows the change in solar PV installed capacity and average installation size over time. The installed capacity in the Inner West has grown by over 300 times in the last ten years. Furthermore, the average installation size has also increased, particularly due to the take-up of solar PV by the non-residential sector (typically installations greater than 10 kW).

Drivers for Solar PV

The key driver for increasing solar PV capacity has been decreasing solar PV panel capital costs (Figure 12). Rising electricity prices (Figure 13) and decreasing battery costs will also increase the attractiveness of solar PV and energy storage systems in the future.

CUMULATIVE SOLAR PV INSTALLED CAPACITY IN THE INNER WEST

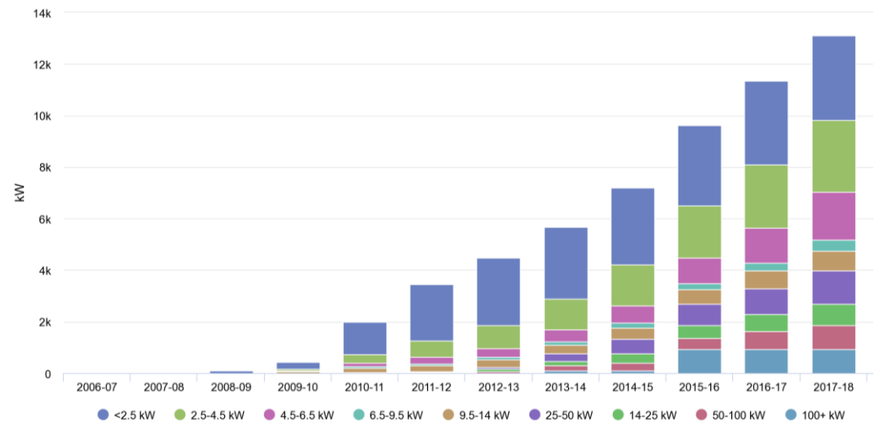


Figure 11: Installed solar PV capacity - FY07 to FY18

5 KW SOLAR PV SYSTEM PRICES

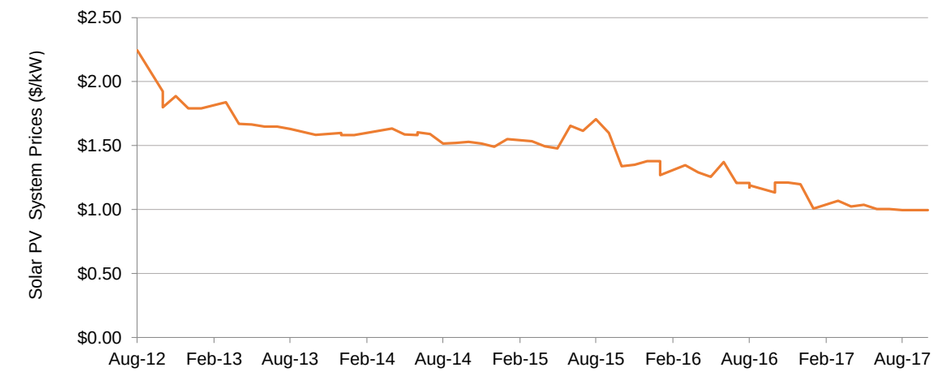


Figure 12: Average of historical 5 kW system prices ($ per installed Watt) in state capital cities in Australia[4]

PROJECTED RETAIL ELECTRICITY PRICES

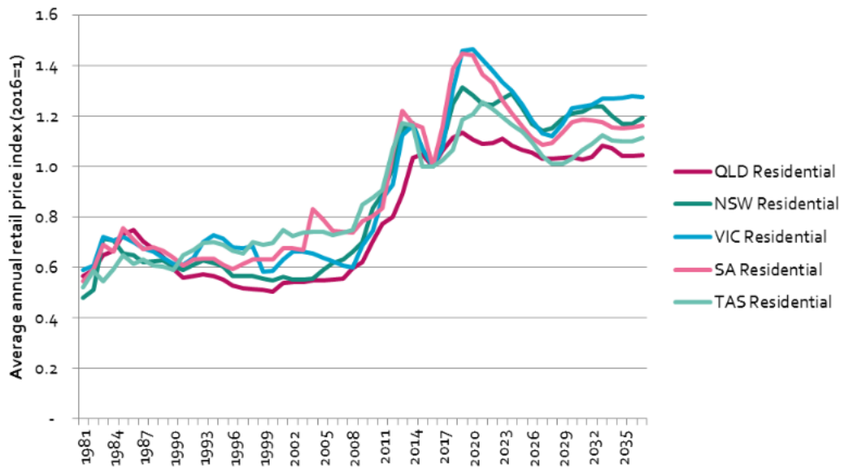


Figure 13: Projected retail electricity prices[5]

[4] Solar Choice (2017), *5kW solar systems: pricing, output and returns*
[5] Jacobs – prepared for AEMO (2017), *Retail electricity price history and projected trends*

Solar PV take up in the Inner West is Low

Despite the increase in solar PV capacity, solar PV penetration (installations divided by dwellings) in the Inner West is relatively low. As is shown in Figure 14, on average only 4% of dwellings in the Inner West have installed solar PV compared to 18% in Sydney's outer suburbs.

Our analysis has highlighted three key issues for solar PV installations in the Inner West:

- **New buildings don't install solar PV**
  BASIX data suggests that only 5-10% of new dwellings in the Inner West install solar PV (Figure 15). This is particularly an issue for apartments or rental dwellings where retrofitting solar PV becomes a barrier to installation after construction.

- **There is significant potential for solar PV on single dwellings and industrial buildings**
  For example, owner occupied single dwellings in Haberfield and industrial sites in Tempe have very low installations of solar PV (Figure 16).

- **Apartments don't install solar PV**
  Split incentives from managing multiple stakeholders in apartments makes it challenging to install solar PV in apartments. As demonstrated by Figure 16, medium and high-density housing along the rail corridor haven't installed solar PV.

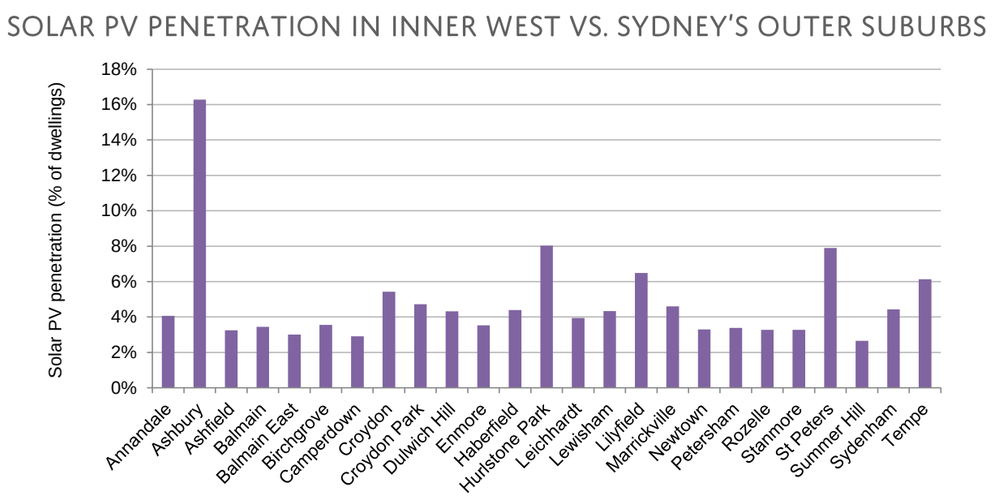


Figure 14: Solar PV penetration in the Inner West LGA

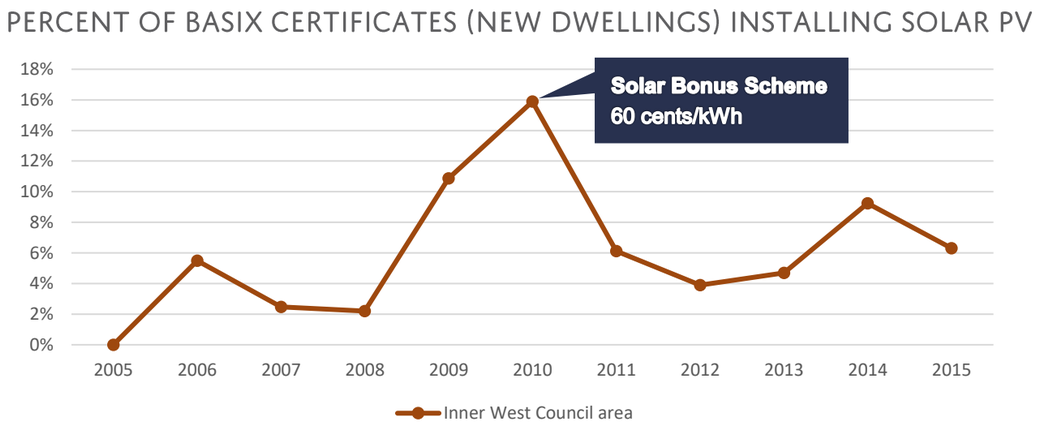


Figure 15: Percentage of BASIX certificates (new dwellings) that install solar PV

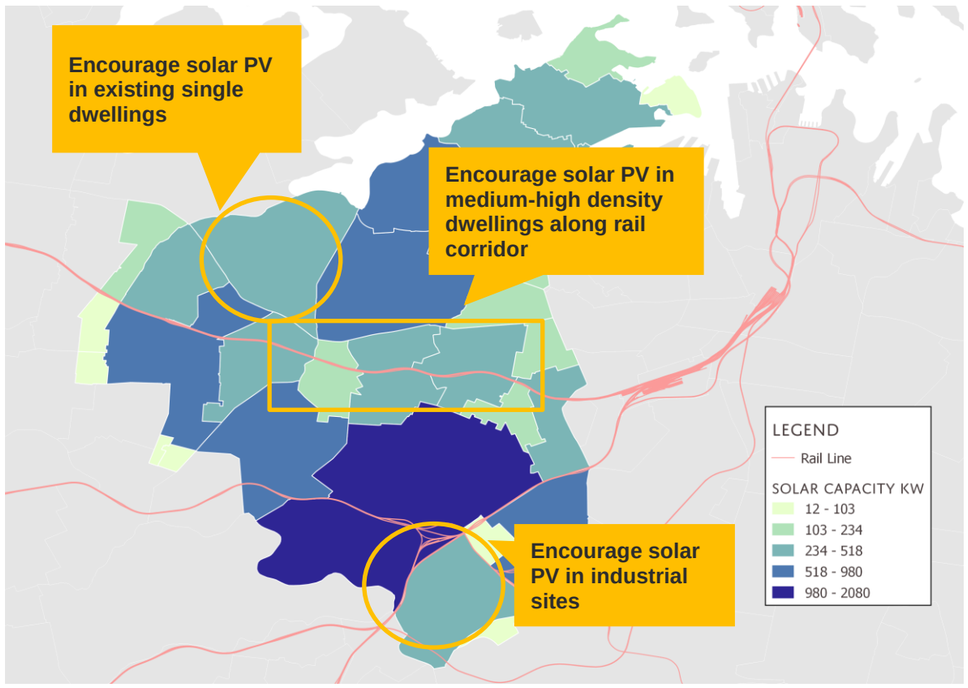


Figure 16: Existing buildings and apartments haven't installed solar PV

PRESENT SITUATION & OPTIONS WORKSHOP

The Emissions and Renewable Energy Baseline outlined in the previous section formed the basis of a workshop on 27 September 2018 with over 20 Council staff from:

- Strategic Planning,
- Development Assessment,
- Traffic,
- Community and Culture,
- Engagement,
- Urban Ecology,
- Resource Recovery,
- Green Living Centre and
- Urban Sustainability.

The purpose of the workshop was to familiarise staff with the Inner West's emissions and renewable energy baselines and identify key opportunities and strategies. Kinesis' modeling and quantification of these strategies is outlined in the next section and forms the pathway to a zero emissions community.

Council staff proposed and discussed strategies and mechanisms to address emissions (particularly sector-based emissions) and encourage higher renewable energy uptake. These fell under 5 key categories:

1. Efficiencies in existing buildings
2. High new building standards
3. Transport efficiencies and innovation
4. Waste management
5. Maximise renewable energy take-up

Detailed outcomes of the workshop were documented in a memo that was circulated to key Council staff.

The next section outlines Kinesis' modelling and quantification of these strategies to develop a pathway towards a zero emissions community for the Inner West.

SECTION 2

TOWARDS A ZERO EMISSIONS FUTURE

TOWARDS A ZERO EMISSIONS FUTURE

OVERVIEW

In *Understanding Our Region*, analysis of the Inner West's carbon emissions and renewable energy baseline by Kinesis and the University of Sydney highlighted resources, sectors, areas and end uses with a high potential for improvement.

Building on this analysis and the outcomes of the *Present Situation and Options* workshop with Council staff, Kinesis has modelled future-state scenarios that gauge the potential for the Inner West region to achieve a zero emissions future. The results of the scenario analysis were workshopped with Council staff and the outcomes of the workshop shaped the development of Section 3: *Strategic Directions to Zero Emissions*.

Towards a zero emissions future encompasses the following:

1. Modeling Methodology
2. Land Use Projections to 2028 and 2036
3. Renewable Energy Projections to 2020, 2028 and 2036
4. Scenario Analysis Overview
5. Greenhouse Emissions Reductions Opportunities

SECTOR-BASED MODELLING METHODOLOGY

Kinesis has employed a modelling methodology that enables a future business-as-usual (BAU) sector-based emissions scenario to be considered alongside the impact of various emission reductions and renewable energy opportunities. Inputs including baseline resource use and waste production data, baseline land use data and projected land use data are used to break down coarse-grain data to fine-grain sectors and areas, to project future-state consumption and emissions based on future land use and to evaluate the relative impact of various opportunities and interventions on carbon emissions in the Inner West.

Kinesis' modelling methodology can be broken down into four key steps:

1. Disaggregation of raw data at a coarse level to theoretical data at a fine grain level. This enables Kinesis to estimate the electricity, gas, waste and transport consumed or produced per job or dwelling in a year for a particular geography (e.g. suburb).
2. Analysis to produce land use projections by geography and sector. The raw data behind these projections is from the Bureau of Transport Statistic's Land Use 2016 Projections
3. Calculation of future business-as-usual (BAU) consumption and emissions based on data from steps 1 & 2
4. Application of opportunities and interventions (policies/technologies) to reduce BAU consumption

A detailed explanation of the modelling methodology and a list of the assumptions behind each of the modelled opportunities and interventions are available in the Appendix.

LAND USE PROJECTIONS TO 2028 AND 2036

Dwelling and jobs were projected to understand the implications of future growth on the Inner West's sector-based carbon emissions. This change in land use over time must be considered to inform future consumption trends in the region. Kinesis drew upon established sources to project housing and jobs in the Inner West to both 2028 and 2036.

Expected new housing supply was sourced from the BTS' Travel Zone Projection 2016 dataset. Kinesis then applied the following assumptions to create a residential dwelling growth scenario (Figure 17):

- Turnover rate of existing dwellings (dwellings that exist in FY 2016-17) of 1 in 200 existing dwellings refurbished per year
- New dwellings were assigned to a typology such that 80% were multi-unit and 20% were attached. This typology split was determined based on data supporting higher density dwelling growth in Greater Sydney[6] and is consistent with similar work that Kinesis has completed for other government clients.

Dwellings in the Inner West are projected to grow by ~25% by 2036, with the majority of the growth attributed to multi-units/apartments and attached dwellings.

Jobs projections to 2028 and 2036 for the Inner West were also obtained from the BTS' Travel Zone Projection 2016 dataset for the following job categories (Figure 18):

- Education (Education and training)
- Health (Health care and social services)
- Industrial (Heavy industry, light industry and warehousing)
- Retail/Population serving (Retail trade, accommodation, food and community services)
- Commercial/Knowledge intensive (Professional services, public administration, finance, insurance, etc.)

Jobs in the Inner West are projected to grow by ~34%, with a high percentage growth in the commercial, education and industrial sectors.

RESIDENTIAL DWELLINGS GROWTH

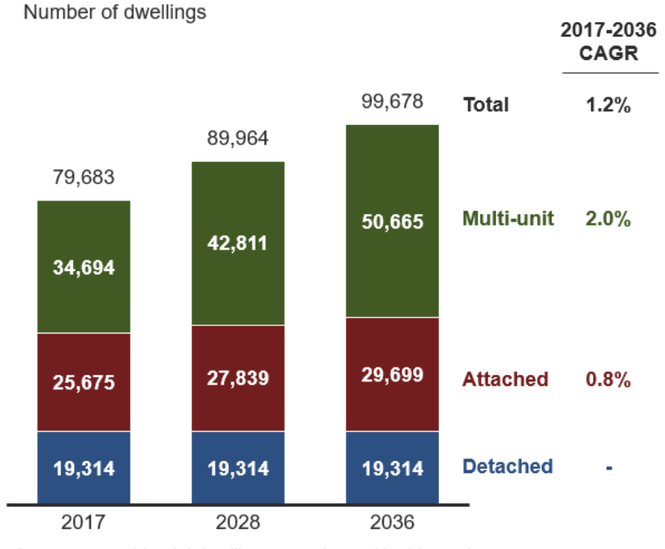


Figure 17: Residential dwellings growth used in this study

Drivers of Growth:

Sydenham to Bankstown Urban Renewal Corridor

Low Rise Medium Density Housing Code

JOBS GROWTH

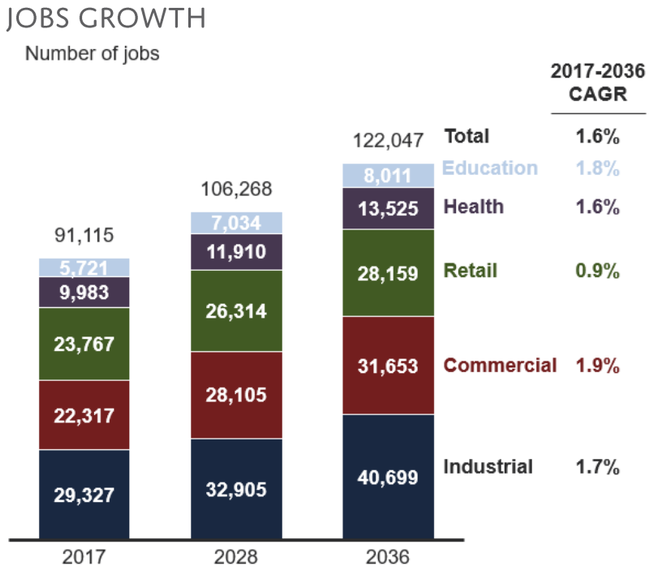


Figure 18: Jobs growth used in this study

Drivers of Growth:

Sydenham to Bankstown Urban Renewal Corridor

Health and Education Precincts (GSC District Plans)

[6] Kinesis (2017), Exploring Net Zero Emissions for Greater Sydney

RENEWABLE ENERGY PROJECTIONS TO 2020, 2028 AND 2036

By building upon observations and trends in renewable energy uptake in the Inner West as explored in the section *Understanding our Region*, Kinesis has projected the installed building-level solar PV capacity in the Inner West to 2020, 2028 and 2036. These projections reflect what is possible given favourable market conditions, the community's willingness and the implementation of innovative programs by Council and higher levels of government.

Kinesis' solar PV uptake projections for 2028 and 2036 are based on the assertion that solar PV capital cost is the primary barrier to uptake in households theoretically capable of installing solar. Figure 19 highlights the strong linear relationship between the capital cost of solar PV and the historical average installation size of solar PV in the Inner West. This linear relationship was used with the projected capital price of solar PV[7] to project the future average installation size in the Inner West (Figure 20).

The projected potential solar PV capacity in the Inner West in 2028 and 2036 and the Inner West's contribution to installed rooftop solar PV in NSW in those years[8] is given in Figure 21. Uptake of solar PV in the residential sector was projected to be primarily driven by single dwellings, whereas the large roof spaces of schools and industrial sites were projected to drive the uptake of solar PV in the non-residential sector. The detailed assumptions behind Kinesis' solar PV projections are available in the Appendix.

SOLAR PV SYSTEM PRICE & AVERAGE INSTALLATION SIZE IN THE INNER WEST

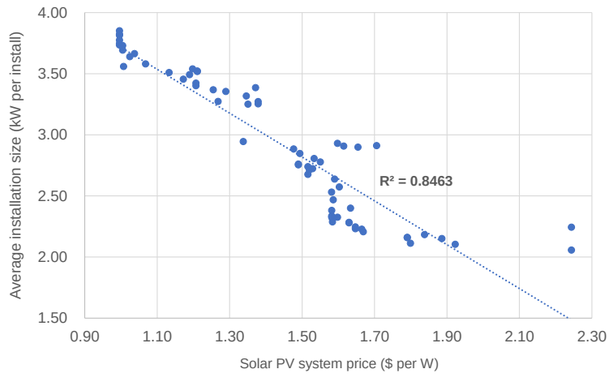


Figure 19: Regression analysis between the capital cost of solar PV ($ per installed Watt) and the historical average installation size in the Inner West (kW of panels). Each point in the X-Y scatter plot represents one month of data.

PROJECTED CAPITAL COST AND INSTALLATION SIZE IN THE INNER WEST

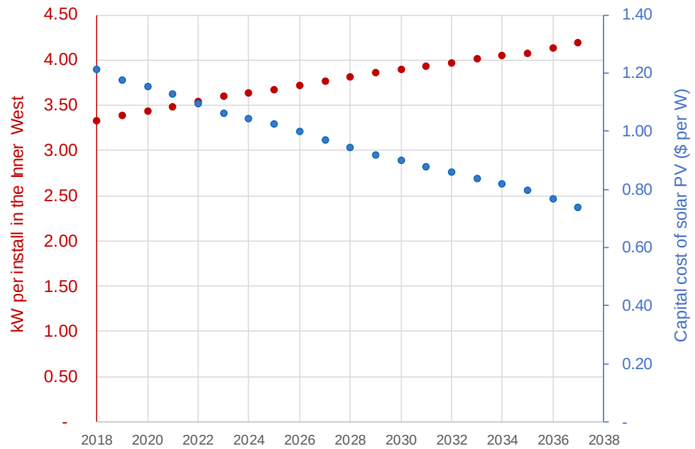


Figure 20: Projected capital cost of solar PV ($ per Watt)[2] and the projected average installation size in the Inner West. By 2036, the average installation size reaches just over 4 kW per installation.

INSTALLED SOLAR PV CAPACITY IN THE INNER WEST IN 2017, 2028 & 2036

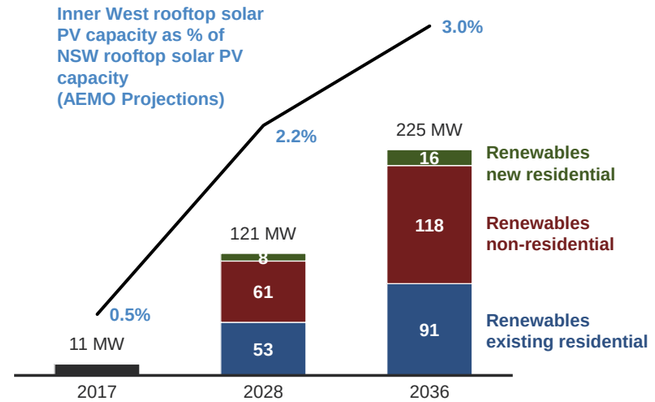


Figure 21: The Inner West's potential for rooftop solar PV, based on Kinesis' projections. By 2036, the solar PV capacity is projected to increase to twenty times that of the capacity in 2017[9]. The majority of this growth is expected to be delivered by non-residential installations.

[7] Jacobs – prepared for AEMO (2017), *Projections of uptake of small-scale systems*
[8] AEMO (2018), *Integrated System Plan*

[9] AEMO projects that 15% of 2036 energy mix in NSW would be generated through rooftop solar PV. 3% of predicted rooftop solar capacity in NSW will come from the Inner West LGA. The Inner West LGA also accounts for 3% of NSW single dwellings.

SECTOR-BASED EMISSIONS SCENARIO ANALYSIS OVERVIEW

The **2016/17 Baseline** aggregates FY 2016-17 consumption in the Inner West (see Sector-Based Emissions Baseline). Two scenarios were considered against the baseline in Kinesis' sector-based analysis of opportunities for a low emissions future:

1. **2036 Reference Scenario**, which assumes growth in land use (dwellings and jobs as per Land Use Projections to 2028 and 2036) but with current energy consumption, transport use and waste generation intensities (e.g. kWh per detached dwelling or kWh per industrial job). That is, the 2036 Reference Scenario consumption is calculated by multiplying the FY 2016/17 electricity and gas consumption, transport use and waste generation per job/dwelling by the number of jobs and dwellings in the Inner West in 2036. This scenario also assumes FY 2016-17 greenhouse gas emission factors (e.g. kgCO2-e per kWh) unless otherwise stated.

2. **2036 Model Scenario**, which explores the implications of existing and emerging policy interventions and technologies on sector-based emissions reductions in the Inner West region to 2036. The impact of these reduction opportunities has been modelled by modifying the consumption intensities or by modifying the greenhouse gas emission factors.

SECTOR-BASED GHG EMISSIONS REDUCTION OPPORTUNITIES

A range of greenhouse gas emission reduction opportunities were explored and analysed to understand the degree to which energy, transport, infrastructure and planning policy and technology interventions can move the Inner West towards a zero emissions future.

The five classes of emissions reduction opportunities identified in the Present Situation and Options Workshop were explored in this analysis. These include:

1. **Efficiencies in existing buildings**
   Retrofits and refurbishments in existing buildings

2. **High new building standards**
   Building standards for new residential and non-residential buildings

3. **Transport efficiencies**
   through mode and technology shifts in transportation

4. **Waste management**
   Reduce waste sent to landfill through product stewardship, home composting and organics collection and processing.

5. **Maximise renewable energy take-up**
   through targeted increases in rooftop solar PV across the region

Two pathways were modelled for reducing emissions, each capturing a different level of change in the emissions intensity of the electricity grid.

Pathway #1 – 2020 RET Emissions Intensity

The first pathway reflects electricity generation at a state and federal level achieving targets set under the Renewable Energy Target 2020. At present, NSW is on track to meet its RET 2020 commitments.

Pathway #2 – A Greener Grid

The second pathway can be considered as an extension to the first and incorporates a greener grid (lower emissions intensity grid) that would develop by 2028 and 2036. The greener grid emission factor is informed by the Australian Energy Market Operator's (AEMO) predicted energy generation mix that reflects coal power stations being decommissioned and replaced with large scale renewable energy generation. This second pathway represents a 'least ambitious' future grid mix – any energy emissions policy implemented at a state and/or federal level is likely to further lower the emissions intensity of the grid.

The details, application and key assumptions behind each opportunity are outlined in the Appendix.

EMISSIONS PATHWAY #1 – INNER WEST COMMUNITY SECTOR-BASED GHG EMISSIONS REDUCTION POTENTIAL (2020 RET)

Figure 22 shows the greenhouse gas emissions reduction potential from the identified opportunities for the Inner West region if current state and federal commitments to renewable energy (the Renewable Energy Target to 2020 or RET 2020) are met. Kinesis' analysis of Emissions Pathway #1 highlights the following key points:

- The reduction opportunities can cumulatively achieve a **42% reduction in emissions** across the Inner West region relative to emissions associated with the 2036 Reference Scenario (or 31% reduction relative to the FY 2016-17 Baseline)
- The biggest drivers of reduction are implementing residential and non-residential renewables, enhanced waste recovery through increased diversion or waste processing, the impact of RET 2020 and transport-related reduction opportunities.

It should be noted that the emissions reductions associated with Reference Scenario consumption with a less emissions intensive grid are captured within the 2020 RET reduction. Any emissions reduction potential attributed to a change in electricity consumption (e.g. replacing halogen light bulbs with LED lighting) was calculated using the predicted electricity grid carbon intensity if RET 2020 were to be achieved (~0.89 kgCO2-e/kWh). Emissions reduction potential associated with other resource types (e.g. natural gas, waste etc.) was calculated using FY 2016-17 emissions factors (see Appendix).

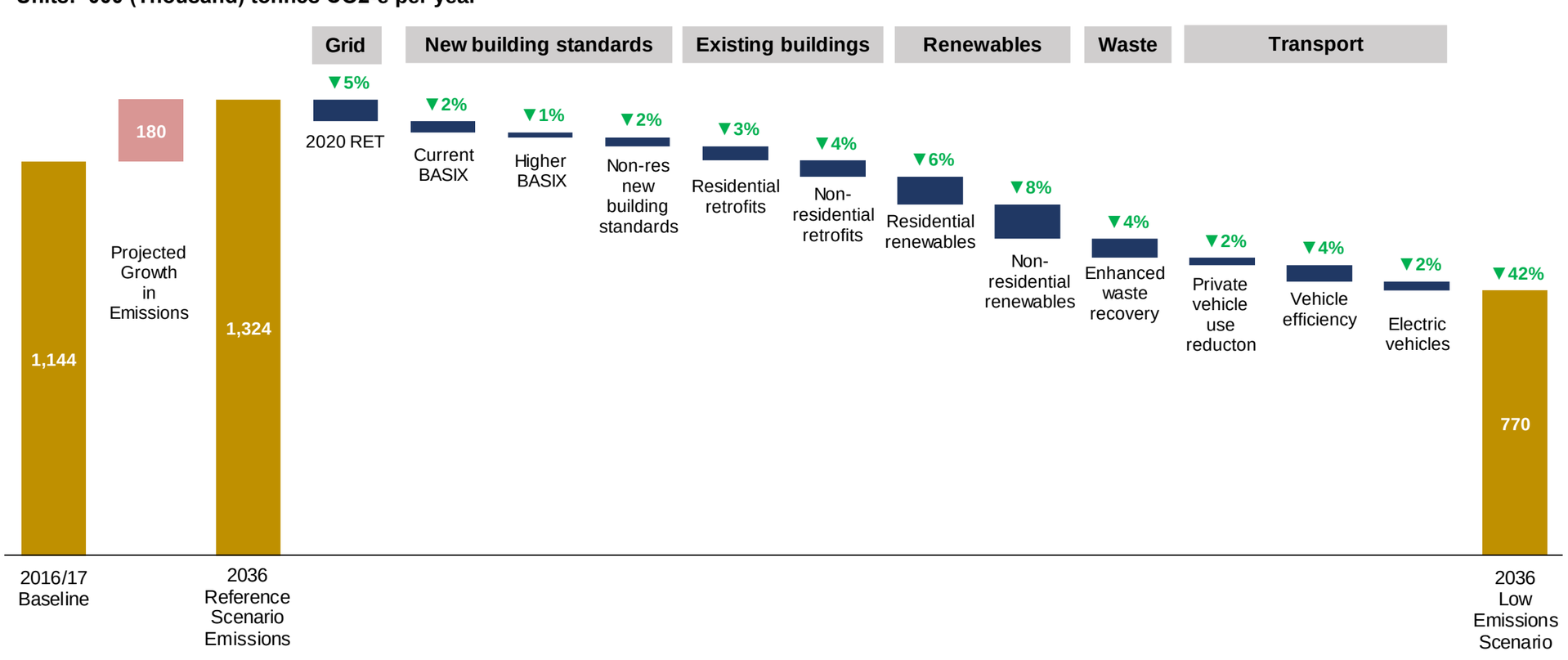


Figure 22: Estimated GHG emissions reduction potential for the Inner West region in the 2020 RET Pathway

EMISSIONS PATHWAY #2 – INNER WEST COMMUNITY SECTOR-BASED GHG EMISSIONS REDUCTION POTENTIAL (GREENER GRID)

Kinesis sought to understand the impact of strategies under a significantly 'greener' (or less emissions intensive) grid.
shows the greenhouse gas emissions reduction potential from the identified opportunities for the Inner West region under a significantly greener electricity grid as predicted by the Australian Energy Market Operator's *Integrated System Plan* (2018). The report takes into account proposed closures of coal power stations and installations of large-scale renewable energy generators that will service future demand. The greener grid will reduce the impact of opportunities such as, new building standards and retrofits, that target reductions in electricity consumption.

Kinesis' technical analysis suggests that with AEMO's predicted generation mix in 2036, the reduction opportunities can cumulatively achieve nearly **80% reduction in emissions** across the Inner West region relative to the 2036 Reference Scenario (or 75% reduction relative to the FY 2016-17 Baseline). The biggest drivers of reductions are the greener grid (future generation mix), enhanced waste management through increased product stewardship, home composting, designs for reuse and recycle and share economy, transport-related reduction opportunities and the electrification of the region (i.e. transition from natural gas to electricity under a greener and cheaper grid). In summary,
highlights that as electricity becomes less emissions intensive, reduction opportunities related to waste and transport will have the greatest impact and withstand the 'test of time'.

The impact of maximising rooftop renewables in the Inner West to generate ~20% of the region's electricity consumption in 2036 is captured in the 2036 Future Generation Mix reduction column. The Future Generation Mix reduction column accounts for emission reductions achieved through the consumption of cleaner electricity under a greener grid. However, under a greener grid the impact of energy efficiency strategies decrease. Any emissions reduction potential attributed to a change in electricity consumption (e.g. replacing halogen light bulbs with LED lighting) was calculated using the predicted 2036 AEMO Generation Mix electricity grid carbon intensity (~0.1 kgCO2-e/kWh). Emissions reduction potential associated with other resource types (e.g. natural gas, waste etc.) was calculated using FY16/17 emissions factors (see Appendix).

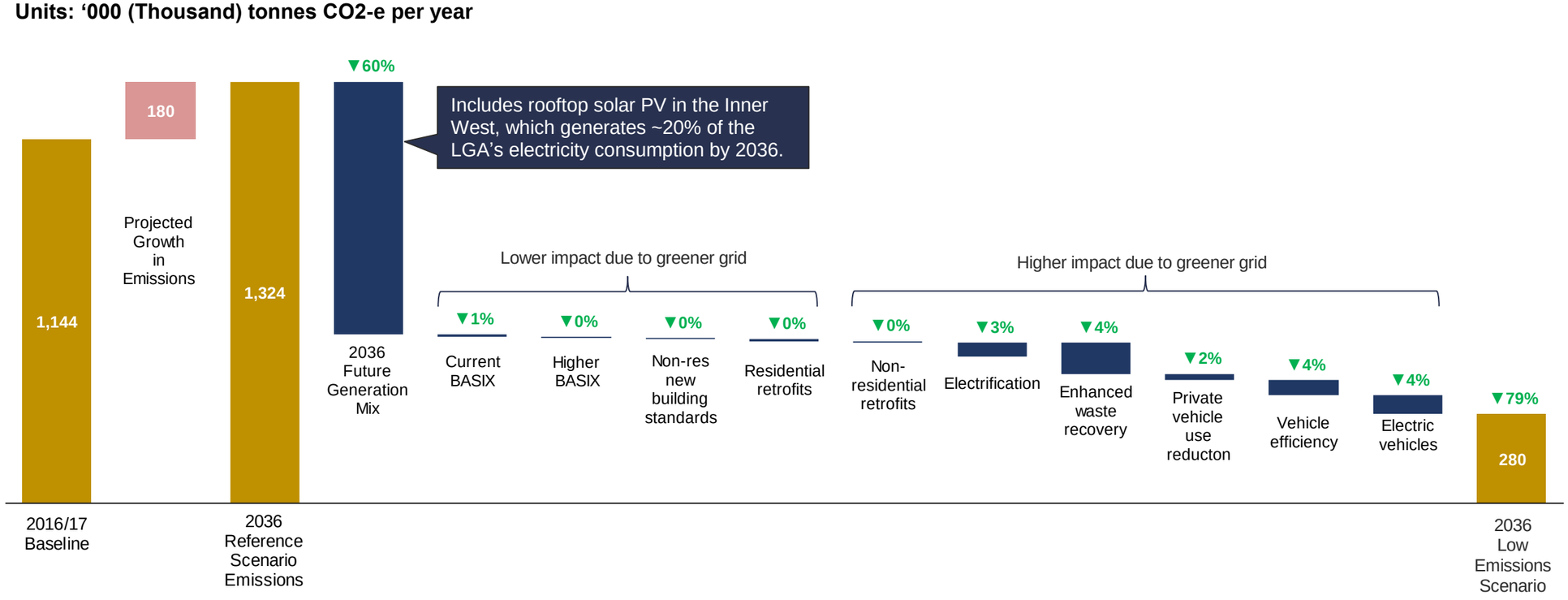


Figure 23: Estimate GHG emissions reduction potential for the Inner West region in the 2036 Future Generation Mix Pathway.

IMPORTANCE OF IMMEDIATE COUNCIL LED ACTION

At first glance, the analysis of Emissions Pathway #2 with AEMO's predicted generation mix in 2036 (Figure 23) may suggest that a greener grid will be the key driver for emissions reductions and initiatives that Council has greater influence over would have a minimal impact.

A greener grid will deliver a large portion of the forecast emissions reductions by 2036. However Council-led strategies will have significant impact in delivering further emissions reductions by taking action between 2018 and 2036.

Excess CO2 is projected to remain in the atmosphere for hundreds to thousands of years, impacting the climate long after emissions stop. Emissions released because of inaction between now and 2036 will effectively be irreversible. Council-led strategies highlighted in blue will drive up to 75% of the reductions until 2028.

Figure 24 highlights a like-for-like comparison of the emissions reduction impact of Council-led strategies versus the impact of a greener grid. The reductions from various strategies have been calculated from a normalised baseline of 2036 business-as-usual emissions with changes to the grid emissions factor each year as per achieving the RET in 2020 and the generation mix predicted by AEMO for the years 2028 and 2036.

Therefore, it is essential for Council to take immediate action to support emissions reductions between now and 2036 despite projections of a greener grid. The emissions mitigated in the short and medium term will have a lasting impact on anthropogenic climate change as a whole.

IMPACT OF GRID EFFICIENCIES VS. COUNCIL LED STRATEGIES, 2020 – 2036

Units: '000 (Thousand) tonnes CO2-e per year

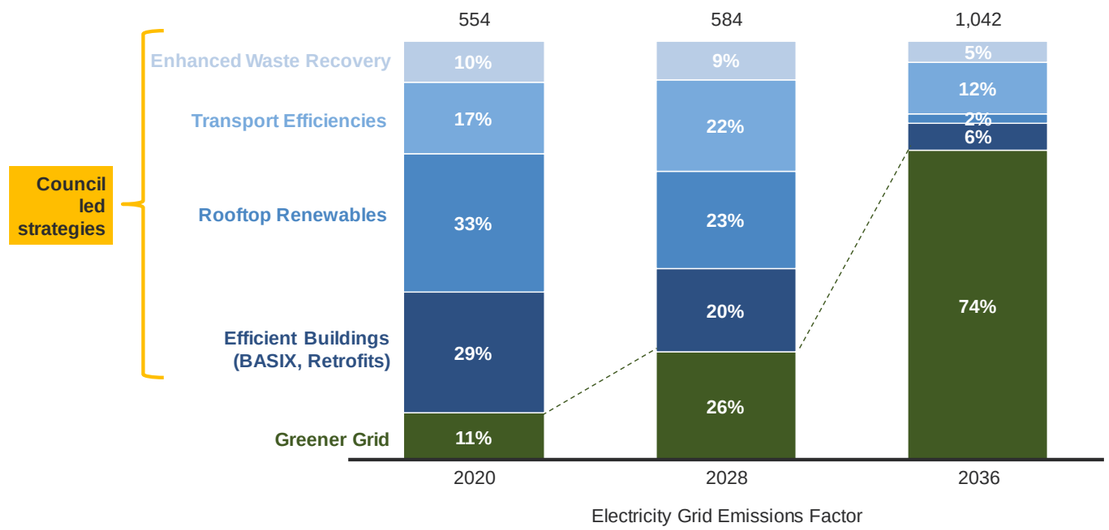


Figure 23: Impact of a greener electricity grid vs. Council led strategies

THE DEFICIT TO ZERO EMISSIONS

Council's strategies along with a greener grid as modelled by the 2036 Future Generation Mix shows that emissions reductions opportunities deliver a total reduction in carbon emissions of 79% relative to the Inner West's 2036 Reference Scenario (or 75% relative to the FY 2016-17 Baseline).

Additional emissions reductions of **280 thousand tonnes of CO2-e** must be made in order to meet the target of zero emissions (Figure 24).

Figure 25 shows the composition of the deficit. The deficit emissions of 280 kt CO2-e can be broken down into:

- 43% from electricity use
- 28% from public transport use
- 22% from private vehicle use
- 6% from waste

Future technologies and an even greener grid driven by federal energy emissions policies or targets will have a vital role to play in reducing the deficit to net zero emissions. The NSW state government can further assist this effort through strategies such as developing a low emissions public transport system and encouraging a mode shift from private vehicle use to lower emission alternatives.

However, a collaborative effort between Council, community and other stakeholders to change consumption behaviour will have a substantial impact. For example, Council can set up service workshops for the community to repair and reuse products, thereby reducing waste generation.

BREAKING DOWN THE DEFICIT TO ZERO EMISSIONS

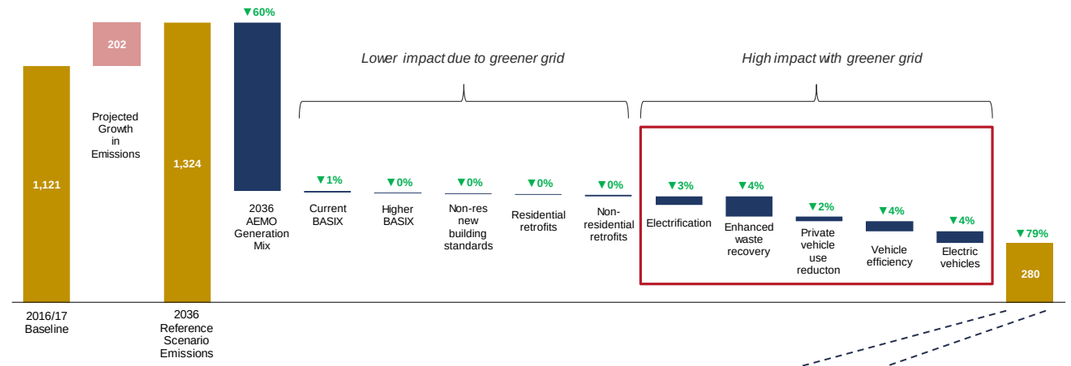


Figure 24: Pathway 2 emissions reduction leaving a deficit of 280 kt CO2-e

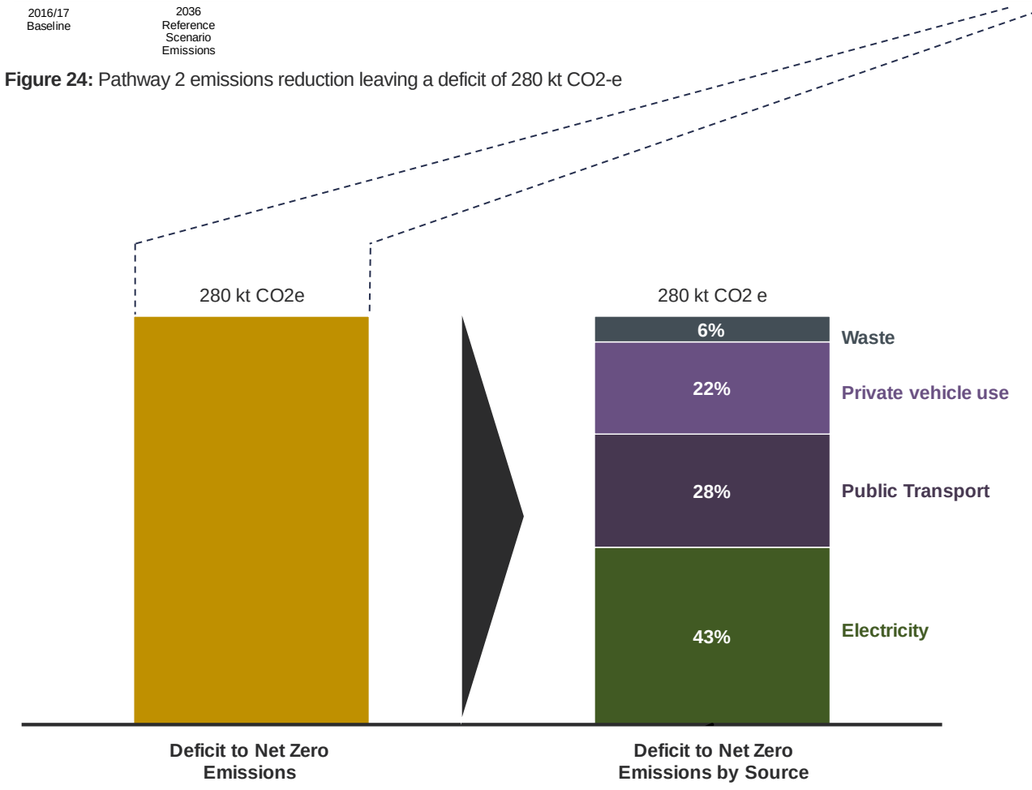


Figure 25: Composition of the deficit

OPPORTUNITIES & TARGET WORKSHOP

Using the analysis outlined above, Kinesis and key staff in the Inner West Council participated in the Opportunities and Targets workshop on the 25th of October 2018.

Following a presentation of the modelled opportunities to a lower emissions future (as outlined above), Council staff engaged in a discussion to develop strategic directions and actions that could be facilitated by Council to move Inner West towards a low emissions future.

Through the workshop, the team:

1. Identified delivery mechanisms to implement opportunities
2. Determined Council's sphere of influence and role in implementing the opportunities
3. Provided examples of specific Council led actions to facilitate implementation

Council staff identified opportunities across five key areas

1. Efficiencies in existing buildings
2. High new building standards
3. Transport efficiencies
4. Waste management
5. Maximise renewable energy

The next section draws on the outcomes of this workshop to recommend six strategic directions and actions Council can pursue to move Inner West towards a low emissions future.

SECTION 3

STRATEGIC DIRECTIONS TO ZERO EMISSIONS

STRATEGIC DIRECTIONS TO ZERO EMISSIONS

Based on our analysis and collaboration with council staff, we have developed six strategic directions for Council to pursue.

Strategic Direction	Key Council Actions
1 **A targeted approach to renewable energy**	• Prioritise engagement with large asset owners and key stakeholders to achieve significant uptake of renewable energy and emissions reduction impact, e.g. Solar My School program • Expand mechanisms to encourage small scale installations, including community energy and equity measures
2 **Moving towards net zero buildings**	• Collaborate with DPE to set locally specific performance standards for new residential and non-residential developments (e.g. BASIX and NABERS pre-commitments) • Explore potential for incentives or other mechanisms to deliver high performance buildings (e.g. VPAs, Design Excellence) • Track and monitor performance of new developments against net zero buildings outcomes and increase sustainability benchmarks further over time
3 **Identify and develop a standard for low carbon precincts**	• Identify Low Carbon Precincts (as per Objective 33 of Greater Sydney Region Plan). Examples of such areas include the Parramatta Road Urban Transformation Corridor and the Sydenham to Bankstown Urban Renewal Area • Set performance standards and requirements through performance-based delivery mechanisms including higher BASIX targets, NABERS incentives or mandates, parking and transport strategies. • Incorporate standards into appropriate planning controls (including Local Strategic Planning Statements, LEP, DCP)
4 **Continue to implement innovations in waste**	• Expand and increase access to current programs for waste diversion • Facilitate collaborative mechanisms including a shared economy approach for the community to reduce, reuse and recycle goods and services
5 **Curb private vehicle use**	• Deliver reductions through increased active and public transport • Encourage parking innovation and deliver car parking that responds to emerging localised car ownership patterns and accessibility • Plan shared mobility investment to substitute private vehicle ownership and as such, reduce transport related consumption-based emissions
6 **Support and plan for a new mobility future**	• Future proof new developments with provisions for EV charging using planning controls • Develop EV and autonomous vehicle plan/strategy • Investigate a Guided Electric Transit System for Parramatta Road Corridor.

1. A TARGETED APPROACH TO RENEWABLE ENERGY

Why?

Rooftop renewables is a strategy that has the potential to deliver significant emissions reduction for the Inner West – a 15% reduction on 2036 BAU emissions.

Current solar PV penetration in the Inner West is low at 4% of dwellings, compared to 18% in the outer suburbs of Sydney. However, increasingly favourable economics is leading to a growth in appetite for solar PV. This is evident from a twelvefold increase in installed capacity over the last ten years. More and bigger solar PV installations in the Inner West have largely been driven by decreasing solar PV capital costs. Projections suggest lower capital costs, increasing electricity prices and decreasing battery costs will increase the feasibility of solar PV in the Inner West.

A targeted approach to engage with key sectors and large asset owners can result in significant renewable uptake and emissions reduction. Inner West Council could build on its existing support program for local schools with a targeted renewables program. A Council-led solar PV program, Solar my School, is being rolled out in the eastern suburbs of Sydney. It has proven to be very successful, helping schools reduce their electricity bills by 30% on average and abate nearly 150 tonnes of CO2-e emissions.

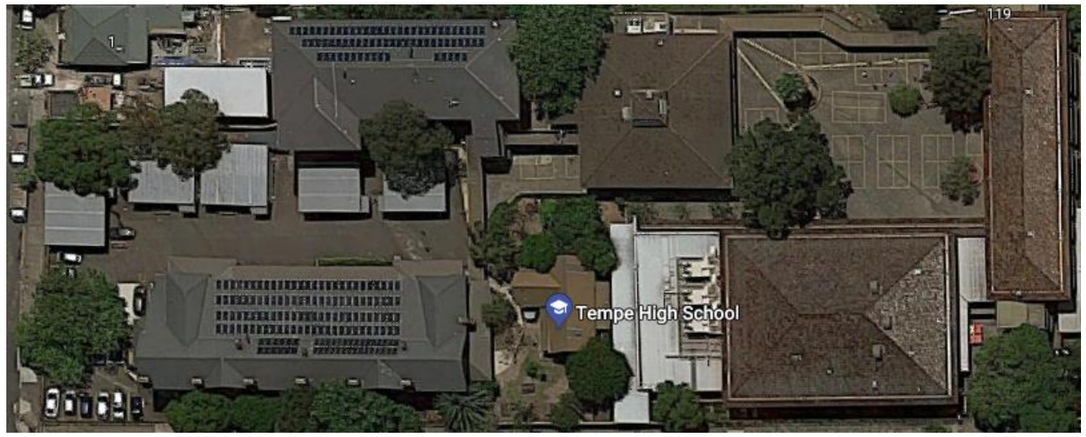


Figure 26: Tempe High School has installed a 50 kW solar PV system as a part of the NSW Department of Education's Resource Efficiency program

Council's role:

Take a targeted approach to increase renewable uptake in the Inner West. As a first priority Council may pursue large scale solar PV installations in sites with significant roof space including industrial sites and schools. Second, Council can build and support current programs to increase small-scale solar PV installations.

1. **Focus on high influence and high impact sites**
   Identify and encourage large asset owners and key stakeholders with whom council has a high degree of influence to encourage large solar PV installations. Examples include schools, childcare centres, local pubs & clubs, industrial sites.

2. **Expand mechanisms to encourage small scale installations, with a focus on community energy and equity measures**
   Council can build on current programs such as Our Energy Future and the Green Living Centre to increase access and support for small-scale installations. Additionally, Council can progress work with the Community Power Agency to identify effective community energy strategies for the Inner West and support fairer access to renewables for those currently locked out of solar (e.g. apartment dwellers and renters).

Recommended actions:

1. **Identify high impact assets and engage with key stakeholders** – engage in discussions with key stakeholders including private schools, the NSW Department of Education, large commercial and industrial property owners and food and retail chain owners to identify high impact asset owners and sites.
2. **Devise and implement programs** – these can include programs that target high impact, high influence assets (e.g. Solar My School) and those that support community energy investment and improve feasibility for residents who would normally be 'locked out' of solar.
3. **Explore funding options** – including support from government agencies including the CEFC for large scale solar PV projects and infrastructure development such as EV charging.
4. **Review planning controls** – review existing planning controls to facilitate increased solar PV take-up. These include increasing BASIX targets to drive increased solar PV uptake in newly-built dwellings and exploring installation options for heritage conservation areas and heritage items whilst ensuring heritage significance is protected.
5. **Marketing and communications** – to increase visibility and access to Council's current programs and support mechanisms for buildings to install solar PV, e.g. Our Energy Future.
6. **Track & monitor program performance**

2. MOVING TOWARDS NET ZERO BUILDINGS

Why?

Based on Kinesis' analysis of Bureau of Transport TZ 2016 projections data, by 2036 the Inner West will see a 30% growth in dwellings and a 25% increase in floor space relative to FY 2016-17. The Inner West is expected to grow by nearly 30,000 new dwellings and 30,000 new jobs. These new developments can be influenced or affected by planning controls that are implemented today.

Minimum environmental performance standards for new buildings are dictated by BASIX and Section J of the National Construction Code (NCC). BASIX was last updated in 2017 and Section J of the NCC is to be updated in May 2019. The updated standards are still lower than the appetite for sustainability in the construction industry. Net zero buildings are those that produce as much energy onsite as they consume. A net zero building must be designed to be as energy efficient as possible and connected to the grid to import and export power from local renewable energy as required. The COAG Energy Council has developed a national plan that sets a trajectory towards net zero carbon buildings for Australia. The trajectory aims to increase building efficiency in Australia every three years by expanding on the NCC's objectives and progress measures outside the NCC such as introducing an energy (and carbon) usage budget and future proofing homes to accommodate renewable uptake and electric vehicles.

Raising the standard of environmental performance in new buildings above those mandated by BASIX and Section J of the National Construction Code is often cost-effective as the initial investment is paid back over the whole life of the asset through reduced operating costs. Trends in construction and planning have highlighted the case for the Inner West to go beyond these minimum environmental standards:

- In 2015, over 80% of new dwellings in the Inner West were over-complying with respect to BASIX Energy targets, and this figure is increasing. This is consistent with trends in Greater Sydney, highlighting the industry's capacity and willingness to exceed compliance.
- Most new developments do not include solar PV to achieve BASIX compliance, presenting a significant opportunity to embed low emissions outcomes in all new development.
- Local Councils are already driving higher performance standards through planning controls via incentives or voluntary planning agreements. Some examples include:
  - **Canterbury-Bankstown and the City of Parramatta** both have an FSR bonus scheme in their CBD for buildings that exceed BASIX by 10 points and meet certain non-residential building performance targets.
  - **City of Sydney** has been collaborating with various stakeholders to understand planning issues and opportunities to transition to net zero buildings. The City of Sydney recently released its *Sustainable Office Buildings Plan* – a plan to encourage efficient office buildings that have rooftop renewable energy and target 5.5-star NABERS ratings. The City of Sydney has also explored net zero residential buildings and found them to be technically feasible and highly cost effective.

These actions by other local governments indicate an opportunity to enforce higher standards for new commercial and residential buildings.

Council's role:

Council's planning and development controls can be established to ensure new developments are sustainable and 'future-proofed'. In NSW, local governments are prevented from mandating residential building performance beyond the level specified under BASIX. However, there are options for Council to collaborate with DPE and developer stakeholders to deliver higher BASIX outcomes through either directly changing the BASIX targets for the Inner West LGA or through voluntary incentives.

Recommended actions:

1. **Develop a business case for increased building performance targets** – analyse local and regional building performance data (e.g. BASIX data). Understand the impact and cost of emerging technologies and their potential to deliver higher building performance targets, including increased solar PV uptake in new dwellings.
2. **Collaborate with stakeholders including DPE to establish regionally specific targets for the Inner West** – for example, Northern Beaches Council and the City of Parramatta are collaborating with the DPE to develop regionally specific targets for the proposed Ingleside and Camellia developments, respectively.
3. **Explore incentives and other mechanisms to deliver net zero buildings** – initiatives to offset the cost of designing and constructing a sustainable building and provide meaningful environmental outcomes. Such mechanisms include Voluntary Planning Agreements.
4. **Review planning controls** –with the aim of improving the environmental performance of new buildings based on the business case for increased new build targets (as per action 1).
5. **Track & monitor program performance** – Council must track and monitor the environmental performance of new buildings. This will enable Council to validate and update its building performance standards to reflect industry's appetite for sustainability.

3. IDENTIFY AND DEVELOP A PATHWAY FOR LOW EMISSIONS PRECINCTS

Why?

The *Greater Sydney Region Plan- A Metropolis of Three Cities* has a specific strategy dedicated to the establishment of low emissions precincts. Strategy 33.1 aims to achieve this by supporting initiatives that contribute to the aspirational objective of achieving net zero emissions by 2050, especially through the establishment of low-emissions precincts in priority areas such as Planned Precincts, Growth Areas and Collaboration Areas. The Inner West contains four priority areas, three of which Inner West Council has care and control:

- Parramatta Road Urban Transformation Corridor
- Sydenham to Bankstown Urban Renewal Area
- Camperdown-Ultimo Collaboration Area

Council's role:

Council's role would be to collaborate with DPE, OEH and the GSC to identify low emissions precincts within these priority areas and set appropriate pathways within the four themes for low emissions precincts as outlined in Figure 27. GSC's Eastern District Plan is a guide for implementing the Greater Sydney Region Plan at a district level. Action 72 of the Plan enables councils to formulate low-emissions high efficiency strategies in precincts where an increase in total floor area is greater than 100,000 square metres in any contiguous area of 10 or more hectares.

Figure 27: Pathway to low carbon precincts (Greater Sydney Region Plan – A Metropolis of Three Cities)

Improved Building Efficiency Standards and Renewables can be achieved through appropriate standards and requirements set through performance-based delivery mechanisms including higher BASIX targets, NABERS incentives or mandates, parking and transport strategies etc. These requirements also need to be incorporated into appropriate planning controls (including Local Strategic Planning Statements, LEP and DCP).

Greater use of public transport and changes to parking supply in locations along transport corridors can significantly reduce GHG emissions from private vehicle use.

Waste avoidance and diversion strategies would also have a significant impact in these precincts.

Recommended actions:

1. **Identify objectives and strategies that should be incorporated in Council's Local Strategic Planning Statement –** the 20-year vision for the region should identify priority areas and adopt future directions that lead to the best sustainability outcomes.
2. **Initiate discussion with DPE and GSC to define, identify and establish standards for low emissions precincts across the LGA** – these are likely to include key growth and priority areas. Establishing standards for low emissions precincts will build upon and extend new building standards formulated as part of Strategic Direction 2. It will investigate opportunities to improve the energy and water efficiency of new and existing buildings, incorporate building and precinct-scale renewables and manage waste more efficiently to reduce greenhouse gas emissions and costs.
3. **Investigation of opportunities and mechanisms to deliver outcomes** – investigate possible opportunities and planning controls or mechanisms that may include incentive schemes or voluntary planning agreements to implement standards for low emissions precincts.
4. **Review parking requirements on a case-by-case basis** – Investigate planning controls that deliver an appropriate level of parking that responds to car ownership patterns and local accessibility.
5. **Develop innovative waste strategies** – Council should investigate innovative waste strategies including centralised composting and resource sharing.

4. CONTINUE TO IMPLEMENT INNOVATIONS IN WASTE

Why?

Waste currently makes up 5% of sector-based emissions and is a significant contributor to the Inner West's consumption-based emissions. Furthermore, Council's waste strategies will have a significant and lasting impact, even under a greener grid.

Waste is also one of the key areas over which Council has direct control. Council-led strategies can enable mechanisms that help the community change its consumption behaviour and attitudes towards waste.

The Inner West's Community Strategic Plan outlines aspirations for the Inner West to be a zero-waste community with an active share economy[10]. Council has been proactive in establishing innovative waste programs including:

- Drop-off and recycling centres for problem wastes and e-waste
- Food waste recycling and composting programs
- Strategic partnerships to support re-use initiatives, such as furniture re-homing, repair cafes and garage sales

There is significant new work in progress to achieve the community's goal of a zero waste community with a vibrant share economy, which will also result in emission reductions.

Council's role:

The Inner West Council has been proactive in establishing innovative waste programs. These programs have been focused towards waste avoidance. They include:

- Support for composting and worm farming.
- Food waste and recycling service.
- Garage sales.
- Supporting the plastic bag free NSW campaign.
- The Repair Café to educate the community and encourage reuse.
- Supporting the Responsible Cafes program.

Council should develop a waste policy that is aligned to the Australian National Waste Policy Targets and the United Nations Targets. The waste policy should continue to support and extend the existing programs to encourage:

- Increased product stewardship.
- Home composting.
- Reuse and recycle before disposing.
- A shared economy to reduce consumption and waste.

Recommended actions:

1. **Develop the Inner West Zero Waste Strategy.**
2. **Review services to expand and increase access to current programs and facilities for waste diversion, especially organics and reusable items.**
3. **Facilitate collaborative mechanisms including a shared economy approach for the community to reduce, reuse and recycle goods and services.**

[10] Our Inner West 2036 A strategic plan for the Inner West Community

5. CURB PRIVATE VEHICLE USE

Why?

Transport contributes to 20% of the Inner West's sector-based emissions and car use contributes to 35% of this. Additionally, from a consumption emissions lens, the emissions associated with manufacturing and purchasing a private vehicle are also considerable.

Curbing private vehicle use is directly related to understanding trends in car ownership and encouraging lower car ownership. Kinesis' analysis of data from the Inner West has produced the following insights into car ownership in the LGA:

- Average household car ownership rates in the Inner West is about 1.2 vehicles per household but varies across the LGA due largely to variability in access to public transport and household type (Figure 28).
- Car ownership rates are lower in areas with increased access to amenities and services indicated by a high walk score.
- Areas with low car ownership are supported by on-street car share services (Figure 28). There are nearly 190 GoGet car share pods scattered across the Inner West.

These local trends are supported by the following observations at the metropolitan level:

- Vehicle license rates for younger demographic are falling. Across the Sydney Metropolitan Area, 1 in 4 people aged 20 to 34 do not have a license or own a car. This has increased from 1 in 5 in 2011.
- Over the last 10 years, car share has grown at an average rate of over 35% per year.
- Across Australia, the number of Uber rides has increased to 1.2 million trips per month.

Council's role:

Council can facilitate reducing car use and ownership through the following mechanisms:

- Planning controls that deliver an appropriate level of parking that responds to emerging car ownership patterns and local accessibility.
- Facilitate alternative vehicle use and ownership models, such as car and bicycle share, through development controls and the provision of public space.
- Encourage active transport, for example, by developing links with the Greenway network.
- Collaborate with Transport for NSW to enhance public transport access across the Inner West, particularly along the north-south axis of the LGA.

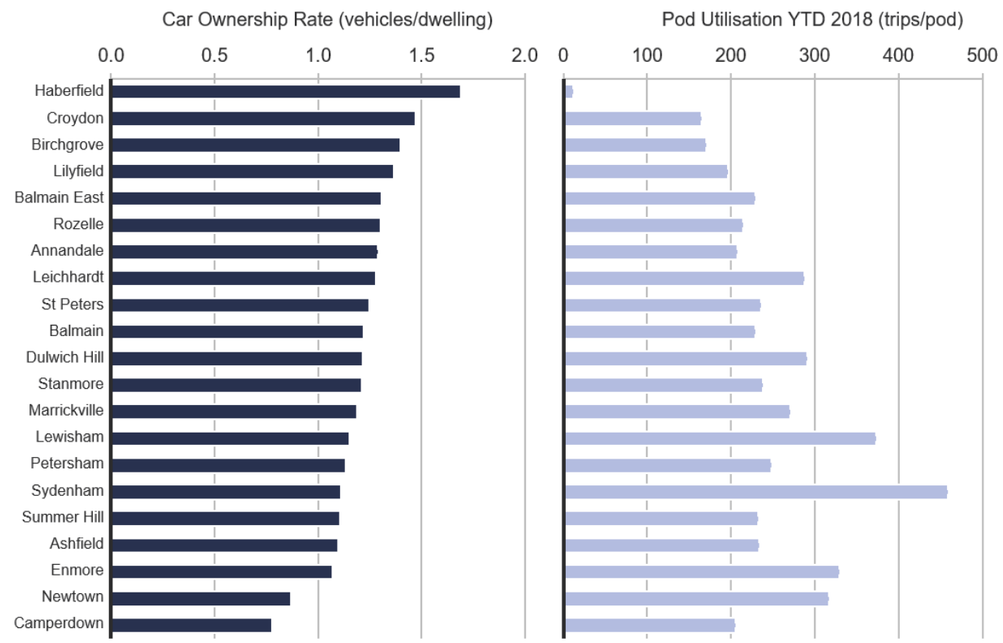


Figure 28: Car ownership (L) and Car share pod utilisation (R)

Recommended actions:

1. **Update Council's parking controls to reflect emerging car ownership and mobility patterns** – parking rates should be set as maximum rates and place-based to respond to public transport and local accessibility.
2. **Work with shared mobility providers to review policy to maximise the utilisation of shared mobility services.**
3. **Collaborate with TfNSW to review public transport access across the LGA, specifically in the growth corridors and along the LGA's north-south axis.**
4. **Adopt an active transport strategy that incorporates the Greenway network and enhances the LGA's active transport network.**

6. SUPPORT AND PLAN FOR A NEW MOBILITY FUTURE

Why?

The potential disruption posed by Electric Vehicles (EVs), mobility as a service (MasS) and autonomous vehicles (AVs) should be considered in Council's plans to move the Inner West towards zero emissions. The nationwide trends outlined below will apply to the Inner West.

The Australian Renewable Energy Agency (ARENA) in its Australian EV Market Study[11] forecasts 1.89 million electric vehicles will be purchased each year by 2040. Electric vehicles sales growth will be driven by:

- Falling battery prices
- Increased model availability by manufacturers
- Decreasing electricity prices relative to petrol prices from large scale renewable uptake

Mobility as a Service (MaaS) describes a shift away from privately owned modes of transport (such as a personal car) towards mobility solutions that are consumed as a service. This type of transport service has already emerged through the recent and significant growth of on-demand ride services, such as Uber. Across Australia, the number of Uber rides has increased to 1.2 million trips per month[12]. On demand bus trials operated by companies such as Bridj and KeolisDowner are underway in various parts of Sydney including Bondi, Strathfield, Canada Bay, Northern Beaches and Macquarie Park.

This trend will be complemented by the implementation of autonomous vehicles (AVs). From driverless single passenger vehicles to shared vehicles and commuter buses, autonomous vehicles have the potential to further deliver the on-demand mobility. The establishment of on-demand ride services provides some insight into a future of mobility as a service, where transport and mobility are powered with electricity, rather than petrochemicals, and provided as a service, rather than something that is owned by individuals.

Recent reports have analysed the expected impact of autonomous vehicles and MaaS on parking requirements[13]. Aside from the potential impacts on local traffic, these recent reports have highlighted the following for parking:

- There may no longer be a need to park vehicles within a building.
- Parking at the destination may not be necessary
- Parking lots may evolve into service centres where AV's recharge.

Council's role:

The impact of these mobility disruptions is hard to predict. However, Council can develop the urban form to support them, primarily through parking and infrastructure provision. Possible impacts include infrastructure requirements for MaaS and reduce private car ownership and the need for parking.

Council can be proactive in future proofing the region for these two impacts by:

- **Supporting the provision of parking that can be repurposed as car ownership declines**
  Decoupled parking is parking that is spatially separated from the building to which the parking services. The parking structure is often shared between multiple buildings. In effect, decoupled parking is equivalent to on-street parking located within a centralised parking station. As car ownership declines in the future, these parking structures can be repurposed for other uses.
- **Facilitating required infrastructure and incentivise these technologies to be piloted and implemented**
  This could begin with the provision of electric vehicle charging stations in Council car parks for public use.

Recommended actions:

1. **Investigate a Guided Electric Transit System** for the Parramatta Road Corridor.
2. **Develop controls that facilitate provision of agile, decoupled parking.**
3. **Develop a policy and strategy that encourages the uptake of electric vehicles** – this could be through incentives such as lower parking permit fees or meter charges.
4. **Future proof new developments** by including electric vehicle charging infrastructure in car parks.
5. **Coordinate with TfNSW to participate in the NSW Government's on-demand mobility service trials** that are already underway across Sydney (Bankstown Hospital and Northern Beaches)[14].

[11] ARENA (2018), Australian EV Market Study Report
[12] Deloitte (2016) Economic effects of ridesharing in Australia
[13] KPMG (2017) Parking Demand in the autonomous vehicle era

[14] https://www.nsw.gov.au/news-and-events/news/book-a-mini-bus-on-demand/

APPENDIX

DETAILED MODELLING METHODOLOGY

DISAGGREGATION TO FINER GEOGRAPHY, SECTORS AND END USES

Disaggregating datasets to a finer geography, sub-sector and end use (e.g. lighting, heating, cooling) enables fine grain analysis.

Kinesis' disaggregation methodology involves calculating 'theoretical consumption' at finer grain geographies and sectors using 'theoretical consumption intensities' (e.g. kWh/dwelling/year or MJ of natural gas/industrial job/year). For this project, theoretical intensities developed using regional attributes, such as occupancy by typology (ABS) and local climate (BOM), with utility data and energy and water consumption data from utility providers and from approximately 5000 assets that are loaded into Kinesis' environmental impact and asset monitoring tool.

The theoretical consumption calculated for the finer grain geographies and sectors is then calibrated/normalised to the total consumption data available for the suburb, postcode or city. This ensures all data reflects the raw data at the coarse geography (suburb, postcode or city) but disaggregated to a finer grain to align with centre typologies and other urban mosaic typology attributes, such as high density or high accessibility areas.

PROJECTION OF FUTURE CONSUMPTION

Kinesis' projections rely on two datasets: calibrated intensities, a result of the disaggregation process, and projected land use.

In the disaggregation process, different confidence factors are attached to the theoretical intensities (based on the confidence or reliability of the intensity estimate) and these in turn affect how the calibration process adjusts the theoretical intensities to reflect the raw consumption data at the coarse geography and/or sector. This process produces 'calibrated intensities' that represent the likely consumption of electricity, gas, etc. by a single dwelling or job in a year for a particular fine grain geography. Therefore, the calibrated intensities represent business-as-usual consumption.

To calculate consumption and emissions associated with a future BAU (business as usual) scenario, the calibrated intensities for a geography must be multiplied by the projected land use for that same geography. Kinesis has adapted dwelling and job projections released by the NSW Bureau of Transport Statistics (LU16, available from Open Transport Data) using the following assumptions:

1. All land use that was present in FY 2016-17 is labelled as 'existing' stock. Specific policies and interventions will only apply to 'existing' land use (e.g. retrofits)
2. Any land use that appears from FY 2017-18 to FY 2036-37 (in addition to the 'existing' land use from FY 2016-17) is labelled as 'new' stock. These represent new residential and non-residential buildings. In the case of dwellings, the following typology split was applied and is consistent with similar work that Kinesis has completed for other government clients:
    a. 80% of new dwellings in a year will be multi-unit dwellings
    b. 20% of new dwellings in a year will be attached single dwellings
3. There is turnover from 'existing' to 'new' stock as dwellings/non-residential buildings are knocked down and rebuilt. This is percentage of the total number of dwellings (i.e. new and existing) in that year

Policies and technology interventions can be applied to reduce the consumption intensities of various land use types, and these represents the policy reductions from the BAU scenario in the regional emissions waterfall chart. To model these interventions, Kinesis defines the following inputs:

1. The reduction in consumption intensity associated with the intervention
2. The land use typology and stock that the intervention is applicable to. For example, retrofits are applicable to existing single and multi-unit dwellings
3. The take-up rate of that intervention in that land use typology for every year. For example, new build single and multi-unit dwellings have a 100% take-up of current BASIX targets as they need to comply with legislation

An explanation of and the detailed assumptions behind each modelled intervention can be found in Table 3.

EMISSIONS REDUCTION OPPORTUNITIES MODELLING ASSUMPTIONS

The assumptions and assertions behind the modelled opportunities and interventions have been drawn from various published studies or have been tested by and developed in consultation with other government clients, such as the Greater Sydney Commission.

Opportunity	Details	Application	Assumptions
RET	In line with the Federal Renewable Energy Target (RET) and NSW Renewable Energy Action Plan	All Inner West	Emissions intensity of NSW's electricity grid reduced to reflect a 20% penetration of renewables (Scope 2 factors - 0.84 kg CO2-e/kWh in 2016-17 to 0.78 kgCO2-e/kWh by 2020)
2036 AEMO Generation Mix	Based on projected generation mix outlined in the Australian Energy Market Operator's *Integrated System Plan* (2018). Emission factors for generators were obtained from the Finkel Review (*Independent Review into the Future Security of the National Electricity Market* (2017))	All Inner West	Emissions intensity of NSW's electricity grid reduced to reflect projected generation mix (Scope 2 factors - 0.84 kg CO2-e/kWh in 2016-17 to ~0.1 kgCO2-e/kWh by 2036)
Current BASIX	Building Sustainability Index (BASIX) is a part of the development application process in NSW and checks elements of a proposed design against sustainability targets	New and renovated dwellings (variable targets by typology)	• BASIX Energy 50 for single dwellings • BASIX Energy 45 for low rise • BASIX Energy 35 for mid rise • BASIX Energy 25 for high rise
Higher BASIX	Higher targets for new and renovated dwellings.	New and renovated dwellings (variable targets by typology)	Higher BASIX introduced in 2020 • BASIX Energy 60 for single dwellings. Following testing in the BASIX tool, our modelling assumes that new single dwellings will install solar PV to achieve this. • BASIX Energy 50 for low rise • BASIX Energy 45 for mid rise • BASIX Energy 40 for high rise
Non-Res New Building Standards	High performance commitments for new non-residential buildings (e.g. NABERS 5-star).	New buildings	Tested and adapted from GSC Exploring Net Zero Emissions Analysis. High performance lighting, equipment and HVAC • Population serving – ~20% reduction • Education – ~30% reduction • Health – ~30% reduction • Industrial – ~20% reduction • Knowledge intensive - ~25% reduction
Residential Retrofits	Refurbishments to current buildings and/or uptake of more efficient appliances and lighting. It is generally more difficult to refurbish multi-unit dwellings	Existing dwellings (variable reductions by typology)	Tested and adapted from GSC Exploring Net Zero Emissions Analysis. LED lighting & appliance efficiency • Detached – ~40% reduction / 50% of homes by 2036 • Attached – ~40% reduction / 50% of homes by 2036 • Apartments – ~5% reduction / 20% of homes by 2036
Non-Residential Retrofits	Refurbishments to current buildings and/or uptake of more efficient appliances and lighting. It is generally more difficult to refurbish industrial and health sector sites/buildings	Existing buildings (variable reductions by sector)	Tested and adapted from GSC Exploring Net Zero Emissions Analysis. Lighting, equipment and HVAC upgrades • Commercial - ~33% reduction / 75% of buildings by 2036 • Retail – ~25% reduction / 50% of buildings by 2036 • Education – ~25% reduction / 50% of buildings by 2036 • Health – ~20% reduction / 50% of buildings by 2036 • Industrial – ~20% reduction / 50% of buildings by 2036

Opportunity	Details	Application	Assumptions
Residential Renewables	Building-level rooftop solar PV panels	All dwellings in the Inner West	Applied only to existing single dwellings and new build multi-unit since Higher BASIX incorporates solar PV for existing dwellings and existing multi-unit are unlikely to retrofit solar PV **Existing single dwellings:** A regression analysis was carried out between the historical average installed capacity per installation in the Inner West (i.e. kW/installation) and the capital cost of solar ($/W). Future annual capital cost from Jacobs' *Projections of uptake of small-scale systems* (2017, prepared for AEMO) was used in the regression model to predict the average installed capacity per installation for every year from FY 2016-17 to FY 2036-37. This was converted to a reduction in electricity consumption in the LGA using a generation factor obtained from the Australian Photovoltaic Institute for the Inner West (~ 1.1 MWh/kW installed). See following section (*Solar PV average installed capacity projection*) for details of the average installed capacity projection. Final take-up (take-up in 2036) was determined to be the ownership rate (from the Australian Bureau of Statistics Census 2016) plus 50% of renters minus 4% to account for unfeasible installations. These assumptions are consistent with those used by Jacobs. **New multi-unit dwellings:** Installation size was assumed to be ~0.2 kW/dwelling, based on Kinesis analysis of solar installations in multi-unit dwellings. Final take-up (take-up in 2036) was determined to be 96% (based on favourable technological and policy conditions for solar PV on multi-unit buildings), accounting for 4% unfeasible installations.
Non-Residential Renewables	Building-level rooftop solar PV panels	All buildings in the Inner West	Tested and adapted from GSC Exploring Net Zero Emissions Analysis. Job to floorspace ratios (based on the City of Sydney Floorspace Employment Survey data) were used to calculate roof areas and hence solar PV installation capacities for various sectors. Final take-up (take-up in 2036) was determined to be 50% for existing non-residential land use and 70% for new non-residential land use.
Electrification	Replacement of appliances reliant on natural gas with those reliant on electricity	All Inner West	All gas usage (after retrofits and refurbishment policies) converted to electricity consumption.
Enhanced Waste Recovery	NSW diversion target is only 25% of waste tonnage to landfill by 2021/22. Kinesis modelling has extended this by 10% by 2036 (i.e. 15% to landfill) to account for enhanced recycling and/or processing (e.g. waste to energy, composting)	All Inner West	25% of all waste to landfill by 2028 and 15% of all waste to landfill by 2036. This waste is putrescible and is still responsible for methane emissions
Private Vehicle Use Reduction	Reduction in the use of private motor vehicle (cars, taxis and motorcycles) and increased use of public transport	All Inner West	This policy will need to be informed and developed in conjunction with the Inner West's transport strategy. At present, Kinesis has assumed a 20% reduction in kilometres travelled by private vehicles and proportionate increase in kilometres travelled by public transport and active modes
Vehicle Efficiency	Expected fuel efficiency improvements by 2036	All Inner West	Car as driver emissions factor reduced from 0.253 kg CO2-e/km in FY 2016-17 to 0.142 kg CO2-e/km in 2036 (based on Climate Change Authority (2014), Light Vehicle Emissions Standards for Australia)
Electric Vehicles	Uptake of electric vehicles	All Inner West	Penetration of ~37% by 2036 (based on Energeia (2018), Australian Electric Vehicle Market Study) and efficiency of 0.16 kWh/km (Nissan Leaf efficiency)

Table 3: Each emissions reduction or renewable energy opportunity modelled by Kinesis, an explanation of what the opportunity encompasses, the type of land use or geography that the opportunity has been applied to and the key assumptions (reduction and take-up) behind the opportunity.

EMISSION FACTORS FOR BASELINE AND OPPORTUNITIES ANALYSIS

Resource Type	Scope 1 Factor	Scope 2 Factor	Units
Electricity	0.84	0.12	kg CO2-e / kWh
Natural Gas	0.05153	0	kg CO2-e / MJ
Bus	0.09	0	kg CO2-e / MJ
Car as Driver	0.254	0	kg CO2-e / km
Train	0	0.11	kg CO2-e / km
Ferry	0.377	0	kg CO2-e / km
Other Mode	0.198	0	kg CO2-e / km
Tram	0.161	0	kg CO2-e / km
Taxi	0.201	0	kg CO2-e / km
Motorbike/scooter	0.127	0	kg CO2-e / km
Residential green waste	0.0043	0	kg CO2-e / kg
Residential landfill	1.4	0	kg CO2-e / kg

Note: Wastewater emissions were obtained from the Ironbark report. The report did not contain the actual volume of waste water or the emission factor associated with wastewater.