ARDEN CLIMATE RESPONSE PLAN

Victorian Planning Authority

CITY OF MELBOURNE

Point. Advisory

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WHO WE ARE

HIP V. HYPE SUSTAINABILITY WORKS WITH CLIENTS WHO ARE SEEKING EXCEPTIONAL SUSTAINABILITY OUTCOMES AND ARE WILLING TO THINK STRATEGICALLY TO ACHIEVE THIS.

WE SEE SUSTAINABILITY AS INHERENT TO GOOD DESIGN. IT'S NOT JUST AN OPTION, A DIFFERENTIATOR OR A MARKETING TOOL. AT A GLOBAL SCALE IT IS ALSO, BY DEFINITION, NON-NEGOTIABLE.

—

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Reviewer: Mitra Anderson-Oliver
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Date: 2nd December 2019

DISCLAIMER

Contents

Executive Summary

The Arden Urban Renewal Area (AURA) will be developed over the next 30 years to cater for 34,000 new jobs and 15,000 residents. For the purposes of this report, 'Arden' is defined as the specific precinct within the AURA boundary. Its evolution over this period will be guided by the planning, investment, governance and operational decisions made through the course of its development.

HIP V. HYPE and partners Point Advisory and Hansen Partnership have been engaged by the Victorian Planning Authority to develop a Climate Response Plan (CRP) Evidence Base for Arden as a key input into the Arden Structure Plan. The Arden Structure Plan is the primary planning mechanism for guiding Arden's future, setting the guiding principles and requirements for the planning rules for the precinct as well as a number of investment commitments. The Arden Vision highlights the underlying sustainability objectives for the precinct, including 'embedding sustainable change' with specific direction for a low carbon precinct. Because of the transformative change envisaged for Melbourne's urban renewal areas and the opportunity for precinct level solutions, Arden has potential to deliver deeper carbon reduction than an area undergoing only incremental change.

This evidence base has been developed to support the establishment of a preferred carbon trajectory for the whole precinct, inclusive of operational stationary energy, transport and waste emissions. A secondary objective of the work is to identify building scale planning controls that can deliver both mitigation and climate resilience outcomes.

METHOD

A six-step process was used to complete this work.

1_ Context setting - re-establishing context through inception meetings with the VPA (Victorian Planning Authority) and City of Melbourne and a review of Arden specific and related policies and documents.

2_ Preliminary stakeholder engagement - Local, State Government and industry stakeholders who have an active interest in or are responsible for delivering the Arden Structure Plan were consulted.

3_ Analysis Framework - A framework for analysis was developed based on the mechanisms that are available to State Government and Local Government to drive climate responsive outcomes in the built environment as outlined below:

_ Direct investment by the State, City or developer partner) in precinct infrastructure to support an outcome (e.g. resource hubs / Electric Vehicle (EV) charging hubs / public transport)

_ Operational arrangements / investments (by the State, City or developer partner) to support an outcome (e.g. organics collection)

_ Planning controls – control / development-based rule or incentive on development that either links to the above investments or stands on its own. (e.g. NABERS (National Australian Built Environment Rating System) or mandated connection to recycled water)

_ Other regulatory mechanisms such as disclosure of energy performance

_ Finance, governance and operational models - mandatory and voluntary (ongoing performance measurement, green concierge etc)

4_ Scenario development and analysis - three carbon scenarios (refer page 6) were developed to understand the opportunity in each sector and the impact of carbon reduction mechanisms in the precinct.

Carbon scenarios were developed alongside an analysis of:

_ Case study exemplars relevant to Arden (national and international)

_ Finance, governance and operational models specific to the Arden context

_ A range of potentially appropriate ratings tools and frameworks which could be applied to the precinct either through planning controls or other mechanisms

_ Planning controls capable of supporting strong carbon reduction and building level climate adaptation responses

_ The specific role of energy efficiency, on-site renewables and off-site renewables as part of a sustainable stationary energy approach

The combination of this analysis informed a refined list of mechanisms which in combination were capable of supporting the ambition for the precinct. Further evidence was sought in relation to the recommended mechanisms to ensure a robust evidence base.

5_ Findings validation - Findings, planning controls and finance, governance and operational models were reviewed in a targeted stakeholder workshop. This included validating:

_ Scenario pathways

_ Preliminary mechanism recommendations

This phase also included validation of potential planning controls and finance, governance and operational models with the development industry to understand their commercial viability and improve implementation. Preferred mechanisms were then further refined and confirmed to deliver a holistic climate response outlined below:

_ Overall climate response – this includes a suite of overarching mechanisms that reinforce Direction 3 of the Arden Vision to embed sustainable change

_ Stationary Energy – a suite of mechanisms that respond to the need to significantly reduce stationary energy consumption and ensure the remainder is sourced from renewable energy

_ Transport – a suite of mechanisms that drive transport related carbon reduction (noting that the outcome of this work will need to be aligned with the Precinct Transport Plan (PTP) (ITP)

_ Waste – a suite of mechanisms that drive waste related carbon reduction (noting that a Precinct Waste Management Plan has not yet been developed)

_ Building scale climate resilience – a suite of planning controls focused on ensuring built form is highly responsive to current and future climate impacts

A summary of these mechanisms and their overall justification is demonstrated on the following 3 pages in Table 1.

Executive Summary

TABLE 1 - MECHANISM SUMMARY TABLE

CLIMATE RESPONSE AREA	MECHANISM	MECHANISM TYPE	OVERALL JUSTIFICATION
Overall climate response	1_Overarching Green Star building standard, including _ 6 Star Green Star (D&AB) for all non-residential development above 2000sqm in GFA (Gross floor area) _ 5-star Green Star (D&AB) for all residential development above 10 dwellings _ For development below this scale, development must achieve 70% using the Built Environment Sustainability Scorecard (BESS).	Planning control	The highest quality buildings are sought in Arden, which is to be an 'exemplar'. Adopting a ratings framework with the market credibility of 2542 certified projects and the strong technical basis and verification process of Green Star will help ensure that this is what is delivered. As built certification is required to ensure objectives are delivered.
	2_Operational Management Plans and planning enforcement - mandating the development of operational management plans and providing significant increased resourcing for planning enforcement to ensure compliance with them.	Planning control and operational investment	The planning control and investment in planning enforcement is necessary to ensure that the commitments made at the design stage are maintained through the operational life of the building locking in certainty around carbon reduction in particular.
	3_Contractual carbon target - the development of contractual conditions with the developer(s) of the Arden Central public land that lock in zero carbon in operation for the portion of that precinct procured through developer partnerships (noting that the hospital (if delivered) and education would be delivered via a separate model).	Finance, governance and operational model	Without a contractual agreement that locks in carbon reporting and targets over the long term there is uncertainty over how zero carbon for Arden Central could otherwise be achieved.
	4_Financial bond for operational performance - recommended to make sure environmental contractual obligations are met. These obligations can be varied in nature, and they can include achieving a set performance objective.	Finance, governance and operational model	The bond creates a strong financial incentive to pay attention to environmental conditions for the project and deliver evidence of conditions being met.
	5_Disclosure of operational performance - a regulatory requirement for building owners to publicly disclose their operational performance.	Other regulatory mechanism	The mechanism provides a powerful yet non-prescriptive market signal that encourages upgrades of building stock and can allow for monitoring of precinct / city wide environmental performance.
Stationary Energy	6_Minimum energy performance standards - development must achieve and maintain energy ratings well beyond minimum compliance (related to building type.	Planning control	Improving energy performance at the design stage is proven to be one of the most effective and cost-effective ways of improving the long-term, 'built-in' performance of buildings.
	7_All electric building standard	Planning control	All-electric buildings significantly reduce the need to purchase offsets to achieve zero carbon by 2030 as all stationary energy can be delivered through renewable electricity.
	8_Power purchase agreement - a government facilitated Power Purchase Agreement (PPA) to be developed for the Arden Urban Renewal Area.	Finance, governance and operational model	The model is recommended as a way of providing leadership and reducing the cost of renewables sourcing to other customers in the precinct, therefore significantly contributing to carbon reduction from stationary energy that would otherwise need to be offset at cost.

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CLIMATE RESPONSE AREA	MECHANISM	MECHANISM TYPE	OVERALL JUSTIFICATION
Transport	9_Consolidated car parking - it involves Government (State or Local) facilitating the locations for a limited number of consolidated car parks on the Arden periphery.	Direct and operational investment	Strategic location of car parking can help promote reduced mode share for private vehicles and more cost-effective electric vehicle charging.
	10_Car parking and active transport standards - a multi-faceted approach to encourage active transport and limit private vehicle trips consistent with the Arden Vision for a mode share of 10% for private vehicle trips.	Planning controls	Car parking spaces must be restricted during the design phase for all new buildings to meet policy requirements for public and active travel mode share to be a 90%. Active transport infrastructure is required to be the highest possible standard to support the 30% target for active transport.
	11_Centralised distribution centre - Government (State or Local) encouraging or mandating a local high efficiency local distribution centre that collects all deliveries for businesses and residents and distributes them in a sustainable way (bike or electric delivery).	Finance, governance and operational model	The purpose is to reduce freight transport emissions and local traffic by reducing trip numbers and using low-emissions vehicles for deliveries.
	12_Electric Vehicle Standards to ensure development: _ Includes preferential location for EV parking in preference to ICE's (Internal Combustion Engine's) _ Requires minimum provision of car spaces to include Level 2 charging infrastructure (with a trajectory rising from 20% to 90% by 2040) _ Locate all charging infrastructure on private land	Planning control	Running transport on electricity enables zero-emissions transport when paired with renewable energy, decreasing the need to continually offset in the precinct.
Waste	13_ Waste standards - requires that any waste management undertaken in private development aligns and responds to any precinct wide waste management plan and that organics are separated at the building level.	Planning control	In higher density, building planning standards are required to embed waste management practices and ensure opportunity is created for source separation and overall waste diversion rate from landfill. From an emissions perspective, and from the perspective of broader waste reduction, there is significant evidence that the separation of organics from general waste streams is one of the critical elements in delivering carbon reduction from the waste sector.
	14_ Resource hubs and waste education - Government (State or Local) facilitating small resource recovery hub(s) for residents and businesses, the location and number to be driven by more detailed precinct waste management planning. The resource hubs would also support an operational function to provide waste education services.	Direct and operational investment	The investment is necessary to increase source separation and overall waste diversion rates from landfill – in particular for the separation of waste streams in buildings to have maximum effectiveness.

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CLIMATE RESPONSE AREA	MECHANISM	MECHANISM TYPE	OVERALL JUSTIFICATION
Building scale climate resilience	15_ Building reuse and adaptability standards - for a range of requirements designed to ensure future reuse of buildings.	Planning control	The environmental and economic costs of demolishing buildings is high. Avoiding this by designing in adaptability will have a long term positive impact on the sustainability of the precinct, and ability for it to take up future opportunities (for example, moving between residential and commercial uses as demand requires) and phase out of unsustainable practices (such as private car parking).
	16_ Urban heat standard - requires materials that minimise UHI (Urban Heat Island) with a standard of at least 75% of the total project site area in plan view that comprise building or landscaping elements that increase the solar reflectance of the site.	Planning control	The retention of heat by buildings is a strong contributing factor to Melbourne's Urban Heat Island effect. These effects are expected to be exacerbated by climate change. With Arden being planned to be a high-density precinct, it is critical to ensure new development avoids further exacerbating the UHI effect.
	17_Green Infrastructure standard - all buildings meet a standard for 40% horizontal or equivalent vertical green cover as demonstrated through the CoM Green Factor tool.	Planning control	This benchmark is a valuable component of any attempt to regulate local climatic conditions given the recognised ability of green cover to a range of ecosystem services including stormwater runoff mitigation, urban heat reduction and habitat for biodiversity. Green infrastructure also contributes to place value and social cohesion.
	18_Integrated Water Management Standards - all buildings must connect to any precinct third pipe and stormwater management system and comply with Best Practice Environmental Management (BPEM) Guidelines for stormwater management	Planning control	Given the extent of flooding present in Arden and its location adjoining one of Melbourne's major waterways, stormwater management is a fundamental part of any policy that applies to the land.

Executive Summary

CARBON SCENARIOS

The combination of mechanisms align to the zero carbon scenario outlined in Section 4 and help justify its adoption. A climate positive scenario was originally envisaged for this work. It has the same emissions trajectory within the Arden boundary as the zero carbon scenario and so does not represent a different carbon model, but includes the potential for additional initiatives with a reach beyond the boundary of the precinct. The C40 framework further defines "climate positive" as a suite of measures "that have an impact that extends beyond the boundary of the site". A reference to climate positive is made where mechanisms could be expanded or lend themselves to improving climate mitigation or adaptation beyond the precinct.

The development of the carbon model for Arden allowed iteration with the mechanisms such that the carbon impacts could be measured in isolation and in aggregate. This is presented in terms of three different scenarios which reflect varying ambition in relation to carbon reduction within the precinct:

Business as usual (BAU) is the most likely scenario if no additional controls or measures are adopted for the Arden precinct. Modelling showed that Arden's emissions are predicted to increase as the precinct develops, increasing to 80,692 tCO2-e in 2040 and then decreasing slightly 77,410 tCO2-e in 2050.

Low carbon incorporates the majority of the mechanisms from the zero carbon scenario (see description of the scenario below), but with less ambitious timeframes and uptake rates assumed. Importantly, the low carbon scenario does not include mechanisms to ensure that renewable energy is purchased to offset the precinct's electricity use. Modelling showed that emissions decrease by 41% from 77,410 to 45,214 tCO2-e in 2050.

Zero carbon: all emissions, sinks and offsets in the precinct's inventory (reported in line with the requirements of the Climate Active Carbon Neutral Standard for precincts (formerly the National Carbon Offset Standard (NCOS) for precincts)) equal net zero emissions by 2030. Two zero carbon models were produced:

- Energy efficiency and other emissions reductions measures were rolled out, to demonstrate how far the precinct can go in terms of emissions reductions without on-site solar generation. Under this scenario, emissions reduction measures reduce emissions by 54% in 2050 compared with the BAU scenario. The remainder of emissions (the emissions 'gap') needs to be filled by renewable electricity, sourced locally for a small proportion and otherwise through off-site energy contracts, and offsets
- A zero carbon trajectory with renewables and offsets included was rolled out; the precinct will be carbon neutral from 2030 with abatement from offsets. Under this scenario, emissions decrease by ~90% in 2040 and 2050 without any offsetting. The majority of abatement from 2030 to 2050 is due to renewable energy procurement, followed by energy efficient commercial buildings and waste reduction strategies

Offsets are still required to address residual emissions from waste) and natural gas (unless all buildings can be fully electric, including the hospital (if delivered)* and some specific research laboratory uses). Offsets also cover emissions from private transport that is not powered by renewable sources, although it is assumed that this tapers off to zero by 2050.

The figures over page summarise the findings from each scenario.

** This report has been prepared on the premise that a hospital could be included in the long term plan for Arden, however there is no current commitment from Government for a hospital to be delivered. A hospital has been included in the analysis and reporting because of its potential as a very high emissions land use to impact the zero carbon outcome being sought if it is pursued in the future. It by no means implies that it will be pursued, but future proofs the climate response plan in the event that it does.*

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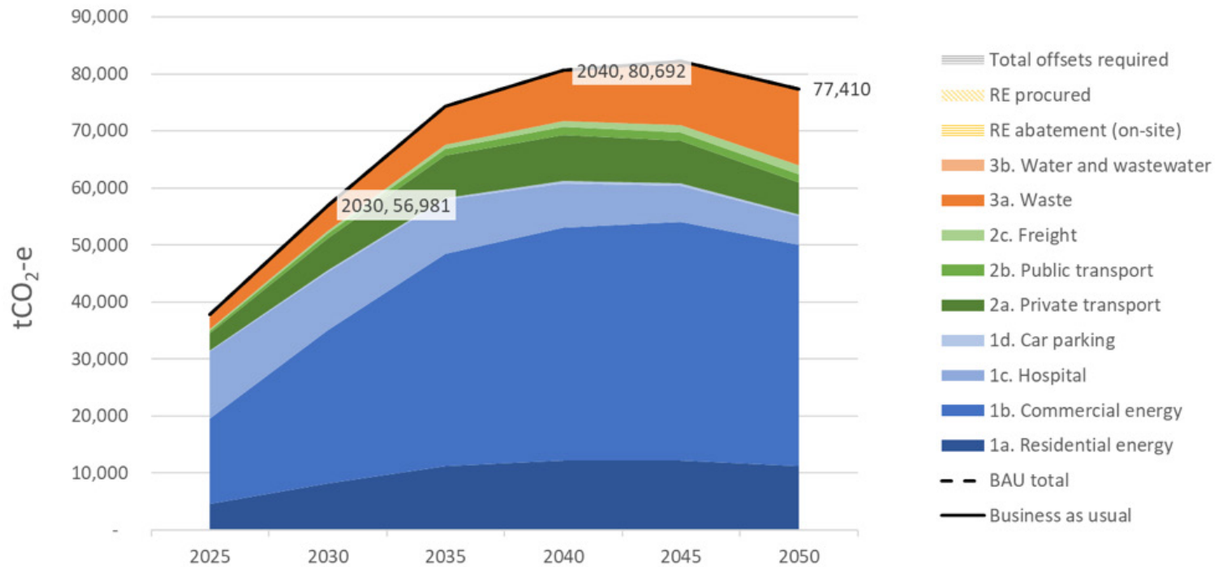


FIGURE 3. BAU TRAJECTORY UNDER A MODERATE RATE OF DECARBONISATION

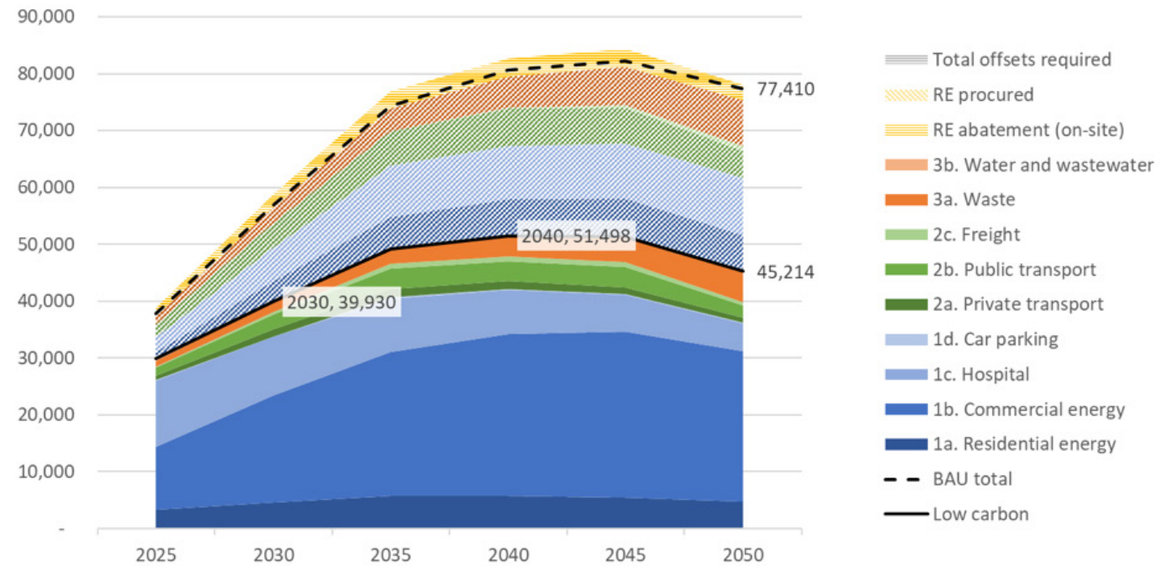


FIGURE 5. LOW CARBON TRAJECTORY

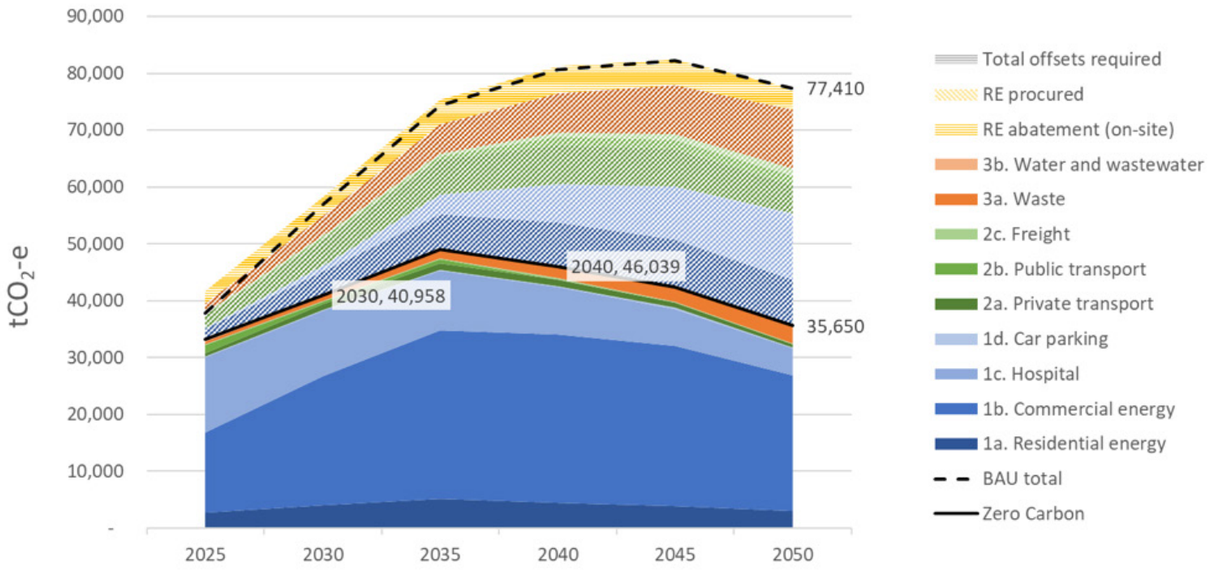


FIGURE 6. ZERO CARBON TRAJECTORY (WITH ENERGY EFFICIENCY AND OTHER REDUCTION MEASURES ONLY)

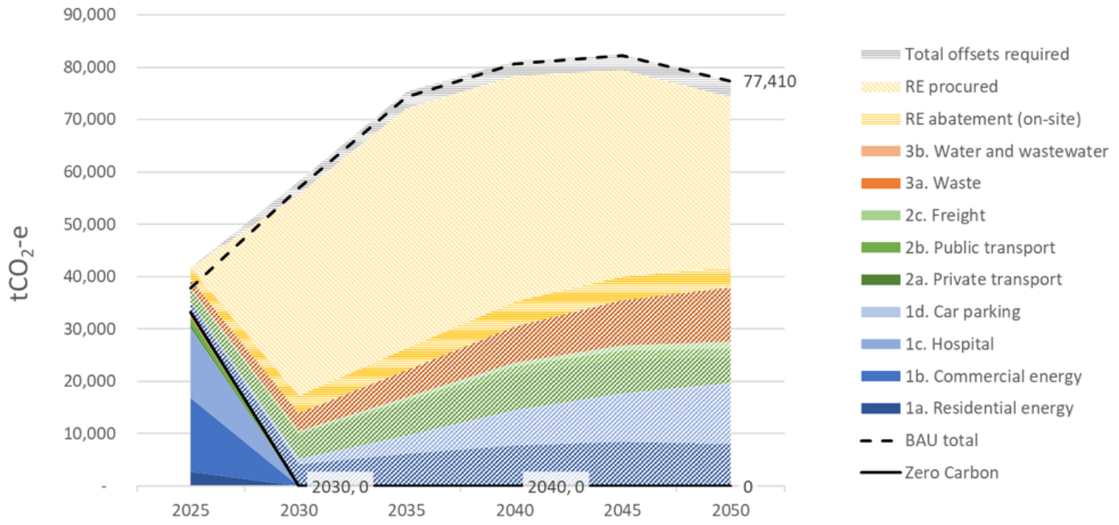


FIGURE 7. ZERO CARBON TRAJECTORY (WITH RENEWABLES AND OFFSETS)

Executive Summary

CONCLUSION

We conclude:

_ The combined urgency of deep carbon reduction and climate resilience to current and future climate impacts provides a strong foundation for needs for global cities to use urban renewal to drive transformative change

_ Both the Arden Vision, State Policy and Local Policy support strong carbon reduction and climate resilience outcomes, as does the earlier Arden Climate Response Framework

_ The pre-conditions for planning of Arden (large public land holding and strong alignment with key stakeholders for an exemplar urban renewal precinct) support strong carbon reduction and capability for highly climate resilient built form

_ The analysis of national and international case studies indicate that the planning and non-planning tools are available to drive the outcomes sought

_ The analysis of ratings tools and frameworks suggest that the Green Star suite of ratings tools are the most appropriate for guiding a holistic climate response

_ There is strong planning evidence for a suite of controls requiring high levels of environmental performance, covering a range of climate response areas

_ A range of finance, governance and operational models could be applied to the precinct to support the planning controls, and there is strong potential to affect carbon related energy supply through a government backed power purchase agreement

_ The development pathways for the publicly held and privately held land are very different and different mechanisms are required to deliver on their potential

_ The bulk of modelled emissions are within the publicly held land, indicating that a development model which supports contractual carbon targets is likely to be highly effective in contributing to precinct wide carbon targets

_ The mechanisms governing the operational phase of the development are critical to long term success

_ The role of on-site generation of electricity is limited by density, increasing the importance of energy efficiency and off-site renewables procurement

_ With the adoption of recommended mechanisms across overarching climate response, stationary energy, transport, waste and building scale climate resilience, a zero carbon target is both practical and commercially sound

_ In adopting a zero carbon pathway there is potential for direct investments / operational models that can support carbon reduction beyond the Arden boundary, which would contribute to a ‘climate positive’ development

_ A small suite of planning controls will be effective in ensuring climate risks are mitigated at the building level, complementing precinct scale responses for reduction of urban heat and integrated water management

_ To reach net zero emissions by 2030 and thus assist the City of Melbourne in meeting a 1.5oC scenario consistent with the Paris Agreement, there will be a need to use mechanisms source 100% renewable electricity for the precinct and to purchase a relatively small quantity of carbon offsets to cover the residual emissions from difficult to eliminate sources, primarily gas use for specific activities (medical / research) and for residual waste emissions.

SECTION 1
BACKGROUND AND METHODOLOGY FOR THE STUDY

Background

The Arden Urban Renewal Area (AURA) will be developed over the next 30 years to cater for 34,000 new jobs and 15,000 residents. For the purposes of this report, 'Arden' is defined as the specific precinct within the AURA boundary. Its evolution over this period will be guided by the planning, investment, governance and operational decisions made through the course of its development.

HIP V. HYPE and partners Point Advisory and Hansen Partnership have been engaged by the Victorian Planning Authority to develop a Climate Response Plan (CRP) Evidence Base for Arden as a key input into the Arden Structure Plan. The Arden Structure Plan is the primary planning mechanism for guiding Arden's future, setting the guiding principles and requirements for the planning rules for the precinct as well as a number of investment commitments. The Arden Vision highlights the underlying sustainability objectives for the precinct, including 'embedding sustainable change' with specific direction for a low carbon precinct. Because of the transformative change envisaged for Melbourne's urban renewal areas and the opportunity for precinct level solutions, Arden has potential to deliver deeper carbon reduction than an area undergoing only incremental change.

Achieving high standards for new buildings and infrastructure is crucial in delivering carbon reduction, as design decisions can lock in operational emissions for the lifetime of the asset (e.g. fuel mix, thermal performance levels). This is well recognised by industry through GBCA's (green Building Council Australia) Carbon Positive Pathway and the recent work by ASBEC (Australian Sustainable Built Environment Council) and ClimateWorks 'Built to Perform: An Industry Led Pathway to a Zero Carbon Ready Building Code'.

The development of this CRP Evidence Base builds on the Climate Response Framework (CRF) created for the precinct, developed between November 2018 and February 2019.

That work, also undertaken by HIP V. HYPE, identified 6 opportunity areas for delivering a climate responsive precinct. These include:

_ Opportunity 1 - A 100 per cent renewable energy supply
_ Opportunity 2 - Healthy and energy efficient buildings
_ Opportunity 3 - Zero emissions transport
_ Opportunity 4 - Enabling a circular economy
_ Opportunity 5 - Integrated water management
_ Opportunity 6 - Cooling and greening

These six opportunity areas are being addressed through several pieces of parallel work, including this engagement. The CRF also highlighted a number of key considerations for delivering a climate responsive precinct, including:

_ High levels of public land ownership
_ A new metro station in North Melbourne currently under construction
_ Moonee Ponds Creek as the western border to AURA
_ Localised flooding as a key challenge for Arden
_ Industrial history and heritage
_ Inequitable open space distribution across the precinct
_ Wurundjeri people as the traditional owners of the land

Of these, the leveraging of the government owned land is critical to ensuring the precinct realises its ambitions. The existence of land held in public ownership has been an essential ingredient in the majority of world leading urban renewal projects, as demonstrated in a number of documented case studies. This report will clearly delineate the different opportunities presented by the public and privately-owned land.

Background

ARDEN'S VISION IS TO CONTRIBUTE TO A FUTURE MELBOURNE THAT IS NOT ONLY THE WORLD'S MOST LIVEABLE CITY, BUT ALSO ONE OF THE MOST FORWARD-THINKING.
IMAGE: VPA

PURPOSE OF THE PROJECT

To support ambitious carbon reduction targets, the VPA and CoM (City of Melbourne) need a strong evidence base for both the targets, and the preferred suite of mechanisms that will underpin Arden's broader climate response. This study was commissioned by the VPA to develop this evidence base. The study tests and makes recommendations for carbon targets for both government and privately controlled land and considers the 'when' and 'how' of both mitigation and adaptation climate responses.

This evidence base has been developed by HIP V. HYPE and partners to support the establishment of a preferred carbon trajectory for the whole precinct, inclusive of operational stationary energy, transport and waste emissions. A secondary objective of the work is to identify building scale planning controls that can deliver both mitigation and climate resilience outcomes. Precinct level infrastructure and public realm design (streetscapes, open space, flood management) are key components of the Arden Structure Plan and critical to delivering a climate resilient Arden. Their consideration is not the focus of this work, however this work references these influences in providing direction to the building scale responses that can complement the precinct scale responses.

The evidence base will underpin content for inclusion within the Structure Plan including robust planning controls. As the planning process is only one of a suite of interventions that will influence the development of the precinct, this study also includes the investigation of non-planning mechanisms such as regulation, finance, governance and operational models that can support carbon reduction and other climate related goals.

Methodology

A comprehensive six-step process was used to complete this work.

1_ CONTEXT SETTING

This stage involved re-establishing context through inception meetings with the VPA and City of Melbourne and a review of Arden specific and related VPA and City of Melbourne policies and documents (see Document Review section below for a full list).

From here, a long-list of potential tools, mechanisms and examples for achieving sustainability outcomes was developed for both government owned and privately owned land. This list formed the foundation for consultation with the VPA, City of Melbourne and other stakeholders to find the most appropriate mechanisms for the Arden context.

2_ PRELIMINARY STAKEHOLDER ENGAGEMENT

The diversity of landownership and scale of the Arden project means that stakeholder buy-in is essential for success. Local, State Government and industry stakeholders who have an active interest in or are responsible for delivering the Arden Structure Plan were consulted to understand the specific perspectives of each entity (something that is not efficiently achieved in a larger multi-stakeholder workshop). This also informed the proposed scenarios for the analysis stage and technical parameters of each scenario (see Stakeholder Engagement section below for further detail).

3_ ANALYSIS FRAMEWORK

A framework for analysis was developed based on the mechanisms that are available to State Government and Local Government to drive climate responsive outcomes in the built environment building and classifying the long list into five types.

_ Direct investment by the State, City or developer partner) in precinct infrastructure to support an outcome (e.g. resource hubs / Electric Vehicle (EV) charging hubs / public transport)

_ Operational arrangements / investments (by the State, City or developer partner) to support an outcome (e.g. organics collection commitment)

_ Planning controls – control / development-based rule or incentive on development that either links to the above investments or stands on its own (e.g. NABERS or mandated connection to recycled water)

_ Other regulatory mechanisms - such as disclosure of energy performance

_ Finance, governance and operational models - mandatory and voluntary (ongoing performance measurement, green concierge etc)

4_ SCENARIO DEVELOPMENT AND ANALYSIS

Three carbon scenarios were developed to understand the impact of carbon reduction mechanisms in the precinct. Analysis was conducted to test three scenarios – low carbon, zero carbon and climate positive – against business as usual (BAU).

These were developed alongside an analysis of:

_ Case study exemplars relevant to Arden (nationally and internationally)

_ Finance, governance and operational models specific to the Arden context

_ A range of potentially appropriate ratings tools and frameworks which could be applied to the precinct either through planning controls or other mechanisms

_ Planning controls capable of supporting strong carbon reduction and building level climate adaptation responses

_ The specific role of energy efficiency, on-site renewables and off-site renewables as part of a sustainable stationary energy approach

The combination of this analysis informed a refined list of mechanisms which in combination were capable of supporting the ambition for the precinct. Further evidence was sought in relation to the recommended mechanisms to ensure a robust evidence base.

5_ VALIDATION

Findings, planning controls and finance, governance and operational models were reviewed in a targeted stakeholder workshop. This included validating:

_ Scenario pathways

_ Preliminary mechanism recommendations

This phase also included validation of potential planning controls and finance, governance and operational models with the development industry to understand their commercial viability and improve implementation.

6_ REPORTING

This report was developed to consolidate the outcomes of the above work to support the development of the Arden Structure Plan.

Methodology

DOCUMENT REVIEW

A review of documents was undertaken (publicly available as well as documents provided by the VPA). This included review of relevant State and Local policy documents as listed below:

_ City of Melbourne Climate Change Mitigation Strategy to 2050 (2018)

_ City of Melbourne Waste and Resource Recovery Strategy 2030 (2019)

_ City of Melbourne Transport Strategy 2030 (2019)

_ City of Melbourne Climate Change Adaptation Strategy Refresh (2017)

_ City of Melbourne Municipal Integrated Water Management Plan (2017)

_ City of Melbourne Urban Forest Strategy (2014)

_ City of Melbourne Open Space strategy (2012)

_ City of Melbourne Planning Scheme (relevant clauses 22.19 and 22.23)

_ City of Melbourne, West Melbourne Structure Plan and Amendment (2018)

_ Victoria State Government, Climate Change Act (2017)

_ Victoria State Government, Victoria's Renewable Energy Roadmap (2015)

_ Victoria State Government, Plan Melbourne 2017-2050 (2017)

_ VPA, Victoria State Government and City of Melbourne, Arden Vision (2018)

_ Victorian Government, Fishermans Bend Framework Plan (2018)

A number of additional technical studies which focus on Arden have been reviewed, including:

_ City of Melbourne, Arden-Macaulay Structure Plan (2012)

_ CRC for Water Sensitive Cities, Monash Art Design and Architecture, Arden Macaulay in Transition, Four adaptive design concepts for drainage and flood management (2017)

_ VPA, Land Contamination Assessment Arden Urban Renewal Precinct (2018)

Additional evidence including technical studies, policy papers and academic literature was reviewed in order to derive and support the evidence base. This evidence is documented in the main body of the report.

Preliminary Engagement

The project team hosted a series of engagement meetings with project stakeholders. The purpose of the engagement was to seek input from local and State Government as well as industry stakeholders who have an active interest in or are responsible for delivering the Arden Structure Plan. Through a series of questions, stakeholders were asked to identify information (both context specific and references) relevant to the development of this work.

Each interviewee took part in a brief project overview followed by a short discussion about their interest in the relation to the Arden Structure Plan.

Stakeholder engagement meetings were held from 16-30 September 2019. Table 2 (opposite) summarises the stakeholders engaged with during this process, and their position / area of expertise within the organisation.

TABLE 2 - STAKEHOLDERS ENGAGED THROUGHOUT THE PROJECT

STAKEHOLDER	POSITION / SECTOR
Department of Jobs, Precincts, Regions (DJPR)	Senior Adviser - Precincts and Suburbs, Precincts Development and Delivery
Development Victoria (DV)	Development Director
Department of Environment, Land, Water and Planning (DELWP) - Planning	Project Officer - Planning
Department of Environment, Land, Water and Planning (DELWP) - Energy	Senior Policy Officer - Distributed Ener-gy Resources
Sustainability Victoria (SV)	Project Lead - Land Use Planning - Waste and Resource Recovery
Department of Transport (DoT)	Transport Planners and Policy Officer
Australian Sustainable Built Environment Council (ASBEC)	Executive Director
Green Building Council of Australia (GBCA)	Senior Manager - Market Engagement

STAKEHOLDER RESPONSES

Stakeholder responses have been summarised below into the following categories: mechanism types, energy, transport, waste and building scale adaptation measures. A detailed summary is provided as Appendix A. The critical responses are outlined below.

Mechanism types

Stakeholders were informed of the different mechanism types being considered by this work (refer Methodology section for description) and provided examples from the long list of potential mechanisms to prompt discussion.

It was highlighted that there is greater opportunity for direct investment into State-owned land with stronger governance and operational controls, compared with private land. DELWP indicated that non-planning mechanisms on private land are often more difficult to enforce.

An Eco-District type model was identified by GBCA as having merit, and could be a good federating mechanism, if government could encourage or require stakeholders to sign up to a vision and partnership for public land (and potentially private land).

Energy

Stakeholders were informed of energy-related mechanisms being considered.

Respondents highlighted that issues of consumer protection interact with embedded networks, micro-grids and, to some extent, with PPA contracts. This is an ongoing area of work for DELWP.

Multiple respondents noted that the potential for government to be an anchor tenant or landlord represents a unique opportunity for government (DJPR, DV) to locate some services or departments in the Arden precinct and leverage the opportunity to aggregate services at scale and support the development of the precinct. GBCA suggested that Government could effectively take on this initial cost and help de-risk for those who follow.

GBCA noted the limited opportunity for on-site energy generation in Arden, pointing to a need to focus on procurement of offsite renewables, with the potential for an owners cooperative or a special purpose vehicle (SPV) for the Arden Central site to be considered for utilities provision.

There was a strong suggestion from ASBEC that there must be verification processes in the policy / compliance process both for energy and other emissions sectors. Stakeholders noted that once the building is developed, maintenance and optimisation of its performance is critical.

According to GBCA, all new Green star rated buildings will be required to be carbon neutral by 2030 according to its Carbon Positive Pathway, and existing buildings by 2050 (by World Green Building Council definition) highlighting the potential for its use as part of a suite of planning controls.

Transport

Stakeholders were informed of detailed transport related mechanisms being considered.

At the time of engagement, planning for transport was not at an advanced stage and no firm commitment beyond the train station had been made with regards to transport for Arden.

Transport stakeholders including DoT highlighted public transport opportunities, safe pedestrian and cycling paths and secure bicycle parking as essential to the transport master plan.

Car parking was raised as a critical issue in supporting modal shift towards active and public transport. De-bundling residential and commercial space from car parking and reducing car parking requirements was considered a strong option to consider. DoT considered that low / no car parking provisions would need to be supported by an increase in carshare services and adequate bike facilities.

Stakeholders including DELWP suggested that removal of car parking must have a very strong evidence base and clear plan as to how to facilitate the necessary reduction in car use.

EV transition was highlighted as both a challenge and an opportunity. The uptake could increase rapidly (30% by 2030, according to a DoT estimate), hence infrastructure at the building level needs to be planned (through provisions in the planning scheme) and discussions with the electricity distributor must be held to ensure that the grid is able to cater for additional electricity demand (DoT).

Waste

Stakeholders were informed of the detailed waste related mechanisms being considered.

SV and GBCA suggested Arden should be looking to use waste mechanisms to achieve higher targets and a circular economy. They considered that management of waste requires a mix of:

- Planning controls to ensure the infrastructure required to optimal waste management is in place (GBCA); and
- Operational mechanisms to ensure waste is managed appropriately in the long run. Buildings must have a considered waste management plan (SV).

SV emphasised that the content of a waste management plan needed to document the specific role of the building manager or owner's corporation manager in facilitating and managing the waste plan. It should also consider what kind of ongoing specialised maintenance must be provided throughout the life of the building. SV highlighted the potential for an ongoing waste management oversight role.

Organics were highlighted by SV as a critical faction in dramatically reducing carbon emissions in waste.

A waste resource recovery hub was highlighted as relevant to Arden with nearby processing stations that commercial operations can 'tap into'. SV were particularly supportive of this concept but stressed that buffer distances to any waste facility need to be carefully considered.

Building Scale Adaptation Measures

Stakeholders were informed of the detailed building scale adaptation related mechanisms being considered.

Most stakeholders considered that connection to precinct infrastructure was critical and that due to the density, there is greater opportunity in Arden to improve building thermal performance, something that can be readily improved on (DELWP).

DELWP noted the need for provision for smart infrastructure and batteries to future-proof buildings.

The GBCA noted that their suite of tools were undergoing significant evolution under Green Star Future Focus. Further direction on the new tools will come out in December 2019, where there will be 10 'rules' that a building must achieve in order to receive any Green Star rating. It will remain a points-based system, but the new approach provides an indication of what prescriptive planning controls may be required in addition to an overall benchmark.

SECTION 2
ANALYSIS

Analysis Overview

A framework for analysis was developed based on the mechanisms that are available to State Government and Local Government to drive climate responsive outcomes in the built environment. The analysis framework was based on the five mechanism types outlined in the methodology section of this report.

A combination of these mechanism types will be required to deliver a climate responsive precinct rather than any mechanism type on its own.

This process included analysis of:

- Case study exemplars relevant to Arden (nationally and internationally)
- Finance, governance and operational models specific to the Arden context
- A range of potentially appropriate ratings tools and frameworks which could be applied to the precinct either through planning controls or other mechanisms
- Planning controls capable of supporting strong carbon reduction and building level climate adaptation responses
- The specific role of energy efficiency, on-site renewables and off-site renewables as part of a sustainable stationary energy approach

This phase also included validation of potential planning controls and finance, governance and operational models with the development industry to understand their commercial viability and improve implementation.

This section of the report represents a summary of the analysis. This analysis supports a preferred suite of mechanisms presented in Section 3. Parallel to this analysis, carbon related mechanisms (e.g. building energy efficiency standards) were iteratively tested in relation to carbon impact in a precinct carbon scenario model. The outcomes of this scenario modelling are presented in Section 4.

TO ENSURE ARDEN IS A CLIMATE RESPONSIVE PRECINCT THAT INTEGRATES INTO THE SURROUNDING URBAN FABRIC, A NUMBER OF PLANNING AND NON-PLANNING MECHANISMS (SUCH AS FINANCE AND GOVERNANCE ARRANGEMENTS) WILL BE REQUIRED. IMAGE: VPA

Review of Exemplars

The approach taken by local and international exemplars to implement ambitious carbon mitigation and adaptation goals can offer valuable insights to inform the approach at Arden. The project team initially undertook a scan of 25 Australian and international projects for relevance.

Five case studies were then analysed and documented in detail in relation to:

_ The context for the project that influenced the approach to climate mitigation and adaptation

_ Key targets and commitments made related to climate

_ The project's contextual similarities with the Arden project

_ The mechanisms implemented, mapped against the five mechanism 'types' adopted for this project

_ The relevance / applicability of these mechanisms in the Arden context

_ The key benefits, considerations and critical success factors for Arden to learn from

The five case studies reviewed in detail included:

_ Barangaroo, Sydney Australia

_ Clichy Batignolles, Paris, France

_ South Waterfront, Portland, USA

_ Stockholm Royal Seaport, Sweden

_ Vauban, Freiburg, Germany

The detailed case study analysis is presented in Appendix 2. A summary of key findings that have informed this work are outlined below:

_ Government owned land is a critical catalyst for urban renewal and provides effective control, particularly into the operational phase

_ In many successful urban renewal examples there is a strong role for a dedicated development authority or similar to drive the ongoing delivery of the precinct beyond planning permission

_ In all case study projects there has been government investment, either directly via infrastructure etc, or indirectly via reduced short-term revenue on sale or lease of publicly owned land - this is critical and should be seen as a long-term investment in total public benefit over the life of the project, rather than a 'subsidy'

_ Contractual conditions are the strongest form of operational control, however other mechanisms such as financial bonds and mandatory reporting of environmental performance can be effective subject to careful implementation

_ Planning controls are highly effective in delivering buildings with high levels of environmental performance, but need to be supported by other mechanisms to have maximum effectiveness at lowest cost

_ High benchmarks for energy efficiency in buildings are common in all exemplar urban renewal precincts and deliver multiple benefits including carbon reduction, operational cost reduction and resilience to extreme weather

_ Development of large parcels of publicly owned land can meet higher environmental performance benchmarks as the scale provides for investment in precinct systems which can reduce cost and provides incentives for developer to fully or co-fund infrastructure

_ Public transport investment is critical to delivering a reduced mode share for private vehicles, but this is most effective when matched with car parking restrictions and active transport infrastructure provision

_ Developer partnerships increase effectiveness when there is a compelling 'place narrative', certainty of outcomes sought by Government and early engagement (which can drive innovation)

_ Verification of design performance into operation is important to allow systems to be optimised over operational life of buildings and precincts

_ Certainty over community infrastructure, high quality open space and public realm not only creates to delivering great places, but drives value creation which can be captured for reinvestment

Ratings Tools and Frameworks Analysis

A preliminary analysis of rating tools and frameworks was completed for the Arden Climate Response Framework. This earlier work concluded that the GBCA's Green Star - Communities and Green Star - Design and As Built (DA&B) was the likely to be the most appropriate tool or framework to apply to the overall precinct and to inform planning controls for individual buildings.

The starting point for this analysis was the Arden Vision. Direction 3 of the Arden Vision highlights as a planned outcome:

Development that meets the highest attainable standards under Green Star or equivalent nationally recognised accreditation for sustainable communities and buildings, and complies with Victorian and local government sustainability policies.

A number of tools and frameworks were analysed in detail in relation to their ability to meet the following criteria:

_ Alignment with the Arden Vision

_ Ability to deliver strong carbon reduction

_ Flexibility to different building typologies and development settings

_ Coverage of broad spectrum of sustainability criteria (such as urban heat reduction, indoor environment quality etc)

_ Planning precedence and industry recognition

_ Technical robustness

Table 3 on the following pages outlines the results of the analysis across the following tools:

_ Green Star (Communities and D&AB)

_ One Planet Living

_ Built Environment Sustainability Scorecard (BESS)

_ EnviroDevelopment

_ Living Community / Building Challenge

Informed by the scenario analysis and stakeholder interviews, Green Star – D&AB (transitioning to Green Star for New Buildings in 2020) has been confirmed as the primary tool for consideration of holistic climate response at the building level.

Green Star - Communities (transitioning to Green Star for Communities in 2020) has emerged as the primary tool for the publicly owned land with the potential extension of the rating to the private land subject to appropriate measures being in place to ensure development on private land can contribute to / not compromise a 6 star Green Star for Communities rating.

The 6 star rating is consistent with the Arden Vision for the highest attainable rating and is considered achievable for Arden due to the high degree of public land ownership and therefore control over the outcome.

The proposed new Green Star for Communities tool has an increased focus on buildings (as the principal mechanism driving deep carbon reduction from the largest emissions sector). The planning mechanisms adopt 6 star Green Star as the non-residential benchmark for buildings. As this is a commercially focussed precinct, this (alongside public investment in key infrastructure) supports at least Arden Central to deliver the highest attainable rating.

A role for BESS has been identified for smaller buildings (with these likely to represent a very small percentage of the built form in Arden). This is because the level of documentation and cost of accreditation for a Green Star building is not considered commercially feasible for buildings below 10 dwellings or 2000 m .

All other tools / frameworks could be encouraged for voluntary assessment of building environmental performance, however are unsuitable for use in planning controls. Living Building Challenge would be a suitable equivalent in place of Green Star D&AB for buildings seeking exemplar environmental performance who were interested in adopting an alternate compliance pathway. It is however not appropriate to be a mandatory tool as it is a costly process that is not broadly adopted in Australia.

Two supporting tools are recommended that assist in measuring building energy design and performance (a key driver for carbon reduction as the Green Star carbon positive pathway matures).

These include NABERS for commercial (office) and NatHERS as the industry standard for residential. The basis for adopting these tools to support planning controls is provided in Section 3.

Ratings Tools and Frameworks Analysis

TABLE 3 - RATINGS TOOL AND FRAMEWORKS ANALYSIS

RATING TOOL	DESCRIPTION	ALIGNMENT WITH ARDEN VISION	CARBON REDUCTION POTENTIAL	ABILITY TO LOCK IN OUTCOMES (DESIGN AND OPERATION)	FLEXIBILITY	BREADTH OF SUSTAINABILITY OBJECTIVES COVERED	PRECEDENTS/ MARKET RECOGNITION	TECHNICAL ROBUSTNESS
GreenStar	Green Star – Communities is Australia's leading tool for assessing planning, design and construction of large-scale development projects at a precinct, neighbourhood and/or community scale. In addition a sophisticated Green Star - Design and As Built (D&AB) rating system assesses individual building performance.	The tool aligns with all aspects of the Vision, with best results achieved through use of a combination of both Green Star -Communities and individual building rating tool. Alignment with the Green Star categories and target of each tool will assist in embedding sustainable change and will support achievement of many other directions and overarching vision of a climate responsive community.	All credits implicitly work towards carbon reduction (e.g. Waste Management; GHG strategy; Sustainable Transport), however the current tool(s) do not have embedded carbon targets. Under Green Star Future Focus the tools are being updated in 2020 to embed carbon targets and a requirement for a 100% renewable energy supply. The GBCA Carbon Positive Roadmap discussion paper outlines this trajectory. The Roadmap establishes steps required for commercial, residential, institutional and government buildings and fit outs to decarbonise.	Design intention can be locked in at an early stage through Governance and Management categories of both Communities and D&AB tools, followed by integrated approach to planning and construction. Registration processes assist in "locking in" outcomes, through independent, third party verified certification process, where an initial Green Star rating is given and confirmed post occupancy. Five yearly recertification (through the performance tool) can ensure ongoing outcomes are met.	All tools can be used together under one banner, rather than having to use several different tools and different organisations. High level of support available from GBCA and ability to tailor tool to inner urban context. Ratings ‘evolve’ over time which means a 5-star building in 2030 delivers greater environmental performance than in 2020. This allows planning controls which mandate a star rating to be ‘future proofed’.	Holistic, integrated approach with ability to achieve best practice standards for environmental, economic and social sustainability in both community and building design. Building rating tool lacks explicit social and economic based credits.	21 Green Star - Communities projects currently registered with the GBCA with over 2000 projects certified in Australia under various GBCA rating systems (see, e.g. Bowden Village, South Australia; Barangaroo South, New South Wales; Fishermans Bend, Victoria). Explicitly supported by CoM's planning scheme, and in place in Fishermans Bend as the overall guiding framework and building level tool. Aligned to the Property Council of Australia and well supported by industry.	Green Star has a robust governance process, which oversees maintenance and updates aligned with best practice, including technical reference groups and strong collaboration with industry in Australia. The tool is aligned with the World Green Building Council.

Ratings Tools and Frameworks Analysis

RATING TOOL	DESCRIPTION	ALIGNMENT WITH ARDEN VISION	CARBON REDUCTION POTENTIAL	ABILITY TO LOCK IN OUTCOMES (DESIGN AND OPERATION)	FLEXIBILITY	BREADTH OF SUSTAINABILITY OBJECTIVES COVERED	PRECEDENTS/ MARKET RECOGNITION	TECHNICAL ROBUSTNESS
One Planet Living	Globally relevant framework with over $30bn of projects registered. Not a rating tool, instead covers ten mandatory Action Plan categories / principles including social and economic sustainability. Predicated on the desire for buildings and precincts to be developed and operated using only their fair share of the earth's resources.	Strong alignment with Vision and identified opportunity areas. Unique combination of categories that go beyond typical rating tools offers a holistic approach to sustainability in community development.	Zero carbon energy principle is main focus in terms of emissions reduction, with overall focus being the creation of "thriving regional economies that enable people to live happy, healthy lives within the natural limits of the planet, leaving space for wild-life and wilderness"	Accreditation occurs in relation to Action Plans developed in for buildings and precincts. These are internationally accredited by BioRegional. Project specific, co-designed 'One Planet Action Plan' aims for a 'cycle of continuous improvement' through monitoring, reporting and adaption across 10 mandatory areas. Annual public reporting is required to maintain accreditation.	Highly flexible and adapt-able to a range of project scales, however based on principles rather than scores creating uncertainty for use in any planning control.	Globally leading framework in terms of breadth of sustainability categories covered, integrating building and construction with life-style choices, public health, transit options, etc.	19 live One Planet Communities around the world, including White Gum Valley in Fremantle, WA. Untested in Australia as part of planning controls.	Strong international technical foundations through BioRegional in the UK. Limited technical resourcing in Australia creates uncertainty for use in planning controls in the local context.
BESS	Victorian based planning tool integrating with local government sustainable planning policies to assess performance of buildings through the planning process.	Tool relates to buildings rather than precincts, so while demonstrated to be effective at a development scale would not meet the broader community-scale and public realm aspirations of the Arden Vision on its own.	Contributes to carbon reduction, through energy, waste and transport categories, however there are no explicit targets or benchmarks for carbon reduction.	Developed specifically for the planning process, with minimum scores required in mandatory categories. Proposed dwellings must satisfy provisions to be approved during the DA stage. No follow up recertification or operational assessment to ensure that targets are met, or measures effective. This would need to be resourced through planning enforcement or an alternate operational model.	Dynamic and flexible tool with effort made to be "location" and size neu-tral. Minimum scores required in mandatory categories, with overall 50% score required to pass. Flexible in that points can accrue across different areas of strength, however minimum pass marks are required in some categories.	Scorecard covers environ-mental sustainability only (not social and economic), and only at building scale. The tool has limited depth in relation to urban ecology and urban heat reduction.	Used in 17 Victorian councils to assess individual developments. Hobsons Bay intends to use it for Precinct 15. CoM scheme recommends use of BESS for smaller buildings, and it is the recommended tool under SDAPP. It has strong recognition in Victoria, but not nationally.	Technical reference panel guides the process of major updates to the tool. Tool has strong technical foundations, however does not have the level of resourcing of Green Star as reliant on subscription from a limited number of Victorian local governments.

Ratings Tools and Frameworks Analysis

RATING TOOL	DESCRIPTION	ALIGNMENT WITH ARDEN VISION	CARBON REDUCTION POTENTIAL	ABILITY TO LOCK IN OUTCOMES (DESIGN AND OPERATION)	FLEXIBILITY	BREADTH OF SUSTAINABILITY OBJECTIVES COVERED	PRECEDENTS/ MARKET RECOGNITION	TECHNICAL ROBUSTNESS
Enviro-development	UDIA-led (Urban Development Institute of Australia) national rating and branding tool providing independent verification of a project's sustainability performance. Aimed at giving future purchasers point of comparison data. Score based on number of individual elements achieved.	Does not align to Arden's Vision to achieve extraordinary targets across a number of categories. Focused on certification of greenfield communities with 'leaves' available for meeting performance benchmarks in six categories.	Would likely contribute indirectly to carbon reduction, however does not have explicit targets or benchmarks. Category performance would not necessarily lead to strong carbon reduction.	Offers third party verification of a project's sustainability credentials. Each individual element recognised as an achievement, with no minimum standard or requirement to achieve a certain number of elements.	Accreditation is available for individual categories which provides flexibility, but undermines the need for a comprehensive ap-proach.	Most environmental criteria are covered, however an absence of management and indoor environmental quality.	High level of industry recognition, but only for masterplanned new suburbs in outer growth areas, not dense urban areas therefore minimal comparison to Arden. Closest precedent is Alphington Paper Mill. No application to office buildings which will be prevalent in Arden.	Although supported technically by significant industry support the tool is relatively untested at higher densities. Technical robustness is undermined by a lack of quantifiable metrics and clear standards.
Living Community/Building Challenge	US-based framework for master planning, design, and construction, with aspiration to create a symbiotic relationship between people and all aspects of the built environment. The Communities Challenge is a pathway to make communities socially just, culturally rich and ecologically restorative. The Living Community Challenge is organized into seven performance areas (Petals). Each performance area has a number of more detailed requirements (Imperatives).	Although not used extensively in Australia, it is an ambitious and holistic method of designing for high performing sustainable communities that aligns well with the Arden Vision and precinct scale in embedding deep sustainable change.	Tool indirectly results in very low carbon communities, however would require complementing it with a carbon-specific reporting framework such as the Climate Active Carbon Neutral Standard to ensure all Vision directions and opportunities are met. Certain elements of tool are highly relevant, including consideration of embodied carbon in development.	Requirements for net positive energy, water and waste go much further than most tools and accreditation is based on actual performance data. Independent (third party) verified assessor licenced and recertification after 5 years. Certification is based on actual, rather than modelled or anticipated, performance. Certification will only be awarded if all requirements are fulfilled in a satisfactory manner and all imperatives are addressed.	A degree of inflexibility in the requirements (all imperatives are mandatory) justified by the level of ambition and commitment to deep sustainability. The Living Building Challenge best serves single buildings but is also appropriate for multiple buildings with the same owner who can combine the buildings' infrastructure needs.	Very broad, deep consideration of "sustainability" and recognition of the interdependency of actions. No element has only a single purpose; everything has multiple benefits to the community and environment. Overarching aim to create regenerative spaces for people and natural ecosystems.	Internationally, there are 16 registered Living Community Challenge projects. As of May 2017, there are nearly 380 registered Living Building Challenge projects in 23 countries around the world. There are 73 certified projects; 15 have achieved Living Certification, 25 have received Petal Certification, and 33 have achieved Net Zero Energy Building Certification (or Zero Energy Certification). One project in Australia (Castlemaine, VIC). However, it is a costly process that is not well understood in Australia and therefore not suitable for a mandatory planning control.	Very strong technical foundations, and highly engaged international fellowship of practitioners.

Planning Analysis

New planning controls for Arden are one of five mechanisms types which have been assessed as part of developing this evidence base.

A number of factors were considered in the assessment of this mechanism, and relevant background work reviewed.

This summary outlines the approach to the planning analysis and informs the suite of preferred planning controls recommended within Section 3.

The analysis incorporated:

- **The existing policy context including Clause 22.19, and any proposed work which may impact this policy context**
- **The development context in Arden as compared with other areas in the inner city**
- **Planning precedents in recent urban renewal such as Fishermans Bend**
- **The clarity and sufficiency of the evidence base for proposed controls**
- **The details of elements which are intended for implementation and the intention behind them**
- **The timeframe of the delivery of Arden over the next 30 years and how planning controls can be 'future proofed'**
- **Contemporary and future 'best practice'**

PLANNING POLICY CONTEXT

In developing a proposed suite of planning controls, it is important to acknowledge two other projects which are likely to have a significant influence. These are the work being undertaken by the State Government in relation to Action 80 of Plan Melbourne (Review of planning and building systems to support environmentally sustainable development outcomes) and a project being undertaken by the City of Melbourne to update their existing sustainability policy, with a particular focus on the delivery of 'green infrastructure' (GOCAP).

In addition, the 'nuts and bolts' of where the proposed policy sits will be strongly influenced by the broader planning framework developed by the Victorian Planning Authority and City of Melbourne as part of the structure planning process. The zoning for example is still yet to be resolved.

Also relevant are the state-wide 'Smart Planning' reforms intended to significantly shift how the planning scheme framework has functioned to date with key emphasis on the removal of duplication and additional weight in decision-making on State policy through ensuring local policy is able to be directly linked with State policy.

There is, however, already considerable existing State planning policy which is relevant to the delivery of Environmentally Sustainable Design (ESD) (in particular through Clauses 15 and 19). This policy support has been further strengthened within the City of Melbourne through a range of ESD planning controls in the Melbourne Planning Scheme, leaving the City with some of the clearest and most ambitious policy currently implemented within the Victorian context. Much of this policy is contained within Clauses 22.19 and 22.23, with more recent targets for Fishermans Bend included in not only policy (Clause 22.27), but also in a zone schedule and overlay controls. An assessment of the adequacy of the existing Clause 22.19 policy is provided as Appendix 5. Proposed planning controls for Arden have been structured differently to Clause 22.19 and have broader application than energy, water and waste (therefore a direct comparison is not provided). In addition, proposed new planning policy being drafted by CoM will supercede Clause 22.19.

This Climate Response Plan Evidence Base cannot provide definitive advice on where planning controls should 'sit' in policy as the planning structure is not yet certain. However, as a general principle, if there are precinct specific controls the preference would be that they sit in a zone schedule or overlay. What this is, and therefore specifically where, will depend on the overall planning approach taken by the VPA / CoM in relation to this precinct and the structure of the VPPs selected.

DEVELOPMENT CONTEXT

A series of draft planning standards relating to ESD have been developed by ARUP as part of City of Melbourne's GOCAP project, and these are currently undergoing review and refinement for intended implementation into the Melbourne Planning Scheme. Where there is no justification for an alternative approach, planning policy which is developed in relation to the Arden precinct should be aligned with these standards. Any standards implemented through GOCAP are likely to end up as policy, rather than integrated into a zone or overlay controls, as GOCAP is taking a municipal wide approach and there will be a wide variety of application types affected,

An opportunity available when planning at a precinct (rather than municipal) scale is to pursue more targeted outcomes with tighter planning controls. Arden is a case in point, where to meet the stated ambitions of the Arden Vision (2018) higher benchmarks will be required than those that apply to the wider municipality. This is appropriate and consistent with existing regional policy, which seeks to maximise the opportunities available at a precinct level.

Importantly, the scale and transformative nature of renewal proposed for Arden (including major government investment in public infrastructure), provides additional justification for higher environmental benchmarks, in that:

- The investment attraction of public infrastructure investment (rail, new parks etc) can assist in mitigating any premium associated with higher standards
- As a renewal precinct, there is an expectation that a new suite of controls would be introduced as planning for the precinct is completed, ensuring that developers can factor in the cost of development to land value
- Within the City of Melbourne, urban renewal areas represent a significant opportunity for development within the municipality, lending greater importance to the delivery of ambitious controls within these areas

Given the proposed 'upping' of benchmarks within Arden and the precinct specific outcomes, the implementation of proposed controls through a precinct wide zone or overlay control would be a likely and supportable outcome. These could then be reviewed to ensure that there was no duplication with the City of Melbourne or State work in relation to ESD policy, and duplications addressed if identified.

Planning Analysis

PLANNING POLICY PRECEDENT

The obvious precedent for policy within the Arden Precinct is Fishermans Bend Renewal Area, which represented a 'forward step' in climate responsive policy beyond that contained in the broader Victorian as well as Melbourne planning schemes at the time. Many of the standards proposed for the City of Melbourne through GOCAP derive from this work, which has been tested by a Planning Review Panel and implemented through Ministerial planning amendments.

As such, Fishermans Bend provides a useful benchmark for Arden (although, with the development of the North Melbourne train station underpinning the precinct, it is arguable that public transport access in Arden will be superior to Fishermans Bend).

The preferred suite of planning controls (standards) for Arden should seek to leverage the Fishermans Bend controls in several key areas:

_ Adoption of Green Star – Communities and Green Star – Design and As Built as the preferred rating tools (outlined in the above analysis of rating tools)

_ Implementation of a hierarchy of controls to ensure critical standards such as energy efficiency are delivered, whist retaining overall flexibility

_ Placing a strong emphasis on post occupancy verification of operational performance – acknowledging the importance of this key stage in development

_ Mandating connection to precinct infrastructure such as third pipe

_ Setting meaningful, yet flexible targets to ensure buildings contribute to reducing the urban heat

EVIDENCE BASE FOR PROPOSED CONTROLS

In addition to the above considerations (planning policy context; development context planning policy precedent) in assessing the evidence base for the proposed planning controls we need to be satisfied that the environmental benefit associated has impact, that there is not an unreasonable impact on commercial viability of development and that developing in accordance with the planning control is technically feasible.

These considerations have been included in the assessment of a preferred suite of controls, along with alignment with the Vision and other local and State policy. This is documented in Section 3.

FUTURE PROOFING OF PLANNING CONTROLS

In order to ensure that planning controls remain contemporary the planning analysis has considered emerging trends in development and likely policy changes, recognising that what may be commercially challenging to deliver today may be have significantly improved viability in the medium and long term. The following areas of policy and technological development have informed the analysis. These are all set within the overarching global climate change context.

_ Likely changes in the National Construction Code

_ Green Star's Carbon Positive Roadmap

_ The cost of renewable energy supply

_ Electric vehicle transition

_ The use of smart technology to enable demand management and sharing of electricity

_ Social changes such as the increased sharing economy

_ Changes in the housing market and diversity of offer (e.g. build to rent models)

Planning Analysis

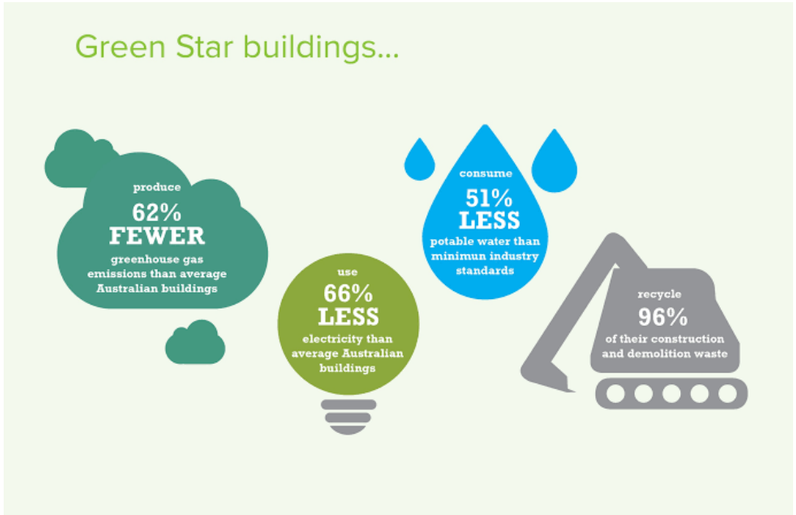
One of the advantages of linking to Green Star as the preferred rating tool is that there is a clear pathway to zero emissions buildings which will assist in delivering the stated ambitions of both State and local government for Arden. However, other tools and standards proposed are likely to require review. ESD is an area where what represents 'best practice' is constantly evolving - technology, societal expectations / culture, scientific understanding and other influences are all changing rapidly.

More specifically within the Arden precinct, there may be precinct scale infrastructure or other opportunities which emerge over time and which would benefit from, or rely on, precinct scale connections. At this point it would be consistent with currently proposed policy that these connections are mandated through review of relevant planning controls.

Furthermore, the energy ratings proposed in relation to NABERS and the Nationwide House Energy Rating Scheme (NatHERS) will need to be reviewed in the absence of stated pathways to ensure that the standards applied in Arden remain consistent with the Vision for the precinct to be an "exemplar".

Changes in the National Construction Code (NCC) very difficult to predict, or future proof against. Accordingly, a comprehensive review of the controls which apply to the precinct should be undertaken in 2030 (at the latest) to ensure that controls are In line with expectations and continue to deliver those important ambitions. This date is a logical review point as it aligns with the carbon neutral ambitions under the Green Star pathway and thus would enable a review against complementary rating tools and associated standards.

Planning controls have specifically been developed to allow maximum flexibility for adoption of new technology (and different building uses), without placing unreasonable cost on short term development. An approach of not ‘designing out’ future opportunity has guided the development of planning controls.



THE SUCCESS OF GREEN STAR AS THE PREFERRED RATING TOOL FOR THE PRECINCT WILL DEPEND UPON SUPPORTING TOOLS AND STANDARDS TO ENSURE TO PUBLIC AND PRIVATELY OWNED LAND ARE DEVELOPED TO THE SAME 6-STAR, ’WORLD LEADERSHIP’ STANDARD. IMAGE: GREEN BUILDING COUNCIL OF AUSTRALIA

Commercial Validation

Validation of potential mechanisms (planning controls and finance, governance and operational models) was undertaken with the property development industry with the aim of understanding the commercial viability and any implementation considerations for potential mechanisms.

This process informed a deeper understanding of what combination of mechanisms would best deliver the outcomes sought, and whether there were direct or operational investments that could help support these planning controls and models.

Developers of different scales were engaged with in order to gain a cross-section of opinions.

Each interviewee was given a brief project overview followed by a short discussion about the Arden Renewal Project. Meetings were held between 22 October - 8 November 2019. A meeting was also sought with the Property Council of Australia, however were unable to be scheduled within the very short timeframe.

SUMMARY OF RESPONSES

The feedback on individual planning controls or models is documented in Section 3.

The key messages from this validation exercise were:

_ Consistency and certainty around planning controls is critical. Developers agreed there must be certainty that planning controls are clear, unambiguous and are not immediately superseded by CoM's planning scheme. If government wants to incentivise better quality outcomes, they must to seek to implement certainty

_ There was no 'major' pushback on the proposed planning controls. Developers did express challenges around 8-star NatHERS on some residential sites (e.g. depending on site layout and orientation), and 6-star Green Star for residential.

_ More sophisticated and larger scale developers will be more capable of responding to higher ratings targets

_ High degrees of uncertainty around planning controls, infrastructure and building performance targets will have an adverse impact on land value for government. Developers will factor in all costs associated with risk within their feasibilities

_ There was overarching support for measures that reduce complexity in the development of land (e.g. support for centralised alternative water supply versus water tanks on each lot)

_ There were mixed responses on the potential for ongoing building performance verification (through a bond or other mechanism). Ongoing reporting requirements requires significant resourcing and Government must consider who will manage and finance this

_ Developers were unanimous in support for height limits related to storeys rather than maximum height in metres, citing a number of benefits (some commercial, some relating to improved amenity for occupiers)

_ Developers are seeking visible, transparent, localised open space contributions

_ Opportunities exist for government to engage with capable developers early for the public land – inviting the market to come back with proposals to develop the public land consistent with clear targets and certainty over public investment

Finance, Governance and Operational Models

Planning controls are a highly useful mechanism for driving design outcomes which can lock in climate responsive designs, resulting in both low carbon buildings and precincts which are also adapted to climate change impacts. When combined with appropriate finance, governance and operational models, the potential exists to drive enduring long term benefit at lower overall cost.

Finance, governance and operational (FGO) models represent alternative ways of delivering sustainability outcomes and have the potential to contribute to the achievement of a broad spectrum of sustainability outcomes for the city. Models are typically a mix of all these aspects, but look beyond planning controls to improve development outcomes.

HV.H and Point Advisory co-authored a 2017 report for CoM which analysed fourteen innovative finance, governance and operational models with specific potential to be applied to the CoM urban renewal areas. The team has leveraged this experience and analysis for the purposes of this project.

The Finance, governance and operational models investigated as part of that project are outlined in Table 5 alongside a contemporary evaluation, factoring in the release of the Arden Vision and a number of parameters for the precinct being established.

TABLE 5- SUMMARY OF FINANCE, GOVERNANCE AND OPERATIONAL MODELS

FINANCE, GOVERNANCE OR OPERATIONAL MODEL	ASSESSMENT OF APPLICABILITY TO ARDEN	RECOMMENDATION
1. Green Roof Incentives - Offer reduced stormwater connection charges when a green roof is installed to certain specifications.	CoM have developed a Green Factor tool and are pursuing a planning scheme amendment that will drive green roof outcomes through planning controls, limiting the benefit of incentives.	Not recommended as an incentive for Arden due to proposed CoM planning policy (that has been mirrored in the proposed controls for Arden)
2. Urban Forest Fund (Green Fund) - Matched funding to incentivise the provision of additional green space on private property that provides a public benefit.	CoM have developed a Green Factor tool and are pursuing a planning scheme amendment that will drive this outcome through the planning scheme. The Green Factor tool scoring rewards designs that contribute to cultural ecosystem services such as aesthetic value, public accessibility and visibility of green infrastructure. As a planning mechanism is proposed an incentive arrangement has limited value.	Not recommended due to proposed planning controls. Recommend that the principles of the Urban Forest Fund (matched dollar for dollar funding) be considered for potential application to other infrastructure.
3. Precinct wide Integrated Water System - Water utility and developers (and potentially a third party operator) adopt consistent standards to enable precinct management of rainwater and stormwater capture, reuse and release to mitigate the impacts of flooding and minimise potable water consumption.	This has potential for Arden, however pursuing of this model is dependent on City West Water developing a business case for third pipe and Melbourne Water, CoM and VPA resolving a precinct wide flooding strategy.	Ensure planning controls for the precinct require connection to future integrated water management systems if imple-mented.
4. Precinct waste management - Coordinated waste management across the precinct, rather than each commercial building contracting separate waste contractors, potentially combined with on site or off site advanced resource recovery / treatment.	Highly applicable, but will be resolved in detail through the development of a precinct waste management plan.	Ensure planning controls enable waste separation beyond recycling and general waste to organics and identify a role for resource hubs for waste education, e-waste drop off etc.
5. ‘Design stage’ precinct energy demand minimisation - Utilise incentives at the design and planning stage to lock in lower maximum electrical demand across the precinct and subsequently reduce network investment, coordinated by the Distribution Network Operator or a third party.	This has potential for Arden, however pursuit of this model is dependent on resolution of the preferred development model for the public land and the servicing strategy for the site in development.	Ensure planning controls mandate high levels of energy efficiency, cooling load reduction and flexibility for future demand management.

Finance, Governance and Operational Models

FINANCE, GOVERNANCE OR OPERATIONAL MODEL	ASSESSMENT OF APPLICABILITY TO ARDEN	RECOMMENDATION
6. 'Operation stage' active precinct energy demand management - Provide incentives to building operators and individual ten-ants to allow 'load shedding' during peak events, reducing network investment.	This has potential for Arden if buildings are built to high thermal efficiency. This is dependent on the aggregation of large energy users who are not yet confirmed. Potential for commercial operators (e.g. GreenSync) and CitiPower to be engaged to ensure opportunity is designed in. No major impact on carbon reduction locally, however supports broader efforts to maximise renewables in the grid while minimising network augmentation costs.	As per above.
7. Offsite renewable energy Power Purchase Agreement (PPA) - Utilise an appropriate procurement mechanism (e.g. CoM's MREP) to coordinate off site renewable energy PPA for all or part of an urban renewal precinct.	Highly applicable	Recommended model (refer Section 3 for full evaluation and justification)
8. Community renewable energy - Provide the opportunity for individual community members, businesses and community groups to invest in local renewable energy projects.	Potentially applicable, but given the significant transition of worker and resident communities expected, not pursued as a high impact model at this stage. The scale of any local renewable energy project within the precinct also significantly constrained (see analysis in this section).	Not recommended at this time.
9. Energy Service Company (ESCos) – Purpose built energy service provider that enables the creation and management of a local energy system. Services delivered by ESCos vary but can include generation, distribution, demand management, billing and maintenance of energy supply.	Dependent on the number of developers engaged in delivering Arden Central, a non-profit version of this model may be applicable in order to advance supporting measures such as micro-grids, demand response and local energy trading.	Ensure recommended mechanisms do not design out a future opportunity.
10. Energy Performance Contracts - A contractor is engaged to design, implement, verify and guarantee the savings from an energy efficiency project, some-times complemented with local renewable energy generation.	This model is more applicable at the retrofit stage rather than new builds. The transforma-tional change expected in Arden indicate that this model will be restricted in impact due to site renewal.	Not recommended at this time.

Finance, Governance and Operational Models

FINANCE, GOVERNANCE OR OPERATIONAL MODEL	ASSESSMENT OF APPLICABILITY TO ARDEN	RECOMMENDATION
11. Precinct parking management - Advanced Precinct Parking Management refers to physically and contractually de-coupling private parking from property ownership, and instead managing parking provision on a precinct scale, based on actual demand.	This model is highly applicable given the mode share target of 10% for private vehicles. Car parking is also being addressed as part of the Integrated Transport Strategy.	Recommended with a combination of direct investment and planning controls to ensure 'decoupling car parking from title' and maximum car parking rates.
12. Locally funded public transport - Financing model for public transport based on uplift in property values or amenity thereby legitimising private contributions to fund public transport infrastructure.	This model is potentially applicable but would need to be addressed in other studies contributing to the Arden Structure Plan.	Not investigated due to scope duplication with value capture work and Precinct Transport Plan (PTP)ning.
13. 'Green door' fast tracked planning - This incentive 'fast tracks' projects that demonstrate verified 'best practice' out-comes that go significantly beyond mini-mum compliance.	This model is potentially applicable, but the process would need to represent a clear benefit to developers to incentivise uptake – these approaches can be compromised (i.e. slowed down) by complexity of planned assessment of non-environmental factors of design. Proposed planning controls for buildings correspond in most cases to the highest rating attainable, reducing impact of this type of incentive.	Not recommended at this time, but undertake a 'watching brief' on the Moreland Design Excellence Scorecard approach.
14. Subsidised consultancy support - Provide developers, builders and designers with free access to a sustainability consulting service to encourage 'over compliance' or to support achievement of above average performance requirements.	This model is mostly suitable for small scale developers with limited complexity in their ESD approach. As the bulk of development in Arden will be of significant scale, we consider uptake of this voluntary model will be limited. Developer feedback supported this view.	Not recommended.

Two additional finance, governance and operational models were highlighted through the case study work as having potential for application in Arden. These are outlined below.

Finance, Governance and Operational Models

FINANCE, GOVERNANCE OR OPERATIONAL MODEL	ASSESSMENT OF APPLICABILITY TO ARDEN	RECOMMENDATION
1. Contractual carbon targets - Alternate development model for publicly held land where developers and building owners are bound by contractual conditions to maintain a zero carbon development – potentially through the sale of developer rights with land retained by Government and administered through long term leases.	Highly applicable to Arden Central, assessed as the most likely model to deliver a zero carbon precinct.	Recommended as the principal model for the public land – refer Section 3.
2. Financial Bond - A performance bond can be imposed to assure the owner that the contractor will complete all obligations set out in the contract, but can also be used to guarantee that funds are avail-able to complete obligations if the con-tractor fails, and in this way protects the owner against possible losses.	Applicable to Arden	Recommended as an operational model for further exploration alongside planning controls and operational investments which can help lock in operational environmental performance (refer Section 3)

Stationary Energy Opportunities Analysis

Analysis was undertaken to inform a preferred balance between energy efficiency measures, on-site solar and offsite solar for Arden. Given the density proposed, total on site solar generation potential was likely to be the most constrained opportunity. Understanding the limitation was able to inform the strategies for energy efficiency and offsite renewables procurement.

An analysis was undertaken on the suitability of Arden for both on-site precinct scale solar and rooftop solar.

PRECINCT SCALE SOLAR

Using the lot yield concept plan provided by VPA as a basis for analysis, potential locations of publicly held land were sought based on a minimum size of 0.5Ha or 400kWp of solar PV for a solar farm.

Analysis quickly confirmed that due to multiple reasons the precinct was unlikely to support precinct solar investment at a meaningful scale as potential locations for ground mounted solar would impact either open space or developable yield. This is not to preclude the potential for small ground mounted solar arrays to potentially play a part in an overall design, but the total generation potential would be almost negligible in comparison to total energy demand when the precinct is fully built out.

Technical feasibility of solar PV is significantly compromised by:

_ The overshadowing from future built form

_ Competition for available remaining land for stormwater retention, public open space and developable area

Financial viability for precinct scale solar (as a public investment) would be impacted by:

_ The opportunity cost of not providing other public realm investments or the loss of developable land required to meet density targets

_ The higher cost of ground mounted solar compared with rooftop solar

_ The existence of offsite alternatives which deliver the same net carbon outcome at a much lower cost

The analysis concluded that public investment and land allocation of public space to ground mounted solar PV is not defendable unless it can be effectively combined with other community infrastructure or is limited in scale with the primary goal of leadership / demonstration value.

GROUND MOUNTED SOLAR PV HAS LITTLE APPLICABILITY DUE TO THE PROPOSED URBAN DENSITY AND PUBLIC SPACE REQUIREMENTS OF ARDEN. A TOTAL POTENTIAL ROOFTOP YIELD OF 229,100 M² REPRESENTS APPROXIMIATELY 8% OF THE BAU STATIONARY ENERGY CONSUMPTIONS. IMAGE: RMIT UNIVERSITY

Stationary Energy Opportunities Analysis

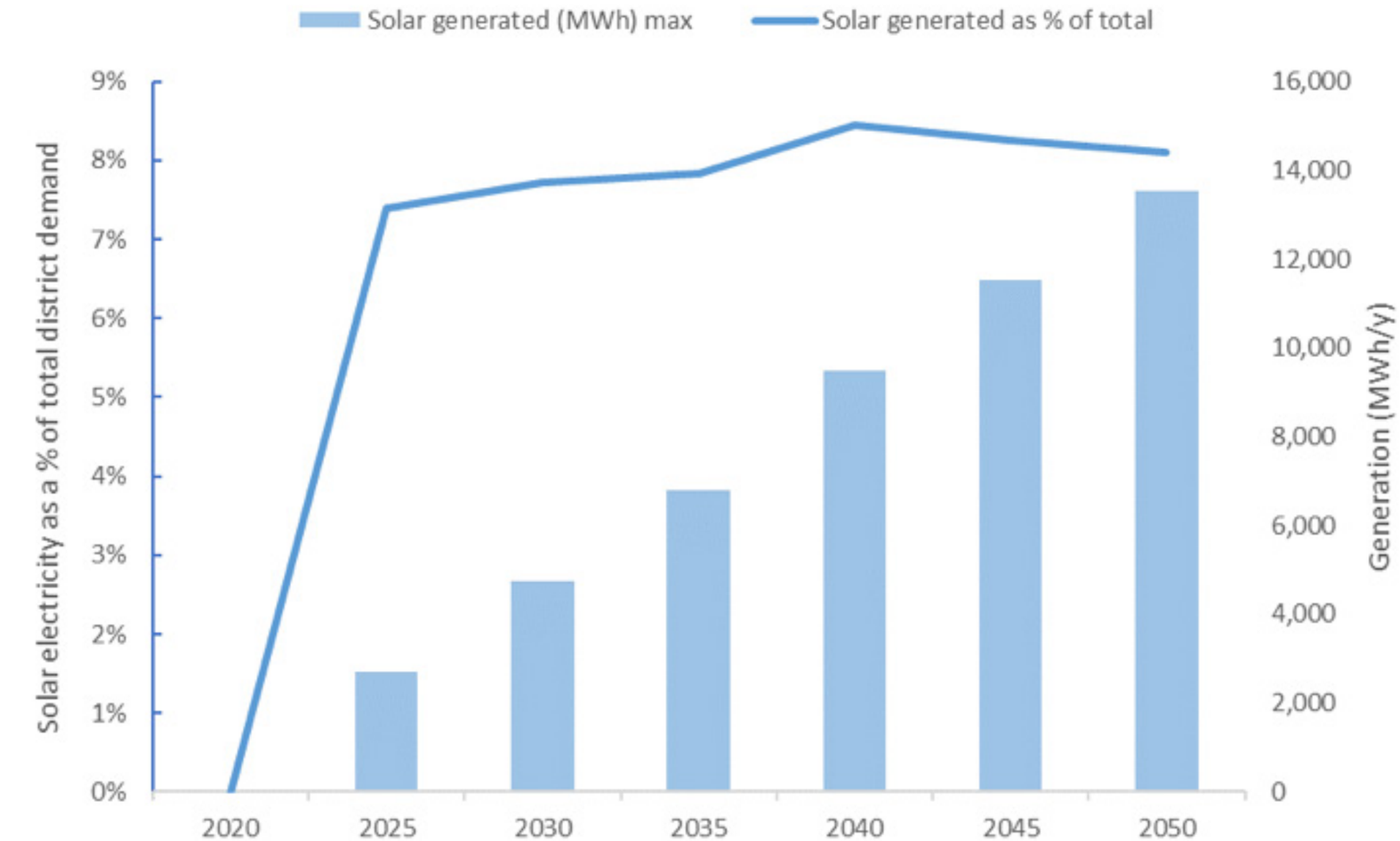


FIGURE 1. MAXIMUM THEORETICAL ON-SITE RENEWABLE ENERGY GENERATION

ROOFTOP SOLAR

Figure 1 shows the potential on-site renewable energy generation of roof-mounted solar PV under the net zero carbon trajectory to 2050. This is based on 100% of available roof space being used for PV, which may limit green infrastructure on the roof. This illustrates that local renewable energy generation can only make up about 7% of total district electricity demand. Therefore, to minimise ongoing operational costs to the precinct (i.e. through a renewable energy PPA), it is important to increase the efficiency of energy use as much as possible.

Local renewable energy generation was estimated using the following inputs and assumptions:

- Total area (precinct- by GIS) = 534,200 m2
- Total area available for rooftop PV = 229,100 m2 (43% of total area)
- Overshadowing factor = 25 % of roof space is unsuitable for solar
- Solar size requirements: 1 kW capacity per 10 m2
- Rooftop space utilisation for solar = 60 %
- Total solar capacity = 10,310 kW
- Average generation per kW per day = 3.6 kWh/day (solarchoice.net.au/blog/how-much-energy-will-my-solar-cells-produce)

Stationary Energy Opportunities Analysis

TABLE 6- ANALYSIS OF STATIONARY OPPORTUNITIES ANALYSIS

SECTOR	2020	2025	2030	2035	2040	2045	2050
BAU demand (MWh)	18	36,197	60,380	84,954	110,327	136,778	164,098
% solar built	0%	20%	35%	50%	70%	85%	100%
Maximum solar generated (MWh)	-	2,710	4,742	6,774	9,483	11,515	13,548
Solar generated as % of BAU	0%	7%	8%	8%	9%	8%	8%

Using these inputs, the maximum solar generation capacity for the precinct was calculated to be 13,548 MWh. The staging of this solar uptake in the precinct per year is shown in Table 6 above.

This illustrates that while on-site solar PV will assist in carbon reduction it is limited to a modest contribution to forecast energy demand, due to physical constraints on total generation capacity. This reality provides support for an increased focus on energy efficiency and off-site procurement of renewables for Arden. It is worth noting that if higher benchmarks for energy efficiency are assumed, solar PV can produce a higher proportional amount of electricity demand.

In situations where solar PV tends to be consumed directly rather than exported to the grid the financial case for battery storage is somewhat reduced. Given that solar PV will generally be a smaller proportion of building energy, this is likely to be the case for the majority of buildings in Arden.

Stationary Energy Opportunities Analysis

EMBEDDED NETWORKS / MICRO-GRIDS

The preliminary potential for embedded networks and micro-grids formed part of the sustainable energy opportunities analysis.

An embedded network is a private electricity network that services multiple customers through a parent connection point (i.e. the customers within the embedded network do not have their own grid connection points). A micro-grid works on the same principle, but for a larger area. The advantage of an embedded network or micro-grid is that it can more readily use renewable energy generated by systems linked to the network, with the full cost savings associated with “behind the meter” generation (i.e. avoiding the costs associated with use of the transmission and distribution networks). The embedded network operator then has the freedom to pass through the full benefit to connected users.

The Australian Energy Market Commission (AEMC) is currently considering updating the regulatory frameworks for embedded networks. In their draft report, the AEMC has expressed concerns about consumer protections in embedded networks. As a result, the AEMC has proposed that the majority of embedded networks (excluding short term holiday accommodation and electric vehicle charging stations) be required to register as both a network service provider and a retailer. These extra obligations are likely to significantly increase the costs for embedded networks, which may affect the financial viability of community models that rely on embedded networks. Furthermore, the operation of embedded networks is likely to be outsourced to large operators who are equipped to handle the extra responsibilities that come with being a retailer and network provider.

Additionally, prior to the November 2018 election, the Victorian State Government announced a policy that would see embedded networks banned from new Victorian apartment developments. The concern related to consumer protection and the fact that an embedded network removes a degree of “power of choice” for the customer. Due to similar consumer protection concerns, the Victorian Government has introduced the Victorian Default Offer (VDO) from 1 July 2019. The VDO was introduced after an independent review found that Victorians were paying more than they should for electricity. Most consumers are now able to ask for the VDO and those on standing offers will be automatically transferred to the VDO.

Given the position of both the AEMC and the Victorian State Government, it appears appropriate to ensure that uncertainty on how the measures and uncertainties mentioned above will affect potential new embedded networks and microgrids is resolved to avoid associated risks of creating stranded assets (i.e. embedded networks or microgrids that cannot be operated to their full potential or recover sunk costs).

It is highly likely that the decision to pursue an embedded network or micro-grid for Arden will be a partnership decision between State Government and the ultimate developer partner(s) of the publicly held land. The potential for the investments to enable sharing of excess generation locally is worth further consideration, but may be limited in this context by the high ratio of electricity demand to rooftop space suitable for solar. It is also important to note that embedded networks or micro-grids may have other advantages in terms of demand response capability and therefore present an opportunity in terms of network modernisation and long-term cost savings for the customers, but they do not on their own contribute to carbon reduction.

SECTION 3
RECOMMENDED MECHANISMS

Recommended Mechanisms Overview

This section builds on the analysis and stakeholder engagement to present a suite of recommended mechanisms across the mechanism types outlined earlier:

_Direct investment

_Operational arrangements / investments

_Planning controls

_Other regulatory mechanisms

_Finance, governance and operational models

There is a high degree of linkage between mechanism types to deliver a holistic climate response. For example, a planning control mandating organic waste separation is supported by a corresponding direct and operational investment in resource hubs and waste education. These response areas are outlined below:

_ Overall climate response – this includes a suite of overarching mechanisms that reinforce Direction 3 of the Arden Vision to embed sustainable change

_ Stationary Energy – a suite of mechanisms that respond to the need to significantly reduce stationary energy consumption and ensure the remainder is sourced from renewable energy

_ Transport – a suite of mechanisms that drive transport related carbon reduction (noting that the outcome of this work will need to be aligned with the Precinct Transport Plan (PTP) (ITP)

_ Waste – a suite of mechanisms that drive waste related carbon reduction (noting that a Precinct Waste Management Plan has not yet been developed)

_ Building scale climate resilience – a suite of planning controls focused on ensuring built form is highly responsive to current and future climate impacts

The combination of mechanisms applied as a suite align to the Zero Carbon scenario outlined in Section 4 and help justify its adoption. A climate positive scenario was originally envisaged for this work. It has the same emissions trajectory within the Arden boundary as the zero carbon scenario and so does not represent a different carbon model, but includes the potential for additional initiatives with a reach beyond the boundary of the precinct.

The C40 framework further defines “climate positive” as a suite of measures “that have an impact that extends beyond the boundary of the site”. The C40 Climate Positive program is however being discontinued. In this context, the reference to climate positive is made only where mechanisms could be expanded or lend themselves to improving climate mitigation or adaptation beyond the precinct. This is noted in the detailed mechanism descriptions as meeting climate positive objectives.

Adoption of this suite of mechanisms also align with the pursuit of a 6 star Green Star Communities rating for the precinct which we recommend based on the earlier analysis of ratings tools and frameworks. The mechanisms in aggregate will strongly support, however do not on their own guarantee a 6 star Green Star Communities rating. A Communities rating requires measures beyond environmental performance to be committed and implemented (e.g. governance, liveability and economic prosperity).

Table 7 below outlines each of the recommended mechanisms in relation to the climate response area.

Recommended Mechanisms Overview

TABLE 7- OVERVIEW OF RECOMMENDED MECHANISMS

CLIMATE RESPONSE AREA	MECHANISM	MECHANISM TYPE
Overall climate response	1_Overarching Green Star building standard	Planning control
	2_Operational Management Plans and planning enforcement	Planning control and operational investment
	3_Contractual carbon target	Finance, governance and operational model
	4_Financial bond for operational performance	Finance, governance and operational model
	5_Disclosure of operational performance	Other regulatory mechanism
Stationary Energy	6_Minimum energy performance standards	Planning control
	7_All electric building standard-	Planning control
	8_Power purchase agreement	Finance, governance and operational model
Transport	9_Consolidated car parking	Direct Investment / Potential Finance, Governance and Operational Model.
	10_Car parking and active transport standards	Planning controls
	11_Centralised distribution centre	Finance, governance and operational model
	12_Electric Vehicle Standards	Planning control
Waste	13_Waste standards	Planning control
	14_Resource hubs and waste education	Direct and operational investment
Building scale climate resilience	15_Building reuse and adaptability standards	Planning control
	16_Urban Heat standard	Planning control
	17_Green Infrastructure standard	Planning control
	18_Integrated Water Management Standards	Planning control

These mechanisms are presented in detail below, grouped by their climate response area, with a short overview and then a description and justification for each mechanism in detail. Detail of each mechanism includes:

_ Mechanism type

_ Detailed mechanism description

_ Overview of justification

_ Impact (environmental, social and economic)

_ Policy alignment

_ Commercial viability

_ Planning evidence / precedence

_ Other evidence

_ Implementation considerations

Where the same evidence supports multiple mechanisms the evidence is only cited once to avoid duplication.

Overall Climate Response

This climate response area is critical in driving a holistic precinct and building level response to climate change. The mechanisms outlined on the following pages reinforce each other. In particular, the Green Star standard is reinforced in operational by a suite of mechanisms that ensure that designs are built as intended, verified post construction and then bound through a series of checks and balances during the operational phase of the development. A contractual carbon target is recommended as the principal mechanism for delivering zero carbon for the public land.

TABLE 8 - OVERALL CLIMATE RESPONSE MECHANISMS

CLIMATE RESPONSE AREA	MECHANISM	MECHANISM TYPE
Overall climate response	1_Overarching Green Star building standard	Planning control
	2_Operational Management Plans and planning enforcement	Planning control and operational investment
	3_Contractual carbon target	Finance, governance and operational model
	4_Financial bond for operational performance	Finance, governance and operational model
	5_Disclosure of operational performance	Other regulatory mechanism

1_Overarching Green Star building standard

GREEN STAR 'DESIGN & AS BUILT' (D&AB) ASSESSES THE SUSTAINABILITY OUTCOMES FROM THE DESIGN AND CONSTRUCTION OF NEW BUILDINGS ACROSS 9 CATEGORIES FROM ENERGY AND TRANSPORT TO MATERIALS AND INNOVATION. IMAGE: GBCA

MECHANISM TYPE

Planning Control (mandatory for Accommodation, Office, Education, Place of Assembly, Retail, discretionary for Industry / Warehouse and alterations and additions over 1000m2)

DETAILED MECHANISM DESCRIPTION

This planning control recommendations involves setting a mandatory minimum planning standard that development must achieve and maintain for a period of 12 months post completion the following ratings:

- 6 Star Green Star (D&AB) for all non-residential development above 2000m2 in GFA
- 5-star Green Star (D&AB) for all residential development above 10 dwellings

For development below this scale, development must achieve 70% using the Built Environment Sustainability Scorecard (BESS).

This mechanism sets a standard for a holistic approach to sustainability at the building scale, but does not impose targets within each emissions sector or category. As a result this standard is supported by specific standards elsewhere.

OVERVIEW OF JUSTIFICATION

The highest quality buildings are sought in Arden, which is to be an 'exemplar'. Adopting a ratings framework with the market credibility of 2542 certified projects and the strong technical basis and verification process of Green Star will help ensure that this is what is delivered. As built certification is required to ensure objectives are delivered.

Scenario modelling highlights the large contributions that buildings will make to the precinct emissions. Green Star has adopted a Carbon Positive Pathway that requires all accredited Green Star buildings to have a 100% renewable electricity supply by 2026, by 2020 for 6 star buildings. This is consistent with state and local ambitions.

BESS is appropriate for smaller scale buildings due to the cost of compliance with Green Star for buildings with lower build costs.

IMPACT

- This standard would impact all emissions sectors, with certainty for stationary energy (residential, commercial)
- The adoption of the highest possible Green Star rating for large commercial buildings ensures a 100% renewable electricity supply for all buildings built post 2020 (consistent with the Green Star Carbon Positive Pathway)
- Environmental impacts beyond energy will be significant, however depend on the credits adopted by individual buildings
- Adoption of this standard would also support building scale climate resilience – Green Star for new buildings (to be released in 2020) will mandate that to achieve a rating buildings need to be 'designed to withstand climate risks'
- Green Star buildings also promote health outcomes through better performing dwellings and commercial premises and higher productivity for workers due to improved indoor environment quality

POLICY ALIGNMENT

The mechanism is consistent with the Arden Vision in that it:

- Supports the planned outcome of 'development that meets the highest attainable standards under Green Star or equivalent nationally-recognised accreditation for sustainable communities and buildings'
- Supports achievement of the Vision statement for Arden to be an "energy efficient district"
- Underpins the ambition for Arden to be at the forefront of sustainable development through low-energy, low-carbon buildings (Direction 3, p.29)
- Supports achievement of the objective of embedding best practice standards for building design (Direction 3, p.28)

Performance standards above the National Construction Code are supported by the Victorian Government's commitment under the Climate Change Act 2017 to reduce greenhouse gas emissions for Victoria to zero net emissions by 2050.

This mechanism also supports Plan Melbourne Direction 6.1, policy 6.1.1 Improve energy, water and waste performance of buildings through environmentally sustainable development and energy efficiency upgrades.

1_Overarching Green Star building standard

Ensuring development in new major precincts achieve high environmental standards is also critical to the achievement of CoM's Climate Change Mitigation Strategy to 2050, as expressed in Initiative 2.6 which seeks to implement policies to support the development of zero emissions buildings and precincts.

This approach is also consistent with planning for urban renewal precincts within the City of Melbourne, as established through Fishermans Bend planning controls, and delivers on state and local policy objectives to deliver energy efficient buildings (Clause 15.02, Clause 22.19).

COMMERCIAL VIABILITY

Benefits

_ Provides industry with the certainty it needs to invest and innovate – Green Star targets were supported by majority of development industry representatives interviews as an effective way to provide certainty

_ Consistent with pathway outlined in new Property Council Australia report Every Building Counts (2019)

_ Provides operational benefits to building occupants (lower costs and improved productivity)

_ Improved commercial value associated with higher rated buildings

_ Improved government tenant attraction and retention

Challenges

_ Building affordability may be used as an argument to lobby against a high level of stringency

_ Potential resources required for enforcement and rectification of non-compliance

_ According to more than one development industry representative high standards were achievable, but may impact the price developers are willing to pay for land

_ There is still a limited number of 6-star Green Star residential buildings, demonstrating challenges with delivering this standard with market acceptance

PLANNING EVIDENCE / PRECEDENCE

_ A 6 star control for commercial buildings would exceed the Fishermans Bend standard of 5 Stars, however is in line with ambition for Arden to be a leader in sustainable development and "exemplar" precinct

_ Higher standards for Arden Central (where the majority of commercial buildings are anticipated to establish) are justified due to the predominance of public land holding, where it is long established practice for higher benchmarks to be delivered

_ Recent changes to Fishermans Bend planning controls introduced permit condition requirements to include "as built" certification to ensure development does in fact meet benchmarks

_ Countless international examples where certification schemes like LEED and Passivhaus form part of minimum requirements demonstrate that achieving aspirations of sustainability leadership within urban renewal projects almost always relies on this mechanism

IMPLEMENTATION CONSIDERATIONS

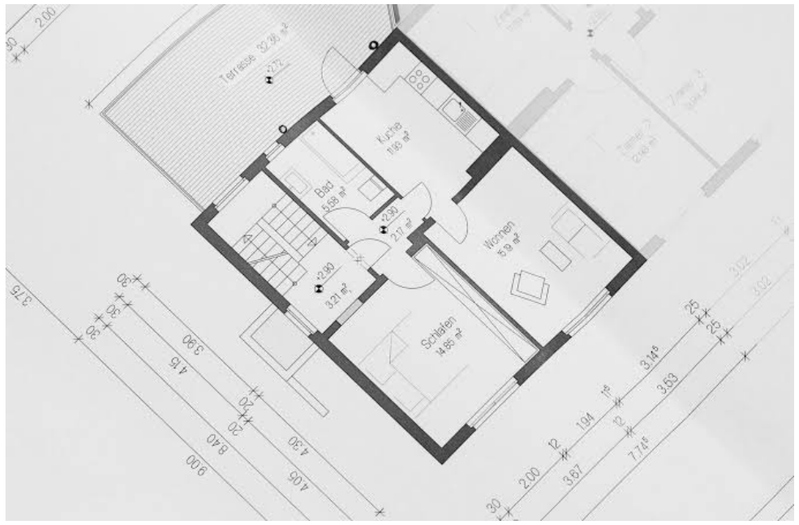
_ The Arden Structure Plan to apply the proposed planning control, with provision for review

_ The inherent flexibility of the tools allows for approaches to be tailored to the diversity of development envisaged for the precinct

_ However, the flexibility of rating tools can also allow developments to avoid delivering fundamental objectives. Best practice now seeks supplementation of overall preferred rating tool with minimum benchmarks which relate specifically to energy efficiency (i.e. NatHERS and NABERS standards) and mandatory requirements to meet objectives. This is the approach taken in this suite of controls (see "Minimum Energy Performance Standards for Commercial and Residential Buildings).

_ Ensure that planning controls when written allow flexibility for new tool naming (D&AB likely to transition to Green Star for New Buildings). A reference to 'or contemporary equivalents' will also allow for the use of alternative tools, provided they deliver the same standards and opportunities to ensure deliver of 'as built' outcomes.

2_ Operational Management Plans and planning enforcement



ENSURING PRECINCT OUTCOMES ARE ALIGNED WITH PLANNING CONTROLS AND ENFORCEMENT WILL IMPROVE BUILDING DESIGNS AND CREATE CERTAINTY FOR PROSPECTIVE INVESTORS AND RESIDENTS. IMAGE: ENGINEERS JOURNAL

MECHANISM TYPE

Planning Control (Discretionary) and Operational Investment

DETAILED MECHANISM DESCRIPTION

This planning control and operational investment involves mandating the development of operational management plans and providing significant increased resourcing for planning enforcement to ensure compliance with them.

Development requires:

_ The provision of an operational management plan outlining operational management of energy, transport and waste as well as (integrated water management and green infrastructure.

Outside Arden Central this would be at the building level, however within Arden Central this could be delivered at a precinct level (subject to the development model adopted).

Operational waste management, green travel plans and Water Sensitive Urban Design (WSUD) maintenance plans are already standard. This planning control seeks to broaden this slightly to include energy.

This would cover for example:

_ Maintenance of key energy systems

_ Ongoing commitment to 100% renewable electricity supply

_ Green travel planning

_ Maintenance of stormwater treatment (rainwater, raingardens etc)

_ Organics collection and in building management of waste

_ Irrigation and maintenance for green infrastructure

One of the key issues with the operational phases of development is performance ‘drift’ from the intended design performance because management plans are not followed through or maintenance is not carried out, leaving systems operating sub-optimally or not functioning at all and commitments not followed through.

This mechanism also involves significantly increased resourcing for pro-active planning enforcement of operational management plans as a tool for holding building owners accountable for the operational phase of development.

This mechanism is further supported by a proposed regulatory mechanism to extend commercial building disclosure to residential and sectors beyond energy performance.

It is also linked to a financial model (financial bond) which would help incentivise accordance with operational plans.

There is an opportunity for planning enforcement officers to be educative for building owners, in additional to an enforcement approach.

OVERVIEW OF JUSTIFICATION

The planning control and investment in planning enforcement is necessary to ensure that the commitments made at the design stage are maintained through the operational life of the building locking in certainty around carbon reduction in particular.

Increased resourcing for ensuring compliance with operational management plans can also be proactive in ensuring smaller scale buildings (which are proposed to use BESS rather than Green Star) are checked post construction against the design commitments.

IMPACT

_ This mechanism combination would impact all emission sectors

_ The environmental impact of well-resourced planning enforcement is not certain, however there is strong anecdotal evidence through the Council Alliance for a Sustainable Built Environment (CASBE) network that operation phases of buildings drift from the processes / designs outlined in original documentation

2_ Operational Management Plans and planning enforcement

POLICY ALIGNMENT

The policy supports the Arden Vision as it aligns with **Direction 3 - Embedding Sustainable Change** in that it assists in locking in the sustainable change for the operational phase of the development.

COMMERCIAL VIABILITY

Benefits

_ Ensures that occupants get the benefit of operational performance (savings)

_ Reduces inefficiencies of non-functioning / poorly performing infrastructure

_ The PCA recommends improved utilisation of on-site inspections timed to ensure compliance with energy efficiency provisions can be verified

Challenges

_ Requires operational investment associated with planning enforcement officer wages – additionally specialist skills are required to understand when systems / commitments have not been carried through

_ Smaller buildings may not have the skills / ability to monitor and report on operational performance

PLANNING EVIDENCE / PRECEDENCE

_ Operational management plans are an established feature of Victorian planning, however traditionally have focused on waste and stormwater management – in general these have also lacked resourcing for enforcement

_ An Energy Management Plan may be a requirement of a Green Lease Schedule

_ US Energy Codes Compliance program – awareness raising and compliance software to improve verification

_ Victorian Building Inspections under the Victorian Energy Efficiency and Productivity Strategy

OTHER EVIDENCE

_ Pro-active planning enforcement is not common

_ A pro-active audit of planning permits associated with Hume and Ballarat found that in both cases more than 18% of permits had at least one example of non-compliance with conditions

IMPLEMENTATION CONSIDERATIONS

_ The Arden Structure Plan to apply the proposed planning control, with provision for review

_ The Arden Structure Plan should note the operational investment and the source of any funding (if this is to be sourced through any developer contributions)

_ The proposed operational investment could be implemented as a trial initially to ensure the rate of non-compliance warrants ongoing resourcing

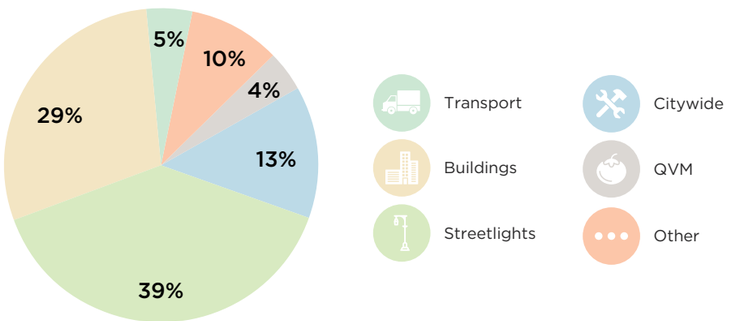
_ Education of owners corporations on their obligations needs to be pro-actively resourced to provide guidance to assist in particular smaller owners corps meet their obligations (for example a fact sheet outlining key content of operational management plans and ongoing roles and responsibilities of building owners, owners corporations etc

_ Requires attention to detail of planners in endorsement of operational management plans, to ensure that key operational commitments such as ongoing procurement of renewable energy is locked in

_ Planning enforcement resources need to have specific skills relating to operation of systems critical for environmental performance

_ A practice note or fact sheet and example of an operational management plan should be developed to ensure that development teams can respond accordingly

3_ Contractual Carbon Target



ENSURING DEVELOPERS UNDERSTAND THE EMISSIONS RESULTING FROM THEIR DEVELOPMENT IS THE FIRST STEP IN UNDERSTANDING HOW MITIGATION CAN OCCUR DURING CONSTRUCTION AND INTO OPERATION. IMAGE: CITY OF MELBOURNE

MECHANISM TYPE

Finance, Governance and Operational model

DETAILED MECHANISM DESCRIPTION

This mechanism involves the development of contractual conditions with the developer(s) of the Arden Central public land that lock in zero carbon in operation for the portion of that precinct procured through developer partnerships (noting that the hospital site (if delivered) and education would be delivered via a separate model).

In principle, a project development agreement would clearly stipulate agreed outcomes in relation to meeting a zero carbon target for the land. These obligations with the developer 'cascade' down to building owners and tenants through sale and lease conditions with the onus with the developer in offsetting any residual carbon unable.

A promising approach is the 'Barangaroo Model' (see case study) where the land is retained by government and developer rights (rather than the land) are sold. The project development agreement integrate with a ground lease and ongoing carbon and other commitments.

The mechanism would involve setting a clear place narrative for the public land through the Arden Structure Plan, which includes:

_ High levels of public infrastructure provision (train station, hospital (if delivered), tertiary education, significant public realm investment)

_ A 6 Star Green Star Communities rating

_ Operational investments and finance, governance and operational models which will support the operational phase

_ Certainty of planning standards

_ A target for a zero carbon precinct in operation by 2030 (which is then required to be maintained over time)

The question then becomes how Government and Industry can work together to achieve this ambition in a way that is commercial viable, provides certainty in locking in the zero carbon outcome by 2030 with clear roles and responsibilities and maximisation of community benefit - new workers, new residents and the general public.

OVERVIEW OF JUSTIFICATION

Without a contractual agreement that locks in carbon reporting and targets over the long term there is uncertainty over how zero carbon for Arden Central could otherwise be achieved. Whilst the exact development model for the publicly held land is not determined, an ability to avoid reliance on planning controls only is critical.

The contractual agreement provides a framework for delivery of carbon reduction with flexibility - allowing developer partners and individual building owners to innovate to meet the zero carbon target.

IMPACT

_ This mechanism combination would impact all emission sectors

_ The environmental impact is very high

_ Adoption of this model would guarantee offsetting of any residual emissions within the Arden Central precinct and provide certainty to being able to meet the Climate Active Carbon Neutral Standard for Precincts certification

_ A project development agreement would also increase certainty of a range of social and economic outcomes including public realm design outcomes, climate adaptation principles etc.

COMMERCIAL VIABILITY

Benefits

_ Ensures that carbon targets can be with flexibility, allowing developer partners to

_ Project development agreement provides certainty for both parties

_ Provides for certainty of direct investments on behalf of the State and associated agencies – developer feedback noted the need for certainty to undertake development feasibility

Challenges

_ Potential reduction in range of development partners who can meet the contractual carbon requirements

_ May reduce the value of the development rights / land value if the model developed isn't easily understood

3_ Contractual Carbon Target

PROJECT PRECEDENCE

The most relevant Australian precedent is Barangaroo a 22 Hectare parcel of land on the western fringe of Sydney's CBD. Mechanisms are in place for the developer Lendlease to report on carbon emissions. A carbon cap exists for each of the leases, with a requirement to fund the gap in offsets. The carbon monitoring and reporting is undertaken through a risk management lens by the developer, i.e. they are incentivised to cascade the carbon reduction through to building owners and tenants to minimise commercial risk.

Refer case study in Appendix 2 for further information.

Contractual targets for the development of public land holdings by developer partners are a feature of successful international urban renewal.

The success of the EcoDistricts in the US is founded on strong project formation with government and industry collaborating to deliver against precinct targets and objectives.

IMPLEMENTATION CONSIDERATIONS

_ Government would need to lead the development of a compelling place narrative for the public land and seek developer partnerships with a strong visioning and detailed expression of interest process

_ A project development agreement and conditions of any ground lease would drive roles, responsibilities and ongoing partnerships

_ Consideration would need to occur as to whether some of the proposed planning controls are not applied to the public land and are instead embedded into project development agreements

4_ Financial bond for operational performance

PARIS CLICHY BATIGNOLLES EMPLOYED A FINANCIAL BOND TO REDUCE PERFORMANCE DRIFT DURING THE OPERATIONAL PHASE IMAGE: PARIS & MÉTROPOLE AMÉNAGEMENT

MECHANISM TYPE

Finance, operational and governance model (financial)

DETAILED MECHANISM DESCRIPTION

This mechanism is typically used to make sure contractual obligations are met. These obligations can be varied in nature, and they can include achieving a set performance objective. A performance bond typically to be imposed to assures the owner that the contractor will complete all obligations set out in the contract, but can also be used to guarantee that funds are available to complete obligations if the contractor fails, and in this way protects the owner against possible losses.[2]

This structure would be effective under a model where government retains ownership of the land and tenders out the development, setting out sustainability objectives.

While there are no obvious examples, a financial bond could also be imposed on developers granted a planning permit, to make sure that planning conditions are met.

The bond is typically set at a few percentage points of the commercial value of the development to ensure that it constitutes a real incentive to deliver on set conditions.

In case of public land development (such as the CityWide site), public funds are protected against financial loss, should the contractor fail to complete the job in accordance with the contract.

OVERVIEW OF JUSTIFICATION

The financial bond is an effective way of ensuring compliance with set conditions, without having to enter into any legal dispute. As the party setting the conditions holds the bond in escrow, the onus is on the obligated party to demonstrate compliance with the conditions. If the bond is set at the right level, there is a strong financial incentive to pay attention to these conditions all through the project and deliver evidence of conditions being met.

IMPACT

_ All measurable outcomes can be managed through this process (including building scale climate resilience outcomes)

_ Does not create the impact, but guarantees its realisation and avoids performance drift

_ Carbon reduction targets could be effectively managed through a bond

_ Social outcomes could also be mandated, such as the delivery and maintenance of community spaces or amenities

COMMERCIAL VIABILITY

Benefits

_ Transparency and accountability around set conditions for operational performance

_ Clear incentive which can carry through to building owners or owners corporations in the case of residential

Challenges

_ Requires a shift in industry culture as this mechanism is largely untested in Australia

_ There may be an additional cost involved in managing the financial bond (especially through a third party)

_ The cost burden of the bond would sit with the building owner until operational performance is demonstrated to be met

PROJECT PRECEDENCE [3 4]

_ Was used in Paris Clichy Batignolles (set at 4% of the commercial value): see case study

_ Performance bonds are widespread across private sector and Commonwealth, State and Local Government Authorities and Agencies.

_ Small bonds for landscaping, maintenance of tree health and commissioning of water infrastructure are commonplace

2. Kubba, S 2010. Green Construction Project Management and Cost Oversight.
3. MG Surety Bonds. 2019. Performance Bonds. https://mgsuretybonds.com/performance-bonds/.
4. Underwriting Australia. 2019. Contract / Performance Bonds. Accessed 29 October 2019: https://www.jwsuretybonds.com/contractor-bonds/performance-bond.

4_ Financial bond for operational performance

OTHER EVIDENCE

_ This arrangement typically consists of a three-party guarantee, whereby the Surety (Bond Company) provides a guarantee to an Obligee (Owner) that their Principal (Contractor Providing Bond) will complete the project according to the terms of the contract.[5]

_ The obligation for the contractor to provide the client with a bond is usually set out in the tender documents.[6]The bond tends to be within 1-6% of the sale price.

IMPLEMENTATION CONSIDERATIONS[7][8]

_ Further market testing is required before this instrument could be applied to non-government land due to the lack of legal precedence in Australia

_ As such it is recommended only for further consideration at this stage and other mechanisms have been recommended as alternatives

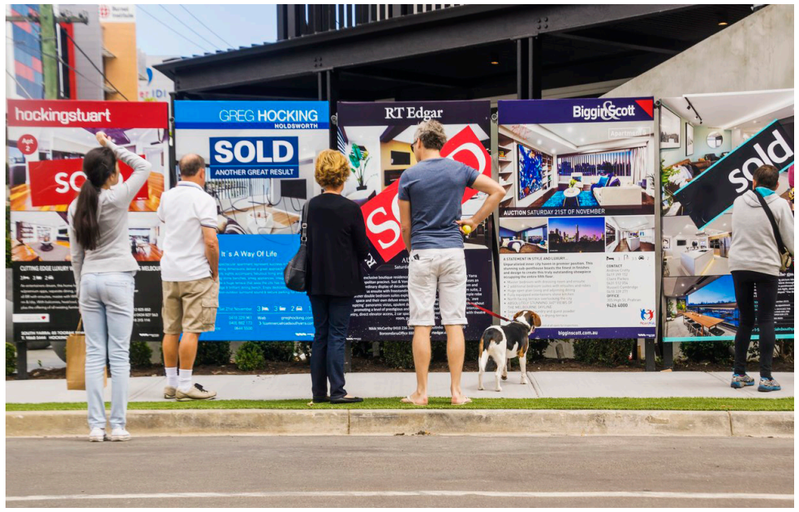
_ The involvement of a third party may create additional complexity. There is a longer procedure than that for preparing regular contracts due to additional legal processes and the general need to source a ‘surety’

_ This mechanism requires a strong position to impose conditions, ideally by incorporating them into a tendering process, for example when opening the development of government-owned land to tenderers

_ The administration of the bond and the process for assessing compliance needs to be defined rigorously and transparently. There is sometimes an independent third party involved as the financial institution managing the bond

5. MG Surety Bonds. 2019. Performance Bonds. https://mgsuretybonds.com/performance-bonds/.
6. Designing Buildings Ltd. 2019. Performance bond for construction. Accessed 28 October 2019: https://www.designingbuildings.co.uk/wiki/Performance_bond_for_construction.
7. MG Surety Bonds. 2019. Performance Bonds. https://mgsuretybonds.com/performance-bonds/.
8. Kraft, E, Park, H & Gransberg, DD. 2014. ‘Performance Bond: Cost, Benefit, and Paradox for the Public Highway Agencies’, Civil, Construction and Environmental Engineering. Accessed 29 October 2019: https://pdfs.semanticscholar.org/55f7/a7883b19e1b8580e8adcf9a3467fecc604fa.pdf.

5_ Disclosure of operational performance



WHILE COMMERCIAL BUILDINGS HAVE BEEN TRANSPARENT REGARDING OPERATIONAL PERFORMANCE FOR SOME TIME, DISCLOSURE WITHIN THE RESIDENTIAL MARKET HAS BEEN SLOWER TO PROGRESS IMAGE: ISTOCK

MECHANISM TYPE

Other regulatory mechanism

DETAILED MECHANISM DESCRIPTION

This mechanism involves a regulatory requirement for building owners to publicly disclose their operational performance.

The regulatory requirement would apply to buildings over:

_ 2000m2 for non-residential and

_ 10 dwellings for residential development

The regulatory mechanism would place the onus on building owners to report on operational performance annually in a consistent way – mirroring the requirements of the commercial building disclosure scheme.

Whilst initial requirements could be restricted to energy (already required at point of sale and lease for commercial buildings over 1000m2) there is strong potential to apply the mechanism to monitoring and disclosure of water (consistent with the NABERS water ratings) and a future potential disclosure of transport mode behaviour and waste diversion from general waste (to recycling and organics collection).

The mechanism is strongly linked with the planning requirement for operational management plans and the increased resourcing for planning enforcement.

OVERVIEW OF JUSTIFICATION

Mandatory disclosure is increasingly viewed as a necessary feature of highly functional building markets as it provides a powerful yet non-prescriptive market signal that encourages upgrades of building stock and can allow for monitoring of precinct / city wide environmental performance.

IMPACT

_ This mechanism would initially likely apply only to energy, but in future could have impact all emission sectors as well as building scale climate resilience

_ Does not create the impact, but could support follow through of design into operational performance, therefore avoiding performance drift

COMMERCIAL VIABILITY

As the regulatory requirement would be imposed on building owners the mechanism does not impact the cost of development, except to the extent that monitoring (energy, water etc) would need to be granular enough to cost effectively report against the requirement.

Benefits

_ The regulatory requirement could transition for carbon reporting for the whole precinct

_ It may reduce the cost of planning enforcement of operational plans as performance data would be regularly reported

Challenges

_ Cost of monitoring and rating would have to be passed on to occupants, who may not benefit from regular disclosure

5_ Disclosure of operational performance

PROJECT PRECEDENCE

_ The existing Commercial Building Disclosure (CBD) scheme requires large commercial office buildings (above 1,000 m2) to disclose their NABERS energy rating at the point of sale or lease. In combination with government and large corporate tenant leasing requirements, this scheme has been instrumental in driving improvements in the large office sector

_ The ACT has had residential building mandatory disclosure for more than 15 years. A 2006 study highlighted a strong correlation between star rating and home value.

_ There is significant international evidence of building operational environmental performance disclosure.

_ For example, New York uses a combination of local laws (84, 87 and 88) to ensure energy and water consumption benchmarking data is disclosed.

IMPLEMENTATION CONSIDERATIONS

_ Further market testing is required to understand how this mechanism would be applied (e.g. through a local law or other regulatory instrument

_ The Arden Structure Plan should note the potential of the mechanism, however further feasibility would occur outside the planning process

_ Planning controls can support future application of the mechanism through the requirement for operational management plans and granular energy and water monitoring

_ Consideration in design would need to be given to both the reporting location and the cost of reporting more regularly than the point of sale or lease

_ This mechanism would be very valuable in monitoring and evaluating precinct carbon performance in particular with the potential for Arden to become a ‘living lab’

_ The disclosure could be linked to contractual conditions on the public land

_ The scale of a disclosure program may be more applicable to a city wide or state scale, however Arden may prove an excellent pilot location

Stationary Energy

This climate response area is critical in driving carbon reduction. Energy use represents the highest proportion of carbon of the precinct inventory. Two key planning controls ensure energy consumption is reduced and fossil fuel lock-in avoided. The remainder of the carbon associated with this sector is then mitigated through the power purchase agreement model (outlined below). The recommendation for 6 star Green Star standard (see above) also assists in the delivery of stationary energy related carbon reduction based on the need for all 6 star buildings designed post 2020 to procure a 100% renewable energy supply. This climate response area is related to Opportunity 1 and 2 of the Arden Climate Response Framework.

TABLE 9 - STATIONARY ENERGY MECHANISMS

CLIMATE RESPONSE AREA	MECHANISM	MECHANISM TYPE
Stationary Energy	6_Minimum energy performance standards	Planning control
	7_All electric building standard	Planning control
	8_Power purchase agreement	Finance, governance and operational model

6_ Minimum energy performance standards

MINIMUM ENERGY PERFORMANCE STANDARDS LARGELY DICTATE THE EFFICIENCY OF THE BUILT FORM. ENSURING DEVELOPMENT EXCEEDS MINIMUM STANDARDS IS ESSENTIAL FOR ARDEN TO DELIVER ITS VISION. NIGHTINGALE 2.0 (PICTURED) ACHIEVED AN AVERAGE NATHERS RATING OF 8.6, DESPITE THE CURRENT NATIONAL 6-STAR MINIMUM. IMAGE: TESS KELLY

MECHANISM TYPE

Planning control (mandatory for Accommodation, Office, Education, Place of Assembly, Retail, discretionary for Industry / Warehouse and alterations and additions over 1000m2)

DETAILED MECHANISM DESCRIPTION

This planning control involves a recommendation for a planning standard as outlined below.

Development must achieve and maintain the following ratings for all commercial office buildings:

_ Arden North and Lauren Street sub-precincts to be at least 5 Star NABERS rising to 6 Star NABERS by 2050 (pre-commitment followed by verification).

_ Arden Central sub-precincts to be at least 6 Star NABERS rising to 7 Star NABERS by 2050 (pre-commitment followed by verification).

All other non-residential buildings (retail, education buildings) achieve an improvement against the minimum energy requirements of the National Construction Code by:

_ 20% for the Arden North and Laurens Street sub-precincts

_ 25% for Arden Central sub-precinct

Development must achieve and maintain the following ratings for all residential buildings:

_ Arden North and Lauren Street sub-precincts to be 7.5 Star NatHERS, rising to 9 Star in 2040

_ Arden Central sub-precinct to be 8 Star NatHERS, rising to 10 Star by 2040

OVERVIEW OF JUSTIFICATION

Improving energy performance at the design stage is proven to be one of the most effective and cost-effective ways of improving the long-term, 'built-in' performance of buildings.

Higher standards for Arden Central (than existing Cl 22.19 and other areas within the precinct) are justified due to predominance of public land holding, where it is long established practice for higher benchmarks to be delivered and the improved ability to site buildings for improved orientation due to a consolidated land holding.

Performance rating systems allow for flexibility to achieve the targeted performance through the most adapted and cost-effective measures. Defining a trajectory for increasing efficiency requirements provides certainty to the market.

IMPACT

_ Stationary energy – residential, commercial

_ Thermal comfort (improvement to health and wellbeing)

_ Scenario modelling highlights the large contribution that efficient commercial (and to a lesser extent residential) builds will make to the precinct emissions. Efficiency and electrification measures are expected to reduce commercial building emissions by 38%, and residential building emissions by 66% by 2050, compared with the BAU.

_ Energy efficiency is largely driven by thermal efficiency which provides a health and wellbeing co-benefit

_ Better performing buildings enable innovative Demand Response mechanisms (as they are better able to maintain thermal comfort in times of load shedding).

POLICY ALIGNMENT

Strong alignment with the Arden Vision and both State and Local Policies. Policy alignment is identical to that outlined for the overarching Green Star building standard so is not duplicated here.

6_ Minimum energy performance standards

COMMERCIAL VIABILITY

Benefits and challenges from a commercial viability perspective are broadly similar to the overarching Green Star building standard so are not duplicated here.

PROJECT PRECEDENCE

_ The proposed mechanism goes beyond existing controls in Fishermans Bend and CoM more broadly, however is consistent with the aspiration for Arden to be an exemplar of sustainable development

_ Existing CoM planning policy and Fishermans Bend controls both use NABERS in standards

OTHER EVIDENCE

_ Buildings account for over 50% of Australia's electricity use (Property Council, 2019)

_ In the 2018 COAG report "Report for Achieving Low Energy Homes", it describes how post 2022 the NCC will require homes to be built to at least 6.5 and 7.0 NatHERS stars equivalent in NCC climates 6 (Melbourne), 7 and 8. In addition, the COAG trajectory is for these homes to be 'ready' to accommodate on-site renewable energy generation, storage and electric vehicles, so as to be ready to achieve net zero energy and carbon.

IMPLEMENTATION CONSIDERATIONS

_ The Arden Structure Plan to apply the proposed planning control, with provision for review (both NABERS and NatHERS ratings are fixed to an energy use intensity per m2, so as BAU performance and NCC requirements increase so to these standards must be reviewed)

_ Consideration could be given to having a "layered" approach where a less complex rating system is used for smaller scale developments (consistent with best practice and Fishermans Bend) – for example commercial buildings of less than 1000m2

_ Standards may require review following the release of state government controls relating to ESD provisions (Action 80 Plan Melbourne), but it is noted that these proposed 'precinct specific' controls may (appropriately) be more complex and set higher benchmarks than statewide provisions.

7_ All-Electric buildings

ALL ELECTRIC BUILDINGS SUCH AS NIGHTINGALE 2.0 AVOID COSTLY AND PATH-DEPENDANT SERVICES SUCH AS GAS CONNECTIONS, ENABLING THE PROCUREMENT OF RENEWABLE ENERGY FOR THE ENTIRE BUILDING. IMAGE: TESS KELLY

MECHANISM TYPE

Planning mechanism (discretionary)

DETAILED MECHANISM DESCRIPTION

This planning control involves setting a planning requirement that development must be all-electric.

OVERVIEW OF JUSTIFICATION

All-electric buildings significantly reduce the need to purchase offsets to achieve zero carbon by 2030 as all stationary energy can be delivered through renewable electricity.

Phase-out of gas use is required to meet precinct, municipal and State ambitions for GHG emissions reduction and uptake of renewable energy.

IMPACT

_ Stationary energy – residential and commercial

_ Whilst in some applications gas is still comparable in carbon terms to 'black' electricity in 2019, the decline in carbon intensity of the grid and the ability to fuel all electric buildings from renewable sources (on-site or off-site) justifies removal of gas from all applications for which electricity is a viable alternative

_ Avoided costs of installing new utility (i.e. gas) only to eventually retrofit with inevitable phase-out of gas to meet state-wide emissions reductions targets

POLICY ALIGNMENT

The mechanism is consistent with the Arden Vision in that it:

_ Supports achievement of Direction 3: Embedding sustainable change, by ensuring that buildings are capable of connecting to alternative energy sources

_ Underpins the ambition for Arden to be at the forefront of sustainable development through low-energy, low-carbon buildings (Direction 3, p.29)

Further policy support is found in Plan Melbourne Direction 6.1 Transition to a low-carbon city to enable Victoria to achieve its target of net zero greenhouse gas emissions by 2050 and policies:

_ 6.1.2 Facilitate the uptake of renewable energy technologies

The Victorian Government's commitment under the Climate Change Act 2017 to reduce greenhouse gas emissions for Victoria to zero net emissions by 2050 requires a phase out of gas.

This policy is specifically supported by CoM's Climate Change Mitigation Strategy 2050 priority action 2.8 Advocate and facilitate to transition from gas to electricity in buildings and precincts.

COMMERCIAL VIABILITY

Benefits

_ Provides industry with the certainty it needs to invest and innovate

_ The lack of existing gas infrastructure 'in ground' in the Arden Central land further supports the business case for a commitment to all-electric buildings, as this will avoid the expense of infrastructure installation

_ The GBCA Carbon Positive roadmap identifies a very limited role for gas in buildings noting as part of the roadmap that greenstar buildings will "be incentivised to put measures in place to support the decarbonisation of the grid, such as storage and eliminating fossil fuels as far as practicable"

_ Gas prices are forecast to rise, whereas renewable electricity prices are forecast to continue to fall

7_ All-Electric buildings

Challenges

_ There is a risk that technology progress may make decarbonised gas a viable option in the future (e.g. hydrogen fuel distributed through gas network)

_ There is a risk of stranded gas assets and increasing gas prices for customers remaining on the network if the transition is not managed correctly.

PLANNING EVIDENCE / PRECEDENCE

_ While this mechanism is supported by State and local planning policy that encourages renewable energy opportunities to be maximised (Clauses 19.01 and 22.19) there are no specific built form controls within current planning schemes mandating all-electric buildings.

_ This mechanism goes beyond planning control in Fishermans Bend which encourages the uptake of renewable energy.

OTHER EVIDENCE

_ A recent Rocky Mountain Institute Study reported that in 'many scenarios, notably for most new home construction, we find electrification reduces costs over the lifetime of the appliances when compared with fossil fuels.' Additionally, it recommended to 'stop supporting the expansion of the natural gas distribution system, including for new homes…that this infrastructure will be obsolete in a highly electrified future, and gas ratepayers face significant stranded asset risk in funding its expansion today'

_ A series of reports authored by Renew demonstrate that for new dwellings installing gas represents a cost to consumers

_ Going all electric is in step with plans of major developers including Mirvac who recently updated their sustainability strategy and included commitments to continuing to shift towards all electric buildings

_ The Board of Supervisors in Marin County, California recently approved energy-efficiency updates to its green building requirements that include provisions providing a compliance pathway for all-electric buildings. The updated standards apply to new buildings in unincorporated areas of the county.

PROJECT PRECEDENCE

_ Monash University has announced it will spend $135 million over the next 13 years to take its campus to 100 per cent renewables, cutting out gas entirely

_ The entire suburb of Ginninderry will be gas-free. Market testing of prospective home purchasers indicated it did not detract from purchasing. Modelling indicated that savings of $14,000 per household over the lifetime of buildings

_ HV.H has recently delivered a 100% renewable building in Fairfield at no cost premium to one which is gas connected

IMPLEMENTATION CONSIDERATIONS

_ Reflected in the Arden Structure Plan planning controls as a discretionary requirement for all buildings

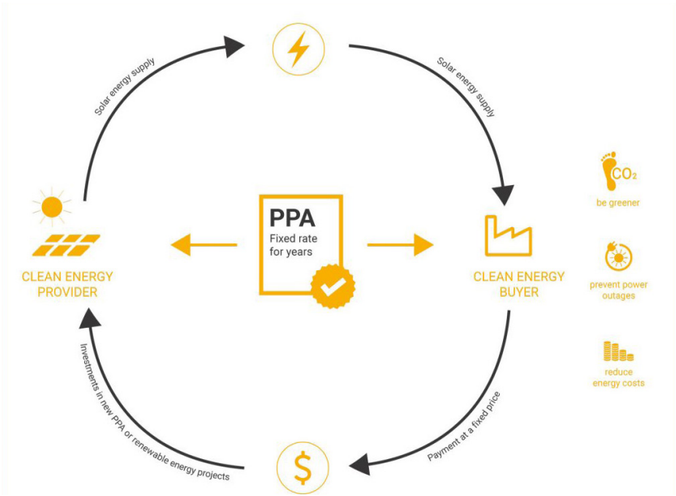
_ Larger scale research, health or other land uses within the precinct may require access to gas for a variety of 'non-standard' purposes, and will require exemptions to any connectivity restrictions

_ Given the current lack of gas infrastructure within the precinct, the preferred approach would be to integrate with utilities planning, so that gas was only delivered to those which are reliant on its provision (for example, the hospital (if delivered) may be unable to operate without gas))

_ This would avoid unnecessary infrastructure costs and may negate the need to implement planning controls on the publicly held land to avoid the use of gas

_ Planning legal advice is required to understand the implications of the subdivision of land (in particular whether the creation of a new lot would require provision of gas to the front of the lot or whether an exemption is possible). This is likely to be most important for the Arden Central land where the land may be subdivided into separate parcels for lease or sale to developers

8_ Power purchase agreement



POWER PURCHASE AGREEMENT'S (PPA'S) ENABLE CUSTOMERS TO PURCHASE BULKQUANTITIES OF RENEWABLE ELECTRICITY, AS WELL AS SECURING SUPPLY AND PRICE OUTSIDE OF THE VOLATILE ENERGY MARKET. IMAGE: MEECO

MECHANISM TYPE

Financial, Operational and Governance Model

DETAILED MECHANISM DESCRIPTION

This proposed model is for a government facilitated Power Purchase Agreement (PPA) to be developed for the Arden Urban Renewal Area.

A PPA enables the purchase of renewable energy from a specific remote renewable energy generator for an agreed price for an agreed length of time. This provides price certainty to both parties to the agreement and creates market demand for renewable energy generation. As there is no physical delivery of the electricity generated off-site, the arrangement does not have any bearing on the local energy network (constraints / peak demand response, etc).

The grid is still used a distribution network, hence such arrangement does not reduce transmission losses. The benefit for PPA electricity buyers is essentially to be able to access renewable energy without having to either develop a project themselves or have appropriate space for installing renewable energy infrastructure on their property.

Depending on the contractual arrangements, the generation capacity may or may not be additional to the mandated federal Renewable Energy Target (which comes with market incentives).

This mechanism strongly links to the overarching 6 Star Green Star standard (which indirectly requires a 100% renewable electricity supply) through GBCA Carbon Positive Pathway.

This mechanism has potential to provide benefit beyond the precinct boundary to contribute to the climate positive scenario as the offer could be extended to large energy users outside Arden precinct.

OVERVIEW OF JUSTIFICATION

Government will develop and maintain assets such as hospitals (if delivered), train stations and community infrastructure. The model is recommended as a way of providing leadership and reducing the cost of renewables sourcing to other customers in the precinct, therefore significantly contributing to carbon reduction from stationary energy that would otherwise need to be offset at cost.

IMPACT

_ Stationary Energy – Buildings and infrastructure

_ High impact - this measure has the largest ability to reduce emissions in the precinct and remove the reliance on the grid decarbonising to achieve emissions reductions

_ A PPA of this scale can secure financing for a new renewable energy project (with large customers locked in the certainty can confirm the business case for a project)

COMMERCIAL VIABILITY

Benefits

_ The Green Star carbon positive pathway requires that all 6-star buildings need to procure 100% renewable electricity supply to gain accreditation post 2020 – this has been robustly tested through a broad industry consultation

_ This model provides a potential pathway for reducing the cost associated with renewable electricity sourcing

_ An understanding of costs of renewable electricity supply can be factored into project feasibility

_ Enables participants to at least partially or fully lock-in long term price certainty while also receiving a retail electricity supply service

_ Enables access to renewable energy to customers who may not be able to access suitable space to implement on- site renewable energy

8_ Power purchase agreement

Challenges

_ Developing a model with flexibility for a range of different customer types is challenging and administratively time consuming for the lead

_ Large Generator Certificates (LGC) prices are expected to continue to fall and the energy market is inherently difficult to predict

_ Lack of market acceptance of a shared electricity product

_ Developing a business case involves specialist electricity market forecasting capability

_ Retail contestability regulations limit the ability to lock in customers with perfect certainty

_ Deal structuring would likely take two years

PROJECT PRECEDENCE

_ Corporate PPA's for renewable electricity have grown strongly over the last two years in particular with the Melbourne Renewable Energy Project bringing confidence to the approach.

_ The CoM Renewable Energy Project (MREP) launched a competitive tender in April 2016 in partnership with local governments, institutions, and private- sector corporations to purchase large volumes of renewable energy. The group collectively purchased 110 GWh, as an effort to bring the City closer to its objective of Net Zero carbon emissions on municipal carbon emissions by 2020.

_ The project has been structured as to achieve a scale that allows to support a new (additional to the federal Renewable Energy Target) renewable energy project in Victoria that would notionally provide renewable energy to the participating organisations. A project at such a scale and using a joint procurement process aims to allow purchasers of renewable electricity to access lower overall renewable electricity than they would have under a smaller, bi-lateral PPA, at a fixed price under a long term agreement.

_ The long-term contract can be considered as a risk mitigation policy for PPA purchasers in a context where electricity prices are uncertain.

_ The ACT government is also procuring 100% renewable electricity for the entire territory.

IMPLEMENTATION CONSIDERATIONS

_ The Arden Structure Plan is recommended to document a commitment for all government and state agency assets within the precinct to have a 100% renewable electricity supply

_ Government would need to lead further exploration of the opportunity by aggregating their existing and future demand (hospital (if delivered), train station, community infrastructure)

_ Locking in renewables procurement for their own demand, which has flexibility to be 'upsized' at rates competitive with the black electricity market provides the basis for the model

_ Other partners are then able to consider the offer conditions and come on board subject to their own needs being met

_ Developers, building owners, tertiary institutions as well as retailers and generators who would respond to the needs of Government and others with competitive offers would be involved in project feasibility

_ Provision should be made for detailed feasibility and model development should occur with alignment to CoM's corporate PPA work

_ There is potential for this PPA to link with 100% renewable electricity sourcing for the train network to aggregate further demand beyond the precinct (consistent with the Climate Positive development scenario)

_ A latent demand for renewable electricity will exist as the adoption of 6 star Green Star as planning standard for large non-residential buildings requires developers / building owners to source renewable electricity

_ The decision (either by Government or developer partners) to pursue an embedded network for the public land may influence the viability of this model (positively or negatively)

Transport

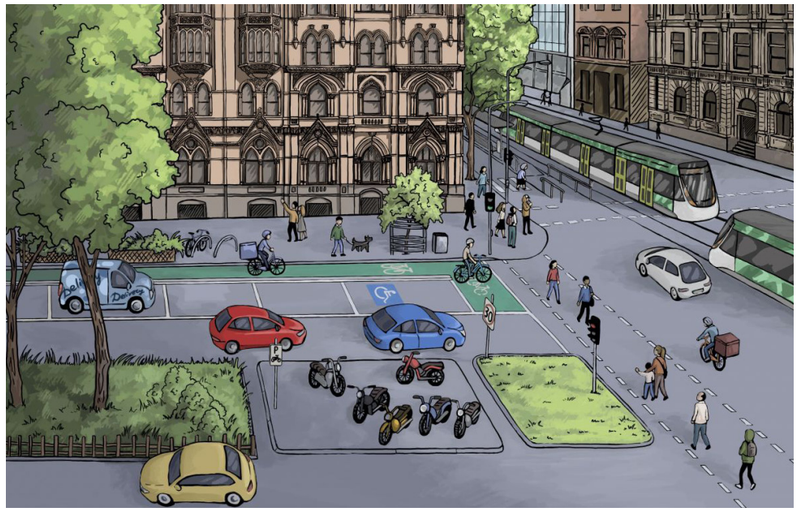
This climate response area is also critical in driving carbon reduction. Transport emissions are challenging to reduce and several mechanisms working in combination are required. Tram or bus transport is strongly supported to complement already committed rail transport. Whilst recommendations for public transport infrastructure are outside the scope of this work (and being considered by a parallel peice of work), we consider the best possible public transport provision combined with active transport and car parking restriction can effectively work in combination to deliver a zero carbon precinct.

We recommend consolidated car parking as a direct and operational investment, to be supported by both restriction of car parking on site and promotion of active transport at the building scale. A further planning control is recommended to ensure electric vehicle transition occurs to further reduce the carbon impact of remaining car parking in the precinct. A model for centralised distribution of goods is also recommended to reduce freight emissions. This climate response area is related to Opportunity 3 of the Arden Climate Response Framework.

TABLE 10 - TRANSPORT MECHANISMS

CLIMATE RESPONSE AREA	MECHANISM	MECHANISM TYPE
Transport	9_Consolidated car parking	Direct and operational investment
	10_Car parking and active transport standards	Planning controls
	11_Centralised distribution centre	Finance, governance and operational model
	12_Electric Vehicle Standards	Planning control

9_Consolidated Car Parking



BEYOND ENVIRONMENTAL CONCERNS, CARS ARE SPACE-WASTERS. REPLACING TRADITIONAL ON-STREET PARKING WITH BIKE LANES AND ADDITIONAL VEGETATION CREATES A MORE SUSTAINABLE URBAN REALM. IMAGE: CITY OF MELBOURNE

MECHANISM TYPE

Direct Investment / Potential Finance, Governance and Operational Model.

DETAILED MECHANISM DESCRIPTION

This direct investment puts government in control of precinct car parking provision. It involves Government (State or Local) facilitating the locations for a limited number of consolidated car parks on the Arden periphery. If an equal distribution between on site car parking and consolidated car parking is assumed, approximately 2650 car parks are required within consolidated car parks. Land space requirements would depend on number of stories.

Three potential cascading levels of investment are considered, depending on the response of commercial car park operators:

1. Designate two to four indicative locations for consolidated car parking and facilitate commercial car park operators to acquire sites, build own and operate commercial car parks (with strict conditions on EV charging, car share space provision and potential reuse to other building types in the future
2. As above, however sites are acquired by Government with a long-term ground lease setting in place the build and operational conditions for a commercial car park operator
3. Government acquires the sites, builds, owns and contracts out the operation

This mechanism is strongly supported by the planning controls for very low maximum car parking provision for commercial and residential development and ‘unbundling’ of car park purchase or lease from buying or renting a residential or commercial property - providing an incentive to go car-free altogether.

The mechanism is also linked to planning controls which ensure EV charging car parking takes priority and that floor to ceiling heights are able to be adapted to future habitable buildings.

OVERVIEW OF JUSTIFICATION

As separation of car parking from new development is uncommon in Australia, modest investment may be required to manage parking demand and facilitate the long term conversion of car parks to residential or commercial development.

Additionally, strategic location of car parking can help promote reduced mode share for private vehicles and more cost-effective electric vehicle charging.

IMPACTS

- Private transport
- Not individually modelled, but a key component of a larger strategy to deliver 10% mode share for private vehicles
- Allows for reduced embodied energy for transitioning building use as car ownership declines

POLICY ALIGNMENT

The mechanism is consistent with the Arden Vision in that:

- Restrictions on car ownership supports Key Direction 5: Prioritising Active Transport, and achievement of Arden becoming one of the most sustainable precincts in Melbourne in relation to transport, with the aim of reducing private vehicle movement to only a 10% share
- Supports achievement of mode share targets of 60% of trips to Arden being by public transport and 30% active transport

The initiative supports City of Melbourne position (Transport Strategy 2030) that electric vehicle charging should be located on private land rather than on-street – consolidated car parking provides this opportunity.

It also supports the initiative (Section 4.5) to title car parking separately to dwellings and commercial tenancies (therefore reducing the vacancy rates of in-building car parking).

9_Consolidated Car Parking

COMMERCIAL VIABILITY

Benefits

_ Cost recovery is embedded into operation (in Options 2 and 3)

_ Improves housing affordability – residents / businesses are not forced to pay for car parking they do not want or need

_ Helps maximise high value GFA for residential and commercial purposes

_ Separation of car parking from commercial and residential development through this direct investment also supports improved utilisation and revenue from public transport investment

_ Ensures that car parking space (25 - 30m2 per space) is not redundant or underutilised

Challenges

_ Not a typical role for Government

_ Risk of being unable to find commercial partners

PROJECT PRECEDENCE

The Vauban case study (refer Appendix 2) highlights project-based evidence of this approach.

IMPLEMENTATION CONSIDERATIONS

_ Arden Structure Plan to outline two to four indicative locations for further investigation with key stakeholders, also ensuring that the location of consolidated car parking is ‘far enough’ from the denser development to incentivise PT and active transport

_ The proposed provision of consolidated car parking at the periphery (with integrated EV facilities) while likely necessary, needs to be reconciled with current CoM policy which seeks to avoid the development of any further commercial car parks

_ Understanding of the local electricity network to the extent that some locations may be more able to support electric vehicle charging with less investment than others

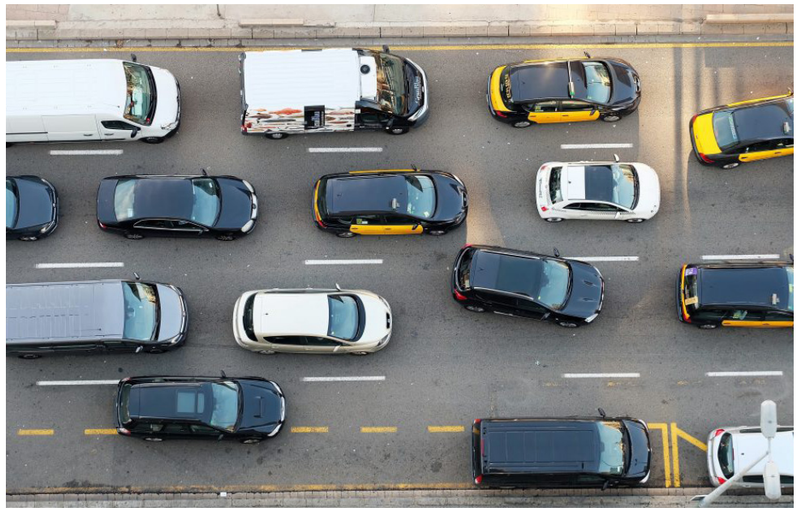
_ Determination of investment / operational model consistent with mechanism options presented

_ Key partnerships are with commercial car park operators and car share operators

_ A need to ensure that car parking supply remains restricted overall so that the cost of a car park lease / purchase is sufficiently high to reduce private vehicle ownership

_ The potential to extend the investment to a Rotterdam-style bicycle garage that demonstrates the active transport alternative at scale

10_Car parking and active transport standards



CURRENT CAR PARKING REQUIREMENTS ARE AT ODDS WITH BROADER SUSTAINABILITY GOALS SUCH AS ACTIVE TRANSPORT. IMAGE: IZABOG

MECHANISM TYPE

Planning mechanism (discretionary – depending on recommendations of ITP)

DETAILED MECHANISM DESCRIPTION

This planning mechanism involves a multi-faceted approach to encourage active transport and limit private vehicle trips consistent with the Arden Vision for a mode share of 10% for private vehicle trips. The following planning standards are proposed:

- One bicycle park per bedroom for residential development
- One bicycle parking space for 10% of regular occupants in the case of a new building without onsite car parking -Regular occupants are occupants who occupy the building for 2 hours a day on a daily basis (excludes weekends for buildings which operate on business days only)
- One bicycle parking space for 5% of peak visitors in the case of a new retail building without onsite car parking
- End of trip facilities with provision of 100% increase over the provisions of Clause 52.34
- A maximum on-site car parking rate of 0.1 car parks per dwelling (not including dedicated car share spaces) with the remaining car park provision to be provided in consolidated car parks
- A maximum on-site car parking rate of 0.3 car parks per 100m2 of office and retail space (not including dedicated car share spaces) with the remaining car park provision to be provided in consolidated car parks
- No permits for commercial car parks except in accordance with designated consolidated car parking locations
- All car spaces are to be separately titled from apartments and commercial tenancies and be constructed to facilitate future adaptation to other building uses

Car parking provision for hospital (if delivered) and education buildings would be developed separately to this piece of work.

Provision for car share spaces would be highly dependent on the distance to consolidated car parks, so a blanket planning standard for car share spaces is not proposed.

OVERVIEW OF JUSTIFICATION

Car parking spaces must be restricted during the design phase for all new buildings to meet policy requirements for public and active travel mode share to be a 90%.

Active transport infrastructure is required to be the highest possible standard to support the 30% target for active transport.

Ensuring long term adaptability of car parking spaces will “future proof” the precinct against further reductions in private transport.

IMPACTS

- Reductions in carbon related to private and public transport
- Has a direct impact on mode share by restricting mode choice to residents and workers in the precinct
- Health benefits of increased use of active transport (walking, cycling)
- Positive amenity outcomes (noise and pollution reduction, reduced congestion) from reduction of traffic across the precinct

POLICY ALIGNMENT

The mechanism is consistent as outlined in the above consolidated car parking mechanism.

Further support for this mechanism is found in CoM’s Transport Strategy 2030 and the overarching commitment to increase public transport, walking and cycling mode share to 70 per cent of all trips by 2030 and the Climate Change Mitigation Strategy 2050 Priority Action 3.1 Continue to reallocate road space to create more space for walking, cycling and green infrastructure.

The Victorian Government’s commitment under the Climate Change Act 2017 to reduce greenhouse gas emissions for Victoria to zero net emissions by 2050 requires immediate action to reduce private transport trips.

10_Car parking and active transport standards

COMMERCIAL VIABILITY

Benefits

_ Space “freed up” from car use and car parking can be reallocated to other services (end of trip facilities, waste management, water management, public or active transport)

_ Allows GFA for residential and commercial space to be maximised without compromising height / amenity impacts

_ Adaptability of car spaces “future proofs” buildings against further reductions in private vehicle use

_ Developer feedback indicated that each avoided car park constituted a saving of between $30,000 and $60,000 in construction cost (dependent on soil conditions etc)

_ Developer feedback indicated that there was little expectation beyond (very) senior executives for car park provision as part of office space, especially with proximity to new North Melbourne Station

_ Furthermore, residential parking often occupies the bottom floors of buildings, creating dull and lifeless streets. Adaptability of car parking spaces is a critical measure to address this and plan for a future where even fewer trips are taken by car

Challenges

_ In the early years of the precinct development, car reliance by existing workers commuting into the precinct may still be challenging

_ Broad acceptance of lack of private car parking in residential buildings may impact marketing to an older demographic

_ Proposed car parking rates are low compared to other precincts and there may be push back on further reductions

PLANNING EVIDENCE / PRECEDENCE

_ The elements of sustainable transport policy have all been previously endorsed through the independent panel process and are current policy in parts of Melbourne Planning Scheme

_ The application of the measures outlined above to the Arden Precinct are consistent with current and best planning practice

_ Car park adaptability requirements mirror requirements in Fishermans Bend

_ The ‘de-coupling’ of car parking spaces from individual ownership has recently been supported by a planning panel in the adjacent West Melbourne precinct

_ Bicycle parking rates are different to those in Fishermans Bend but are consistent with the preferred standards proposed for the updated City of Melbourne planning policy

OTHER EVIDENCE

_ Significant research was undertaken by the CoM in preparation of the Transport Strategy 2030, in particular a background paper developed by RMIT which found from an international literature review that restriction of car parking in combination with unbundling provision from title of residential apartments was highly effective as a driver of sustainable transport behaviour

_ A study undertaken by RMIT (2018) confirmed that off-street car parking is over-supplied across the municipality (40% more spaces than cars owned)

PROJECT PRECEDENCE

Vauban is the most celebrated example of the effectiveness of separating car parking title from residential / commercial space (refer Case Study) to drive reduce car ownership

The Commons and Nightingale projects in Melbourne’s inner north demonstrate market acceptance of apartments with no car parking when high quality public transport and amenities are close by

IMPLEMENTATION CONSIDERATIONS

_ For these proposed planning controls to be reflected in the Arden Structure Plan as a mandatory requirement and public

_ Further policy guidance beyond what is currently provided could be developed to address:
+ Provision of a diverse range of bicycle spaces, including those suitable for cargo bikes etc
+ The provision for electric bike charging

_ Alignment is required with work being undertaken by DoT in relation to sustainable transport policy, particularly in regard to delivery of public realm infrastructure such as cycling lanes and pedestrian areas which will be critical in providing the supportive environment for uptake of the opportunity – in addition the need for ‘drop off’ parking spaces for bulky items

_ The short-term viability of very low car parking rates is predicated on the certainty and delivery timing of consolidated car parking on the edge of precinct and opening of the North Melbourne Train Station. Controls may need to be drafted to allow for interim measures (which will increase the importance of adaptability standards)

11_Centralised distribution centre

'LAST MILE' DISTRIBUTION CENTRES REDUCE CARBON EMISSIONS ASSOCIATED WITH FREIGHT TRANSPORT

MECHANISM TYPE

Operational Investment / Model

DETAILED MECHANISM DESCRIPTION

This operational investment involves Government (State or Local) encouraging or mandating a local high efficiency local distribution centre that collects all deliveries for businesses and residents and distributes them in a sustainable way (bike or electric delivery). The purpose is to reduce freight transport emissions and local traffic by reducing trip numbers and using low-emissions vehicles for deliveries.

The operational investment requires facilitating or potentially investing in a small-scale distribution hub where deliveries to Arden can be centralised to single or multiple points (potentially near the train station) to be collected by recipients or delivered 'the last mile' by sustainable transport modes. This does not take the place of larger basement deliveries, but reduces incidental, inefficient freight movements.

Such a distribution centre would enable 'click and collect services' such that are now offered by Woolworths etc, however with additional function for cost-effective doorstep delivery by electric van / bike (dependent on the package size).

This mechanism has potential to provide benefit beyond the precinct boundary to contribute to the climate positive scenario.

OVERVIEW OF JUSTIFICATION

The investment is necessary to ensure that the transport emissions from small scale freight are limited.

IMPACTS

_ Transport (freight)

_ The environmental impact is small but significant amongst transport freight emissions which are difficult to otherwise address. This measure can encourage a faster adoption of low emissions vehicles by freight companies

POLICY ALIGNMENT

The policy supports the Arden Vision of 10% mode share for private vehicles, by reducing traffic movements for single delivery of items, replacing them with active transport or at minimum electric vehicle movements

COMMERCIAL VIABILITY

Benefits

_ Improve the utilisation of goods vehicles and improve traffic in the precinct

_ Futureproof the precinct to facilitate the large increase in online shopping and deliveries in the future

_ Does not impact viability of any commercial or residential development

Challenges

_ Designing an effective delivery system to meet the expectations of both business and consumers

_ Cost recovery structure

_ Requires leadership from government to support the operational model

_ May not be suitable for the delivery of large/bulk goods

11_Centralised distribution centre

PROJECT PRECEDENCE

In **Bordeaux**, France, **'Nearby delivery areas'** were set up in 2017 (following a trial from ~2004-2010) to dispatch goods for the last mile in the inner city. Goods are unloaded from incoming vehicles and loaded onto trolleys, carts electric vehicles or bicycles for the final distribution leg.[9]

In Oslo, Norway, private company DB Schenker opened a low-carbon city distribution centre (named the 'Oslo City Hub') to reduce emissions from freight by 80% using electric vehicles and e-bikes.

Similar examples and pilot programs can be found in the city centres of Brussels, Oslo, Prague, and London.

Low Emissions Zones are also observed throughout Europe, restricting freight vehicle access in certain regions and encouraging the uptake of electric vans and bicycle delivery systems.

IMPLEMENTATION CONSIDERATIONS

- The Arden Structure Plan to nominate an indicative location for a centralised distribution centre
- State or Local Government would dictate traffic restrictions (loading zones and/or freight routes or pedestrian only access) or use of a ‘low emissions zone’
- This could make a centre necessary for practical reasons (but government would not necessarily own or operate the service as a ‘click and collect’ location)
- An investment (incentive) from Government may be required to ensure that the opportunity is delivered sustainably (with renewable electricity sourced distribution for example), however there is potential for a sustainable commercial operational model
- Design of streetscapes to provide preferential short-term parking for electric vans and facilitate electric bicycle movements

ADDITIONAL EVIDENCE

The **Citylab** project on **Urban Freight Logistics** reviews and presents case studies from cities around Europe for reducing last-mile freight impacts.

9. tmv.laet.science/formation/BordeauxELP.html

12_Electric vehicle standards

PRIORITISED ELECTRIC VEHICLE CHARGING CAN BE AN EFFECTIVE TOOL FOR DISINCENTIVISING ICE'S IMAGE: THE CONVERSATION

MECHANISM TYPE

Planning control (discretionary – depending on recommendations of ITP)

DETAILED MECHANISM DESCRIPTION

This mechanism includes adoption of planning controls for EV's consistent with the accelerated scenario outlined in the Australian Electric Vehicle Market Study (May 2018). This requires that development:

- Includes preferential location for EV parking in preference to ICE's
- Requires minimum provision of car spaces to include Level 2 charging infrastructure (with a trajectory rising from 20% to 90% by 2040)
- Locate all charging infrastructure on private land

These planning standards apply to car parking which is provided as part of development and consolidated car parks outlined as a Direct Mechanism.

OVERVIEW OF JUSTIFICATION

Running transport on electricity enables zero-emissions transport when paired with renewable energy, decreasing the need to continually offset in the precinct. Even without renewable energy, EVs will become much more efficient than existing vehicles. It is more cost effective to make provision for EV infrastructure requirements in the design and development of buildings, rather than as a retrofit. Indeed, if consideration is not given to EV requirements at design stage, it may prohibitively expensive to retrofit in some cases.

IMPACTS

- Emissions relating to private transport
- Freight (Light Commercial Vehicles, or LCVs).
- Running transport on electricity enables zero-emissions transport when paired with renewable energy
- A trip by an EV reduces emissions by 60% compared to a petrol vehicle in 2030, and by 80% in 2050 and by 100% if the electricity is renewably sourced
- Lower noise impact and reduced air pollution will have positive health benefits across the precinct
- Likely to be monetary benefits to owners of EVs as total cost of ownership lower than traditional vehicles by 2025

POLICY ALIGNMENT

Electric vehicles are not specifically referred to in the Arden Vision, however enabling wide-scale use across the precinct will further reduce the environmental impact of the remaining vehicle trips through the replacement of fossil fuels with renewable electricity.

An EV transition is supported by CoM Climate Change Mitigation Strategy 2050, subject to improvements in renewable electricity in the grid. This includes advocacy for:

- Policy to support the transition to electric vehicles powered by renewable energy, prioritising buses and last-kilometre freight
- Encourage private providers to provide electric vehicle charging facilities

Action 24 of the CoM Transport Strategy 2030 supports this position, as does the Climate Change Mitigation Strategy 2050 Priority Action 3.5 Advocate for lower carbon intensity of motor vehicles and support transition to electric vehicles

A 2018 report by Infrastructure Victoria to State Government highlighted a supportive environment for fleet transition, enabling the energy sector to respond to the emergence of zero emissions vehicles as priorities.

12_Electric vehicle standards

The National Select Committee on Electric Vehicles highlighted in their recommendations the need to coordinate with charging infrastructure operators to develop a comprehensive plan for the rollout of a national public charging network.

The Victorian Government's commitment under the Climate Change Act 2017 to reduce greenhouse gas emissions for Victoria to zero net emissions by 2050 requires a phase out of petrol vehicles.

COMMERCIAL VIABILITY

Benefits

_ By 2025, switching from conventional to electric vehicles could save drivers an average net annual savings of approximately $350 over a five-year ownership period (ClimateWorks 2018)

_ The very low mandatory maximum car parking rates result in provision of charging infrastructure having limited impact on building cost

_ The separation of car spaces from apartment or commercial tenancy title allows transparent cost recovery for electric vehicle charging infrastructure

_ The planning control reduces future costs on owners corporation and building owners to retrofit at cost

Challenges

_ High levels of provision may see increases in electricity connection cost (although this is offset by reduce car parking numbers overall)

PLANNING EVIDENCE / PRECEDENCE

_ Mandating EV charging infrastructure has not previously been implemented in the Victorian planning scheme. This represents an opportunity to lead without risk, due to overall low car parking numbers across the precinct

OTHER EVIDENCE

_ Australian Electric Vehicle Market Study (May 2018) outlines the key public investments required to assist in EV transition

_ The State of Electric Vehicles in Australia (2018) by ClimateWorks highlights infrastructure provision as a key constraint

IMPLEMENTATION CONSIDERATIONS

_ The Arden Structure Plan to apply the proposed planning controls as a mandatory requirement

_ CitiPower to be engaged to understand the impacts of provision of electric vehicle charging on capacity of building scale electricity connection – with a view to developing a transparent, fair method for evaluating electrical connection requirements and costs and ensuring this process includes consideration of control / orchestration technologies that can reduce this cost

_ Development of a planning practice note to clearly outline requirements for developers, given that this is 'new ground' in planning policy

Waste

This climate response area is important in driving carbon reduction. It is highly dependent on the ability to capture emissions associated with the release of methane from organics. Two mechanisms are proposed, which work in combination to significantly reduce operational carbon associated with waste. The carbon reduction is also supported by overarching climate response mechanisms for contractual carbon targets for the public land as well as operational waste management plans and planning enforcement. This climate response area is related to Opportunity 4 of the Arden Climate Response Framework. There is a high level of dependency on the development of a precinct waste management plan for the optimisation of waste standards and direct and operational investments.

TABLE 11 - WASTE MECHANISMS

CLIMATE RESPONSE AREA	MECHANISM	MECHANISM TYPE
Waste	13_ Waste standards	Planning control
	14_ Resource hubs and waste education	Direct and operational investment

13_Waste standards

THE VARIOUS COLOURS OF WASTE SEPARATION. IMAGE: KS ENVIRONMENTAL

MECHANISM TYPE

Planning control (Discretionary - depending on recommendations of a precinct waste management plan)

DETAILED MECHANISM DESCRIPTION

A planning control is proposed at the building scale that requires:

_ Any waste management undertaken in private development aligns and responds to any precinct wide waste management plan

_ The provision of an operational waste management plan capable of delivering a 90% diversion rate from landfill in operation and ongoing monitoring of performance

_ Separation of three waste streams, including general waste, recycling and organics in all buildings

_ Space provision for non-standard waste (clothing, e-waste etc)

OVERVIEW OF JUSTIFICATION

In higher density, building planning standards are required to embed waste management practices and ensure opportunity is created for source separation and overall waste diversion rate from landfill.

From an emissions perspective, and from the perspective of broader waste reduction, there is significant evidence that the separation of organics from general waste streams is one of the critical elements in delivering carbon reduction from the waste sector.

IMPACTS

_ Waste related emissions – residential and commercial

_ Moderate impact when combined with resource hubs and waste education

_ Food waste accounts for approximately 21-42% of total waste (residential and commercial have differing proportions). Appropriately treated (i.e. through diversion to a biodigester or other processes which capture methane) emissions from food waste can be eliminated

_ Good waste diversion practices for recyclable materials can increase total waste diversion from approximately 40% (City of Melbourne averages) to 80-90% or higher in the precinct, resulting in a significant diversion of waste from landfills

_ Less leachate: Breakdown of organic waste in landfills produces leachate which can create odour and pollute water

_ Less scarce resources are wasted and processes are created to ensure they can be recycled and reused

_ Reduction of valuable resources ending up in landfill by ensuring markets exist for recycled and reused materials

_ Organics collection leads to creation of a nutrient rich resource which can support open space health

_ Employment opportunities are created through recycling (9.2 jobs per 10,000 tonnes compared to 2.8 jobs if the waste is landfilled)

_ Waste separation can have positive behaviour change impacts, in drawing attention to the amount of waste that is neither organic, nor recyclable

POLICY ALIGNMENT

The mechanism is consistent with the Arden Vision in that it:

_ Supports Direction 3: Embedding sustainable change, and specifically the planned outcome to ensure buildings are connect with and support alternative waste solutions

_ Achieves the vision of Arden demonstrating leadership in waste practices, including precinct-wide shared waste management systems and best practice waste minimisation and conversation of waste to energy

Further support for this mechanism is found in :

_ Clause 22.19 of the Melbourne Planning Scheme, which requires most applications to prepare a Waste Management Plan (WMP) in line with specified guidelines.

13_Waste standards

_ The City of Melbourne's Waste and Resource Recovery Strategy which set a 90% diversion target for reduction in waste going to landfill

This initiative supports achievement of the State Government's SWRRIP (2018) goal of only diverting to landfill waste streams that contain no materials that could be viably recovered.

COMMERCIAL VIABILITY

Benefits

_ Valuable resources are created, for example compost from organics collection can be sold and used by councils in activities and agriculture

_ Developer feedback indicated that three waste streams would not impact feasibility significantly

Challenges

_ There may be a cost to government to develop the waste processing infrastructure and ongoing management to support building level separation

_ Creates a cost to building owners for organics collection (however this is low because of the value of the resource collected)

_ Minor space allocation increase for new waste streams in cabinetry, waste chutes, basements etc

PLANNING EVIDENCE / PRECEDENCE

Fishermans Bend aims to have one of the highest recycling rates in Victoria, with planning controls that include requirements for on-site waste separation (Strategy 1.7.1). There are also high standards for waste management plans and building design guidelines to ensure all waste is managed within buildings.

The proposed waste standards provide a level of consistency with proposed standards under the proposed CoM planning scheme changes.

The separation of organic waste streams is already occurring in a number of municipalities (such as Darebin) and references to alignment with precinct wide waste management plans is also consistent with current planning controls which mandate alignment with precinct wide outcomes.

OTHER EVIDENCE

Around 35% of household waste is food waste and around 97% of this component of household waste currently ends up in landfill (SWRRIP 2018). Separation and appropriate treatment of this waste stream is essential to achieving the sustainability goals of Arden.

IMPLEMENTATION CONSIDERATIONS

_ The Arden Structure Plan to apply the proposed planning mechanism as a planning control at the building level

_ New precinct specific controls may not be required if updated municipal wide controls are put in place. Prior to this, updates to the City of Melbourne Waste Management Plan (WMP) guidelines may provide a suitable interim response

_ These could then translate to the requirements for any permit within Arden without the need for details to be specified in the planning scheme. This would allow for change and adaptation over time depending on the development of infrastructure and the roll out of operational systems within the precinct

_ A precinct waste management plan is strongly recommended to ensure that the role of resource hubs, waste education, collection and building level planning controls are integrated

_ Detailed drafting of planning controls for residential development should have regard to the Waste Management and Recycling in Multi-unit Developments - Better Practice Guide

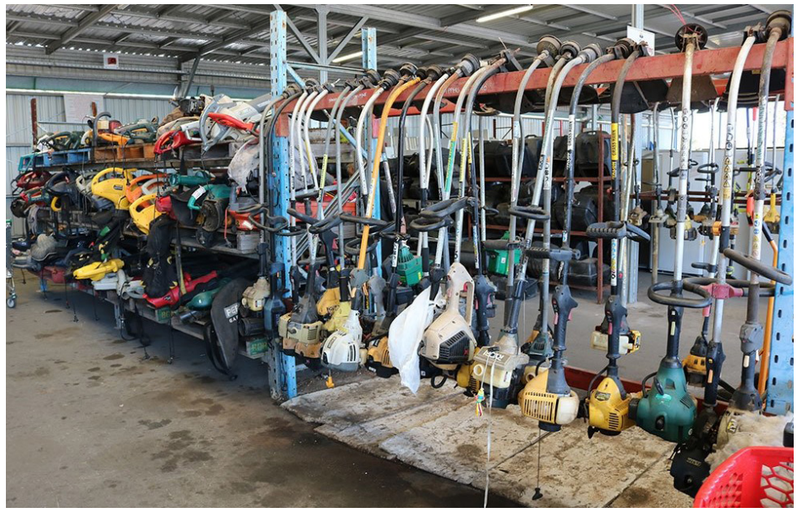
_ There is potential to further explore the opportunity with Melbourne Water to use the sewage system as a processing option for organic waste

_ The Arden Central precinct has opportunity to manage waste optimally through contractual conditions to meet diversion rates or manage emissions (potentially obviating the need for a planning control)

_ There is opportunity to avoid individual commercial collection contracts operating 24 hr 7 days. By coordinating you can get efficiency but also major amenity improvement – this could potentially be initiated as part of the development of the publicly held land, then leveraged to the Arden North and Lauren St when it becomes available

_ Dependent on resolution of the recycling crisis a fourth building based waste stream for glass (as distinct from comingled recycling may need to be considered)

14_Resource hubs and waste education



THE LOGAN RECYCLING MARKET IS A RESOURCE HUB RUN BY COUNCIL TO DIVERT A VARIETY OF GOODS FROM ENDING UP IN LANDFILL AND ADJOINS THE BROWNS PLAINS WASTE AND RECYCLING FACILITY. IMAGE: MUST DO BRISBANE

MECHANISM TYPE

Direct Investment and Operational Investment

DETAILED MECHANISM DESCRIPTION

This direct investment involves Government (State or Local) facilitating small resource recovery hub(s) for residents and businesses, the location and number to be driven by more detailed precinct waste management planning. A small scale resource hub would have significantly reduced spatial requirements when compared with the existing CityWide site. The land allocation is highly dependent on what waste accepted and how often resources are processed. These decisions should be driven by detailed precinct waste management planning.

The resource hubs would also support an operational function to provide waste education services to businesses and residents, not only at the resource hub site, but through programs for new residents and businesses and to support maintenance of good waste practices.

As a precinct waste management plan is still in development, this report limits recommendations to the need for this supporting infrastructure to be further investigated and location(s) rather than designating a specific location or confirming the exact role.

From an emissions perspective, the key outcome is that residents and businesses are supported in diversion of organic waste from landfill. This mechanism has potential to provide benefit beyond the precinct boundary to contribute to the climate positive scenario.

OVERVIEW OF JUSTIFICATION

The investment is necessary to increase source separation and overall waste diversion rates from landfill – in particular for the separation of waste streams in buildings to have maximum effectiveness.

IMPACTS

_ Waste – residential and commercial

_ Moderate emissions impact when combined with waste standards

_ Other impacts are identical to those outlined above in waste standards

POLICY ALIGNMENT

The policy supports the Arden Vision as it aligns with **Direction 3 - Embedding Sustainable Change.** Direction 3 includes a planned outcome as follows:

_ Sustainable waste and water management systems integrated with the metropolitan waste and resource recovery network, and the existing drainage network

The Statewide Waste and Resource Recovery Plan authored by Sustainability Victoria highlights the role of small local resource recovery hubs as serving a local function, and the importance of linking to regional and state significant hubs which can handle waste processing without the buffer issues of the inner city.

Resource hubs are consistent with Action 8.1 of the CoM Waste and Resource Recovery Strategy 2030, in particular the opportunity to work with businesses for improved organics recovery.

14_Resource hubs and waste education

GREEN POINT ARE USED AS DROP OFF POINTS FOR RESOURCES THAT CAN'T BE THROWN INTO STREET CONTAINERS. THEY'RE COMPACT SIZE REPRESENTS A POTENTIAL MODEL FOR CONSIDERATION IN DENSE AREAS.

COMMERCIAL VIABILITY

Benefits

In addition to those outlined in the mechanism above:

_ There is potential to retain some of the CityWide site for a significantly reduced scale resource hub, given synergies with current use

_ Potential to attract investment in resource recovery infrastructure, particularly those relying on specific material streams

Challenges

_ Allocation of space in a dense environment may be perceived as an under-utilisation of land

_ Does require capital and operational investment, however potential revenue stream can be obtained through special levy, developer contribution or contractual condition on the Arden Central land

PROJECT PRECEDENCE

Resource hubs are already in operation all over Melbourne, however do not currently respond to higher densities.

The Barangaroo South development employs a waste concierge to undertake the role of waste education for businesses within the precinct.

The Barcelona example of the Green Points networks offers a model for consideration in a denser Arden (a network of smaller 'drop off' points). The existing Melbourne model of a several hectare land take is not appropriate for an urban renewal area where land value will be at a premium.

(https://ajuntament.barcelona.cat/ecologiaurbana/en/services/the-city-works/maintenance-of-public-areas/waste-management-and-cleaning-services/green-points-network)

OTHER EVIDENCE

_ In 2011-12 approximately 2.25 million tonnes of organic waste was generated in Victoria and about 1.27 million tonnes of this ended up in landfill, representing an estimated loss to the economy of $30 million (Victorian Community and Business Waste Education Strategy 2015–2020)

_ An evaluation of waste education programs for the City of Yarra highlighted the ability for dedicated waste programs to be effective. An average landfill diversion rate of 2.8 tonnes per week of food waste was achieved from households, offices and cafes at end of program (approx. 550 engaged in the project)

IMPLEMENTATION CONSIDERATIONS

In addition to the implementation considerations outlined above:

_ The Arden Structure Plan should outline the need for a precinct waste management plan to be developed and note the potential for Resource Hubs with Waste Education function, with consideration for siting at the existing CityWide site

_ The funding from State or Local Government would fund the resource hub(s) potentially using development contributions or other revenue linked to the development process

_ A range of Government / non-government organisations could have a role in operating resource hubs and delivering waste education - City of Melbourne, Sustainability Victoria, MWRRG or others.

_ To ensure no impact on residential or commercial development, resource hub(s) would need to manage any organics processing within strict operational control (e.g. daily removal to processing hubs) such that odours or other amenity impacts (rodents etc) do not impact on other Arden objectives.

_ Synergies with function of existing CityWide site and the ability to continue to provide some value beyond the precinct boundary

Building scale climate resilience

This climate response area is important in driving carbon reduction. It is highly dependent on the ability to capture emissions associated with the release of methane from organics. Two mechanisms are proposed, which work in combination to significantly reduce operational carbon associated with waste. The carbon reduction is also supported by overarching climate response mechanisms for contractual carbon targets for the public land as well as operational waste management plans and planning enforcement. This climate response area is related to Opportunity 4 of the Arden Climate Response Framework. There is a high level of dependency on the development of a precinct waste management plan for the optimisation of waste standards and direct and operational investments.

TABLE 12 - BUILDING SCALE CLIMATE RESILIENCE MECHANISMS

CLIMATE RESPONSE AREA	MECHANISM	MECHANISM TYPE
Building scale climate resilience	15_ Building reuse and adaptability standards	Planning control
	16_ Urban heat standard	Planning control
	17_Green Infrastructure standard	Planning control
	18_Integrated Water Management Standards	Planning control

15_Building reuse and adaptability standards

THE FUTURE ARENA (PICTURED) BUILT FOR THE 2016 OLYMPIC GAMES IN RIO, WAS DESIGNED TO BE DISMANTLED AND RE-ADAPTED. SECTIONS OF VARIOUS INTERNAL ELEMENTS AND THE EXTERNAL TIMBER FACADE WILL BE RE-ASSEMBLED TO CREATE FOUR STATE SCHOOLS FOR MORE THAN 2,000 STUDENTS. IMAGE: LEONARDO FINOTTI

MECHANISM TYPE

Planning control (discretionary)

DETAILED MECHANISM DESCRIPTION

A planning control is recommended:

- For height limits on all building uses to be restricted only by storey maximum rather than mandatory height limits (noting exception proximate to open space)
- For built form controls to encourage ‘gridded structures’ that are easier to reconfigure / retrofit
- That any car parks included within developments or within consolidated car parks are capable of being adapted at a later stage into commercial or residential floorspace, for example through ensuring adequate floor to ceiling heights.
- That building services are designed to maximise future flexibility for integration of current and future energy technologies (e.g. demand management and micro-grids) and precinct infrastructure

OVERVIEW OF JUSTIFICATION

The environmental and economic costs of demolishing buildings is high. Avoiding this by designing in adaptability will have a long term positive impact on the sustainability of the precinct, and ability for it to take up future opportunities (for example, moving between residential and commercial uses as demand requires) and phase out of unsustainable practices (such as private car parking). This also allows a degree of responsiveness to increasing climate change impacts.

IMPACTS

- Building scale climate resilience and carbon (Embodied energy)
- Reduction of potential future emissions impact of redevelopment of buildings for change of use (embodied energy can be the equivalent of many years of operational energy)
- Resource efficiency/avoided resource use from adapting built fabric rather than demolition and reconstruction
- Avoided costs of demolition and reconstruction due to changes to demand profile
- Flexibility to retrofit to new technologies providing future social and economic benefit of access to new cost-effective technology
- Increased floor to ceiling heights provide for improved daylight and ventilation of habitable space and reduce cooling loads (providing an adaptation response)

POLICY ALIGNMENT

The mechanism is consistent with the Arden Vision in that both the Vision Statement and the Built Form Guidelines refer to ensuring that buildings (including community facilities, schools and workplaces) are ‘adaptable’.

Further support for this mechanism is found in CoM’s Climate Change Mitigation Strategy 2050 priority action 2.9 encouraging the adoption of circular economy principles to reduce the environmental impact and embodied emissions from products, materials and buildings across the city through procurement, urban design and planning.

15_Building reuse and adaptability standards

COMMERCIAL VIABILITY

Benefits

_ Enables greater flexibility in building use to respond to market demand

_ Avoids costs of demolition, instead enabling adaptation and refurbishment to meet emerging needs and trends

_ As a future consideration, reuse of existing stock is pragmatic, providing a faster build time compared to demolition and new build

_ Developer feedback indicated uniformly that planning controls which restricted height by stories rather than metres would create higher amenity buildings and would improve value

Challenges

_ Upfront cost of delivering additional floor to ceiling height above current standards (developer feedback indicated that this would be returned in increased value)

_ Developer feedback indicated that anticipating technology change was challenging and space flexibility was needed to accommodate for example transition from gas to electric

PLANNING EVIDENCE / PRECEDENCE

There are a number of precedents where adaptability has been sought through the introduction of minimum floor to ceiling heights (Chapel Street is one example, the controls around car parking design in Fisherman's Bend is another).

OTHER EVIDENCE

_ Several studies have confirmed the potential of delivering sustainability in urban areas by building adaptation, upgrading the environmental performance of existing (predominantly office) buildings (Wilkinson 2017), with the biggest contribution to sustainability being from the embodied energy in the original structure

_ At the household level, research by CSIRO has found that the average house contains about 1,000GJ of energy embodied in the materials used in its construction. This is equivalent to about 15 years of normal operational energy use. For a house that lasts 60 years this is approximately 25% of the energy used in its life. Whilst this research was on freestanding buildings, a similar principle applies.

_ Another paper puts embodied materials in a house at over 2600GJ. (https://www.etoolglobal.com/wp-content/uploads/2012/10/Embodied-Energy-Paper-Richard-Haynes.pdf)

PROJECT REFERENCES

One of the most easily retrofittable buildings types are warehouses because of their simple structures and high ceilings. For example, warehouses in SoHo, New York, that had a utilitarian function, now have a residential function, providing successfully re-purposing into very high value stock.

A disused carpark level in the QV building in Melbourne was converted to 8 high quality apartments by Breathe Architecture (https://www.breathe.com.au/qv8)

IMPLEMENTATION CONSIDERATIONS

_ The Arden Structure Plan to apply the proposed planning mechanism as a planning control

_ Further work is required to provide guidance to developers on the expectations for future proofing building services to integrate current and future energy technologies (e.g. demand management and micro-grids) for example guidelines or alignment with a relevant new Green Star credit

_ An exception to 'building height maximums by storey' will need to be built into the controls to allow for the situation where building heights have been set to avoid overshadowing key public spaces, in which case the importance of solar access to these areas may outweigh the benefits of potential adaptation of the building form

16_Urban heat standard

EXTENSIVE GREEN INFRASTRUCTURE IS PLANNED THROUGHOUT ARDEN TO REDUCE THE URBAN HEAT ISLAND EFFECT. IMAGE: VPA

MECHANISM TYPE

Planning control (mandatory)

DETAILED MECHANISM DESCRIPTION

A planning standard is proposed as follows:

_ To use materials that minimise UHI with a standard of at least 75% of the total project site area in plan view that comprise building or landscaping elements that increase the solar reflectance of the site

The standard mirrors the Green Star Urban Heat credit.

OVERVIEW OF JUSTIFICATION

The retention of heat by buildings is a strong contributing factor to Melbourne's Urban Heat Island effect.

These effects are expected to be exacerbated by climate change. With Arden being planned to be a high-density precinct, it is critical to ensure new development avoids further exacerbating the UHI effect.

IMPACTS

_ Urban heat with marginal impact on stationary energy

_ Aggregated impact of building scale responses (two thirds of the land will be in private development) are effective alongside public realm strategies to reduce urban heat

_ Lower rates of heat stress will improve local ecological performance (plants and animals)

_ Depending on the type of response other environmental impacts such as improved stormwater management and air purification are expected

_ Lower incidence of heat-related illness and heat stress

_ Reduction in total economic cost to community of heat waves

POLICY ALIGNMENT

The Arden Visions and Plan Melbourne clearly indicate urban heat as an area of priority.

The mechanism is consistent with the Arden Vision in that it:

_ Supports the overarching aim for Arden to be a "cooler, greener, version of the city"

_ Supports Direction 3: Embedding Sustainable Change and the planned outcome of ensuring development meets or exceeds targets for urban cooling.

Further support for this mechanism is found in Plan Melbourne Direction 6.4 Make Melbourne cooler and greener.

The CoM's Climate Change Adaptation Strategy Refresh addresses Urban Heat, with Goal 2 being to Shape our built form and urban renewal areas to withstand future climate change impacts and specific highlighting of the opportunity with new precincts such as Arden to act early to avoid urban heat effects.

COMMERCIAL VIABILITY

Benefits

_ Reduced cooling costs in summer

_ Developer feedback indicated that flexible benchmarks for each development to deliver it in a manner reflective of the site constraints and development aspirations.

Challenges

_ Potential for increased development costs through use of potentially more advanced materials selection

_ Developer feedback noted the need for certainty as to what could contribute to the 75% target

16_Urban heat standard

PLANNING EVIDENCE / PRECEDENCE

_ The Fishermans Bend planning controls mandate a minimum 70% target

_ A higher target of 75% is justified in the Arden context as it corresponds with the Green Star standard sought and is also congruent with established practice in the USA through LEED certification (Leadership in Energy and Environmental Design)

_ The proposed standard aligning with the relevant Green Star credit will further strengthen the outcome. Mandating the use of the complementary benchmark within the chosen rating tool simplifies the process for any applicant avoids potential duplication or contradictions

_ Specific policy direction to reduce the UHI effect is included in both state and local policy (e.g. 15.02)

OTHER EVIDENCE

_ SRI is an established metric used in LEED certification as a way to evaluate a cool roof. 75% is a long-established standard, developed in the USA. SRI incorporates reflectivity and emissivity properties into one metric

_ AECOM's 2012 Economic Assessment of the Urban Heat Island Effect undertaken for CoM found that the CBD experiences a significant UHI when compared to surrounding areas. Effectively, when non-CBD areas experience a 30 degree day, the City experiences a 30.8 degree day – a UHI effect of 0.8 degrees C

_ AECOM found that the total economic cost to the community due to hot weather is estimated to be approximately $1.8 billion in present value terms. Approximately one-third of these impacts are due to heatwaves. Of the total heat impact, the Urban Heat Island effect contributes approximately $300 million in present value terms

IMPLEMENTATION CONSIDERATIONS

_ The Arden Structure Plan should articulate the specific role of building based measures in reducing urban heat

_ Depending on the controls applied by the City of Melbourne as part of their broader review of ESD controls and the timing of their implementation, it may not be necessary to apply this standard specifically to Arden

_ Further guidance on what constitutes an increase in solar reflectance will need to be developed to guide developer responses. As much as possible this should mirror the Greenstar credit criteria as outlined below.

To meet the credit at least 75% of the site comprises one, or a combination, of the following:

_ Vegetation

_ Green roofs;

_ Roofing materials, including shading structures, having the following :
+ For roof pitched<15° a three year SRI>64;
+ For roof pitched>15°a three year SRI>34;

_ Only where three-year SRI for products is not available use the following:
+ For roof pitched<15°an initial SRI>82;
+ For roof pitched>15°an initial SRI>39;

_ Unshaded hard-scaping elements with a three-year SRI> 34 or an initial SRI >39;

_ Hard-scaping elements shaded by overhanging vegetation or roof structures;

_ Water bodies and/or water courses; and

_ Areas directly to the south of vertical building elements, including green walls and shaded by these elements at the summer solstice.

17_Green infrastructure standard

BOSCO VERTICALE (TRANSLATION: VERTICAL FOREST) IS A DUAL TOWER RESIDENTIAL DEVELOPMENT IN MILAN, ITALY THAT PROVIDES 20,000 M2 EQUIVALENT OF WOODLAND VEGETATION WHICH HELPS TO REGULATE HUMIDITY FOR RESIDENTS AS WELL AS CARBON SEQUESTRATION. IMAGE: STEFANO BOERI

MECHANISM TYPE

Planning control (mandatory)

DETAILED MECHANISM DESCRIPTION

This planning control proposes that all buildings meet a standard for 40% horizontal or equivalent vertical green cover as demonstrated through the CoM Green Factor tool.

OVERVIEW OF JUSTIFICATION

'Green cover' plays and important role in urban heat reduction. This benchmark is a valuable component of any attempt to regulate local climatic conditions given the recognised ability of green cover to a range of ecosystem services including stormwater runoff mitigation, urban heat reduction and habitat for biodiversity. Green infrastructure also contributes to place value and social cohesion.

This approach is consistent with global best practice, as well as local precedents which seek to identify appropriate tools which then allow individual developments to achieve a set benchmark in a way which is best suited to the particular site context and other characteristics.

IMPACTS

Impacts are dependent on the type of green infrastructure and the type of ecosystem service. The following are significant:

_ Urban heat mitigation

_ Habitat for biodiversity

_ Stormwater runoff mitigation

_ Additional minor impacts include carbon sequestration and air purification

_ "Greener" living and working environments have been shown to lower stress levels, improve productivity and have positive amenity impacts that translate into higher property prices

_ Green infrastructure provides cultural ecosystem services including place value and social cohesion, accessibility to nature and recreation value

POLICY ALIGNMENT

The mechanism is consistent with the Arden Vision in that it:

_ Supports Direction 3: Embedding Sustainable Change and the planned outcome of ensuring development meets or exceeds targets for urban cooling, extending the tree canopy and protecting biodiversity.

_ Enables provision of "green links" for people and biodiversity (p.29)

_ Supports Direction 8: Creating Diverse Open Spaces, including ambitions around tree canopy cover and local open spaces, which, due to the predominance of privately owned land, will have to at least in part be delivered within site boundaries.

Further support for this mechanism is found in :

_ State Planning Policy, Clause 15.02-1 (Reduce the urban heat island effect by greening urban areas, buildings, transport corridors and open spaces with vegetation), which explicitly acknowledges the importance of green infrastructure to any climate change response

_ Plan Melbourne Direction 5.4 Deliver local parks and green neighbourhoods in collaboration with communities; 6.4 Make Melbourne cooler and greener; and 6.5 Protect and restore natural habitats

_ City of Melbourne's Urban Forest Strategy, which outlines ambitious plans for the 'greening' of the public realm. With the majority of the Arden Precinct in private ownership, a regulatory approach is supported to ensure precinct-wide outcomes

17_Green infrastructure standard

COMMERCIAL VIABILITY

Benefits

_ Reduced cooling costs in summer

_ Developer feedback indicated that this sort of benchmark allowed flexibility for each development to deliver it in a manner reflective of the site constraints and development aspirations

_ Commercial feasibility testing undertaken for the City of Melbourne's proposed planning policy indicated that the 40% green cover target could be met without unreasonable impact on building cost

_ Urban greening is a significant driver of building value

Challenges

_ Ongoing maintenance costs of green infrastructure can be challenging and periodic assessment of ongoing performance is required

PLANNING EVIDENCE / PRECEDENCE

_ "Green infrastructure" has not been introduced to Victoria's planning scheme in any way other than broad objectives - accordingly there are no current precedents to consider.

_ The figure of 40% is consistent with proposed targets underpinning City of Melbourne's implementation of Green Our City.

_ Many other international cities have incorporated Green Cover / Factor targets in their planning processes through a range of methods

OTHER EVIDENCE

_ HV.H and partners Thrive Research Hub undertook a detailed literature review to support development of the CoM Green Factor tool. The evidence base outlines the relationship of green infrastructure in delivering seven ecosystem services.

_ A separate suite of evidence supports the appropriateness of the 40% benchmark including Nice et al (2018) and Adams et al (2014)

IMPLEMENTATION CONSIDERATIONS

_ The Arden Structure Plan to articulate the specific role of building based measures in providing a range of ecosystem services

_ The Arden Structure Plan to apply the proposed planning mechanism as a planning control

_ CoM will need to ensure the Green Factor tool is maintained consistent with the policy standards and evolving best practice

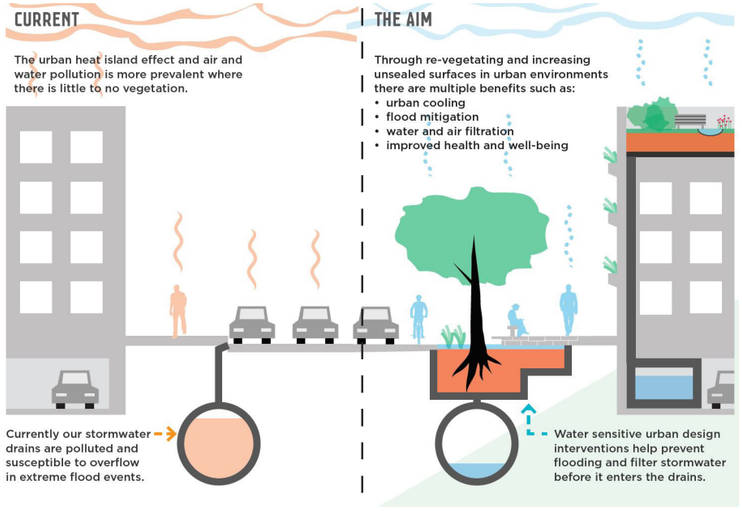
_ Planning controls should include permit conditions requiring the development of a Landscape or Green Infrastructure Management Plan to the satisfaction of the responsible authority to ensure ongoing viability of green cover

_ As with the proposed UH standard, should an equivalent municipal wide standard be introduced in advance of any Arden specific controls, then this standard may not be required

_ It is important to ensure that green infrastructure on buildings is supported by significant investment in the public realm to assist in meeting the 40% canopy cover for the municipality

_ Additionally, availability of non-potable water supply will be critical in keeping green infrastructure healthy on buildings – this could be factored into the City West Water business case for third pipe

18_Integrated water management standards



THE ELIZABETH STREET CATCHMENT IWM PLAN PROVIDES AN EXAMPLE OF INTEGRATED WATER SOLUTIONS THAT MITIGATE STORMWATER AND REDUCE URBAN HEAT WHILE INCREASING ACCESS TO ALTERNATIVE SOURCES. IMAGE: CRC

MECHANISM TYPE

Planning control (discretionary depending on outcome of IWM strategy)

DETAILED MECHANISM DESCRIPTION

This planning control mandates that buildings:

_ Connect to any precinct third pipe and stormwater management system

_ Comply with Best Practice Environmental Management (BPEM) Guidelines for stormwater management

In areas where third pipe is not available, rainwater tanks are strongly encouraged as the primary mechanism for meeting stormwater management guidelines.

A further planning mechanism is proposed that all buildings eligible for a NABERS rating meet a 4-star NABERS target for water. An exception applies where landscape watering can be demonstrated as the primary reason for non-compliance with the target.

We also recommend that urban design controls strongly encourage an approach based on maintaining a strong street presence in areas like Langford St where raised floor levels may otherwise be required. This includes, but is not limited to:

_ Elevation of critical infrastructure outside flood risk zone

_ Employment of design solutions such as waterproof doors and windows

_ Integration of any level change in the design of the building

OVERVIEW OF JUSTIFICATION

Given the extent of flooding present in Arden and its location adjoining one of Melbourne's major waterways, stormwater management is a fundamental part of any policy that applies to the land.

IMPACTS

_ Integrated water management

_ Reduction in unnecessary potable water usage

_ Removal of stormwater from systems is beneficial to riparian ecology

_ Allows diversion of scarce resource to open space (critical for active lifestyle and urban heat reduction)

_ Potential minor reductions in carbon (pumping and hot water heating reductions)

_ Reduction in localised flooding impacts, through reduction of flows to stormwater

_ Increased resilience to any future State water restrictions

POLICY ALIGNMENT

The mechanism is consistent with the Arden Vision in that it:

_ Supports Direction 3

_ Supports Direction 7: Celebrating Water and the objective of Arden utilising integrated water management to manage flood risk and reduce stormwater.

_ Direction 7 also requires all new development in Arden to meet "best practice" WSUD standards, necessitating the designing in of IWM solutions.

Further support for this mechanism is found in Plan Melbourne Directions 6.3 Integrate urban development and water cycle management to support a resilient and liveable city and 6.5 Protect and restore natural habitats

Significant state and local policy emphasis on the delivery of best practice stormwater management including through Clauses 12.05 and 22.23).

COMMERCIAL VIABILITY

Benefits

_ Integrating IWM connectivity into the design and build phase safeguards the opportunity and avoids costly retrofits

_ Lower ongoing costs for building owners through water efficiencies

_ Development feedback indicated that certainty on third pipe provision was critical so that this could be reflected in development feasibility

_ Third pipe was strongly supported by developers, subject to avoidance of having to 'double up' by needing to supply an onsite tank for stormwater treatment purposes

Challenges

_ The current ambitions for the Arden Precinct in terms of the integration of third pipe systems remains unresolved, with the potential to lead to costly requirements with uncertain impacts – developer feedback strongly noted the need for certainty

_ The scale of some larger buildings dictates that water captured onsite is very unlikely to cater for all non-potable water demand

PLANNING EVIDENCE / PRECEDENCE

_ City of Melbourne Planning Scheme, Clauses 22.19 and 22.23, already provides guidelines to ensure that the design, construction and operation of buildings enables connectivity to alternative water sources and the development of integrated precinct solutions, with an emphasis on stormwater management

_ The application of permit conditions requiring connections to third pipe and stormwater systems is consistent with the policy approach in relation to other precinct scale infrastructure investment and is critical to the achievement of a precinct scale response and has precedence in Fishermans Bend

_ Fishermans Bend also established design criteria in relation to flood resilience at a building scale which is aligned with proposed controls

_ Given that the flooding in Arden primarily comes from the east of the precinct and from Moonee Ponds creek there is not evidence to support planning controls beyond the BPEM guidelines for stormwater management at this stage

_ Subject to further discussions with Melbourne Water and resolution of alternative water to the precinct this may need to be reviewed

IMPLEMENTATION CONSIDERATIONS

_ The Arden Structure Plan to articulate the specific role of building based measures in providing integrated water management and the strong role precinct infrastructure such as third pipe and stormwater retention plays in meeting overall objectives

_ Before controls are finalised, there is a need to confirm with certainty the type of water infrastructure being delivered to avoid duplication of water efficiency policy (for example, requiring the provision of tanks for the same purpose)

_ The Arden Structure Plan to apply the proposed planning mechanism as a planning control

_ A carefully considered and integrated response to the flood issues affecting the precinct is critical to managing the risks, particularly as the impacts of climate change begin to be felt more strongly

_ While Arden is not identified as being affected by sea level rise at 0.8m in 2100, impacts of the latest IPCC predictions may result in impacts on the precinct being identified which would need to be considered in any planning response

_ The risks of flooding are so high (particularly in the context of increasing impact of climate change) that, dependent on the progress of the IWMP, a 'backup' policy could also be delivered in this area. Any policy applied in this precinct needs to be very carefully considered and developed in conjunction with Melbourne Water who are a Determining Authority in relation to flooding within the precinct

_ Precinct based approaches that integrate with building controls are likely to be most effective – the ability to manage the overland flows through a combination of mechanisms including WSUD in streetscapes, stormwater retention and harvesting and innovative approaches to a celebration of water in the landscape are likely to provide the best certainty in meeting objectives and providing a robust climate response.

SECTION 4
CARBON SCENARIO MODELLING

Carbon Scenario Modelling Background

This section of the report outlines the carbon impacts of the mechanisms identified in Section 3. The development of the carbon model for Arden allowed iteration with the mechanisms such that the carbon impacts could be measured in isolation and in aggregate. This is presented in terms of three different scenarios which reflect varying ambition in relation to carbon reduction within the precinct.

Each scenario has a temporal dimension, that is, they will evolve over the 2020 to 2050 period, and the boundary will remain the same and the definition will follow the requirements of the Climate Active Carbon Neutral Standard for precincts (formerly the National Carbon Offset Standard (NCOS) for precincts).

SCENARIO DEFINITION

Business as usual (BAU)

The BAU is the most likely scenario if no additional controls or measures are adopted for the Arden precinct. Buildings and infrastructure performance will therefore follow the likely evolution of standards and practices over time, in particular the most likely progression of the National Construction Code (NCC). The decarbonisation of the grid drives the curbing of emissions in this scenario. This scenario is not aligned with the 1.5oC scenario meeting the objectives of the Paris Agreement, as it does not achieve the necessary level of decarbonisation by 2050.

Low carbon

The low carbon scenario incorporates the majority of the mechanisms from the zero carbon scenario (see description of the scenario below), but with less ambitious timeframes and uptake rates assumed. Importantly, the low carbon scenario does not include mechanisms to ensure that renewable energy is purchased to offset the precinct's electricity use. In the absence of renewable energy purchasing and recourse to carbon offsets, this scenario would not align with a 1.5oC scenario by the end of the century.

Zero carbon

All emissions, sinks and offsets in the precinct's inventory (reported in line with the requirements of the Climate Active Carbon Neutral Standard for precincts (formerly the National Carbon Offset Standard (NCOS) for precincts)) equal net zero emissions by 2030. This is achieved by applying strong energy efficiency standards across the district, followed by the use of renewable energy for 100% of the electricity procurement in the precinct and finally the purchase of carbon offsets to bring the remaining emissions sources to zero, corresponding to the use of natural gas, if and where residual use is considered as unavoidable and emissions from waste and transport that have not be reduced by other means. Such a scenario would align with a 1.5oC scenario under the Paris agreement and would allow the City of Melbourne to progress towards the same goal.

BUSINESS AS USUAL EMISSIONS

The 'business-as-usual' (BAU) emissions scenario estimates emissions from the precinct out to 2050 based on:

1. the rate of development of the precinct,
2. standard practices and existing policies for new developments in Victoria and nationally, and
3. predicted changes to the electricity grid emissions factors over time, as a result of an increasing penetration of renewable energy sources in the electricity mix.

A summary of the assumptions underpinning the BAU scenario is provided in Table 13. A full list of assumptions is provided in Appendix 4 and 5.

TABLE 13 - BUSINESS AS USUAL ASSUMPTIONS

SECTOR AND SOURCE	KEY FACTORS AND ASSUMPTIONS DRIVING EMISSIONS TO 2050
ALL SECTORS AND SOURCES: PRECINCT LEVEL	
Rate of development	The rate of development in terms of gross floor area (GFA) and building type has been based on the information provided by VPA for this project (in terms of total gross floor area by sub-precinct) and the more detailed information on GFA split by various building categories provided in the 2018 Arden Concept Plan. The Figure illustrates the assumed GFA broken down by building use type across the precinct in 2050. In the absence of specific forecasts, it is assumed that the rate of development is linear from 2020 to 2050. Note that building energy ratings are implemented in 5-year blocks in the model. All building ratings specified in a particular year apply to all development that has occurred since the previous 5-year block (for example, a 2050 NatHERS rating of 10 stars for residential energy equates to all new residences with 10 star-rated dwellings from 2046 to 2050). Given the lag time between construction and commissioning of buildings, ratings must be adopted/enforced ahead of time to ensure when buildings are commissioned, they meet the performance standards specified.
Rate of population growth	The rate of population growth for residents and workers has been based on information provided by the City of Melbourne. By 2050, it is assumed that the number of residents in the precinct is 15,000 and the number of workers is approximately 34,000. To enable the model to be easily updated (and in particular, scaled up and down), it has been built in such a way that the number of workers and the number of residents drive most components of the footprint. In the absence of specific forecasts, it is assumed that the rate of population growth is linear from 2020 to 2050.
STATIONARY ENERGY	
All sources of electricity use	The rate of decarbonisation of the Victorian electricity grid has a large impact on emissions and needs to take into account the recent legislation of the Victorian Renewable Energy Target (VRET). The VRET requires that 50% of Victorian electricity is produced from renewable generation sources, which will impact the emissions intensity of the grid to 2030 and beyond. To account for the inherent uncertainty associated with forecasting grid emissions factors, sensitivity testing of various decarbonisation rates has been developed for the model
Residential	Energy intensity of dwellings Number of new dwellings connected to gas
Commercial	Energy intensity, by building type Proportion of gas energy use to total energy use

Carbon Scenario Modelling Background

SECTOR AND SOURCE	KEY FACTORS AND ASSUMPTIONS DRIVING EMISSIONS TO 2050
Hospital (if delivered)	Energy intensity of a hospital (which is assumed to remain constant once built across the time period) Note that the emissions model has been developed so that the inclusion of a hospital can be switched on or off. This was carried out due to the uncertainty about whether a hospital will be located in the precinct, and because if included this will have a significant impact on the emissions profile due to the large assumed floor area (88,000 m2), the relatively high energy use intensity of hospital (if delivered), and the likelihood of hospitals using gas
Car parking	Percentage of car parking with mechanical vs natural ventilation Energy intensity of mechanical car parking
TRANSPORT	
Private transport	Level of intervention affecting electric vehicle uptake Percentage mode share of travel in private vehicles for residents and workers
Public transport	Percentage of buses that are electric servicing the precinct Percentage mode share of travel on public transport for residents and workers
Freight	Existence of a centralised distributor to consolidate freight deliveries to businesses in the precinct Proportion of vehicles used in deliveries (light commercial vehicles and trucks) that are electric
OTHER	
Waste	Average waste generated per person (resident and worker) in the precinct Proportion of food and garden organics in waste Total organic diversion rate for residential and commercial waste
Water and wastewater	Average wastewater generated per person (resident and worker) in the precinct Emissions intensity of wastewater generation, noting that Melbourne Water has a commitment to be carbon neutral by 2030, which will essentially mean that post 2030, all emissions from water and wastewater use within the precinct will be zero emissions

Carbon Scenario Modelling Background

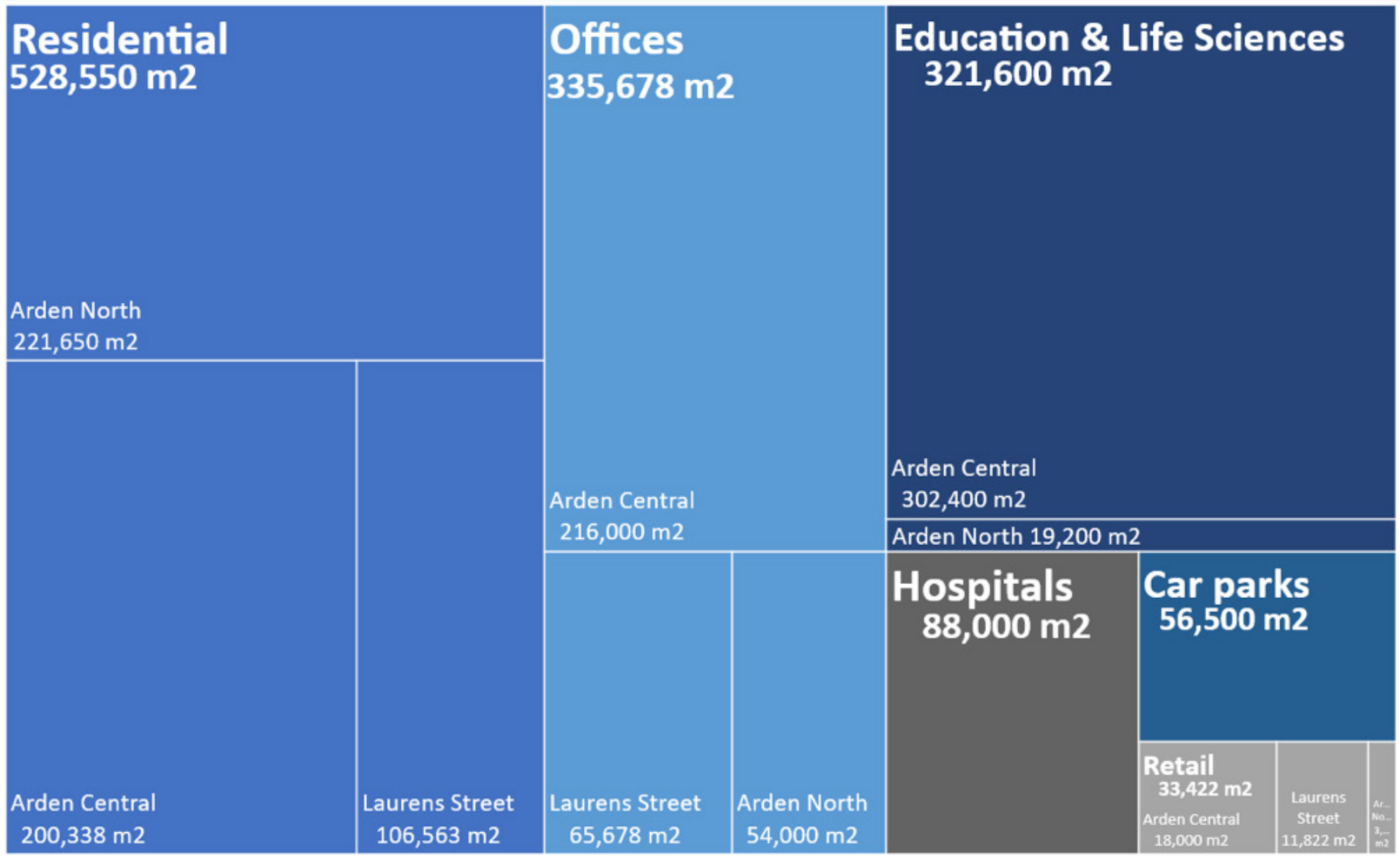


FIGURE 2 - GFA BY BUILDING SEGMENT PER SUB-PRECINCT IN 2050

MECHANISMS TO REDUCE EMISSIONS

Table 14 below outlines how the mechanism types (outlined in the Methodology) impact on carbon reduction specifically.

TABLE 14 - CARBON IMPACT OF MECHANISMS

MECHANISM TYPE	CARBON IMPACT
Direct investment	Direct investment in infrastructure will be necessary to ensure that public transport and active transport infrastructure offer attractive and altogether preferable alternatives to private transport. Direct investment is also likely to be required to upgrade waste management infra-structure
Operation investments / arrangements	Operational investments are likely required to maintain the ongoing high-performance of buildings within the precinct so that carbon targets continue to be met and behaviour change is sustained
Planning controls	Planning controls are likely to be the most effective in curbing carbon emissions from build-ings (the control would be set by reference to a performance rating system, NABERS or equivalent, thus leaving flexibility to achieve the target performance through whatever energy efficiency or renewable energy measures are the most adapted and cost effective)
Other regulatory mechanisms	Other regulatory mechanisms such as mandatory reporting and performance disclosure provide visibility and ongoing responsibility for carbon accountability
Finance, Governance or Operational models	Finance, governance and operational models can lock in, or incentivise design, construction and operation of low / zero carbon buildings and precincts

Carbon Scenario Modelling Background

Mechanisms related to stationary energy use, transport and waste were prioritised since these sectors represent the greatest source of emissions in the precinct. The choice of mechanisms and the carbon modelling were developed in parallel to ensure that the carbon scenarios represented the highest impact and most feasible mechanisms being implemented. Whilst the justification for individual mechanisms is presented in Section 3 of this report, the table below outlines how these are applied in the scenario models.

Table 15 below summarises the differences between each of the three scenarios in the model. Specific opportunities are identified in the main texts, while the general mechanisms required to achieve these opportunities are provided in brackets following the opportunity. Finance, governance and operational models have been abbreviated to FGO models in this section.

TABLE 15 - DIFFERENCES BETWEEN SCENARIOS

SECTOR AND SOURCE	BAU	LOW CARBON	ZERO CARBON
STATIONARY ENERGY			
All sectors/sources	No renewable energy procured No uptake of rooftop solar PV	Moderate (70% of maximum) uptake of rooftop solar PV	100% renewable energy from 2030 for all precinct electricity use (PPA – Finance, Governance and Operational Models) Maximum uptake of rooftop solar PV
Residential	95% of all new dwellings connected to gas, for all years Mandated NatHERS ratings remain at 6 stars from 2020, and 6.5 stars from 2025 to 2050 (in line with the COAG trajectory for the National Construction Code) Performance drift occurs, increasing energy use by 5% after 5 years for new dwellings	Phase-down to fully electric buildings from 2040 Mandated NatHERS ratings to increase from 7 stars in 2020 to 9 stars by 2050 in Arden Central and 8 stars in Arden North and Laurens Street (Planning Controls - Minimum energy performance standards) Operational investment to prevent performance drift (Planning enforcement, Operational Management Plans)	Fully electric buildings from 2020 (Planning Controls) Mandated NatHERS ratings to increase from 8 Stars in 2020 to 10 Stars by 2040 (planning controls) in Arden Central and from 7.5 Stars to 9 stars in Arden North and Laurens Street (Planning Controls - Minimum energy performance standards) + FGO Models - Contractual carbon target) Operational investment to prevent performance drift (Planning enforcement, Operational Management Plans)
Commercial	30% of energy used on site is from gas use (all sub-sectors) No mandated NABERS ratings, resulting in 5-star office buildings for all years No mandated ratings, resulting in buildings all performing to the National Construction Code standard Performance drift occurs, increasing energy use by 5% after 5 years for new buildings	Phase-down to fully electric buildings from 2040 Mandated NABERS ratings to improve office buildings to 6 stars by 2050 in all precincts (Planning Controls - Minimum energy performance standards) Mandated ratings to improve on the National Construction Code by up to 25% in 2050 for Arden Central and up to 20% in 2050 for the Arden North and Laurens Street (Planning Controls - Minimum energy performance standards) Operational investment to prevent performance drift (Planning enforcement, Operational Management Plans)	Fully electric buildings from 2020 for all building types (Planning Controls) Mandated NABERS ratings to improve office buildings to 7 stars by 2050 in Arden Central and 6 stars in Arden North and Laurens Street (Planning Controls - Minimum energy performance standards) + Contractual carbon target) Mandated ratings to improve on the National Construction Code by up to 25% in 2050 for Arden Central and up to 20% in 2050 for the Arden North and Laurens Street (Planning Controls - Minimum energy performance standards) Operational investment to prevent performance drift (Planning enforcement, Operational Management Plans)

Carbon Scenario Modelling Background

SECTOR AND SOURCE	BAU	LOW CARBON	ZERO CARBON
Hospital (if delivered)	The model assumes no change in operational performance of the hospital (if delivered) over the BAU and Low carbon scenarios.		Fully electric hospital (if delivered) from the year of commissioning. Reduction in total energy use by 30% based on energy efficiency (as reference, the Humber River in Toronto, Canada offers a contemporary example of energy efficiency in hospital: https://plenarygroup.com/news-and-media/news/2017/humber-river-hospital-achieves-leed-gold-certification)
Car parking	100% of commercial car parking and 80% of residential car parking with mechanical ventilation (all scenarios) Standard efficiency mechanical ventilation 250 additional car spaces with the hospital (if delivered) in the precinct (all scenarios)	High efficiency mechanical ventilation (assumed credit through Green Star D&AB)	High efficiency mechanical ventilation (assumed credit through Green Star D&AB)
TRANSPORT			
Private transport	Mode share equal to mode share observed in the City of Melbourne No intervention on electric vehicle uptake	Mode share limited by available parking spaces (Planning controls + Direct investment – Consolidated car parking) Moderate intervention on electric vehicle uptake (Direct investment in infrastructure, planning controls to preference EVs)	Mode share limited by available parking spaces and achieving 10% trips by private vehicle across workers and residents (as per 2018 Arden Vision) (Planning controls + Direct investment – Consolidated car parking) Strong intervention on electric vehicle uptake (Direct investment in infrastructure, planning controls to preference EVs, etc)
Public transport	Tram, trains and buses provide public transport needs No electric buses servicing the precinct No changes to train trip energy intensity	50% of buses are electric by 2040 and 100% by 2050 (FGO Model – Power Purchase Agreement) No changes to train trip energy intensity	50% of buses are electric by 2030 and 100% by 2040. (FGO Model – Power Purchase Agreement) Renewable electricity sourcing for train network by 2030 (Assumes either through FGO Model – Power Purchase Agreement or other Government procurement)
Freight	No freight vehicles are electrified	100% of freight vehicles are electric by 2050, with a 25% increase every 5 years prior (Direct investment in infrastructure, planning controls to preference EVs, etc)	100% of freight vehicles are electric by 2040, with a 25% increase every 5 years prior (Direct investment in infrastructure, planning controls to preference EVs, etc) Centralised distributor decreases light commercial vehicle trips by 75% (Operational investment - centralised distribution centre)

Carbon Scenario Modelling Background

SECTOR AND SOURCE	BAU	LOW CARBON	ZERO CARBON
OTHER			
Waste	Standard waste diversion rate (recycling + organic) equal to Victorian average (in line with Melbourne metropolitan average diversion rate)	Food organics collection and aerobic composting to remove 80% of food waste from general waste and eliminate emissions from this diverted waste (Direct investments in resource hubs + Planning controls – Waste standards) Increase recycling waste diversion rate to 90% to achieve a total waste diversion of 78% for municipal solid waste, thereby significantly reducing waste to landfill (Operational investments – multiple + Planning controls – Waste standards)	Food organics collection and aerobic composting to remove 99% of food waste from general waste and eliminate emissions from this diverted waste (Direct investment in resource hubs + Operational investments + Planning controls – Waste standards) Maximise recycling waste diversion rate to 99% to equal the ambition of the City of Melbourne's Waste and Resource Recovery Strategy 2030 to achieve a total waste diversion rate of 90%, thereby minimising waste to landfill (Operational investments + direct investment in resource hubs + Planning controls – Waste standards) Waste education to reduce quantity of waste by 90% per person (Operational investments + direct investment in waste hubs)
Water and wastewater	No initiatives required as Melbourne Water has committed to reduce its carbon emissions to net zero by 2030		

Carbon Scenario Modelling Results

BAU TRAJECTORY

The BAU trajectory to 2050 is shown in Figure 3. Arden's emissions are predicted to increase as the precinct develops, increasing to 80,692 tCO2-e in 2040 and then decreasing slightly 77,410 tCO2-e in 2050. Emissions are dominated by commercial buildings from 2030, followed by fairly even contributions from waste and residential buildings, followed by the hospital (if delivered) and private transport.

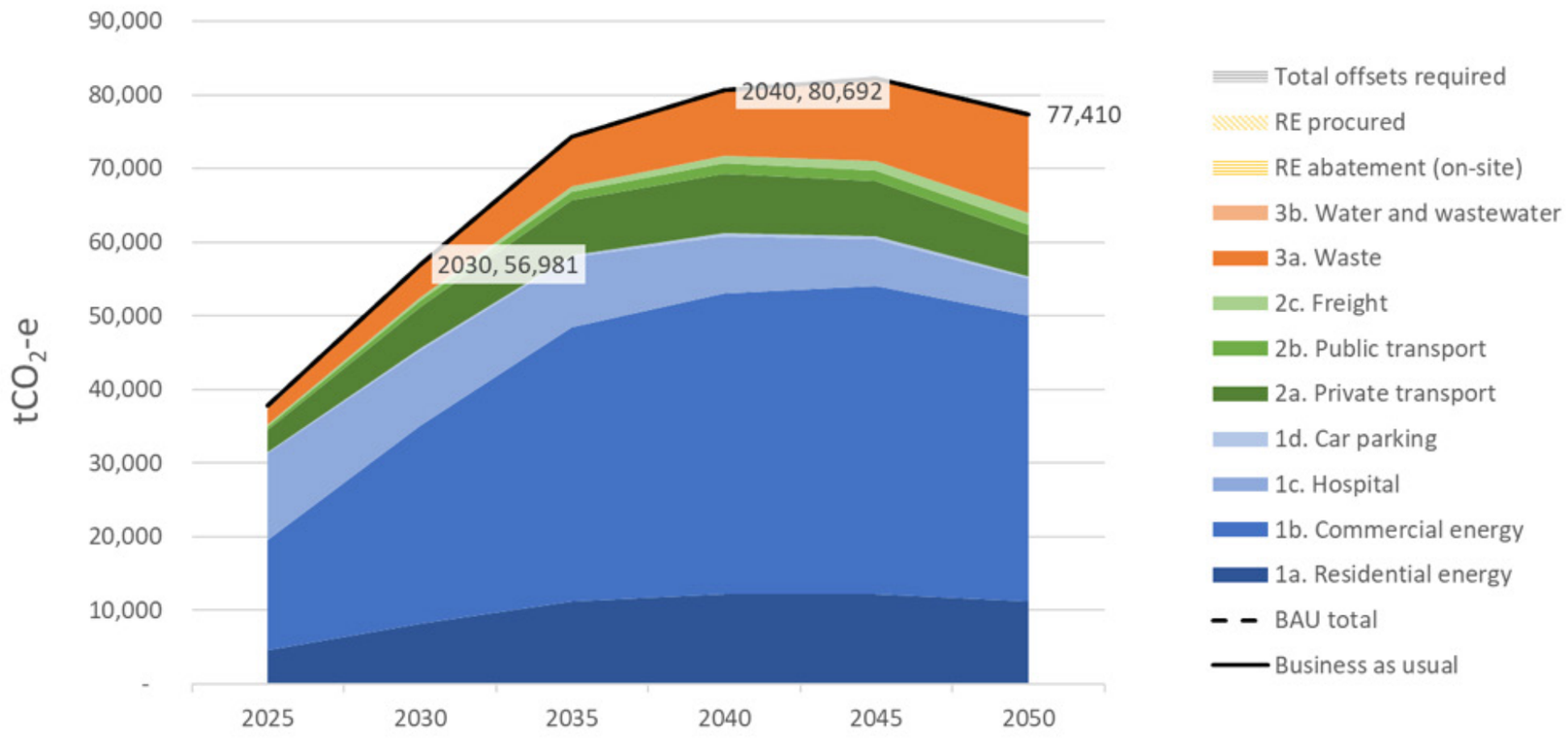


FIGURE 3. BAU TRAJECTORY UNDER A MODERATE RATE OF DECARBONISATION

Carbon Scenario Modelling Results

Note that significant uncertainty exists around the rate of decarbonisation of the Victorian electricity grid to 2050. As such, a sensitivity test was undertaken to show the impacts of the grid emissions intensity under three scenarios (a low, moderate and high degree of decarbonisation). The sensitivity test is shown in Figure 4. As evident from the figure, emissions increase by 62% under a low grid decarbonisation scenario compared with a moderate level of decarbonisation (assumed to align with the ambitions of the VRET); and decrease by 37% under a high grid decarbonisation scenario.

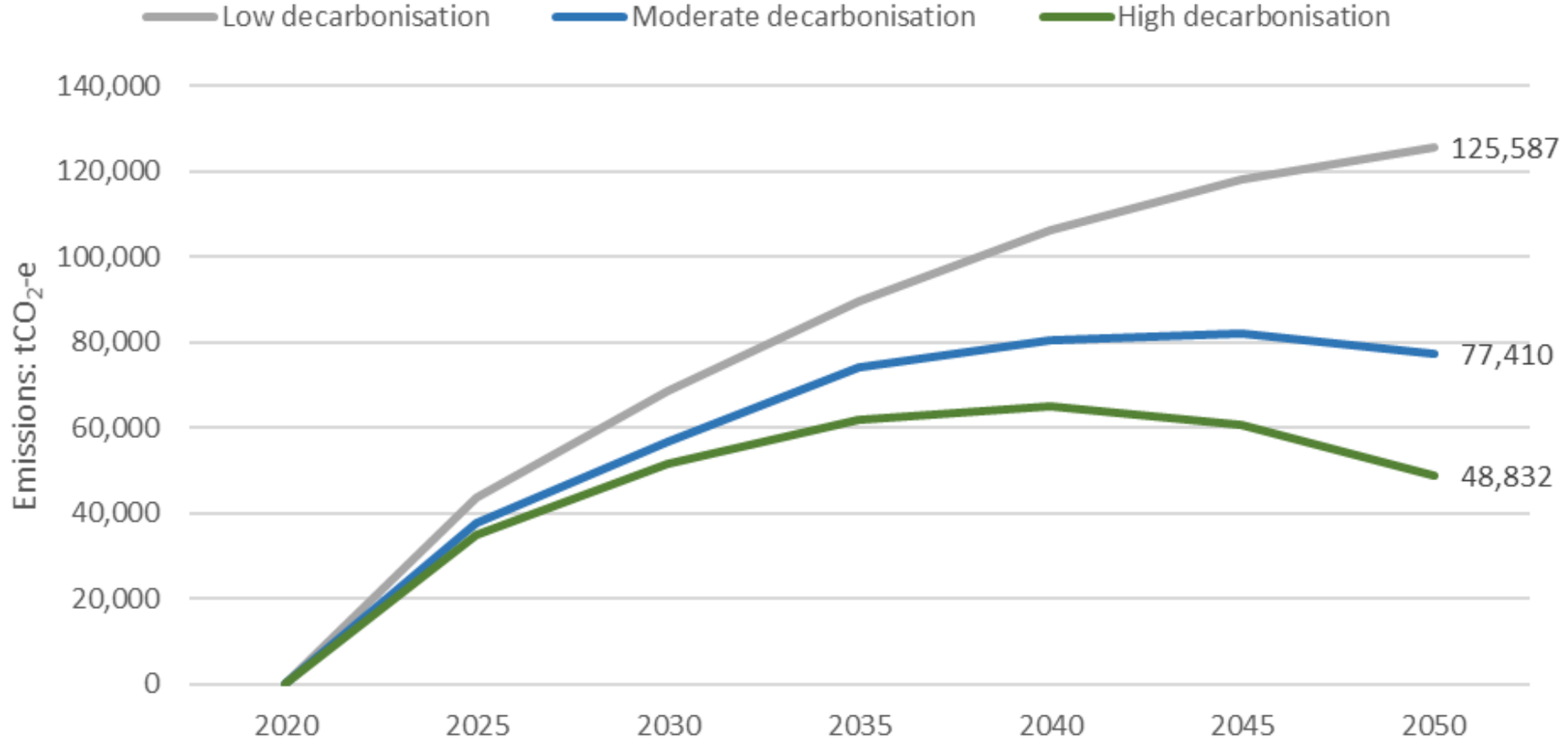


FIGURE 4. SENSITIVITY TEST: IMPACT OF DIFFERENT RATES OF DECARBONISATION ON THE BAU SCENARIO

Carbon Scenario Modelling Results

LOW CARBON

The Low Carbon trajectory to 2050 is shown in Figure 5. This trajectory has several sector-specific initiatives and on site solar PV to reduce emissions (shown as 'wedges' above the 'Low carbon' line). Under this scenario, emissions decrease by 41% from 77,410 to 45,214 tCO2-e in 2050. Note that abatement 'wedges' are observed above the BAU line due to the increase in emissions in public transport.

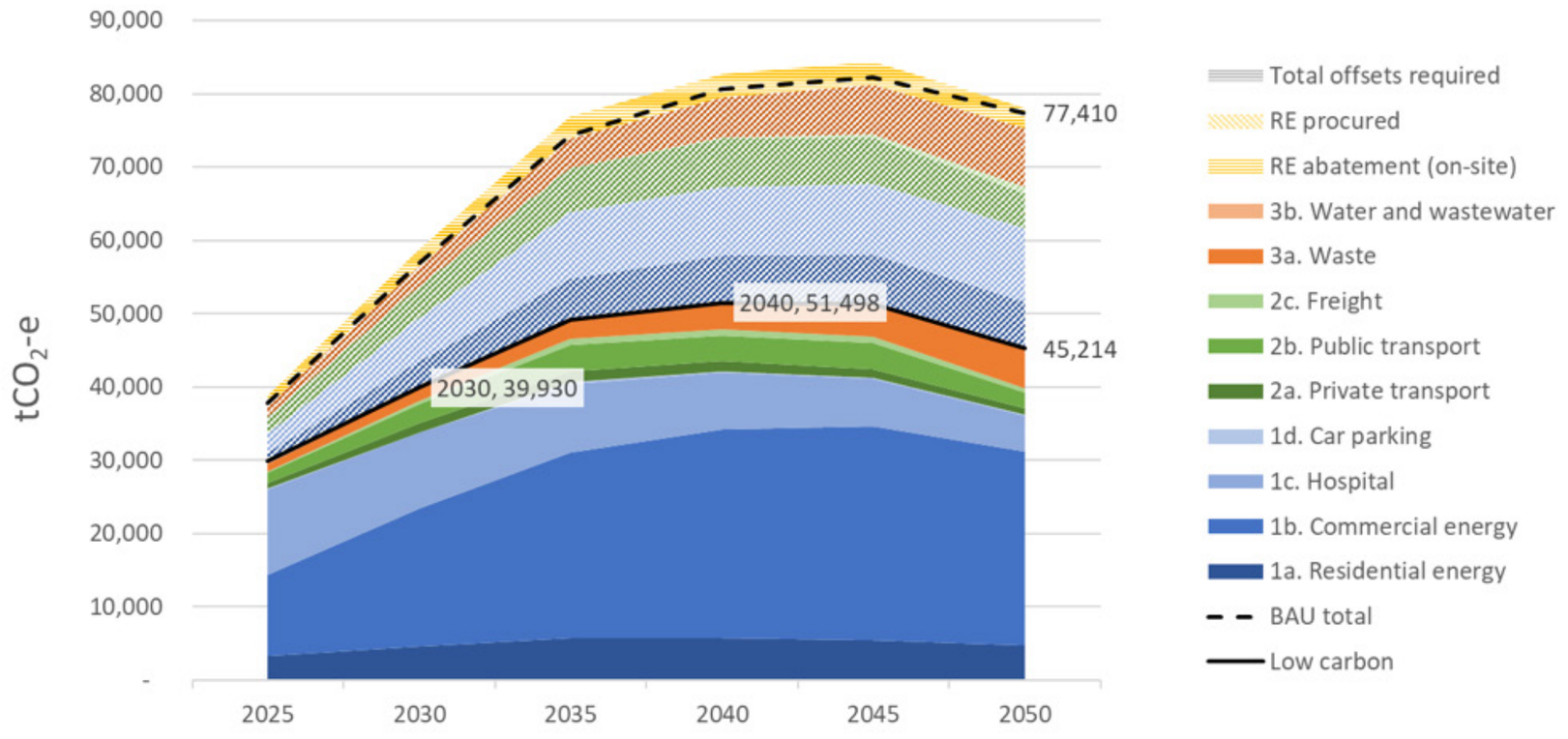


FIGURE 5. LOW CARBON TRAJECTORY

INSERT CAPTION

Carbon Scenario Modelling Results

ZERO CARBON

The Zero Carbon trajectory to 2050 is shown in Figure 6, with only energy efficiency and other emissions reductions measures rolled out, to demonstrate how far the precinct can go in terms of emissions reductions without on-site solar generation, FGO model - Power Purchase Agreement applied or the residual carbon being accounted for through the FGO model – Contractual Carbon Targets.

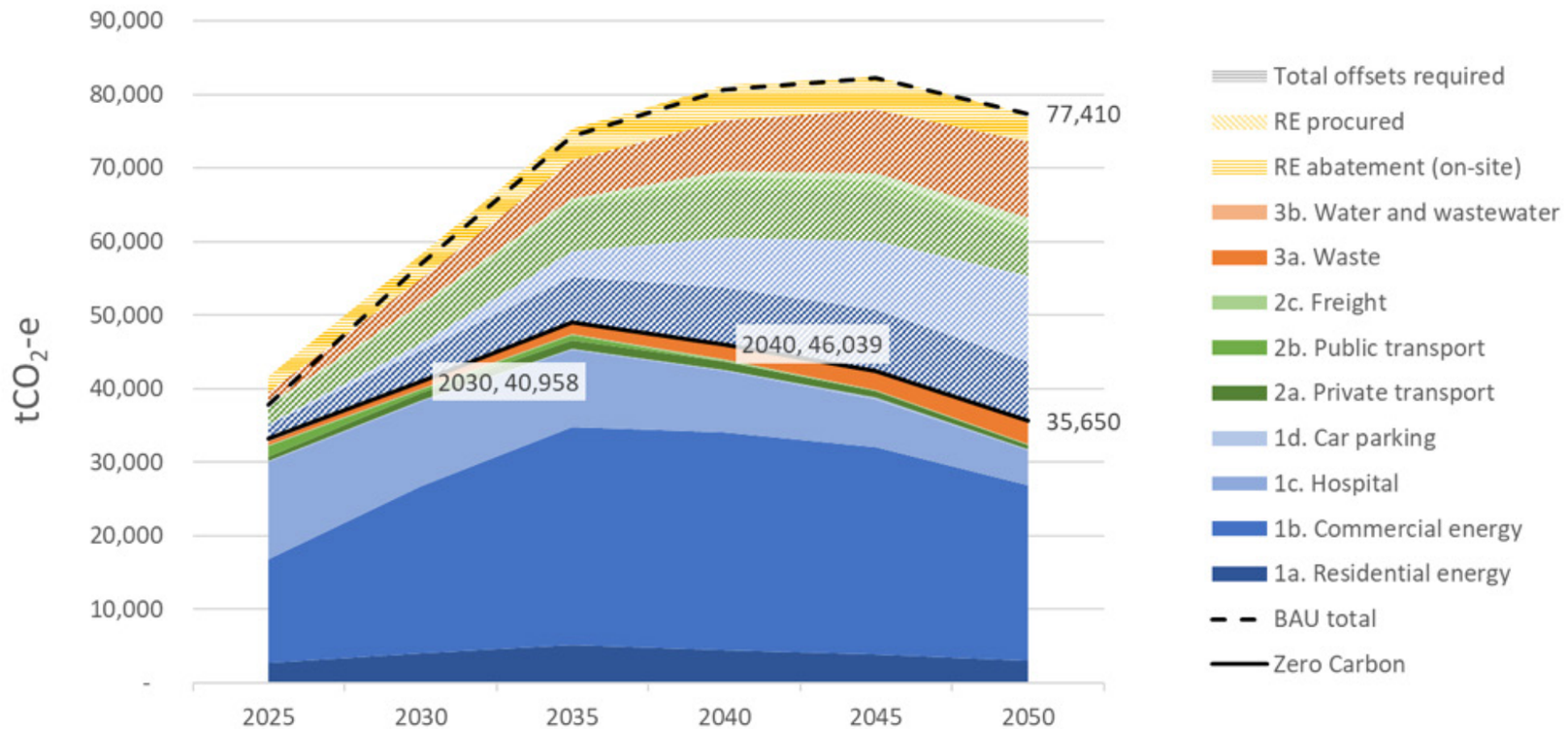


FIGURE 6. ZERO CARBON TRAJECTORY (WITH ENERGY EFFICIENCY AND OTHER REDUCTION MEASURES ONLY)

INSERT CAPTION

Carbon Scenario Modelling Results

The biggest opportunities in terms of emissions reductions associated with different initiatives are:

1. Minimum performance standards for commercial and residential properties that increase in stringency over time
2. Diverting waste from landfill to recycling, composting and biodigesters, through various activities such as three bin waste collections and waste education
3. Decreasing the mode share of private vehicle use through the roll-out of electric vehicle charging infrastructure, attractive public transport options and the minimisation of the number of car spaces across the precinct

Under this scenario, emissions reduction measures reduce emissions by 54% in 2050 compared with the BAU scenario. The remainder of emissions (the emissions 'gap') needs to be filled by renewable electricity, sourced locally for a small proportion and otherwise through off-site energy contracts, and offsets. This is reflected in the recommended mechanisms by a combination of the application of the Planning Control - Green Star 6-star standard (which requires a 100% renewable energy supply) the FGO model - Power Purchase Agreement and any residual carbon being accounted for through the FGO model – Contractual Carbon Targets.

Figure 7 illustrates the zero carbon trajectory with renewables and offsets included. This trajectory includes 100% renewable energy for the precinct from 2030, and also has several mechanisms to reduce emissions (shown as 'wedges' above the 'Low carbon' line. In addition, under this scenario the precinct will be carbon neutral from 2030 with abatement from offsets also shown in the figure. Under this scenario, emissions decrease by ~90% in 2040 and 2050 without any offsetting. The majority of abatement from 2030 to 2050 is due to renewable energy procurement, followed by energy efficient commercial buildings and waste reduction strategies.

Offsets are still required to address residual emissions from waste) and natural gas (unless all buildings can be fully electric, including the hospital (if delivered) and some specific research laboratory uses). Offsets also cover emissions from private transport that is not powered by renewable sources, although it is assumed that this tapers off to zero by 2050.

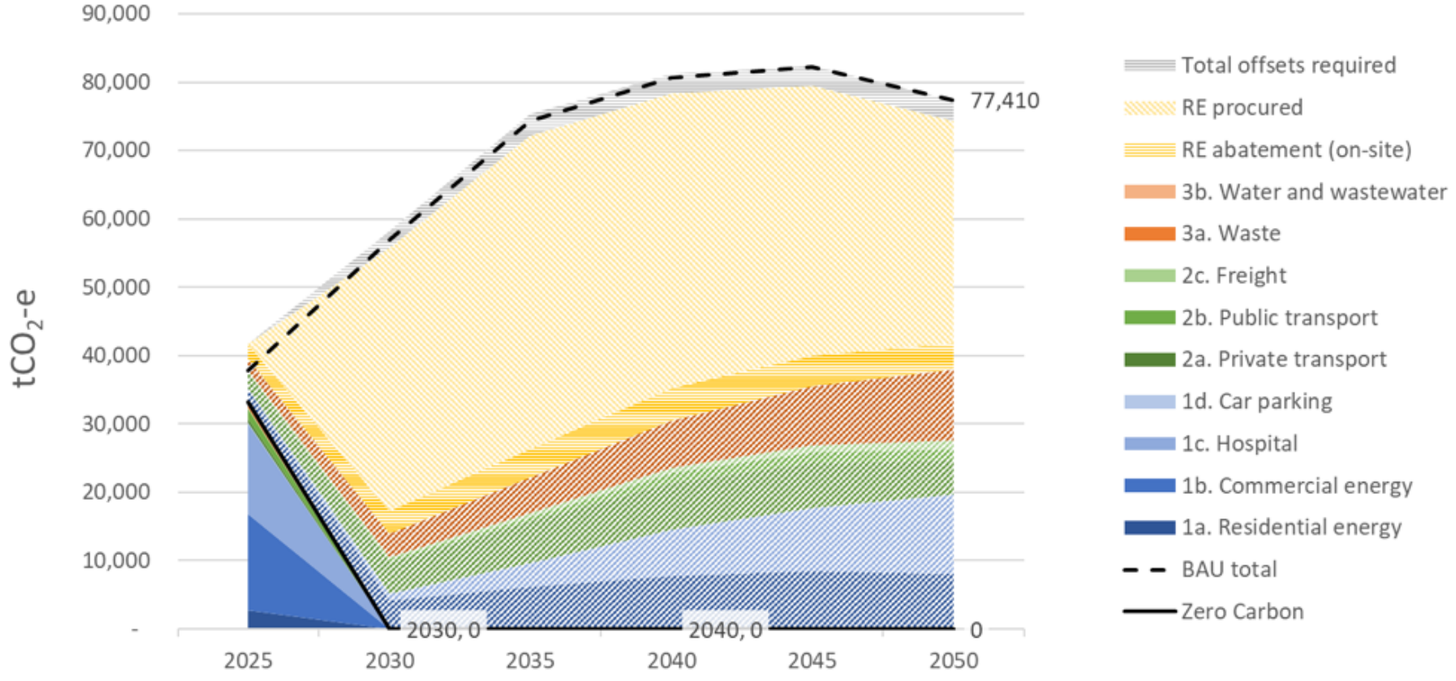


FIGURE 7. ZERO CARBON TRAJECTORY (WITH RENEWABLES AND OFFSETS)

Carbon Scenario Modelling Results

NET ZERO STATIONARY ENERGY EMISSIONS TRAJECTORY BY SUB-PRECINCT

Figure 8 illustrates the difference in emissions associated with energy consumption across Arden Central, Arden North and Laurens Street. This highlights that the bulk of energy consumption is in Arden Central, driven by the presence of the majority of commercial offices, the hospital (if delivered), education and retail. This has underpinned the justification for higher energy efficiency and thermal performance standards and controls for this area of the precinct, as well as Arden Central being public land.

The conclusions from the carbon scenario modelling and the supporting analysis are drawn together in Section 5 below.

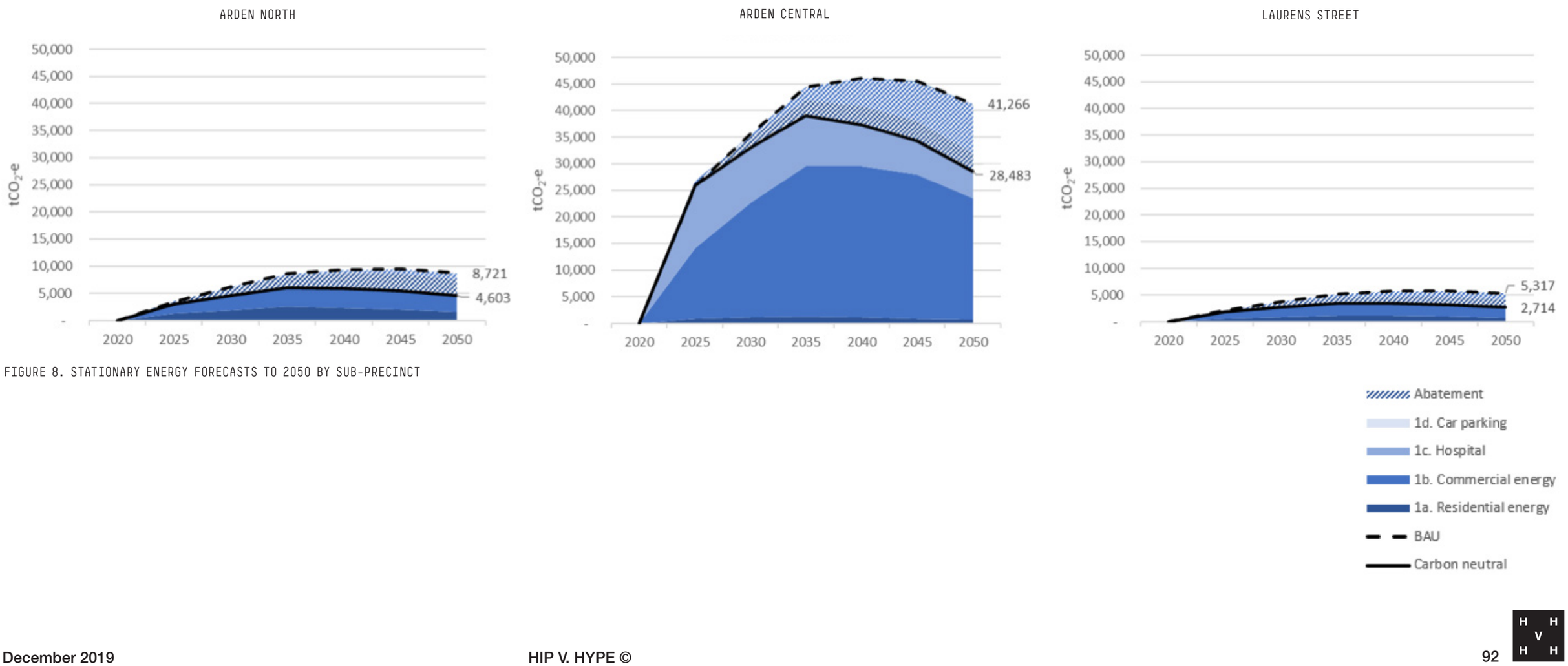


FIGURE 8. STATIONARY ENERGY FORECASTS TO 2050 BY SUB-PRECINCT

SECTION 5
CONCLUSION AND NEXT STEPS

Conclusion and Next Steps

This work has investigated and compiled evidence for a suite of mechanisms capable of delivering a climate responsive Arden precinct.

We conclude:

_ The combined urgency of deep carbon reduction and climate resilience to current and future climate impacts provides a strong foundation for needs for global cities to use urban renewal to drive transformative change

_ Both the Arden Vision, State Policy and Local Policy support strong carbon reduction and climate resilience outcomes, as does the earlier Arden Climate Response Framework

_ The pre-conditions for planning of Arden (large public land holding and strong alignment with key stakeholders for an exemplar urban renewal precinct) support strong carbon reduction and capability for highly climate resilient built form

_ The analysis of national and international case studies indicate that the planning and non-planning tools are available to drive the outcomes sought

_ The analysis of ratings tools and frameworks suggest that the Green Star suite of ratings tools are the most appropriate for guiding a holistic climate response

_ There is strong planning evidence for a suite of controls requiring high levels of environmental performance, covering a range of climate response areas

_ A range of finance, governance and operational models could be applied to the precinct to support the planning controls, and there is strong potential to affect carbon related energy supply through a government backed power purchase agreement

_ The development pathways for the publicly held and privately held land are very different and different mechanisms are required to deliver on their potential

_ The bulk of modelled emissions are within the publicly held land, indicating that a development model which supports contractual carbon targets is likely to be highly effective in contributing to precinct wide carbon targets

_ The mechanisms governing the operational phase of the development are critical to long term success

_ The role of on-site generation of electricity is limited by density, increasing the importance of energy efficiency and off-site renewables procurement

_ With the adoption of recommended mechanisms across overarching climate response, stationary energy, transport, waste and building scale climate resilience, a zero carbon target is both practical and commercially sound

_ In adopting a zero carbon pathway there is potential for direct investments / operational models that can support carbon reduction beyond the Arden boundary, which would contribute to a ‘climate positive’ development

_ A small suite of planning controls will be effective in ensuring climate risks are mitigated at the building level, complementing precinct scale responses for reduction of urban heat and integrated water management

_ To reach net zero emissions by 2030 and thus assist the City of Melbourne in meeting a 1.5oC scenario consistent with the Paris Agreement, there will be a need to use mechanisms source 100% renewable electricity for the precinct and to purchase a relatively small quantity of carbon offsets to cover the residual emissions from difficult to eliminate sources, primarily gas use for specific activities (medical / research) and for residual waste emissions.

References

_ AECOM, Economic Assessment of the Urban Heat Island Effect (2012)

_ ARENA, CEEFC and Energeia, Australian Electric Vehicle Market Study (2018)

_ Climate Works Australia and Electric Vehicle Council, The state of electric vehicles in Australia (2018)

_ COAG Energy Council, Report for Achieving Low Energy Homes (2018)

_ Deakin University and Delft University of Technology, Sustainability and within use office building adaptations: A comparison of Dutch and Australian practices (2011)

_ Designing Buildings Ltd, Performance bond for construction (2019) (designingbuildings.co.uk/wiki/Performance_bond_for_construction)

_ Green Building Council of Australia, A Carbon Positive Roadmap for the Built Environment (2018)

_ Green Building Council of Australia and Property Council of Australia, Every Building Counts – A practical plan for emissions reduction in the built environment (2019)

_ Infrastructure Victoria, Advice on Automated and Zero Emissions Vehicles Infrastructure (2018)

_ Iowa State University, Performance Bond: Cost, Benefit, and Paradox for the Public Highway Agencies (2014)

_ Kerry A. Nice et al (2018) Development of the VTUF-3D v1.0 urban micro-climate model to support assessment of urban vegetation influences on human thermal comfort

_ Matthew P. Adams, Peter L. Smith (2014) A systematic approach to model the influence of the type and density of vegetation cover on urban heat using remote sensing

_ MG Surety Bonds, Performance Bonds (2019) (mgsuretybonds.com/performance-bonds)

_ Property Council of Australia and Green Building Council, Every Building Counts (2019) (everybuildingcounts.com.au)

_ RMIT and City of Melbourne, Transport Strategy Refresh Background paper – Car Parking (2018)

_ Rocky Mountain Institute, Electrifying Building for Decarbonization (2018)

_ Sustainability Victoria, Statewide Waste and Resource Recovery Infrastructure Plan

_ S.J. Wilkinson and H. Remoy (2017) Adaptive reuse of Sydney offices and sustainability, Sust. Build. Volume 2, 2017 Zero Energy Mass Custom Homes (School of Built Environment, University of Technology, Sydney, Australia) (https://www.sustainable-buildings-journal.org/articles/sbuild/full_html/2017/01/sbuild160001/sbuild160001.html)

_ S.J. Wilkinson, Office building adaptations and the growing significance of environmental attributes, J. Corp. Real Estate 16, 252 (2014) [CrossRef] [Google Scholar]

_ S.J. Wilkinson, H. Remøy, Sustainability and within use office building adaptations: a comparison of Dutch and Australian practices, in Pacific Rim Real Estate Conference, January 16–19, 2011, Gold Coast, Australia (2011)

_ Sam Kubba, Green Construction Project Management and Cost Oversight (2010)

_ The Senate Select Committee on Electric Vehicles Report (2019)

_ Transport Strategy refresh background paper: Car parking, RMIT 2018

_ Underwriting Australia, Contract / Performance Bonds (2019) (jwsuretybonds.com/contractor-bonds/performance-bond)

_ University of Technology Sydney, Wilkinson and Remoy Adaptive reuse of Sydney offices and sustainability (2017)

SECTION 6
APPENDICES

Appendix 1_Mechanism for Environmental Performance - Long-list

TYPE	DETAILED MECHANISM	DESCRIPTION	APPLICABILITY TO SCENARIOS	SEGMENT IMPACT	LAND APPLICABILITY
Direct Investments	Waste hubs	Local biodigesters and e-waste/hard waste drop off.	Zero Carbon + Climate Positive only	Waste	Public / private / Arden North etc
	North Melbourne (Arden) Train Station	Major public transport infrastructure.	BAU + All scenarios	Transport	Public (with broader benefit)
	Tram investment	Major public transport infrastructure.	BAU + All scenarios	Transport	Public / Private
	Bus investment (if relevant)	Investment in EV fleet	Zero Carbon + Climate Positive only	Transport	Public / Private
	Active transport investment (pedestrians, cyclists)	Active transport infrastructure, urban furniture and end of trip facilities	All scenarios except BAU	Transport	Public / Private
	Precinct PV on public land	Various mechanisms to boost local renewable energy generation	All scenarios except BAU	Stationary energy	Public / Private
	Gas network transition (if relevant)	Public subsidy for transition to clean gas distribution or no gas distribution	Zero Carbon + Climate Positive only	Stationary energy	Public / Private
	Investment in EV charging infrastructure	Public subsidy for accelerated EV charging.	Zero Carbon + Climate Positive only	Stationary energy / Transport	Public / Private
	State of the art public lighting	Street light energy efficiency and / or local generation	All scenarios except BAU	Stationary energy / public infrastructure	Public
	Water and wastewater: refer to work done by water authorities for carbon neutrality: out of scope for public realm and hence direct investment				
	Greening public space: refer to work done by CoM: out of scope for public realm and hence direct investment				
Operational investments	Organics collection commitment	3rd bin or maintenance of organics processing infrastructure	All scenarios except BAU	Waste	Public / Private
	Renewable energy sourcing for public infrastructure	PPA or equivalent for all public electricity use including lighting, public spaces and transport	All scenarios and, in some cases, BAU (for trams)	Stationary energy	Public
	Behavioural change / education programs	Promoting and reinforcing sustainable behaviours	All scenarios except BAU	All segments	Public
	Infrastructure maintenance / ongoing support for sustainability initiatives	E.g. maintenance of end of trip facilities / facilitation of community energy / greening programs	Zero Carbon + Climate Positive only	All segments	Public / Private
	Carbon offsets for publicly owned infrastructure and spaces	Purchase of offsets with a view to reach carbon neutrality for all or part of the precinct	Zero Carbon + Climate Positive only	All segments	Public extended in some cases to the private realm

Appendix 1_Mechanism for Environmental Performance_Long-list

TYPE	DETAILED MECHANISM	DESCRIPTION	APPLICABILITY TO SCENARIOS	SEGMENT IMPACT	LAND APPLICABILITY
Planning mechanisms	Mandate 5.5 star NABERS (whole building), with clear trajectory progressing to 6 star for commercial buildings	Mandated performance above NCC	All scenarios except BAU	Stationary energy (mostly)	Mostly Private
	Mandate 5 star – Green Star D&AB for multi-unit dwellings plus 7.5 star NatHERS	Mandated performance with specific ENE1 target (% improvement over reference building)	All scenarios except BAU	Stationary energy (mostly)	Public / Private
	6 star – Green Star Communities	Mandated benchmark (assumed carbon reduction consistent with other projects)	All scenarios except BAU	Stationary energy (mostly)	Public land only
	Require evidence that building is performing	Mandated verification of building performance post commissioning	All scenarios except BAU	Stationary energy (mostly)	Public / Private
	Incentivise performance through Floor Area Uplift	Greater density / height allowed for those committing to and achieving performance in excess of planning requirements	All scenarios except BAU	Stationary energy (mostly)	Public / Private
	Mandate higher standards for HVAC, ventilation and heat recovery	Improve efficiency of heating / cooling in all buildings	All scenarios except BAU	Stationary energy	Public / Private
	Develop and enforce standards ensuring buildings are ready for technology upgrades	E.g. EV ready, water tank ready, third pipe ready, Demand Response ready, etc.	All scenarios except BAU	Stationary energy (mostly)	Public / Private
	Mandate end of trip facilities and reduce car parking space requirements for both residential and office buildings	Precinct Transport Plan (PTP)ning	All scenarios except BAU	Transport	Public / Private
	Regulate location of car parks	Precinct Transport Plan (PTP)ning	All scenarios except BAU	Transport	Public / Private
	Require space provision for waste management in both private and office buildings	Retain flexibility in waste management	All scenarios except BAU	Waste	Public / Private
	Mandate shading of north / west facing windows	Avoid excessive heat gain	All scenarios except BAU	Climate resilience	Public / Private
	Require building resilience assessment at design stage	Occupants safety / emergency planning	All scenarios except BAU	Climate resilience	Public / Private
	Mandate materials selection which minimise UHI	External materials selection	All scenarios except BAU	Climate resilience	Public / Private
	On-lot rainwater tanks	Retarding water tanks working in conjunction with precinct-wide infrastructure	All scenarios except BAU	IWM	Public / Private
	Mandate % of green surface on private land / CoM Green Factor tool	Roofs / façade / public spaces	All scenarios except BAU	Green Infrastructure and urban ecology	Public / Private
	Mandated connection to all precinct infrastructure	Mandated connection to any direct investment made e.g third pipe	All scenarios except BAU	All sectors + IWM	Public / Private

Appendix 1_Mechanism for Environmental Performance_Long-list

TYPE	DETAILED MECHANISM	DESCRIPTION	APPLICABILITY TO SCENARIOS	SEGMENT IMPACT	LAND APPLICABILITY
Non-Planning - Regulatory	Extend CBD disclosure to all commercial buildings	Incremental step to signal importance of ratings	All scenarios except BAU	Stationary energy	Mostly Private
	Require rating disclosure for all residential buildings	Educate the market on the importance of transparency	Zero Carbon + Climate Positive only	Stationary energy	Mostly Private
	Mandatory reporting / data sharing of environmental data for benchmarking purposes	Enable analytics, create a culture of openness and collaboration	Zero Carbon + Climate Positive only	All segments	Public / Private
Non-Planning - Finance, governance or operating models	Designated zero carbon precinct and leasing of land (rather than sale)	Alternative development model where developer rights are sold with ongoing estate levy, but land retained in public ownership (allowing for lock in of zero carbon trajectory)	Zero Carbon + Climate Positive only	All segments	Public
	Technical support (for developers)	Free / discounted access to design professionals and construction contractors to encourage the design of buildings with improved performance	Zero Carbon + Climate Positive only	All segments	Public / Private
	Sustainability concierge (in operation)	Facilitation of ongoing diagnostic and investment in performance improvement, including bulk purchases, etc. for precinct occupants	Zero Carbon + Climate Positive only	All segments	Public / Private
	Government facilitated PPA	With attractive electricity price points for all participants	All scenarios except BAU	Stationary energy	Public / Private
	Energy service contracting	Facilitate (and sponsor) an “energy as a service” offering for the precinct	Zero Carbon + Climate Positive only	Stationary energy	Public / Private
	Financial incentives for greening on private property	As per the Melbourne Green Fund	All scenarios except BAU	Urban ecology	Private
	Incentives for PV wherever technically possible	Ensure local energy generation is maximised	Zero Carbon + Climate Positive only	Stationary energy	Public / Private

Appendix 2_Case Study_Barangaroo

Barangaroo is owned by the NSW Government and was managed by the Barangaroo Delivery Authority (BDA). The responsibilities of the BDA are now administered by Infrastructure NSW (INSW).

The site is a 22 hectare urban renewal area on the west of the Sydney CBD adjoining Sydney Harbour comprising three distinct parcels; Barangaroo South, Barangaroo Central and a large area of open space. A critical point is that the mechanisms employed for Barangaroo are for the most part only applicable to Arden Central where the publicly owned land allow the State an increased level of control over the development.

The Barangaroo South Project Development Agreement enshrined key public expectations for the site to deliver world-class public domain, sustainability targets and retention of land ownership by the public. The Agreement allows the developer partner - Lendlease to develop leasehold buildings subject to 99 year leases. The public spaces are retained in public ownership for the benefit the people of New South Wales and are managed by INSW.

TARGETS / KEY COMMITMENTS

The targets and key commitments for the precinct are as follows:

- The Barangaroo precinct committed to being a climate positive development through the Clinton Climate initiative and C40. Part of this commitment is delivering carbon neutrality in operation
- A 50% target for open space across the precinct
- A commitment to water positive – where the treatment of recycled water on site is equal to or greater than water consumption

ALIGNMENT WITH ARDEN

The precinct shares significant similarities with Arden as outlined below:

- Strong connections to the CBD and high value commercial and residential land
- A commitment to strong carbon reduction as part of the development process and operation
- A new metro station (Barangaroo) links to the CBD in much the same way as Arden (North Melbourne) train station will
- Large areas of publicly owned land – 22 hectares in the case of Barangaroo and 18 hectares in the case of Arden
- Strong focus on the public realm with intention to maximise the relationship with the water (Sydney Harbour and Moonee Ponds Creek)
- Significant density targets with commercial and residential development
- Former industrial uses with high levels of contamination

THE DARAMU HOUSE (PICTURED) WILL BECOME BARANGAROO'S SECOND TIMBER BUILDING. THE 7 STOREY STRUCTURE WILL DELIVER 10,000 M2 OF COMMERCIAL FLOOR SPACE, WITH AN ADDITIONAL 680 M2 OF RETAIL ACTIVATION AT STREET LEVEL.

Appendix 2_Case Study_Barangaroo

RELEVANT MECHANISMS	DESCRIPTION	APPLICABILITY TO ARDEN	BENEFITS / CONSIDERATIONS / CRITICAL SUCCESS FACTORS
Direct investments (State / Local)	New metro station (Barangaroo)	Applicable – already committed	Not formally committed until after Barangaroo South commenced development. Proximity of Wynyard Station meant no significant uplift in value as a result of the train station. This is different to North Melbourne (Arden) Station where the station is the key catalyst for density.
	Annual carbon reporting	Highly applicable to Arden Central	Mechanism in place for the developer Lendlease to report on carbon emissions. A carbon cap exists for each of the leases, with a requirement to fund the gap in offsets. The carbon monitoring and reporting is undertaken through a risk management lens by the developer, i.e. they are incentivised to cascade the carbon reduction through to building owners and tenants to minimise commercial risk.
	Embedded electricity network	Highly applicable to Arden Central	The embedded network was set up by Lendlease for Barangaroo South with them retaining the licensing to buy and on-sell electricity to building owners / tenants. This allows the flexibility for an aggregate renewable energy purchase, or the separate purchase of equivalent Large Generation Certificates (LGC's) or matching 'black' electricity purchase with carbon offsets.
	On-site renewable energy generation	Applicable, but density and contested roof space represent challenges.	The renewable energy contribution (6000m2 of solar) has been sized to power at least the public domain and recycled water plant. Obligations exist as a requirement of the ground lease to fund the gap between renewable energy generation on-site and zero net energy.
	Recycled water treatment plant	Applicable but beyond scope of Climate Response Plan. Connection to Fishermans Bend and local stormwater harvesting being considered by City West Water.	Requirements for the development to be 'water positive' as a condition of the lease. This means recycled water production is greater than the precinct water consumption. Water is treated to a level required to meet the needs of recycled water customers. The developer has invested in this precinct infrastructure in order to meet the target.
Operational investments	Operational waste commitments including 'concierge' service	Applicable to assist in locking in zero emissions waste for Arden Central.	Requirements on operational waste are set through the ground lease including the need for the precinct waste operator to be approved by the BDA or INSW. All building owners and tenants are bound to the approved waste operator. Lendlease has recently appointed a waste 'concierge' to assist tenants with meeting the waste commitments. The governance is set through the Barangaroo South Management Committee, with a key role for INSW in decision making. The Management Plan sets out a number of other key roles and responsibilities. https://media.opengov.nsw.gov.au/pairtree_root/e7/68/24/45/7b/0b/4a/8e/82/39/1f/1d/8b/8a/45/74/obj/Barangaroo_South_Management_Plan___signed_by_all_parties_2015_05_27.pdf
Planning mechanisms	Open space target (50%)	Applicable (but target likely too high for Arden)	Consistent with community expectations, a large commitment to public open space was made through the planning process. The large public open space on the northern site was developed by the State Government in order to retain full control given the sensitivity of the location and the state significance of the asset.
	Green Star 6 star for commercial buildings, 5 star for residential buildings	Applicable to both public and private land	Benchmark minimums at the building level were set through the planning stage, but are enforced through the ground lease, so are not strictly a planning mechanism for Barangaroo. Using a rating tool framework such as Green Star is applicable to both public and private land however if applied to private land the planning mechanism would be the preferred control rather than through a lease.

Appendix 2_Case Study_Barangaroo

RELEVANT MECHANISMS	DESCRIPTION	APPLICABILITY TO ARDEN	BENEFITS / CONSIDERATIONS / CRITICAL SUCCESS FACTORS
Non-planning (Regulatory)	No relevant non-planning regulatory mechanisms applied		
Non-planning (Finance, governance or operating models)	Project Development Agreements	Very highly applicable for Arden Central	The key plank of the development process for Barangaroo the State Government of NSW has retained the land and has sold development rights to Lendlease and Crown Resorts for Barangaroo South and Barangaroo Central respectively. The expectations of parties are set out in the Project Development Agreement - the contract between the NSW Government represented by the Barangaroo Delivery Authority and the developer of the land. Importantly this allows a significantly increased level of control for State Government which locks in ongoing requirements for carbon targets through the Project Development Agreement with Lend Lease and Crown Resorts. If the land itself had been sold, ongoing requirements for carbon neutrality and associated targets may have been difficult to enforce. The Agreement also guarantees that the land title to Barangaroo South always remains in public ownership, with INSW as landlord, with the developers responsible for meeting the terms of the agreement (environmental and otherwise). The developers make agreements with building owners (e.g. institutional funds) who then ensure their tenants meet requirements through cascading responsibilities. Partially redacted versions of Project Development Agreements are available. https://resource.barangaroo.com/hc/en-us/articles/115009627028-Barangaroo-South-Project-Development-Agreement
	Estate levy	Applicable as mechanism to retain ongoing investment into sustainability practices	An Estate Levy of $4.90 per square meter of Gross Floor Area (GFA) per annum applies as a cascading condition of Project Development Agreement and an ongoing mechanism to fund sustainability in operation within the Barangaroo precinct. The estate levy funds activities which supports progress towards sustainability goals including waste operation. Importantly this provides a mechanism for new operational investments which can assist in meeting carbon and water targets.
	Barangaroo Development Authority delivery model	Potentially applicable	The BDA was set up to expressly manage the urban renewal process for the State Government, akin to but learning the lessons of the Docklands Authority. Their obligations have now been brought into the remit of INSW through July 1, 2019 changes to the machinery of government. Given the role of Development Victoria in the Arden Central precinct, it is unlikely that separate delivery authority will be pursued. From a climate response perspective, the key requirement is strict governance over up-front investments and operational obligations to meet carbon and water targets.

Appendix 2_Case Study_Stockholm Royal Seaport

Set to be completed in 2030, Stockholm Royal Seaport (SRS) is the largest urban development area in Sweden, with plans for at least 12,000 new homes and 35,000 jobs.

The Stockholm Royal Seaport (SRS) project is transforming the old industrial port area into a modern city environment for both residents and businesses, setting the standard for creating a fossil-fuel free Stockholm. In addition, the development will provide space for recreation, with dynamic and vibrant living and working spaces.

The site is a 236 hectare brownfield site, which is owned by the City of Stockholm. It was granted economic support from the Swedish Delegation of Sustainable Cities in order to contribute to making the Royal Seaport in Stockholm a world-class environmental, globally recognised urban area. Approximately 5,100 housing units have already been allocated to 55 developers, but more than half of the development is still to be planned. The district is being planned to adapt to future climate changes as well as safeguarding existing ecological values.

TARGETS / KEY COMMITMENTS

The targets and key commitments for the precinct are as follows:

- Fossil fuel free and low carbon Stockholm / Royal Seaport: the calculated reduction in GHG emissions for the present requirements is approximately 30,000 tonnes CO2e/year, or 60% less than the City of Stockholm's conventional baseline planning. If more stringent requirements are applied, a further reduction of some 10,000 tonnes CO2e/year could be achieved (-80%).
- Target emission rates: Carbon dioxide emissions below 1.5 tonne per person by 2020, adapted to climate change, and fossil fuel free by 2030
- Highly energy efficient buildings, with a target for energy use of 55 kWh per square meter per year
- Transport / mobility: strong investment in active transport to meet local needs and help people commute to work
- Behaviour change programs in relation to car use and energy transition

ALIGNMENT WITH ARDEN

The precinct shares significant similarities with Arden as outlined below:

- Strong connections to the CBD and waterways
- A commitment to strong carbon reduction as part of the development process and operation
- Significant publicly owned land
- Remediation requirements due to previous uses
- Strong commitment to transport mix and shifting away from private vehicles

THE STOCKHOLM ROYAL SEAPORT (SRS) HAS THE POTENTIAL TO REDUCE GHG EMISSIONS BY 80% COMPARED TO STOCKHOLM'S CONVENTIONAL USAGE.

Appendix 2_Case Study_Stockholm Royal Seaport

RELEVANT MECHANISMS	DESCRIPTION	APPLICABILITY TO ARDEN	BENEFITS / CONSIDERATIONS / CRITICAL SUCCESS FACTORS
Direct investment	Waste to energy investment	An option to consider, but highly unlikely to be feasible in the Arden context	In Stockholm, there are many strong prerequisites in place: most Stockholmers have access to district heating, which in 2020 will be completely powered by biofuel and a well-functioning waste disposal system. Although waste generation in Stockholm is somewhat lower than the average for the OECD countries (1.43 kg/capita/day compared to the OECD average of 1.48 kg/capita/day), the share of incineration of solid waste is high (69%) and the recycling rate for organic waste and bulky waste is relatively low. Stockholm also has higher generation of waste than the rest of Sweden (average of 1.32 kg/capita/day). The recycling rate for organic waste is around 21% (2010) and has not risen as quickly as in many other countries.
Operational arrangements / investments	Behaviour change	Applicable	Behaviour change efforts are being employed to drive the precinct toward eco-labelled renewable electricity from the grid. The current assumption is that 50-100 percent of building electricity, 25-75 percent of household electricity and 50-100 percent of commercial electricity use will be eco- labelled. Eco-labelling is the Swedish equivalent of GreenPower.
Planning controls	Planning control - Solar PV	Highly applicable to Arden, needs to acknowledge density of built form	Stringent planning controls require developers to install enough solar photovoltaic to cover at least 10-20 percent of building electricity needs. The technology must be installed in a way that makes it simple remove or replace, as newer technologies emerge, without affecting the building's overall design and character.
	Planetary boundaries from the Stockholm Resilience Centre Ecological and carbon footprints	Use of frameworks and tools is applicable to Arden	SRS used a combination of the planetary boundaries from the Stockholm Resilience Centre, ecological footprinting and carbon footprinting as a guiding framework for the precinct. Planetary boundaries are a concept which build on earth system processes and environmental boundaries, proposed in 2009 by Stockholm Resilience Centre and Will Steffen from the Australian National University. The combination of these approaches is appropriate in the Swedish context given the local partnership with the Stockholm Resilience Centre, and could be academically applied to Arden. Application to underpin planning controls or finance, governance and operational controls would be problematic.
	Energy efficient buildings	Thermal performance benchmarks are applicable in the Arden context	The objective of energy requirements for all new buildings in the SRS are that they are as close as possible to the Passivhaus standard. Agreements have been signed with developers and a thorough monitoring process is in place to ensure that the targets are met. The City initiates a close dialogue early on in the development process and supports the developers throughout the planning and implementation stages. A capacity development programmed has been set up and an energy expert evaluates all plans and measures and gives advice throughout the process. SRS standard: Current requirement for developers: at 55 kWh/m2/year (which is 25 for hot water, 22 for heating and 8 for operational electricity), equivalent to a 40% reduction compared with the Swedish National Building Code. The long-term ambition is to achieve net-positive energy buildings near the end of the project, based on a near-zero energy requirement in the buildings and local production of renewable energy. This scenario, however, is not included in the current road map. A competition for a plus-energy building was held in 2014 and, based on the experiences from this competition; a more progressive set of requirements will be developed.
Other regulatory mechanisms	No relevant mechanism		

Appendix 2_Case Study_Stockholm Royal Seaport

RELEVANT MECHANISMS	DESCRIPTION	APPLICABILITY TO ARDEN	BENEFITS / CONSIDERATIONS / CRITICAL SUCCESS FACTORS
Finance, governance and operational models	Low carbon commitment	One of the main objectives in SRS is to limit greenhouse gas (GHG) emissions and in the long-term, become a Climate Positive urban district	In 2017, SRS became an official member of the Climate Positive Development Programme (CPDP), under C40's Urban Planning & Development Initiative. The CPDP prescribes a framework for developing strategies for becoming a climate-positive urban district. The roadmap development process has created an understanding and knowledge of decision-making to deliver a climate-positive perspective during operation.
	Transport during construction	Potential application for construction phase as operational model	During construction a Construction Consolidation Centre (CCC) has been developed to coordinate transport to construction sites, the number of vehicle trips is reduced both in and across the urban development area, while increasing accessibility and safety during the construction. The biggest challenge is bringing about a fuel switch in the transport system, the Royal Seaport is dependent on national ambitions for fossil-free fuel and is shifting towards metro, biogas and electro hybrid buses, and commuter boats.
	Smart grid / precinct energy system	Potential application on the Arden Central land	A smart grid is being installed to help manage local energy production and storage between buildings in the urban renewal area. This allows more efficient demand response, through the deployment of intelligent technologies, active consumer engagement and incentive models. It also allows for potentially higher levels of renewable energy generation to occur within the precinct.

Appendix 2_Case Study_Paris Clichy Batignolles

The 54-hectare urban renewal project is one of the major urban renewal projects occurring in Paris ("within the walls", i.e. within the ring road called the "périphérique").

It was made possible by the decommissioning of a large railway yard, thus creating a unique historic opportunity for a coherent modern development in a city typically too dense and full of heritage to allow for such redevelopments. This opened an opportunity for integrated town planning, creating linkages between districts historically separated by the impenetrable barrier of the railway lines and yards. It was decided that the urban development should be mix-use and resolutely ambitious, in terms of triple-bottom-line sustainability goals.

TARGETS / KEY COMMITMENTS

The targets and key commitments for the precinct are as follows:

_ Energy use targets, including:
  + Heating requirements under 15kWh/m2/year (equivalent to Passiv Haus standard), make possible by a district energy network using ground-source energy
  + Overall imported energy (for buildings) under 50kWh/m2/year
  + Local PV generation 4500MWh/year
  + First smart grid in Paris

_ Pneumatic waste collection network, reducing waste collection truck movements (in service since 2013)

_ Commitment to 50% affordable housing, including 500 student accommodation, 400 social housing rental dwellings and 200 senior citizen accommodation

_ Commitment to social infrastructure (childcare, education, sport infrastructure using 38,000 m2).

_ A commitment to water positive – where the treatment of recycled water on site is equal or greater to water consumption

TO ACHIEVE THE PROJECT'S OBJECTIVES, PARIS BATIGNOLLES AMÉNAGEMENT (PBA) HAS IMPLEMENTED VERY PRECISE ENVIRONMENTAL TARGETS INCLUDED IN THE SALES AGREEMENTS FOR BUILDING LOTS, WITH POTENTIAL FINES FOR NON-COMPLIANCE. EVERY PROJECT IS MONITORED TO ENSURE THAT ENVIRONMENTAL COMMITMENTS ARE MET.

ALIGNMENT WITH ARDEN

The 54-hectare urban renewal project presents a number of similarities with Arden:

_ At 54 ha, its size is quite similar to Arden's

_ Developed on the site of a former railway yard, the land was owned publicly owned to a large extent

_ It set the bar quite high on green ambitions from the planning stage and is labelled "Ecodistrict"; it was used as a test case for a number of sustainability initiatives, including the CORDEEs project financed by the European Union (see below)

_ It is a mix-used district, which will eventually house 7,500 residents (200,000m2) and 12,000 jobs (140,000m2 office space and 31,000m2 retail), including a new justice administration district

_ It will all be medium to high density

_ It includes a 10 ha park at its heart, which is likely to be used by people from outside the district

_ The district is well integrated into the Paris public transport network, with two metro lines, one tram line and even the regional train serving the district

Contrary to Arden, however, the project will be completed over a shorter timeframe. Launched in 2002, the district is already home to 4000 people and houses 3000 jobs and is scheduled to be completed by 2022.

Appendix 2_Case Study_Paris Clichy Batignolles

RELEVANT MECHANISMS	DESCRIPTION	APPLICABILITY TO ARDEN	BENEFITS / CONSIDERATIONS / CRITICAL SUCCESS FACTORS
Direct investment	Public transport	Applicable – already committed	Proximity to existing metro lines (2, 3, 13) and train lines as well as one tram line plus extension of metro line 14 (most modern, driverless metro line).
	Park and access to park	In principle, although no major park is planned	The Martin Luther King park is a link for pedestrian as well as a recreation area: it was planned with access and transit in mind (14 access points). The park is managed for biodiversity and has been certified as such in 2015 ("Ecojardin"). It is also used for Urban Heat Island management.
	Shared "boulevard"	Applicable – already committed	Streets are planned as shared space for active transport, discouraging private transport.
	District energy using ground-source energy	Applicable - but unlikely in Melbourne context	All buildings are linked to a district energy network using 85% renewable energy thanks to a ground-source system
	Vacuum waste collection system (ENVAC)	Applicable - but unlikely in Melbourne context (and costly)	Underground vacuum system for waste to reduce traffic of garbage collection trucks. Only glass and large items are collected through other means.
Operational arrangements / investments	CoRDEES (Co-Responsibility in District Energy Efficiency & Sustainability) project, subsidised by the European Union: energy data collection, analytics and optimisation of a "smart grid" with engagement with occupants	Similar investment could be considered with a view to progress Net Zero emissions governance	Based on the observation that well-built buildings still require ongoing management, maintenance and commitment to achieve their optimal performance, the project is to create a Community Energy Management Platform to collect in real time and analyse energy data from buildings (electricity and heat) and public facilities (electric vehicle stations, street lighting and automated waste collection) and define optimisation scenarios. The project is based on the principle of "co-responsibility" of all stakeholders, i.e. residents, network operators, building systems operators, etc. and is considering data sharing and analysis a tool for performance. This requires engagement with residents (who have to accept to share their energy use data) and is considered necessary to achieve the objectives of the climate change plan, to emit 90 per cent less CO2 and satisfy Passivhaus requirement (energy use from the first occupied buildings suggest that energy use is higher than forecasted). This investment by the European Union is considered as a "smart grid" experimentation and could lead to a replicable model. The first conclusions are expected in the near future but informal conversations with sources close to the project suggest that many challenges remain to be addressed. However, an immediate benefit of the project is to be able to identify and rectify any need to tweak or optimise operational parameters or faults in the sophisticated energy systems in place (in particular District Energy).
	Waste – ENVAC operation	See above	See above – uncertainty about lifecycle costs and carbon emissions costs related to the operation of an ENVAC system, although one source12 mentions a 42% CO2-e savings compared to truck collection (notwithstanding the fact that in Paris some garbage trucks are electric).
Planning controls	District energy (heat) mandatory connection	Applicable (but unlikely in Melbourne context)	35,000 m© of PV will be installed on private and public buildings, generating 3.5GWh / year (estimated) or 40% of the district's need. There is a requirement for solar PV to be installed on all suitable roofs, but also on façades. Consistent with community expectations, a large commitment to public open space was made through the planning process. The large public open space on the northern site was developed by the State Government in order to retain full control given the sensitivity of the location and the state significance of the asset.
	On-site renewable energy generation	Applicable, but density and contested roof space represent challenges.	The renewable energy contribution from the district is not accounted for in the energy consumption target, as it is not integrated to a microgrid or embedded network. The energy generated is sold to the network which partially funds some of the body corporate costs, but does not necessarily maximise building occupants' benefits.
	Mandated energy performance	Applicable	The required energy performance for the buildings in the district is about 30% below regulatory requirements. Developers were bound to this performance through contractual obligations accompanied by financial bonds and evaluation mechanisms (4% of the estimated sales value is held as a bond until compliance has been verified).

Appendix 2_Case Study_Paris Clichy Batignolles

RELEVANT MECHANISMS	DESCRIPTION	APPLICABILITY TO ARDEN	BENEFITS / CONSIDERATIONS / CRITICAL SUCCESS FACTORS
	Mandated green roofs	Applicable	16,000m² of green roofs (about 30% of overall roof areas) have been achieved on public and private buildings (where PV were not suitable), plus 6,500m² of gardens in private spaces (usually accessible to all occupants of the property).
	Rainwater capture and reuse targets	Applicable	50% rainwater capture on public land and 30% on private land. Rainwater is used for irrigation and toilets. Rainwater covers 40% of the irrigation requirements for the 10ha Martin Luther King park.
	Car parking limitations	Applicable	Maximum car parking offer: _ 1 car space for 100m² residential area _ 0.33 car space for 100m² office space _ 0.28 car space for 100m² retail space _ Street level car parking is only for deliveries and disabled parking spaces. A car sharing service is planned.
Other regulatory mechanisms	No relevant non-planning regulatory mechanisms identified		
Finance, governance and operational models	Project Development Governance	Highly applicable for Arden Central	The project is managed by a public local development authority, 100% owned by local government (and regional government).
	Assistance to developers	Applicable for Arden	Developers were assisted through: _ The provision of tools supporting the most innovative requirements (in particular in relation to energy efficiency and management, as well as materials to be used in construction) _ Specialised consultants paid for by the Development Authority and working in collaboration with the developers to advise them _ Evaluation of building performance during the planning, building phases and at the commissioning + 1 year point
	Estate levy	Applicable as mechanism to retain ongoing investment into sustainability practices	We could not obtain information on the ongoing estate levy, but it is likely that it would be collected through private body corporates for private buildings.

KEY TAKE HOME MESSAGES

_ Nothing can replace contractual obligations put on developers in terms of effectiveness: this needs to be done early in the negotiation phase

_ It is of paramount importance to give energy systems 6 to 18 months from commissioning to be tweaked and optimised: the need for data analysis cannot be overstated during this period.

_ Working with Energy Network operators and retailers in a collaborative way can be very productive to come up with effective solutions.

_ Obtaining data sharing consent is complex, due to the number of stakeholders and the need to engage them not only at the start of the project (relatively easy) but in the long term (including when new owners / occupants move in). This is easier for district energy than for electricity micro-grid because people are locked into the district energy. Creation of a resident association can be useful, but there is a need for an “energy facilitator” to keep the momentum. It is necessary to assist people for at least an ongoing period of 18 months to embed good energy management habits at the household level.

Appendix 2_Case Study_South Waterfront, Portland

The district began as an expansion site for Oregon Health Science University (OHSU), which is connected to the OHSU main campus on Marquam Hill by the Portland Aerial Tram. To support the university expansion, the district was zoned to encourage residential mixed-used development and potential spin-off growth in the biotech industry.

The Area of development is 57 hectares, it is a mixed-use redevelopment on former industrial sites (brownfield). The district currently has 16 residential and mixed-use buildings, and 5 buildings operated by Oregon Health Science University (OHSU), who operated the Knight Cancer Research Centre in the district. The district had for over 100 years been home to numerous marine industrial uses, and as such the area had significant contamination issues that needed to be addressed. The area also lacked most infrastructure needed to support mixed-use development, so there existed an opportunity to create a new district that was intended from the ground up to be more sustainable, have a strong and healthier connection to the Willamette River, and have a lower carbon footprint than other mixed-used districts in the City.

The City of Portland owns 2.6 hectares of open space in the district. OHSU owns 10.5 hectares of land used for institution purposes. The remaining 42.5 hectares of the land, not counting right of way, is owned by private landowners and used for office, residential, and retail uses. The total City of Portland Investment is US $ 180 million. The City of Portland entered into this project as a public/private partnership. The City highlights the partnership with OSHU as critical, and has advised that for successful urban renewal, acquisition of areas planned for public open space, such as parks and the greenway needs to happen as early as possible.

TARGETS / KEY COMMITMENTS

The targets and key commitments for the precinct are as follows:

- A strong commitment to transport mix; a light rail, aerial tram, reducing carparks and the use of sole vehicle transport, more cycle linkages to the city. (Already proving to have great success)
- Renewal and protection of environmental values, including protect endangered species in the river. There has been increase in biodiversity due to the development.
- Renewal of the area, socially, having been closed off to community for a long time due to industrial sites.
- LEED certification at a minimum of silver, this has been generally exceeded with platinum and gold. The LEED system is categorized in five basic areas: Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources, and Indoor Environmental Quality. Buildings are awarded points based on the extent various sustainable strategies are achieved.

ALIGNMENT WITH ARDEN

The precinct shares significant similarities with Arden as outlined below:

- A strong connection to water
- A focus on a diverse transport mix and shifting away from single use vehicles
- Public and Private Partnerships
- Influence other precincts and state-wide change
- Health / innovation hub
- Contaminated land

THE PRECINCT IS HOME TO THE FIRST LEED PLATINUM MEDICAL BUILDING AND HAS THE MOST LEED RESIDENTIAL TOWERS OF ANY NEIGHBOURHOOD IN THE UNITED STATES.

Appendix 2_Case Study_South Waterfront, Portland

RELEVANT MECHANISMS	DESCRIPTION	APPLICABILITY TO ARDEN	BENEFITS / CONSIDERATIONS / CRITICAL SUCCESS FACTORS
Direct investment	Transport mix (Light rail, aerial tram, cycling paths, reducing parking)	Highly applicable, except aerial tram	District has transportation constraints for vehicles, due to a lack of carparks throughout the site, resulting in significant investments having been made to extend bus service, streetcar, light rail, aerial tram, bicycle, and pedestrian connections to and through the district. This has been highly successful. Approximately 1000 bicycles are parked at the tram daily, this connects to the greater city areas. Reduced commute from district to hospital (if delivered), for staff, researchers, patients and visitors, from 30 to 3.5 minutes. The aerial tram caters for 60 people per trip. The tram has minimised car use between the district and hospital (if delivered).
	Connectivity	Highly applicable	The district is connected to the east side of the Willamette River by a new bridge that conveys bus, streetcar, light rail, bicycles, and pedestrians only, with car access prohibited. These connections further link to the Portland aerial tram which provides direct access to OHSU's Marquam Hill facilities allowing transit and cycling commuters to access OHSU without the use of a car.
	Early open space acquisition	Highly applicable	Allocation of land for green and open space was undertaken early prior to land value increasing to also drive investment benefits. Green spaces were developed early on (alongside transport mix).
Operational arrangements / investments	Stormwater management, land ecology and green infrastructure	Applicable – Arden committed to these focus areas	There are district strategies in place regarding stormwater management, the use of native vegetation in most landscaping, green roofs, and riparian habitat restoration are demonstrating improved water and air quality at a district level, that have been detailed in the development contract. District stormwater management plans have been implemented to treat both public and private runoff, native landscaping is used through much of the districts landscaped and open space areas, and green roofs have been installed on most new development. Further, new regulations adopted in 2018 require that all new buildings must install green roofs and pursue "low carbon building" certification.
	Changes to policy (state-wide)	Applicable to use Arden as 'test bed' for broader policy application	Bureau of Planning influenced progressive state-wide policies in regard to transport, buildings, greenways for this precinct, which have since acted as a catalyst for state-wide change.
	Greenways	Potentially applicable to Moonee Ponds interface	The district adopted new greenway regulations that required greater building setbacks of 31 metres or more from the Willamette River, as well as standards for habitat restoration along 1700m of riverfront. This setback also includes space for regional pedestrian and bicycle trails.
	Building controls	Highly applicable in relation to having planning controls which reference third party tool frameworks	The plan, and associated redevelopment plan, encouraged and in some cases required that buildings have a LEED rating of silver or better. However, of the 15 new buildings constructed to date, 13 have pursued certification, with two achieving Platinum rating, 5 Gold, and 6 in progress to obtain Gold or better. The South Waterfront Central District, subject to a public / private partnership has a Gold LEED rating.

Appendix 2_Case Study_Vauban, Freiburg

A former army barracks, Vauban is now a 38-ha neighbourhood that hosts 2,000 low-energy dwellings and 600 jobs.

The land was owned by Council, allowing the development to be closely managed in line with the project vision, to deliver a cooperative development with strong ecological, social, economic and cultural outcomes. A collaborative governance model was developed early on, which enabled and utilised genuine engagement from the community.

A not-for-profit organization, Forum Vauban, was created and led by community and government leaders, and contracted by the City of Freiburg to lead community engagement and the establishment of long-term sustainability goals for the precinct.

TARGETS / KEY COMMITMENTS

The targets and key commitments for the precinct are as follows:

_ Delivery of car-free streets and easy access to a diversity of public and active transport options

_ Precinct wide guidelines for ecological design that considers sustainable water, onsite energy generation, energy efficiency, collection and use of rainwater, and recycling

_ All new buildings to meet a minimum standard of 65 kWh/m2a

_ Commitment to a participatory development process to ensure buildings and infrastructure perfectly fit the needs for a diverse population now and into the future

_ Designing public spaces to facilitate the development of a strong, connected local community

ALIGNMENT WITH ARDEN

The precinct shares significant similarities with Arden as outlined below:

_ Strong commitment to transport mix and shifting away from private vehicles

_ A commitment to renewable energy generation and high efficiency buildings

_ Large areas of publicly owned land coupled with a focus on maximising the value of the public realm

_ A commitment to delivering a diversity of housing stock, including social housing, that is suitable for current and future populations

_ Close proximity to the CBD, Vauban is only 3km from Freiburg CBD

PEDESTRIAN AND BICYCLE PATHS FORM A HIGHLY-CONNECTED, EFFICIENT, GREEN TRANSPORTATION NETWORK WITH SOLAR PV ON EVERY BUILDING IN VAUBAN.

Appendix 2_Case Study_Vauban, Freiburg

RELEVANT MECHANISMS	DESCRIPTION	APPLICABILITY TO ARDEN	BENEFITS / CONSIDERATIONS / CRITICAL SUCCESS FACTORS
Direct investment	Social housing	Applicable	Ten former barrack buildings were converted into affordable housing by the City of Freiburg Student Union and the S.U.S.I. project (self-organised, independent neighbourhood initiative). The participatory development process ensured housing fits the needs of occupants and supported connectivity between the diverse populations.
	Transport mix Car free	Highly applicable	The precinct has implemented traffic calming, 30 km zone and home zones. Rather than being offered at each building, car parking is located in two common garages on the edge of the precinct. The need for residents to walk to the garage, increases the appeal of public and active transport options. For convenience, there are short-term loading zones within the home zones. Completely removing parking was not an option because the Baden Württemberg Land law requires every home to have access to a parking space. Forum Vauban, negotiated a compromise resulting in a parking ratio of less than 0.5 per housing unit, with most parking located in parking garages on the edge of the district. Residents can choose to lease or purchase a parking space as a separate cost to purchasing or renting their property. This has made the cost of car parking a tangible and optional for residents. Car-free households save on the substantial costs of a parking space that is normally hidden in purchase or lease costs. The garages were built and financed by a private firm largely owned by the City of Freiburg. 430 households have opted to go car-free and instead make use of the tram and bus links, cycle paths and car sharing vehicles. Visitors make use of the 200 public parking spaces located in access roads, while car sharing users can park in one of 30 dedicated spaces located around the district. Financed by the “car-free” residents, the green area has been reserved for an additional car park if the need arises.
	Green infrastructure	Highly applicable	The former stock of trees has been largely preserved and new plants have been planted. Green spaced between rows of houses guarentee good climatic conditions and provide play areas for children. Vegetation-covered green roots store rainwater, which is collected and re-used in the district. As Vauban is a densely built-up district, incorporating green areas was seen as critical.
Other regulatory mechanisms	Energy	Highly applicable	The Kleehäuser zero-energy houses as well as the PlusEnergy Solar Settlement and Sun Ship are all unique, as they produce more energy than they use. The district’s heat is supplied by a combined heat and power plant, which also joins forces with numerous photovoltaic installations to supply electricity to households. Supported by heat pumps and a heat storage system, the CHP plant uses natural gas and wood, a renewable fuel, to supply Vauban’s residents with district heating.
	Low energy buildings (Passivhaus standards)	Highly applicable	Low-energy building is mandatory in this district and around 170 units have been built as ‘passive houses’ and a further 70 as ‘energy-plus’ homes. Heating from a local heating network powered by renewable energy sources and the use of solar technology is largely standard for most homes. All buildings must meet minimum low energy consumption standards of 65 kWh/m2a (i.e., at least half the average German energy standards).

Appendix 2_Case Study_Vauban, Freiburg

RELEVANT MECHANISMS	DESCRIPTION	APPLICABILITY TO ARDEN	BENEFITS / CONSIDERATIONS / CRITICAL SUCCESS FACTORS
Finance, governance and operational models	Governance	Potentially applicable	he NGO "Forum Vauban" was founded in late 1994 and became the official body of the broad citizen participation in 1995. The city of Freiburg formed a special committee from the City Council concerning Vauban. In this committee, representatives from political parties discuss the main Vauban issues together with representatives from the administration and other consultative members such as Forum Vauban. There are three main acting bodies or institutions connected with Vauban can be identified (see graphic): Project Group Vauban (the administrative coordination of local authorities dealing with the Vauban project), City Council Vauban Committee (the main platform for information exchange, discussion, and decision preparation; decisions are ultimately made by the City Council); Forum Vauban (the local citizens' association, being the legal body of the participation process, as well as responsible for the social work within the district).
	Organic waste	Applicable	Organic household waste is treated with an anaerobic digester. The place contains a unique ecological sewage system in one pilot project: sucked by vacuum pipes, with human waste transported into this digester, generating biogas, which is used for cooking. Grey-water is cleaned in biofilm plants and returned to the water cycle.
	Life cycle analysis and monitoring		Importantly, the project is being monitored using lifecycle and regional material flow analysis with the GEMIS software. This is the first time that a complete urban neighborhood in Germany has been analyzed with respect to buildings, infrastructure, electricity supply, heat supply, water and waste, traffic and private consumption with a full life-cycle perspective and using regional data.
	Financing		The project has a special status as "development site" and its own budget (US $85,000,000) controlled by Project Group Vauban. The money to clean the area and develop the infrastructure (neighborhood center, kindergartens and primary school included) comes from the Redevelopment Fund of the Federal State of Baden-Wrttemberg (US $5,000,000 = 5.9 %) and from credits raised by the city of Freiburg. All credits have to be repaid through sale of the building plots.

Appendix 3_Detailed Notes Summary, Preliminary Engagement

This section outlines a more detailed summary of the preliminary engagement, including documentation of questions asked and summary of responses.

MECHANISM TYPES

QUESTIONS ASKED

1. Are there any additional mechanisms and levers not covered by the categories?
2. Are there specific opportunities and challenges for the publicly held land as distinct from privately held land?

SUMMARY OF RESPONSES

_ It was highlighted that there is greater opportunity for direct investment into State-owned land with stronger governance and operational controls, compared with private land. Non-planning mechanisms on private land are often more difficult to enforce.

_ Government can afford to be more experimental on the public land and targets can be higher.

_ With EV charging, it will be easier to coordinate EV charging infrastructure through partnerships on the public land, rather than through private sector.

_ Adopting a combination of all mechanisms is the preferred approach for Arden. Planning and non-planning mechanisms combined will be required to achieve the outcomes sought.

_ Any separation requirements between residential and industrial land could provide good opportunities for land allocation for investment in precinct infrastructure.

_ The GBCA referenced Fishermans Bend as an example where there is too greater reliance on planning controls alone to drive outcomes. There is a greater opportunity in Arden given the amount of government owned land.

_ One stakeholder proposed an Eco-Districts Model could be effective, whereby government invites stakeholders to sign up to a vision and a partnership for the public land. For example, utility providers, waste contractors, and potential future landowners or developers. This would be required to be done upstream of any planning controls being established for the public land. Once planning applications are submitted, government would have lost this as a point of leverage over carbon and other outcomes.

_ This process mechanism would enable the 'right' type of developers to be attracted to invest in the precinct, those who sign up to the Vision, allowing the private sector through their innovations to help make the case for zero carbon. It was felt this would create the commitment from the right parties and achieve a balance between the commercial and environmental aspects of government land.

Appendix 3_Detailed Notes Summary, Preliminary Engagement

ENERGY

Stakeholders were informed that the evidence base work is considering a range of opportunities for carbon reduction relating to stationary energy; for example:

- Building thermal performance improvement
- Other building related energy efficiency (lighting, car park ventilation, services etc)
- Fuel switch from gas to electric for all stationary energy
- Building scale PV (roof only) / BIPV integration
- Building scale / precinct scale storage / Demand Response management (value capture)
- Precinct scale generation
- Renewable energy purchase (aggregation/PPA)

QUESTIONS ASKED

3. Are there any specific opportunities or challenges identified across these (with a focus on built form), or any particular sector opportunities / challenges - residential, commercial etc.
4. What direct investments by State or city do you think are critical for reducing carbon related to stationary energy?
5. Which other mechanisms or levers do you consider are going to be most effective in reducing stationary energy?
6. Are there any major stationary energy considerations not on this list, e.g technology solutions which you consider will be financially viable and technically feasible in the short to medium term?
7. Given the density, it will not be possible to generate all the energy required on-site, what models of renewable energy procurement do you consider are most appropriate for Arden?

SUMMARY OF RESPONSES

- In response to this question, State Government is conscious of the need for planners, developers and distribution businesses to liaise with each other to successfully integrate high Distributed Energy Resources (DER) penetration precincts into the grid. DELWP Energy is considering ways to improve collaboration amongst these groups.
- Regulatory gaps currently exist for microgrids to operate particular functions both in the National Electricity Rules and within Victoria's legislative framework, however this is an active policy area within DELWP. The government has provided $10M in funding as part of its Microgrid Demonstration Initiative project. The findings from these projects will feed into DELWP's policy development.
- There is an opportunity to investigate the potential of a micro-grid for Arden. This could be a feasible solution, however, space allocation within the Arden precinct may be a barrier.
- It was suggested that the State Government election commitment in Victoria to ban embedded networks for residential buildings could have an impact on Arden, although exemption processes exist.
- The concept of a power purchase agreement (PPA) for bulk renewable energy was raised, and the potential to reproduce this at a larger scale. This may take the form of a government-facilitated bulk purchase that the private sector can buy into. The notion of consumer protection must be considered in this scenario including 'opting out' and meeting requirements of retail contestability. Embedded networks and micro-grids also raise consumer protection issues (perhaps greater ones)
- The consensus was that bulk purchasing was in general a strong idea, however it might be difficult to find a 'blanket offer' that can suit different types of customers.
- If government is going to be an anchor tenant or landlord (e.g. for public health), this represents a big opportunity for the precinct. There is a unique opportunity for government to locate some services or departments in Arden and leverage the 'shared services' opportunity that exists. Government could effectively take on this initial cost and help de-risk for those who follow.
- Setting up a 'smart precinct' that is reporting and monitoring itself would be beneficial, but a key consideration will be: how to you keep the system sustainable in the long term?
- Owners Cooperative or a Special Purpose Vehicle (SPV) for the whole site could be considered for utilities provision. This could help sustain these initiatives in the long term – to deliver precinct generation and storage, plus residual from renewable energy purchase from a joint PPA. If no one is 'clipping the ticket' on it, it could provide for a more fair and reasonable way to procure renewables. There may be potential to apply this method to waste and recycling as well.
- According to ASBEC, the Building Code Board are currently scoping two options for multi-unit residential buildings:
  + Option 1- 7 Star NatHERS as a minimum by 2022 plus a net zero energy target.
  + Option 2- 7 Star NatHERS as a minimum by 2022 plus a maximum energy allowance target.
- A precinct scale approach would be required to achieve this for apartment buildings, due to the mismatch between roof space available for renewables and energy consumption.
- ASBEC sees limited movement on commercial buildings energy performance regulations in 2022. The next big piece of work at the NCC level in the commercial space will be 2025, given the step change improvements in 2019.
- One stakeholder noted the limited opportunity for on-site generation in Arden, pointing to a need to focus on procurement of offsite renewables. The Property Council were noted as big advocates in this space and supportive of advancing commercial provisions.
- There was a strong suggestion that there must be verification processes in the policy / compliance process both for energy and other emissions sectors. Once the building is developed, maintenance of its performance is critical. One stakeholder recommended a third-party Green Star verification once new buildings are complete.
- According to GBCA, all new buildings will be required to be carbon neutral by 2030 according to its Carbon Positive Pathway, and existing buildings by 2050 (by World Green Building Council definition). This could enable a GBCA target in planning controls to lock in post 2030 carbon neutrality for private land (2025 if the Green Star benchmark is higher).

Appendix 3_Detailed Notes Summary, Preliminary Engagement

RECOMMENDED REFERENCES - ENERGY

The below list is a summary of specific reports and case studies that were recommended to inform the analysis. It includes lessons learnt from previous work in the context of the Arden Structure Plan.

- Clean Energy Council (August 2019), The Distributed Energy Resources Revolution: A Roadmap for Australia's Enormous Rooftop Solar and Battery Potential, https://assets.cleanenergycouncil.org.au/documents/advocacy-initiatives/the-distributed-energy- resources-revolution-paper.pdf
- Australian Renewable Energy Agency (May 2016), Delivering Higher Renewable Penetration in New Land and Housing Developments Through Edge-of-Grid Microgrids, https://arena.gov.au/assets/2015/04/Delivering-higher-renewable-penetration-new-land-housing- developments-microgrids.pdf
- Central Victorian Greenhouse Alliance (July 2017), Future Energy Planning: Improving collaboration between electricity networks, local and State Government planning, http://www.cvga.org.au/uploads/9/8/3/8/9838558/naga-future-energy-plan.pdf
- Eastern Alliance for Greenhouse Action Solar Saver Project: https://eaga.com.au/projects/solar-savers/
- Clean Energy Finance Corporation & Property Council of Australia (2018), Distributed Energy In The Property Sector, https://www.cefc.com.au/media/401973/cefc-distributed-energy-in-the-property-sector.pdf
- COAG Energy Council (July 2019), Trajectory for Low Energy Buildings, http://coagenergycouncil.gov.au/publications/trajectory-low- energy-buildings
- World Green Building Council (September 2019), Bringing Embodied Carbon Upfront: https://www.worldgbc.org/bringing-embodied-carbon-upfront-report-webform
- CRC Low Carbon Living (June 2019), Guide to Low Carbon Precincts, http://builtbetter.org/node/7731
- Green Building Council of Australia (June 2018), A Carbon Positive Roadmap for the Built Environment, Stage 1: Commercial, Institutional and government buildings and fitouts, https://gbca-web.s3.amazonaws.com/media/documents/carbon-positive-roadmap-discussion-paper-fa.pdf

TRANSPORT

Stakeholders were informed that the evidence base work is considering the following for carbon reduction relating to transport:

- No or minimal private car parking within precinct
- PT and Active transport delivery
- Accelerated EV transition - precinct charging station(s), electric car share, prioritised car parking, building level charging infrastructure

QUESTIONS ASKED

8. Are there any specific opportunities or challenges identified across these? No private car parking for example?
9. What direct investments by State or city do you think are critical for reducing carbon related to transport - what critical infrastructure is required to make active transport attractive?
10. Which other mechanisms or levers do you consider are going to be most effective in reducing carbon related to transport?
11. Are there any major transport considerations not on this list, e.g technology solutions which you consider will be financially viable and technically feasible in the short to medium term?

SUMMARY OF RESPONSES

- There was a consistent message from multiple stakeholders that no firm commitment beyond the train station has been made with regards to transport for Arden. The Department of Transport (DoT) advised that limited studies have been completed around tram, car parking scenarios, electric vehicles and train station surrounds analysis.
- DoT advised there is not a 100% commitment to the tram and no timeline for a decision to be made.
- DoT are working on car parking requirements, with analysis still in its preliminary stages.
- DoT estimated 30% of vehicles by 2030 will be electric. The demand is increasing, and has the potential to become popular rapidly. This could place a very high demand on the electricity grid to support charging. The Arden precinct therefore must consider electricity supply to support charging vehicles, and may need to include this in on-street parking. Currently there are no standards in Australia, with both California and New Zealand providing examples of EV standards.
- A precinct approach to EVs will be necessary, with shared EV charging and battery facilities. Commercial operators will end up providing this, but potentially through government partnerships.
- At a city scale, Government doesn't yet understand how EVs will be accommodated for in our current road pricing structures at scale. A proper EV regulatory approach has not yet been addressed, so Arden must be flexible. Everyone agrees EVs are coming...!
- Safe cycling paths and secure bicycle parking are essential components to this transport master plan. Whilst EV transition will transition fuels to potentially lower carbon, active transport permanently removes any carbon from the trip.
- DoT advised that the VPA are currently looking at opportunities to increase connection to Moonee Ponds Creek.
- De-bundling residential and commercial space from car parking and reducing car parking requirements is a positive option to consider. Any significant policy changes implemented here would need to be supported by an increase in carshare services and adequate bike facilities. A stronger understanding beyond baseline of end of trip facilities provisions is required.
- CoM currently allow reductions in car parking facilities with significant bicycle and end of trip facilities.
- Any suggestions to remove car parking must have a very strong evidence base and answer how you would facilitate people to reduce car use.

WASTE

Stakeholders were informed that the evidence base work is considering the following for carbon reduction relating to waste:

_ Organics collection (with planning controls and ongoing governance)

_ Waste hubs + education

_ Wastewater: Water authorities' carbon neutrality commitment (Melbourne water, City West Water)

QUESTIONS ASKED

12. Are there any specific opportunities or challenges identified across these?
13. What direct investments by State or city do you think are critical for reducing carbon related to waste?
14. Which other mechanisms or levers do you consider are going to be most effective in reducing carbon related to waste?
15. Are there any major waste considerations not on this list, e.g. technology solutions which you consider will be financially viable and technically feasible in the short to medium term?

SUMMARY OF RESPONSES

_ There appears to be government appetite to use Arden as an innovative precinct that looks unlike the other urban renewal areas. Arden should be looking to achieve higher targets and waste mechanisms with a circular economy.

_ A waste resource recovery hub is relevant to Arden with nearby processing stations that commercial operations can 'tap into'. Particular reference was made to the state-wide Waste Resource Recovery Infrastructure Plan. SV were particularly supportive of this concept.

_ It was noted that Banyule City Council provide a good example of waste practices within their Council area.

_ Buffer distances to any waste facility need be considered. There is a need to consider where waste hubs are located in relation to residential developments. Separation requirements for industrial and commercial are likely to work better than residential (referring to the EPA's buffer requirements).

_ SV has two funding options for waste investment:
+ Resource Recovery Infrastructure Fund (RRIF) - https://www.sustainability.vic.gov.au/Grants-and-funding/Resource- recovery-infrastructure-fund. SV will provide dollar or dollar for recycling infrastructure in the state.
+ Research, Development and Demonstration Grant - https://www.sustainability.vic.gov.au/Grants-and-funding/Research-Development-and-Demonstration-grants. This program supports research, development and demonstration projects that can increase the quantity of recycled products being sold in Victoria.

_ The option of processing waste through bio-digestors to capture methane that can then be used for other purposes was raised, instead of collecting organics needing to go to a separate processing facility.

_ Arden could investigate using the sewer to remove the residual waste, this would mean the emissions associated would then be incorporated into Melbourne Water's carbon inventory.

_ The consideration around the practicalities of waste collection and traffic congestion must be considered. Once the built form is designed and space is allocated, there is limited room to manoeuvre in terms of waste and recycling.

_ Planning controls should control waste requirements in new builds. Planning is the most effective lever for commercial developers. There is motivation to obtain a permit and therefore applicants are incentivised to meet planning policies. For existing buildings, efforts made during design and construct are pursued throughout the lifecycle of building.

_ Buildings must have a considered waste management plan. This plan should indicate what the specific role of the building manager or owner's corporation manager is in facilitating and managing the waste plan. It should also consider what kind of ongoing specialised maintenance must be provided throughout the life of the building.

_ Currently it seems the planning scheme does not provide this level of detail or consideration early in the planning process.

_ There could be consideration for SV or another entity to have an ongoing waste management oversight role.

_ Planning should consider how public space areas can be designed to encourage waste recycling.

_ It was suggested that residents should be encouraged to take more ownership of the waste that is produced in their building, but this required significant education and potentially incentives. For example, worm farms, composting. Refer to: Better Practice Guide for waste management in multi-unit developments (link in resources section above).

_ Consideration of upfront space allocation for waste in any new builds and the ability to repurpose space.

_ Organics can be viable products for agricultural land. There are less waste processing issues, planning and operational arrangements. Waste operators including Councils should move towards removing organic waste from residual waste in residential and commercial buildings.

_ The focus of the studies listed below is on organics waste & carbon reduction. SV advised they have created an 'evidence base' so the VPA can afford to be ambitious with their targets for the Arden Precinct.

RECOMMENDED REFERENCES - WASTE

The below list is a summary of specific reports and case studies that were recommended to inform the waste component of the analysis.

- Sustainability Victoria (2018), Waste Management and Recycling in Multi-Unit Developments: Better Practice Guide: https:// s3.ap- southeast-2.amazonaws.com/hdp.au.prod.app.vic-engage.files/2015/4326/1480/Better_Practice_Guide_for_Waste_Management_and_Recycling_in_Multi-unit_Developments_-_26.11.18.pdf
- Sustainability Victoria (2018), State-Wide Waste and Resource Recovery Infrastructure Plan, Chapter 3: Integrated Land Use Planning & Hubs, https://www.sustainability.vic.gov.au/About-us/What-we-do/Strategy-and-planning/Statewide-Waste-and-Resource-Recovery-Infrastructure-Plan
- Sustainable Built Environment National Research Centre (November 2018), A National Economic Approach to Improved Management of Construction and Demolition Waste: https://sbenrc.com.au/research-programs/1-65/

BUILDING SCALE ADAPTATION MEASURES

QUESTIONS ASKED

16. What do you consider to be the most important building scale adaptation measures to be addressed by our work, i.e. they won't occur if left to the market and other existing policy / legislation?
17. Which mechanisms or levers do you consider is going to be most effective in promoting these outcomes?

SUMMARY OF RESPONSES

- Most stakeholders considered that connection to precinct infrastructure was critical.
- Due to the density, there is greater opportunity in Arden to improve building thermal performance, something that can be readily improved on.
- Building in space for smart infrastructure and batteries would be beneficial to future proof buildings.
- There is a need to consider what Green Star is doing in the future, as frameworks are currently undergoing changes, due mid next year.
- Green Star New Buildings is now out available in public domain. A revised and more robust version will come out in December 2019, there will be 10 'rules' that a building must achieve in order to receive any Green Star rating. It will remain a points-based system.
- It will be critical that in considering non-carbon related building scale measures that this list is considered, in order to understand what separate prescriptive planning controls may be required if a Green Star pathway is adopted as a planning control.
- There is an opportunity for the Arden Precinct to develop a 'pilot project' for Green Star Communities.

Appendix 4_Analysis of Clause 22.19

An analysis was undertaken in relation to the existing Clause 22.19 of the City of Melbourne Planning Scheme to understand the need for planning controls to be developed for Arden.

The assessment has been undertaken for office and residential only as they are likely to cover the vast majority of GFA in Arden.

City of Melbourne is currently reviewing this policy.

BUILDING TYPE	CLAUSE 22.19 STANDARD	ASSESSMENT
OFFICE	5 Star Greenstar (above 5000m2)	Insufficient for Arden as the Vision directs the area to achieve the highest attainable rating. Additionally a 6 star target locks in zero carbon buildings at 2020 rather than 2026
	5 star NABERS (Energy)	Insufficient for the Arden Central land due to public land ownership and improved development siting
	Greenstar Water Credit (3 points)	NABERS water now exists and is a more appropriate standard
	A Waste Management Plan prepared in accordance with the current version of the City of Melbourne's Guidelines for Waste Management Plans.	Insufficient for Arden as organics separation is not mandatory under the guidelines and is essential for zero carbon from waste
ACCOMMODATION	5 Star Greenstar (above 5000m2)	Recommended for Arden due to the lower market acceptance of 6 star Green Star for residential and the predominant commercial focus (ie minimal impact on zero carbon outcome)
	N/A (sufficiently covered by the Building Code of Australia)	Insufficient for Arden as highly energy efficient residential buildings are not required by the building code (now National Construction Code). Thermal performance is locked in for the building lifetime so is critical
	Greenstar Water Credit (1 point)	NABERS water now exists and is a more appropriate standard
	A Waste Management Plan prepared in accordance with the current version of the City of Melbourne's Guidelines for Waste Management Plans.	Insufficient for Arden as organics separation is not mandatory under the guidelines and is essential for zero carbon from waste

Appendix 5_Setting the boundary

This section provides the key assumptions that have been used to set the boundary for the emissions inventory for AURA to 2050.

This section serves to complement the Excel model developed for this engagement. The baseline model is transparent and can be updated as the planning and development of the AURA evolves.

BOUNDARIES FOR THE PRECINCT

Arden as a precinct

Arden will be an intense knowledge-innovation precinct that supports cross-disciplinary partnerships. It was act as a new employment hub which will be pivotal to the growth of Victoria's knowledge economy. It will have rapid rail connections to the Parkville National Employment and Innovation Cluster, the Central Business District and Melbourne's western suburbs. It will be developed to accommodate more than 35,100 jobs and 12,500 residents by 2051.

The three key sub-precincts within the precinct are:

_ Arden North: This area will comprise of new mixed-use commercial and residential development will combine with civic and community uses, drainage functions and open spaces. It has an area of approximately 22 hectares.

_ Arden Central: This area will feature a mix of research, commercial, educational, recreational, retail, cultural and residential land uses, with the greatest intensity of activity around the new North Melbourne underground station. It has an area of approximately 16 hectares.

_ Laurens Street: It has significant potential as a transitional zone for smaller scale residential and commercial development. The existing industries are likely to remain, and there are opportunities to expand North Melbourne's vibrant creative start-up sector, including innovative co-working spaces. It has an area of approximately 12 hectares.

ALIGNMENT WITH EXISTING STANDARDS

The two key standards used for defining Arden's emissions reporting boundaries footprint are:

_ The Climate Active Carbon Neutral Standard for Precincts (formerly the National Carbon Offset Standard (NCOS) for Precincts)[1]. This is used specifically to define the zero carbon scenario of our modelling, and this standard therefore, underpins the carbon inventory for Arden. Figure 9 presents the high-level overview of the process of becoming zero carbon (or carbon neutral) for a precinct.

_ The GHG Protocol for Community-Scale Emissions (GPC)[2] that aligns with City of Melbourne's net zero carbon community calculations.

The reference to these standards, in particular the NCOS for precincts, does not mean that there is any commitment for Arden to become certified carbon neutral under NCOS; simply that there is a desire to align with a scheme that:

_ is robust

_ is comprehensive

_ encourages emission reductions and continuous improvements before any offsets are considered

_ has been used as a reference for other projects (e.g. Barangaroo South in Sydney)

_ is consistent with international best practices guidelines

_ aligns with industry standards and trends, (Green Star and NABERS in particular).

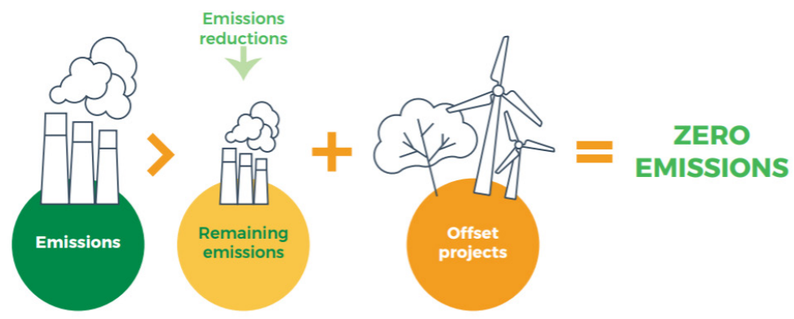


FIGURE 1: THE PROCESS OF CARBON NEUTRALITY FOR A PRECINCT

1. environment.gov.au/system/files/resources/54577129-0a84-42f7-8eeb-9c70c31e5711/files/j-climate-active-carbon-neutral-standard-precincts.pdf
2. ghgprotocol.org/sites/default/files/standards/GHGP_GPC_0.pdf

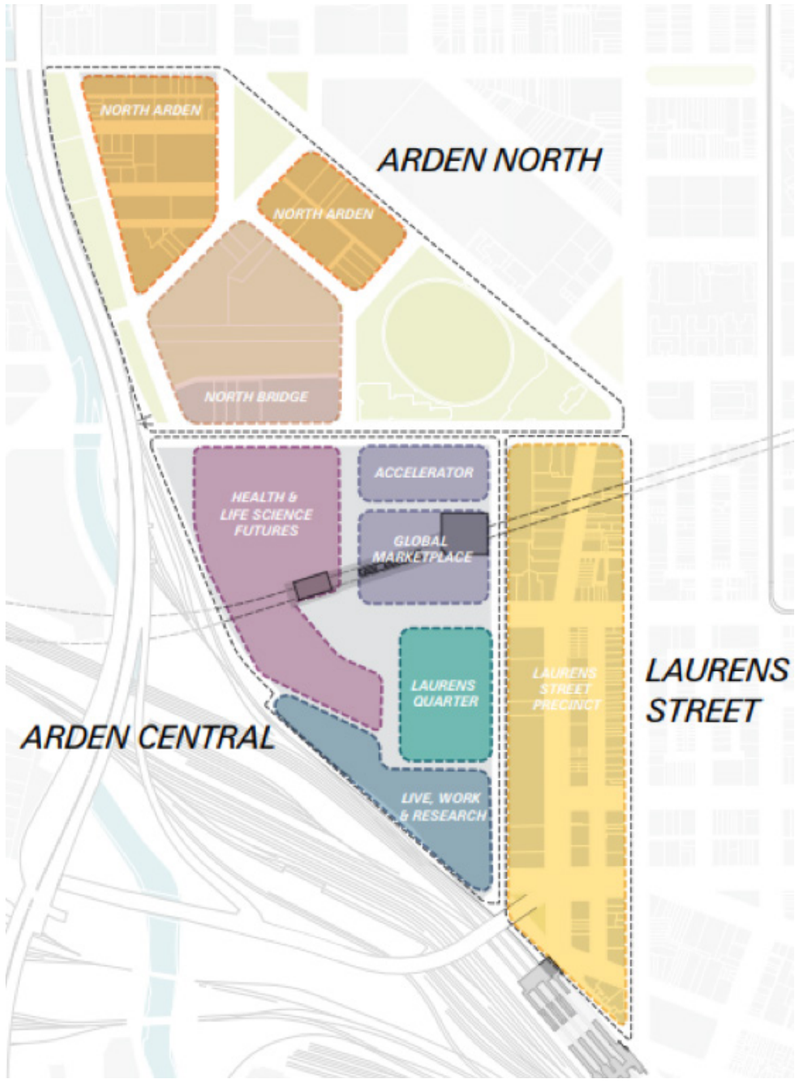


FIGURE 2: ARDEN SUB-PRECINCTS

BOUNDARY SETTING

The geographic boundary of the precinct is the main criterion for defining the emissions boundary. The geographic boundary should be consistent with the boundary of the precinct in planning documents and should also align with community expectations of the precinct's border. Figure 10 shows where the geographic boundaries for the three sub-precincts located in Arden.

Emissions from the AURA are those generated from the day-to-day running of the precinct; for example, stationary energy (lighting, heating and cooling, occupant energy use, plant equipment, other infrastructure and shared services), transport (private vehicles, public transport, and freight), as well as upstream and downstream emissions from resource consumption and waste generation (waste, water and wastewater).

Defining the emissions boundary means deciding on inclusions and exclusions of these emissions sources. All energy use and emissions from the following sources used in the day-to-day running of the precinct are considered in the BAU emissions forecast for Arden:

_ Residential buildings (both medium and high multi-storey density)
_ Commercial buildings including retail, hospitality, office, and education buildings and public infrastructure
_ A hospital (if delivered), to be commissioned in (2025) (note: this may not be approved for the final precinct plan)
_ Transport: private, public and freight
_ Waste management
_ Water and wastewater

Below is a summary of the key inclusion and exclusions from the Arden emissions inventory:

Stationary energy: Emissions from the operation of the precinct are included in the footprint and include building and infrastructure-related emissions. Emissions associated with construction and demolition activities were excluded from the inventory. While efforts should be made to reduce lifecycle emissions associated with building materials and emissions from construction machineries and other activities, accounting for such activities goes beyond the scope of the present piece of work.

Buildings-related emissions include base building operations and energy consumption by occupants (residents and companies) for both residential and commercial buildings from lighting, heating and cooling, occupant energy use, plant equipment, and shared services. Infrastructure emissions includes streetlights and public buildings (such as the hospital (if delivered) and car parking).

Renewable energy generated in the district is deducted from the total energy use, regardless of the fact that 100% of renewable energy generated may not be used within the district due to oversupply at specific times of the day.

Fuel used by co and tri-generation systems would be considered within the inventory boundary, however none is expected to be developed at this stage.

Stationary energy emissions also include upstream emissions associated with gas use from extraction, processing, and transport and upstream emissions associated with electricity use from transmission and distribution losses.

Transport: The Induced activity approach was used from the Global Protocol for Community-scale Greenhouse Gas Emission Inventories (the GPC) to estimate transport emissions from AURA. This is the recommended approach by the GPC because it is more suited to local policy making.

As such, private and public transport emissions from resident and worker travel are included in the inventory, along with freight emissions. Emissions from other induced activities such as shopping and education trips by non-residents were excluded, given its estimated low materiality. Note due to limited information available, several high-level assumptions were used to estimate emissions from the transport sector. Transport emissions comprise:

- Resident and worker trips:
  - 100% of intra-boundary trips by private vehicle
  - 50% of cross-boundary trips
- Freight - 50% of the freight traffic resulting from the commercial activities within the precinct, thereby assuming that all freight trips are cross-boundary trips

Note that 50% of cross-boundary trips are accounted for because the other 50% of the trip should be accounted for in the precinct/area where the trip originated/finished, to align with the GPC and NCOS. Upstream emissions from the extraction, processing and transport of fuels were also accounted for in the transport inventory.

Waste and wastewater

Solid waste emissions for waste managed on-site or off-site are included. Note however, that waste-to-energy systems located in Arden have not been considered for this analysis, as the precinct is too small and densely populated to support this sort of system.

Emissions associated with water and wastewater treatment are also included. Importantly, Melbourne Water has committed to reduce its carbon emissions to net zero by 2030[3]. Melbourne Water supplies City West Water which is the water retailer for Arden.

Exclusions from the footprint: The following sources of emissions were excluded from the inventory:

- Embodied energy: We understand that, for Arden, the focus is on energy and carbon emission reductions in operation, and as such, carbon emissions embodied in construction materials and energy used in construction have not been included in the current scope of work. However, these emissions are not insignificant. Leaders, such as Barangaroo South, have set targets for reduced embodied carbon for the construction of the built environment in the precinct (-20% compared to standard construction). Embodied carbon is often considered in built environment planning tools concerned with the minimisation of buildings and precincts' carbon footprint, but most of the time in principle or at a high level.
- Residents' consumption (e.g. food, clothing, etc.)
- Consumables, services and products used by companies to carry out their economic activities

3. melbournewater.com.au/about-us/towards-net-zero-carbon-emissions

Appendix 6_Emissions Projections to 2050

Emissions were estimated in 5-yearly intervals from 2020 to 2050 based on three key inputs:

- **The rate of development of the precinct**
- **Changes in consumption and energy use – associated with planning requirements and infrastructure demands**
- **Changes to emissions factors.**

RATE OF DEVELOPMENT

To enable the model to be easily updated (and in particular, scaled up and down), it has been built in such a way that the number of workers and the number of residents drive most components of the footprint. The only components that are fixed are the public lighting infrastructure, as the roads and hence the streetlights are fixed infrastructure largely independent of the density of the precincts.

The rate of development of the precinct is therefore a key assumption that will have a bearing not only on the overall footprint of the precinct in 2050, as emissions are "locked in" when buildings are approved and built. Note that when a minimum rating is set for a building, it is applied to all buildings in the 5-years prior to the year listed.

The rate of development of Arden has been modelled in 5-yearly time intervals from 2020 to 2050, based on:

- A linear growth rate of residents and worker numbers to 2050 based on information provided by the City of Melbourne(see Table 1).
- A linear growth rate in gross floor area (GFA) based on total GFA presented by sub-precinct in the "Arden – Indicative Yield" document provided by VPA, and then split further using the detailed percentage of commercial GFA provided in the 2018 Arden Concept Plan (see Table 2). It is important to note that this spatial plan will likely change as further technical work is finalised. In addition, the average floorspace per worker type is provided in Table 3.

TABLE 1 RESIDENTIAL POPULATION AND WORKERS IN ARDEN TO 2050

Population	2020	2025	2030	2035	2040	2045	2050
Arden Central	0	948	1,895	2,843	3,790	4,738	5,685
Arden North	0	1,048	2,097	3,145	4,194	5,242	6,290
Laurens Central	0	504	1,008	1,512	2,016	2,520	3,024
Total	**0**	**2,500**	**5,000**	**7,500**	**10,000**	**12,500**	**15,000**
Workers							
Arden Central	**0**	**4,609**	**9,219**	**13,828**	**18,438**	**23,047**	**27,656**
Life Science jobs	0	2,049	4,097	6,146	8,195	10,243	12,292
Health services jobs	0	683	1,366	2,049	2,732	3,414	4,097
Commercial	0	1,676	3,352	5,028	6,705	8,381	10,057
Retail / hospital)ity	0	78	155	233	310	388	466
Education (tertiary)	0	124	248	372	497	621	745
Education (community)	0	0	0	0	0	0	
Arden North	**0**	**497**	**993**	**1,490**	**1,987**	**2,483**	**2,980**
Life Science jobs	0	0	0	0	0	0	
Health services jobs	0	0	0	0	0	0	
Commercial	0	419	838	1,257	1,676	2,095	2,514
Retail / hospitality	0	16	31	47	62	78	93
Education (tertiary)	0	0	0	0	0	0	
Education (community)	0	62	124	186	248	310	372
Laurens Central	**0**	**561**	**1,121**	**1,682**	**2,242**	**2,803**	**3,364**
Life Science jobs	0	0	0	0	0	0	
Health services jobs	0	0	0	0	0	0	
Commercial	0	510	1,019	1,529	2,039	2,548	3,058
Retail / hospitality	0	51	102	153	204	255	306
Education (tertiary)	0	0	0	0	0	0	
Education (community)	0	0	0	0	0	0	
Total	**0**	**5,667**	**11,333**	**17,000**	**22,667**	**28,333**	**34,000**

TABLE 2 RESIDENTIAL AND COMMERCIAL GFA (M2) ACROSS SUB-PRECINCTS IN ARDEN TO 2050

Arden Central	2020	2025	2030	2035	2040	2045	2050
Residential	0	33,390	66,779	100,169	133,558	166,948	200,338
Life Science jobs	0	44,000	88,000	132,000	176,000	220,000	264,000
Health services jobs	0	88,000	88,000	88,000	88,000	88,000	88,000
Commercial	0	36,000	72,000	108,000	144,000	180,000	216,000
Retail / hospitality	0	3,000	6,000	9,000	12,000	15,000	18,000
Education (tertiary)	0	6,400	12,800	19,200	25,600	32,000	38,400
Education (community)	0	0	0	0	0	0	0
Arden North							
Residential	0	36,942	73,883	110,825	147,767	184,708	221,650
Life Science jobs	0	0	0	0	0	0	0
Health services jobs	0	0	0	0	0	0	0
Commercial	0	9,000	18,000	27,000	36,000	45,000	54,000
Retail / hospitality	0	600	1,200	1,800	2,400	3,000	3,600
Education (tertiary)	0	0	0	0	0	0	0
Education (community)	0	3,200	6,400	9,600	12,800	16,000	19,200
Laurens Street							
Residential	0	17,760	35,521	53,281	71,042	88,802	106,563
Life Science jobs	0	0	0	0	0	0	0
Health services jobs	0	0	0	0	0	0	0
Commercial	0	10,946	21,893	32,839	43,785	54,732	65,678
Retail / hospital)ity	0	1,970	3,941	5,911	7,881	9,852	11,822
Education (tertiary)	0	0	0	0	0	0	0
Education (community)	0	0	0	0	0	0	0

TABLE 3 AVERAGE M2 FLOORSPACE PER WORKER ACROSS VARIOUS COMMERCIAL SEGMENTS

GFA per worker	m2
Life Science jobs / Health services jobs	20
Commercial office	20
Retail / hospitality	36
Education (tertiary and community)	48

OTHER ASSUMPTIONS REGARDING THE RATE OF DEVELOPMENT

The modelling has assumed that:

- There is no large data centre located in the precinct. If one was to be located in the precinct this could have a significant impact on electricity consumption as these types of buildings have high energy use intensities.
- There are no large industrial sites or warehouses located in the precinct.
- There are no redevelopments to the North Melbourne Football club and swimming pool. Although these will be big energy users, these sites are not assumed to be affected by the redevelopment of precinct, and so were not quantified for the modelling. [DN: VPA may require to include, if able to provide plans]

1.4 CHANGES IN CONSUMPTION AND ENERGY USE

Residential buildings

Energy use in residential buildings is driven by two factors in the model:

- Energy use intensity of dwellings, as defined by mandated performance standards from NatHERS ratings
- The proportion of dwellings connected to gas.

Table 4 summarises the population and dwelling extent for multi-unit residential buildings across the three sub-precincts.

TABLE 4 MULTI-UNIT RESIDENTIAL CHARACTERISTICS IN 2050

Sub-precinct	Residents	Dwellings	Total GFA (m2) excluding parking*
Arden Central	5,685	2,100	200,338
Arden North	6,290	2,250	221,650
Laurens Street	3,024	1,950	106,563
Total	15,000	6,300	528,550

Assumptions used to define the baseline emissions, BAU trajectory and pathways are defined below:

Baseline energy consumption

- Average energy use per dwelling for 2020 was assumed to be 73.3 kWh/m2 for the whole building for a 'base case' apartment in Climate Zone 6 (Melbourne) (Cooperative Research Centre for Low Carbon Living, 2018)
- Energy consumption is proportional to the NatHERS rating of the dwelling, and an increase in the NatHERS rating results is a proportionate decrease in total energy use of the dwelling according to the NatHERS rating scale for Melbourne.
- All dwellings in AURA are multi-storey residential buildings
- For dwellings connected to gas, electricity use accounts for 79% of total energy use in the dwelling and gas use accounts for 21% of total energy use in the dwelling. Average gas use per dwelling changes depending on whether the dwelling uses gas for heating, hot water and/or cooking. A dwelling with all three is likely to use much more gas than a dwelling with just gas for cooking. Since the exact proportions of gas use types is unknown for new dwellings, gas use was estimated to comprise 21% of a dwelling's total energy use if the dwelling is connected to gas.

Business-as-usual consumption

- For 2025, the EUI is assumed to improve compared with 2020, in line with the assumptions provided in the 2019 COAG Energy Council Report "Trajectory for Low Energy Buildings"[4] i.e. that post 2022 the NCC will require homes to be built to at least 6.5 and 7.0 NatHERS stars equivalent in NCC climates 6 (Melbourne), 7 and 8. In addition, the COAG trajectory is for these homes to be 'ready' to accommodate on-site renewable energy generation, storage and electric vehicles, so as to be ready to achieve net zero energy and carbon.
- 95% of all new dwellings are connected to the natural gas network and use gas for heating, hot water, and cooking, in the absence of any specific policies to 2050.
- Energy performance of new dwellings increases based on increasing NatHERS standards, as shown in Table 5:
  + Across all sub-precincts, average ratings increase from 6 stars in 2020, to 6.5 stars in 2025 to 2050

4. coagenergycouncil.gov.au/sites/prod.energycouncil/files/publications/documents/Report%20for%20Achieving%20Low%20Energy%20Homes.pdf

Low carbon scenario

_ 95% of all new dwellings are connected to the natural gas network and use gas for heating, hot water, and cooking, in the absence of any specific policies to 2050.

_ Energy performance of new dwellings increases based on increasing NatHERS standards, as shown in Table 5:
+ In Arden Central, average ratings increase from 8 stars in 2020, to 9 stars in 2030 and 10 stars in 2040
+ In Arden North and Laurens Street, average ratings increase from 7 Stars to 2030, to 8 stars to 2040.

Zero Carbon scenario

_ No new dwellings are connected to the natural gas network and use gas for heating, hot water, and cooking, in the absence of any specific policies to 2050.

_ Energy performance of new dwellings increases based on increasing NatHERS standards, as shown in Table 5:
+ In Arden Central, average ratings increase from 8 stars in 2020, to 9 stars in 2030 and 10 stars in 2040
+ In Arden North and Laurens Street, average ratings increase from 7 Stars to 2030, to 8 stars to 2040 and 10 stars to 2050

The assumed NatHERS star rating trajectory for the three scenarios is defined in Table 5

TABLE 5 - MULTI-UNIT RESIDENTIAL BUILDING NATHERS STAR RATINGS

NATHERS Rating	2020	2025	2030	2035	2040	2045	2050
BAU							
Arden Central	6	6.5	6.5	6.5	6.5	6.5	6.5
Arden North	6	6.5	6.5	6.5	6.5	6.5	6.5
Laurens Street	6	6.5	6.5	6.5	6.5	6.5	6.5
LOW-CARBON							
Arden Central	7	8	9	9	9	9	9
Arden North	7	7	8	8	8	8	8
Laurens Street	7	7	8	8	8	8	8
ZERO CARBON							
Arden Central	8	8	9	9	10	10	10
Arden North	7	7	8	8	8	8	10
Laurens Street	7	7	8	8	8	8	10

COMMERCIAL BUILDINGS

Energy use in commercial buildings (retail, offices, education and life sciences) is driven by the following factors in the model:

_ NABERS rating (representing energy use intensity of the building) for office buildings

_ Performance of other building types relative to the National Construction Code

_ The proportion of energy consumed that is electricity and gas.

Assumptions used to define the baseline emissions, BAU trajectory and pathways are defined below:

Baseline energy consumption

_ For retail buildings, average total energy use intensity for buildings meeting the NCC for fast food is 1,937 kWh/m2, for street retail is 109 kWh/m2, and for supermarkets is 937 kWh/m2. 70% of total energy use was assumed to be from electricity.
+ – High energy intensity restaurant / fast food: 1 per 760 residents and adding 30% to account for workers patronage, then assuming 75m2 per outlet
+ – Supermarket: one supermarket located in Arden Central (5158 m2) for 15,000 residents, adding 30% to account for workers patronage.
+ – Street retail / low intensity food retail: This was assumed to equal the difference between the above retail types.

_ For office buildings, average total energy use intensity for buildings meeting 5 stars NABERS is 151.5 kWh/m2. 70% of total energy use is assumed to be from electricity.
+ – For an office building occupied for 51 hours per week, with 6.8 computers per 10 m2

_ For education buildings (tertiary, community and life sciences), average total energy use intensity for buildings meeting the NCC is 287 kWh/m2, with 70% of total energy use assumed to be from electricity.

Business-as-usual consumption

_ 70% of total energy use is electricity and 30% is gas for all commercial building types until 2040, when 100% of energy use from new buildings is electricity.

_ Energy performance of new dwellings increases as shown in Table 6 to Table 8.

Low carbon scenario

_ 70% of total energy use is electricity and 30% is gas for all commercial building types until 2040, when 100% of energy use from new buildings is electricity.

_ Energy performance of new dwellings increases as shown in Table 6 to Table 8.

Zero Carbon scenario

_ 70% of total energy use is electricity and 30% is gas for all commercial building types until 2040, when 100% of energy use from new buildings is electricity.

_ Energy performance of new dwellings increases as shown in Table 6 to Table 8.

TABLE 6. COMMERCIAL OFFICE BUILDING PERFORMANCE RATINGS

NATHERS Rating	2020	2025	2030	2035	2040	2045	2050
BAU							
Arden Central	5 Star	5 Star	5 Star	5 Star	5 Star	5 Star	5 Star
Arden North	5 Star	5 Star	5 Star	5 Star	5 Star	5 Star	5 Star
Laurens Street	5 Star	5 Star	5 Star	5 Star	5 Star	5 Star	5 Star
LOW-CARBON							
Arden Central	6 Star	6 Star	6 Star	6 Star	6 Star	6 Star	6 Star
Arden North	5.5 star	5.5 star	6 Star	6 Star	6 Star	6 Star	6 Star
Laurens Street	5.5 star	5.5 star	6 Star	6 Star	6 Star	6 Star	6 Star
ZERO CARBON							
Arden Central	6 Star	6 Star	6.5 star	6.5 star	7 Star	7 Star	7 Star
Arden North	5.5 star	5.5 star	6 Star	6 Star	6 Star	6 Star	6 Star
Laurens Street	5.5 star	5.5 star	6 Star	6 Star	6 Star	6 Star	6 Star

TABLE 7. COMMERCIAL RETAIL BUILDING PERFORMANCE RATINGS

NATHERS Rating	2020	2025	2030	2035	2040	2045	2050
BAU							
Arden Central	NCC	NCC	NCC	NCC	NCC	NCC	NCC
Arden North	NCC	NCC	NCC	NCC	NCC	NCC	NCC
Laurens Street	NCC	NCC	NCC	NCC	NCC	NCC	NCC
LOW-CARBON							
Arden Central	NCC	NCC -5%	NCC -10%	NCC -15%	NCC -20%	NCC -20%	NCC - 25%
Arden North	NCC	NCC	NCC -5%	NCC -10%	NCC -15%	NCC -20%	NCC -20%
Laurens Street	NCC	NCC	NCC -5%	NCC -10%	NCC -15%	NCC -20%	NCC -20%
ZERO CARBON							
Arden Central	NCC	NCC -5%	NCC -10%	NCC -15%	NCC -20%	NCC -20%	NCC - 25%
Arden North	NCC	NCC	NCC -5%	NCC -10%	NCC -15%	NCC -20%	NCC -20%
Laurens Street	NCC	NCC	NCC -5%	NCC -10%	NCC -15%	NCC -20%	NCC -20%

TABLE 8. COMMERCIAL EDUCATION AND LIFE SCIENCES BUILDING PERFORMANCE RATINGS

NATHERS Rating	2020	2025	2030	2035	2040	2045	2050
BAU							
Arden Central	NCC	NCC	NCC	NCC	NCC	NCC	NCC
Arden North	NCC	NCC	NCC	NCC	NCC	NCC	NCC
Laurens Street	NCC	NCC	NCC	NCC	NCC	NCC	NCC
LOW-CARBON							
Arden Central	NCC	NCC -5%	NCC -10%	NCC -15%	NCC -20%	NCC -20%	NCC - 25%
Arden North	NCC	NCC	NCC -5%	NCC -10%	NCC -15%	NCC -20%	NCC -20%
Laurens Street	NCC	NCC	NCC -5%	NCC -10%	NCC -15%	NCC -20%	NCC -20%
ZERO CARBON							
Arden Central	NCC	NCC -5%	NCC -10%	NCC -15%	NCC -20%	NCC -20%	NCC - 25%
Arden North	NCC	NCC	NCC -5%	NCC -10%	NCC -15%	NCC -20%	NCC -20%
Laurens Street	NCC	NCC	NCC -5%	NCC -10%	NCC -15%	NCC -20%	NCC -20%

STREETLIGHTS

Streetlights were calculated for one light every 24 metres from 8.3 kilometres of the road network in the precinct, resulting in 277 lights. All streetlights are assumed to be 18 W LED. 6 major intersections were also modelled, each with 4 x VLED lights.

HOSPITAL (if delivered) AND HEALTH SERVICE BUILDINGS

Energy use from a proposed hospital (if delivered) was included as an optional item in the emissions model and as such can be toggled ‘on’ or ‘off’. The following key assumptions were used to estimate energy use from the hospital (if delivered):

_ A hospital has an assumed floor area of 88,000 m2

_ Electricity use intensity of the hospital (if delivered) is 150 kWh/m2 for electricity and 250 MJ/m2 for natural gas for a standard electricity/gas energy mix and 190 kWh/m2 for an all-electric hospital (if delivered), based on Point Advisory’s industry sector experience.

_ The hospital (if delivered) will be operational in 2025.

CAR SPACES

Car spaces affect the estimated emissions in the model in two key sectors: (1) stationary energy use from ventilation and (2) private and public transport mode share.

For stationary energy use, the following assumptions were used to estimate emissions from car parks:

_ 80% of parking spaces were mechanically ventilated

_ 75% of car parks are used for commercial purposes, and 25% for residential areas.

_ For residential parking spaces, standard energy intensity of mechanical ventilation is 9.4 kWh/m2 and high efficiency mechanical ventilation is 8 kWh/m2

_ For commercial parking spaces, standard energy intensity of mechanical ventilation is 24.5 kWh/m2 and high efficiency mechanical ventilation is 21 kWh/m2

For transport, mode share was defined for the Low Carbon scenario based on the following assumptions:

_ 25% of car parking is for dwellings and 60% is for workers and 15% is for ‘other’ (schools, shops, etc)

_ An average of 2.2 trips per day is associated with car parking for workers

_ An average of 1.2 trips per day is associated with car parking for residents

The number of car spaces for the precinct is shown in Table 9.

TABLE 9. CAR PARKING SPACES FOR THE PRECINCT OVER TIME

Car space	2020	2025	2030	2035	2040	2045	2050
Arden Central	0	250	500	750	1,000	1,250	1,500
Arden North	0	433	867	1,300	1,733	2,167	2,600
Laurens Street	0	217	433	650	867	1,083	1,300
Total	**0**	**900**	**1,800**	**2,700**	**3,600**	**4,500**	**5,400**

These car parking spaces translate to 0.21 car parks per dwelling, and 0.6 car parks per 100 m2 of commercial floor area.

PRIVATE TRANSPORT

Emissions from private transport are driven by two factors in the model:

_ The mode share of private vehicle use for trips by residents and workers

_ The uptake of electric vehicles, affecting electric vehicle ownership in the precinct by residents and workers

Baseline emission

Several other factors affecting transport emissions were included in the model but left to default values, due to the limited influence the Victorian Government has over these factors:

_ The average fuel efficiency of private vehicles (10.4 l/100km for petrol vehicles and 10.1 l/100km for diesel vehicles)

_ The average improvement over time in vehicle fuel efficiency, assumed to be 0.5 litres per 100 kilometres every 5 years based (loosely) on historical trends).

_ The proportion of petrol, diesel and LPG vehicles in the vehicle fleet

_ Trip behaviour of residents and workers: the number and average distance of trips taken per person per day (VISTA)

+ – Average trip distance by residents = 5.9 km (trips by all trip purposes)

+ – Average trip distance by workers = 8.7 km (journey to work trips only)

+ Assumptions used to define the BAU trajectory and pathways are defined below:

Business-as-usual emissions

_ A scenario of 'no intervention' in encouraging the uptake of electric vehicles, resulting in a low percentage of private vehicles that are electric

_ A private vehicle mode share of 39% for residents, based on the private travel mode share observed in VISTA data for the City of Melbourne from 2014-2016

_ A private vehicle mode share of 66% for workers, based on the private travel mode share observed in VISTA for the inner, middle and outer city and assuming equal proportions of workers from the three zones of Melbourne.

Low carbon scenario emissions

_ A scenario of 'moderate intervention' in encouraging the uptake of electric vehicles, resulting in a moderate percentage of private vehicles that are electric

_ A private vehicle mode share of 15% for residents, based on private transport trip restrictions from reduced access to parking based on the 5,400 car parks available in 2050 (of which 25% are residential)

_ A private vehicle mode share of 10% for workers, based on private transport trip restrictions from reduced access to parking based on the 5,400 car parks available in 2050 (of which 75% are for commercial purposes).

_Zero Carbon scenario emissions

_ A scenario of 'strong intervention' in encouraging the uptake of electric vehicles, resulting in a high percentage of private vehicles that are electric

_ A private vehicle mode share of 10% for residents and workers, in line with the 2018 Arden Vision

The uptake of electric vehicles for the three levels of intervention is shown in Table 10. Examples of interventions for electric vehicles include:

_ Preferential parking and use of transit lanes in and around the precinct

_ Access to recharge stations (including a mix of normal and fast-charging stations)

_ Stamp duty and registration discounts on electric vehicle purchases

TABLE 10. ELECTRIC VEHICLE FLEET PROPORTION BASED ON LEVEL OF INTERVENTION

Level of intervention	2020	2025	2030	2035	2040	2045	2050
None	**0%**	**1%**	**5%**	**14%**	**30%**	**52%**	**75%**
Moderate	1%	4%	14%	32%	55%	78%	94%
Strong	1%	8%	22%	44%	65%	88%	100%

PUBLIC TRANSPORT

Emissions from public transport are driven by two factors in the model:

_ The mode share of public transport for trips by residents and workers

_ The uptake of electric buses servicing the precinct

Baseline emissions

Several other factors affecting public transport emissions were included in the model but left to default values, due to the limited influence the Victorian Government has over these factors:

_ The emissions intensity of the metropolitan train network

_ The emissions intensity of the metropolitan tram network (assumed to be 0 due to the Victorian Government's commitment to run all trams on 100% renewable energy)

_ The average emissions intensity of buses

_ Trip behaviour of residents and workers: the number and average distance of trips taken per person per day

Assumptions used to define the BAU trajectory and pathways are defined below:

Business-as-usual emissions

_ Public transport mode share of 17% for residents and 22% for workers, based on VISTA data and assumptions used to estimate mode share for private travel under Private Transport emissions projections

_ No electric buses are used in the precinct for any trips

_ No change to the emissions intensity of the metropolitan rail network.

_Low carbon scenario emissions

_ Public transport mode share of 41% for residents and 78% for workers, based on VISTA data and assumptions used to estimate mode share for private travel under Private Transport emissions projections, and assuming active transport rates cannot increase above 44% and 12% respectively for residents and workers.

_ 50% of buses servicing the precinct are electric from 2040 and 100% of buses from 2050.

_ No change to the emissions intensity of the metropolitan rail network.

Zero Carbon scenario emissions

_ Public transport mode share of 46% for residents and 78% for workers, based on VISTA data and assumptions used to estimate mode share for private travel under Private Transport emissions projections, and assuming active transport rates cannot increase above 44% and 12% respectively for residents and workers.

_ 50% of buses servicing the precinct are electric from 2030 and 100% of buses from 2040.

_ A carbon neutral train network from 2030.

The uptake of electric vehicles for the three scenarios is summarised in Table 11

TABLE 11. UPTAKE OF ELECTRIC BUSES FOR HTE THREE SCENARIOS

% electric fleet buses	2020	2025	2030	2035	2040	2045	2050
BAU	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**
Low carbon	0%	0%	0%	0%	50%	50%	100%
Zero Carbon	0%	0%	50%	50%	100%	100%	100%

FREIGHT

Emissions from freight are driven by two factors in the model:

_ The proportion of freight vehicles that are electric and/or hydrogen fuelled

_ The presence of a central distributor coordinating deliveries within the precinct

Baseline emissions

Several other factors affecting freight emissions were included in the model but left to default values, due to the limited influence the Victorian Government has over these factors:

_ The average fuel efficiency of light commercial vehicles (LCVs) and trucks

_ The proportion of petrol and diesel freight vehicles

_ Delivery characteristics of businesses in the precinct, including average length and frequency of trips

Assumptions used to define the BAU trajectory and pathways are defined below:

Business-as-usual emissions

_ No centralised distributor

_ No electric or hydrogen vehicles used in the precinct to 2050

Low carbon scenario emissions

_ No centralised distributor

_ 50% of freight vehicles are electric by 2040 and 100% of freight vehicles are electric by 2050

_Zero Carbon scenario emissions

_ Centralised distributor

_ 50% of freight vehicles are electric by 2030 and 100% of freight vehicles are electric by 2040.

TABLE 12. UPTAKE OF ELECTRIC FREIGHT VEHICLES FOR THE THREE SCENARIOS

% Electric	2020	2025	2030	2035	2040	2045	2050
BAU	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**
Low carbon	0%	0%	0%	25%	50%	75%	100%
Zero Carbon	0%	0%	50%	50%	100%	100%	100%

WASTE

Emissions from waste are driven by multiple factors in the model:

_ Average waste generated per resident and per worker, affected by the presence of ongoing waste reduction initiatives such as education of residents, business awareness, and initiatives to reduce packaging by local businesses

_ The presence of a food organics collection service

_ The diversion rate of recyclables in the general waste stream

_ The assumed landfill gas capture rate (assumed to be 50%)

Note emissions from recyclables were excluded from the inventory, as advised by the GPC since recycling actually reduces total life cycle carbon emissions. Emissions from waste transportation were also excluded from the inventory given emissions are immaterial (based on Point Advisory's experience with precinct-scale emissions inventories).

Baseline emissions

To establish baseline waste assumptions, we have aligned our assumptions with the waste generation rates (MSW, C&I) provided in the City of Melbourne's Waste and Resource Recovery Strategy 2030[5] and City of Melbourne's CLUE database for worker population data.

Table 13 provides solid waste generation rates across the residential and commercial sectors. Table 14 provides the emissions factors used for calculating emissions from solid waste across various treatment systems derived mostly from the National Greenhouse Accounts Factors.

TABLE 13. SOLID WASTE GENERATION ASSUMPTIONS

	2020	Source
RESIDENTIAL		
Residential waste generation – Garbage (t/person/yr)	0.177	CoM Waste and Resource Recovery Strategy 2030
Residential waste generation – Recyclables (t/person/yr)	0.060	CoM Waste and Resource Recovery Strategy 2030
COMMERCIAL		
Commercial waste generation – Garbage (t/person/yr)	0.400	Based on total C&I waste generation rates for CoM reported in the CoM Waste and Resource Recovery Strategy 2030, and total population of workers (461,000) that work in CoM every day[6] .
Commercial waste generation – Recyclables (t/person/yr)	0.620	As for waste stream above.

5. melbourne.vic.gov.au/SiteCollectionDocuments/waste-resource-recovery-strategy.pdf
6. melbourne.vic.gov.au/SiteCollectionDocuments/clue-2017-summary-report.pdf

TABLE 14. SOLID WASTE EMISSION FACTORS AND OTHER ASSUMPTIONS

TYPE OF WASTE TREATMENT	VALUE	UNIT
LANDFILL		
Residential (MSW) to landfill	1,400	kg CO2-e/t waste
Commercial (C&I) to landfill	1,200	kg CO2-e/t waste
Capture rate of methane at landfill	50%	%
AFTER SOURCE SEPARATION		
Waste emissions at landfill following source separation (MSW)	900	kg CO2-e/t waste
Waste emissions at landfill following source separation (C&I)	830	kg CO2-e/t waste

Business-as-usual

The business-as-usual scenario assumes that the diversion rates for both recyclables and organics remain fairly constant at current City of Melbourne diversion rates across the period (approximately 40%).

Low carbon scenario emissions

For the low carbon scenario, it was assumed that there is

_ A food organics collection and aerobic composting to remove 80% of food waste from general waste and eliminate emissions from this diverted waste.

_ An increase in recycling waste diversion rate to 90% of total recyclables.

This allows AURA to achieve a 78% waste diversion from landfill (organics plus recycling), thereby significantly reducing waste to landfill.

Zero Carbon scenario emissions

For the zero carbon scenario, it was assumed that there is

_ A food organics collection and aerobic composting to remove 99% of food waste from general waste and eliminate emissions from this diverted waste.

_ An increase in recycling waste diversion rate to 99% of total recyclables.

This allows AURA to achieve a 90% waste diversion from landfill (organics plus recycling) in line with the City of Melbourne's Waste and Resource Recovery Strategy 2030, thereby significantly reducing waste to landfill. This is achieved through operational investments (organics collection service), direct investment in waste hubs and waste education programs.

WATER AND WASTEWATER

Emissions from water and wastewater are primarily driven by the number of people (residents and workers) in the precinct.

Baseline emissions from water and wastewater were calculated using the following assumptions:

_ an emissions factor estimated from City West Water of 1 kg CO2-e/kL water use

_ an average water use of 161 litres per person per day (resident) based on City West Water 2018: Melbourne Water Outlook 2019

_ an average water use of 79 litres per person per day (workers)

Initiatives to reduce emissions from water and wastewater were not considered further in modelling, due to Melbourne Water's commitment to be carbon neutral by 2030, which will essentially mean that post 2030, all emissions from water and wastewater use within the precinct will be zero emissions.

Note that the watering of open spaces was excluded from the model due to its low materiality, based on Point Advisory's previous experience in modelling precinct-level emissions.

Table 15 provides the assumptions used to calculate the emissions factor for water and wastewater for Arden.

7. melbournewater.com.au/media/6126/download

TABLE 15. WATER AND WASTEWATER ASSUMPTIONS

Assumption	Value	Unit	Source
Volume delivered by Melbourne water (L)	**449,000,000,000**	**L**	**Melbourne Water Annual Report 2017-18[7]**
GHG emissions Melbourne Water	453,477	tonnes CO2-e	Melbourne Water Annual Report 2017-18
Potable water full cycle emissions: 2018	0.0010	tonnes CO2-e/ML	Calculation based on total emissions reported by Melbourne water divided by total water delivered. This emissions factor is used for water and wastewater
Potable water full cycle emissions: 2025	0.0005	tonnes CO2-e/ML	Melbourne Water have 50% reduction 2025 target

LOCAL RENEWABLE ENERGY GENERATION

Local renewable energy generation was estimated using the following inputs and assumptions:

_ Total area (precinct – by GIS) = 534,200 m2

_ Total area available for rooftop PV = 229,100 m2 (43% of total area)

_ Overshadowing factor = 25 % of roof space is unsuitable for solar

_ Solar size requirements: 1 kW capacity per 10 m2

_ Rooftop space utilisation for solar = 60 % (assumption accounting for HVAC units, eaves, access, etc that reduces useable roof space)

_ Total solar capacity = 10,310 kW

_ Average generation per kW per day = 3.6 kWh/day (source: solarchoice.net.au/blog/how-much-energy-will-my-solar-cells-produce/)

Using these inputs, the maximum solar generation capacity for the precinct was calculated to be 13,548 MWh. The staging of this solar uptake is shown in Table 16.

TABLE 16. SOLAR PV UPTAKE IN THE PRECINCT PER YEAR

Sector	2020	2025	2030	2035	2040	2045	2050
BAU demand (MWh)	**18**	**36,197**	**60,380**	**84,954**	**110,327**	**136,778**	**164,098**
% solar built	0%	20%	35%	50%	70%	85%	100%
Maximum solar generated (MWh)	-	2,710	4,742	6,774	9,483	11,515	13,548
Solar generated as % of BAU	0%	7%	8%	8%	9%	8%	8%

1.5 Changes to emissions factors

Electricity

Emissions factors for grid electricity change over time as the grid generation mix changes. The rate of "decarbonisation" of the grid over time is unknown and surrounded with high political, and to a lesser extent, technical uncertainty. That said, the following comments can be made about the trends in Victoria's electricity generation mix and the grid intensity factor into the future:

- The generation mix will trend towards a higher penetration of renewables. The forecasted generation mix used for this engagement (see Table 18), assumes that the ambition of the Victorian Renewable Energy target (VRET) is achieved and by 2030, meaning that 50% of Victorian electricity generation is from RE sources. This achievement is aligned with AEMO's ISP generation forecast (neutral scenario) for Victoria. As more renewable electricity comes into the generation mix, the emissions intensity of the grid will come down.
- Victoria is likely to remain a net exporter of electricity (rather than importer), as AEMO expects that the amount of exports from Victoria will only increase over time as new renewable generation is connected[8]. In addition, even if Victoria does need to import electricity from NSW/Tasmania on occasions, this will not put upward pressure on the grid intensity factor as these states have lower grid intensities (0.81 NSW, 0.15 Tasmania compared with 1.02 for VIC).

In order to understand how the achievement of the VRET (50% RE penetration in the grid by 2030) will impact the Victorian grid emissions factor, it was necessary to establish the generation mix and supply currently and how it may change out to 2050.

To account for the inherent uncertainty in forecasting grid emissions factors into the future, the model incorporates three trajectories for Victorian electricity grid emission factors, which can be explored as three separate scenarios (high / medium / low decarbonisation). Note that these should be considered as hypotheses rather than forecasts as many factors will impact

TABLE 17 ELECTRICITY EMISSION FACTORS PROJECTIONS(KG CO2-E/KWH)

Scenario	2018	2020	2025	2030	2035	2040	2045	2050
High emissions, low decarbonisation, where the grid intensity reduces in line with a 25% decrease in the VRET ambition	**1.02** [9]	**0.94**	**0.87**	**0.79**	**0.71**	**0.64**	**0.56**	**0.48**
Medium emissions, moderate decarbonisation, where Victoria achieves the ambition of the VRET i.e. 50% RE penetration in the grid by 2030.	1.02	0.90	0.71	0.60	0.53	0.41	0.30	0.19
Low emissions, high decarbonisation, where the grid intensity reduces in line with a 25% increase in the VRET ambition	1.02	0.83	0.64	0.52	0.40	0.27	0.15	0.03
Flat (for reference)	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02

8. aemo.com.au/-/media/Files/Electricity/NEM/Planning_and_Forecasting/VAPR/2019/Victorian-Annual-Planning-Report-2019.pdf
9. Latest NGA estimate

TABLE 18. VICTORIAN ELECTRICITY GENERATION MIX TO 2040 (AEMO NEUTRAL SCENARIO) [10]

Generation technology	2018-19	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2039-40
Biomass	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**439**
Black coal	0	0	0	0	0	0	0	0	0	0	0	0	0
Brown coal	32184	32194	32259	32543	30095	29986	32528	32484	28718	32338	28664	28591	18147
CCGT	482	68	59	61	93	62	53	43	91	27	89	168	0
Distributed storage generation	29	60	91	125	174	202	236	267	298	325	357	384	637
Distributed storage load	-32	-67	-101	-139	-193	-224	-262	-296	-331	-362	-397	-427	-707
Hydro	3363	3372	3363	3363	3363	3372	3363	3363	3363	3372	3363	3363	3372
Peaking (gas & liquids)	207	105	79	74	115	86	74	117	215	64	107	160	1463
Rooftop PV	1970	2286	2604	2913	3212	3505	3799	4056	4312	4582	4803	4997	6381
Utility solar	862	1195	1193	1308	1704	3151	3561	3570	3558	3560	3538	3545	6649
Utility storage generation	14	24	17	24	36	34	39	39	39	40	39	38	2799
Utility storage load	-18	-30	-21	-30	-45	-43	-49	-49	-49	-50	-49	-48	-3499
Wind	5437	9064	11142	12229	13625	15455	16848	16754	17283	16526	17350	17042	19251
Total	44,498	48,271	50,685	52,471	52,179	55,586	60,190	60,348	57,497	60,422	57,864	57,813	54,932

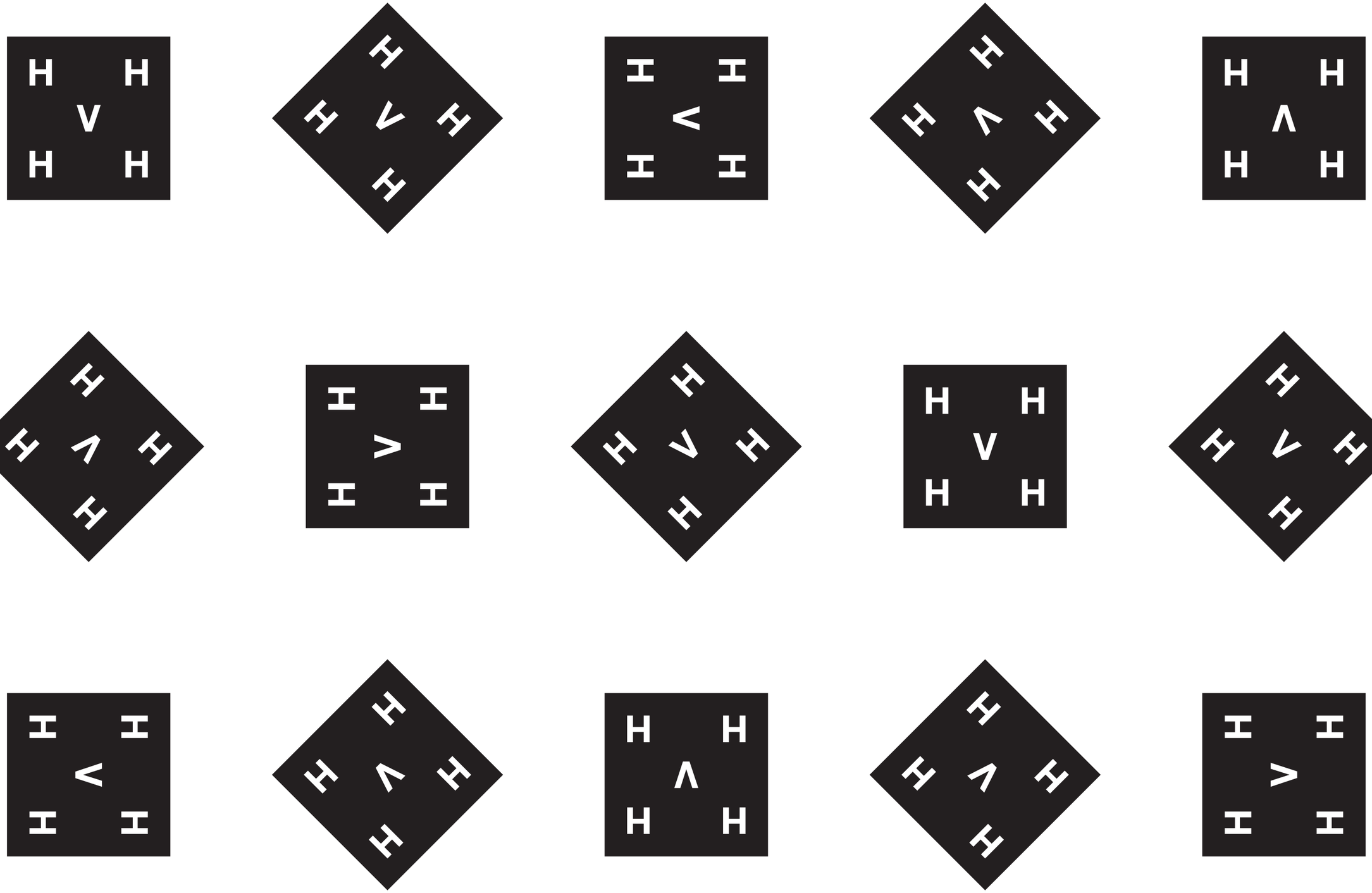
ALL OTHER SOURCES

The emissions factors for gas, diesel and other fossil fuels are assumed to remain the same for the period as these are determined by chemistry and it is assumed that no technologies to capture carbon emissions at the point of combustion could be implemented on a small scale (for example, in vehicles). Fuel efficiency may improve, but the emissions factors for a unit of fuel will remain the same. Table 19 provides the emissions factors used in this analysis, noting that Scope 1 and 3 factors have been combined to include full-cycle fuel emissions.

TABLE 19. FUEL EMISSION FACTORS PROJECTIONS

FUEL	EMISSION FACTOR	UNIT
Distributed gas (Victoria)	**55.43**	**kg CO2-e /GJ**
LPG	1.69	kg CO2-e /GJ
Diesel fuel	2.86	kg CO2-e /GJ

10. aemo.com.au/aemo/apps/visualisations/map.html



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