Final

Five Dock Metro Precinct Environmental Sustainability Study

2 May 2025

Prepared for:

CITY OF CANADA BAY

Prepared by:

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Acknowledgement of Country

We acknowledge and pay respect to the Wangal people as the Traditional Custodians of the land. We pay our respect to their Elders past, present, and emerging, and honour their enduring connection to this land. We acknowledge and hold in high regard their ongoing cultural significance and contributions to the life of this city and its surroundings.

Acknowledgement

We gratefully acknowledge the use of the images sourced from third parties. All externally sourced images have been duly noted and credited individually.

Proudly funded by the Commonwealth Government and NSW Government with the City of Canada Bay

Executive Summary

The City of Canada Bay has commissioned Flux to advise on environmental sustainability to support the masterplanning of the Five Dock Metro Precinct.

A review of the existing environmental context and impacts has identified the characteristics of the current uses within the precinct area. The context review confirms that the current precinct area experiences elevated land surface temperatures, indicative of the urban heat island effect and transport impacts dominated by private vehicle usage. Benchmarks for energy use, water use, waste management, commuter transport and the synthetic greenhouse gases used in air conditioning systems have been used to establish a baseline greenhouse gas inventory, estimated to be approximately 15 Mt.CO2e per year.

A projection of changed environmental impacts was made on the basis that the Masterplan is developed to the full extent following the controls of the current DCP and relevant state planning policy. The projected impacts in 2046 show that the operating greenhouse gas footprint is forecast to reduce by 40%, despite significant growth in building floor area. The considerable drop is attributed to the current NSW government forecast of reducing emissions from electricity generation. However, other sources of emissions, such as natural gas, commuter transport, waste management and refrigerants, are seen to increase. Water consumption is also forecast to increase significantly in proportion to the planned increase in floor space and residential population.

A review of NSW government policy has confirmed the dominant themes in strategy and regulation, from targeting net zero carbon in 2050 to adapting to the effects of a changing climate. In addition, integrated urban water management and the circular economy have been identified as relevant policy priorities of the NSW government for consideration when formulating the Masterplan. These, together with local planning strategies and plans, have informed the development of priority outcomes areas to which the Masterplan can positively contribute.

A review of best practice examples of sustainability controls within development control plans and planning proposals identified a move towards more ambitious and forward-looking environmental sustainability controls supporting a broader range of environmental sustainability objectives. The objectives for resilience and safeguarding health, amenity, and future value are vital to navigating the potential barrier imposed by the Sustainable Buildings State Environmental Planning Policy 2022 non-compete provisions that prevent better outcomes for greenhouse gas emissions, water conservation, and thermal performance in local planning instruments.

After reviewing the existing context and the impacts of the current development potential, four themes have been identified for integrating improved sustainability outcomes into the Masterplan. Recommendations have been made for additional controls to guide the implementation of the Masterplan for each theme. The benefits of these additional controls have been projected, indicating a potential reduction in greenhouse gas emissions by an additional 42% by 2046 compared to delivery under the current planning policy. The broad considerations for costs and adjustments associated with each potential additional control are also presented.

Climate resilience

Health and wellbeing

Net zero ready

Circular economy

The proposed additional controls and their contribution to the proposed themes are shown below.

Goals	Strategies	Climate resilience	Health and wellbeing	Net-zero ready	Circular economy
Urban cooling	Surface permeability	●	○		
	Urban shade	●	○		
Resilient buildings	Natural ventilation	●	●	○	
	Facades	●	○	○	
Connection to nature	Local open space	○	●		
	Biodiversity	○	●		
Energy	Energy Efficiency	○		●	
	On-site solar	○		●	○
Rapid decarbonisation	All-electric building	○	●	●	
	Refrigerant GWP			●	
	Electric vehicle infrastructure			●	
Urban Water Management	Water efficiency				●
	Water resilience				●
Integrated waste management	Equitable disposal of waste			●	●
	Design and construction impacts				●

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Figures

Document Control

Project Name	Five Dock Metro Precinct
Project Number	223
Document Title	Environmental Sustainability Study

Revision	Date	Prepared By	Approved By	Changes
80% Draft	17 December 2024	Helda Lim	Ché Wall	
Final draft	27 February 2025	Helda Lim	Ché Wall	Final draft of the report with council comments addressed.
Final	2 May 2025	Helda Lim	Ché Wall	Comments addressed

Section 1
Introduction

1. Introduction

This report outlines aspirational sustainability initiatives for the Five Dock Masterplan and provides recommendations for new or revised planning controls within the City of Canada Bay local planning framework.

The proposed initiatives are informed by analysing the existing environmental contexts and their implications for Greenhouse Gas (GHG) emissions. They are also shaped by state and local policies and planning frameworks relevant to the Five Dock Metro Precinct Masterplan.

This report also examines the impact of the proposed sustainability initiatives on GHG emissions when fully implemented and the broad potential cost-benefit outcomes.

1.1. Report structure

This report is constructed with the structure as below.

Environmental Context reviews the existing environmental conditions of the Precinct.

Environmental Impacts provides an assessment of the Greenhouse Gas (GHG) emissions for the existing environmental conditions of the Precinct when current controls are implemented to their maximum capacity.

Policy and Planning Context reviews relevant policies and planning controls, ranging from state-wide frameworks to local guidelines.

Precedents reviews how emerging environment sustainability issues are being addressed in recent amendments to DCPs in other local government areas.

Sustainability Initiatives presents proposed visions, goals, and provisions for implementation within the Masterplan. These initiatives are derived from existing environmental and policy contexts to drive the Precinct toward achieving sustainability.

GHG Emissions Impacts of Sustainability Initiatives provide forecasts of GHG emissions in 2046 when the proposed sustainability initiatives are implemented as part of the Masterplan.

Costs and Benefits are presented at a high level for each potential additional control.

1.2. Sources of information

Various sources of information have been used to establish the existing environmental print.

Data sources have been selected to provide the most granular information relevant to the study site. Where possible, data sources have also been chosen to avoid distortions from the change in building use under the Covid lockdown.

Primary data sources include:

- Five Dock Masterplan Final Draft Report.
- ABS Data Cubes.
- ABS 2016 Method of Travel to Work for SA2 and SA1.
- Endeavour Energy Zone substation reports.
- Jemena Gas Network Average Consumption by LGA 2022.
- Bureau of Meteorology.
- NSW NARCliM 2.0.

Primary GIS data sources include:

- NSW UHI 2016.
- NSW HVI 2016.
- NSW Existing Green Assets and Green Grid Corridors 2019.
- NSW Tree Canopy Cover 2020.
- TfNSW Bicycle Use Propensity Index.
- NSW and NARCliM 2024.
- NSW BioNet Species Sightings
- The Native Vegetation of the Sydney Metropolitan Area V3.1 OEH 2016.

Policy, planning contexts and guidelines include:

- NSW Climate Change Policy Framework 2016.
- Net Zero Plan Stage 1: 2020-2030.
- Electric Vehicle Strategy.
- Waste and Sustainable Materials Strategy 2041 Stage 1: 2021-2027.
- NSW Food Organics and Garden Organics (FOGO).
- NSW Circular Design Guidelines for the Built Environment.
- Greater Sydney Water Strategy 2022.
- Eastern City District Plan.
- Ozone Protection and Synthetic Greenhouse Gas Management Amendment (2024 Measures No. 1) Regulations 2024.
- Our Future 2036 City of Canada Bay Community Strategic Plan.
- City of Canada Bay LSPS 2020.
- City of Canada Bay Environmental Strategy 2020 Our Sustainable City.
- City of Canada Bay Emissions Reduction Action Plan 2020.
- City of Canada Bay Urban Tree Canopy Strategy.
- City of Canada Bay Council Social Infrastructure (Open Space and Recreation) Strategy and Action Plan.
- Canada Bay Biodiversity Framework and Action Plan.
- Canada Bay Resource Recovery and Waste Strategy.
- City of Canada Bay DCP.
- SEPP and NCC 2022.

Other sources of information are noted within this report's body.

1.3. Limitations

This report has been compiled within the scope and programme provided.

No breakdown of existing commercial uses within the precinct has been provided, so the testing of existing impacts has assumed a split of uses from a visual survey of the streetscapes to estimate energy, water consumption and waste generation rates. The split assumed is:

Use type	Areas allocation (m2)
Office	10,000
Retail	15,800
Retail F+B	5,000
Schools, Community and Institutions	10,000
Short Term Accommodation	5,000
Others	6,000

Table 1. Building uses and areas

Section 2
Environmental Context

2. Environmental Context

This section analyses the environmental contexts that direct the areas and ambition for sustainability initiatives for the Five Dock Metro Precinct Masterplan.

Introduction to Five Dock Metro Precinct

The Five Dock Metro Precinct bounds a confirmed Metro West station within the City of Canada Bay LGA. Centrally located in the established Five Dock local centre, the station enhances connectivity and drives opportunities for future growth.

The precinct covers the area bounded by Harris Rd to the west, Park Rd to the east, Lyons Rd to the north, and Queens Rd to the south. The Five Dock Metro Precinct integrates retail and residential space with a public school. The precinct is supported by a bus network that positions it as both a point of origin and destination for commuters.

Figure 1. Five Dock Metro Precinct

The Five Dock Metro Precinct is home to several local heritage buildings. Figures 2 and 3 provide examples of local heritage buildings in Five Dock along Great North Rd.

Figure 2. St Alban's Church - Local heritage building

Figure 3. Bank - Local heritage building

Environmental Context Analysis

The context analysis is structured to assess various environmental factors that influence the Five Dock Metro Precinct. This analysis evaluates the following environmental contexts: Urban Heat Island, Heat Vulnerability Index, Urban Tree Canopy, Local Open Space, Existing Green Assets and Green Grid Corridors, Biodiversity, Air Temperature, Rainfall, Method of Travel to work, Cycling Propensity and Network, Waste Generation, Water Consumption, Gas Demand, Renewable Energy, EV Ownership and Infrastructure, and Refrigerant Bank.

These environmental contexts are integral to understanding the existing conditions of the Five Dock Metro Precinct and will be explored in detail in the following pages.

Geographical Boundaries of the study area

The Five Dock Metro Precinct Masterplan area lies across various boundaries relevant to data capture that inform the analysis. The data boundaries that have been used are:

- **ASGS 2016 Statistical Area (SA) 4**: Sydney - Inner West.
- **Local Government Area (LGA)**: City of Canada Bay.
- **ASGS 2016 Statistical Area (SA) 2**: Five Dock Abbotsford.
- **ASGS 2016 Statistical Area (SA) 1**: Various SA1 codes representing the Five Dock Metro Precinct.
- **Suburb/localities**: Five Dock.
- **Postal Code Area (POA)**: 2046.

Figure 4 shows the Masterplan area in comparison to select data boundaries.

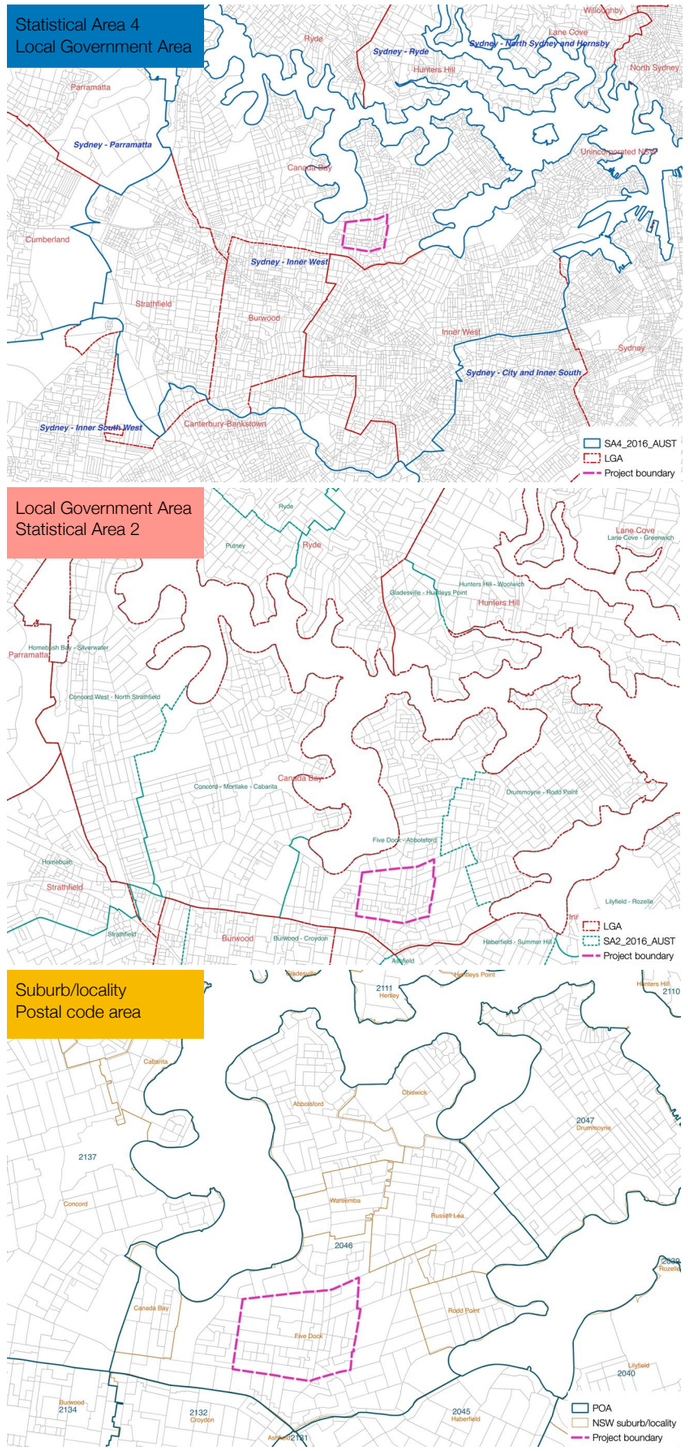


Figure 4. Study area geographical boundaries

2.1. Urban Heat Island

The Urban Heat Island (UHI) measures the effects of urbanisation on Land Surface Temperatures (LST) by assessing the LST deviation of the study area compared to a non-urban vegetated reference within the Greater Sydney Region. Elevated LST indicates UHI effects, as it results from the absorption and retention of heat within urban environments.

The data was observed from the thermal and infrared data by Landsat satellite in the summer of 2015 - 2016, combined with the Australian Bureau Statistics (ABS) Mesh Block Polygon.

Figure 5 LST elevation frequency comparison in summer 2015-2016.

Figure 5 compares the 2016 urban heat mesh block LST elevations between the Greater Sydney, City of Canada Bay LGA, Five Dock Abbotsford region, and the Five Dock Metro Precinct.

It reveals that Canada Bay LGA experienced a higher LST elevation in general than Greater Sydney. The Five Dock Abbotsford area was recorded with more mesh blocks with elevated LST compared to the broader Canada Bay LGA.

Figure 6 confirms that most areas in the City of Canada Bay experienced LST elevations ranging from 6° - 12°C, with Five Dock Metro Precinct showing a high concentration of regions with significant LST elevation.

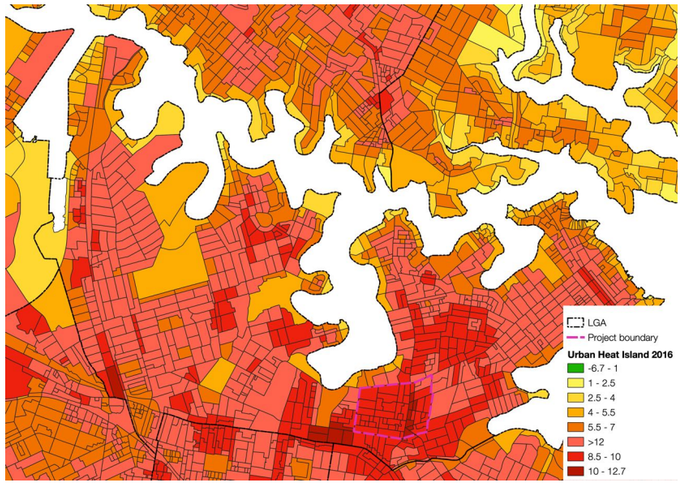


Figure 6. City of Canada Bay LST deviation in summer 2015-2016.

A closer review in Figure 7 reveals that the Five Dock Metro Precinct experienced LST elevations of at least 8°C, with some locations exceeding 10°C. These higher elevations were observed along the Great North Rd, First Ave and Ramsay Rd.

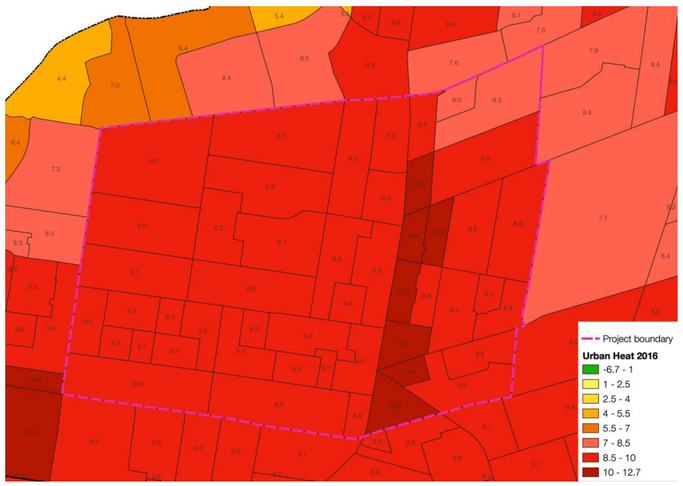


Figure 7. Five Dock Metro Precinct LST deviation in summer 2015-2016.

2.2. Heat Vulnerability Index

The Heat Vulnerability Index (HVI) dataset highlights areas to monitor where populations are more vulnerable to the adverse effects of urban heat. The HVI is based on exposure, sensitivity, and adaptive capacity indicators.

A vulnerability of 1 represents a combination of low exposure, low sensitivity and/or high adaptive capacity, whereas a vulnerability of 5 represents high exposure, high sensitivity, and/or low adaptive capacity.

The data in this study shows the HVI in the summer of 2015 - 2016.

Figure 8 highlights the Five Dock Metro Precinct as one of the key areas within Canada Bay LGA with significant heat vulnerability.

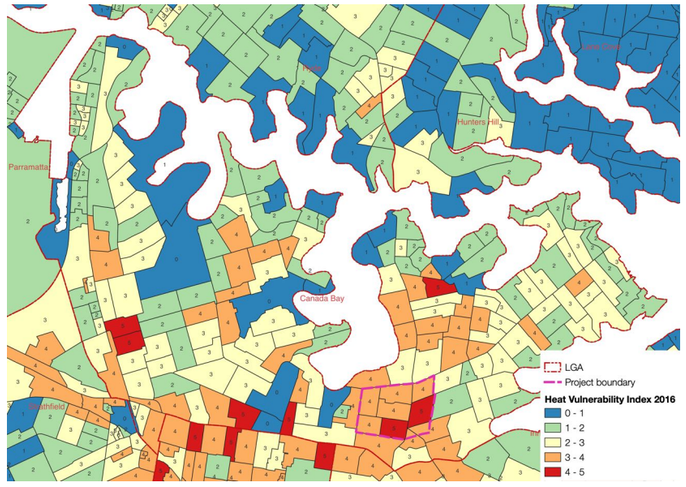


Figure 8. City of Canada Bay LGA HVI summer 2015-2016

Figure 9 shows that the HVI in the Five Dock Metro Precinct during the summer of 2015 - 2016 reached a minimum of 4, with some locations reaching 5.

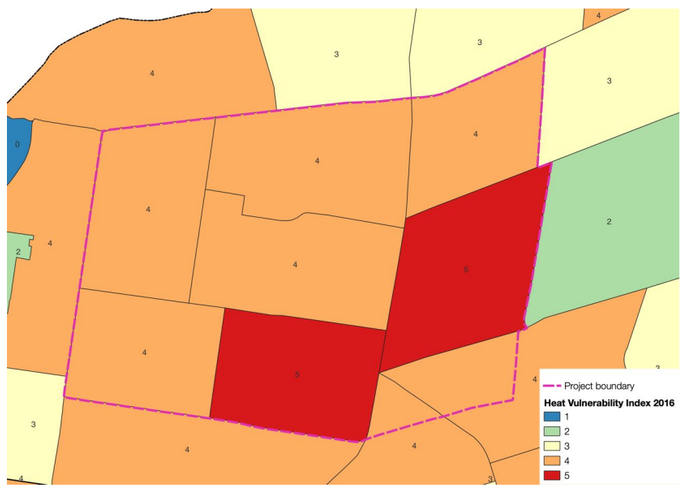


Figure 9. Five Dock Metro Precinct HVI summer 2015-2016.

2.3. Urban Tree Canopy and Surface Permeability

The City of Canada Bay *Urban Tree Canopy Strategy 2019*[1] provides insights into the distribution of impervious areas, tree canopy coverage, and plantable and unplantable areas across the Canada Bay LGA.

Impervious surfaces accounted for approximately 55.5% of the total area in the Canada Bay LGA, with the Five Dock suburb being the second-largest contributor despite representing only 12% of the LGA's total area.

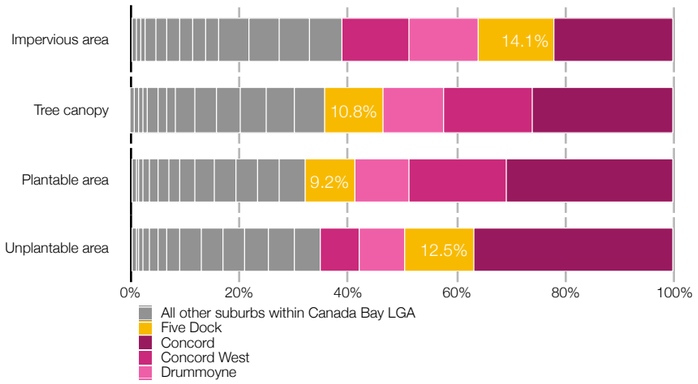


Figure 10. Five Dock suburb urban tree canopy and permeability context

In the Urban Tree Canopy Strategy, Five Dock suburb is categorised as a suburb with medium priority for hot and plantable suburbs within the LGA, with the majority of street planting concentrated on Henry St and Great North Rd.

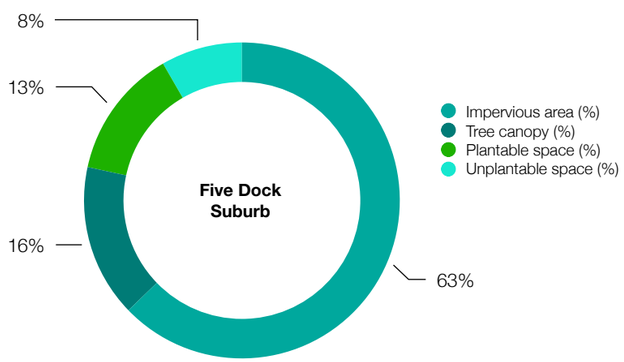


Figure 11. Impervious, plantable and tree canopy in Five Dock.

The Strategy reveals that the Five Dock suburb has a tree canopy coverage of 16%, with 9.11% on private land and 6.51% on public land, making it susceptible to canopy loss in the event of urban infill on private land. The suburb also has 13% of potential plantable areas, offering opportunities for greening initiatives, although more than half occurs on private land.

The Five Dock suburb is dominated by 63% of impervious surfaces. This includes nearly 28% covered by impervious buildings, less than 13% by impervious roads, and the remainder by other impervious surfaces.

Figure 12 illustrates the distribution of tree canopy within the Five Dock Metro Precinct. The highest concentration of tree canopy is found around Five Dock Primary School and along sections of Kings Rd and Garfield St. In contrast, the area east of Great North Rd has less than 5% tree canopy coverage.

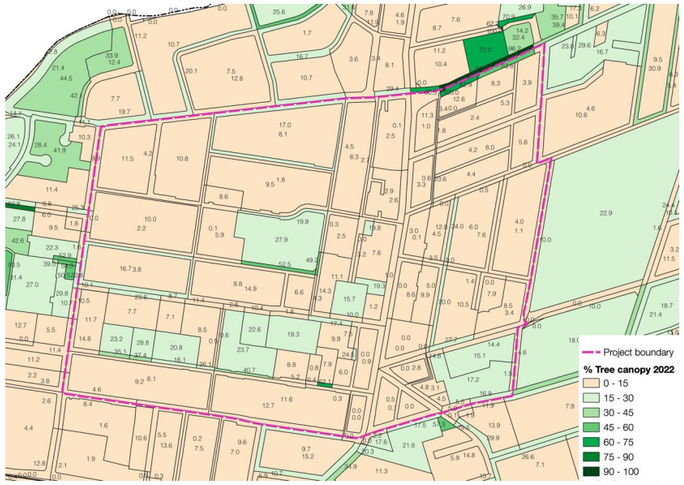


Figure 12. Five Dock study area tree canopy cover 2022.

The distribution of tree canopy was established from Greater Sydney Region Tree Canopy Modified Mesh Block 2022. Figure 13 shows that only 3.6% of the Five Dock Metro Precinct mesh blocks had tree canopy coverage exceeding 20% with a height above 10 m, compared to 34.5% frequency in Greater Sydney overall.

Areas with trees reaching at least 10 m in height were most concentrated around Five Dock Primary School and several locations along Kings Rd and Garfield St.

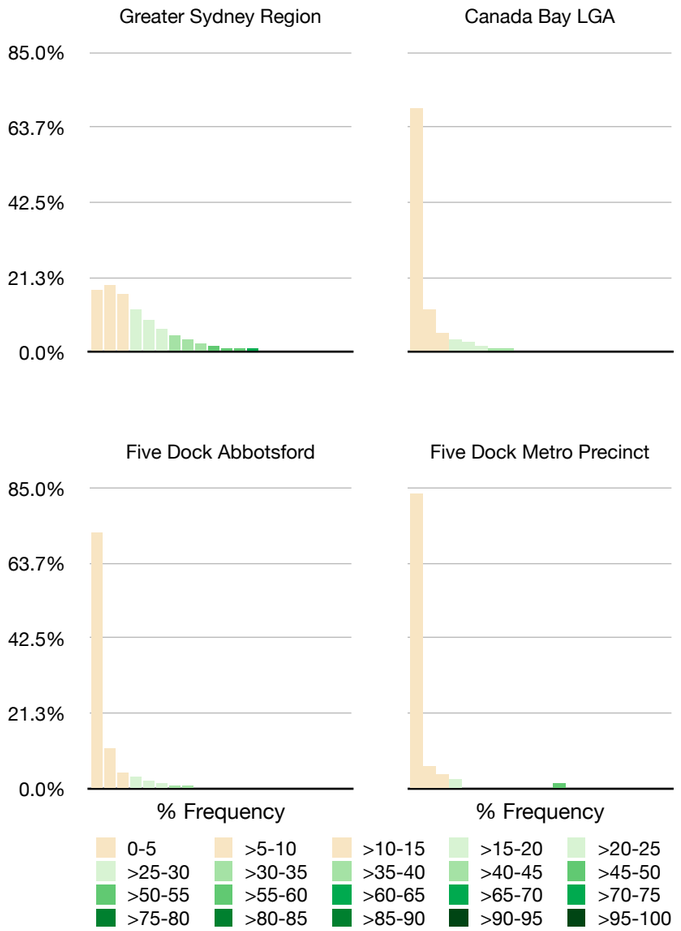


Figure 13. Tree cover (> 10 m) - regional comparison.

[1] *Urban Canopy Strategy*. City of Canada Bay. https://www.canadabay.nsw.gov.au/council/sustainable-council/our-urban-tree-canopy/urban-canopy-stategy

2.4. Local Open Space

Local open space data and mapping were sourced from the *City of Canada Bay Council Social Infrastructure (Open Space and Recreation) Strategy and Action Plan 2019*.

The City of Canada Bay council has adopted proximity-based benchmarks by the Government Architect NSW *Greener Spaces* Draft Open Space for Recreation Guide (2018) and local needs, which sets benchmarks requiring all dwellings to be within 400 m of 0.3 ha open space and high-density housing (60+ dwellings/ha) within 200 m of 0.1 ha open space.

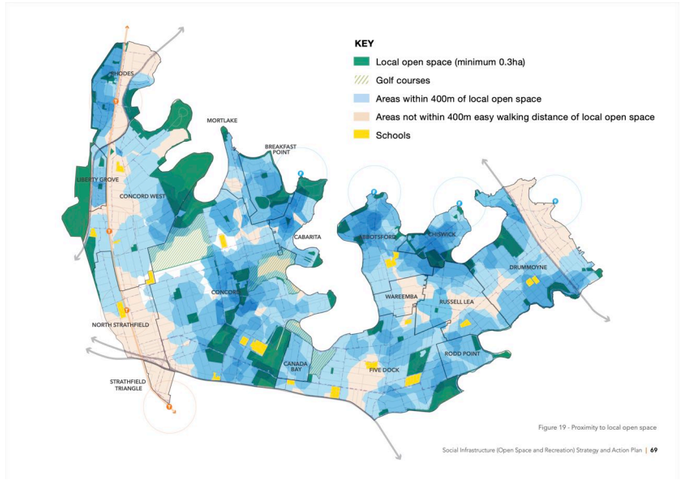


Figure 14. Five Dock Metro Precinct in Canada Bay LGA - Local open space (source: *Social Infrastructure (Open Space and Recreation) Strategy and Action Plan 2019)*

Figure 14 illustrates that the central and southern parts of the Five Dock Metro Precinct fell outside the 400 m easy walking distance to local open space.

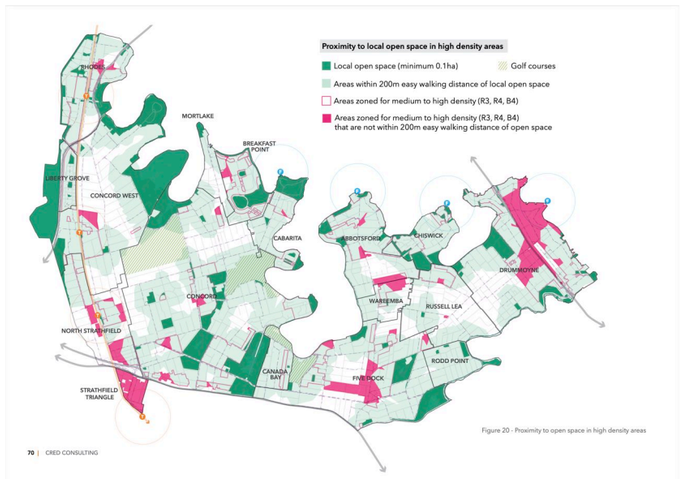


Figure 15. Five Dock Metro Precinct in Canada Bay LGA - Open space proximity, high density area (source: *Social Infrastructure (Open Space and Recreation) Strategy and Action Plan 2019)*

Figure 15 highlights that high-density areas along Garfield St, Kings Rd, and Great North Rd were not within 200 m of easy walking distance of open space.

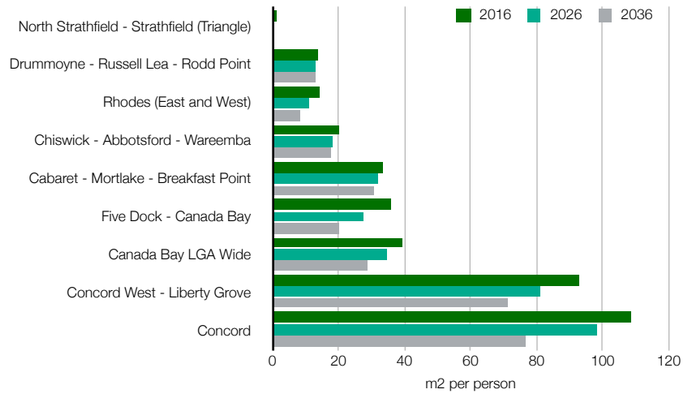


Figure 16. Canada Bay LGA and suburbs - Local open space m2 per person

In 2016, the combined suburbs of Five Dock and Canada Bay had a total open space of 395,069 m^2, averaging 36 m^2 per person. While this was below the Canada Bay LGA average, it was the third-largest among the LGA's suburbs.

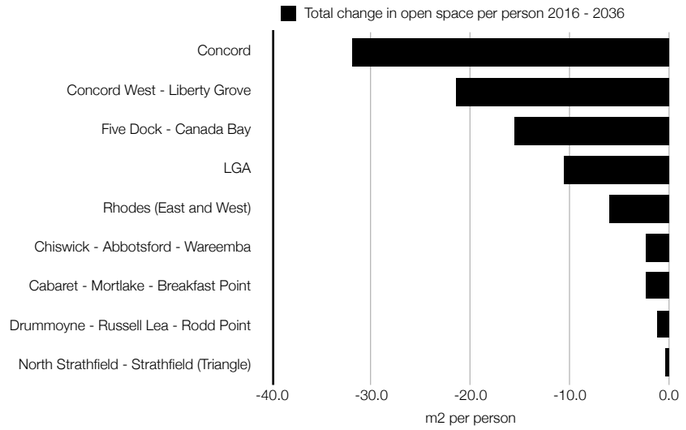


Figure 17. Canada Bay LGA and suburbs - Total change 2016 - 2036

Figures 16 and 17 show that Five Dock - Canada Bay is expected to experience the third-largest decline in open space per person by 2036, with a reduction of 15.7 m^2 compared to 2016.

2.5. Existing Green Assets

Existing green assets were established from the Greater Sydney Region Existing Green Assets with temporal coverage from October 2016.

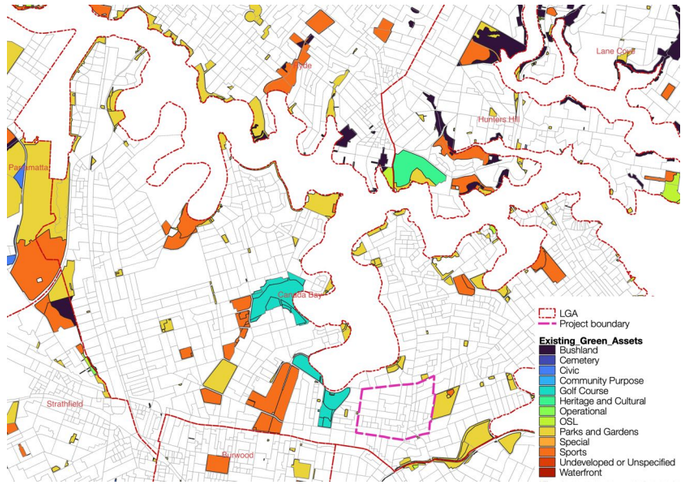


Figure 18. Existing Green Assets - Five Dock Metro Precinct in Canada Bay LGA

Five Dock Metro Precinct is located near a golf course and several parks and gardens, with a large park/garden right next to the Precinct boundary. The map shows no existing green assets within the Precinct.

2.6. Existing Green Grid Corridors

Green grid corridors were established from the Greater Sydney Region Existing Green Assets with temporal coverage from October 2016. It shows that while there are green grid corridors connecting to the north and south boundaries of the precinct, none traverse it.

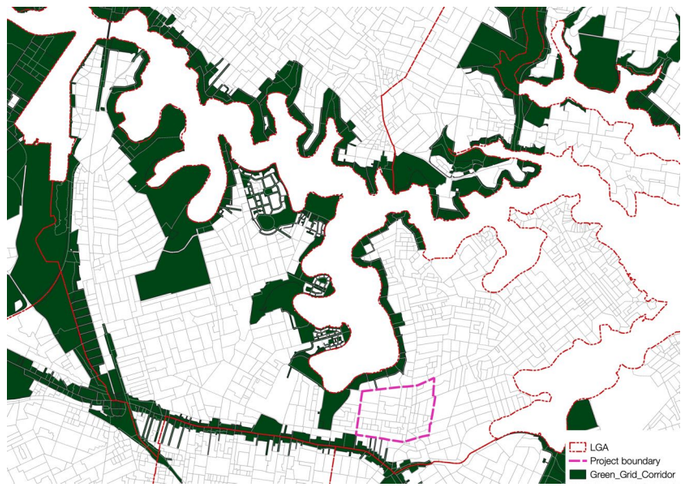


Figure 19. Green Grid Corridors - Five Dock Metro Precinct in Canada Bay LGA

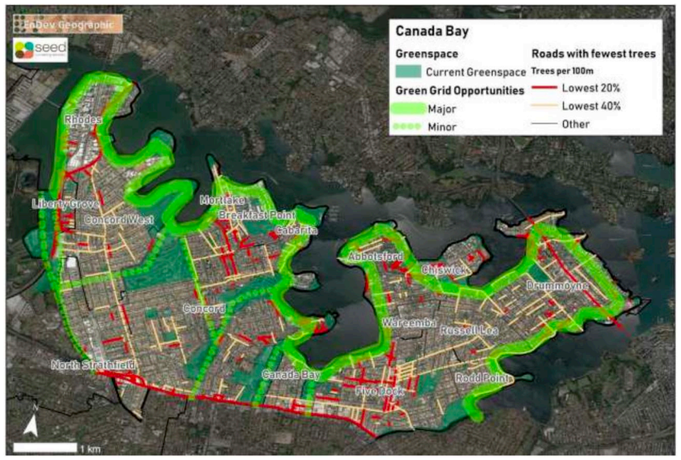


Figure 20. Green Grid Opportunities (*Urban Tree Canopy Strategy*)

The City of Canada Bay Urban Tree Canopy Strategy maps green grid opportunities in Canada Bay LGA. The mapping shows no identified green grid opportunities within Five Dock Metro Precinct.

2.7. Biodiversity

Biodiversity mapping was extracted from Native Vegetation of the Sydney Metropolitan Area - Version 3.1 OEH 2016 and NSW BioNet Species Sightings.

Figure 21. Native vegetation 2016

Native vegetation OEH 2016 mapping shows Urban exotic/Native in Five Dock Public School and some lots around the Southwest area of the Precinct as well as near the Precinct boundaries.

Canada Bay Biodiversity Strategy provides a historical mapping of vegetation communities pre-1750. It shows that most of Five Dock Metro Precinct was predominantly covered by Turpentine-Ironbark forest and Eucalypt woodland. This highly contrasts the native vegetation condition in 2016.

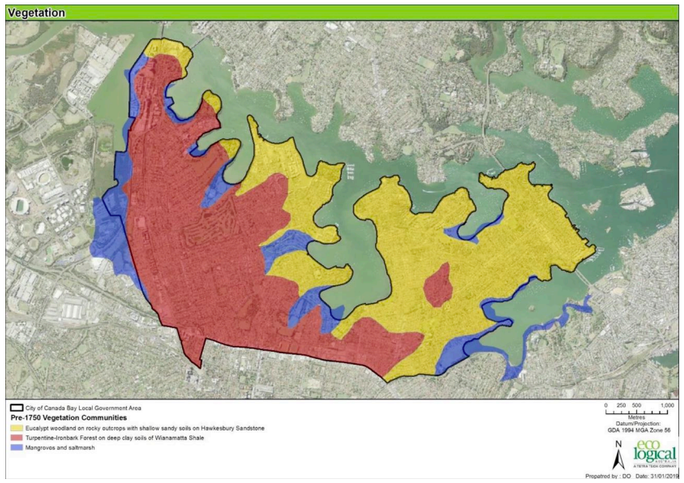


Figure 22. Pre-1750 Vegetation communities (source: Canada Bay Biodiversity Strategy)

NSW BioNet Species Sightings mapping covers flora and fauna records in the Species Sightings module of the NSW BioNet-Atlas application at the OEH. This data is made available by OEH's Sensitive Species Data Policy.

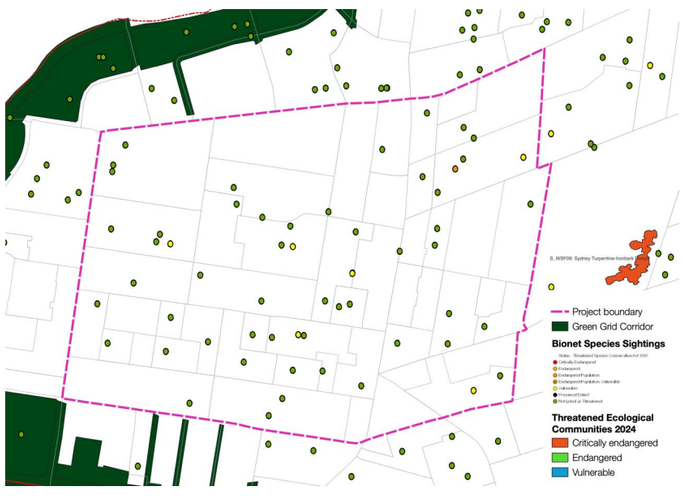


Figure 23. BioNet Species Sightings mapping

The mapping shows there was a sighting of long-nosed bandicoot around the northeast of the precinct. This fauna is listed as an endangered population.

Other fauna within the Precinct are grey-headed flying fox and noisy minors, which are listed as vulnerable species.

2.8. Air temperature

Air temperature analysis considered existing conditions and future projections under different emissions scenarios.

2.8.1. Existing condition

The air temperature data was analysed for the period 2001-2020 from the nearest weather monitoring station, Canterbury Racecourse AWS (approximately 4.2 km from Five Dock)[2], and compared to the Mascot AMO weather station, which is commonly used to inform energy assessments across much of the Greater Sydney Region. This comparison provides insights into Five Dock's seasonal air temperature based on the nearest available data.

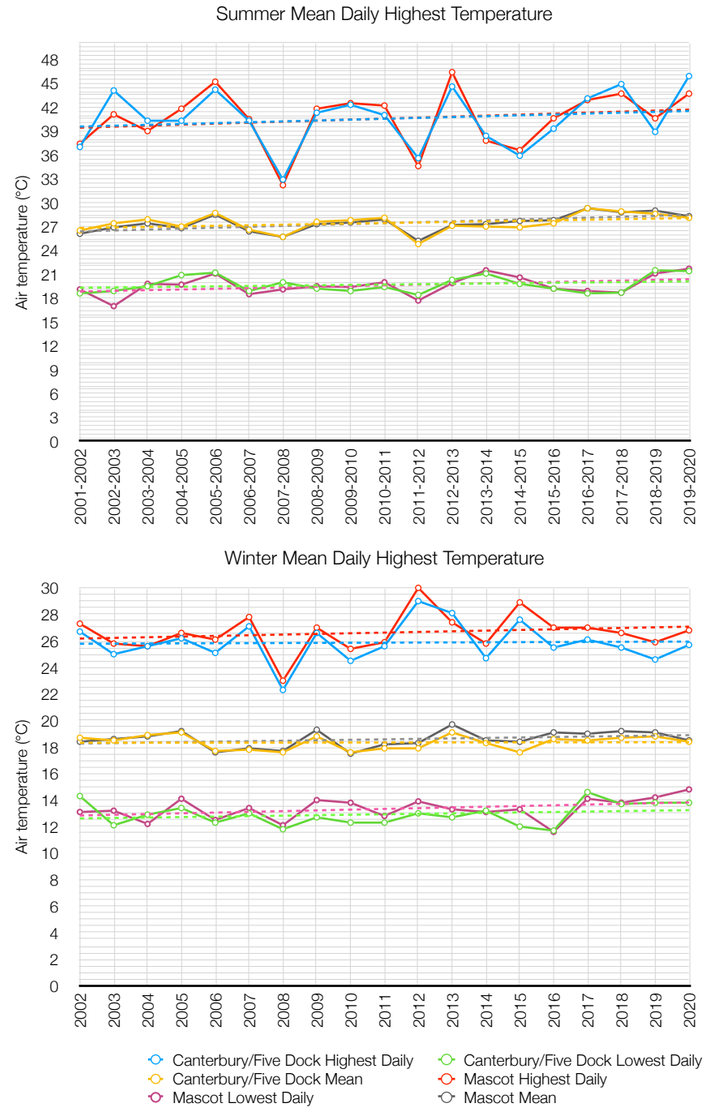


Figure 24.Summer and winter daily temperature comparison.

[2]

The graph illustrates a linear increase of over 1°C in the summer mean daily highest air temperature from 2001 - 2020 recorded in Canterbury racecourse. This rise is lower than the corresponding increase recorded in Mascot.

Further analysis reveals an increasing trend in the number of days exceeding 35°C or 40°C and the occurrence of the highest temperatures.

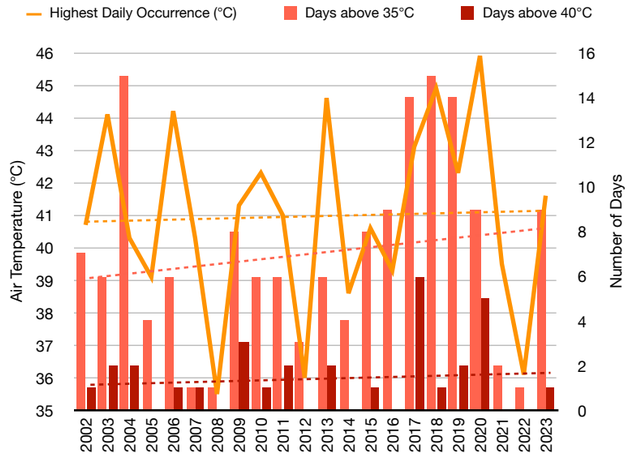


Figure 25. Days above 35°C, 40°C and highest temperature occurrence recorded in Canterbury Racecourse.

From 2002 to 2023, the highest daily air temperatures were often above 40°C. The highest peak daily temperature of 45.9°C was recorded in 2020, while the lowest was 35.5°C in 2008.

The number of days exceeding 35°C or 40°C fluctuates annually. The worst year on record was 2017, with 14 days above 35°C, including 6 days surpassing 40°C.

2.8.2. Projection

Projections of air temperature were analysed using TIFF images provided by the NSW and Australian Regional Climate Modelling (NARCliM) project, which offers insights into plausible future climates based on the latest emissions scenarios.

The NSW NARCliM 2.0 offers future climate projections from the historical baseline period of 1990-2009 (representing the '2000' climatology) under two emissions scenarios:

- Low emissions scenario (SSP1-2.6): aligned with our 2050 Net Zero Targets.
- High emissions scenario (SSP3-7.0).

Table 2 presents the historical air temperature for the '2000' climatology. It shows that Five Dock Metro Precinct had a slightly higher average temperature and experienced marginally more hot days compared to Mascot. Despite these differences, both were found to have similar overall conditions.

'2000' Historical	Five Dock Metro Precinct			
	Average temperature (°C)	Maximum temperature (°C)	Minimum temperature (°C)	Hot days* (day)
Annual	19.52	23.95	15.60	6.34
Summer	24.10	28.18	20.83	4.45
Autumn	20.58	24.70	16.73	0.48
Winter	13.90	18.60	9.58	0.00
Spring	19.50	24.31	15.25	1.17

'2000' Historical	Mascot			
	Average temperature (°C)	Maximum temperature (°C)	Minimum temperature (°C)	Hot days* (day)
Annual	19.48	23.38	15.88	4.83
Summer	23.84	27.33	21.02	3.45
Autumn	20.65	24.21	17.09	0.36
Winter	14.11	18.40	9.95	0.00
Spring	19.31	23.57	15.45	1.02

Table 2. '2000' Historical air temperature.

Figure 26 to 29 compare projections of air temperature and hot days for Five Dock and Mascot suburbs under low (SSP1-2.6) and high (SSP3-7.0) emissions scenarios. These projections, spanning seven future climatology periods, are presented as changes relative to the '2000' climatology baseline.

Under scenario SSP3-7.0, both suburbs are expected to experience significantly higher average, maximum, and minimum temperatures, along with an increase in the frequency of hot days. By contrast, scenario SSP1-2.6, which aligns with our achieving 2050 Net Zero targets, demonstrates a notable capacity to curb these increases.

Table 3 below provides the approximate projection summary for Five Dock Metro Precinct.

Climatology	Scenario	Average temperature rise (°C)	Increase in hot days (days)
2050	SSP1-2.6	1.02	3.99
	SSP3-7.0	1.66	5.31
2090	SSP1-2.6	1.16	4.82
	SSP3-7.0	3.36	12.61

Table 3. NSW NARCliM 2.0 - Air temperature projection summary

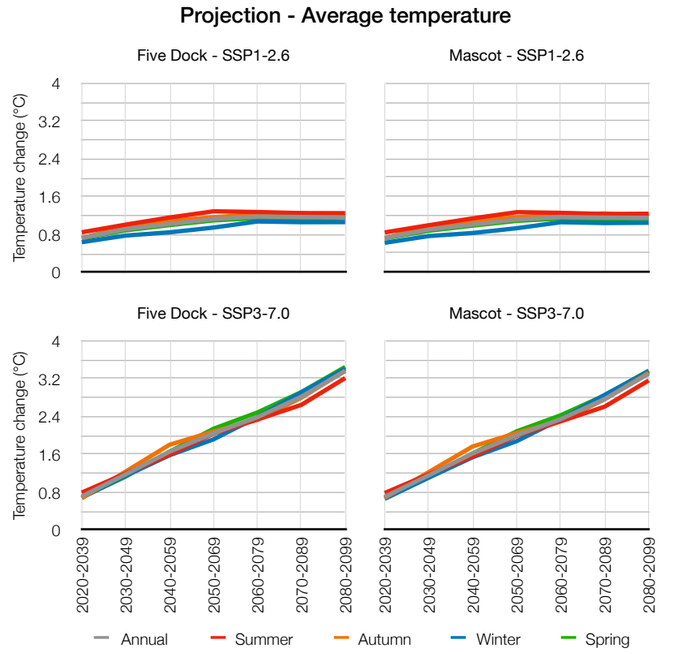


Figure 26. Average temperature projection for seven future climatologies

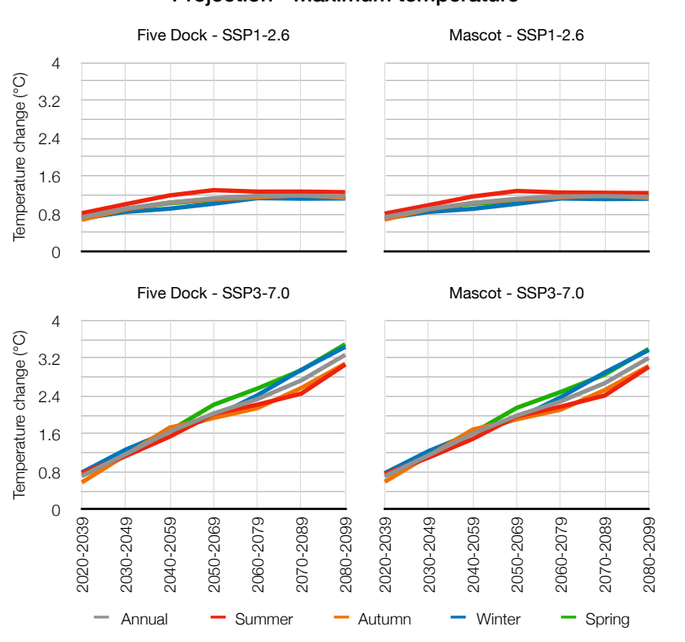


Figure 27. Maximum temperature projection for seven future climatologies

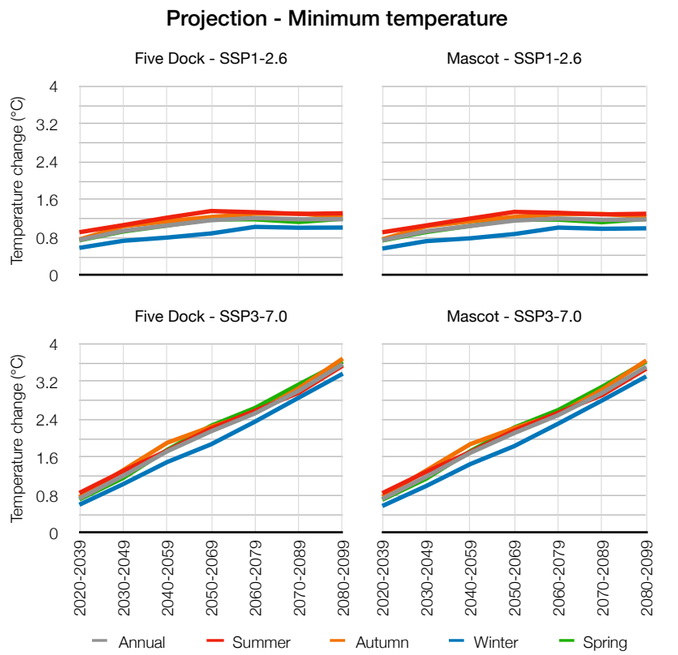


Figure 28. Minimum temperature projection for seven future climatologies

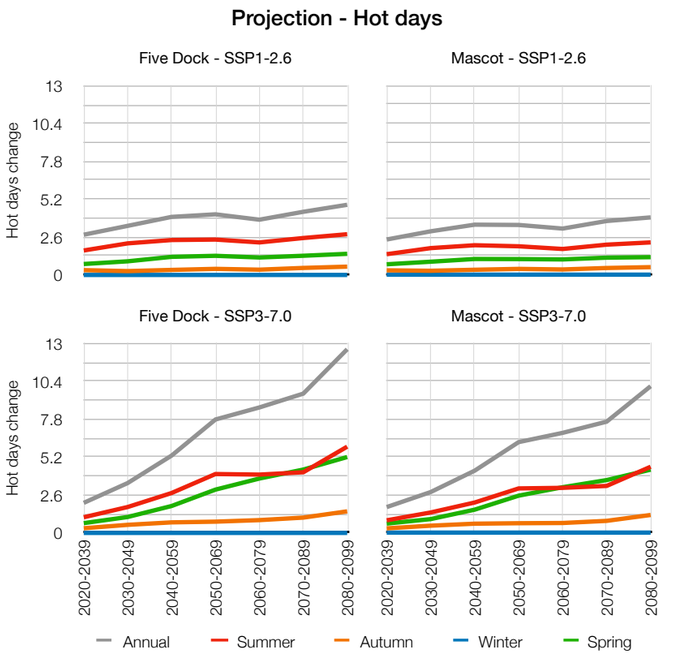


Figure 29. Hot days projection for seven future climatologies

2.9. Rainfall

Rainfall analysis considered both existing conditions and future projections under different emissions scenarios.

2.9.1. Existing condition

The rainfall was benchmarked using the nearest available weather monitoring station, Abbotsford (Blackwell Point Rd), and compared to the Sydney rainfall data (Mascot AMO).

The analysis revealed no year with typical annual rainfall for any weather station for the last 20 years. The average annual rainfall in Abbotsford from 2004 to 2023 is 1114.18 mm, compared to 1070.17 mm in Mascot.

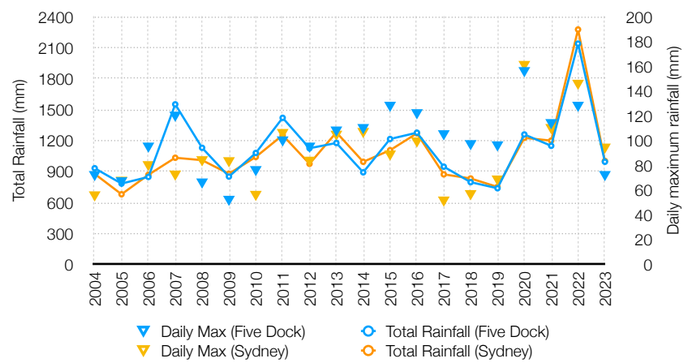


Figure 30. Daily maximum and annual rainfall.

An analysis of BASIX Dwelling Certificates 2011 - 2020[3] in Five Dock suburb reveals that all projects were registered with centralised or individual rainwater or stormwater tanks, with 17 achieving the exact water target and the rest exceeding it.

2.9.2. Projection

The NSW NARCliM offers future climate projections of rainfall from the historical baseline period of 1990-2009 (representing the '2000' climatology) under emissions scenario SSP1-2.6 and SSP3-7.0.

Table 2 shows the historical rainfall for the '2000' climatology.

2000 Historical rainfall	Five Dock Metro Precinct (mm)	Mascot (mm)
Annual	1110.67	1170.36
Summer	318.95	321.51
Autumn	360.81	385.77
Winter	250.14	273.72
Spring	180.78	189.35

Table 4. '2000' Historical rainfall.

The '2000' historical rainfall data indicates that Five Dock Metro Precinct had slightly lower average rainfall than Mascot. Despite this minor difference, both suburbs were found to have similar overall rainfall conditions.

The average annual rainfall in Five Dock Metro Precinct's '2000' climatology aligns closely with existing conditions observed from the nearest recorded weather data.

Figure 31 compares rainfall projections for Five Dock Metro Precinct and Mascot under low (SSP1-2.6) and high (SSP3-7.0) emissions scenarios. These projections, spanning seven future climatology periods, are presented as changes relative to the '2000' climatology baseline.

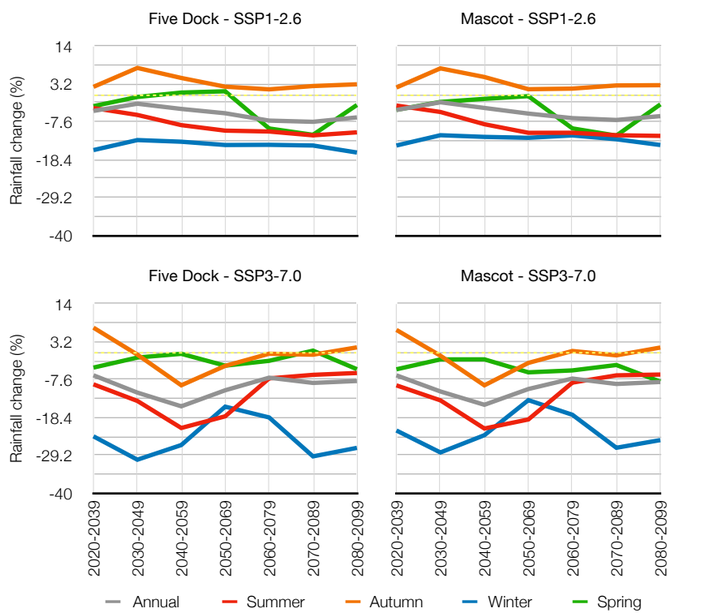


Figure 31. Rainfall projection for seven future climatologies

Projections for the Five Dock Metro Precinct and Mascot indicate an annual decrease in average rainfall across all scenarios and climatologies. Under the SSP3-7.0 scenario, the annual decrease is expected to be higher than SSP1-2.6.

Seasonal variations are most pronounced in Winter, which under SSP3-7.0 is anticipated to experience a substantially higher decrease compared to SSP1-2.6.

The table below shows the rainfall projection summary for Five Dock Metro Precinct.

Climatology	Scenario	Average (mm)	Summer (mm)	Autumn (mm)	Winter (mm)	Spring (mm)
2050	SSP1-2.6	1055	287	376	213	179
	SSP3-7.0	934	250	324	180	181
2090	SSP1-2.6	1029	281	370	205	173
	SSP3-7.0	1022	299	371	179	173

Table 5. NSW NARCliM 2.0 - Rainfall projection summary

[3] *BASIX_Dwelling_Certificates_2011-2020.* NSW Department of Planning, Housing, and Infrastructure. https://www.planningportal.nsw.gov.au/opendata/dataset/basix_dwelling_certificates_2011-2020

2.10. Method of Travel to Work

The method of travel to work was analysed from the ABS 2016 Census of Population and Housing Data for Five Dock Abbotsford, comparing it to Canada Bay LGA and Sydney - Inner West regions.

The data below presents the outbound and inbound journeys.

Outbound Journey	Five Dock Abbotsford	Canada Bay LGA	Sydney - Inner West
Train	4.3%	16.5%	23.6%
Bus	14.5%	9.0%	8.8%
Ferry	3.7%	2.4%	1.2%
Tram	0.4%	0.2%	1.1%
Taxi	0.3%	0.3%	0.4%
Car, as driver	54.7%	50.4%	42.7%
Car, as passenger	3.5%	3.2%	3.1%
Truck	0.6%	0.6%	0.5%
Motorbike/scooter	1.1%	0.8%	0.9%
Bicycle	1.1%	0.9%	1.3%
Walked only	2.0%	2.9%	3.8%
Other Mode	0.6%	0.6%	0.6%
Worked at home	4.9%	4.6%	4.4%
Did not go to work	8.3%	7.5%	7.5%

Table 6. Outbound journey.

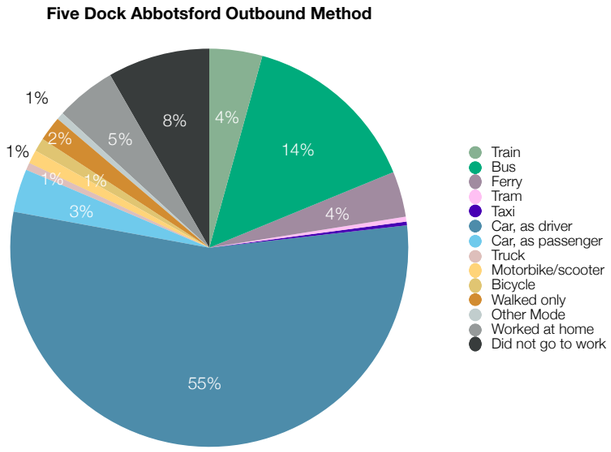


Figure 32. Five Dock Abbotsford outbound method proportion

The data shows that private cars were the dominant mode of transport for outbound and inbound journeys in the Five Dock Abbotsford area, accounting for 54.7% and 62.5%, respectively. These percentages were higher than the reliance on private cars in the broader Canada Bay LGA and Sydney - Inner West region.

The data also highlights a relatively high use of buses for outbound journeys in Five Dock Abbotsford. However, overall public transport usage in the area remained lower.

Public transport was also less popular for inbound journeys, with usage roughly half that compared to Canada Bay LGA and Sydney - Inner West.

Inbound Journey	Five Dock Abbotsford	Canada Bay	Sydney - Inner West
Train	4.1%	14.8%	14.4%
Bus	5.0%	3.2%	3.6%
Ferry	0.0%	0.1%	0.1%
Tram	0.1%	0.0%	0.1%
Taxi	0.2%	0.2%	0.2%
Car, as driver	62.5%	58.3%	57.0%
Car, as passenger	5.0%	3.6%	3.7%
Truck	0.6%	0.4%	0.6%
Motorbike/scooter	0.5%	0.6%	0.6%
Bicycle	0.5%	0.5%	0.6%
Walked only	4.5%	3.9%	4.9%
Other Mode	0.4%	0.5%	0.5%
Worked at home	8.0%	6.0%	5.7%
Did not go to work	8.6%	8.0%	8.0%

Table 7. Inbound journey.

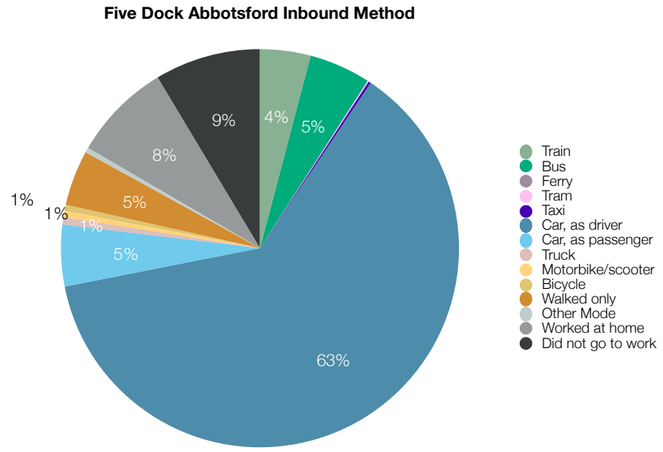


Figure 33. Five Dock Abbotsford outbound method proportion

2.11. Cycling Propensity and Network

This section examines the latent demand for cycling within the study areas in 2016 using the Cycling Propensity Index data from Transport for NSW (TfNSW). The index assigns a value between 0 and 1 for each Statistical Area (SA) 1, with 1 indicating the highest inclination for cycling.

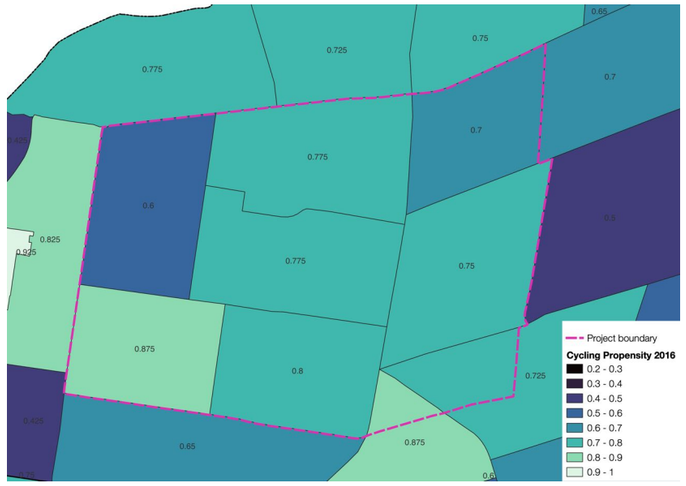


Figure 34. Bike Use Propensity Index Based on Census 2016

Figure 34 shows that the cycling propensity index in Five Dock Metro Precinct in 2016 ranged from 0.6 - 0.875, indicating a high propensity of cycling by residents.

	Train	Bus	Car, as driver	Bicycle	Walked only
Over 0 km to less than 1 km	0	7	48	0	124
1 km to less than 2.5 km	0	23	81	6	11
2.5 km to less than 5 km	0	30	242	0	17
5 km to less than 10 km	96	533	599	35	3
10 km to less than 20 km	89	77	680	0	0
20 km to less than 30 km	6	6	143	0	0
30 km to less than 50 km	0	0	61	0	0
50 km to less than 100 km	0	0	5	0	0
100 km to less than 250 km	0	0	0	0	0
250 km and over	0	0	17	0	0

Table 8. Five Dock Metro Precinct Method of Travel to Work 2016 by distance travel.

Table 8 compares common modes of transport based on the ABS Census 2016 - public transport, active travel, and private cars - used by Five Dock Metro Precinct residents based on travel distance to work. The data shows that around 20% of private car journeys were for short trips (less than 5 km), indicating a reliance on private cars even for distances that could be comfortably cycled.

Given the high cycling propensity and car reliance on short trips, there is an opportunity to shift some car trips to cycling.

Figure 35 shows the existing cycling network in the Five Dock Metro Precinct in 2024. It was found that the existing cycling network consists of mixed traffic in Barnstaple Rd and Queens Rd, as well as parking lanes in Henry St and First Ave. Parking lanes in Henry St and First Ave are found to be disconnected from the rest of the cycling infrastructure.

Figure 35. Existing cycling network 2024

2.12. Waste Generation

Waste generation has been estimated using bottom-up analysis of the existing building stock and typical generation benchmarks. Canada Bay[4] data was used as the basis for residential waste generation rates.

Type	Estimate of waste generation (t/annum)
Non-residential	1,558
Residential	1,303
Parks	4
Total	**2,865**

Table 9. Estimated waste generation by building type

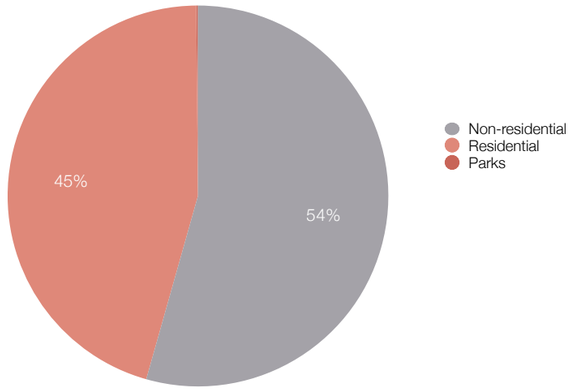


Figure 36. Contribution of building type to waste generation in the study area

2.13. Water Consumption

Non-residential water use has been estimated using bottom-up analysis of the existing building stock and typical use benchmarks from Sydney Water, Hunter Water and other sources. Residential water demand is taken from Sydney Water consumption statistics for the Canada Bay LGA and is seen to be dominant.

Type	Estimate of water use (ML/annum)
Non-residential	44.4
Residential	247.3
Parks	0.5
Total	**292**

Table 10. Estimated water demand by building type

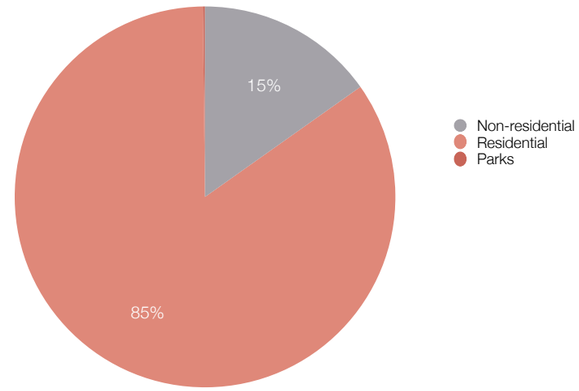


Figure 37. Contribution of building type to water use in the study area

[4] NSW EPA 2021-22-LG-WARR-Report-Appendix

2.14. Gas Demand

Current gas use in the Five Dock Metro Precinct area has been estimated from bottom-up analysis of estimated building energy demands and typical fuel splits and confirmed with the average customer usage data supplied by Jemena for 2022, which showed 78% of residential homes are connected to the gas service in Five Dock.

There is limited information on fuel split by building types in NSW. The NABERS dataset provides valuable information for the Sydney metropolitan region. However, it covers only a few building use types and excludes tenant-related impacts in most building types. For retail, this limits the insight into the common areas of shopping centres and excludes any information on energy consumption in retail tenancies, where food retailers will be big consumers of gas for cooking or High street retail shops. The fuel splits provided in the Commercial Building Baseline Study 2022 have been used for all other building uses.

The comparison with Jemena's published averages confirmed that the Flux estimated aggregated gas demand of the buildings is in line with the LGA total when the relative density of use is considered.

Type	Gas proportion of building energy use	GJ/Annum
Non-residential	31%	9,900
Residential	69%	21,870
Average / Total	**100%**	**31,770**

Table 11. Estimated gas usage by building use.

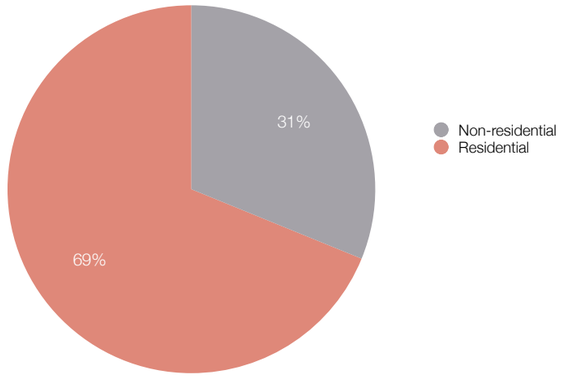


Figure 38. Contribution of building type to overall gas use in the study area

2.15. Renewable Energy (Solar PV)

The rooftop solar photovoltaics (PVs) were benchmarked using postcode-level data supplied by the Clean Energy Regulator[5].

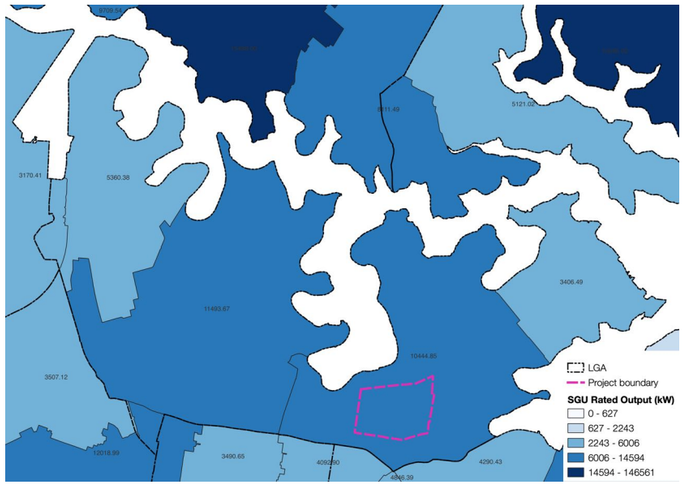


Figure 39. SGU Rated Output from Jan 2001- Oct 2024 per postcode.

Total PV installation sizes in postcode 2046 as of October 2024 are recorded to be 10.45 MW.

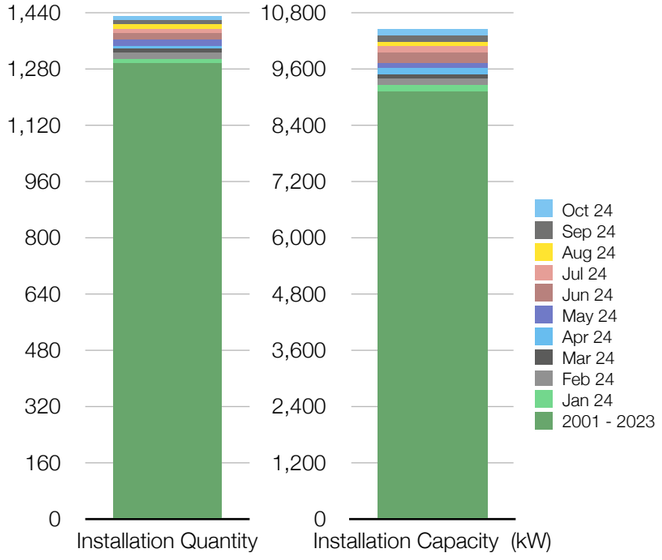


Figure 40. Solar PV Installation 2001 - 2024 in postcode 2046

The Australian PV Institute (API) data shows no large-scale PV system (with a capacity of more than 100 kW) installed within postcode 2046 as of September 2024[6].

Clean Energy Regulator does not provide information on whether the systems are installed on houses, apartments, or non-residential buildings.

API estimates that approximately 19.5% of dwellings in the area are equipped with solar PV systems, with about 94.5% being residential buildings. This data may be understated as it only includes accredited solar PV systems.

The cumulative capacity installed by the size of the installation in postcode 2046 is shown in the chart below.

Figure 41. Solar PV cumulative capacity in postcode 2046

An analysis of BASIX Dwelling Certificates 2011 - 2020[7] in Five Dock suburb reveals a significant under-provision of PV systems in multi-residential buildings. Of the 39 residential projects, only one building (152 dwellings) was registered as having a PV installation with a peak output of 35 kW.

All other projects met or exceeded the minimum energy target without implementing solar PV systems. Of these, 19 achieved the exact energy target, 14 achieved scores 1-3% above the target, and the rest exceeded it by a greater margin.

[5] *Small-scale installation postcode data.* Clean Energy Regulator. https://cer.gov.au/markets/reports-and-data/small-scale-installation-postcode-data

[6] *Large-Scale PV Systems. PV Postcode Data.* Australian PV Institute. https://pv-map.apvi.org.au/

[7] *BASIX_Dwelling_Certificates_2011-2020.* NSW Department of Planning, Housing, and Infrastructure. https://www.planningportal.nsw.gov.au/opendata/dataset/basix_dwelling_certificates_2011-2020

2.16. Electric Vehicle Ownership and Infrastructure

Data on the ownership of electric vehicles (EVs) has been taken from the NSW vehicle registration database. The data shows that 1,269 EVs are garaged in the area out of 62,868 private motor vehicles as of November 2024, representing approximately 2% of all private vehicle ownership.

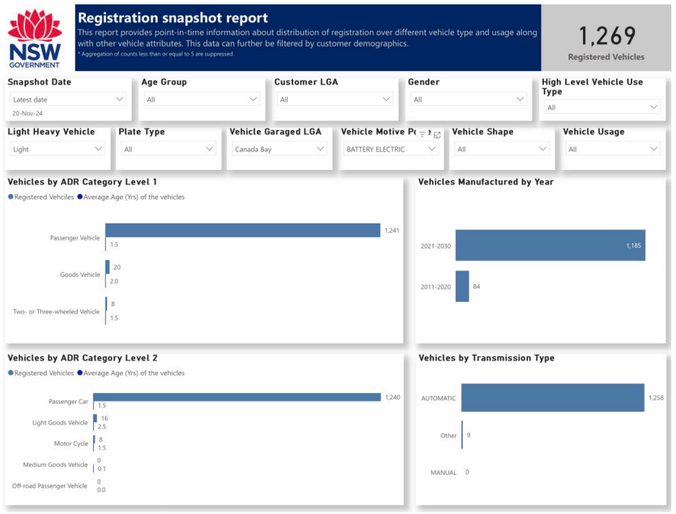


Figure 42. Registered Battery Electric Vehicles in Canada Bay LGA

The NSW Climate and Energy Action has released an EV Public Charging Masterplan, outlining ideal zones for public EV charging stations and projecting the current and future networks of public EV chargers in NSW by 2031. This mapping is shown in Figure 43.

Figure 43 shows that the Five Dock suburb has one existing or planned DC Fast charger with a capacity exceeding 50 kW and one approved charger under Drive Electric NSW EV Fast Charging Grants, which aims to establish charging stations at intervals of every 5 km in metropolitan areas. Both chargers are located outside the Five Dock Metro Precinct.

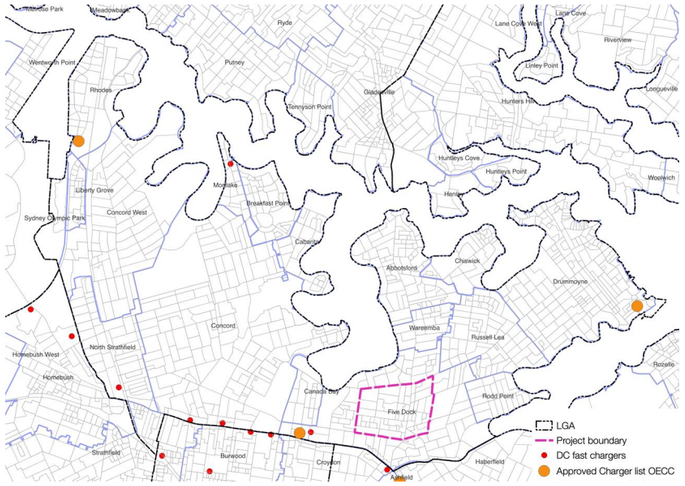


Figure 43. NSW EV Public Charging Masterplan map.

2.17. Refrigerant Bank

The bank of synthetic greenhouse gases contained in air-conditioning and heat pump installations was estimated in the Five Dock Metro Precinct area. The proportion of dwellings with air conditioning was taken to be 75%, which was derived from BASIX Certificate data. Air conditioning of commercial buildings was taken at 100%, with schools/ community use buildings at 50%.

A total of 5.63 tonnes of synthetic greenhouse gases are estimated to be installed in the study area.

Type	Estimate of refrigerant charge (kg)
Non-residential	1,180
Dwelling house	2,688
Apartment	1,763
Total	**5,630**

Table 12. Estimated current total refrigerant bank by building type

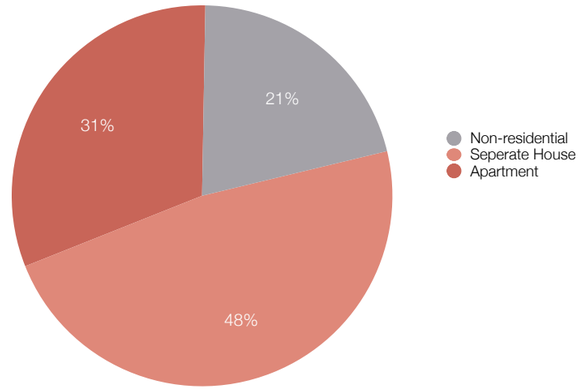


Figure 44. Contribution of building type to the refrigerant bank in the Study Area

Section 3
Existing Environmental Impacts

3. Environmental Impacts

This section presents the current environmental impacts within the Five Dock Masterplan precinct area and the emissions changes expected to occur in 2046 if the precinct is developed to the floor space capacity of the Masterplan, applying current requirements for environmental sustainability.

The projections consider the growth in floor space planned and the resulting impacts on energy consumption, transport use, etc. Appendix A details various assumptions that underpin the projections.

3.1. Greenhouse Gas Inventory

Based on the Five Dock Metro Precinct detailed in Section 2, a baseline current greenhouse gas inventory has been prepared. The inventory follows standard greenhouse gas accounting protocols for emissions scope allocation and materiality testing for inclusion.

The estimated annual Greenhouse Gas emissions associated with the study area is 15 Mt.CO2e per year. This is made up of the components shown in the chart below.

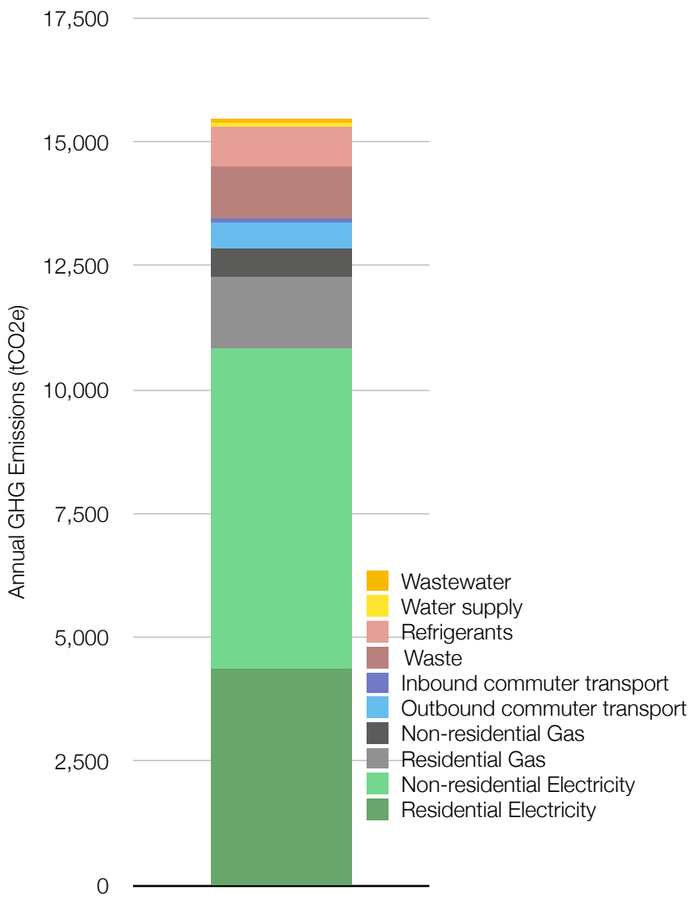


Figure 45. Current annual greenhouse gas emissions by contribution

A breakdown of emissions by Scope is shown below.

Scope 1 represents direct emissions in the Study Area from sources such as gas combustion.

Scope 2 represents emissions that occur offsite as a direct result of electricity usage within the Study Area.

Scope 3 represents emissions that occur offsite but are caused by the activities within the study area. Examples included commuter transport, disposal of waste, and the distribution losses associated with bringing electricity and gas to the Study Area.

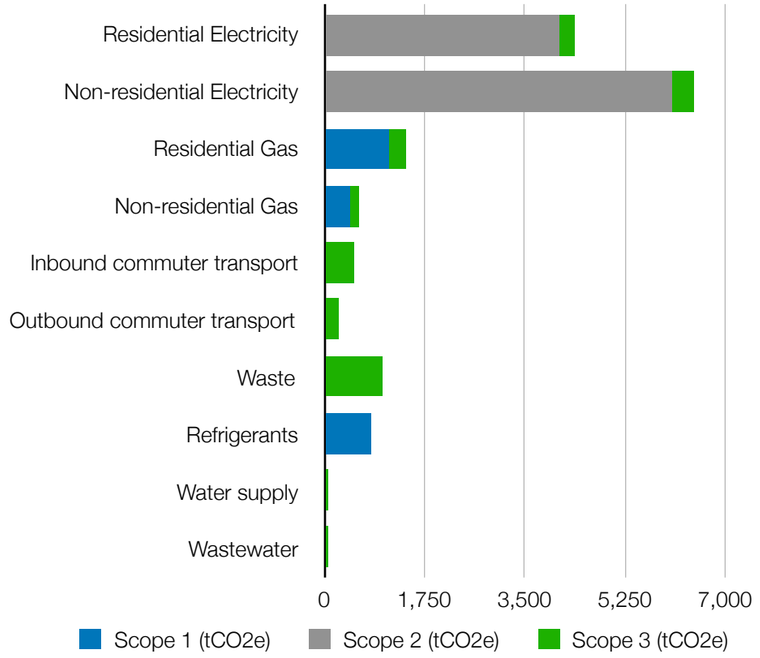


Figure 46. Breakdown of current emissions by scope.

The analysis reveals that Scope 2 emissions from electricity consumption currently dominate. This is despite the adoption of rooftop solar in the study area, which is estimated to reduce Scope 2 emissions by over 16%.

The use of gas is seen to be the most significant contributor to Scope 1 direct emissions, with the leakage of refrigerants also being a considerable source.

Waste management is the most significant contributor to Scope 3 emissions.

The following pie chart shows the proportional contribution of each source towards the current total greenhouse inventory for the Five Dock Metro Precinct Area.

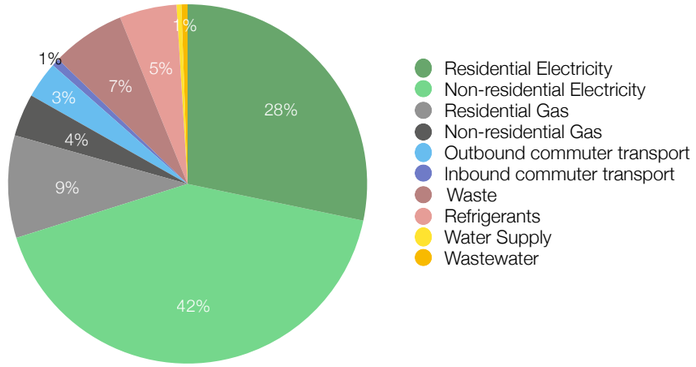


Figure 47. Breakdown of current emissions by source

3.2. Future Greenhouse Gas Inventory

The projection of emissions in 2046 that will occur if the Five Dock Metro Precinct Masterplan is delivered to its full potential by 2046 is shown below. It is projected that overall emissions will be reduced by 40% despite a significant increase in emissions associated with natural gas, transport, waste and refrigerants due to the growth in floor space.

The forecast reduction is due almost entirely to the projected rapid decarbonisation of the electricity grid and the small number of buildings retained.

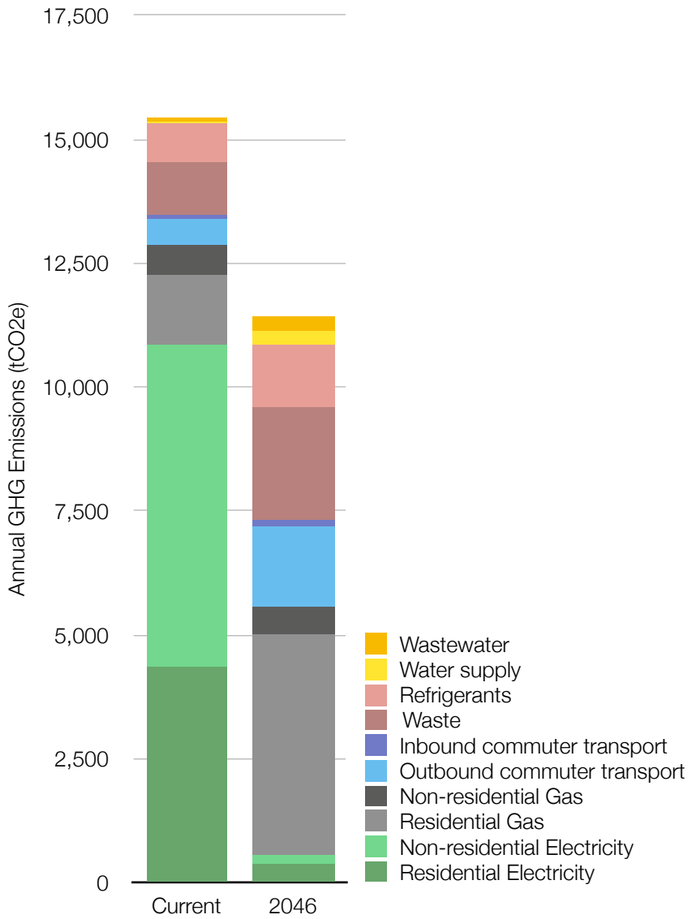


Figure 48. Projected change in GHG emission when fully developed under current controls

The relative proportion of GHG emission forecast in 2046 is shown below.

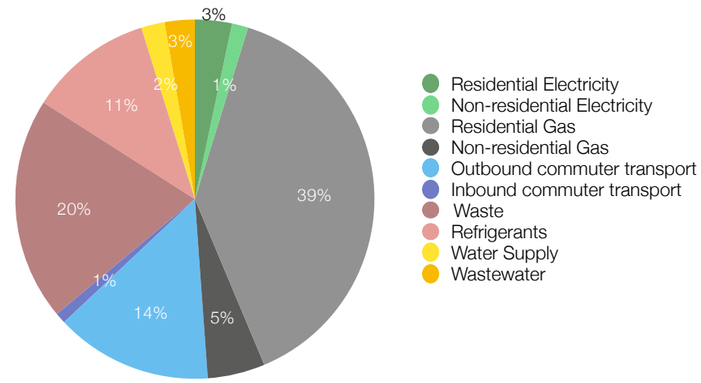


Figure 49. Breakdown of 2046 emissions by source

The 2046 forecast shows that under the current controls, the use of gas in buildings will contribute 44% of annual greenhouse gas emissions. This is after a minor allowance for reduced consumption due to a warming climate has been considered.

By comparison, electricity emissions are reduced to contribute no more than 4% of emissions in the precinct, compared to 70% of current contributions.

A comparison of impacts that isolate gas and electricity energy sources is shown below. Gas emissions are shown to increase by 250% by 2046. This starkly contrasts with electricity emissions, which are reduced by 95% compared to current levels. This highlights the undesirable, significant climate legacy of delivering new buildings that rely on gas for heating, cooling, or cooking.

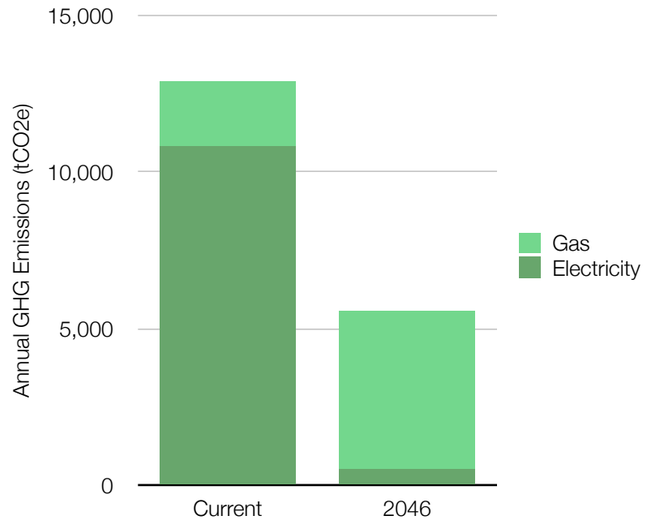


Figure 50. GHG emissions comparison between gas and electricity

The contribution of waste to the overall annual emission grows significantly, even after allowing increased proportions of organics to be diverted from landfill due to the NSW government FOGO legislation. This is mainly due to the inability to capture significant portions of organic waste from apartment buildings under current controls.

Outbound commute impacts grow by 300% and contribute 14% of the overall annual greenhouse gas emissions despite benefitting from the increased adoption of electric vehicles and the decarbonisation of metro trains and trams. 50% of total vehicles have been assumed to be battery EVs in 2046, facilitated by the NSW policy target of 50% of new vehicle sales being EVs by 2050 and the National Construction Code (NCC) requirements for 100% EV-ready infrastructure in all new residential apartment buildings.

Inbound commute impacts are reduced due to EV adoption, decarbonisation of electric transport and the lack of material change in employment floor space within the precinct.

Fugitive refrigerant emissions are forecast to contribute 11% of annual greenhouse gas emissions in 2046. The government's importation restriction of high GWP small charge refrigeration units limits growth in residential impacts.

3.3. Water Demand

The current demand for mains-supplied drinking quality water is estimated as 285ML per year and is forecast to grow to 1,032 ML per year, representing a 360% increase. The breakdown of building use contributions to the current and 2046 development potential demands is shown below.

The significant increase in residential water use is attributed to the growth in residential floor space and the failure of the Sustainable Buildings SEPP to increase the water targets in BASIX or set non-residential water targets above existing below-average consumption levels.

A slight reduction in water use is projected for non-residential buildings. Water use in parks is forecast to increase threefold (from 0.45 ML to 1.67 ML) due to increased irrigation area and irrigation demands. However, it will remain an insignificant component of the precinct's water footprint.

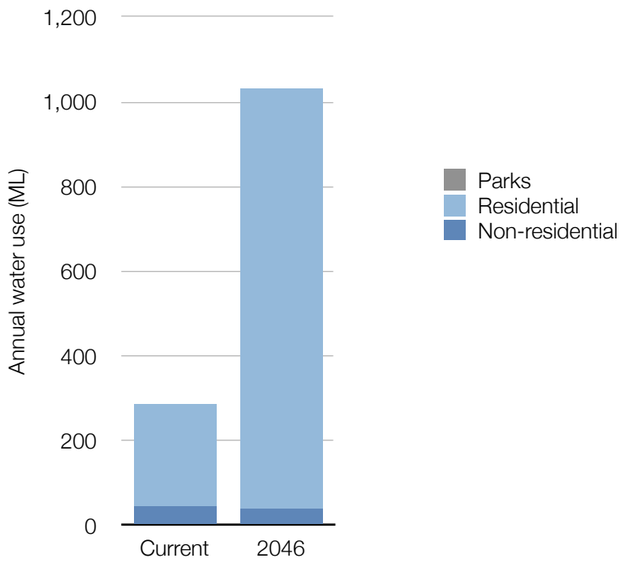


Figure 51. Projected change in water use when developed under current controls

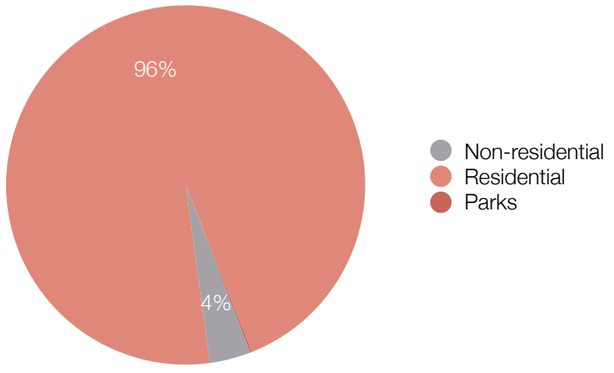


Figure 52. Breakdown of 2046 water demand by use

3.4. Waste Generation

Waste generation, excluding recovered organics, is estimated at 2.9 Mt per year for the current uses in the precinct and is forecast to grow 250% to 7.1 Mt per year in 2046 when developed under the current planning controls.

The generation rates scale with the increase in floor areas by usage type and the significant growth in residential apartments means controls for effective management of food organics waste will be important to limit waste to landfill.

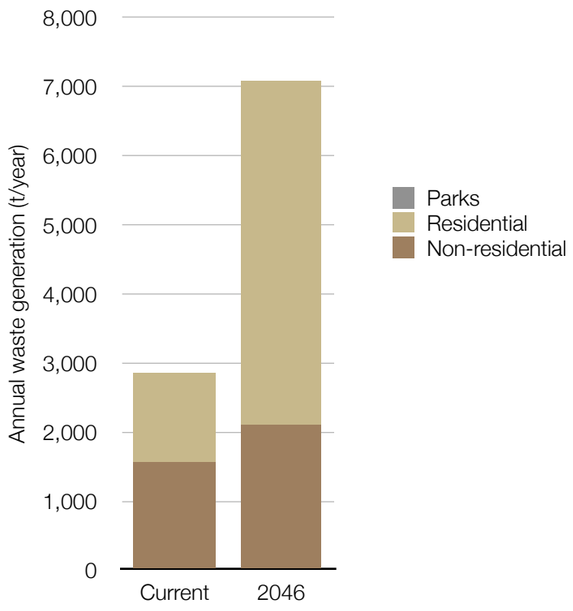


Figure 53. Projected change in waste generation when developed under current controls

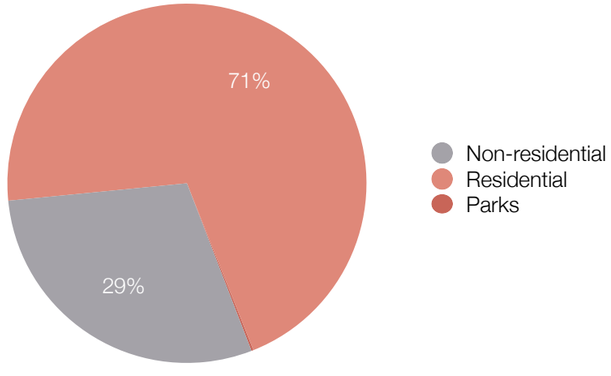


Figure 54. Breakdown of 2046 waste generation by source

Section 4
Policy and Planning

4. Policy and Planning

This section summarises the environmental policy and planning context relevant to the Five Dock Metro Precinct.

4.1. NSW Government Policy Context

The NSW Government has implemented plans and policies in several areas of environmental sustainability outcomes that are progressive in an Australian context.

4.1.1. NSW Climate Change Policy Framework 2016

NSW Climate Change Policy Framework sets two aspirational objectives for NSW:

-to achieve net-zero emissions by 2050

-for NSW to be more resilient to a changing climate

The framework sets out the international context of the Paris Agreement and how more ambitious commitments are needed globally to achieve global temperature and emissions objectives. The NSW Government endorses the Paris Agreement.

The framework established several policy directions, which include the following that are relevant to sustainability controls for new development:

- Boost energy productivity, put downward pressure on household and business energy bills
- Reduce risks of damage to public and private sector assets arising from climate change
- Reduce climate change impacts on health and wellbeing
- Manage impacts on natural resources, ecosystems and communities

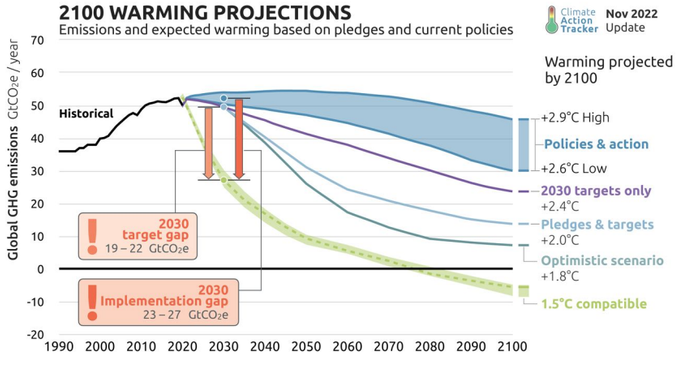


Figure 55. Emissions and expected warming based on pledges and policies[8]

4.1.2. Net Zero Plan Stage 1: 2020-2030

The Net Zero Plan details the policy priorities to fast-track emissions reduction over the decade to support the NSW Government's net-zero emissions by 2050 target.

The Net Zero Plan lays out several clear priority areas that should inform any amendment to local planning controls. In addition to the goal of accelerating emissions reduction, the themes of government leadership, reducing the cost of living and data transparency are also very relevant.

The relevant Net Zero priorities in the plan are:

Priority 1 - Drive uptake of proven emissions reduction technologies that grow the economy, create new jobs, or reduce the cost of living.

This priority includes sub-priorities directly relevant to establishing new development controls, including energy efficiency, electric vehicle infrastructure and a target for net-zero emissions from organic waste.

The priority to reduce the cost of living is also relevant to the setting of new controls.

Priority 2 - Empower customers and businesses to make sustainable choices.

Sub-priorities relevant to buildings and precincts include NABERS and BASIX ratings for buildings and transparency in emissions reporting of electricity retailing.

Priority 3 - Invest in the next wave of emissions reduction innovation to ensure economic prosperity from decarbonisation beyond 2030.

The priority notes the significant potential to cut emissions from onsite fuel use through electrification and renewable energy.

4.1.3. NSW The Climate Change (Net Zero Future) Act 2023 - Net Zero Commission

The Net Zero Commission provides an annual report to monitor, review, report on and advise on progress towards net zero targets set by The Climate Change (Net Zero Future) Act 2023. These targets include:

- 50% reduction on 2005 levels by 30 June 2030.
- 70% reduction on 2005 levels by 30 June 2035.
- Net zero by 30 June 2050.

In 2024, NSW released the first annual Net Zero Commission report. It is reported that the state's total emissions decreased by 27% or 42 Mt CO_2-e between 2005 and 2022. Built environment was the only sector to record an increase in emissions, rising from 4 Mt CO_2 -e to 7.7 Mt CO_2 -e.

According to the state's emissions inventory, the electricity and energy sector is the largest source of emissions, followed by the transport sector. Emissions in the Electricity and energy sector are primarily driven by fossil-fuel-based electricity generation.

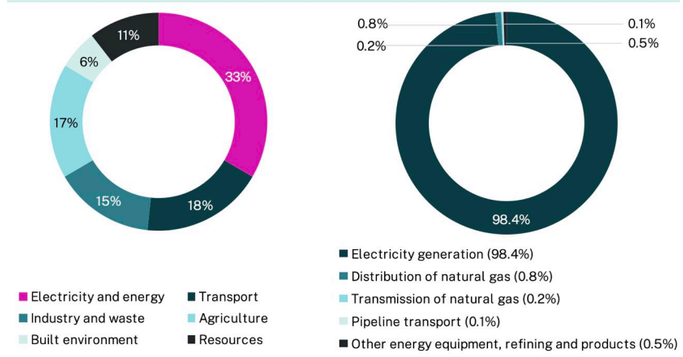


Figure 55. NSW Emissions breakdown year 2022.

It is noted that the Net Zero Commissions reporting of the Built Environment sectors contribution to NSW emissions does not include scope 2 electricity emissions. The impact of electrcity use within the building environment is included with the Electricity and energy sector.

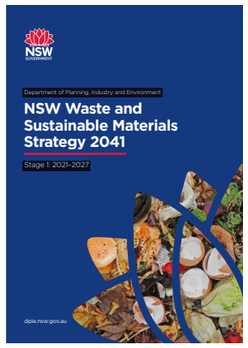
According to the report, the electricity and energy sector will remain central to achieving net zero by reducing its own emissions and enabling other sectors to decarbonise through electrification.

Meeting the 2030 and 2035 targets will also require faster progress in transport, buildings, and resource management, where emissions-reduction technologies are already available.

Additionally, there are proposed coal mine expansions and extensions that pose a risk of increasing emissions. These projects could place greater pressure on other sectors to further reduce their emissions in order to keep NSW on track to meet its climate goals.

[8] 2100 Warming Projections: Emissions and expected warming based on pledges and current policies. November 2022. Available at: https://climateactiontracker.org/global/temperatures/

4.1.4. Waste and Sustainable Materials Strategy 2041 Stage 1: 2021-2027



The NSW government is committed to participating in the transition to a circular economy over the next 20 years. Stage 1 of the Waste and Sustainable Material Strategy outlines the actions to be taken in the first six years to deliver the circular economy objective.

The targets are given as follows:

-Reduce total waste generated by 10% per person by 2030

-Have an 80% average recovery rate from all waste streams by 2030

- Significantly increase the use of recycled content by governments and industry
- Phase out problematic and unnecessary plastics by 2025
- Halve the amount of organic waste sent to landfill by 2030

The target of halving the amount of organic waste in landfills is particularly relevant to multi-unit residential development planning.

The NSW Government proposes mandating source-separated Food Organics and Garden Organics (FOGO) collection services[9]. These mandates will apply to businesses starting 1 July 2026[10] and households from 1 July 2030. This initiative aims to halve the amount of organics, including food waste, going to landfill and achieve net zero emissions from organics in landfill by 2030. This mandate will affect all residential buildings.

A circular economy is one where the value of resources is retained for as long as possible. In addition to minimising resource consumption and maximising reuse and recycling, a circular economy for the built environment also includes concepts such as design for longevity, adaptability and disassembly, and the provision of goods as a service.

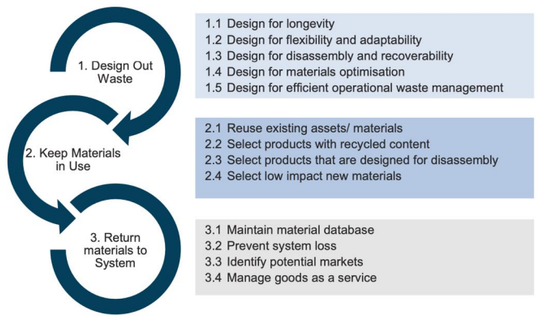


Figure 56. Circular economy strategies for the built environment source: NSW DPIE[11]

4.1.5. Greater Sydney Water Strategy 2022

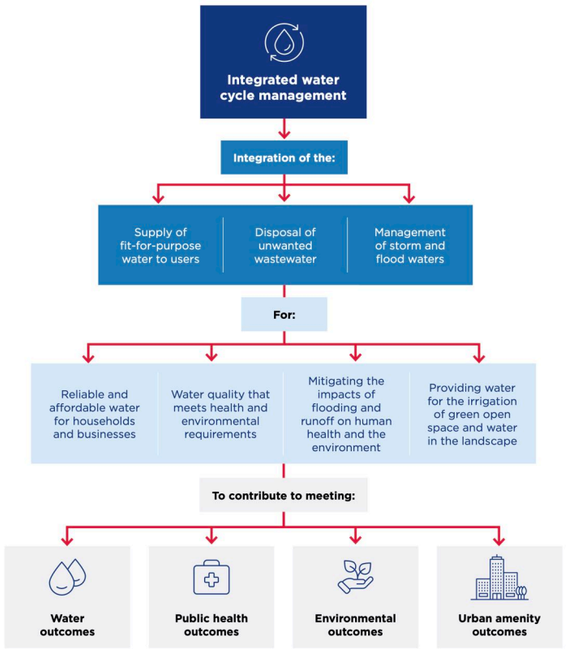


Figure 57. Integrated Water Cycle Management source: NSW DPE

The Greater Sydney Water Strategy charts the long-term vision and direction for ensuring the region's sustainable and resilient water services for the next 20 years. The report notes that the future water demand in Greater Sydney will exceed the sustainable supply from existing infrastructure to the finite limitation of the water catchment area and the need to move toward rainfall-independent sources of water.

The strategy includes delivering drinking water, wastewater, recycled water and stormwater services. A core focus of the strategy is better integration with land use planning, the need for rainfall-independent water sources and the supply of fit-for-purpose water to users.

Priorities in the strategy that may guide the development of new development controls are:

Priority 2 - Our water systems are sustainable for the long term and resilient to extreme events.

This priority includes further water conservation and new rainfall-independent supply capacity planning.

Priority 3 - Our City is green and liveable.

This priority considers several approaches to cool and green Greater Sydney, including:

- Integrate water cycle and land use planning
- Support the design principles for Greater Sydney
- Water for green public and private spaces
- Progress a circular economy approach

In addition to conservation and reuse, the integrated water cycle approach acknowledges that rainfall on a site must be treated as a resource to be retained and utilised.

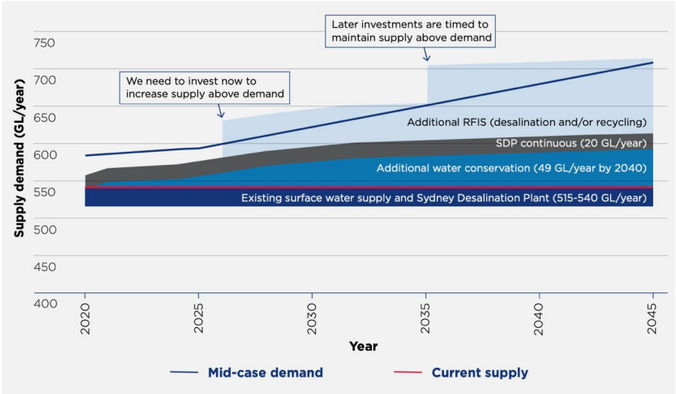


Figure 58. Portfolio of actions to support growth source: NSW DPE[12]

[9] Food and Garden Organics mandates proposed paper. NSW EPA. https://hdp-au-prod-app-nswepa-yoursay-files.s3.ap-southeast-2.amazonaws.com/8617/1688/1797/Food_and_garden_organics-mandates-proposal-paper.pdf

[10] Protection of the Environment Legislation Amendment (FOGO Recycling) Bill 2024. Parliament of New South Wales. https://www.parliament.nsw.gov.au/bills/Pages/bill-details.aspx?pk=18693

[11] Circular Design Guidelines for the Built Environment - Online Workshop Discussion Guide

[12] Greater Sydney Water Strategy August 2022 NSW Department of Planning and Environment

4.1.6. Ozone Protection and Synthetic Greenhouse Gas Management Amendment (2024 Measures No. 1) Regulations 2024.

Starting 1 July 2024, Australia has banned the import of small air conditioning equipment designed to use hydrofluorocarbon (HFC) refrigerants with a Global Warming Potential (GWP) of over 750.

This includes equipment with a standard charge of up to 2.6 kg or less of refrigerant intended for cooling, heating, or both for human comfort in a stationary space.

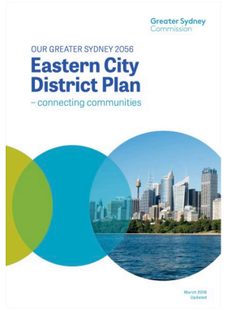
The ban applies even if the equipment is imported without refrigerant. It covers:

- Outdoor units of single-head split system air conditioners.
- Portable air conditioners.
- Wall or window-mounted air conditioners.

It is reasonable to assume that similar bans will be implemented in the future for larger equipment to meet national commitments.

4.2. Local Planning Context

4.2.1. Eastern City District Plan



The Eastern City District Plan is a 20-year plan to manage growth in the context of economic, social and environmental matters to achieve the 40-year vision for Greater Sydney.

Relevant directions for sustainability:

“A city in its landscape”

Planning Priority E14. Protecting and improving the health and enjoyment of Sydney Harbour and the District’s waterways.

Objective 25. The coast and waterways are protected and healthier.

Planning Priority E15. Protecting and enhancing bushland and biodiversity.

Objective 27. Biodiversity is protected, urban bushland and remnant vegetation is enhanced.

Planning Priority E17. Increasing urban tree canopy cover and delivering Green Grid connections.

Objective 30. Urban tree canopy cover is increased.

Objective 32. The Green Grid links parks, open spaces, bushland and walking and cycling paths.

Planning Priority E18. Delivering high quality open space.

Objective 31. Public open space is accessible, protected and enhanced.

“An efficient city”

Planning Priority E19. Reducing carbon emissions and managing energy, water and waste efficiently.

Objective 33. A low-carbon city contributes to net-zero emissions by 2050 and mitigates climate change.

Objective 34. Energy and water flows are captured, used and re-used.

Objective 35. More waste is re-used and recycled to support the development of a circular economy.

“A resilient city”

Planning Priority E20. Adapting to the impacts of urban and natural hazards and climate change.

Objective 36. People and places adapt to climate change and future shocks and stresses.

Objective 37. Exposure to natural and urban hazards is reduced.

Objective 38. Heatwaves and extreme heat are managed.

4.2.2. Our Future 2036 - Community Strategic Plan

Our Future 2036 captures community’s collective vision for the City of Canada Bay from now until 2036.

Direction that guides the community strategic plan relevant to sustainability:

Direction 2 Sustainable and Thriving Environment

The community strategic plan provides 5 future goals set for 2036 under Direction 2:

1. Reduce greenhouse gas emissions.
2. Increase urban tree canopy.
3. Reduce waste to landfill through waste avoidance and increasing recycling and reuse.
4. Enhance and protect native flora and fauna to support local biodiversity.
5. Improve access to, and enhance quality of, foreshore and waterways.

Community Strategic Plan provides four indicators below to achieve Direction 2.

OUR INDICATORS			
Biodiversity and climate mitigation		**Resource recovery**	
Measure: Increase in tree canopy	**Scope:** Influence	**Measure:** Waste diverted from landfill	**Scope:** Influence
Target/trend: On track to increase to 25% by 2040	**Source:** Council data collected to monitor the Urban Tree Canopy Strategy	**Target/trend:** Increase to 60% by 2026–27	**Source:** Council data collected to monitor the Resource Recovery and Waste Strategy
Access to foreshore		**Carbon emissions**	
Measure: Satisfaction level with foreshore access	**Scope:** Influence	**Measure:** Net zero community emissions	**Scope:** Influence
Target/trend: On track to increase to 75% by 2026	**Source:** Community Satisfaction Survey	**Target/trend:** On track to achieve by 2050	**Source:** Council data collected to monitor Emissions Reduction Action Plan

Figure 59. Community Strategic Plan indicators.

4.2.3. City of Canada Bay Local Strategic Planning Statement (LSPS)

The Local Strategic Planning Statement (LSPS) is informed by a range of guiding frameworks, including the Eastern City District Plan, Future Transport Strategy 2056, the State Infrastructure Strategy and other Council's planning and controls, such as Local Environmental Planning (LEP), Development Control Planning (DCP), and Contributions Plans, to provide a cohesive strategic framework at the local level.

LSPS is also informed by *Your Future 2030* Community Strategic Plan to reflect the community's key aspirations and pathways to achieve them.

Relevant land use visions are:

- Improve access to the Parramatta River foreshore.
- Facilitate sustainable development and renewal.
- Increase biodiversity and the urban tree canopy.

The LSPS provides Sustainability visions/values and planning priorities. Relevant aspects are highlighted below:

Planning Priorities 13. Protect and improve health and enjoyment of the Parramatta River Catchment and waterways.

Action 13.2 Review and update water sensitive urban design controls to ensure:

- Reduced stormwater runoff volumes and pollution entering waterways;
- Pervious areas are maximised.
- All stormwater is treated before it reaches waterways.
- Stormwater management systems are vegetated to slow down and clean runoff and provide passive irrigation, greening and urban cooling on lot, street, and precinct scales.

Planning priorities 14. Protect and enhance bushland and biodiversity.

Action 14.1 Implement land use planning actions arising from the preparation of the Canada Bay Biodiversity Framework.

Action 14.2 Review the land use zones and environmental controls in the Canada Bay LEP and DCP to ensure that significant remnant habitats are retained to protect endangered flora and fauna, and improve habitat connectivity.

Action 14.3 When preparing planning studies and controls, create links to habitat sites through canopy cover, the Green Grid and waterways and improve planting of shrubs and understory.

Planning priorities 14. Protect and enhance bushland and biodiversity.

Action 14.1 Implement land use planning actions arising from the preparation of the Canada Bay Biodiversity Framework.

Action 14.2 Review the land use zones and environmental controls in the Canada Bay LEP and DCP to ensure that significant remnant habitats are retained to protect endangered flora and fauna, and improve habitat connectivity.

Action 14.3 When preparing planning studies and controls, create links to habitat sites through canopy cover, the Green Grid and waterways and improve panting of shrubs and understory.

Planning priorities 16. Increase urban tree canopy and deliver Green Grid connections.

Action 16.1 Prepare a street tree Masterplan in accordance with the principles and outcomes of the Canada Bay Urban Tree Canopy Strategy to increase tree canopy on public land.

Action 16.3 Increase urban tree canopy on private land by amending the Canada Bay DCP to:

- Update the list of recommended tree species;
- Require tree planting when land is redeveloped;
- Include appropriate controls to protect trees, including the definition of a tree.

Action 16.4 Investigate the potential for landowners to provide a monetary contribution towards the planting of trees on public land when replacement planting is unable to be accommodated on private land.

Action 16.5 Ensure that Masterplans and Precinct Plans achieve a minimum of 25% canopy cover. Where targets are unable to be achieved on individual sites, a precinct wide target is to be achieved.

Action 16.6 Prepare a Green Grid delivery strategy that seeks to align the relevant recommendations contained within the:

- Biodiversity Strategy;
- Urban Tree Canopy Strategy;
- Social Infrastructure (Open Space and Recreation) Strategy;
- Local Movement Strategy;
- Walking Strategy.

Planning priorities 17. Deliver high quality open space and recreation facilities.

Action 17.1 Consider and implement the Canada Bay Social Infrastructure (Open Space and Recreation) Strategy to deliver:

- The expansion of Fred Kelly Place on the eastern and western side of Great North Rd in Five Dock.

Planning priorities 18. Reduce carbon emissions and manage energy, water and waste efficiently.

Action 18.1 Advocate for increased BASIX water and energy targets.

Action 18.3 Where appropriate, develop controls to compel developers to connect to planned recycled water schemes for all non-potable water uses, including dedicating space for required metering, storage, connection and plumbing infrastructure.

Action 18.4 Undertake a Waste Management Review to identify potential improvements to the waste related controls in the Canada Bay Development Control Plan, to assist in developing a circular economy.

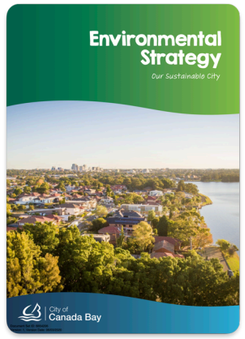
Action 18.5 Undertake a review of Canada Bay DCP to:

- Identify provisions for electric vehicles and shared infrastructure;
- Consider whether there is a need to provide controls regarding solar panels; and
- Require a dedicated space for battery storage.

Action 18.6 Prepare a Guideline to inform the implementation of green infrastructure as part of development, with consideration given to:

- Green roofs and walls; and
- Passive design to ensure efficient and resilient buildings.

4.2.4. Environmental Strategy 2020 - Our Sustainable City



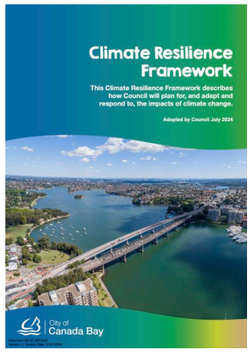
This strategy builds upon the delivery strategies established in Council's long term community plan, *Your Future 2030*. It provides Council's environmental commitment into four key themes, three of which below are relevant to the Five Dock Masterplan.

"Connected to nature"		
3.1a Biodiversity	Target: - No decrease in native fauna species - compared to the 2014 Fauna Survey. - No decrease in native plant species - as compared to those identified in the 2019 Biodiversity Framework - No decrease in the area or number of vegetation communities - compared to OEH 2016 mapping.	Goal: - Improve connectivity and protect the current habitat. - Protect and enhance habitat for fauna. - Plant species that are characteristics of naturally occurring vegetation communities and habitat requirements. - From our bush regeneration and Bushcare volunteers program. - Increase and protect habitat areas, fauna, and native species. - Empower residents to increase biodiversity on their own properties. increase involvement in citizen science programs.
3.1b Urban canopy	Target: Increase tree canopy cover from 18.2% across the city to 25% by 2040.	Goal: - Increase the number of trees by planting over 2,500 trees per year. Plant the right tree in the right place. - Move towards managing trees as an asset and as part of ecosystem approach. - Increase trees on both public and private land.
3.1c Waterways	Target: Make the Parramatta River swimmable again by 2025.	Goal: Increase the adoption of WSUD principles on private and public land.

"Resilient city"		
3.2a Climate change		Goal: - Embed climate resilience within Council's planning and management. - Improve liveability through cooling and heat mitigation measures. - Increase tree canopy. - Promote WSUD principles. - Educate the community on key climate risks and vulnerabilities and provide strategies to respond to these. - Emergency response for community, particularly members most vulnerable to the impacts of climate change (i.e. children and elderly population). - Collaborate with businesses, utilise and other government agencies to strengthen our complex infrastructure network to withstand proposed climate change impacts.
3.2b Transport	Target: - 5% of trips made by cycling by 2036 (1% in 2016). - 20% of trips made by walking by 2036 (12% in 2016). - 30% increase in total kilometres of cycleways from 2019 baseline by 2030 (39km of cycleway in 2019).	Goal: - Improved access to sustainable transport options. - Improved cycleway facilities. - Improved walkability and accessibly to ease congestion. - Improved health outcomes. - Reduced emissions and pollutions.

"Resource efficient community"		
3.3a Waste	Target: - Residential waste - increase waste diverted from landfill to 75% of total waste by 2021-22 (state target). - Litter 50% reduction - in identified hotspot locations.	Goal: - Use innovation and technology to improve resource recovery. - Work with our community to reduce kerbside recycling contamination. - Reduce litter and illegal dumping. - Improve data collection, monitoring and reporting. - Influence building design to improve waste outcomes. - Increase community clean up participation. - Reduce emissions from waste through greater diversion from landfill. - Support the community to adopt waste avoidance behaviours.
3.2b Transport		Goal: - Support the community on their journey to reduce their emissions. - Council lead by example inspiring the community to reduce their own emissions. - Reduce energy costs for households and businesses. - Educating, training and supporting the community through programs to reduce emissions focusing on key areas: • Energy efficiency. • Renewable energy generation through solar PV. • Buying renewable energy. • Fuel switching from gas to electricity. • Transition to electric vehicles.
3.3c Water	Target: Community target of no net increase on average annual household water consumption based on 2017-18 levels.	Goal: Support the community to reduce potable water consumption.

4.2.5. Climate Resilience Framework



Climate Resilience Framework sets out City of Canada Bay Council's goals to 2035 with actions for implementation within the next four years, from 2025 - 2029.

City of Canada Bay Council is already responding to climate change through adopted individual targets and plans below:

- Increasing canopy cover through tree planting in streets, parks, and gardens.

This includes 25% tree canopy cover by 2040 and 25% reduction in potable water use based on 2013 consumption, while refer to Urban Tree Canopy Strategy and Nature Strip Policy.

- Improving the health of Parramatta River.
- Conserving and enhancing natural areas and biodiversity.
- Transport resilience.

This includes a target of 5% of trips made by cycling and 20% of trips made by walking by 2036, increase EV charge points, bike plan and other transport strategies.

- Climate mitigation

This includes target to achieve Community Net Zero by 2050, reducing waste sent to landfill per person by 20% by 2030, organics collection and recycling program diverting waste from landfill by 2026.

4.2.6. Emissions Reduction Action Plan

This action plan supports the delivery of targets outlined in the City of Canada Bay's Environmental Strategy. It is also guided by Your Future 2030 Community Strategic Plan.

The City of Canada Bay's community target is to reach net-zero emissions by 2050, with 2035 interim emissions target of 351,682 tCO2-e (~45.5% reduction from 2020).

The action plan to achieve the target is organised into seven priority areas:

	**Grid decarbonisation** To keep abreast of changing trends, lobby effectively and use trends to inform future revisions to Council's community climate change plans and targets.
	**Buying clean energy** To provide the residential and business community with the most current information about the renewable energy market, to help accelerate the transition to clean energy. Council is aware that changing to renewable energy supply may be one of the most cost-effective ways for the City of Canada Bay community to reduce its emissions over the long term.
	**Generating renewable energy** To triple the amount of solar PV capacity in Canada Bay by 2025 through its support initiatives and the community's response to climate change. This equates to a further 17 MW of solar PV capacity across all sectors of the community, as monitored and reported by the CER.
	**Energy efficiency** To achieve changes to the BASIX requirements that will see future new single and multi-unit residential developments achieve a significantly higher level of energy efficiency. To see sustained reductions in the amount of stationary energy (electricity and natural gas) consumed per resident and per business in the City of Canada Bay, as monitored via annual reporting by utilities.
	**Sustainable transport** Recommended actions in this study refer to measures that can help to reduce climate change impacts of transport and are a subset of the adopted Local Movement Strategy.
	**Waste management** Council is undertaking a broader waste strategy review and action plan development, including the challenges and options relating to waste disposal.

4.2.7. City of Canada Bay Urban Tree Canopy Strategy

This strategy provides key directions for on-going planning and management of the City of Canada Bay's urban forest under five priorities categories into short-, medium-, and long-term actions to achieve Council's vision and targets to 2040.

Vision

The council's vision is underpinned by the principle of "right tree, right place", aims to grow and protect the urban forest by:

- Ensuring that trees are selected that align with community values for shade, playable spaces, and cultural relevance;
- Matching tree size and form to local growing conditions, such as in streets and parks;
- Accounting for future potential tree related risks to people and infrastructure;
- Allowing for projected changes in the local climate.

Target and outcomes

The City of Canada Bay will increase its the canopy cover across the city to at least 25% by 2040, an increase of over 6%. The increase in canopy cover will occur primarily in streets and parks on public land and by working with private land holders.

Objectives

7.3.1 Protect and value - Ensure that tree management policies and programs help to protect the urban forest by increasing the retention of existing trees on public and private land.

7.3.2 Renew and grow - Ensure that tree planting programs strategically plan for increasing the total canopy cover across council.

7.3.3 Support and sustain - Manage the health and condition of urban trees to minimise risk and support and sustain healthy, growing urban forest.

7.3.4 Engage and create - Work with the community and key stakeholder groups to enhance the urban forest for amenity, liveability, and biodiversity benefits and provide opportunities for collaboration.

7.3.5 Manage and resource - Reduce conflicts between people, infrastructure and trees and ensure adequate funding is available to support urban forest growth and management.

4.2.8. Canada Bay Biodiversity Framework and Action Plan

Visions:
"Our community shares a collective responsibility to protect or environment and actively participates in innovative programs to mitigate climate change. These programs, along with our well cared for and cherished, active and passive open spaces and waterways, are sustaining our future."

Relevant themes:

Native vegetation: Protection, managing and restoring native vegetation and biodiversity for current and future generations.

Corridors and Connectivity: enhancing landscape linkages.

Public Space: managing our reserves to promote biodiversity and community interaction.

Urban Habitat: protecting, conserving and managing biodiversity with the community in the urban landscape.

Green Infrastructure: providing opportunities for green infrastructure, innovation, enhancements and demonstration of excellence in biodiversity, and fostering partnerships and education opportunities in Canada Bay.

4.2.9. Resource Recovery and Waste Strategy

Key goals:

- Reduce waste to landfill and reduce greenhouse gas emissions.
- Recycle and reuse more.
- Improve our waste service.
- Reduce litter and illegal dumping.
- Lead by example.

Relevant targets:

- Reducing waste sent to landfill per person by 20% by 2030.
- Increasing diversion of landfill from 38% to 60% by 2027.
- Reducing contamination in our recycling to below 10% by 2025.
- Maintaining 93% community satisfaction with our services.
- Reducing the total number of illegal dumping incidences per year from a baseline of 1,180 events in 2019-20.

4.2.10. City of Canada Bay Council Social Infrastructure (Open Space and Recreation) Strategy and Action Plan 2019

Open space and recreation principles to drive the design, delivery and management of open space and recreation facilities to 2036 in City of Canada Bay. Below are the relevant principles:

- Optimise capacity - Address current and future gaps by realising the capacity of existing open space and recreation facilities.
- Diversity - Deliver open space and recreation facilities, services and programs to cater for the informal and formal recreation needs of the diversity of age groups, cultures and genders.
- Accessibility and connectivity - Improve accessibility and connectivity to open space and recreation facilities, services and programs through green streets, active transport links, affordable access, universal design, and equitable distribution.
- Well-designed - be adaptable and future-proof open space for growth through co-located, multipurpose, shared use, diverse and flexible space. Optimise recurrent asset management and maintenance costs.
- Sustainability - be environmentally and financially sustainable through the provision of recreation facilities and programs;
  - That enhance connections to nature, biodiversity, ecology and mitigate the impacts of climate change.
  - That remain fit for purpose through quality maintenance and asset management.

The Strategy and Action Plan outlines open space and recreation priorities to 2036. Relevant priorities for Five Dock Metro Precinct are:

- New open space in town centre (minimum 0.3 ha) to support increased population including form future Metro station (2036).
- New youth and recreation area (2026).

4.2.11. City of Canada Bay Development Control Plan (DCP) 2023

This section provides overview of Canada Bay DCP 2023 in relation to sustainability.

B3 Vehicle and bicycle parking and access

B3.6 Bicycle parking and storage facilities.

This section outlines controls designed to promote bicycle use among residents, employees, and visitors within the LGA, providing minimum requirements for bicycle parking and storage in residential, commercial, and industrial developments.

B3.7 End of trip facilities.

This section provides controls for bicycle end of trip facilities in non-residential developments and public domain.

B3.8 Electric Vehicles.

This section provides minimum electric vehicle charging facilities based on development typologies.

B4 Waste Management

This section provides waste management controls for:

- Waste source separation facilities and collections - includes onsite separation and the facilities capacity for residential and mixed-use buildings and its amenity, waste vehicle access, and chutes.
- Building construction waste - includes minimisation of materials with building design to align with standard material sizes, reuse and recycle, and replaceable building components.

B5 Water Conservation

This section provides water conservation controls to satisfy BASIX and WSUD strategies. This includes water saving devices and strategies, fit-for-purpose water usage and minimum water requirements.

B6 Urban Forest

B6.3 City of Canada Bay tree species

This section provides controls to prioritise planting and conservation of native and exotic species and lists of flora species that is indigenous to Canada Bay LGA.

B6.4 Biodiversity

This section provides controls and mapping of Biodiversity map in Canada Bay LGA for E2 Environmental Zone. The mapping shows no Zone E2 within the Precinct.

B6.5 Habitat Connectivity

This section provides habitat connectivity map in Canada Bay LGA for biodiversity corridor. The mapping shows that the Precinct is not located within a Biodiversity Corridor.

B6.7 Replacement planting

This section provides replacement planting ratio for trees removed from private land.

B6.9 Threatened and migratory species

This includes controls and mapping of buffer area for threatened and migratory species. The map shows one buffer area within the Precinct where Long-nose bandicoot is spotted.

B6.10 Urban Tree Canopy

This section outlines the minimum tree canopy cover requirements based on lot size/dwelling and replacement ratios for any trees removed, as well as deep soil requirements.

B11 Energy Efficiency

This section outlines controls to support current or future installation of energy efficient technologies.

Part E and F Environmental Criteria and residential amenity

These sections outline controls design for solar access for single and multi residential buildings.

4.3. SEPPs and NCC

4.3.1. State Environmental Planning Policy (Sustainable Buildings) 2022

The Sustainable Buildings (SB) SEPP and Regulation amendments commence on 1 October 2023.

The SB SEPP replaces the BASIX SEPP, changes the BASIX standards and introduces new requirements for non-residential buildings.

Non-compete provisions.

The BASIX non-compete provisions are retained in the SB SEPP. A competing provision of an environmental planning instrument or development control plan, whenever made, is of no effect to the extent to which the provision aims:

a. To reduce consumption of mains-supplied potable water or greenhouse gas emissions related to the use of:
   - a building, or
   - The land on which a building is located, or

b. To improve the thermal performance of development, or

c. To quantify and report on the embodied emissions attributable to development.

The non-compete provisions do not apply to the non-BASIX portion of a mixed-use development or where a planning instrument offers incentives for the adoption of measures beyond the measures required by provisions of the kind referred to in the definition of competing provision.

The non-compete provisions are not extended to any other aspect of the SEPP apart from BASIX.

Changes to BASIX standard.

The SEPP requires improved BASIX targets for greenhouse gas emissions. However, the relative improvement gained from the improved greenhouse gas emissions target is difficult to quantify due to several changes to the BASIX scoring methodology. The changes included:

- Updating of the emission coefficients applied to gas and electricity use.
- Changing to the technical scoring of some elements, such as heat pumps.
- Changes to the relative contribution of thermal performance assessed with NatHERS.
- Changes to the height bands that are used for different targets.

Whilst the precise improvement in requirements cannot be determined, it is clear that the more ambitious greenhouse gas targets are likely to require an improvement in energy efficiency in the order of 20% on a like-for-like basis.

There is no increase in the BASIX water targets.

4.3.2. State Environmental Planning Policy (Housing) 2021

The SEPP 65 was rescinded in December 2023, and the provision for better apartment design was consolidated into Chapter 4 of State Environmental Planning Policy (Housing) 2021 (Housing SEPP).

The Housing SEPP maintains the design quality principles and the operation and provisions of the Apartment Design Guide (ADG).

Relevant aims of Chapter 4 of the Housing SEPP include

- Improving the design quality of residential apartment development to ensure that it contributes to the sustainable development of New South Wales by providing sustainable housing in social and environmental terms
- to maximise amenity, safety and security for the benefit of its occupants and the wider community, and
- to minimise the consumption of energy from non-renewable resources, to conserve the environment and to reduce greenhouse gas emissions.

Schedule 9 provides Design principles for residential apartment development. The most relevant to environmentally sustainable design in the Five Dock Metro Precinct Masterplan are Principles 4, 5 and 6.

The Housing SEPP requires that development consent must not be granted unless the quality of the design has been evaluated in accordance with :

- The design principles for residential development in Schedule 9
- The ADG
- Any advice from a design review panel.

A change in the SEPP is the additional clarification that evaluation in accordance with the ADG does not require a consent authority to require compliance with design criteria specified in the ADG.

The Housing SEPP, like SEPP 65 before confirms that the ADG prevails over any requirement, standard or control within a DCP, regardless of when made, in relation to scheduled matters. The matters scheduled relevant to environmental sustainability are:

(b) solar and daylight access,

(f) private open space and balconies,

(g) natural ventilation,

A non-discretionary standard requires that the car parking for the building must be equal to, or greater than, the recommended minimum amount of car parking specified in Part 3J of the ADG. The Design Criteria supporting Objective 3J-1 establishes the minimum requirements as being set out in the Guide to Traffic Generating Development, or the car parking requirements prescribed by the local council, whichever is less.

4 Sustainability

(1) Good design combines positive environmental, social and economic outcomes.

(2) Good sustainable design includes—

(a) use of natural cross ventilation and sunlight for the amenity and liveability of residents, and

(b) passive thermal design for ventilation, heating and cooling, which reduces reliance on technology and operation costs.

(3) Good sustainable design also includes the following—

(a) recycling and reuse of materials and waste,

(b) use of sustainable materials,

(c) deep soil zones for groundwater recharge and vegetation.

5 Landscape

(1) Good design recognises that landscape and buildings operate together as an integrated and sustainable system, resulting in development with good amenity.

(2) A positive image and contextual fit of well designed development is achieved by contributing to the landscape character of the streetscape and neighbourhood.

(3) Good landscape design enhances the development's environmental performance by retaining positive natural features that contribute to the following—

(a) the local context,

(b) co-ordinating water and soil management,

(c) solar access,

(d) micro-climate,

(e) tree canopy,

(f) habitat values,

(g) preserving green networks.

6 Amenity

(1) Good design positively influences internal and external amenity for residents and neighbours.

(2) Good amenity contributes to positive living environments and resident well-being.

(3) Good amenity combines the following—

(a) appropriate room dimensions and shapes,

(b) access to sunlight,

(c) natural ventilation,

(d) outlook,

(e) visual and acoustic privacy,

(f) storage,

(g) indoor and outdoor space,

(h) efficient layouts and service areas,

(i) ease of access for all age groups and degrees of mobility.

4.3.3. National Construction Code of Australia

The Building Code of Australia (BCA) is not an item for consideration under Clause 4.15 of the EP&A Act. However, any proposed development is required to be capable of complying with the BCA.

The energy efficiency provisions of the BCA are not enforced in NSW, where BASIX is used instead.

Energy efficiency requirements for non-residential buildings remain relevant in NSW.

New additions for NCC 2022 BCA Volume One that commence in May 2023 and are adopted in NSW, relevant to sustainability are:

J9D4 Facilities for electric vehicle charging equipment

Car parks associated with Class 2, 3, 5, 6, 7b, 8 or 9 buildings must be provided with electrical distribution boards dedicated to electric vehicle charging under the Deemed to Satisfy (DTS) provisions.

The distribution boards are to be sized to support the connect:

- 100% of car park space associated with a Class 2 buildings
- 10% of car parking spaces associated with a Class 5 or 6 building
- 20% of car parking spaces associated with a Class 3, 7b, 8 or 9 building; and

J9D5 Facilities for solar photovoltaic and battery systems

Switchboards must include empty circuit breakers for fire safety of batteries and photovoltaic sized to accommodate solar photovoltaic panels on at least 20% of the building roof area. Additionally, at least 20% of the roof area of a building must be left clear for installing solar photovoltaic panels.

The DTS EV provisions are considered very robust and essential for more sustainable buildings. However, the performance requirement is far less robust and may not result in the necessary infrastructure being provided.

Volume Two of the NCC 2022 BCA contains the requirements for single-occupant dwellings and does not include renewables or EV charging requirements.

NCC 2025 has been exhibited as a draft for public comment. There are changes proposed for the energy efficiency of commercial buildings, the most material of which are:

- Increased EV charging requirements.
- A requirement for rooftop solar for 100% of the roof not serving other uses (plant, equipment, roof garden, etc.)
- Significantly reduced envelope solar admittance.

Section 5
Precedents

5. Precedents

5.1. Local Planning Instruments

This section presents precedents of sustainability controls from LEP or DCPs.

5.1.1. Woollahra

The Woollahra DCP was the first to adopt a provision for electric vehicle charging in new development. Whilst innovative at the time, the requirements have since been slightly improved upon in other DCPs and the new NCC 2022 BCA provisions.

Other ESD controls, such as NABERS for office buildings, need to be updated. The current requirement for 4-star NABERS for new development represents a low performance level relative to existing building stock and needs to catch up to contemporary targets for new buildings.

Amendments to the DCP currently on exhibition include new urban greening controls framed by an objective of mitigating urban heat:

- A new control will require a certain percentage of the site to be covered by tree canopy. The proposed controls range from 25-35% of the site area to be covered by canopy and establish the minimum height and crown dimensions for a canopy tree.
- A deep soil control of 35% of the site area is proposed for development in our residential areas.

Illustrations support both proposed controls to describe the calculations required. Deep soil is included in the Principles of SEPP65 only in the context of recharging groundwater, and urban heat is not contemplated. The attention to tree canopy in SEPP65 and the ADG is limited to the consideration of good landscape design. Therefore, Flux considers the proposed controls complementary to, and not inconsistent with the Housing SEPP.

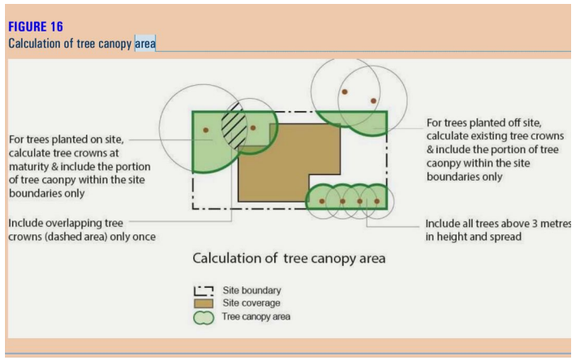


Figure 60. Diagrams to support Woollahra's proposed Urban Green controls[13]

5.1.2. Penrith

The Penrith LEP and DCP were amended in 2022 to require consideration of urban heat.

The LEP amendment has the objectives:

- to ensure development incorporates planning and design measures to reduce the urban heat island effect in Penrith, and
- to ensure buildings and outdoor spaces are thermally comfortable for people living and working in Penrith, particularly during summer, and
- to promote the cooling benefits of green infrastructure and water in the landscape to ensure

The LEP required that development consent must not be granted unless the consent authority is satisfied that planning and design measures are incorporated to reduce the urban heat island effect that:

- maximise green infrastructure, and
- retain water in the landscape, and
- use design measures to ensure the thermal performance of the development achieves a high degree of passive cooling, and
- use building, paving and other materials that minimise heat impacts, and
- reduce reliance on mechanical ventilation and cooling systems, to conserve energy and to minimise heat sources.

The supporting DCP provisions are extensive, including a glossary of terms (refer to Figure 7) and objective targets for many elements. Except for irrigation requirements, the control applies equally to development covered by BASIX.

Cool refuges: provide temperatures of no more than 27°C on extreme heat days and should also aim to achieve between 40% to 60% relative humidity. Principally through passive design for thermal comfort.

Efficient/Efficiency: The operational effectiveness of the subject is maximized by its design and location and any impacts on the effectiveness of the subject are managed or mitigated.

Extreme Heat: days where maximum air temperatures exceed 40°C.

Green roof: A green roof is vegetation covering at least 30% of available rooftop space -that is, space which is not occupied by structures housing plant, equipment, or stairway accesses. A green roof should provide measurable environmental benefits. The green roof includes a vegetated layer, growing medium, and a waterproof membrane. Plants grown in sectioned lots are acceptable, however, potted plants/planter boxes which cover less than 30% of available rooftop space are not considered as a green roof. Additional to the minimum 30% vegetation cover, a green roof can include facilities for renewable energy, water collection infrastructure, walkways, furnishings, and the like.

Green wall: Green walls are either free standing or part of a building that is partially or completely covered with vegetation. The wall may incorporate soil and/or inorganic material as the growing medium. There are two main types of green wall: green façades and living walls. Green façades are made up of climbing plants either growing directly on a wall or on specially designed supporting structures. The plant's shoot system grows up the side of the building while being rooted in the ground. With a living wall, modular panels are affixed to the wall and geo-textiles, irrigation and a growing medium combine to support a dense network of plants.

High Albedo: high solar reflectance

High thermal emittance: materials that release heat quickly.

Hot days: where maximum air temperatures exceed 35°C.

Solar Reflectance Index: (SRI) measures a surface's ability to reflect solar heat, as shown by a small temperature rise caused by the materials reflectance and emittance properties. It is defined so that a black surface is 0 and a white surface is 100.

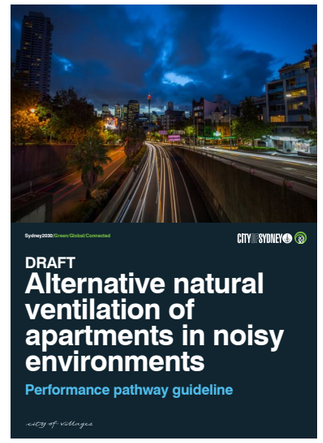
Thermal comfort/thermally comfortable: temperatures of between 22°C to 27°C, with a relative humidity of 40% to 60%.

Urban Heat Island Effect: increased heat in developed areas, when compared with the temperatures in nearby areas with less development.

Figure 61. Definitions supporting Penrith's Urban Heat Management controls[14]

5.1.3. City of Sydney

The City of Sydney has published guidelines to support the DCP.



The draft performance pathway for natural ventilation in noise-affected environments[15] describes a process to demonstrate alternative natural ventilation solutions to comply with the ADG requirements for natural ventilation and acoustic amenity.

The pathway allows natural ventilation to be supplied through acoustically attenuated openings with sizes less than specified in the ADG, subject to demonstration of adequate performance, with the balance of the ADG opening requirement provided without attenuation.

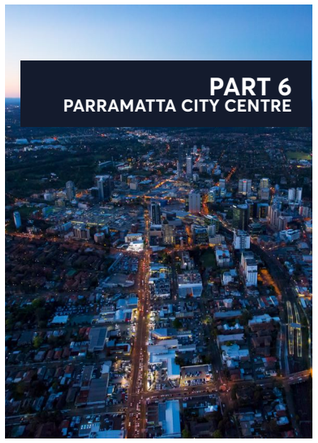
A passive sustainability design guide is published to: describe how passive design contributes to "sustainable design" and "ecologically sustainable development" (ESD) that are required to be addressed in Sydney Local Environmental Plan 2012 and the meaning of "passive environmental design" in the NSW government's Apartment Design Guide (ADG).

[13] source: draft DCP amendments - August 2022. Retrieved from https://yoursay.woollahra.nsw.gov.au/download_file/1253/819

[14] source: Penrith DCP 2014.

[15] https://www.cityofsydney.nsw.gov.au/-/media/corporate/files/2020-07-migrated/files_n/natural-ventilation-guide-note-310818.pdf?download=true

5.1.4. City of Parramatta



The City of Parramatta amendments to the LEP and DCP to introduce new controls for the Parramatta City Centre were effected in October 2022.

The new LEP provisions related to sustainability include end-of-journey facilities, dual water systems and high-performance buildings.

The dual water systems provision was to give more weight to an existing DCP provision with the objective of ensuring water security in the Parramatta City Centre.

The high performance building design provisions apply to hotels/motels, offices, residential flat buildings, large retail premises, serviced apartments and mixed-use developments. The requirement for residential flat buildings is attached to an FSR bonus of up to 5% for residential accommodation.

Figure 9 shows the published targets for residential and non-residential buildings. The residential targets are published relevant to BASIX before the SB SEPP and will need to be amended. The non-residential targets need more clarity on how they are to be measured, so will rely on the DCP to be effective.

(f) the part of a building that is a dwelling is capable of exceeding—

(i) the applicable BASIX target for water by at least 15 points or equivalent, and

(ii) the applicable BASIX target for energy by at least the amount of points specified for the building in the following table, or equivalent—

Height of building	Building with FSR of at least 6:1 but less than 14:1	Building with FSR of at least 14:1
	BASIX points	BASIX points
5–15 storeys	25	15
16–30 storeys	20	10
31–40 storeys	10	10
41 or more storeys	10	10

Figure 62. Residential High Performance Building requirements for Parramatta City Centre

(a) the part of a building used for the purposes of retail premises is capable of achieving the following—

(i) a maximum energy target of 52.8kg CO_2e/m^2 per year,

(ii) a maximum water target of 1.1kL/m^2 per year,

(b) the part of a building used for the purposes of office premises is capable of achieving the following—

(i) a maximum energy target of 63.8kg CO_2e/m^2 per year,

(ii) a maximum water target of 0.5kL/m^2 per year,

(c) the part of a building used for the purposes of hotel or motel accommodation or serviced apartments is capable of achieving the following—

(i) a maximum energy target of 5,220kg CO_2e per room each year,

(ii) a maximum water target of 76.1kL per room each year.

Figure 63. Non-residential High Performance Building requires for Parramatta City Centre

Part 6 of Parramatta DCP 2012 contains many progressive new environmental sustainability controls. Most of the controls were adopted after being implemented in Design Excellence Competition briefs over several years, which provided the opportunity for feedback and tuning. The controls that were most novel were:

High performance building provisions support the LEP amendments and provide the verification requirements for non-residential buildings through equivalent NABERS ratings. The Provisions also flag the intent to improve the targets over time to maintain a performance level representing the top 15% of the market.

An **all-electric buildings** control requires that all new development uses only electricity for all requirements associated with normal operations. The objectives include:

- Reduce the combustion of fossil fuels through electric-only connected new buildings that benefit from the progressive greening of grid-supplied electricity in NSW.
- Reduce indoor air pollutants associated with the onsite combustion of gas to improve air quality for occupants.
- Operational cost savings to occupants through avoiding gas connections and ongoing connection charges.
- Reduction in the need for utility cabinets in the street and on street walls.

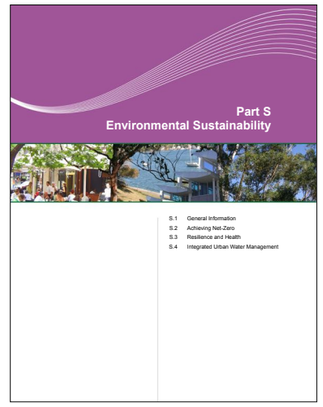
Urban cooling controls include reducing the reflectivity of solar heat from reflective building facades through the reduction of glazing or the use of external shading. The controls have numerical targets and must be demonstrated with shadow diagrams or each facade at a nominated time.

Natural refrigerants in air conditioning controls aim to reduce the use of synthetic refrigerants, which have a high Global Warming Potential. The lack of market readiness for this control is anticipated with a market availability and cost test.

Bird-friendly design controls seek to minimise the risk of bird collisions due to building facades' high transparency or reflectivity. The controls have additional provisions for developments within 100m of nominated parkland, reserves and the Parramatta River corridor.

Wintergarden controls seek to safeguard natural ventilation and cross ventilation from enclosed balconies often used to protect from external noise. The controls include a requirement for an adequate permanently open area to outside, reinforcing ADG criteria, and prohibiting heat rejection within the space.

5.1.5. Lane Cove



Lane Cove DCP amendments were effected in February 2024. The amendment introduced a new Part S Environmental Sustainability with three main areas: Achieving Net-Zero, Resilience and Health, and Integrated Urban Water Management.

The following summarises the key objectives and provisions:

All-electric buildings for all building use types

On-site Solar to an amount no less than 60% of the unutilised roof area, or 45w/m2 of the total site area for four storeys and above or, no less than 25% of the unutilised roof area, or 25w/m2 of the total site area for three storeys or less.

Refrigerant GWP limits with the same criteria applied in the Parramatta DCP

Natural ventilation for residential buildings, generally consistent and reinforcing of the ADG

Glazing with guidance on window-to-wall ratios and external shading for residential and non-residential buildings.

Urban Heat and Shade with requirements for site and roof treatments.

Sustainable materials with objectives relating to native habitat loss, toxicity and human heat risks.

Design and Construction impacts requiring a life cycle assessment for all buildings over 1000m2 GFA

Water efficiency with improvement on Sustainable Buildings SEPP requirements for non-residential buildings.

Stormwater management to reduce peak stormwater flows and maximise porous surfaces.

5.1.6. City of Canterbury Bankstown

The City of Canterbury Bankstown has adopted Masterplans and progressing development controls for the strategic growth centres of Bankstown and Campsie. Both are now being assessed as Planning Proposals by DPE.

The proposed environmental sustainability related controls include:

Powered by 100% Renewable Resources by 2050

- All-electric buildings
- Embracing electric vehicles
- Maximising Rooftop Solar
- Improved natural ventilation

Minimise Heat Island Effect

- Setback, solar amenity, deep soil landscape controls for mature trees
- Reduce heat reflectivity, absorption and rejection controls of new buildings
- Revised natural ventilation controls
- All cooling systems to use natural refrigerants
- Green roofs and green wall design

Increase Water Efficiency & Flood Resilience

- introduce a minimum BASIX water score for all new buildings, including plumbing fixtures and appliances.
- Require best practice water saving measures for all new buildings not subject to BASIX.
- Require cooling towers to meet best practice guidelines for water consumption.
- Require all new buildings to provide on-site rainwater collection and dual reticulation system for future or immediate connection to a recycled water system.

Become a Waste Smart City

- Provision for organic waste storage facilities and communal area for organic waste composting
- Provision of separate recycling chutes

The City of Canterbury Bankstown exhibited model controls and supporting rationale[16] before adopting the Masterplan.

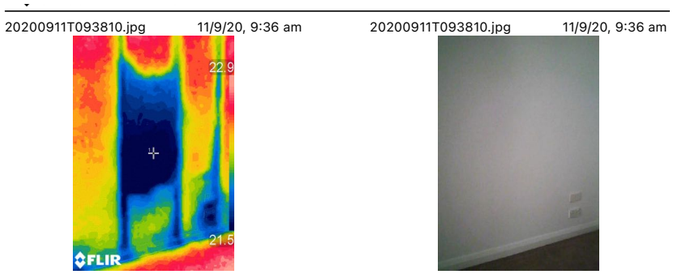
When the Masterplan was initially exhibited, it attracted significant criticism from a section of the media and politics, which presented the all-electric building controls as a ‘crazy’ plan[17] to ban the use of gas and barbecues. However, the all-electric building proposal was supported by community feedback, and the proposed control is included in the Planning Proposals.

Compliance review

The existing Bankstown LEP contains a sustainability bonus scheme, which provides additional FSR for improved outcomes. The Campsie and Bankstown Masterplans have an action to redesign the Sustainability Incentive Scheme. This is due to concerns about design and compliance with the existing scheme[18].

The review of projects awarded FSR bonuses based on improved levels of BASIX certification found evidence of non-compliance in both the original certificates and in the construction. For example, certificates were found to describe the proposed development improperly, resulting in a higher score than should have been achieved.

An inspection of a finished building found that the rainwater collection and distribution required for the BASIX certification had not been installed, and thermal insulation was improperly installed. The image below shows thermal imaging (left) of the audited apartment in Bankstown and a standard photograph of the same view (right). Dark blue colours in the thermal images show areas with insulation within the stud wall.



MEASUREMENTS (°C)	
Spot	21.5

PARAMETERS	
Emissivity	0.90
Refl. temp.	22.0 °C
Distance	3.00 m
Relative humidity	50 %

Figure 64. BASIX compliance review - thermal imaging showing insulation defects. Source: Flux

[16] Bankstown City Centre and Campsie Town Centre Sustainability Study Phase 3 Flux Consultants 9 March 2021

[17] https://www.dailymail.co.uk/news/article-9416225/Sydney-crazy-plan-ban-Canterbury-Bankstown-using-GAS.html

[18] Bankstown City Centre and Campsie Town Centre Sustainability Study Phase 2 Flux Consultants 5 March 2021

Section 6
Summary of Context

6. Summary of Context

The environment context review identified that the urban heat island effect contributes to significant local land surface temperature elevation in the precinct. The increase in heat will be compounded by the changing climate, making resilience an important priority to safeguard ecological and human health and wellbeing.

The policy context review has identified clear NSW priorities for accelerating the transition to net zero. This priority needs to consider building design, transport and waste management.

The baseline of the existing GHG footprint found an emissions profile characteristic of the building use mix. It highlighted the critical impact of the planned decarbonisation of the NSW electricity grid on projected GHG emissions if the floor space capacity of the Masterplan is fully realised in 2046. GHG emissions generated due to electricity use within buildings transition from being the single most critical concern in 2024 to being the area of least concern in 2046. Transport emissions are also reduced with the increased share of electric vehicle use and the decarbonisation of electrified transport. The 2046 projected emissions identified fossil fuel use in buildings and the global warming potential of refrigerants used in air conditioning and heat pumps as the two most significant direct emissions sources in 2046, with waste management being the largest source of indirect emissions.

The GHG 2046 projection also highlighted a unique opportunity inherent in the Masterplan arising from the low retention of existing buildings. New buildings provide a unique opportunity to fundamentally reposition ongoing environmental impacts, making new building standards critically important to determine the future impacts of the precinct.

The policy context has identified strong ambitions and controls in areas of the sustainable building SEPP, the NCC and the City of Canada Bay Canada Bay DCP. Despite this, there remain areas that are not addressed and will need to considered as site-specific provisions to minimise the impact of the Masterplan on the environment.

Relationship with other planning instruments

The operation of SEPPs was identified as potential barriers to establishing appropriate targets for residential buildings due to the regulated protection against competing provisions or inconsistency. The BASIX non-compete is the most impactful and makes direct regulation of better residential outcomes for greenhouse gas emissions reduction or mains water conservation impossible without providing an incentive to the developer.

Where non-compete provisions limit the effectiveness of a planning instrument without an incentive, the process of agreeing on better outcomes in planning proposals, concept plans, VPAs, etc., becomes an important strategy to deliver the required improvement to environmental sustainability outcomes.

The repeal of SEPP 65 and the integration of the ADG into the Housing SEPP have provided greater flexibility in the application of the ADG. The ADG continues to play a vital role in protecting amenity in residential flat buildings, and the Masterplan can enhance the guidance that is most relevant to achieving priority sustainability outcomes.

Non-residential buildings are free of non-compete restrictions in the Sustainable Buildings SEPP and benefit from new minimum NABERS targets.

The NCC is not a matter for consideration under the EP+A Act, but new development must comply with NCC provisions adopted in NSW. NCC 2022 BCA includes new provisions for EV charging and renewable energy infrastructure that align well with the government's policy ambitions. The energy efficiency provisions of the BCA are not adopted in NSW for residential buildings, and the deemed to satisfy amenity provisions in the NCC are significantly improved upon by the Housing SEPP and the ADG.

Whilst the NCC maintains a trajectory of improved energy efficiency standards with the public consultation draft for NCC 2025 proposing mandatory renewable energy in Volume One, there is no sign that the NCC will address electrification, refrigerant GWP, building resilience or improved occupant amenity.

Priorities for the Masterplan

The context review has led to the development of the following key themes to guide sustainability in the Masterplan:

Climate Resilience

NSW Climate Change Policy Framework establishes policy directions to reduce risks of damage to public and private sector assets arising from climate change and reduce climate change impacts on health and wellbeing.

Climate resilience is inherent to the "Resilient city" key theme of the City of Canada Bay Environmental Strategy 2020. This key theme is also discussed as part of the Council's targets and plans in the City of Canada Bay Climate Resilience Frameworks 2024.

The highest priority for the Masterplan is initiatives relating to urban cooling.

Health and Wellbeing

The issues of resilience, health and well-being and particularly interlinked in residential development, where improved passive resilience will safeguard occupant amenity.

Health and wellbeing also extend to ecological health, nature and biodiversity. Many relevant issues are included in the 'Connected to nature" key City of Canada Bay Environmental Strategy 2020 theme.

Net-zero ready

NSW aspires to a net-zero emissions economy by 2050. A necessary component to achieve this ambition is to transition the electricity grid to renewable energy generation. A clean energy electricity grid allows other sectors to eliminate residual greenhouse gas emissions by switching to electricity.

This theme for the Masterplan is considered the most important to reduce the future greenhouse gas emissions associated with the precinct.

Circular Economy

The Greater Sydney Water Strategy identifies that Sydney's water supply is unsustainable. Water conservation is a key contributor and is a fit-for-purpose use of water, where alternative water sources can supply water demands that do not require drinking quality water.

The NSW Waste and Sustainable Materials Strategy 2041 establishes the principles of a circular economy. It identifies organic wastes from households and buildings as a significant opportunity to reduce landfill and greenhouse gas emissions. New buildings must provide the space and infrastructure to facilitate the recovery of recyclables, including organics.

Construction impacts are an area deserving particular attention given the extent of new development proposed by the Masterplan.

Many issues relevant to a circular economy are also relevant to delivering the "Resource efficient community" key theme of the City of Canada Bay Environmental Strategy 2020.

Section 7
Sustainability Initiatives

7. Sustainability Initiatives

This section outlines sustainability initiatives to address the existing environmental challenges in the delivery of the Five Dock Metro Precinct and limit the ecological impacts of new development.

Sustainability initiatives have been developed by analysing key environmental issues alongside relevant planning and policy contexts, providing a cohesive approach to building a more sustainable and resilient Precinct.

The sustainability initiatives proposed generally fall into one of three categories:

- A new requirement to provide significant additional environmental benefit to the planning instruments.
- An additional requirement to complement and strengthen an existing DCP control.
- Additional guidance reinforcing SEPP-guided requirements to maximise realised benefits.

7.1. Climate Resilience

Vision:

"*To support climate-resilient communities*"

Climate resilience refers to the ability of communities and infrastructure to prepare for, adapt to, and recover from the impacts of climate change.

In the Five Dock Metro Precinct, the predominance of impervious surfaces hinders natural water infiltration, exacerbates heat retention and intensifies urban heat stress. Combined with limited urban tree canopy, this creates localised heat hotspots that affect the communities.

To build a more climate-resilient community, the Precinct must prioritise strategic actions that reduce heat impacts, enhance environmental sustainability, and support equitable access to cooling resources.

7.1.1. Urban cooling

Goal:

To mitigate urban heat island effects.

Urban cooling integrates strategies designed to lower temperatures in urban areas to mitigate the Urban Heat Island (UHI) effect and improve thermal comfort for communities.

Key urban cooling strategies can be found in the subsequent sections.

Urban tree canopy is addressed, as the DCP provides comprehensive controls for urban tree canopy, including requirements for tree numbers and replacement planting ratios.

7.1.1.A. Surface Permeability

Five Dock suburb is predominantly covered by imperious surfaces, with nearly 13% of the area comprising impervious roads. Enhancing surface permeability through porous pavements and vegetated surfaces is an effective strategy to lower land surface temperatures by reducing heat absorption. This approach also improves water infiltration, contributing to sustainable urban cooling and stormwater management.

Objectives:

a) To increase soil moisture and promote evaporative cooling to lower local ambient temperature.

b) To maximise rainwater infiltration into the ground.

Provisions:

a) All new development must prioritise the use of permeable materials in private and public domain for:

   (i) pedestrian pathways;

   (ii) driveways;

   (iii) outdoor parking areas

Compliance requirements:

Detail plans showing that all required surfaces are pervious, indicating permeable areas and features.

7.1.1.B. Urban shade

The urban heat island results from an energy imbalance with an urban centre where more heat is received than can be dissipated.

It is important that strategies to reduce the amount of heat received or increase the amount of heat dissipated are effective and do not result in adverse amenity impacts.

Objectives:

a) To limit the retention of heat within the urban environment.

b) To improve the passive resilience of dwellings.

c) To provide sufficient shade for pedestrians and users of open space.

Provisions:

a) For medium and high-density development (FSR > 1), where surfaces on rooftops or podiums are used for communal open space or other active purposes, the development must demonstrate that at least 50% of the accessible roof area complies with one or a combination of the following:

   (i) Be shaded by a shade structure

   (ii) Be shaded by solar panels;

   (iii) Be covered by vegetation;

   (iv) Provide shading through canopy tree planting, to be measured on the extent of the canopy cover two years after planting.

b) For all other development where surfaces on rooftops or podiums are not used for communal open space, solar panels or heat rejection plants, the development must demonstrate the following:

   (i) Materials used have a minimum solar reflectivity index (SRI) of 82 for a horizontal surface or a minimum SRI of 39 for a sloped surface greater than 15 degrees; or

   (ii) 75% of the total roof or podium surface is covered by vegetation; or

   (iii) A combination of (i) and (ii) for the total roof surface

c) At least 75% of the ground plane must comprise one or a combination of the following when assessed in plan view:

   (i) Vegetation,

   (ii) Hardscaping elements shaded by overhanging vegetation or roof structures, including solar hot water panels and photovoltaic panels;

   (iii) Water bodies and/or watercourses; or

   (iv) Areas shaded by the proposed development for at least 50% of all daylight hours in summer.

d) Roof surfaces visible from the public domain or overlooked by neighbours are to limit visible reflectivity and avoid bright surfaces, so they may not be able to meet SRI requirements of a) (iii) and (c) (i).

Compliance requirements

A site plan indicating the proportion of the site covered by scheduled provisions together with a table showing areas (m^2) and proportion of site (%) covered by the scheduled provision when measured in the plan.

7.1.2. Passive survivability

Goal:

To ensure buildings and communities are able to maintain liveability and comfort during extreme weather events or power outages.

Passive survivability refers to the ability of a building or space to remain habitable and maintain thermal comfort without heavy reliance on active mechanical systems, such as air conditioning, heating or electrical power. It also focuses on designing buildings in a way that allows them to adapt to environmental conditions while reducing the need for external energy sources.

Key passive survivability strategies can be found in the subsequent sections.

7.1.2.A. Natural ventilation

Effective natural ventilation supports the ability of a building to provide necessary amenity to occupants during short or long-term disruption to power supply and services. Adequate natural ventilation is also needed to safeguard the wellbeing of occupants by removing pollutants and promoting good indoor air quality.

Insect protection of natural ventilation openings is necessary to allow ventilation whilst protecting from an increased risk of mosquito and fly-borne diseases in a warming climate.

Natural ventilation opening sizes need to be delivered to a minimum level to ensure the adequate dilution of CO_2 as atmospheric background levels of CO_2 continue to rise.

Objectives:

a) To maintain habitability in the event of short or long-term interruptions to the power supply or building services.

b) To improve amenity and liveability of residents and reduce reliance on cooling and associated operation costs.

c) To increase the lifespan of air conditioning and reduce the need for maintenance and repairs.

d) To provide the ability to rapidly purge the build-up of heat and indoor air pollutants from within residential dwellings.

Provisions:

a. All multi-unit residential dwellings must meet the objectives and design guidance for Natural Ventilation in Part 4B of the Apartment Design Guide. The following interpretations are to be applied to remove uncertainty.

   (i) Unobstructed window opening area is to be calculated following the ADG Glossary definition of Effective Openable Area (EOA), including necessary allowance for insect screens.

   (ii) Apartments with natural cross ventilation are to have unobstructed window areas of no less than 5% of the apartment floor area with no less than 2% of the apartment floor area in any individual facade providing dual aspects.

   (iii) Facades counted as dual aspects for natural cross ventilation are to be unsheltered from wind for at least 50% of the length. Notches, building indentations, ventilated corridors and breezeways are generally unsuitable for natural cross ventilation.

   (iv) Facades contributing to dual aspects are to be directly exposed to the outside. Using plenums that bridge other spaces to connect to the outside is not allowable.

   (v) Natural ventilation cannot be provided through any balcony that can be fully enclosed.

b. Where protected balconies or wintergardens are needed to temper noise and harsh conditions, they must be designed to not limit natural ventilation or natural cross ventilation within the apartment. A permanent opening is to be provided at the top of the wintergarden or protected balcony no smaller than:

   (i) 25 per cent of the external face of the balcony on its longest aspect or;

   (ii) Twice the EOA Effective Openable Area (EOA) that is required for the openings from the apartment onto the winter garden to support natural ventilation or natural cross-ventilation.

Notes

i. The provisions do not increase the numerical measures of the ADG criteria and guidance but provide necessary interpretation to ensure they are correctly delivered.

7.1.2.B. Facades

Appropriately designed facades balance internal amenity, energy efficiency and external impacts.

Excessive glazing in the facade can reduce amenity through excessive heat and glare. Additionally, using high-performance solar control glass can result in excessive heat being reflected into the public domain. Reducing glass area and providing effective shading provide a better response to limit overheating within the space in the event of power of service failure and limit the contribution of increased urban heat within the public domain.

The placement of heat rejection units on facades and balconies negatively impacts amenity and adds heat into the public domain, contributing to the urban heat island effect.

Objectives:

a) To maintain habitability in the event of short or long term interruptions to the power supply or building services.

b) Reduce excessive heat and glare within habitable spaces.

c) Reduce the amount of solar heat reflected into private open spaces or the public domain, and limit its contribution to the urban heat island.

d) To avoid or minimise the impact of heat rejection from air conditioning and refrigeration systems on user comfort in private open space and the public domain.

Provisions:

a) Window-to-wall ratios of each major aspect are to be limited to a maximum of 70% when measured externally or 50% when measured on the internal facade, whichever is lower.

b) External solar shading should be provided to glazing on the north, east and western facades where it is not significantly overshadowed by neighbouring buildings or shaded by the inclusion of balconies. The solar shading should be designed to maximise the protection of the glazing from the summer sun and maximise solar transmission in the winter sun.

c) Green walls and other living infrastructure elements can be considered shading where long-term maintenance arrangements can be confirmed.

d) Glazing is to be selected with external solar heat and visible light reflectivity no greater than 20% measured at normal incidence.

e) Residential apartments within a mixed-use development or residential flat building should incorporate efficient heating, ventilation and cooling systems that reject heat from a centralised source on the upper-most roof.

f) Heat rejection units are strongly discouraged from being located on building facades or private open space, such as balconies and courtyards. However, where it is demonstrated that heat rejection

cannot be achieved per the controls e) above and these units are installed, the HVAC system must demonstrate:

(i) Heating, ventilation and cooling systems exceed current Minimum Energy Performance Standard requirements; and

(ii) The heat rejection units are situated with unimpeded ventilation, avoiding screens and impermeable balcony walls; and

(iii) The area required by the heat rejection units is to be additional to the minimum area requirements for private open space.

g) Where a mixed-use development or residential flat building proposes wintergardens as the primary private open space, no heat rejection source systems are permitted to be located in the wintergarden.

Compliance requirements:

Solar shading should be detailed for each facade. A shadow diagram for each elevation in winter and summer will confirm the extent of shading.

All developments should confirm indicative glass selections that meet the limits for external solar heat and visible light reflectivity. Values are to be provided for the combined reflectances of all panes where laminates or Insulated Glazing Units (IGUs) are proposed.

BASIX developments should additionally confirm that the indicative glass selection(s) also meets BASIX performance requirements.

Notes

i. The provisions do not stipulate a numerical measure for shading to reduce compliance and assessment costs.

ii. The normal incident reflection is the standard measure used in glazing catalogues and technical data sheets. It has been added to avoid ambiguity, as reflectivity increases significantly and higher angles of incidence.

iii. Condition of consent required for the glazing reflectivity limits.

7.2. Health and wellbeing

Vision:

"*To foster environments that prioritise the health and wellbeing of humans and nature*"

Health and wellbeing in urban environments stem from a holistic approach that nurtures both human and ecological needs. In the Five Dock Metro Precinct, this involves fostering meaningful and healthy connections between people and nature, promoting active lifestyles, and ensuring the built environment supports physical and mental health.

7.2.1. Connection to nature

Goal:

To foster healthy connections between humans and nature.

This goal emphasises fostering healthy interactions between humans and the natural environment without negatively impacting each other. Enhancing biodiversity and providing accessible green spaces create opportunities for relaxation, recreation, engagement with nature, benefiting both physical and mental health without bringing negative impacts on the environment.

Bicycle infrastructure is addressed by the DCP.

7.2.1.A. Biodiversity

Biodiversity emphasises the importance of reconnecting the community to nature through the preservation and restoration of local ecosystems and ensuring that new development does not further degrade these natural habitats.

Objectives:

a) To maximise the coverage of native vegetation.

b) To protect endangered and vulnerable species from negative impacts of urban development.

c) To provide improved connectivity along existing or broken habitat corridors.

Provisions:

a) Retain existing native vegetation where feasible.

b) Use native and locally endemic species wherever possible.

c) Terrestrial habitat features are to be incorporated into landscape plans and building designs. This should aim to provide both micro-habitats and stratified habitats and improve connectivity along existing or broken habitat corridors wherever practicable.

d) Retain and protect existing vegetation and habitat on site until replacement vegetation and habitat are established.

Compliance requirements:

Landscape plans identifying all retained element showing native or locally endemic planting and local habitat context.

A landscape management plan may be required to detail how existing vegetation and habitat will be protected until replacement vegetation and habitat are established.

7.2.1.B. Local open space

The Five Dock Metro Precinct faces challenges with a lack of accessible open spaces, particularly in the Southwest and along the Great North Rd.

Open spaces are vital for fostering community health and wellbeing, offering residents the opportunity physical activity and relaxation with nature in built environment.

Objectives:

a) To connect people with nature.

b) To contribute to maintaining or improving the City of Canada Bay open space area.

c) To provide sufficient and good quality of local open space within reasonable walking distance.

Provisions:

a) All new development not within 400 m walking distance to an existing open space must investigate opportunities for, and if possible, integrate public open space within the site or nearby.

b) All new multi-residential development must provide open space that complies with *Apartment Design Guidelines* (ADG) part 3D - Communal and public open space.

c) All new multi-residential development with 60 or more dwellings not within 200 m walking distance to 0.1 ha of existing open space is encouraged to exceed the ADG minimum open space area requirement.

Compliance requirements:

A report outlining how the development meets the provisions, including public open space opportunities and alignment with ADG requirements.

Architectural plans clearly showing the location, design, and connectivity of proposed open spaces and stated open space area.

Notes

ADG requires all new multi-residential development to provide a minimum of 25% of the site for communal open space.

7.3. Net Zero ready

Vision:

"*To achieve net zero carbon emissions in all sectors*"

Australia is committed to achieve net zero emissions by 2050, with progressive targets of a 50% reduction on 2005 levels by June 2030 and 70% reduction by June 2035. Achieving net zero emissions requires rapid decarbonisation across key areas such as energy efficiency, renewable energy integration, electric vehicle infrastructure, and the electrification of buildings.

7.3.1. Rapid Decarbonisation

Goal:

To adopt sustainable practices and technologies that support rapid decarbonisation in impactful sectors.

Achieving rapid decarbonisation requires urgent action across key sectors focusing on reducing GHG emissions at an accelerated pace.

7.3.1.A. Energy efficiency

Energy efficiency is now well regulated in NSW, and there is limited merit in requiring higher targets. Additionally, setting higher targets for residential buildings is only possible with incentives due to BASIX / SEPP non-compete provisions. A passive first solution will promote reliance and survivability.

Objectives:

a) To maximise efficiency and minimise the demand for energy and associated greenhouse gas emissions.

b) To reduce the ongoing cost to occupants by lowering the electricity usage associated with heating and cooling.

Provisions:

a. All development must demonstrate the prioritisation of passive design measures to minimise the energy gained and lost through the building envelope.

b. All development must maximise the use of natural light to reduce the need for artificial lighting during daytime hours.

c. All Non-residential development must:

   (i) Demonstrate that they meet the relevant requirements of the Sustainable Buildings SEPP, and

   (ii) Demonstrate that it is capable of meeting the relevant requirements of Section J of the NCC BCA Volume 1.

d. All residential development must meet the relevant requirements of the Sustainable Buildings SEPP.

Compliance requirements:

Non-residential development must provide an energy efficiency report by a suitably qualified professional detailing all relevant matters.

Residential development must provide a BASIX certificate and stamped plan set that provides all details and specifications necessary to deliver the BASIX requirements.

Notes

(i) Whilst the NCC isn't a matter relevant to approval under the EP & A Act, there is a benefit in reporting and documentation to make the subsequent private certification more robust. Additionally, NCC facade requirements may impact the facade design, which is a matter for DA; therefore, consideration is needed before the DA.

(ii) Condition of consent required to ensure delivery of benefits. These conditions should itemise the major energy efficiency initiatives for all building types.

7.3.1.B. On-site solar

On-site solar energy is affordable and will generate significant ongoing savings for building owners. A requirement to maximise the potential of each new roof will ensure that the misalignment of financial benefits for developers is overcome within multi-unit residential developments.

Objectives:

a) To maximise the on-site collection of renewable energy

b) To reduce reliance on electricity grid.

c) To reduce the cost to households and businesses to meet operational energy needs.

Provisions:

a. Non-residential development will include the installation of a solar PV system of no less capacity than:

   (i) A coverage area of solar panels of not less than 60% of the roof area not occupied by cooling towers or communal open space, or

   (ii) Sized to provide no less than 45 W/m^2 of total site area in year one AC maximum peak power delivery, after allowances for inverters and system losses.

b. Residential development of four storeys and above will include the installation of a solar PV system of no less capacity than:

   (iii) A coverage area of solar panels of not less than 60% of the roof area not occupied by cooling towers or communal open space, or

   (iv) Sized to provide no less than 45 W/m^2 of total site area in year one AC maximum peak power delivery, after allowances for inverters and system losses.

c. Residential development of three storeys of less will include the installation of a solar PV system of no less capacity than:

   (v) A coverage area of solar panels or not less than 25% of the roof area, or

   (vi) Sized to provide no less than 25 W/m^2 of total site area in year one AC maximum peak power delivery, after allowances for inverters and system losses.

d. Strata residential buildings of three storeys or less are to connect solar panels directly to the meters of individual units, or integrate hardware for the distribution of generated electricity to all residents.

e. Strata residential buildings of four storeys or more are to connect solar panels directly to the common areas services or integrate hardware for the distribution of generated electricity to all residents

f. The integration of rooftop solar and green roofs and/or community open space is encouraged to maximise the utility of the roof.

g. Where a building is a heritage item, the extent of solar panels is to be considered to ensure no reduction in the heritage value of the building.

h. Consider the provision of a battery to maximise the utilisation of renewable energy resources.

i. Where a roof or part of a roof is overshadowed by existing tree canopy to the extent that the annual efficiency generation of solar is reduced by more than 50%, then a) to e) do not apply to that extent of the roof. Tree removal is not allowed under this control.

j. The view impacts of solar panels on the urban form should be minimised by avoiding excessive framing in visible locations.

Compliance requirements:

Roof plan showing the area(s) allocated to PVs and necessary access requirements for cleaning and routine maintenance.

Notes

(i) NCC 2022 BCA Volume One requires 20% of the roof area to be dedicated to future PVs without considering other uses.

7.3.1.C. All-electric building

Burning fuels in buildings negatively impacts air quality within and externally. Avoiding fuel combustion in new buildings will provide immediate health benefits, reduce operating costs and prevent future expenses and disruption required to replace fossil fuel services with all-electric servicing.

Objectives:

a) To minimise the installation of plant and equipment in new buildings that rely upon on-site fuel combustion.

b) To reduce indoor and outdoor air pollutants associated with the combustion of gas or wood and improve air quality.

c) To reduce the cost to occupants by avoiding ongoing gas connection standing charges.

d) To reduce the contribution of gas combustion to the anthropogenic heat contribution flux in the urban area.

Provisions:

a. All new developments are to use only electricity for all energy requirements associated with normal operations.

Compliance requirements:

A statement of compliance is required at the DA stage to confirm that no natural gas service is provided and that the application is designed as an all-electric building.

This requirement is to be expressly scheduled as a condition of consent.

BASIX certificates and Section J reports should be reviewed to confirm that no gas is proposed to achieve compliance.

7.3.1.D. Refrigerant Global Warming Potential (GWP) [new control]

Air conditioning and heat pumps use refrigerants to move heat within the equipment. Synthetic greenhouse gases are almost universally used today for domestic and commercial scale air conditioning and heat pumps, even though they are being phased down under the Kigali amendment to the Montreal Protocol, which Australia is a signatory.

Natural refrigerants have a global warming potential hundreds of times lower than the commonly used synthetic refrigerants and can improve energy efficiency.

The current market for air conditioning supplied with GWP <10 is extremely limited. This is why the DCP provision has a market test. However, the skilling of the industry and market growth to support refrigerants with very low GWP will become increasingly essential to meet net-zero ambitions, and the DCP provision will become more effective as the market grows.

Objectives:

a) To minimise the installation of equipment that relies on Hydrofluorocarbons (HFCs) and to avoid the inbuilt obsolescence from using gases subject to the HFC phase-down provisions of the Kigali Amendment to the Montreal Protocol.

b) To reduce operating costs for owners and tenants.

Provisions

a) Natural or Hydrofluoroolefin (HFO) refrigerants with a GWP of less than 10 should be used in all air conditioning, refrigeration and heat pump equipment:

   (i) if the equipment can be supplied on similar terms to conventional systems, and

   (ii) at a cost of not more than 10% higher than the market rate for conventional equipment.

Compliance requirements

Confirmation of commitment or details of market testing for each component of the development using refrigerants.

Notes

(i) Australia is phasing down HFCs. Australia was one of the first countries to ratify the amendment in 2018, demonstrating its commitment to reducing HFC emissions. Australia has set targets to phase down HFC consumption as part of its commitment, reducing levels by 85% by 2036. Newly installed HFC air conditioning will need conversion or replacement when the importation for HFC is more restricted in 13 years.

(ii) The most suitable very low-GWP refrigerant for residential use is Propane and Isobutane, which are both highly flammable. However, this does not mean they cannot be used. It just means the design must consider limiting the amount of refrigerant leaking into any enclosed space and is guided by an Australian Standard.

(iii) There are considerable market inertia issues and industry concerns regarding accelerating the move towards alternative refrigerants. However, these are addressed by applying the relevant standards and using accredited installers.

(iv) Part (i) and (ii) of the provision are essential in the initial years of the DCP, as the market may not be able to meet the requirements for many types of installation.

(v) Condition of consent required to ensure delivery of benefits.

7.3.1.E. Electric Vehicle infrastructure

Providing essential infrastructure for vehicle charging will future-proof the buildings and ensure residents can easily transition to electric vehicles. Without the necessary infrastructure, an apartment owner's future installation of EV charging facilities can be much more expensive and, in some cases, technically impossible. EV charging in long-stay locations is also the most convenient for users and least impactful of the maximum demand on the distribution network.

Objectives:

a) To accelerate the positive benefits of increased electric vehicle adoption on the urban environment, including air quality, urban heat and acoustic amenity.

b) To ensure development in Five Dock Metro Precinct provides the essential infrastructure to support the charging of electric vehicles.

c) To minimise the impact that electric vehicle charging has on peak electricity demand requirements.

d) To remove the procedural, technical and financial barriers to installing future EV charging capacity in strata titled buildings.

Provisions

a) All new developments are to provide electric vehicle charging infrastructure according to City of Canada Bay DCP Part3.13 and the Table below. The Table below takes precedence in the event of conflict.

Car Space type	Minimum % charging stations installed	Minimum % space to hav EV ready infrastructure	Minimum capacity provided to each car space	Energy provision required for car space Overnight is between the hou 11pm and 7am Daytime is between 9am and
Dwelling houses, dual occupancies, semi-detached dwellings				
Resident	Per DCP	100	15A	12kWh overnight
Multi-dwelling, including residential flat building, shop-top housing, boarding houses, manor houses and co-living				
Resident	Per DCP	100	32A	12kWh overnight
Car share/Visitor	100	100	40A	48kWh overnight
Commercial hotel and serviced apartments				
Guest / resident	20	100	32A	48kWh overnight
Staff	10	100	32A	12kWh daytime
Car share/Visitor	100	100	40A	48kWh overnight

Table 13. EV requirements table for DCP, source: Flux adapted from NCC 2022 Volume One

b) All car-share spaces and spaces allocated to visitors must have a minimum Level 2 40A fast charger.

c) All bicycle parking must provide at least 10A GPO for every 5 spaces distributed throughout the parking or at least 1 10A GPO if spaces are less than 5.

Compliance requirements

The location of the electric vehicle charging infrastructure is to be shown on DA pans.

A statement of adequacy by an electric engineer is to be provided for parts a), b), c) and d)

This item is to be expressly scheduled as a condition of consent.

7.4. Circular economy

Vision:

"*To sustainably manage resources to support circular economy and ecological balance*"

A circular economy is an economic model that focuses on reducing waste and maximising the use of resources. Unlike the traditional linear economy, which follows a "take, make, dispose" pattern, a circular economy aims to close the loop by reusing, repairing, refurbishing, and recycling products and materials.

7.4.1. Urban Water Management

Goal:

To manage water resources through a circular economy.

To minimise potable water demand.

To manage stormwater from polluting surrounding areas.

Additional initiatives are proposed for both non-residential water efficiency and dual piping. The treatment of stormwater with the DCP is considered adequate, and the residential water management is subject to non-compete provision on the Housing SEPP and is to be considered only with development incentives.

7.4.1.A. Water resilience

Maximising the collection and reuse of water will help reduce demands on Sydney's finite drinking water supply capacity, which is coming under increasing stress due to a changing climate and the needs of a growing population.

Objectives:

d) To increase resilience and water security by providing an alternative water supply to buildings.

e) To maximise the use of rainwater as a resource.

f) To reduce loads on the stormwater system infrastructure.

g) To reduce the technical and financial barriers to upgrading buildings to connect to future non-drinking water supply infrastructure.

Provisions

a) All development should refer to Canada Bay DCP Part B5 Water Conservation.

b) All development involving the construction of a new building or significant alterations to an existing building must install a dual water or reticulation system to support the immediate or future connection to a recycled water network. The design of the dual reticulation system is to be such that a future change-over to an alternative water supply can be achieved without significant civil or building work, disruption or cost.

c) The dual reticulation is to have:

   i) One reticulation system servicing drinking water uses, connected to the drinking water supply, and

   ii) One reticulation system servicing all non-drinking water end uses. The non-drinking water system is to be connected to the rainwater tank with drinking water supply backup, until an alternative water supply connection is available. The non-drinking system is to be provided with a connection point adjacent the street boundary for easy connection to a future district non-drinking water supply

Compliance requirements

Rainwater collection should be demonstrated at DA stage.
Requirements for dual piping are required to be conditioned.

7.4.1.B. Water efficiency

Water efficiency in new development is needed to reduce the demands on drinking quality and reuse water.

Minimising water demand in new development is essential for integrated urban water management as it reduces augmentation needs on the drinking and non-drinking water supply infrastructure.

Objectives:

a) To maximise the efficient use of water.

b) To reduce the ongoing cost to occupants by reducing the demand for water.

Provisions

a) All development must demonstrate the prioritisation of water conservation measures to minimise water consumption.

b) All Non-residential development must exceed the relevant requirements of the Sustainable Buildings SEPP by 1 star, and

c) All residential development must meet or exceed the relevant requirements of the Sustainable Buildings SEPP.

Compliance requirements

Non-residential development should provide a water efficiency report detailing all relevant matters.

Residential development should provide a BASIX certificate and BASIX stamped plan set that provides all details and specifications necessary to deliver the BASIX requirements.

Notes

i) The Sustainable Buildings SEPP targets for water are not as ambitious as those for energy, and there is room for the DCP to require better outcomes for non-residential buildings.

ii) Condition of consent required to ensure delivery of benefits. These conditions should itemise the major water efficiency initiatives for all building types

7.4.2. Buildings support integrated waste management

Goal:

To minimise waste-to-landfills by supporting waste separation systems for organic waste.

To manage construction waste in alignment with a circular economy.

The DCP provisions for waste are comprehensive. Additional controls are proposed to enhance the current DCP provisions for waste management for dealing with FOGO in apartment buildings.

7.4.2.A. Management of waste

Design for waste management to support equitable disposal of three primary waste streams necessary to support a circular economy.

Objectives:

a) To enhance the Canada Bay DCP Part B4 Waste Management for the management of organic food waste and recyclables.

b) Provide equitable disposal, transport and storage for food organic waste, recyclables and general waste.

Provisions

a) Waste facilities should be provided in accordance with Canada Bay DCP Part B4 Waste Management and the following provisions, which prevail in the event of conflict.

b) For apartments:

   (i) Facilitate waste separation at source by providing a dedicated waste storage area within each apartment to accommodate 2 days worth of waste, recycling and organics.

   (ii) Integrate waste management infrastructure to facilitate the separation of general waste, recycling and organics at the point of disposal and on each residential level for large buildings.

   (iii) If a chute system is used, a separate chute must be provided for each type of waste stream. Chute systems that rely on diverters to separate different waste streams are not allowed.

c) For commercial buildings:

   i) Integrate waste management infrastructure to facilitate the separation of waste, recycling and organics at the point of disposal and on each level for large buildings.

   ii) Provide space for on-site equipment to reduce the waste volume leaving the development appropriate to the proposed use, i.e. cardboard balers for large retail.

   iii) Commercial disposal and collection infrastructure must be separated and secure from residential waste infrastructure in mixed-use developments.

Compliance requirements

Plan showing necessary storage areas for supporting the management of separated waste treatment

The adequacy of storage for separated waste streams is to be demonstrated in an operational waste management plan.

7.4.2.B. Design and construction impacts

A circular economy aims to preserve natural resources by reducing the extraction and consumption of finite resources and promoting the use of renewable resources.

In a circular economy, waste is minimised through strategies such as reducing the use of non-renewable resources, using material that can be reused, repaired or recycled, and promoting responsible consumption and production.

Objectives:

a) To minimise the use of non-renewable resources in construction

b) To minimise the embodied energy of materials and construction.

c) To maximise the reuse of materials.

d) To design and construct to minimise the generation of waste.

e) To maximise durability and adaptability to avoid the future impacts of replacement and redevelopment.

Provisions:

a) Design to minimise demolition of existing structures where possible.

b) Design structures to allow reduced Portland cement in concrete mixes and steel profiles with high recycled content and reduced embodied energy.

c) Design for prefabricated elements where suitable.

d) Standardise details to avoid cutting on site.

e) Avoid finishes and materials with warranties of less than 20 years.

f) Design floor plates and floor-to-floor heights to maximise the suitability for alternate uses.

g) Divert a minimum of 80% of construction waste from landfill by separating and recovering recyclable resources.

Compliance requirements:

A circular economy design statement that details how material impacts are minimised in the design and construction should be provided for all development over 1,000 m2 GFA.

A construction waste management plan is to be provided for all development over 500 m2

Section 8
Impacts of Sustainability Initiatives

8. Impacts of sustainability initiatives

This section presents the annual impact benefits in 2046 if the Five Dock Metro Precinct Masterplan is developed with additional environmental sustainability controls.

The potential benefits of controls relating to potential environmental sustainability initiatives are presented individually and as a combined suite of controls. In each case, the initiatives' environmental benefits are projected for 2046 and compared against the sustainability BAU delivery of the Masterplan without additional controls.

8.1. GHG emissions reduction from All-electric buildings

This section outlines the projected 2046 annual GHG emissions reduction realised through the addition of all-electric building control.

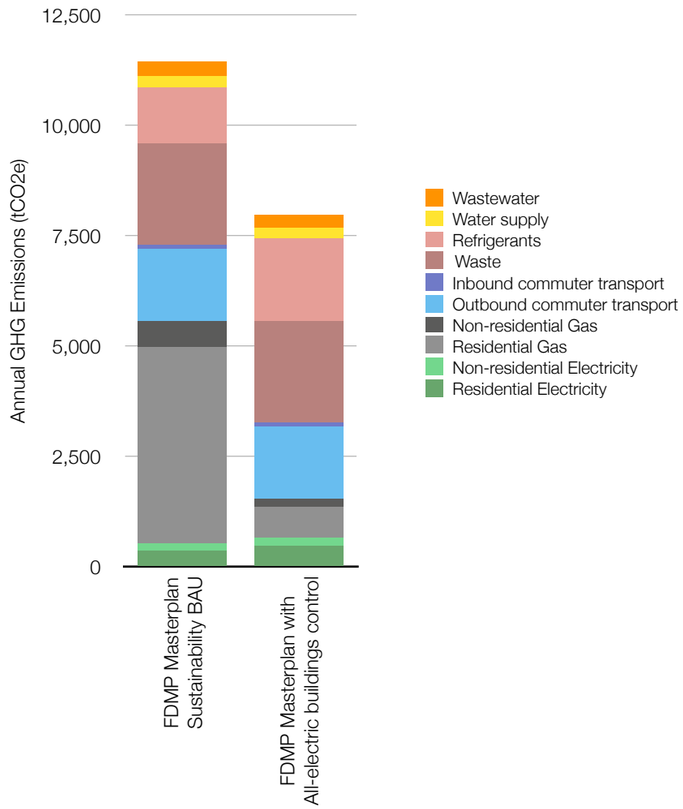


Figure 65. Projected impact of all-electric buildings controls - GHG emissions.

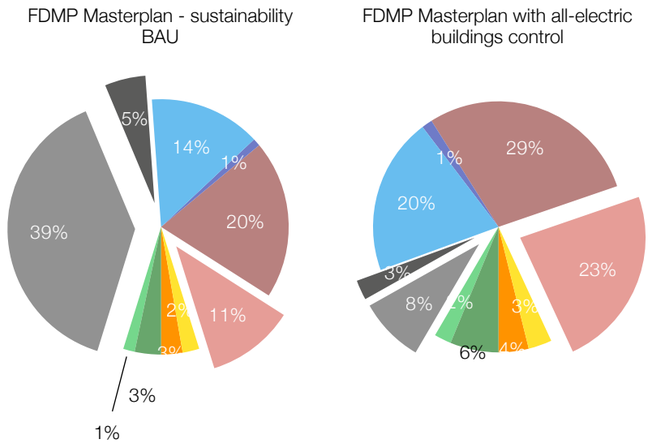


Figure 66. Projected impact of all-electric buildings control - Emissions proportion.

Phasing out fossil gas in the Draft Masterplan by delivering all-electric buildings could significantly reduce GHG emissions, with a potential 85% reduction in residential gas and a 65% reduction in non-residential gas-related GHG emissions.

	Draft Masterplan Sustainability BAU (tCO_2e)	Draft Masterplan with All-electric buildings control (tCO_2e)	Difference (tCO_2e)	Difference (%)
Residential Electricity	380	498	118	31.1%
Non residential Electricity	167	176	9	5.4%
Residential Gas	4,444	673	-3,771	-84.9%
Non Residential Gas	591	205	-386	-65.3%
Commuter Transport	1,616	1,616	0	0.0%
Worker transport	110	110	0	0.0%
Waste	2,294	2,294	0	0.0%
Refrigerants	1,273	1,866	593	46.6%
Water supply	242	242	0	0.0%
Waste Water	310	310	0	0.0%
Total	**11,427**	**7,990**	**-3,437**	**-30.1%**

Table 14. Projected impact of all-electric buildings control - comparison.

In this scenario, all-electric building controls are assumed to be delivered for new construction. A 100% reduction is not feasible due to the continued use of gas in existing buildings retained in the Five Dock Metro Precinct Masterplan.

Replacing gas boilers with electric heat pumps will increase greenhouse gas (GHG) emissions associated with electricity and refrigerants. It is estimated there will be a 31% increase in emissions related to electricity and a 46% increase in emissions from refrigerants. However, this increase is more than offset by the reduction in emissions from fossil gas.

Overall, requiring all-electric buildings reduces the Five Dock Metro Precincts Draft Masterplan's annual GHG emissions by 30%, making this the single most impactful initiative.

8.2. GHG emissions reduction from increasing on-site solar

In this scenario, rooftop solar control is assumed to apply to all new residential buildings with a target of 20% coverage of roof space, compared to the 10% projected under current regulations and codes. 80% of generated energy is assumed to be used behind the meter, with the remaining 20% being exported and having no benefit to reducing the precinct's greenhouse gas emissions footprint.

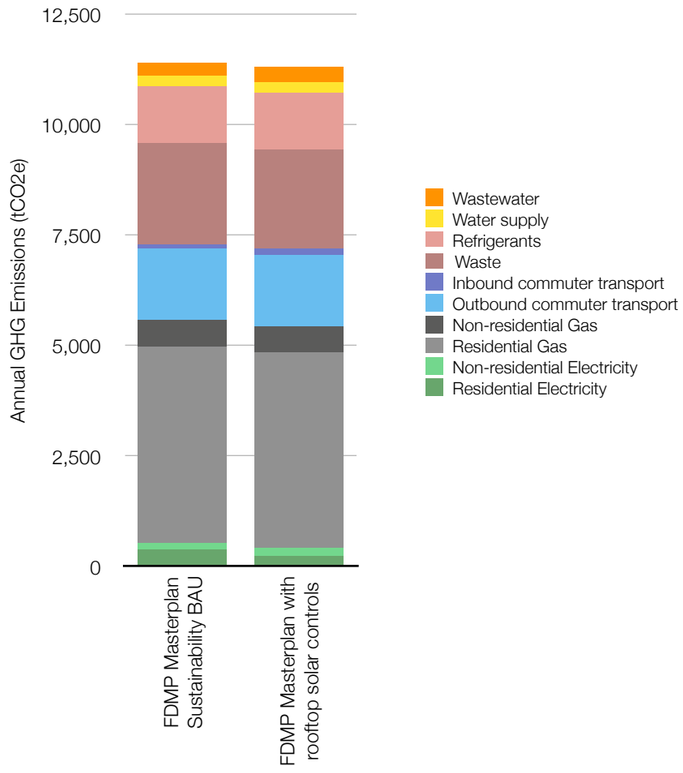


Figure 67. Projected impact of rooftop solar controls - GHG emissions.

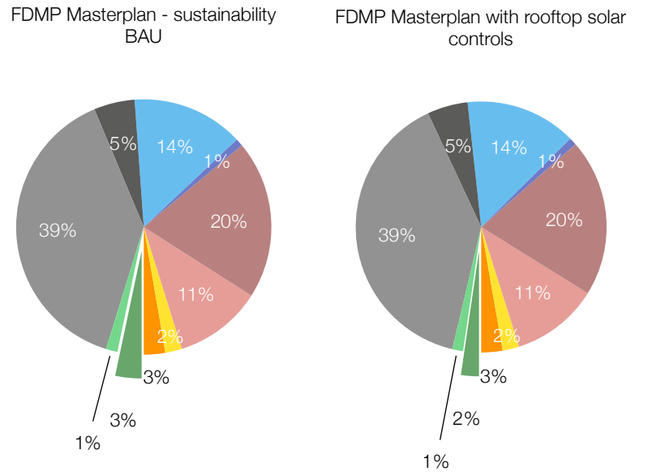


Figure 68. Projected impact of rooftop solar controls - Emissions proportion.

Doubling the amount of rooftop renewable energy generation provides a 30% reduction in residential electricity consumption. However, it has negligible net impact on the overall annual emissions inventory due to the expectation that the NSW electricity grid will be effectively decarbonised.

	Draft Masterplan Sustainability BAU (tCO_2e)	Draft Masterplan with All-electric buildings control (tCO_2e)	Difference (tCO_2e)	Difference (%)
Residential Electricity	380	261	-119	-31.4%
Non residential Electricity	167	157	-10	-6.0%
Residential Gas	4,444	4,444	0	0.0%
Non Residential Gas	591	591	0	0.1%
Commuter Transport	1,616	1,616	-0	-0.0%
Worker transport	110	110	0	0.4%
Waste	2,294	2,294	0	0.0%
Refrigerants	1,273	1,273	-0	-0.0%
Water supply	242	242	-0	-0.2%
Waste Water	310	310	0	0.1%
Total	**11,427**	**11,298**	**-129**	**-1.1%**

Table 15. Projected rooftop solar controls - comparison.

The greenhouse gas benefits of solar will be more pronounced before 2030, and regardless of emissions benefits, the reduction in demand for electricity will directly benefit occupants through the reduction in electricity purchase from a retailer.

8.3. GHG emissions reduction by limiting GWP of refrigerants

In this scenario, The GWP of refrigerants used in air condoning and heat pumps is reduced beyond the minimum regulated requirements.

The comparison of GHG emissions shows potential for reducing annual greenhouse gas emissions.

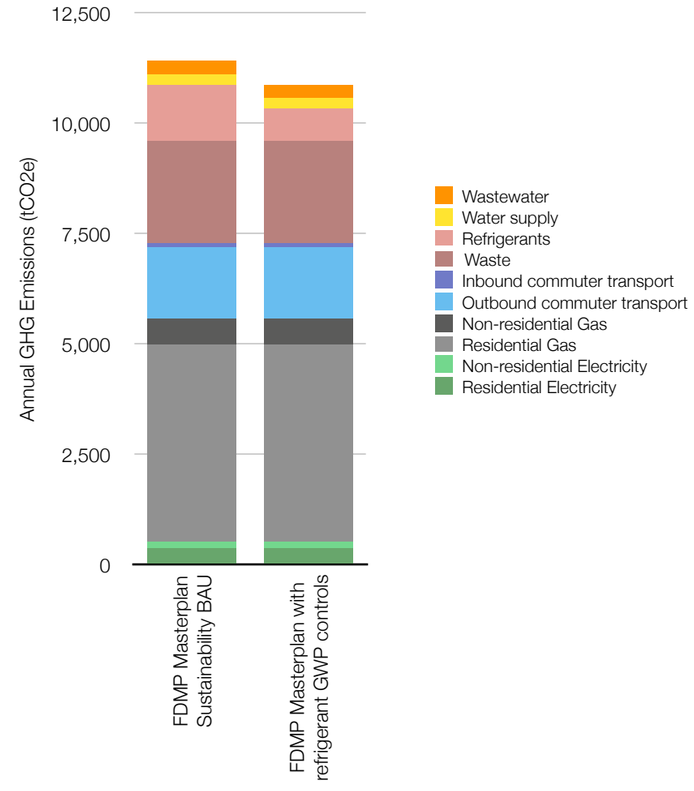


Figure 69. Projected impact of refrigerant GWP controls - GHG emissions.

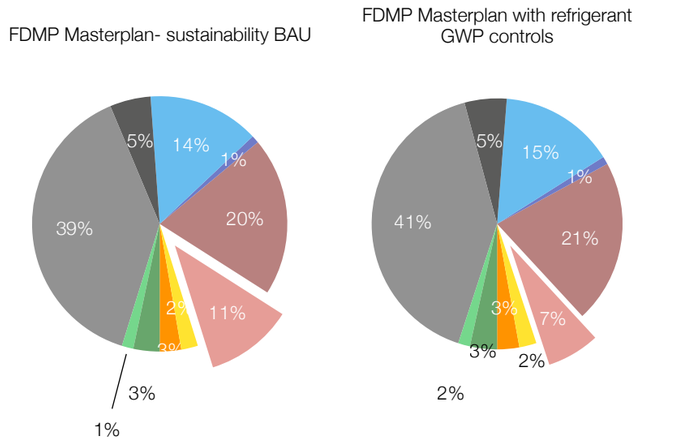


Figure 70. Projected impact of refrigerant GWP controls - Emissions proportion.

Limiting GWPs is projected to offer a 40% reduction in refrigerant-related emissions and an overall annual emissions inventory reduction of almost 5%. The relative benefits of all-electric buildings will increase due to the increased mass of refrigerants.

	Draft Masterplan Sustainability BAU (tCO_2e)	Draft Masterplan with All-electric buildings control (tCO_2e)	Difference (tCO_2e)	Difference (%)
Residential Electricity	380	380	0	0.1%
Non residential Electricity	167	167	-0	-0.1%
Residential Gas	4,444	4,444	0	0.0%
Non Residential Gas	591	591	0	0.1%
Commuter Transport	1,616	1,616	-0	-0.0%
Worker transport	110	110	0	0.4%
Waste	2,294	2,294	0	0.0%
Refrigerants	1,273	742	-531	-41.7%
Water supply	242	242	-0	-0.2%
Waste Water	310	310	0	0.1%
Total	**11,427**	**10,897**	**-530**	**-4.6%**

Table 16. Projected impact of refrigerant GWP controls - comparison.

8.4. GHG emissions reduction by natural ventilation design measures

In this scenario, improved natural ventilation and resilient design strategies are assumed for residential buildings. This control reduces reliance on mechanical ventilation, year-round air conditioning and winter heating through improved solar access. A net benefit of 10% savings to thermal loads is tested. The comparison of GHG emissions shows potential for reducing annual greenhouse gas emissions.

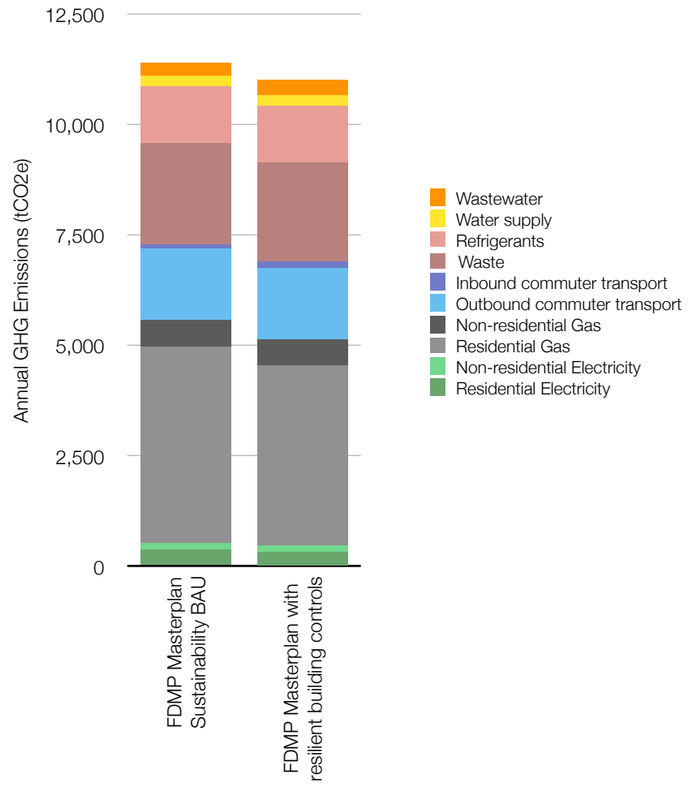


Figure 71. Projected impact of resilient building controls - GHG emissions.

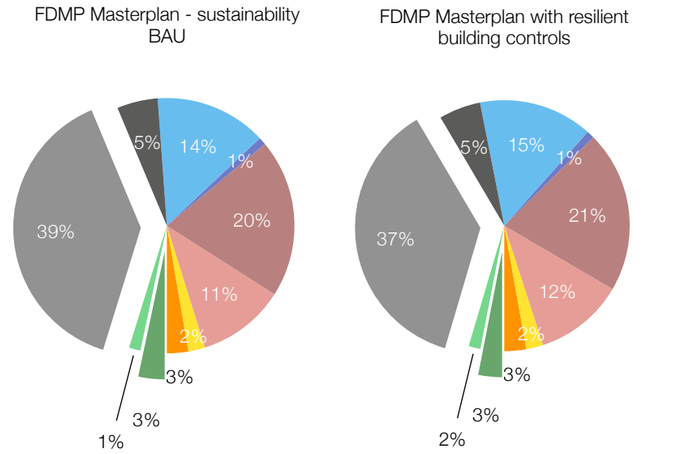


Figure 72. Projected impact of resilient building controls - Emissions proportion.

	Draft Masterplan Sustainability BAU (tCO_2e)	Draft Masterplan with All-electric buildings control (tCO_2e)	Difference (tCO_2e)	Difference (%)
Residential Electricity	380	336	-44	-11.6%
Non residential Electricity	167	167	0	0.0%
Residential Gas	4,444	4,067	-377	-8.5%
Non Residential Gas	591	591	0	0.0%
Commuter Transport	1,616	1,616	0	0.0%
Worker transport	110	110	0	0.0%
Waste	2,294	2,294	0	0.0%
Refrigerants	1,273	1,273	0	0.0%
Water supply	242	242	0	0.0%
Waste Water	310	310	0	0.0%
Total	**11,427**	**11,006**	**-421**	**-3.7%**

Table 17. Projected impact of resilient building controls - comparison.

8.5. GHG emissions reduction by improved equitable disposal of waste

In this scenario, increased recovery of organic food waste within apartment buildings through equitable disposal infrastructure is tested. Recovered or organic waste streams for apartment buildings are assumed to increase from 20% under BAU to 90% with improved infrastructure.

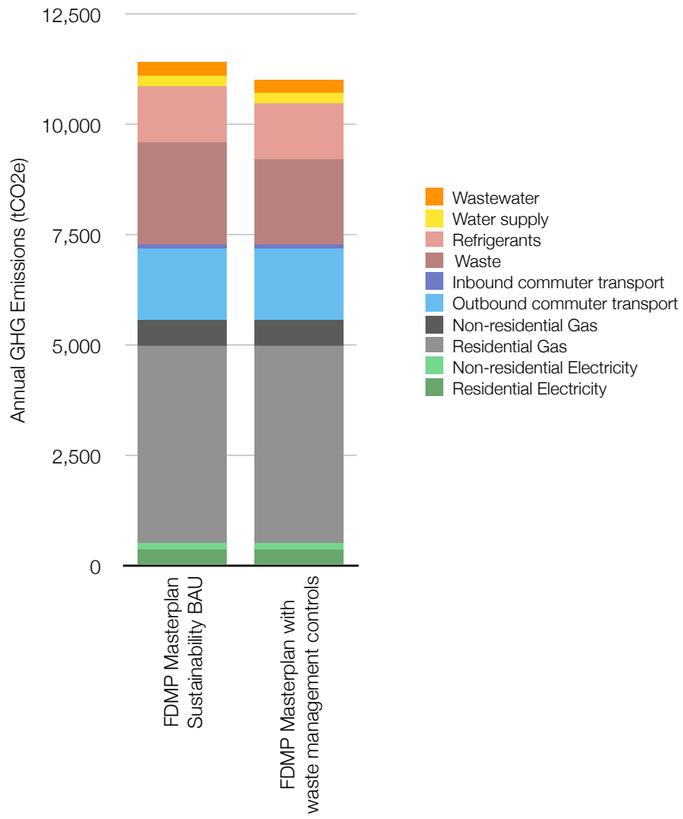


Figure 73. Projected impact of resilient building controls - GHG emissions.

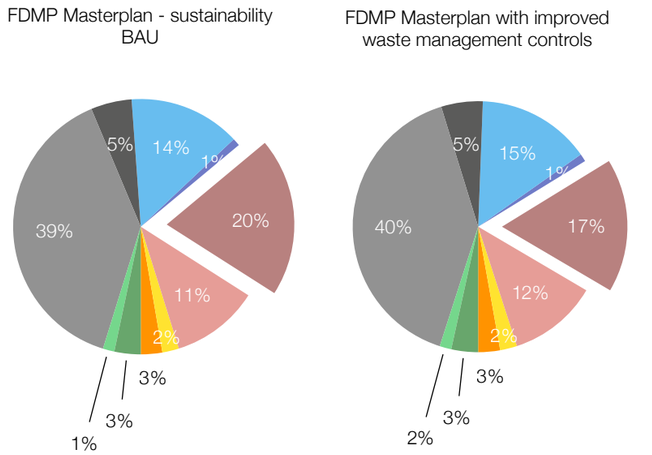


Figure 74. Projected impact of waste management controls - Emissions proportion.

Improving the recoverability of organic food waste within apartment buildings is projected to reduce waste-related greenhouse gas emissions by 17% and precinct-wide greenhouse gas emissions by 3.4%

	Draft Masterplan Sustainability BAU (tCO_2e)	Draft Masterplan with All-electric buildings control (tCO_2e)	Difference (tCO_2e)	Difference (%)
Residential Electricity	380	380	0	0.1%
Non residential Electricity	167	167	0	0.0%
Residential Gas	4,444	4,444	0	0.0%
Non Residential Gas	591	591	0	0.0%
Commuter Transport	1,616	1,616	0	0.0%
Worker transport	110	110	0	0.0%
Waste	2,294	1,900	-394	-17.2%
Refrigerants	1,273	1,273	0	0.0%
Water supply	242	242	0	0.0%
Waste Water	310	310	0	0.0%
Total	**11,427**	**11,034**	**-393**	**-3.4%**

Table 18. Projected impact of resilient building controls - comparison

8.6. GHG emissions reduction from integrated controls

This scenario tests the integrated benefits of the potential controls that impact greenhouse gas emissions.

Assuming all controls tested are implemented within a site-specific DCP, the annual GHG emissions are forecast to be 6.6 Mt.CO2e. This is a 42% reduction compared to the sustainability BAU scenario.

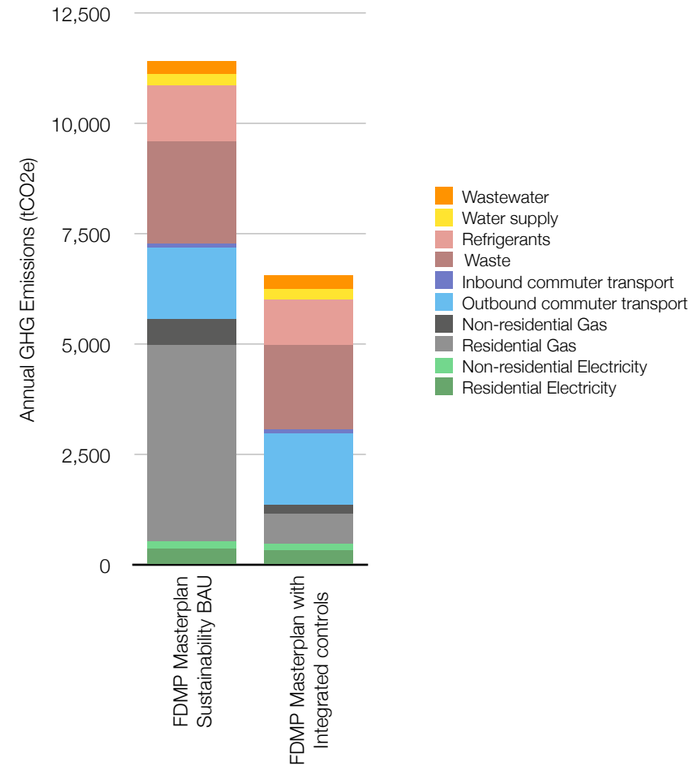


Figure 75. Projected impact of waste management controls - GHG emissions.

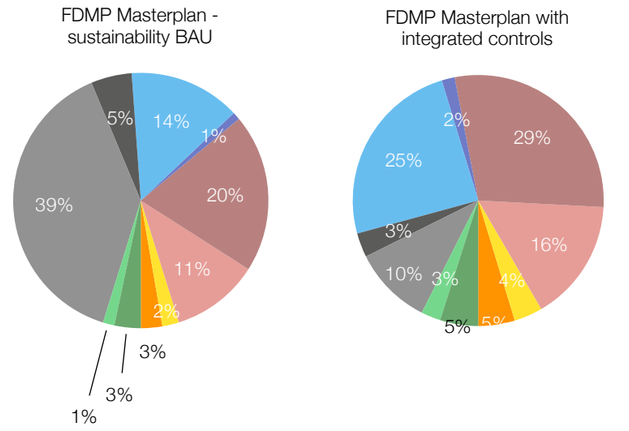


Figure 76. Projected impact of waste management controls - Emissions proportion.

Improving the recoverability of organic food waste with apartment buildings is projected to reduce waste-related greenhouse gas emissions by 17% and precinct-wide greenhouse gas emissions by 3.4%

	Draft Masterplan Sustainability BAU (tCO_2e)	Draft Masterplan with All-electric buildings control (tCO_2e)	Difference (tCO_2e)	Difference (%)
Residential Electricity	380	323	-57	-15.0%
Non residential Electricity	167	166	-1	-0.6%
Residential Gas	4,444	673	-3,771	-84.9%
Non Residential Gas	591	205	-386	-65.3%
Commuter Transport	1,616	1,616	0	0.0%
Worker transport	110	110	0	0.0%
Waste	2,294	1,900	-394	-17.2%
Refrigerants	1,273	1,039	-234	-18.4%
Water supply	242	242	0	0.0%
Waste Water	310	310	0	0.0%
Total	**11,427**	**6,584**	**-4,843**	**-42.4%**

Table 19. Projected impact of waste management controls - comparison

8.7. Drinking water savings from dual piping

This section outlines the potential saving in the volume of drinking water required in the Five Dock Metro Precinct if it required all new buildings to be dual piping for drinking and non-drinking water quality end uses, and an alternative water supply was available before 2046 for the dual plumbed building to connect to.

The testing shows that 28% of water demand in the precinct could be met through an alternative water utility if all buildings were dual piped and connection ready.

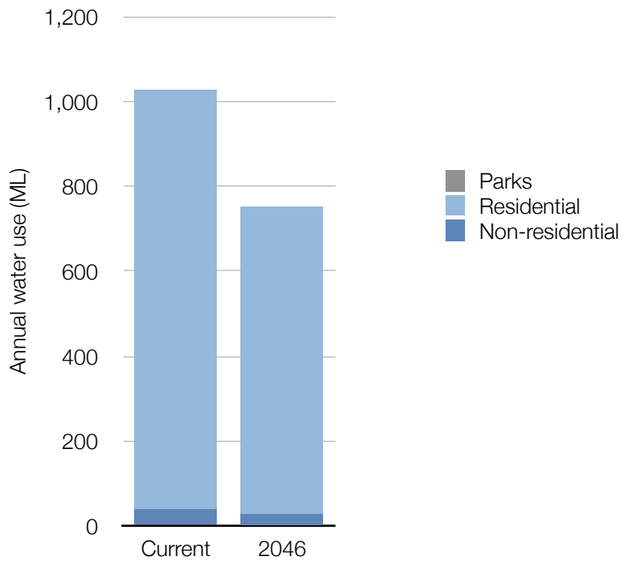


Figure 78. Projected change in drinking water use with dual piping

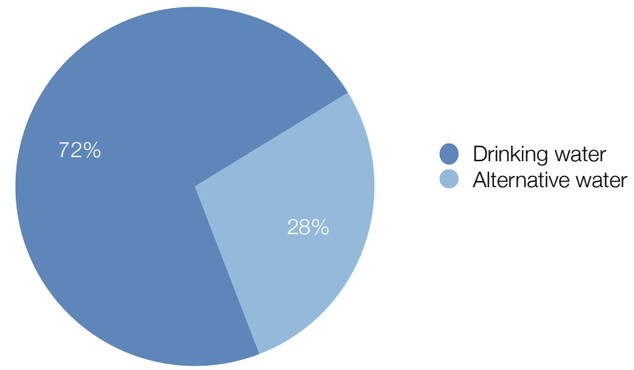


Figure 79. Breakdown of 2046 water demand by quality

8.8. Water savings from higher BASIX Water

This section outlines the potential savings in the volume of drinking water required in the Five Dock Metro Precinct if BASIX Water 55, which is 15 points higher than the regulated requirement of BASIX 40 in the Sustainable Buildings SEPP, were mandated.

Requiring a more stringent BASIX target could reduce total water demand by 22%.

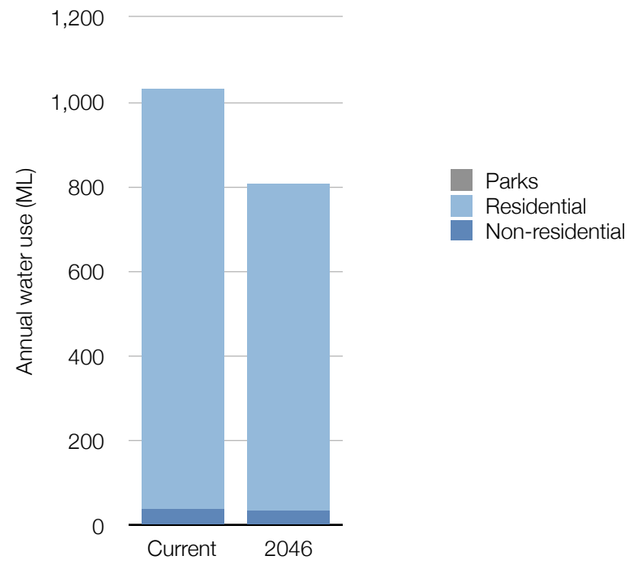


Figure 79. Projected change in drinking water use with dual piping

Section 7
Cost and Benefit

9. Cost and Benefit

This section provides the benefits of proposed sustainability strategies and the broader cost impacts on the developments and/or ongoing costs.

9.1. Surface permeability

Climate resilience benefits

A 20-year study[19] of impervious surfaced development impact on land surface temperature in China revealed a significant exponential correlation between impervious surface and Land Surface Temperature (LST). The impact of impervious surface on LST is found to be greater than the sum of vegetation and water contributions. For each 10% reduction of impervious surface with additional 10% green or water space could lower the LST by up to 2.5°-2.9°C.

Permeable pavements are considered as sustainable drainage systems due to their ability to reduce stormwater runoff. A study[20] comparing permeable pavement to conventional asphalt found that permeable pavement can provide up to 42% more effective peak flow reduction and results in longer discharge times.

Likely order of costs to a builder or developer

Many studies show that the initial cost of permeable pavements is generally higher than traditional non-permeable surfaces. However, this can be offset by reductions in stormwater management infrastructure.

A study[21] in Oregon shows that the cost for the implementation of permeable pavement was US$102/m2 and was designed with 100% infiltration in precipitations of up to 51 mm. In comparison, conventional pavement system would vary from US$35/m2 to US$46/m2 for runoff of 15,000 litres for a 25 mm of precipitation.

A study[22] conducted in Olympia, Washington compared the life cycle costs of traditional non-permeable with permeable concrete sidewalks. It is found that the permeable option cost US$ 8 per square foot, while the traditional impermeable option cost US$ 15 per square foot. The higher cost of the traditional option was attributed to the need for a stormwater pond to manage runoff for the impervious surface.

9.2. Urban shade

Climate resilience benefits

A study on heat-related mortality in Sydney[23] found that, based on a high-range greenhouse-gas-emissions scenario, Sydney could experience a fourfold increase in the numbers of heatwave days and heatwave-attributable deaths by 2100, warranting immediate interventions to reduce the UHI effect.

The study found that substantial health gains could be achieved if the UHI effect was reduced in the Sydney Greater Metropolitan Region. Annually, the heatwave death rate was 2.2 per 100,000 people) culminating in 117.3 heat deaths annually across the entire study area. If all residents of the study area were relieved of the UHI effect, the heat death rate would be reduced to 0.2 per 100,000 or 9.3 in total.

Likely order of costs to a builder or developer

No cost is assigned to this initiative, given that compliance can be achieved by simply selecting the appropriate colour roof.

Ongoing cost savings to households and businesses

Low temperatures on roofs and reduced UHI will provide savings in reduced cooling loads.

9.3. Natural ventilation

Health and wellbeing benefits

In addition to the basic amenity provided by removing odours and stale air, high ventilation rates can improve indoor air quality and correlate to reduced illnesses.

Figure 80 below shows the relationship between minimum outdoor air ventilation rates and the prevalence of illness or sick leave in several research studies. The studies are consistent in showing better health outcomes as a result of increased ventilation rates. The minimum ventilation rate required by the Australian Standard for a two-bedroom apartment is shown for benchmarking purposes. It can be seen that any increase in the minimum ventilation rates is likely to be beneficial to occupants.

Conversely, not safeguarding natural ventilation and when the NCC or other standards are increasing air-tightness requirements for buildings risks poorer health outcomes for occupants.

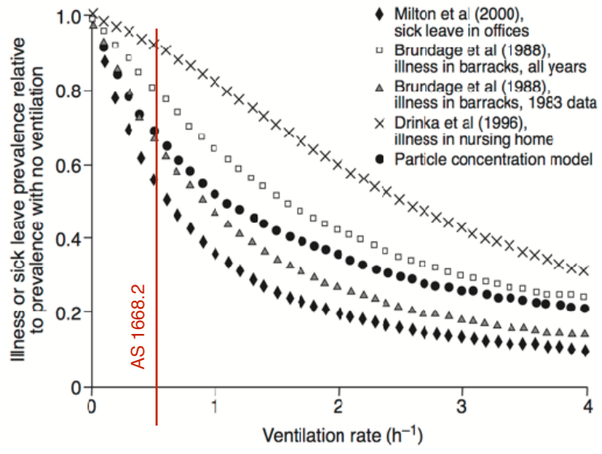


Figure 80 - Relationship between ventilation and illness Adapted from WE Fisk

A UK study from the University of Reading[24] describes the tension between home energy standards, which are scheduled to reduce minimum outside air rates, and the promotion of health and wellbeing. For example, the study estimates a 2-3% increase in asthma for every 1-point increase in minimum energy efficiency requirements.

[19] "The impact of impervious surface development on land surface temperature in a subtropical city: Xiamen, China". Xu et al. 2012.

[20] "Review of permeable pavement systems". Scholz, Miklas and Piotr Grabowiecki. 2006.

[21] "Permeable Pavements Life Cycle Assessment: A Literature Review". Antunes et al. 2018. https://doi.org/10.3390/w10111575

[22] "Permeable Pavements". USA EPA. 2021

[23] Chaston TB, Broome RA, Cooper N, Duck G, Geromboux C, Guo Y, Ji F, Perkins-Kirkpatrick S, Zhang Y, Dissanayake GS, Morgan GG, Hanigan IC. Mortality Burden of Heatwaves in Sydney, Australia Is Exacerbated by the Urban Heat Island and Climate Change: Can Tree Cover Help Mitigate the Health Impacts? *Atmosphere.* 2022; 13(5):714. https://doi.org/10.3390/atmos13050714

[24] Indoor Air Quality in UK Homes and its Impact on Health, Professor Hazim B Awbi, School of the Built Environment University or Reading

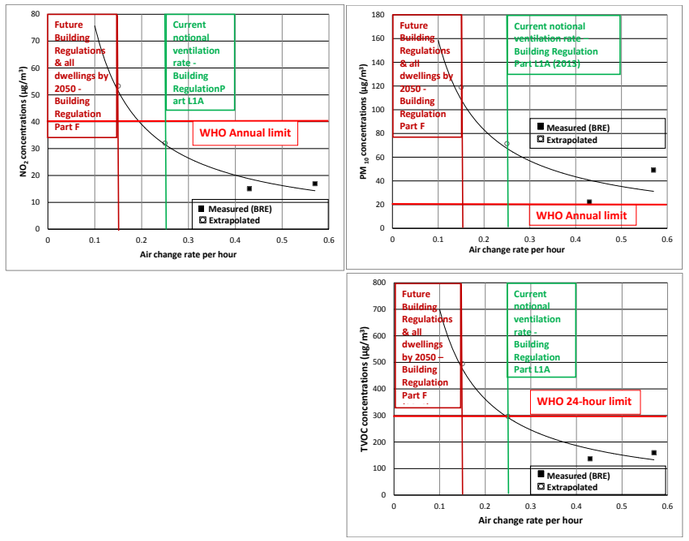


Figure 81 - Relationship between ventilation indoor pollution limits Source: H Awbi

The study provides a useful comparison of the impact of reduced outdoor air ventilation rates upon predicted concentrations of pollutants and the corresponding World Heath Organisation exposure guidelines. Figure 82 shows the annual exposure limits to NO_2 and PM_{10}, and 24-hour exposure limits are provided for Total Volatile Organic Compounds (TVOC). It can be seen that all indicators are at risk from reduced ventilation rates.

VOCs are the air pollutants referenced when it is claimed that the air inside a building is up to 10 times more polluted than outside. A literature review of TVOC levels in classrooms[25] found that 65% of classrooms had a TVOC ratio of over ten times that outdoors, with some over 100 times. A further literature review observed a moderate correlation between classroom TVOC levels and CO_2 levels.

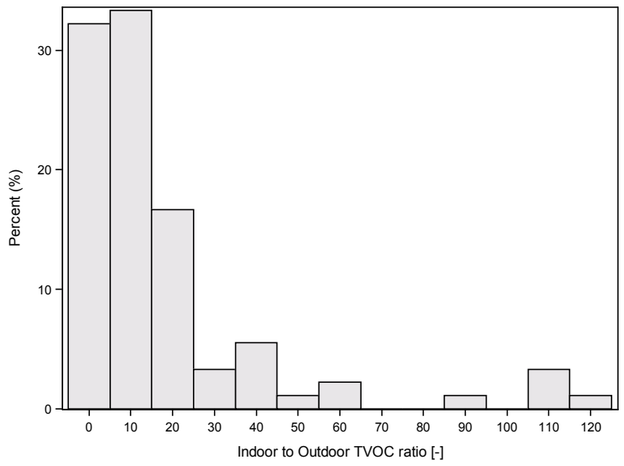


Figure 82 - Comparison of indoor to outdoor air pollutants Source: E Chatzidiakou

Covid 19 transmission has placed a renewed focus on ventilation's role in controlling indoor air quality. Burridge[26] et al. note:

> *The focus on energy efficiency, often imposed by changes in construction standards, in combination with space restrictions arising from higher population density, have led to more tightly constructed, and less spacious, buildings. These tightly constructed structures can, without careful design, maintenance and operation, result in inadequate ventilation provision.*

The paper concludes that the primary control measure for airborne transmission indoors is ventilation, and achieving adequate outdoor air supply rates to ensure an acceptable level of risk should be the priority.

A common recommendation in public health guidance is to open windows and doors to facilitate improved ventilation.

Flyscreens are an effective way of keeping insects out of the home while allowing natural ventilation. Besides being a nuisance, many insects, especially flies (Diptera), including houseflies and mosquitoes, are also known pathogen vectors, posing a health risk. The benefit to health and resilience gained from fly screens will increase in the warming climate.

Fly species, such as the housefly (Musca domestica), are known to spread salmonellosis, shigellosis, trachoma and hepatitis A[27]. In contrast, others, such as the mosquito (Culicidae), are vectors for the transmission of numerous diseases such as Dengue fever, Malaria, Barmah Forest virus, Chikungunya virus, Elephantiasis, Murray Valley encephalitis, Ross River virus, Zika virus and Yellow fever[28]. However, most studies on vector-borne diseases have focused on Dengue due to the incidence rising 30-fold in the last 50 years, affecting 50-100 million people in more than 100 endemic countries[29].

NSW is not immune to vector-borne disease, recording hundreds of locally transmitted vector-borne diseases from the Ross River and Barmah Forest virus infections. For example, the estuarine wetlands along the Parramatta River have some of Australia's most important pest species. These include the saltmarsh mosquito, Aedes vigilax, and the southern saltmarsh mosquito, Aedes camptorhynchus. They can get exceptionally abundant during periods of favourable environmental conditions[30], such as during the unusually warm and wet weather at the start of 2020, contributing to the high mosquito numbers recorded[31].

Co-benefits

An improvement in indoor air quality and health will decrease healthcare costs.

Passive survivability refers to a building or structure's ability to maintain habitable conditions without active heating, cooling, or ventilation systems. Effective natural ventilation and natural cross ventilation are critical strategies for improving passive survivability.

Power outages are caused by planned maintenance and unplanned interruption of the distribution network. An unplanned power outage can be caused by many things, such as damage by fallen trees during a storm or an unexpected fault in equipment. Unplanned power outage risks will be increased by climate change.

Ausgrid publishes quarterly records of power outages and causes[32]. Flux reviewed a sample reporting period for the first quarter of 2020. In the period, Ausgrid reported 888 outages:

- An average of 500 customers were impacted per outage.
- The average duration of an outage was over 4.5 hours.
- 10% of incidents lasted over 11 hours.
- A total of 430k customers suffered outages.

Figure 83 below plots the outages in the period by date and the cause attributed to the outages. Environmental causes are the most significant reason for failure in the distribution network. Ausgrid reporting is limited to owned assets, so the statistics do not include equipment failure on the building side or in the transmission network.

[25] Is CO_2 a good proxy for Indoor Air Quality in school classrooms? Doctoral Thesis by Evangelia Chatzidiakou University College London

[26] Burridge, Henry C.; Bhagat, Rajesh K.; Stettler, Marc E. J.; Kumar, Prashant; De Mel, Ishanki; Demis, Panagiotis; et al. (2021): "The ventilation of buildings and other mitigating measures for COVID-19: a focus on wintertime". The Royal Society. Collection. https://doi.org/10.6084/m9.figshare.c.5325030.v2

[27] https://www1.health.gov.au/internet/publications/publishing.nsf/Content/ohp-enhealth-manual-atsi-cnt-l~ohp-enhealth-manual-atsi-cnt-l-ch5~ohp-enhealth-manual-atsi-cnt-l-ch5.3

[28] https://www.healthdirect.gov.au/mosquito-borne-diseases

[29] Global Strategy for Dengue prevention and control 2012-2020; World Health Organisation; ISBN 978 92 4 150403 4

[30] Webb.C.; 2013; Workbook for managing urban wetlands in Australia Chapter: 3.6: Managing mosquitoes in coastal wetlands; Sydney Olympic Park Authority

[31] Webb.C.E; 2020; Reflections on a highly unusual summer: bushfires, COVID-19 and mosquito-borne disease in NSW, Australia; SAX institute; Vol. 30(4):e3042027

[32] https://www.ausgrid.com.au/Industry/Our-Research/Data-to-share/Past-outage-data

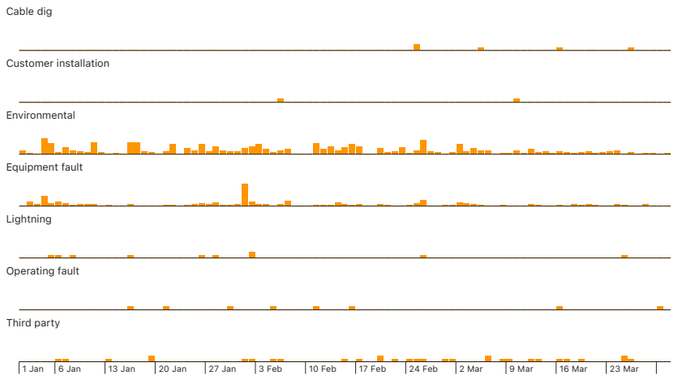


Figure 83. Q1 2020 supply interruption on the Ausgrid network. Source: Flux from Ausgrid data

Likely order of costs to a builder or developer

The first cost is identified as nil due to provisions simply ensuring the proper application of the existing NCC and SEPP requirements.

Given the range of design impacts, the cost savings from current non-compliance with guidance for effective open area and fly screens are difficult to quantify.

Ongoing cost savings for households

The provision of effective natural cross ventilation will provide some savings in electricity bills to residents through reduced reliance on air conditioning to provide thermal comfort on warm days. The savings are estimated to be between $50 and $150 per year (2 - 6 kWh/m^2/annum), depending on the exposure of the rooms to solar heat.

Natural ventilation can and should be designed to avoid uncontrolled infiltration and drafts and increased heating costs.

9.4. Facade

Health and resilience benefits

The benefits of improved resilience are not able to be readily quantified.

The reflection of solar heat from high-glazed facades into the lower parts of street canyons contributes to the elevation of surface and air temperatures at the street level. Therefore, reducing the amount of solar heat that can reach the street is an important strategy to reduce the heat imbalance that is the cause of the urban heat island effect.

Facade controls are important in the context of the increasing energy efficiency stringency of the building code. These energy efficiency requirements are met with increasingly sophisticated spectrally-selective high-performance glazing coatings, which reflect most solar heat away from the glass. This benefits energy efficiency and has allowed Section J to be met with unshaded, highly glazed facades, but it leads to more solar heat entering the public domain.

Likely order of costs to a builder or developer

This provision is not expected to result in a cost increase for residential development.

Additional costs may be incurred for commercial development to meet Section J requirements without reliance on glass without high levels of star heat reflectivity. However, these costs are difficult to quantify due to the direct influence of the design approach taken.

Ongoing cost savings

Ongoing cost savings have not been attributed to this provision, although reducing urban heat will contribute to lower costs associated with air conditioning.

9.5. Biodiversity,

Health and wellbeing benefits

Protecting biodiversity has numerous health benefits, supporting human and ecological wellbeing.

A paper investigating the extent to which threatened species overlap with urban areas in Australia[33] found that cities in Australia support a substantial number of nationally threatened animal and plant species and that individual cities contain unique suites of threatened species. Sydney was found to be the city with the most threatened species (124 species).

A paper[34] reviewing links between biodiversity, ecosystem services, and human well-being discusses the importance of maintaining and restoring biodiversity and ecosystem services in urban areas, where most of the world's population lives. The authors suggest that urban green spaces, such as parks and gardens, can provide important health and wellbeing benefits, such as stress reduction, improved cognitive function, and increased physical activity. They also argue that urban ecosystems can support food production, water management, and climate resilience, making cities more sustainable and resilient in the face of environmental change.

Likely order of costs to a builder or developer

This provision requires thoughtful design and should not require an increased capital cost.

[33] Ives, C.D., Lentini, P.E., Threlfall, C.G., Ikin, K., Shanahan, D.F., Garrard, G.E., Bekessy, S.A., Fuller, R.A., Mumaw, L., Rayner, L., Rowe, R., Valentine, L.E. and Kendal, D. (2016), The importance of cities for threatened species. Global Ecology and Biogeography, 25: 117-126. https://doi.org/10.1111/geb.12404

[34] Haines-Young, R., & Potschin, M. (2010). The links between biodiversity, ecosystem services and human well-being. In D. Raffaelli & C. Frid (Eds.), *Ecosystem Ecology: A New Synthesis* (Ecological Reviews, pp. 110-139). Cambridge: Cambridge University Press. doi:10.1017/CBO9780511750458.007

9.6. Local open space

Health and wellbeing benefits

Providing local open space offers significant health and well-being benefits.

Studies cited in the Urban Institute research report[35] highlight a strong link between proximity to local open spaces and increased physical activity. This is shown to reduce risk of cardiovascular disease, diabetes, cancer and heart disease.

Research indicates that individuals with a higher sense of connectedness to nature are more likely to employ adaptive emotion regulation strategies, such as cognitive reappraisal and mindfulness, which in turn can lead to improved emotional outcomes.

Likely order of costs to a builder or developer

Additional costs are not anticipated beyond ADG requirements.

Ongoing cost savings

A study shows that annual healthcare cost savings from preventing physical inactivity related diseases range from A$2,800 to A$99,600 per 100,000 adults.[36]

9.7. Energy efficiency

This provision only seeks confirmation that the SEPP and NCC provisions can be satisfied. Therefore, costs and benefits are not attributable to the DCP.

9.8. On-site solar

Net zero benefit

The environmental benefits of rooftop solar are significant. Using the latest published data, every kilowatt hour of electricity generated will avoid the greenhouse gas emission associated with generation in the NSW electricity grid, which is 0.81 kgCO2e.[37]

Using a factor of 1.4 kWh annual yield per watt of installed capacity, every additional 100 kW of installed power capacity under this provision would generate 140,000 kWh of energy per year in its first year and off-set approximately 100,000 kgCO2e once a reduction in the greenhouse intensity of grid provided electricity is allowed for. However, the benefits would decrease in subsequent years due to the degradation of the solar panels (0.5%) and the continued greening of the NSW electricity grid.

Co-benefits

The increase in renewable energy generation within the LGA will assist in curtailing increased demand on the zone substations that provide grid electricity to the LGA due to growth and the electrification of buildings.

Likely order of costs to a builder or developer

The likely order for costs based on building types are:

- $9,000 for a Single-family house on a 400 m^2 block
- $4,500 for an apartment in a three-storey block
- $40,000 for all other development, assuming a 1,000 m^2 block.

Ongoing cost savings for households and businesses

The cost savings for residential are estimated assuming a finite amount of rooftop generation is used directly and surplus power to demand at the time of generation is exported to the grid. This provides a conservative view of potential cost savings given the low price for exported electricity.

The following table summarises financial benefits.

Type	Consumed electricty (kWh)	Exported Electricity (kWh)	Saving ($/ year)	Simple payback
per House	10	20	1,800	5 years
per Apartment in block < 3 storeys	8	8	1,300	4 years
body corporate of mid apartment building on 1,000 m^2 site	90	90	14,800	3 year
body corporate high rise apartment building on 1000 m^2 site	130	50	19,900	2 year

Table 20. Onsite solar financial benefits

The proportion of generated electricity consumed within the building improves for non-residential uses due to the higher daytime demands. However, the cost of electricity is reduced due to lower cost tariffs for larger users. Flux anticipates a cost saving in the order of $13,000 per annum for a 1,000m2 site and a simple payback of 3-4 years.

[35] "The Health Benefits of Parks and their Economic Impacts. A Review of Literature". Urban Institute. 2022. https://www.urban.org/sites/default/files/2022-03/the-health-benefits-of-parks-and-their-economic-impacts_0.pdf

[36] "The effects of built environment attributes on physical activity-related health and health care costs outcomes in Australia". Diomedi et al. 2017

[37] 2022 NGA Factors Workbook DCCEEW.

9.9. All-electric building

Net zero benefits

The immediate environmental benefits of delivering all-electric buildings are the reduction in urban air pollution resulting from the combustion of natural gas and a reduction in the greenhouse gas emissions associated with the production of natural gas and its combustion on site.

The benefits will increase significantly as the electricity grid moves toward zero net emissions. As a result, the air quality in NSW will improve further as fossil fuel sources are removed from electricity generation, and the greenhouse benefits of a low-carbon grid will be fully realised.

Co-benefits

Although commonly used, gas stovetops are highly inefficient for heat utilisation. Only about 40% of the heat generated by the gas flame is utilised in heating the contents of the pan. The remaining 60% of the heat is lost to the surrounding environment, contributing to overheating and increased cooling loads. In comparison, induction cooktops have an inherent efficiency of over 80%, with the majority of the heat generated being utilised to heat the contents of the pan. This increased efficiency can result in lower temperatures and reduced cooling requirements, which is highly beneficial for both commercial kitchens and residential dwellings.

Not only are gas stovetops inefficient, but they are also a significant source of indoor air pollutants. Gas combustion releases a variety of contaminants, including nitrogen oxides (NO_x), carbon monoxide (CO), formaldehyde (CH_2O or HCHO), and $PM_{2.5}$ particles. Gas cooking produces about twice as much $PM_{2.5}$ as electric cooking. These pollutants pose a significant health risk if not properly managed.

According to a study by the University of Queensland (2018), 12% of childhood asthma around the country can be related to gas cooking[38].

Table 19 below shows the measured emissions for gas stoves[39]. For comparison, the maximum contaminant limit for acceptable indoor air quality in the NCC 2019 BCA for NO_2 is 0.0897ppm (1hr averaging).

Measured NO_2 Emissions from Gas Stoves	Peak (ppm)
Frying bacon	0.104
Boiling water	0.184
Gas cooktop - no food	0.082-0.300

Table 21. Measured NO_2 emissions from gas stoves

All-electric buildings can help combat the Urban Heat Island effect by reducing the amount of anthropogenic heat released. Traditional gas hot water heating systems release waste heat into the atmosphere through flues for combustion exhaust gases, resulting in a significant energy loss. While commercial gas condensing boilers can reduce these losses to 15%, conventional boiler and balanced flue units can lose up to 30% of the consumed energy in heat, contributing to the energy imbalance that causes the Urban Heat Island effect. On the other hand, heat pumps transfer heat from the atmosphere to water through an evaporation cycle, which cools the outdoor air while heating the water. Therefore, heat pumps do not contribute to anthropogenic heat release, unlike gas-fired hot water systems.

Likely order of costs to a builder or developer

A US study[40] found that delivering new fully electric single-family homes was cheaper than a mixed-fuel building, saving between $2.15/sqft and $2.35/sqft (around AUD30/$m^2$). However, the same study noted a minor increase in cost for a medium-sized office of $0.33/sqft and $0.50/sqft (around AUD5-7.50/m^2, or 0.1% of construction costs).

Flux does not expect the order of savings and costs to be significantly different in the Sydney market and provides the following commentary on Australian costs with respect to apartment buildings.

Likely order of costs for apartments

Any development that provides all-electric servicing will save the cost associated with installing a gas service to the building, gas distribution pipework to each apartment and the cost of a gas meter and cupboard space for each apartment. These costs are in the order of $2,000 per apartment.

The cost difference between an induction hob in an all-electric apartment and a gas hob is considered negligible.

Gas hot water heating has a cheaper first cost than an electric heat pump, which is necessary to provide energy-efficient hot water in an all-electric building. If distributed hot water systems are used, a gas cost is likely to be in the order of $1,000 per apartment compared to $3,000 per apartment for a heat pump. The cost difference is expected to be lower for centralised hot water heating.

There will also be an impact on maximum demand in switching to all-electric servicing. Assuming electric storage or instantaneous water heaters for power requirements is very much worst-case (but lower first cost than heat pumps). With this worst-case assumption, the after-diversity maximum demand increases by approximately 10% per apartment. However, the overall increase in the building will be lower after common loads such as lifts and car park ventilation are added. Any increase in cost for an all-electric apartment building will likely be marginal

Ongoing cost savings to households and businesses

Electric equipment is generally more energy-efficient than gas-fired equipment, which can lead to lower utility bills and reduced energy consumption.

There is also a significant saving for a homeowner in avoiding standing meter charges associated with gas. The current Jemena standing charge for a gas connection is 65.8c/day, which equates to a cost of approximately $240/year, which is saved by not having a gas connection.

Removing a gas meter is also costly. The minimum scheduled cost for removing a gas meter is $1,169.30. This provides a simple payback of approximately five years for an apartment owner who no longer wants to be connected to gas.

If 1000 apartments were built in Lane Cove without a new gas connection, the avoided liability for disconnection would be over $1m.

[38] Cooking with Gas: bad for the planet, and bad for your health 21 May 2020 The Fifth Estate

[39] Nitrogen Dioxide levels using gas stoves in comparison with the standard levels of Nitrogen Dioxide in Guidelines: https://rmi.org/insight/gas-stoves-pollution-health

[40] Cost Study of the Building Decarbonization Code. New Buildings Institute April 2022

9.10. Refrigerant GWP

Net zero benefits

Conventional refrigerants are synthetic greenhouse gases, and their significant environmental impact is why they are subject to a global phase-down.

The environmental impact of the synthetic greenhouse gas is given as a Global Warming Potential (GWP) value, which represents how many times larger than CO_2 their global warming potential is when released into the atmosphere.

The following figure contains the GWP of some refrigerants currently being used in Australia:

HFC-410A, which is most commonly used in air conditioning, has a GWP_{100} of over 2,000. R32 is better, having a GWP_{100} of 650, and is becoming more common in air conditioning applications.

However, there is debate about whether quoting the GWP of refrigerants using a start 100-year GWP indicator is correct to recognise the Global warming impact of synthetic refrigerants, which have a shorter life in the atmosphere. For example, R32 has an atmospheric life of just over 5 years, and if the GWP were measured over 20 years, the GWP would increase to 2,300 times that of CO_2.

The total distribution of refrigerants in Australia is published by the Australian Department of Climate Change, Energy, the Environment[41] and Water and is shown below.

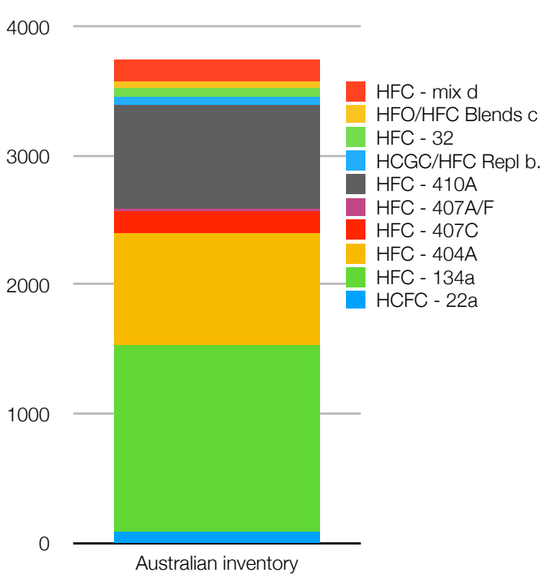


Figure 84. Australian refrigerant bank source: Flux from CECEWW data

The move towards all-electric buildings will also require heat pumps for hot water generation, which will further increase the use of refrigerants.

Allowing for 4kg of refrigerant inventory in each house with a blended GWP_{100} of 1,500 and an 8% leakage rate, synthetic refrigerants will contribute an average of 480kg CO_2e/annum in greenhouse gas emissions per house. If the more time-relevant blended GWP_{20} of 3,000 is used, the synthetic refrigerants will contribute approximately 1 tCO_2e/annum.

Using an alternative refrigerant allows both the charge to be reduced (to about 1kg) and GWP_{100} and GWP_{20} to be reduced to 0.24 kg CO2e/annum.

The same relative saving is achieved for apartments, but the magnitude is expected to be reduced by 30%.

Likely order of costs to a builder or developer

The likely order for costs based on building types, allowing for the full 10% cost premium contemplated by the provision and using standard published rates[42], are:

- $1,500 for a Single-family house
- $1,000 for an apartment
- $40,000 for all other development assuming a 1,000m^2 block.

Ongoing cost savings for households and businesses

The avoided future cost to a business or homeowner would depend on whether any HFC-charged equipment can be re-gassed when needed. Should HFCs not be available to the importation phase down Australia has committed, the owner would be liable for costs ranging from the conversion of the equipment to allow an alternative non-HFC refrigerant or for the replacement of the appliance.

9.11. Water resilience

Circular economy benefits

Maximising the collection and reuse of water will help reduce demands on Sydney's finite drinking water supply capacity, which is coming under increasing stress due to a changing climate and the needs of a growing population.

Likely order of costs to a builder or developer

The provision is a more descriptive version of the requirements of a provision in the current DCP, and therefore, if any cost increase is incurred, it is marginal and limited to the size of the tank.

Ongoing cost savings for households and businesses

If the dual reticulation system is not installed during the initial development but is required to be retrofitted in the future, the cost will be significantly higher due to the complexity of retrofitting and the additional work involved.

[41] Cold Hard Facts 2022, DECEEW February 2023

[42] Riders Digest Sydney https://s31756.pcdn.co/oceania/wp-content/uploads/sites/1/2021/04/Riders-Digest_Sydney_2021.pdf

9.12. Water efficiency

Circular economy benefits

The water-saving benefit of the 1-star increment in NABERS Water ratings against the Sustainable Buildings SEPP minimum requirements for commercial office buildings is approximately 0.3kL/m² NLA/annum. This is derived from the spread of NABERS Water rating buildings in metropolitan Sydney immediately before the Covid lockdowns. The range of consumption within any given star band and the normalisation processes used by NABERS Water introduce some uncertainty, but it reasonably approximates the benefit.

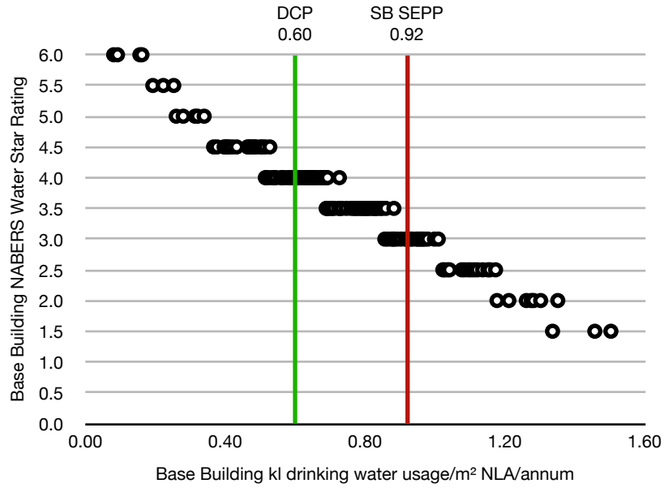


Figure 85. NABERS Office Water ratings and usage in Greater Sydney Source: Flux

For Hotels, the number of NABERS Water rating buildings in Greater Metropolitan Sydney is very low, so it does not provide a robust guide for estimating benefits. However, a saving of 30-35kL per guest room per annum seems reasonable.

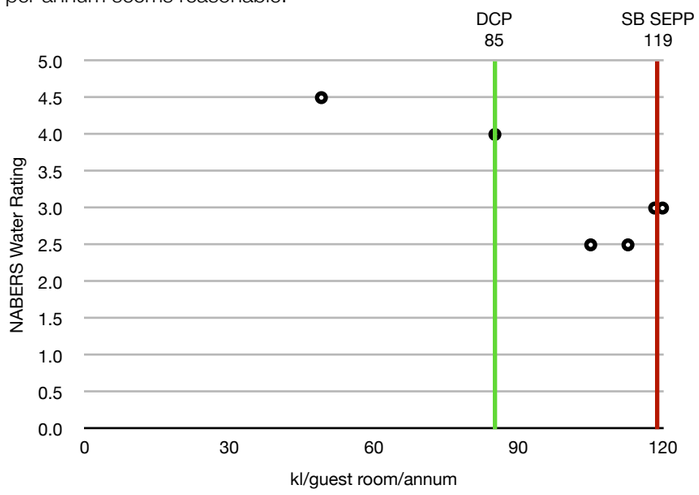


Figure 86. NABERS Hotel Water rating and usage in Greater Sydney Source: Flux

Likely order of costs to a builder or developer

Residential development will have a nil cost impact as the SEPP is not varied, and significant operating cost savings are not anticipated.

The additional 1 star required for non-residential buildings in the proposed control is not expected to attract a cost premium, given the associated provision for rainwater collection and reuse. In addition, having the additional one-star requirement safeguards other water efficiency measures, such as efficient fixtures and fittings.

Ongoing cost savings

The ongoing cost savings to commercial offices will be in the order of $1.10-$1.40/m² NLA.annum depending on whether Sydney Water activates the low dam level pricing rate. The savings per hotel room are anticipated to be between $100 and $145 per guest room per year.

9.13. Waste management

Circular economy benefits

Additional waste management infrastructure is necessary to support the NSW government's target to reduce organic waste to landfill by 50% by 2030.

Likely order of costs to a builder

Additional costs are not anticipated above and beyond the existing DCP requirements except in the case of apartment buildings where the infrastructure for a third separated waste stream is likely to impose cost in either the provision of the infrastructure or loss of floor space. However, the quantum of the cost depends on the chosen system and other design choices, such as the number of crew, so it cannot be readily quantified.

Ongoing cost savings

Assuming the landfill costs of the NSW Government levy and gate fees of more tan $200/tonne are passed on to householders, the savings would be $27/year.

9.14. Design and construction impacts

Circular economy benefits

Using increased quantities of Supplementary Cementitious Material (SCM) in concrete also diverts waste products from landfills.

The diversion of construction waste from landfill has a direct proportionate benefit of extending the useful life of the materials within the waste stream.

Likely order of costs to a builder

Most of the cost of these provisions can be fully mitigated with good design. Flux anticipates a premium for concrete mixes with reduced Portland cement in the order of 5-10% supply cost. If the concrete structure is 10% of the total construction budget, this will increase total costs by 0.5-1%.