PARRAMATTA CBD PLANNING REVIEW

SUSTAINABILITY AND INFRASTRUCTURE STUDY

PREPARED BY KINESIS FOR PARRAMATTA CITY COUNCIL

9 NOVEMBER 2015

Prepared by Kinesis
Level 6, 155 Clarence Street

Sydney, 2000 NSW

P.O. Box Q164

Queen Victoria Building

NSW 1230

admin@kinesis.org

Document Version
Final

Authors
Bruce Taper, Director

David Holden, Associate Director

Tom Watson, Sustainability Analyst

Cover Image Credits
Google Maps, Photo Sphere (2011)

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

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

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

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

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

CONTENTS

INTRODUCTION

The Parramatta CBD Planning Strategy was adopted by Council in April 2015 and sets the vision for the growth of the Parramatta CBD:

"Parramatta will be Australia's next great city, defined by landmark buildings and high quality public spaces with strong connections to regional transport. It will respect its heritage, be an exemplar in design excellence, facilitate job growth and ensure its streets are well activated." (Parramatta CBD Planning Strategy – Vision)

To deliver on this vision, the strategy establishes principles and actions to guide a new planning framework.

The purpose of this study is two-fold:

1. Analyse and understand the impact of Parramatta CBD Planning Review on the delivery of infrastructure and sustainability outcomes for the development of the Parramatta CBD.

2. Identify opportunities and strategies that support the delivery of the Planning Strategy Vision and supporting principles.

OUR APPROACH

Our approach integrates both planning and environmental data with predictive analytics to help the City of Parramatta understand the implications of growth years before development begins. In addition, the integration of demand forecasting across energy, water, sewer, peak demand, transport patterns and financial modelling provides a unique and joined-up approach to infrastructure delivery opportunities to help enable the future of the Parramatta CBD.

Analysis was undertaken using a combination of Parramatta City Council's CCAP City tool alongside CCAP Precinct. CCAP Precinct is 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.

KEY FINDINGS OF THIS REPORT

1. THE IMPLICATIONS OF GROWTH ARE SIGNIFICANT

Under a business as usual scenario (assuming current building compliance requirements such as BASIX, Section J of the building code and existing Council parking ratios are met) the growth across the Parramatta CBD within the next 20 years is expected to:

- **Triple electricity demand and water consumption**
- **Increase peak electricity demand by over 100 MW (nearly twice the existing demand)**
- **Increase sewer loads by nearly 4 times**
- **More than double parking spaces**

However, increased growth delivered with the current building standards is also expected to deliver significant benefits and resident efficiencies. When compared to the existing Parramatta CBD, a new resident living in the study area is expected to:

- **Consume 10% less stationary greenhouse gas emissions**
- **Consume 30% less water**
- **Drive 40% less**
- **Save 30% in household operating cost from energy, water and transport (equivalent to approximately $5,500).**

2. OPTIMISING THE GROWTH AND DEVELOPMENT OF THE PARRAMATTA CBD CAN DELIVER SIGNIFICANT SAVINGS AND IMPROVED URBAN OUTCOMES

It is recommended that Parramatta City Council pursue the following strategies to optimise the development of the Parramatta CBD:

1. **High performance building requirements** can mitigate this growth and deliver more affordable and sustainable development outcomes.
2. **Recycled water integrated with public domain improvements** will provide a more resilient and cooler urban experience
3. **Strategic Parking Strategies** will improve development feasibility and deliver a more pedestrianised and future proofed CBD

Compared to the BAU growth scenario, the combination of these strategies is expected to deliver:

- **60% reduction** in electricity demand, effectively ensuring no net increase in electricity demand**.**
- **55% reduction** in peak electricity demand, effectively reducing the need for major electricity infrastructure augmentation.
- **35% reduction** in per person stationary greenhouse gas emissions.
- **50% reduction** in water consumption.
- **30% reduction** in sewer loads.
- **Significant reductions** in urban heat island.
- **50% reduction** in car use.
- **Significant opportunities** for investment in car share for improved mobility choice.
- **40% reduction** in household operating costs from energy, water and transport, equivalent to a household saving of over $5,000 per year.

UNDERSTANDING THE PARRAMATTA CBD

The Parramatta CBD study area is outlined in Figure 1 and extends from Boundary Street to the south and, crossing the Parramatta River to Isabella Street to the north. The Parramatta CBD study area is currently estimated to include approximately 1.2 million m2 of floor space, translating to approximately 6,300 dwellings and 685,000 m2 of non-residential floor space.

Development and growth in the Parramatta CBD should respond to and build on the unique patterns and demographics of the area. In order to understand these patterns, existing and future trends were analysed. For the scope of this project, five key trends have been identified that require particular consideration:

1. Car ownership trends
2. Travel patterns and containment
3. Urban heat
4. Cost of housing and living
5. Building performance trends

These trends are explored and discussed below.

PARRAMATTA CBD PLANNING REVIEW STUDY AREA

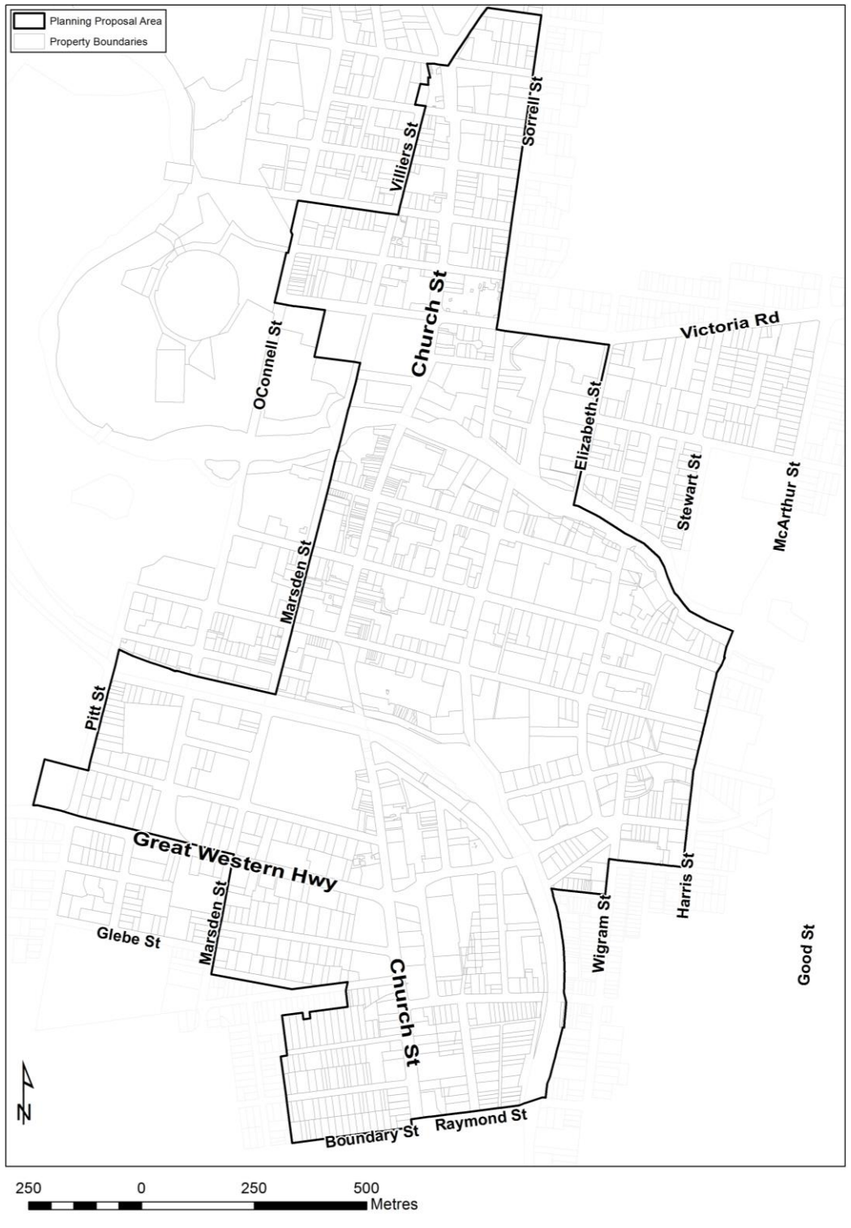


Figure 1: Parramatta CBD Planning Review Study Area boundary

1. CAR OWNERSHIP – A TREND THAT CAN BE PLANNED FOR

Vehicle ownership in the Parramatta CBD is low and trends at the Metropolitan level highlight that these rates are falling.

- Car ownership rates were analysed by ABS Census statistical area (SA) 1 zones. Data is shown for 2011.
- While varying significantly across the Parramatta LGA, average household car ownership rates in the Parramatta CBD are between 0.5 to 1 vehicles per household (Figure 2).
- This is further highlighted when looking at households with no vehicles. Within the Parramatta CBD, there are currently between 30% and 35% of households who do not own a vehicle (Figure 3).
- This low car ownership rate is reflective of the significant accessibility of the study area, including access to high frequency rail and bus services, local employment and retail services. This level of car ownership is comparable to other accessible centres including Granville, Strathfield and Ashfield (Figure 4).
- At a metropolitan level, additional trends can also be considered:
  - Vehicle license rates for younger demographic are falling. Across the Sydney Metropolitan Area, 1 in 4 people aged 18 to 35 do not have a license or own a car (Bureau of Transport Statistics, 2009).
  - Currently, approximately 8% of City of Sydney residents are car share members. This is as high as 20% in high density, highly accessible locations such as Darlinghurst and Surry Hills.

EXISTING CAR OWNERSHIP

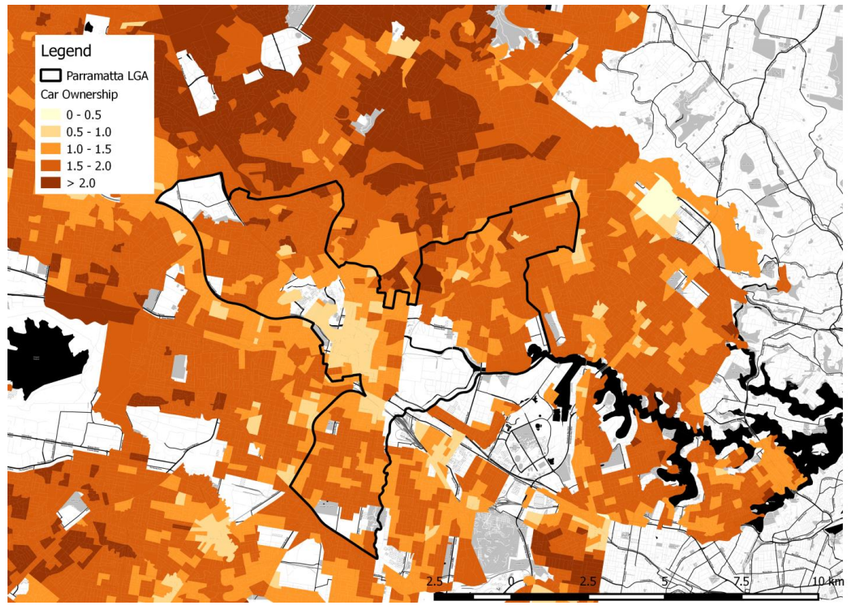


Figure 2: Average car ownership rates (source: ABS Census 2011)

HOUSEHOLD WITH NO CARS

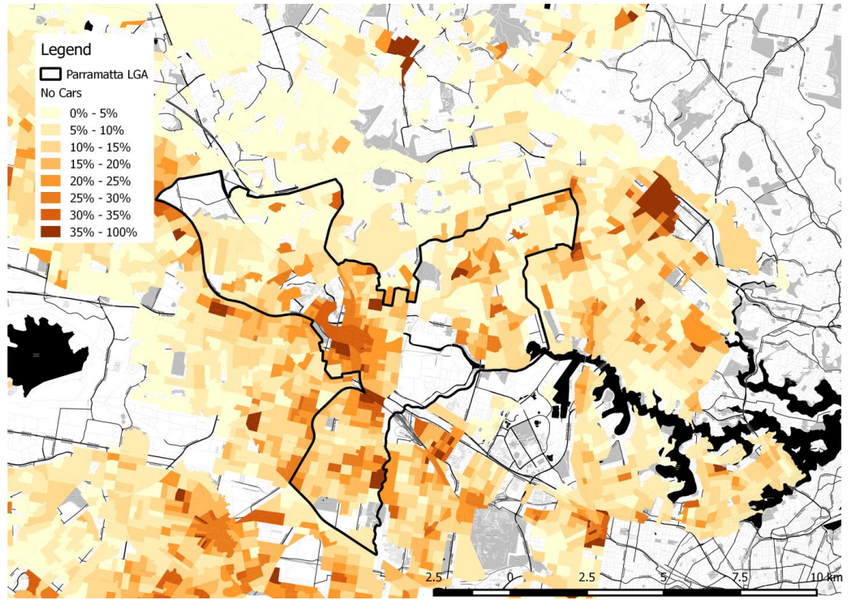


Figure 3: Percent of households with no vehicles (source: ABS Census 2011)

2. TRAVEL PATTERNS AND CONTAINMENT

There is a high level of trip containment in the Parramatta CBD, reflecting access to jobs and services. New development in the CBD should respond to and build on the levels of walking and cycling in the city.

- Travel patterns were analysed to understand travel and containment patterns in the Parramatta CBD. This data was sourced from the Bureau of Transport Statistic's Household Travel Survey and the ABS Census Journey to Work (2011).

- Employment containment can be measured by the percent of the population who walk or cycle to work. Within the Parramatta CBD, approximately 20% to 25% of people walk or cycle to work, reflecting the significant levels local and accessible employment (Figure 5).

COMPARISON OF MAJOR CENTRES

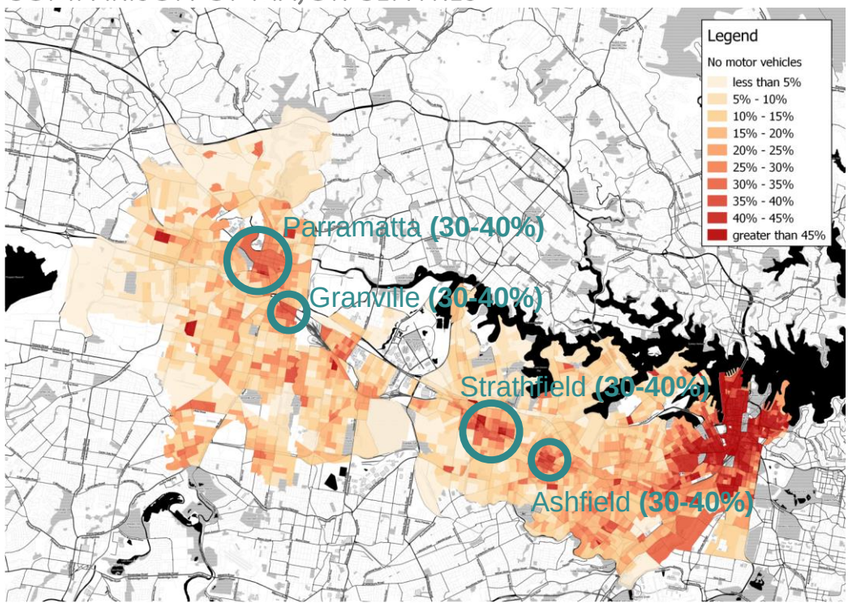


Figure 4: Comparison of centres with high percent of households with no vehicles (source: ABS Census 2011)

WALK + CYCLE TO WORK

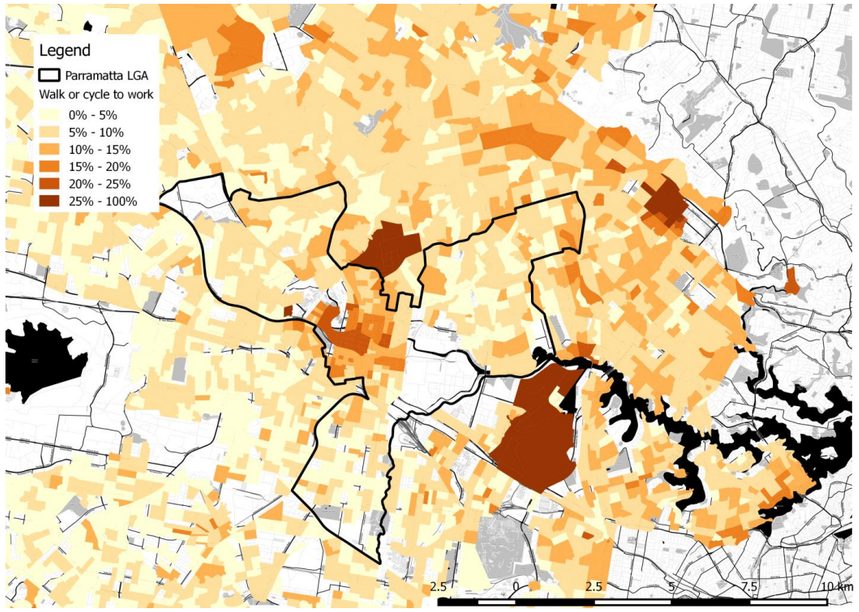


Figure 5: Percent of persons who walk or cycle to work (source: ABS Census 2011)

3. URBAN HEAT

The number of hot days in Parramatta is increasing higher than coastal areas and future climate projections will accelerate this trend.

- The impact of local climate can be considered across three key areas: local existing climate, future climate projections and the urban heat island.

- Without the cooling sea breeze off the coast, Western Sydney residents feel the full effect of heatwave conditions and this gap is widening. Analysis of temperature records over the last 40 years shows that Parramatta has seen a rise in annual temperatures above that experienced in coastal parts of the city (Figure 6).

- From a climate projection perspective, the Parramatta CBD is located in the East Coast South sub-cluster. Climate projections published by the Department of Environment in partnership with CSIRO and the Bureau of Meteorology outline the following changes for this sub-cluster:

  - Average temperatures will continue to increase in all seasons (very high confidence).
  - More hot days and warm spells are projected with very high confidence. Fewer frosts are projected with high confidence.
  - Decreases in winter rainfall are projected with medium confidence. Other changes are possible but unclear.
  - Increased intensity of extreme rainfall events is projected, with high confidence.
  - Mean sea level will continue to rise and height of extreme sea-level events will also increase (very high confidence).
  - A harsher fire-weather climate in the future (high confidence).
  - On annual and decadal basis, natural variability in the climate system can act to either mask or enhance any long-term human induced trend, particularly in the next 20 years and for rainfall.

- Major heat waves are Australia's deadliest natural hazards. Major heat waves have caused more deaths since 1890 than bushfires, cyclones, earthquakes, floods and severe storms combined (Department of Infrastructure and Regional Development (2013) State of Australian Cities). People living in urban environments can be more susceptible than non-urban dwellers to the effects of heatwaves as a result of the urban heat island. The urban heat island is effectively the difference between the land surface temperature and the average air temperature. This is caused by the prevalence in cities of heat-absorbing materials such as dark coloured pavements and roofs, concrete, urban canyons trapping hot air, and a lack of shade and green space in dense urban environments.

- Studies undertaken by the Parramatta City Council highlight a strong correlation between surface types and vegetation with lower land surface temperatures. Figure 11 outlines the land surface temperature in and around the Parramatta CBD, highlighting the temperature variation between the less vegetated CBD environment compared to surrounding streets with more street trees and vegetation.

- In addition, the increase in both local temperatures, heat island and extreme heat events has a direct impact on electricity demand for air conditioning which is expected to increase peak electricity demands and household electricity costs. This is further analysed in the *Implications of Parramatta CBD Growth* section of this report.

CLIMATE TRENDS SYDNEY V PARRAMATTA

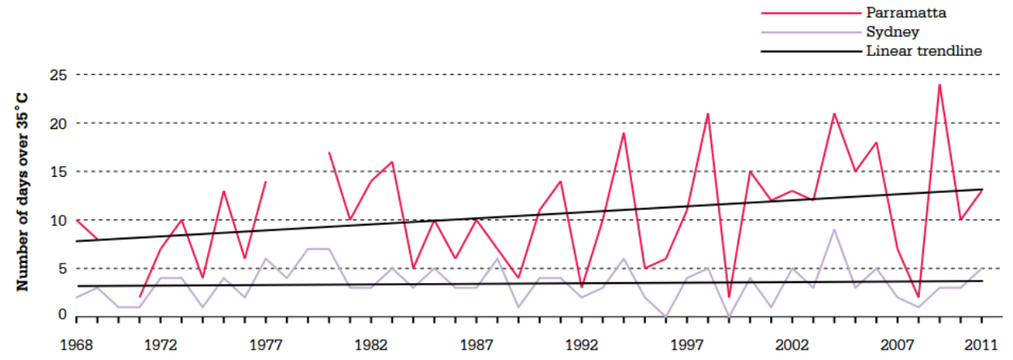


Figure 6: Measured days of 35 degrees for Parramatta and Sydney from 1968 to 2011 (Source: BOM)

URBAN HEAT MAPPING OF THE PARRAMATTA CBD

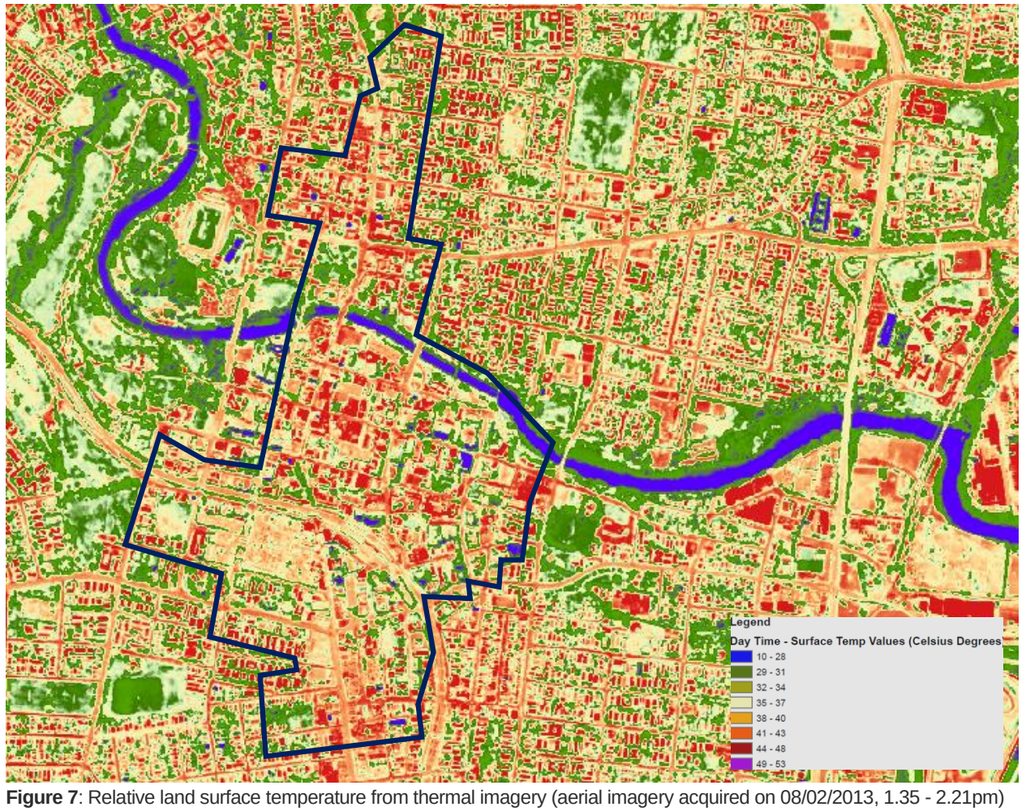


Figure 7: Relative land surface temperature from thermal imagery (aerial imagery acquired on 08/02/2013, 1.35 - 2.21pm)

4. COST OF HOUSING AND COST OF LIVING

Transport is second only to housing as the highest household cost in Parramatta. How we affect transport can deliver significant affordability benefits.

- Affordability is often considered only in the context of the cost of housing. However, when looking at average household expenditure, transport costs associated with car ownership and fuel consumption can be as high as housing costs (see Figure 8). Like housing, expenditure on transport is highly context specific.

- It is also important to understand how planning for new development can affect household expenditure. For the Parramatta CBD, how our buildings are designed and where development occurs will affect household costs related to housing, transport and utilities (energy and water).

- To better understand this variable for the Parramatta CBD, housing, transport and utility expenditure analysis was undertaken across the Parramatta LGA and incorporated the following:

  - Housing costs were calculated based on the purchase of a home at the median house and unit sales price in the LGA for the last 12 months, assuming 5% deposit, 30 year loan, 5% interest rate.
  - Transport costs were calculated based on existing car ownership and travel patterns (car use and public transport use) in the LGA.
  - Utility costs were calculated based on existing average energy and water consumption for the average household in the LGA, assuming current retail tariffs.
  - For the purpose of this analysis, all other household expenditure including food, clothing, household items, medical and recreation was based on the average expenditure reported in the ABS Household Expenditure Survey.

- The results of this analysis are shown in Figure 9 and highlight the following:

  - Recent housing sales highlight the significant costs associated with the purchase of a home in the Parramatta LGA.
  - After housing, transport is the highest household cost and the ability to affect transport costs can drive significant affordability outcomes.
  - Utility costs are low when compared to housing and transport costs. However, significant household savings can still be achieved through more efficient housing design.

AVERAGE HOUSEHOLD EXPENDITURE ACROSS NSW

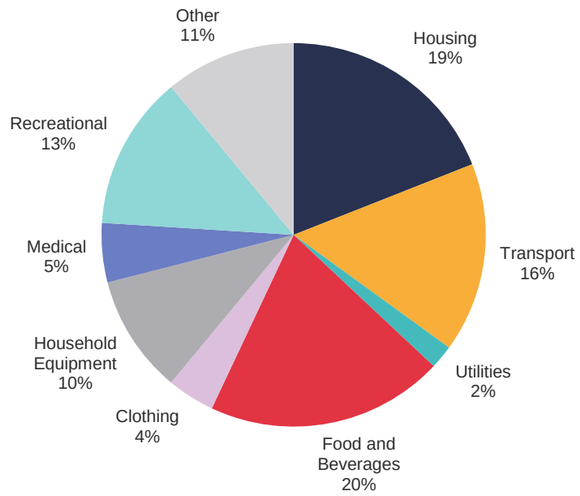


Figure 8: NSW average household expenditure (ABS Household Expenditure Survey 2009-10).

ESTIMATED HOUSEHOLD EXPENDITURE FOR THE PARRAMATTA LGA

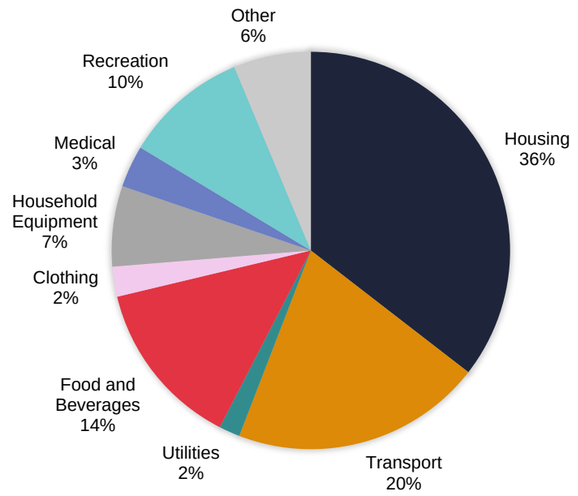


Figure 9: Estimated Parramatta LGA average household expenditure assuming the purchase of a new home (ABS Household Expenditure Survey 2009-10 and analysis by Kinesis of transport and property data).

5. BUILDING PERFORMANCE TRENDS

There is a trend towards higher building performance across Parramatta, reflecting the building industry's capacity to deliver more efficient buildings.

- Environmental sustainability was analysed across energy, greenhouse gas emissions and water consumption. Data for existing consumption profiles was sourced from Parramatta City Council's CCAP City tool which incorporates the latest energy and water profiles from Endeavour Energy, Jemena and Sydney Water.

- On average, residents in the Parramatta CBD consume approximately:
  - 2,150 kWh per person of electricity per year (approx. equal to the Sydney Metropolitan Average)
  - 4,000 MJ per person of gas per year (approx. equal to the Sydney Metropolitan Average)
  - 225 L per person of water per day (5% lower than the Sydney Metropolitan Average)

- Analysis also showed that solar PV installations were relatively high across the Parramatta LGA, but low in the high density Parramatta CBD location (Figure 10). This is largely due to the high density built form of the Parramatta CBD.

- Finally, Department of Planning BASIX data highlights the outcomes of new developments. Since the introduction of BASIX, Sydney and Parramatta has seen increasing trends in over-compliance, particularly in BASIX Energy outcomes, i.e. new developments are achieving higher BASIX targets. Over compliance can be attributed to both the increasing efficiency and lower costs of market available technologies (such as lighting and solar PV). It should be noted that trends in over-compliance are less significant in apartments which are generally flat (see Figure 12) highlighting the need to establish higher performance requirements for this dwelling typology.

COMPARISON OF SOLAR PV INSTALLATIONS

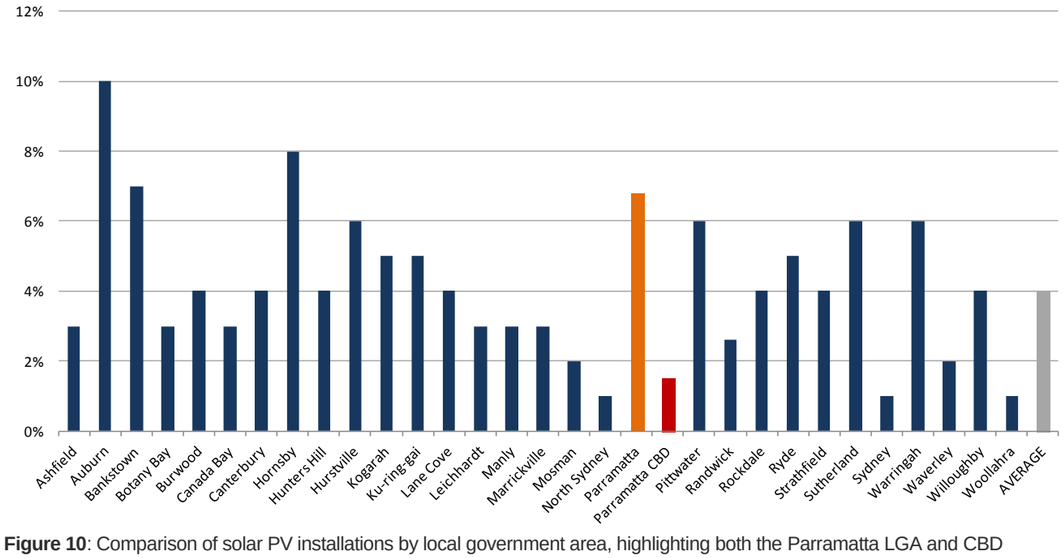


Figure 10: Comparison of solar PV installations by local government area, highlighting both the Parramatta LGA and CBD (Source: Clean Energy Regulator, 2015)

BASIX OVER COMPLIANCE SCORES FOR ALL DWELLINGS (PARRAMATTA)

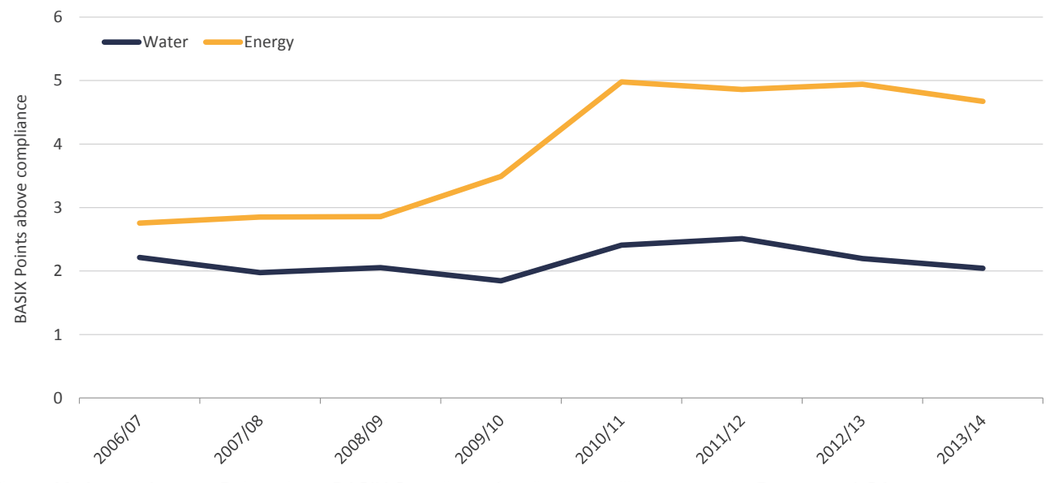


Figure 11: Annual Average Points above BASIX Compliance for all new dwellings across the Parramatta LGA (Source: NSW Department of Planning, 2015)

BASIX OVER COMPLIANCE FOR APARTMENTS (SYDNEY METRO AREA)

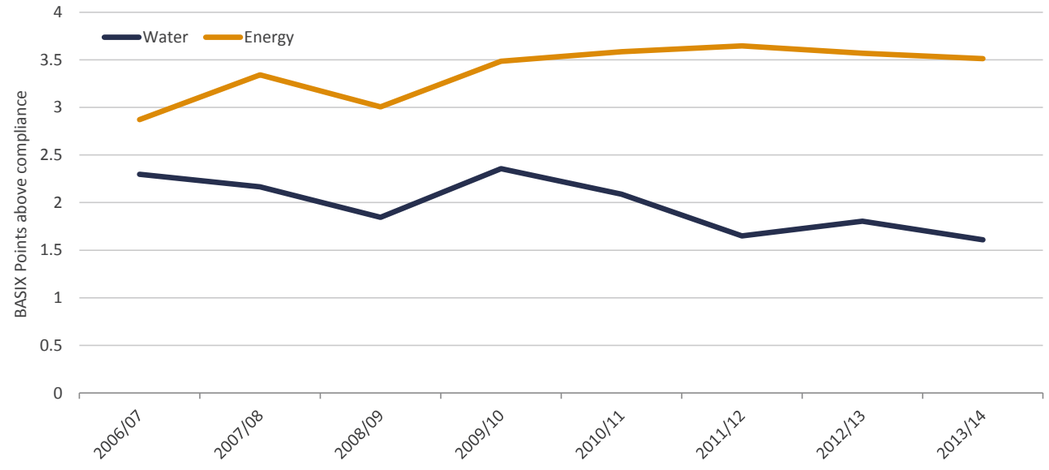


Figure 12: Annual Average Points above BASIX Compliance for new apartments across the Sydney Metropolitan Region. Data for the entire Sydney Metro Area is shown here as the sample size for the Parramatta LGA is too low to identify trends. (Source: NSW Department of Planning, 2015)

KEY TRENDS AND ISSUES FOR THE PARRAMATTA CBD

The analysis above has highlighted seven key trends and issues that should be considered in the development and growth of the Parramatta CBD:

1. Vehicles ownership in the Parramatta CBD is low and Sydney Metropolitan trends highlight that vehicle ownership in falling, reflecting shifts in mobility preferences that is occurring across our major metropolitan regions.

2. These shifts are driven by changing consumer preferences and technology (including car share, combined with access to public transport). If you add to this the disruption posed by the emergence of the of the autonomous vehicle within the development timeframe of the Parramatta CBD, it is clear that our planning has to be agile and respond to a city's agenda that is unlike anything Sydney has ever faced before.

3. After housing, transport is the highest household cost and the ability to affect transport costs can drive significant affordability outcomes.

4. Utility costs are low when compared to housing and transport costs. However, significant household savings can still be achieved through more efficient housing design. Australians have experienced significant electricity price growth in recent years. According to a Grattan Institute report (Wood & Carter 2014), the average household power bill has risen 70% in the five years to 2013. However, it is expected that future price increases will moderate or even fall as network cost pressures are stabilising (Figure 13). Similarly, NSW retail gas prices have risen significantly from 2013/14 to 2014/15, however future increases are expected to be moderate (Independent Pricing and Regulatory Tribunal [IPART] 2014).

5. Shifts in energy generation, use (such as electric vehicles) and battery storage represents a significant opportunity for the way energy is delivered to cities allowing for more efficient and optimised peak demand profile and infrastructure delivery management.

6. Parramatta has seen a rise in annual temperatures above that experienced in coastal parts of the city and this scenario is expected to get worse for the Parramatta CBD with climate change projections and the impact of the urban heat island. The increase in both local temperatures, heat island and extreme heat events has a direct impact on electricity demand for air conditioning which is expected to increase peak electricity demands and household electricity costs.

7. There is a trend towards higher building performance across Parramatta, reflecting the building industry's capacity to deliver more efficient buildings.

SYDNEY UTILITY PRICE GROWTH

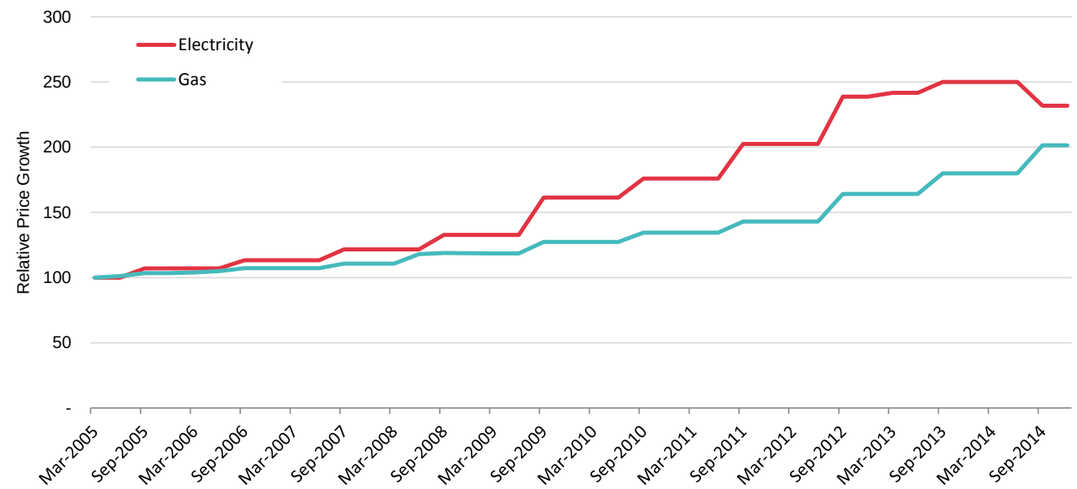


Figure 13: Sydney electricity and gas relative price increases from a base value of 100.

ELECTRIC VEHICLES AND BATTERY STORAGE

Figure 14: The emergence of new technologies represent a significant opportunities to the way energy is delivered to a city.

PARRAMATTA CBD PLANNING SCENARIOS

Scenario analysis was undertaken using key planning and development information for the study area. Kinesis worked closely with the Parramatta City Council planning teams to understand:

- **Existing Floor Space** within the study area
- Projected floor space under **Existing Planning Controls**
- Project floor space under two **Proposed Planning Control** scenarios:
    1. **Proposed Controls 1** assumes no residential in the CBD commercial core
    2. **Proposed Controls 2** assumes residential in the CBD commercial core

Summary planning and land use information used in the scenario analysis is documented in Tables 1 and 2 and is shown spatially in Figures 15 to 18.

Please note: Proposed controls assume two-thirds of the total potential floor space yield will be taken up as per SGS advice.

Notes on adopted floor space

- Additional floor space outlined in Table 1 was provided by the Parramatta City Council and is current at 3/7/2015.
- Existing floor space was calculated by Kinesis adopting the following method and assumptions developed in discussion with Parramatta City Council:
    - Current zoning FSR was calculated for each lot
    - Existing development deductions were then subtracted from the current zoning assuming B1, R2, R3 and R4 adopted a 1:1 deduction and B3, B4 and B5 adopted a 2:1 deduction.
- Total floor space and dwellings equate to the existing floor space plus the additional floor space outlined in Table 1, assuming 100m2 per apartment and two-thirds of potential floor space yield will be taken up as per SGS advice.

PARRAMATTA CBD FLOOR SPACE UNDER TESTED VARIOUS SCENARIOS

Scenario	Additional Residential Floor Space (m2)	Additional Residential dwellings (approx.)	Additional Commercial Floor Space (m2)	Additional jobs (approx.)
Existing controls	832,756	5,552	835,655	23,213
Proposed Controls 1 (no residential on commercial core)	2,517,845	16,786	2,205,622	61,267
Proposed Controls 2 (residential in commercial core)	2,905,636	19,371	1,817,832	50,495

Table 1: Additional floor space, dwellings and jobs for the study area.

TOTAL FLOOR SPACE AND DWELLINGS MODELLED IN EACH SCENARIO

Scenario	Residential Dwellings	Commercial Floor Space (m2)*
Existing Development (estimated)	6,301	685,238
Existing Controls	11,853	1,242,981
Proposed Controls 1 (no residential on commercial core)	23,087	2,156,291
Proposed Controls 2 (residential in commercial core)	25,672	1,897,765

Table 2: Total floor space and dwellings modelled under each scenario for the study area.

***Note**: As per residential dwelling projections, the commercial floor space modelled for the Existing Controls and the Proposed Controls scenarios assume two-thirds of the total potential floor space yield (as outlined in Table 1) will be taken up as per SGS advice.

EXISTING FLOOR SPACE

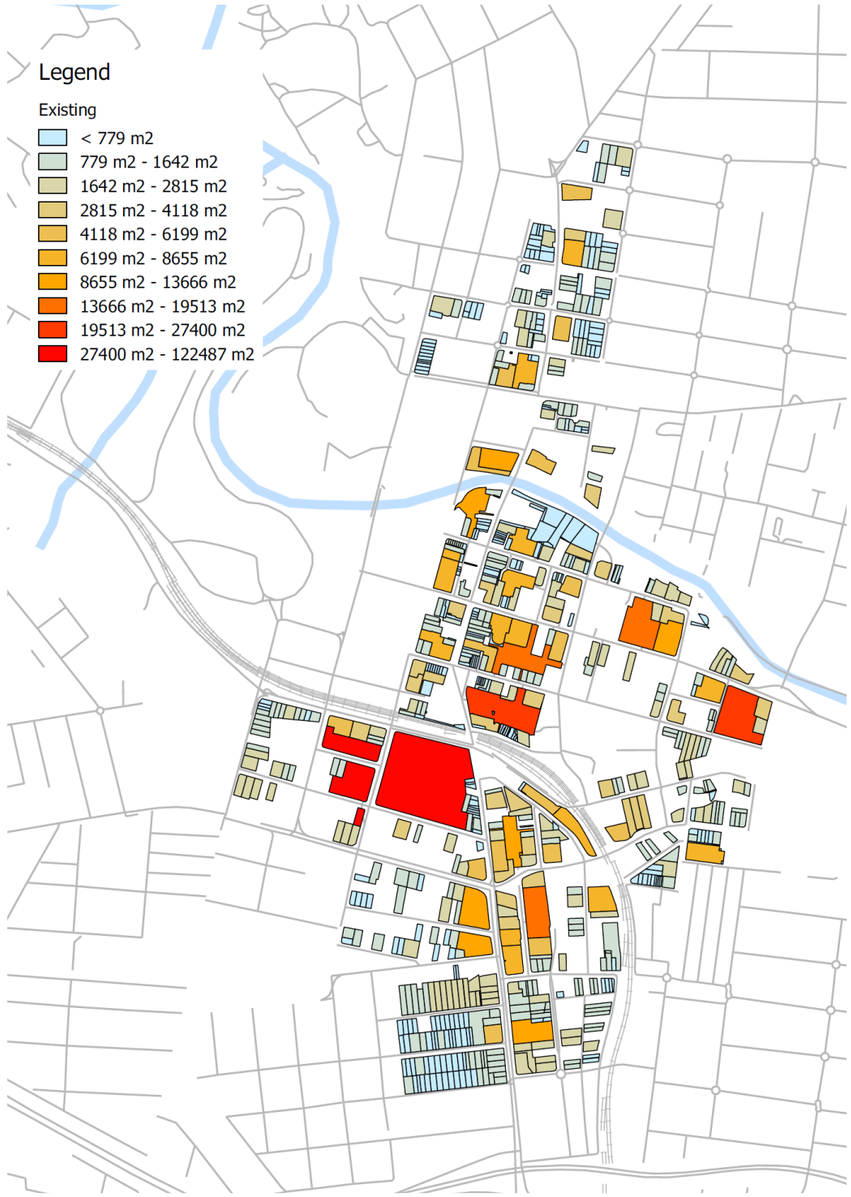


Figure 15: Estimated existing floor space across the study area

FLOOR SPACE GROWTH UNDER CURRENT CONTROLS

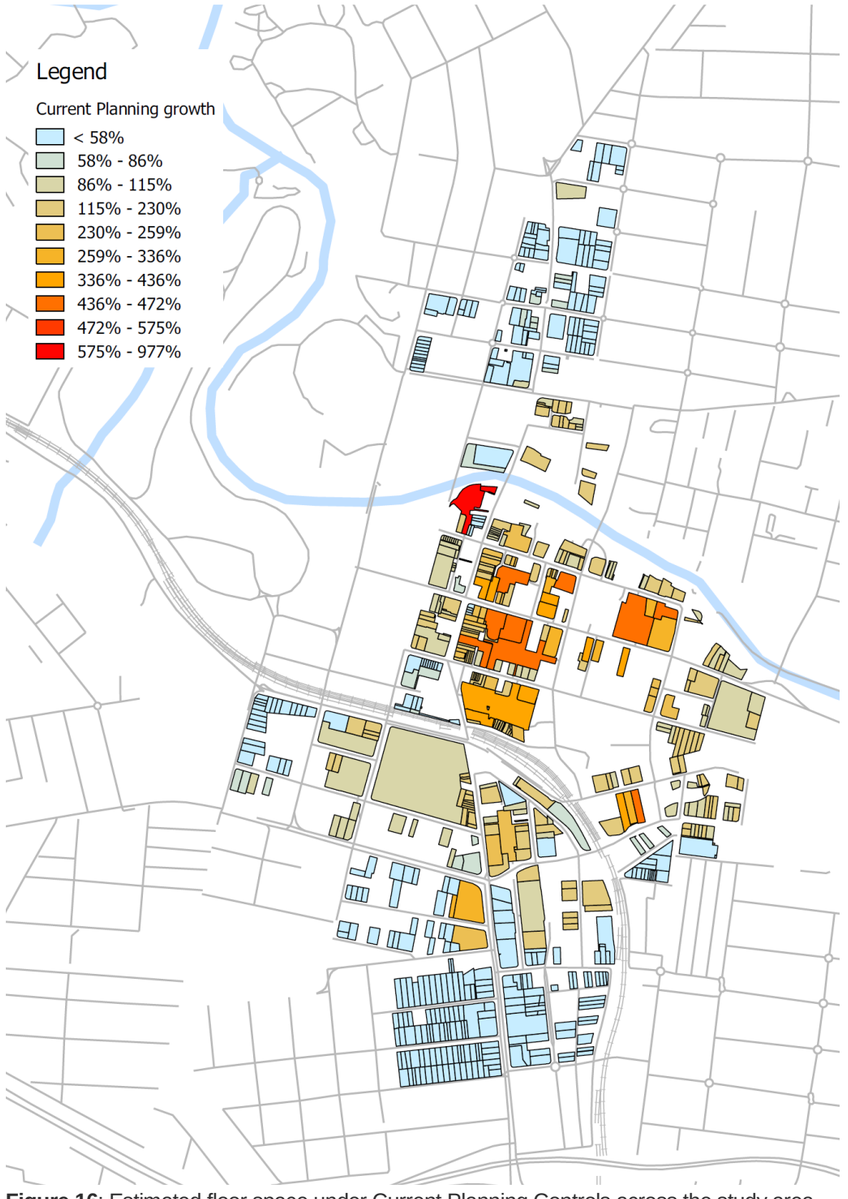


Figure 16: Estimated floor space under Current Planning Controls across the study area

PROPOSED 1 FLOOR SPACE

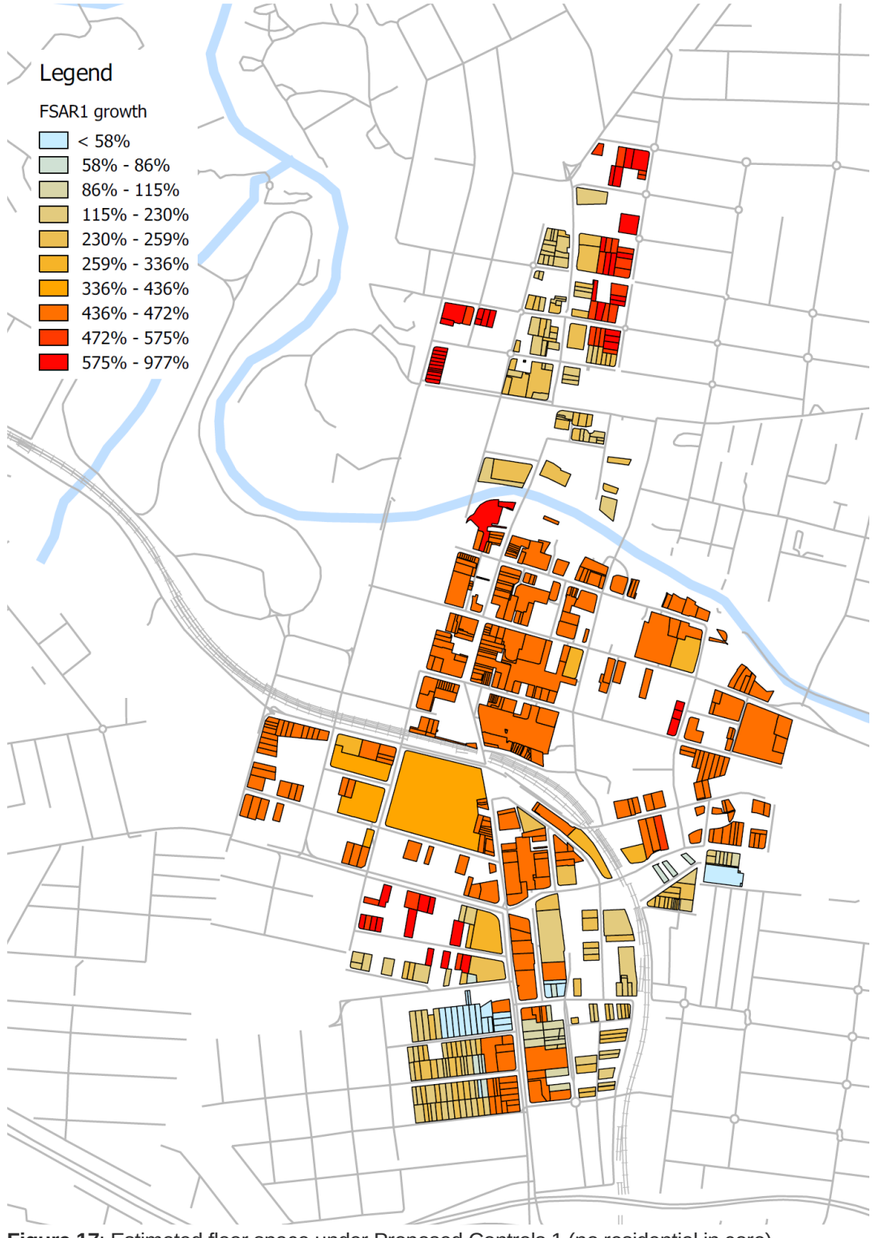


Figure 17: Estimated floor space under Proposed Controls 1 (no residential in core)

PROPOSED 2 FLOOR SPACE

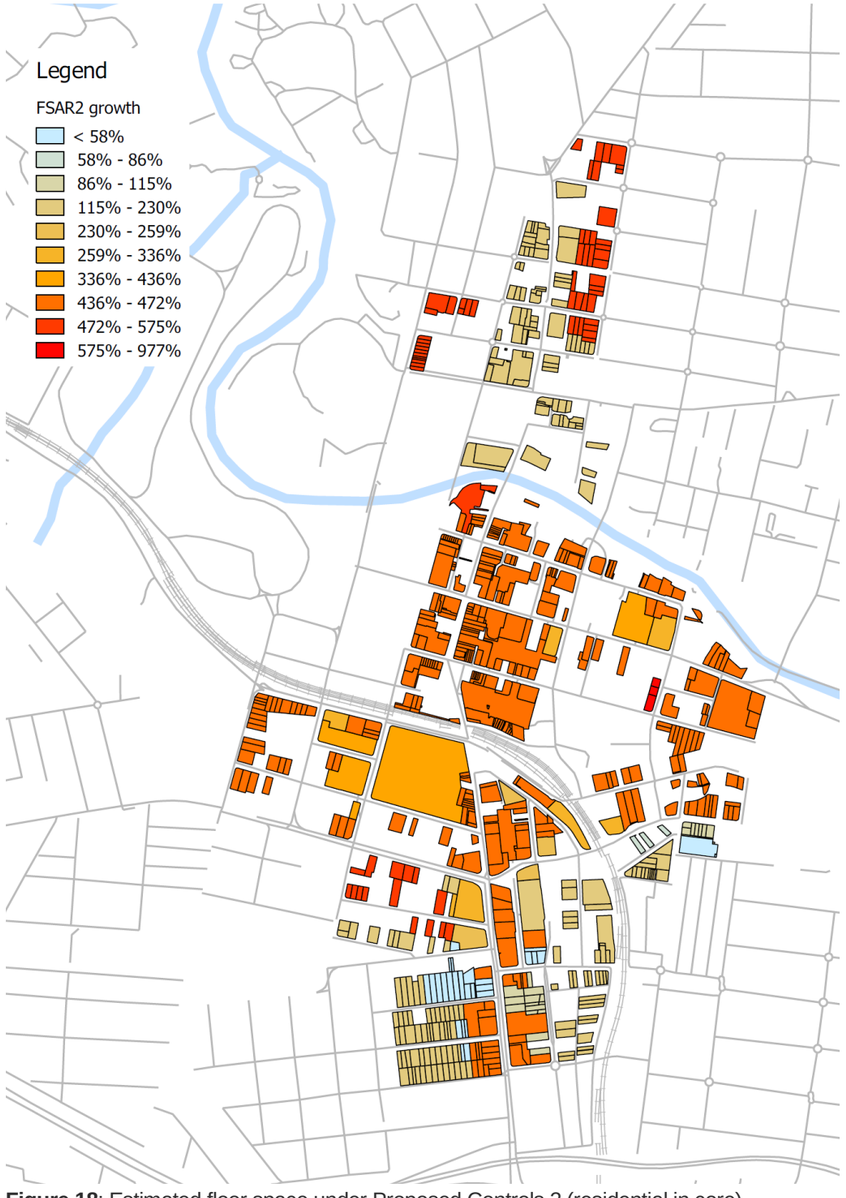


Figure 18: Estimated floor space under Proposed Controls 2 (residential in core)

IMPLICATIONS OF PARRAMATTA CBD GROWTH

Scenario analysis of the Parramatta CBD was analysed under each planning scenario to understand the implications of the Parramatta CBD growth on:

- Energy demand and infrastructure
- Water and sewer infrastructure
- Greenhouse gas emissions
- Transport and car dependence
- Cost of living

Modelling was first undertaken for a **Business As Usual scenario**, which assumes that all new development under each planning scenario achieves building compliance (with BASIX and Section J of the Building Code) as well as conforms with existing Parramatta City Council parking controls.

Analysis was undertaken using a combination of Parramatta City Council's CCAP City tool alongside CCAP Precinct. CCAP Precinct is 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.

ENERGY DEMAND AND INFRASTRUCTURE IMPLICATIONS

The Parramatta CBD is currently serviced by Endeavour Energy (electricity) and Jemena (gas). Electricity is delivered from large, regionally located coal and gas fired power plants located over 85 km from the Parramatta CBD.

Under the proposed planning scenarios, the energy implications are significant:

- **Electricity demand is expected to nearly triple** when compared to existing demands (see Figure 19).
- **Peak day electricity demand is expected to increase by over 100 MW** (twice the existing demand), see Figure 20.
- **Gas demand is expected to more than triple** when compared to existing demands.

Peak electricity demand is driven by the hour or series of days where hot temperatures require significant air conditioning loads. To further test the implications of the planning scenarios, peak day electricity demand was also modelled under the following climate and urban heat island scenarios:

- A 2 degree temperature rise
- Street level, un-vegetated temperature settings

This sensitivity testing showed a further 10% increase in peak electricity demand under a 2 degree temperature rise and more significant increase and change in the peak day load profile if the Parramatta CBD is further affected by the urban heat island effect (see Figure 20).

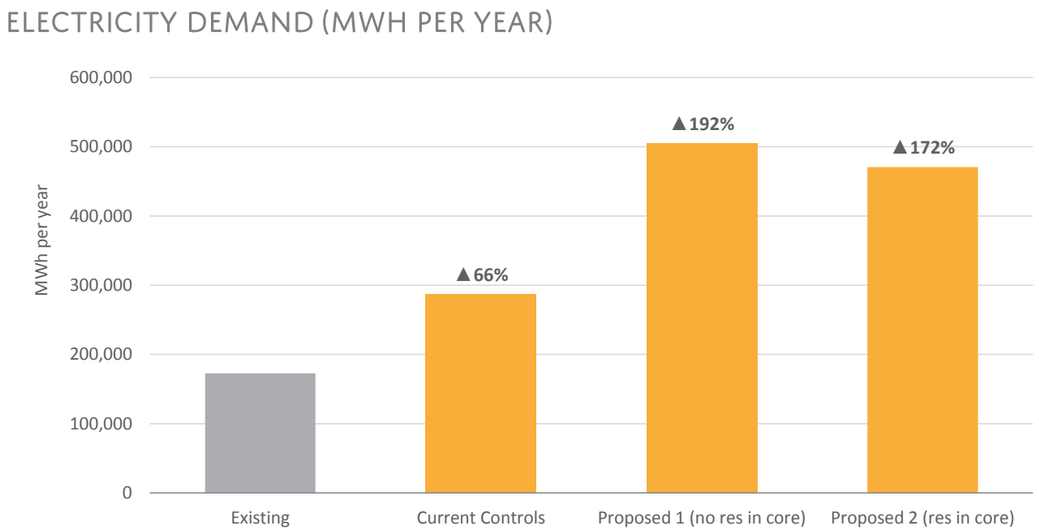


Figure 19: Expected electricity demand under each planning scenario (in comparison to existing demands)

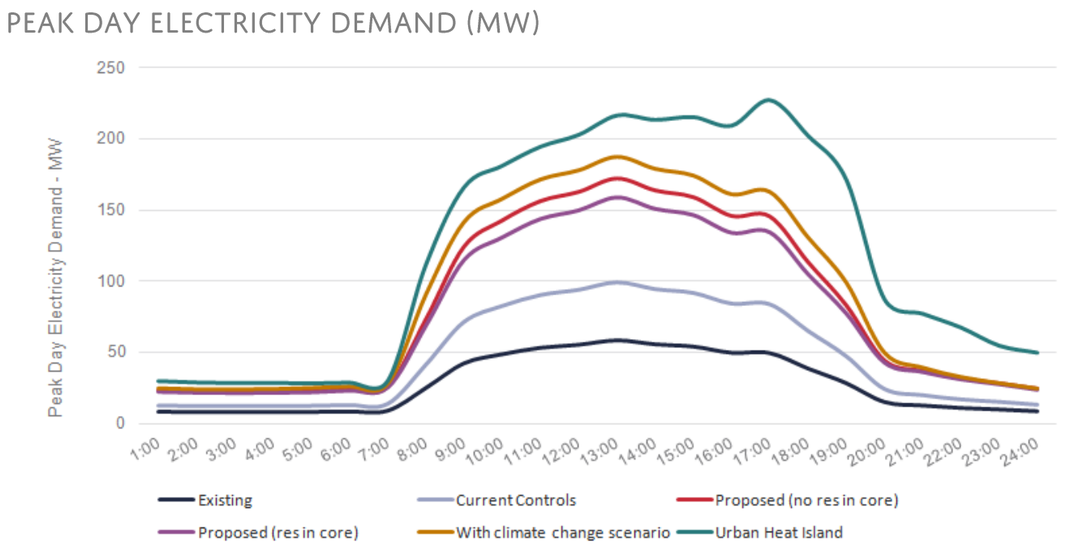


Figure 20: Expected peak day electricity demand profile under each planning scenario as well as under various climate change scenarios.

WATER DEMAND AND INFRASTRUCTURE IMPLICATIONS

The Parramatta CBD is currently serviced by Sydney Water for potable water and sewer. Water is delivered from several regional dams, including Warragamba, Nepean, Coreaux and Cataract. Sewer is collected and pumped 25 km to the Sydney Water's North Head Wastewater Treatment Plant at Manly which disposes of the treated wastewater through an ocean outfall. The Parramatta CBD is not currently serviced by recycled water.

Under the proposed planning scenarios, the water and sewer implications are significant:

- Water demand is expected to triple when compared to existing demands (Figure 21). The higher residential component in the Proposed Controls 2 scenario reflects the higher water demands from the residential sector.
- Sewer loads are expected to increase by nearly 4 times (Figure 22).

TRANSPORT AND PARKING IMPLICATIONS

Under the proposed planning scenarios, the transport implications are two-fold:

1. All scenarios are expected to deliver a 30% to 35% reduction in per person car use. This is delivered through the expected lower car ownership rates driven by Council's existing parking rates.
2. Despite this, all scenarios will deliver significantly more vehicles into the Parramatta CBD. Under existing parking controls, the planning scenarios are expected to more than double parking and associated vehicles.

Parramatta City Council recently completed a parking survey of the Parramatta CBD and additional analysis was undertaken to understand the current supply and expected demand for parking under each planning scenario (Table 3 and Figure 23).

This analysis reviewed the parking survey which counted on and off-street parking across the study area. On average existing off-street parking had an average occupancy of 69% when counted (i.e. 31% of spaces were vacant).

To understand how this compares to existing parking ratios, the existing floor space was multiplied by Parramatta City Council's existing parking ratios for various building typologies. This generated a parking supply that is approximately 26% less than current supply i.e. if the Parramatta CBD was rebuilt today, the city would require 26% less parking than is currently in the study area.

If current rates are assumed for the Existing Planning Controls and the Proposed Planning Controls, parking rates are expected to increase by 23% and over 100% respectively, creating over 50,000 parking spaces across the study area.

WATER CONSUMPTION (ML PER YEAR)

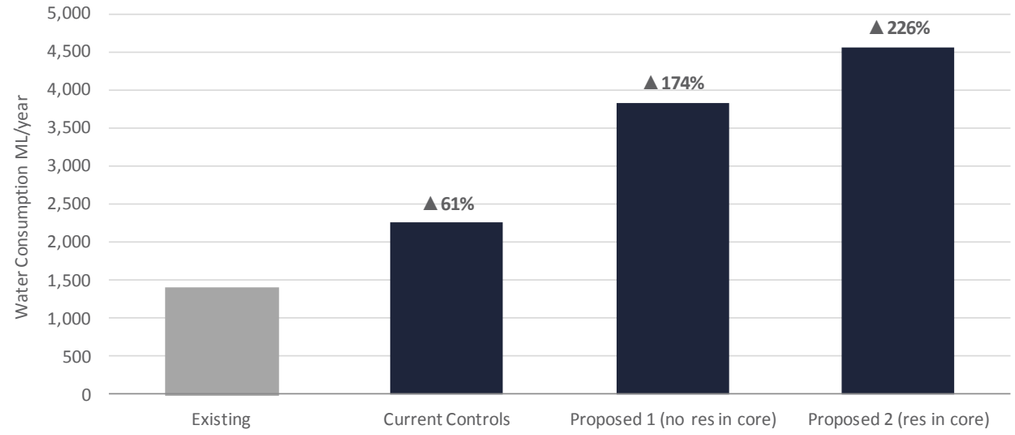


Figure 21: Expected water demand under each planning scenario (in comparison to existing demands)

SEWER LOADS (ML/YEAR)

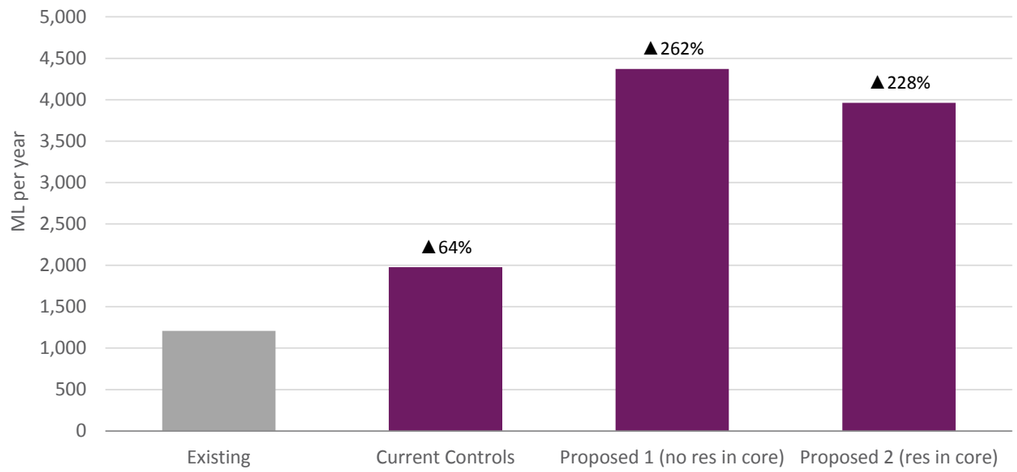


Figure 22: Expected sewer loads under each planning scenario (in comparison to existing demands)

PARRAMATTA CBD PARKING COUNTS

Parking Type	Total Spaces	% Utilisation
Parking Off-Street	23,908	69%
Public (Council) Off-Street	3,461	n/a
On-Street	1,849	n/a
Total	29,218	n/a

Table 3: Existing parking counts for the study area

PARRAMATTA CBD PARKING RATIOS

Building Use	Maximum Parking Spaces
Commercial	1 space for every 100m2
Shops	1 space for every 30m2
Multi-Dwelling	1 space for every dwelling (plus 1 visitor space for every 5 dwellings)

Table 4: Existing parking controls used in parking analysis (Parramatta City Centre LEP 2007)

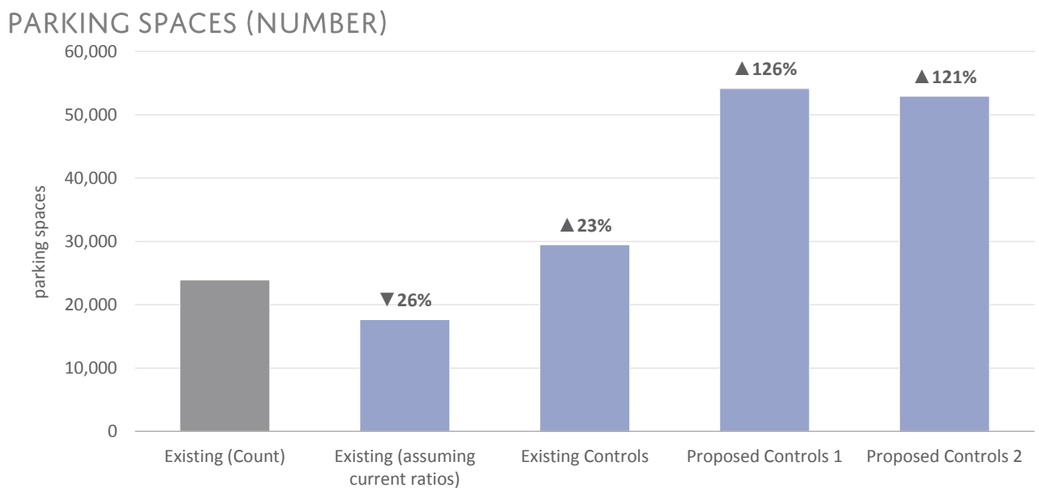


Figure 23: Parking space across the study area under various scenarios

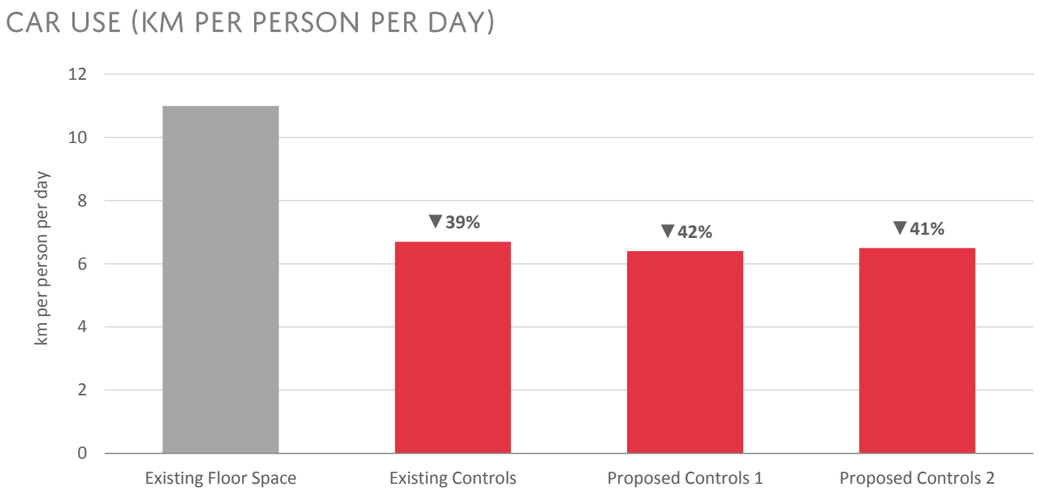


Figure 24: Expected car use for residents living in the study area under various scenarios

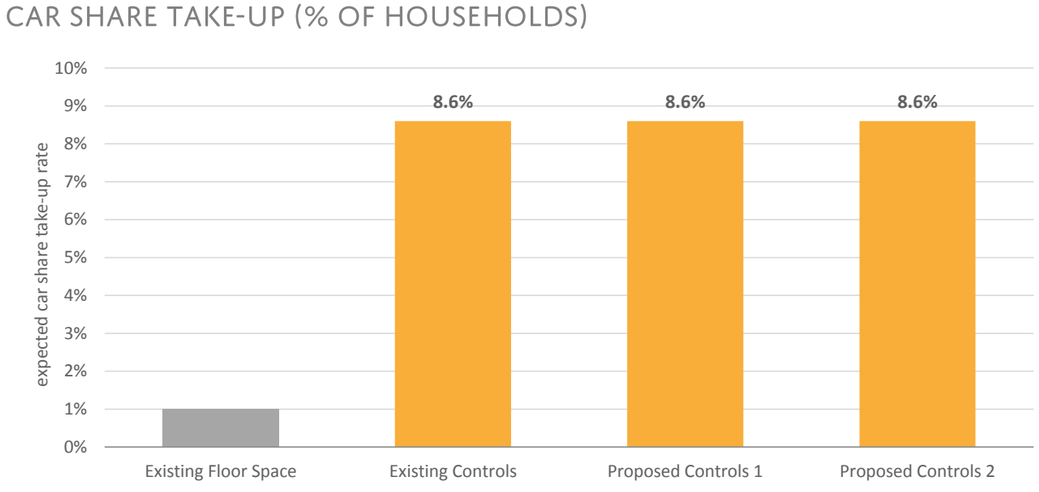


Figure 25: Expected car share take-up (percent of households who would take-up car share) under various scenarios

COST OF LIVING OUTCOMES

Household costs and affordability is often considered only in the context of the cost of housing. However, as shown in the previous section of this report, transport costs associated with car ownership and fuel consumption can be as high as housing costs in Parramatta.

New development can have a significant impact on the cost of transport as well as utility costs for energy and water. For the study area, how buildings are designed will affect household costs related to transport and utilities (energy and water).

To better understand this transport and utility expenditure analysis was undertaken for the study area. This analysis assumed the following:

- Transport costs were calculated based on existing and projected car ownership and travel patterns (car use and public transport use) in the LGA.
- Utility costs were calculated based existing average and projected energy and water consumption for the average household in the LGA, assuming current retail tariffs.

Under the Existing Controls and Proposed Controls, new residents in the Parramatta CBD are expected to spend approximately $5,500 less per year in transport costs (due to lower car use and expected car ownership rates) and approximately $150 less in energy and water utility costs (due to BASIX requirements).

COST OF LIVING

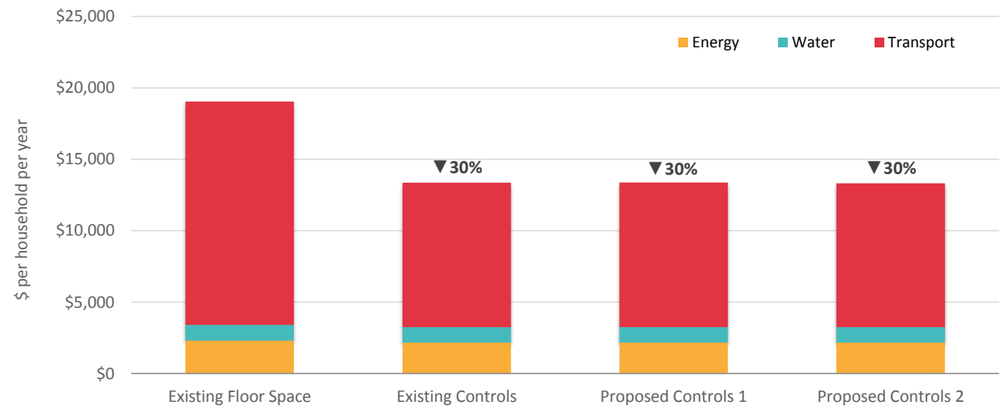


Figure 26: Expected households costs for energy, water and transport under various scenarios.

KEY FINDINGS

Under a business as usual scenario (assuming current building compliance requirements, such as BASIX, Section J of the building code and existing Council parking ratios are met), the growth across the Parramatta CBD is expected to:

- **Triple electricity demand and water consumption**
- **Increase peak electricity demand by over 100 MW (nearly twice the existing demand)**
- **Increase sewer loads by nearly 4 times**
- **More than double parking requirements**

However, increased growth is also expected to deliver significant benefits and resident efficiencies. When compared to the existing Parramatta CBD, a new resident living in the study area is expected to:

- **Consume 10% less stationary greenhouse gas emissions**
- **Consume 30% less water**
- **Drive 40% less**
- **Save 30% in household operating cost from energy, water and transport (equivalent to approximately $5,500).**

KEY OPPORTUNITIES AND RECOMMENDATIONS

Based on the findings of this study and the vision and principles that have been identified by Parramatta City Council to guide the development of the Parramatta CBD, Kinesis modelled a series of **Optimised Parramatta CBD growth scenarios** which incorporate a suite of recommendations outlined below.

1. HIGH PERFORMANCE BUILDINGS

High performance building requirements can mitigate this growth and deliver more affordable and sustainable development outcomes.

Compared to a business as usual approach, the delivery of high performance buildings (through increased BASIX targets and NABERS ratings) is expected to deliver:

- **60% reduction in electricity demand,** effectively ensuring no net increase in electricity demand (Figure 27)
- **55% reduction in peak electricity demand,** effectively reducing the need for major electricity infrastructure augmentation (Figure 28)
- **35% reduction in per person stationary greenhouse gas emissions**
- **50% reduction in per person water consumption**

Please note – high performance building outcomes can be delivered through building by building technology and efficiency upgrades and/or precinct level energy and water solutions (see discussion on precinct scale infrastructure below).

We have seen that the development of the Parramatta CBD will require significant energy, water and sewer infrastructure augmentation. The delivery of high performance buildings that use less energy and water will mitigate this impact, reducing development costs and disruption to the CBD. We have also seen that there is an appetite from the development industry to deliver buildings that exceed BASIX and building code compliance. Based on this, it is recommended that Parramatta City Council:

1. **Seek mandatory or incentive based higher BASIX targets.**

   Councils have established planning controls that provide incentives to developments that exceed BASIX compliance. Bankstown Councils LEP 2015, Clause 4.4A provides for a FSR Bonus of 0.5:1 in the Bankstown CBD where developers can demonstrate that commercial buildings achieve 5-star NABERS Energy rating and 4.5-star NABERS Water rating and residential buildings achieve 10-point increase for BASIX Energy and BASIX Water 60 (see Case Study, page 20). For Parramatta City Council, this could be linked to a FSR Bonus proposed for the CBD. Preliminary analysis by Kinesis suggests that new development in the CBD could achieve:

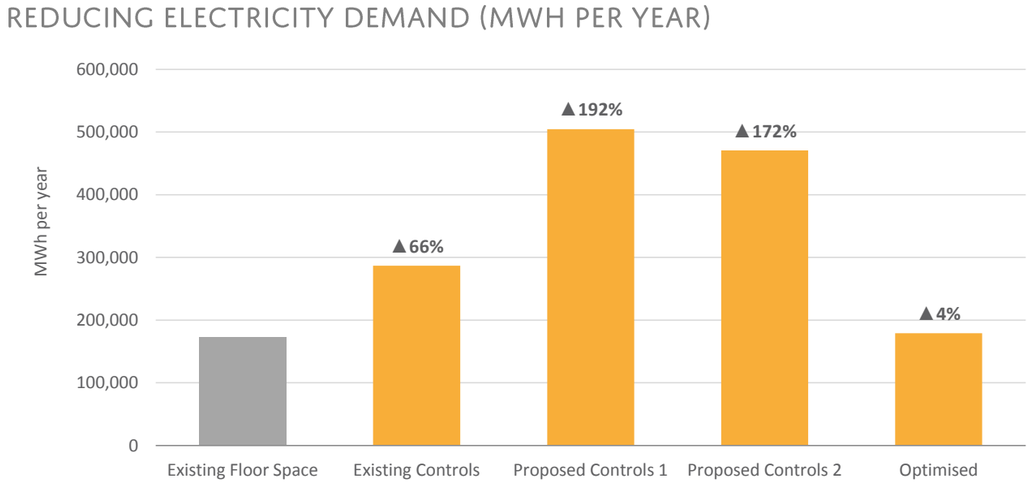


Figure 27: Expected electricity demand under each planning scenario (in comparison to existing demands)

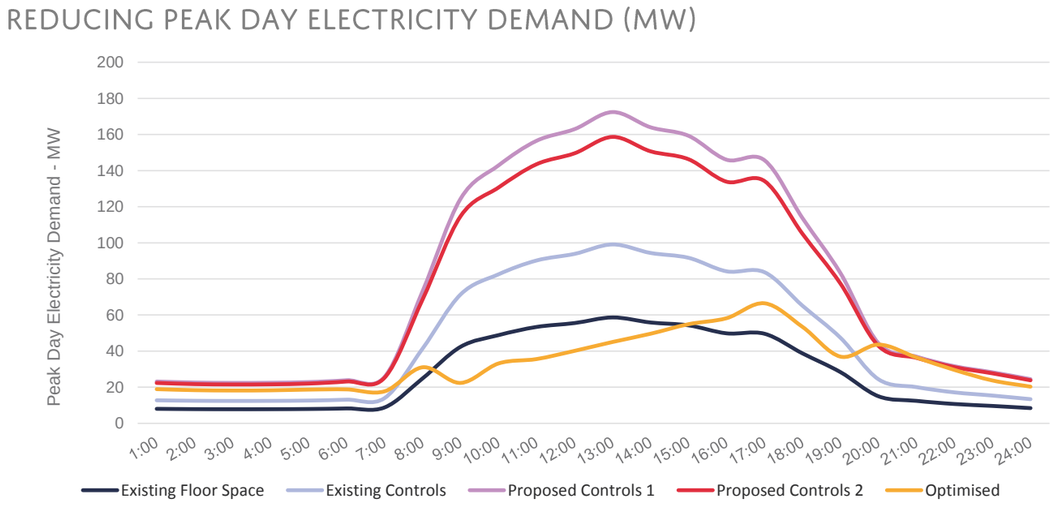


Figure 28: Expected peak day electricity demand profile under each planning scenario as well as under various climate change scenarios.

Residential buildings

- BASIX Energy: increase current targets by up to 20 BASIX points
- BASIX Water: increase the target from 40 to 60 BASIX points

Non-Residential buildings (greater than 2,000 m2)

- NABERS Energy: minimum 5-star performance
- NABERS Water: minimum 5-star performance

Next Steps *- Detailed studies and cost-benefit analysis has been undertaken by both the NSW Department of Planning as part of the BASIX Target Review which proposed, for most developments, a 5 to 10 point increase in BASIX Water and Energy targets[1]. The City of Sydney also conducted a study on BASIX Energy Targets for multi-unit dwellings proposed a 20 to 25 point increase in BAIX Energy targets[2].*

To ensure appropriate targets are established for the Parramatta CBD, is it recommended that specific building upgrades for new builds in the Parramatta CBD are defined in order to develop quantity surveyor cost estimates for increased residential and non-residential building performance targets.

CASE STUDY - LINKING ENVIRONMENTAL PERFORMANCE TO DEVELOPMENT INCENTIVES

Clause 4.4A of Bankstown Local Environmental Plan (LEP) 2015 provides for Floor Space Ratio (FSR) Bonus of 0.5 on the FSRs allowed under the Local Area Plan for the Bankstown CBD on the condition that they achieve the following environmental design standards:

Residential component of a building:

- Energy target is a minimum 10-point increase in the BASIX score compared to current requirements.
- Water target is a minimum BASIX 60.

Non-Residential component of a building:

- Energy target is a maximum 135 kg of CO2/m2 per year (equivalent to a 5-star NABERS rating for commercial buildings)
- Water target is a maximum 0.47 kL/m2 per year for office (equivalent to a 4.5-star NABERS rating for commercial buildings)

As the FSR Bonus will increase the size of new buildings this will lead to increased environmental impact, in terms of increased greenhouse gas emissions from energy consumption and increased water consumption. The environmental performance standards established by Council seek to offset the impact of the increased floor space so that buildings which receive the FSR Bonus have the same environmental performance as buildings which do not.

2. Future proof all new buildings with dual reticulation for recycled water.

Given the 30-100 year life of new buildings in the Parramatta CBD, it would be considered prudent to ensure these assets are future proofed to connect to precinct level recycled water system (see Strategy 2 below). This would require dual reticulation for recycled water for both internal and external uses.

Next steps *– Quantity Surveyor cost estimates for cost per m2 for dual reticulation in new development to build the case for establishing the requirement for dual reticulation in all new buildings.*

3. Require electric vehicle and battery storage infrastructure in new buildings.

New buildings should consider and plan for the growth of new trends including electric vehicle charging points and space and electrical wiring to enable battery storage in the future.

Next steps *– define the technical specifications for EV and battery "ready" solutions in new buildings and determine cost estimated with quantity surveyor.*

[1] http://www.basix.nsw.gov.au/basixcms/images/4050pdfs/BASIX-Target-Review-supporting-research.pdf
[2] http://planspolicies.planning.nsw.gov.au/?action=view_submission&job_id=6332&submission_id=92318

2. RESILIENT INFRASTRUCTURE AND PUBLIC DOMAIN

Recycled water integrated with public domain improvements will provide a more resilient and cooler urban experience. This could be delivered as an Integrated Utility Solution incorporating both precinct water and energy solutions.

Compared to a business as usual approach under the proposed controls, the combination of this strategy is expected to deliver:

- **50% reduction in water consumption**
- **30% reduction in sewer,** delivered through the recycled water system
- **Significant reductions in urban heat island,** delivered through the improved public domain

No new additional green space (public parks) are proposed as part of the Parramatta CBD growth. This places even more importance on increasing street tree and building façade 'greening' to deliver a cooler urban environment that is more pleasant and walkable on hot summer days.

Left to chance, the Parramatta CBD experience an increase in days over 35 degrees, exacerbated by the urban heat island due to the increased development in the CBD. To ensure a more active and resilient CBD environment for both residents, workers and retail activity, the following is recommended:

1. **Parramatta CBD incorporates green streets in key pedestrian and retail activity areas.**

   Significant, additional greening is delivered through increased street tree canopy and green walls throughout the CBD. This green public domain is linked to the delivery and management of the recycled water system.

2. **Recycled water is enabled throughout the Parramatta CBD.**

   All new building incorporate dual reticulation for recycled water for both internal and external uses. Such a requirement would significantly enhance the business case for a recycled water scheme. Recycled water will deliver unlimited water to irrigate the increased green canopy and green facades throughout the CBD, as well as significantly reducing any sewer infrastructure upgrades required.

   Next steps *– Quantity Surveyor cost estimates for cost per m2 for dual reticulation in new development to build the case for establishing the requirement for dual reticulation in all new buildings.*

3. **Parramatta City Council seeks collaboration with a utility to develop and manage recycled water.**

   Both public and private utilities can develop and manage the delivery of recycled water across the Parramatta CBD. However, without coordination with development and infrastructure delivery, a business as usual approach to water and sewer connection is expected. Parramatta City Council is in a unique position to coordinate and enable a precinct level recycled water scheme and ensure new buildings are configured to connect to this system.

   In addition, due to the link between the business case for recycled water and irrigation demands, it is proposed that this partner is also involved in the management of improved public domain (see Case Studies, Page 22).

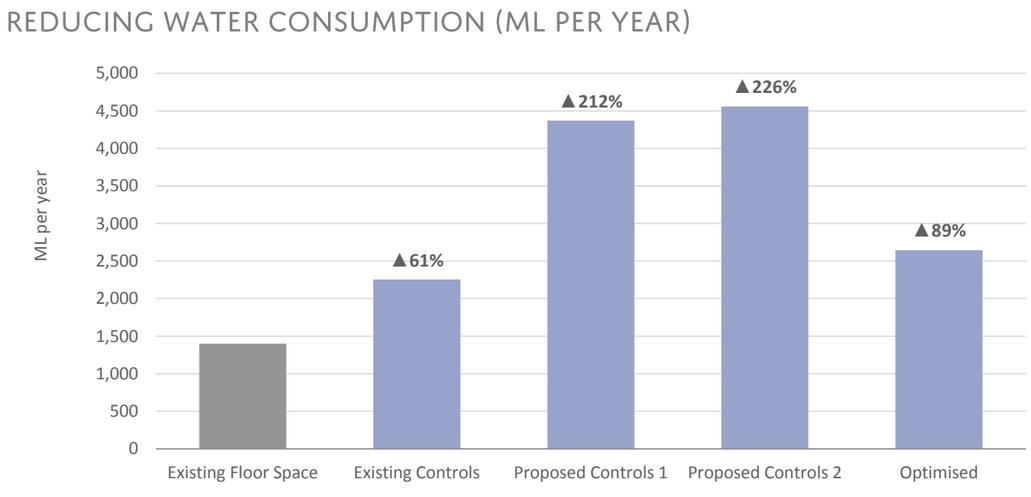


Figure 29: Expected water demand under each planning scenario (in comparison to existing demands)

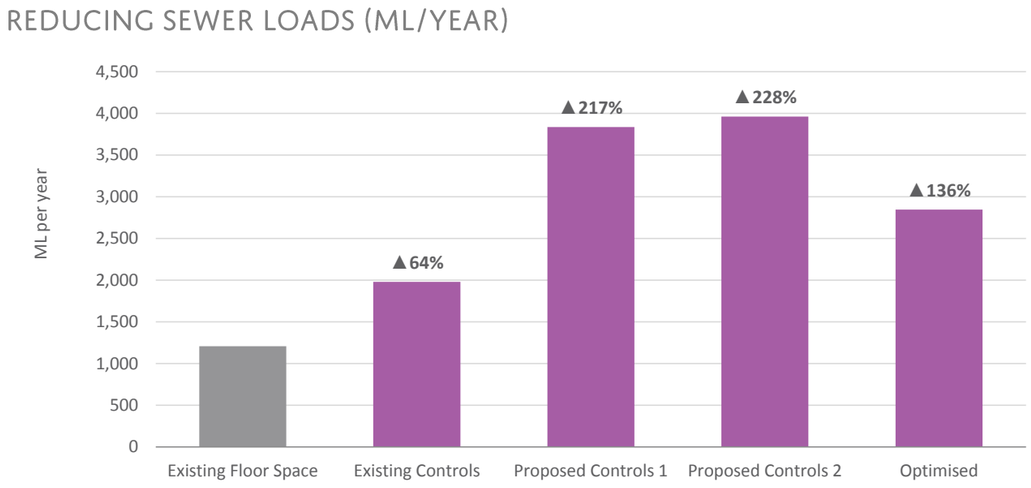


Figure 30: Expected sewer loads under each planning scenario (in comparison to existing demands)

4. **Parramatta City Council plan for and coordinate infrastructure augmentation to reduce disruption to the CBD.**

   We have seen that the development of the Parramatta CBD will require significant energy, water and sewer infrastructure augmentation. The delivery of high performance buildings and recycled water will mitigate this impact. However, some infrastructure augmentation is inevitable and to ensure this augmentation is done in an efficient and timely manner it is recommended that Parramatta City Council work closely with both private (as required) and public utilities to coordinate this to ensure minimum disruption to streets and associated retail activity.

5. **Precinct Scale Energy Infrastructure**

   It is clear that there are benefits to be explored by coupling district energy solutions with district water recycling in CBD development areas. The analysis for high performance buildings was done agnostic of the way energy services are delivered, i.e. building by building or precinct solutions (or combinations of both). It would be considered prudent to ensure that given the 30-100 year life of these urban assets that they are designed to accommodate district energy to future proof their owners and tenants against a rapidly changing energy services environment. There are clear examples globally where significant buildings are required to install appropriate services and plant space for ground or roof connection to accommodate the energy services provider of tomorrow.

Next steps for the Delivery of Precinct Scale Energy and Water

Additional planning and analysis on the delivery of precinct infrastructure could be undertaken through the development of an Integrated Utility Master Plan. The development of a Master Plan creates a vision and attracts interest from both public and private utility providers.

However, it is the opinion of Kinesis that the urgency and risk associated with the delivery of infrastructure to the Parramatta CBD is better managed through a more collaborative process that clearly outlines Councils role in the delivery of community infrastructure. To achieve this, it is recommended that Council establish and publish a set of commitments and standards that Council could provide to a public or private utility if the right performance outcomes are achieved. These standards or commitments could include opportunities to use Council land or assets (such as car parks) and dual reticulation requirements in new developments.

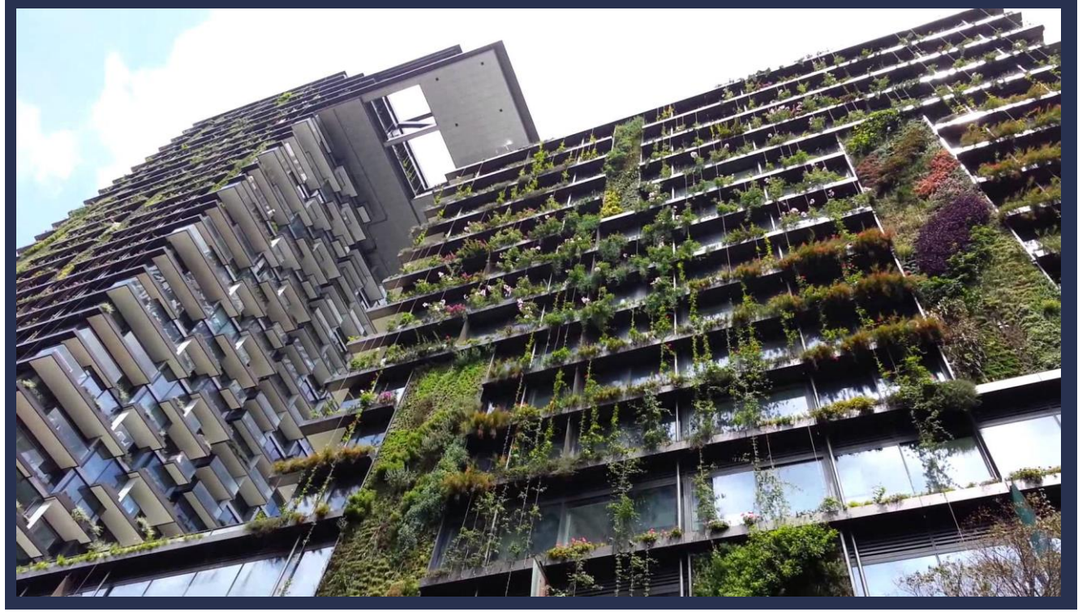
Given the learnings from the City of Sydney and Parramatta City Council's recent Parramatta Square development, this document should establish the next set of engagement and collaborative strategies between local governance and community infrastructure delivery.

CASE STUDIES – RECYCLED WATER AND URBAN GREEN SPACE

Precinct scale recycled water systems 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.



3. STRATEGIC PARKING MANAGEMENT

Reduced parking rates alongside decoupled parking will improve development feasibility and deliver a more pedestrianised and future proofed CBD.

Compared to a business as usual approach, the combination of this strategy is expected to deliver:

- **50% reduction in car use** (Figure 31)
- **Enabling significant opportunities for investment in car share for improved mobility choice** (Figure 32)
- **40% reduction in household operating costs from energy, water and transport,** equivalent to a household saving of over $5,000 per year (Figure 33)

The development of Parramatta's CBD must plan for and adapt to trends in car ownership rates. Given the 30 to 100 year life of new buildings, we are at risk of developing underground parking that, in 10 to 20 years' time, may be a worthless asset. Studies have already identified an oversupply of parking in accessible locations.

The RMS update to Guide to Traffic Generating Developments (2013) surveyed 10 high-rise residential buildings around Sydney that were close to public transport, greater than six storeys and almost exclusively residential in nature. While only a small sample, this survey showed an oversupply of car parking compared to demonstrated demand for car parking in all the surveyed high-density residential buildings[3].

Based these trends, it is recommended that Parramatta City Council:

1. **Reduce parking rates across the CBD and across all building typologies by 50%.**

   It is recommended that, on average, current parking ratios are reduced by 50% (refer Table 4, p17). The benefits of reduced parking rates in new development is clear:

   - Reduced vehicle traffic in the CBD.
   - Lower construction costs associated with excavation and construction of underground parking.
   - Reducing parking by 1 space per dwelling could equate to $50,000 to $70,000 off the sales price of a new apartment.
   - Less energy demands for parking lighting and ventilation equates to lower compliance costs with BASIX Energy Targets and lower energy costs and strata fees for an apartment body corporate.
   - The reduction in parking provides a business case for private investment in the provision of car share.

[3] RMS (2013) Updated Traffic Surveys, http://www.rms.nsw.gov.au/trafficinformation/downloads/td13-04a.pdf

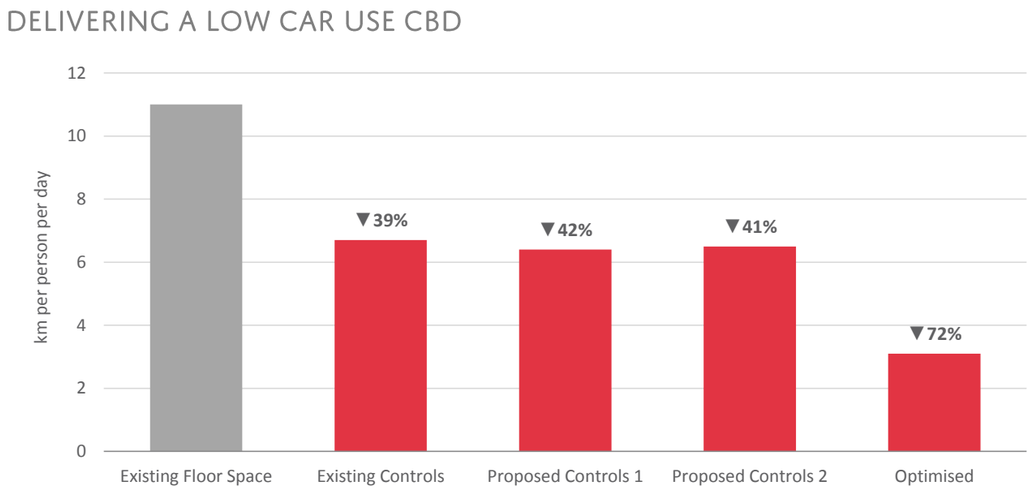


Figure 31: Expected car use for residents living in the study area under various scenarios

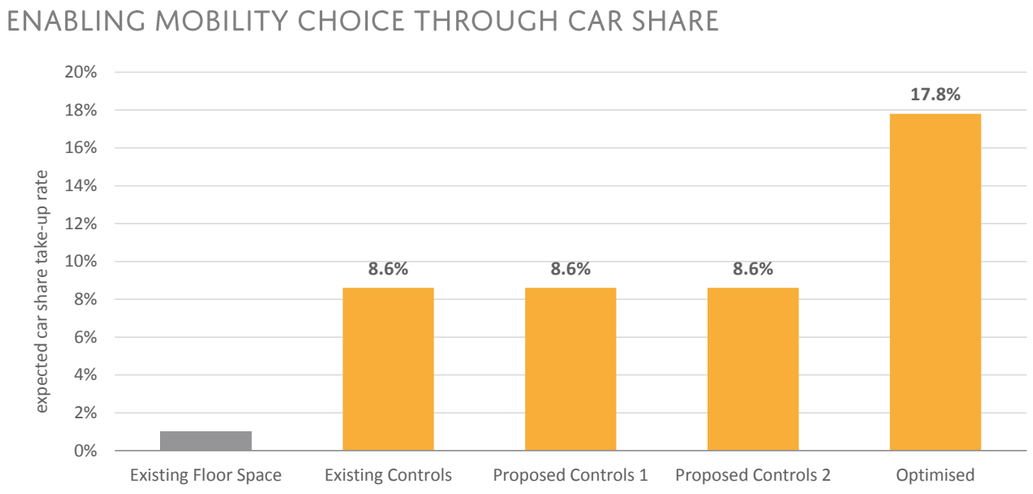


Figure 32: Expected car use for residents living in the study area under various scenarios

2. **Enable on-site parking to be decoupled from the building lot (delivered through a centralised parking station or through parking available on another site).**

To mitigate the risk of providing low off-street parking ratios, decoupled, adaptable and temporary car parking strategies are recommended.

Council or privately owned and operated parking stations at the periphery of the precinct (as opposed to the centre of the precinct) would address short term parking needs and to reduce the need for individual developments to supply car parking on-site and minimise the impact of traffic in order to deliver a highly pedestrianised precinct. This could be funded by a development fee in lieu of providing parking on-site.

3. Enable a CBD Parking Trading Scheme to manage new parking requirements with under-utilised parking across the CBD

To ensure the most efficient use of existing and new parking across the CBD, it is proposed that a CBD Parking Trading Scheme is establishing by Parramatta City Council. Similar to a floor space trading scheme, this scheme would allow and encourage new developments to seek decoupled parking from existing under-utilised parking across the CBD.

***Next Steps**: The recent parking survey undertaken by Council identifies parking utilisation at a block by block level across the CBD. It is recommended that further analysis of this data is undertaken to:*

- *Inform existing potential parking that could be used for new development*
- *Establish rules and requirements for the Parking Trading Scheme.*

It is proposed that the Parking Trading Scheme is managed by Parramatta City Council through a web-based portal which matches supply and demand for parking across the precinct.

4. Provision of End of Trip Facilities in Commercial Buildings

To complement lower parking rates and facilitate increased active transportation options, it is proposed that end of trip facilities are encouraged in new commercial development across the Parramatta CBD. To encourage this, it is recommended that end of trip facilitates are excluded from the floor space ratio (FSR) calculation). In effect, commercial premises that incorporate end of trip facilities are eligible for additional floor space equal to the floor space provided for end of trip facilities. An example of this type of provision is Clause 6.6 of the City of Sydney LEP 2012.

5. Develop a plan to transition Parramatta City Council parking station assets over time.

As the Parramatta CBD develops, existing and future Council above-ground parking assets should be managed as transitional and adaptable multi-use spaces that could house decoupled parking, precinct energy or water infrastructure as well as open space.

New Council parking assets should be built to enable this asset for adaptable use over time, including increasing floor to ceiling heights to transition parking to other residential, commercial or retail uses.

The emergence of autonomous vehicles will further reduce the need for parking and investment in underground parking, in particular, may lose value as an asset as vehicles no longer need to be parked or housed at origin or destination locations. The recommendations in this report seek to minimise underground parking and the emergence of autonomous vehicles should further support the approach to more flexible and agile parking structures that can be adapted over time.

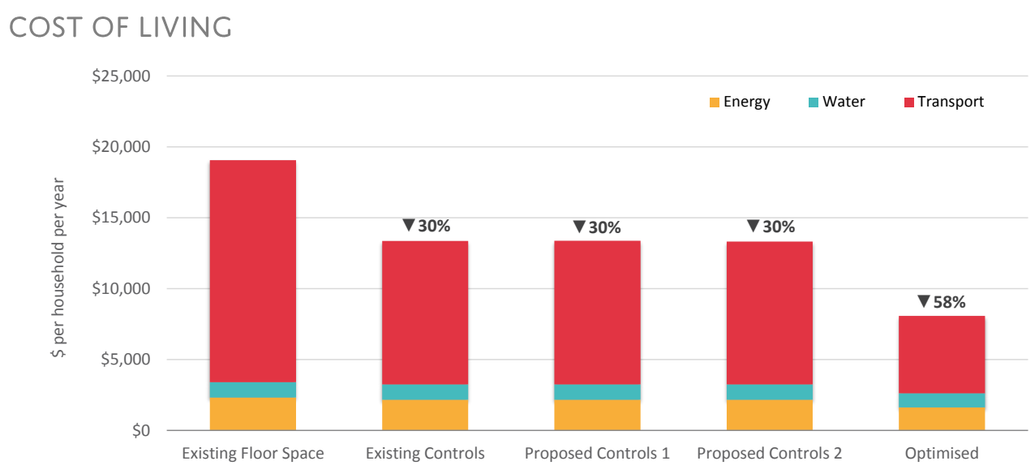


Figure 33: Expected households costs for energy, water and transport under various scenarios.

Note – Energy and water cost savings delivered from High Performance Building strategies is also shown in this graph. Under the Optimised Scenario, new residents in the Parramatta CBD are expected to spend approximately $10,000 less per year in transport costs (due to lower car use and expected car ownership rates) and approximately $750 less in energy and water utility costs (due to high performance building requirements).

SUMMARY OF RECOMMENDATIONS AND NEXT STEPS

The following table summarises the benefits, implementation mechanisms and next steps for each recommendation discussed above.

RECOMMENDATION	DETAILS	POTENTIAL BENEFIT	POTENTIAL IMPLEMENTATION MECHANISM	RECOMMENDED NEXT STEPS
High Performance Buildings	• Increased BASIX targets for residential dwellings. • Increased performance targets (e.g. NABERS) for non-residential buildings. • Dual reticulation in all buildings. • Battery and EV ready buildings.	• No net increased in electricity demand • Less need for major peak electricity upgrades • Reduction in stationary greenhouse gas emissions and water consumption • Reduction in energy and water utility costs	• NSW Department of Planning BASIX • Parramatta City Council Design Excellence guidelines • LEP for dual reticulation and EV/battery ready requirements	• Meet with NSW Department of Planning regarding increased BASIX targets whether mandatory or enabled through LEP FSR Bonus scheme. • Quantity Surveyor cost estimates for increased BASIX targets, dual reticulation and EV/Battery storage ready requirements. • Consider the use of the Design Excellence process to capture non-BASIX sustainability requirements.
Resilient Infrastructure and Public Domain	• Recycled water integrated with public domain improvements will provide a more resilient and cooler urban experience. • Could be delivered as an Integrated Utility Solution incorporating both precinct water and energy solutions.	• Reduction in water consumption • Reduction in sewer, delivered through the recycled water system • Significant reductions in urban heat island, delivered through the improved public domain	• Collaboration with public or private integrated utility and public domain management plan.	• Meet with utilities to discuss key infrastructure demands and constraints in the CBD and augmentation plans. • Establish Council commitments and performance standards for integrated utility partnership/collaboration for public domain management and maintenance. • Develop coordinated infrastructure augmentation plan.
Strategic Parking Management	• Reduce existing parking rates by 50%. • Enable on-site parking to be decoupled from the building lot. • Enable a CBD Parking Trading Scheme. • Provision of End of Trip Facilities in Commercial Buildings.	• Responding to key trends. • Reduction in parking requirements and associated car use. • Enabling significant opportunities for investment in car share. • Reduction in household costs.	• LEP for revised parking ratios and car share allowances. • LEP to enable decoupled parking allowances. • LEP for end of trip facility floor space allowance.	• Establish Parking Trading Scheme. • Develop a plan to transition Parramatta City Council parking station assets over time.

Table 5: Summary of recommendations and next steps.

KEY ASSSUMPTIONS

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	19.98 km per person/day

Tariffs and rates

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

Residential Water	**Rate**	**Unit**
Mains tariff	2.232	$/kL
Recycled water tariff	2.068	$/kL
Service charge per dwelling	765	$/yr
Recycled water service charge	0	$/yr

Residential Grid Electricity	**Rate**	**Unit**
Applied tariff	0.2514	$/kWh
Solar feed-in tariff	0.06	$/kWh
Service charge per dwelling	289.16	$/yr

Residential Gas	**Rate**	**Unit**
Gas (first 3,775 MJ per qtr/remaining)	0.041/0.023	$/MJ
Service charge per dwelling	207	$/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

- 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.
- Sydney Water (2009) Rouse Hill 15 minute and daily demand profiles (Kinesis request, unpublished)
- Department of Resources, Energy and Tourism, 2010, Energy in Australia – 2010, ABARE, Canberra
- Kinesis 2014, Additional water end use breakdowns derived from first principle analysis of residential and non-residential building types.
- National Water Commission, 2011, National performance report 2009-2010: urban water utilities, National Water Commission, Canberra
- NSW Department of Planning, BASIX Residential Water Consumption Data (2010)
- Sydney Water Best Practice Guidelines for water conservation in commercial office buildings and shopping centres (2007), http://www.sydneywater.com.au/web/groups/publicwebcontent/documents/document/zgrf/mdu0/~edisp/dd_054580.pdf
- Sydney Water Best Practice Guidelines for holistic open space turf management (2011), www.sydneywater.com.au/web/groups/publicwebcontent/documents/document/zgrf/mdq1/~edisp/dd_045253.pdf
- Water Corporation. (2014). Mapping water use at school. from https://www.watercorporation.com.au/home/teachers/lesson-plans-and-teaching-resources/lesson-plan-search/lesson-plan/?id=%7BD9516524-4A2C-4B98-A113-3891D59F1AAA%7D
- Department of Resources, Energy and Tourism, 2010, Energy in Australia – 2010, ABARE, Canberra
- Department of Infrastructure and Transport, 2011, Road vehicle kilometres travelled: estimations from state and territory fuel sales, Australian Government, Canberra
- Department of the Environment, 2014, National Greenhouse Accounts Factors, http://www.environment.gov.au/system/files/resources/b24f8db4-e55a-4deb-a0b3-32cf763a5dab/files/national-greenhouse-accounts-factors-2014.pdf
- Energy Use in the Australian Residential Sector, 1986 – 2020, Australian Government Department of the Environment, Water, Heritage and the Arts (DEHWA), 2008.
- Energy Efficient Strategies (2009), Appliance Energy Consumption in Australia: Equations for Appliance Star Ratings
- Building Code of Australia (2007) Energy Efficiency Requirements in Commercial Buildings
- Transport Data Centre (2006) The Development of a Sydney VKT Regression Model
- ABS (2010) 'Household Expenditure Survey, Australia: Summary of Results', catalogue number 65300DO001_200910, Australian Bureau of Statistics, Canberra.

Memorandum

To	Janelle Scully, Darya Fatah, Helen Papathanasiou
From	Harish Moro, David Holden, Kinesis
Date	5 June 2019
Subject	Sustainability and Infrastructure Study – High level review

This memo documents our review of the Sustainability and Infrastructure study conducted in 2015. Based on this review, we can confirm that:

1. The key trends and issues identified in 2015 have continued as expected.
2. Parramatta CBD's future land use growth may be different but the implications of this growth on resource demands and infrastructure continue to be significant.
3. The three opportunities and recommendations that were identified in 2015 are still valid today. These recommendations have been reinforced in the recently revised Parramatta CBD Higher Performance Buildings study.

We expect that a detailed review of the study would update the specific numbers and analysis. However, the insights, outcomes and recommendations of the Sustainability and Infrastructure study will remain unchanged.

Background

Since 2014-15, Kinesis has been working with the City of Parramatta to develop a strategy that delivers the City's vision for sustainable growth in Parramatta CBD. Kinesis was engaged to perform a Sustainability and Infrastructure Study for the Parramatta CBD. This study was composed of three key parts:

1. Analyse and understand key trends and issues that are relevant to the planning of Parramatta CBD
2. Model future growth in Parramatta CBD and resulting resource demands and infrastructure requirements.
3. Identify key opportunities and recommendations to deliver sustainable growth in the CBD.

In the study, Kinesis made three recommendations:

1. Implement High Performance Buildings
2. Resilient Infrastructure and Public Domain
3. Strategic Parking Management

As a follow up to the first recommendation of the Sustainability and Infrastructure study, Kinesis performed a High-Performance Buildings Study recommending floorspace bonus incentives for higher sustainability standards in residential/ mixed use buildings.

Since the original Sustainability and Infrastructure Study was conducted in 2015, there have been several changes including changes to the Parramatta LGA boundary, a proposed floorspace bonus scheme impacting projected land use in the CBD, revision of BASIX policy and the National Construction Code, etc.

This memo documents a high-level summary of the impacts of these changes on the three sections of the original study.

Kinesis Pty. Ltd.
Level 6, 155 Clarence Street, Sydney, NSW 2000, Australia
P.O. Box Q164 QVB, NSW 1230, Australia
admin@kinesis.org
www.kinesis.org
Office: 02 8005 4290
Fax: 02 9280 0953

High level review

This section documents expected changes to each of the three sections of the Parramatta Sustainability and Infrastructure study

1. Key trends and issues relevant to Parramatta CBD

Five key trends were investigated for Parramatta CBD. The original observation and changes since are outlined below.

Trend	Original	Change
1. Car ownership	Car ownership in Parramatta CBD is low and trends at the Metropolitan Level highlight these rates are falling.	Trend continues.
2. Travel patterns and containment	High level of trip containment in Parramatta CBD reflecting access to jobs and services. New development in the CBD should respond to and build on the levels of walking and cycling in the city.	Trend continues.
3. Urban Heat	The number of hot days in Parramatta is increasing higher than coastal areas and future climate projections will accelerate this trend.	Trend continues and has accelerated as suggested.
4. Cost of housing and living	Transport is second only to housing as the highest household cost in Parramatta. How we can affect transport can deliver significant affordability benefits.	Trend continues. Car share and Mobility as a service options can be alternatives to private vehicle ownership.
5. Building performance trends	Trend towards higher building performance across Parramatta, reflecting the building industry's capacity to deliver more efficient buildings.	Trend continues. Updates to BASIX policy are delivering more efficient buildings.

2. Parramatta CBD's future growth and implications

Kinesis obtained two future land use growth scenarios for Parramatta CBD. Under a business-as-usual approach to future growth in the CBD, the resource demands and infrastructure requirements were expected to be significant.

Kinesis Pty. Ltd.
Level 6, 155 Clarence Street, Sydney, NSW 2000, Australia
P.O. Box Q164 QVB, NSW 1230, Australia
admin@kinesis.org
www.kinesis.org
Office: 02 8005 4290
Fax: 02 9280 0953

Future land use growth in the CBD will differ from that used in the original analysis undertaken by Kinesis. As such, the resource, infrastructure and greenhouse gas emissions impact of this growth under a business as usual (BAU) scenario would be different. However, we expect the relative increase and impact of this increased floor space to remain. If sustainability requirements and parking controls remain unchanged,

- Electricity and water demand will continue to be significant under the proposed growth in the CBD
- Peak electricity demand will be high
- Sewer loads will be high
- There will likely be an oversupply of parking

3. Key opportunities and recommendations

Given that the implications of future growth under a BAU scenario continue to be significant, our recommendations for the following three sustainability strategies are still relevant;

i. High Performance Buildings

The High-Performance Buildings study was recently revised to encourage sustainability across a broader range of buildings. Residential and mixed-use buildings with FSR of 6:1 and higher are eligible for a 5% floorspace bonus permitting they achieve a set of BASIX targets depending on the height of the building.

ii. Resilient Infrastructure and Public domain

Urban heat continues to be a problem at Parramatta CBD. If unchecked, this will have a negative impact of walkability and amenity for residents and workers at Parramatta CBD. Urban greening serviced through a reliable recycled water system continues to be a valid strategy to tackle urban heat. Additionally, the High-Performance Buildings study also recommends introduction/ strengthening of controls and design guidelines in the following areas to support the reduction in urban heat:

- reflectivity of building roofs, podiums and facades
- heat rejection sources, systems, and locations
- encouraging laminar wind flows
- vegetation and street trees for shade and cooling through evapotranspiration
- water sensitive urban design, irrigation, water features and the retention of water and moisture
- cool materials and climate adapted building design

iii. Strategic Parking Management

We reinforce our recommendation to review parking controls in the CBD to respond to mobility trends including:

- Reducing car ownership rates
- Mobility as a service – e.g., GoGet car share and Uber
- Uptake of Electric Vehicles
- Emergence of Autonomous Vehicles

These recommendations have also been advised as future proofing strategies in the Parramatta CBD High Performance Buildings Study.

PARRAMATTA CBD

HIGH PERFORMANCE BUILDING STUDY

PREPARED BY KINESIS FOR CITY OF PARRAMATTA

15 OCTOBER 2019

Prepared by Kinesis
Level 5, 222 Clarence Street
Sydney, 2000 NSW
P.O. Box Q164
Queen Victoria Building
NSW 1230
admin@kinesis.org

Document Version
Final

Cover Image Credits
Google Maps, Photo Sphere (2011)

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

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

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

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

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

CONTENTS

INTRODUCTION

The Parramatta CBD is currently undergoing significant growth and in order to help facilitate this growth, Council is undertaking a strategic review of the Parramatta CBD planning framework. A key outcome of this review will be revised zoning and development controls for the CBD planning area.

We have been informed that Council has received the Gateway Determination from the DPE for its CBD planning proposal. This study is a revision of the Parramatta CBD bonus scheme to demonstrate that sites with an FSR greater than 6:1 are suitable for the intended 5% FSR high performing buildings bonus.

This study is intended to be read in conjunction with the existing Parramatta CBD Planning Review Sustainability and Infrastructure Study, a study undertaken by Kinesis which highlights the impact of this new development on infrastructure, affordability and environment outcomes. Its recommendation for the implementation of high-performance building standards to position Parramatta as a global leader in sustainable planning, attract A-Grade office development, ensure resource and infrastructure efficiency and future proof the city against emerging technologies and investment continue to remain valid.

To deliver on this recommendation, City of Parramatta is proposing a combination of requirements and incentives to deliver higher environmental performance outcomes in all new developments across the CBD, specifically:

- Higher BASIX requirements for all new residential use development, tied to a 5% Floorspace bonus.
- Mandating new non-residential development such as; retail premises (including as part of a mixed-use development), office premises, hotel or motel accommodation or serviced apartments meet a ‘best in market’ standard for energy and water building performance.
- Future proofing requirements for all new development to provide dual reticulation to achieve significant potable (drinking) water savings.

Kinesis have been asked by City of Parramatta to investigate the potential for higher environmental standards for new development across the CBD. Implementing such a policy successfully will require careful consideration of procedural, environmental and financial feasibility factors. In particular, Council will need to ensure:

- The environmental performance of a building above regulatory standards are cost effective
- The development standard proposed will provide a genuine and effective environmental outcome
- Robustness in the development standard so that Council have scope to reject an application if the proponent cannot meet the test of providing an improved environmental outcome
- The policy allows for densities which reflect principles of good planning and design
- The policy is consistent and predictable
- The policy is applied in a fair and equitable manner

The Parramatta CBD study area is outlined in Figure 1 and extends from Boundary Street to the south and, crossing the Parramatta River to Isabella Street to the north.

PARRAMATTA CBD PLANNING REVIEW STUDY AREA

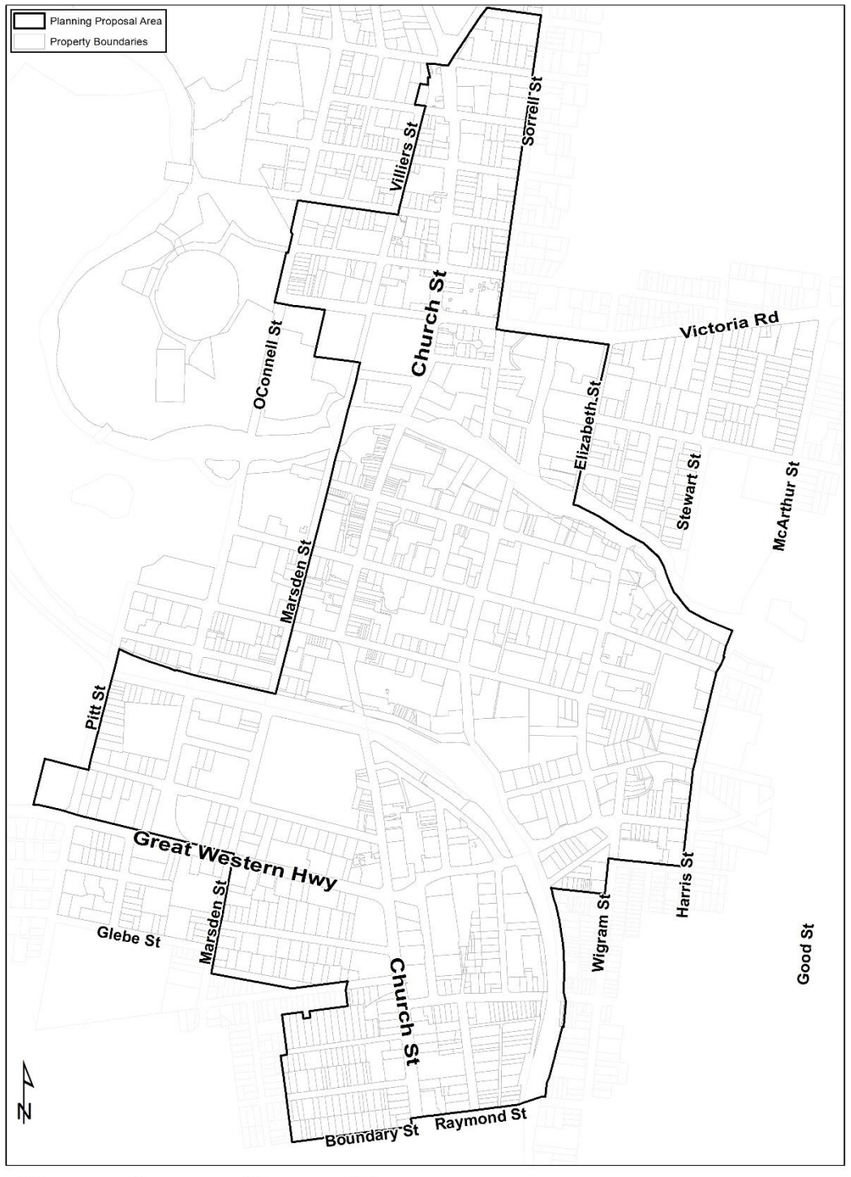


Figure 1: Parramatta CBD Planning Review Study Area boundary

OUR APPROACH

The aim of this study is to develop a set of environmental performance targets for sites with an FSR greater than 6:1 to be eligible for a 5% FSR bonus. Our testing approach was to develop these targets based on 'use' rather than 'zone'. That is, we have developed a new set of targets for residential use and carried forward our recommended targets for non-residential use from the February 2016 version of the study. For example, the residential targets would apply across an R4 (residential) zoned and the residential component of a B4 (mixed use) zoned site in Parramatta CBD provided the site has an FSR of 6:1 or higher. It should be noted that where relevant, we have incorporated the outcomes of the addendum prepared in July 2017 as part of this study.

The key steps in our approach to determine an appropriate environmental standard for new development in the Parramatta CBD include:

1. Understand the scale and value of 5% FSR bonus scheme in the Parramatta CBD

Kinesis has used the same land lift calculation as the previous version to understand the scale and value of FSR increase in the Parramatta CBD. Floor space analysis was undertaken to understand the range and scope of development that could be subject to a floor space bonus as well as the potential value of this increased floor space. This ensured that all environmental performance analysis was undertaken using realistic building typologies and parameters.

2. Environmental performance analysis across typologies

To develop an FSR bonus scheme based on BASIX targets, it is crucial to determine BASIX targets that are achievable and feasible. By analysing current construction trends in Sydney, Kinesis has understood that the level of BASIX achievable depends on the building height. As buildings get taller, centralised energy loads increase making it increasingly difficult to achieve higher BASIX scores. Furthermore, the cost of achieving higher BASIX scores increases with residential floorspace. This section explains how building characteristics, specifically, building height and FSR are key factors that influence BASIX targets.

3. Sustainability Pathway Modelling

Three sustainability pathways were analysed across building typologies with varying FSRs and building heights to understand the achievability and feasibility (impact and cost) of higher environmental performance standards. The analysis provides Council with a clear understanding of the range of environmental standards that could be delivered across various building heights in the Parramatta CBD. We also compared the associated costs of higher environmental performance to the floorspace uplift from the FSR bonus scheme to test the feasibility of the three pathways across the range of FSRs.

The expected capital cost and (as applicable) financial return was considered under the various environmental performance standard outcomes for the different building typologies.

4. Delivering sustainable commercial and other non-residential buildings

The National Construction Code has been recently revised. This section discusses our recommended mechanism to ensure high performance non-residential development via a 'best in market' standard for energy and water building performance.

CALCULATING THE VALUE OF THE INCREASED FLOOR SPACE

A floor space bonus is proposed for new residential development that meets higher BASIX targets. In order to determine whether the costs associated with improved development outcomes are of a magnitude that ensures the FSR bonus is taken up, the value of the floor space bonus must be determined. Several options can be used to calculate the value of a floor space bonus.

For the purpose of this analysis, the value of the increased floor space has been calculated based on a land lift calculation. Land lift calculates the additional value added to the land which is attributable to the increased floor space.

The increased floor space can be compared to creating new land and the value of this land can be calculated based on current land values. The lift in value is determined by multiplying the additional floor space by the "buildable rate". The buildable rate is the current land value divided by the floor area allowed by the current FSR.

Land Lift = ((Land Area x Land Value) / Base Floor Area) x New Additional Floor Area

Example:

- Land Area = 5,000 m2
- Base floor area under minimum FSR of 6:1 = 30,000 m2
- Current land value = $10,000 m2 of land
- Additional floor space under FSR Bonus = 1,500 m2
- Land lift = $15,000,000

Under this approach the additional financial benefit attributed to increased land value is attributed to Council and can be used to deliver improved performance outcomes while the additional financial benefit derived from the additional development (e.g. sale of apartments) flows through to the developer.

FLOORSPACE BONUS CASE STUDIES

Floorspace bonus schemes have been used to promote environmental performance and social outcomes in cities. Typically, cities capture between 50% and 100% of the land lift value from a Floorspace bonus scheme for use in the delivery of improved development, environmental or social outcomes. Local case studies of where environmental performance and social outcomes have been linked to development incentives and increased floor space is provided below.

CASE STUDY - LINKING ENVIRONMENTAL PERFORMANCE TO DEVELOPMENT INCENTIVES

Clause 4.4A of Bankstown Local Environmental Plan (LEP) 2015 provides for Floor Space Ratio (FSR) Bonus of 0.5 on the FSRs allowed under the Local Area Plan for the Bankstown CBD on the condition that they achieve the following environmental design standards:

Residential component of a building:

- Energy target is a minimum 10-point increase in the BASIX score compared to current requirements.
- Water target is a minimum BASIX 60.

Non-Residential component of a building:

- Energy target is a maximum 135 kg of CO2/m2 per year (equivalent to a 5-star NABERS rating for commercial buildings)
- Water target is a maximum 0.47 kL/m2 per year for office (equivalent to a 4.5-star NABERS rating for commercial buildings)

As the FSR Bonus will increase the size of new buildings this will lead to increased environmental impact, in terms of increased greenhouse gas emissions from energy consumption and increased water consumption. The environmental performance standards established by Council seek to offset the impact of the increased floor space so that buildings which receive the FSR Bonus have the same environmental performance as buildings which do not.

CASE STUDY - LINKING SOCIAL OUTCOMES TO DEVELOPMENT INCENTIVES

The State Environmental Planning Policy (Affordable Rental Housing) 2009 (AHSEPP) uses floorspace incentives to encourage investment in new affordable housing. The policy provides floorspace incentives for villa, townhouse and residential flat building development projects (in accessible locations and where these uses are already permitted) may be available for projects which include some affordable rental housing. Floorspace incentives may also be available for new generation boarding house developments.

The AHSEPP offers a floor space ratio (FSR) bonus ranging from a minimum of 0.2 :1 and up to 0.5 :1 (or 20%, whichever is greater provided between 20% and 50% of the gross floor area of the development is allocated to affordable housing and they are accessible by public transport[1].

Some local councils such as City of Sydney offer additional incentives to encourage the development of affordable housing. These may be offered through mechanisms such as negotiated planning agreements.

[1] NSW Department of Planning and Environment – Supporting infill affordable rental housing – State Environmental Planning Policy (Affordable Rental Housing https://www.planning.nsw.gov.au/-/media/Files/DPE/Factsheets-and-faqs/supporting-infill-affordable-rental-housing-2014-08.pdf?la=en

UNDERSTANDING THE VALUE OF FSR GROWTH

Floor space data was provided by the City of Parramatta to understand the range and scope of development that could be subject to higher environmental performance requirements or incentives. The proposed zoning that has obtained Gateway Determination from DPE is shown in Figure 2. Analysis of this data highlights the following:

- Sites eligible for the FSR bonus in the Parramatta CBD study area could cover cumulatively ~395,000 sqm.
- Council is proposing a 5% floor space bonus for residential, commercial and mixed-use lots under the planning controls of 6:1 or greater, which would deliver upwards of **118,000 m2** of additional floor space.
- Council is proposing no height limits within the CBD to attract A-Grade high density developments.

Based on recent acquisitions and developments, City of Parramatta advised that a value of $10,000 per m2 of land area can be assumed. Using the land lift calculation:

- The floor space bonus (if taken up across all 6:1 or greater FSR lots) can effectively deliver over **$1 billion of additional land value**.

Note: Kinesis is aware of a number of current development applications within the study area that exceed the proposed development controls and FSRs outlined here. Kinesis is not under the assumption that the land value will remain constant as FSR and building heights increase but has used the assumption of $10,000 per m2 of land area for the purpose of this report.

PROPOSED ZONING

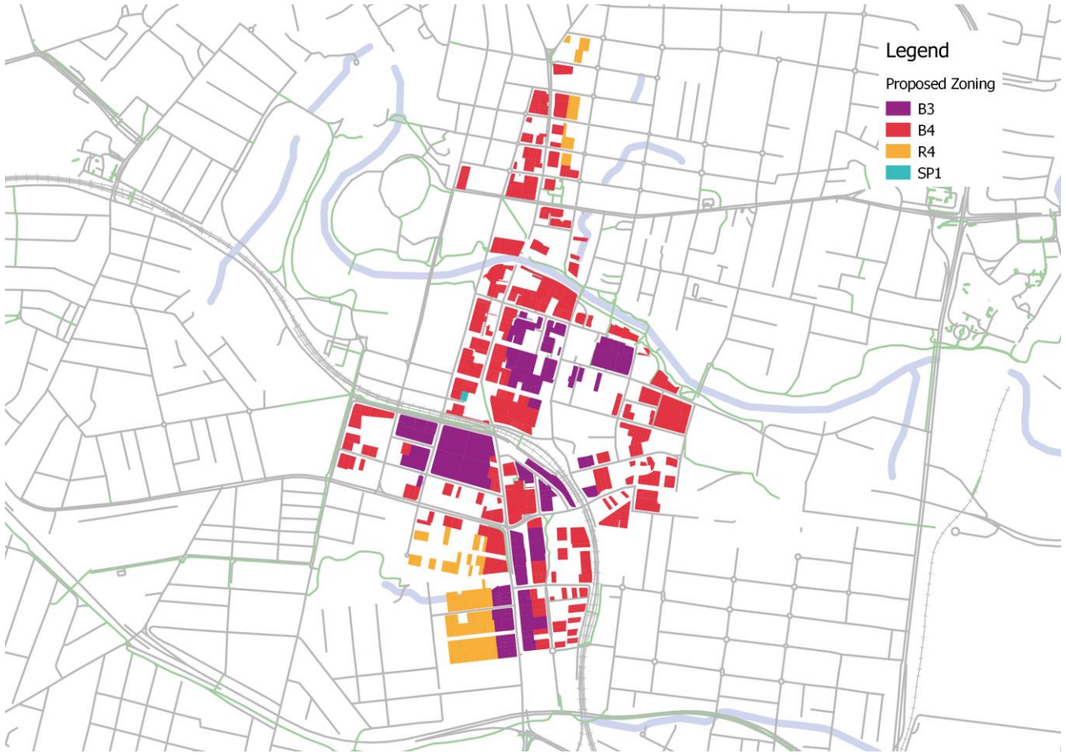


Figure 2: Proposed Zoning in Parramatta CBD

ENVIRONMENTAL PERFORMANCE ANALYSIS

Environmental performance analysis was undertaken across various Residential and Mixed-Use typologies ranging in height and FSR. We have revised our approach since the July 2017 study to consider both building height and FSR for three key reasons:

1. Higher BASIX scores are harder to achieve as building height increases

BASIX scores are harder to achieve as building height increases. Looking at current multi-unit building construction trends shown in Figure 3, as buildings get taller:

- Number of dwellings and common area plateaus
- Floorspace is instead used for non-residential purposes which increases centralised energy demands such as lifts

As such, on a per dwelling level, centralised energy demand increases. Hence the achievability of higher environmental performance decreases as buildings get taller.

2. Higher BASIX scores become less feasible as FSR increases

Council has proposed an equitable floorspace bonus scheme - By applying a standard 5% bonus on floorspace, the additional floorspace attainable is the same across all FSRs for a given site area.

However, the cost of achieving higher BASIX increases with the number of dwellings. As FSR increases, residential floorspace and the number of dwellings increases. Hence, the feasibility of higher environmental performance depends on the FSR.

3. Building height can vary significantly for a given FSR

Kinesis has explored the option of testing the environmental performance against just FSR. However, current construction trends suggest that building heights can vary significantly for a given FSR.

Figure 4 shows the relationship between building height and FSR for every multi-unit BASIX certificate. While there is a general increase in building height with FSR, the building height can vary significantly with each FSR. For example, at an FSR of 10:1, building heights can range between 10 storeys to 40 storeys.

RATE OF CHANGE IN BUILDING FLOORSPACE USE WITH BUILDING HEIGHT

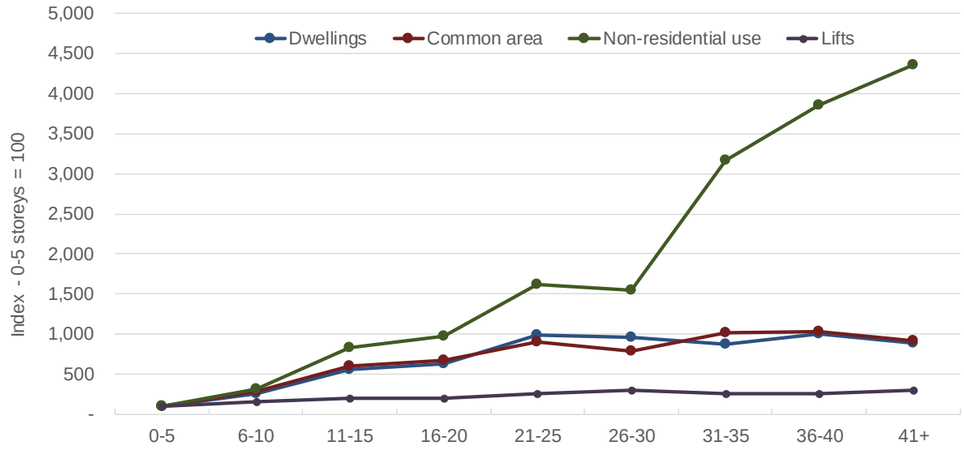


Figure 3: Rate of change in building's floorspace use with building height (Source: BASIX data)

RELATIONSHIP BETWEEN BUILDING HEIGHT AND FSR

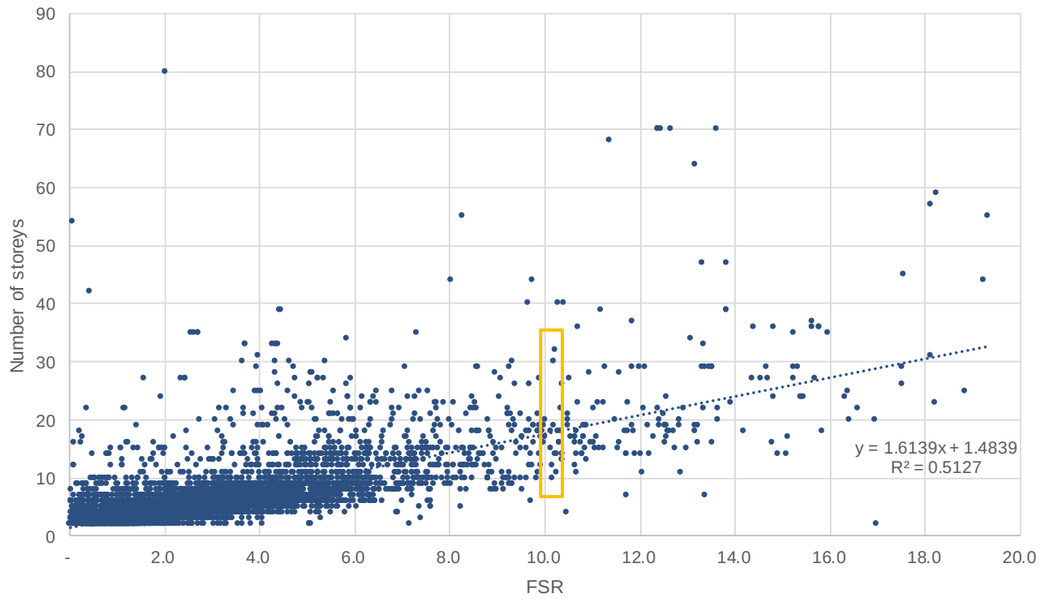


Figure 4: Relationship between building height and FSR (Source: BASIX data)

SUSTAINABILITY PATHWAY MODELLING

Kinesis has modelled three sustainability pathways across various building heights and FSRs to understand 2 things:

- **Achievability - What BASIX scores are achievable across different building heights**
- **Feasibility - Which pathways are cost-effective across different FSRs**

The three pathways modelled are summarised below and detailed technology descriptions are provided in Table 1. It should be noted that a connection to a recycled water system or a rainwater reuse system is considered under all three pathways.

- **Building Efficiency**
  The building efficiency pathway represents the most widely practiced method to achieve higher BASIX in apartments. It incorporates installing efficient appliances, efficient lighting and high thermal performance. Kinesis has chosen energy efficiency appliance ratings that deliver the best sustainability performance for the lowest cost. As the rating increases, the marginal cost for performance increases and the range of appliances available is limited.

- **On-site Renewables Pathway**
  Installing rooftop solar panels is the least cost pathway to achieve higher BASIX but it has a variety of barriers that make it less practical than the building efficiency pathway. This pathway also incorporates efficient lighting and high thermal efficiency as they are cost effective measures that are widely adopted in projects across Greater Sydney.

- **Building Efficiency + On-site Renewables Pathway**
  This is a combination of both pathways to maximise sustainability outcomes

Notes on scenario analysis:

- Results are generated by CCAP Precinct, a mathematical model of sustainability performance, and reflect the specific modelled performance of a new residential building in the Parramatta CBD climate zone.
- Standard Practice reflects the consumption of the average technology in the market place. Best Practice refers to appliances or fixtures within 1-star of the best available on the market.
- Analysis showed that, without recycled water, achieving higher BASIX Water scores on high rise developments was challenging due to the low roof space available for rainwater or stormwater collection and reuse.

PATHWAY TECHNOLOGY ASSUMPTIONS

	Building Efficiency	On-site Renewables	Building Efficiency + On-site Renewables
Dwellings			
NatHERS	6-star average	6-star average	6-star average
Hot Water	Centralised gas instantaneous with internal piping insulated with an R-value of 0.6	Centralised gas instantaneous with internal piping insulated with an R-value of 0.6	Centralised gas instantaneous with internal piping insulated with an R-value of 0.6
Space Heating & Cooling	5-star A/C (bedrooms only)	2-star A/C (bedrooms only)	5-star A/C (bedrooms only)
Lighting	Dedicated LED lighting	Dedicated LED lighting	Dedicated LED lighting
Solar	None	~30% of roof space and $7m^2$/panel	~30% of roof space and $7m^2$/panel
Appliances	3-star fridge, 4-star energy and 5-star water dishwasher, 4-star energy and 5-star water clothes washer, 6-star clothes dryer, electric oven and gas cooktop, indoor (or under-cover) clothes drying line	Fridge not specified, 2.5-star dishwasher (water & energy), clothes washer not specified, 2-star clothes dryer, electric oven and gas cooktop, indoor (or under-cover) clothes drying line	3-star fridge, 4-star energy and 5-star water dishwasher, 4-star energy and 5-star water clothes washer, 6-star clothes dryer, electric oven and gas cooktop, indoor (or under-cover) clothes drying line
Water Fixtures	4-star WELS toilet, 5-star WELS tapware, 3+-star WELS showerhead	4-star WELS toilet, 5-star WELS tapware, 3+-star WELS showerhead	4-star WELS toilet, 5-star WELS tapware, 3+-star WELS showerhead
Ventilation	Fans in laundry and bathroom with ducted exhaust and manual switch. Fan in kitchen not ducted with manual switch	Fans in laundry and bathroom with ducted exhaust and manual switch. Fan in kitchen not ducted with manual switch	Fans in laundry and bathroom with ducted exhaust and manual switch. Fan in kitchen not ducted with manual switch
Common area + Central Systems			
Underground carpark	LED lighting with time clock and motion sensors for carpark. Supply and exhaust ventilation with CO sensor and VSD fan installed	LED lighting with time clock and motion sensors for carpark. Supply and exhaust ventilation with CO sensor and VSD fan installed	LED lighting with time clock and motion sensors for carpark. Supply and exhaust ventilation with CO sensor and VSD fan installed
Lift	Gearless traction lift servicing the upper limit of storeys in the height band	Gearless traction lift servicing the upper limit of storeys in the height band	Gearless traction lift servicing the upper limit of storeys in the height band
Parking	0.6 spaces/dwelling + EV charging	0.6 spaces/dwelling + EV charging	0.6 spaces/dwelling + EV charging
Water reuse (Recycled Water or Rainwater 50L per dwelling tank)	Connected for irrigation, toilet and laundry	Connected for irrigation, toilet and laundry	Connected for irrigation, toilet and laundry
Parking	LED lighting with time clock and motion sensors for carpark. Supply and exhaust ventilation with CO sensor and VSD fan installed	LED lighting with time clock and motion sensors for carpark. Supply and exhaust ventilation with CO sensor and VSD fan installed	LED lighting with time clock and motion sensors for carpark. Supply and exhaust ventilation with CO sensor and VSD fan installed

Table 1: Pathway technology assumptions

DEVELOPING BASIX TARGETS BY BUILDING HEIGHT

BASIX in its current form in 2019, applies the following standard compliance targets for apartments of all building heights in Greater Sydney.

- **BASIX Energy 25**
- **BASIX Water 40**

Through our analysis, apartments of all building heights can achieve BASIX scores higher than these compliance standards. However, higher BASIX scores are harder to achieve as building height increases. As such, the BASIX targets at Parramatta CBD would vary by building height.

The three pathways were modelled across different building heights ranging from 5 storeys to over 40 storeys. Through the modelling, Kinesis identified four height bands between which the BASIX scores achievable from the pathways varied significantly. They can be summarised as:

- **5-15 storey**
  Can achieve high BASIX overcompliance

- **16-30 storey**
  A step change in centralised energy load decreases the level of BASIX overcompliance achievable

- **31-40 storeys**
  Limited roof space reduces the impact of on-site renewables on higher BASIX scores. Increased non-residential floorspace and associated centralised energy demand further decreases BASIX scores achievable through efficiency measures.

- **Beyond 40 storeys**
  Difficult to achieve BASIX overcompliance without efficiency measures and appropriate lift configuration*

The specific BASIX scores achievable under the three pathways for each of the 4 building height bands are outlined in Table 2.

***Note:** As buildings get taller they require more lifts. Typically buildings over 40 storeys have 4-5 lifts. These lifts need to be configured to service only some parts of the building to achieve just BASIX compliance.

For example, the proposed development at 2-10 Phillip Street in Parramatta is 55 storeys tall and has 4 lifts.

- If the lifts service all 55 storeys of the building it would not achieve BASIX Energy compliance (BASIX Energy 25).
- To achieve compliance, each lift services only certain floors of the building (45-47 floors each) and not the entire 55 storeys of the building.
- The development can achieve BASIX Energy 35 (overcompliance by 10 points) by implementing the building efficiency + on-site renewables pathway provided it follows a lift configuration that services only certain floors of the building (45-47 floors each).

BASIX PERFORMANCE UNDER THE THREE PATHWAYS BY BUILDING HEIGHT BAND

	On-site Renewables	Building Efficiency	Building Efficiency + On-site Renewables
5-15 storeys	+15 Energy, +15 Water	+15 Energy, +15 Water	+25 Energy, +15 Water
16-30 storeys	+10 Energy, +15 Water	+10 Energy, +15 Water	+20 Energy, +15 Water
31-40 storeys	Not enough roof space for energy overcompliance through solar PV, +15 Water	+10 Energy, +15 Water	+10 Energy, +15 Water
Greater than 40 storeys*	Not enough roof space for energy overcompliance through solar PV, +15 Water	+10 Energy, +15 Water	+10 Energy, +15 Water

Table 2: BASIX performance under the three pathways by building height band

Note on recycled water

- Recycled Water is the recommended mechanism under all three pathways to achieve higher BASIX Water scores.
- Alternatively, rainwater reuse can be used to achieve BASIX Water +15 overcompliance.
- At the scale of development expected for the CBD, the implementation of a precinct wide recycled water system would be most effective.
- The performance standards above incorporate a recommendation that dual reticulation is incorporated into residential buildings for both internal and external uses to enable recycled water in the future (see *Performance Standards for Future Proofing*).

TESTING THE FEASIBILITY OF THE PATHWAYS BY FSR

To maximise the utilisation of the floor space bonus scheme, it is important to ensure the benefits of the floor space bonus are of a magnitude that provides adequate incentive for developers to meet this enhanced standard. This was determined by comparing the land lift value to the expected capital cost of higher BASIX targets. **For the purposes of this analysis, feasibility is defined as instances where the land lift value exceeds the cost of implementing higher BASIX pathways.**

For a given site area, as the FSR increases:

- The 5% floorspace bonus results in the same land lift value
- The cost of implementing the pathways increases with number of dwellings or residential floorspace

Kinesis has considered a standard lot area and estimated the costs and the benefit under each of the pathways for all viable FSRs ranging from 6:1 to 16:1. The cost of implementing the pathways is however sensitive to:

- Appliance costs
- Number of dwellings

A comparison of land lift value and marginal cost of higher BASIX requirements is shown in Figure 5 highlighting:

- All three pathways are expected to cost less than the land lift value for FSRs of 6:1 up to 14:1.
- The Building Efficiency Pathway is feasible for FSRs 15:1 and 16:1

Note:

Given that the cost of the pathways vary based on appliance costs and number of dwellings, the feasibility of the pathways would need to be tested on a case by case basis by developers. This analysis simply provides a rule of thumb as to which pathways are feasible across different FSRs. As a minimum, the Building Efficiency pathway is feasible under all FSRs and the targets have been set accordingly. Key assumptions used in this analysis are outlined below.

Appliance Costs

We have obtained appliance costs from a range of retailers. Appliances with the same rated performance come in a range of prices depending on the brand and the retailer. Sometimes, the prices can deviate from the median price by over 20%. For example, a heap pump dryer can be priced anywhere between $630 to $1,600. Kinesis has collated the range of capital costs under all three pathways in Table 3. Our analysis has assumed the lower end of capital costs. This is reasonable as developers can negotiate large purchase agreements and realise cost efficiencies while implementing the pathways.

COST BENEFIT ANALYSIS OF PATHWAYS - LAND LIFT VALUE VS CAPITAL COSTS

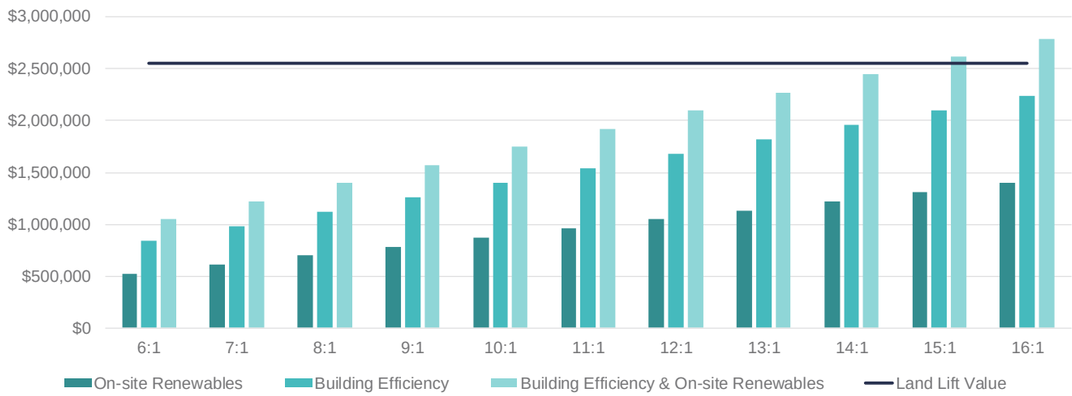


Figure 5: Land Lift Value compared to marginal cost of implementing the three sustainability pathways. While feasibility should be tested on a case-by-case basis, for this particular set of assumptions Land Lift Value is higher than all three pathways up to FSRs

	Building Efficiency	On-site Renewables	Building Efficiency + On-site Renewables
Capital Cost	**$4,000 - $4,700 / dwelling**	**$2,500 - $3,100 / dwelling**	**$6,500 - $7,800 / dwelling**

Table 3: Per dwelling capital cost for the three pathways

Number of dwellings

The cost of implementing the pathways scale with the number of dwellings whereas the land lift value from the FSR benefit does not. In this analysis, a “typical number of dwellings” has been estimated for each FSR. Through analysis of the BASIX certificates, we have estimated the average proportion of residential floorspace to total GFA in a building as 57% and average apartment sizes as 76 sqm. These have been used to estimate the typical number of dwellings for each FSR and is provided in Table 4.

FSR	6	7	8	9	10	11	12	13	14	15	16
Dwellings Estimate	227	265	302	340	378	416	454	491	529	567	605

Table 4: Estimate of number of dwellings by FSR

Other assumptions

- Standard lot area of 5,100 sqm across each FSR from 6:1 to 16:1
- Land value of $10,000 per sqm of land (land value estimate provided by City of Parramatta)

RECOMMENDED TARGETS BY FSR & HEIGHT BANDS

City of Parramatta have noted that the floor space bonus is available to residential and mixed-use developments in the CBD with a base FSR greater than 6:1.

However, the findings in this report have outlined that:

1. Achievability of higher BASIX depends on building height and
2. Sustainability pathways become less feasible as the FSR increases

Based on the modelled BASIX performance by building height band (Table 2) and the cost benefit analysis in Figure 5.

- Table 5 highlights the BASIX performance standards that are achievable for new residential and mixed-use development across the Parramatta CBD over and above 2019 BASIX compliance standards of BASIX Energy 25 and BASIX Water 40.
- Developers can achieve these targets by pursuing the Building Efficiency and On-site Renewables Pathway.
- While feasibility needs to be performed on a case-by-case basis, our analysis in this report has found that this combination pathway is feasible for FSRs up to 13:1. Beyond these FSRs, Building Efficiency by itself is feasible and will achieve the prescribed targets.

FSR	FSR 6:1 to 13:1	FSR 14:1 to 16:1
5-15 storeys	BASIX Energy +25, BASIX Water +15	BASIX Energy +15, BASIX Water +15
16-30 storeys	BASIX Energy +20, BASIX Water +15	BASIX Energy +10, BASIX Water +15
31-40 storeys	BASIX Energy +10, BASIX Water +15	BASIX Energy +10, BASIX Water +15
41+storeys	BASIX Energy +10, BASIX Water +15	BASIX Energy +10, BASIX Water +15

Table 5: BASIX performance targets by building height band and FSR band

Please note that these higher BASIX targets are over and above 2019 BASIX compliance standards of BASIX Energy 25 and BASIX Water 40. They may be subject to review following changes to the BASIX SEPP policy by the NSW government.

Two examples,

1. A developer intending to build a 20-storey residential development with a 10:1 FSR in Parramatta CBD would need to achieve BASIX Energy +20 and BASIX Water +15 over current BASIX compliance requirements of BASIX Energy 25 and BASIX Water 40.

2. A developer intending to build a 55-storey residential development with a 15:1 FSR in Parramatta CBD would need to achieve BASIX Energy +10 and BASIX Water +15 over current BASIX compliance requirements of BASIX Energy 25 and BASIX Water 40.

Note: Buildings with high FSR (14:1 to 16:1) and low building height (5-15 storeys)
The prescribed targets by discrete building height bands have been developed by observing consistent sustainability performance across building heights within each of the height bands – 5-15 storeys, 16-30 storeys, 31-40 storeys and 40+ storeys.

It is not intuitive that buildings with high FSR (14:1 to 16:1) can be short, i.e., it is not intuitive that buildings can have an FSR greater than 14:1 and be 5-15 storeys. It is however important to note that height bands are large enough that, while it is unlikely for buildings with high FSRs to be 5 storeys, it is possible that they can be 15 storeys.

The findings in this report have outlined that:

1. Achievability of higher BASIX depends on building height and
2. Sustainability pathways become less feasible as the FSR increases

As such,

1. Short buildings (5-15 storeys) can achieve higher BASIX scores of BASIX Energy +25 and BASIX Water +15 from the Building Efficiency & On-Site Renewables Pathway,
2. But at large FSRs, only the Building Efficiency pathway is feasible, limiting the target to BASIX Energy +15 and BASIX Water +15

DELIVERING SUSTAINABLE NON-RESIDENTIAL BUILDINGS

The City of Parramatta is taking steps to deliver a sustainable CBD. In addition to sustainable residential development, the City is also investigating best practice standards for commercial and other non-residential buildings.

DELIVERING SUSTAINABLE COMMERCIAL OFFICE, RETAIL AND HOTEL BUILDINGS

In 2016, Kinesis recommended the following targets:

Office

- **Energy (base building and tenancy) -** 140 kgCO2-e/m2/yr (equivalent to approximately NABERS Energy 5-star)
- **Water (base building and tenancy) -** 0.65 kL/m2/yr (equivalent to approximately NABERS Water 4-star)

Retail

- **Energy (base building only**) - 100 kgCO2-e/m2/yr (Approximately equivalent to 5-Star NABERS)_
- **Water (base building only)** - 0.95 kL/m2/yr (Approximately equivalent to 4-Star NABERS)

These recommendations no longer remain valid as the National Construction Code (NCC) was updated in May 2019 to targets higher than those proposed in 2016.

Under the revised NCC, non-residential development such as; new commercial and other non-residential buildings have a choice between two mechanisms to achieve building code compliance being:

1. NABERS Energy for Office - A minimum 5.5-star NABERS Energy for Office Base Building Commitment Agreement is obtained along with satisfying additional conditions as outlined in Section JV1 and JVa of the NCC.
2. Green Star - An alternative compliance pathway is for commercial and other non-residential buildings to be registered for a Green Star – Design & As-Built rating. Under this pathway, the proposed building needs to only demonstrate that its annual greenhouse gas emissions are less than 90% of the reference building - a hypothetical building to calculate the maximum allowable greenhouse gas emissions.

Aligning the CBD planning proposal with a particular NCC pathway is not supported due to potential inconsistencies with commitments made by the NSW Government under the Australian Building Codes Board Intergovernmental Agreement.

Therefore, to ensure that the CBD meets its 'high building performance' objectives, Kinesis recommends taking the following 'best-in-market' approach for all non-residential development, including; retail premises (including as part of a mixed-use development), office premises, hotel or motel accommodation or serviced apartments:

- annual energy (base building) performance to be within the top 15% of the performance of similar existing buildings of a similar usage type in the Sydney metropolitan region, benchmarked on an emission (CO2e/m2) basis at the time of application, and
- the annual water (whole building) consumption to be within the top 15% of the performance of similar existing buildings of a similar usage type in the Sydney metropolitan region, benchmarked on a net water demand (l/m2) basis at the time of application.

The rationale for this approach is as follows:

- The 15th percentile of current market performance is used to derive city specific emission intensity benchmarks for low carbon buildings under the International Climate Bond Standard.
- Since the introduction of the method in 2015, the process has been used to establish baselines for cities including New York, San Francisco, Singapore, Tokyo, Seoul, London and through extension, Paris, Berlin, Warsaw, Prague, São Palao, etc.
- The method is used by Climate Bonds to establish a baseline performance from which a city specific zero carbon trajectory to 2050 is applied to ensure the targets are in-line with the requirements of the Paris agreement.
- The Climate Bond method has been extensively tested and proven to be robust. Most recently in Australia it was used to establish the target used by Woolworths in their green bond for supermarkets https://www.climatebonds.net/certification/woolworths
- Applying the same 'best-in-market' test within the LEP will ensure that targets for new buildings improve over time and do not get outdated as is inevitable if a static target is published in the LEP.
- The use of a 'best-in-market' calibration on new development target will ensure the targets represent genuine best practice, are achievable and not cost prohibitive, given that 15% of the existing buildings of the relevant type in the Sydney metropolitan area will already be operating at the required level of performance at the time of application.

The proposed methodology to determine 'best in market' targets is as follows:

1. Determine the current operating performance of buildings in the given asset class for energy and water in the Sydney metropolitan region.

   (i) Data for annual emissions and water usage for offices, hotels and shopping centres is published by NABERS, a national government program, administered by the NSW Department of Planning, Industry and Environment.

   Link to data set https://www.nabers.gov.au/ratings/find-a-current-rating Data is in Excel format.

   (ii) Additionally, the federal government publish annual emissions intensity for all offices under the CBD (Commercial Building Disclosure) Program. This is being expanded to include hotels.

   Link to data set http://cbd.gov.au/registers/cbd-downloadable-data-set Data is in Excel format.

The 15th percentile of best performance for emission intensity or water is able to be calculated through the inbuilt Excel formula, or by sorting the records by emissions intensity and determine the 15th percentile by manual count. [See diagram below].

This above process can be undertaken by each applicant or could be undertaken once per year by Council and published.

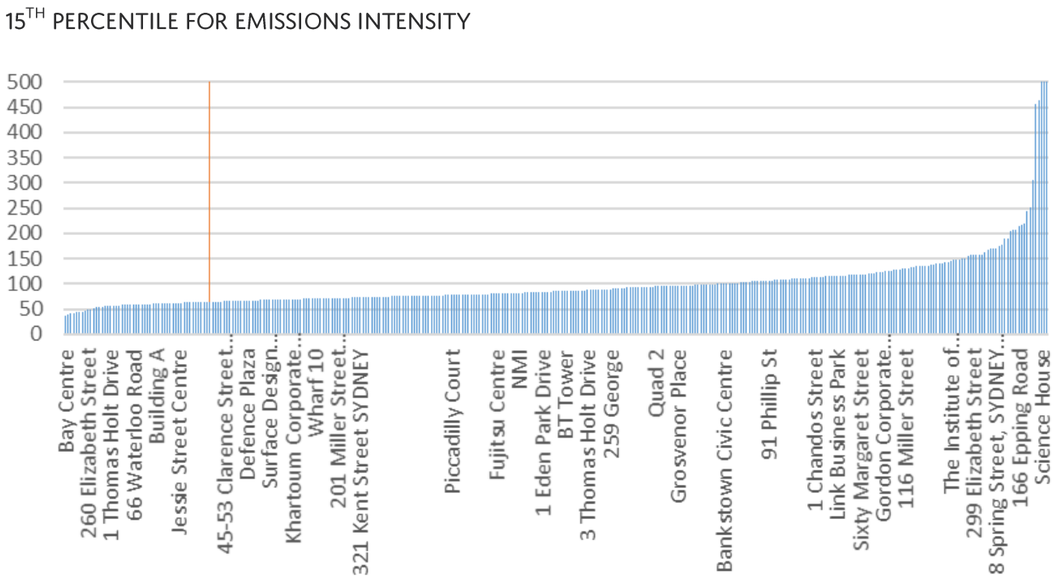


Figure 6: 15th percentile for emissions intensity (record 52 of 438 in OEH data set retrieved 4 Oct 2019] – Target =64kgCO2/m2 NLA (no green power)

PERFORMANCE STANDARDS FOR FUTURE PROOFING

DUAL RETICULATION

Environmental performance targets outlined in the previous section provide a performance outcome to ensure new development contributes towards a reduction in energy consumption, greenhouse gas emissions and water consumption consistent with what is allowable under NSW planning and building controls. This analysis has shown that:

- As building height increases, the impact of rainwater reuse decreases due to the lower roof area available for rainwater collection and increased demand.
- Because of this, without recycled water, achieving BASIX Water 60 on high rise developments was unachievable.

Given the 30-100 year life of new buildings, it would be considered prudent that new development is designed to accommodate future district water or energy infrastructure and emerging technologies, to future proof their owners and tenants against a rapidly changing utility services environment.

For example, a district recycled water scheme is proposed at the Parramatta Square development. It is also possible to extend the current water recycling scheme at Rosehill or alternative water recycling providers to be established within the Parramatta CBD. With these systems in place, and to ensure future buildings can connect to this opportunity, dual reticulation is required at building construction.

Dual reticulation has been estimated at $1,000 per apartment (or $10 per m2) including piping and metering requirements. Given a large part of this cost is metering, this cost is expected to be less for commercial buildings. This requirement could deliver significant future environmental performance outcomes. It is estimated that residential buildings with recycled water for irrigation, toilet flushing and laundry would achieve a BASIX Water target 55 (+15 on current compliance).

Based on this, it is recommended that all new buildings incorporate dual reticulation for recycled water for both internal and external uses. Such a requirement would significantly enhance the business case for a recycled water scheme extending through the CBD.

OTHER FUTURE PROOFING STRATEGIES

In addition to dual reticulation, City of Parramatta should consider encouraging other future proofing strategies that respond to future technologies and address existing future challenges as the Parramatta CBD grows and develops:

- **EV Charging Bays** - 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.

- **Battery Storage Ready**- With the cost of batteries expected to decrease rapidly it is considered desirable to build the future capacity so the Parramatta CBD can have a dispersed capability of battery capacity to manage energy demands, solar PV generation and significantly reduce peak electricity demands and growing infrastructure requirements. This would be assisted by the following:

  1. Each residence being allocated a virtual 5-10 KWh battery capacity.
  2. 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.

- **Addressing Urban Heat Island**
  New development in the CBD is likely to result in a 2-3 fold increase in vertical surfaces (facades) compared to horizontal surfaces (roofs). This growth in vertical surfaces will lead to an increase in solar reflection, particularly from glazed façade buildings, into the public domain, and thereby contribute to increasing Parramatta's urban heat.

  While existing building regulations focus on regulating the solar impact on the 'internal' building environment, new development controls are required to specifically address the impact of the building on the 'external' environment (street and public domain). New urban heat island development controls are required to ensure that as the City grows, the City and buildings are designed to in ways that do not further exacerbate the problem, but assist to reduce the urban heat effect. Accordingly, controls in the following areas should be introduced and or strengthened to support the reduction in urban heat:

  – reflectivity of building roofs, podiums and facades
  – heat rejection sources, systems, and locations
  – encouraging laminar wind flows
  – vegetation and street trees for shade and cooling through evapotranspiration
  – water sensitive urban design, irrigation, water features and the retention of water and moisture
  – cool materials and climate adapted building design

- **Planning for autonomous vehicles** – with the emergence of autonomous or self-driving vehicles, the requirement for on-site parking will be significantly reduced. Studies predict that within 25 to 30 years, automated vehicles will reduce the need for on-site parking requirements, effectively reducing the need and therefore the value of parking. In this scenario, underground parking will have limited value and developments that incorporate reduced parking or decoupled, above ground parking that can be repurposed for other commercial or residential uses in the future should be encouraged.

FINDINGS OF THIS STUDY

Council's CBD Planning Proposal has received the Gateway Determination from the DPE and is pending public exhibition. We believe that the findings from this revised study demonstrate that sites with an FSR greater than 6:1 are suitable for the intended 5% FSR high performing buildings bonus extending the sustainability impact Council can have in the CBD.

In summary, this study's findings and recommendations are:

Residential

1. Residential developments that have an FSR of 6:1 and higher are eligible for a 5% floorspace bonus provided they achieve the BASIX overcompliance targets corresponding to their building height and FSR as outlined below:

	FSR 6:1 to 13:1	FSR 14:1 to 16:1
5-15 storeys	BASIX Energy +25, BASIX Water +15	BASIX Energy +15, BASIX Water +15
16-30 storeys	BASIX Energy +20, BASIX Water +15	BASIX Energy +10, BASIX Water +15
31-40 storeys	BASIX Energy +10, BASIX Water +15	BASIX Energy +10, BASIX Water +15
41+storeys	BASIX Energy +10, BASIX Water +15	BASIX Energy +10, BASIX Water +15

   It should be noted that these higher BASIX targets are over and above 2019 BASIX compliance standards of BASIX Energy 25 and BASIX Water 40. These targets may be subject to review following changes to the BASIX SEPP policy by the NSW government.

2. The environmental performance targets developed are equitable across building typologies and can be achieved through a combination of currently practiced building efficiency measures and rooftop solar PV. The floorspace bonus scheme along with the suggested future proofing strategies has the potential to attract A-Grade development, ensure resource and infrastructure efficiency and future proof the city for emerging technologies and investment. The impact of the FSR bonus scheme can be monitored through the Kinesis Platform *(See Next Steps).*

Non-residential

3. Kinesis recommends taking the following 'best-in-market' approach for all non-residential development, including; retail premises (including as part of a mixed-use development), office premises, hotel or motel accommodation or serviced apartments:

   - annual energy (base building) performance to be within the top 15% of the performance of similar existing buildings of a similar usage type in the Sydney metropolitan region, benchmarked on an emission (CO_2e/m^2) basis at the time of application, and
   - the annual water (whole building) consumption to be within the top 15% of the performance of similar existing buildings of a similar usage type in the Sydney metropolitan region, benchmarked on a net water demand (l/m^2) basis at the time of application.

   Applying the 'best-in-market' approach within the LEP will ensure that targets for new buildings improve over time and do not get outdated as is inevitable if a static target is published in the LEP.

   The use of a 'best-in-market' calibration on new development target will ensure the targets represent genuine best practice, are achievable and not cost prohibitive, given that 15% of the existing buildings of the relevant type in the Sydney metropolitan area will already be operating at the required level of performance at the time of application.

Future proofing

4. Given the 30 to 100 year life span of new development in the CBD, dual reticulation in all new development would significantly improve the business case for recycled water and further drive high performance outcomes for the city. The prescribed BASIX Water +15 targets for residential developments can be achieved through recycled water use.

5. Additional design requirement measures including, EV charging bays, battery storage capability, green walls and lower parking rates should be in place to ensure the CBD is future proofed.

NEXT STEPS

Two key steps can help Council deliver a CBD that becomes increasingly sustainable through data driven programs monitored using the Kinesis Platform. The City of Parramatta has licensed the platform to monitor city-wide sustainability performance, and can extend this platform to track and monitor the success and value of the High Performance Building clauses.

A. MONITOR THE IMPACT OF THE FLOORSPACE BONUS SCHEME

The floorspace bonus targets developed in this study have been informed through sustainability interventions practiced today. With rapid advancements in building efficiency and solar PV technologies, the interventions and the prescribed targets need to be continually monitored and revised to maximise sustainability in the CBD. Council can create programs that track and monitor the pathways and their performance to achieve increased sustainability in mixed use and residential developments in the CBD.

As an example, the City of Sydney's Smart Green Apartments program is aimed at increasing the energy and water efficiency of multi-unit buildings. The City uses the Kinesis Platform to track the impact of this program and assess the pathways implemented across individual buildings in the program.

B. ENGAGE WITH INDUSTRY TO IMPROVE COMMERCIAL BUILDINGS

This study has identified an opportunity to improve the performance of existing commercial buildings in Parramatta. The City of Parramatta can engage with the industry through programs such as the Better Building Partnership (BBP). This will enable Council to improve sustainability standards across existing commercial buildings.

Council can use the Kinesis' platform as a mechanism to track the implementation and demonstrate the value of the High-Performance Building clauses. For example, Figure 7 shows a screenshot of City of Sydney's Kinesis Platform to spatially analyse emissions of buildings registered under the Better Building Partnership. Figure 8 shows the impact of the program - the Platform has registered a steady decline in energy consumption of Better Building Partnership members, demonstrating the success and value of the program sought by the City and their members.

KINESIS PLATFORM - SPATIAL MONITORING OF EMISSIONS PERFORMANCE OF BBP BUILDINGS

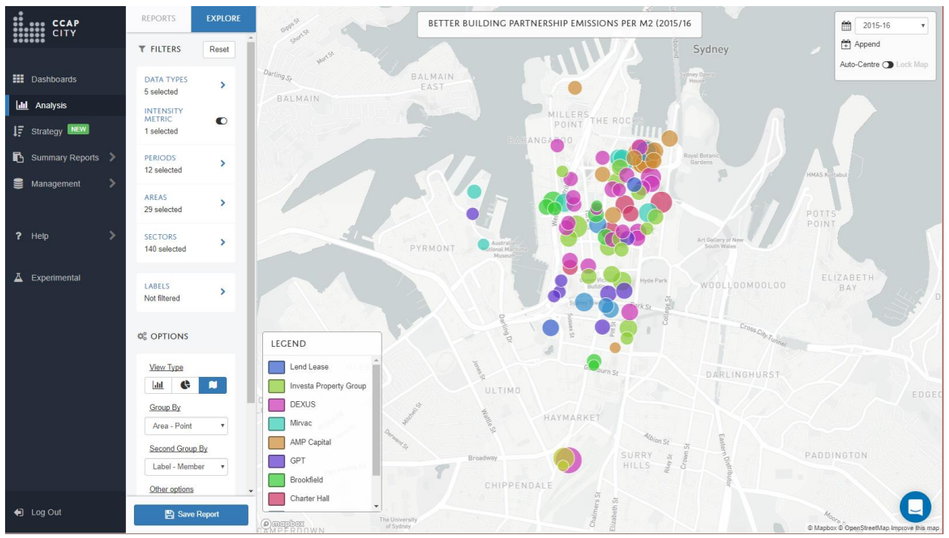


Figure 7: Use of the Kinesis Platform for spatial monitoring of emissions performance of BBP buildings.

KINESIS PLATFORM – TRACKING ENERGY PERFORMANCE OF BBP BUILDINGS

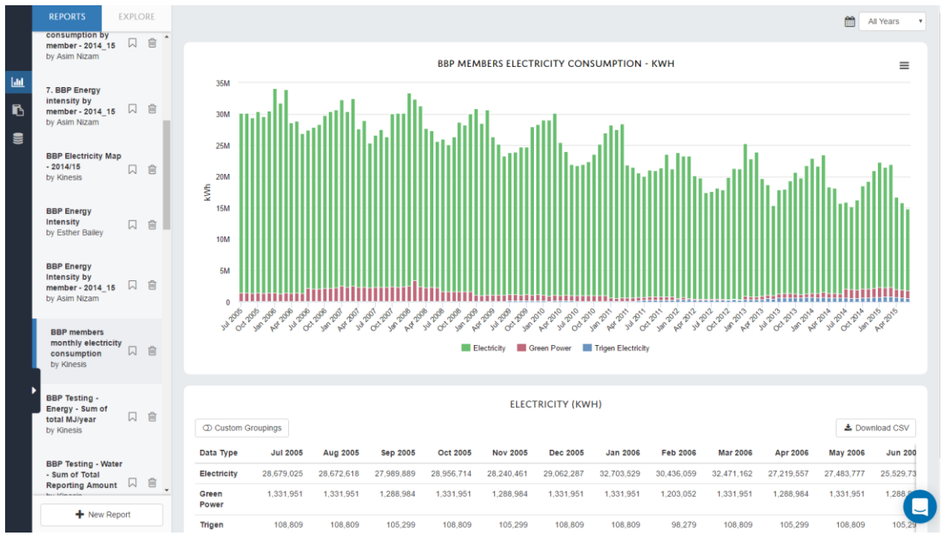


Figure 8: Use of the Kinesis Platform to track the energy performance of BBP buildings.

AMENDMENTS TO DRAFT LEP PROVISIONS

Based on our analysis and findings, we have drafted the following clauses for the LEP provisions.

– ***Clause 7.6AA High Performing Buildings*** and
– ***Clause 7.6B Dual water system***

7.6A High performing buildings

(1) The objectives of this clause are as follows:
(a) to encourage high performing building design (namely the built form, layout and services) of office premises, large-scale retail premises, hotel or motel accommodation, serviced apartments, residential flat buildings and mixed-use development in the Parramatta City Centre that minimises the consumption of energy and water, and
(b) to provide increased amenity to occupants over the long term, and
(c) to ensure the increase in gross floor area is compatible with surrounding buildings in terms of bulk, height and amenity.

(2) This clause applies to:
(a) development for the purposes of office premises with a gross floor area of 1,250 square metres or greater; or
(b) development for the purposes of retail premises with a gross floor area of 5,000 square metres or greater; or
(c) development for the purposes of serviced apartments or hotel or motel accommodation; or
(d) development for the purposes of residential flat buildings and mixed-use development, but only where:
(i) the lot on which the development will be sited is at least 24 metres wide at the front building line and has a minimum site area of at least 1,800 square metres, and
(ii) the lot on which the development will be sited has a maximum floor space ratio of at least 6:1, as shown on either the Floor Space Ratio Map or Incentive Floor Space Ratio Map (as applicable to the development), and
(iii) the applicant for the development has chosen to develop their building utilising this clause; or
(e) significant alterations and additions (that have a capital value of more than $5 million) to existing retail premises (with a gross floor area of 5,000 square metres or greater), office premises, hotel or motel accommodation or serviced apartments.

(3) Before granting development consent to development under this clause, the consent authority must be satisfied that:

(a) The part of any building used for the purposes of retail premises (including as part of a mixed-use development), office premises, hotel or motel accommodation or serviced apartments complies with the following standards:

(i) the annual energy (base building) performance is within the top 15% of the performance of similar existing buildings of a similar usage type in the Sydney metropolitan region, benchmarked on an emissions (CO_2e/m^2) basis at the time of application, and
(ii) the annual water (whole building) consumption is within the top 15% of the performance of similar existing buildings of a similar usage type in the Sydney metropolitan region, benchmarked on a net water demand (l/m^2) basis at the time of application, and
(iii) a report prepared by a qualified consultant to the satisfaction of the Council verifies that:
a. the necessary annual emissions intensity and water performance targets to meet the requirements under this subclause at the time of application have been established and confirmed, and
b. the building will meet the annual energy and annual water performance targets established under this subclause, has adequate allowance (including budget) in the design of the building and its services to meet these targets, and is committed to a post occupancy verification against the targets.

(4) The part of any building that is a dwelling, including as a part of a residential flat building or mixed use development, complies with the following higher BASIX Energy and BASIX Water standards (shown Column 2) than the minimum standards as provided in *State Environmental Planning Policy (Building Sustainability Index: BASIX) 2004*, which correspond to the height of the building (shown in Column 1) and its floor space ratio (also shown in Column 2), as indicated in the table to this subclause.

Building Height	Higher BASIX Energy and Water Standards		
	BASIX standard	Points above minimum BASIX standard for development with a floor space ratio of 6:1 or greater, up to, but not including, 14:1	Points above minimum BASIX standard for development with a floor space ratio of 14:1 or greater
5-15 storeys	Energy	+25	+15
	Water	+15	+15
16-30 storeys	Energy	+20	+10
	Water	+15	+15
31-40 storeys	Energy	+10	+10
	Water	+15	+15
41+ storeys	Energy	+10	+10
	Water	+15	+15

Note. These higher BASIX standards may be subject to review following changes to the *State Environmental Planning Policy (Building Sustainability Index: BASIX) 2004* by the NSW Government.

(5) A residential flat building or a mixed use development (that contains dwellings) which complies with this clause is eligible for an amount of additional residential floor space (above that already permitted elsewhere under this Plan) equivalent to that which exceeds the floor space ratio as shown on the Floor Space Ratio Map or Incentive Floor Ratio Map (as applicable to that development) by up to 5%, subject to the consent authority being satisfied that this additional residential floor space does not adversely impact on neighbouring and adjoining land in terms of visual bulk and overshadowing.

(6) This clause does not apply to land on which development to which clause 13 of *State Environmental Planning Policy (Affordable Rental Housing) 2009* applies is to be carried out.

(7) In this clause:

BASIX means a rating under *State Environmental Planning Policy (Building Sustainability Index: BASIX) 2004*.

mixed use development means a building or place comprising two or more different land uses, where at least one of these land uses is dwellings.

Clause 7.6B dual water systems

(1) The objective of this clause is to future proof the security of water supply in the Parramatta City Centre.

(2) This clause applies to the Parramatta City Centre, but not including “Area 6” on the Special Provisions Area Map.

(3) The consent authority must not grant consent to development involving the construction of a new building or significant alterations to an existing building unless that building contains both potable water pipes and recycled water pipes for the purposes of all available internal and external water uses.

KEY ASSSUMPTIONS

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	19.98 km per person/day

Tariffs and rates

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

Residential Water	**Rate**	**Unit**
Mains tariff	2.232	$/kL
Recycled water tariff	2.068	$/kL
Service charge per dwelling	765	$/yr
Recycled water service charge	0	$/yr

Residential Grid Electricity	**Rate**	**Unit**
Applied tariff	0.2514	$/kWh
Solar feed-in tariff	0.06	$/kWh
Service charge per dwelling	289.16	$/yr

Residential Gas	**Rate**	**Unit**
Gas (first 3,775 MJ per qtr/remaining)	0.041/0.023	$/MJ
Service charge per dwelling	207	$/yr

Residential Transport	**Rate**	**Unit**
Fuel	1.50	$/L
Annual capital costs (devaluation)	6,642	$/yr
Annual registration/insurance	2,172	$/yr

Floor Space Data

Floor space used in this study is based on the estimated GFA of existing, current controls and proposed controls outlined in the Kinesis *Parramatta CBD Planning Review Sustainability and Infrastructure Study.*

In addition, Parramatta Council provided floor space under the proposed controls for developable lots within the Parramatta CBD.

KEY DATA SOURCES

- 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.
- Sydney Water (2009) Rouse Hill 15 minute and daily demand profiles (Kinesis request, unpublished)
- Department of Resources, Energy and Tourism, 2010, Energy in Australia – 2010, ABARE, Canberra
- Kinesis 2014, Additional water end use breakdowns derived from first principle analysis of residential and non-residential building types.
- National Water Commission, 2011, National performance report 2009-2010: urban water utilities, National Water Commission, Canberra
- NSW Department of Planning, BASIX Residential Water Consumption Data (2010)
- Sydney Water Best Practice Guidelines for water conservation in commercial office buildings and shopping centres (2007), http://www.sydneywater.com.au/web/groups/publicwebcontent/documents/document/zgrf/mdu0/~edisp/dd_054580.pdf
- Sydney Water Best Practice Guidelines for holistic open space turf management (2011), www.sydneywater.com.au/web/groups/publicwebcontent/documents/document/zgrf/mdq1/~edisp/dd_045253.pdf
- Water Corporation. (2014). Mapping water use at school. from https://www.watercorporation.com.au/home/teachers/lesson-plans-and-teaching-resources/lesson-plan-search/lesson-plan/?id=%7BD9516524-4A2C-4B98-A113-3891D59F1AAA%7D
- Department of Resources, Energy and Tourism, 2010, Energy in Australia – 2010, ABARE, Canberra
- Department of Infrastructure and Transport, 2011, Road vehicle kilometres travelled: estimations from state and territory fuel sales, Australian Government, Canberra
- Department of the Environment, 2014, National Greenhouse Accounts Factors, http://www.environment.gov.au/system/files/resources/b24f8db4-e55a-4deb-a0b3-32cf763a5dab/files/national-greenhouse-accounts-factors-2014.pdf
- Energy Use in the Australian Residential Sector, 1986 – 2020, Australian Government Department of the Environment, Water, Heritage and the Arts (DEHWA), 2008.
- Energy Efficient Strategies (2009), Appliance Energy Consumption in Australia: Equations for Appliance Star Ratings
- Building Code of Australia (2007) Energy Efficiency Requirements in Commercial Buildings
- Transport Data Centre (2006) The Development of a Sydney VKT Regression Model
- ABS (2010) 'Household Expenditure Survey, Australia: Summary of Results', catalogue number 65300DO001_200910, Australian Bureau of Statistics, Canberra.