

Sustainable Centres of Tomorrow: People and Place

Final Industry Report, Project 1.62



April 2020

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Acknowledgements

This research has been developed with funding and support provided by Australia's Sustainable Built Environment National Research Centre (SBEnc) and its partners. Core Members of SBEnc include Aurecon, BGC, Queensland Government, Government of Western Australia, New South Wales Roads and Maritime Services, Curtin University, Griffith University and RMIT University.

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Preface

The Sustainable Built Environment National Research Centre (SBEnc), the successor to Australia's Cooperative Research Centre (CRC) for Construction Innovation, is committed to making a leading contribution to innovation across the Australian built environment industry. We are dedicated to working collaboratively with industry and government to develop and apply practical research outcomes that improve industry practice and enhance our nation's competitiveness.

We encourage you to draw on the results of this applied research to deliver tangible outcomes for your organisation. By working together, we can transform our industry through enhanced and sustainable business processes, environmental performance and productivity.



John V McCarthy AO
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Message from the Chair

Across Australia we face the challenge making our urban centres more people focused in ways that integrate contemporary values such as equity, affordability, environmental, climate outcomes, and good design that celebrate a high quality public realm and local place values. Just as importantly the centres and precincts need to be well connected with reasonable density and mixed use created around quality transit systems. This project has illustrated through its case studies, how a new generation of mid-tier transit systems —trackless trams—is a key ingredient in unlocking quality urban development both in new parts of this city and existing urban fabrics. I commend this report and the associated videos which summarises these important insights.

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The project videos can be viewed on the SBEnc YouTube Channel: <https://www.youtube.com/user/sbenrcvideo/videos>

Recommended Citation: Newman, P., Mouritz, M., Desha, C., Reid, S., Caldara, S., Scheurer, J. (2020) Sustainable Centres of Tomorrow: People and Place — Final Industry Report, Sustainable Built Environment National Research Centre (SBEnc), Australia.



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Executive Summary

The future of urbanism in Australia and across the globe to adapt and respond to the big challenges of climate change, economic development and social inclusion, will depend on how well we create urban centres, not just suburbs. Creating Sustainable Centres of Tomorrow needs a new and transformative approach. The Sustainable Built Environment National Research Centre (SBEnc) has been conducting research on how cities regenerate and create new centres by integrating new forms of transit along streets (e.g. Trackless Trams) with urban regeneration around stations now called Transit Activated Corridors. Previous research has concluded that this could only be done by integrating a new approach to funding and financing with partnerships between land developers, the local community, state agencies and federal government. These findings align with the successes observed in initiatives, such as the City Deal model, that are now being adopted across Australia.

This SBEnc Project has developed a model for how to create the Centres of Tomorrow and has applied this to the needs of communities in Townsville, Liverpool (Sydney), Wyndham (Melbourne) and in a corridor crossing 5 local governments in Perth. The model has created the following elements:

1. A Precinct Design Framework with seven best practice principles was developed as shown in Figure 1;
2. The Application of this Precinct Design Framework to each of the case study urban fabrics was demonstrated to show how it can cross all the different types of centres needed in different urban fabrics creating Transit Activated Corridors;

3. The value of SNAMUTS modelling on the integration for a new transit system along a corridor, together with urban regeneration opportunities, was demonstrated to show their combined transformative potential. The application of the SNAMUTS model was demonstrated in the Wyndham and Perth corridors showing significant improvements in accessibility and valuable urban regeneration being unlocked as a result.
4. A High-Level Technical Assessment Tool was created with 12 criteria to enable rapid assessment of the corridors. This was demonstrated to be rapid, simple and useful as a step towards creating the Trackless Tram corridor and the Centres of Tomorrow along these corridors.

The following videos were developed to illustrate these outcomes:

1. Overview: Compendium,
2. Case Study of Townsville,
3. Case Study of Liverpool,
4. Case Study of Wyndham, and
5. Case Study of Perth.

These videos and the associated reports can be found at :
<https://sbenrc.com.au/research-programs/1-62/>



1. Introduction: Why we need Sustainable Centres in Cities and how do we build them for People and Place

Australian cities are part of a global economy that recognises the value in agglomeration (Clark and Moonan, 2018). This is because the last few decades of technological and economic change have highlighted the importance of knowledge economy jobs, which rely on people being able to creatively work together face-to-face (Glaeser, 2011). Creating Centres of Tomorrow is therefore high on the agenda for all Australian cities. Such agglomeration needs to be facilitated by quality public transport and active transport, as only by balancing these modes with car access do the appropriate agglomerations become enabled. At the same time, the Centres of Tomorrow must also enable us to meet a range of other public values such as equity, affordability, environmental and climate outcomes, and most of all—the local place values—in the precincts created around new transit systems.

This project provides an opportunity to reflect on global best practices in prioritising thriving, productive, sustainable, liveable centres, towards unlocking such potential in our Australian cities. It also is based on how technological innovation such as the Trackless Tram and other Local Shared Mobility technologies, can help enable these goals.

The following outline of the key components researched, as part of planning for Sustainable Centres of Tomorrow, shows what is needed and how they can be applied in the four case studies in this national study: Townsville (Qld), Liverpool (Sydney, NSW), Wyndham (Melbourne, Vic) and Perth (WA) Consortium made up of 5 local governments and Curtin University.

2. The People and Place Design Framework.

Building on previous SBEnc studies, the research group developed a Precinct Design Framework of core principles and practices that can be used to help create the best outcomes from the regenerating centres around transport nodes that are being sought by state and local governments across their cities. This includes seven core principles and twenty-one associated core practices to ensure urban design and infrastructure development priorities are addressed. Given the national appetite (evidenced through SBEnc consultation) for Trackless Trams,

the research focused on this technology as a key lever to unlock urban development potential, as a city-shaping technology. Moving beyond traditional design or redesign, Trackless Trams can be fitted into centres as a fast corridor service as well as enabling walkable, dense centres at stations.

The seven design principles for successfully dealing with a range of urban design and infrastructure development issues in Centres of Tomorrow are shown in Figure 1 are outlined below.

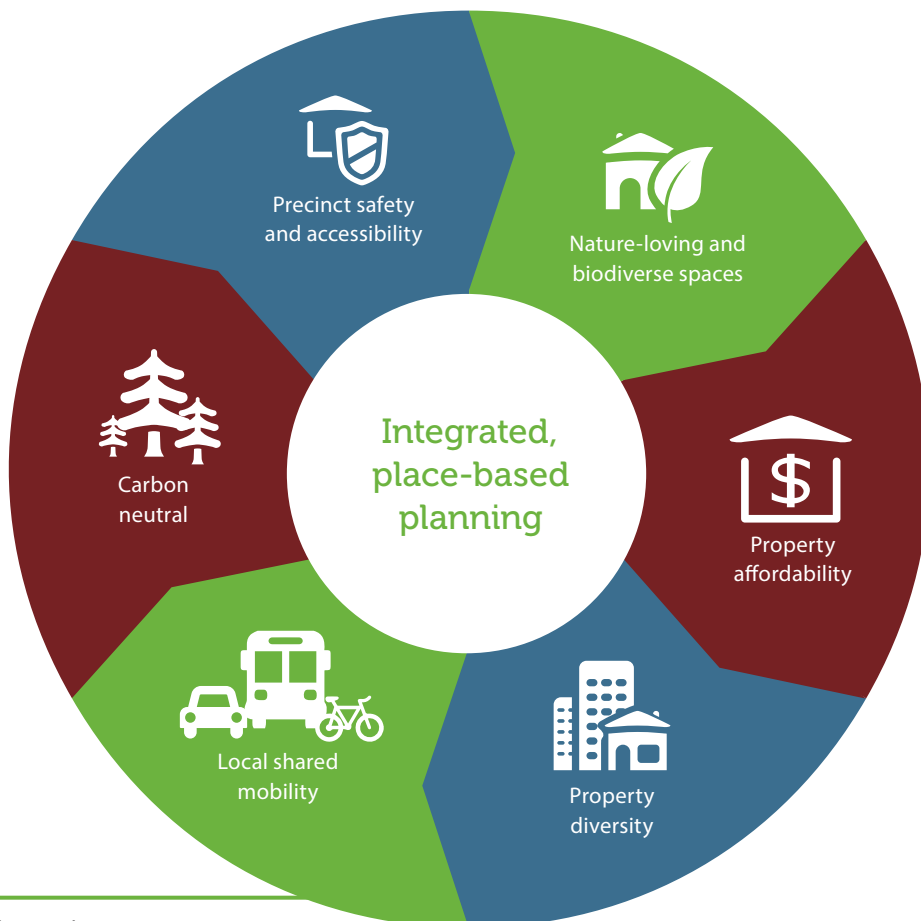


Figure 1. Place Making Principles for Centres of Tomorrow

Principle 1: Precinct safety and accessibility

The development should be safe and healthy for people waiting to access transport nodes

Walkable urban design needs to provide safe, healthy and attractive spaces linking the transport nodes and right through the development (Gehl, 2013). Walkability has become the basis of the knowledge economy with its need for professional people to have face-to-face contact (Matan & Newman, 2016; Matan & Newman 2012; Newman et al., 2016). It is critical to assess therefore how the transport nodes could be optimised, along with the demand for management practice to improve the functionality of centres for human interaction and knowledge economy, adopting the principles of Human Centred Design (Maguire, 2001). While creating these healthy, attractive, human-centred spaces, a place-making approach (Glazebrook & Newman, 2018) has emerged as a targeted method to examine the core elements of these processes, in particular the role of community-led processes and the role of the creative sector (Suleman, 2013).

This walkability aspiration will not be possible unless the centre is part of a high-quality transit corridor which provides access across the city. This access is needed for people living in the centre catchment and also for those who live elsewhere and want to use the centre for work and services (Newman et al., 2016). The importance of corridor access by transit as well as walkable access within a centre is a fundamental question for this research project. Rail stations in the past have been where walkable centres have emerged as they have been traditional places where walkability was possible.

Similarly tram lines in the past had walkable areas around tram stops. However, the world of car-based planning has meant that tram lines have been either removed or filled with competing cars and increasingly heavy rail stations are being built with parking close to stations and hence walkability is lost. This project is now considering the potential for a Trackless Tram route down a street to reclaim walkability around stations as well as reclaiming speed along a corridor.

The resolution developed so far – through the SBEnrc project work with traffic engineers and urban designers – is to enable a transit urban fabric to develop where there is both corridor speed and nodal walkability. The two together can create a place of accessibility which is not car dependent. This requires corridor speeds of around 70 km/h with transit-way space that can enable such speeds, in addition to nodal speeds of around 30 km/h where traffic and space for cars is at a minimum and nodal walkability is maximised. This is not unlike how cities now function where they have quality transit along streets – with fast and slow sections – but it is not what is currently in traffic manuals, even those attempting to resolve issues of ‘place and movement’ (Newman et al., 2016). This is the basis of a Transit Activated Corridor.



Principle 2: Carbon neutral–positive approach

The development should aim for carbon positive, being at least zero carbon, in both power and transport

To adopt a carbon neutral or carbon positive approach to achieve as close to zero carbon as possible, in both power and transport, it is important to evaluate how innovations can be utilised as a part of centres (Chen, Wiedmann, Wang, & Hadjikakou, 2016; Kennedy & Sgouridis, 2011). This includes for example on-demand transportation (ODT), Information and Communication Technologies (ICT), Autonomous Vehicles (AVs), Electric vehicles (EVs), in addition to smart buildings, building design/building diversity and building types and associated smart cities concepts. To optimise their value, provisioning for flexibility is needed to accommodate these changes. This includes changes in renewable energy mix and solar passive, which are critical to provide sufficient solar power for the buildings, transit technologies and for local shared EVs. Various modelling techniques to optimise urban energy consumption have been developed using energy supply data and post-code information (Brownsword, Fleming, Powell, & Pearsall, 2005).

A three step process is required to integrate carbon neutral approaches for urban development (Newman, 2010), comprising: 1) reducing energy wherever possible (i.e.: building and transport sector), 2) using renewable energy, and 3) offsetting greenhouse gas emissions. For example, in Sydney, the State of New South Wales through its Building and Sustainability Index (BASIX) programme, has mandated that new homes must now be designed to produce 40 per cent fewer greenhouse gas emissions, compared with the existing housing stock. The programme targeted reducing carbon

dioxide (CO₂) emissions by 8 million tonnes and water use by 287 billion litres in ten years (Farrelly, 2005). Malmö (Sweden) claims that it has already become a carbon-neutral city and Newcastle in the United Kingdom and Adelaide (Australia) also aspire to be carbon-neutral, taking important steps in the direction of renewable energy.

The implementation of solar energy in Barcelona was possible with a broad range of small actions and renewable energy projects spanning political commitment, capacity building and participation of the people. An innovative solar law, called “Barcelona Ordinance on Application of Solar Thermal Energy Systems into the Buildings” or “Barcelona Solar Ordinance, supported action”. This requires all new buildings in Barcelona to have solar thermal water systems to cover 60 per cent of sanitary water heating needs. This highlights the criticality of government commitment and community participation for changing the way energy is generated and used.

WGV is a Perth example of a carbon-positive planned precinct of 100 homes which has demonstrated ‘shared solar’ in three types of medium density development. The system used blockchain software to enable strata title governance to manage solar-based electricity in a way that created carbon-positive outcomes at very affordable rates. It also enables shared Electric Vehicle management, as well as a series of other precinct scale outcomes that are part of these design guidelines (Wiktorowicz et al, 2018).



Principle 3: Local shared mobility

The development should encourage diverse local modal services to access the transit service, with defined spaces

To ensure that a precinct will not be dominated by parking and by vehicles trying to access the transit service, options for local access via walking, biking and local shared mobility shuttle vehicles need to be facilitated (Kenworthy & Laube, 1996). Within this context, new city shaping technologies can be used to promote local connectivity, shared mobility and modal diversity. Integration of transport modes which includes walking and cycling, seeking to minimise the amount of travel and value-creation should be a key focus.

Enhanced value-creation can be achieved through connecting the clusters, through well-defined corridors, serviced by a quality high priority transit system and recognising that value-creation varies along the corridor as related to proximity to stations (Newman, Mouritz, et al., 2018; Rawnsley, 2017; Scheurer, 2019; Wamsler, Brink, & Rivera, 2013). The local accessibility within centres aims to decrease the incentive for car ownership and use, instead encouraging walking and cycling. The mixed land use within station precincts along rail corridors also makes the rail corridor and infrastructure itself more economically efficient, by creating destinations around stations that attract transit riders at all times of day and from all directions, rather than just transporting commuters to and from work (Cervero, Ferrell, & Murphy, 2002).

The public perception of shared goods has shifted placing high importance on sharing bikes, cars or rides on on-demand basis (Cohen & Kietzmann, 2014). This shared economy has gained popularity among many cities that are struggling with increased congestion and inner city traffic. Cohen and Kietzmann (2014) proposed a shared mobility business model to demonstrate the optimal relationship between service providers and local government. European cities are classic examples of laboratories for sustainable mobility through walking (Barcelona, Roca, Aquilué, & Gomes, 2015), cycling (Amsterdam, Groningen, Copenhagen, Odense, Berlin, and Muenster) (Pucher & Buehler, 2008) and shared mobility services (Berlin and Paris) (Hildermeier & Villareal, 2014).

Within the shared mobility services examples, the use of clean energy technologies received special attention. For example, two public electric car services in Berlin (BeMobility) and Paris (Autolib') demonstrated how each initiative enables shaping the future vision of sustainable mobility and transform regional transport systems in specific ways through their performative impact as local transport policy tools. BeMobility integrates electric cars as one element in Berlin's intermodal transport system, and focuses on 'intermodality' as the central vision of sustainable transport (Hildermeier & Villareal, 2014).

Principle 4: Property diversity

The density and urban mix should contribute to urban regeneration

Density and urban mix should be part of a local community engagement process to enable urban regeneration while fulfilling local needs and aspirations. For developers to evaluate how affordable higher density housing can be a key part of the 'people and place' transformation, a deep appreciation of creating centres through liveable, community-oriented design will be required. Community engaged planning process, diversity of property densification and evidenced based financial modelling, have been identified as key practices to promote urban mix to enable developers to create viable and integrated corridors (Ball, Lizieri, & MacGregor, 2012; Brownsword et al., 2005; Robinson et al., 2003). It is also key to understanding the value uplift that captures the land value and positive externalities to ensure establishment of a context-based solution to creating a centre.

Density in activity centres has a clear link to urban productivity and it is established through 'The Triumph of the City' by Harvard Professor Ed Glaeser (2011) where it has been measured in a number of cities including Melbourne, Australia. This phenomenon of agglomeration economies occurs as a result of clustering of urban activities and jobs that require face-to-face interactions for the creativity and innovation related to urban productivity gains, particularly in the knowledge economy sector. Within this context agglomeration benefits, such as economies that can be gained by the new density and mix of land uses, which are facilitated by the project, can be achieved. Such elasticities are assessed in many cities such as those developed by Trubka (2012) on Australian cities (Newman, Davies-Slate, & Jones, 2018).



Principle 5: Property affordability

The development should include diverse property options to provide affordable living as well as affordable housing

There should be a clear goal of providing affordable and social housing along the corridor with particular goals for each station precinct. To achieve those goals, it is critical to assess how affordable higher density housing can be a key part of the 'people and place' transformation of centres through liveable, community-oriented design. Inclusion of diverse housing products, inclusion of social housing and diversity of property product are therefore critical aspects to promote property affordability. Within this milieu, it is imperative to strike the right balance between appropriate quality, sustainability and safety standards and responsiveness to housing supply and affordability.

Many governments at the national level promote and support affordable and social housing; and at local level various new housing provision schemes have been tested, but their scale and impact have been limited because of the priority given to economic growth (Wang & Murie, 2011).

The Australian Housing and Urban Research Institute has reported the diminishing supply of affordable housing options for lower income workers near job-rich central city locations. This is having an impact on businesses and on the overall productivity of the economies of city centres. There is evidence of increasing recognition by major-city governments, both in Australia and overseas, of high housing costs. High housing costs is recognised as a social welfare and equity problem in a policy context. However, there are emerging conversations in a number of strategic planning policies that specifically address the direct impacts of housing costs on urban economic growth. For example, in both Sydney and Melbourne, housing and economic development strategies note that housing costs can limit access to central city locations, which can in turn thin lower income labour markets, reduce productivity (Van Den Nouwelant et al., 2016).



Principle 6: Nature-loving and biodiverse spaces

The development should include and connect biophilic and biodiverse greenspaces, supporting endemic species and habitat

Sustainable design embraces societal, economic and environmental principles, although conventionally landscape designers are brought into project works late, and with minimal scope or budget to effect design solutions that could be considered 'nature-loving' (biophilic) or biodiverse. Participation in the design process especially in landscape architecture and design is critical (El Baghdadi et al, 2018), to ensure solutions are community-oriented and sympathetic to local environmental attributes.

Within this context, biophilic design and water sensitive design principles should be required to be part of all buildings and across the precinct. Creating a nature-oriented space to promote diverse, resilient and healthy ecosystem that contributes to local biodiversity will also have impact on the health and wellbeing of our community. A good example of this is the Urban Ecology and Biodiversity Strategy in the City of Melbourne (Ives et al., 2013). To create better people friendly and place-based urban spaces that are not affected by excessive traffic, nature-oriented spaces have emerged as a targeted practice adopted by many cities over the world. With the emergence of sustainable urban planning, the ideal of the sustainable cities can be characterized by high density, mixed land use and attractive green infrastructure. This has become a desirable urban form at global scale (Tappert, Klöti, & Drilling, 2018).

Urban greening, including urban gardening, has a great contribution in creating nature orientated places while offering benefits such as shade and urban cooling (Desha, Reeve, Newman, & Beatley, 2016; Hargroves, Spajic, Gallina, & Newman, 2018). For example, Singapore demonstrates nature-oriented urban planning efforts weaving nature throughout—which includes plant life in the form of gardens, green roofs, cascading vertical gardens, and verdant walls. The policies and capacities both requires and enables these forms of global cities and centres to be rapidly and constantly reworked while embedding nature-oriented spaces (Olds & Yeung, 2004).



Principle 7: Inclusive, integrated, place-based planning

Planning, design and implementation should involve diverse stakeholders and all tiers of government to provide an integrated place-based approach

The need for an inclusive and integrative design process that focuses on a place-based outcome is the final principle that needs to guide all planning and design. There are a range of processes that have been used over time but in recent periods, there has been an emphasis on City Deals that integrate the physical planning processes, the human-oriented planning processes and the financial planning processes. The guidelines of a partnership like a City Deal should be established with core functions involving planning strategy, planning controls, partnership development and investment mechanisms. Partnership models for delivering transformation, particularly the provision of private funding based on value creation/ capture approaches is an important part of new forms of integrated place partnerships.

The governance process should identify the most appropriate procurement and delivery models, as well as statutory requirements, including a review of what powers local governments do have and recommend what extra powers might be useful. Key practices such as upfront and integrative whole of agency approaches, regular

and iterative consultation and harnessing existing incentive schemes are key success factors for effective integrated planning processes (Atkinson, 2001; Goldman & Gorham, 2006). By overcoming institutional barriers related to cross-agency collaboration, governments must integrate transport and land use planning to realize integrated developments to enable people to walk or use transit between mixed-use complexes to satisfy daily needs (Hargroves et al., 2018). As outlined in this and other SBEnrc reports (Newman et al. 2018) the role of private investment in enabling integration is also crucial.

To support each of these principles it is important to establish the most appropriate Transit Corridor governance arrangement that harness the best outcomes through urban re-shaping opportunities. A critical starting point is who is presently responsible for the preferred alignment and if there is a need for any shift in the governance of the alignment and the associated urban development opportunities presented by the introduction of trackless tram stations. Therefore, it is critical to identify what structure is best able to deliver such a project. Is it a local government, a series of local governments, a new integrated state agency with capability in both land management and transit, with capacity to attract the funding and financing, or a facilitated unsolicited bid process?

From Principles to Practices

The seven core principles can be enabled through professional practices. Each principle is a necessary component that can support the integration of transit technology – specifically trackless tram technology – within cities and how they can assist the creation of new centres through urban regeneration. The coalescence of advancements of technologies in transport, communications and energy now presents a

unique opportunity to achieve city shaping transformational change. Thus, the combination of practices brings together some new elements not usually considered as a necessary part of the tool kit used by urban designers, planners and transport engineers. Core practices are listed in Table 1, along with some key references and links to manuals that help with these practices.

Table 1: Practices informing the Framework for Designing and Implementing Centres of Tomorrow

Practices informing the principles	Key literature references	References and resources for good practice
1. Precinct safety and accessibility <ul style="list-style-type: none"> • Human centred design • Walkable urban design • Place and movement design 	(Gudowsky, Sotoudeh et al., 2017; Russo, Lanzilotti et al., 2018) (Forsyth, 2015; Badland, Mavoa et al., 2017; Litman, 2017) (Carmona, 2014; Wunderlich, 2017)	Design Kit (IDEO.org) Pedestrians First (ITDP.org) Movement and Place Framework (Transport Victoria)
2. Carbon neutral - positive approach <ul style="list-style-type: none"> • Solar passive design • Solar active design • Carbon neutral analysis 	(Horvat and Dubois, 2012; Futcher, Mills et al., 2017) (Kanters, Wall et al., 2014; Mohajeri, Gudmundsson et al., 2019) (Liu, Zhou et al., 2014; Tozer, Klenk et al., 2018)	A focus on Greening our Precincts (Aurecon) Solar Energy (International Energy Agency) Carbon Value Analysis Tool (World Resources Institute)
3. Local shared mobility <ul style="list-style-type: none"> • Local mobility design • Feeder transport design • Mobility as a service 	(Hüging, Glensor et al., 2014; Lyons and Practice., 2018) (Cole, Burke et al., 2010; Venter, Jennings et al., 2018) (Hietanen 2014; Jittrapirom, Caiati et al., 2017)	Pedestrian Access and Mobility Plan (NSW RTA) Principles of Network Planning (Griffith University) Rise of Mobility as a Service (Deloitte)

Practices informing the principles	Key literature references	References and resources for good practice
<p>4. Property diversity</p> <ul style="list-style-type: none"> • Community engaged planning • Agglomeration economy analysis • Financial modelling 	<p>(Bose, Horrigan et al., 2014; Konsti-Laakso and Rantala, 2018)</p> <p>(Duranton and Kerr 2015; Jin; Gong et al., 2018; Thisse, 2019)</p> <p>(Evans, Foord et al., 2007; Mulley, Ma et al., 2016)</p>	<p>Resources (Internat. Assoc. for Public Participation)</p> <p>Spatiotemporal Analysis Framework (Jin et al 2018)</p> <p>Toolkit for rapid economic assessment of cities (ADB)</p>
<p>5. Property affordability</p> <ul style="list-style-type: none"> • Social housing analysis • Life cycle assessment • Sustainability operational analysis 	<p>(Kraatz, Mitchell et al., 2015; Flanagan, Martin et al., 2019)</p> <p>(Lee, Ellingwood et al., 2017; Petit-Boix, Llorach-Massana et al., 2017; Trigaux, Wijnants et al., 2017; Mirabella and Allacker, 2018)</p> <p>(Gunasekaran and Irani, 2014; Yigitcanlar and Kamruzzaman, 2015; Nesticò, Sica et al., 2017; Nijkamp and Perrels, 2018)</p>	<p>Conceptual Analysis (AHURI)</p> <p>Applied to Urban Fabric Planning (Gabbarell et al, 2015)</p> <p>Sustainable affordable housing (Wiesel et al, 2012)</p>
<p>6. Nature-loving and biodiverse spaces</p> <ul style="list-style-type: none"> • Biophilic design • Water sensitive design • Landscape oriented design 	<p>(Cabaneq, Newman et al., 2017; el-Baghdadi, Desha et al., 2017)</p> <p>(Seminal: Wong, 2006; Furlong, Dobbie et al., 2019)</p> <p>(Choi and Seo, 2018; Dennis, Barlow et al., 2018)</p>	<p>Biophilic Design Initiative (Living-Future.org)</p> <p>Scenario Tool (CRC Water Sensitive Cities)</p> <p>Foreground Forum (Inst. of Landscape Architects)</p>
<p>7. Inclusive, integrated, place-based planning</p> <ul style="list-style-type: none"> • Joined up governance analysis • Partnership analysis • Procurement option analysis 	<p>(Keast, 2011; van der Jagt, Elands et al., 2017; Rode, 2019)</p> <p>(McAllister, Taylor et al., 2015; Farhat, 2018)</p> <p>(Grimsey and Lewis, 2017; Hueskes, Verhoest et al., 2017)</p>	<p>A Joined Up Policy Guide (South Aust. Government)</p> <p>Partnerships Analysis Tool (Vic Health)</p> <p>National Guideline (Australian Government)</p>

3. Applying the Design Framework to Australian Case Studies – Townsville, Liverpool, Wyndham and Inner/Middle Perth

The four case studies are briefly outlined to show the key issues and opportunities that have been worked on, in consultation with a range of local stakeholders.

Townsville

Townsville has a City Deal which involves the Townsville Council, James Cook University and Townsville University Hospital, as well as State and Federal Governments. The city, the university and the hospital are partnering in the development of a health and knowledge precinct with a particular emphasis on the tropics, now known as TropiQ. The need for a new technology transit system as a means of facilitating accessibility and creating urban regeneration in the old city and the TropiQ precinct which is outer suburban area, has driven the project. Two workshops have enabled detailed planning and assessment of how a Trackless Tram can enable urban development and the local community has expressed strong support for this to proceed to the next stage of delivery.

Liverpool

Liverpool is an old walking city centre on the Georges River in Sydney surrounded by car-dependent suburbs. The focus of this project is on how their City Deal within Western Sydney could assist them to build a quality Trackless Tram system from the old city out to the new Western Suburbs Airport with different kinds of urban development along the route. Two workshops have worked out that there is a real demand for such a second-tier transit linking the city out to the growing employment centre at the airport as well as genuine urban development opportunities along the route. This project is also moving closer to delivery stage with strong community and council support.



Wyndham

Wyndham is a very rapidly growing suburban area in Melbourne where many suburbs have become trapped in traffic and cannot access the two rail lines in the area. The need for a quality transit link was sought that may also achieve other urban regeneration goals and a first cut design framework was used to assess routes. Then a SNAMUTS report built on this showing how it could achieve a first cut solution and then in stages complete a network of connection that would help overcome the traffic problems and build a much more attractive opportunity for investment in new centres for employment and services. The delivery of this project is being assessed through various options.



Table 2: The Centres Framework applied to four different urban fabrics found in the case studies

Core Principles/ Urban Fabric Examples	Central City Walking Fabric (current rail-based centre)	Inner City Transit Fabric (old tram line area)	Middle Suburb Transit Fabric (infill failing)	Outer Suburb Automobile Fabric (new area needing a centre)
1. Precinct safety and accessibility	Walkability the critical value	Walkability in centre and corridor access both critical	Walkability in centre and corridor access both critical	Walkability in centre and corridor access both critical
2. Carbon neutral—positive approach	Strong transport carbon reductions but harder to do solar on buildings	Easier to do solar on buildings and harder on transport carbon reductions	Easy to do solar on buildings and hard on transport carbon reductions	Very easy to do solar on buildings and much harder on transport carbon reductions
3. Local shared mobility	Essential character	Essential character	Essential character	Essential character
4. Property diversity	Essential character	Essential character	Essential character but markets harder on mixed use	Essential character but markets hard on mixed use
5. Property affordability	Important but more difficult	Important but still difficult	Important and easier to achieve	Important and easier to achieve
6. Nature oriented space	Critical with emphasis on biophilic buildings and small pocket parks	Critical with emphasis on biophilic buildings, small pocket parks and green corridor	Critical with emphasis on biophilic buildings, small pocket parks and green corridor	Critical with emphasis on small pocket parks, green corridor and landscape-oriented development
7. Inclusive, integrated, place-based planning	Essential for delivery	Essential for delivery	Essential for delivery	Essential for delivery

Inner/Middle Perth

Perth has a need to upgrade its transit system and accelerate urban regeneration along main roads in the inner and middle suburbs. The Trackless Tram has been adopted by a consortium of 5 local governments to help solve this and the project has had a number of workshops and a SNAMUTS assessment that has developed the best routes to help deliver the best outcomes. A High Level Technical Assessment (see section 5) has also been done together with more work on potential financing and governance of the proposed options. Delivery strategies are now needed.

In Table 2 above, the seven core principles are applied to four kinds of urban fabrics that are relevant to the case studies in this research. All but two of the case studies go through a central city walking fabric, all but two go through an inner city transit fabric that has been defined by a previous tramway, all have a middle suburb with potential for transit fabric as the only redevelopment is backyard infill that is failing to provide a centre with transit and all have an outer suburb automobile fabric area with the need for a centre and transit.

4. SNAMUTS Modelling Transit Activated Corridors in Perth and Wyndham (Melbourne)

This component of the SBEnrc 1.62: Sustainable Centres of Tomorrow project assessed proposals for Transit Activated Corridors developed with stakeholders for establishing Trackless Tram networks in inner Perth and in Wyndham (Melbourne) with regard to spatial accessibility across the multimodal public transport network.

The Spatial Network Analysis for Multimodal Urban Transport Systems (SNAMUTS) tool¹ was used to undertake a comprehensive accessibility assessment, across a range of options. This highlighted how public transport movement across inner Perth and Wyndham can address mounting capacity problems on the bus system and vehicle congestion, to varying extents. A key part of the assessment is that an evaluation of the urban intensification opportunities created by the new public transport infrastructure.



4.1 Perth

An initial stakeholder workshop in October 2019 resulted in three proposals for route variations of a 30-km diametrical Trackless Tram line linking Scarborough Beach and Cannington via central Perth and Curtin University. Additional route variations along the same corridor were added by the project team after the first three options had been assessed, in order to further optimise its performance. After further consultations with political decision makers, it was decided to also assess two route options for a shorter (16 km) radial Trackless Tram corridor connecting Burswood and central Perth with the Morley-Embleton area. After further discussions with the Perth Consortium Partners a final scenario, which included a Perth CBD circuit was developed which included a corridor along Wellington Street and St Georges Tce and a branch from West Perth to UWA creating a six-line network. A further branch line between Curtin University and Canning Bridge station can further add to this rationale and greatly improve network connectivity in the inner south. Importantly this configuration allows for the removal and redeployment of all Causeway bus routes. This scenario is the best performer on all SNAMUTS indicators including resilience (congestion relief), and can be considered as a medium-term Trackless Tram network in inner Perth. Trackless Tram target network in inner Perth. This configuration is shown in Figure 2 as Option Z provides for an additional 100,000 residents and more than 100,000 jobs.

¹ See www.snamuts.com for a detailed description of the SNAMUTS model

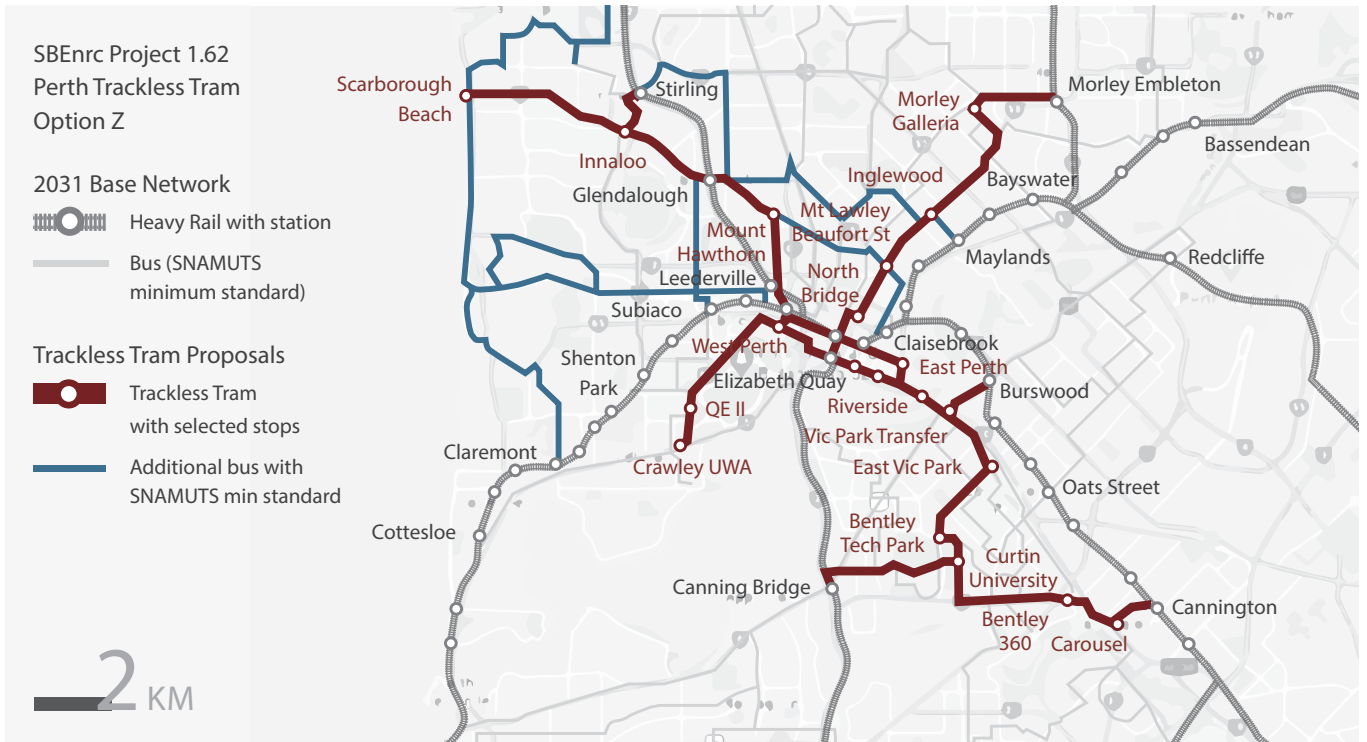


Figure 2. Perth – Proposed Transit Activated Corridor routes.

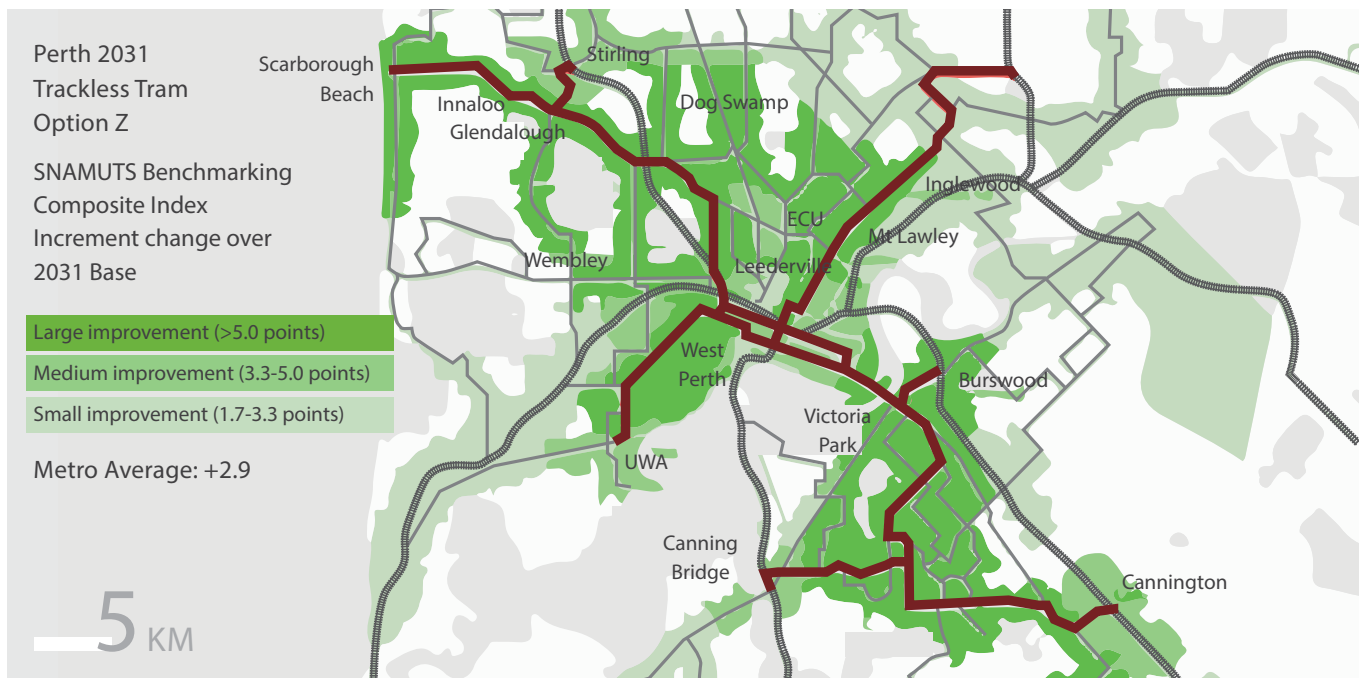


Figure 3. Potential urban intensity improvements stimulated by Transit Activated Corridor (shown in increasing shades of green).

4.2 Wyndham

The Spatial Network Analysis for Multimodal Urban Transport Systems (SNAMUTS) tool was applied to Transit Activated Corridors identified by stakeholder workshops in the municipality of Wyndham. This process has helped quantify and visualise the added value of a Trackless Tram corridor for Wyndham’s (and metropolitan Melbourne’s) public transport system as a whole. The urban intensification capacity assessment, derived from the SNAMUTS analysis, will assist City of Wyndham to identify minimum targets for additional residents and jobs in the catchment areas of corridor nodes to inform joint development decisions and value capture funding mechanisms.

The assessment helped quantify the extent of land use intensification (additional residents and jobs) over and beyond the 2036 trend that is required along the Trackless Tram corridors to make the deployment of an intermediate-capacity public transport mode imperative. Or in other words: what is the threshold of population and employment concentration along these routes that would overwhelm the capacity and performance of the existing bus system? Figure 4 illustrates the preferred corridor, highlighting development potential.

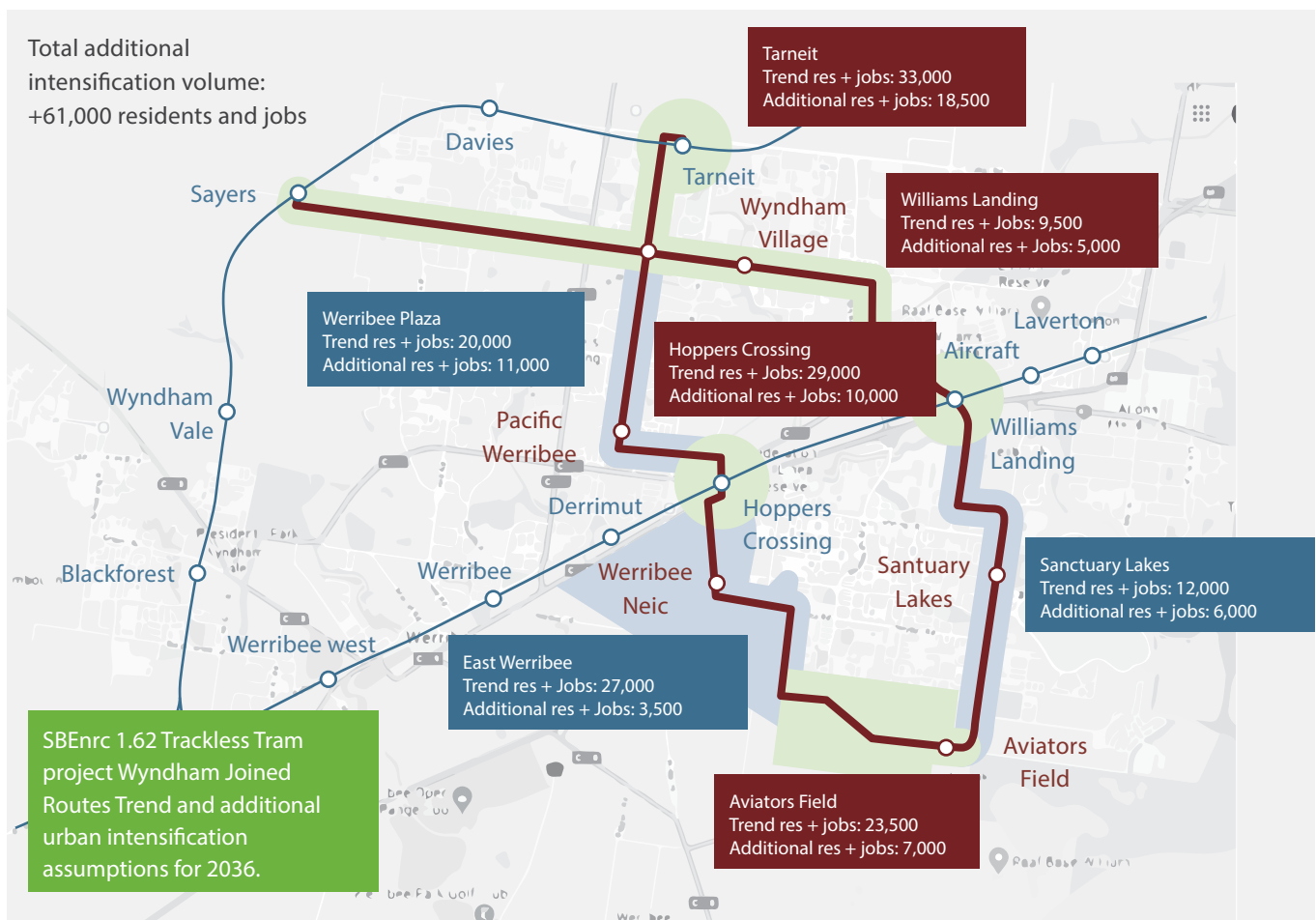


Figure 4. Illustrates the Transit Activated Corridors in Wyndham, showing additional development potential achieved by the introduction of Trackless Tram service.

5. A High-Level Technical Assessment of Implementation Challenges and Opportunities for Transit Activated Corridors

A set of 12 criteria for assessment of Transit Activated Corridors developed for the Perth Consortium case study is set out in Table 3 below. The purpose of the assessment framework is to highlight challenges and opportunities within the various segments of the route—drawing on the local knowledge of the partners.

Table 3 below provides a summary of the finding of the readiness of the whole corridor and provides valuable insights to the next steps for more detailed master planning and design. This represents an important tool for assessing the ease or difficulty of implementation along the selected route.

Table 3 High Level Assessment—Implementation Challenges and Opportunities Criteria

Criteria	Measures	Score 1-10	Explanatory Notes
1. DEPOT The ease of providing Servicing and maintenance facilities	<ul style="list-style-type: none"> • Agreed sites • Ability to use existing depots • Potential locations • No planned sites 	10	No need for depot inner city Sites available Curtin and Stirling and existing bus depots suitable
2. LAND OPPORTUNITIES Potential development uplift	<ul style="list-style-type: none"> • Large under-utilised sites (potential to leverage private sector funding) • Potential to develop public sector sites • Medium density strata • Low density that could be uplifted 	7.8	Apart from CBD most route sections have good opportunities due to under-utilised light industrial and commercial uses on large lots
3. VALUE CAPTURE / PLANNING ENABLED Planning enabled development uplift	<ul style="list-style-type: none"> • statutory uplift in place • strategic in place • in process • nothing 	7.9	City already well served by PT zoned for development so little value uplift. TT will unlock development in the city at key nodes

Criteria	Measures	Score 1-10	Explanatory Notes
4. ROAD RESPONSIBILITY Ease of delivery due to road classification and governance	<p>Who has governance of the road</p> <ul style="list-style-type: none"> • red road • blue road • local road 	7.3	Manning Road currently blue slated to become red. Constraint mainly on Albany Highway and Causeway. Issues could be intersections
5. PLANNING READINESS Alignment with state and local 'planning'	<ul style="list-style-type: none"> • local strategy in place • only identified in broad MRS terms • local govt strategies begun 	8.5	Mostly planning in place
6. ROAD READINESS Ease of delivering transit priority	<ul style="list-style-type: none"> • Bus lane already in place • Can you easily take out a lane of traffic • Do you need road widening • Do you own the land • Is it reserved 	6.1	<p>Most of Scarborough Beach Road Glendalough to Beach is procured or identified. Vincent sections of SBR, Oxford and Vincent difficult, William and Barrack intersections with St Georges Terrace need addressing Albany Highway has difficult sections</p> <p>Manning Road has level changes that may be better suited to kerb side running.</p>
7. STATION READINESS Ease of delivering stations	<ul style="list-style-type: none"> • Stations sites identified • Existing Verge width • Road reserve width fits station • Gaps in the built form in the right space for the station 	5.9	Pinch points may mean land procurement for some station sites. The height of the platform may be problematic in the Terrace.

Criteria	Measures	Score 1-10	Explanatory Notes
8. ENGAGEMENT Has the transit planning been agreed by community/ business	<ul style="list-style-type: none"> • Certainty of agreement with community and business. • (statutory plans endorsed 10 • Strategic agreement 5 • No engagement 0) 	6.3	<ul style="list-style-type: none"> • Certainty of agreement with community and business. • (statutory plans endorsed 10 • Strategic agreement 5 • No engagement 0)
9. LANDSCAPE OPPORTUNITIES/ PUBLIC REALM Impact and potential for tree-lined boulevard or Impact on Public Realm	<ul style="list-style-type: none"> • Trees already there, planned or possible. • Impact on or potential for tree-lined boulevard / Impact on or potential for Public Realm improvements 	7.2	The opportunities for public realm improvements are influenced by corridor width and the ability or willingness to take out lanes of traffic or parking or purchase land.
10. SOCIAL HOUSING Enabling low cost housing opportunities	<ul style="list-style-type: none"> • Public / social / affordable housing plans for route 	5.2	Opportunities at key sites but not along the whole corridor
11. CIVIC ASSETS Opportunities to enhance civic assets	<ul style="list-style-type: none"> • Enhanced accessibility to public services; Enhancement of civic identity; Improved social interaction 	7.3	Opportunities along the corridor less in the city and inner areas where good accessibility and high level of service currently exists
12. ECONOMIC ASSETS Opportunities to enhance economic assets	<ul style="list-style-type: none"> • Enhanced accessibility to employment, shops and other services. 	8.6	Opportunities along the corridor less in the city and inner areas where good accessibility and high level of service currently exists

The High-Level Technical Assessment Tool was applied to the Perth case study with local government involvement. It was found to be a useful approach to assisting with strategic

consideration of the corridor and provides a framework for the next level of detailed assessment.





Conclusions

Creating Sustainable Centres of Tomorrow needs a new approach. This research project has shown that there is a need for a Design Framework of Principles and Practices which has been applied to four different urban fabric types, based on the fabrics in the four case studies being studied as part of the SBEnrc project. In each case, the Centres of Tomorrow will not emerge unless they have a quality transit corridor that can reduce car dependence, nodes at stations which emerge from redevelopment opportunities, and place-based design that can make the most of the amenity needed to create value along the whole corridor.

The project has also supplemented the Design Framework with modelling of the transit corridors in two case studies (Wyndham and Perth) using the SNAMUTS model which has generated considerable insight into the best routes for transit-urban regeneration integration. It has set out a new concept called Transit Activated Corridors for enabling this kind of integrated development. And it has done a High-Level Technical Assessment showing how a strategic assessment can be done leading to Master Plans for delivery.

This shift to Centres of Tomorrow with more urban places and spaces will also require renewed leadership and governance approaches built around new forms of co-creation, ideally involving enhanced levels of civil society involvement.

The future of urbanism in Australia and around the globe to adapt and respond to the big challenges of climate change, economic development and social inclusion, will depend on how well we create Sustainable Centres of Tomorrow.

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Proposed Transit Activated Corridor Bentley
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Image on page 6 and 31 Visualisation of potential urban
development form in Liverpool Local Government Area on
FAST Corridor — (Source: Provided by Permission Liverpool
City Council 2020) 'FAST Corridor Design Framework'

Image on page 26 ART Trackless Tram in Yimbin, China –
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This research would not have been possible without the ongoing support of our core industry, government and research partners:

