NEW PARRAMATTA RD

Parramatta Road Corridor Urban Transformation Strategy

Sustainability Implementation Plan

REFERENCE REPORT

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1. Contents

1. Contents 2
Executive Summary 3
2. Introduction 5
2.1 Overview 5
2.2 Parramatta Road Urban Transformation Program 5
2.3 The Parramatta Road Corridor 6
2.4 Precinct Plans for the Parramatta Road Corridor 7
..... 8
3. Quantifying Sustainability 9
4. Sustainability Strategy for New Parramatta Rd 11
4.1 High Performance Buildings 11
4.2 Strategic Parking 14
Case Study – Implementing Decoupled, Unbundled Parking 18
4.2.1 What is it? 18
4.2.2 What are we trying to achieve? 18
4.2.3 International and Local Applications of Unbundled and Decoupled Parking 19
4.2.4 CAMPERDOWN PRECINCT CASE STUDY 20
4.2.5 Implementing Decoupled Parking 22
4.2.6 Precinct by Precinct Approach 26
4.3 Urban Resilience and Sustainable Infrastructure 26
5. Summary of Strategies & Development Controls 29
6. Sustainability Targets 31
6.1 Parramatta Road Corridor Sustainability Targets 32
6.2 Individual Precinct Sustainability Targets 34
6.2.1 Camperdown Precinct Sustainability Targets 35
6.2.2 Leichhardt Precinct Sustainability Targets 36
6.2.3 Taverners Hill Precinct Sustainability Targets 38
6.2.4 Kings Bay Precinct Sustainability Targets 39
6.2.5 Burwood-Concord Precinct Sustainability Targets 41
6.2.6 Homebush Precinct Sustainability Targets 42
6.2.7 Auburn Precinct Sustainability Targets 44
6.2.8 Granville Precinct Sustainability Targets 45
APPENDIX 47

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Executive Summary

Purpose

The Parramatta Road Urban Transformation Program (PRUTP) is the integrated, cross-agency project established by the NSW Government in 2013 to explore, capture and deliver on opportunities for urban transformation along the Corridor.

This report builds on the *Parramatta Road Urban Transformation PRECINX Strategy Report* (Kinesis 2015) to detail the sustainability strategies and key development controls that will deliver Parramatta Road as world leading urban transformation.

Sustainability for the Parramatta Road Urban Transformation

In order to deliver world class urban renewal outcomes along the Corridor, the opportunity exists to strive for sustainability outcomes that exceed current requirements. Three key strategies have been identified and recommended to deliver a more sustainable, resilient and affordable community:

- High Performance Buildings

  Best practice BASIX Energy and Water targets, incorporating significant renewable energy and water reuse requirements, as well as 5-star NABERS commercial and retail buildings, will deliver significant reductions in energy, carbon, water and improved household affordability.

- Strategic Parking Strategies

  Maximum parking rates, coupled with car share, unbundled parking and decoupled parking strategies will drive reduced car ownership and dependence, improve local air quality and reduce carbon, lower construction costs and improve development feasibility and housing choice

- Urban Resilience and Sustainable Infrastructure

  Increased open space, green infrastructure and networks provides the potential to create a cooler urban environment that is resilience against a changing climate and, furthermore, the effects of urban heat island. Coupled with recycled water and buildings future proofed for emerging energy technologies, development along the corridor will be resilient and future thinking.

Given the scope of the PRUTP, the strategies and sustainability targets outlined in this report focus on built form outcomes along the Parramatta Road Corridor. These strategies are not exhaustive and should be read in conjunction with the urban design, open space, transport and community strategies proposed for the corridor.

Performance Outcomes and Sustainability Targets

Strategies along the Parramatta Road Corridor have been modelled in UrbanGrowth NSW's PRECINX Strategic Design and Infrastructure Planning Tool. Detailed modelling in PRECINX enables UrbanGrowth NSW to quantify the benefits of the proposed transformation across the sustainability aspirations for the project.

Through the comprehensive delivery of built form strategies across building efficiency, renewable energy, strategic parking, public domain and sustainable infrastructure, the Parramatta Road Corridor has the capacity to deliver:

- **Over 20% reduction** in greenhouse gas emissions (compared to the Base Case)

- **Nearly 60 MW** of renewable energy installed
- **30% reduction** in peak electricity demand (compared to the Base Case), delivering approximately **1.7 kVA per dwelling**.
- **Over 30% reduction** in water consumption (compared to the Base Case)
- **Over 15%** of water delivered by non-potable sources, including rainwater or recycled water
- **30% reduction** in car use (compared to the Base Case)
- **8% to 17%** car share take-up rate
- **29.8 ha** of additional open space
- **31 km** of new, safe bicycle connections

This Sustainability Implementation Plan documents the development of sustainability strategies, development controls and both corridor wide and precinct level targets to be pursued for PRUTP.

2. Introduction

2.1 Overview

Sydney is one of the most liveable cities in the world, boasting a strong economy, skilled labour force, beautiful natural environment and good lifestyle. A sign of its prosperity is that the city is growing. With a current population of about 4.3 million people, Sydney's population will increase by 1.6 million people over the next 20 years. The city will need to provide more diverse and affordable housing, a broader range of job opportunities and easier ways for people and goods to move around. As the city grows, we must renew existing urban areas to provide a sustainable way to meet increasing demand for housing, transport and services, and maintain our international competitiveness.

The Parramatta Road Corridor (the Corridor) is identified in A Plan for Growing Sydney as an urban renewal corridor that will be the focus for increased housing, economic activity and social infrastructure. The Corridor will be transformed over the next 30 years through implementation of the Parramatta Road Urban Transformation Strategy. In 2050, the Corridor will have an estimated resident population of 62,000, approximately 33,000 new homes and 33,000 new jobs.

Realising the Corridor's full potential is important to the future productivity and liveability of metropolitan Sydney. It also presents an opportunity to optimise its sustainability performance.

The Corridor renewal could incorporate building and infrastructure optimisation strategies to improve resource efficiency, reduce peak demand impacts and lower capital and recurrent costs for infrastructure providers, developers and householders above and beyond a business as usual scenario.

While exact technologies and strategies to achieve these gains would be considered at the next phase of planning, a range of potential sustainability strategies have identified what could be considered by planning authorities when undertaking future strategic and statutory planning processes.

2.2 Parramatta Road Urban Transformation Program

The Parramatta Road Urban Transformation Program (PRUTP) is the integrated, cross-agency project established by the NSW Government in 2013 to explore, capture and deliver on opportunities for urban transformation along the Corridor, resulting in part from the WestConnex Motorway, and in line with A Plan for Growing Sydney.

The PRUTP incorporates three key deliverables:

- an Urban Transformation Strategy for the future growth and development of the Parramatta Road Corridor - set out in the document known as the Parramatta Road Urban Transformation Strategy
- a transport infrastructure program for the Corridor – set out in the document known as the Sydney CBD to Parramatta Strategic Transport Plan
- a $198 million[1] program of local urban amenity improvement works to deliver tangible public domain improvements to the Corridor aligned with its staged redevelopment – set out in the document known as the Parramatta Road Urban Amenity Improvement Plan.

The PRUTP has been led by UrbanGrowth NSW, the NSW Government's urban transformation delivery organisation. In developing the Strategy, UrbanGrowth NSW has worked closely with Transport for NSW, Roads and Maritime Services, Sydney Motorways Corporation, the Greater Sydney Commission (GSC), the

[1] In 2015 dollars

Department of Planning and Environment (DPE), the Department of Education and Training (DET), Sydney Local Health Districts and the councils along the Corridor.

The Greater Sydney Commission has been charged with preparing the District Plans for each of Sydney's six districts. The District Plans will identify the basis for strategic planning in each district, having regard to economic, social and environmental matters, and set out the actions required for achieving those planning priorities.

The Parramatta Road Corridor is located in the Central and Central West districts. The long-term delivery of the Strategy will be taken over by the GSC and will inform the relevant District Plans.

2.3 The Parramatta Road Corridor

Due to the nature of the required inputs and key deliverables of the Strategy, the Corridor and its components are referred to in different ways, for various components and stages of work.

The **Study Area** covers Local Government Areas (LGAs) that the Corridor spans and includes the geographical area between Parramatta CBD in the west and Sydney CBD in the east, and the Parramatta River in the north to the Western Rail Line in the south.

The **Parramatta Road Corridor** is the continuous length of Parramatta Road, and includes land with direct frontage to Parramatta Road, as well as the eight Precincts.

Change and growth along the Corridor is focused in eight **Precincts** which have been chosen for their ability to support growth, and their access to public transport, services and jobs. In some cases, the Precincts straddle LGA boundaries.

Frame Areas are portions of the Corridor located between the identified Precincts with direct frontage to Parramatta Road, and typically include the first strip of lots or land to the first street/laneway running parallel to the north or south of Parramatta Road. The Frame Areas are important links that may have some change at a lower intensity than that anticipated in the Precincts. The transformation should not be seen as the redevelopment of Precincts alone, but rather the combined renewal of Precincts and Frame Areas that will collectively deliver a transformational effect along the Corridor.

Figure 1 identifies the extent of the Study Area, Corridor, Precincts and Frame Areas. **Table 1** identifies the LGAs that the Precincts are located within.

Local Councils in the Parramatta Road Corridor

The Parramatta Road Urban Transformation Program is an integrated, cross-agency project established by the NSW Government in 2013. The Program explores, captures and facilitates opportunities for urban transformation along the Parramatta Road Corridor – a 20 km stretch that spans multiple jurisdictions.

When first established, the Corridor covered ten local government areas. During the course of the Parramatta Road Urban Transformation Program, new councils have been created and at the time of Strategy's publication, there are seven local government areas in the Corridor and additional merger proposals are being considered.

The Parramatta Road Urban Transformation Strategy and Implementation Tool Kit has been prepared in collaboration with all councils in place along the Corridor over the last three years. The technical supporting documents that have informed the Strategy and the Implementation Tool Kit also acknowledge past and present councils. Former councils are referenced for the purposes of citing local plans and policies that were, and continue to be, in place whilst the Strategy and Implementation Tool Kit was being prepared.

The NSW Government is continuing to work with all councils and will work with administrators where they have been appointed.

Table 1: Parramatta Road Corridor Precincts by Local Governmenmt Area

Precinct	Corresponding LGAs
Granville	City of Parramatta Council
Auburn	Cumberland Council
Homebush	City of Canada Bay Council and Strathfield Municipal councils
Burwood	Burwood Council, City of Canada Bay Council
Kings Bay	Burwood Council, City of Canada Bay Council and Inner West Council
Leichhardt	Inner West Council
Taverners Hill	Inner West Council
Camperdown	City of Sydney, Inner West Council

2.4 Precinct Plans for the Parramatta Road Corridor

Precinct Plans have been developed for each Precinct along the Corridor, determining the expected floor space, dwelling, population and employment yields. A summary of these yields for each Precinct are shown in Table 2.

Parramatta Road Corridor Precinct Yields

Table 2: Parramatta Road Corridor precincts floor space, dwelling and employment yields

Precinct (Core and Frame)	Total GFA (m2)	Dwellings	Population	Jobs
Granville	1,012,741	5,867	11,118	6,147
Auburn	1,201,299	1,748	3,321	10,265
Homebush	1,575,651	11,271	21,415	6,243
Burwood-Concord	725,881	5,963	11,329	2,942
Kings Bay	449,543	3,002	5,704	2,543
Taverners Hill	519,881	2,553	4,851	2,600
Leichhardt	152,814	678	1,288	1,425
Camperdown	305,617	1,828	3,473	1,297
Total	**5,943,426**	**32,910**	**62,501**	**33,462**

Figure 1 – Map of Precincts within the Parramatta Road Corridor

3. Quantifying Sustainability

PRECINX was integrated into the various project streams prepared under the PRUTP to provide a measurable and quantifiable basis to determine the benefits of the PRUTP and identify strategies to improve its performance and outcomes.

Analysis included in this report was undertaken using UrbanGrowth NSW's integrated sustainability, infrastructure and design tool, PRECINX. PRECINX is a tool used to evaluate the sustainability of a neighbourhood or large urban transformation projects. It is designed to test a project's social, economic and environmental performance against existing conditions, a business-as-usual base case, and can also calculate and the assess performance of an optimised scenario that relies on the introduction of additional interventions above and beyond existing or base requirements.

Developed in partnership with UrbanGrowth NSW, Sydney Water, Ausgrid and the Bureau of Transport Statistics, PRECINX is a strategic infrastructure and sustainability design tool, used in the analysis of key performance metrics of precincts, integrating land use and development inputs with demographic, utility, transport and affordability models.

Drawing on comprehensive local data sources including climate and utility data, PRECINX links urban planning and urban design inputs with environmental metrics to calculate the performance of a development across transport, land–use, embodied energy, operational energy, water and stormwater, housing affordability, capital and recurrent costs and household operating costs.

PRECINX is currently used by a range of collaborators from government agencies, public and private developers and public and private utilities, who provide the tool with updated datasets to continuously improve its ability to predict the sustainability impact of future development.

Elements of PRECINX were used in the development and analysis of sustainability for the PRUTP. The hourly model, linked to local climate, demographic and travel pattern data provides network-level analysis and scenario modelling across:

- Energy, peak demand, renewable energy and greenhouse gas emissions
- Water, sewer, rainwater, stormwater and recycled water scenario analysis
- Transport, car use, car share and parking strategies
- Cost of living analysis, incorporating local retail tariffs and fuel costs

Each Precinct Plan was analysed to calculate the performance outcomes for PRUTP. To understand the performance and benefits of the proposed strategies, analysis of each Precinct was undertaken under two scenarios:

1. **PRUTP Base Case** – the proposed development under current building code and BASIX requirements including existing local development controls (i.e. the performance of the development if it was built to meet current compliance requirements).
2. **PRUTP Proposed** – the proposed development under the proposed PRUTP strategies.

Quantifying elements of sustainability through PRECINX

PRECINX also allows analysis against local and metropolitan benchmarks to help answer the question:

"Are we making the city better or worse?"

The proposed key strategies and sustainability performance outcomes for the PRUTP are documented on the following pages.

All results contained in this report are derived from PRECINX. Key assumptions and datasets used in PRECINX are provided in the Appendix of this report.

4. Sustainability Strategy for New Parramatta Rd

To create sustainable, resilient and affordable communities along the Corridor, the *Parramatta Road Sustainability PRECINX Strategy Report* identifies three key areas of intervention:

1. High performance buildings

2. Reduced and decoupled strategic parking

3. Urban resilience and infrastructure delivery

The details and outcomes of these strategies are documented below.

4.1 High Performance Buildings

Residential Buildings

The current BASIX requirements for the PRUTP are BASIX Water 40 for all dwellings, BASIX Energy 20 for buildings of 6+ storeys, Energy 30 for buildings of 4 to 5 storeys and Energy 35 for 3 to 4 storeys.

Through key interventions, new residential buildings in PRUTP are proposed to achieve:

- BASIX Water 50 for all dwellings (and up to 60 where recycled water is available)2[2]
- BASIX Energy 40 for buildings of 6 storeys or greater
- BASIX Energy 50 for buildings of 4 to 5 storeys
- BASIX Energy 55 for buildings of 3 to 4 storeys
- BASIX Energy 60 for single dwellings.

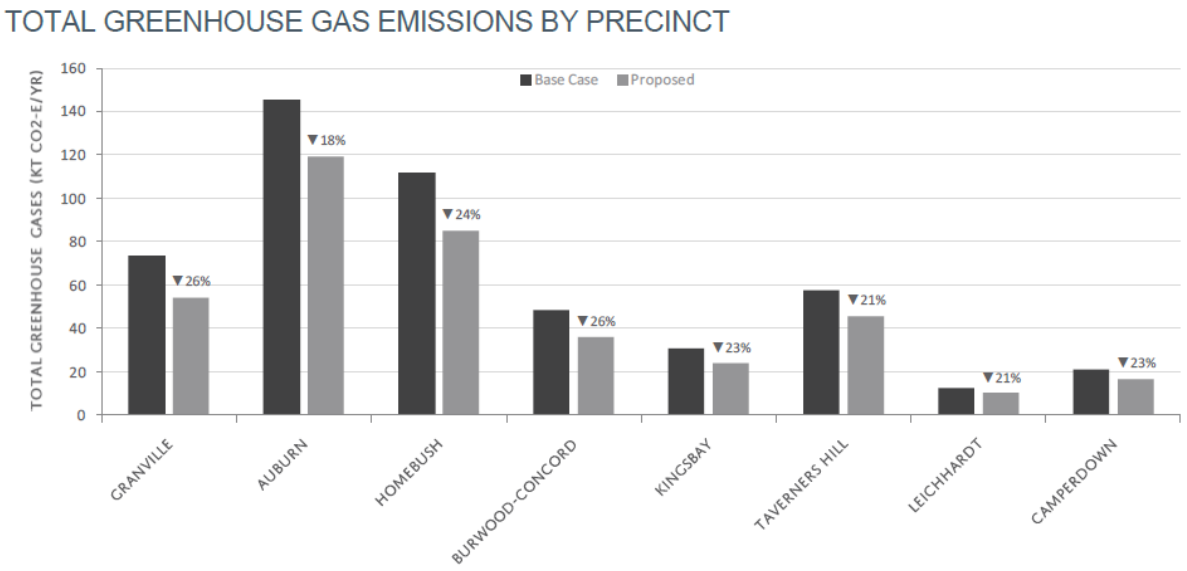
To achieve these outcomes, the following strategies have been assumed:

- Thermal performance to an average of 6-star NatHERS
- Air conditioning with a minimum COP (coefficient of performance) of 3.5
- Efficient, LED lighting
- Energy and water efficient dishwashers, clothes washers and clothes dryers (within 1 Star of the best available on the market).
- Building level rainwater reuse for irrigation and toilet flushing (recycled water reuse for irrigation, toilet and laundry to achieve BASIX Water 60).
- Renewable energy on every residential building

Please note – while the list of strategies above were used to in the modelling to achieve the proposed BASIX targets, this list is not exhaustive and could also include alternative strategies such as cogeneration, geothermal heating, occupancy sensors and/or cooling or solar thermal energy. This plan is agnostic to the design and technologies used to achieve these performance outcomes.

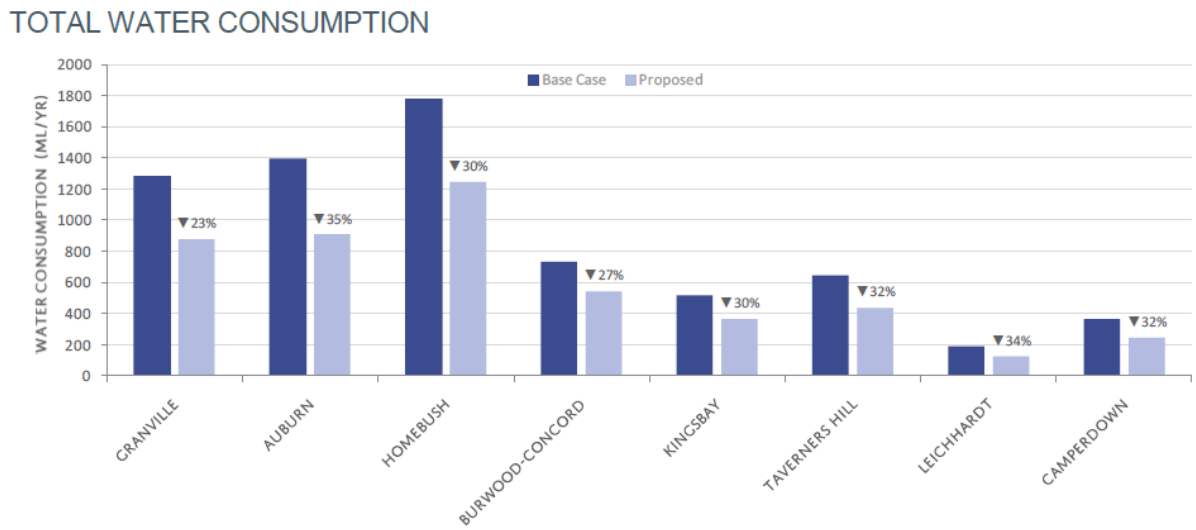
[2] See recycled water discussion in Urban Resilience and Sustainable Infrastructure

Figure 2 – Estimted stationary emissions under the Base Case and Proposed scenarios



*Note: Percent reductions are shown as a reduction against the Base Case (building code compliance)

Figure 3 – Estimated per person water use under the Base Case and Proposed scenarios



*Note: Percent reductions are shown as a reduction against the Base Case (building code compliance)

Commercial and Retail Buildings

The current requirements for new commercial and retail buildings are established by the National Construction Code (Section J Energy Efficiency), supplemented by local development controls and voluntary rating systems, including Green Star, which encourage low carbon and low resource outcomes.

To embed high performance outcomes in all new commercial and retail buildings, new commercial and retail buildings in PRUTP are proposed to achieve:

- **Commercial Development** >10,000 m2 GFA:
  - NABERS Energy 5-star (whole building)
  - NABERS Water 4-star (whole building)

- NABERS Water 5-star where recycled water is available (whole building)

- **Shopping Centre Development:**
  - NABERS Energy 5-star (base building)
  - NABERS Water 4-star (base building)
  - NABERS Water 5-star where recycled water is available (base building)

This plan is agnostic to the design and technologies used to achieve these performance outcomes.

Compared to current requirements (Base Case) these strategies are expected to deliver:

- **18% to 26% reduction** in total greenhouse gas emissions from stationary energy (Figure 2).
- **23% to 35% reduction** in total water consumption (Figure 3).

Renewable Energy and Water Reuse

The building performance requirements established above will ensure the delivery of significant renewable energy and water reuse (rainwater, stormwater or recycled water). It is expected that:

- BASIX Energy requirements will ensure solar PV (at a minimum) is installed on every new residential and mixed use building along the Corridor.
- BASIX Water requirements will ensure water use (at a minimum rainwater reuse for both internal and external uses) is delivered in every new residential and mixed use building along the Corridor.
- 5-Star NABERS Energy for commercial buildings often incorporate or is expected to require renewable energy, including rooftop solar PV to achieve the high performance rating.
- 5-star NABERS Water for commercial buildings is expected to require rainwater, stormwater or recycled water use for both external and internal uses.

Based on these requirements, the expected installed renewable energy and water reuse by Precinct is shown in Figures 4 and 5.

Additional opportunities for district energy and water solutions is further discussed in *Urban Resilience and Sustainable Infrastructure.*

Figure 4 – Estimated stationary emissions under the Proposed PRUTP

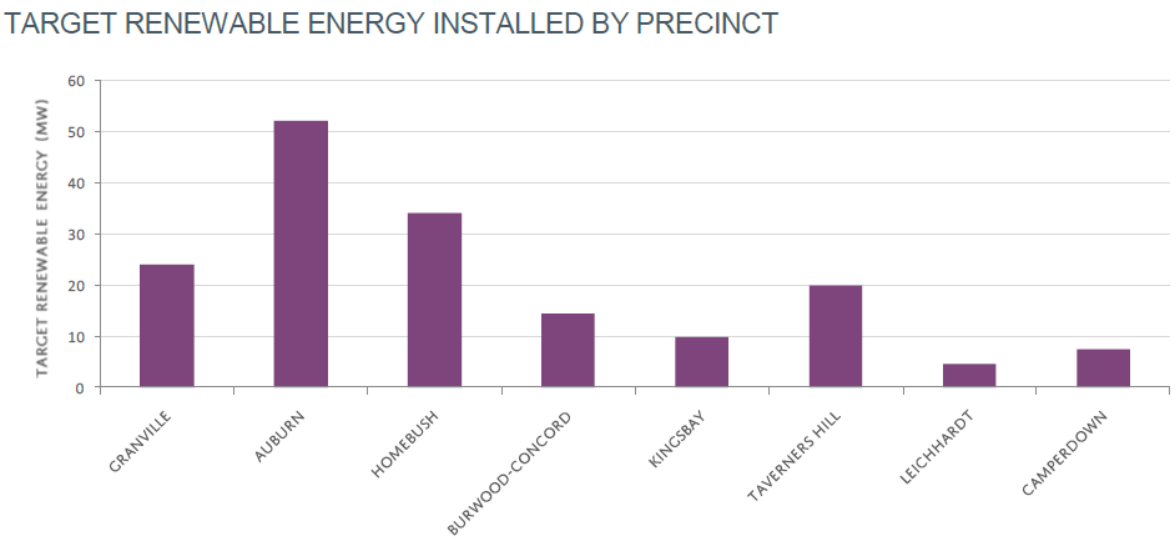
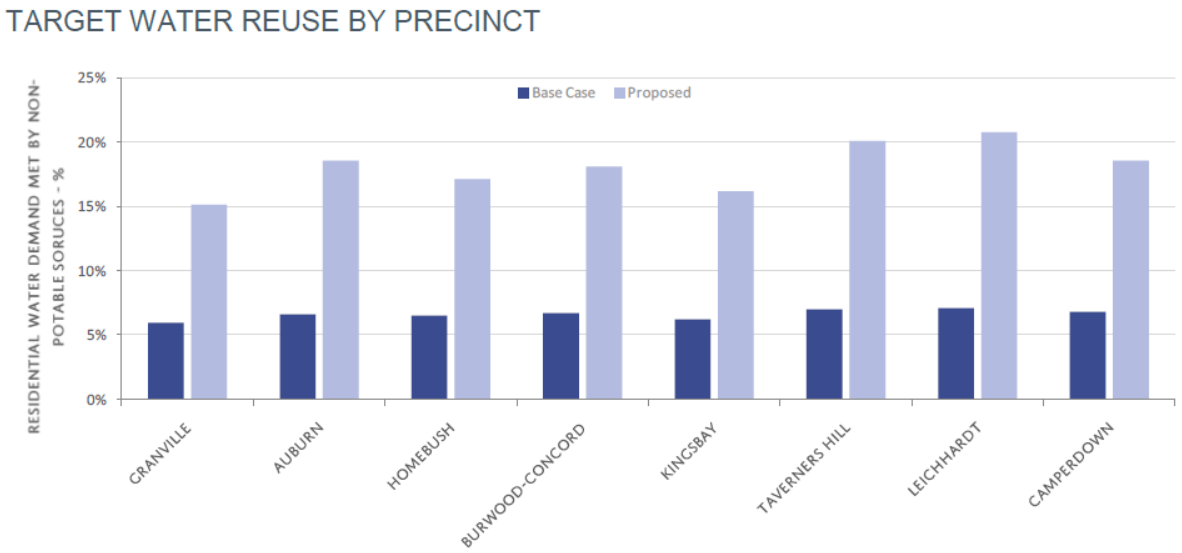


Figure 5 – Estimated per person water use under the Base Case and Proposed PRUTP



4.2 Strategic Parking

Why is it so important to get parking right?

Parking was identified in the PRUTP PRECINX Strategy Report as a key strategy to drive multiple benefits and outcomes (see Figure 6); including:

- Reduced car dependence, car ownership and household costs
- Improved air quality and reduced greenhouse gas emissions
- Reduced construction costs and improved development feasibility
- Increased housing choice
- Improved the business case for private investment in car share

- Reduced common area energy demands from underground parking lighting and ventilation, delivering lower electricity costs and strata fees

Parking across the Corridor will be delivered and designed to transition future communities to low car dependency. The parking approach has been developed in conjunction with principles to encourage active and public transport use and discourage car use. The strategy for parking delivery along the Corridor is proposed using the following hierarchy of principles:

1. Minimise parking

2. Minimise underground parking

3. Unbundle parking from dwelling and building ownership

4. Share parking

5. Decouple parking

The implementation of these strategies along Parramatta Road are expected to deliver the multiple benefits outlined above, including a **50% to 75% reduction** in car use, compared to the current Sydney Metropolitan Average (Figure 5).

The following strategies should be adopted to implement the outcomes targeted above:

1. Parking rates should be minimised

Parking and bicycle parking rates have been established for each precinct cognisant of the fact that there are eight Precincts over a 20km length Corridor with varying levels of public transport access. These parking rates are detailed in the Precinct Transport Report and Design Guidelines.

2. Flexible parking ratios should be adopted

Generally parking ratios are established per dwelling. Establishing maximum parking rates for different dwelling sizes (e.g. studio, 1 bed, 2 bed, etc.) but allowing flexible parking rates for individual dwellings within the overall maximum rate will provide a higher mix of housing choice and affordability. For example, 2 parking spaces could be provided for some 3 bedroom apartments and no parking for some 2 bedroom apartments. The total provided parking would remain the same.

Figure 6 – Potential benefits of strategic parking strategies

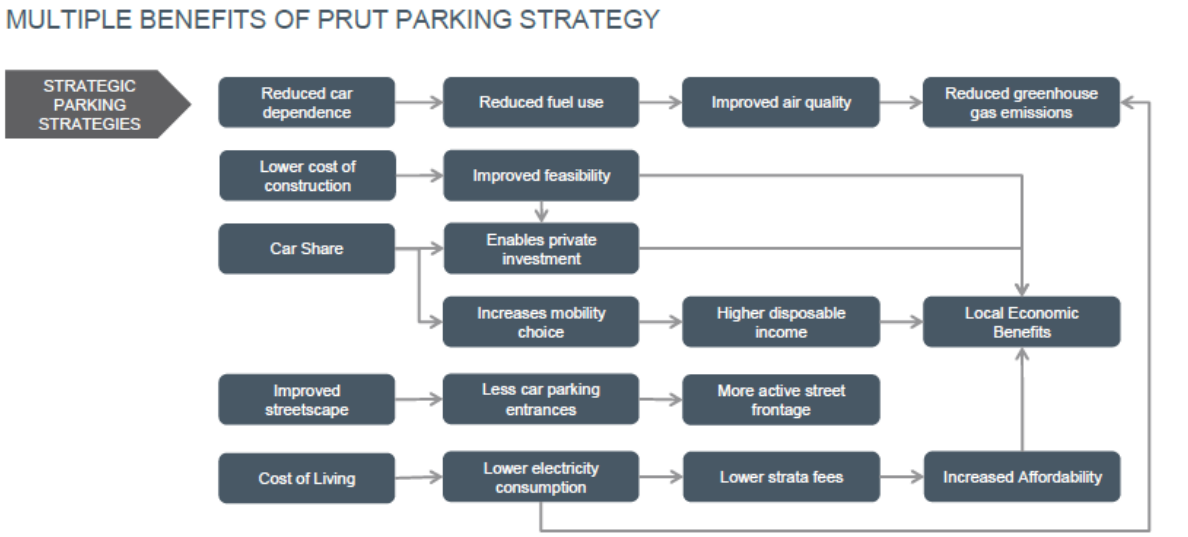
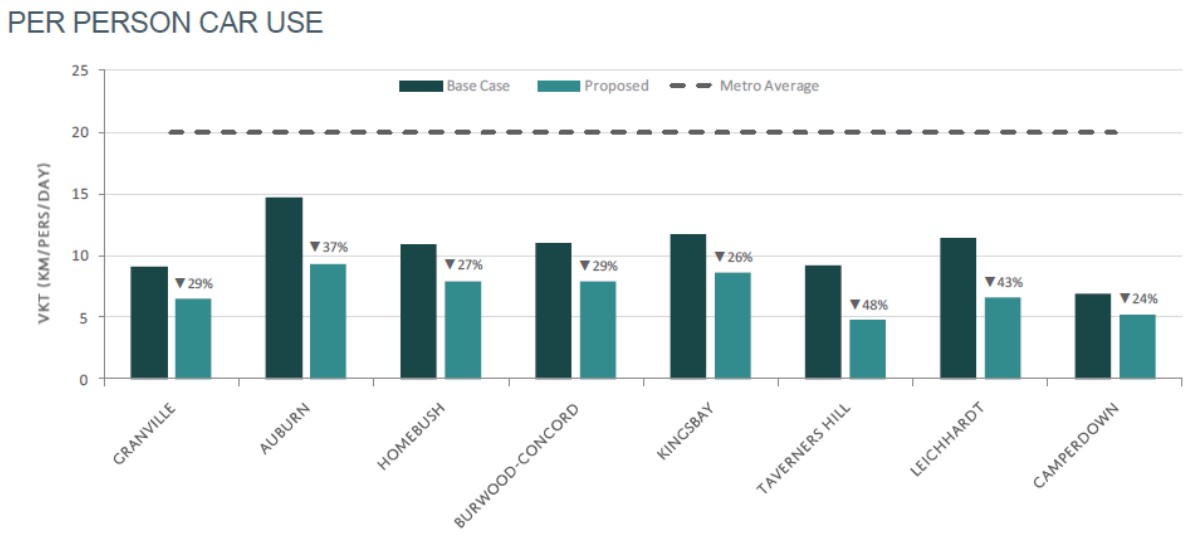


Figure 7 – Estimated per person car use under the Base Case and Proposed PRUTP



*Note: Percent reductions are shown as a reduction against the Metropolitan Average

Note: VKT results outlined in Figure 7 are calculated based on the PRECINX VKT Model which calculates the potential car use (km/person/day) based on access to public transport, housing density, access to employments, distance to a major centre, land use mix, expected car ownership and expected car share take-up. See: www.bts.nsw.gov.au/articledocuments/82/vkt-regression.pdf.asx.

3. Parking should be unbundled from the purchase or lease of a dwelling or building

Unbundled parking is parking that is separated from the cost or rent of a dwelling or building. This is not only more equitable, but can also reduce the total amount of parking required for the building. For buildings with unbundled parking, a parking rate reduction of 20% is proposed.

4. Car share should be adopted along the corridor

Car share provides an alternative to traditional car ownership, allowing residents or businesses to use a shared vehicle fleet. Car share relies on the restriction of parking and car ownership in areas of high public transport and mobility choice. Car share targets have been calculated for each Precinct using PRECINX based on car share algorithms which takes into account land use mix, population density, access to public transport, car parking and car ownership.

Car share rates have been established for each precinct cognisant of the fact that there are eight Precincts over a 20km length Corridor with varying levels of public transport access. These rates are detailed in the Precinct Transport Report and Design Guidelines.

5. Parking should be shared where possible

Shared parking is parking shared by more than one user, which allows parking facilities to be used more efficiently. Parking requirements may be shared and potentially reduced where it can be determined that the peak parking requirements occur at different times (either daily or seasonally).

Figure 8 – Estimated car share take-up rate under the Base Case and Proposed PRUTP

6. Parking should be spatially decoupled from buildings

Decoupled parking is parking that is spatially separated from the building to which the parking services. It is also generally unbundled from the sale or rental of an apartment or building.

The benefits of decoupled parking are significant, enabling the Parramatta Road Corridor to transition to a low car dependant future. Decoupled parking has the potential to deliver the significant and mutually reinforcing benefits of parking outlined in Figure 6.

The shift towards lower car ownership rates and emergence of the autonomous vehicle will reduce the need for parking and investment in underground parking. In particular, parking stations/basement parking may lose value as vehicles may no longer need to be parked or housed at origin or destination locations.

To achieve this:

- Parking should be spatially decoupled from buildings where possible.
- Sites should be identified for decoupled parking to reduce the need for on-site, underground parking.
- Decoupled parking should be built above ground and managed flexibly as the corridor transitions towards low car ownership and use.

For buildings with decoupled, unbundled parking, a parking rate reduction of 40% on maximum parking rates is proposed.

Decoupled parking could be transitioned to other uses when the demand for parking is no longer required, including where new public transport infrastructure is delivered and parking rates for the Precinct are reduced to a more accessible parking classification.

This approach to parking is further detailed in the Case Study on the following page.

Case Study – Implementing Decoupled, Unbundled Parking

4.2.1 What is it?

Unbundled parking is parking that is purchased or leased separately from housing. Unbundled parking can be provided in a number of forms, either on-site or in a separate building. When unbundled parking is provided in a separate building, this is known as decoupled parking.

4.2.2 What are we trying to achieve?

A Plan for Growing Sydney demonstrates a strong link between improved quality of life and greater access to public transport. However, a weakness or potential shortfall of this strategy is that it does not address the other side of the coin - car dependency and parking, and its impact on local amenity, affordability and the feasibility of urban transformation projects. This is potentially affecting our ability to deliver "density done well".

Consider the following:

- A study of the travel behaviour of over 16,000 Sydney households over 7 years revealed that car ownership is the biggest determining factor in transport mode choice and also the empirical measurement of vehicle kilometres travelled (VKT) rates[3].
- Studies have shown that cars are parked for 95% of the time[4].
- In a typical new apartment development, parking is equivalent to between 30% and 50% of the development floor area.
- Reducing underground parking by 1 space could equate to reducing the sales price of a new apartment by $60,000 to $100,000.
- Less energy demands for parking lighting and ventilation equate to lower compliance costs with BASIX Energy Targets.
- Studies have shown that underground parking can contribute up to 50% of the energy demands in a high rise apartment building[5].
- The average household in Sydney spends 16% of their household expenditure on transport, including fuel, insurance and vehicle maintenance[6].

The purpose of unbundled and decoupled parking is to contribute positively towards metropolitan, urban and household considerations, such as:

- Reduce disruption and lower the costs of construction by reducing the need for excavation required by underground parking.
- Improve housing affordability and choice, enabling residents to choose whether to purchase a car space and purchase and own a vehicle.
- Reduce local traffic by better managing vehicle movements to and from parking and encouraging residents to use public transport, walking and cycling.

[3] Holden (2005) The relationship between land use and car dependence and its application for land use planning policy in Sydney, http://atrf.info/papers/2006/2006_holden.pdf
[4] LSE (2014) The New Climate Economy, Accessibility in Cities: Transport and Urban Form
[5] Multi-Unit Residential Building Energy and Peak Demand Study (2005) EnergyAustralia, http://www.ausgrid.com.au/Common/Our-network/Demand-management-and-energy-efficiency/Energy-use-facts-and-figures/~/media/Files/Network/Demand%20Management/Energy%20use%20resources/Networks_multi_unit_sumrep_Oct08.pdf
[6] ABS Household Expenditure Survey

- **Reduce the energy demands** and greenhouse gas emissions of new residential development by removing the significant electricity demands of underground parking, lighting and ventilation.
- **Enable fine grain** and smaller lot development by reducing the need for site amalgamation that is often required to deliver underground parking. This maintains and enhances the pedestrian friendly grid of many parts of the Parramatta Road Corridor.
- **Increase street activity and safety** by encouraging residents and businesses to enter buildings from street level, rather than through underground parking garages.

The Parramatta Road Corridor Urban Transformation Strategy presents the opportunity to **decouple urban development from car parking and car dependence**.

This case study includes a high level review of the application of unbundled and decoupled parking, particularly in our neighbouring Asian cities; a case study of its application on a site in the Camperdown Precinct within the corridor; and outlines a number of implementation scenarios for consideration.

4.2.3 International and Local Applications of Unbundled and Decoupled Parking

Decoupled and, in particular, unbundled parking are fairly common in cities in neighbouring Asian countries.

A recent study by the Asian Development Bank highlighted the prevalence of unbundled parking in cities such as Singapore, Hong Kong and Manila (see Figure A). In some Asian cities, it is common for resident parking to be leased from decoupled parking, with residents leasing parking from a parking station. This is common in Ha Noi, Tokyo, and to some extent in Taipei city. In some cases, parking within residential buildings or complexes forms a part of the local parking market by allowing non-residents to rent or buy parking rights or spaces[7].

In Singapore, most residents live in developments with unbundled parking and in most cases this parking is provided in separate buildings (decoupled). An example development is shown in Figure B[8].

Unbundled parking is becoming popular in US cities as a mechanism to deliver integrated land use and transport and affordable housing outcomes. Berkeley, California, includes regulations to require private parking to be priced and sold separately from the purchase of dwellings. San Francisco limits parking in some downtown neighbourhoods to 0.75 spaces per dwelling in an effort to force developers to unbundle parking from housing costs. In order to build more parking, developers are required to obtain a conditional use permit which stipulates that parking costs must be unbundled from housing costs[9].

Within Sydney, the Kings Cross Parking Station (owned by the City of Sydney and managed by Wilson Parking) operates as a decoupled, unbundled parking station. As a mechanism to address a shortage of on-site resident parking in the local neighbourhood of Elizabeth Bay, residents may purchase long term parking leases for spaces. Residents with long term leases have 24/7 access to the parking station.

Other cities in Australia are beginning to adopt the use of unbundled parking in areas of high accessibility to facilitate integrated land use and transport outcomes. Gold Coast City Council, for example, enables a 30% reduction in parking where a development is located within defined accessible areas and where a development allocates 20% to 50% of its car parking stock as unbundled[10].

[7] Parking Policy in Asian Cities (2011) Asian Development Bank, http://www.adb.org/sites/default/files/publication/28935/parking-policy-asia.pdf
[8] It should be noted that while almost all of the cases of unbundled parking in Singapore were in publically governed and developed housing, public housing in Singapore is largely middle-income housing, with 80% of the population currently living in public housing developments.
[9] Adam Millard-Ball, "Putting on their parking caps", Planning, April 2002, v68 i4 p16(6).
[10] http://www.goldcoast.qld.gov.au/documents/bf/city-plan-practice-note-unbundled-parking.pdf

Figure A – Percent of surveyed respondents with unbundled parking (source: Asian Development Bank 2011)

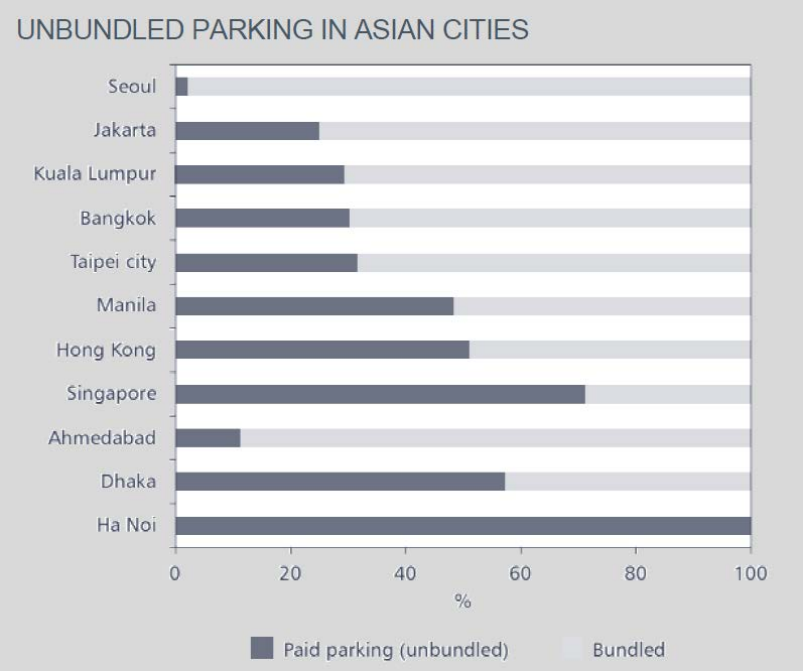


Figure B – Street view of typical decoupled parking in resdiential complex, Singapore

4.2.4 CAMPERDOWN PRECINCT CASE STUDY

This Sustainability Implementation Plan identifies Decoupled, Unbundled Parking as a key strategy for improve economic, social and environmental outcomes for the Corridor and its Precincts. Working with the City of Sydney and Inner West Councils, a hypothetical case study has been analysed to provide an example of the implications of decoupled parking on a specific site.

Based on discussions with the City of Sydney and Inner West Council, a site within the Camperdown Precinct was selected. This site is currently a light industrial zoning, with relatively large lots and land ownership is not significantly fragmented so development could be expected to occur in one stage or as a single project.

Please note – this case study is hypothetical only and does not reflect the expected development yields, design or development outcomes for the identified site.

An indicative development layout was mapped for the site to provide an expected dwelling yield and associated car parking requirements. FSR and parking rates are derived from the Design Guidelines for the Camperdown Precinct.

- Site area: 38,665 m^2
- Estimated Floor Area: 61,864 m_2 (based on 1.6:1 FSR)
- Estimated dwellings: 800 dwellings
- Estimated parking rate: 560 parking spaces (based on Category 1 parking rates)
- Space required for parking: 19,600 m^2 (based on 35 m^2 per space)

Adopting the parking reductions recommended in the Design Guidelines, parking rates could be reduced by 40% with decoupled parking, delivering:

- Estimated parking rate: 336 parking spaces (based on Category 1 parking rates)
- Space required for parking: 11,760 m^2 (based on 35 m^2 per space)

This translates to a savings of:

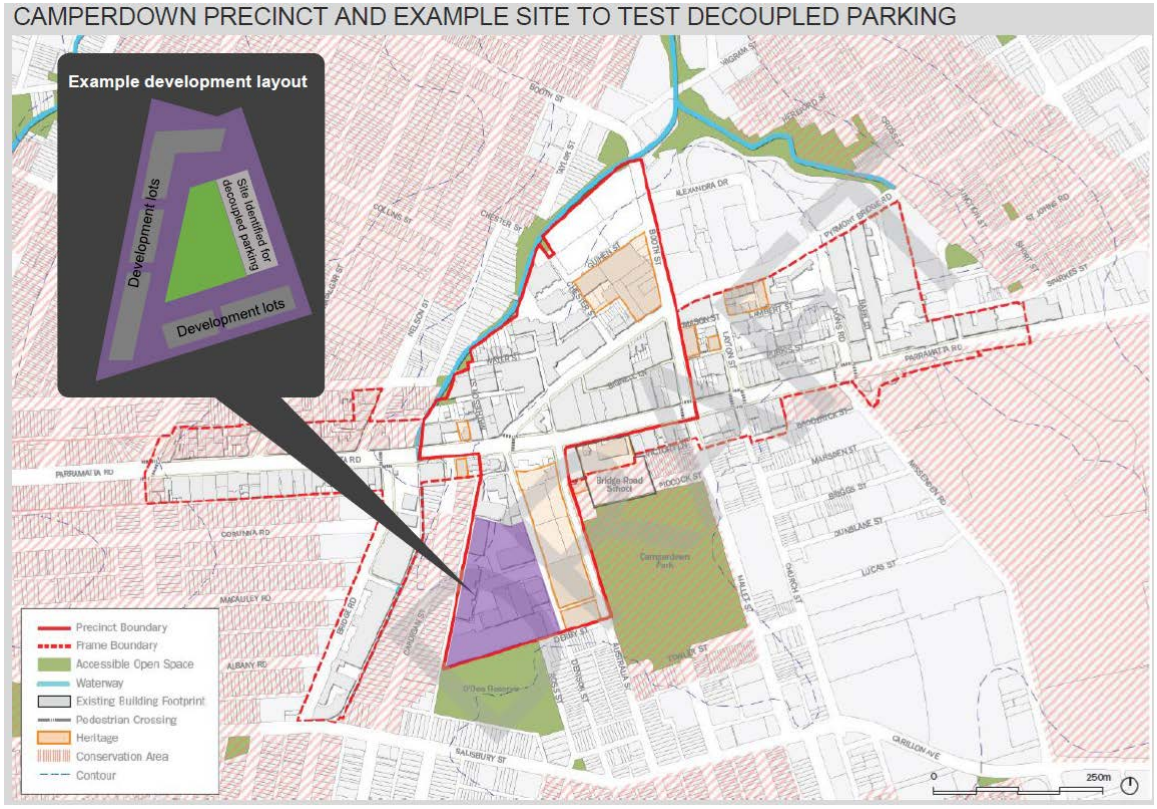
- 224 car parking spaces, which equates to approximately 300 traffic movements per day[11]
- 7,940 m2 of GFA which could be developed as additional residential or retail floor space.

Outcomes

- No on-site parking is required within the residential buildings, reducing the need for site excavation.
- Parking rates are reduced by 40%, significantly improving housing affordability and providing choice to residents to own a vehicle or access other car ownership models, such as car share.
- Parking is managed more efficiently across the neighbourhood as resident parking is managed alongside the existing Resident Parking Permits (i.e. as an extension of current on-site parking).

[11] Based on 1.34 vehicle trips per day per car space, http://www.rms.nsw.gov.au/trafficinformation/downloads/td13-04a.pdf

Figure C – Hypothetical decoupled parking case study site and example development layout



- On-street parking can be reserved for short term, high access requirements, including loading bays and mobility parking needs.
- Parking as a proportion of total development is reduced from 30% to less than 20%.

Implementation

- The scenario outlined in this case study could be implemented through a Council owned delivery of decoupled parking (see Scenario 1 in *Implementing Decoupled Parking* below)
- Under a Council owned model, in-lieu of providing on-site parking, developers for the adjacent sites would contribute financially to the development of a public parking facility.
- The parking facility is owned by Council and managed by Council or a private parking operator.
- Parking is allocated to residents through the existing Resident Parking Permits (i.e. as an extension of current on-site parking).

More detail on design, planning and commercial considerations of various decoupled parking implementation options are outlined below.

4.2.5 Implementing Decoupled Parking

Several options have been canvassed and discussed with the City of Sydney and Inner West Councils to facilitate unbundled and decoupled parking along the Corridor. Three scenarios for implementation are outlined below for consideration at a Precinct level.

Scenario 1 - Decoupled, Council Owned

Best suited for…

- Large development sites or precincts where development is expected to occur over a short period of time (5-7 years) and parking is not necessarily expected to transition to another use.
- Precincts where growth is expected to occur incrementally and Council can purchase and develop a standalone parking facility upfront, prior to the local incremental growth occurring.
- Precincts where land values preclude the market delivering stand-alone parking stations for local resident use.

How does it work?

- A site within a Precinct is identified and acquired by Council for decoupled resident parking.
- On-site parking includes priority uses only, including for mobility parking and loading zones, with a small amount of private parking allowed.
- In-lieu of providing parking on-site, developers pay a fee to Council for the development of a decoupled parking station on the identified site.
- Parking station is owned and managed by Council and parking is allocated through the existing Resident Parking Permits (i.e. as an extension of current on-site parking)
- Zoning allows for the parking station to transition to other uses (such as community facilities or active open space) if parking demand falls.
- Parking provision in the decoupled parking facility should reflect a 40% reduction in the equivalent amount of parking provided on-site.

Design considerations

- Design must address street frontage and activation, minimising “blank wall” outcomes.
- Safety and surveillance will need to be addressed through adequate lighting, security and multi-use buildings that overlook parking areas.
- Parking provision should cater for the full range of parking needs, including mobility parking, bicycle and motorbike parking, car share.
- All car spaces should be “EV ready” with charge points for electric vehicles.
- Floor to ceiling heights should be a minimum of 4m to enable retail, commercial or community facility uses.

Planning considerations

- Zoning should enable a flexible permitted use including car parking, community facilities, retail and commercial zoning to enable transition of the building if required.
- Maximum on-site parking rates should be limited to priority parking requirements only (e.g. mobility parking, loading zones etc).

Commercial considerations

- Decoupled parking will be funded through a fee in-lieu of parking provided by the developer for identified sites within Precincts where decoupled parking has been identified.

- Parking permit discounts should be available for electric vehicles.
- Income from resident parking permits and the electricity for EV charging could be used to manage the parking station and fund local public domain improvements.
- Decoupled parking facility will only transition to another use where demand is no longer required and the facility is no longer uses by local residents. In many cases, as car ownership rates decrease, parking demand may not decline but the facility may service a broader catchment - in this case the parking facility may not transition to another use.

Scenario 2 - Decoupled, Market Led

Best suited for...

- Large development sites or precincts where development is expected to occur over a short period of time (5-7 years).
- Precincts where parking is expected to (or should be allowed to) transition to another use over time as parking needs decline and the value of other uses (such as retail or low rent commercial) increase.

How does it work?

- A site within a Precinct is identified by Council for decoupled resident parking. This site would be acquired by a third party parking provider.
- Parking rates are regulated to minimise parking requirements on-site. On-site parking caters for mobility parking and loading zones with a small amount of private parking allowed.
- The provision of decoupled parking is market-led and dependant on market demand.
- A parking station is owned and managed by a private entity and long-term parking leases are provided to local residents on an as needs basis.
- Zoning allows for the parking station to transition to other uses (such as community facilities, active open space, retail or commercial uses) if parking demand falls. This will be driven by the value of parking compared to the commercial value of other uses.

Design considerations

- Design must address street frontage and activation, minimising “blank wall” outcomes.
- Safety and surveillance will need to be addressed through adequate lighting, security and multi-use buildings that overlook parking areas.
- Parking provision should cater for the full range of parking needs, including mobility parking, bicycle and motorbike parking, car share.
- All car spaces should be “EV ready” with charge points for electric vehicles.
- Floor to ceiling heights should be a minimum of 4m to enable retail, commercial or community facility uses.

Planning considerations

- Zoning should enable a flexible permitted use including car parking, community facilities, retail and commercial zoning to enable transition of the building if required.
- Maximum on-site parking rates should be limited to priority parking requirements only (e.g. mobility

parking, loading zones etc).

Commercial considerations

- Decoupled parking will be market led based on local demand.
- Decoupled parking facility may transition to another use. This will be driven by the value of parking compared to the commercial value of other uses.

Scenario 3 - Onsite, Unbundled, Market Led

Best suited for…

- Precincts where decoupled parking sites are not available.
- Precincts where growth is expected to occur incrementally.
- Precincts where parking is provided as an interim use of ground floor space prior to residential growth providing the demand for local retail services.

How does it work?

- Parking is provided on-site (not decoupled), unbundled from the sale of a residential dwelling.
- On-site parking provision should reflect a 20% reduction in the equivalent amount of parking provided under the current rates.
- On-site parking should be provided above ground.
- On-site parking is managed by the building body-corporate.
- Zoning allows for the on-site, above ground parking to transition to other uses (such as community facilities, retail or commercial uses) if parking demand falls and is no longer required. This will be driven by the value of parking compared to the commercial value of other uses.

Design considerations

- Design must address street frontage and activation, minimising “blank wall” outcomes.
- Ground floor parking areas adjacent to the street should be designed to transition in the short term (5-7 years) to retail service, sleeving parking from street level.
- Parking provision should cater for the full range of parking needs, including mobility parking, bicycle and motorbike parking, car share.
- All car spaces should be “EV ready” with charge points for electric vehicles.
- Floor to ceiling heights should be a minimum of 4m to enable retail, commercial or community facility uses.

Planning considerations

- Above ground on-site parking is not included as part of the development floor space.
- Zoning should enable a flexible permitted use of on-site parking including car parking, community facilities, retail and commercial zoning to enable transition of the space if required.

- Ground floor parking areas should be transitioned in the short term (5-7 years) to retail services once the demand for retail is viable.
- A maximum of one level of underground parking should be established.

Commercial considerations

- On-site parking may transition to another use. This will be driven by the value of parking compared to the commercial value of other uses.

4.2.6 Precinct by Precinct Approach

While unbundled parking should be considered in every Precinct along the Parramatta Road Corridor, further design, planning and commercial considerations will be required to ensure decoupled parking can be implemented where appropriate along the Parramatta Road Corridor.

Councils should identify both Precincts and individual sites appropriate for decoupled parking as part of the future rezoning along the Corridor.

4.3 Urban Resilience and Sustainable Infrastructure

When compared to an unvegetated public domain, a well-managed, lush tree canopy can reduce land surface temperature by up to 150C on a 350C day.

The Parramatta Road Corridor seeks to deliver a resilient and cool urban environment and public domain. Increased open space, green infrastructure and networks (such as water sensitive urban design) provides the potential to create this cooler urban environment that is resilient against a changing climate and, furthermore, the effects of urban heat island.

The delivery of green, open space along the Parramatta Road Corridor has been developed in the context of the Sydney Green Grid. The Sydney Green Grid is a network of open space, parks, bushland, natural areas, waterway corridors and tree-lined streetscapes that connect homes to centres, public transport, jobs and recreation. Open space within each Precinct along the Parramatta Road Corridor will be delivered as a continuous open space sequence and linked to pedestrian and bicycle connections.

Urban Heat Island and Water Sensitive Design

To support the Green Grid and address the impacts of changing climate and the effects of urban heat island, it is proposed that public domain and buildings are designed to reduce localised heat created by the urban heat island affect through the following:

- Maximising canopy cover on all Local Places for People and Vibrant Streets (as identified on the Street Function Plan within the Design Guidelines) and targeting canopy cover of at least 60% over all pedestrian spaces (footpaths, trafficable pedestrian areas).
- Maximising the use of vegetation on buildings, including above ground parking facilities. Vegetation, green roofs, green walls and materials with a high solar reflectance index are encouraged on at least 50% of the surfaces of all buildings. Western and northern building facades should be particular areas of focus.

Solutions to address urban heat need to be site specific and incorporate a combination of appropriate façade treatments as well as shading/ greening and water elements for cooling within the public domain.

In addition, the “greening” of the corridor should be supported through principles of water sensitive urban design (WSUD) and seek to incorporate:

- Gross Pollutant Traps along the drainage network.

- Bio-retention systems delivered along streets and public domain areas.
- Passive irrigation by ensuring rainwater and stormwater is directed to vegetated areas.
- Through these strategies, precincts along the corridor should aim for the following targets:
- Flow rates from the site are not more than the pre-development site discharge.
- Stormwater runoff quality is improved by reducing the average annual load of
    - Total Nitrogen by 45%
    - Total Phosphorous by 65%
    - Total Suspended Solids (TSS) by 85%[12]

Detailed stormwater analysis has not been undertaken as part of the development of this report. It is recommended that these flow rate and stormwater pollutant targets are further customised and identified by individual councils as part of the future rezoning, if desired.

Recycled Water linked to Resilient Public Domain

While water reuse has traditionally been considered as a water conservation objective, recycled water from black and grey wastewater provides the opportunity to support urban resilience. The delivery of increased open space, canopy cover and vegetation on buildings inevitably creates higher irrigation demands from broad leaf canopy, soft surfaces and green walls and roofs. The delivery of recycled water should be pursued to support these higher water demands and provide an unlimited supply of water that is not dependant on rainfall variability and a changing climate.

In addition, the business case for recycled water supported by increased local water demands. This is evident at Central Park where the green wall is part of the recycled water system, allowing constant irrigation and high use of treated recycled water on-site (further reducing sewer infrastructure requirements and costs for the site) – see case study.

Where the scale and staging of development allows, recycled water should be pursued at the Precinct scale. Where recycled water infrastructure is expected, dual reticulation to enable recycled water for both internal and external uses should be required at building construction.

District and Future Energy Opportunities

Urban resilience and sustainable infrastructure should also consider emerging energy technologies. Given the 30-100 year life of new buildings, it is recommended that new development is designed to accommodate future energy infrastructure and emerging technologies such as battery storage. For example, buildings could be future proofed for battery storage through the provision of:

- Each residence being allocated a virtual 5-10 KWh battery capacity.
- Building infrastructure providing sufficient plant room space and electrical services connectivity (e.g. wiring loops to meters and switchboards) so batteries can be retrofitted into buildings at a later date.

[12] Landcom WSUD Policy Handbookhttp://www.wsud.org/wp-content/uploads/2012/08/WSUD_Book1_Policy_Draft_0409_6d9c.pdf

Case Study – Recycled water and urban green space

Precinct scale recycled water systems linked to improved public domain outcomes are currently in operation in two locations across Sydney:

1. Central Park, currently supplying 1,400 customers with water for irrigation, toilet flushing and laundry use. A private water utility operates and maintains all water related infrastructure across the precinct. The recycled water system is housed in a Local Water Centre, built over four basement levels under the residential buildings. For more information see flowsystems.com.au/communities/central-park-water.

2. Discovery Point, is designed to serve 1,800 apartments, capturing 100% of wastewater from the apartments and non-residential and used for irrigation, toilet flushing and laundry as well as adjacent council parks and sporting fields. For more information see www.metrowater.nsw.gov.au/recycling/australand-discovery-point-wolli-creek

Image: centralparksydney.com

5. Summary of Strategies & Development Controls

Table 3 – Summary of Strategies & Development Controls

Recommendation	Development Controls
High Performance Buildings	
New residential buildings should include higher BASIX targets (including efficient, renewable energy and water reuse)	**BASIX Water** • Water 50 for all new dwellings • Water 60 for all new dwellings where recycled water is available **BASIX Energy** • Single dwellings – Energy 60 • Apartment 1-3 storeys – Energy 55 • Apartment 4-5 storeys – Energy 50 • Apartment 6+ storeys – Energy 40
New non-residential buildings should adopt high NABERS Energy and Water targets (including efficient, renewable energy and water reuse)	**NABERS Energy** • **Commercial** >10,000m2 GFA – NABERS 5-star (whole building) • **Shopping Centre** – NABERS 5-star (base building only) **NABERS Water** • **Commercial** >10,000m2 GFA – NABERS 4-star, increasing to 5-star where recycled water is available (whole building) • **Shopping Centre** – NABERS 4-star, increasing to 5-star where recycled water is available (base building only)
Strategic Parking Strategies	
Parking rates should be minimised	• Car and bicycle parking rates have been established for each Precinct based on varying levels of public transport access.
Flexible parking ratios should be adopted	• On-site parking provision should be flexibly delivered across a building, allowing per dwelling parking rates to be varied but total building parking requirements to be delivered.
Parking should be unbundled from the purchase or lease of a dwelling or building	• Parking that is unbundled or separated from dwelling and building ownership should be encouraged in all developments. • For buildings with unbundled parking, a parking rate reduction of 20% is proposed.
Car share should be adopted along the corridor	• Car share rates have been established for each Precinct based on varying levels of public transport access.
Parking should be shared where possible	• Parking requirements for non-residential uses may be shared and potentially reduced where it can be determined that the peak parking requirements occur at different times (either daily or seasonally).

Parking should be spatially decoupled from buildings	• Parking should be spatially decoupled from buildings where possible. • Sites should be identified for decoupled parking to reduce the need for on-site, underground parking. • Decoupled parking should be built above ground and managed flexibly as the corridor transitions towards low car ownership and use. • For buildings with decoupled, unbundled parking, a parking rate reduction of 40% on maximum parking rates can be applied.
Plan for electric vehicles	• Where commercial and residential parking is provided it is considered prudent to provide the infrastructure or the capacity for EV Charging Points, including appropriate charging outlets in each parking space.
Urban Resilience & Sustainable Infrastructure	
Deliver connected open space	• Open space within each Precinct along the Parramatta Road Corridor will be delivered as a continuous open space sequence and linked to pedestrian and bicycle connections.
Address urban heat island	Public domain and buildings shall be designed to reduce localised heat created by the urban heat island affect through the following: • **Maximising canopy cover** on all Local Place for People and Vibrant Streets and targeting canopy cover of at least 60% over all pedestrian spaces (footpaths, trafficable pedestrian areas); • **Maximising the use of vegetation** on buildings, including above ground parking facilities. Vegetation, green roofs, green walls and materials with a high solar reflectance index are encouraged on at least 50% of the surfaces of all buildings. Western and northern building facades should be particular areas of focus.
Encourage recycled Water	• Where the scale and staging of development allows, recycled water should be pursued at the Precinct scale. • Where recycled water infrastructure is expected, dual reticulation to enable recycled water for both internal and external uses should be required at building construction.
Plan for district and future energy solutions	Given the 30-100 year life of new buildings, it would be considered prudent that new development is designed to accommodate future energy infrastructure and emerging technologies. This would be assisted by the following: • Each residence being allocated a virtual 5-10 KWh battery capacity. • The building infrastructure to provide sufficient plant room space and electrical services connectivity (e.g. Wiring loops to meters and switchboards) so batteries can easily be retrofitted into buildings at a later date.

6. Sustainability Targets

Performance targets have been established to guide the development of PRUTP. Given the scope of the PRUTP, these targets focus on the built form outcomes, including buildings and public domain.

Targets have been established both at a Corridor and Precinct level and address key areas for the Corridor, and include targets for:

- Greenhouse gas emission reductions
- Renewable energy installed
- Peak demand reductions
- Building design requirements (including BASIX and NABERS ratings)
- Water use reductions
- Non-potable water consumption
- Car use and car share
- Walkability
- Bicycle infrastructure
- Open space and networks
- Canopy, green cover and reflective materials
- Cost of living

The performance of each Precinct has been analysed using PRECINX against two key scenarios:

1. Base Case, which reflects the expected outcomes of the proposed development along the Parramatta Road Corridor if delivered under current development controls and building compliances (including existing local parking rates, building code and BASIX compliance).

2. Proposed, which reflects the expected outcomes of the proposed development along the Parramatta Road Corridor if the sustainable built form controls are delivered (including proposed parking rates and strategies, increased BASIX and NABERS targets, public domain and sustainable infrastructure).

When reviewing these results, comparisons can also be made to the Existing scenario (the performance of what exists there now) and the Sydney Metropolitan Average to determine whether or not we are making the city better or worse.

Figure 8 – Performance targets established to guide PRUTP

6.1 Parramatta Road Corridor Sustainability Targets

The following targets are proposed for all precincts along the corridor.

- BASIX Water
  - BASIX Water 50 for all new dwellings
  - BASIX Water 60 where recycled water is available
- BASIX Energy
  - Single dwellings – Energy 60
  - Apartment 1-3 storeys – Energy 55
  - Apartment 4-5 storeys – Energy 50
  - Apartment 6+ storeys – Energy 40
- NABERS Energy
  - Commercial >10,000m2 GFA – NABERS 5-star (whole building)

- Shopping Centre – NABERS 5-star (base building only)

- NABERS Water
  - Commercial >10,000m2 GFA – NABERS 4-star, increasing to 5-star where recycled water is available (whole building)
  - Shopping Centre – NABERS 4-star, increasing to 5-star where recycled water is available (base building only)
- Flow rates from the site are not more than the pre-development site discharge.
- Stormwater runoff quality[13] is improved by reducing the average annual load of
  - Total Nitrogen by 45%
  - Total Phosphorous by 65%
  - Total Suspended Solids (TSS) by 85%

In addition, Councils are encouraged to adopt Green Star or other building rating tools through future re-zonings to support the sustainability targets outlined in this plan.

The sustainable development controls and targets listed here should be used to guide the development of the Corridor. Additional targets for each Precinct along the Corridor are documented in the following pages.

Through the comprehensive delivery of the sustainability targets outlined for each precinct, the Parramatta Road Corridor as a whole is expected to achieve:

- Over 20% reduction in greenhouse gas emissions (compared to the Base Case)
- Nearly 60 MW of renewable energy installed
- 30% reduction in peak electricity demand (compared to the Base Case), delivering approximately 1.7 kVA per dwelling.
- Over 30% reduction in water consumption (compared to the Base Case)
- Over 15% of water delivered by non-potable sources, including rainwater or recycled water
- 30% reduction in car use (compared to the Base Case)
- 8% to 17% car share take-up rate
- 29.8 ha of additional open space
- 31 km of new, safe bicycle connections

Detailed performance outcomes are documented in the table below.

[13] Detailed stormwater analysis has not been undertaken as part of the development of this report. It is recommended that these flow rate and stormwater pollutant targets are further customised and identified by individual councils as part of the future rezoning.

Table 4 – Parramatta Road Corridor Wide Epxected Performance Outcomes

Indicator	Sydney Metro	Existing	Base Case	Proposed
Estimated number of dwellings		500	32,916	32,916
Estimated number of jobs		1470	33,462	33,462
Estimated Total Greenhouse gas emissions (kt CO2-e/yr)			479	373
% reduction compared to Base Case				▼22%
Estimated greenhouse gas emissions (tCO2-e/person/year)	2.4	2.5	2.4	1.7
% reduction compared to Base Case				▼31%
Estimated renewable energy (MW)			0	58
Energy demand delivered by renewable energy sources (%)				6%
Estimated peak electricity demand (MW)			224	159
% reduction compared to Base Case				▼29%
Estimated total water consumption (ML/yr)			6,531	4,471
% reduction compared to Base Case				▼32%
Estimated water consumption (litres/person/day)	238	249	143	109
% reduction compared to Base Case				▼24%
Water demand delivered by non-potable sources (%)			6%	17%
Estimated car use (VKT per person/day)	20.0	15.1	10.7	7.5
% reduction compared to Base Case				▼30%
Estimated car ownership rates (vehicles per household)	1.5	1.4	1.0	0.8
Car share take-up rate (%)			0%	13%
Car share potential (number of pods)			0	131
Canopy Cover in pedestrian streets (%)				60%
Public Open Space (ha)			29	29
New safe, connected cycle ways (m)			28,546	28,546
Residential lots within walking distance to a large park (%)		74%	100%	100%
Estimated cost of living ($ per household/year)	$20,000	$18,600	$13,700	$10,500
% reduction compared to Base Case				▼23%

6.2 Individual Precinct Sustainability Targets

The following pages documents the specific sustainability performance outcomes targets for each precinct. These targets have been modelled using PRECINX based on the full build out of the development proposed for each precinct and assumes the implementation of the Corridor Sustainability Targets listed above, the

parking rates list in the PRUTP Design Guidelines and public transport that comprising heavy rail and rapid bus in the long term.

Targets for each precinct should be used to guide the development of the Corridor and cover:

- Greenhouse gas emissions
- Renewable energy
- Peak electricity demand
- Water consumption
- Recycled water and water reuse
- Car dependence and use
- Car share
- Open space
- Canopy cover
- Cycling and active transport

It should be noted that all targets are to be pursued on-site or within the precincts along the corridor, rather than through off-site strategies or “off-sets”.

6.2.1 Camperdown Precinct Sustainability Targets

In addition to the corridor targets outlined above, through the comprehensive delivery of built form sustainability strategies across building efficiency, renewable energy, strategic parking, public domain and sustainable infrastructure, Camperdown will target:

- 23% reduction in greenhouse gas emissions (compared to the Base Case)
- 2.8 MW of renewable energy installed
- 27% reduction in peak electricity demand (compared to the Base Case), delivering approximately 1.7 kVA per dwelling.
- 32% reduction in water consumption (compared to the Base Case),
- 19% of water delivered by non-potable sources, including rainwater or recycled water
- 24% reduction in car use
- 17% car share take-up rate
- 1.03 ha of additional open space
- 2 km of new, safe bicycle connections

Detailed performance outcomes and targets are documented in the table on the right. The sustainable development controls and targets listed here should be used to guide the development of the Precinct.

Table 5 – Camperdown Precinct Summary Results

Indicator	Sydney Metro	Existing	Base Case	Proposed
Estimated number of dwellings		426	1828	1828
Estimated number of jobs		560	1297	1297
Estimated Total Greenhouse gas emissions (kt CO2-e/yr)			21.2	16.4
% reduction compared to Base Case				**▼23%**
Estimated greenhouse gas emissions (tCO2-e/person/year)	2.4	2.0	2.4	1.6
% reduction compared to Base Case				**▼31%**
Estimated renewable energy (MW)			**0.0**	**2.8**
Energy demand delivered by renewable energy sources (%)			0%	7%
Estimated peak electricity demand (MW)			10	7.3
% reduction compared to Base Case				**▼27%**
Estimated total water consumption (ML/yr)			359	244
% reduction compared to Base Case				**▼32%**
Estimated water consumption (litres/person/day)	238	n/a	143	108
% reduction compared to Base Case				▼24%
Water demand delivered by non-potable sources (%)			**7%**	**19%**
Estimated car use (VKT per person/day)	19.98	10.1	6.9	5.2
% reduction compared to Base Case				**▼24%**
Estimated car ownership rates (vehicles per household)	1.5	1.1	0.7	0.6
Car share take-up rate (%)			**0%**	**17%**
Car share potential (number of pods)			0	10
Canopy Cover in pedestrian streets (%)				60%
Public Open Space (ha)			**1.03**	**1.03**
New safe, connected cycle ways (m)			**1,968**	**1,968**
Residential lots within walking distance to a large park (%)			100%	100%
Estimated cost of living ($ per household/year)	$20,000	$15,300	$10,100	$8,200
% reduction compared to Base Case				**▼19%**

6.2.2 Leichhardt Precinct Sustainability Targets

In addition to the corridor targets outlined above, through the comprehensive delivery of built form sustainability strategies across building efficiency, renewable energy, strategic parking, public domain and sustainable infrastructure, Leichhardt will target:

- 21% reduction in greenhouse gas emissions (compared to the Base Case)
- 1.8 MW of renewable energy installed
- 26% reduction in peak electricity demand (compared to the Base Case), delivering approximately 1.6 kVA per dwelling.

- 34% reduction in water consumption (compared to the Base Case)
- 21% of water delivered by non-potable sources, including rainwater or recycled water
- 43% reduction in car use
- 17% car share take-up rate
- 1 km of new, safe bicycle connections

Detailed performance outcomes and targets are documented in the table on the right. The sustainable development controls and targets listed here should be used to guide the development of the precinct.

Table 6 – Leichhardt Precinct Summary Results

Indicator	Sydney Metro	Existing	Base Case	Proposed
Estimated number of dwellings		380	678	678
Estimated number of jobs		2,130	1,425	1,425
Estimated Total Greenhouse gas emissions (kt CO2-e/yr)			12.5	9.9
% reduction compared to Base Case				**▼21%**
Estimated greenhouse gas emissions (tCO2-e/person/year)	2.4	2.3	2.1	1.4
% reduction compared to Base Case				**▼33%**
Estimated renewable energy (MW)			0.0	1.8
Energy demand delivered by renewable energy sources (%)			0%	6%
Estimated peak electricity demand (MW)			6.2	4.6
% reduction compared to Base Case				**▼26%**
Estimated total water consumption (ML/yr)			181	120
% reduction compared to Base Case				**▼34%**
Estimated water consumption (litres/person/day)	238	n/a	142	106
% reduction compared to Base Case				▼25%
Water demand delivered by non-potable sources (%)			7%	21%
Estimated car use (VKT per person/day)	19.98	9.9	11.4	6.5
% reduction compared to Base Case				**▼43%**
Estimated car ownership rates (vehicles per household)	1.5	1.2	1.0	0.6
Car share take-up rate (%)			**0%**	**17%**
Car share potential (number of pods)			0	3
Canopy Cover in pedestrian streets (%)				60%
Public Open Space (ha)			**0.0**	**0.0**
New safe, connected cycle ways (m)			**516**	**516**
Residential lots within walking distance to a large park (%)			100%	100%
Estimated cost of living ($ per household/year)	$20,000	$16,600	$13,400	$8,500
% reduction compared to Base Case				▼36%

6.2.3 Taverners Hill Precinct Sustainability Targets

In addition to the corridor targets outlined above, through the comprehensive delivery of built form sustainability strategies across building efficiency, renewable energy, strategic parking, public domain and sustainable infrastructure, Taverners Hill will target:

- 21% reduction in greenhouse gas emissions (compared to the Base Case)
- 7.4 MW of renewable energy installed
- 29% reduction in peak electricity demand (compared to the Base Case), delivering approximately 1.6 kVA per dwelling.
- 32% reduction in water consumption (compared to the Base Case)
- 20% of water delivered by non-potable sources, including rainwater or recycled water
- 48% reduction in car use
- 17% car share take-up rate
- 0.74 ha of additional open space
- 1 km of new, safe bicycle connections

Detailed performance outcomes and targets are documented in the table on the right. The sustainable development controls and targets listed here should be used to guide the development of the Precinct.

Table 9 – Taverners Hill Precinct Summary Results

Indicator	Sydney Metro	Existing	Base Case	Proposed
Estimated number of dwellings		367	2,553	2,553
Estimated number of jobs		300	2,600	2,600
Estimated Total Greenhouse gas emissions (kt CO2-e/yr)			57.4	45.5
% reduction compared to Base Case				**▼21%**
Estimated greenhouse gas emissions (tCO2-e/person/year)	2.4	2.0	2.2	1.5
% reduction compared to Base Case				**▼33%**
Estimated renewable energy (MW)			0.00	7.40
Energy demand delivered by renewable energy sources (%)			0%	5%
Estimated peak electricity demand (MW)			28.1	19.9
% reduction compared to Base Case				**▼29%**
Estimated total water consumption (ML/yr)			638	432
% reduction compared to Base Case				**▼32%**
Estimated water consumption (litres/person/day)	238	n/a	143	107
% reduction compared to Base Case				▼25%
Water demand delivered by non-potable sources (%)			7%	20%
Estimated car use (VKT per person/day)	19.98	10.1	9.2	4.8
% reduction compared to Base Case				**▼48%**
Estimated car ownership rates (vehicles per household)	1.5	1.1	1.0	0.6
Car share take-up rate (%)			**0%**	**17%**
Car share potential (number of pods)			0	14
Canopy Cover in pedestrian streets (%)				60%
Public Open Space (ha)			**0.74**	**0.74**
New safe, connected cycle ways (m)			985	985
Residential lots within walking distance to a large park (%)			100%	100%
Estimated cost of living ($ per household/year)	$20,000	$15,300	$13,000	$8,200
% reduction compared to Base Case				**▼37%**

6.2.4 Kings Bay Precinct Sustainability Targets

In addition to the corridor targets outlined above, through the comprehensive delivery of built form sustainability strategies across building efficiency, renewable energy, strategic parking, public domain and sustainable infrastructure, Kings Bay will target:

- 23% reduction in greenhouse gas emissions (compared to the Base Case)
- 3.6 MW of renewable energy installed
- 29% reduction in peak electricity demand (compared to the Base Case), delivering approximately 1.7

kVA per dwelling.

- 30% reduction in water consumption (compared to the Base Case)
- 16% of water delivered by non-potable sources, including rainwater or recycled water
- 26% reduction in car use
- 12% car share take-up rate
- 0.38 ha of additional open space
- 2 km of new, safe bicycle connections

Detailed performance outcomes and targets are documented in the table on the right. The sustainable development controls and targets listed here should be used to guide the development of the Precinct.

Table 9 – Kings Bay Precinct Summary Results

Indicator	Sydney Metro	Existing	Base Case	Proposed
Estimated number of dwellings		260	3,002	3,002
Estimated number of jobs		1370	2,543	2,543
Estimated Total Greenhouse gas emissions (kt CO2-e/yr)			30.7	23.6
% reduction compared to Base Case				**▼23%**
Estimated greenhouse gas emissions (tCO2-e/person/year)	2.4	2.2	2.5	1.7
% reduction compared to Base Case				**▼31%**
Estimated renewable energy (MW)			0.0	3.6
Energy demand delivered by renewable energy sources (%)			0%	7%
Estimated peak electricity demand (MW)			13.9	9.9
% reduction compared to Base Case				**▼29%**
Estimated total water consumption (ML/yr)			516.5	362.4
% reduction compared to Base Case				**▼30%**
Estimated water consumption (litres/person/day)	238	n/a	144	110
% reduction compared to Base Case				▼23%
Water demand delivered by non-potable sources (%)			6%	16%
Estimated car use (VKT per person/day)	19.98	14.3	11.7	8.6
% reduction compared to Base Case				**▼26%**
Estimated car ownership rates (vehicles per household)	1.5	1.3	1.0	0.8
Car share take-up rate (%)			**0%**	**12%**
Car share potential (number of pods)			0	12
Canopy Cover in pedestrian streets (%)				60%
Public Open Space (ha)			**0.38**	**0.38**
New safe, connected cycle ways (m)			**2,481**	**2,481**
Residential lots within walking distance to a large park (%)			100%	100%
Estimated cost of living ($ per household/year)	$20,000	$18,600	$13,800	$10,900
% reduction compared to Base Case				**▼21%**

6.2.5 Burwood-Concord Precinct Sustainability Targets

In addition to the corridor targets outlined above, through the comprehensive delivery of built form sustainability strategies across building efficiency, renewable energy, strategic parking, public domain and sustainable infrastructure, Burwood-Concord will target:

- 26% reduction in greenhouse gas emissions (compared to the Base Case)
- 3.8 MW of renewable energy installed
- 35% reduction in peak electricity demand (compared to the Base Case), delivering approximately 1.7 kVA per dwelling.
- 27% reduction in water consumption (compared to the Base Case)
- 18% of water delivered by non-potable sources, including rainwater or recycled water
- 29% reduction in car use
- 13% car share take-up rate
- 2 km of new, safe bicycle connections

Detailed performance outcomes and targets are documented in the table on the right. The sustainable development controls and targets listed here should be used to guide the development of the Precinct.

Table 10 – Burwood-Concord Precinct Summary Results

Indicator	Sydney Metro	Existing	Base Case	Proposed
Estimated number of dwellings		1,056	5,963	5,963
Estimated number of jobs		2,180	2,942	2,942
Estimated Total Greenhouse gas emissions (kt CO2-e/yr)			48.5	36.0
% reduction compared to Base Case				**▼26%**
Estimated greenhouse gas emissions (tCO2-e/person/year)	2.4	2.1	2.4	1.7
% reduction compared to Base Case				**▼31%**
Estimated renewable energy (MW)			**0.0**	**3.8**
Energy demand delivered by renewable energy sources (%)			0%	7%
Estimated peak electricity demand (MW)			22.0	14.5
% reduction compared to Base Case				**▼35%**
Estimated total water consumption (ML/yr)			732.8	537.4
% reduction compared to Base Case				**▼27%**
Estimated water consumption (litres/person/day)	238	n/a	143	109
% reduction compared to Base Case				▼24%
Water demand delivered by non-potable sources (%)			7%	18%
Estimated car use (VKT per person/day)	19.98	7.4	11.0	7.9
% reduction compared to Base Case				**▼29%**
Estimated car ownership rates (vehicles per household)	1.5	1.3	1.0	0.8
Car share take-up rate (%)			**0%**	**13%**
Car share potential (number of pods)			0	25
Canopy Cover in pedestrian streets (%)				60%
Public Open Space (ha)			**0.0**	**0.0**
New safe, connected cycle ways (m)			**2,487**	**2,487**
Residential lots within walking distance to a large park (%)			100%	100%
Estimated cost of living ($ per household/year)	$20,000	$16,800	$13,400	$10,400
% reduction compared to Base Case				**▼23%**

6.2.6 Homebush Precinct Sustainability Targets

In addition to the corridor targets outlined above, through the comprehensive delivery of built form sustainability strategies across building efficiency, renewable energy, strategic parking, public domain and sustainable infrastructure, Homebush will target:

- 24% reduction in greenhouse gas emissions (compared to the Base Case)
- 11.2 MW of renewable energy installed
- 31% reduction in peak electricity demand (compared to the Base Case), delivering approximately 1.7 kVA per dwelling.

- 30% reduction in water consumption (compared to the Base Case)
- 17% of water delivered by non-potable sources, including rainwater or recycled water
- 27% reduction in car use
- 13% car share take-up rate
- 16.19 ha of additional open space
- 6 km of new, safe bicycle connections

Detailed performance outcomes and targets are documented in the table on the right. The sustainable development controls and targets listed here should be used to guide the development of the Precinct.

Table 11 – Homebush Precinct Summary Results

Indicator	Sydney Metro	Existing	Base Case	Proposed
Estimated number of dwellings		1,025	11,271	11,271
Estimated number of jobs		1,760	6,243	6,243
Estimated Total Greenhouse gas emissions (kt CO2-e/yr)			111	85
% reduction compared to Base Case				▼24%
Estimated greenhouse gas emissions (tCO2-e/person/year)	2.4	2.3	2.5	1.7
% reduction compared to Base Case				▼31%
Estimated renewable energy (MW)			0.0	11.2
Energy demand delivered by renewable energy sources (%)			0%	6%
Estimated peak electricity demand (MW)			49.6	34.0
% reduction compared to Base Case				▼31%
Estimated total water consumption (ML/yr)			1780	1243
% reduction compared to Base Case				▼30%
Estimated water consumption (litres/person/day)	238	n/a	143	110
% reduction compared to Base Case				▼24%
Water demand delivered by non-potable sources (%)			6%	17%
Estimated car use (VKT per person/day)	19.98	11.5	10.9	7.9
% reduction compared to Base Case				▼27%
Estimated car ownership rates (vehicles per household)	1.5	1.4	1.0	0.8
Car share take-up rate (%)			0%	13%
Car share potential (number of pods)			0	48
Canopy Cover in pedestrian streets (%)				60%
Public Open Space (ha)			16.19	16.19
New safe, connected cycle ways (m)			5,635	5,635
Residential lots within walking distance to a large park (%)			100%	100%
Estimated cost of living ($ per household/year)	$20,000	$18,300	$13,500	$10,600
% reduction compared to Base Case				▼21%

6.2.7 Auburn Precinct Sustainability Targets

In addition to the corridor targets outlined above, through the comprehensive delivery of built form sustainability strategies across building efficiency, renewable energy, strategic parking, public domain and sustainable infrastructure, Auburn will target:

- 18% reduction in greenhouse gas emissions (compared to the Base Case)
- 20.9 MW of renewable energy installed
- 26% reduction in peak electricity demand (compared to the Base Case), delivering approximately 1.7 kVA per dwelling.
- 35% reduction in water consumption (compared to the Base Case)
- 19% of water delivered by non-potable sources, including rainwater or recycled water
- 37% reduction in car use
- 8% car share take-up rate
- 0.35 ha of additional open space
- 8 km of new, safe bicycle connections

Detailed performance outcomes and targets are documented in the table on the right. The sustainable development controls and targets listed here should be used to guide the development of the Precinct.

Table 12 – Auburn Precinct Summary Results

Indicator	Sydney Metro	Existing	Base Case	Proposed
Estimated number of dwellings		1,882	1,748	1,748
Estimated number of jobs		660	10,265	10,265
Estimated Total Greenhouse gas emissions (kt CO2-e/yr)			145	119
% reduction compared to Base Case				**▼18%**
Estimated greenhouse gas emissions (tCO2-e/person/year)	2.4	1.7	2.1	1.5
% reduction compared to Base Case				**▼31%**
Estimated renewable energy (MW)			**0.0**	**20.9**
Energy demand delivered by renewable energy sources (%)			0%	4%
Estimated peak electricity demand (MW)			70.4	52.1
% reduction compared to Base Case				**▼26%**
Estimated total water consumption (ML/yr)			1,398	903
% reduction compared to Base Case				**▼35%**
Estimated water consumption (litres/person/day)	238	n/a	143	108
% reduction compared to Base Case				▼24%
Water demand delivered by non-potable sources (%)			7%	19%
Estimated car use (VKT per person/day)	19.98	13.8	14.7	9.3
% reduction compared to Base Case				**▼37%**
Estimated car ownership rates (vehicles per household)	1.5	1.4	1.5	1.1
Car share take-up rate (%)			**0%**	**8%**
Car share potential (number of pods)			0	4
Canopy Cover in pedestrian streets (%)				60%
Public Open Space (ha)			**0.35**	**0.35**
New safe, connected cycle ways (m)			**7,661**	**7,661**
Residential lots within walking distance to a large park (%)		0.85	100%	100%
Estimated cost of living ($ per household/year)	$20,000	$18,900	$18,600	$13,600
% reduction compared to Base Case				**▼27%**

6.2.8 Granville Precinct Sustainability Targets

In addition to the corridor targets outlined above, through the comprehensive delivery of built form sustainability strategies across building efficiency, renewable energy, strategic parking, public domain and sustainable infrastructure, Granville will target:

- 26% reduction in greenhouse gas emissions (compared to the Base Case)
- 9.4 MW of renewable energy installed
- 28% reduction in peak electricity demand (compared to the Base Case), delivering approximately 1.7 kVA per dwelling.

- 32% reduction in water consumption (compared to the Base Case)
- 15% of water delivered by non-potable sources, including rainwater or recycled water
- 29% reduction in car use
- 13% car share take-up rate
- 11.11 ha of additional open space
- 9 km of new, safe bicycle connections

Detailed performance outcomes and targets are documented in the table on the right. The sustainable development controls and targets listed here should be used to guide the development of the Precinct.

Table 14 – Granville Precinct Summary Results

Indicator	Sydney Metro	Existing	Base Case	Proposed
Estimated number of dwellings		500	5,867	5,867
Estimated number of jobs		1,470	6,147	6,147
Estimated Total Greenhouse gas emissions (kt CO2-e/yr)			73	54
% reduction compared to Base Case				**▼26%**
Estimated greenhouse gas emissions (tCO2-e/person/year)	2.4	2.5	2.4	1.7
% reduction compared to Base Case				▼30%
Estimated renewable energy (MW)			**0.0**	**9.4**
Energy demand delivered by renewable energy sources (%)			0%	7%
Estimated peak electricity demand (MW)			33.4	24.1
% reduction compared to Base Case				**▼28%**
Estimated total water consumption (ML/yr)			1,285	873
% reduction compared to Base Case				**▼32%**
Estimated water consumption (litres/person/day)	238	249	144	111
% reduction compared to Base Case				▼23%
Water demand delivered by non-potable sources (%)			6%	15%
Estimated car use (VKT per person/day)	19.98	15.1	9.1	6.5
% reduction compared to Base Case				**▼29%**
Estimated car ownership rates (vehicles per household)	1.5	1.4	1.0	0.8
Car share take-up rate (%)			**0%**	**13%**
Car share potential (number of pods)			0	25
Canopy Cover in pedestrian streets (%)				60%
Public Open Space (ha)			**11.11**	**11.11**
New safe, connected cycle ways (m)			**8,781**	**8,781**
Residential lots within walking distance to a large park (%)		0.74	100%	100%
Estimated cost of living ($ per household/year)	$20,000	$18,600	$13,300	$10,400
% reduction compared to Base Case				**▼22%**

APPENDIX

Key Assumptions

Metropolitan Sydney average benchmarks

- Electricity 2,132 kWh per person/year
- Gas 3,888 MJ per person/year
- Water 237.8 L per person/day
- Transport 18.5 km per person/day

Grid Co-efficient

- Electricity 0.990 kgCO2-e/kWh
- Gas 0.064 kgCO2-e/MJ

Tariffs and rates

Household cost savings outlined in this report are based on current tariffs outlined below:

Residential Water	Rate	Unit
▪ Mains tariff	2.276	$/kL
▪ Recycled water tariff	1.817	$/kL
▪ Service charge per dwelling	771	$/yr
▪ Recycled water service charge	0	$/yr
Residential Grid Electricity	**Rate**	**Unit**
▪ Applied tariff	0.233	$/kWh
▪ Solar feed-in tariff	0.06	$/kWh
▪ Service charge per dwelling	303.78	$/yr
Residential Gas	**Rate**	**Unit**
▪ Gas (first 3,775 MJ per qtr/remaining)	0.038610/0.025784	$/MJ
▪ Service charge per dwelling	217	$/yr
Residential Transport	**Rate**	**Unit**
▪ Fuel	1.50	$/L
▪ Annual capital costs (devaluation)	6,642	$/yr
▪ Annual registration/insurance	2,172	$/yr

Key Data Sources

All results contained in this report are derived from PRECINX, a strategic infrastructure and urban design tool, used in the analysis of key performance metrics of precincts, integrating land use and development inputs with demographic, utility, transport and affordability models. PRECINX draws on local climate, land use and tariff data, and available utility, government, public and private sector datasets to calculate to performance of proposed developments, precincts, corridors and regions.

Important datasets used in PRECINX include:

- ACADS-BSG Australian Climatic Data (Reference Meteorological Year, RMY) for hourly temperature, insulation and humidity.
- Bureau of Meteorology local rainfall and evaporation data
    - Data is from the representative weather station for the local climate zone
    - The RMY (Representative Meteorological Year) is synthesized from a composite of 12 typical meteorological months that best represent the historic average of the specified location using post-1986 data in addition to the earlier weather data for each of the 69 climate zones in Australia.
- Department of the Environment (Ongoing) National Greenhouse Accounts Factors
- Sydney Water Best Practice Guidelines for water conservation in commercial office buildings and shopping centres (2007) and Best Practice Guidelines for holistic open space turf management (2011)
- National Water Commission, 2011, National performance report 2009-2010: urban water utilities, National Water Commission, Canberra
- NSW Department of Planning (Ongoing) BASIX Report Data.
- Department of Resources, Energy and Tourism, 2010, Energy in Australia – 2010, ABARE, Canberra
- Energy Use in the Australian Residential Sector, 1986 – 2020, Australian Government Department of the Environment, Water, Heritage and the Arts (DEHWA), 2008.
- National Construction Code (2010) Section J - Energy Efficiency Requirements
- Transport Data Centre (2006) The Development of a Sydney VKT Regression Model
- Department of Infrastructure and Transport, 2011, Road vehicle kilometres travelled: estimations from state and territory fuel sales, Australian Government, Canberra
- ABS (2010) 'Household Expenditure Survey, Australia: Summary of Results', catalogue number 65300D0001_200910, Australian Bureau of Statistics, Canberra.
- Kinesis (Ongoing) Water and energy end use data derived from first principle analysis of a range of metered residential and non-residential building types (ongoing, sourced from anonymised CCAP datasets from thousands of buildings, suburbs and cities across Australia), see: www.kinesis.org/ccap-asset and www.kinesis.org/ccap-city.

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