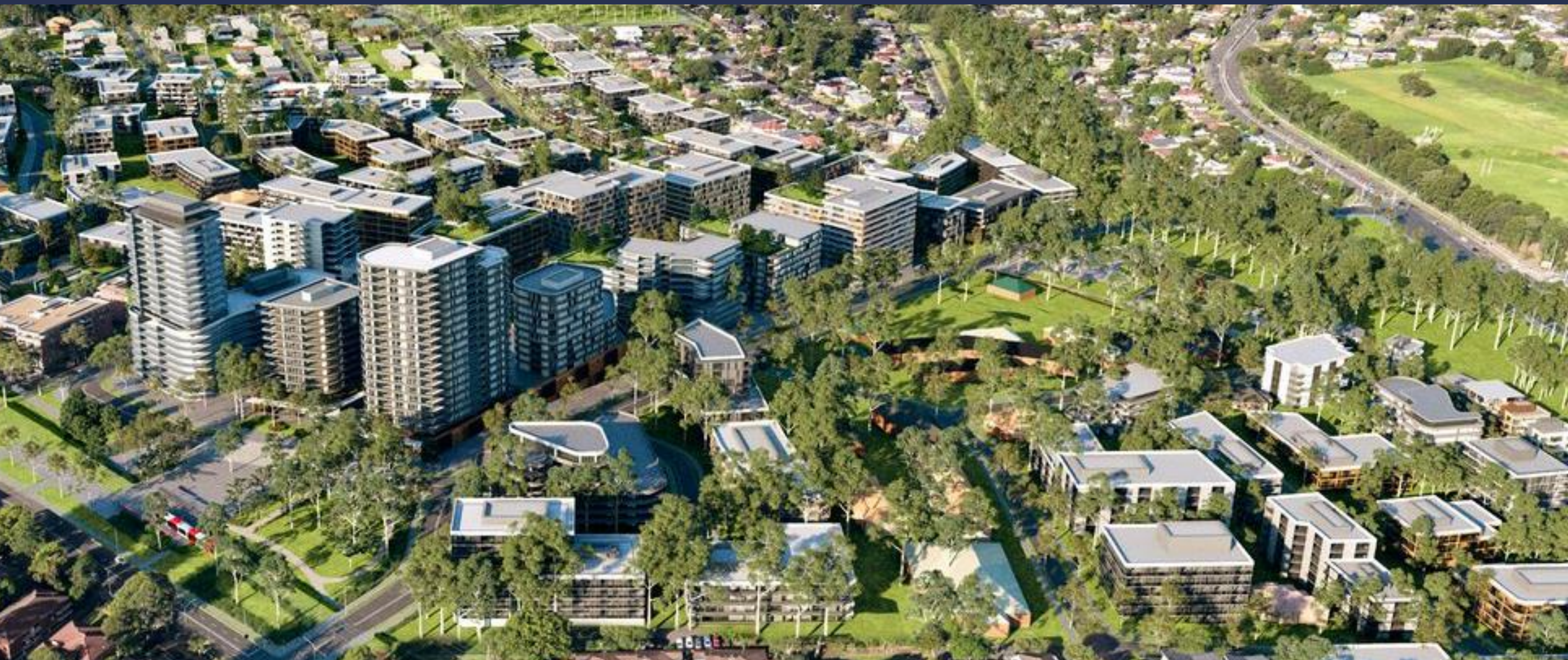


GREATER PARRAMATTA URBAN RENEWAL AREA

INCREASING BASIX STUDY

PREPARED BY KINESIS FOR THE CITY OF PARRAMATTA COUNCIL

OCTOBER 2020





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.

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EXECUTIVE SUMMARY

PURPOSE

The purpose of this report is to investigate the potential for higher BASIX targets for new residential development across the Parramatta local government area.

This report provides both an evidence base for higher BASIX targets, as well as an appropriate cost-benefit analysis for determining the appropriateness of the higher BASIX targets recommended for the Parramatta Local Government Area.

SUMMARY OF FINDINGS

This report has found the following in relation to increasing BASIX targets for new residential development across the Parramatta Local Government Area:

- There is a significant potential to increase BASIX energy targets today, with new single dwellings able to achieve close to net zero emissions or BASIX 100. Significant on-site solar PV is required to achieve these high BASIX energy targets.
- There is a moderate potential to increase BASIX water targets through improved efficiency and moderate increases in rainwater tanks. Without recycled water, the maximum water target that can be achieved is BASIX Water 50. With recycled water, BASIX Water 65 can be achieved for all dwelling typologies.
- BASIX target increases will need to differentiate between both dwelling typologies (single dwellings and apartments) as well as building height, with low rise development more able to achieve higher BASIX targets than high rise development.
- Targets should consider an “all-electric” development typology as a means of future proofing new residential development, moving away from gas as a fossil fuel to 100% renewable energy.
- Single dwellings in particular are able to achieve close to net zero emissions outcomes. Apartments, on the other hand, are unable to achieve zero emissions outcomes onsite, requiring offsets or off-site renewable energy to achieve net zero emissions.

RECOMMENDATIONS

Kinesis developed pathways to higher environmental performance outcomes that reflected the typologies that are being built in Parramatta, technologies and strategies that are already being used by developers today and the relative cost of implementing those technologies/ strategies. Based on this pathway analysis, Kinesis recommends the following higher BASIX targets for new residential development across the Parramatta LGA:

Single dwellings and townhouses:

- BASIX Energy 90 and BASIX Water 50

Apartments:

- BASIX Energy 50 and BASIX Water 50 (<14 storeys)
- BASIX Energy 40 and BASIX Water 50 (15 - 29 storeys)
- BASIX Energy 35 and BASIX Water 50 (30 - 39 storeys)
- BASIX Energy 30 and BASIX Water 50 (40+ storeys)

The recommended BASIX energy targets are built off pathways that require solar PV thus increasing the case for all electric (no gas) new development. In addition to the above targets, BASIX Water 65 should be pursued where recycled water is available for connection and use.

The cost-benefit outcomes, water and emissions reductions and corresponding BASIX scores are summarised in Table 1 and 2.

NEXT STEPS

The City of Parramatta Council should work with DPIE to urgently increase BASIX targets as outlined in this report in order to ensure the significant amount of residential development is delivered with best practice environment performance, and action on both climate change and water reductions are achieved. As part of any BASIX increase, the City of Parramatta Council should ensure frequent review and updates of higher performance targets to progressively move new residential development towards net zero emissions housing.

Any delay in increasing BASIX targets for the LGA would see tens of thousands of dwellings built without best practice environmental outcomes, further exacerbating the emissions and water impact of Sydney's growth.



Dwelling Type	Single Dwelling typology	Pathway	BASIX Energy & Water Performance	Delivery Cost (Marginal)	Delivery Cost as % of average house price (\$950,000)	Household Savings	Reductions Relative to Compliance
Large Lots	5 bed	4 kW Solar PV + Rainwater reuse for irrigation and toilets	BASIX Energy 90 BASIX Water 50	~\$5,500 per dwelling	<1%	~\$750 per year per dwelling	GHG reduction ~35% Potable water reduction ~10%
	5 bed	7 kW Solar PV + Rainwater reuse for irrigation, toilets and laundry	BASIX Energy 90 BASIX Water 55	~\$8,500 per dwelling	<1%	~\$1,200 per year per dwelling	GHG reduction ~40% Potable water reduction ~15%
	5 bed	7 kW Solar PV + Rainwater reuse for irrigation, toilets and laundry (All Electric)	BASIX Energy 98 BASIX Water 55	~\$10,700 per dwelling	1%	~\$1,850 per year per dwelling	GHG reduction ~48% Potable water reduction ~15%
Standard Lots	4 bed	3 kW Solar PV + Rainwater reuse for irrigation and toilets	BASIX Energy 85 BASIX Water 50	~\$5,000 per dwelling	<1%	~\$750 per year per dwelling	GHG reduction ~35% Potable water reduction ~10%
	4 bed	5 kW Solar PV + Rainwater reuse for irrigation, toilets and laundry	BASIX Energy 90 BASIX Water 55	~\$6,200 per dwelling	<1%	~\$1,200 per year per dwelling	GHG reduction ~40% Potable water reduction ~15%
	4 bed	5 kW Solar PV + Rainwater reuse for irrigation, toilets and laundry (All Electric)	BASIX Energy 98 BASIX Water 55	~\$8,400 per dwelling	<1%	~\$1,730 per year per dwelling	GHG reduction ~48% Potable water reduction ~15%
Small–Medium Lots	3 bed	1.5 kW Solar PV + Rainwater reuse for irrigation and toilets	BASIX Energy 70 BASIX Water 45	~\$4,200 per dwelling	<1%	~\$500 per year per dwelling	GHG reduction ~20% Potable water reduction ~5%
	3 bed	3 kW Solar PV + Rainwater reuse for irrigation, toilets and laundry	BASIX Energy 90 BASIX Water 50	~\$5,200 per dwelling	<1%	~\$750 per year per dwelling	GHG reduction ~40% Potable water reduction ~10%
	3 bed	3 kW Solar PV + Rainwater reuse for irrigation, toilets and laundry (All Electric)	BASIX Energy 97 BASIX Water 50	~\$7,400 per dwelling	<1%	~\$1,350 per year per dwelling	GHG reduction ~47% Potable water reduction ~10%
Small Lots	2 bed	1.5 kW Solar PV + Rainwater reuse for irrigation and toilets	BASIX Energy 75 BASIX Water 45	~\$4,200 per dwelling	<1%	~\$500 per year per dwelling	GHG reduction ~25% Potable water reduction ~5%
	2 bed	3 kW Solar PV + Rainwater reuse for irrigation, toilets and laundry	BASIX Energy 90 BASIX Water 50	~\$5,200 per dwelling	<1%	~\$750 per year per dwelling	GHG reduction ~40% Potable water reduction ~10%
	2 bed	3 kW Solar PV + Rainwater reuse for irrigation, toilets and laundry (All Electric)	BASIX Energy 97 BASIX Water 50	~\$7,400 per dwelling	<1%	~\$1,010 per year per dwelling	GHG reduction ~47% Potable water reduction ~10%

Table 1: Summary of the residential high performance building modelling for Single dwelling typologies

Dwelling Typology	Height Band	Pathway	BASIX Energy & Water Performance	Delivery Cost (Marginal)	Delivery Cost % of unit price	Household Savings	Reductions Relative to Compliance
Low – Mid Rise	2-14 storeys	Appliance Efficiency (with/without recycled water)	BASIX Energy 41-42 BASIX Water 50 / 65	~\$4,900 per dwelling	<1%	~\$550-610 per year per dwelling	GHG reduction ~20% Potable water reduction ~10/15%
	2-14 storeys	Solar PV + LED Lighting (with/without recycled water)	BASIX Energy 40-45 BASIX Water 50 / 65	~\$3,000 – \$3,300 per dwelling	<1%	~\$320-370 per year per dwelling	GHG reduction ~20% Potable water reduction ~10/15%
	2-14 storeys	Appliance Efficiency + Solar PV (with/without recycled water)	BASIX Energy 52-57 BASIX Water 50 / 65	~\$5,400 – \$5,700 per dwelling	<1%	~\$770-820 per year per dwelling	GHG reduction ~40% Potable water reduction ~10/15%
	2-14 storeys	App Eff + Solar PV (All electric) (with/without recycled water)	BASIX Energy 40-45 BASIX Water 50 / 65	\$7,500 - \$8,000 per dwelling	1.3%	~\$950-1,000 per year per dwelling	GHG reduction ~20% Potable water reduction ~10/15%
Mid – High Rise	15-30 storeys	Appliance Efficiency (with/without recycled water)	BASIX Energy 38-39 BASIX Water 50 / 65	~\$4,900 per dwelling	<1%	~\$550-610 per year per dwelling	GHG reduction ~15% Potable water reduction ~10/15%
	15-30 storeys	Solar PV + LED Lighting (with/without recycled water)	BASIX Energy 32-34 BASIX Water 50 / 65	~\$2,800 – \$2,900 per dwelling	<1%	~\$320-370 per year per dwelling	GHG reduction ~10% Potable water reduction ~10/15%
	15-30 storeys	Appliance Efficiency + Solar PV (with/without recycled water)	BASIX Energy 44-46 BASIX Water 50 / 65	~\$5,200 – \$5,300 per dwelling	<1%	~\$740-790 per year per dwelling	GHG reduction ~25% Potable water reduction ~10/15%
	15-30 storeys	App Eff + Solar PV (All electric) (with/without recycled water)	BASIX Energy 40 BASIX Water 50 / 65	~\$7,400 – \$7,500 per dwelling	1.2%	~\$920-970 per year per dwelling	GHG reduction ~15% Potable water reduction ~10/15%
High Rise	30-39 storeys	Appliance Efficiency (with/without recycled water)	BASIX Energy 26-33 BASIX Water 50 / 65	~\$4,900 per dwelling	<1%	~\$550-610 per year per dwelling	GHG reduction ~0-5% Potable water reduction ~10/15%
	30-39 storeys	Solar PV + LED Lighting (with/without recycled water)	BASIX Energy 19-24 BASIX Water 50 / 65	~\$2,700 per dwelling	<1%	~\$320-370 per year per dwelling	GHG increase ~5% Potable water reduction ~10/15%
	30-39 storeys	Appliance Efficiency + Solar PV (with/without recycled water)	BASIX Energy 31-36 BASIX Water 50 / 65	~\$5,200 per dwelling	<1%	~\$710-760 per year per dwelling	GHG reduction ~10% Potable water reduction ~10/15%
	30-39 storeys	Appliance Efficiency + Solar PV (All electric) (with/without recycled water)	BASIX Energy 28-30 BASIX Water 50 / 65	~\$7,400 per dwelling	1.2%	~\$890-940 per year per dwelling	GHG reduction ~0-5% Potable water reduction ~10/15%
Super High Rise	40+ storeys	Appliance Efficiency (with/without recycled water)	BASIX Energy 33* BASIX Water 50 / 65	~\$4,900 per dwelling	<1%	~\$550-610 per year per dwelling	GHG reduction ~5% Potable water reduction ~10/15%
	40+ storeys	Solar PV + LED Lighting (with/without recycled water)	BASIX Energy 25* BASIX Water 50 / 65	~\$2,700 per dwelling	<1%	~\$190-240 per year per dwelling	GHG reduction 0% Potable water reduction ~10/15%
	40+ storeys	Appliance Efficiency + Solar PV (with/without recycled water)	BASIX Energy 37* BASIX Water 50 / 65	~\$5,100 per dwelling	<1%	~\$640-690 per year per dwelling	GHG increase ~10% Potable water reduction ~10/15%
	40+ storeys	App Eff + Solar PV (All electric) (with/without recycled water)	BASIX Energy 31 BASIX Water 50 / 65	~\$7,300 per dwelling	1.2%	~\$820-870 per year per dwelling	GHG increase ~5% Potable water reduction ~10/15%

Table 2: Summary of the residential high performance building modelling for multi-unit dwelling typologies

INTRODUCTION

In 2017 the City of Parramatta developed an Environmental Sustainability Strategy. The Strategy identified higher BASIX targets as a key lever to achieve the desired emission and water reduction targets across Parramatta. Figure 1 shows the emissions reduction pathway for Parramatta. Reduction categories 2 & 3 relate to current and higher BASIX, equating to 6% emission reductions.

BASIX was selected as a key lever in the Environmental Sustainability Strategy due to the significant residential development forecast for the Parramatta LGA (see Figure 2). If this new development can be built to be more efficient, low carbon and low water, significant emission and water reductions can be achieved across the LGA to support Councils environmental targets.

In addition, higher BASIX targets across the Parramatta LGA aligns with several state government policies and legislation, as well as local council planning priorities and actions.

NSW Net Zero by 2050

The NSW Climate Change Policy Framework sets out the aspirational long-term objective for NSW to achieve net-zero emissions by 2050. This objective is support by Net Zero Plan Stage 1: 2020–2030 which sets out how the NSW Government will deliver on significant emission reductions over the next decade. Specifically, Net Zero Stage 1 outlines a commitment to improve the Building Sustainability Index (BASIX) to provide a pathway to deliver cost-effective, low emissions outcomes for residential buildings.

The Greater Sydney Region Plan and Central District Plan

The Greater Sydney Region Plan, *A Metropolis of Three Cities*, is a legislative document which sets a 40-year vision (to 2056) and establishes a 20-year plan to manage growth and change for Greater Sydney in the context of social, economic and environmental matters.

The Greater Sydney Region Plan includes two key objectives which require the need for new buildings to deliver more efficient resources and emissions and seek to support the delivery of the state’s net-zero emissions by 2050 objective:

- **Objective 33:** A low-carbon city contributes to net-zero emissions and mitigates climate change
- **Objective 34:** Energy and water flows are captured, used and re-used

Both objectives support the need for higher BASIX targets as part of delivering a low carbon and water efficient city. In giving effect The Greater Sydney Region Plan, the Central City District Plan includes Planning Priority C19: Reducing carbon emissions and managing energy, water and waste efficiently. This priority includes several key actions that require Council and state government to work together to delivery more efficient, low carbon and low water development across Parramatta, specifically:

Environmental Sustainability Strategy Emissions Reduction Pathway

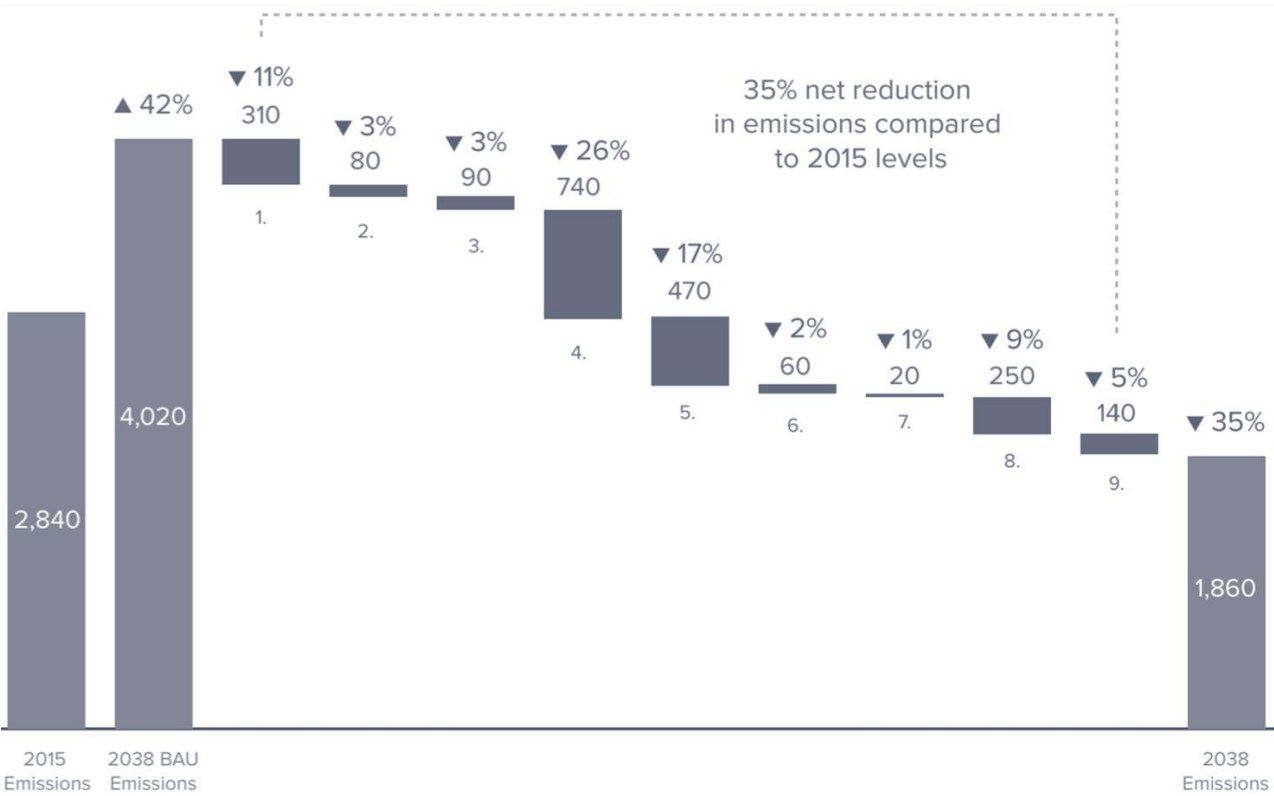


Figure 1: City of Parramatta’s Emissions Reduction Opportunities (Source: Environmental Sustainability Strategy 2017)

Parramatta LGA Dwelling Forecast

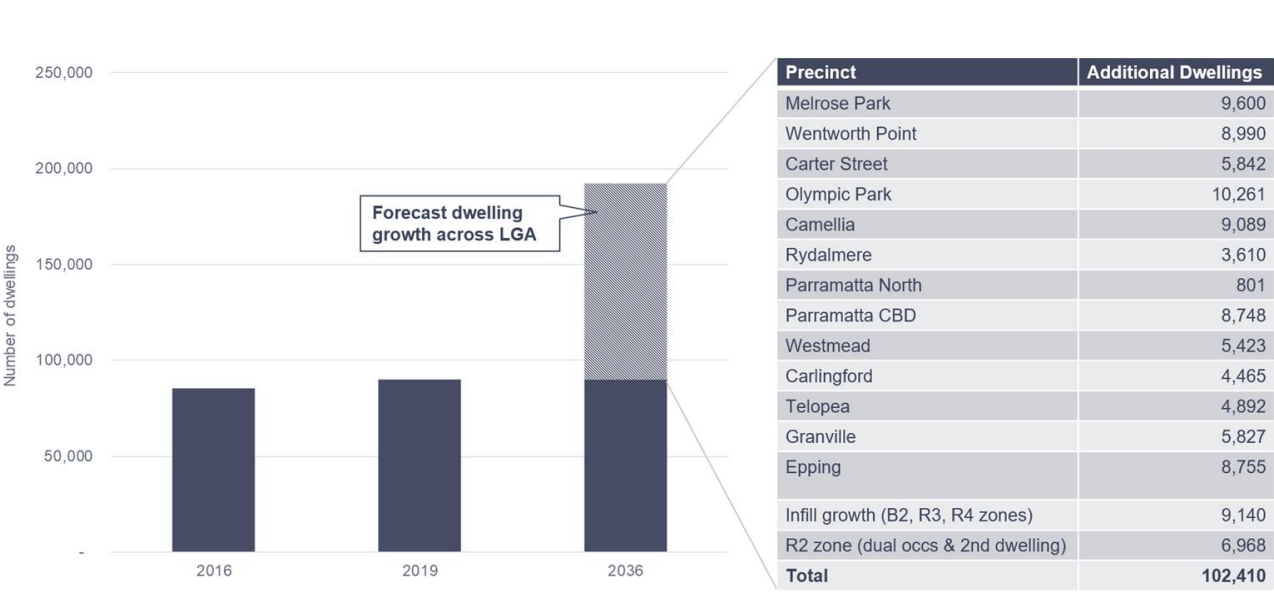


Figure 2: Parramatta LGA dwelling forecast to 2036 by precinct (Source: City of Parramatta Council)

- **Action 75** - Support initiatives that contribute to the aspirational objective of achieving net-zero emissions by 2050, especially through the establishment of low-carbon precincts in Growth Areas, Planned Precincts, Collaboration Areas, State Significant Precincts and Urban Transformation projects.
- **Action 76** - Support precinct-based initiatives to increase renewable energy generation and energy and water efficiency, especially in Growth Areas, Planned Precincts, Collaboration Areas, State Significant Precincts and Urban Transformation projects.
- **Action 79** - Encourage the preparation of low-carbon, high efficiency strategies to reduce emissions, optimise the use of water, reduce waste and optimise car parking provision where an increase in total floor area greater than 100,000 square metres is proposed in any contiguous area of 10 or more hectares.
- **Action 80** - Investigate potential regulatory mechanisms that sets low-carbon, high efficiency targets to be met through increased energy efficiency, water recycling and waste avoidance, reduction or re-use.

City of Parramatta Local Strategic Planning Statement

In responding to the Greater Sydney Region Plan and Central District Plans, the City of Parramatta more recently prepared their Local Strategic Planning Statement (LSPS). The local strategic planning statement sets out a 20-year land use planning vision for the City of Parramatta and includes specific priorities and actions which seek to support more efficient, low carbon development across the local government area, specifically:

- **Planning Priority 15** - Reduce emissions and manage energy, water, and waste efficiently to create better buildings and precincts and solve city planning challenges.

This priority is supported by the following short-term actions to be pursued by the City of Parramatta Council:

- **Action 92** - Progress the draft high performance building planning controls (energy, water and dual piping) for both residential and non-residential developments within the Parramatta CBD Planning Proposal area.
- **Action 93** - Investigate applying new minimum sustainability requirements (including; energy, water, renewables - including precinct-scale renewables - waste, dual piping and electric vehicles) for areas outside the Parramatta CBD.
- **Action 94** - Review sustainability and high performance building requirements (including higher BASIX targets) to determine their applicability across the local government area.

In preparing the LSPS, the City sought community feedback on these planning priorities, actions and specific measures, including increasing BASIX targets. Specific community feedback relevant to this report is outlined below, highlighted significant local support for increasing the performance of new development across the local government area:

- **95.66%** of respondents support the idea that all new development should incorporate the latest sustainability technologies and design to reduce the cost of living and impact on the environment.
- Of the 14 respondents that provided comment on why they did not support the above statement, the main reason was due to **cost and affordability**.
- Overall, there is relatively even support for initiatives relating to enabling a future proof city and doing more with less energy, water and waste. **Over 200 respondents chose to support these actions.**

A combined effort by Local Governments

Finally, the City of Parramatta joins a number of other Councils across metropolitan Sydney who are seeking to increase BASIX targets to ensure their local planning and development responds to the state government District and Region Plans.

The following councils have included actions in their Local Strategic Planning Statements to increase BASIX targets across their local government area:

- | | |
|---------------|------------------------|
| • Blacktown | • North Sydney |
| • Parramatta | • Willoughby |
| • Bayside | • Canterbury-Bankstown |
| • Canada Bay | • Georges River |
| • Inner West | • Sutherland Shire |
| • Randwick | • Camden |
| • Strathfield | • Campbelltown |
| • Sydney | • Liverpool |
| • Waverley | • Penrith |
| • Woollahra | • Wollondilly |
| • Lane Cove | |

The purpose of this report

The purpose of this report is to provide an evidence base and cost-benefit analysis for higher BASIX targets across the Parramatta local government area in order to support state government policy and legislation as well as delivering on the City of Parramatta's Local Strategic Planning Statement.

This report should be considered as the supporting evidence required by Council to seek higher BASIX targets from the NSW Department of Planning, Industry and Environment (DPIE) through the BASIX SEPP or BASIX online tool.

BACKGROUND TO BASIX

Delivered initially in 2004, the NSW Building Sustainability Index (BASIX) establishes energy (greenhouse gas emission) and water performance requirements for all new residential development across NSW. BASIX established a benchmark for the average per person greenhouse gas emissions and water consumption in NSW, based on 2003 end-use data from energy and water utilities.

This became BASIX 0 (zero) and was equivalent to:

- **90,340 litres of mains potable water** consumption per person per year
- **3,292 kg CO₂-e** of greenhouse gas emissions per person per year

Consequently, scores of BASIX '100' effectively equated to zero carbon and zero mains water use dwellings. Under current controls, the following BASIX compliance targets apply for new residential dwellings across the Parramatta LGA:

BASIX Typology	BASIX Energy Target	BASIX Water Target
Single dwelling	50	40
Apartment (2-3 storey)	45	40
Apartment (4-5 storey)	35	40
Apartment (6+ storey)	25	40

Table 3: BASIX Compliance Targets for Parramatta LGA Dwelling typologies

The simple logic of the targets was that the homes we were designing to live in tomorrow should perform better than the homes we live in today. The immediate impact on the residential housing industry was significant with the uptake of new technologies and design practices widespread across NSW. This was subsequently validated by a post examination of actual end use performance and technology choices across new residential homes¹.

BASIX provides a whole of building assessment, analysing the performance and establishing greenhouse gas emissions and water reduction targets across a range of end uses. BASIX goes beyond the requirements outlined in the National Construction Code (NCC) and provides a performance based mechanism to cover the following end uses of residential buildings:

- Space heating and cooling, including separate heating and cooling thermal caps
- Air conditioning systems, including ceiling fans
- Hot water systems
- Lighting demands
- Water fixture and fitting consumption
- Appliance demands (including refrigerator, dishwasher, clothes dryer and clothes washer)
- Common area and base building demands for apartment buildings, such as swimming pools, lifts, car parks and shared gardens
- Energy generation and water reuse

Because of this coverage, NSW remains ahead of other states in delivering homes that are designed to emit less greenhouse gas emissions and use less mains potable water. A review of recent developments across Australia² highlighted, for example, that new apartments in Queensland often install electric instantaneous hot water systems, while BASIX homes install more efficient gas or solar hot water systems. In addition, BASIX drives significant rainwater reuse which is not seen in other states.

However, BASIX is now 16 years old, and while there was a small increase in BASIX targets in 2018, significant changes in both technology and industry practice provides an opportunity to further increase BASIX targets for specific typologies and local areas.

It is understood from DPIE that the next update of BASIX is expected to be delivered in 2022. However, the potential increase in performance due to this update is uncertain. The findings in this report will enable Council to actively engage with other local governments and DPIE to lift BASIX targets across the region.

¹ Sydney Water (2009) BASIX Water Savings Monitoring
https://www.basix.nsw.gov.au/iframe/images/water_monitoring_report-2008-09.pdf
BASIX Monitoring 5 Year Summary Report
https://www.basix.nsw.gov.au/iframe/images/BASIX_Five_Year_Outcomes_Summary.pdf

² Based on a review by Kinesis of 25 recently completed apartment, land and mixed use residential development projects in NSW, Victoria, Queensland and Western Australia.

STRUCTURE OF THIS REPORT & METHODOLOGY

This report sets out an evidence base and cost-benefit analysis for higher BASIX targets across the Parramatta local government area. It first sets out the dwelling typologies investigated, then outlines the cost and benefits of various higher BASIX target scenarios for these typologies, before recommending higher BASIX targets specific for the Parramatta LGA.

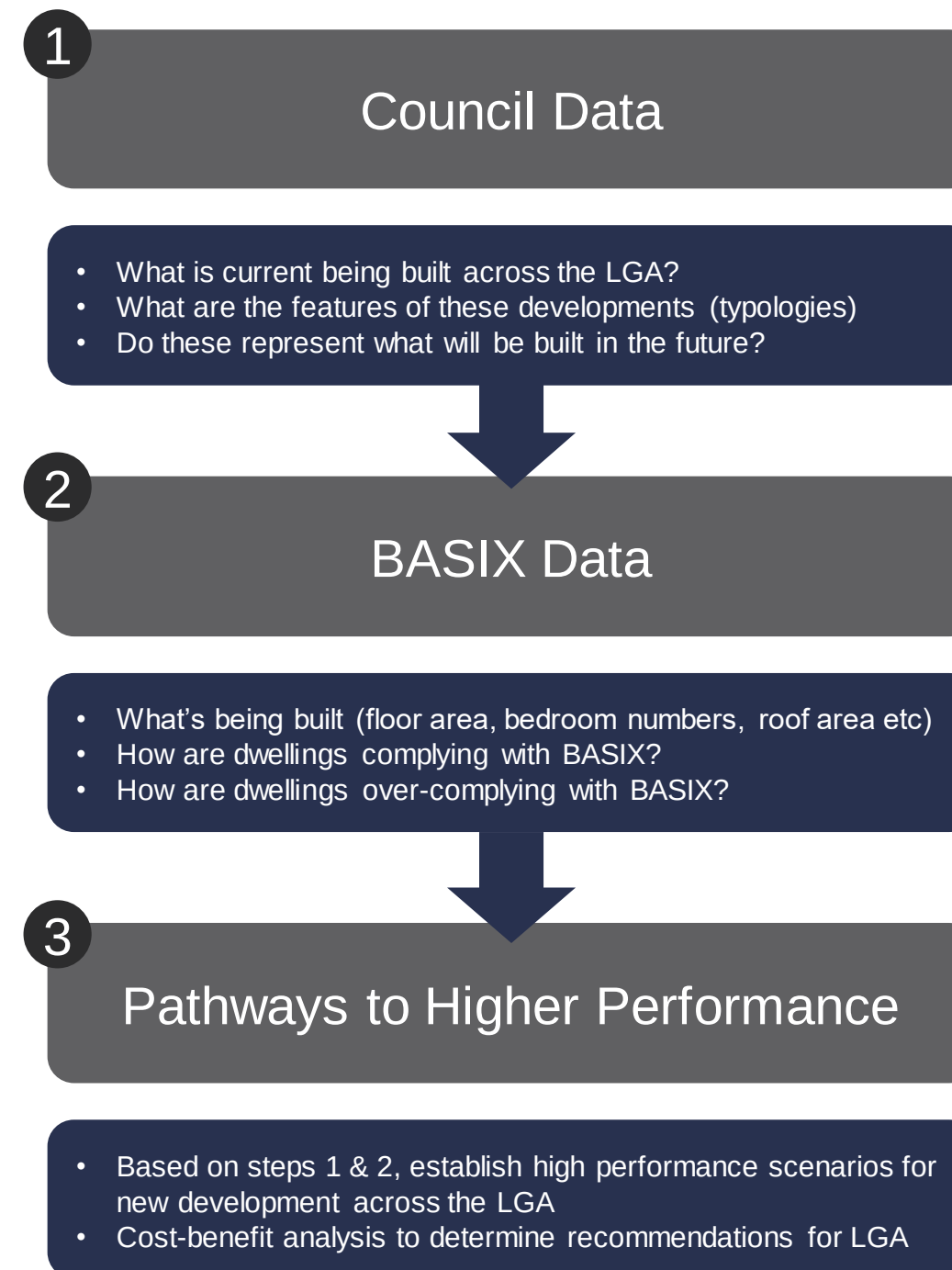
Our methodology focused on developing cost-effective approaches to deliver higher BASIX targets whilst ensuring that these higher targets support improved cost of living and affordability outcomes, and do not impact significantly on house prices across the region. In order to do this, Kinesis undertook the following key steps:

1. Use Council data to understand what is currently being built and what is expected to be built in the future to develop representative typologies for analysis.
2. Use BASIX data from the Department of Planning, Industry and Environment (DPIE) to determine details about developments in Parramatta, such as estimated floor area, roof areas and how they are currently complying and over-complying with the current BASIX targets.
3. Based on this analysis we developed pathways to higher environmental performance outcomes that reflected both the typologies that are being built in Parramatta as well as technologies and strategies that are already being used by developers today.

This methodology ensures that the recommendations outlined in this report are both cost-effective and practical, i.e. are already being delivered in some developments and are therefore achievable and implementable.

The results of this analysis are outlined in the following pages of this report.

Additional assumptions and references used in the analysis have been provided as an appendix to this report.



ESTABLISHING REPRESENTATIVE TYPOLOGIES

To develop cost-effective higher BASIX targets for the Parramatta LGA, Kinesis investigated relevant data to construct representative residential dwelling typologies. To undertake this analysis Kinesis used the FY15-18 BASIX data from DPIE to understand the most popular dwelling typologies in Parramatta:

- Single Dwellings:** 2 bed, 3 bed, 4 bed and 5 bed dwellings make up 95% of single dwellings in Parramatta. The future single dwellings stock is like to be largely made of these typologies as well.
- Multi-unit dwellings:** Most multi-unit projects are low to mid rise apartments (3-15 storeys). However the future stock will include high and super high rises (Beyond 15 storeys), especially in Camellia and the CBD. As such, these typologies were also considered.

TYPOLOGY ANALYSIS FOR PARRAMATTA LGA

Dwelling type	Number of projects (FY15-18)	% of projects
Single Dwellings		
1 bed	109	3%
2 bed	47	18%
3 bed	7	18%
4 bed	64	44%
5 bed	26	13%
6+ bed	8	2%
Apartments		
2-4 storeys	62	37%
5-9 storeys	43	26%
10-14 storeys	17	10%
15-19 storeys	5	3%
20-24 storeys	10	6%
25-29 storeys	13	8%
30-34 storeys	2	1%
35-40 storeys	0	0%
Over 40 storeys	16	10%

Table 4: Analysis of new development across Parramatta LGA from 2015 to 2018

SINGLE DWELLINGS REPRESENTATIVE TYPOLOGIES

Single Dwellings	Number of bedrooms	Roof Area (sqm)	Conditioned Floor Area (sqm)	Unconditioned Floor Area (sqm)	Garden/ Lawn area (sqm)
Large Lot	5 bed	180	180	20	70
Standard Lot	4 bed	170	170	20	70
Small-Medium Lot	3 bed	180	130	25	30
Small Lot	2 bed	90	50	8	10

Table 5: Representative dwelling typologies for single dwellings

APARTMENT REPRESENTATIVE TYPOLOGIES

Multi Unit Dwellings	# of Storeys	Bedrooms per Dwelling	Conditioned Floor Area per Dwelling (sqm)	Unconditioned Floor Area per Dwelling (sqm)
Low-Mid Rise	2-4	1.8	73.0	2.3
	5-9	1.8	75.0	1.4
	10-14	1.8	74.3	1.2
Mid-High Rise	15-19	1.8	73.1	1.1
	20-24	1.7	71.5	1.5
	25-29	1.7	70.9	0.9
High Rise	30-34	1.9	74.9	2.1
	35-40	1.8	74.6	0.6
Super High Rise	Over 40	1.8	82.3	1.5

Table 6: Representative dwelling typologies for RFB dwellings

ESTABLISHING SCENARIOS FOR HIGHER PERFORMANCE

This step first involved analysing the key attributes to understand historical BASIX Energy and Water compliance and then reviewing developments that over-complied in order to establish higher BASIX target scenarios for the Parramatta LGA.

Kinesis obtained the past 8 years of BASIX certificate data from the Department of Planning and Environment (DPIE). From site and floor areas to multi-unit appliance fit-outs, the data contains all the information that is submitted to the DPIE as a part of the Development Application process. Kinesis has leveraged this entire dataset across the Sydney Metropolitan Area (~9,000 projects) for three purposes:

1. Exploring typology trends (e.g. number of dwellings, common area, number of lifts, etc.) in residential buildings in Parramatta, nearby suburbs and the Great Sydney.
2. To provide current market practice typology inputs for modelling different dwelling typologies
3. Analysing how residential developments have historically exceeded BASIX Energy targets, thereby highlighting the most popular and practical pathways to BASIX exceedance.

Based on this analysis, Kinesis observed the following:

Single Dwellings & Townhouses

- Current BASIX compliance targets for single dwellings are BASIX Energy 50 and BASIX Water 40
- Using BASIX data, it was observed that single dwellings most commonly achieve compliance by:
 - Installing gas hot water
 - having high thermal efficiency
 - Installing efficient lighting and space conditioning appliances
 - Installing efficient water fixtures
 - Having efficient irrigation systems with low water use species in their gardens
 - Installing efficient ventilation systems
- Reviewing dwellings that have over-complied with BASIX, the most common methods for exceeding BASIX compliance targets include:
 - Rooftop solar PV
 - Water reuse systems, specifically larger rainwater tanks for external and multiple internal uses, as well as recycled water (where available).

BASIX ENERGY PERFORMANCE IN SINGLE DWELLINGS IN PARRAMATTA

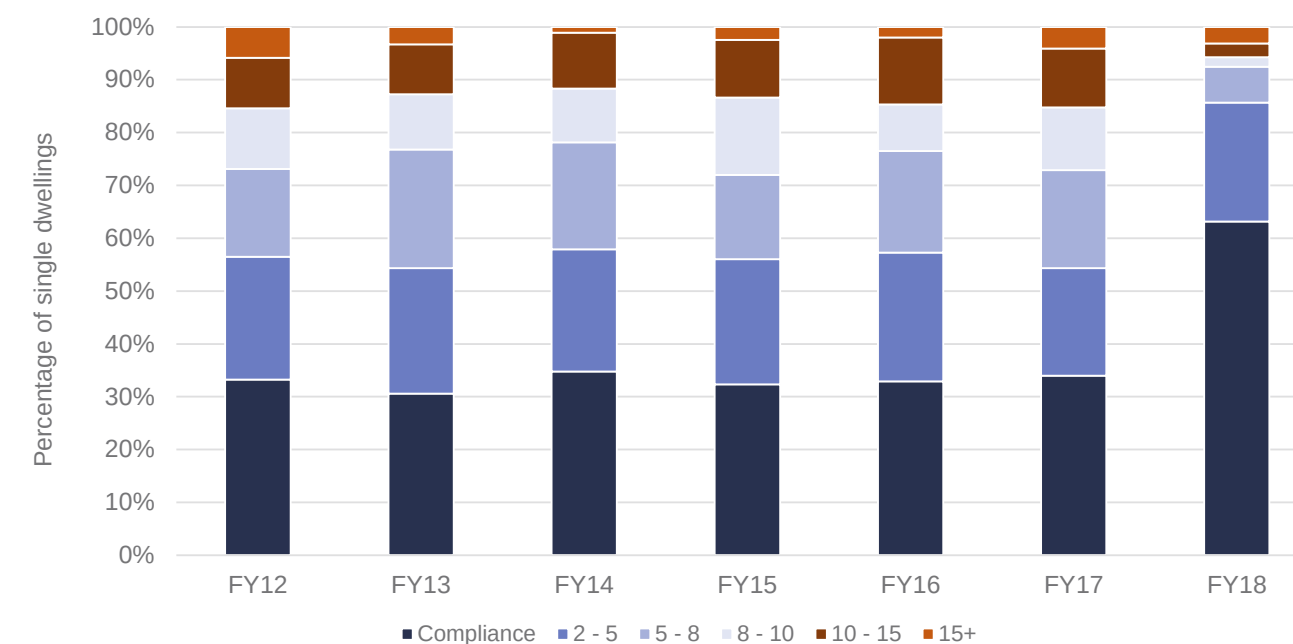


Figure 1: BASIX Energy performance in single dwellings in Parramatta

Apartment

- Current BASIX compliance targets for multi unit dwellings are BASIX Energy 25 to 45 (depending on building height) & BASIX Water 40.
- Using BASIX data, it was observed that single dwellings most commonly achieve compliance by:
 - Installing gas hot water
 - having high thermal efficiency
 - Installing standard lighting and appliances
 - Installing efficient water fixtures
 - Installing standard ventilation systems
 - Installing efficient LED lighting and ventilation in car parks
 - Installing efficient lifts
- Reviewing dwellings that have over-complied with BASIX, the most common methods for exceeding BASIX compliance targets include:
 - Efficient appliances (dishwashers, fridges, washing machines and clothes dryers)
 - Rooftop solar PV
 - Efficient water fixtures
 - Water reuse systems, specifically larger rainwater tanks for external and multiple internal uses, as well as recycled water (where available).

BASIX ENERGY PERFORMANCE IN MULTI UNIT DWELLINGS IN PARRAMATTA

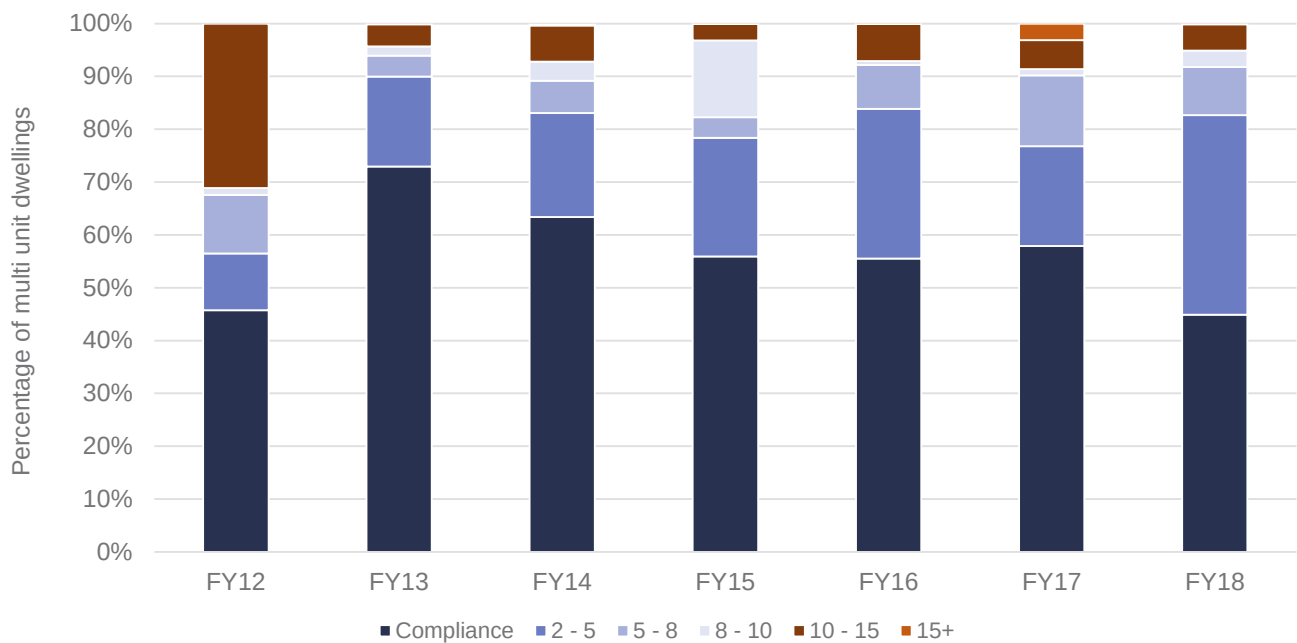


Figure 2: BASIX Energy performance in apartment dwellings in Parramatta

CURRENT BASIX COMPLIANCE TARGETS FOR THE PARRAMATTA LGA

BASIX Typology	BASIX Energy Target	BASIX Water Target
Single dwellings	50	40
Apartments (2-3 storey)	45	40
Apartments (4-5 storey)	35	40
Apartments (6+ storey)	25	40

Table 7: BASIX Energy and Water Compliance Targets for the Parramatta LGA

High Performance Scenarios

Based on the analysis of current compliance and over-compliance, Kinesis established various higher BASIX target performance scenarios.

All scenarios were analysed in the on-line BASIX tool to identify cost-effective and high-performing BASIX energy and water targets for all the dwelling typologies across the Parramatta LGA. The modelled scenarios are outlined below:

1. **Base Case (BASIX Compliance)**, which includes necessary internal fit outs and technology interventions to comply with the minimum BASIX requirement in both energy and water.
2. **Moderate Scenario**, which includes significant increases with relatively moderate interventions and at a lower cost per dwelling.
3. **Stretch Scenario**, which includes stretch interventions, such as maximising solar PV and water reuse. For example, 7 kW of solar PV has been modelled on large lot single dwellings. While not standard, the BASIX data shows that there have been examples of single dwellings installing 7kW or higher in Parramatta.
4. **Stretch Scenario (All Electric)**, which includes the same interventions as the stretch scenario but removing gas connection and replacing gas hot water and cooking for electric systems. There are two concepts to note while moving to an all-electric pathway:
 1. Electric heat pump hot water systems used in the all-electric pathway are more emissions intensive than gas instantaneous hot water systems under the current NSW electricity grid.
 2. Despite delivering both cost savings and additional emission reductions, BASIX does not recognise solar PV that is exported beyond the dwelling(s). This is highlighted in some dwelling types where, for example, energy demand from lifts and other centralised energy loads increase as heights of apartments increase leading to less solar PV export and in turn more BASIX points for the same solar PV system.

The combination of these impacts above plays out differently for different dwelling types. In the case of single dwellings, the BASIX uplift from less solar PV export due to increased electricity demand under the all electric scenario offsets the BASIX decrease from using the more emissions intensive electric heat pump hot water system. In the case of apartments, as the number of storeys increases, the increased centralised energy loads from lifts and other centralised systems means less solar PV export, offsetting the BASIX decrease from using a more emissions intensive hot water system.

A higher number of scenario iterations were also explored for apartment buildings in order to understand the impact of specific interventions and comparisons between these such as solar PV v appliances.

Estimated capital costs and household savings of each scenario are documented in detail in Table 8 to Table 19. Upfront marginal capital costs and operational cost savings are both calculated relative to the Base Case technology and infrastructure assumptions. That is, the marginal capital costs listed are in addition to the cost of meeting BASIX compliance and the savings are from achieving the proposed higher BASIX score.

SUMMARY AND RECOMMENDATIONS

Across all typologies, improved building design and fixture efficiency delivers water and emissions savings as well as operational cost savings to residents.

For single dwellings, solar PV and water re-use systems have the highest energy and water reduction impacts. For apartments, household appliances can be used in BASIX to deliver significant water and energy savings.

Solar PV has become increasingly cost-effective on a per dwelling basis as the technology matures and capital cost reduces. For all typologies, solar PV is generally the least cost pathway to achieve higher sustainability performance.

As such, it is recommended that solar PV be maximized on all dwelling typologies.

Based on the analysis of each scenario, Kinesis recommends the following high performance targets for new residential development across the Parramatta LGA:

Single dwellings and townhouses:

- BASIX Energy 90 (+50) and BASIX Water 50 (+10)

Apartments:

- BASIX Energy 50 (+25) and BASIX Water 50 (+10) (<14 storeys)
- BASIX Energy 40 (+15) and BASIX Water 50 (+10) (15 - 29 storeys)
- BASIX Energy 35 (+10) and BASIX Water 50 (+10) (30 - 39 storeys)
- BASIX Energy 30 (+5) and BASIX Water 50 (+10) (40+ storeys)

In addition to the above targets, BASIX Water 65 (+25) should be pursued where recycled water is available for connection and use.

These recommendations reflect the scenario analysis results (Table 8 to Table 19) under the assumption that developments in Parramatta will follow the representative dwelling typologies discussed in prior sections.

LARGE LOT – BASIX OUTCOMES AND ESTIMATED COST-BENEFIT

	Base Case	Moderate	Stretch	Stretch (all electric)
NatHERS	6-star average	6-star average	6-star average	6-star average
Hot Water	Gas Instantaneous	Gas Instantaneous	Gas Instantaneous	Electric Heat Pump (more than 45 STCs)
Space Heating & Cooling	3.5-4 star AC (split system)	3.5-4 star AC (split system)	3.5-4 star AC (split system)	3.5-4 star AC (split system)
Lighting	Efficient LED Lighting	Efficient LED Lighting	Efficient LED Lighting	Efficient LED Lighting
Cooking	Gas cooktop / electric oven	Gas cooktop / electric oven	Gas cooktop / electric oven	Electric cooktop / electric oven
Solar PV	-	4 kW	7 kW	7 kW
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	4-star WELS toilet, 5-star WELS tapware, 3+-star WELS showerhead
Irrigation	Efficient Irrigation/ Indigenous, low water use species	Efficient Irrigation/ Indigenous, low water use species	Efficient Irrigation/ Indigenous, low water use species	Efficient Irrigation/ Indigenous, low water use species
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	Fans in laundry and bathroom with ducted exhaust and manual switch. Fan in kitchen not ducted with manual switch
Water Reuse	-	Rainwater for irrigation and toilets	Rainwater for toilets, irrigation and laundry	Rainwater for toilets, irrigation and laundry
BASIX Score	BASIX Energy 50 BASIX Water 40	BASIX Energy 90 BASIX Water 50	BASIX Energy 90 (solar export does not contribute to BASIX Energy) BASIX Water 55	BASIX Energy 98 BASIX Water 55
Marginal cost of higher BASIX (Solar PV array + rainwater tank)*		\$4,000 for 4 kW solar PV* \$1,500 for 3-4 kL rainwater tank* \$5,500 total (includes installation)	\$6,500 for 7kW solar PV* \$2,000 for 3-4 kL rainwater tank & connection to laundry* \$8,500 total (includes installation)	\$6,500 for 7kW solar PV* \$2,000 for 3-4 kL rainwater tank & connection to laundry* \$2,200 for heat pump over gas hot water \$10,700 total (includes installation)
Total Cost as a % of median single dwelling sale price in Parramatta		<1%	<1%	<1%
Household savings per annum		\$600 from solar PV; \$150 from rainwater tank; \$750 total	\$1000 from solar PV; \$200 from rainwater tank; \$1,200 total	\$1000 from solar PV; \$200 from rainwater tank; \$650 from heat pump hot water (\$229 from no gas service charges); \$1,850 total

Table 8: Modelled outcomes and cost-benefit estimates for 5-bedroom single dwelling.

Notes:

Appliances (dishwashers, washing machines, clothes washers and dryers) cannot not be used for single dwellings in BASIX to achieve energy and water efficiency outcomes so have not been included in this analysis.

Costs savings for not including gas connection under the all-electric scenario is unknown and dependant on gas network available and dwelling typology so has not been included in this analysis.

Medium sales price for single dwelling approximately \$1,150,000 (As at March 2020)

STANDARD LOT – BASIX OUTCOMES AND ESTIMATED COST- BENEFIT

	Base Case	Moderate	Stretch	Stretch (all electric)
NatHERS	6-star average	6-star average	6-star average	6-star average
Hot Water	Gas Instantaneous	Gas Instantaneous	Gas Instantaneous	Electric Heat Pump (more than 45 STCs)
Space Heating & Cooling	3.5-4 star AC (split system)	3.5-4 star AC (split system)	3.5-4 star AC (split system)	3.5-4 star AC (split system)
Lighting	Efficient LED Lighting	Efficient LED Lighting	Efficient LED Lighting	Efficient LED Lighting
Cooking	Gas cooktop / electric oven	Gas cooktop / electric oven	Gas cooktop / electric oven	Electric cooktop / electric oven
Solar PV	-	3 kW	5 kW	5 kW
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	4-star WELS toilet, 5-star WELS tapware, 3+-star WELS showerhead
Irrigation	Efficient Irrigation/ Indigenous, low water use species	Efficient Irrigation/ Indigenous, low water use species	Efficient Irrigation/ Indigenous, low water use species	Efficient Irrigation/ Indigenous, low water use species
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	Fans in laundry and bathroom with ducted exhaust and manual switch. Fan in kitchen not ducted with manual switch
Water Reuse	-	Rainwater for irrigation and toilets	Rainwater for toilets, irrigation and laundry	Rainwater for toilets, irrigation and laundry
BASIX Score	BASIX Energy 50 BASIX Water 40	BASIX Energy 85 BASIX Water 50	BASIX Energy 90 BASIX Water 55	BASIX Energy 98 BASIX Water 55
Marginal cost of higher BASIX (Solar PV array + rainwater tank)*		\$3,500 for 3 kW solar PV* \$1,500 for 3-4 kL rainwater tank* \$5,000 total (includes installation)	\$4,200 for 5kW solar PV* \$2,000 for 3-4 kL rainwater tank & connection to laundry* \$6,200 total (includes installation)	\$4,200 for 5kW solar PV* \$2,000 for 3-4 kL rainwater tank & connection to laundry* \$2,200 for heat pump over gas hot water \$8,400 total (includes installation)
Total Cost as a % of median single dwelling sale price in Parramatta		<1%	<1%	<1%
Household savings per annum		\$600 from solar PV \$150 from rainwater tank \$750 total	\$1000 from solar PV \$200 from rainwater tank \$1,200 total	\$1000 from solar PV \$200 from rainwater tank \$530 from heat pump hot water (\$229 from no gas service charges) \$1,730 total

Table 9: Modelled outcomes and cost-benefit estimates for 4-bedroom single dwelling.

Notes:

Appliances (dishwashers, washing machines, clothes washers and dryers) cannot not be used for single dwellings in BASIX to achieve energy and water efficiency outcomes so have not been included in this analysis.

Costs savings for not including gas connection under the all-electric scenario is unknown and dependant on gas network available and dwelling typology so has not been included in this analysis.

Medium sales price for single dwelling approximately \$1,150,000 (As at March 2020)

SMALL-MID LOT – BASIX OUTCOMES AND ESTIMATED COST-BENEFIT

	Base Case	Moderate	Stretch	Stretch (all electric)
NatHERS	6-star average	6-star average	6-star average	6-star average
Hot Water	Gas Instantaneous	Gas Instantaneous	Gas Instantaneous	Electric Heat Pump (more than 45 STCs)
Space Heating & Cooling	3.5-4 star AC (split system)	3.5-4 star AC (split system)	3.5-4 star AC (split system)	3.5-4 star AC (split system)
Lighting	Efficient LED Lighting	Efficient LED Lighting	Efficient LED Lighting	Efficient LED Lighting
Cooking	Gas cooktop / electric oven	Gas cooktop / electric oven	Gas cooktop / electric oven	Electric cooktop / electric oven
Solar PV	-	1.5 kW	3 kW	3 kW
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	4-star WELS toilet, 5-star WELS tapware, 3+-star WELS showerhead
Irrigation	Efficient Irrigation/ Indigenous, low water use species	Efficient Irrigation/ Indigenous, low water use species	Efficient Irrigation/ Indigenous, low water use species	Efficient Irrigation/ Indigenous, low water use species
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	Fans in laundry and bathroom with ducted exhaust and manual switch. Fan in kitchen not ducted with manual switch
Water Reuse	-	Rainwater for irrigation and toilets	Rainwater for toilets, irrigation and laundry	Rainwater for toilets, irrigation and laundry
BASIX Score	BASIX Energy 50 BASIX Water 40	BASIX Energy 70 BASIX Water 45	BASIX Energy 90 BASIX Water 50	BASIX Energy 97 BASIX Water 50
Marginal cost of higher BASIX (Solar PV array + rainwater tank)*		\$3,000 for 1.5 kW solar PV* \$1,200 for 2 kL rainwater tank* \$4,200 total (includes installation)	\$3,500 for 3 kW solar PV* \$1,700 for 2 kL rainwater tank & connection to laundry* \$5,200 total (includes installation)	\$3,500 for 3 kW solar PV* \$1,700 for 2 kL rainwater tank & connection to laundry* \$2,200 for heat pump over gas hot water \$7,400 total (includes installation)
Total Cost as a % of median single dwelling sale price in Parramatta		<1%	<1%	<1%
Household savings per annum		\$400 from solar PV \$100 from rainwater tank \$500 total	\$600 from solar PV \$150 from rainwater tank \$750 total	\$600 from solar PV \$350 from rainwater tank \$400 from heat pump hot water (\$229 from no gas service charges) \$1,350 total

Table 10: Modelled outcomes and cost-benefit estimates for 3-bedroom single dwelling.

Notes:

Appliances (dishwashers, washing machines, clothes washers and dryers) cannot not be used for single dwellings in BASIX to achieve energy and water efficiency outcomes so have not been included in this analysis.

Costs savings for not including gas connection under the all-electric scenario is unknown and dependant on gas network available and dwelling typology so has not been included in this analysis.

Medium sales price for single dwelling approximately \$1,150,000 (As at March 2020)

SMALL LOT – BASIX OUTCOMES AND ESTIMATED COST-BENEFIT

	Base Case	Moderate	Stretch	Stretch (all electric)
NatHERS	6-star average	6-star average	6-star average	6-star average
Hot Water	Gas Instantaneous	Gas Instantaneous	Gas Instantaneous	Electric Heat Pump (more than 45 STCs)
Space Heating & Cooling	3.5-4 star AC (split system)	3.5-4 star R AC (split system)	3.5-4 star R AC (split system)	3.5-4 star AC (split system)
Lighting	Efficient LED Lighting	Efficient LED Lighting	Efficient LED Lighting	Efficient LED Lighting
Cooking	Gas cooktop / electric oven	Gas cooktop / electric oven	Gas cooktop / electric oven	Electric cooktop / electric oven
Solar PV	-	1.5 kW	3 kW	3 kW
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	4-star WELS toilet, 5-star WELS tapware, 3+-star WELS showerhead
Irrigation	Efficient Irrigation/ Indigenous, low water use species	Efficient Irrigation/ Indigenous, low water use species	Efficient Irrigation/ Indigenous, low water use species	Efficient Irrigation/ Indigenous, low water use species
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	Fans in laundry and bathroom with ducted exhaust and manual switch. Fan in kitchen not ducted with manual switch
Water Reuse	-	Rainwater for irrigation and toilets	Rainwater for toilets, irrigation and laundry	Rainwater for toilets, irrigation and laundry
BASIX Score	BASIX Energy 50 BASIX Water 40	BASIX Energy 75 BASIX Water 45	BASIX Energy 90 BASIX Water 50	BASIX Energy 97 BASIX Water 50
Marginal cost of higher BASIX (Solar PV array + rainwater tank)*		\$3,000 for 1.5 kW solar PV* \$1,200 for 2 kL rainwater tank* \$4,200 total (includes installation)	\$3,500 for 3 kW solar PV* \$1,700 for 2 kL rainwater tank & connection to laundry* \$5,200 total (includes installation)	\$3,500 for 3 kW solar PV* \$1,700 for 2 kL rainwater tank & connection to laundry* \$2,200 for heat pump over gas hot water \$7,400 total (includes installation)
Total Cost as a % of median single dwelling sale price in Parramatta		<1%	<1%	<1%
Household savings per annum		\$400 from solar PV \$100 from rainwater tank \$500 total	\$600 from solar PV \$150 from rainwater tank \$750 total	\$600 from solar PV \$150 from rainwater tank \$260 from heat pump hot water (\$229 from no gas service charges) \$1,010 total

Table 11: Modelled outcomes and cost-benefit estimates for a 2-bedroom single dwelling.

Notes:

Appliances (dishwashers, washing machines, clothes washers and dryers) cannot not be used for single dwellings in BASIX to achieve energy and water efficiency outcomes so have not been included in this analysis.

Costs savings for not including gas connection under the all-electric scenario is unknown and dependant on gas network available and dwelling typology so has not been included in this analysis.

Medium sales price for single dwelling approximately \$1,150,000 (As at March 2020)

2-14 STOREYS – PATHWAY TECHNOLOGY ASSUMPTIONS

	Appliance Efficiency	Appliance Efficiency + Recycled Water	Solar PV + LED Lighting	Appliance Efficiency + Solar PV	Appliance Efficiency + Solar PV (all electric)
Dwellings					
NatHERS	6-star average	6-star average	6-star average	6-star average	6-star average
Hot Water	Centralised gas instantaneous with piping R-value of 0.6	Centralised gas instantaneous with piping R-value of 0.6	Centralised gas instantaneous with piping R-value of 0.6	Centralised gas instantaneous with piping R-value of 0.6	Electric Heat Pump with more than 45 STCs (centralised system)
Space Heating & Cooling	5-star A/C (bedrooms only)	5-star A/C (bedrooms only)	2-star A/C (bedrooms only)	5-star A/C (bedrooms only)	5-star A/C (bedrooms only)
Lighting	Dedicated LED lighting	Dedicated LED lighting	Dedicated LED lighting	Dedicated LED lighting	Dedicated LED lighting
Solar	None	None	~30% of roof space and 7m2/panel	~30% of roof space and 7m2/panel	~30% of roof space and 7m2/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	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	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 electric 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	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	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 and 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	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	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	1.04 spaces/dwelling + EV charging	1.04 spaces/dwelling + EV charging	1.04 spaces/dwelling + EV charging	1.04 spaces/dwelling + EV charging	1.04 spaces/dwelling + EV charging
Water Reuse (Recycled Water)		Connected for irrigation, toilet and laundry	Connected for irrigation, toilet and laundry	Connected for irrigation, toilet and laundry	Connected for irrigation, toilet and laundry
BASIX Energy Score	41-42	41-42	40-45	52-57	40-45
BASIX Water Score	50	65	65	65	65

Table 12: Technology assumptions modelled for 2-14 storey unit dwellings.

2-14 STOREYS – COST-BENEFIT

	Appliance Efficiency	Appliance Efficiency + Recycled Water	Solar PV + LED Lighting	Appliance Efficiency + Solar PV	Appliance Efficiency + Solar PV (all electric)
	Upfront Marginal Capital Cost (\$/dwelling)	Upfront Marginal Capital Cost (\$/dwelling)	Upfront Marginal Capital Cost (\$/dwelling)	Upfront Marginal Capital Cost (\$/dwelling)	Upfront Marginal Capital Cost (\$/dwelling)
Hot Water	-	-	-	-	\$2,200
Cooktop	-	-	-	-	-
Space Heating & Cooling	\$360	\$360	-	\$360	\$360
Lighting	\$560	\$560	\$560	\$560	\$560
Fridge	\$764	\$764	-	\$764	\$764
Dishwasher	\$200	\$200	-	\$200	\$200
Clothes washer	\$630	\$630	-	\$630	\$630
Clothes Dryer	\$500	\$500	-	\$500	\$500
Solar PV	-	-	\$510 - \$840	\$510 - \$840	\$510 - \$840
Water Reuse (Recycled Water)	-	\$1,200	\$1,200	\$1,200	\$1,200
EV Charging	\$510	\$510	\$510	\$510	\$510
Parking & Common Areas	\$200	\$200	\$200	\$200	\$200
Cost Benefit Summary					
Total Cost	~\$3,700 per dwelling	~\$4,900 per dwelling	~\$3,000 - \$3,300 per dwelling	~\$5,400 - \$5,700 per dwelling	~\$7,500 - \$8,000 per dwelling
Total Cost as a % of median unit sale price in Parramatta	~0.6%	~0.8%	~0.5%	~0.9%	1.3%
Operational Cost Savings (relative to Base Case)	\$550 per year per dwelling	~\$610 per year per dwelling	~\$370 per year per dwelling	~\$820 per year per dwelling	~\$1,000 per year per dwelling
BASIX Energy	41-42	41-42	40-45	52-57	40-45
BASIX Water	50	65	65	65	65

Table 13: Cost – benefit analysis for 2-14 storey unit dwellings.

Notes:
Costs savings for not including gas connection under the all-electric scenario is unknown and dependant on gas network available and dwelling typology so has not been included in this analysis.
Medium sales price for apartment approximately \$650,000 (As at March 2020)

15-29 STOREYS – PATHWAY TECHNOLOGY ASSUMPTIONS

	Appliance Efficiency	Appliance Efficiency + Recycled Water	Solar PV + LED Lighting	Appliance Efficiency + Solar PV	Appliance Efficiency + Solar PV (all electric)
Dwellings					
NatHERS	6-star average	6-star average	6-star average	6-star average	6-star average
Hot Water	Centralised gas instantaneous with piping R-value of 0.6	Centralised gas instantaneous with piping R-value of 0.6	Centralised gas instantaneous with piping R-value of 0.6	Centralised gas instantaneous with piping R-value of 0.6	Electric Heat Pump with more than 45 STCs (centralised system)
Space Heating & Cooling	5-star A/C (bedrooms only)	5-star A/C (bedrooms only)	2-star A/C (bedrooms only)	5-star A/C (bedrooms only)	5-star A/C (bedrooms only)
Lighting	Dedicated LED lighting	Dedicated LED lighting	Dedicated LED lighting	Dedicated LED lighting	Dedicated LED lighting
Solar	None	None	~30% of roof space and 7m ² /panel	~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	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	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 electric 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	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	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 and 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	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	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	1.04 spaces/dwelling + EV charging	1.04 spaces/dwelling + EV charging	1.04 spaces/dwelling + EV charging	1.04 spaces/dwelling + EV charging	1.04 spaces/dwelling + EV charging
Water Reuse (Recycled Water)	Connected for irrigation, toilet and laundry	Connected for irrigation, toilet and laundry	Connected for irrigation, toilet and laundry	Connected for irrigation, toilet and laundry	Connected for irrigation, toilet and laundry
BASIX Energy Score	38-39	38-39	32-34	44-46	40
BASIX Water Score	50	65	65	65	65

Table 14: Technology assumptions modelled for 15-29 storey unit dwellings.

15-29 STOREYS – COST BENEFIT

	Appliance Efficiency	Appliance Efficiency + Recycled Water	Solar PV + LED Lighting	Appliance Efficiency + Solar PV	Appliance Efficiency + Solar PV (all electric)
	Upfront Marginal Capital Cost (\$/dwelling)	Upfront Marginal Capital Cost (\$/dwelling)	Upfront Marginal Capital Cost (\$/dwelling)	Upfront Marginal Capital Cost (\$/dwelling)	Upfront Marginal Capital Cost (\$/dwelling)
Hot Water	-	-	-	-	\$2,200
Cooktop	-	-	-	-	-
Space Heating & Cooling	\$360	\$360	-	\$360	\$360
Lighting	\$560	\$560	\$560	\$560	\$560
Fridge	\$764	\$764	-	\$764	\$764
Dishwasher	\$200	\$200	-	\$200	\$200
Clothes washer	\$630	\$630	-	\$630	\$630
Clothes Dryer	\$500	\$500	-	\$500	\$500
Solar PV	-	-	\$280 - \$400	\$280 - \$400	\$280 - \$400
Water Reuse (Recycled Water)	-	\$1,200	\$1,200	\$1,200	\$1,200
EV Charging	\$510	\$510	\$510	\$510	\$510
Parking & Common Areas	\$200	\$200	\$200	\$200	\$200
Cost Benefit Summary					
Total Cost	~\$3,700 per dwelling	~\$4,900 per dwelling	~\$2,800 - \$2,900 per dwelling	~\$5,200 - \$5,300 per dwelling	\$7,400 - \$7,500
Total cost as a % of median unit sale price in Parramatta	~0.6%	~0.8%	~0.5%	~0.9%	~1.2%
Operational Cost Savings (relative to Base Case)	~\$550 per year per dwelling	~\$610 per year per dwelling	~\$340 per year per dwelling	~\$790 per year per dwelling	~\$970 per year per dwelling
BASIX Energy	38-39	38-39	32-34	44-46	40
BASIX Water	50	65	65	65	65

Table 15: Cost – benefit analysis for 15-29 storey unit dwellings.

Notes:

Costs savings for not including gas connection under the all-electric scenario is unknown and dependant on gas network available and dwelling typology so has not been included in this analysis.
Medium sales price for apartment approximately \$650,000 (As at March 2020)

30-39 STOREYS – PATHWAY TECHNOLOGY ASSUMPTIONS

	Appliance Efficiency	Appliance Efficiency + Recycled Water	Solar PV + LED Lighting	Appliance Efficiency + Solar PV	Appliance Efficiency + Solar PV (all electric)
Dwellings					
NatHERS	6-star average	6-star average	6-star average	6-star average	6-star average
Hot Water	Centralised gas instantaneous with piping R-value of 0.6	Centralised gas instantaneous with piping R-value of 0.6	Centralised gas instantaneous with piping R-value of 0.6	Centralised gas instantaneous with piping R-value of 0.6	Electric Heat Pump with more than 45 STCs (centralised system)
Space Heating & Cooling	5-star A/C (bedrooms only)	5-star A/C (bedrooms only)	2-star A/C (bedrooms only)	5-star A/C (bedrooms only)	5-star A/C (bedrooms only)
Lighting	Dedicated LED lighting	Dedicated LED lighting	Dedicated LED lighting	Dedicated LED lighting	Dedicated LED lighting
Solar	None	None	~30% of roof space and 7m ² /panel	~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	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	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 electric 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	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	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 and 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	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	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	1.04 spaces/dwelling + EV charging	1.04 spaces/dwelling + EV charging	1.04 spaces/dwelling + EV charging	1.04 spaces/dwelling + EV charging	1.04 spaces/dwelling + EV charging
Water Reuse (Recycled Water)	Connected for irrigation, toilet and laundry	Connected for irrigation, toilet and laundry	Connected for irrigation, toilet and laundry	Connected for irrigation, toilet and laundry	Connected for irrigation, toilet and laundry
BASIX Energy Score	26-33	26-33	19-24	31-36	28-30
BASIX Water Score	50	65	65	65	65

Table 16: Technology assumptions modelled for 30-39 storey unit dwellings.

SECTION

ESTABLISHING SCENARIOS FOR HIGHER PERFORMANCE

30-39 STOREYS – COST BENEFIT

	Appliance Efficiency	Appliance Efficiency + Recycled Water	Solar PV + LED Lighting	Appliance Efficiency + Solar PV	Appliance Efficiency + Solar PV (all electric)
	Upfront Marginal Capital Cost (\$/dwelling)	Upfront Marginal Capital Cost (\$/dwelling)	Upfront Marginal Capital Cost (\$/dwelling)	Upfront Marginal Capital Cost (\$/dwelling)	Upfront Marginal Capital Cost (\$/dwelling)
Hot Water	-	-	-	-	\$2,200
Cooktop	-	-	-	-	-
Space Heating & Cooling	\$360	\$360	-	\$360	\$360
Lighting	\$560	\$560	\$560	\$560	\$560
Fridge	\$764	\$764	-	\$764	\$764
Dishwasher	\$200	\$200	-	\$200	\$200
Clotheswasher	\$630	\$630	-	\$630	\$630
Clothes Dryer	\$500	\$500	-	\$500	\$500
Solar PV	-	-	\$200 - \$260	\$200 - \$260	\$200 - \$260
Water Reuse (Recycled Water)	-	\$1,200	\$1,200	\$1,200	\$1,200
EV Charging	\$510	\$510	\$510	\$510	\$510
Parking & Common Areas	\$200	\$200	\$200	\$200	\$200
Cost Benefit Summary					
Total Cost	\$3,700 per dwelling	~\$4,900 per dwelling	~\$2,700 per dwelling	~\$5,200 per dwelling	~\$7,400 per dwelling
Total cost as a % of median unit sale price in Parramatta	~0.6%	~0.8%	~0.4%	~0.8%	~1.2%
Operational Cost Savings (relative to Base Case)	~\$550 per year per dwelling	~\$610 per year per dwelling	~\$310 per year per dwelling	~\$760 per year per dwelling	\$940 per year per dwelling
BASIX Energy	26-33	26-33	19-24	31-36	28-30
BASIX Water	50	65	65	65	65

Table 17: Cost – benefit analysis for 30-39 storey unit dwellings.

Notes:
Costs savings for not including gas connection under the all-electric scenario is unknown and dependant on gas network available and dwelling typology so has not been included in this analysis.
Medium sales price for apartment approximately \$650,000 (As at March 2020)

40+ STOREYS: PATHWAY TECHNOLOGY ASSUMPTIONS

	Appliance Efficiency	Appliance Efficiency + Recycled Water	Solar PV + LED Lighting	Appliance Efficiency + Solar PV	Appliance Efficiency + Solar PV (all electric)
Dwellings					
NatHERS	6-star average	6-star average	6-star average	6-star average	6-star average
Hot Water	Centralised gas instantaneous with piping R-value of 0.6	Centralised gas instantaneous with piping R-value of 0.6	Centralised gas instantaneous with piping R-value of 0.6	Centralised gas instantaneous with piping R-value of 0.6	Electric Heat Pump with more than 45 STCs (centralised system)
Space Heating & Cooling	5-star A/C (bedrooms only)	5-star A/C (bedrooms only)	2-star A/C (bedrooms only)	5-star A/C (bedrooms only)	5-star A/C (bedrooms only)
Lighting	Dedicated LED lighting	Dedicated LED lighting	Dedicated LED lighting	Dedicated LED lighting	Dedicated LED lighting
Solar	None	None	~30% of roof space and 7m2/panel	~30% of roof space and 7m2/panel	~30% of roof space and 7m2/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	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	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 electric 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	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	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 and 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	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 half the height of the modelled development *	Gearless traction lift servicing half the height of the modelled development *	Gearless traction lift servicing half the height of the modelled development *	Gearless traction lift servicing half the height of the modelled development *	Gearless traction lift servicing half the height of the modelled development *
Parking	1.04 spaces/dwelling + EV charging	1.04 spaces/dwelling + EV charging	1.04 spaces/dwelling + EV charging	1.04 spaces/dwelling + EV charging	1.04 spaces/dwelling + EV charging
Water Reuse (Recycled Water)	Connected for irrigation, toilet and laundry	Connected for irrigation, toilet and laundry	Connected for irrigation, toilet and laundry	Connected for irrigation, toilet and laundry	Connected for irrigation, toilet and laundry
BASIX Energy Score	33	33	25	37	31
BASIX Water Score	50	65	65	65	65

Table 18: Technology assumptions modelled for +40 storey unit dwellings.

40+ STOREYS: COST-BENEFIT

	Appliance Efficiency	Appliance Efficiency + Recycled Water	Solar PV + LED Lighting	Appliance Efficiency + Solar PV	Appliance Efficiency + Solar PV (all electric)
	Upfront Marginal Capital Cost (\$/dwelling)	Upfront Marginal Capital Cost (\$/dwelling)	Upfront Marginal Capital Cost (\$/dwelling)	Upfront Marginal Capital Cost (\$/dwelling)	Upfront Marginal Capital Cost (\$/dwelling)
Hot Water	-	-	-	-	\$2,200
Cooktop	-	-	-	-	-
Space Heating & Cooling	\$360	\$360	-	\$360	\$360
Lighting	\$560	\$560	\$560	\$560	\$560
Fridge	\$764	\$764	-	\$764	\$764
Dishwasher	\$200	\$200	-	\$200	\$200
Clotheswasher	\$630	\$630	-	\$630	\$630
Clothes Dryer	\$500	\$500	-	\$500	\$500
Solar PV	-	-	\$210	\$210	\$210
Water Reuse (Recycled Water)	-	\$1,200	\$1,200	\$1,200	\$1,200
EV Charging	\$510	\$510	\$510	\$510	\$510
Parking & Common Areas	\$200	\$200	\$200	\$200	\$200
Cost Benefit Summary					
Total Cost	~\$3,700 per dwelling	~\$4,900 per dwelling	~\$2,700 per dwelling	~\$5,100 per dwelling	\$7,300 per dwelling
Total cost as a % of median unit sale price in Parramatta	~0.6%	~0.8%	~0.5%	~0.8%	~1.2%
Operational Cost Savings (relative to Base Case)	~\$550 per year per dwelling	~\$610 per year per dwelling	~\$240 per year per dwelling	~\$690 per year per dwelling	~\$870 per year per dwelling
BASIX Energy	33	33	25	37	31
BASIX Water	50	65	65	65	65

Table 19: Cost – benefit analysis for +40 storey unit dwellings.

Notes:

Costs savings for not including gas connection under the all-electric scenario is unknown and dependant on gas network available and dwelling typology so has not been included in this analysis.

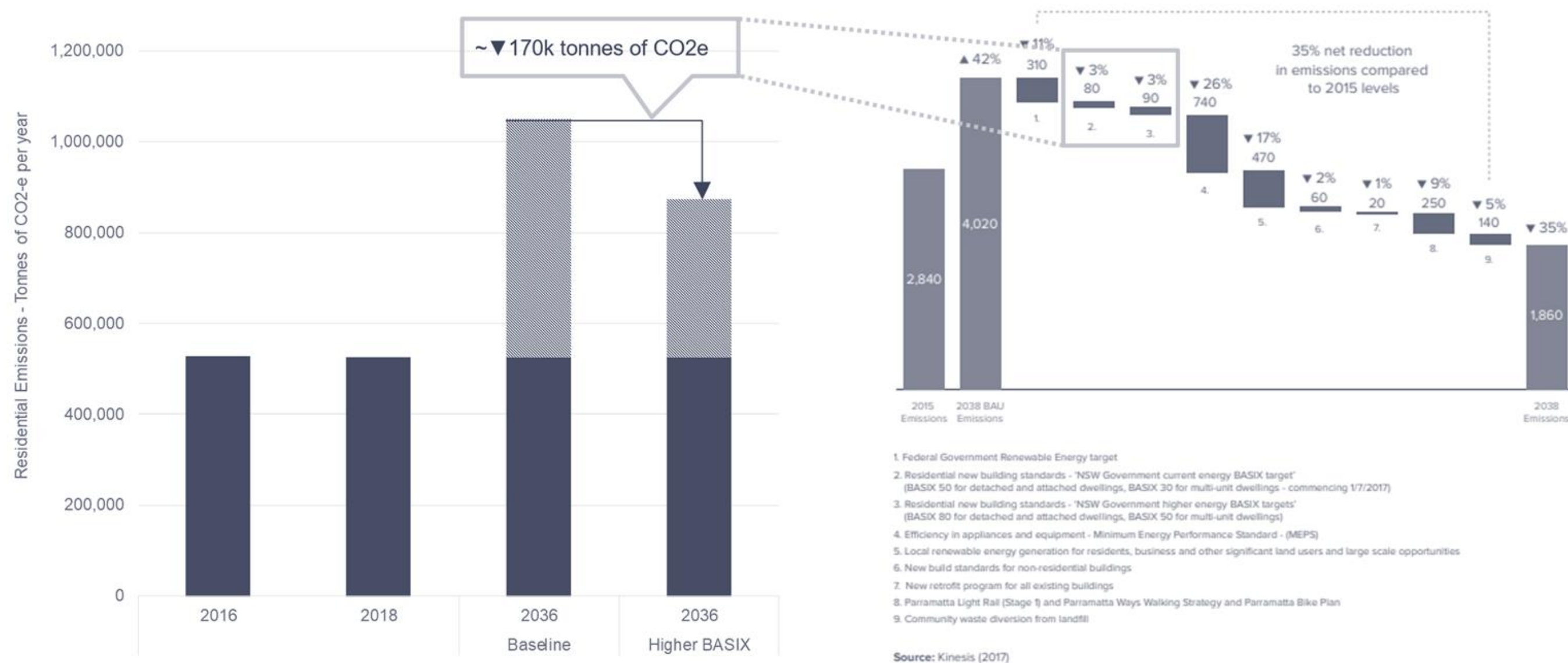
Medium sales price for apartment approximately \$650,000 (As at March 2020)

CUMULATIVE IMPACT OF HIGHER PERFORMANCE

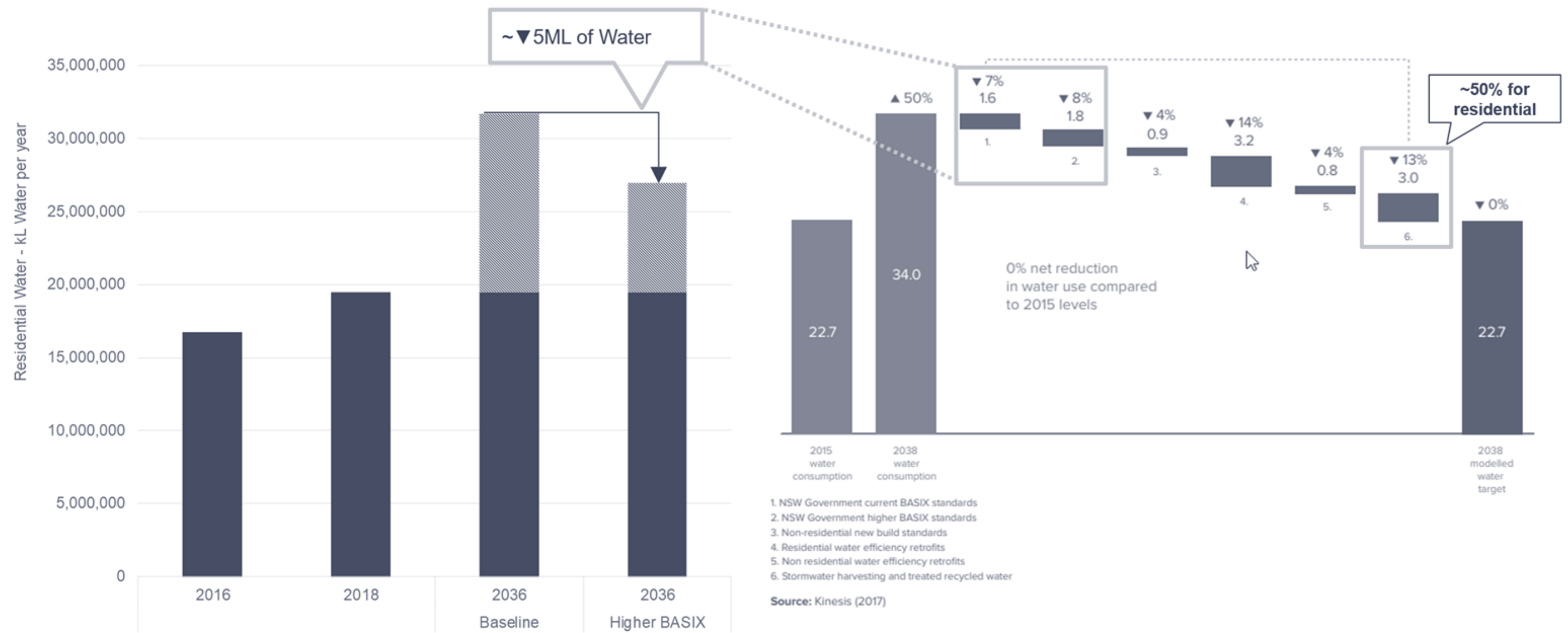
Based on the current projections of dwellings across the Parramatta LGA, Kinesis modelled the cumulative impact of the recommended higher BASIX targets to 2036 to understand its alignment with the original Parramatta Environmental Sustainability Strategy. Both the emission and water reductions from the higher BASIX targets align to the projected impact outlined in the strategy, further supporting the recommended BASIX targets for the Parramatta LGA.

These results are outlined below:

GREENHOUSE GAS EMISSIONS CUMULATIVE IMPACT



WATER REDUCTION CUMULATIVE IMPACT



RECOMMENDATIONS & NEXT STEPS

New residential development across the Parramatta LGA presents an opportunity to deliver significant emissions and water reductions, while also delivering cost savings to residents.

This report has found the following in relation to increasing BASIX targets for new residential development across the Parramatta Local Government Area:

- There is a significant potential to increase BASIX energy targets today, with new single dwellings able to achieve close to net zero emissions or BASIX 100. Significant on-site solar PV is required to achieve these high BASIX energy targets.
- There is a moderate potential to increase BASIX water targets through improved efficiency and moderate increases in rainwater tanks. Without recycled water, the maximum water target that can be achieved is BASIX Water 50. With recycled water, BASIX Water 65 can be achieved for all dwelling typologies.
- BASIX target increases will need to differentiate between both dwelling typologies (single dwellings and apartments) as well as building height, with low rise development more able to achieve higher BASIX targets than high rise development.
- Targets should consider an “all-electric” development typology as a means of future proofing new residential development, moving away from gas as a fossil fuel to 100% renewable energy.

Based on the findings of this report, Kinesis recommends the following higher BASIX targets for new residential development across the Parramatta LGA:

Single dwellings and townhouses:

- BASIX Energy 90 (+50) and BASIX Water 50 (+10)

Apartments:

- BASIX Energy 50 (+25) and BASIX Water 50 (+10) (<14 storeys)
- BASIX Energy 40 (+15) and BASIX Water 50 (+10) (15 - 29 storeys)
- BASIX Energy 35 (+10) and BASIX Water 50 (+10) (30 - 39 storeys)
- BASIX Energy 30 (+5) and BASIX Water 50 (+10) (40+ storeys)

In addition to the above targets, BASIX Water 65 (+25) should be pursued where recycled water is available for connection and use.

In addition, based on the findings of this report, it is clear that single dwellings in particular are able to achieve close to net zero emissions outcomes. Apartments, on the other hand, are unable to achieve zero emissions outcomes onsite due to limitations in roof space for solar PV, requiring offsets or off-site renewable energy to achieve net zero emissions.

As part of any BASIX increase, the City of Parramatta Council should ensure frequent review and updates of higher performance targets to progressively move new residential development towards net zero emissions housing.

Next Steps

This report provides an evidence base and robust cost-benefit analysis for higher BASIX targets across the Parramatta local government area in order to support state government policy and legislation as well as delivering on the City of Parramatta’s Local Strategic Planning Statement.

Coupled with the Local Strategic Planning Statement engagement process, this report should be considered as the supporting evidence required by Council to seek higher BASIX targets from the NSW Department of Planning, Industry and Environment (DPIE) through the BASIX SEPP or BASIX online tool.

The City of Parramatta Council should work with DPIE to urgently increase BASIX targets as outlined in this report in order to ensure the significant amount of residential development is delivered with the highest environment performance, and action on both climate change and water reductions are achieved. Based on the expected growth rates for the Parramatta LGA outlined previously in this report, any delay in increasing the BASIX targets for the LGA would see tens of thousands of dwellings built without these environmental outcomes achieved, further exacerbating the emissions and water impact of Sydney’s growth.

APPENDIX

KEY ASSUMPTIONS

Metropolitan Sydney average benchmarks

Electricity	2,310 kWh per person/year
Gas	3,888 MJ per person/year
Water	201.9 L per person/day
Transport	19.2 km per person/day

Grid Co-efficient

Electricity	0.950 kgCO ₂ -e/kWh
Gas	0.064 kgCO ₂ -e/MJ

Tariffs and rates

Household cost savings outlined in this report are based on 2019 tariffs outlined below:

Residential Water	Rate	Unit
Mains tariff	2.04	\$/kL
Recycled water tariff	1.817	\$/kL
Service charge per dwelling	738	\$/yr
Recycled water service charge	0	\$/yr

Residential Grid Electricity	Rate	Unit
Applied tariff	0.314	\$/kWh
Solar feed-in tariff	0.06	\$/kWh
Service charge per dwelling	335.04	\$/yr

Residential Gas	Rate	Unit
Gas (first 7,565 MJ per qtr/remaining)	0.0407/0.0275	\$/MJ
Service charge per dwelling	229	\$/yr

KEY DATA SOURCES

All results contained in this report are derived from Kinesis analysis using both the DPIE BASIX engine and the Kinesis PRECINX modelling platform.

PRECINX draws on local climate, land use and tariff data, and available utility, government, public and private sector datasets to calculate to performance of proposed developments, precincts, corridors and regions.

Important datasets used in the analysis include:

- Department of Planning and Environment, BASIX – www.basix.nsw.gov.au
- NSW Department of Planning (Ongoing) BASIX Report Data.
- Department of the Environment (Ongoing) National Greenhouse Accounts Factors
- Sales price data sourced from realestate.com.au (accessed March 2020)
- Sydney Water Best Practice Guidelines for water conservation in commercial office buildings and shopping centres (2007) and Best Practice Guidelines for holistic open space turf management (2011)
- National Water Commission, 2011, National performance report 2009-2010: urban water utilities, National Water Commission, Canberra
- Department of Resources, Energy and Tourism, 2010, Energy in Australia – 2010, ABARE, Canberra
- Energy Use in the Australian Residential Sector, 1986 – 2020, Australian Government Department of the Environment, Water, Heritage and the Arts (DEHWA), 2008.
- National Construction Code (2010) Section J - Energy Efficiency Requirements
- Transport Data Centre (2006) The Development of a Sydney VKT Regression Model
- Department of Infrastructure and Transport, 2011, Road vehicle kilometres travelled: estimations from state and territory fuel sales, Australian Government, Canberra
- ABS (2010) 'Household Expenditure Survey, Australia: Summary of Results', catalogue number 65300DO001_200910, Australian Bureau of Statistics, Canberra.
- Kinesis (Ongoing) Water and energy end use data derived from first principle analysis of a range of metered residential and non-residential building types (ongoing, sourced from anonymised CCAP datasets from thousands of buildings, suburbs and cities across Australia), see: www.kinesis.org/ccap-integrated and www.kinesis.org/ccap-city