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Transport and Urban Fabrics: Moving from TODs to TACs with Greyfield Regeneration

1 Introduction

Greyfields were built as automobile-related urban fabric from the 1940s onwards, and are now highly dysfunctional, as they no longer provide the best housing options but they are unable to cope with the traffic demands of the twenty-first-century city. Although they are desperately in need of regeneration, there is no model that can facilitate their transition in a functional and sustainable way. This chapter will introduce a new model of how main roads and their associated precincts can become the focus for grey-field urban regeneration through an integrated approach using new transit technology, their associated micro-mobility systems, and the distributed infrastructures for net-zero buildings and precincts outlined in Chap. 3.

2 Urban Fabrics and Urban Metabolism

Urban fabric theory (Newman et al., 2016) is based on an analysis of how cities have created different urban fabrics around their transport choices over centuries due to the average travel time budget for the journey to

work, which has been seen to be a consistent driver of how cities are shaped and reshaped (Marchetti, 1994; Newman & Kenworthy, 2015). It shows that all cities have three ‘cities’ within their structures:

- **The walking city** in the historic centre, densely built with narrow streets usually in a period before mechanised transport; can walk across in one hour.
- **The transit city** in corridors based around trains or trams, usually built in the period from 1850 to 1940; can transit across in one hour.
- **The automobile city** in rings of suburbs built around main road corridors and freeways from 1940 onwards; can drive across in one hour.

Urban fabric theory suggests that all three fabrics are merging and need to be recognised, respected, and regenerated, but in recent decades the demand has been for more walking fabric (Gehl, 2010) and transit fabric (Ewing & Bartholomew, 2013; Newman & Kenworthy, 2015; Sharma & Newman, 2017), especially in the rebuilding of earlier automobile fabric in middle greyfield suburbs that are in need of regeneration. The impossibility of building further automobile capacity into such areas and the inability to enable consistent urban regeneration despite increased demand for more compact, higher-density cities have become major issues in planning and transport policy, and they suggest the need for a simultaneous achievement of improved transit along main roads, micro-mobility along feeder streets, and stations that can be associated with significant precinct-scale urban regeneration, housing densification, and decarbonisation. This is a solution for the sustainable redevelopment of greyfields, though it should also be employed in the design of new estates on the fringe, or even rural settlements.

Effective and efficient corridor-transit infrastructure *and* urban-fabric improvements together enable a zero-carbon corridor to create a market that demands attention. This new market is being driven by the fact that finance for infrastructure investment is demanding net-zero outcomes, governments are wanting urban development to contribute to their net-zero goals, and new mid-tier transit technology is becoming faster than automobile traffic in most cities, creating an opportunity to deliver transit services that are less welfare-oriented and more broadly in demand as part of urban regeneration (Newman & Kenworthy, 2015).

Transit-activated corridors (TACs) are proposed as a new mechanism to help develop more transit fabric in twenty-first-century cities that builds on traditional approaches and adds a high level of twenty-first-century innovation. Different parts of cities have different urban fabrics, and lend themselves to different types of intervention and change, as summarised in Tables 4.1 and 4.2, which show that the three types of fabric also have different urban metabolisms (Thomson & Newman,

Table 4.1 Resource-input variations between urban form types

Input (per person per year)	Automobile city	Transit city	Walking city
<i>Resources</i>			
Fuel in megajoules (MJ)	50,000	35,000	20,000
Power in megajoules (MJ)	9240	9240	9240
Gas in megajoules (MJ)	4900	2940	2940
Total energy in gigajoules (GJ)	64.14	47.18	32.18
Water in kilolitres (kl)	70	42	35
Food in kilograms (kg)	451	451	451
Land in metres squared (m ²)	547	214	133
Urban footprint in hectares (ha)	2.29	1.97	1.78
<i>Basic Raw Materials (BRM) for new building types per person</i>			
BRM (1) sand in tonnes (T)	111	73	57
BRM (2) limestone in tonnes (T)	67	44	34
BRM (3) clay in tonnes (T)	44	29	23
BRM (4) rock in tonnes (T)	66	43	33
Total BRM in tonnes (T)	288	189	147

Source: Thomson and Newman (2018)

Table 4.2 Waste-output variations between urban form types

Output (per person per year)	Automobile city	Transit city	Walking city
<i>Waste</i>			
Greenhouse gas (fuel, power & gas) in tonnes (T)	8.01	5.89	4.03
Waste heat in gigajoules (GJ)	64.14	47.18	32.18
Sewage (incl. storm water) in kilolitres (kl)	80	80	80
Construction & demolition waste in tonnes (T)	0.96	0.57	0.38
Household waste in tonnes (T)	0.63	0.56	0.49

Source: Thomson and Newman (2018)

2018). It is possible to see a greening the greyfields story evolve as communities and governments seek to recreate more walking and transit fabric out of the oldest post-war automobile fabric, which is now failing. Such development can have many advantages, as outlined in this book, prime among them being reduced ecological footprint and enhanced liveability that can achieve net-zero outcomes with more diverse housing at a range of price points.

3 Cities' Current Mobility Trends and Trajectories

The 1950s began the era of car-based urban sprawl that created cities' enormous spatial spread, especially in the new world cities of North America and Australasia. This was associated with growth in high-consumption lifestyles that were locked in by a dependence on cars and oil, along with the adoption of new suburban living patterns and a culture of privatism. Densities plummeted and planning systems locked the new normal into their strategic and statutory systems. There was limited choice as the suburbs were rolled out in 'cookie-cutter' fashion. The differences in resource use and waste impacts is very large between the three urban fabrics (as shown in Tables 4.1 and 4.2) and do not appear to be related to an income effect; for example, in Australian cities, inner suburbs are higher-income areas than outer suburbs, in contrast to most US cities (Newman & Kenworthy, 2015). European trends were much less 'suburban', and urbanism remained as an influence on city planning in those countries during much of the twentieth century. However, there has been a surge in peri-urbanism in the twenty-first century as the established sections of European cities have become very desirable and expensive with peri-urban villages receiving more affordable housing but generally being less transport-friendly (Piorr et al., 2011).

Late twentieth-century suburban 'gated' communities in the suburbs of new world cities ('don't let densities change') meant that many people were forced to move further out into what has been variously called urban scatter, peri-urban, or tree-change areas where low-income residents are

even more at risk socially, economically, and environmentally (Sipe & Dodson, 2008) and very car-dependent. This is a future that is further exacerbated by climate change and the concomitant bushfire threat, now especially evident on the fringes of Australian low-density cities (Newton et al. 2018; Norman et al., 2021).

Re-urbanisation of inner and central cities via compact-city strategies and infill policies has become part of twenty-first-century urbanism approaches, as outlined in Chaps. 1 and 2. The demand for housing in inner suburbs has been constrained by a combination of restrictive residential zoning and resident push-back; as a consequence, this infill and densification movement has spread into middle suburbs, replete with NIMBY issues, as outlined in Chap. 6. However, no models of redevelopment—much less regeneration—were working in suburban car-based middle and outer suburbs, thwarting any attempt to realise higher (‘urban’) densities capable of supporting more liveable, self-sufficient, mixed-use, transit-oriented, 20-minute neighbourhoods. Notwithstanding the turn in the stated preferences of large segments of big city populations towards denser urbanism (Chap. 6).

Thus twenty-first-century urban planning in North American and Australasian cities is failing to curb sprawl and create what communities and markets are seeking in re-urbanisation, as well as what government strategic plans are saying they need. Why is this locked in? There are many factors in play, but certainly the lack of a good transport solution to enable a greening of the greyfields is likely to be a major one.

4 TODs and TACs

The need for transit-oriented development (TOD) around rail stations has been well accepted (Calthorpe, 1993; Cervero et al., 2002), and persists as an integral feature of city planning that looks for new ways to simultaneously regenerate both transit and urban development around stations. The huge international growth in investments in urban rail has enabled a reduction in car dependence, especially when associated with TOD. However, large parts of inner, middle, and outer suburbs remain without quality transit options. Main roads (often created by removal of

original tram lines following the end of the Second World War) are now usually heavily congested.

The need to regenerate both the mobility and land redevelopment along such roads is the next significant agenda in transport and urban policy. The solution suggested in this chapter is regenerating main roads using transit-activated corridors (TACs), which are a combination of providing new road-based transit technology and creating transit-activated GPR around the resulting station precincts. Just as TOD's role was to help transform rail policy relative to its role in urban densification around stations, the role of TACs is to help transform road policy. The similarity lies in the need to integrate quality transit technology with quality precinct-scale land development on, in, and around transit stops, and to include last-mile integration (Fig. 4.1). TACs are thus a corridor created from currently car-oriented activity centres (often represented by ageing shopping strips; <https://tract.com.au/rethinkingthestrip/>) by linking them with quality mid-tier transit. The difference is also that TOD projects have primarily been a government initiative, whereas TACs require private-sector engagement in an entrepreneurship role, as they involve considerable urban development, which is usually accomplished by the private sector in accordance with public regulation.

The key to unlocking transit-activated GPR is that communities love the resulting benefits: they get more than just infill housing; instead, they get a transit service along with other urban services within the transit-activated precinct. This is termed 'additionality'—a critical factor enabling transition from NIMBY to YIMBY. This is a fundamental factor

Fig. 4.1 Transit activated corridor. (Source: CRC for Low Carbon Living Guide to Low Carbon Precincts, Thomson et al. (2018))

recognised as missing in recent greyfield infill and is perhaps a key to how greyfield precincts can be regenerated. One of the biggest opportunities in these days of attempting to build net-zero cities is that transit-activated GPR provides an integrated model to generate net-zero corridors, as outlined in Fig. 4.1.

Transit-activated GPR is based on a whole-of-corridor approach where land development and transit are integrated from the outset, and it uses private finance in public-private partnerships to achieve this integration, as well as the technologies outlined in Chap. 3 to introduce distributed infrastructure into precincts. It also needs to draw on a number of the urban planning, design, and engagement processes linked to governments and communities that are the focus of Chap. 7.

5 New Transit and Transit-Activated GPRs

The electrification of heavy train and tram systems is a mature technology based on overhead catenaries, but new lithium-ion batteries have revolutionised the electrification of buses into electric bus rapid transit (BRT) and converting some into trackless trams with smart-city sensors (Newman et al., 2019) that can replace up to the equivalent of six lanes of traffic. These readily fit into cities and enable the development of new higher-density residential and mixed-use precincts around transit stops due to their quiet, pollution-free accessibility. As urban development moves to net-zero buildings and infrastructure, this process can be integrated into a transit-activated GPR. The resultant residential and commercial regeneration can be used to help pay for developing the new transit system (e.g., the associated transit precincts can include recharge hubs for battery-based transit and micro-mobility last-mile linkages). They are therefore enabling distributed infrastructure and supporting the development of a zero-carbon city with less automobile congestion on main roads.

Traditional transit along main road corridors has mostly been buses with some trams left over from previous eras, generally in conflict with traffic. In more recent times, mid-tier transit—both BRT and light rail transit (LRT)—have increasingly shown that there is a role for road-based

transit that occupies a dedicated lane of its own, capable of accommodating the approximate equivalent of six lanes of car traffic (Vuchic, 2005). Increasingly, these systems have improved their service quality (Hidalgo & Muñoz, 2014) through enhanced vehicle guidance, low-floor disability access, and stabilisation of sideways and bumpy movement. However, the arrival of electric battery-powered buses has revolutionised these systems with quieter, emissions-free systems similar to light rail. All of these transit electrification projects involving batteries can make transit-activated GPRs part of facilitating climate-change-based transformation to zero-emissions transit and zero-emissions station precincts where the use of renewable energy and recharging technology are built into the station precincts. If developed with a shared micro-grid and smart technologies managed locally, as outlined in Chap. 3, the new net-zero urban development can move out into the surrounding suburb as each adjoining area joins the local system.

Road-based mid-tier transit was given a significant boost when a new transit technology was developed that we have called a ‘trackless tram’ (Newman et al., 2019). The trackless tram system has taken six innovations from high-speed rail, put them in a carriage bus—or tram-like vehicle—with stabilisation through bogeys and optical guidance systems; this not only makes them largely autonomous (although not completely driverless), but also able to move at speed down a road with the ride quality of a light-rail car. Being electric battery-powered and with no need for steel tracks, it is significantly cheaper and easier to implement than a light rail system. It is also much better than traditional BRT at being able to attract urban development around it (new European and Chinese electric buses are showing that they are positively associated with significant improvements in urban development (e.g., the new Brisbane Metro; <https://www.brisbane.qld.gov.au/traffic-and-transport/public-transport/brisbane-metro/about-brisbane-metro>)). These innovations in ride quality and speed, as well as the electric traction now in all three on-road systems, have helped make new transit technology for BRT, LRT, and the trackless tram system much more attractive to urban development partnerships. The trackless tram is a low-cost option that brings a much-needed opportunity to create TACs and transit-activated GPRs.

6 Micro-Mobility and Active Transport in Transit-Activated GPRs

Micro-mobility devices, including electric bikes, scooters, skateboards, and auto rickshaws, represent ideal ways to enable ‘last mile’ trip integration with autonomous shuttles and fixed rail to provide integrated mobility-as-a-service for greyfield precinct residents. New transport options presented by emerging technologies will require new levels of urban design and planning management to enhance station precincts for walkability and to avoid promoting more car-dependent, end-to-end travel (Currie, 2018). This should include electric shuttle buses (not necessarily autonomous but certainly on-demand), which can carry people to station precincts (providing first- and last-mile solutions) without ruining the walkability qualities of the area (Glazebrook & Newman, 2018).

Emerging e-scooter, other on-demand micro-mobility and car-sharing business models may hold the key to reducing car dependence, while reinforcing transit-activated GPR in all its functions. Membership of car-sharing services has been shown to reduce vehicle use and car ownership rates (Muheim & Reinhardt, 1999; Becker et al., 2018), which may achieve a balance with demand-based systems like Uber or Lyft and autonomous vehicles that tend to increase car dependence; though solar-based electric would be still contributing to net zero outcomes (Schaller, 2018; Calthorpe & Walters, 2016).

All forms of electro-mobility need recharging. In cities these can become part of a new recharge hub or battery-storage precinct strategically positioned to support the grid balance needed to ensure universal access and resilience. Such recharge hubs are likely to be driven by power utilities paying for the grid services as well as users’ refuelling charges. In Canberra 60% of electric-bus recharge power will be obtained from rooftop solar installations at bus depots. These recharge services can be made available to the multitude of micro-mobility vehicles in local areas, thus supporting local economies and providing last-mile linkages for electric transit as they service corridors of mixed-use development. This integration between electric power and transport delivers net-zero corridors, as outlined below.

The benefits of micro-mobility in enabling local centres to work with fewer cars and to enable transit systems to work without the need for car-dependent corridors has certainly rapidly emerged over the past decades. Transit was seriously damaged during COVID, but so was car traffic, and thus the emergence of the need for and growth of local walkability and active transport has been a global phenomenon, with many cities building this into permanent plans for change (Davies, 2020; Laker, 2020). Electric micro-mobility will be a major part of future greyfield regeneration.

The co-benefits of active transport are very high, and if local economic development is facilitated, active transport becomes part of a low-carbon, green growth agenda to redistribute jobs within cities around these new station/precincts (Laker, 2020; Reid, 2020). Re-localising the city like this becomes a strong positive outcome from the move to active transport, with its support from micro-mobility and new electric transit systems as well as the localised power systems emerging from the solar-battery-based infrastructure to further the transformation of a range of urban precincts and town centres. It is a sign that a new policy orientation has emerged from this cluster of innovations, capable of mainstreaming post-COVID, and exemplified by transit-activated GPR.

7 Delivering Transit-Activated GPR

To convert a main-road corridor into a corridor of transit-activated GPR requires both strategic and statutory planning innovations that are focused on particular corridors and precincts. It also requires significant partnership development, a high-quality transit system, the declaration or zoning of the corridor as *primarily for transit and dense urbanism*, and associated high goals for more-sustainable urban development (e.g., net-zero and water-sensitive precinct development). These are pursued further in later chapters.

A series of plans to integrate movement and place have emerged around the world since Transport for London declared their Street Families policy (Transport for London, 2013), which identifies the streets that give priority to transit and where denser urban development will be given

special encouragement. The Movement and Place framework developed by VicRoads (<https://www.vicroads.vic.gov.au/traffic-and-road-use/traffic-management/movement-and-place>) has gained traction by asserting that streets are not only about moving people from A to B, but in many contexts also acting as places for people and public life to thrive (Jones et al., 2008). All Australian states are now following this model.

A planning and procurement process could enable the redevelopment of a corridor with a mid-tier transit system that enabled higher-density, mixed-use redevelopment along the corridor and a subsequent increase in land values. Developers could be chosen for each station based on their bids to deliver integrated higher-density development around each station that is walkable and contains all the distributed infrastructure outlined in Chap. 3 and the nature-based solutions from Chap. 5. The central part of this would be a micro-grid that can manage the distributed energy generated from rooftop solar installations and would be critical to managing recharge of all electric vehicles in the area (as well as the transit if necessary); the implementation of the micro-grid would include working with utility managers to provide grid services for back-up and stability (electric vehicles have substantial capacity for stabilising grids based on renewable energy sources). As greyfield regeneration happens in the station precincts, micro-grids can act as micro-utilities that provide net-zero networks to new redevelopments in ageing adjacent suburbs. The distributed net-zero city would thus emerge.

Enabling TACs would necessarily require multi-purpose governance along the corridor. This could come from a consortium of local governments, property developers, and utilities seeing opportunities requiring a shift from traditional dedicated ‘specialist’ services to a partnership model. The partnership would have responsibility for delivering urban regeneration and next-generation, networked transit, energy, and water services. For example, roads chosen for this category would shift their priority from providing mobility services for ‘through traffic’ to enabling quality regenerative urban design and development and urban network services delivery (mobility, energy, and water) along the designated corridor. This would deliver value to both developers and resident communities.

8 Conclusion

This chapter suggests that one pathway for greening the greyfields is to build new precincts in a chain along a transit-activated corridor to create a string of transit-activated GPRs. This era of technological advancement is developing systems that work best at a precinct scale, like solar power, batteries, and new small-scale water and waste systems, but they work particularly well if a row of precincts is linked by new local electric transit and micro-mobility systems. Most importantly, the necessary uplift in value that can release the funding or financing of a series of net-zero urban regeneration projects that seek to implement such new technologies will only happen if there is a strong and competitive new-technology transit system feeding residents, workers, and visitors to the precinct. Each precinct will therefore be an opportunity to show how new technology can be used and, most importantly, how the precinct can link into the new-technology transit system.

Fig. 4.2 Future transit-activated precinct. (Source: City of Canning)

Each of the regenerating greyfield precincts will need to have a station with potential to recharge transit, micro-mobility, and private electric vehicles, and a built environment that collects solar energy and incorporates other distributed infrastructure. The whole corridor can be part of an integrated local-metropolitan power system that ultimately spreads across the whole city.

A future city with a network of transit-activated GPRs across most parts of the city and a series of localised centres around stations would begin to look like the precinct illustrated in Fig. 4.2 and the city illustrated in Fig. 1.1, with the various urban fabrics now filled out by a series of new, twenty-first-century boulevards and dense urbanism, providing an enhanced structure for the suburbs that these boulevards traverse.

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