FINAL REPORT

X

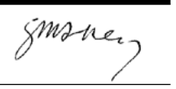
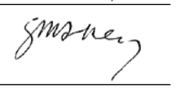
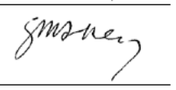
WARRNAMBOOL CITY COUNCIL

ZERO NET CARBON DEVELOPMENT OPPORTUNITIES & FEASIBILITY REPORT

WHO WE ARE

HIP V. HYPE Sustainability provides advice that is commercially grounded, yet ambitious. We pursue exceptional outcomes that are socially, economically and environmentally sustainable and enable action across government, institutions and organisations.

We seek to partner with those who are willing to think strategically to achieve better. We lead, collaborate and support others to deliver impact and build Better Cities and Regions, Better Buildings, and Better Businesses.

REV	DATE	DETAILS	NAME/ POSITION	SIGNATURE
1.0	18.05.20	Report 2 (draft)	Gavin Ashley, Lead	
2.0	22.07.20	Report 2	Gavin Ashley, Lead	
3.0	11.12.20	Final Report	Gavin Ashley, Lead	

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Introduction

HIP V. HYPE Sustainability was engaged by the Warrnambool City Council (WCC) to undertake analysis into low carbon and climate resilient responses that can inform the East of Aberline Precinct Structure Plan.

This report has been developed through research, analysis and targeted engagement. The objective of this report is to highlight and analyse opportunities that are relevant to the location and scale and identify an implementation pathway for these in the Precinct Structure Plan.

Undertaking this review now as part of Precinct Structure Plan development will ensure that sustainability is a core driver for the future planning of the precinct.

ABOUT EAST OF ABERLINE

Located approximately 4 kilometres north east from Warrnambool, the East of Aberline (EoA) site covers an area of 360 hectares and has the potential to deliver 4,000 dwellings for the region.

The site is bounded by pastoral and grazing land to the north and east beyond Wangoom and Horne road, and residential development to the south east of the site along Aberline and Boiling Down road.

While EoA is largely cleared, the presence of ecological assets such as Tozer Reserve, and Russell Creek dissect the site and provide opportunities to integrated biodiversity conservation with residential development to create a climate resilient community.

PURPOSE OF THIS DOCUMENT

This report represents the first stage of the project. It highlights relevant technical and policy context and stakeholder perspectives.

The purpose is to highlight opportunities for low carbon and climate resilience and a number of mechanisms which can be used to drive those opportunities. This project has adopted the category headings in the Sustainable Subdivisions Framework for the analysis - consistent with work recently led by HIP V. HYPE for a range of local governments including Warrnambool. The analysis however does cover both land development and built form opportunities.

The Sustainable Subdivisions Framework (SSF) sets out a series of sustainable built environment opportunities which can be influenced through the development planning and subdivision planning processes. Sustainable subdivisions can be facilitated through a number of planning stages including Precinct Structure Plans, Development Plans, and through provisions already contained within the Planning Scheme. The Framework responds specifically to the subdivision stage, but recognises precinct structure planning as a foundation of good subdivisions and the building level opportunities if mechanisms such as Design Guidelines are adopted to control them.

IMAGE: TOZER RESERVE AND RUSSELL CREEK ARE PROPOSED TO INTERSECT TO FORM A CENTRAL ZIBE FOR BIODIVERSITY AND OPEN SPACE (SOURCE: SPIIRE)

The seven Framework categories include:

_ Site Layout and Liveability
_ Streets and Public Realm
_ Energy
_ Ecology
_ Integrated Water Management (IWM)
_ Urban Heat
_ Circular Economy (Materials and Waste)

These opportunity areas are core to developing a climate responsive precinct and pursued because of their importance to planning at this scale and in this location.

Low Carbon Focus

The primary focus of this work is to highlight opportunities for developing a low carbon precinct, consistent with Green Warrnambool - a key local strategy for WCC.

Support for this action is found in the Victorian Government's commitment under the Climate Change Act 2017 to reduce greenhouse gas emissions for Victoria to zero net emissions by 2050, which requires immediate action to reduce carbon emissions in the built environment.

There is strong support in State policy for embedding sustainability into new Precincts. East of Aberline will be a demonstration project in low carbon precincts for the WCC and has the support of the VPA. The intention is that East of Aberline is a regional exemplar, for others to follow. There is a clear distinction between the opportunity set presented with a Greenfield development from existing suburbs.

To undertake this work, an emissions scope was developed to provide a technical basis for the comparison of low carbon strategies with 'Business as Usual'.

EMISSION SCOPE

To help differentiate between different emissions sources, emissions may be classified into the following scopes:

- Scope 1 emissions include all direct greenhouse gas emissions from sources that are within the precinct's geographic boundary. These could be emissions from fuel use, refrigerants and electricity generation taking place on-site in the precinct
- Scope 2 emissions include offsite emissions from purchased electricity, heat, cooling and steam (i.e. energy produced outside the geographic boundary of the precinct but consumed within the precinct)
- Scope 3 emissions include all indirect emissions that occur as a result of the activities of the precinct, but occur from sources outside the precinct's geographic boundary

An inventory boundary identifies the geographic area, time period, GHG gases and emission sources covered by a GHG inventory.

The boundary is designed to provide an understanding of where the precinct emissions are coming from and where action can be taken to reduce or influence change. In the context of this project, the physical boundary is defined by the East of Aberline site plan opposite (dotted blue line).

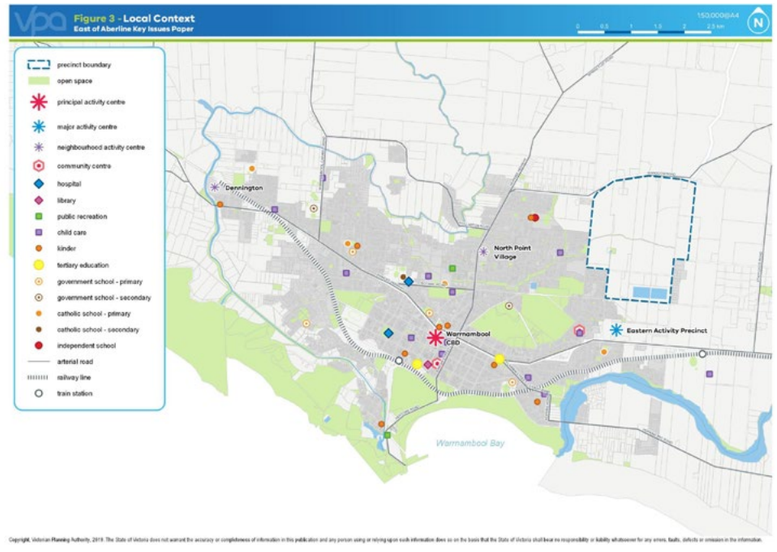


IMAGE: PHYSICAL BOUNDARY OF EAST OF ABERLINE PRECINCT (SOURCE: VPA)

Low Carbon Focus

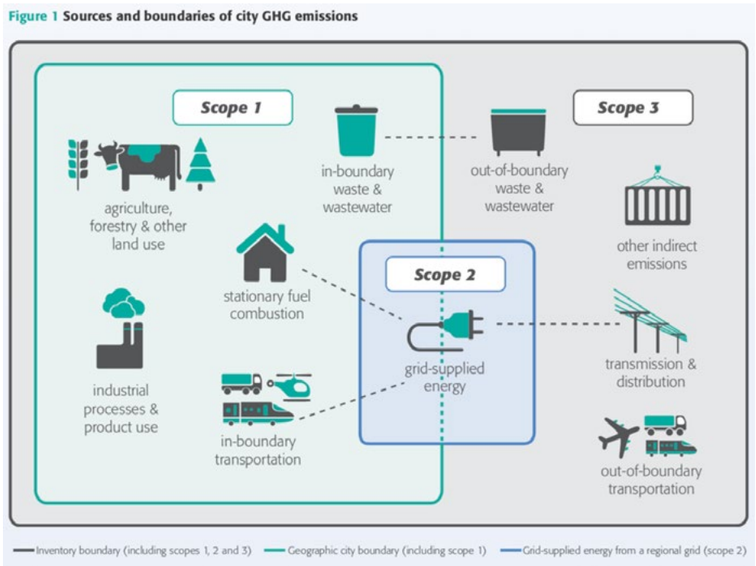


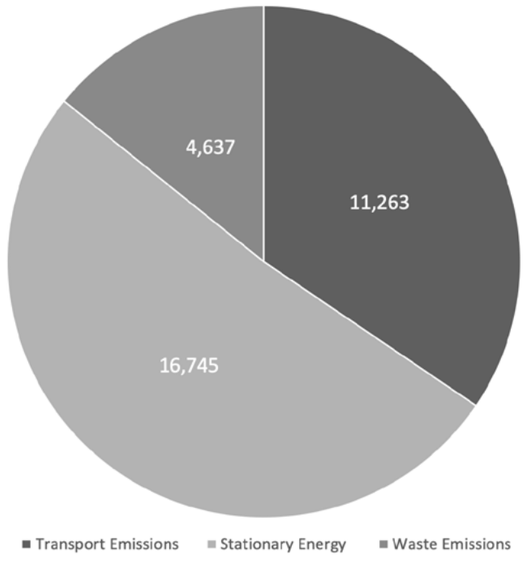
IMAGE: A BREAKDOWN OF THE SOURCES AND BOUNDARIES OF GHG EMISSIONS FOR A PRECINCT OR CITY (SOURCE: GREENHOUSE GAS PROTOCOL) THE GREENHOUSE GAS PROTOCOL (GHGP) PROVIDES ACCOUNTING AND REPORTING STANDARDS, SECTOR GUIDANCE, CALCULATION TOOLS, AND TRAININGS FOR BUSINESS AND GOVERNMENT. IT ESTABLISHES A COMPREHENSIVE, GLOBAL, STANDARDIZED FRAMEWORK FOR MEASURING AND MANAGING EMISSIONS FROM PRIVATE AND PUBLIC SECTOR OPERATIONS, VALUE CHAINS, PRODUCTS, CITIES, AND POLICIES.

EMISSION SCOPE

The emission scope for the East of Aberline precinct will include the following sources. The majority of these are Scope 1 and 2 emissions, however the waste category includes some Scope 3 emissions. Conversations with Wannon Water indicate a potential for on-site 'pre-treatment' of waste water. Whilst this has not been examined within this scope, subject to further discussions this can formally be included within the emissions boundary. The key driver to decisions on what Scope 3 components are included is relevance - asking the question as to what it is within the power of key stakeholders to influence within the geographic boundary of the Precinct Structure Plan.

1. Stationary Energy
   + Residential buildings
   + Commercial and institutional buildings
   + Community infrastructure (e.g. street lighting)
2. Transportation
   + On-road
3. Waste
   + Solid waste disposal

The pie chart below represents the breakdown of emissions sources in a BAU scenario in 2040. Each 'wedge' includes the emissions sources outlined, noting that the emissions profile does not include all Scope 3 emissions.



In order to understand performance against any targets set monitoring and evaluation would be critical to ensure that modelled outcomes reflect those on the ground

The PSP should ensure funding is set aside for a review every five years, with opportunity to modify planning controls if there is a gap between real world performance and that modelled through this piece of work.

This five-year evaluation would:

_ Look at forecast assumptions informing this work against actual outcomes
_ Acknowledge changing technology
_ Collect real data on household and other stationary energy consumption
_ Collect data on transport and waste (combination of audits and survey information)
_ Undertake emissions accounts for the East of Aberline precinct
_ Apply a trajectory to the results to understand whether the 2040 zero / low carbon scenario is likely to be successful with current settings

Opportunity Areas & Delivery Mechanisms

The opportunity areas identified form a robust criteria for targeting best practice and delivering a climate responsive community.

These are defined opposite with reference to the Sustainable Subdivisions Framework noted earlier, but are equally applicable to other ratings tools and frameworks.

A range of delivery mechanisms have been identified which can tangibly impact the opportunity areas. These mechanism types are also highlighted opposite.

OPPORTUNITY AREAS

Site Layout & Liveability

The overall layout of the site will determine the level of connection residents have to local amenity. This entails: the location of community infrastructure, lot diversity, street permeability, integration of natural assets, and opportunities for active commuting and way-finding.

Streets & Public Realm

This opportunity area focuses on street level and public realm amenity: street diversity, extent and quality of pedestrian network, permeable street blocks, street canopy, visible landscape features and rest nodes and crime prevention through environmental design (CPTED).

Energy

Opportunities to reduce operational carbon (at the subdivision phase) include: Improved efficiency of street lighting, lot orientation, procurement of stationary energy from guaranteed renewable sources, and provision of solar PV and battery infrastructure.

Ecology

Development is expected to retain and enhance ecological quality through: projected canopy cover, landscaped parking areas, biodiversity retention and protection, indigenous or climate resilient vegetation, mitigate habitat fragmentation, and waterway conservation.

Integrated Water Management

Creating synergies with the water cycle to reduce the consumption of potable water, provide water security and reduce run-off into local waterways - maintaining consistent flows and ecosystem health. Strategies focus on: Stormwater harvesting and reuse (and treatment), water efficiency, flood management and water sensitive urban design (WSUD).

Urban Heat

Reducing the Urban Heat Island (UHI) effect associated with development entails: access to shelter in public spaces (including canopy cover), irrigated open spaces, and surface treatments which limit solar absorbency.

Circular Economy (Waste & Materials)

Reducing the resources used (in construction and operation), and improving the retention of value through a materials life-cycle through: reducing embodied carbon in materials, increasing recycled content (i.e. in road-base), locally sourcing, use of durable materials, environmental certifications (i.e. FSC timber), and organics collection and processing.

Opportunity Areas & Delivery Mechanisms

DELIVERY MECHANISMS

There are a range of mechanisms which need to be employed to achieve a climate responsive precinct. A combination of these mechanism types will be required rather than any mechanism type on its own. The effectiveness of these mechanisms will depend on the nature of the opportunity area or category being pursued.

The range of mechanisms that the project will consider as part of the East of Aberline project include:

PSP Element

Precinct infrastructure which supports a desired outcome (e.g. energy efficient street lighting infrastructure) will typically require early upfront investment, with the understanding that the benefits will accrue over time. The investment could be made via the Development Contributions Plan (DCP) or Infrastructure Contributions Plan (ICP).

Some PSP elements do not carry a cost, but rely on a specific location to deliver a climate responsive outcome. For example, location of smaller lots near services.

Planning controls

Planning controls on development require or prohibit certain outcomes. They can link to and support other types of mechanisms or stand on their own (e.g. thermal efficiency standard or mandated connection to roofwater harvesting scheme). There may be potential implicit costs for developers in meeting the planning control requirements, which can result in financial savings for residents.

A key overarching mechanism could be a planning requirement in the Precinct Structure Plan that references the Sustainable Subdivisions Framework as a planning tool for assessing individual subdivision applications.

Additionally, Design Guidelines are proposed as recommended tool for mandating dwelling scale outcomes that drive significant emission reductions. Design Guidelines are usually registered on title through a Section 173 agreement. It is recommended that the PSP require the development of Design Guidelines and that Council or the VPA develop these to draft level on the basis of this report in order to create consistency across the precinct. This will require further coordination, however will ensure a unified vision and ‘buy-in’ from the developer group. Further consideration on compliance with the Design Guidelines will be required to ensure that review of dwelling documentation against Design Guidelines is resourced and robust.

Finance, governance and operational models

Non-planning mechanisms can include finance, governance and operational models as well as mandatory and voluntary mechanisms (ongoing performance measurement, operational incentive) that support the desired outcome. This mechanism type also supports process improvements for the PSP process.

Operational investments

Operational investments can be put in place by State or Local government but could be developer funded (e.g. new residents organic waste program). They typically require ongoing funding. An example is a program investment such as waste behaviour change.

Desktop Review

A desktop review of relevant documents which specifically relate to the East of Aberline precinct was undertaken. The table opposite summarises the document and its relevance to this work. Technical or policy information which is drawn from these documents is embedded within each opportunity area.

DOCUMENT	DESCRIPTION	RELEVANCE TO EOA
Terramatrix (2018) Bushfire Development Report for the East of Aberline Precinct Structure Plan Warrnambool - December 2018	The Bushfire Development Report assesses EOA from the perspective of bushfire risk - Identifying the entire site as a 'Bushfire Prone Area' (BPA), and the presence of a Bushfire Management Overlay (BMO) within the site. The report identifies bushfire protection measures required for development to achieve a (low) Bushfire Attack Level of 12.5 (BAL-12.5).	The identified bushfire protection measures include: building setbacks, materiality, vegetation provision (and classification based on intensity), and use of roads and pedestrian corridors as a buffer between development and areas of high bushfire risk. These have potential impacts for site layout and liveability, streets and public realm and ecology. In addition, designing for reduction of bushfire risk can have an impact on thermal performance (energy).
Ecology & Heritage Partners (2018) [Draft Report] Aberline to Horne Growth Corridor, Warrnambool, Victoria: Aboriginal and Historical Heritage Assessment - March 2018	This report summarises the results of the Aboriginal and Historical Heritage Assessment (AHHA) conducted for the EOA site. The assessment includes both a detailed desktop review of relevant literature and previous studies, in addition to a detailed field study of the site itself.	The Aboriginal and Historical Assessment revealed that while there are no significant cultural or historical assets present on the site, tasks associated with widening, or developing adjacent to Russell Creek will likely trigger the requirement for a Cultural Heritage Management Plan. This has potential impact for site layout and liveability and ecology.
Ecology & Heritage Partners (2018) [Final Report] Flora and Fauna Assessment: Aberline to Horne Growth Corridor - January 2018	The Flora & Fauna Report presents a summary of the ecological values present on site - and is based on a detailed desktop review and field surveys of accessible land within the study area (from September 2017). The main objective of the report is to: Map and describe natural assets, identify issues and opportunities, and determine further ecological studies for corridor planning.	The Flora and Fauna Assessment sets the foundation for conservation through locating and classifying ecological assets on site. This has potential impact for site layout and liveability, ecology and integrated water management.
Landtech Consulting (2019) Growling Grass Frog Study: Aberline to Horne Road - Future Urban Growth Area - January 2019	This study summarises the findings from targeted surveys of the Growling Grass Frog - 'Litoria raniformis' - undertaken during November to December 2018. The aim of the surveys was to determine if the Growling Grass Frog was present or is likely to be present in the habitats within or adjacent to the proposed urban growth area.	Despite presenting a negative survey result (i.e. no Growling Grass Frog present on site), the report provides a great summary of potential habitats within the site, and future rehabilitation to restore species numbers. This has potential impact for site layout and liveability and ecology.
Spiire (2018) Aberline to Horne Growth Corridor: Infrastructure / Servicing Assessment - February 2018	The Infrastructure Servicing Assessment outlines the servicing requirements for EOA, identifying the location of existing services infrastructure periphery to the site, and provides commentary on how to extend these utilities into the development. These include: sewerage reticulation, potable water supply, roof water harvesting, electricity supply, gas reticulation, and telecommunications.	The Infrastructure Servicing Assessment provides a snapshot for the viability, and potential stages for development by locating existing service infrastructure and its capacity. Identifying capacity shortfalls enables further design and planning of these systems to create resilience. This has potential impact for all opportunity areas.

Desktop Review

DOCUMENT	DESCRIPTION	RELEVANCE TO EOA
Spiire (2018) Aberline to Horne Growth Corridor Landscape Strategy - September 2018	The Landscape Strategy provides guidance for appropriate development that protects and reinforces scenic amenity, natural values and landscape character within the precinct including: identifying areas for conservation, identifying key views to be retained, identify landscape features and vegetation to be retained, location of pedestrian infrastructure and open space and recommendations regarding their interface with Tozer Reserve and Russell Creek.	The Landscape Strategy synthesises the results from the Flora and Fauna Assessment alongside open space considerations to propose the integration of conservation reserves Tozer and Russell), pocket parks, sport ovals, public open spaces, and pedestrian networks. These have potential impacts for site layout and liveability, streets and public realm, integrated water management and ecology.
WCC & VPA (2019) East of Aberline PSP: Landowner Consultation - April 2019	The Landowner Consultation presentation from the 9th April 2019 provides an overview of the VPA's role in regional subdivision delivery, details the EOA site, key issues and opportunities, alignment with local policy and the need for climate responsive planning.	The presentation includes content from the Key Issues Paper, alongside content regarding climate responsive planning and development and an economic analysis and ROI of a net zero dwelling.
Wannon Water (2019) Start With Water: IWM investigations to inform options for the East of Aberline Precinct Structure Plan - February 2019	This brief presentation back from Wannon Water identifies 5 primary options available to deliver an integrated water solution for EOA. For each option; costs, benefits, benchmarks and assumptions (to achieve delivery) are provided.	This presentation from Wannon Water has introduced 5 primary options for Integrated Water Management, of which will now be investigated in the [pending] Integrated Water Management and Drainage Plan.
WCC & VPA (2019) East of Aberline Precinct Structure Plan: Key Issues Paper - February 2019	The Issues Paper provides context for EOA in terms of demographics and relevant policies and details the sites opportunities and constraints against elements such as: bushfire risk, biodiversity and infrastructure and services - while also presenting the draft principles and outcomes that will underpin the developments success.	The Key Issues Paper largely summarises the content from each of the above consultant reports alongside relevant policy context, local demographics and a draft set of vision and principles for the development.
Austral (2019) Land Capability Assessment for the Aberline to Horne Growth Corridor	The report is a high level, desktop land capability assessment (LCA) for the Aberline to Horne Rd Growth Corridor - to identify the likelihood of potential contamination in the area of relevance to future uses.	Twenty-one locations with a high or medium likelihood of potential contamination were identified in the growth corridor, primarily stockyards with relatively small spatial extents. Other land uses of concern include machinery fabrication and an associated stormwater pond, an informal vehicle wrecking/scrap yard and areas where substantial fill has been deposited. While the majority of these uses were away from waterways, the relatively shallow water table means that there is a likelihood of any contaminants having interacted with groundwater. The report recommends that where sites of high and medium potential for contamination exist, these should be further investigated to assess their suitability for future permitted land uses.

Preliminary Stakeholder Engagement

Engagement with local stakeholders was undertaken with relevance to specific opportunities within the East of Aberline precinct. The table opposite summarises the key stakeholders, their roles and the relevance to this work. Information which is drawn from these stakeholder conversations is embedded within each opportunity area.

ORGANISATION	CONTACT	ROLE	RELEVANCE TO EOA
Wannon Water	Murray Dancey Brad Clingin	Carbon Neutrality Program Manager Project Manager	Wannon Water is the responsible authority for sewer reticulation and potable water supply within the growth area and has been involved in planning for the East of Aberline site since its inception. They are the key stakeholder in relation to integrated water management.
Barwon South West Resource Recovery Group (BSWRRG)	Belinda Bennett	Manager, Government Relations and Engagement	BSWRRG works with 9 councils within the Barwon South West area to find innovative ways to reduce waste and increase recycling opportunities through communications with council Waste Officers and local government forums. BSWRRG has been consulted in relation to circular economy (waste and materials).
Victoria Planning Authority (VPA)	Jeff Tait Peter Murrell	Senior Strategic Planner Sustainability and Liveability Officer	The Victorian Planning Authority (VPA) is assisting Warrnambool City Council in the preparation of the East of Aberline Precinct Structure Plan to guide development. They have a key role in developing the Precinct Structure Plan and were consulted to understand State priorities, staging and status of other technical inputs.
Powercor	Chris McCallum	Network Planner	PowerCor are the local Distribution Network Service Provider (DNSP) for electricity. They will be the key stakeholder in relation to the energy opportunity area. Discussions with the network planning team indicated no obvious barriers to the ambition for low carbon. The discussion highlighted some potential need for export limitation of solar if penetration levels are high or battery uptake is low. The Wannon Water site was highlighted as an ideal location to connect to the 66kV line.
Sustainability Victoria (SV)	Inge Sarunic Andrea Pape	Senior Project Lead, Zero Net Carbon Homes Strategic Coordinator, Barwon South West	Sustainability Victoria's 'Zero Carbon Homes Pilot Program' has enabled a number of volume builders to offer sustainable, net zero dwellings alongside more traditional residential products. While the program is currently criteria-based, there is a tool being developed by SV that would enable a 'whole of house' assessment including energy associated with fixed appliances. The program could potentially be leveraged as a pathway for zero carbon homes within the precinct.

Benchmarking success

There are a number of rating tools available to support East of Aberline's objectives and realise planned outcomes. The table on the following pages highlights potential rating tools and their applicability to the PSP area.

It is not an exhaustive list and performance standards such as Living Building Challenge may be applicable for individual buildings rather than whole precincts.

RATINGS TOOLS AND FRAMEWORK ANALYSIS

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

+ Applicability to the East of Aberline context and ambition
+ 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

The table on the following pages outlines the results of the analysis across the following tools:

+ Green Star (Communities and Green Star for Homes)
+ Sustainable Subdivisions Framework
+ One Planet Living
+ Built Environment Sustainability Scorecard (BESS)
+ EnviroDevelopment

Ratings Tools and Frameworks Analysis

RATINGS TOOL AND FRAMEWORKS ANALYSIS

	DESCRIPTION	APPLICABILITY TO EAST OF ABERLINE	CARBON REDUCTION POTENTIAL	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 new Green Star for Homes rating system assesses individual dwelling performance The ratings systems are currently being significantly updated through the Future Focus program.	The tool is highly applicable to a precinct-scale development, 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 could assist in embedding sustainable change and will support achievement of many of the sustainability mechanisms. The new Green Star for Homes may offer a potential compliance pathway for building related performance. The number of landowners and the lack of Government owned land add complexity to any pursuit of a communities rating.	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.	All tools can be used together under one banner, rather than having to use several different tools and different organisations, however the mos. High level of support available from GBCA and ability to tailor tool to different contexts. 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. The East of Aberline precinct is almost exclusively residential, rather than a self-sufficient community. The new Green Star for Homes tool covers the majority of opportunity areas in this analysis, however the BESS tool may be better recognised in the Victorian market.	23 Green Star - Communities projects currently registered with the GBCA with over 2000 projects certified in Australia under various GBCA rating systems. The Alkimos Beach residential project in Perth is an example. Aligned to the Property Council of Australia and well supported by industry but not as well recognised in regional markets such as Warrnambool.	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

	DESCRIPTION	APPLICABILITY TO EAST OF ABERLINE	CARBON REDUCTION POTENTIAL	FLEXIBILITY	BREADTH OF SUSTAINABILITY OBJECTIVES COVERED	PRECEDENTS/MARKET RECOGNITION	TECHNICAL ROBUSTNESS
Sustainable Subdivision Framework	The Sustainable Subdivisions Framework is a newly developed planning assessment framework aimed at assessing and incorporating sustainability into the subdivision application phase of land development.	Warrnambool City Council was one of a number of regional local governments involved in the framework's development. As such, the East of Aberline project offers an exceptional opportunity to use the framework to influence the design and delivery of highly sustainable greenfield subdivision development. The categories within the Sustainable Subdivisions Framework have been used to communicate the opportunities areas in this report.	While all of the categories aim to influence and deliver a more sustainable urban environment (with downstream emission reduction potential), the energy category in particular aims to integrate renewable energy generation with energy efficiencies to deliver zero emission residential development that is also climate resilient.	The framework was developed alongside collateral material to assist regional planners in identifying and assessing sustainability within subdivision design - however, at such an early stage in the land development process it can also be used to influence design.	The framework is aligned to the existing buildings based 'SDAPP' framework and covers: + Site Layout & Liveability + Streets + Energy + Ecology + IWM + Urban Heat, and + Circular Economy (Materials & Waste) The intention is that the land opportunities are complemented by building scale measures at the next development stage.	The framework was developed in collaboration with 16 regional Victorian councils, CASBE and the VPA.	The Sustainable Subdivisions Framework is underpinned by a technical evaluation of the most impactful opportunities. The trial of the framework commencing September 2020. This 18-month trial includes technical evaluation to further the investment already made.
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.	The unique combination of categories in the OPL Framework promote deep and holistic sustainability outcomes in design and operation. It is suitable for smaller-scale subdivisions, but given lack of absolute metrics may be most useful to complement another rating or verification system such as GreenStar.	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"	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. The Framework may struggle to deal with the complexity of a 20-year timeframe and approximately 15 landowners.	Globally leading framework in terms of breadth of sustainability categories covered, integrating building and construction with life-style choices, public health, transit options, etc. Reasonable alignment with opportunities, although would require alignment with several other disciplines including economics and social considerations.	19 live One Planet Communities around the world, including White Gum Valley in Fremantle, WA. Relatively unknown in developments of this type, especially when applied to multiple landowners in regional areas.	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.

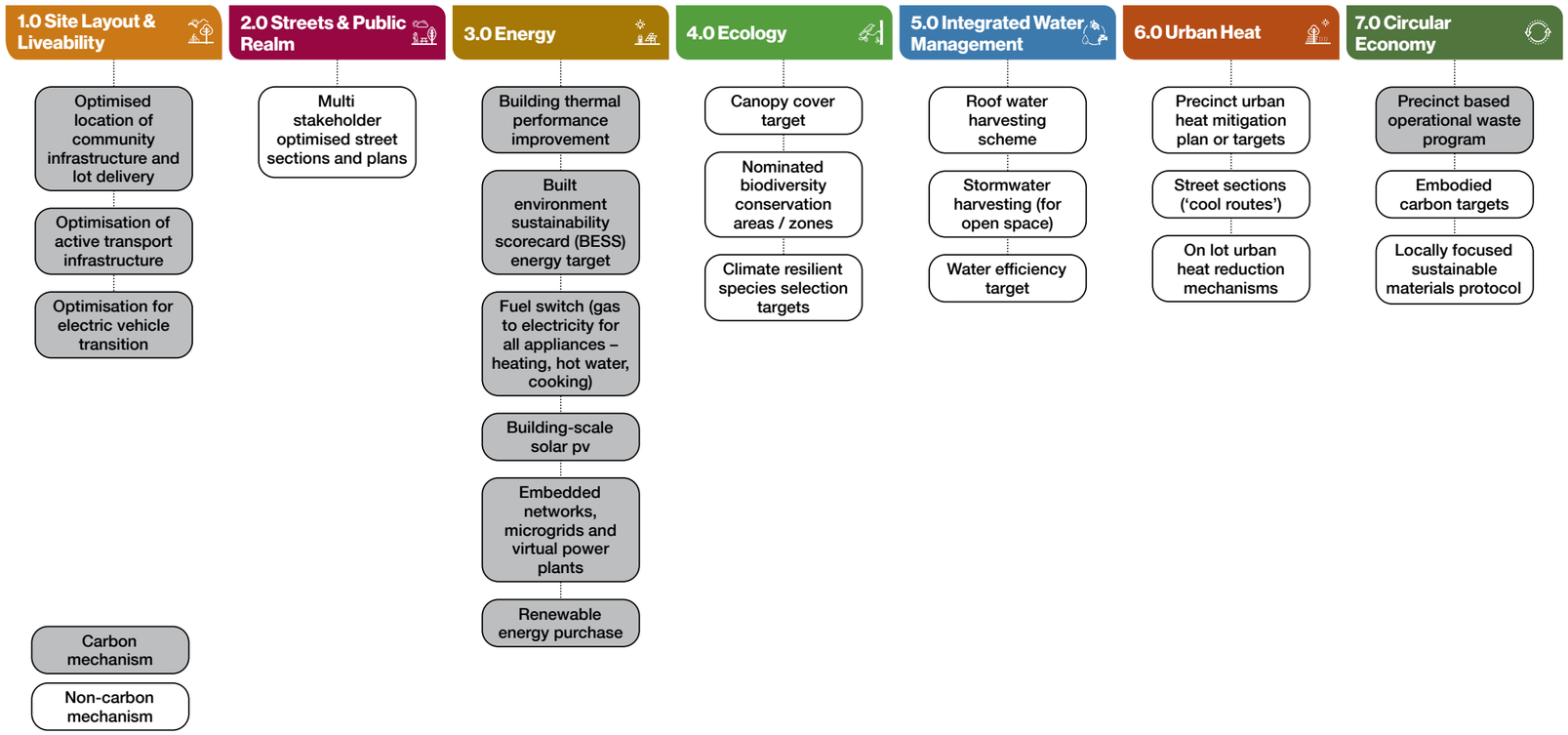
Ratings Tools and Frameworks Analysis

	DESCRIPTION	APPLICABILITY TO EAST OF ABERLINE	CARBON REDUCTION POTENTIAL	FLEXIBILITY	BREADTH OF SUSTAINABILITY OBJECTIVES COVERED	PRECEDENTS/MARKET RECOGNITION	TECHNICAL ROBUSTNESS
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 requirements of the East of Aberline PSP. Could be effective in benchmarking building design compliance with Design Guidelines.	Contributes to carbon reduction, through energy, waste and transport categories, however there are no explicit targets or benchmarks for carbon reduction.	Dynamic and flexible tool with effort made to be "location" and size neutral. 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 environmental sustainability only (not social and economic), and only at building scale. The tool has limited depth in relation to ecology and urban heat and some circular economy aspects.	Used in more than 20 Victorian councils to assess individual developments. It is the recommended tool under SDAPP. It has strong recognition in Victoria.	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.
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.	Traditionally, EnviroDevelopment has focused on certification of greenfield communities. It is focused on objectives and lacks a strong verification process however may be appropriate for the East of Aberline context depending on appetite/ interest from development partners. Most likely to be effective when developer led in relation to one or more parcels rather than whole of development.	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.	Accreditation is available for individual categories which provides flexibility, but undermines the need for a comprehensive approach and can encourage trade-offs.	Focused on certification of greenfield communities with 'leaves' available for meeting performance benchmarks in six categories. Most environmental criteria are covered, however an absence of management and indoor environmental quality.	High level of industry recognition, particularly for masterplanned new suburbs in outer growth areas.	Supported technically by significant industry support in application to greenfield developments. Technical robustness is undermined by a lack of quantifiable metrics and clear standards.

Mechanism overview

This section of the report outlines the mechanisms explored to deliver on the objectives for the East of Aberline precinct. The graphic on the right outlines the relationship of the mechanism to the specific carbon impact for the precinct, noting that all two of the circular economy mechanisms contribute to embodied rather than operational carbon reduction and therefore are not reflected in the carbon modelling for the precinct.

These mechanisms are discussed in turn on the following pages.



Site Layout & Liveability

The policy, technical and stakeholder context for site layout and liveability is outlined opposite.

In addition to ensuring appropriate lot orientation to maximise solar access, the Precinct Structure Plan will need to consider appropriate locations for a potential retail convenience centre and the likely provision of a primary school which can be accessible to residents without a private vehicle. It will make sense for any increases in residential density to locate in the western portion of the site where access to town and other destinations such as North Point Village is improved.

While not directly linked with carbon reduction - the principles of Healthy Active by Design (HAbD) should also be considered in the formation of the PSP. HAbD calls for a thoughtful approach to the delivery of public open space, community facilities and movement networks to facilitate healthy environmental and behavioural changes.

LOCAL POLICY CONTEXT

Both Warrnambool 2040 and Green Warrnambool promote the retention and integration of established vegetation and prioritise investment in public transport, walking and cycling. Goal 7 focuses on 'encouraging and prioritising sustainable transport'. In particular, by 2026:

- All daily destinations (work, school, shopping, recreation, health services) are accessible within 15 minutes using active/sustainable travel modes.
- Principle Pedestrian and Principle Cycling Network Plans (including off road trails) have been developed and recommendations are being implemented to improve sustainable transport infrastructure.
- More residential properties are within 400m of public transport than in 2017.
- The proportion of residents walking, cycling or taking public transport to school and work has significantly increased (doubled) since 2017.
- Warrnambool has developed a plan to provide for autonomous electric vehicles (AEVs).

The role of this work will be to promote these outcomes through the analysis and demonstrate the carbon reduction impact. Green Warrnambool recognises the regional dependence on private vehicles and emphasises the fuel switching that needs to occur towards electric vehicles in order to get to zero.

Clause 21.06-2 Sustainable Development from the Warrnambool Planning Scheme sets out key objectives and strategies which are consistent with the drive for East of Aberline to be a Victorian exemplar for sustainable development, including a 'compact' and 'sustainable urban form' to reduce car dependency and appropriate solar orientation.

TECHNICAL CONTEXT

The Bushfire Development Report identifies that while much of the site is low risk, development abutting the BMO (within 150m either side of Tozer Reserve) will have to employ setbacks between 19m to 41m from classified vegetation, impacting site layout.

The Flora & Fauna Assessment identifies similar setbacks for biodiversity concerns, with implications on the built form abutting identified nature reserves (Tozer and Russell). It also suggests the siting of infrastructure within areas already disturbed or support existing infrastructure to reduce ground disturbance.

The Landscape Strategy identifies the potential co-location of both local and district open space reserves near Russell Creek, providing open space within 400m of 94% of residents.

The Land Capability Assessment identified a number of locations with medium or high potential for contamination. Further investigation of these sites will drive any remediation required and any restriction of land uses at particular locations.

The Landowner Consultation identifies the need for a range of housing typologies to serve a diverse population range, in addition to a community infrastructure yet to be located (i.e. Primary School, Community Centre). The Landowner Consultation further suggests the location of shared paths along Tozer Reserve and Russell Creek as an opportunity to increase active commuting - and proposes the inclusion of a bus route through the site.

The Key Issues Paper articulates the request from the Glenelg Hopkins Catchment Management Authority (GHCMA) to provide a 30m buffer on either side of Russell Creek, measured from the top of the banks to mitigate flood risk, the location of roads and footpaths separate from this buffer.

The Key Issues Paper articulates Council's support for a neighbourhood design that limits car activity by providing strong bicycling and pedestrian linkages and integration with Public Transport where possible.

There is currently no technical integrated transport plan or report for the site (this is pending). This project can help inform the brief for this technical work to support the ambition for less reliance on private vehicles and increased utilisation of low emissions vehicles for those vehicle trips that remain.

STAKEHOLDER CONTEXT

Wannon water highlighted the potential for reduction in the size of stormwater retarding basins if a roofwater harvesting scheme was implemented.

No transport stakeholders were interviewed during this first stage of the work, however their involvement will be critical to detailed integrated transport planning. Issues such as lot diversity will be tested through the proposed Pathways Workshop in June.

Site Layout & Liveability

Three mechanisms which are relevant to the precinct structure planning stage and can be used to drive climate responsive outcomes including carbon reduction have been highlighted for further investigation through this work.

The following pages outline analysis of these mechanisms.

MECHANISM / OPPORTUNITY	MECHANISM TYPE	CARBON IMPACT
Optimised location of community infrastructure and lot diversity	PSP element and Planning Control	_ Reduction in length of trips (reducing transport related carbon emissions) _ Reduction in vehicle trips per day (transport related carbon emissions)
Optimisation of active transport infrastructure	PSP element	_ Reduction in vehicle trips per day (transport related carbon emissions)
Electric vehicle transition	Planning control	_ Reduction in carbon emissions associated with vehicle trips (in particular as carbon intensity of grid declines or if charging is via renewable sources of electricity)

SITE LAYOUT AND LIVABILITY: Community infrastructure and lot diversity

MECHANISM DESCRIPTION

The optimised location of community infrastructure and lot diversity is a critical factor in enabling achievement of site layout objectives. The Precinct Structure Plan will need to consider appropriate locations for a potential retail convenience centre and the provision of a primary school which can be accessible to residents without a private vehicle. Given there is not proposed to be a vehicle crossing of Russell Creek, location of the primary school on the Creek with active transport over is critical.

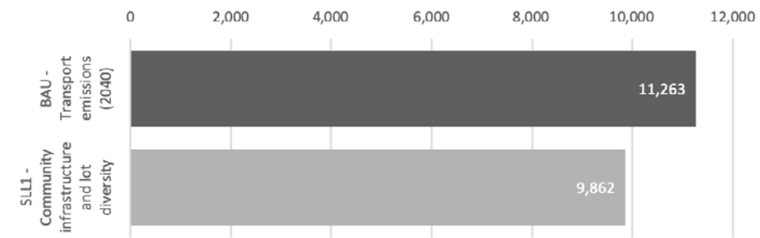
The PSP will need to consider appropriate locations and provision of a diversity of lot sizes. There is value in providing larger 'superlots' capable of denser housing typologies close where community services and infrastructure are concentrated. This creates a greater population closer to services and promotes a walkable neighbourhood.

Mechanism type

_ PSP Element - Service provision and location (note markup of proposed urban structure)
_ PSP Element - Nomination of higher density locations (note markup of proposed urban structure)
_ Planning control: - each landowner to demonstrate at least 5% of lots less than 250sqm / dwelling size of 150sqm or less (targets to be tested at workshop)

Carbon Impact

_ Reduction in length of trips (reducing transport related carbon emissions)
_ Reduction in vehicle trips per day (transport related carbon emissions)
_ Combined impact is demonstrated below in relation to transport



COST IMPLICATIONS

_ The costs are relatively intangible and borne by different parties
_ P-6 School would be delivered by Dept of Education (VSBA)
_ Community Centre would be an owned and operated Council facility (funded through the Infrastructure Plan)
_ Holding costs may accrue to landholders to 'preserve' super-lots for future medium density closer to services

KEY BENEFITS

Social

_ Improved walkability encouraging physical activity
_ Lot diversity increases ability to "age in place" and cater for a wider range of household types, increasing social diversity

Environmental

_ Reduced emissions from private vehicle trips by car due to ability to access community infrastructure by active transport means and shorter private vehicle trips
_ Achieve a more compact sustainable urban area reduced pressure on housing supply in productive rural areas
_ Integration of infrastructure with Tozer Reserve and Russell Creek will increase accessibility for many while providing desirable recreational space

Economic

_ Appropriate siting and increased density around retail convenience and community facilities will improve its economic viability and chance of success
Smaller lots meeting affordability/student/aged care housing need

BARRIERS/CONSTRAINTS

Political

_ Lack of co-ordination in delivery due to varying ownership of land
_ Desire by developers to progress development on own timeframe
_ Potential for pressure to subdivide lots from developers if don't see a ready market for denser housing typologies

Financial

_ Lack of viability of retail centre and/or primary school in early stages of development
_ Costs of holding larger lots while local housing market matures to support higher density housing choices
_ Market resistance and cost to develop smaller lots (compared to business as usual)
_ 'Off the shelf' housing products may not fit on smaller lots

Social

_ Potential resistance to denser housing typologies/preference for single detached dwellings
_ Scale and location to Warrnambool CBD may promote car-use, combined with existing car-culture

CRITICAL SUCCESS FACTORS

_ Reservation of larger lots must be made at PSP stage in order to realise this opportunity, despite the potential for delay in market appetite for denser housing typologies
_ Clear designation of lot diversity and location of higher densities in plan
_ Identification of appropriate support for landholders to bank land for higher density, such as through Council leading market testing for smaller lot product for smaller households
_ Co-location of convenience retail, education and community facilities so they can support each others offering
_ Given there is a single proposed vehicle crossing of Russell Creek it is critical that there is multiple walking or bike path crossings of the creek to enable active transport access
_ Ideally, the benckmarks set in the Sustainable Subdivisions Framework is met (a target of 95% of lots to be within a maximum safe walking distance to key local destinations - 2km to retail convenience, open space 400m)
_ Planning and identification of key nodes, hubs and linkages throughout the site - and connections to key external assets such as the coast
_ A clear narrative on the need for density in appropriate locations to ensure that East of Aberline delivers for all household structures, not just family households

Dohertys Creek p-9 college in Melbourne's west (Source: Britex)

SITE LAYOUT & LIVEABILITY: Optimisation of Active Transport Infrastructure

MECHANISM DESCRIPTION

This mechanism supports Goal 7 of Green Warnambool focusing on 'encouraging and prioritising sustainable transport' through a range of mechanisms including ensuring daily destinations are within 15 minutes of home using active transport; developing and implementing pedestrian and cycling network plans, and locating homes within 400m of public transport.

Of critical importance is linking active transport within the precinct to the existing Russell Creek path, creating an uninterupted (relatively flat) 5km journey to the CBD from the centre of the East of Aberline precinct. To be effective this alignment along Russell Creek will need to be supported with north-south connections from the northern precinct and southern precinct (as well as each side of Tozer Reserve as it is not proposed to be bisected by a crossing).

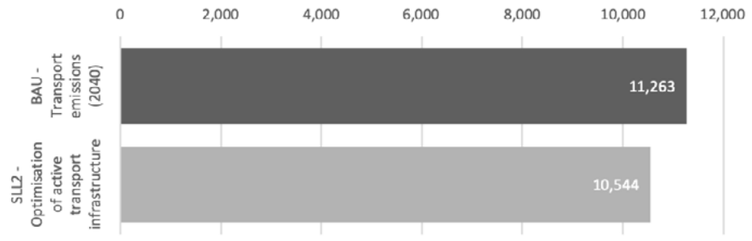
This mechanisms has strong alignment with the HAbD principles which highlight how the built environment can make it easier for Australians to be more active. HAbD can be used as an additional guide for the location and design of an integrated pedestrian network.

Mechanism type

_ PSP Element - Nomination of additional active transport provision (note markup of proposed urban structure)

Carbon Impact

_ Reduction in vehicle trips per day (transport related carbon emissions)
_ Carbon impact is provided below, based on a 5% increase in mode share due to improved infrastructure provision



COST IMPLICATIONS

_ Active transport shared paths and on-road funded through infrastructure plan
_ A shared use path (2.4m) is delivered at a cost of $250,000 per km
_ Every active transport trip reduces the cost of personal vehicle travel - a 5km trip at ATO rates cost a driver approximately $3.50

KEY BENEFITS

Social

_ Health benefits of increased active transport (walking/cycling)
_ Ability to integrate pedestrian network with a defined community hub

Environmental

_ Reduction in carbon related to private transport
_ Improved air quality
_ Ability to combine conservation of Tozer/Russell with open space recreation

Economic

_ Potential higher land value/marketability of development due to positive amenity outcomes (noise and pollution reduction, reduced congestion) from reduction of traffic across the precinct

BARRIERS/CONSTRAINTS

Political

_ Demonstrating community benefit
_ Land allocation

Financial

_ Up front cost of provision

Technical

_ Tozer Reserve and Russell Creek bisect the site, requiring a crossing
_ Planned activity centre within the precinct may not contain enough services, leading to external trips

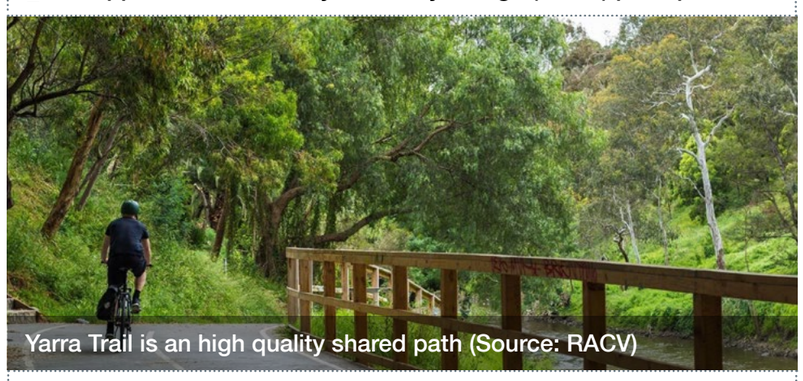
Social

_ Behaviour change within the community around active commuting may be difficult to influence


Cycling and parking at local Primary Schools (Source: DPTI SA)

CRITICAL SUCCESS FACTORS

_ Consideration of siting of services and lay out of residential areas for support active transport must be made in a coordinated way in order to maximise opportunity
_ Alignment required with VicRoads and local government (particularly transport) in relation to delivery of public realm infrastructure such as cycling lanes and pedestrian areas
_ New active transport infrastructure must link with existing township cycling and pedestrian network, as well as proposed off road paths and eco trails. The WCC Sustainable Transport Strategy 2010-2020 will need to be updated to incorporate the East of Aberline development
_ Costs need to be fully reflected in Infrastructure Cost Plan
_ To promote uptake active transport links need to connect regionally, in particular with the established link to the CBD, noting existing infrastructure may need to be upgraded to ensure a safe, integrated network to external amenity
_ Street design needs to reduce friction with private vehicles and other road users
_ The application of Healthy Active by Design (HAbD) principles


Yarra Trail is an high quality shared path (Source: RACV)

CASE STUDY REFERENCE POINT

The Perth to Midlands Principal Shared Path project provides an example of increasing cycling numbers through the provision of dedicated infrastructure.

The project, which began in 2003 has delivered a total of 17 kilometres of dedicated pedestrian and cycling infrastructure, including bike parking, co-located bike shops and rest areas. Data published in 2008 indicated that the initial 4 kilometre section from Perth to Maylands, had resulted in an additional 708 cyclists per weekday (206,500 extra cycling trips per year), which increased as the route was extended, with a cost-benefit ratio of 3.3:1.

The benefits of cycling are quantified in terms of the negative costs associated with driving a vehicle that are avoided, such as operating costs, congestion, parking, road trauma (wear and tear), climate change and pollution, as well as the health and fitness benefits associated with physical activity.

SITE LAYOUT & LIVEABILITY: Optimisation for electric vehicle transition

MECHANISM DESCRIPTION

This mechanism supports Goal 7 of Warnambool 2040 to 'encouraging and prioritising sustainable transport'. It involves accelarating the uptake of electric vehicles through planning controls / Design Guidelines, nominally the provision for EV infrastructure at the dwelling-scale (either as a functional charging point, or wiring for future EV capabilities). This is one of the key barriers to electric vehicle uptake, and could be further supported through measures taken at local destinations to preference electric vehicle charging over ICE vehicles.

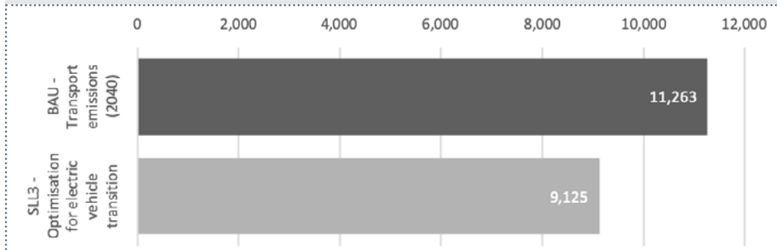
Acknowledging the transition away from Internal Combustion Engines (ICE) and providing fundamental infrastructure to support the uptake of Electric Vehicles (EV) is critical to creating a future-proofed, low carbon community and meeting he Victorian Government's commitment under the Climate Change Act 2017 to reduce greenhouse gas emissions for Victoria to zero net emissions by 2050.

Mechanism type

_ Planning control - Implemented through Design Guidelines - All dwellings would require pre-wiring to support a 32 A Mode 3 EVSE. Actual chargers would be purchased at the same time as their first electric car purchase.

Impact

_ Reduction in carbon emissions associated with vehicle trips (in particular as carbon intensity of grid declines or if charging is via renewable sources of electricity)
_ Carbon impact is provided below, based on an accelarated take up of electric vehicles



COST IMPLICATIONS

_ Likely to be monetary benefits to owners of EVs as total cost of ownership lower than traditional vehicles by 2025
_ Cost implication of mechanism to owners restricted to pre-wiring of garage (<$800) for a single phase 32 A Mode 3 EVSE

KEY BENEFITS

Social

_ Removes barriers/incentivises uptake of electric vehicles
_ Lower noise impact and reduced air pollution will have positive health benefits across the precinct

Environmental

_ Reduction in emissions relating to private transport (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)
_ EV batteries can make better use of solar PV if there is low daytime usage

Economic

_ More cost effective to make provision for EV infrastructure requirements in the design and development of buildings, rather than as a retrofit
_ Running transport on electricity enables zero-emissions transport when paired with renewable energy, decreasing the need to continually offset in the precinct
_ May be benefit in neighbourhood recharge locations for visitors and external users

BARRIERS/CONSTRAINTS

Political

_ Mandating EV charging infrastructure has not previously been implemented in regional Victoria

Financial

_ Upfront cost of installation of EV infrastructure before widescale use/take up of EVs must be justified
_ By extention upfront cost of EV vehicles are declining but still high

Social

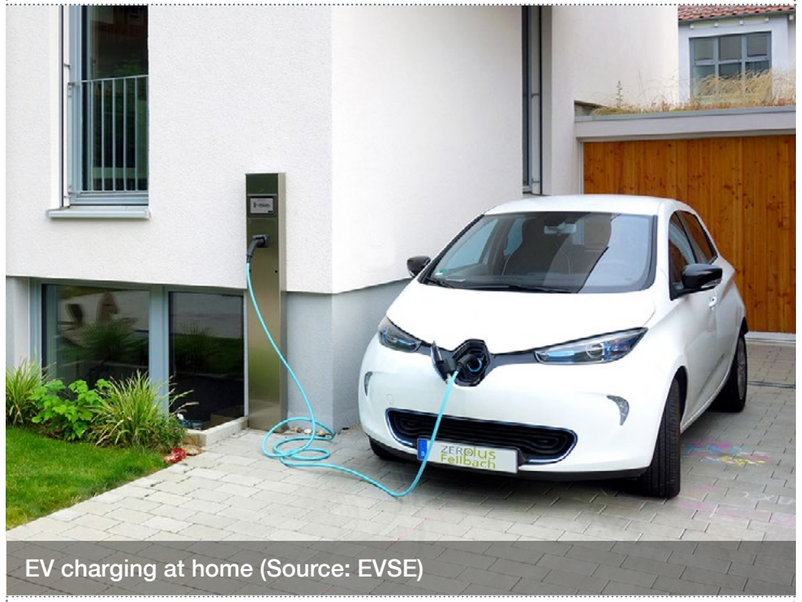
_ Potential unwillingness to use EVs in regional areas due to issues/ perception of travel distance constraints

Technical

_ Lack of supportive regional charging infrastructure may limit uptake
_ Potential capacity issues of surrounding network without renewable generation onsite

CRITICAL SUCCESS FACTORS

_ If consideration is not given to EV requirements at design stage, it be more expensive to retrofit in some cases
_ The National Select Committee on Electric Vehicles highlighted in their recommendations the need to coordinate with infrastructure across the city to gain the greatest uptake
_ Regional public charging infrastructure is required along key long-distance routes (Warnambool-Melbourne; Warnambool-Portland) to make EVs a viable choice for residents
_ Public education to overcome 'range anxiety' will also be critical
_ Warnambool City Council has a lead role to play in implementation of the standard
_ Powercor 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 guidelines to clearly outline requirements for developers / builders, given that this is 'new ground' in planning policy



EV charging at home (Source: EVSE)

CASE STUDY REFERENCE POINT

The Design Guidelines at Cape Paterson (The Cape) mandates this pre-wiring to encourage EV uptake. According to Developer Brendan Condon, this has only slightly impacted the cost of new builds: "a couple of hundred dollars" only.

Streets & Public Realm

The policy, technical and stakeholder context for Streets and Public Realm is outlined opposite.

The Precinct Structure Plan will consider street treatments which support climate resilience. A key outcome will be street sections which can simultaneously cater for underground service delivery whilst supporting urban greening, active transport and water management outcomes on the surface. An additional benefit of a well-designed streetscape is crime prevention (CPTED) which facilitates natural surveillance, activity support, regular vegetation maintenance and territorial reinforcement (clear delineation between public and private land).

The site has obvious natural assets (such as Russell Creek and Tozer Reserve) which can be built on to deliver a high-quality public realm.

LOCAL POLICY CONTEXT

An 'Immediate Action' for council within Green Warrnambool is the development of a bicycle network with strategic corridors - suggesting the support and future integration of a bicycle network between Warrnambool and the EOA site (and will need to integrate with the design of residential streets).

Green Warrnambool also supports the development and implementation of an integrated strategy to deliver adaptive building and open/green space design, noting it 'is key to incorporate vegetation in streets, parks, sporting grounds, gardens, river and creek embankments.' WCC is a signatory to the Infrastructure Design Manual (IDM) and Sustainable Infrastructure Guidelines (SIG) which includes guidance on delivering more sustainable streetscapes. WCC has also committed to trail the Sustainable Subdivisions Framework (SSF) which will further underpin the delivery of an integrated public realm.

The role of this work will be to support the development of streets that meet a variety of needs with a key focus on climate adaptation, community resilience and active transport.

TECHNICAL CONTEXT

The Bushfire Development Report suggests that where development encroaches both Tozer or Russell - mitigating fire risk would be the priority, and may result in mandated building setbacks, roads and footpaths used to create separation to reserves and highly managed vegetation (to achieve 'declassification'). Streetscape design in these locations will need to respond to fire risk.

The Landscape Strategy proposed a number of pocket parks across the site, which are integrated with larger biodiversity assets (such as Tozer and Russell) through a network of off-road shared paths.

The Infrastructure Servicing Assessment details a range of potential internal road typologies however requires further study to determine projected traffic volumes, the function of particular streets (i.e. barrier to BMO/nature reserve, pedestrian route etc.), and logical service locations. In particular detailed consideration will need to be given to how active transport is facilitated in street sections and how the streets can maximise canopy vegetation, biodiversity and water sensitive urban design.

The Growth Corridor Strategy suggests that there is to be no vehicular crossings over Russell Creek, and those periphery roads to Tozer and Russell to act as neighbourhood defining boulevards, designed and of a size to support larger tree species. In addition, where a park is adjacent a drainage reserve (i.e. wetland or retardation basin) the two will be designed holistically.

STAKEHOLDER CONTEXT

The Victorian Planning Authority, has identified some misalignment between their standards and those of the Infrastructure Design Manual, and indicated a willingness to work with WCC to develop effective street cross-sections to deliver services and public realm amenity simultaneously.

There is also a pending integrated transport study to be conducted, which will inform these discussions between the VPA and WCC. Due to the multiple outcomes that streets need to deliver in residential subdivision this will be a key focus area for the PSP and one which would benefit from a highly collaborative stakeholder led approach.

Streets & Public Realm

There are a range of mechanisms which could be relevant to delivering climate responsive outcomes within the streets and public realm. The landscape strategy has already laid a firm foundation for the open space network, so the critical focus for this work is in guiding the development of street typologies which can simultaneously support the needs of a range of services alongside active transport, urban greening and integrated water management. A multi stakeholder approach has been investigated as the primary mechanism for delivery - which will help deliver on the Sustainable Subdivisions Framework (SSF) (of which WCC has signed up to trial).

The following page outlines analysis of this mechanism.

MECHANISM / OPPORTUNITY	MECHANISM TYPE	CARBON IMPACT
Multi stakeholder optimised street sections and plans (as per Sustainable Subdivisions Framework)	Finance, Governance or Operational model	_ Marginal reduction in vehicle trips per day (higher amenity streetscape promoting 'an inviting walk')

IMAGE: EOA AIMS TO DELIVER HOUSING WITH A HIGHLY PERMEABLE, VEGETATED STREET NETWORK (SOURCE: THE NATURE CONSERVANCY)

STREETS & PUBLIC REALM: Multi stakeholder optimised street sections and plans

MECHANISM DESCRIPTION

The critical focus for this work is in guiding the development of street typologies which can simultaneously support the needs of a range of services alongside active transport, urban greening and integrated water management. A multi-stakeholder approach is being tested as the primary mechanism for delivery.

The VPA has established street sections and Warrnambool has established street sections as part of its adoption of the Infrastructure Design Guide (IDG).

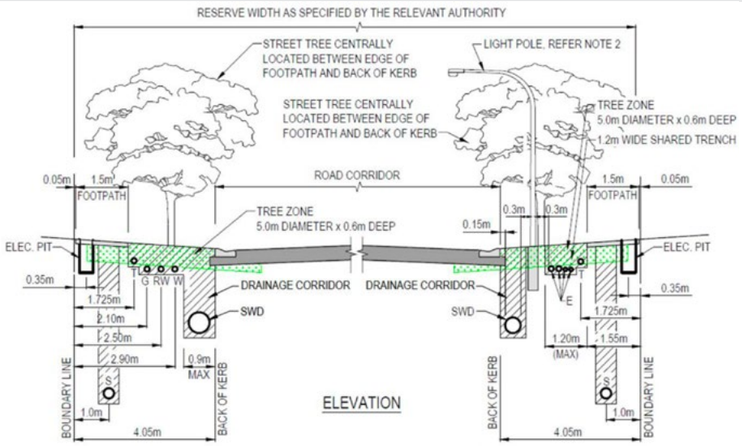
A PSP typically sets up a street sections for a heirarchy of streets. This mechanism proposes to bring the group of stakeholders with an interest in streets to optimise street sections and plans for residential streets and higher order roads.

Mechanism type

Finance, Governance or Operational model - Process commitment in development of PSP (outcomes would be reflected in PSP and applications for subdivision would need to be in accordance with adopted street sections and plans).

Impact

Marginal reduction in vehicle trips per day (higher amenity streetscape promoting ‘an inviting walk’)



The complexity of services and vegetation (Source: Spiire)

COST IMPLICATIONS

_ There are no obvious cost implications resulting from the process
_ There is the potential for increased costs of vegetation planting and maintenance, bicycle lane provision and WSUD - however this would be agreed through the process proposed

KEY BENEFITS

Social

_ A multi-stakeholder approach can build social capital for future projects
_ Crime Prevention Through Environmental Design (CPTED) such as natural surveillance, activity support and regular maintenance supported through a multi-stakeholder approach
_ Recreation, aesthetic value and contribution to place
_ Health and wellbeing benefit (from improved active transport)
_ Reduced exposure to extreme heat

Environmental

_ Stormwater quality improvement through enabling WSUD in streets
_ Better vegetation health (quality)
_ Improved biodiversity outcomes

Economic

_ Amenity improvement of streets leads to value uptick
_ Protection of surfaces (potential longer life of hard landscaping)
_ Development of efficiencies between stakeholders (through collaboration)

BARRIERS/CONSTRAINTS

Political

_ Potential perception of loss of control in decision making
_ Roles and responsibilities for investment and relationship to Infrastructure Contributions Plan
_ Streetscapes in particular are strongly contested

Financial

_ The upfront and ongoing investment required for blue / green infrastructure to be established and its health maintained

Technical

_ Competition within road reserves means street trees need to be carefully planned (and means that technical stakeholders may need to compromise on established methods of servicing for example)
_ Some design responses may challenge the IDM

CRITICAL SUCCESS FACTORS

_ Buy in for stakeholders is critical - there must be buy in to this design exploration and a commitment to be bound by the outcomes that come from it
_ Organisations need direction to be flexible, to give ground where impacts to their role in the streetscape are minor and to find solutions where conflicts arise
_ Prioritising function e.g. WSUD and traffic calming and require optimised street sections as standard in PSP
_ Broad representation from stakeholders underground service providers, Distributed Network Service Providers (DNSP), Council (multiple reps), VPA, developers, road users (vehicle owners, cyclist and pedestrian groups)
_ Council’s commitment to the Sustainable Subdivision Framework (SSF) and flexibility around IDM

A render of the Napier Street upgrade, which has relocated services and planted additional trees in the median strip to (Source: Bendigo Advertiser)

CASE STUDY REFERENCE POINT

A recent report by Spiire highlights the issues with decreasing lot frontages and the spatial conflict between service infrastructure and vegetation provision within the streetscape.

The Napier Street project being delivered by VicRoads in Bendigo has seen this conflict minimised by relocating electrical assets underneath paved footpaths to ensure adequate space for tree plantings and eventual canopy cover. The project highlights the importance of a multi-stakeholder approach in developing street typologies, both in terms of development and usability.

Energy

The policy, technical and stakeholder context for Energy is outlined opposite.

The Precinct Structure Plan will consider energy servicing in detail. At an infrastructure level, electricity network planning to support a high level of distributed energy resources and a significantly reduced role for gas will be critical. The PSP will also need to consider the ability to exert influence over the design of dwellings to ensure thermal efficiency and to promote energy generation and storage on site.

LOCAL POLICY CONTEXT

Both Warrnambool 2040 and Green Warrnambool provide strong policy support for the project, identifying EOA as an obvious opportunity for delivering zero carbon housing development consistent with Council ambitions. This includes explicit outcomes being sought by 2026 as outlined below:

_ Warrnambool will pave the way for a Zero Net Carbon Housing Development.
_ Warrnambool will source 20% of its citywide energy from renewable resources.
_ Warrnambool will have at least 1 micro-grid set up and operating

As the key area of residential growth, East of Aberline will be critical to meeting this ambition. Clause 21.06-2 again supports sustainable development, identifying passive design as a key strategy to reduce greenhouse gas emissions.

TECHNICAL CONTEXT

The Bushfire Development Report identifies the site as a 'Bushfire prone Area' (BPA) with a BAL-12.5 (Bushfire Attack Level) construction standard. There may be synergies between BAL requirements and thermal performance in terms of materiality (i.e. glazing) that can be pursued.

The Infrastructure Servicing Assessment includes advice from Powercor indicating that surrounding High Voltage feeder cables are nearing capacity and require upgrade to service the entire precinct. There is an opportunity to reduce the cost of electricity infrastructure provision by shifting to locally produced renewable energy (i.e. rooftop solar and battery). Ausnet Services have advised the existing gas infrastructure is capable to supply the initial stages, however this work will explore options for reducing or removing gas supply.

The Landscape Strategy suggests N-S street orientation be incorporated to protect a number of existing view-lines within the site. This creates E-W lot orientations with greater solar access on the longer northern facade - increasing thermal performance (and solar PV access).

The Key Issues Paper puts forward a number of strategies under 'A low carbon community' that will push the development to net zero, including: trialling micro-grid technology and community owned renewable energy generation, a gas-free community, addressing embodied carbon of materials, energy efficient dwellings (8-10 stars), battery storage and the procurement of green power.

STAKEHOLDER CONTEXT

The south east corner of the lot abutting Dales Road contains two open-air raw-water storage ponds that have been identified as a potential location for a floating solar system, with the energy sold locally. The original high-level investigation envisaged a limited number of industrial customers, which would have been administratively less complex than a large number of residential customers. This opportunity could be a potential pathway for one of the delivery mechanisms highlighted on p. 13.

Discussions with the VPA suggested that the approach to energy outlined in the 2018 Infrastructure Servicing Report may need to be revised to better reflect a climate ready and gas-free community.

Sustainability Victoria's 'Zero Carbon Homes Pilot Program' provides a potential pathway for delivering zero carbon homes within the precinct. Currently the program is in its infancy with three volume builders, but could be leveraged to demonstrate the benefits (e.g. through display homes etc.).

Energy

There are a range of mechanisms which could be relevant to driving significant reduction in stationary energy related carbon emissions. These focus on the four areas of opportunity including; using less energy, fuel switching to renewable energy sources, generating electricity on site (household or precinct level) and procuring renewables from off-site generation. The delivery mechanisms opposite will be explored in this work.

The following pages outline analysis of these mechanisms.

MECHANISM / OPPORTUNITY	MECHANISM TYPE	CARBON IMPACT
Building thermal performance improvement	Planning control	_ Reduction in stationary energy consumption for heating and cooling (at dwelling scale) leading to lower carbon emissions
Built Environment Sustainability Scorecard (BESS) energy target	Planning control	_ Reduction in stationary energy consumption overall (at dwelling scale)
Fuel switch (gas to electricity for all appliances – heating, hot water, cooking)	PSP element	_ Reduction in carbon associated with stationary energy consumption, based on declining carbon intensity of the electricity network
Building scale Solar PV	Planning control	_ Reduction in carbon associated with stationary energy consumption
Embedded Network, Microgrids and Virtual Power Plants	Finance, Governance and Operational models (various)	_ The carbon benefit remains relative to the aggregated capacity of solar PV within the precinct
Renewable energy purchase	Finance, governance and operational model	_ Reduction in carbon associated with residual energy supply (following energy efficiency and on-site generation)

ENERGY: Building thermal performance improvement

MECHANISM DESCRIPTION

Buildings with better thermal performance will consume less energy - reducing operational energy costs while improving energy security for residents.

This mechanism includes the introduction of thermal performance targets for buildings through the PSP through Design Guidelines. The standard NatHERS target of 6 stars, increases to 8 stars under this mechanism.

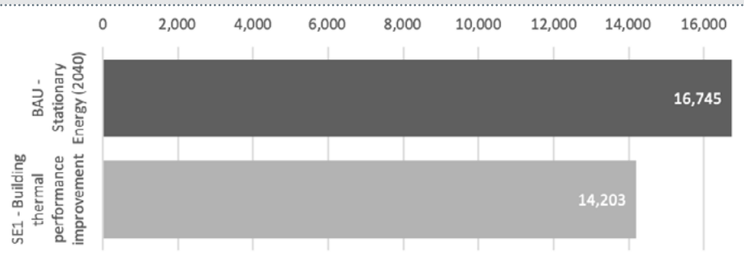
Improvements may include: orientation to maximise solar exposure, material / colour specifications, building fabric and insulation improvements and glazing.

Mechanism type

Planning control - A minimum NatHERS standard of one star above (Mandated through Design Guidelines)

Carbon Impact

_ Reduction in stationary energy consumption for heating and cooling (at dwelling scale) leading to lower carbon emissions
_ Carbon impact is provided below, based on an ultimate 50% reduction in the heating and cooling demand for all dwellings in the precinct



COST IMPLICATIONS

_ Costs for improved energy performance are borne by the developer / builder initially but incorporated into the purchase cost. Generally speaking there will be a minor increase in the development cost, which is almost always offset by lower operational costs, often within a short payback. Sources indicate a potential increase in cost of $8,100 for an additional NatHERS stars
_ The operational cost benefit of this investment is approximately $400 per year (this does not include comfort and health benefit)
_ A split incentive exists where the resident receives the benefit, hence the need for planning controls to drive the outcome

KEY BENEFITS

Social

_ Creation of more liveable environments by improving the indoor air quality for all buildings
_ Passive design principles for balanced thermal comfort can lead to an improvement in health outcomes of tenants

Environmental

_ Reduces the carbon emissions associated with energy consumption in dwellings, supporting state and local emissions reduction targets
_ Meet environmental objectives faster through precinct wide application
_ Improved climate resilience to extreme heat

Economic

_ Reduced heating and cooling bills for households and businesses (lower life-cycle costs)
_ Could potentially reduce the additional network infrastructure required to service a growing precinct
_ Improved building values
_ Reduced pressure on energy grid during heat events

BARRIERS/CONSTRAINTS

Political

_ State wide ESD policies are under development and could potentially duplicate place based controls for improved energy performance

Financial

_ There is an increase in build cost relating to the building fabric

Social

_ Optimum performance reliant on a degree of behaviour change by tenant
_ Potential lack of long-term thinking from purchasers to demand improved building products

Technical

_ Integration of thermal efficient best practice with building designs
_ Engagement and support of volume builders to deliver, and exceed BCA minimum requirements

CRITICAL SUCCESS FACTORS

_ Alignment with other planning mechanisms can improve sustainability performance overall.
_ Thermal efficiency measures should be integrated as early as possible into the design process of the new precinct to ensure optimisation for orientation.
_ Whilst lot orientation is emphasised in planning policies and rating tools, attention to energy efficiency at the lot level beyond this is limited and education may be required.
_ Developers in meeting the requirements of any on-lot development controls
_ Planning authority to participate in decision making for on-lot control
_ Local government to administer any planning controls through their role as the statutory authority
_ Demonstration to provide engagement and education - opportunity for collaboration with volume builder to develop improved housing
_ Community buildings to take the lead in ‘best practice’ and deliver substantial ESD benefits - and potentially aligned with a tool such as Green Star to illustrate


A 10-star house at Cape Patterson Eco-Village (Source: The Cape)

CASE STUDY REFERENCE POINT

A 12-month study conducted by RMIT university and RENEW has revealed that dwellings within the Cape Patterson Eco-village were able to reduce their consumption of grid electricity by 88 percent. The study revealed the average home within The Cape was consuming an average of 5.2kWh/day without gas, and were operationally carbon positive, reducing C02 production of more than 8 tonnes per annum when compared to the average Victorian home. The houses and estate generate between three to four times the energy as they use, and are able to export that back into the grid for surrounding suburbs to consume.

By employing off the shelf technologies and passive design, homes within The Cape exceeded 8-star NatHERS were able to reduce their annual energy bills to <$500 compared to $2,500+ within conventional housing estates.

ENERGY: Built Environment Sustainability Scorecard (BESS) energy target

MECHANISM DESCRIPTION

The energy category within BESS awards points for passive design and energy efficient services and appliances that deliver energy savings above a benchmark building.

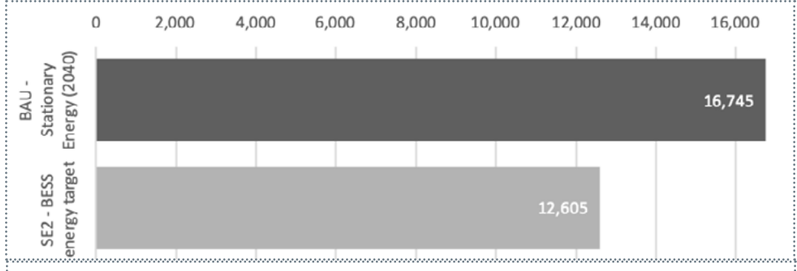
For councils that have a Local ESD Policy in place, BESS has become one of the primary tools for documenting and assessing sustainable built form. There is potential to use this tool at the dwelling scale to increase dwelling energy efficiency. A benchmark of 67% in the energy category is assumed and whilst flexible, would generally include improvement to hot water and appliance efficiency in addition to the thermal performance improvement.

Mechanism type

Planning control - A minimum BESS score of 67%, representing an approximate 25% reduction in carbon for stationary energy without solar included in calculation (implemented through Design Guidelines)

Impact

_ Reduction in stationary energy consumption overall (at dwelling scale)
_ Carbon impact is provided below, based on a reduction in heating and cooling demand and an increase in the efficiency of key appliances at the dwelling level



COST IMPLICATIONS

_ Costs for improved energy performance are borne by the developer initially but incorporated into the purchase cost. Generally speaking there will be a minor increase in the development cost, which is almost always offset by lower operational costs, often within a short payback. Sources indicate a potential increase in cost of $4,120 compared with a standard dwelling
_ The operational benefit of this investment is approximately $700 per year in 2040

KEY BENEFITS

Social

_ Efficient appliances and awareness of ratings can have a positive impact on tenant energy consumption behaviour
_ Adoption of BESS standard supports building scale climate resilience and has simple communication value
_ Improved climate resilience to extreme heat

Environmental

_ Reduces the carbon emissions associated with energy consumption in dwellings, supporting state and local emissions reduction targets
_ BESS can be used to drive other building scale improvements unrelated to carbon ie there is potential to also use BESS to drive water efficiency targets for example
_ Meet environmental objectives faster through precinct wide application

Economic

_ Reduced heating and cooling bills for households and businesses (lower life-cycle costs)
_ Could potentially reduce the additional network infrastructure required to service a growing precinct
_ Improved building value

BARRIERS/CONSTRAINTS

Political

_ State wide ESD policies are under development and could potentially duplicate place based controls for improved energy performance

Financial

_ Can marginally increase the build cost

Social

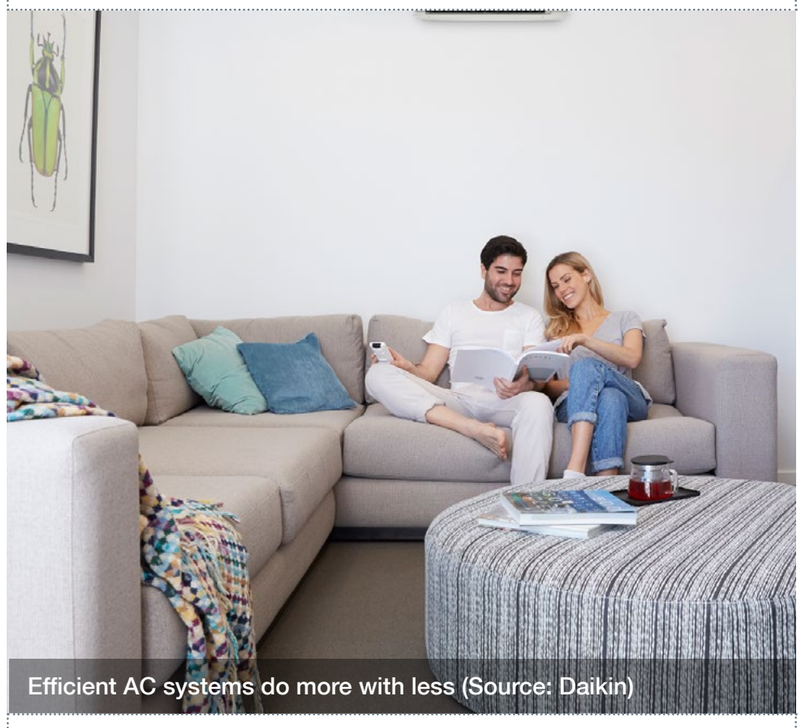
_ Optimum performance reliant on positive energy behaviour change by tenant

Technical

_ Integration of thermal efficient best practice with building designs

CRITICAL SUCCESS FACTORS

_ A solid mechanism in Design Guidelines or similar (and their governance) that locks in meeting the requirements of any on-lot development controls
_ Building owners in maintaining operation of assets to deliver benefits associated with improved energy performance and generation
_ Local government to administer any planning controls through their role as the statutory authority or in partnership with developers through a funded 'Design Review Panel'
_ A suite of 'pre-approved' home designs which require consideration only of thermal performance (related to orientation)
_ A clear narrative to purchasers about the benefits in relation to the slightly additional cost
_ Use of display suite to showcase and allow the community understand the potential cost savings associated with energy efficiency


Efficient AC systems do more with less (Source: Daikin)

AIR CONDITIONING EFFICIENCY

_ COP and EER indicate the energy efficiency of air conditioning units for heating and cooling respectively. An air conditioner that generates 4.1kW of heating using 1kW of energy has an COP of 4.1, and similarly for cooling and EER. Units with a higher COP/EER rating are therefore more efficient and should be prioritised.

ENERGY: Fuel switch (gas to electricity for all appliances – heating, hot water, cooking)

MECHANISM DESCRIPTION

The provision of gas locks in fossil fuels that contribute to climate change, and requires expensive and path dependant infrastructure to deliver to customers. 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.

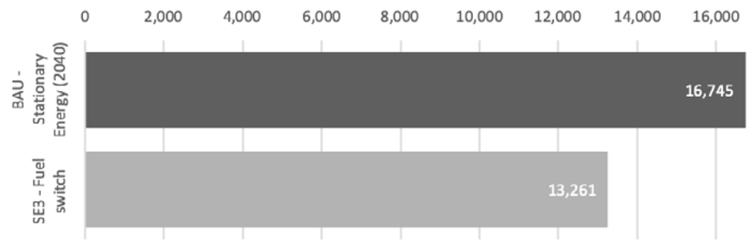
Improvements in technology have enabled all-electric alternatives to gas applications such as heating, hot water and cooking. This mechanism involves a confirmation that gas will not be supplied to the precinct. A low carbon precinct is dependent on removal of gas supply i.e, is required to meet precinct, municipal and State ambitions for GHG emissions reduction.

Mechanism type

PSP element - The PSP mandates no connection to gas.

Impact

_ Reduction in carbon associated with stationary energy consumption, based on declining carbon intensity of the electricity network
_ Carbon impact is provided below, based on a reduction in heating and cooling demand and a replacement of key appliances at the dwelling level with electric alternatives



COST IMPLICATIONS

_ Any higher / lower cost for change out of appliances are borne by the developer initially but incorporated into the purchase cost. Sources indicate a potential increase in cost of $1,870 compared with a standard dwelling, including avoided infrastructure costs of $1,000 (highly conservative)
_ The operational benefit of this investment is approximately $750 per year in 2040 (comprising approx $500 in operational savings and $250 in avoided gas supply charge)
_ It is critical that gas is not supplied (rather than just not used), in order that the once off, avoided gas infrastructure and the avoided supply charge per resident ($260 per year) are saved

KEY BENEFITS

Social

_ No-gas precincts require less "behaviour change" from residents in reducing energy demand from carbon-based sources

Environmental

_ Reduces the carbon emissions associated with energy consumption
_ Electricity can be matched with solar generation on site or locally, gas cannot
_ Avoided double up of embodied carbon of space conditioning appliances (under a gas scenario, a separate heater and air con is required)
_ More space in the road reserve for other infrastructure (i.e. WSUD and vegetation)

Economic

_ Gas prices are forecast to rise, whereas renewable electricity prices are forecast to continue to remain constant or fall
_ 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
_ Provides industry with the certainty to invest and innovate
_ Reduce need to purchase offsets to achieve net zero carbon
_ Avoiding gas supply saves residents a $260 + supply charge annually
_ Avoided future cost of transitioning gas infrastructure to meet State zero net emissions 2050 target
_ Avoided the risk of stranded gas assets

BARRIERS/CONSTRAINTS

Political

_ Potential for pressure from developers and/or future residents for gas as still considered usual practice (perception of higher cost of electricity for heating)

Social

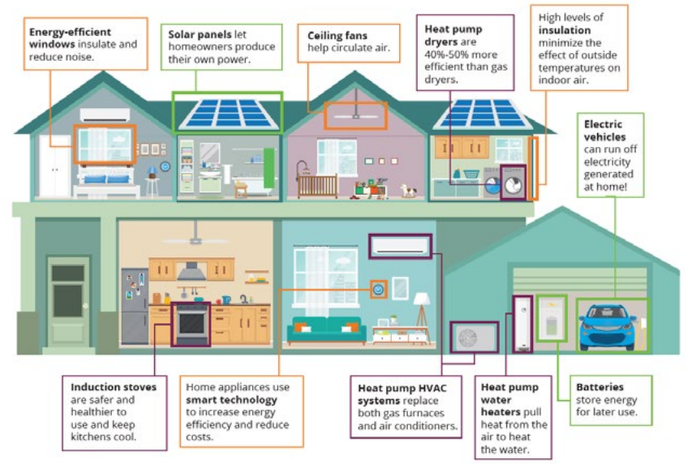
_ Potential expectation of gas as a choice in the energy mix

Technical

_ Risk that technology progress may make decarbonised gas a viable option in the future (e.g. hydrogen fuel)
_ No specific built form controls within current planning schemes mandating all-electric buildings
_ Referral to local gas supply authority under Clause 66.01, creates uncertainty over whether gas suppliers can mandate connection

CRITICAL SUCCESS FACTORS

_ The PSP provides 100% certainty on no provision of gas to the precinct
_ Clear business case from the purchaser and developer perspective
_ A clear narrative to purchasers about the economic and other benefits of all-electric
_ Collaboration with volume builders to create all-electric housing product (standard, cost-effective appliance packages)
_ Confirmation from PowerCor about any impact on the sizing of electricity infrastructure (the key difference noted is initial stakeholder conversations is additional sub-stations and a large low voltage cable size, however these costs are not borne by the developer or residential customer)
_ Building State government support for all-electric suburbs



Components of an all-electric home (Source: RTO Insider)

CASE STUDY REFERENCE POINT

In a first for the ACT, the state government has put forward a Territory Plan waiver for Ginninderry that allows stage 1 of the development - 350 dwellings - to be constructed without the inclusion of gas-mains infrastructure, ensuring all-electric (and potential fossil-fuel free) houses.

The trial allows a reasonable time frame to gather data and feedback to ensure consumer needs and grid security requirements are met. However due to the increasing supply and affordability of renewable energy sources, the ACT Governments commitment to achieving net zero emissions by 2050 and the sustainable focus of the Belconnon Structure Plan, Ginninderry estate is not intending to provide gas supply to homes and is looking to amend the current Estate Development Code to continue this gas-free model.

ENERGY: Building-scale Solar PV

MECHANISM DESCRIPTION

The provision of renewable energy generation at the dwelling scale is critical in pursuing zero net emissions for stationary energy. At the building-scale, dwellings use significant roof space for solar PV to offset electricity consumption behind the meter (where the full retail cost of electricity can be avoided).

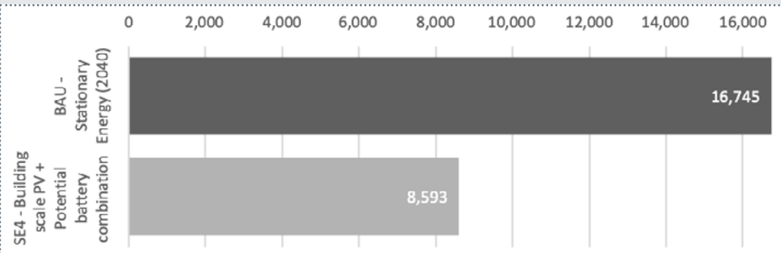
The size of any household battery system would be dependent on network capacity to support export of solar during peak production times, with initial discussions with Powercor indicating that some export limitation may be required for larger systems.

Mechanism type

Planning control - A minimum provision of solar PV generation per dwelling (Mandated through Design Guidelines). This minimum provision would be resolved on the basis of other energy mechanisms adopted.

Impact

_ Reduction in carbon associated with stationary energy consumption.
_ The mechanism offsets the electricity consumption only, so subject to adoption of an 'electric only' precinct the impact of this mechanism can increase through mandating larger solar PV systems (modelled system size is 3.5kW - assumes gas)
_ Carbon impact is provided below



COST IMPLICATIONS

_ The cost of solar PV (and potentially storage) is borne by the developer initially but incorporated into the purchase cost. Sources indicate an increase in cost of $3,500 based on a 3.5kW system (allowing for some further decline in solar PV costs)
_ The operational benefit of this investment is approximately $950 per year in 2040
_ It gas is not supplied and energy efficiency mechanisms are also adopted, then the system size would be increased (higher capital costs), but the operation benefit would also be increased

KEY BENEFITS

Social

_ Solar PV at the household scale is a proven, commercially mature technology

Environmental

_ Reduces the carbon emissions associated with energy consumption, the larger the system size the greater the environmental benefit (noting best outcome when this is combined with an all electric home

Economic

_ Standalone solar PV systems tend to have a payback period of under 7 years in the vast majority of residential applications (this changes in response to the amount of self consumption)
_ No transmission losses when energy is self consumed
_ Job creation for local renewable energy companies
_ Availability of government grants, and developer incentives to subsidise costs
_ Potential economies of scale for the whole precinct adopting a similar system
_ Decreasing technology costs (for panels and batteries)
_ Increased trade within the South West region for renewables

BARRIERS/CONSTRAINTS

Political

_ Mandating renewable energy may be opposed by some developers / residents

Financial

_ There is an increase in capital cost of the dwelling

Technical

_ PowerCor noted that solar generation may have to be 'export limited' meaning that a cap of say 2kW can be exported
_ Unless coupled with an electric only home, the benefit is somewhat limited by the retention of gas
_ Challenge to ensure all dwellings are orientated to maximise solar exposure (and avoid future canopy coverage)

CRITICAL SUCCESS FACTORS

_ Most effective in reducing carbon emissions if dwellings are all electric
_ Finance options available could limit the upfront cost e.g. Warrnambool could adopt residential environmental upgrade agreements
_ Management of network through periods of high generation (and therefore export)
_ A clear narrative to purchasers about the benefits of solar PV, including examples of building-scale solar and how it can reduce costs over certain timeframes (i.e. within life of a mortgage)
_ Managing any conflict with trees (shading)

Residential Rooftop Solar (Source: Clean Energy Ideas)

CASE STUDY REFERENCE POINT

Denman Prospect, a new ACT suburb on the outskirts of Canberra has mandated a minimum 3kw rooftop solar system for every new home build, including 24 public housing dwellings located within stage 1.

This has been mandated through Development Guidelines, and promises to generate 4,146kWh annually and reduce GHG emissions by 3.7 tonnes per house.

While integrated on-site batteries are not mandatory, a partnership with Harvey Norman Commercial Division has been developed to offer residents upgrade packages to install a battery to match their rooftop PV system. The battery package comes with a web-based energy monitoring platform and promises to reduce household energy bills by up to 80 percent.

ENERGY: Embedded Networks, Microgrids and Virtual Power Plants

MECHANISM DESCRIPTION

Whilst different, embedded networks, microgrids and virtual power plants have similar goals, ie to improve reliability, resiliency and economy for the end user and improve efficiency of electricity distribution. The idea is that the energy is generated, stored and distributed within the entity as much as possible.

Embedded networks aggregate the energy usage of individuals within the 'network' (i.e. precinct) to act as a collective to potentially procure cheaper wholesale power prices and share electricity 'behind the meter'.

A micro-grid is a miniature model of a complete grid system where you have a form of electricity generation, storage, distribution and consumption, all within clearly specified electrical boundaries.

Virtual power plants (VPP's) rely less on a physical location and use software to control and optimise a network of generation and demand side storage. Battery storage can be added to traditional energy generation methods such as solar panels.

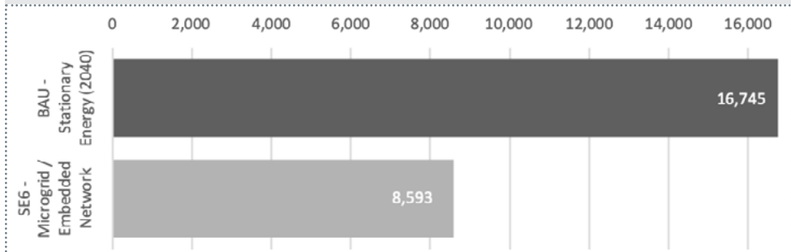
In a greenfield context, these initiatives would require several years of planning, multi-stakeholder collaboration and commercial investment.

Mechanism type

Finance, Governance and Operational models (various)

Carbon impact

The key point is that the carbon benefit remains relative to the aggregated capacity of solar PV within the precinct, the main benefit is reducing any export and other objectives around reliability, resilience and financial benefit.



COST IMPLICATIONS

_ The cost of these mechanisms are dependent on third party feasibility
_ Business models are structured so capital investment is recouped through a return in operation
_ Participation in a micro-grid or VPP is dependent on purchase of a battery, which whilst declining in cost are still $7,500 for 7kWh system and $10,000 for a 10kWh system

KEY BENEFITS

Social

_ Potential improved resilience of local energy system
_ Increase customers' visibility of their energy use

Environmental

_ Reduces the carbon emissions associated with energy consumption

Economic

_ Lower energy prices
_ Increase grid stability
_ Protection during an outage for microgrid participants

BARRIERS/CONSTRAINTS

Political

_ The (perhaps perceived) technical complexity of the approach may limit uptake for opt in
_ All of these options rely on a multi-stakeholder approach, which adds governance complexity.

Financial

_ VPP's and Microgrids require investments at the household scale

Social

_ Customers (residents) need to understand the value

Technical

_ These options require customers to be able to opt out, adding complexity and reducing certainty for commercial investors
_ PowerCor has indicated that they would be unlikely to own precinct batteries in the short term

CRITICAL SUCCESS FACTORS

_ Ultimately a PSP cannot impose a micro-grid or embedded network on a parcel of land
_ A strong business case would need to be developed to engage land owners / developers to become participants in an embedded network or microgrid
_ There is still policy uncertainty at State Government level which increases risk for developers and third party owners / operators of embedded networks
_ Micro-grids require the strong participation of PowerCor, which could not confirm support and would require several years in planning / feasibility


Rooftop solar on houses in Yackandandah (Source: Mondo)

CASE STUDY REFERENCE POINT

Totally Renewable Yakandandah (TRY), which is a volunteer run community group, has teamed up with Mondo Power in order to achieve 100% renewable energy by 2020.

With support from Indigo Shire Council and State government funding, a number of renewable energy projects have been realised. The first of which saw 550kW of rooftop solar PV installed across 106 dwellings, and 110kWh of battery storage - forming one of Australia's first mini grids, integrated with UBI systems that enabled real-time feedback. Additional funding has allowed an additional 33 houses (and 12 UBI systems) to get involved with subsidies for 8 batteries and 7 hot water heat pumps.

As of early 2019 the project had generated over 1GWh of renewable energy, equating to more than $160,000 in local energy cost savings.

ENERGY: Renewable energy purchase

MECHANISM DESCRIPTION

For developments that are aiming for zero net emissions, following the increase in thermal performance (and potential renewable generation and storage), any residual energy needs could be procured through renewable sources such as 'GreenPower' (a government program that enables households and businesses to displace their electricity usage with certified renewable energy).

At precinct scale, this would require a facilitated power purchase agreement (PPA) to enable the purchase of renewable energy from a specific remote renewable energy generator for an agreed price for an agreed length of time, with the idea that this could then be 'white labelled' and marketed to residents (noting retail contestability would need to be maintained).

Mechanism type

Finance, governance and operational model - This could be noted as an outcome sought through the PSP, but would need to be separately delivered (brokered and promoted).

Carbon impact

_ Reduction in carbon associated with residual energy supply (following energy efficiency and on-site generation)
_ The benefit is however scaleable and relies on voluntary uptake. Current broad community uptake is low. The potential impact is scalable

112 MW Karadoc Solar Farm in Victoria (Source: PV Magazine Australia)

COST IMPLICATIONS

_ The retail cost premium for traditional 'GreenPower' renewable energy purchase is approximately 4c kWh. This rate fluctuates and cannot be forecast with accuracy for 2040.
_ A facilitated PPA through a retail partnership may be able to offer customers a lower marginal rate on top of a traditional black power price

KEY BENEFITS

Social

_ Promotes equality of access to renewables
_ Ability to access renewable energy without residents/business having to either develop a project themselves or have appropriate space for installing renewable energy infrastructure on their property

Environmental

_ This measure has the largest ability to reduce residual electricity emissions in the precinct and remove the reliance on the grid decarbonising to achieve emissions reductions

Economic

_ Promotes investment in fossil fuel free electricity investment
_ Enables support for new renewable energy projects
_ Enables participants to at least partially lock-in long term price certainty while also receiving a retail electricity supply service
_ Provides price certainty to both parties to the agreement and creates market demand for renewable energy

BARRIERS/CONSTRAINTS

Political

_ Legislative challenges to "lock in" contracts and "embedded networks"

Financial

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

Social

_ Lack of market acceptance of a shared electricity product

Technical

_ Developing a model with flexibility for a range of different customer types is challenging and administratively time consuming for the lead
_ Coordination of multiple authorities to ensure equitable and safe outcomes

CRITICAL SUCCESS FACTORS

_ Demonstrating benefit to voluntary purchasers will be critical - white labelling (East of Aberline Power)
_ Linkages with VPP's or in precinct solar generation (e.g. mid scale solar farm) can improve communication value (please note Precinct Solar opportunity highlighted)
_ High levels of building scale solar and on-site storage will be effective in limiting the residual electricity that needs to be procured (an extra 4c kWh on 3kWh a day is better than an extra 4c kWh on 16kWh per day

MREP2.0 used renewable wind energy (Source: Energetics)

CASE STUDY REFERENCE POINT

The City of Melbourne has facilitated a commercial power purchase agreement (PPA) for a number of large businesses within the city, in the second instalment of the Melbourne Renewable Energy Project (MREP2.0).

The project uses a supply-linked PPA to secure 110 GWh of renewable electricity per year to the purchasing group, over 10 years. The renewable energy will be used to power 14 shopping centres, nine office buildings, seven educational campuses, and four manufacturing facilities across greater Melbourne.

In addition to reducing emissions and supporting the development of renewable energy generation, the project provides members with greater electricity and environmental budget certainty as 40% of the costs of electricity, and Large-scale Generation Certificate prices for 100% of consumption, are fixed until 2030.

Ecology

The policy, technical and stakeholder context for Ecology is outlined opposite.

The Precinct Structure Plan will have a key role in ensuring biodiversity assets are conserved, with a focus on Tozer Reserve and Russell Creek.

This work will focus on the integration points between ecology and carbon reduction and climate resilience.

LOCAL POLICY CONTEXT

Both Green Warrnambool and Warrnambool 2040 communicate the need the increase community knowledge around biodiversity to create 'buy-in' regarding conservation. Tozer Reserve, which is specifically identified in Green Warrnambool as 'at risk' from urban development provides opportunity to do both while underpinning the ecological value of the precinct.

A number of objectives and strategies in Clause 21.05-2 are specific to Russell Creek and highlight the 'environmental values of Russell Creek could be enhanced both in terms of the riparian vegetation, in stream rehabilitation and improved stormwater quality.'

TECHNICAL CONTEXT

The Bushfire Development Report suggests that the location and interface of biodiversity conservation areas will have to adhere to, or 'take advantage' of vegetation classifications to ensure adequate setbacks for bushfire risk.

The Aboriginal and Historical Heritage Assessment of the site indicates that the retention (of existing vegetation), and integration with new vegetation is not hindered by cultural significance.

The Flora and Fauna Report identifies Tozer Reserve and Russell Creek as the primary conservation areas, suggesting the development of design and siting requirements for development (including recommended plant species for local biodiversity) While the Growling Grass Frog Study returned a negative survey results (i.e. no frogs identified on site), there were a number of existing water features that lend themselves to restoration to support the return of the Growling Grass Frog - and provide opportunities for restricted recreation and environmental education.

The Landscape Strategy suggests the widening and rehabilitation of Russell Creek (including re-vegetation of native species) will be required to improve the amenity and environmental health of the waterway, which may increase the overall width of the reserve and associated development interface.

The Key issues paper and Landowner Consultation further support the conservation of Tozer Reserve due to the presence of the Grassy Eucalypt Woodland (8ha), and Russell Creek - stressing the importance of 'blue-green' infrastructure to provide ecological services while supporting active transport and integrated water management.

STAKEHOLDER CONTEXT

Discussions with Wannon Water reiterated the risk 'Open Stream Syndrome' - the ecological degradation of waterways used to drain urban land. Reducing this risk involves slowing down the flow of water. Stormwater retarding basins adjacent to Russell Creek will obviously be a key component of this strategy, but this can also be partly achieved through the roof water harvesting program (reducing runoff into Russell Creek). Stakeholders are keen to avoid 'urban stream syndrome' where urban waterways are degraded through development pressure.

Consultations between the VPA and landowners had revealed general support for ecologically-led development. Protection of Tozer Reserve and Russell Creek are core to meeting that goal.

Ecology

There are a range of mechanisms that can assist in the preservation and enhancing ecology through the development of the East of Aberline precinct.

Protection of Tozer Reserve and Russell Creek are foundational and are assumed to be embedded in the design of the precinct. Mechanisms explored focus on ecology enhancement through a canopy cover target, ensuring resilience of species to hotter temperatures and reduced rainfall as well as ensuring the connection of other sustainability initiatives to deliver multiple benefits.

The following pages outline analysis of these mechanisms.

MECHANISM / OPPORTUNITY	MECHANISM TYPE	CARBON IMPACT
Canopy cover target	Planning Control	_ Minor carbon reduction related to reduced air conditioning for homes and carbon sequestration, but major benefit is adaptation and amenity related
Nominated biodiversity conservation areas / zones	PSP Element	_ Benefits beyond carbon reduction
Climate resilient species selection targets	Planning Control	_ Major benefit is climate adaptation and ecology

ECOLOGY: Canopy cover target

MECHANISM DESCRIPTION

This mechanism proposes a tree canopy cover target be put in place for the public realm. Green infrastructure can deliver a range of benefits (ecosystem services) including biodiversity and urban heat mitigation. By setting a target for canopy cover, land developers can retain flexibility as to how canopy cover is delivered.

An extended hand over period is proposed to improve establishment and maintain tree health.

Mechanism type

Planning control - The planning control would require that subdivision plans / landscape plans provided through subdivision applications meet a minimum modelled canopy cover % (e.g 25%) within a defined period (e.g. within 25 years).

Carbon impact

Minor carbon reduction related to reduced air conditioning for homes and carbon sequestration, but major benefit is adaptation and amenity related.

Vegetation mitigates urban heat in outer suburbs (Source: Domain)

COST IMPLICATIONS

_ The capital investment is made by the developer through the subdivision process
_ Green infrastructure programs can be staged over time and are already a part of subdivision development
_ A higher maintenance cost for Council through increase tree maintenance following handover is offset by delivery of range of ecosystem services

KEY BENEFITS

Social

_ Improved connection to nature
_ Recreation, aesthetic value and contribution to place
_ Health and well-being benefit of increased open space in dense centres
_ Reduced exposure to extreme heat, increased privacy and noise buffering

Environmental

_ Canopy trees reduce stormwater runoff and filter air/water
_ Carbon benefits through sequestration and through reduced use of air conditioning during summer
_ Improved ecological outcomes such as biodiversity links for koalas, local birds and Growling Grass Frog

Economic

_ Increased value of homes
_ Reduction of summer cooling loads (lower energy bills)
_ Protection of surfaces (potential longer life of hard landscaping)

CRITICAL SUCCESS FACTORS

_ Clear parameters around canopy targets and methodology for deriving requirements for individual development parcels (absences of parks may put more pressure on streets or vice versa)
_ Targets need to be devised with specific outcomes in mind (i.e. urban heat reduction, cool routes, stormwater management)
_ WCC is best placed to deliver maintenance programs, but would require expanded teams
_ Partnerships with water authorities are critical in establishing opportunities for passive irrigation and alternative water supply
_ An agreed palette of suitable local species which have potential for reasonably quick growth and broad canopy cover, and integration with existing (locally native) vegetation
_ Other owners of infrastructure in road reserves need to be involved in order to align objectives to provide ‘complete streets’

CASE STUDY REFERENCE POINT

Brimbank City Council, through it’s Urban Forest Strategy 2016 - 2046 has created a pathway for increasing canopy cover in the City from 6.2% to an ambitious 30% over 30 years.

The strategy builds on the ‘Greening the West’ initiative, and provides a strategic framework for supporting urban greening.

BARRIERS/CONSTRAINTS

Political

_ Roles and responsibilities for investment
_ Streetscapes in particular are strongly contested for other infrastructure, making increased greening challenging - selection criteria may include ‘tree root impact’ to mitigate

Financial

_ The upfront and ongoing investment required for canopy to be established and its health maintained
_ Developers may push back due to reduced lot yield and additional involvement required

Social

_ Not everyone is supportive for a range of reasons and considered communication around benefits for businesses and residents needs to be provided

Technical

_ The species of trees that will best survive and thrive in the future may differ from those previously been planted
_ Underlying soil profiles may require improvement (potential contaminants in some areas of land)
_ A target alone doesn’t consider optimised location - competition within road reserves means street trees need to be carefully planned (improved regulation to meet the objectives of a range of stakeholders would improve this)

Shading thermal mass elements such as brick helps reduce the urban realm (Source: CoM)

ECOLOGY: Nominated biodiversity conservation areas / zones

MECHANISM DESCRIPTION

This opportunity includes the development and enhancement of key biodiversity conversation areas or zones through the East of Aberline Precinct. The Precinct Structure Plan will have a key role in ensuring biodiversity assets are conserved, with a focus on Tozer Reserve and Russell Creek.

The Flora and Fauna Report identifies Tozer Reserve and Russell Creek as the primary conservation areas, suggesting the development of design and siting requirements for development (including recommended plant species for local biodiversity). While the Growling Grass Frog Study returned a negative survey results (i.e. no frogs identified on site), there were a number of existing water features that lend themselves to restoration to support the return of the Growling Grass Frog.

Enhancement of biodiversity conservation zones supports a range of benefits including improved amenity, biodiversity and stormwater quality. This aligns with other opportunities such as increasing canopy cover, WSUD projects and programs as well as stormwater harvesting

Mechanism type

PSP Element - Designation of Tozer Reserve and Russell Creek as open space or public use and appropriate buffering to ensure protection. A further operational (program) investment in distilling environmental custodianship in new residents is proposed.

Volunteers plant many thousands of seedlings every year in Warrnambool and district (Source: Warrnambool Coast Care Landscare)

COST IMPLICATIONS

_ The cost implications relate primarily to the opportunity cost of not being able to develop the land, however the community benefit far outweighs this lost in developable area

_ Management costs may increase for Tozer Reserve due to the urban interface, currently managed by the Tozer Reserve Commitee of Management

KEY BENEFITS

Social

_ Increase community knowledge and awareness of biodiversity values - including integration with Primary School and environmental curriculum

_ Increase membership and involvement of Landcare groups in the area

_ Potential community ownerships and management of Tozer Reserve, or 'friends of Tozer Reserve' initiative

_ Core recreational realm inspires community engagement and sense of place - with key opportunity around Primary School and wildlife links

Environmental

_ Achieve improved waterway health

_ Protect, enhance and rehabilitate biodiversity

_ Targets for peripheral dwellings such as native 'bee corridors'

_ This aligns with other opportunities such as increasing canopy cover, WSUD projects and programs as well as stormwater harvesting

Economic

_ Value uplift and investment catalyst through investment in place

_ Provides a natural system framework to underpin regional planning

_ Provides multiple benefits from single opportunity (conservation, recreation, urban heat mitigation etc.)

CRITICAL SUCCESS FACTORS

_ Clear designation of Tozer Reserve for conservation purposes

_ Resolved operational governance for Tozer Reserve and the Russell Creek buffer

_ Appropriate zoning of Tozer Reserve and Russell Creek to reflect ecological significance

_ Environmental program investments to ensure new residents understand environmental values and can help ensure conservation / protection of habitats

_ Signage and other communication to improve awareness and educate residents

BARRIERS/CONSTRAINTS

Political

_ Demonstrating community benefit from conservation areas

_ Multi-stakeholder processes with potentially complex governance

Financial

_ Management and complexity of financial contributions from a range of parties

Technical

_ The Bushfire Development Report suggests that the location and interface of biodiversity conservation areas will have to adhere to, or 'take advantage' of vegetation classifications to ensure adequate setbacks for bushfire risk

_ Ongoing maintenance requirements to maintain ecology value, aesthetics and bushfire safety

_ Limited planning provisions to recognise the ecological significance due to current zoning (largely identified as 'Farming Zone')

_ Challenge to protect native vegetation during development and construction

Ginninderry's conservation zone (Source: Ginninderry)

CASE STUDY REFERENCE POINT

The Ginninderry precinct just outside of Canberra (on the ACT/ NSW boarder) has retained 596 of the 1,600 hectare site as a conservation corridor.

The size of the corridor and location of boundaries were determined through scientific studies, and aim to protect the endangered Pink-Tailed Worm Lizard habitat, conserve Yellow Box Red Gum Grassy woodland and to preserve the natural beauty of the landscape.

In addition to protection of endangered species and ecological communities, the corridor has additional benefits as an asset for nature based recreation, and education for the broader Belconnen community.

ECOLOGY: Climate resilient species selection targets

MECHANISM DESCRIPTION

Many native and indigenous plant species are consider climate resilience due to their ability to withstand dry and hot conditions - which are expected to increase with climate change, however some species have a more limited range of conditions and may not fare well in hotter and slightly drier conditions.

Setting lot or precinct-scale targets in relation to plant species selection is critical in reducing potable water consumption for irrigation, and community resilience.

Additional benefits for biodiversity can be achieved if plant species are locally indigenous and facilitate rehabilitation where ecosystems have been previously fragmented by development.

Mechanism type

_ Planning Control - Requirement for subdivision application (public land) which requires % (e.g. 70%) of non-productive (food) plants specified to accord with an approved climate resilience list
_ Secondary mechanism for private land where the same list guides landscaping at the lot level (through Design Guidelines mechanism) - this may be restricted to front yard plantings only

Warrnambool enjoys a variety of ecosystems and native plant species (Source: Waterfront Living)

COST IMPLICATIONS

_ No cost implications on capital investment beyond the initial investment in the development of a suitable local species list
_ Theoretically climate resilient species should require less water for establishment and less ongoing care due to high levels of adaptation to local conditions (reducing operations and maintenance costs)

KEY BENEFITS

Social

_ Development of awareness about climate resilient species

Environmental

_ Reduction in potable water consumption in private and public open space
_ Additional biodiversity benefits is plant species are locally indigenous
_ Facilitation of rehabilitation of the local ecosystem

Economic

_ Increased resilience improves likelihood of plantings surviving extreme conditions and therefore avoiding replacement costs
_ Vegetated areas typically attract price premiums
_ Decreased irrigation costs
_ Potential collaborations and incentives with local nurseries to offer discounts (particularly for private, on-lot plantings)

BARRIERS/CONSTRAINTS

Financial

_ Investment required to establish a suitable local species list

Social

_ Resistance to constraining plantings to climate resilient species
_ Community may lack understanding of the benefits of 'restricting' selection to climate resilient species

Technical

_ Available evidence on resilience of local plants in hotter and slightly drier conditions
_ Bush Fire control risk associated with new plantings

CRITICAL SUCCESS FACTORS

_ Choice of plants and design of gardens important in demonstrating the aesthetic values of climate resilient and locally native species
_ Potential to incorporate species selection into display suite to showcase benefits (and aesthetic values)
_ Council in setting and monitoring the targets/standards, ensuring that compliance is maintained beyond the initial landscaping
_ Education of lot owners - a compelling narrative as to why to plant in accordance with the species list
_ Suitable investment in the development of a suitable climate resilient species list that provide context around selection (to educate residents)

The Australian plant Society provides great advice for Warrnambool, and is supported by Council (Source: Victorian Native Seed)

CASE STUDY REFERENCE POINT

The City of Melbourne along with the University of Melbourne has undertaken research to identify the vulnerability of the urban forest to climate change.

The report, titled 'Future Urban Forest', identifies that of the 375 species currently planted in Melbourne, 48% of the species (and 35% of currently planted trees) were found to be moderately or extremely vulnerable to a mean average increase of 0.8 degrees by 2040 - and even more so with an increase of 3 degrees.

The research helps identify drought and heat tolerant species that can be incorporated into the urban forest (as older European trees reach the end of their life span) to ensure a diverse and resilient urban forest is maintained in the future.

Integrated Water Management

The policy, technical and stakeholder context for integrated water management is outlined opposite.

The Precinct Structure Plan will have a key role in reducing potable water use, managing flooding and boosting the health of vegetation within the streets and public realm.

In anticipation of a detailed integrated water management plan and drainage strategy (currently in development), this work will focus on primarily on governance and integration of IWM opportunities.

LOCAL POLICY CONTEXT

A number of 'Immediate actions' for council presented in Green Warrnambool support an Integrated Water approach for EOA include: develop a 'Blue-Green' City Plan to guide IWM and WSUD in development and support neighbourhood-scale solutions for stormwater and treatment reuse. Water conservation is further supported in local policy, with clause 21.06-2 identifying WSUD principles and stormwater management through constructed wetlands as key strategies.

The PSP for East of Aberline presents a key opportunity for delivering a truly integrated approach, in particular with localised opportunities for reuse of roof water and other surfaces.

TECHNICAL CONTEXT

The Bushfire Development Report highlights the potential for re-vegetation of existing water features (i.e. Wetlands, and drainage areas) to increase bushfire risk, and may have implications regarding their design and integration with open space.

Both the Aboriginal and Historical Heritage Assessment and Flora and Fauna Report articulate that any future development within the EOA site should adopt the principles of Water Sensitive Urban Design (WSUD) with an integrated approach to stormwater and flood management that meets the objectives for hydraulic capacity, flood management and water cycle management.

The Flora and Fauna Report further recommends that drainage infrastructure such as wetlands should be strategically located to integrate with natural assets such as Russell Creek. The Landscape Strategy supports this view and sets up obvious opportunities to link stormwater harvesting with the proposed location of active open space.

The Infrastructure Servicing Report highlights advice from Wannon Water that there is limited capacity to service the entire site from a mains water perspective, and the early identification and planning of a number of detention tanks will be essential to ensuring the network is not at risk of overloading. Roof water harvesting has been identified as a strategy to explore further in the IWM and drainage strategy currently out for tender by the VPA.

The Landowner Consultation supports integration with and expansion of the existing Wannon Water roof rainwater harvesting scheme which has the potential to significantly reduce the size and cost of the wetlands required and reduces the increase in runoff into Russell Creek. It also describes climate responsive neighbourhoods as those that deliver ecological benefits for local waterways, reduce potable water consumption and reduce flood risk while increasing vegetation.

STAKEHOLDER CONTEXT

Wannon Water is supportive of extending their roof water harvesting scheme to the precinct. The concept involves harvesting roof water directly to water storage, significantly boosting local supplies and reducing pumping costs and environmental impacts of sourcing in the Otways. Wannon Water are also supportive of exploring stormwater harvesting solutions which link to irrigation needs within the precinct.

Additionally, Wannon Water is interested in exploring innovative wastewater treatment (refer Aquarevo case study as an example).

The VPA indicated the delivery of a comprehensive IWM and Drainage strategy by December 2020.

Integrated Water Management

There are a range of mechanisms can assist in delivering a truly integrated approach to water management.

The mechanisms highlighted focus on two major infrastructure opportunities and the potential for target setting to guide on-lot and public realm potable water reduction.

The following pages outline analysis of these mechanisms.

MECHANISM / OPPORTUNITY	MECHANISM TYPE	CARBON IMPACT
Roof water harvesting scheme	PSP element	_ Major benefit is in water supply resilience and stormwater management (however carbon benefit in reduced pumping energy requirements)
Stormwater harvesting (for streets and open space)	PSP element	_ Major benefit is water supply resilience and ecology
Water efficiency target	Planning control	_ Major benefit is in water supply resilience (however minor carbon benefit in reduced pumping energy requirements)

IWM: Roof water harvesting scheme

MECHANISM DESCRIPTION

In this opportunity, rooftops within the East of Aberline precinct are viewed collectively as a new drinking water catchment.

Stormwater from rooftops is collected and transferred to local raw water storage ponds (or tanks) before being processed at a water treatment plant before being reticulated back to the households as an alternative drinking water supply.

This opportunity is specific to the local conditions where water storages are located proximate to the development area. The ability to augment potable water supplies means the cost and carbon emissions associated with water supply from the Otways can be avoided. The opportunity is being investigated in detail through the IWM planning process.

Mechanism type

PSP element - Direct investment associated with innovative governance model. A control (implemented through Design Guidelines) would be required for compliance.

Carbon impact

Major benefit is in water supply resilience and stormwater management (however carbon benefit in reduced pumping energy requirements)

Rainwater storage in Fitzroy Gardens, Melbourne (Source: CoM)

COST IMPLICATIONS

_ An investment is required both on lot and in to pay for the additional underground infrastructure to distribute roofwater harvested to water storages
_ There is potential to recoup investment through a suite of mechanisms, e.g. through co-contributions, waiver of some aspects of water supply connection / supply / usage charges

KEY BENEFITS

Social

_ Avoids households needing to install and manage own rainwater collection system

Environmental

_ Reduced take from the Gellibrand River (~5% of annual requirements)
_ Reduction in peak and flash flows to Russells Creek, reduced pollutant load
_ Reduced carbon associated with pumping
_ Infrastructure and stormwater quality improvements

Economic

_ Wannon water highlighted the potential for reduction in the size of stormwater retarding basins if a roofwater harvesting scheme was implemented (this means less loss of development area for stormwater retention and reduced capital cost of excavation)

Technical

_ Decentralised tanks can be located on individual lots to allow for private use

BARRIERS/CONSTRAINTS

Political

_ The scheme is challenging to communicate to non-technical audiences

Financial

_ The scheme comes with an infrastructure supply cost, which is currently in subject to further development
_ Landowners don't receive any reduction in water supply costs

Technical

_ The scheme requires a separate pipe network (both within and outside lot boundary)
_ Buffer tanks required due to limited trunk main capacity
_ No obvious technical issues as scheme has been trialled successfully in adjacent development

CRITICAL SUCCESS FACTORS

_ The business case and distribution of costs and benefits establishing a benefit or only minor financial loss to residents and developers - currently developers / purchasers outlay additional costs of infrastructure but are not distributed the benefit via lower water costs
_ Clear governance arrangements that ensure maintenance of assets on private land
_ Council support for the extension of the scheme
_ A clear outline of the benefit of potential reduction in stormwater retention sizes
_ Conclusive support from the IWM Planning going on currently with this work
_ Inclusion as an infrastructure requirement in subdivisions

Slimline tanks offer benefits with minimal spatial requirements (Source: Kingspan)

CASE STUDY REFERENCE POINT

The Warrnambool Roof Water Harvesting Initiative is a leading example of integrated water management. The project essentially creates a new water catchment by capturing water from roofs that would otherwise be 'lost' as stormwater runoff.

Beginning in 2011 with 250 lots across two subdivisions, the program has now grown to include industrial sheds at the Gateway Business Park, and is capable of connecting another 580 dwellings due to a recent 500-metre extension of the main pipeline.

IWM : Stormwater harvesting (for open space)

MECHANISM DESCRIPTION

This opportunity involves harvesting stormwater for reuse for non-potable purposes. Stormwater is usually harvested from the drainage network.

Stormwater is retained in below-ground or above-ground storages and then treated to the level required by the end user. Treatment can be via mechanical means or through natural system filtration e.g. wetlands. In this case the proposed stormwater retention basins on Russell Creek would be used as sources for open space irrigation. A similar project has just received funding locally for Albert Park.

The stormwater once treated can be made available to local open space or other non-potable end uses. The owner of the scheme (Wannon Water, Local Government or third party) can charge users for the supplied water to contribute to the operation of the scheme. As the scheme also provides stormwater quality benefits, an offset mechanism can also be used to part fund the capital cost. The opportunity is being investigated in detail through the IWM planning process.

Mechanism type

PSP element - Direct investment associated with potential finance model for recouping investment through a usage charge for the harvested stormwater

Stony Creek is currently undergoing revitalisation to restore it to it's natural (vegetated) state (Source: Melbourne Water)

COST IMPLICATIONS

_ Capital investment required for stormwater harvesting infrastructure, including pumps, treatment (filtration / cleaning) and storage (these costs are being investigated through IWM planning)
_ Return on these investments through water customers including Council as the owner of active open space (potential for others)

KEY BENEFITS

Social

_ Supports greening outcomes to improve local amenity
_ Demonstrates leadership for individual action
_ Potential to help mitigate urban heat
_ Can be incorporated into community planning and open space provision further connecting residents to their natural surroundings

Environmental

_ Reduce flood risk and improved waterway health through reduced stormwater volumes to waterways
_ Integrated into other streetscape WSUD initiatives such as permeable surfaces and additional vegetation
_ Reduce use of potable water resources through supply
_ Can reduce urban heat island through open space irrigation
_ Improve health of open space and biodiversity

Economic

_ Can reduce flood risk leading to potential reduction in costs
_ Potentially reduces the cost of potable water supply
_ Well irrigated green parks and open spaces are a catalyst for private investment and land value improvement

BARRIERS/CONSTRAINTS

Political

_ Ownership and maintenance of assets

Financial

_ Equitable distribution of costs and benefits of stormwater harvesting

Technical

_ Yield issues including balancing flows available during low rainfall periods when demand is high
_ Space allocation
_ Local contamination may increase the technical challenges of earthworks
_ Linking location for stormwater harvesting with significant local demand for non-potable water
_ Ensuring synergies between other mechanisms such as roof water harvesting scheme

CRITICAL SUCCESS FACTORS

_ Ensuring the location and scale of open space responds to existing drainage channels - in this case initial locations of active open space (a major water user) seem very well located to Russell Creek and associated stormwater retention basins
_ Appropriate environmental management of run-off into Russell Creek to ensure quantity and quality
_ Willing customer for water (Warrnambool Council as manager of active open space)
_ Support of Wannon Water (the likely owner / operator of the stormwater harvesting assets) to identify flooding and climate scenarios and allocate planning controls appropriately
_ The business case and distribution of costs and benefits establishing mutual benefit

Stormwater Harvesting in Darling Street (Source: Greening the West)

CASE STUDY REFERENCE POINT

The Darling Street Stormwater Harvesting project in East Melbourne is an innovative approach that facilitates irrigation for a handful of neighbouring parks and tree medians.

The system harvests stormwater from two nearby existing drains, which flow through a Gross Pollutant Trap (GPT) and a sedimentation chamber before being stored in underground tanks. Pumps can then be used to convey the collected stormwater into the above-ground biofiltration systems for treatment. The treated stormwater is finally stored in a holding tank ready for irrigation use.

IWM: Water efficiency target

MECHANISM DESCRIPTION

This opportunity includes the adoption of water efficiency targets for buildings and key infrastructure either through planning controls or operational targets.

Reducing the need for water across the precinct could be effective in delivering greater water allocation to areas that may be unable to be serviced by a recycled water supply.

Targets could be attached to planning and development, enforced through specification of water efficient infrastructure as part of builds or through monitoring and operational commitments (e.g. reductions in supply / usage charges if targets are met).

Mechanism type

Planning control - Implemented through Design Guidelines which would specify benchmark for WELS fitings, minimum tank size requirements (TBD following resolution of roofwater harvesting) and low water garden.

Carbon impact

Major benefit is in water supply resilience (however minor carbon benefit in reduced pumping energy requirements)

Drought tolerant landscaping with a river rock swale and resilient plant species (Source: Abben Art)

COST IMPLICATIONS

_ Higher WELS fittings have negligible differential cost
_ An household 2000 ltr rainwater tank (plumbed to toilets) installed is approximately $1700 installed
_ A low water garden is no more expensive
_ Water savings are accrued but these are marginal due to the very low cost of water

KEY BENEFITS

Social

_ Awareness raising for water as a scarce resource
_ Strongly aligned to the drier climate in the west

Environmental

_ Reduced pressure on potable water resources
_ Potential minor reductions in carbon (pumping and hot water heating reductions)
_ Greater climate resilience
_ Reduced wastewater
_ Slightly reduced carbon emissions (from hot water heating and pumping)

Economic

_ Lower water use lowers costs for consumers
_ Increased resilience to State water restrictions
_ Locks in long-term reduced potable water supply requirements, reducing pressure on regional water supplies
_ Reduces costs of supply side solutions (reduced capacity required)

BARRIERS/CONSTRAINTS

Political

_ Resistance from developers and/or market

Financial

_ Potential premium on water efficient infrastructure
_ Currently no incentives (financial or otherwise) for consumers to use these premium products

Social

_ Hard to enforce targets in practice - operational controls are required

Technical

_ Potential contested water (roofwater harvesting scheme would be restricted to tank overflow)
_ Potentially contrary to urban heat mitigation objectives (irrigation required for landscaping etc.)

CRITICAL SUCCESS FACTORS

_ Certainty. Water efficiency targets may have the potential to reduce the size of water supply infrastructure (e.g. stormwater harvesting) however the targets would need to be locked in with certainty.
_ Co-operation of Wannon Water and willingness to administer scheme (if an operational rather than household target) .
_ Review process against Design Guidelines
_ Partnership with volume builders about on-site provision of water infrastructure
_ Potential for community facilities to champion best practice in terms of water efficiency targets

5-star WELS washing machines such as the model pictured use as little as 57 litres of water per cycle (Bosch)

CASE STUDY REFERENCE POINT

The Aquarevo development in Lindhurst, Victoria, a project between South East Water and Villawood is aiming to reduce household potable water consumption by 70%.

A number of innovations have been proposed to achieve this, including: rainwater supply for hot water use, local class A recycled water for non-potable uses, smart ‘talk-tank’ technology that enables rainwater tanks to receive weather forecasts, and a network of vegetated wetlands which further reduce pollutant loads in stormwater.

Urban Heat

The policy and technical context for urban heat is outlined opposite.

The Precinct Structure Plan will have a role in managing urban heat in a number of ways, but the role of water in the landscape and canopy cover in streets and private land are most critical.

LOCAL POLICY CONTEXT

Both Warrnambool 2040 and Green Warrnambool commit to an immediate action to pilot a ‘Green Streets’ initiative to use vegetation to cool the urban environment, with the 2040 goal of a 30% canopy coverage across the municipality.

The East of Aberline precinct offers a critical opportunity to redefine regional residential streets to reduce urban heat and provide a ready local exemplar of the target being met.

TECHNICAL CONTEXT

The Bushfire Development Report introduces the concept of vegetation classification based on its potential fire risk, which may have implications for canopy coverage and vegetation provision along those interfaces adjacent the BMO (150m either side of Tozer Reserve). There is therefore a need to meet the objectives of bushfire protection in a way that does not lead to urban heat hotspots in these locations. These locations may require additional maintenance or careful design to reduce their risk classification.

The Key Issues Paper highlights the need for Warrnamabool to be resilient to extreme weather events, including heat waves - and mentions the use of canopy cover to mitigate urban heat, and foster climate change responsiveness.

IMAGE: URBAN HEAT CAN BE REDUCED THROUGH THE USE OF LIGHT COLOURED MATERIALS WITH LOW RATES OF SOLAR ABSORPTION, THE PROVISION OF VEGETATION AND THE USE OF PERMEABLE SURFACES (SOURCE: AUSTIN MAYNARD ARCHITECTS)

Urban Heat

There are a range of mechanisms can assist in reducing urban heat in residential subdivision.

The mechanisms highlighted include the development of a precinct wide plan for managing urban heat as well as exploring the role of pedestrian priority streets to maintain higher standard of amenity during extreme heat. The exploration will also include opportunities for on lot urban heat reduction.

The following pages outline analysis of these mechanisms.

MECHANISM / OPPORTUNITY	MECHANISM TYPE	CARBON IMPACT
Precinct Urban Heat Mitigation Plan and target	PSP element and Planning control	_ Major benefit is adaptation, health and amenity related
Multi stakeholder optimised street sections ('cool routes') linked with Streets and Public realm section and PPN	PSP element with Operational investment	_ Reduction in vehicle trips per day (additional adaptation, ecology and amenity benefit)
On lot urban heat reduction mechanisms	Planning control	_ Major benefit is adaptation, health and amenity related

URBAN HEAT: Precinct Urban Heat Mitigation Plan or Targets

MECHANISM DESCRIPTION

Mitigating the Urban Heat Island effect across a precinct requires multiple interventions in terms of landscape design, integrated water management and materiality. Responsibility may be spread across various stakeholders.

An Urban Heat Mitigation Plan consolidates and prioritises these interventions, articulating targets (and responsibilities) around public shelter, canopy cover and materiality (i.e. high SRI roofing). There is a specific policy direction to reduce the UHI effect included in both state and local policy. Urban heat can be mitigated through a number of strategies on private and public land. If an urban heat mitigation plan cannot be funded in this PSP, then prescriptive targets can be implemented at a subdivision application stage.

Mechanism type

PSP Element - Either a PSP process is funded for an Urban Heat Mitigation Plan which delivers site specific responses OR

Planning control - Put in place for each subdivision application (or masterplan area) a proportion of public realm surfaces which constitute either tree canopy at 15 years, other physical shade structure, shrubs or ground covers, irrigated open space, water bodies or hard landscape meeting an Solar Reflectance Index of 50 or greater.

Permeable pavement reduces heat gain of thermal mass elements (Source: Premier Pavers)

COST IMPLICATIONS

_ Cost implications vary according to which cooling measures are adopted
_ Generally speaking, materials with a high solar reflectance are equal or only marginally more expensive
_ Shrubs and ground cover require greater capital investment than turf, but lower maintenance

KEY BENEFITS

Social

_ Effective strategies to lower urban heat can lower incidence of heat-related illness and heat stress
_ Support the delivery of more comfortable, social street environments

Environmental

_ Aggregated impact of building scale responses 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
_ Provides additional support for additional mechanisms such as canopy cover, stormwater harvesting (as there are overlaps in outcomes)

Economic

_ Reduction in total economic cost to community of heat waves
_ Reduced cooling costs in summer

BARRIERS/CONSTRAINTS

Political

_ To be effective, an Urban Heat Mitigation Plan would require coordination across agencies
_ Landowners may resist some of the requirements

Financial

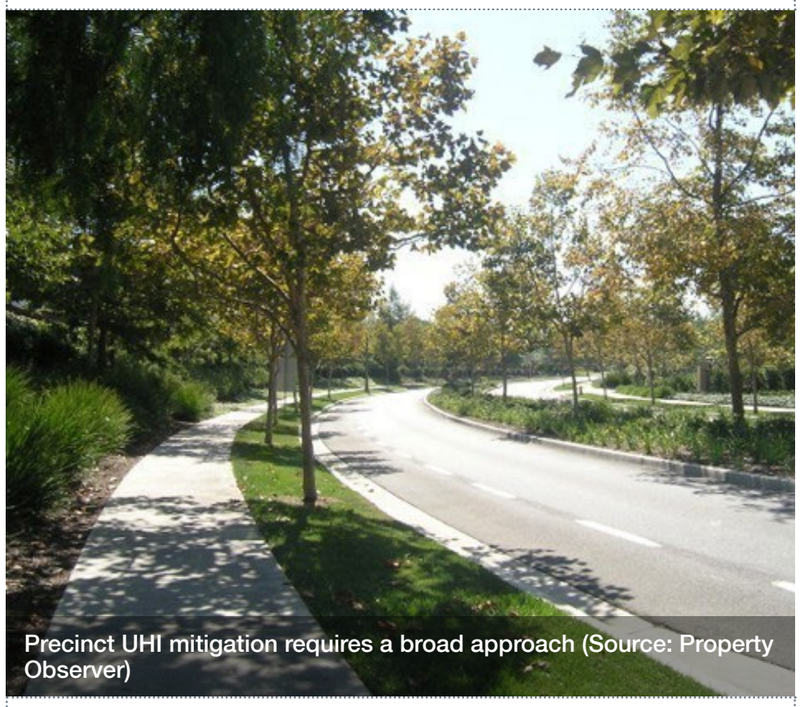
_ Potential for slightly increased development costs through use of more advanced materials selection

Technical

_ Flexible benchmarks will assist in delivering on targets in a manner reflective of site constraints
_ Further guidance on what constitutes an increase in solar reflectance will need to be developed to guide developer responses

CRITICAL SUCCESS FACTORS

_ A clear delineation in the East of Aberline PSP of the specific role of public realm and building based measures in reducing urban heat (see next page)
_ Flexibility in approaches - 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
_ Multi-stakeholder participation in Urban Heat Mitigation Plan
_ Clear definition of targets and responsibilities in the Urban Heat Mitigation Plan or PSP



Precinct UHI mitigation requires a broad approach (Source: Property Observer)

CASE STUDY REFERENCE POINT

Urban renewal precincts such as Fishermans Bend have articulated the challenges associated with intensified development and urban heat, and the need to become ‘climate adept’.

The Fishermans Bend Vision and Sustainability Goals includes objectives such as ‘4.1: reduce the urban heat island effect’, and ‘4.2: Embed green infrastructure into the design of public spaces and buildings, to reduce heat, capture storm water and provide biodiversity’. With a 2050 target that ‘the urban heat island effect is reduced so that Fishermans bend will be no hotter than inner Melbourne’, supporting a community that is resilient to the shocks and stresses of climate change.

URBAN HEAT: Street sections ('cool routes')

MECHANISM DESCRIPTION

A 'cool route' is essentially a streetscape designed to create a cooler micro-climate for pedestrians through the use of shade, vegetation and materiality (i.e. lighter coloured paving).

It is critical that cool routes (and all pedestrian infrastructure) service multiple stakeholders through accessible design and are well integrated and articulated within the broader Principal Pedestrian Priority Network.

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), explicitly acknowledges the importance of green infrastructure to any climate change response.

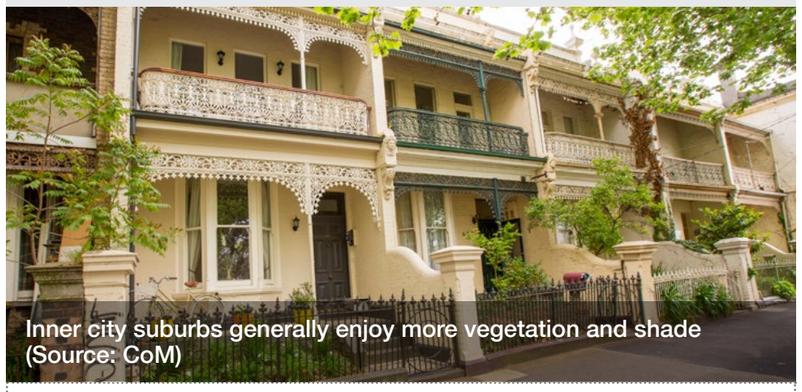
Mechanism type

PSP element - Cool routes are identified in the Transport Plan. The PSP is specific about the role of cool routes, their relationship with the PPPN and how they are defined in the East of Aberline context. A target would be set for higher canopy cover levels, frequency of street furniture and prescriptive guidance around hardscaping materials.

Operational investment - Designation of these routes are supported by wayfinding and potentially by online mapping tools.

Carbon impact

Minor (unquantified) reduction in vehicle trips per day (primarily adaptation, ecology and amenity benefit).



Inner city suburbs generally enjoy more vegetation and shade (Source: CoM)

COST IMPLICATIONS

_ Minor additional investment in street furniture / tree planting / surface treatments
_ Operational investment in communications
_ Operational benefit to residents from improved pedestrian amenity (offsetting car use)

KEY BENEFITS

Social

_ Effective strategies to lower urban heat can lower incidence of heat-related illness and heat stress
_ Increased likelihood of use of active transport options (walking, cycling) during hot weather
_ Green infrastructure provides cultural ecosystem services including place value and social cohesion, accessibility to nature and recreation value
_ Integration potential with rest-nodes and pocket parks to support a variety of pedestrian users and social interaction
_ Ecologically diverse areas more conducive to mental health and well-being (i.e. Biophilia)

Environmental

_ Green cover provides a range of ecosystem services including stormwater runoff mitigation, urban heat reduction, habitat for biodiversity

Economic

_ "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
_ Integrate with convenience centre to support pedestrian access during all weather conditions

BARRIERS/CONSTRAINTS

Political

_ Potential conflicts with contested streetscape for other requirements (cross overs etc.)

Financial

_ Some additional capital cost of infrastructure to support cool routes

Social

_ Communication of investment / priority status of streets to increase adoption of routes for walking

Technical

_ Promenade designs using singular trees may be susceptible to future shocks and stressors of climate change - need to ensure variety

CRITICAL SUCCESS FACTORS

_ Responding to site context and integration of local indigenous species will ensure a cool route that performs both ecological and aesthetic functions.
_ Subdivision applications must require of a Landscape Plan to the satisfaction of the responsible authority to ensure ongoing viability of mechanisms supporting 'cool routes'
_ WCC will needs to set standard in PSP and ensure routes are aligned with broader objectives around connection to other services such as schools
_ Potential conflicts with other needs in streets will need to be successfully managed
_ Must be coordinated with active transport planning to deliver greatest outcome

'Cool routes' incorporate shade to support multiple users (Source: Weekend Notes)

CASE STUDY REFERENCE POINT

The Shadeways project in Bendigo highlights new approaches to understanding and designing green infrastructure within the public realm.

The project aims to essentially identify and support the creation of 'cool routes' through a prototype route mapping tool that uses a range of data inputs including, satellite images, census demographics, sky level factor and Google street images (and more) to assess the heat vulnerability and thermal discomfort associated with various urban pathways.

The output allows greater certainty for public investment into streetscape improvements in terms of vegetation and urban heat mitigation.

URBAN HEAT: On lot urban heat reduction mechanisms

MECHANISM DESCRIPTION

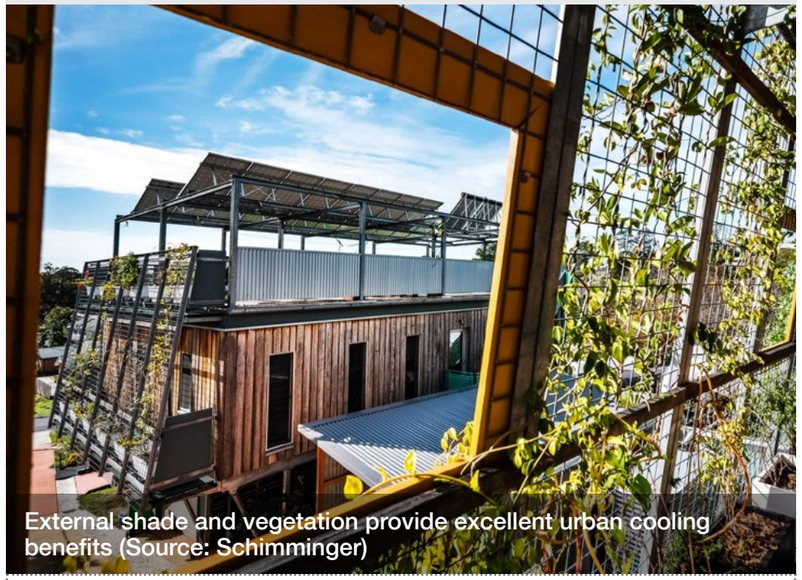
Reducing urban heat at the dwelling-scale involves setting targets parameters for built form which promote vegetation on private land, as well as surface treatments which absorb less solar energy.

The benefit is gained when the ratio of green space to built form is higher, hardscaping is minimised and surfaces such as roofs are lighter coloured colourbond (rather than dark coloured concrete tiles).

All of these measures could be effectively controlled through Design Guidelines, with the potential adoption of the Melbourne Green Factor tool for assessment of on-site green infrastructure.

Mechanism type

Planning control - Implemented through Design Guidelines which mandates a proportion of private lot surfaces which constitute either tree canopy (at 15 years), other physical shade structure, shrubs or ground covers, irrigated open space, water bodies or hard landscape or roofs meeting a Solar Reflectance Index of 50 or greater. Design Guidelines could be extended to mandate some adaptation measures such as external shading. A secondary mechanism (also a Design Guideline) may be required to manage built form as a percentage of the lot.



External shade and vegetation provide excellent urban cooling benefits (Source: Schimminger)

COST IMPLICATIONS

_ Some of the measures proposed by Design Guidelines may add cost (shade structures etc.) however these will be more than offset is home sized is managed effectively

KEY BENEFITS

Social

_ Reduction in heat stress on hot days

Environmental

_ Reduction in energy demand during heat events
_ Increase in on-lot vegetation provides a range of ecosystem services including stormwater runoff mitigation, urban heat reduction and habitat for biodiversity
_ Potential for mandated front setbacks for dwellings supports vegetated public realm delivering multiple benefits

Economic

_ Reduced cooling costs to household
_ Likely to have a degree of developer support, as consultation on the Sustainable Subdivisions Framework revealed that landscaping seen as a top ESD measure to add commercial value
_ “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

BARRIERS/CONSTRAINTS

Political

_ Imposing requirements regarding on-lot measures may be met with resistance by private land owners

Financial

_ Ongoing cost to lot-owner of maintaining vegetation, shade structures and/or water bodies

Social

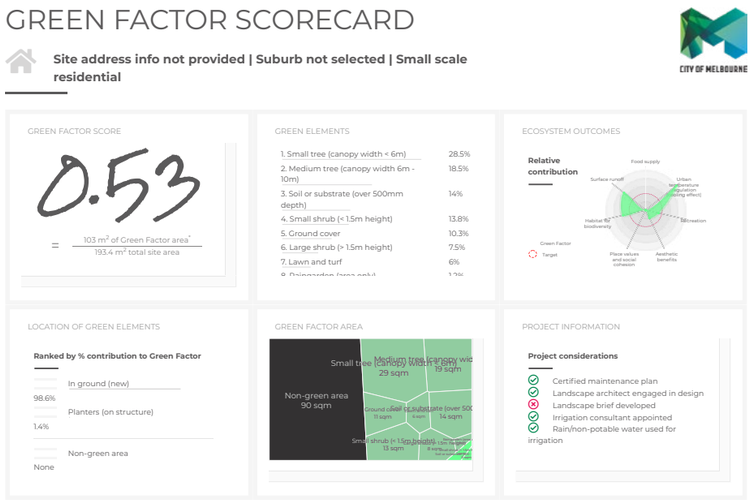
_ Requirement to educate incoming residents on importance of maintaining on lot heat measures
_ Challenges current convention of high site coverage for dwellings

Technical

_ Further guidance on what constitutes an increase in solar reflectance will need to be developed to guide developer responses

CRITICAL SUCCESS FACTORS

_ Success of measures will be dependant on lot owner meeting targets and maintaining measures that reduce heat (including planting and tending trees until maturity, installing shade sales, maintaining a reflective roof, etc.)
_ The proposed Design Guideline measures will be more effective and deliver significant other benefits (such as carbon reduction) if home size can be reduced - this creates more garden space on the same size lot, makes canopy trees easier to site and gives greater balance to any hardscaped versus softscaped areas
_ Design Guidelines will need to clearly articulate private lot surfaces which can contribute to the proposed target
_ A clear narrative for home builders and dwelling owners will be required to communicate benefits
_ Road reserve widths and dwelling setbacks need to be prescribed together to support urban heat mitigation



An example of the green factor score for a BAU single residential project in Melbourne (Source: CoM)

CASE STUDY REFERENCE POINT

The City of Melbourne has recently launched a Green Infrastructure tool that is able to measure the quality and quantity of vegetation prevision at the planning permit stage to ensure new developments are in line with municipal urban cooling and canopy cover targets.

The tool generates a ‘green factor’ score and takes into account the scale, accessibility, ecosystem services, aesthetics and biodiversity quality of vegetation provision.

Circular Economy (Waste & Materials)

The policy, technical and stakeholder context for circular economy is outlined opposite.

The Precinct Structure Plan can guide progress towards a circular economy in a number of ways, including 'closing the loop' on household level waste practices and ensuring that the materials that are used in creating the community are low impact.

LOCAL POLICY CONTEXT

Both Warrnambool 2040 and Green Warrnambool list the introduction of kerbside FOGO, investing in local recycling markets, investigating centralised systems and supporting local circular economy initiatives as immediate council actions. There is a significant opportunity to integrate (for example) a community garden and repair shed into broader community infrastructure provision.

As a signatory of the Infrastructure Design Manual (IDM), Warrnambool can support the development of infrastructure with a longer usable life, with lower carbon through its application. Warrnambool City Council are encouraging the use of the Sustainable Infrastructure Guidelines (related to the IDM) which advocates for the use of recycled, locally procured materials in the delivery of infrastructure projects.

Although a full analysis has not been completed due to the focus on local policy in this review, the freshly minted Recycling Victoria strategy presents potential opportunities for funding and program alignment.

TECHNICAL CONTEXT

The Key Issues Paper identifies a number of opportunities regarding waste and materials such as: the recovery and reuse of construction materials, recycled content in road base, increasing recycling waste streams and the promotion of community gardens and FOGO.

STAKEHOLDER CONTEXT

Wannon Water has also indicated interest in investigating organic solutions for on-lot processing of wastewater. This will both facilitate more efficient water re-use, while potentially delivering broader emissions reductions associated with reducing the transportation and mechanical filtration of stormwater.

BSWRRG's primary focus has been to work with councils to create campaign resources and education opportunities, however is supportive of a number of precinct-scale interventions to facilitate more efficient waste management.

Creating local opportunities for reuse of organics and other waste were identified as key priorities and the opportunity to support new residents in establishing good waste behaviour was identified as a program opportunity. Creating local recycling markets was also identified, however relies on volume of which can be a challenge in regional areas.

BSWRRG has identified the expansion of the current 3-bin kerbside collection, to 4, which requires space for storing the bins in addition to adequate access to collect (via four trucks). The alternative entails centralising the final waste stream and having a drop-off service.

Circular Economy (Waste & Materials)

There are a range of mechanisms can assist in accelerating the circular economy for East of Aberline.

The mechanisms highlighted focus primarily on maximising the impact of existing investments and the use of materials have lower embodied carbon, reducing the immediate impact of construction.

The following pages outline analysis of these mechanisms.

MECHANISM / OPPORTUNITY	MECHANISM TYPE	CARBON IMPACT
Precinct based operational waste program	Operational investment	_ Reduced carbon associated with waste management through increased use of existing FOGO collection and improved diversion of paper and cardboard from landfill
Embodied carbon targets	PSP element	_ Reduction in carbon associated with embodied energy of materials
Locally focused Sustainable Materials Protocol	Operational investment and Planning control	_ The major benefit is embodied rather than operational carbon

CIRCULAR ECONOMY: Precinct based operational waste program

MECHANISM DESCRIPTION

Keeping FOGO out of landfill helps improve soils on local farms and increases carbon capture, generates significantly less methane and results in significant cost savings for council. Recycling, also results in significant carbon savings.

An effective waste management system however relies on residents understanding how to use the service correctly, to keep contamination rates low and diversion rates high. In Victoria the average contamination rates of recycling services are 6.5%.

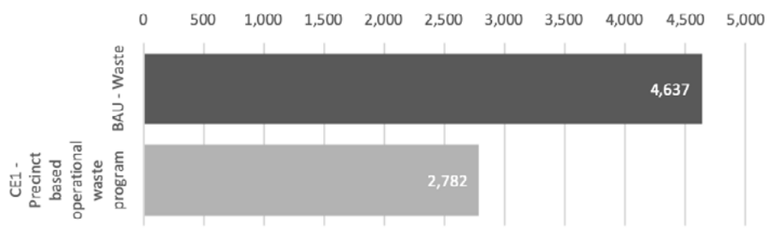
This proposed mechanism would deliver a behaviour change and education program to support residents to build their knowledge and establish good waste management practices as they move into their newly built home.

Mechanism type

Operational investment - In staffing, travel and other supporting resources (i.e. a FOGO starter kit, caddy, bin liners, signage/ stickers etc.).

Carbon impact

Reduced carbon associated with waste management through increased use of existing FOGO collection and improved diversion of paper and cardboard from landfill.



COST IMPLICATIONS

_ $150 per household ($30K per year)
_ Opportunity to leverage existing investment in waste education
_ It is possible that this additional operational investment in improving diversion rates with new residents could result in a net economic benefit.

KEY BENEFITS

Social

_ Community and household pride in doing the right thing
_ Contributing to making good quality compost locally
_ Key opportunity for new residents to engage with Council and neighbours
_ Waste as a starting point for engagement on broader environmental and climate issues (and education)

Environmental

_ Increased household waste diversion
_ Improved soils on local farms and increased carbon capture
_ Reduction in carbon/methane from landfill

Economic

_ Cost savings for council with improved rates of diversion
_ Extend the life of landfill
_ Creates value from organic waste (to be incorporated into local food production)
_ Potential digester could be used to generate energy (and consume sewage solids)

CRITICAL SUCCESS FACTORS

_ Effective waste management system in place ensuring a good user experience
_ Provision of physical infrastructure to support the behaviour change
_ Well designed, evidence based behaviour change model
_ Long term commitment to the program
_ Consistent messaging
_ Prioritising behaviours that require changing and the strategies to do so.
_ Building community ownership and pride of the solutions

Providing multiple waste streams and supporting infrastructure is critical to support (Source: The Conversation)

BARRIERS/CONSTRAINTS

Political

_ Lack of perceived value in improving diversion rates and reducing contamination

Financial

_ Requires additional operational investment

Social

_ Perceptions of the difficulty of recycling or separating waste streams and the ‘yuk’ factor, including smell from organic waste

A circular economy requires behaviour change (HV.H)

CASE STUDY REFERENCE POINT

In 2015, the City of Wodonga and Indigo Shire Council introduced a 3-bin kerbside collection service. In the lead-up to the launch of the new service, the councils received funding from Sustainability Victoria to roll out a behaviour change and education program using community-based social marketing (CBSM).

The program utilised a budget of $10.40 per household over two and a half years to deliver a range of interventions including: physical infrastructure (like kitchen caddies, bin liners), prompts (magnet reminders), staff training for all customer serviced staff, printed collateral (an introductory pack with fact sheets, stickers etc), community engagement events and education and local advertising.

Waste diversion increased by 36 per cent and contamination in the organics bin fell to below 1 per cent. Investment in the behaviour change program paid back within one year thanks to reduced waste disposal costs.

CIRCULAR ECONOMY: Embodied Carbon Targets

MECHANISM DESCRIPTION

During the construction phase a significant amount of GHG emissions are 'released' due to the extraction, processing and transportation of materials.

In order to reduce the impact of development a number of measures can be taken. This is important as the impact is felt immediately on climate, whereas operational emissions contribute over time.

The best strategies target the materials that are used in the greatest quantities and have the highest carbon intensity (embodied CO2-e by volume, area or weight). For residential development (low density) this is road base, concrete, asphalt and steel.

Mechanism type

The mechanism would combine a PSP element (prescribed PSP element) and a subdivision requirement which requires applicants to demonstrate compliance with the following targets:

_ % reduction in embodied carbon in bitumen compared to the reference case - Australian Standard (30%)
_ % reduction in embodied carbon in cement compared to the reference case - Australian Standard (25%)
_ % reduction in embodied carbon in pipes compared to the reference case - Australian Standard (20%)
_ % reduction in embodied carbon in aggregates compared to the reference case - Australian Standard (10%)

Carbon impact

Reduction in carbon associated with embodied energy of materials.

This is from the reduced quantity of virgin materials (extraction, processing and transportation), and subsequent increase in locally procured, post-consumer content (i.e. recycled glass in road base), in addition to increased use of natural materials with (positive) carbon impacts.

COST IMPLICATIONS

_ Costs associated with sourcing adequate recycled content as markets for such materials are in their infancy and lack scales of economy
_ Costs of specialised labour and/or reduced productivity associated with new/hybrid materials and building methods
_ Reporting and carbon accounting (i.e. Life Cycle Assessment consultancy fees)

KEY BENEFITS

Social

_ Demonstrates potential for circular economy of waste products
_ Potential to incorporate more natural materials into urban environments
_ Creates a point of difference within the community that supports sustainable behaviour

Environmental

_ Reduces the carbon emissions associated with the building materials and practices involved in the development of the new precinct
_ Explore natural alternatives to 'hard infrastructure' (particularly drainage and treatment systems)

Economic

_ Creates value for waste products, supporting transformation of waste management and circular economy
_ Opportunities for local industry to fulfil emerging needs given the appropriate support

BARRIERS/CONSTRAINTS

Political

_ Perceived technical complexity and risk
_ Emerging materials and techniques may lack engineering support due uncertainty

Financial

_ Added costs of materials, expertise/knowledge and time to work through new processes

Social

_ Concerns around durability and safety or certain recycled components

Technical

_ Higher levels of uncertainty around installation, durability and maintenance
_ Sourcing appropriate materials locally may be difficult

CRITICAL SUCCESS FACTORS

_ The availability of recycled materials (especially within a regional context)
_ Overcoming technical uncertainty through knowledge sharing and employing a 'learning laboratory' mindset (i.e. not being afraid to fail)
_ Increasing number of examples and Business Cases that support such approaches
_ Warrnambool is a signatory to the Infrastructure Design Manual and Sustainable Infrastructure Guidelines which supports Material Recycling & Reuse
_ Consideration for piloting, rather than strict adherence to targets in early years of development

Use of PlastiPhalt in Geelong (Source: Geelong Australia)

CASE STUDY REFERENCE POINT

The City of Geelong has joined a growing list of Victorian councils by using 'PlastiPhalt', a product by Fulton Hogan that incorporates recycled plastic into the asphalt mixture, which also contains 20% Recycled Asphalt Pavement (RAP).

1,100 metres of road surface contained an equivalent of 3,500 kilograms of plastic that would otherwise go to landfill. The thoroughly tested product is free from micro-plastics, and while installation cost is approximately 10% higher than standard asphalt, tests indicate that the product is more durable and resistant to potholes.

PlastiPhalt can itself be reused as RAP in future road surfaces, and can reduce emissions by up to 30% due to its warm-mix application.

CIRCULAR ECONOMY: Locally Focused Sustainable Materials Protocol

MECHANISM DESCRIPTION

This opportunity includes the development of a Locally Focused Sustainable Materials Protocol to drive a transition to a local sustainable and circular economy. Development of the protocol would involve selection of a panel of vetted local suppliers meeting local and sustainable sourcing criteria.

Mechanism type

Operational investment - The mechanism would require a Governance model to develop the materials protocol and identify local suppliers (within 50 kms), with facilitation through a PSP element to support adoption by developers.

Planning control - Subdivision applications would be required to articulate a % of materials (by volume or weight) to be procured through local suppliers.

Such targets would require detailed analysis of the local manufacturing and production capacity to gauge supply, with targets (i.e. demand) generated to ensure a synergy between local production and development needs.

Carbon impact

The major benefit is embodied rather than operational carbon, as local materials include higher levels of recycled content, in addition to reduced 'carbon miles' or transport associated with delivery to site. There would also be a significant benefit for the local economy.

The success of such an approach will depend on local manufacturing capacity (Source: Sustainability Victoria)

COST IMPLICATIONS

_ Costs associated with the development of the governance model
_ Costs (potentially) to support local manufactures to 'flex up' through additional staff training or equipment/plant upgrades
_ Costs of local specialised labour and/or reduced productivity associated with smaller, less centralised manufacturing and distribution outputs

KEY BENEFITS

Social

_ Increased awareness of design and the construction industry
_ Product stewardship and Increased awareness of waste creation and disposal
_ Sense of local 'ownership' and contribution

Environmental

_ Reduced embodied carbon and 'carbon miles' (i.e. transportation) in production processes by prioritising local suppliers
_ Less scarce resources are wasted, with processes created to ensure higher levels of recycling and reuse

Economic

_ Improves climate resilience through deployment of materials which are durable in an Australian climate
_ Local innovation opportunity with potential for new models for production, design and waste management (i.e. improve technology and design to increase value capture)
_ Potential industry alignment with local trades training, local suppliers consumption, distribution and logistics (supporting the development of a circular economy plan)

BARRIERS/CONSTRAINTS

Political

_ Requires incentives or planning controls to support development over time
_ Will require buy-in across the wider community and from home builders who have established supply chains

Financial

_ Complex distribution of costs and benefits
_ Without financial supports (in the form of grants) local manufacturing may be slow to increase production capacity

Social

_ Education and supply chain management shifts are often slow
_ A circular economy requires close cooperation and connection between sectors and supply chains

Technical

_ Multiple dependencies as part of a complex system
_ Addressing technology gaps in cost efficient processing
_ Scaling from pilot technologies to commercial scale

CRITICAL SUCCESS FACTORS

_ Warrnambool is a signatory to the Infrastructure Design Manual, which supports Material Recycling & Reuse and the Sustainable Infrastructure Guidelines
_ WCC can act as a leader in local procurement of their own infrastructure development projects to highlight transition
_ WCC can support success through education and engaging with local stakeholders about options to progress
_ Businesses and developers can bring forward ideas and highlight potential obstacles that could be met in the transition progress
_ The availability of materials in a regional context (both virgin and recycled) to ensure production maximised local resources
_ Consideration for piloting, rather than strict adherence to targets in early years of development

Prince's Terrace in Adelaide emphasised the use of local materials and trades, while achieving significant thermal performance (Source: Sustainable Building Awards)

CASE STUDY REFERENCE POINT

The Prince's Terraces in Adelaide was the first residential GBCA 6-star Green Star Design and As-Built project in Australia (in 2015), and emphasised the use and benefits of locally procured materials.

Construction of the 12 dwellings included locally produced materials including: concrete with blast furnace slag, granite, 100-year-old salvaged bricks, Zego foam block work, pavers and fabricated iron balustrades.

In addition to exceptional operational performance (average 7.2-star NatHERS), the project's use of local materials and trades supported the creation of local jobs and reduced carbon emissions associated with construction by 50% compared to a traditional build, with increased costs of approximately 6%.

Future Opportunities

Through the analysis above, two other opportunities were raised, however not analysed in detail because of a question over initial feasibility or their relationship to the PSP.

These ‘future opportunities’ are addressed opposite.

PRECINCT SOLAR

Throughout the project, the opportunity of ‘precinct solar’ was been tested and discussed - however ultimately not recommended within the suite of actions to deliver a low carbon precinct.

When the intention is that land be rezoned for residential purposes, the future value of the land becomes higher than its potential value to a ground mounted solar array (farm). In any financial assessment of highest and best use, the value of the land is too high to justify setting aside as a dedicated solar array - it makes more sense to retain the yield for residential development. Where solar PV can be a viable use of the land is where zoning does not support a more intensive use (farmland) or when there are land capability reasons (such as on an old rubbish tip) which means the land is unsuitable for higher uses.

The only potentially suitable site using this criteria is the use of the Dales Road water reservoir’s for a floating solar array. This was discussed in detail with Wannon Water who are exploring this option in more detail, however the decision to pursue the project falls outside of the scope of the EoA PSP Consideration.

This opportunity then remains a possibility, however will require additional research to understand feasibility and its direct relationship to the East of Aberline Precinct. There is potential for solar generation from a future solar array on the site to be ‘sold’ to residents via a retailer and for WCC to be a future partner. A watching brief on this opportunity for deeper carbon reduction should be maintained.

HYDROGEN

Another opportunity that arose during this project was the inclusion of hydrogen into the precincts future focus - and a potential alignment between East of Aberline and the Warrnambool Hydrogen Transition Centre, established by Deakin University.

The ‘HyceL @ Warrnambool’ project has recently received $2m in Federal Government Funding and aims to create 200 full-time jobs once established. Research and testing at the centre will cover hydrogen fuel-cells, electric vehicles, and gas distribution - with a focus on reducing the impact of freight trucking.

Despite no direct alignment between EoA and HyceL, the opportunity could be monitored throughout development of EoA to identify further opportunities.

Implementation Plan

EOA ZERO NET OPPORTUNITIES OVERVIEW

Following the desktop review and initial stakeholder engagement phases, the mechanisms were presented at both landowner, and key stakeholder workshops to test and refine their applicability for inclusion within the PSP.

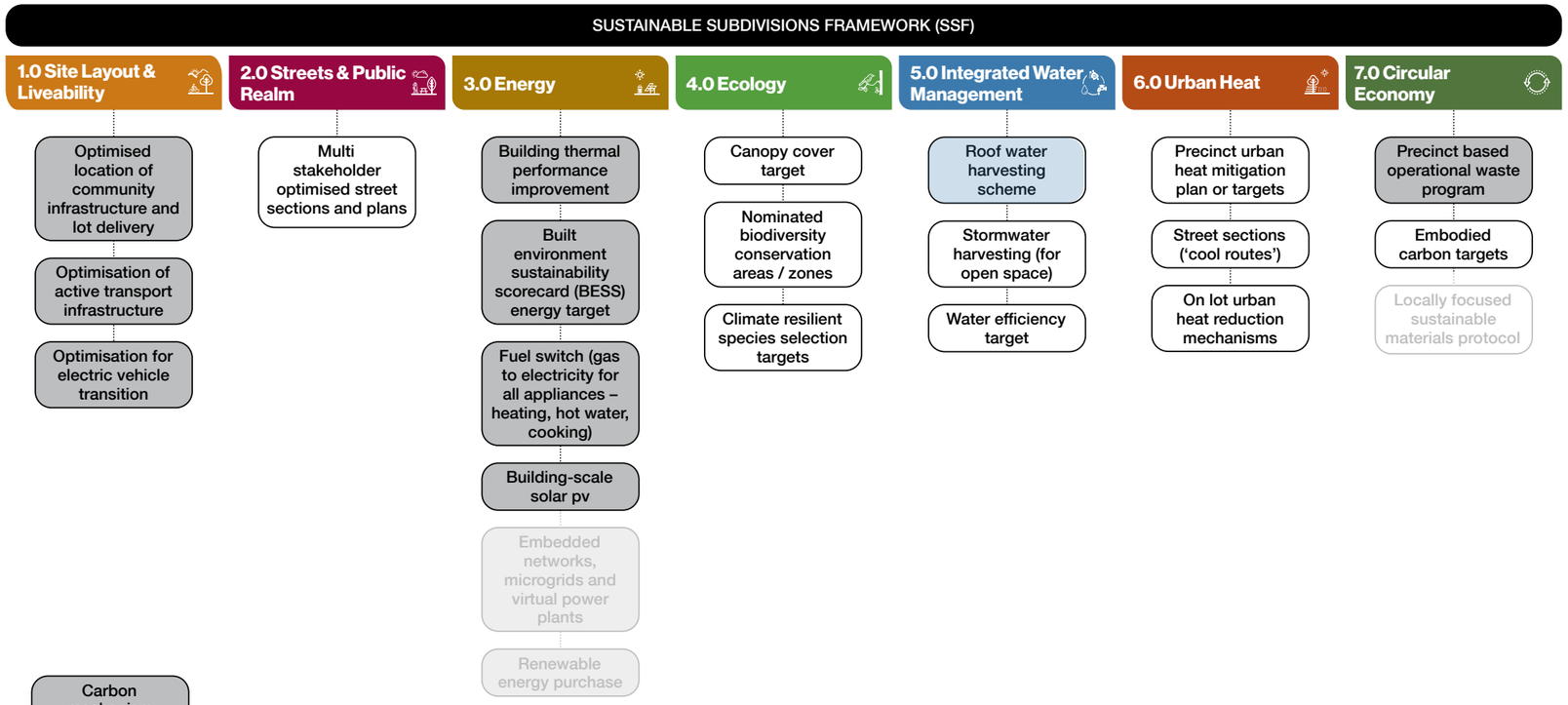
The following implementation plan identifies the suite of mechanisms that were supported through the consultation process.

'Carbon' mechanisms, when combined provide a pathway towards delivery of a net-zero precinct - with their carbon impact measured against the BAU baseline discussed earlier.* 'Non-carbon' mechanisms are those that aim to embed climate resilience into the community and future proof the precinct.

The graphic to the right highlights the alignment with the Sustainable Subdivisions Framework - which is reiterated throughout the implementation plan for reference.

'Greyed out' mechanisms are those which were analysed in detail above, but which following consultation, were not recommended as part of the final strategy. One IWM mechanism is dependent on further investigation by other consultant teams. We have noted this in light blue.

*Note that whilst embodied carbon targets (circular economy) are carbon related, they do not contribute to the operational carbon 'footprint' of the development so have not been highlighted in the graphic.



Implementation Plan

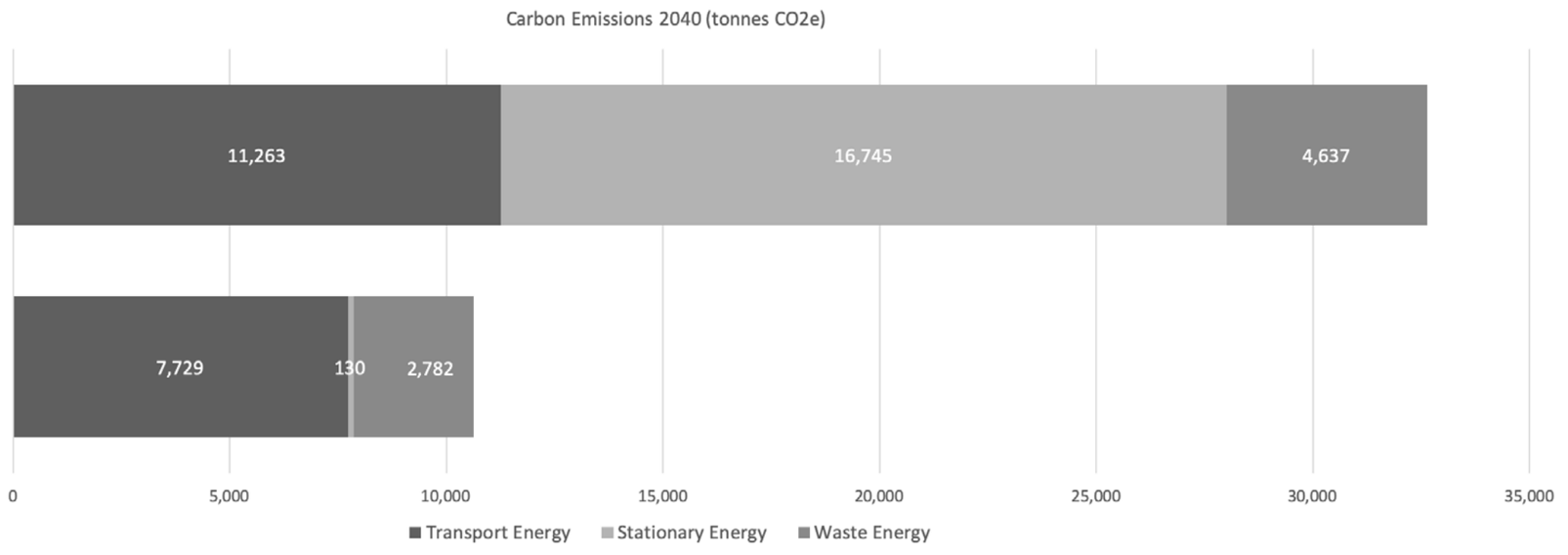
CARBON MECHANISMS

The mechanisms highlighted in dark grey on the previous page are recommended as part of the preferred carbon scenario for East of Aberline.

As discussed above, in isolation each of the recommended mechanisms have calculated reduction in carbon emissions against the BAU baseline. While some of these reductions may initially appear low, when combined and delivered together as a suite of mechanisms, the precinct can achieve zero-net emissions for electricity and establish itself as an exemplar for regional residential greenfield development.

These mechanisms when aggregated and delivered in combination can result in approximately 67% reduction in operational carbon in 2040, as outlined in the bar chart below.

This future carbon scenario refers to the full precinct being built out in 2040. The predominant remaining emissions stem primarily from transport emissions, but as the carbon intensity of the electricity network further declines and the transition to electric vehicles is completed post 2040, this sector will continue to decline. The residual waste emissions may need to be offset, depending on the success of behaviour change programs tackling organic waste in particular.



Implementation Plan

MECHANISM	DESCRIPTION	IMPLEMENTATION	DELIVERY LEAD	SUPPORTING STAKEHOLDERS	TIMELINE
Optimised location of community infrastructure and lot delivery Planning mechanism (PSP element and requirement)	The location of community infrastructure and lot diversity (i.e. 'superlots' for increased housing density) to ensure greater population is closer to services and promote a walkable neighbourhood.	_ The PSP to include a **Housing Plan** - demonstrating the location of densities, with a focus on higher densities in the north -western quadrant, abutting open space and community or retail facilities and lower densities abutting the rural interface _ The PSP to include a **Housing Table** - which responds to the **Housing Plan** and outlines the intended housing yield, mix of lot sizes and densities and sets targets which need to be achieved in individual land parcels (indicatively at least 7% of the land to achieve greater than 20 dwellings per NDHA) _ The PSP meets the targets for location of community infrastructure outlined for Site Layout and Liveability in the Sustainable Subdivisions Framework. _ The PSP to include a **Community Facilities Plan** which includes: + At least one public primary school + Locates primary schools this as close as practical to a pedestrian crossing point of Russell Creek + Co-locates education with the convenience retail + Provides for a community centre / which is co-located with education and convenience retail + Locates all community facilities on a priority pedestrian route and highly accessible with active transport	Victorian Planning Authority (VPA)	_ Warrnambool City Council (WCC) _ Landowners	Immediately, through the resolution of the Precinct Structure Plan
Optimisation of active transport infrastructure Planning mechanism (PSP element)	'Encouraging and prioritising sustainable transport' through a range of mechanisms including ensuring daily destinations are within 15 minutes of home using active transport; developing and implementing pedestrian and cycling network plans, and locating homes within 400m of public transport.	_ The PSP to include an **Active Transport Plan** which: + Includes an east-west link along Russell Creek with a seamless, safe connection to Warrnambool CBD + Provides for no fewer than three dedicated on or off-road cycling connections north of Russell Creek to this east-west transport link (including over creek connections as if required) + Provides for no fewer than three dedicated on or off-road cycling connections south of Russell Creek to this east-west transport link (including over creek connections as if required) + Provides seamless integration with education and other community facilities + Integrates with street sections and plans to provide for cycling connections on road (reducing friction) with private vehicles and other road users + Designates priority pedestrian routes and for those priority pedestrian routes which link to education and other community facilities to be 'cool routes' _ PSP requirements ensure footpaths on both sides of street _ PSP requirements consistent with the targets outlined in the Sustainable Subdivision Framework.	VPA	_ WCC _ Landowners _ VicRoads _ Victoria Walks	Immediately, through the resolution of the Precinct Structure Plan

Carbon mechanism

Non-carbon mechanism

Implementation Plan

MECHANISM	DESCRIPTION	IMPLEMENTATION	DELIVERY LEAD	SUPPORTING STAKEHOLDERS	TIMELINE
Optimisation for electric vehicle transition Planning mechanism (PSP requirement)	Accelerating the uptake of electric vehicles through planning controls / Design Guidelines, nominally the provision for EV infrastructure at the dwelling-scale (either as a functional charging point, or wiring for future EV capabilities).	_ PSP requirement requiring Design Guidelines to be developed to the satisfaction of the Responsible Authority _ Design guidelines to include requirement that dwellings would require pre-wiring to support a 32 A Mode 3 EVSE _ See detailed pathway for Design Guidelines p.61 _ See summary of all-electric home p. 62	WCC (see p. 61)	_ VPA _ Developers / Landowner	As outlined p. 61
Multi-stakeholder optimised street sections and plans Non-planning Governance Model	The critical focus for this work is in guiding the development of street typologies which can simultaneously support the needs of a range of services alongside active transport, urban greening and integrated water management. A multi-stakeholder approach is being tested as the primary mechanism for delivery.	_ Agreement sought from stakeholders to take part in EoA street Enquiry by Design (EbD) and be bound by consensus outcomes _ 1-day EbD to explore and resolve: + Objectives for high amenity streets (being guided by objectives in the Sustainable Subdivisions Framework) + Standard street sections and indicative street plans for EoA + Decision making criteria for alternatives _ Outcomes documented for agreement by stakeholders, with targeted meetings to resolve specific issues _ Establishment of a governance body (e.g. committee) representative of stakeholders to review and approve alternatives (governance mechanism) _ PSP objectives to reflect resolved objectives for high amenity streets _ PSP requirements developed to respond to process outcomes _ PSP Street Sections developed to respond to process outcomes _ PSP 'Indicative' Plans developed to respond to process outcomes (note this as a non-standard requirement of a PSP process) _ PSP Service Placement Guidelines to reflect process outcomes _ PSP requirement on subdivision that information at application stage be provided that is consistent with process outcomes and the Sustainable Subdivisions Framework information requirements	VPA	_ WCC _ Developers / Landowners _ Wannon Water _ Powercor _ Local Government Infrastructure Design Association (IDM governance) _ DELWP (Biodiversity / Urban Greening) _ Bicycle Victoria (or other agreed cyclist representative)	Agreement to participate and be bound by outcomes end November 2020 Enquiry by Design by end Feb 2021 Outcomes reflected in Precinct Structure Plan (timing TBD) Governance mechanism established for review and approval of street alternatives

Carbon mechanism | Non-carbon mechanism

Implementation Plan

MECHANISM	DESCRIPTION	IMPLEMENTATION	DELIVERY LEAD	SUPPORTING STAKEHOLDERS	TIMELINE
Building thermal performance improvement Planning mechanism (PSP requirement)	Introduction of thermal performance targets for buildings through the PSP through Design Guidelines. The mechanism recommends a NatHERS target of 1 star above the NCC standard, reducing heating and cooling energy by at least 28%.	_ PSP requirement requiring Design Guidelines to be developed to the satisfaction of the Responsible Authority _ Design guidelines to include requirements that all residential dwellings have a minimum NatHERS standard of one star above the applicable National Construction Code standard* _ See detailed pathway for Design Guidelines p.61 _ See summary of all-electric home p. 62 * Note that this has been modified from the 8-star target outlined earlier in the report to allow for increased flexibility until the mooted NCC update in 2022.	WCC (see p. 61)	_ VPA _ Developers / Landowner	As outlined p. 61
Built environment sustainability scorecard (BESS) energy target Planning mechanism (PSP requirement) This benchmark improvement would include the building thermal performance energy category which would generally include improvements to hot water and appliance efficiency.	The energy category within BESS awards points for passive design and energy efficient services and appliances that deliver energy savings above a benchmark building.	_ PSP requirement requiring Design Guidelines to be developed to the satisfaction of the Responsible Authority _ Design guidelines to include requirements that all residential dwellings achieve a minimum BESS score of 67% (without including solar PV in scoring) in the energy category (or demonstrate equivalent performance using another built environment rating tool) _ See detailed pathway for Design Guidelines p.61 _ See summary of all-electric home p. 62 * Note that this has been modified from the original 75% target through further consultation and model refinement	WCC (see p. 61)	_ VPA _ Developers / Landowner	As outlined p. 61
Fuel switch (Gas to electricity for all appliances - heating, hot water and cooking) Planning mechanism (PSP element)	This mechanism involves a confirmation that gas will not be supplied to the precinct. A low carbon precinct is dependent on removal of gas supply and is required to meet precinct, municipal and State ambitions for GHG emissions reduction.	_ PSP utilities requirement which excludes gas mains infrastructure within the precinct _ PSP **Utilities Plan** which provides for an extension of the electricity network, but not the gas network _ Design guidelines to preclude gas hot water and heating appliances _ See detailed pathway for Design Guidelines p.61 _ See summary of all-electric home p. 62	VPA	_ Powercor _ WCC _ Developer / Landowners	Immediately, through the resolution of the Precinct Structure Plan

Carbon mechanism | Non-carbon mechanism

Implementation Plan

MECHANISM	DESCRIPTION	IMPLEMENTATION	DELIVERY LEAD	SUPPORTING STAKEHOLDERS	TIMELINE
Building-scale solar PV Planning mechanism (PSP requirement)	The provision of renewable energy generation at the dwelling scale is critical in pursuing zero net emissions for stationary energy. At the building-scale, dwellings use significant roof space for solar PV to offset electricity consumption behind the meter (where the full retail cost of electricity can be avoided).	_ PSP requirement requiring Design Guidelines to be developed to the satisfaction of the Responsible Authority _ Design guidelines to include requirements that all dwellings include the following solar PV provision at a minimum: + 3kWp for all dwellings under 120sqm + 4kWp for all dwellings greater than 120sqm but less than 150sqm + 5kWp for all dwellings greater than 150sqm _ See detailed pathway for Design Guidelines p.61	WCC (see p. 61)	_ VPA _ Developers / Landowner	As outlined p. 61
Canopy cover target Planning mechanism (PSP element and requirement)	This mechanism proposes a tree canopy cover target be put in place for the public realm. Green infrastructure can deliver a range of benefits (ecosystem services) including biodiversity and urban heat mitigation. By setting a target for canopy cover, land developers can retain flexibility as to how canopy cover is delivered.	_ **A PSP Public Realm Plan** to be incorporated into the PSP to illustrate and quantify canopy tree coverage, assuming typical tree species for the PSP area at maturity and during the summer months _ **Public Realm Plan** to demonstrate 30% or greater canopy cover (excluding areas dedicated to biodiversity or native vegetation conservation) _ **Street sections** to demonstrate the role of streets in delivering this 30% canopy cover target (noting increased requirements for 'cool routes' _ A PSP requirement to require subdivision applications (through landscape plans) demonstrate consistency with the canopy cover target, and how the health of canopy is assisted through passive irrigation and robust maintenance plans	VPA	_ WCC	Immediately, through the resolution of the Precinct Structure Plan
Nominated biodiversity conservation areas/ zones Planning mechanism (PSP element)	This opportunity includes the development and enhancement of key biodiversity conversation areas or zones through the East of Aberline Precinct. Enhancement of biodiversity conservation zones supports a range of benefits including improved amenity, biodiversity and stormwater quality. This aligns with other opportunities such as increasing canopy cover, WSUD projects and programs as well as stormwater harvesting.	_ **A PSP Public Realm Plan** to be incorporated into the PSP which designates: + Tozer Reserve as a conservation reserve with appropriate zoning (and buffers if required to ensure no conflict between bushfire regulations and conservation outcomes) + Russell Creek as a waterway and drainage reserve (incorporating 30m buffer) with appropriate zoning _ Confirmation of investment in an operational program in distilling environmental custodianship of Tozer Reserve in new residents	VPA for Public Realm Plan Lead to be confirmed for Tozer Reserve conservation program	_ Tozer Reserve Committee of Management to implement Tozer Reserve Program	PSP Public Realm Plan immediately, through the resolution of the Precinct Structure Plan Funds committed to Tozer Reserve conservation program through PSP - program triggered by first subdivision permit within 100m of reserve

Carbon mechanism

Non-carbon mechanism

Implementation Plan

MECHANISM	DESCRIPTION	IMPLEMENTATION	DELIVERY LEAD	SUPPORTING STAKEHOLDERS	TIMELINE
Climate resilient species selection targets Planning mechanism (PSP requirement)	Setting lot or precinct-scale targets in relation to plant species selection is critical in reducing potable water consumption for irrigation, and community resilience. Additional benefits for biodiversity can be achieved if plant species are locally indigenous and facilitate rehabilitation where ecosystems have been previously fragmented by development.	_ A PSP requirement to require subdivision applications (through landscape plans) demonstrate at least 60% consistency with the proposed climate resilient species list _ Climate resilient species list to be developed ahead of first subdivision application (note that this would have potential wider application than EoA and potentially wider than Warrnambool)	VPA for PSP requirement WCC for Climate resilient species list	_ Landowners / Developers _ Local environmental groups	Immediately, through the resolution of the Precinct Structure Plan
Roof water harvesting scheme Planning mechanism (PSP element) Operational model	In this opportunity, rooftops within the East of Aberline precinct are viewed collectively as a new drinking water catchment. Stormwater from rooftops is collected and transferred to local raw water storage ponds (or tanks) before being processed at a water treatment plant before being reticulated back to the households as an alternative drinking water supply.	_ This mechanism is supported by the analysis from an environmental perspective _ Before further consideration for inclusion in PSP, a cost benefit analysis (CBA) is recommended to outline costs and benefits to key stakeholders (Wannon Water, developer, resident, broader community) _ CBA to be driven by Wannon Water, and consider the outcomes of the IWM planning (underway)	Wannon Water	_ VPA WCC	Immediately, through the resolution of the Precinct Structure Plan
Stormwater harvesting (for open space) Planning mechanism (PSP element)	This opportunity involves harvesting stormwater for reuse for non-potable purposes. Stormwater is usually harvested from the drainage network. The opportunity is being investigated in detail through the IWM planning process.	_ This mechanism is supported by the analysis from an environmental perspective _ Inclusion in PSP to be driven by analysis as part of the IWM planning (underway)	WCC or Wannon Water (depending on ownership of land and decision-making)	_ VPA	Immediately, through the resolution of the Precinct Structure Plan

Carbon mechanism | Non-carbon mechanism

Implementation Plan

MECHANISM	DESCRIPTION	IMPLEMENTATION	DELIVERY LEAD	SUPPORTING STAKEHOLDERS	TIMELINE
Water efficiency target Planning mechanism (PSP requirement)	This opportunity includes the adoption of water efficiency targets for buildings and key infrastructure either through planning controls or operational targets. Targets could be attached to planning and development, enforced through specification of water efficient infrastructure as part of builds or through monitoring and operational commitments (e.g. reductions in supply / usage charges if targets are met).	_ PSP requirement requiring Design Guidelines to be developed to the satisfaction of the Responsible Authority _ Design guidelines to include requirements that all residential dwellings include water efficient fittings (WELS ratings within one star of best available) and dwellings over 150sqm include a 2000Ltr or greater water tank plumbed to toilets and irrigation* _ See detailed pathway for Design Guidelines p.61 * Note that this design guideline recommendation is subject to change following resolution of the precinct IWM Planning	WCC (see p. 61)	_ VPA _ Developers / Landowner	As outlined p. 61
Precinct urban heat mitigation plan or targets Planning mechanism (PSP requirement)	An Urban Heat Mitigation Plan consolidates and prioritises various 'cooling' interventions, articulating targets (and responsibilities) around; landscape design & public shelter, canopy cover and materiality (i.e. high SRI roofing).	_ Precinct level Urban Heat Mitigation Plan not pursued for EoA _ PSP requirement for subdivision application that at least 70% of public realm surfaces constitute either tree canopy at 25 years, other physical shade structure, shrubs or ground covers, irrigated open space, water bodies or hard landscape meeting a Solar Reflectance Index of 50 or greater.	VPA	_ WCC	Immediately, through the resolution of the Precinct Structure Plan
Street sections ('Cool Routes') Planning mechanism (PSP element)	This mechanisms involves the delivery of 'cool routes', which are essentially streetscapes designed to create cooler micro-climates for pedestrians through the use of shade, vegetation and materiality (i.e. lighter coloured paving). It is critical that cool routes (and all pedestrian infrastructure) service multiple stakeholders through accessible design and are well integrated and articulated within the broader Principal Pedestrian Priority Network.	_ The PSP to include an **Active Transport Plan** which: _ Identifies cool routes aligned to the priority pedestrian network _ Identifies a street sections and plan for 'cool routes' which deliver: + A 35% canopy cover target + At least 85% of public realm surfaces constitute either tree canopy at 25 years, other physical shade structure, shrubs or ground covers, irrigated open space, water bodies or hard landscape meeting an Solar Reflectance Index of 50 or greater	VPA	_ WCC	Immediately, through the resolution of the Precinct Structure Plan (targets to be further tested through multi-stakeholder EbD)

Carbon mechanism | Non-carbon mechanism

Implementation Plan

MECHANISM	DESCRIPTION	IMPLEMENTATION	DELIVERY LEAD	SUPPORTING STAKEHOLDERS	TIMELINE
On-lot urban heat reduction mechanisms Planning mechanism (PSP requirement)	Reducing urban heat at the dwelling-scale involves setting targets and parameters for built form which promote vegetation on private land, as well as surface treatments which absorb less solar energy. This could be effectively controlled through Design Guidelines, with the potential adoption of the Melbourne Green Factor tool for assessment of on-site green infrastructure.	_ PSP requirement requiring Design Guidelines to be developed to the satisfaction of the Responsible Authority _ Design guidelines to include requirements that all residential lots achieve at least 85% of horizontal surfaces of either tree canopy at 15 years, other physical shade structure, shrubs or ground covers, irrigated open space, water bodies, hard landscape or roofs meeting a Solar Reflectance Index of 50 or greater _ See detailed pathway for Design Guidelines p.61	WCC (see p. 61)	_ VPA _ Developers / Landowner	As outlined p. 61
Precinct-based operational waste program Non-planning operational investment	This mechanism would deliver a behaviour change and education program to support residents to build their knowledge and establish good waste management practices as they move into their newly built home.	_ Development of program, including organic waste kit and procurement and partnerships	WCC	_ Sustainability Victoria	Confirmation of status of program in ICP.
Embodied carbon targets Planning mechanism (PSP requirement)	During the construction phase a significant amount of GHG emissions are 'released' due to the extraction, processing and transportation of materials. The best strategies target the materials that are used in the greatest quantities and have the highest carbon intensity (embodied CO2-e by volume, area or weight). For residential development (low density) this is road base, concrete, asphalt and steel.	_ PSP requirement to be included that civil construction prior to 2025 demonstrates: + A trial of a range of approaches which reduce embodied carbon with agreed monitoring and evaluation with SV, WCC and other stakeholders as relevant + Consistency with the Sustainable Infrastructure Guidelines + Subdivision applications comply with the information requirements of the Sustainable Subdivision Framework (Circular Economy category) _ PSP requirement to be included that civil construction after 2025 demonstrates compliance with the Sustainable Subdivision Framework targets (Circular Economy category)	Sustainability Victoria	_ VPA _ WCC _ Landowners / Developers _ Service authorities	Immediately, through the resolution of the Precinct Structure Plan (targets to be further tested through trial of the Sustainable Subdivisions Framework)

Carbon mechanism | Non-carbon mechanism

Implementation Enablers

In order to assist with the implementation of the preferred carbon scenario and ensuring that EoA becomes a climate resilient precinct, several enablers have been identified which help deliver multiple mechanisms at the same time.

ON-LOT PROVISIONS

In order to drive outcomes related to future private residential land the use of Design Guidelines or a similar mechanism will be a critical enabler in delivering the intended outcome for the precinct. This is primarily because the stationary energy use in the precinct is almost exclusively driven by the residential energy use. Controlling the built form, and specifying energy efficient appliances and energy generation is the key strategy for reducing stationary energy emissions.

Design guidelines can specify built-form, materiality, colour pallets, energy and water technology and infrastructure (i.e. solar and rainwater tanks). Design Guidelines are effective in these areas and will also assist in delivering climate resilience and transport related outcomes.

Three options are presented with commentary on their relevant merits.

Option 1 - includes the development of Design Guidelines by Council in accordance with this report. In this option, a PSP requirement would mean that residential land would conform to the Guidelines. They would then be required to be registered on title by way of a permit condition. This option puts full carriage of the Design Guidelines in Council's control and creates the potential for them to be applied to other areas of residential subdivision. The risk is that developers see this as a constraint on flexibility or potential inconsistency with Design Guidelines they have plans to impose on their own land.

Option 2 - includes the development of standards only by Council in accordance with this report, but the responsibility of developing Design Guidelines to rest with the developer of the land as part of the subdivision planning process. In this option, a PSP requirement would mean that residential land would conform to the standards, but developers would have the benefit of being able to incorporate, adapt standards for higher performance and include different standards or requirements (for example colour palettes, landscape palettes etc). This has the benefit of flexibility for the developer, but potentially creates confusion with variation across the precinct.

Option 3 - includes the development of a Design and Development Overlay or similar planning instrument as part of the PSP implementation. The DDO or similar could be drafted in such a way as to require a permit only when the standards (drawn from this report) are proposed to be varied. This has advantages, in that Design Guidelines are only applied to land where developers want to impose other on lot guidance, but the administration burden to Council statutory planners is restricted to a limited number of incidences where purchasers want to vary the standards imposed through the planning instrument.

These options will be further considered through the resolution of the Precinct Structure Plan.

In terms of implementation, if Design Guidelines are adopted, developers / landowners would generally appoint a local architect to ensure compliance that house designs comply with the Design Guidelines. Under this model, WCC would undertake occasional pro-active and re-active checks, to ensure that built outcomes are in accordance with approved building plans and with Design Guidelines.

BUILT ENVIRONMENT ASSESSMENT TOOLS

The use of a built-environment assessment tool, such as Green Star Communities had been discussed throughout this project however ultimately has not been recommended. This is due to the variety and number of separate landowners within the precinct and the challenges with creating alignment between each subdivision proposal and the overall goal.

The BESS tool is recommended to work in combination with Design Guidelines to 'pre-approve' home designs. The intention would be:

- That the tool is used to benchmark performance of a particular house design (meeting the required mark of 67%)
- Further assessments of that design would not be required subject to a NatHERS assessment demonstrating at least an equivalent NatHERS rating as that of the pre-approved design

Alternative tools such as Green Star for Homes, Sustainability Victoria's Zero Net Carbon Home tool or the Whole of House approach / tool currently in development by the Federal Government to inform the NCC could potentially form equivalents to the BESS tool, but would need to be approved as alternative pathways following further review of their assumptions (when available).

Implementation Enablers

WARRNAMBOOL HAS THE OPPORTUNITY TO DELIVER ITS HOUSING NEEDS WHILE PROVIDING AN EXEMPLAR FOR RESIDENTIAL GREENFIELD DEVELOPMENT (SOURCE: ABC NEWS)

ALL-ELECTRIC HOME DEMONSTRATION

In order to educate, build awareness and create value for purchasers in EoA, demonstrating highly comfortable and efficient all electric homes will be critical.

A strategy to build demonstration dwellings early in the precinct's evolution will assist in driving this purchaser appreciation for these zero carbon homes. The intention would be to partner with builders to deliver examples of homes that are fully compliant with the Design Guidelines.

A suitable funding / partner approach to the demonstration homes is recommended to be developed with key stakeholders through the PSP process.

REFERENCE THE SUSTAINABLE SUBDIVISIONS FRAMEWORK

The outcomes sought for East of Aberline could be further strengthened through reference in the PSP to require subdivisions to comply with the Sustainable Subdivisions Framework.

This would allow the Sustainable Subdivisions Framework to have statutory weight in the assessment of subdivisions applications and allow for the ongoing reinforced of the objectives and targets recommended in this report.

SUSTAINABLE INFRASTRUCTURE GUIDELINES AS AN IMPLEMENTATION TOOL FOR CIRCULAR ECONOMY

As a signatory to the Sustainable Infrastructure Guidelines (SIG) - an 'opt in' appendix to the Infrastructure Design Manual (IDM) - Warrnambool City Council has indicated their support for trialling alternative approaches to infrastructure design and construction.

The SIG can enable the outcomes sought for the 'Circular Economy' category, providing a method for determining options and calculating the associated embodied carbon benefit.

MONITORING AND EVALUATION

As part of the evolution of the precinct it will be critical to monitor the effectiveness of strategies outlined in this report.

We recommend that a review of progress towards the low carbon and climate resilient goals be undertaken within the first five years and include:

- A carbon investigation for the precinct, with the intention to understand whether the strategies have been effective and the precinct is tracking towards the low carbon goal for 2040 (including transport, energy and waste surveys etc)
- An evaluation of the first stages of subdivision to understand whether streets are being delivered in accordance with the street sections and plans in the PSP and that other climate targets and initiatives are proceeding as planned
- An evaluation of the first stages of subdivision to understand whether on-lot compliance with Design Guidelines has been achieved
- Changes in State and Federal Government policies or programs (operating environment) and evaluation of advocacy priorities
- Review of available research, technology and other information (in particular the maturing of key solutions)

The outcome of the overall review will determine whether changes to planning mechanisms, programs or operational / governance models may need to be made to ensure the long-term trajectory of the precinct is in line with stated goals.

Appendix A: Case Studies

Ginninderry - Canberra, ACT/NSW

Ginninderry is a collaborative project between the ACT Government and Riverview Developments, that aims to deliver 11,500 sustainable dwellings, $120m of community infrastructure and a 577 hectare conservation corridor on a 1,600 hectare site located on the ACT/ NSW boarder.

KEY PROJECT STATS[1,4]

Location

Ginninderry (on the ACT/NSW border)

Site Area

1,600 Ha

Development Type

Residential + community infrastructure

Year

2013

Status

Ongoing

Sustainability Accreditation

6-star Green Star for Communities

Key Stakeholders

_ ACT Government / Suburban Land Agency
_ Riverview Developments Pty Ltd (on behalf of Corkhill Brothers Pty Ltd)
_ Evoenergy

IMAGE: 'THE LINK' [PICTURED] IS A MULTI-PURPOSE COMMUNITY AND INFORMATION FACILITY, CONSTRUCTED LARGELY FROM RECYCLED MATERIALS WITH A 30 KW ROOFTOP PV SYSTEM

ESD INITIATIVES

Zero Carbon

As a 6-star Green Star community, Ginninderry is committed to reducing household energy use (GHG intensity reduced 85-100%). An Energy Snapshot and Roadmap report for the site identified dwellings in Stage 1 would be designed with the following:

_ A minimum energy efficiency rating (EER) of 6 stars
_ All-electric dwellings (Stage 1 at least)
_ 4-star reverse cycle heating and cooling
_ Electric heat pump HWS
_ Rooftop solar PV system (according to house size); and
_ Home energy management systems (allow integration into future micro-grid, or distributed renewable solutions)

Ginninderry - Canberra, ACT/NSW

IMAGE: AN AERIAL VIEW OF THE GINNINDERRY SITE IN 2019 (SOURCE: GINNINDERRY PROJECT TEAM)

Sustainable Water

Bounded by the Murrumbidgee River and the Ginninderry Creek, the precinct has been designed with a number of 'best practice' water sensitive urban design responses, including:

_ A network of bioretention swales, wetlands and basins capable of capturing, filtering, storing and recycling water on-site before discharge back into local waterways
_ Reaching or exceeding regional water quality targets
_ Using captured stormwater for landscape irrigation
_ Increasing rainwater tank requirements for residential blocks to decrease potable water consumption at the household level.

Sustainable Transport

Houses are to be located within walking distance of a bus stop to be able to access broader commercial amenities located in West Belconnen (and beyond), with an extensive pedestrian and cycling network provided throughout the precinct to create linkages to key infrastructure.

Ecology and Biodiversity

More than a third of the land at Ginninderry is being set aside as a Conservation Corridor.

The Corridor will total 577 hectares and will include the land adjacent to the Murrumbidgee River and Ginninderry Creek. The size and boundaries of the Corridor were determined scientifically to protect the endangered Pink-Tailed Worm Lizard habitat, conserve Yellow Box Red Gum Grassy woodland and to preserve the natural beauty of the landscape.

DELIVERY MECHANISMS

Planning

For the development to occur, the land on both sides of the border needed to be rezoned.

The land within the ACT required a variation to the Territory Plan, an amendment to the National Capital Plan and an amendment to the Yass Valley Local Environment Plan. In addition an approval under the Commonwealth's Environment Protection and Biodiversity Conservation Act was also required for the entire site, which was obtained in 2017.

For the NSW component - which isn't staged for development until 2033 - a Gateway Determination issued by the NSW Minister for Planning has found the proposal has merit, with a final decision to be made later this year.

Governance & Finance

A Joint Venture (JV) between the ACT Government and Riverview Developments Pty Ltd (On behalf of Corkhill Brothers Pty Ltd) was agreed upon to combine the potential of land and extend the development across into NSW - with a 60:40 ratio of ownership agreed between the two parties.[2]

While the NSW component isn't scheduled to begin until 2033, the JV identifies that in the event of a rezoning failure (of the NSW land), the rights would be held by the ACT, and the project would continue entirely within the ACT (still with the 60:40 ratio).

Such an agreement not only provides a sound financial basis for agreeing to a joint venture but also provides considerable incentive for Riverview when seeking agreement with the NSW Government to have the land in NSW rezoned.

Ginninderry - Canberra, ACT/NSW

IMAGE: THE GINNINDERRY MASTERPLAN (SOURCE: GINNINDERRY PROJECT TEAM)

CRITICAL SUCCESS FACTORS

Joint Venture

The JV agreement between ACT's Suburban Land Agency and the NSW developer, Riverview Developments Pty Ltd enabled project costs and risks to be distributed across both parties, and will be in place until the development is complete (30-40 years)[2].

Borderless Masterplan

The site was masterplanned as 'borderless' to ensure essential services and infrastructure aligned despite the state boundary (note: the NSW component of the site is cut-off from NSW by the surrounding river and is only accessible from the ACT side)

Stakeholder Engagement[5]

From 2008 extensive stakeholder engagement has been conducted to ensure alignment, stakeholders included:

_ ACT Planning and Land Authority
_ Chief Ministers Department
_ Territory and Municipal Services (TAMS) including ACT Parks and Conservation
_ ACT Department of Environment, Climate Change, Energy and Water
_ ACT Department of Housing and Community Services

Community Engagement[5]

Since 2011, extensive engagement with the community, and various community groups has been conducted, with the following strategies used to communicate with the community:

_ Market testing for electric only dwellings
_ Project Office opened in 2014 to showcase large-scale 3D model and site information
_ Community Information and Feedback sessions in Kippax
_ Publication of 5 project newsletters, distributed to approximately 10,000 households/stakeholders
_ Project website, and
_ Social media

In addition to appointing a Community Liason Officer and hosting community events, a 'people & place' group (PPG) was established in 2013 to test and refine project ideas. Members of the PPG included:

_ Belconnen Community Council
_ Ginninderra Catchment Group
_ Ginninderra Falls Association
_ Kippax Uniting Care
_ Strathnairn Arts Association
_ ACT Shelter
_ ACT Council of Social Services

RELEVANCE TO EAST OF ABERLINE

_ **Biodiversity Conservation:** Similar to the Tozer Memorial Reserve expected to be retained for biodiversity conservation at Aberline, Ginninderry has also retained an area for biodiversity (577 Ha).
_ **Natural approach to water:** Both sites feature natural environmental and hydrological features that promote opportunities to create integrated water management systems to reduce overall potable water use.
_ **Stage 1 Gas-Free:** A Territory Plan waiver was announced for Ginninderry that allowed stage 1 to be constructed without the inclusion of gas-mains infrastructure, ensuring all-electric (and potential fossil-fuel free) houses - the program is the first in the ACT. Despite the proximity of Ausnet's gas infrastructure around the periphery of Aberline, going all-electric offers significant cost savings at the dwelling level and in infrastructure provision as well as a benefit for carbon reduction..
_ **Embodied Carbon:** 'The Link' Which is Ginninderry's community-centre, was constructed using recycled and reused materials to reduce embodied carbon. Similar objectives are embedded in the planning for East of Aberline, and may be facilitated through application of a combination of Sustainable Infrastructure Guidelines, Design Guidelines and Life Cycle Assessments.

References

1. Ginninderry (n.d) Environment and People - Sustainability < https://ginninderry.com/environment-and-people/sustainability/>
2. Ginninderry (2018) Ginninderry JV Background [factsheet]
3. Riverview and LDA (2014) West Belconnen Urban Design Report
4. Ginninderry (2017) Ginninderry Project Vision [factsheet]
5. Riverview and LDA (2015) A History of Community Consultation and Engagement for the West Belconnen/Parkwood Project: From Inception to Marketing.

The Cape Eco-Village - Cape Paterson, VIC

Located approximately 140 kilometres South East of Melbourne, and overlooking the spectacular Bunurong Coast and Bass Strait, 'The Cape' Eco-Village at Cape Paterson champions environmentally sustainable design and community living.

The Cape, and the homes within it, have already won 17 design, architecture and sustainability awards.

KEY PROJECT STATS[1]

Location

Cape Paterson, Victoria

Site Area

40.5 Ha (approx.)

230 home sites

Development Type

Residential + community infrastructure

Year

2003 (land purchased, 6+ year rezoning process)

Status

Ongoing

Sustainability Accreditation

No specific accreditation

Key Stakeholders

_ Small Giants
_ Australian Ecosystems
_ TS Constructions
_ The Sociable Weaver
_ Martin Builders

IMAGE: EACH DWELLING AT THE CAPE IS EQUIPPED WITH MINIMUM 2.5KW ROOFTOP SOLAR PV SYSTEM (SOURCE: LIVINGATTHECAPE.COM)

ESD INITIATIVES[1]

Energy Efficiency

The Cape has teamed up with a number of local designers and builders to offer 10 contemporary housing designs with a minimum NatHERS ratings of 7.5-stars, including one design which is Victoria's first 10-star house!

Energy efficiency is achieved through:

_ Site orientation and solar access
_ Various shading treatments
_ High efficiency glazing
_ Insulation
_ Natural ventilation

In addition each dwelling equipped with a minimum 2.5kW solar rooftop system and energy efficient appliances specified throughout.

The Cape Eco-Village - Cape Paterson, VIC

IMAGE: THE CAPE ECO-VILLAGE MASTERPLAN AS CURRENTLY DEVELOPED (SOURCE: LIVEATTHECAPE.COM)

Design guidelines have been provided for residents who wish to alter their pre-approved design, or construct their own sustainable dwelling.

Sustainable Water

Each house will feature at least 10,000 litres of rainwater storage for garden irrigation and to assist with toilet flushing. This helps create year-round water security, with excess stormwater redirected through a series of collections ponds before permeating into the groundwater and natural wetlands.

The site will also feature a 5000 m^2 community garden supported by a 230,000 litre rainwater tank for landscape irrigation.

Ecology and Biodiversity

The site has been designed to co-exist with the coastal headland, surrounding wetlands and Banksia Woodland habitats keeping approximately half of the site area for open space.

The project has committed to restoring and maintaining the adjacent Cape Patterson Coastal reserve.

DELIVERY MECHANISMS

Planning Panel and Ministerial Approval[2]

The Cape Paterson Eco-Village was subject to a lengthy land-use rezoning process (6+ years) in which the proposal was referred to an expert panel, and denied - despite its sustainability criteria.

As a result, Bass Coast Shire Council thought it inappropriate to go against the advice of the panel, instead finalising their coastal strategy (with a town boundary for Cape Paterson) and referred the proposal to the Victorian Planning Minister - who approved the development.

Amendment C119 to rezone the land to the western edge of Cape Paterson for the Eco-Village was gazetted in mid-2011 essential rezoning it from Farming Zone (FZ) to Comprehensive Development Zone, and adjusting some of the overlays applicable.

Governance & Finance[2]

For the development phase, financial backing was secured through ethical investment company Small Giants, who had previously helped deliver 'The Commons' in inner Melbourne.

CRITICAL SUCCESS FACTORS

Sustainability Experience

The developer, Australian Ecosystems, is an experienced Victorian-based Environmental Landscape company known for designing and constructing wetland systems for residential subdivisions.

Public Intellectual Property

The developers collaborated with some of Australia's most sustainable designers and architects to offer (initially) 10 house designs that were then peer-reviewed by energy efficiency experts (in collaboration with Sustainability Victoria) and made publicly available (over 40,000 downloads). Residents are encouraged to pick and choose elements, with the 'rules' being: Minimum 7.5-star rating, <200 m^2, no gas connection, a mandatory 2.5kW solar PV system and a 10,000-litre rainwater tank.[2]

Design Guidelines

Beyond the housing design provided, general design guidelines for the precinct are provided, and include: North orientation, double-glazed windows, slab and reverse insulated brick walls with timber composite cladding (for thermal mass), with a combination of natural and operable shading treatments.

Household Savings

The Zero Carbon Study Peer Review claimed that compared to a new 6-star house on a 25-year mortgage, a house at Cape Paterson could save buyers between 2.5-5.5 years, with cumulative savings on mortgage and energy bills potentially exceeding $3000,000 under a high future price scenario (of traditional electricity)[3].

The Cape Eco-Village - Cape Paterson, VIC

IMAGE: VICTORIA'S FIRST 10-STAR HOUSE AT THE CAPE ECO-VILLAGE (SOURCE: LIVEATTHECAPE.COM)

RELEVANCE TO EAST OF ABERLINE

_ **Regional/Coastal Location:** Both sites share regional locations along the Victorian coast, offering alternative residential locations to larger urban or regional centres such as Melbourne or Geelong.

_ **Gas-Free Suburb:** 'The Cape' provides yet another example of a successful 'all-electric' development. Gas mains represent a redundant and path-dependant technology that 'locks in' fossil fuel use and high energy prices for years to come.

_ **Certification-free:** Unlike some of the other exemplars within this review, Cape Paterson Eco-Village did not prescribe to, or attain sustainability certification - and provides an example where a strong vision that supports best practice can be achieved without formal certification (which may be challenging at East of Aberline with such a large number of landowners).

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Salt - Torquay, VIC

Salt is a residential community located on the edge of the coastal township of Torquay, approximately 100 kilometres south-west of Melbourne. Salt is the first community precinct in regional Australia to be recognised as a One Planet Community[1].

The project promises to deliver a diverse range of housing typologies including; villas, town-houses and units - all with universal access, a minimum 7.5-star NatHERS rating, zero carbon energy (no gas), EV infrastructure and a 10,000 litre rainwater tank[2].

KEY PROJECT STATS[1]

Location

Torquay, VIC

Site Area

5.4 Ha

81 dwellings

Development Type

Residential

Year

2018

Status

Ongoing

Sustainability Accreditation

Bioregional One Planet Living (OPL) Framework

Key Stakeholders

_ Barwon Water
_ James Deans & Associates (Design Consultant)

IMAGE: SALT IS WITHIN WALKING DISTANCE TO SCHOOLS, CAFES, FARMERS MARKETS AND CO-WORKING SPACES WITHIN TORQUAY (SOURCE:SALT-TORQUAY.COM.AU)

ESD INITIATIVES

Zero Carbon Energy

SALT has committed to target of 100% renewable electricity by 2025, and zero net emissions by 2030. To achieve this, building design guidelines have been provided that specify:

_ High thermal efficiency (of building fabric)
_ EV charge points
_ Energy efficient appliances,
_ Energy monitoring systems
_ All-electric dwellings (i.e. no gas connections), and
_ A minimum 2.5Kw rooftop solar PV system and a $5,000 rebate on battery storage per household provided by Barwon Water[2].

Salt - Torquay, VIC

IMAGE: VARIOUS DWELLING TYPOLOGIES ARE PROVIDED (TOWNHOUSE PICTURED), WITH LOTS RANGING FROM 300-830 M^2 (SOURCE:SALTHOMESTORQUAY.COM.AU)

In addition to the dwelling-scale initiatives, a 250kW solar array capable of generating 370,000 kWh of energy a year is to be located adjacent the site[4]. The array will be used to power Barwon Water's Torquay operations, with additional energy feeding back into the grid - and has been designed to allow a future mirco-grid to distribute renewable energy to the homes at SALT[4] (capacity to meeting 93% of the estates energy needs)[2].

Sustainable Water

SALT has set potable water targets of 120L (of potable water) per person, facilitating this with a 10,000 litre rainwater tank for each dwelling, and mitigating flood risk through streetscape design that includes raingardens and retarding basins (i.e. Water Sensitive Urban Design)[2].

Sustainable Transport

Due to the regional location there are naturally minimal connections with broader public transportation networks, however the following strategies have been articulated:

_ Site layout and location based on the 20-minute neighbourhood principles to encourage walking and cycling
_ 32Amp EV chargers mandatory for each dwelling
_ A community sustainability coordinator who will be tasked with promoting car and rise sharing alternatives, and raising awareness for ecological impacts of travel

Materials and Waste

Low embodied carbon materials, and recycled products are preferenced, and specified in the design guidelines, with a commitment to educate builders and owners on the alternatives [to traditional building materials].

Private waste management requirements are to be use to maximise the mass of construction waste diverted from landfill, with operational waste

DELIVERY MECHANISM

Governance & Finance

The key governance mechanism is preserving the future ability to link the 250kW solar array to the development and share energy through a local micro-grid. Barwon Water's ownership and long term interest in the site is a crucial factor.

CRITICAL SUCCESS FACTORS

One Planet Living Action Plan

Bioregionals One Planet Living framework certifies an action plan of sustainability initiatives to report against annually - creating greater certainty over building and operational phases.

The action plan is accessible to the public and communicates the full suite of initiatives planned for SALT.

Building Design Guidelines

The Building Design Guidelines take a lot of the content from the OPL action plan that is applicable at the building-scale and communicates it in the context of designing and constructing a home within SALT. The guidelines cover elements such as: orientation, setbacks, dwelling size, landscaping, glazing, thermal mass, and universal access among others[3]. They also the planning approval process for SALT, construction requirements and a number of application forms and check-lists to ensure potential residents are well equipped to enter the SALT community.

Salt - Torquay, VIC

IMAGE: THE STREETSCAPE MASTERPLAN FOR SALT DETAILING HIGH-LEVEL VEGETATION AND TREATMENT STRATEGIES (SOURCE: HUMAN HABITATS)

RELEVANCE TO EAST OF ABERLINE

_ **Zero Carbon Energy:** SALT has set targets around zero carbon, articulating them (via the OPL action plan), and developing design and precinct guidelines that will help deliver - providing a great example for East of Aberline to set firm goals around zero carbon energy.

_ **Solar PV and microgrid connection:** The development sets up future potential for a large solar array to integrate with residential development on the adjacent site. This has synergies with the fact that Wannon Water has two raw water storage ponds within the precinct boundary at East of Aberline which have previously been mooted for ‘floating solar’.

_ **Embodied Carbon:** The OPL action plan and Building Design Guidelines highlight the preference for recycled, and low embodied carbon materials such as: Recycled fly-ash (content) concrete, Timber framed windows, recycled masonry materials, and use of laminated structural beams. The design guidelines in particular provide inspiration for East of Aberline to ensure low embodied carbon materials are prioritised.

_ **Flood Mitigation:** Flood mitigation has been identified as a potential issue for East of Aberline, with Russells Creek dissecting the site. SALT has addressed flood risk through the provision of rainwater tanks and the design of streetscapes to includes swales and stormwater retention.

References

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2. Barwon Water (2018) Salt Torquay - One Planet Action Plan: August 2018
3. SALT (2018) Building Design Guidelines: Medium Denstiy Unit and Townhouse Sites - October 2018
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Aquarevo - Lyndhurst, VIC

Aquarevo by South East Water and Villawood Properties - located approximately 60 kilometres south east of Melbourne - aims to reduce potable water consumption by 70% and save residents up to 60% on their energy bills[1].

Constructed on the site of the former South East Water wastewater treatment plant, the development aims to tackle water consumption at every scale, installing rainwater tanks that can talk to each other, reconstructing an on-site wastewater treatment plant for resident use, and creating a series of natural wetland systems across the site[5].

KEY PROJECT STATS

Location

Lyndhurst, (Greater Melbourne) VIC

Site Area

42 Ha

460 homes

Development Type

Residential + community infrastructure

Year

2013

Status

Ongoing

Sustainability Accreditation

EnviroDevelopment (Ecosystems, Waste, Energy, Materials, Water, Community)

Key Stakeholders

_ Villawood Properties
_ South East Water
_ Oliver Hume

IMAGE: AQUAREVO EMBRACES WATER AT ALL SCALES FROM THE DWELLING (ONEBOX)TO WETLANDS (SOURCE: ENERGY MATTERS)

ESD INITIATIVES

Zero Carbon

Dwellings within stages 1-4 will be equipped with a minimum 2.5kW solar PV system (3kW for stage 5), with a bonus battery offer currently available for residents to install a 5kWh Sonnen battery[3,4].

Sustainable Water

Aquarevo homes will be supplied with 3 types of water[3]:

+ Drinking Water: Potable water (hot and cold) supplied throughout metropolitan Melbourne for all drinking and food preparation needs.
+ Class A Recycled Water: Waste water from Aquarevo homes is held in a small pod unit until the a trigger level is hit sending it to an on-site water recycling plant via a pressurised sewer network. Wastewater is returned as (cold) Class A water for use in gardens, toilets and

Aquarevo - Lyndhurst, VIC

IMAGE: THE AQUAREVO MASTER-PLAN HIGHLIGHTS ITS GREEN-BLUE SPINE (SOURCE: VILLAWOOD PROPERTIES)

washing machines.

+ Rainwater: Captured on roof before being screened, filtered and treated -using a high-tech hot water system, supplied back into the house and non-drinking water for bath, showers and laundry.

For each dwelling, this system is managed by a 'Onebox Controller' unit, a device created by South East Water that not only gives them visibility over the system, but enables residents to view and track near-real time data regarding water and energy use.

Flood Mitigation - TalkTank[6]

Expanding upon this already impressive integrated water system, small sensors have been installed in all rainwater tanks and connected to the dwelling's OneBox, which enables all the rainwater tanks across the development (almost 1 million litres combined), connecting to online weather forecasts and communicating with each other reduce peak flows and mitigate flood risk. They are estimated to reduce stormwater runoff by 25% across the estate.

DELIVERY MECHANISM

State Government Alignment

The development was positioned as a valuable opportunity for South East Water to demonstrate innovation, partnering with Villawood Properties and stimulating new knowledge through the design process and pursuing best practice concepts and technologies[5].

Business Case

South West Water believed there was more value in partnering to develop the land that selling it outright, putting forward a business case to the board in which the costs of the experimental water infrastructure could be covered due to ownership of the land, and broader commercial opportunities. South East Water then set up a subsidiary company 'iota Services', to demonstrate and promote these technologies for use in developments beyond Aquarevo[5].

CRITICAL SUCCESS FACTORS

Strategic Partnership

South East Water released an expression of interest to the market to secure a development partner, with 15 responses, finally coming to an arrangement with Villawood Properties[5].

The partnership enables shared risks and costs, with each partner able to focus on their area of expertise (land development, and water systems).

Aquarevo - Lyndhurst, VIC

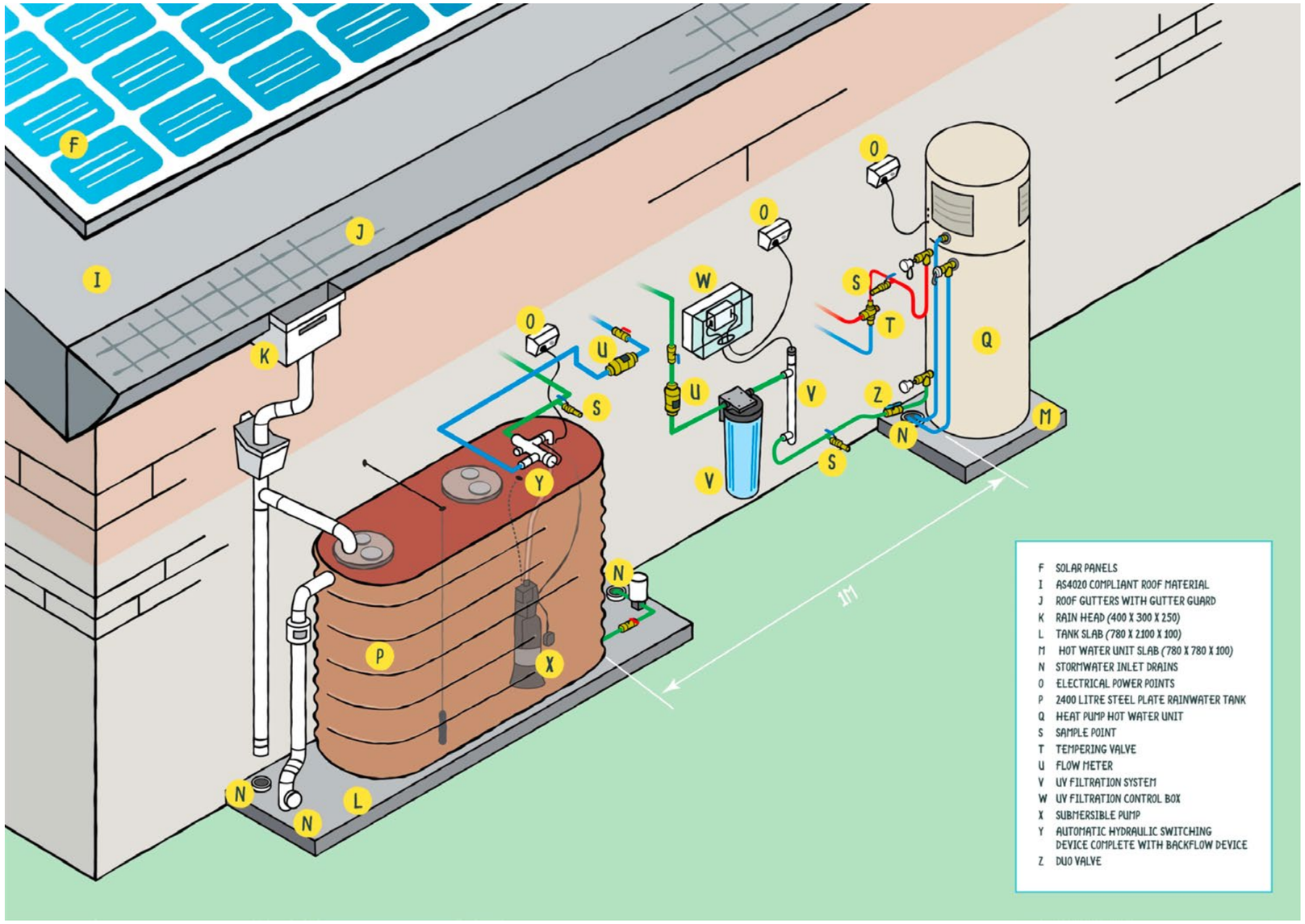

IMAGE: SOME OF THE WATER AND ENERGY SYSTEMS PROPOSED AT AQUAREVO (SOURCE: VILLAWOOD PROPERTIES & SOUTH EAST WATER)

RELEVANCE TO EAST OF ABERLINE

_ **Integrated water management governance:** The complex water arrangements at Aquarevo provide options as to how governance for a roof water harvesting system may proceed for the land and how complexity in ongoing operation can be managed where there are a large number of stakeholders

_ **Partnerships**: The project demonstrates the strong value of close partnerships with Water Authorities to deliver integrated systems with mutual benefit.

_ **Wastewater treatment on site:** Wannon Water have highlighted an intention to explore options for treatment of wastewater on site - Aquarevo provides an example of how this could be achieved using the innovative Organic Food Chain Reactor process

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4. Villawood Properties & South East Water (n.d) Aquarevo Lyndhurst, Bonus Battery Offer
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Alkimos - Perth, WA

The Alkimos development which is located 40 kilometres north of Perth comprises of 4 integrated precincts that aim to create a sustainable community for 57,000 residents.

Energy smart home packages, community-scale energy storage, and sustainable design guidelines articulate a new norm for a large residential development - achieving UDIA EnviroDevelopment and 6-star Green Star for Communities certification in the process.

KEY PROJECT STATS[1]

Location

Alkimos Beach, Perth (North Coast), WA

Site Area

710 Ha

Development Type

2x Residential precincts, 2x Mixed-use precincts

Year

2013

Status

Ongoing

Sustainability Accreditation

6-star Green Star for Communities: and

UDIA EnviroDevelopment certification

Key Stakeholders

_ Development WA
_ Lendlease
_ LandCorp
_ Metronet
_ Synergy
_ Australian Renewable Energy Agency (ARENA)

IMAGE: AN ARTISTS IMPRESSION LOOKING WEST ACROSS THE SITE TOWARDS THE COAST (SOURCE: LANDSCAPE AUSTRALIA)

ESD INITIATIVES[1,2,3]

Energy Smart Home Package

All dwellings at Alkimos Beach are equipped with a $4,150 Energy Smart Home Package, with residents provided with eco-coaching, which together promise to save up to 50% of household energy bills. The package includes rebates towards:

_ 1.5kW solar PV system
_ Gas or electric boosted solar HWS, or heat pump
_ Energy efficient AC system
_ Energy monitoring device

Alkimos Beach - Perth, WA

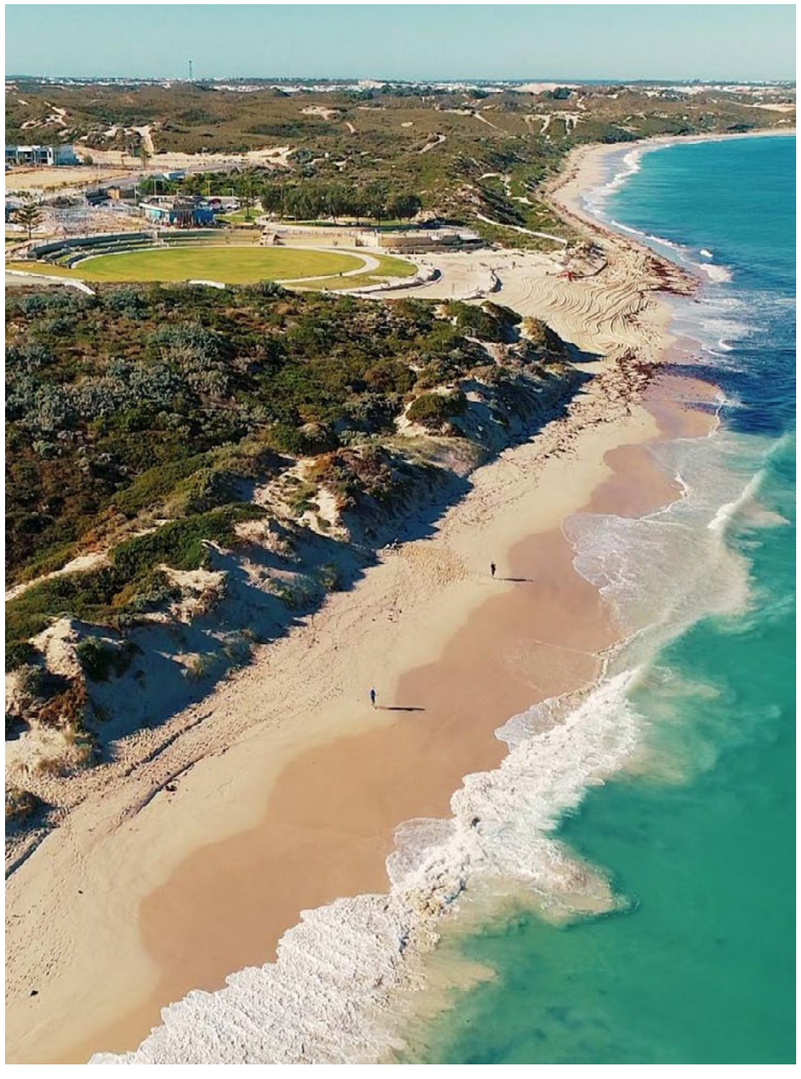

IMAGE: ALKIMOS BEACH HAS COLLABORATED WITH SURF LIFESAVING WESTERN AUSTRALIA (SLSWA) TO BECOME AUSTRALIA'S FIRST 'BEACHSAFE' COMMUNITY, WITH A FREE RANGE OF PROGRAMS FOR RESIDENTS (SOURCE: LEND LEASE)

Community-Scale Energy Storage

Alkimos Beach, in partnership with ARENA and WA's largest energy generator and retailer, Synergy, has embarked on a 4-year trial for a community energy storage system.

The 1.1MWh community battery helps residents generate solar credits to offset part or all of the energy they use in off-peak times (4pm - midnight), with any residual power not used paid back to residents at the end of their billing cycle.

Sustainable Water

The urban water cycle will be managed as a single interconnected system at Alkimos Beach. The strategy encompasses and recognise the connection of the site's potable water supply, groundwater, stormwater, wastewater, wetlands and coastal waters.

While there is no mention of mandatory rainwater storage for dwellings, the design guidelines provided outline water-efficient tapware and drought resilient vegetation as the primary water-saving strategies.

Sustainable Transport

Currently the metro line ends at nearby Butler station, with plans for MetroNet to extend this line through to Yanchep with a station planned for Alkimos Central (opening 2022), the 212 Ha mixed-use component of the development which promises to deliver a range of retail, commercial, civic, cultural, and recreational facilities for Alkimos residents.

'The Gateway' shopping mall situated within this precinct is to provide a 200kW rooftop solar PV system with an embedded network and sub-metering, with a minimum of 2x Tesla and 2x Universal EV chargers on site.

In addition, Josh Byrne & Associates (JBA) are currently undertaking a market analysis and forecasting study for the feasibility of Electric Vehicle infrastructure throughout Alkimos.

A integrated network of cycling and pedestrian routes have been planned for the site, meandering through the conservation area and foreshore corridor, allowing access for residents to the pristine coastal environment.

Ecology and Biodiversity

A complimentary 'Front Landscaping Package' is provided for all dwellings. While there are a variety of designs available, the below criteria must be met:

+ 20% site area permeable
+ At least 85% plants to be indigenous to WA and drought-resistant
+ Each detached dwelling has 1 mature tree to help establish tree-lined streets
+ Natural turf is limited to 80% of planted area, with synthetic turf to be 100% recycled and used for maximum 50% of area

Urban Heat Island (UHI) Reduction[1]

More than half of the site has been retained as green space, with light coloured roofing specified within the design guidelines to reduce the urban heat.

DELIVERY MECHANISM [1,4]

Principles and Objectives

The Alkimos development has been designed with a number of principles and objectives in mind that have driven sustainability outcomes throughout the process, including:

_ Lendlease project priciples and objectives
_ Green Building Council Australia 5 Green Star Principles
_ Community Development Plan Framework Outcomes (devised by Lendlease and LandCorp)

Planning

Planning integrates three main mechanisms:

_ **Alkimos Eglinton District Structure Plan (DSP)**: Is a flexible framework provided to guide development in the area
_ **Alkimos Vista Local Structure Plan (LSP)**: This details the planned community infrastructure for the Alkimos Vista Precicnt,
_ **Alkimos City Centre Activity Centre Structure Plan:** This outlines the design and planning considerations for Alkimos Central, and includes the Environmental Sustainability Strategy (ESS).

CRITICAL SUCCESS FACTORS

Residential Design Guidelines

Design Guidelines are provided which outline 'Smart Home Considerations' to ensure all homes are constructed with orientation, solar access, natural ventilation and shading that increases the dwellings thermal performance.

Alkimos Beach - Perth, WA

IMAGE: THE ALKIMOS PRECINCT MASTERPLAN (SOURCE: PERTH LANDFINDER)

Stakeholder Alignment

A strong vision with stakeholder buy-in was critical so that developer partner Lendlease, state development agency Landcorp and research partners ARENA were all aligned in their objectives in particular for the

Landscape as a core design driver

The coastal landscape was a strong driver within the design, meaning a highly site responsive site layout and stronger community support through the preservation of environmental value.

RELEVANCE TO EAST OF ABERLINE

_ **Mandatory Solar PV:** All dwellings in Alkimos are equipped with a mandatory 'sustainability' package which includes a solar PV system. Bundling initiatives together this way into the house package ensures broader take up and acceptability by residents who may not otherwise procure such items.

_ **Community-scale Energy Storage:** The energy storage trial at Alkimos Beach will use a Community Energy Scale Device (CESD) - a shipping container with all the communication equipment, electrical switchgear, control system, batteries and inverter. Similar options could be considered at East of Aberline.

_ **Land Parcels/Precincts:** While Alkimos is twice the land area as Aberline, it was sectioned and staged in a manner that has created various precincts - particularly so with the activity centre integrated with the proposed Alkimos metro station. This sub-precinct approach is applicable to East of Aberline, given the three quite separated nodes of residential development (separated by Tozer Reserve and Russell Creek.

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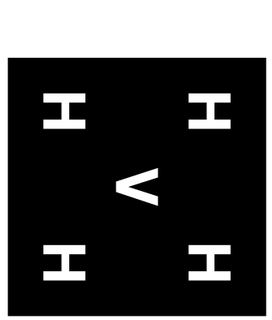



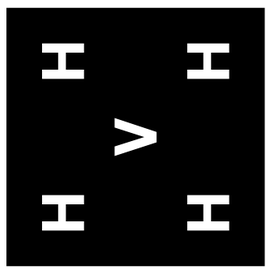



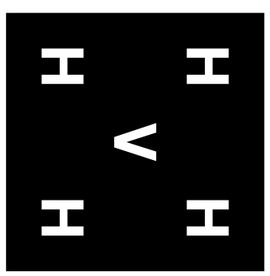



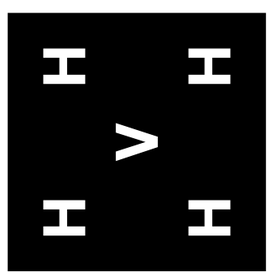

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