Towards Hume as a Circular City

Quantifying Circular Economy Opportunities in Hume

August 2021

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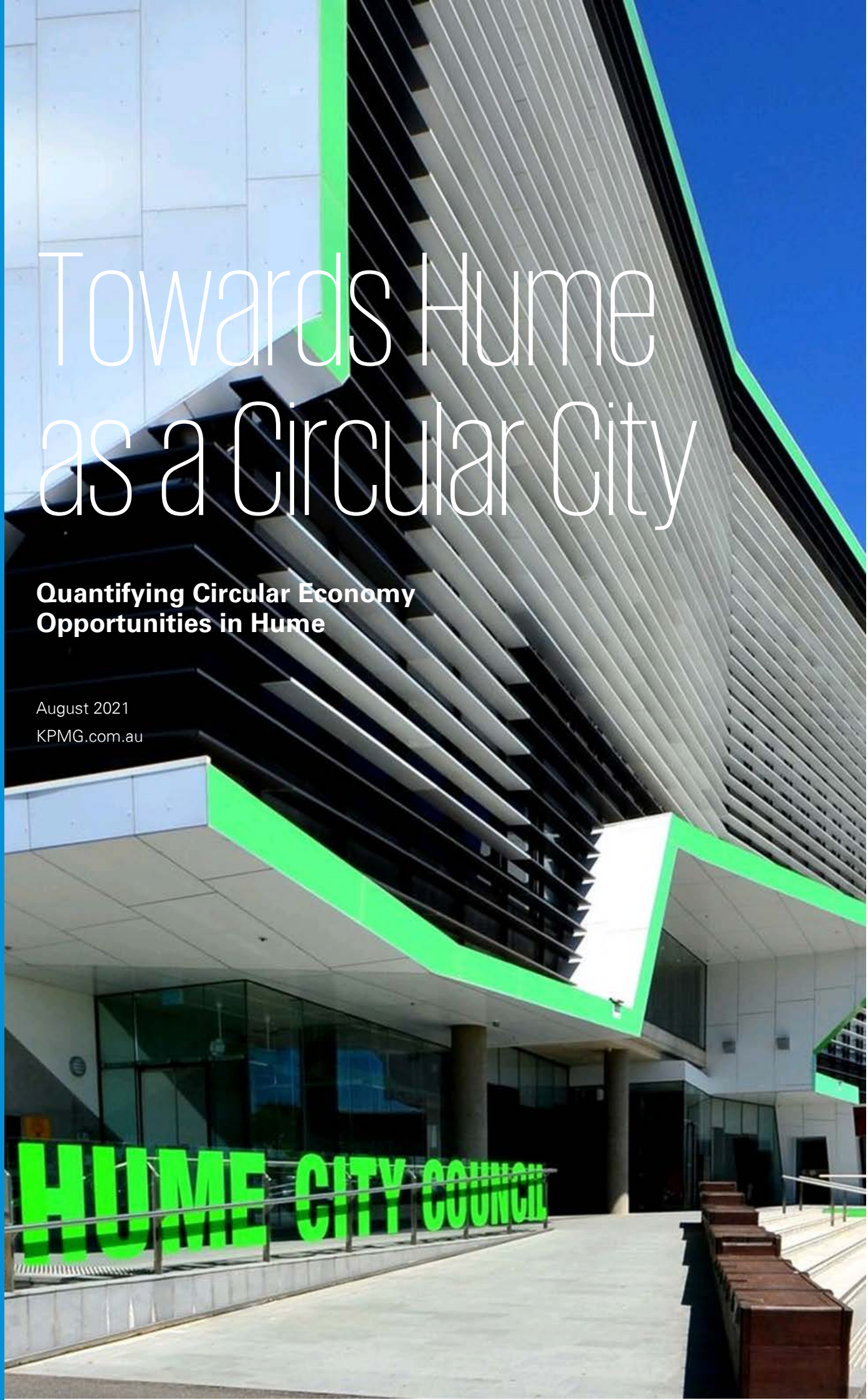

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Executive Summary

An economic assessment of three scenarios in Hume shows that all three had benefits to the Hume economy. However, the implementation of the Circular Economy scenario in Hume has been projected to have the largest economic benefit, increasing real Gross Regional Product (GRP) by 2.82%, or $903 million dollars above baseline per annum in 2040. Creating an additional 1,556 jobs within Hume's economy in 2040 alone. While reducing emissions in Hume by two-thirds from the baseline. At the same time, Hume City Council will save over $12 million per year in landfill levies by 2040.

The Circular Economy in Hume represents a new approach to economic growth, which emphasises resource productivity. The current linear economic paradigm presents an unsustainable pathway to growth for Hume City Council, it's businesses and residents. Landfills overflow, costs of operating and disposing of waste increase exponentially, and socioeconomic status is perpetuated in a business as usual future.

The circular economy approach, on the other hand, has the potential to:

- Enhance productivity and profitability;
- Reduce resource costs including costs of disposing of current waste resources;
- Catalyse innovation;
- Make manufacturing more competitive; and
- Create new business offerings and jobs.

This report summarises the findings of an economic assessment of the opportunities associated with efforts to transition Hume to a Circular City where circular economy principles drive activities across a number of economic sectors. The analysis underpinning this report projects three futures from now to 2040.

We begin the report by setting the context, understanding what is happening within the circular economy globally and in Australia. We then set the Hume baseline, showing the current trajectory to 2040 for the City of Hume without any changes to current policy landscape. This yields an understanding of where Hume is currently positioned and highlights the key areas of impact for circular economy indicatives including key industries.

We then turn to examining the significant achievements of Hume City Council's Economic Development team in progressing the vision of a new circular economic paradigm for Hume, centring on seeding business networks that focus on efficiency and circularity.

The report adopts an aspirational futures scenario co-design, featuring collaboration with a multi-disciplined team of experts from the council, and a selection of Hume businesses. The result is the development of three scenarios for Hume's future under circularity – **the Waste Management City, the Resource Recovery City and the Circular City.**

It starts with the **Waste Management City scenario** that is predicated on a waste management plan currently under development within Hume's Waste and Resource Recovery team, and which will be presented to council in early 2022. This scenario proactively extends Hume's work in enhancing waste management. However, it focuses mostly on the recovery of materials within Hume's council operated sites, rather than on broader industry transition.

While this scenario delivers significant benefits to Hume City through reduced fees from landfill disposal (saving $11.5 million per year by 2040), it is not as effective in expanding industry involvement and CE uptake, leading to a lower real GRP gain compared to the other two scenarios, but nevertheless delivering $212 million more compared to baseline projections by 2040.

The median scenario – the **Resource Recovery City scenario** - then quantifies the economic opportunities associated with a future that strategically emphasises assertive development and expansion in the waste management and advanced materials recycling sectors. In this scenario, we begin to see larger impacts on the boarder Hume economy, with a gain in real GRP of $393 million per annum by 2040.

The final scenario – the **Circular City scenario** – builds on the Resource Recovery City scenario to incorporate the additional economic opportunities associated with a transition to a full circular economy – one that emphasises optimisation of existing resources (e.g. land, labour, space and inputs), innovation, and utilisation of circular design principles that design out waste. This scenario has by far the largest economic benefit to Hume. With an estimated escalation in real GRP of 2.82% per year, adding $903 million dollars to GRP per annum compared to the baseline by 2040, creating an additional 1,556 jobs per annum within Hume's economy.

The Circular City transition will make Hume a more attractive place to live, encourage new business, technologies and industries to be established, while at the same time reduce both waste to landfill and carbon emissions associated with Hume economic activity. In this advanced scenario, the amount of waste to landfill is expected to decrease to just over 4,600 tonnes per annum by 2040 compared to the estimated 101,000 tonnes per annum under Hume's baseline. This will reduce council's costs of landfill disposal by just over $12 million per annum with landfill levy's costing the council a total of $0.6 million per annum by 2040, compared to the $12.7 million per annum in estimated landfill costs in the baseline.

CO2e emissions from industry are also projected to decrease within Hume's Circular City from close to 4 million tonnes of CO2e in per year 2020 to 1.4 million tonnes per year by 2040. This contrasts to the baseline of 5.1 million tonnes of CO2e in 2040 under business as usual.

These reductions in GHG emissions will yield a cost saving of $151 million per annum in carbon mitigation – measured by the current cost of carbon credits – with carbon offsets costing the council only $60 million per annum by 2040, compared to the baseline estimate of $211 million per annum by 2040.

1 For Hume City Council to continue on its journey towards unlocking the benefits of a comprehensive Circular City, we recommended as next steps the following: **Develop a supportive policy environment for the circular economy to flourish in Hume, starting with changes to central policies from 2021-2022,** including developing and approving a CE centred waste strategy, circular procurement specifications, business support policy and advocating for circular standards and regulations at all levels of government.

2 **Enable the sharing of resources and circular economy knowledge throughout Hume,** by establishing a virtual materials marketplace, funding circular business competencies, and establishing a one-stop-shop for circular business advice.

3 **Establish a circular economy network, hubs and community with a whole of city approach**, through codesign, facilitating R&D support, encouraging logistics networks, and establishing innovation and materials reprocessing precincts.

	IMPACT RATING			
Metric	**Low**	**Moderate**	**High**	**Change from baseline by 2040**
Waste Management City				
Economic benefits		▲		Real GRP growth of 0.69% from baseline, representing $212 million. Jobs grow by 0.37% from baseline, representing 475 new FTE.
Environmental Benefits		▲		Waste to landfill decreases by 91 thousand tonnes. Cost of disposal of this landfill decreases by $11.5 million. No difference from baseline CO2e emissions.
Social and Community Benefits	▲			Minimal change.
Resource Recovery City				
Economic benefits			▲	Real GRP growth of 1.25% from baseline, representing $393 million. Jobs grow by 0.41% from baseline, representing 529 new FTE.
Environmental Benefits		▲		Waste to landfill decreases by 94 thousand tonnes compared to the Hume baseline. Cost of disposal of this landfill decreases by $12 million. Additional 1.8 million tonnes of CO2e released.
Social and Community Benefits		▲		Community outreach programs focusing on recycling, waste separation and at home composting. Improved University R&D programs.
Circular City				
Economic benefits			▲	Real GRP growth of 2.82% from baseline, representing $903 million. Jobs grow by 1.21% from baseline, representing 1,556 new FTE.
Environmental Benefits			▲	Waste to landfill decreases by 96 thousand tonnes compared to the Hume baseline. Cost of disposal of this landfill decreases by $12.1 million. Reduction of 3.6 million tonnes of CO2e from the baseline.
Social and Community Benefits			▲	Community engagement and skills programs. Jobs closer to home. Improved community centres. Industry collaboration with universities focusing on R&D.

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Introduction

Drivers of a Circular Economy

The circular economy is a new economic development paradigm that emphasises enhancing the productivity of resources, through design thinking or progressive improvements. This extends the life of existing resources in the economic system, whilst reducing the negative impacts of excessive waste to landfill practices. When implemented properly, a circular economy development strategy can enhance corporate profitability, economic outcomes and reduce the ecological footprint associated with economic activity.

Globally, the rise of circular economy (CE) policy is widespread. The European Union's circular action, launched in 2020 as part of the new European Green Deal, aims to foster a fully circular European economy by 2050.[1] In Asia, Chinese efforts toward fostering a CE through policy began in 2009 with the announcement of the Circular Economy Promotion Law.[2] Since then, policy in support of advancing a CE in China has become entrenched, playing a prominent role in the current 13th five-year plan.[3] Industry and government leaders in Japan – Asia's second largest economy – announced a Partnership on Circular Economy in March 2021, intended to escalate CE development in the nation.[4]

These CE developments in major overseas markets give rise to opportunities and threats for Australian business. As these major economies make the transition to a CE, procurement specifications will be introduced, circular supply chain requirements will arise, and new business models will emerge. For Australian businesses that proactively align operations to support circular business practice, there will be a bounty of opportunities both at home and overseas; but for businesses that are slow to respond, overseas markets will increasingly become impenetrable.

Here in Australia, federal and state policies have emerged over the past two years that clearly push Australia's economic development trajectory toward a circular transition. Prior to 2018, a great deal of Australia's recyclable waste was being shipped overseas for processing. The National Sword policy introduced by China in January 2018[5] restricted imports of 24 types of solid waste, including various plastics and unsorted mixed papers, and set far more stringent standards for acceptable contamination levels in waste that would be accepted. Soon after, other nations that had been key

[1] European Commission. (2020). Communication from the Commission to the European parliament, The Council, The European Economic and Social Committee and the Committee of the Regions. https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1583933814386&uri=COM:2020:98:FIN and Fluence Corporation Limited. (2021). EU Aims for Circular Economy by 2050. https://www.fluencecorp.com/eu-aims-for-circular-economy-by-2050/

[2] The World Bank. (2020). China Circular Economy Promotion Law. World Bank Group. https://ppp.worldbank.org/public-private-partnership/library/china-circular-economy-promotion-law

[3] The Open University. (2020). Waste Management and Environmentalism in China. https://www.open.edu/openlearn/nature-environment/environmental-studies/waste-management-and-environmentalism-china/content-section-1.4.1

[4] World Economic Forum. (2021). Japan Launches Circular Economy Collaboration with World Economic Forum. https://www.weforum.org/press/2021/03/japan-launches-circular-economy-collaboration-with-world-economic-forum/

[5] The State of Victoria Department of Environment, Land, Water and Planning. (2018). Victorians urged to keep recycling. State Government of Victoria. https://www.environment.vic.gov.au/sustainability/victorians-urged-to-keep-recycling

export destinations for Australia's recyclable waste – Thailand, Malaysia, Indonesia and India – enacted their own bans on importing waste. [6]

The result was a national waste crisis, with domestic waste recyclers unable to respond quickly to pick up the slack. Meanwhile, national and state policymakers seized the opportunity to revisit domestic waste management policy and engender the development of a more efficient, technically advanced waste sector that is more closely integrated with companies capable of advanced materials reprocessing.

Subsequently, Australia's National Waste Policy was published in 2018, and its action plan laid out a series of ambitious targets for 2030 and beyond. [7, 8] These were to: [9]

- ban the export of waste plastic, paper, glass and tyres, commencing in the second half of 2020;
- reduce total waste generated in Australia by 10% per person by 2030;
- reach 80% average recovery rate from all waste streams by 2030;
- significantly increase the use of recycled content by governments and industry;
- phase out problematic and unnecessary plastics by 2025; and
- halve the amount of organic waste sent to landfill by 2030.

The Policy aims to achieve these waste reduction targets by integrating CE principles into the action plan, while also mandating state government action to realign state waste management policy to the national plan. At the same time, the Productivity Commission has begun their enquiry into consumer rights such as the Right to Repair. [10]

At the state level, the Victorian government has released the Recycling Victoria: A New Economy strategy. [11] This state-wide strategy, developed through extensive public consultation, has been built around four CE goals: [12]

- **Goal 1 - Design to last, repair and recycle.** Generate less waste in businesses through innovation and design; use recycled materials in products and consider impacts across product life cycles; and support business to explore new CE business models.
- **Goal 2 - Use products to create more value.** Help people make smart purchasing decisions and extend the life of products and support the reuse economy; and repair goods where possible.
- **Goal 3 - Recycle more resources.** Reform kerbside collections to generate more value from waste; improve the separation of recyclable materials; develop markets for recovered materials; plan for and boost investment in recycling infrastructure; embed the waste hierarchy in the management of materials; and support the development of appropriate waste to energy facilities.
- **Goal 4 - Reduce harm from waste and pollution.** Protect communities and the environment from high-risk and hazardous wastes.

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[6] Schauenberg, T. (2021, 5 April). After China's import ban, where to with the world's waste? *Deutsche Welle*. https://www.dw.com/en/after-chinas-import-ban-where-to-with-the-worlds-waste/a-48213871

[7] Schauenberg, T. (2021, 5 April). After China's import ban, where to with the world's waste? *Deutsche Welle*. https://www.dw.com/en/after-chinas-import-ban-where-to-with-the-worlds-waste/a-48213871

[8] Australian Government Department of Agriculture, Water and the Environment. (2019). National Waste Policy Action Plan. Department of the Environment and Energy. https://www.environment.gov.au/protection/waste/publications/national-waste-policy-action-plan

[9] Australian Government Department of Agriculture, Water and the Environment. (2019). National Waste Policy Action Plan. Department of the Environment and Energy https://www.environment.gov.au/protection/waste/publications/national-waste-policy-action-plan

[10] Productivity Commission. (2021). Right to Repair. https://www.pc.gov.au/inquiries/current/repair#report

[11] Victoria State Government. (2020). Recycling Victoria A new economy. Environment, Land, Water and Planning. https://www.vic.gov.au/sites/default/files/2020-02/Recycling%20Victoria%20A%20new%20economy.pdf

[12] P. 10: Victoria State Government. (2020). Recycling Victoria A new economy. Environment, Land, Water and Planning. https://www.vic.gov.au/sites/default/files/2020-02/Recycling%20Victoria%20A%20new%20economy.pdf

With a ten-year action plan to deliver a cleaner, greener Victoria with less waste and pollution, better recycling, more jobs and a stronger economy, there are a series of incentives and tiered increases to landfill levies embedded in the Recycling Victoria policy. [13] This carrot and stick approach will aim to drive funding for the development of CE businesses, infrastructure development for hazardous waste and waste to energy, and accelerate recycling. The government will also double landfill levies from $65.90 per tonne of waste for metropolitan municipal areas to $125.90 per tonne by 2023.

In an ecosystem that is pursuing such a rapid transition, it is imperative that Hume City Council is at the forefront of this transition, to attract business, promote development, reduce waste to landfill and contribute to a sustainable future for the region, the state and the nation.

In business and in broader society, there is a growing awareness of the limits that exist in the natural ecosystem – otherwise known as planetary-boundaries. The planet is comprised of natural systems, on which humanity has layered social, economic and technological structures. However, the economic systems supporting humanity cannot grow indefinitely, and neither can the resultant environmental impacts. [14] By adopting a planetary-boundaries approach, business leaders can help close the gap between current production, and the capacity of existing natural systems. The CE contributes to this aim.

Opportunities for the Circular Economy

While the CE focus from national and state policy has primarily been on waste and resource recovery, when fully implemented, CE also catalyses improvements in financial, environmental and social performance. When materials stop being used, they return to another position in the economic cycle – hence the term 'circular economy'. The new approach has the potential to:

- Enhance productivity and profitability;
- Reduce resource costs and waste disposal costs;
- Catalyse innovation;
- Make manufacturing more competitive; and
- Create new business offerings and jobs.

Figure 1 provide a macro perspective on the CE where any material that enters the resource pool is used in an optimal manner, reducing waste and excessive resource reliance. The material then recirculates with higher order uses such as re-use and repair prioritised. Recycling and materials recovery plan a key role in the CE but only after other value-added recirculation strategies have been exhausted. In this way, all materials are optimised across an extended lifecycle.

Consumers can also play a key role in the CE by making better purchasing decisions, emphasising quality over quantity. They can actively decide to reduce consumption, purchase second hand or reconditioned goods and repair goods when possible. They can also play a positive role in ensuring that recycling of goods is optimised by disposing of goods in the most suitable manner.

In the CE, new business models arise to support resource reduction, circularity and innovation. There are new expanded roles for advanced waste and materials reprocessors, service businesses (including repair and reuse), logistics and transport companies, manufacturing and energy sector firms. All these new businesses can help retain economic value in the system through recycling and recovery of residual materials.

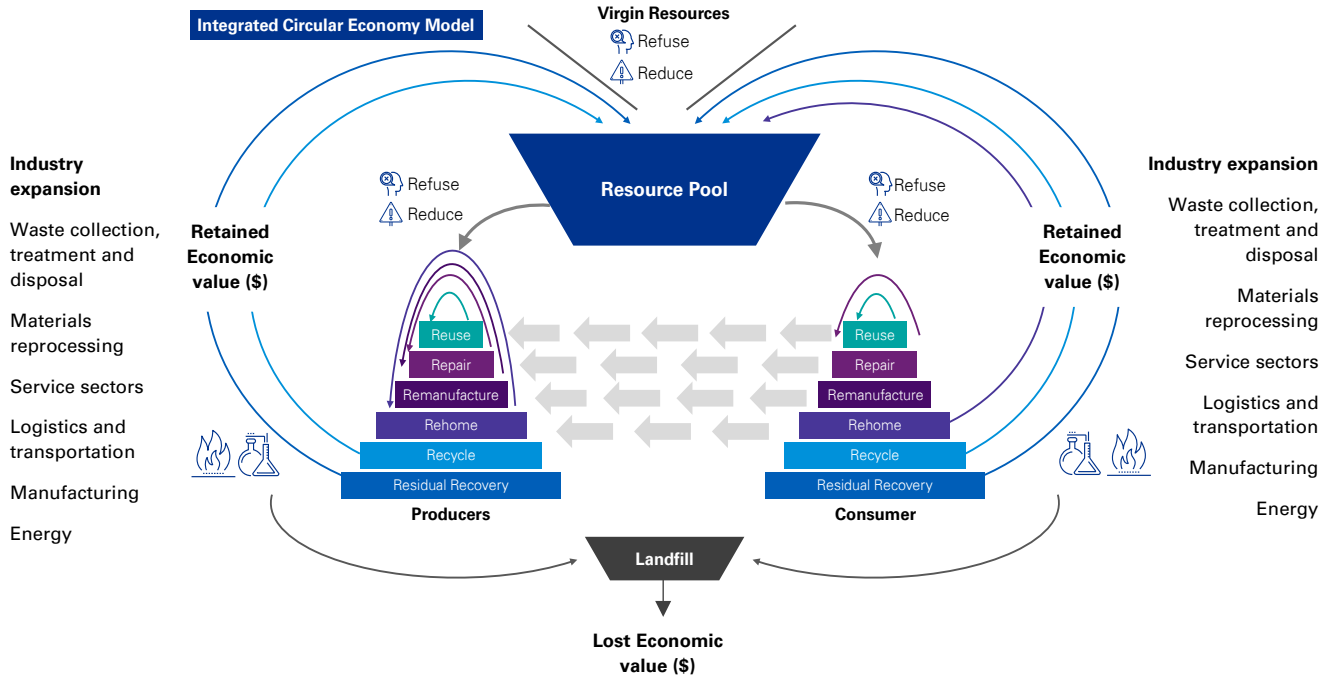
[13] Victoria State Government. (2020). Recycling Victoria: A new economy. The State of Victoria Department of Environment, Land, Water and Planning. https://www.vic.gov.au/sites/default/files/2020-02/Recycling%20Victoria%20A%20new%20economy.pdf

[14] KPMG Impact. (2021). You Can't Go Green Without Blue. KPMG International. You can't go green without blue - KPMG Global.

The CE has a pivotal role to play in supporting quality economic growth. A 5% improvement in materials efficiency could increase the size of the Victorian economy by $6.7 billion [15], an opportunity which both private and industry, local government authorities and community stakeholder can benefit from.

At the business level, using resources more efficiently leads to more competitive, profitable industries, engendering job growth as economic value is retained, and channelled into business development. [16] Considering the costs companies presently face for disposing of and dealing with waste and ineffective resource usage, there are no risks associated with using resources more efficiently and in a more circular manner. There are only benefits.

Figure 1 - Circular Economy Model



Source: Valentine, 2020

[15] Victoria State Government. (2020). Recycling Victoria: A New Economy. The State of Victoria Department of Environment, Land, Water and Planning. https://www.vic.gov.au/sites/default/files/2020-02/Recycling%20Victoria%20A%20new%20economy.pdf

[16] OECD (2020). The Circular Economy in Cities and Regions: Synthesis Report. OECD Urban Studies. OECD Publishing, Paris. https://doi.org/10.1787/10ac6ae4-en.

Hume City Council

The City of Hume is located in the northern outskirts of Melbourne, between 15 and 45 km from Melbourne CBD. Suburbs within council bounds include Attwood, Broadmeadows, Bulla, Campbellfield, Clarkefield (part), Coolaroo, Craigieburn, Dallas, Diggers Rest (part), Fawkner (part), Gladstone Park, Greenvale, Jacana, Kalkallo, Keilor (part), Meadow Heights, Melbourne Airport, Mickleham, Oaklands Junction, Roxburgh Park, Somerton, Sunbury, Tullamarine (part), Westmeadows, Wildwood and Yuroke. [17]

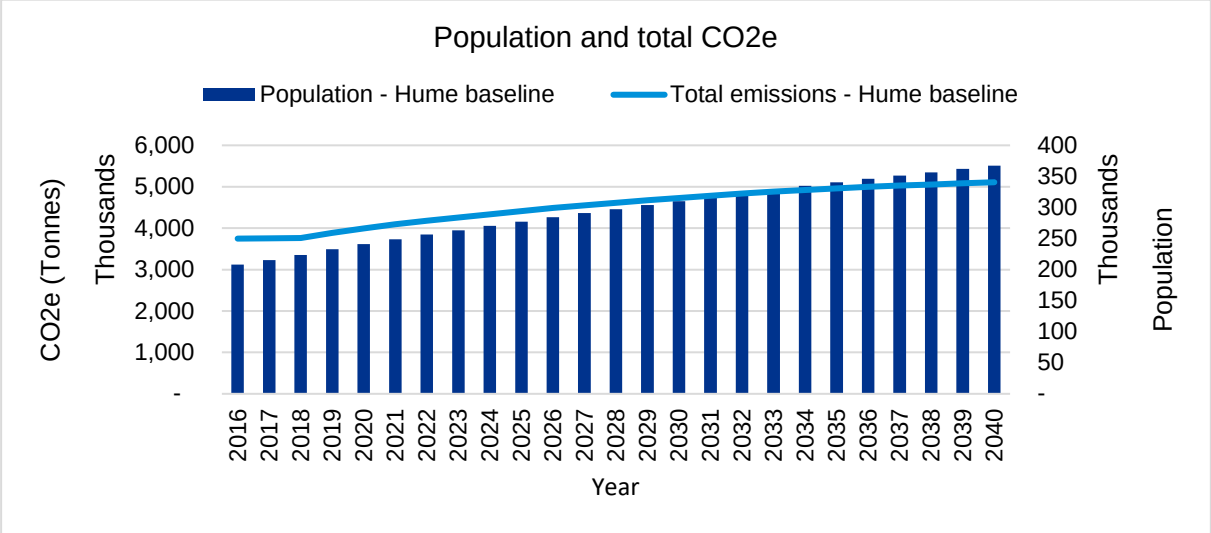
Hume is in the midst of an urban transition. Its mix of rural and urban areas include residential, industrial and commercial precincts. While the areas to the south of the council region are well established urban areas; the northern regions are primarily rural. [18]

Currently, 55% of Hume's working residents travel outside the municipality to work, with many residents (40%) travelling to work using private vehicles. This is partially due to a lack of convenient public transport infrastructure. [19]

Hume's residents are in the bottom quartile of Australia's Socio-Economic Indexes for Areas (SEIFA). This means that compared to the national average, Hume's residents are, on average, characterised by lower levels of income, and education. [20]

The population in Hume is projected to increase over the next 40 years from 214,000 in 2020 to 367,000 in 2040 (Figure 2). With both population and business growth expected, the total carbon emissions are set to increase year-on-year, reaching over 5 million tonnes of CO2e by 2040. Offsetting these emissions to meet net-zero targets would cost Hume over $200 million dollars per year by 2040. For this reason, encouraging a clean energy transition is a policy priority in Hume.

Figure 2 - Population and CO2e emissions to 2040



[17] Hume City Council. (2020). Hume City Community Profile. https://profile.id.com.au/hume/about
[18] Hume City Council. (2020). Hume City Community Profile. https://profile.id.com.au/hume/about
[19] Hume City Council. (2020). Hume City Resident's Place of Work. https://profile.id.com.au/hume/residents
[20] Hume City Council. (2020). Hume City SEIFA by Local Government Area. https://profile.id.com.au/hume/seifa-disadvantage?SeifaKey=40002

In 2020, according to Remplan data [21], gross regional product (GRP) in the City of Hume was $16 billion, which is largely driven by interregional exports and household consumption.

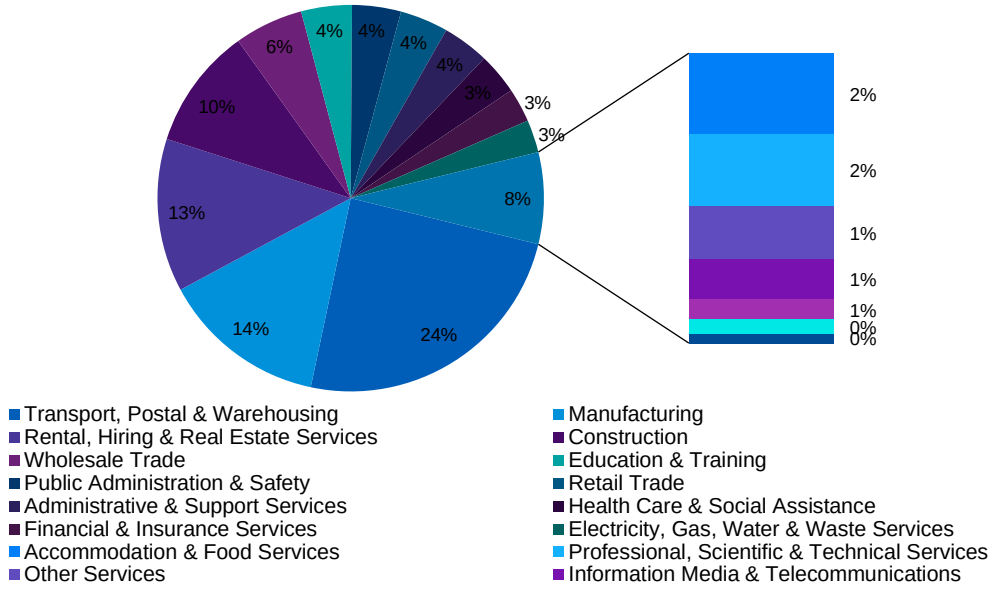
Table 1 - Baseline macroeconomic economic data

Macro variables $m	2020
Household consumption	$ 9,865.98
Aggregate investment	$ 3,064.66
Government expenditure	$ 3,651.82
Inventory stocks	-$ 37.63
International exports	$ 1,346.29
International imports	-$ 2,273.30
Interregional exports	$ 10,301.50
Interregional imports	-$ 9,995.33
Real Gross Regional Product	**$ 15,924.00**

Source: Remplan, 2020

Value-added economic contribution, which represents the marginal economic contribution of each sector, shows that the largest sector in Hume is transportation, postal and warehousing services (24%), followed by manufacturing (14%) and rental, hire and real-estate services (13%) (Figure 3). These industries collectively contributed to 36,225 jobs, roughly 40% of the total jobs in Hume.

Figure 3 – Percentage of value-added by industry sectors in Hume in 2020



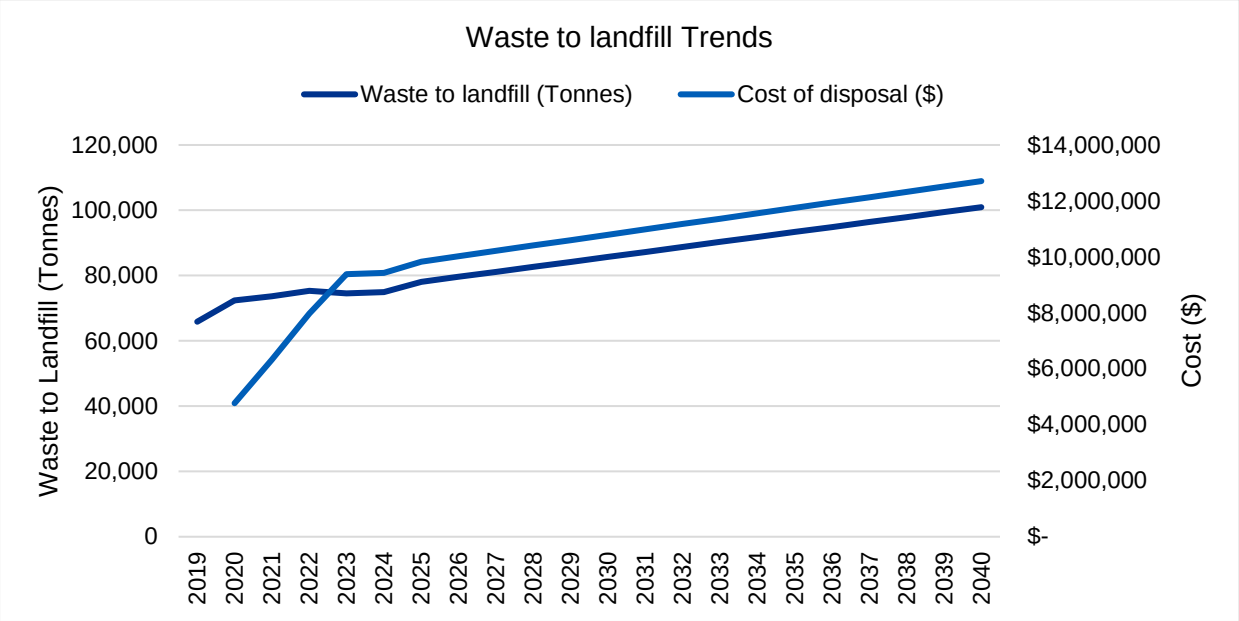
Source: Remplan, 2020

[21] Remplan. Hume City Council. (2020). https://app.remplan.com.au/hume/economy/summary?state=nL3YF5KGFy3w75SB7wy4yTxSLSqDm.

Based on a materials flow analysis conducted in 2020 by Hume City Council, waste to landfill from Hume's City Council facilities was 72,000 tonnes. Based on current trends, this is set to increase to 89,000 tonnes in 2040 (Figure 4, left axis).

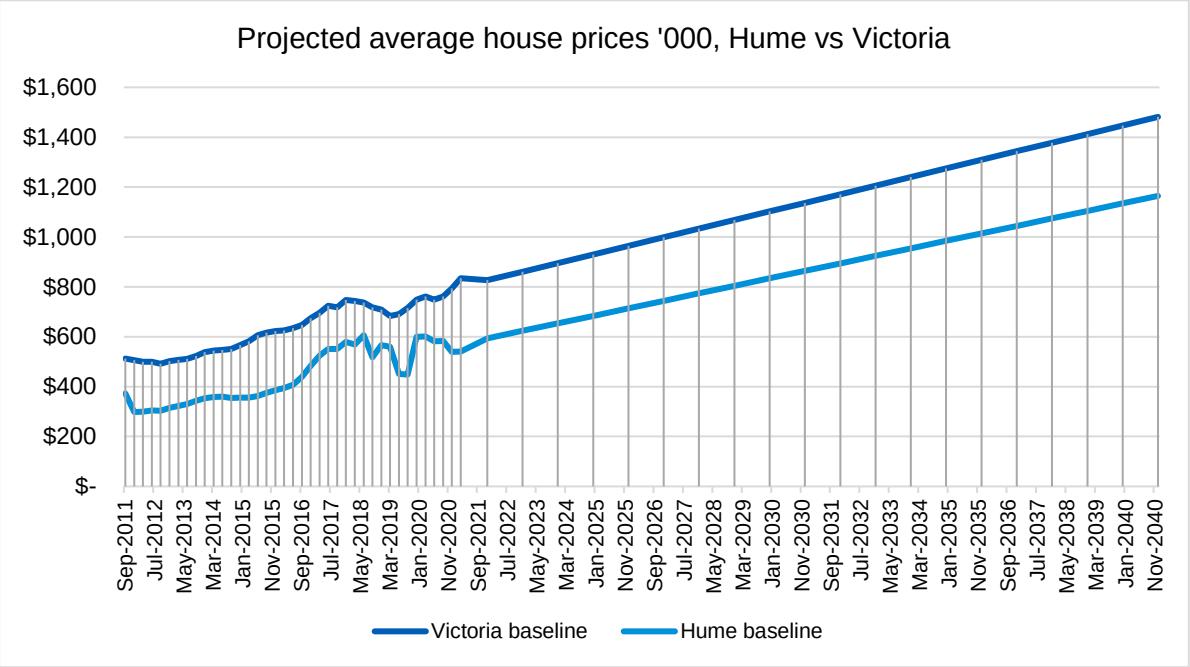
The levies to be introduced by the Recycling Victoria Policy, which will double landfill charges between 2021 and 2023, will increase the cost of disposal of waste in Hume (Figure 4 – right axis),. The higher cost of disposal will place greater impetus on recycling. With no change to the current rate of recycling, the cost to Hume City Council of landfilling waste in Hume will reach $9 million by 2023 and is projected to increase to $13 million per year by 2040.

Figure 4 - Waste to landfill and cost of disposal in Hume



House prices are an indicator of the attractiveness of a region to live and are influenced by the availability and proximity to work, school quality, shopping facilities, local amenities or community facilities, in addition to the socio-economic development and wages within a region. Hume's property prices have historically been below the state average for Victoria by between 20-40% (Figure 5).[22]

Figure 5 - Projected house prices in Hume (business as usual)



In the absence of a suitable policy response, the cumulative effect of the trends outlined in this section portends an emergent scenario whereby Hume will become more crowded, business costs will rise due to increased waste management costs, and local landfills will more rapidly reach capacity. It is for these reasons that Hume City Council has begun to re-align policy around enhanced waste management, programs to help businesses recycle their waste to avert high landfill costs, advancement of clean energy technologies and promoting a shift to a CE business strategy. The end goal is an economy that continues to flourish but does so with companies that are highly productive when it comes to resource use and with an approach to urban transition planning that focuses on environmental and social regeneration in its communities.

[22] KPMG review of historic house prices in Hume from Domaine, compared to the Victorian average from the ABS. Please see Appendix 3.4 Property Prices for more detail.

Hume's path towards circularity

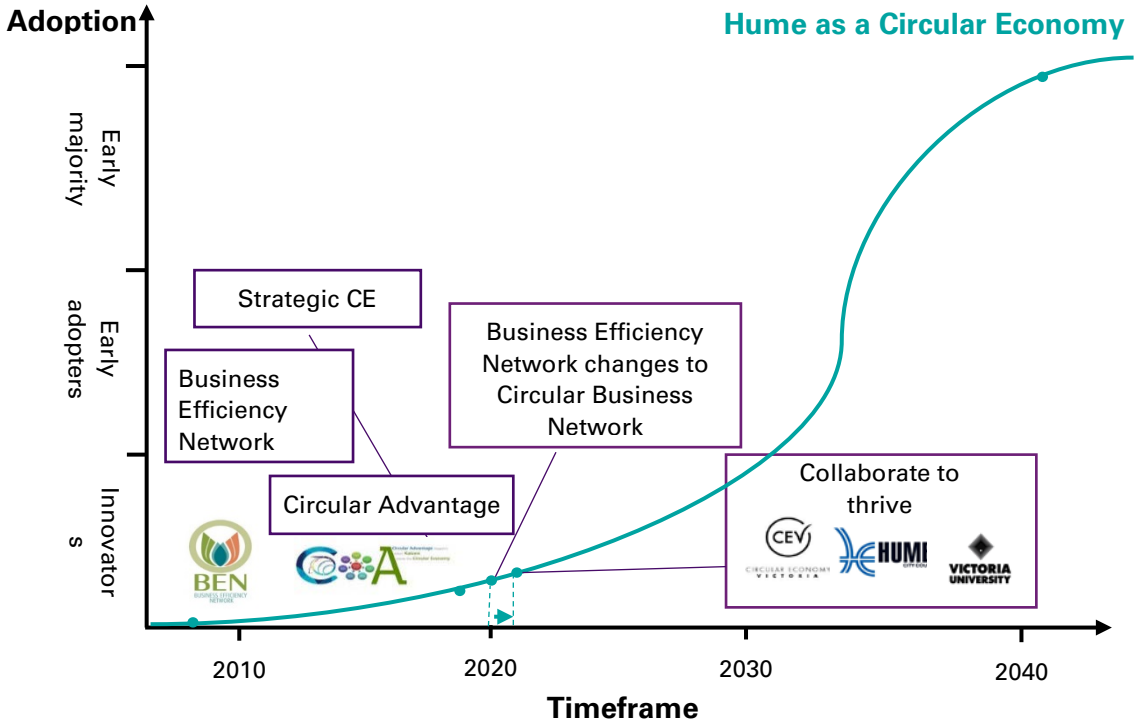
Hume have been in the early stages of adoption in CE principles from the late 2000's, through being actively involved in progressive business improvement through the Business Efficiency Network (BEN), which has now transitioned to the Circular Business Network.

Leading up to the Victorian State government's Recycling Victoria action plan, Hume were on their own journey to understand and assess the economic opportunities of the CE for the City of Hume. In December 2019, Hume Council's Director of Planning and Development charged its Manager of Economic Development with a Strategic Performance Objective to: "assess the economic opportunities to the City of Hume arising from the state's circular economy policy".

By 2020, they had become one of the first local councils to utilise and support a CE training program for local businesses – the Circular Advantage Program. In its first year, nine businesses in Hume participated in the program, with six of these businesses being part of the manufacturing industry.

This business capacity building program paralleled the establishment of the Hume Circular Economy Sector Working Group which met monthly over the course of six months to consider CE ramifications for Hume City Council's Economic Development, Procurement, Strategic Planning, Sustainable Environment, and Waste and Resource Recovery teams. Findings of this working group were presented to Council on the 6 April 2021, which resulted in Council's unanimous endorsement of the *Towards Hume as a Circular City* vision.

Figure 6 - Hume adoption of the Circular Economy



Hume Circular City

In April 2021, Hume City Council unanimously approved the Hume Circular City vision under the Hume City Council Plan for 2017 to 2021, which outline's council's vision to be a "recognised leader in achieving social, environmental and economic outcomes with a common goal of connecting our proud community and celebrating the diversity of Hume".[23] This marked the start of Hume's formalised journey towards circularity, guided by the circularity road map, shown in Figure 7.

Figure 7 - Hume's circularity roadmap

This report represents the completion of the first stage of the circularity road map, the business case. It seeks to understand the key opportunities for the CE in Hume and begin to engage businesses in Hume City to build capacity in the CE. By undertaking an economic analysis exercise, Hume City Council can gain a better understanding of what comprehensive opportunities exist for the CE in Hume.

CE networks need to be participative in nature, because collaboration drives circularity. In recognition of the participatory requirements of CE network development, this economic study approach has, uniquely, taken a collaborative and deliberative approach to quantifying the economic opportunities of progression of scenarios which represent possible futures that gradually escalate towards a comprehensive Circular City strategy. This involved engaging with various businesses and key materials reprocessing and waste companies in order to reflect upon and enumerate CE opportunities various policy scenarios.

Stage two of Hume's CE network development process will involve the participative design of a CE network. This initiative that we call the Circular Champions will bring together industry participants from the economic analysis, Hume business participants in KPMG's Circular Advantage program (a CE

[23] Hume City Council. (2021). The Hume City Council Plan 2017-2021: Incorporating the Disability Action Plan and Strategic Resource Plan 2020/21-2023/24. https://www.hume.vic.gov.au/files/sharedassets/public/your-council/council-plans/hume-city-council-plan-2017-2021-2020-2021-actions.pdf

corporate strategy program), influential industry leaders and participation from other relevant stakeholder groups to begin a deliberative process of designing a CE network for Hume that is based on participative intent.

Stage three of this process draws all stakeholders that are interested in supporting a Hume CE into a capacity building program designed to elicit business commitment to specific CE network support activities.

The fourth stage will extend development of the CE network from stage three by identifying bridging activities that can connect economic activities in the emerging CE network. The process will target entrepreneurs and small businesses that can drive these activities and will provide training to these small businesses in order to consolidate CE network activities.

The fifth stage of CE capacity building in Hume will inject resilience in the ecosystem by broadening the CE support web through enhanced logistic design, capacity building programs, CE retail planning, virtual marketplace development and connecting entrepreneurs to university and technical support to add-value to all CE initiatives in the Hume Circular City.

This report: Quantifying an aspirational future

Despite the plethora of benefits that the CE brings to an economic system through improved resource productivity, efforts to quantify this, and link to economic outcomes are rare and complicated. Yet, economic analysis is an important factor in driving policy and investment buy in. Thus, progressing the CE requires an understanding of exactly what benefits exist for companies, regions and non-economic stakeholders when applying CE principles. This report is an economic assessment of the opportunities within the City of Hume up to 2040 over three future scenarios: **Waste Management City, Resource Recovery City and Circular City.**

By its nature, economic analysis is hindered by extrapolations from previous trends which omit uncertainties and dynamics affecting future events. This is particularly relevant when predicting the evolution of complex adaptive systems, such as economic systems. Therefore, we have supplemented the economic analysis with an adaptation of a methodology called aspirational futures.

Aspirational futures is a group-focused stakeholder methodology that centres on co-design of future goals and ambitions. In urban planning, the method is operationalised by bringing together a representative group of community stakeholders and inviting them to create a joint urban planning vision. Data and grounded information are used to frame starting points and stakeholders then begin to construct viable future scenarios through discussions centring shared community aspirations. The process typically yields strategic stretch ambitions compared to business as usual plans because the aspirational goals inevitably entail developments in a community that have yet to materialise. This methodology has been previous employed by planners in Bristol and Birmingham. [24]

Our approach to aspirational futures incorporated a dual form of quantification, where we began to understand the linear improvements to the CE through traditional economic projection techniques based on known baselines, and then projected CE innovation, through the development of aspirational future scenarios. This process aligns seamlessly with Hume City Council plans to ensure the construction of a CE is deliberative, participative and re-iterative.

The analysis was performed in three main stages:

A) Baseline: Review of current economic activity, employment and trends by sector in Hume. This also encompassed a review of economic, social and environmental trends in Hume.

B) Material Flow Analysis (MFA): Building from previous MFA analyses in Hume, we gathered waste management data from Hume's municipal facilities and a number of private companies in the materials reprocessing sector to understand:

1. What materials exist in Hume;
2. How much waste is being sent to landfill;
3. What are the associated emissions with this waste;
4. What are the volumes of the main waste resources; and
5. The potential opportunities to utilise these materials elsewhere in Hume.

[24] Rogers, C. D., & Hunt, D. V. (2019). Realising visions for future cities: an aspirational futures methodology. *Proceedings of the Institution of Civil Engineers-Urban Design and Planning, 172*(4), 125-140.

C) Scenarios and Economic Projections: Working from the baseline economic data and materials flow analysis, we began to engage companies in Hume to understand and examine potential growth opportunities for the CE for their businesses. This enabled us to create growth estimates for economic variables including real GRP, business profits, jobs, household consumption, investment, energy and emissions and net exports under three scenarios: Waste Management City, Resource Recovery City and the Circular City. Each scenario was then projected using KPMG's Computable General Equilibriums (KPMG-SD) to provide future economic estimates for the opportunities within the CE for Hume. KPMG-SD is a multi-regional, dynamic CGE which is ideally suited to estimating changes to economic indicators for a region-specific project or change such as a move to a CE. Key features of the KPMG-SD are described in Appendix 3.

Scenarios: building an aspirational future

Waste Management City

The Waste Management City scenario aligns with Hume City Council's draft waste management plan which is currently under development within the council's Waste and Resource Recovery team. This plan will be presented to council in early 2022. This Waste Management City represents ambitious policy efforts to improve recycling rates and encourage waste reprocessing. While this strategy is already nudging Hume towards elements of the CE, it falls short of optimising recycling or fostering a Circular City.

Storylines: What happens in Hume under the Waste Management City?

Policy

The federal and state government's policies to elevate recycling percentages creates an enhanced supply of recycled commodities and recycled-content procurement specifications may encourage incorporation of recycled content into products. The Recycling Victoria Policy catalyses a series of incentives for CE innovations, and disincentivises waste to landfill through the introduction of higher landfill levies. This doubles the cost of landfill by 2023 and recycling progressively expands as higher levies and subsidies are progressively introduced.

The Victoria State Government's recycling policy encourages competitive growth in the private waste management sector and upgrading of technology to reprocess waste to higher levels of quality and efficacy. Overall, the state and federal government's policy to enhance recycling, creates a market for recycled products and provides funding for expansion of materials reprocessing.

In response to and support of state policy, Hume City Council re-aligns strategy to connect municipal waste management to advanced material reprocessing, further expanding the availability of recycled materials for local businesses through a Draft Waste Strategy. Several materials reprocessing companies relocate to Hume because waste resources that were previously sent to landfill now require reprocessing, remanufacture or recycling.

The roll out of organic bins across Hume leads to an estimated 34,000 tonnes of organic waste and compost being diverted from landfills for use in public areas throughout Hume, with the remainder being sold off to other consumers. The use of compost around common areas of Hume, replaces the need for fertiliser and results in disposal cost savings of $11.9 million per annum.

The Waste Management City scenario aims at fostering a sharp decline in waste to landfill with reductions reaching 72% by 2025, and 90% in 2040 (see Figure 8). By 2022, reductions in waste to landfill begin to offset landfill cost increases (Figure 9). Diverting waste from landfills to private material re-processors represents a progressive cost saving to Hume when compared to the baseline. Consequently, Hume City Council saves $11.5 million per year by 2040 in the Waste Management City scenario compared to the Hume Baseline.

Hume City Council considers releasing its own procurement specifications which where applicable and practicable, preferences the procurement of recycled content for certain product categories. Municipal infrastructure projects feature higher levels of recycled content. Moreover, public-private

partnerships (PPP) between Hume City Council and local businesses increasingly deploy recycled content.

Case Study 1

The Victoria Government are investing almost $100 million to strengthen Victoria's waste and recycling industry. This investment will catalyse growth of local industry, create local jobs and drive innovation and new technologies.

By 2022-2023, a container deposit scheme will allow all Victorians to swap empty cans and bottles for cash. By 2030, a new 4-bin waste and recycling system will be the standard for households across Victoria. In addition to the standard red bin for general waste, and yellow bin for mixed recycling, this system will introduce a green bin for food organics and garden waste (by 2030) and a purple bin for glass recycling (by 2027). [25]

Through a new waste and recycling act and a waste authority, the Victorian Government will increasingly push waste management away from landfill dumping practices.

Figure 8 – Hume City Council waste to landfill under the Waste Management City compared to Hume baseline

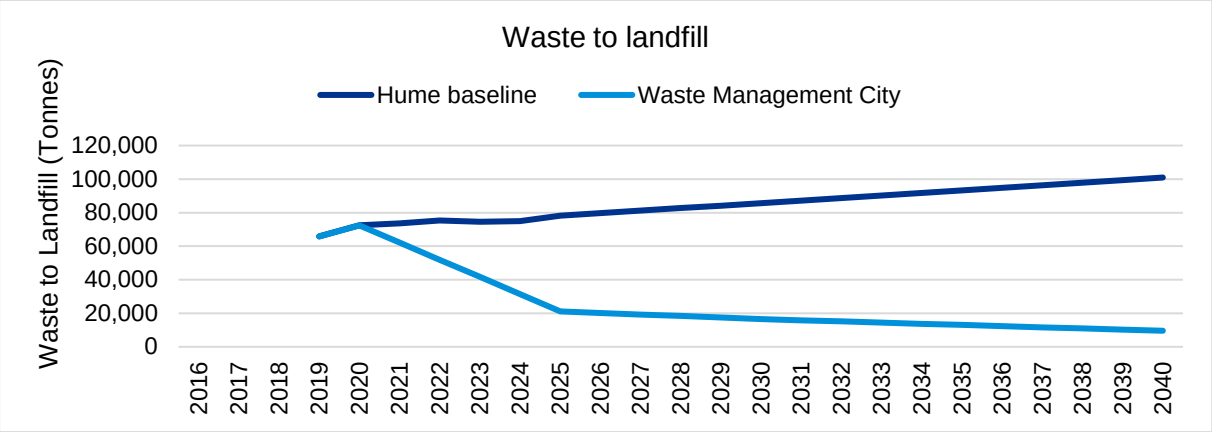
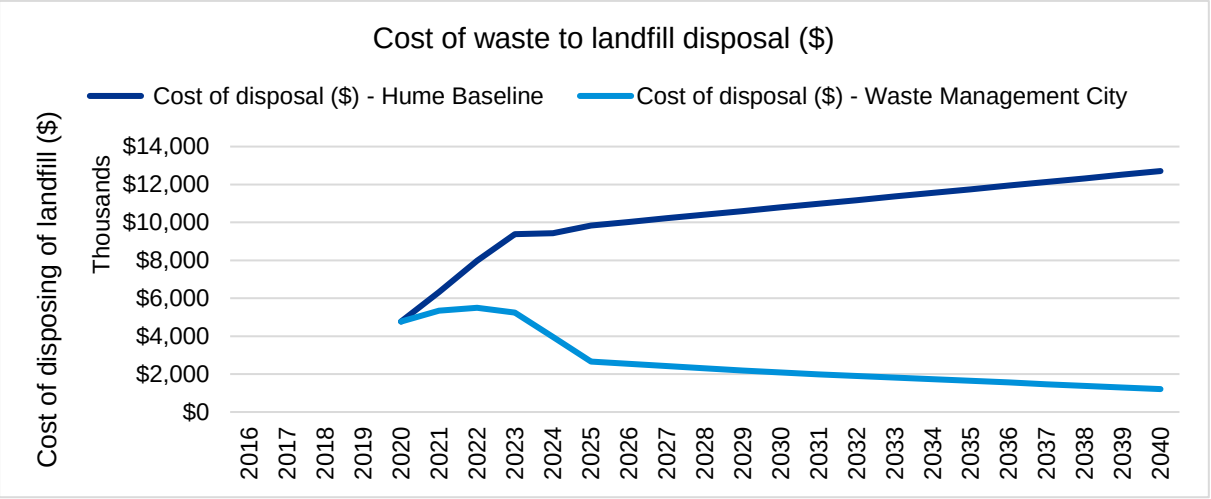


Figure 9 - Cost savings for Hume City as a result of reducing waste to landfill



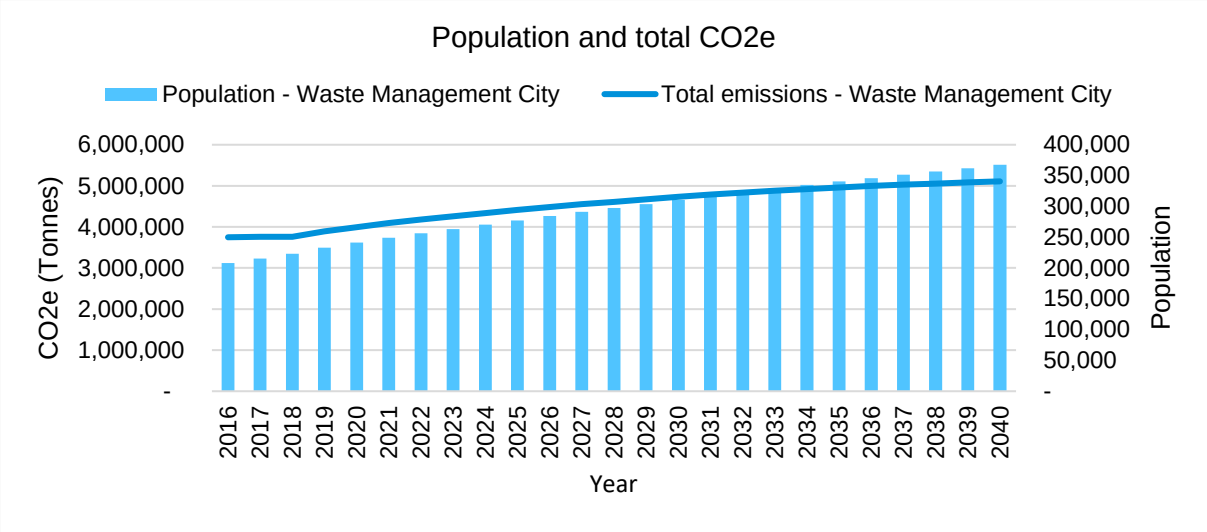
[25] Victorian Government. (2021). Stanadardising household recycling across Victoria. https://www.vic.gov.au/Standardising-household-recycling-across-Victoria

Economic

Under the Waste Management City, new businesses in the waste and advanced materials reprocessing sectors are attracted to Hume, and existing businesses expand. However, business growth is hampered by suitable land constraints and a lack of access to feedstock that is needed to drive economies of scale. In terms of traditional industry development, the Council continues to advance plans to prepare development ready land for industrial sites, for example, in areas such as Craigieburn in Melbourne's North.

A slight increase is expected in CO_2e emissions under the Waste Management City which mirrors the baseline projections in Figure 10. This transpires because of clashing forces. Small-scale renewable energy installations continue to expand; however, the uptake of larger renewable installations is expected to be limited. As a result, the supply of renewable energy remains limited. At the same time, government supported programs improve energy efficiency while industrial activity across sectors such as advanced materials reprocessing increases, resulting in an overall increase in energy demand. Increased energy demand from industrial processes and growth in population results in carbon emissions in Hume increasing to just over 5 million tonnes by 2040 (Figure 8).

Figure 10 - Total population and emissions in Hume in the Waste Management City



This carbon is expected to cost $200 million by the year 2040 to mitigate – based on the cost of carbon credits, up from an estimated $43 million in 2016 (Figure 11). The cost of carbon credits are sourced from ACCU's as described in Appendix 3.2 Carbon Emissions.

Figure 11 – Total carbon emissions and Cost of carbon mitigation in Hume

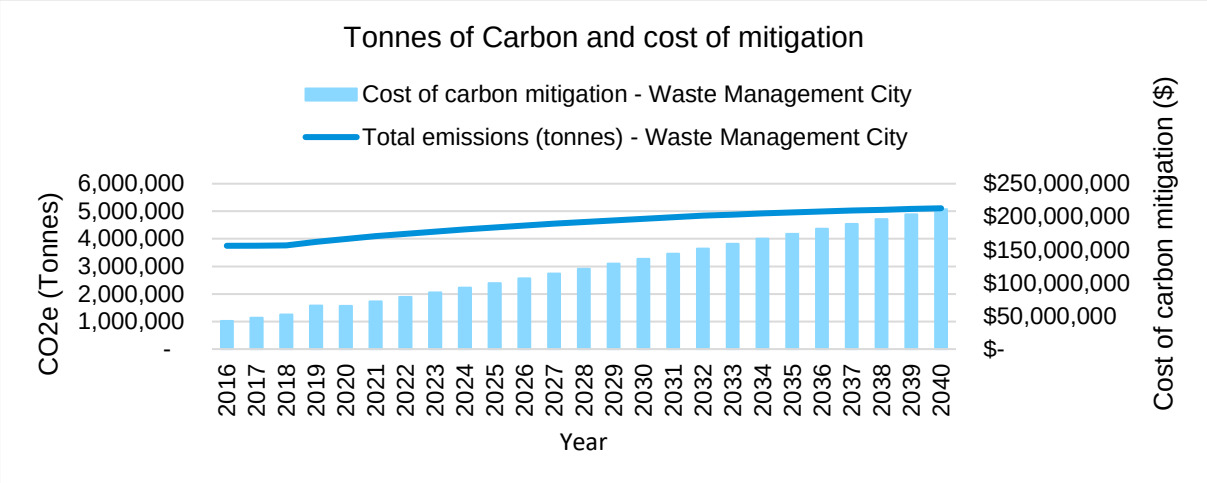


Figure 12 summarises the real GRP effects of the policy changes outlined above, and the shocks to Hume's economic sectors. It represents **change** from the current baseline trend. To clarify, Figure 11 illustrates that under the Waste Management City scenario, by 2025, real GRP is expected to increase by 0.24%, contributing $45 million more to the Hume economy compared with the baseline. By 2040, real GRP for the City of Hume will be 0.69% higher and this increase will amount to $212 million larger Real GRP compared to baseline trends

GRP is equal to the sum of household consumption, aggregate investment and net exports (international and interregional exports minus international and interregional imports). The breakdown of these results is presented in Table 2.

Figure 12 - Changes in GRP under the Waste Management City Scenario (compared to Hume's baseline)

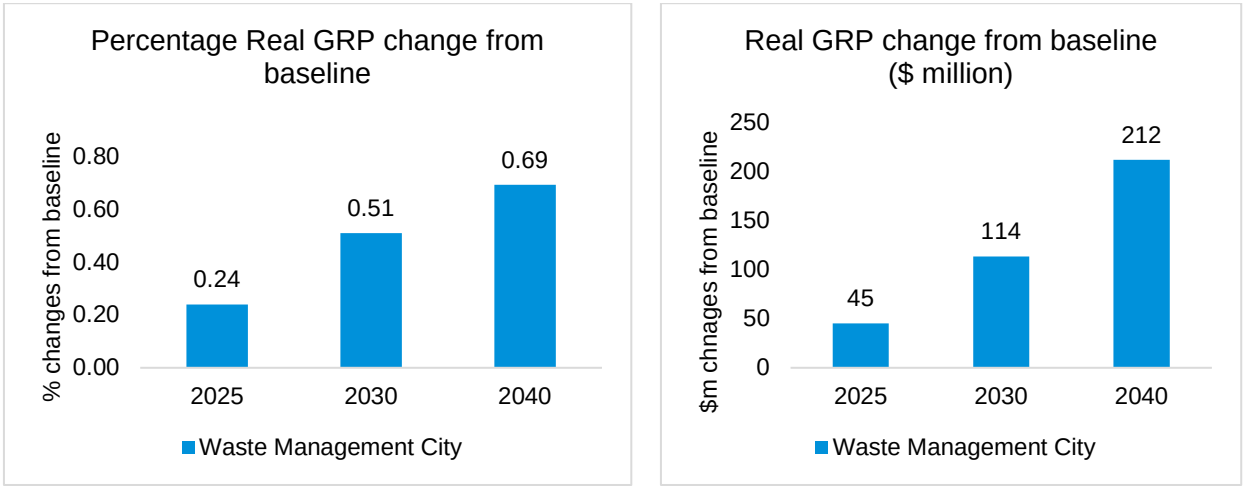


Table 2 - Real GRP effects: expenditure components under the Waste Management City Scenario

	Waste Management City		
$ changes (million)	**2025**	**2030**	**2040**
Household consumption	17	51	146
Aggregate investment	22	39	44
Net exports	6	23	22
Real GRP	**45**	**114**	**212**

From Table 2, we can see that most GRP gains come from higher household consumption and investment with a slight increase in net exports up to 2030. Government consumption remains fixed in each scenario reflecting no change in purchases of goods and services by government relating to the Draft Waste Scenario.

Table 2 indicates that household consumption increases from 2025 to 2040. This reflects the increase in household income from increased returns to labour and capital due to the increase in economic activity in the Waste Management City, which is primarily driven by increased economic activity in the waste sector. Net exports remains positive reflecting the increased competitiveness of industries in Hume relative to the rest of Australia and the rest of the world. The improvement in competitiveness derives from lower production costs resulting from better waste processing technologies, which in turn improves efficiency.

Figure 13 – Changes in full time employment (FTE) employment stemming from Waste Management City adoption

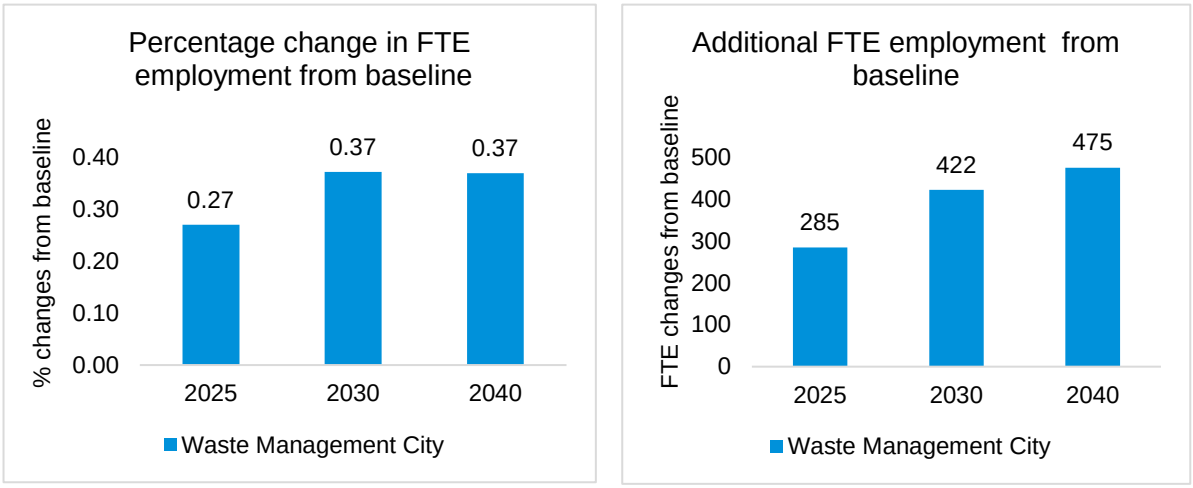


Figure 13 summarises the total employment projection of the changes imposed by the Waste Management City scenario. In comparison to the business as usual trend, full time employment (FTE) under this scenario is expected to increase by 475 FTE per year by 2040. Table 3 reports the results for change in sectoral output (reported in millions) compared to the baseline for Hume. The Manufacturing, Waste Collection, Treatment and Disposal Services, Construction and Transport, Postal and Warehousing sectors are expected to experience the largest increases in output in the Waste Management City.

Table 3 - Sectoral output effects in the Waste Management City

	Waste Management City		
$ changes (million) compared to business as usual	**2025**	**2030**	**2040**
Agriculture, Forestry and Fishing	0.30	0.60	1.20
Mining	0.00	0.00	0.00
Manufacturing	17.52	43.75	44.18
Electricity and Gas	1.30	3.82	8.02
Water Supply, Sewerage and Drainage Services	0.38	1.14	3.02
Waste Collection, Treatment and Disposal Services	14.55	42.25	66.22
Construction	17.18	34.61	45.45
Wholesale Trade	2.92	6.75	9.22
Retail Trade	1.59	3.87	6.65
Accommodation and Food	1.22	2.90	3.07
Transport, Postal and Warehousing	17.57	42.01	118.47
Information media and Telecommunications	1.16	2.97	5.31
Financial and Insurance Services	0.81	1.92	5.17
Rent, Hire, and Real Estate	0.61	2.36	8.86
Professional, Science and Technical Services	2.95	5.62	7.91
Administrative and Support Services	5.49	13.94	22.58
Public Administration and Defence	0.74	1.63	1.98
Education and training services	1.07	2.50	4.55
Health Care and Social Assistance	2.83	6.49	11.58
Arts and Recreation Services	0.59	1.54	3.19
Other Services	1.70	3.80	7.85

Community

With collaborative support from Circular Economy Victoria (a community activation platform focusing on transitioning Victoria towards the CE) and other community environmental groups, Hume provides community education programs and communication which encourage improved recycling (such as better home composting or better disposal of recyclable items). Overall contamination of recyclable goods declines, thereby reducing the cost of reprocessing recycled materials. Recycling rates also improve slightly due to these efforts.

Community initiatives in regard to the CE are minimal. University courses do not focus on the CE strategic initiatives and CE principles only appear tangentially in some sections of the curriculum and research. Hume Multiversity engages with tertiary education to ramp up recycled content procurement specifications to fulfill sustainability pledges. Student run community groups further raise attention to the importance of sustainable production and consumption, and university curriculum and research continue to focus more on sustainability (see Case Study 2); however, in the absence of clear CE support from senior management, the resulting changes are negligible.

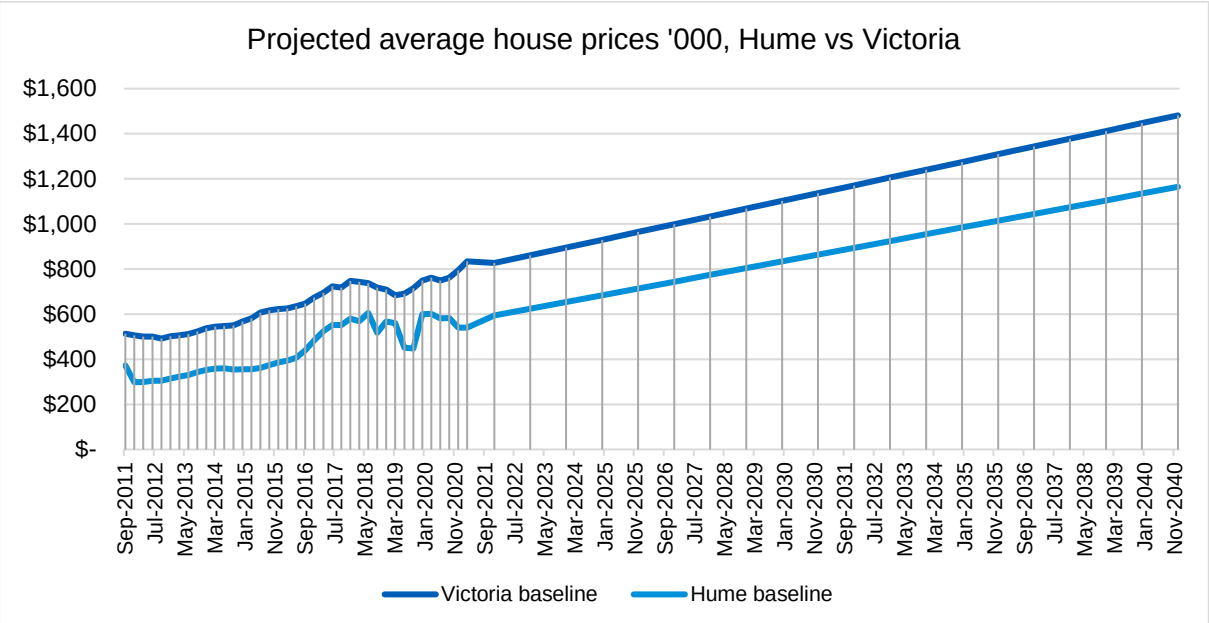
Case Study 2

Planetary Health – Victoria University, Melbourne, Australia

In 2020, Victoria University made a commitment to make planetary health core to everything that they do. Awareness of the importance of planetary health is enhanced through encouraging applied research, an expansion of course offerings in the sustainability space, more sustainable operational decisions regarding university purchases and infrastructure planning, and through engaging with communities to find innovative solutions to complex Planetary Health challenges. Planetary Health became a strategic project for Victoria University with a research investment of one million dollars.

With no major changes to community facilities or job availability in Hume, demand for residential housing parallels the Victorian average and, consequently, Hume housing prices stay on-trend with the Hume baseline (See Figure 14).

Figure 14 - Projected house prices in Hume



Resource Recovery City

The Resource Recovery City scenario presents a future where recycling of waste resources is prioritised, but the innovative benefits of a resource-optimised CE are largely unexploited. In this scenario, waste management approaches optimisation, resulting in municipal savings. Advanced materials reprocessing activities are significantly elevated generating new revenues and new jobs. Uptake of recycled materials in the traditional business sector also increases and robust government procurement specifications that prioritise recycled content drive enhanced use of recycled materials.

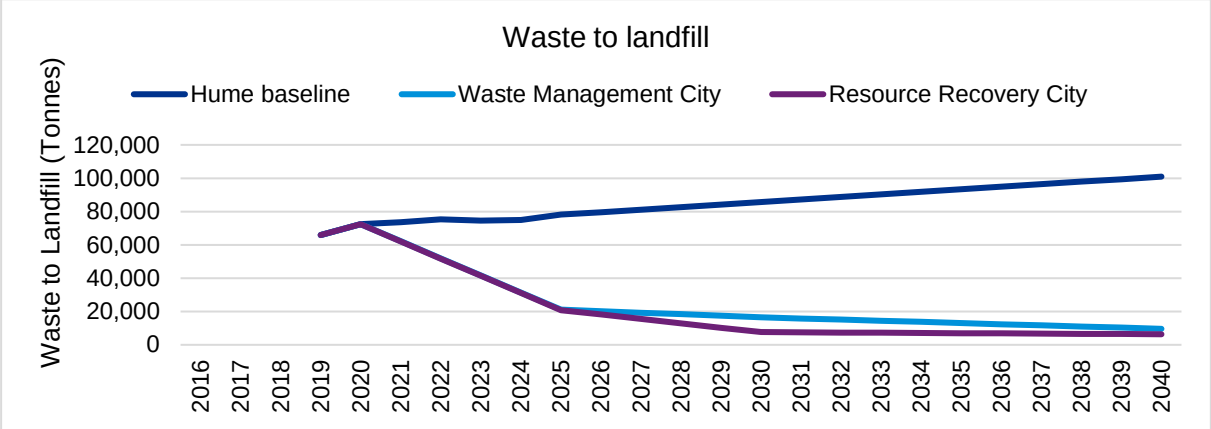
Storyline: What happens in Hume under the Resource Recovery City?

Policy

The Resource Recovery City scenario seeks to optimise the management of waste in Hume by tapping into opportunities arising from the Victorian government's, Recycling Victoria strategy. This strategy pushes councils and businesses towards better waste resource recovery by doubling landfill levies and providing a portfolio of funding programs to persuade waste sector businesses to upgrade technologies and invest in programs to add-value in the processing of waste. The strategy also features access to government funding for businesses to enhance resource efficiency and make better use of recycled materials.

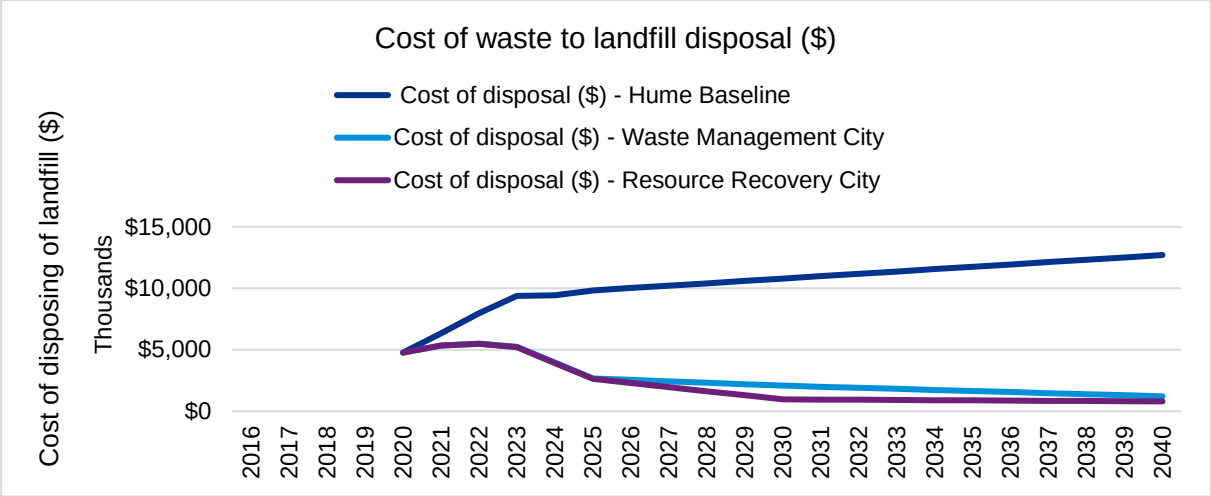
As was the case with the Waste Management City scenario, a realigned municipal waste strategy improves connectivity between municipal waste management efforts and private sector waste reprocessing. However, in the Resource Recovery City scenario, initiatives to rapidly catalyse a diversion of resources from landfill results in much higher achievements, with a 90% reduction in waste to landfill targeted by 2030, and a 93% reduction targeted by 2040. This represents elevated reductions from 72% in 2030 and 90% in 2040 that were projected under the Waste Management City scenario.

Figure 15 – Comparative waste to landfill change in the Resource Recovery City



In this scenario, the cost of landfill to Hume City Council peaks at $5.2 million per year by 2023 due to increased landfill levies introduced by the Recycling Victoria Policy. However, as waste optimisation efforts progress, aggregate landfill costs drop to $0.8 million by 2040 (Figure 16). This compares to $1.2 million under the Waste Management City scenario.

Figure 16 – Comparative cost of disposal of landfill in the Resource Recovery City Scenario



Hume's planned procurement specifications integrate national best practice on locally sourced, recycled content. Business development efforts are intensified around enticing specifications value-added materials reprocessing companies to set up in Hume. Municipal procurement specifications require a portion of recycled content in goods purchased by council, where relevant and possible. Procurement specifications for the purchase of public goods (such as roads, paths and park benches) also favour Hume businesses, and prioritise products that are produced using Hume feedstocks, this includes, to the extent approved by Council, a local business weighting criteria for specified procurement categories. Numerous new Hume initiatives mirror the example illustrated in Case Study 3.

In the Resource Recovery City, council's proactive support for materials repurposing companies encourages new business establishments and existing reprocessing businesses to grow in Hume, resulting in the majority of Melbourne North's new waste reprocessing companies setting up shop in Hume. Specialised businesses that add-value to reprocessing of resources – i.e. soft plastics - increase significantly. The local Materials Recycling Facility (MRF) begins to exploit opportunities to process waste streams that were commercially infeasible and it upscales technologies to improve throughput efficiency.

The council supports collaboration with other local councils, including the Northern Councils Alliance Purchasing Group, to increase uptake of product recycling requirements and procurement approaches. Materials flow into Hume from surrounding Northern Councils as Hume reaps the benefits of its strategic cluster of materials repurposing companies and this improves recycled resource availability within Hume. The Resource Recovery City remains focused on increasing recycled content in goods rather than embracing other circular economy principles of reuse, repair and remanufacturing initiatives.

Case Study 3
Downer and Close the Loop's have created a new asphalt product, Reconophalt™, that incorporates plastic from plastic bags and printer carriages. It lasts 30% longer than traditional asphalt mixtures. From 2018 to 2021, Hume City Council helped Downer and Close the Loop pilot this product by entering into a public-private partnership to upgrade approximately 300 square km of roads in Hume with Reconophalt™. This alone has diverted 80.2 tonnes of plastic bags, 80.2 tonnes of printer cartridges and 5,229 tonnes of recycled asphalt from going to landfill, saving 126 tonnes of CO_2-e emissions.

Economic

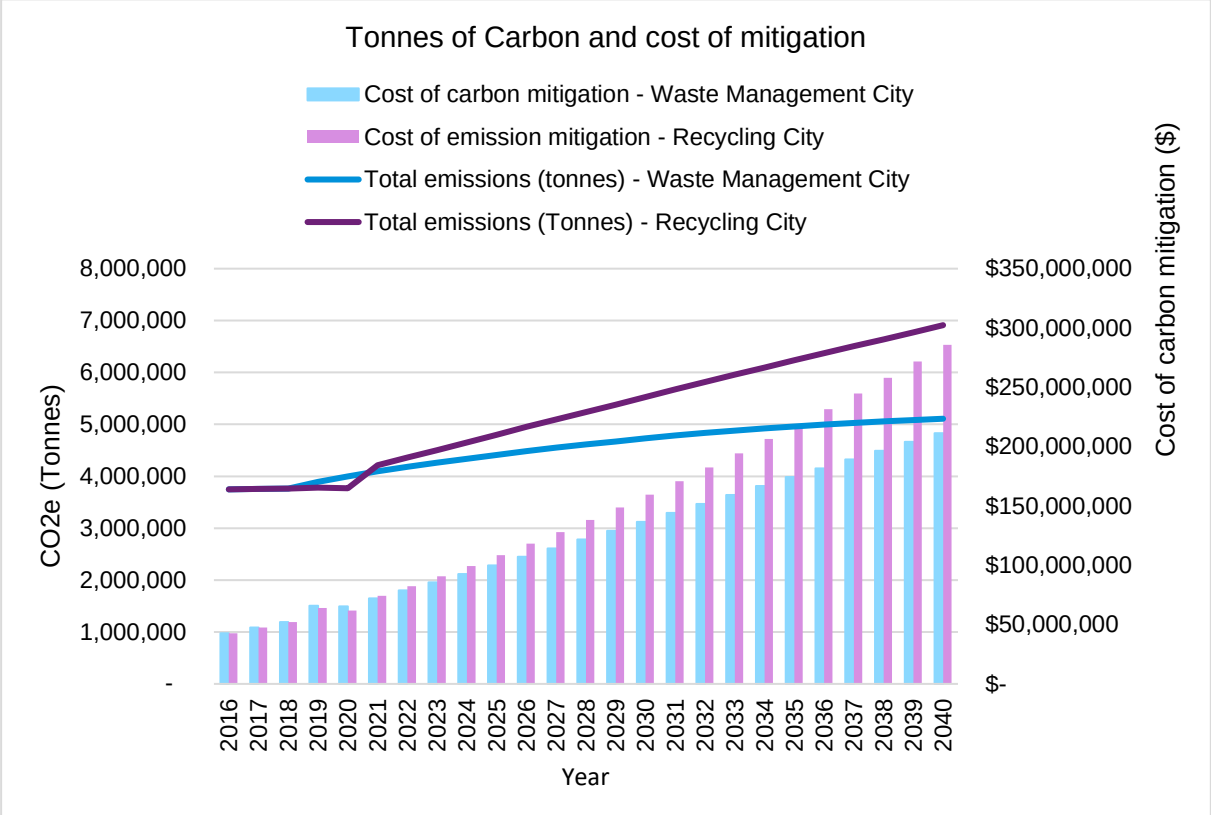
In the Resource Recovery City scenario, private sector investment in materials processing grows as a result of increased availability of recyclable content in Hume. This in turn leads to increased availability of recycled materials, allowing local businesses to readily access recycled content to support their operations. In a virtuous circle, increased business demand for recycled content catalyses progressive development of specialised materials reprocessing companies, which is assured through the adoption of the advanced materials marketplaces, which allow buyers and seller to virtually carry our transactions in a timely and cost-effective manner.

Thanks to state government support for local manufacturing businesses, Hume City Council's incentives for attracting new businesses and local access to recycled materials, growth in Hume's manufacturing sector outpaces the national average.

Highly coordinated waste management and an optimised materials marketplace also drives an increase in service sector businesses. Local logistics businesses expand to support the need to transport materials from waste resource reprocessors to manufacturers. New businesses relocate to Hume to take advantage of proximity to resource reprocessing. The upswell of new market entrants enhance competition and engender more efficient businesses.

CO_2 emissions grow under the Resource Recovery City scenario increasing by nearly 1 million tonnes more under the Resource Recovery City scenario than under the business as usual scenario (shown in the Hume baseline below). This is because minor gains in energy efficiency and expansion in renewable energy capacity are insufficient to offset the increase in energy use due to elevated recycling and materials reprocessing activities and growth in the manufacturing sector. Figure 17 illustrates these trends.

Figure 17 - Emissions in Hume under Resource Recovery City scenarios



The focus on enhancing privately funded waste reprocessing and advanced materials reprocessing facilities enhances utilisation and productivity of land. Moreover, employment in Hume increases at a slightly higher rate compared to the projected economic growth rate because materials reprocessing is labour-intensive.

Figure 18 summarises the real GRP changes for the policy changes outlined above, and the associated shocks to Hume's economic sectors. The change in economic variables in the Resource Recovery City scenario are much larger than the Waste Management City Scenario with GRP expected to be $92 million higher than the 2020 baseline by 2025 and $393 million higher by 2040. This suggests that investing in policies to support operationalisation of this scenario would benefit Hume greatly.

Figure 18 – Change in real GRP compared to business as usual and the Waste Management City scenario

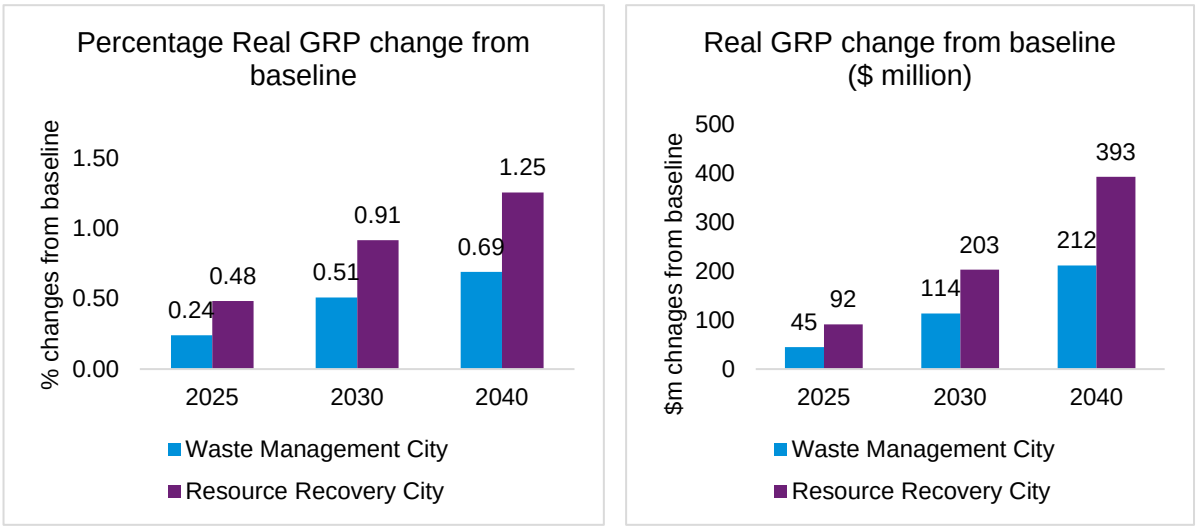


Table 4 shows the changes in real GRP broken down into household consumption, aggregate investment, government consumption and net exports.

Table 4 - Real GRP expenditure effects summarised: macro economy components in the Resource Recovery City

	Resource Recovery City		
$ changes (million)	**2025**	**2030**	**2040**
Household consumption	23	73	215
Aggregate investment	34	59	82
Net exports	34	71	96
Real GRP	**92**	**203**	**393**

The majority of real GRP changes in the Resource Recovery City scenario come from higher household consumption and net exports. Additional consumption is driven by ramped up activities in the waste collection, treatment and disposal services sector which leads to higher wages and return to labour and increased return to capital.

Net exports grow more strongly under this scenario, reflecting larger increases in the competitiveness of industries in Hume relative to the rest of Australia and the rest of the world. The larger improvement in competitiveness derives from a larger fall in production costs, this is due to the larger efficiency improvements associated with the Resource Recovery City.

Figure 19 - FTE employment changes compared to business as usual

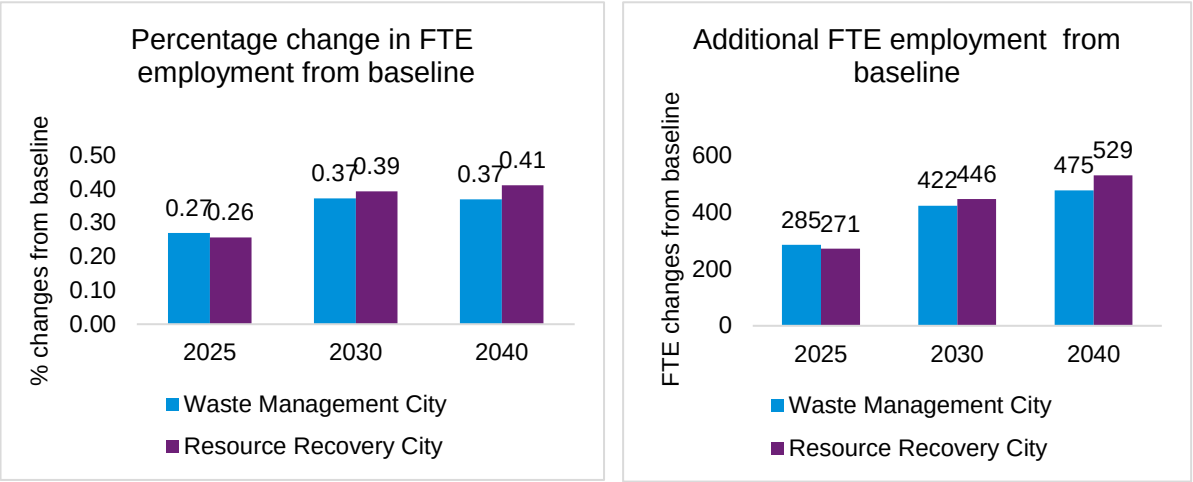


Figure 19 summarises the total employment effects of the economic dynamics within the Resource Recovery City scenario. FTE growth under this scenario is expected to exceed both the business as usual baseline and the Waste Management City, with an annual increase in the number of FTE in Hume reaching 529 by 2040.

Table 5 reports the economic simulation results for annual dollar change (compared to business as usual) by economic sector as a result of the Resource Recovery City scenario. In the Resource Recovery City scenario, as a result of the additional volume of recycling in Hume, there is a large increase in the waste collection, treatment and disposal services and in the transport, postal and warehousing sectors.

Table 5 - Sectoral output effects in the Resource Recovery City

	Resource Recovery City		
$ changes (million)	**2025**	**2030**	**2040**
Agriculture, Forestry and Fishing	0.75	1.50	3.00
Mining	0.00	0.00	0.00
Manufacturing	31.89	65.83	51.56
Electricity and Gas	1.84	5.19	10.16
Water Supply, Sewerage and Drainage Services	0.34	1.18	3.27
Waste Collection, Treatment and Disposal Services	29.99	91.56	145.23
Construction	24.88	49.73	70.59
Wholesale Trade	4.77	10.00	13.00
Retail Trade	2.37	5.52	9.39
Accommodation and Food	1.77	3.70	2.17
Transport, Postal and Warehousing	35.17	84.20	238.02
Information media and Telecommunications	1.68	4.01	6.80
Financial and Insurance Services	0.15	0.79	3.81
Rent, Hire, and Real Estate	0.45	2.40	9.82
Professional, Science and Technical Services	3.05	5.79	7.52
Administrative and Support Services	9.48	21.83	35.11
Public Administration and Defence	1.10	2.28	2.58
Education and training services	2.56	6.15	13.91
Health Care and Social Assistance	3.87	8.61	15.37

Arts and Recreation Services	0.81	2.02	4.05
Other Services	1.55	4.05	9.08

Community

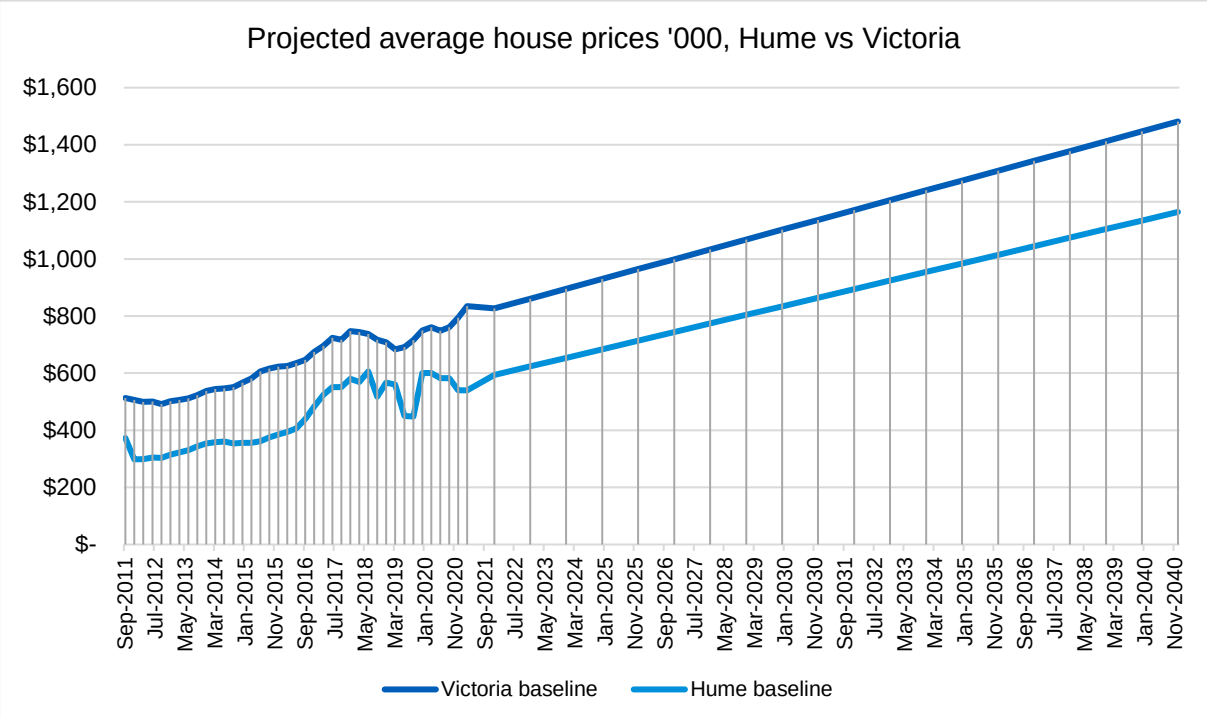
In the Resource Recovery City scenario, community outreach efforts in regard to waste management in Hume focus on improved waste separation, home composting, and recycling practices. These efforts engender reductions in recycled waste contamination and amplified residential recycling rates. Reprocessed municipal organic waste diverts 34,000 tonnes of waste from neighbouring councils into compost and this is then used in public areas throughout Hume, with the remained being sold off to other consumers in the region.

The virtual materials marketplace platform that emerges to connect businesses also begins to attract general public participation. It is estimated that this platform would enable transactions that amount to at least 50% of the $13.6m of Hume City Council's materials that are not currently reprocessed. Adding residential participation, the volumes of waste resources transacted could double this estimate.

As competition to add-value through advanced resource reprocessing heats up and encourages R&D, university researchers begin to tap into federal and state research funding to advance reprocessing techniques and technology. This amplifies the level of start-ups in Hume and provides existing business with access to the knowledge necessary to upgrade reprocessing technologies. Tertiary and secondary education institutions also begin to adopt improved recycling plans and include recycled content in their procurement specifications. At the tertiary level, short courses (micro credentials) in resource management and sustainable innovation areas increase, generating greater overall awareness of sustainable resource management.

The attractiveness of Hume as a community to live in is unchanged in the Resource Recovery City scenario; however, migrants to the city increase slightly in response to elevated job availability. Overall, the Resource Recovery City scenario envisages no dramatic changes to house prices in Hume beyond the baseline trend.

Figure 20 - Projected house prices in Hume



Circular City

The Circular City represents an ambitious aspirational future for Hume. Uptake of CE strategies and principles proliferates, guiding business strategy and new business development across a breadth of sectors beyond the waste and recycling sectors. CE innovations in established businesses positively affects the bottom lines of companies and engender job growth. Entrepreneurial businesses and social ventures spring up offering new products and services linked to the CE in areas such as retailing, hospitality, education, logistics, asset sharing models, leasing activities, digital services, residential services, repair services and design driven manufacturing. This scenario comprehensively encapsulates all benefits found in a CE.

Storyline: What happens in Hume under the Circular City?

Policy

Federal and state government waste policies continue to aggressively target waste to landfill reduction. Bans emerge on complex or tainted material disposal reducing the impeding effect these products have on recovery and reprocessing (i.e. laminates, polystyrene, compound plastics and plastic bags). Concurrently, EPA policy and engineering standards are streamlined to encourage CE initiatives around reuse, repair and remanufacturing setting clear engineering guidelines for waste and remanufacturing businesses on the quality of feedstocks.

Hume advocates and lobbies for governments at all levels to establish circular mechanisms to complement recycled content standards, and actively assists businesses in the Hume area with unlocking and accessing available funding.

The cumulative effect of these policies is that more federal and state funding is channelled into supporting value-added waste management, resource efficiency, reuse, remanufacture and repair.

In the Circular City scenario, Hume City Council realigns strategy to leverage its core competences for supporting innovation (through Start North), advanced materials reprocessing and high tech manufacturing (through economic development subsidies), and CE-focused research and development (through its Multiversity links and Innovation precincts) to become an enabler of circular excellence. The total adoption of CE principles and a comprehensive build out of an integrated CE network takes place through the progressive development program laid out by KPMG Australia.

Hume's position as a recognised leader in advanced materials repurposing is leveraged to attract new manufacturers and other businesses that add-value to materials reprocessing through new business models. Hume City Council plays a coordination role in building capacity and sparking innovation by connecting businesses to university researchers, technology providers and specialised consultants. This supports the commercialisation of new ideas through business incubators, innovation precincts and guidance in attaining funding for taking new products to market. The council also connects local residents and small business owners that wish to play a role in the CE to emergent opportunities through CE support groups.

In the Circular City, recycling rates improve only slightly in comparison to the Resource Recovery City scenario. The real change is to economic value-added activities. Due to elevated support for value-added advanced materials reprocessing businesses, an industry transition takes place where technology adoption leads to better reprocessing capabilities and higher industry profits. The volume of waste diverted from landfill does not deviate significantly from the Resource Recovery City

scenario; however, the biggest change is the way recaptured waste is now re-tasked – rather than recycling taking centre stage, resource reduction, reuse and repair activities are prioritised.

As was the case with the Resource Recovery City scenario, in the Circular City, waste to landfill declines steeply from 2020 through to 2025, culminating in 95% of waste to landfill being diverted and recaptured as economic value by 2040. The cost of disposing waste to landfill for the council will increase slightly until 2022 as a result of the doubling of landfill levies mandated by the Recycling Victoria policy, but costs will begin decreasing as the aggregate volume of waste to landfill decreases (Figure 21).

Figure 21 – Comparative changes in waste to landfill in the Circular City and other scenarios

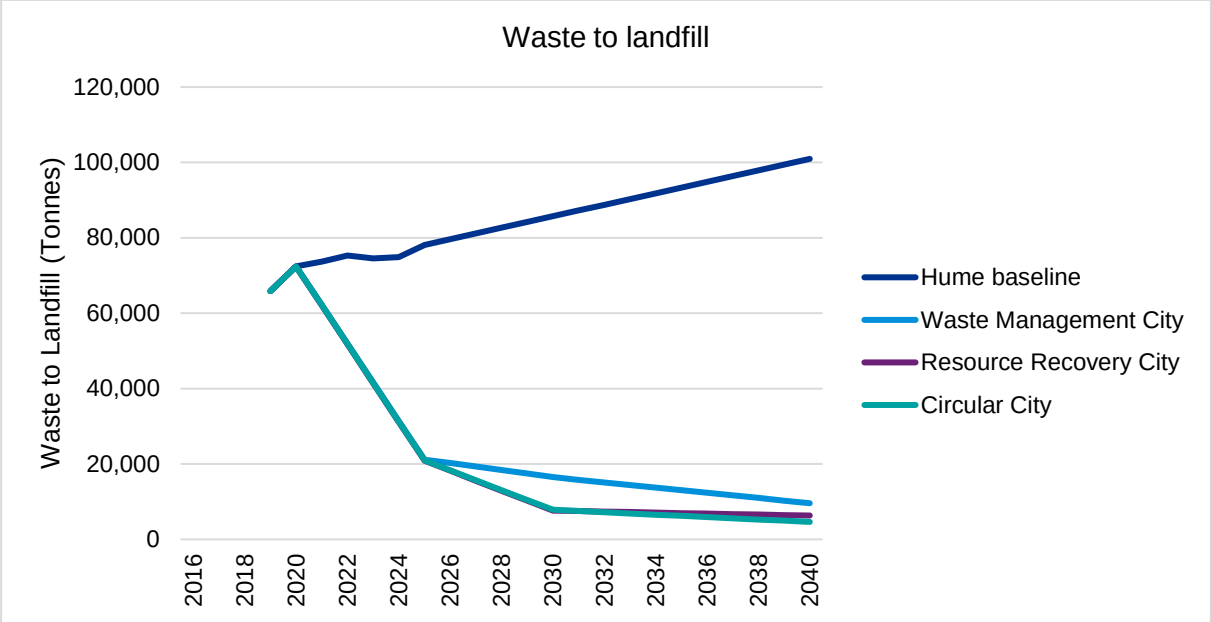
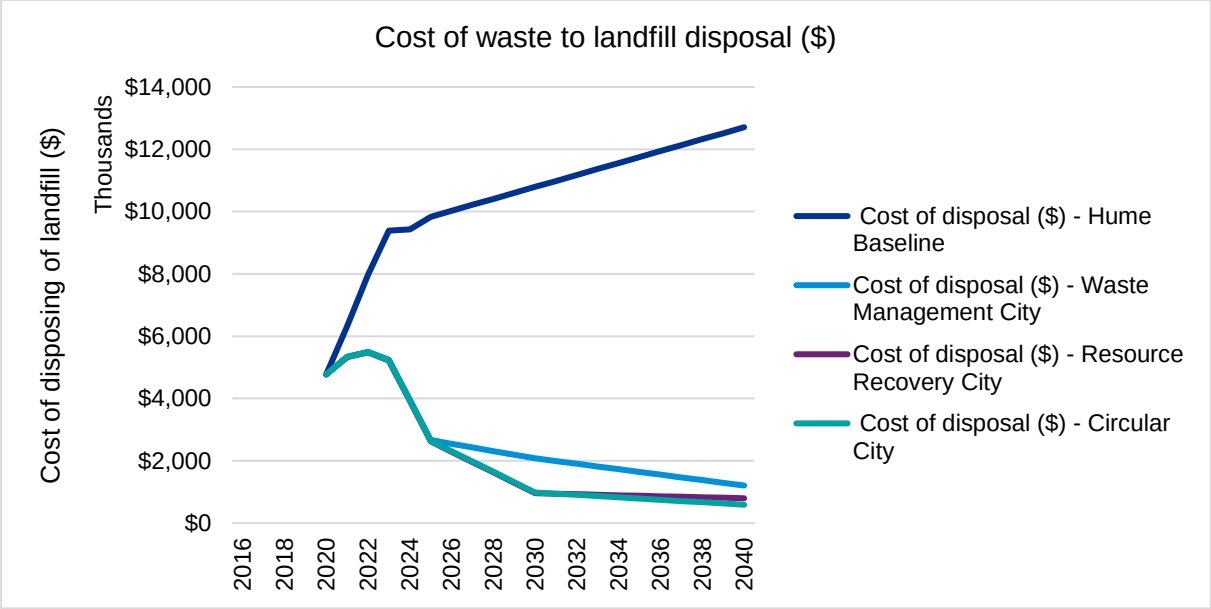


Figure 22 – Change in cost of disposal of landfill under the Circular City scenario



In the Circular City, leading edge strategies set at the council level begin to prioritise reduction, reuse, repair and remanufacturing ahead of recycling activities. Policies support business investment into affordable circular product design. New policies are created to encourage a situation whereby waste that is created within the municipality becomes the feedstock for public products in Hume (i.e. though tax incentives and public projects). Hume City Council's procurement specifications for specific goods enable the council to trial and endorse new and innovative products that incorporate Hume created feedstocks, for use in public projects such as parks and new roads. This enhances Hume's uptake of recycled and redesigned products and provides a vital opportunity for entrepreneurs to trial new public infrastructure products.

The Melbourne Northern Councils collaborate to set firm requirements for re-use and repair content in procurement specifications and the tendering process shifts to support for reduction, reuse and repair activities.

Economic

Hume City Council spearheads growth of CE support infrastructure such as an innovation precinct, with support from Victoria University and other tertiary institutions. The innovation precinct helps waste processors add-value to feedstocks and waste streams through applied R&D. Hume businesses engage further with tertiary institutions to conduct research into alternative uses for waste and improve demand for waste products. This research helps drive more rigorous applications, standards and requirements for recycled materials and feedstock.

Multi-featured material marketplaces enable companies and individuals to easily trade in waste resources and access CE services such as product sharing, repair and second-hand purchase. Transactional volume is bolstered by an expansion of logistics companies offering specialty services.

Hume becomes a leader in attracting government and state investment in both advanced manufacturing and new economy businesses connected to the CE. Consequently, economic activity outpaces the national growth average twice over.

Hume City Council works with developers to earmark land for development of advanced materials reprocessing hubs and innovation precincts to enable improved recovery and remanufacture of materials. At the same time, Council planners ensure a balanced and environmental approach to town planning which maintains green spaces including development of parks and reserves which maintain important nature services such as biodiversity, air purification and heat reduction in urban spaces.

Economic clusters attract new business and talent into Hume, which establishes Hume as the central location for resource reprocessing and advanced manufacturing in the northern region. These initiatives drive declines in industrial vacancy rates and enhance overall land productivity. The reprocessing hubs geographically connect advanced materials reprocessors and encourages smaller businesses to set up bridging services to support the work of the material reprocessors. Increased collaboration between companies in Hume intensifies the demand for advanced logistics companies to transport materials (see an example of this type of initiative in Case Study 4).

Resource recovery and advanced materials remanufacturer also require sophisticated logistics technologies, which enable transportation of feed stock between hubs and within them to enable streamlined remanufacture and reprocessing into another good. This increases the demand for the services of the Transport, postal and warehousing sector.

Case Study 4
The Cooper Street Hub (City of Whittlesea): currently contributes to Victoria's WRR system through the management of organics, and construction and demolition (C&D) materials. The Hub benefits from its proximity to metropolitan Melbourne as well as through transport links such as the Hume Freeway and Western Ring Road. A Hub Plan has recently been developed and released by the Metropolitan Waste and Resource Recovery Group (MWRRG). The plan identified a range of future activities for the site, including food organics, garden organics (FOGO) processing and waste to energy (WtE).

In the Circular City, CE strategy capacity building permeates Hume businesses encompassing most industries through the Circular Advantage program and similar CE strategy development programs. These focus on upskilling businesses in Circular Economy principles, including designing out waste from their product life cycle. Many programs connected to entrepreneurial start-ups and the CE are offered through Start North (a Council affiliated co-working space located in Hume) and these encourage new SMEs to set up in Hume, and existing businesses to escalate innovation.

Business innovation and new start-ups in Hume champion adding value to used goods, novel re-use ideas, advanced commercial repair services, product leasing and CE business support. Demand for circular goods and services continues to grow further driving industry transition, and enhanced products and services proliferate.

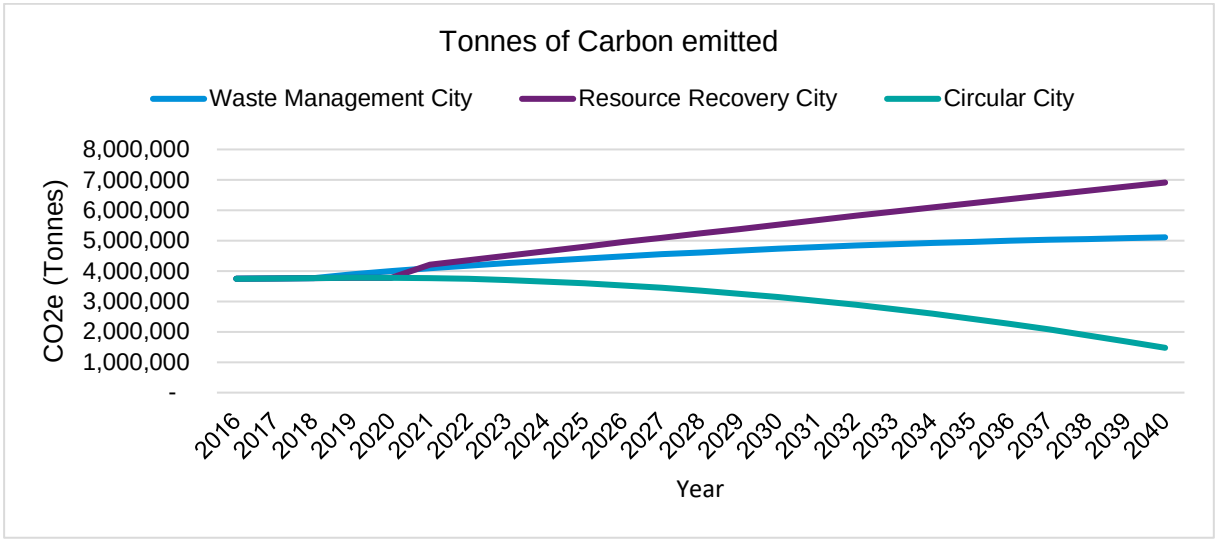
Collaborative CE networks spring up in non-waste sectors ranging from retail to hospitality; and events and exhibits drive community interest in the CE. Pop-up activities and events further improve use of vacant spaces in Hume.

Elevated economic activity in energy intensive industries such as recycling, advanced material reprocessing and advanced manufacturing is offset by energy efficiency gains. Businesses take advantage of subsidies and technical support through grants to undertake energy audits, implementing more efficient energy practices. Meanwhile, accelerated adoption of renewable energy technologies including solar PV and waste to energy engender a reduced carbon footprint in Hume. Vehicles utilised within Hume also transition to primarily electric. Residents utilise shared car services and improved public transportation to ensure maximum utilisation of existing vehicles. Transportation, Postal and Warehousing businesses also transition their fleets to electric trucks which reduces noise pollution and emissions from fuel. Hume City Council facilitates an electric charging network across the region in public spaces encouraging the adoption and utilisation of electric vehicles.

Accordingly, despite the large increase in commercial activity in Hume, there is a projected decrease in overall emissions from 3.7 million tonnes of CO2e per year in 2020, to 1.4 million tonnes of CO2e per year by the year 2040. This results in a decrease in cost of offsetting the remaining carbon cost as fewer carbon credits are required to adhere to federal carbon reduction targets. The costs of offsetting carbon produced by Hume's industries maxes out at $91 million in 2031, and slowly decreases to $60 million per year by 2040 (Figure 23). Carbon offsetting is predicted to cost $150 million less in Circular City scenario than the Waste Management City, and $224 million less than the Resource Recovery City per year by 2040.

Employment in Hume increases slightly more than in the Resource Recovery City scenario. A shift from part-time to full-time also occurs as activities in the service sector increase, small service businesses increase, and new business models draw in a higher proportion of youth employment.

Figure 23 - Total tonnes of CO_2 emissions and the cost of carbon mitigation under a Circular City scenario



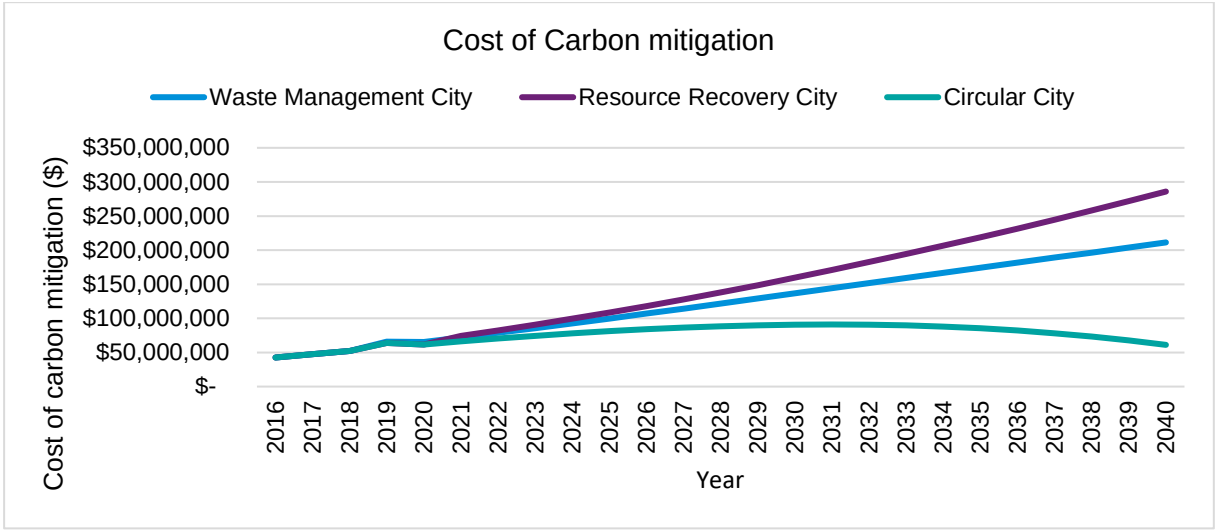
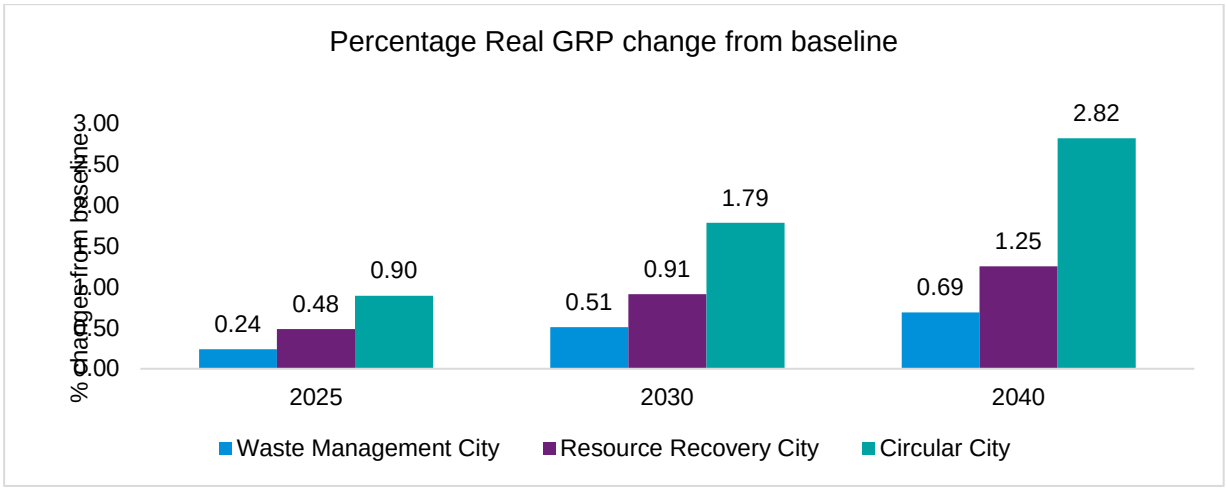


Figure 28 summarises the real GRP changes of the policy changes outlined above, and the shocks to the Hume economic sectors under the Circular City. Table 6 provides the dollar value equivalent of the percentage changes in real GRP given in Figure 24. The Circular City is expected to have by far the largest change of the three scenarios, with real GRP nearly double the Resource Recovery City scenario, with $170 million in real GRP by 2025 and close to triple the Resource Recovery City scenario by 2040, with $903 million in real GRP.

Figure 24 – Increase of Real GRP in Hume under a Circular City scenario from baseline



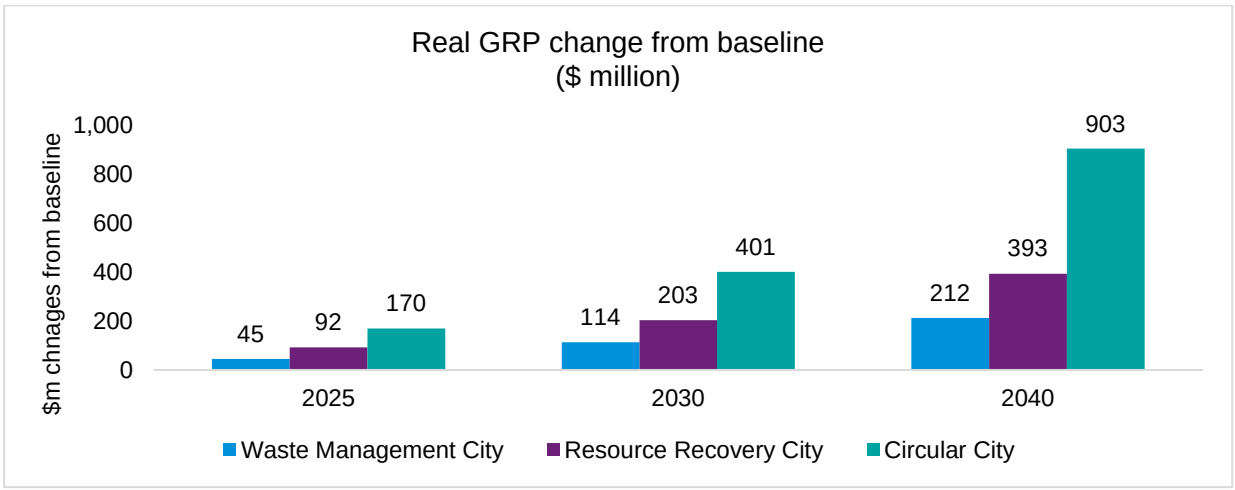


Table 6 - Real GRP changes to macroeconomic categories in the Circular City

	Circular City		
$ changes (million)	**2025**	**2030**	**2040**
Household consumption	35	121	397
Aggregate investment	49	91	103
Net exports	86	189	404
Real GRP	**170**	**401**	**903**

Similar to the Waste Management City and Resource Recovery City, under the Circular City scenario changes in GRP are primarily driven by increased household consumption and increased exports.

Household consumption improvements result from increases in profitability and improved marginal wage for Hume's businesses. This increases the income of Hume's residents and hence a portion of that increased income is designated to consumption. The type of goods consumed in the Circular City shift away from the purchase and acquiring of personal physical goods and focuses more on purchase of services such as the sharing economy, repair and purchasing second hand.

Net exports contribute strongly to real GRP in the Circular City. This reflects the increase in household income from increased returns to labour and capital due to the increase in economic activity in the Circular City. As before, the strong growth in net exports reflects the increased competitiveness of industries in Hume relative to the rest of Australia and the rest of the world. The improvement in competitiveness derives from lower production costs and innovations, due to applying CE strategy. The Circular City productivity improvements are proportionally larger than the other scenarios leading to a larger increase in net exports relative to household consumption in this scenario.

Figure 25 - FTE employment changes

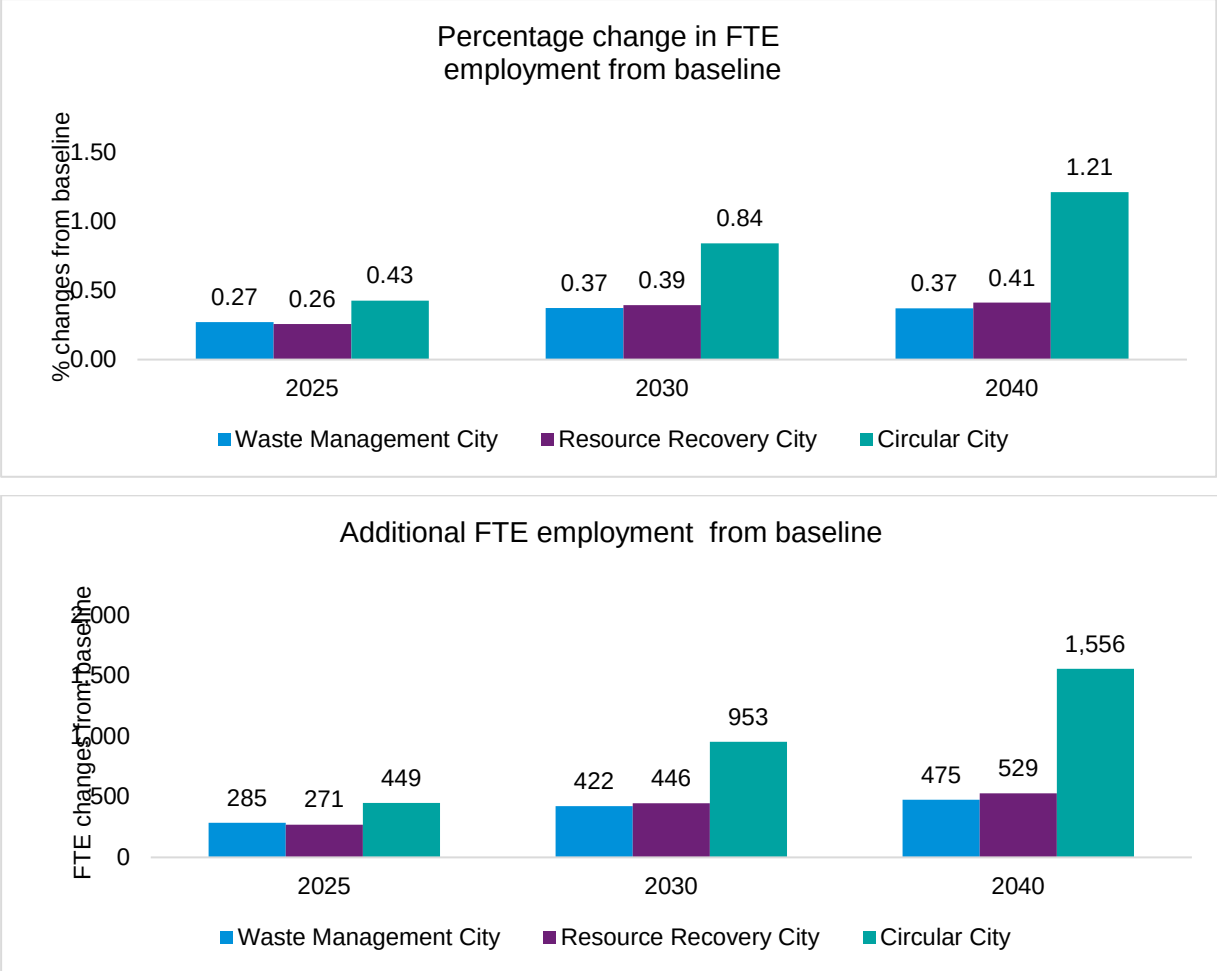


Figure 25 summarises the results of the changes imposed by the Circular City scenario on total employment. The Circular City is projected to generate the highest employment opportunities of the three scenarios, stemming from the relatively high expansion in real GRP in this scenario. At the sectoral level, the Transport, Postal and Warehousing sector shows the largest increase in employment in all years followed by the Transport Equipment sector. The main contributing sectors to the employment increase under Circular City plan are (i) Food Products, (ii) Transport, Postal and Warehousing, and (iii) Construction.

Table 7 details the results for dollar change in economic activity, by sector. These sectoral changes underpin the increases observed for the employment and real GRP results reported earlier. In the Circular City scenario, as a result of the additional volume of recycling required in Hume, there is a large increase in both the waste collection, treatment and disposal services and the transport, postal and warehousing sectors. A large increase is also noted in the manufacturing sector as a result of additional advanced re-manufacturing activity.

Table 7 - Sectoral output effects in the Circular City

	Circular City		
$ changes (million)	**2025**	**2030**	**2040**
Agriculture, Forestry and Fishing	2.15	5.48	12.21
Mining	0.00	0.00	0.00
Manufacturing	39.69	109.22	279.52
Electricity and Gas	4.12	10.70	26.13
Water Supply, Sewerage and Drainage Services	1.41	3.64	10.78
Waste Collection, Treatment and Disposal Services	40.79	140.12	160.02
Construction	40.32	82.74	118.24
Wholesale Trade	5.93	16.96	33.81
Retail Trade	-1.11	4.48	17.01
Accommodation and Food	6.90	16.10	24.58
Transport, Postal and Warehousing	70.65	169.57	481.65
Information media and Telecommunications	3.09	7.29	14.38
Financial and Insurance Services	1.98	5.09	19.16
Rent, Hire, and Real Estate	14.83	45.14	95.94
Professional, Science and Technical Services	5.00	11.52	21.28
Administrative and Support Services	16.53	40.76	65.18
Public Administration and Defence	2.06	4.71	8.25
Education and training services	9.92	22.87	56.96
Health Care and Social Assistance	8.58	16.78	30.42
Arts and Recreation Services	2.38	5.27	10.80
Other Services	5.65	12.96	31.35

Community

In the Circular City scenario, an escalation of council efforts to enhance the consumer's role in the recycling process alongside public events around building CE capacity amongst small entrepreneurs increases community awareness of CE. Council focuses on building support from the community with inclusion of community champions and leaders to disseminate information.

Council campaigns to improve residential waste disposal practices lead to better resource recovery rates as products are correctly disposed of and the tainting of recyclable products is reduced. Council uses vacant retail and industrial spaces to create popup CE Hubs, as well as establishing a more permanent CE Hub at Craigieburn. These facilitate intensified trading of materials throughout the community, and also provides sites for sharing services, repair hubs and reuse product retailing.

Consumers start to play a more active role in a sharing economy and sharing activities that we have started to see today, including sharing of cars and bicycles. These sharing services begin to expand into other products and become the norm by 2040. Hume City Council facilitates start-ups and small businesses offering shared services through their CE Hub and capacity building programs.

Community-based goods trading is facilitated by public-facing virtual materials marketplaces and repair services become more accessible through virtual marketplaces. Within the Circular City, community gardens, urban farming and organic composting become prominent. Even manufacturing businesses begin to adopt more efficient practices for processing food waste and managing gardens around factories because there are support services and small companies emerging to help them do so.

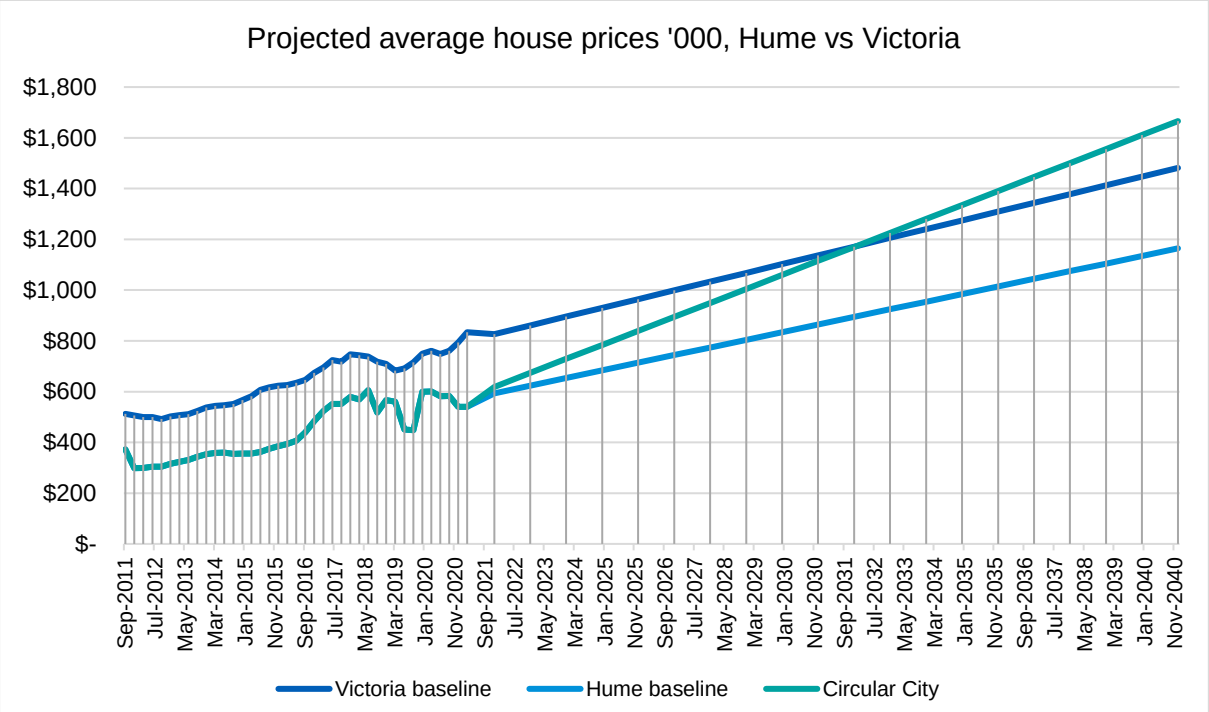
The availability of CE consulting services expands exponentially in response to growing interest in exploiting CE opportunities. Some of these consultants focus on community capacity building and begin to create training programs to help householders play a role in the CE. Hume City Council begins to offer CE advisory services to both businesses and community members. Community based businesses run by social enterprises and retirees increase markedly.

In the university sector, research and development opportunities arise, strengthened by greater industry collaboration through the innovation precincts. These research projects seed new business development. Tertiary institutions also play an influential role in capacity building through CE course offerings, micro-credentials and free workshops related to topics such as design, kaizen and innovation. All educational institutions also play a role in altering business practice by introducing CE procurement standards that nudge companies to alter their product offerings to meet these standards.

Council works with commercial and retail real estate to better utilise the vacant properties, by introducing CE models to property management. These include cooperative space leasing, shared leasing models that allow subletting to smaller companies, mixed-use buildings, more buildings for the rental market, and short-term leases to accommodate pop-up shops for new enterprises and social entrepreneurships.[26] More stores and office spaces are made available through short term arrangements to support SMEs, social enterprises and community groups. This may include pop-up repair cafes or events for example. Office space utilisation rates improve due to these developments.

In the Circular City, Hume becomes an increasingly attractive place to live. Additional jobs, green spaces, community space and an underlying current of innovative vibrancy drive Hume population growth, particularly from older people, youth and higher-income earners. Consequently, property prices rise. Improved and more convenient public transportation networks including rideshare and other shared transportation options also support house price increases in Hume. Overall, the property prices outpace both the Hume baseline and the Victorian baseline house prices, reaching an average house price of over $1.6 million in 2040 (Figure 26).

Figure 26 - Projected house prices in Hume



[26] Ellen Macarthur Foundation. (2020). From Principles to Practices: Realising the Value of Circular Economy in Real Estate. https://www.ellenmacarthurfoundation.org/assets/downloads/Realising-the-value-of-circular-economy-in-real-estate.pdf

Next steps towards the circular city

The assessment of CE opportunities in Hume under a Circular City scenario fuels a compelling case for investing in a strategy to turn this vision into a reality. Pursuing the circular economy in Hume has the potential to unlock significant economic, social and environmental benefits for the City of Hume. Under an advanced circular economy, the real GRP in the City of Hume is expected to increase by 2.82% from baseline, representing $903 million in additional GRP by 2040. The number of jobs available in Hume are also expected to expand by 1.21% from baseline by 2040, representing 1,556 new FTE jobs.

For the environment, a comprehensive circular economy is expected not only to provide large benefits in waste reduction (reducing council expenditures), but also will significantly reduce industry emissions. Waste to landfill is expected to decrease by 96 thousand tonnes compared to the Hume baseline by 2040, reducing cost of disposal by $12.1 million in 2040 compared to baseline. CO2e are expected to decrease by 3.6 million tonnes of CO2e from the baseline by 2040.

Consequently, it merits taking the time to highlight mission critical elements that need to be effectively managed to ensure achievement of this vision. As a result, our recommendations for Hume to progress towards a Circular City are:

1. **Develop a supportive policy environment for the circular economy to flourish in Hume, starting with changes to the below central policies from 2021-2022:**
    - i. **Approve and implement Waste Strategy:** Hume City Council develops a Draft Waste Strategy informed by the MFA and business case, which compels private waste re-processors to adopt leading edge technology. This strategy should be presented to council in early 2022 and approved by mid-2022.
    - ii. **Implement CE procurement specifications:** Hume City Council should continue to design CE procurement specifications for all public purchases to nudge businesses toward circular models. This should include effectively managing the potential conflicts that exist between recycled-content and CE-content procurement specifications and endorse trials of CE products. Early adoption may be possible for public projects and infrastructure such as roads and park projects. Such a policy would set clear guidelines for recyclers and advanced materials reprocessors to expand their businesses.
    - iii. **Business Support Policy:** Research from around the world demonstrates that many companies that adopt CE strategies run into barriers or obstacles to implementation. A working group should be created within Council to solicit feedback from businesses and contemplate how policy can be designed to support CE developments by mitigating barriers.

iv. **CE standards and regulations:** Advocating all levels of government, business and community to promote CE strategies around re-use, repair and remanufacturing give rise to safety concerns that require balanced policy – too stringent and CE innovation stops; too lax and public safety is undermined. This also includes advocating for improved policy at state and federal level to help facilitate the transition to the circular economy.

2. **Enable and facilitate sharing of resources and circular economy knowledge through:**

   i. **Virtual marketplaces:** Ensure the development of a competitive market for providers of virtual materials marketplaces to enable cost-effective transactions. Consideration should be given to ensuring a system of quality assurance over materials, as some buyers will need such assurance to support the decision to buy recycled over virgin sources materials.

   ii. **Funding CE business strategic competencies:** Develop a clear plan for building capacity in CE strategy and CE business design. Recognise that in early stages of the CE, businesses might need financial support to first understand the CE, before turning to investment in new technologies and new business models and unlocking funding from federal and state government.

   iii. **Establishing a one-stop shop for CE advice:** Building on the role of the Circular Business Network Officer, create a role at Hume City Council responsible for centralising the process of educating, informing, and connecting collaborators; and to consolidate capacity building in the CE. This service should also centralise access to federal, state and other funding sources to support resource optimisation initiatives and investment.

3. **Establish a circular economy network, hubs and community using a whole of city approach:**

   i. **Co-design of the Circular City:** The only way a large municipality like Hume can seed widespread CE network development is to ensure that it includes CE business champions in the co-design process. Businesses make the investment that drive the CE and they need to have a say in the design process to encourage buy-in.

   ii. **R&D support:** Universities provide a key bridge between business needs and R&D, but strategies are needed to ensure that business leaders can readily identify and connect with the academic researchers best suited to resolve a given problem. Moreover, universities need to streamline the industry-funded research project to expedite responsiveness to business needs. One approach to consider is to encourage the development of industry engagement offices in universities such as Victoria University through Hume's Multiversity team.

   iii. **Logistics, transportation and warehousing:** Investigate the current state of logistic services in Hume and make efforts to ready this sector for participating in the CE and for sharing models that optimise logistics.

   iv. **Innovation precincts:** Entrepreneurs need physical space where they can access technical, financial and business support in advancing new business models. One approach is to seed the creation of innovation precincts by providing public innovation space in privately owned innovation precincts. This gives developers some certainty

that investing in such specialised precincts will be partially supported by public investment.

v. **Advanced material reprocessing precincts:** Utilise the local government planning scheme to create strategic clusters of businesses that can capitalise on geographic proximity to engender competitive advantage. Effort should be made to identify both public and private spaces that would be sizable enough to support material reprocessing precinct development. This will enhance cluster effects and improve transportation of feed stock.

While the path towards the circular economy in Hume is a long one, and there is work ahead for Hume to achieve this vision, it is clear from this business case that successfully enabling a comprehensive circular economy vision would have substantial benefits to the residents and businesses within Hume City, unlocking not only an additional $903 million in real GRP, but also contributing towards a safer and healthier planet.

Appendices

Appendix 1: Glossary

ANZSIC	The Australian and New Zealand Standard Industrial Classification (ANZSIC) is a classification that provides a framework for organising data about businesses by grouping business units carrying out similar productive activities.
CGE	Computable General Equilibriums analyse both direct and indirect (flow-on) economic outcomes following a shock to the economy. CGE captures the economy as a complex system of simultaneous equations that represent interrelated economic agents operating in competitive markets. Economic theory in this regard focuses on the behaviour and market interactions of economic agents, including consumers, investors, producers and governments. These agents operate in domestic and foreign goods markets, and capital and labour markets.
Employment	Employment refers to the number of people employed. In some industries a significant proportion of employment is part time (including intermittent and project-based), which is accommodated in this study by estimating total Full Time Equivalent (FTE) jobs
Exports	Exported goods and services are those that are produced domestically and purchased by overseas consumers. Exports are goods and services flowing out of the country.
FTE	Full-time equivalent (FTE) employment adjusts headcount employment figures (which capture all employees regardless of hours worked) to full-time equivalent figures by converting part time workers to full-time equivalent workers. This metric allows for a standardised and more representative comparison of employment across industries. Total FTE jobs is equal to the number of full-time workers plus 0.5 x (the number of part-time workers).
GDP, GRP	Gross Domestic Product is the total market value of goods and services produced in an economy. GDP is equivalent to gross national expenditure (the sum of household and government consumption and investment) plus exports of goods and services,

	less imports of goods and services. Gross regional product (GRP) is similarly defined except for a sub-national region.
Imports	Imported goods and services are those that are produced overseas and purchased by domestic consumers. Imports are goods and services flowing into the country.
IO Tables	Input-output tables are part of the Australian National Accounts, complementing the quarterly and annual series of national income, expenditure and product aggregates produced and maintained by the Australian Bureau of Statistics (ABS).
Output	Output is a measure of the value of the goods and services produced by an industry or sector, where the value reflects the cost of inputs: labour, capital, and intermediate inputs of goods and services, including imports.
Value-added	Value-added (or factor income) is equivalent to output less goods and services sourced from other suppliers (including imports) and is a sector's contribution to gross domestic product or gross regional product. By excluding goods and service inputs from other domestic industries and from overseas, 'value added' avoids double counting as it does not include the value-added from other industries.
WRR	Waste and Resource Recovery

Appendix 2: Materials Flow Analysis

Hume City Council and KPMG conducted a materials flow analysis based on a waste audit conducted over Hume City Council run facilities in 2020. The results of this formed the baseline for the core material flows in Hume during 2020 and enabled better understanding of key resource target areas for supporting Hume's CE ambitions. This is summarised in Table 8 - Materials Flows Analysis. In 2020, Hume had 72,000 tonnes of waste going to landfill, which equates to 118 tonnes of CO2e released annually due to its composition. Emissions factors were sourced from the National Greenhouse accounts.[27] When an emissions factor was not specifically designated for a material stream from the National Greenhouse Accounts, the Municipal solid waste emissions factor was used.

The materials flow analysis identified a number of waste flows that contribute to a significant proportion of Hume's waste and are primarily sent to landfill. These include food waste, where 99% of food waste is currently sent to landfill, contributing to 35% of the total waste to landfill in Hume and accounting for 44% of the CO2e emissions from landfill. The second largest waste resource for Hume is cardboard and paper which contribute 12% of the total waste to landfill, and 25% of the total CO2e emissions from waste to landfill.

While some materials flow data was collected from Hume's businesses, a low response rate meant that the data was not usable for the purposes of extrapolation to the whole of Hume. Future efforts should be made to improve the data capture of waste sources in Hume from industry, beyond just council collected waste.

Table 8 - Materials Flows Analysis

Material stream	Waste to landfill (tonnes)	Emissions factor (t CO2e/t waste)	CO2e emissions (tonnes)
Cardboard, Paper	8,963	3.3	29,577
Chemicals	24	1.6	38
Clothing, Fibre, Textiles	2,750	2.0	5,500
Commercial and Industrial (C&I)	250	1.3	325
Construction and Demolition (C&D)	2,478	0.2	496
E-waste	784	1.6	1,254
Glass	5,595	0	-
Metals	472	0	-
Organics waste			
Medical waste	73	1.6	117
Animal Waste	1,247	1.6	1,995
Cooking oil	3	3.3	10
Food waste	25,002	2.1	52,505
Garden mulch, green waste	5,828	1.6	9,325
Wood	1,546	0.7	1,082
Plastics, Polymers	7,526	0	-
Rubber	210	3.3	693
Waste Collection (Bins)	9,648	1.6	15,437
Total	72,399		118,353

[27] National Greenhouse accounts tables 45 and 47, Available from: https://www.industry.gov.au/sites/default/files/2020-10/national-greenhouse-accounts-factors-2020.pdf

Appendix 3: Detailed Methodology

3.1 Population

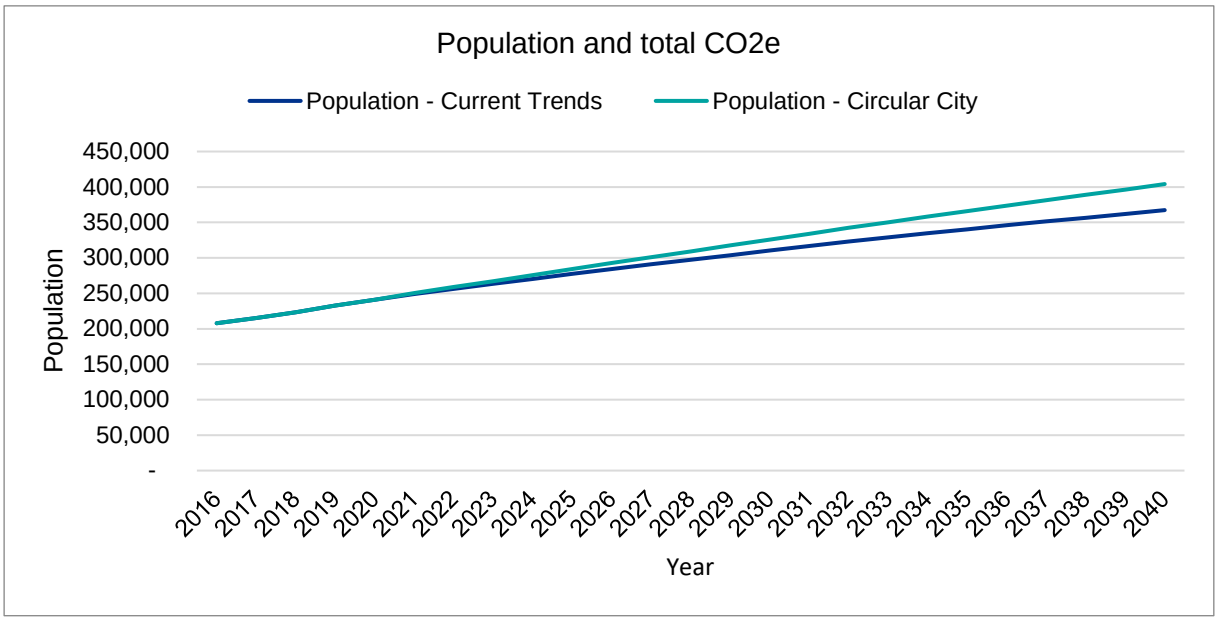
Baseline population data was sourced from forecast.id[28], which provides population estimates for growth in population from 2016 to 2041.

Assumptions

Forecast.id's recognises that rapid residential growth in the northern and north-western regions of Hume. Future growth areas include the industrial areas of Craigieburn and Greenvale which are also likely to increase as they provide an employment source. As Hume's land-use in the Waste Management City and Resource Recovery City scenario is consistent with the current trends, the population forecasts provided by forecast.id were considered reasonable.

In the circular city, we assume an added component of growth for Hume's population, which is a direct result of the improved attractiveness of Hume as a destination and due to improved community and lifestyle. It is also likely that as industries such as materials reprocessing, waste and transportation expand, we will also see additional growth in population. As a result, we have assumed a 0.5% increase in population per year beyond the current trends.

Figure 27 - Population projection



[28] Hume City Council. (2020). Welcome to the Hume City Population Forecasts. https://forecast.id.com.au/hume

3.2 Carbon Emissions

Data sources

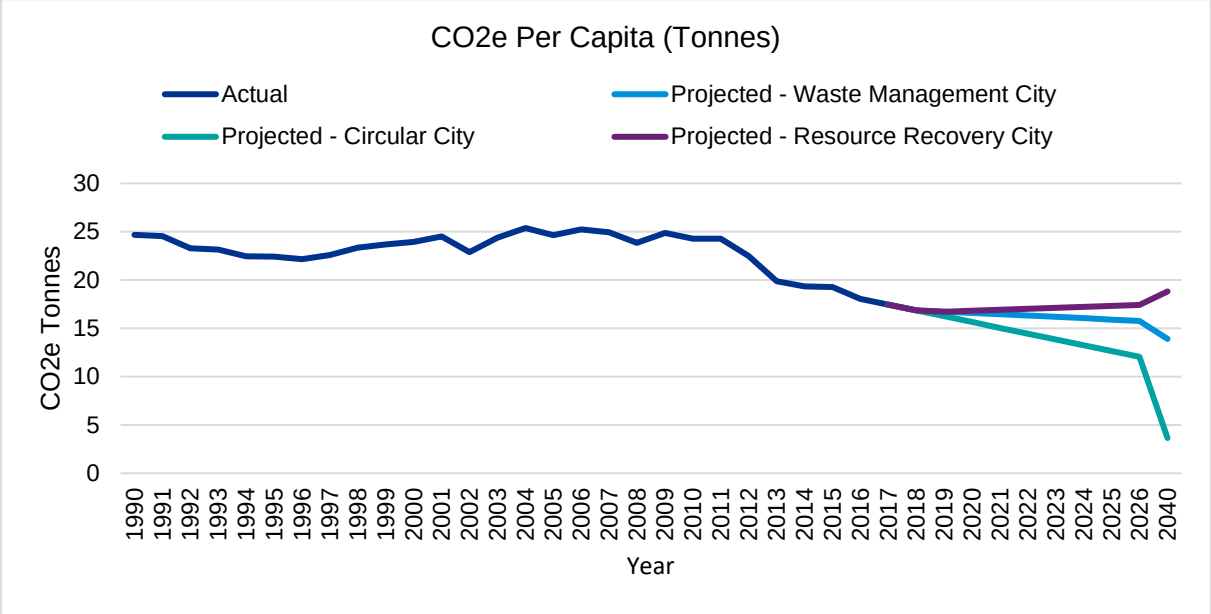
Due to lack of data availability for Hume City's carbon emissions, we have used data from the Australian Government Department of the Environment and Energy which contains state and territory emission data per capita (CO2e) from the National Greenhouse Accounts. [29] The National Greenhouse Accounts comprise of a series of comprehensive reports and databases that estimate, and account for, Australia's greenhouse gas emissions estimates from 1990 onwards. This data is reported at a state level, providing tonnes of CO2e emissions per capita.

For the price of carbon, we use the Australian Carbon Credit Units (ACCU's) spot-price, taken from the Quarterly ACCU market updates released from the Clean Energy Regulator. We extrapolated the average Q4 spot-prices for 2018, 2019 and 2020. [30] The ACCU spot-price data was not released prior to 2017.

Projection

Emissions per capita have been decreasing in Victoria have been decreasing since 1990 and are set to decrease over the next 20 years (Figure 28). Continuing the current trend up to 40, emissions per capita will have decreased to 14 tonnes of CO2e per person. Under the circular city scenario, we assume an accelerated decrease in the emissions per capita as a result of increasing green and waste to power solutions.

Figure 28 - Tonnes of greenhouse gas emissions per capita in Victoria from 1990 to 2040



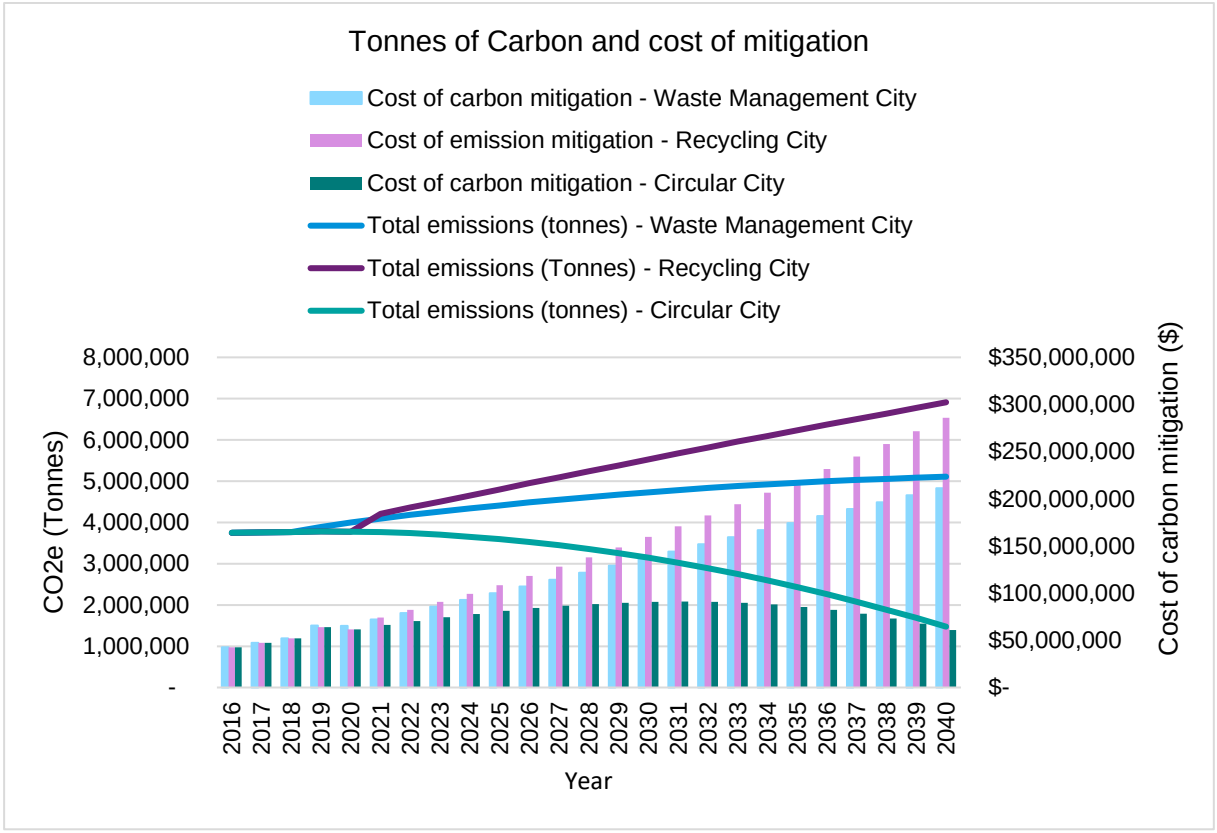
[29] Australian Government Department of the Environment and Energy, State and Territory CO2e data per capita 1990-2017, projected by KPMG to 2040 using linear regression. Available from: https://data.gov.au/data/dataset/77726fe7-ac78-4e4d-a8f7-05c55b417858/resource/7c13f590-a4c6-415c-af4d-9a8e982a0578/download/state-co2e-emissions-per-capita.csv

[30] Australian Government Clean Energy Regulator. (2020). Data workbook – December Quarter 2020 and 2019. cleanenergyregulator.gov.au

Source data: Australian Government Department of the Environment and Energy, State and Territory CO2e data per capita 1990-2017, projected by KPMG to 2040 using linear regression. Available from: https://data.gov.au/data/dataset/77726fe7-ac78-4e4d-a8f7-05c55b417858/resource/7c13f590-a4c6-415c-af4d-9a8e982a0578/download/state-co2e-emissions-per-capita.csv

Taking the population projections in 3.1, total emissions will increase in Hume to 5.1 million tonnes by 2040 in the baseline, Waste Management City and Resource Recovery City. While emissions in the circular city will decrease to 1.4 million tonnes by 2040. Population was not considered a key driver of growth in the Resource Recovery City Scenario, instead, it was assumed that emissions per capita would increase as a result of industrialisation required to process an increased volume of recycling.

Figure 29 - Population and CO2e



3.3 Waste to landfill

Data sources

Waste to landfill for Hume City Council is calculated from a materials flow analysis of waste streams collected at council waste depots (see Appendix 2: Materials Flow Analysis). From this data and some limited 2019 waste flows data in 2019, a linear extrapolation of the data was performed to represent the baseline or current trends if Hume continued without any major action on the CE.

We have also applied the population growth model from the "3.1 Population" section to estimate the future growth in waste as a result of population growth.

Assumptions and limitations

We assume that 336 kg of waste to landfill is created by each new person who moves into Hume from the baseline year of 2020. This assumption was made in discussion with Hume's Waste and Resource Recovery Manager. Under the Hume baseline, all of this waste is assumed to go to landfill. Progressively under each scenario, waste recovery increases. As a result, we assume a progressive reduction in the amount of waste going to landfill per new resident.

Table 9 - Change to waste to landfill for every new resident of Hume

	Hume baseline	Waste Management City	Resource Recovery City	Circular City
Change to waste (tonnes) from one additional resident	0.336	0.235	0.188	0.169

The Waste Management City represent the amount of waste to landfill under the Waste Management City scenario, the Resource Recovery City represents the waste to landfill under the Resource Recovery City Scenario, and the Circular City represents the same under the Circular City Scenario. We assume a reduction in line with the waste reduction targets set by Hume (see Table 10).

Figure 30 - Waste to landfill projection

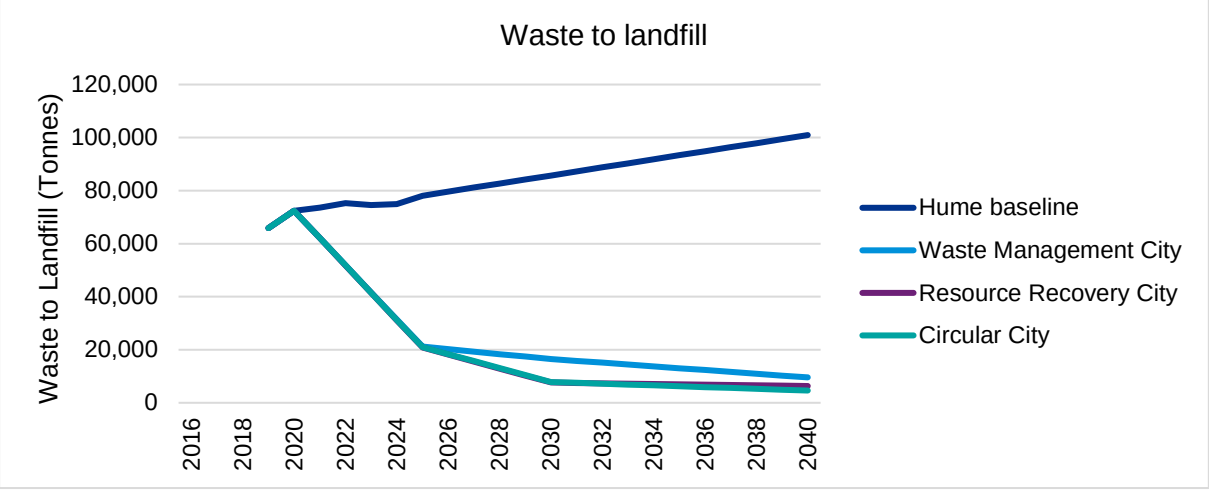


Table 10 - Waste to landfill Target

Scenario	2025	2030	2040
Waste Management City	Reduction of 72%	Reduction of 80%	Reduction of 90%
Resource Recovery City	Reduction of 72%	Reduction of 90%	Reduction of 93%
Circular City	Reduction by 72%	Reduction by 90%	Reduction by 95%

The waste to landfill data projected above only reflects that of Hume City Council and the businesses that use its depots for waste disposal. It does not reflect the waste from private waste collection and disposal companies in Hume. While some limited data was collected from Hume's businesses on their materials flows, a low response rate meant that the data was not usable for the purposes of extrapolation to the whole of Hume. Future efforts should be made to improve the data capture of waste sources in Hume from industry, beyond just council collected waste.

To assign a cost of disposing landfill, the cost of sending waste to landfill for the metropolitan municipal region was utilised, this is displayed in Figure 31. For beyond 2023, we assume that the landfill cost will remain steady.

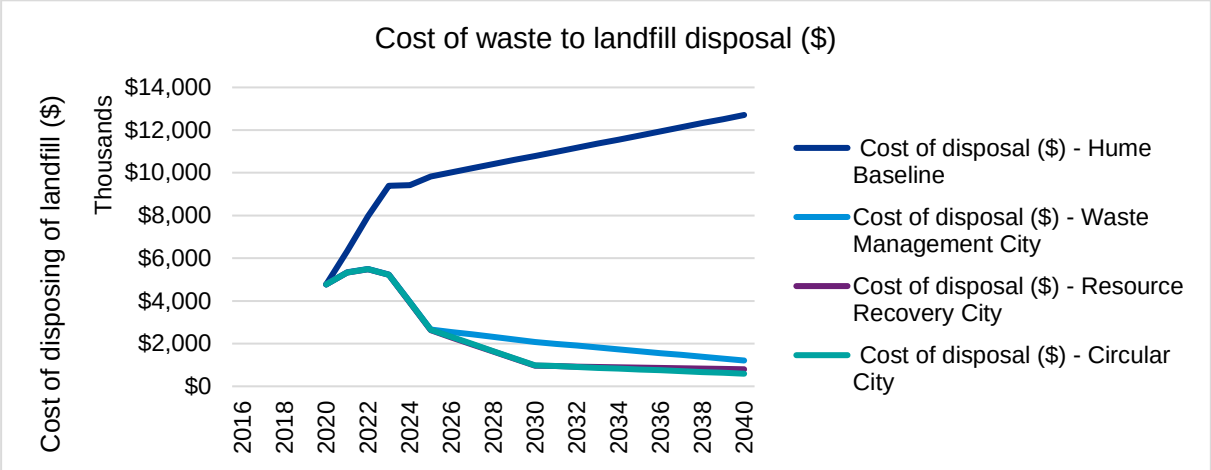
Table 11 - Landfill Levy resulting from Table 1 of the Recycling Victoria Policy [31]

Year	Levy rate ($/t)
2020	$ 65.90
2021	$ 85.90
2022	$ 105.90
2023	$ 125.90

This results in the Figure 31 below demonstrate that the cost of disposal of landfill under the circular city scenario is the lowest. However, due to the ambitious nature of the reductions in waste to landfill under all three scenarios, there is not a large difference between the cost of disposal under the three scenarios.

[31] Victoria State Government. (2020). Recycling Victoria: A new economy. The State of Victoria Department of Environment, Land, Water and Planning. https://www.vic.gov.au/sites/default/files/2020-02/Recycling%20Victoria%20A%20new%20economy.pdf

Figure 31 - Cost of disposing of waste to landfill



3.4 Property Prices

Data sources

Due to the limited data availability for Hume council, we've developed a simple approach to obtain information for the current and future state. First, information about the historical trend in average house price for Victoria was collected from two sources:

- The Victorian Average House Price from (2011 to 2021) from the ABS [32]; and
- A selection of years of sales data from Domain were analysed comparing the average house price sale in Hume to the Victorian average to find a percentage difference. [33]

We then calculated the percentage difference for missing months by interpolating, which was used to calculate house prices in Hume. This enabled us to obtain complete historical information about house sales in Hume.

To build a fuller picture of what may influence sales in Hume, we also added household income and person age data to the projection, which was sourced from Census data. [34]

Projections

Two primary projections were built.

First, a linear forecast using future prices in Hume and Victoria based on historical trends. These are shown in Figure 34. This demonstrates that using a simple linear forecast, Hume's house prices are below the average for the state.

Second, we've calculated a percentage of households in Hume with a weekly income over $3000 and a percentage of people aged over 70 year's old. The data was available only for 2006, 2011 and 2016, and to find the missing years, we performed a simple interpolation. The data showed a clear correlation with house prices in Hume (Figure 32 and Figure 33). Therefore, we used the percentage of households with higher income and the older population as dependent parameters for the regression. The developed regression was then used to predict house prices in Hume under a baseline scenario (income and age percentage for 2021-2040 was extracted from historical data using trend analysis).

Table 12 - Regression coefficients

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
% of higher income	33.38	9.990	3.34	0.01	10.78	55.98	10.78	55.98
% of people over 70yo	16.74	15.69	1.07	0.31	-18.76	52.23	-18.76	52.23

[32] Australian Bureau of Statistics (2021). Victoria average house prices (2011-2021). https://www.abs.gov.au/statistics/economy/price-indexes-and-inflation/residential-property-price-indexes-eight-capital-cities/latest-release

[33] Domain. (2021). Hume house prices (selected years between 2011 and 2021) https://www.domain.com.au/sold-listings/broadmeadows-vic-3047/house/3-bedrooms/

[34] Australian Bureau of Statistics (2021). Household income and persons age (2006, 2011, 2016). https://www.abs.gov.au/websitedbs/censushome.nsf/home/factsheetsuid

To create projections for the Circular Economy scenario, we assumed that more people with higher income and more older people would tend to move to the area that has more favourable living conditions, better jobs, improved community spaces and more green places. Therefore, under this scenario, the proportion of older people and higher-income groups increase by 0.5% every year. This enabled us to estimate both parameters for 2021-2040, which was then used in the regression to calculate house prices in Hume.

Figure 32- Correlation between the percentage of households with higher income and house prices in Hume

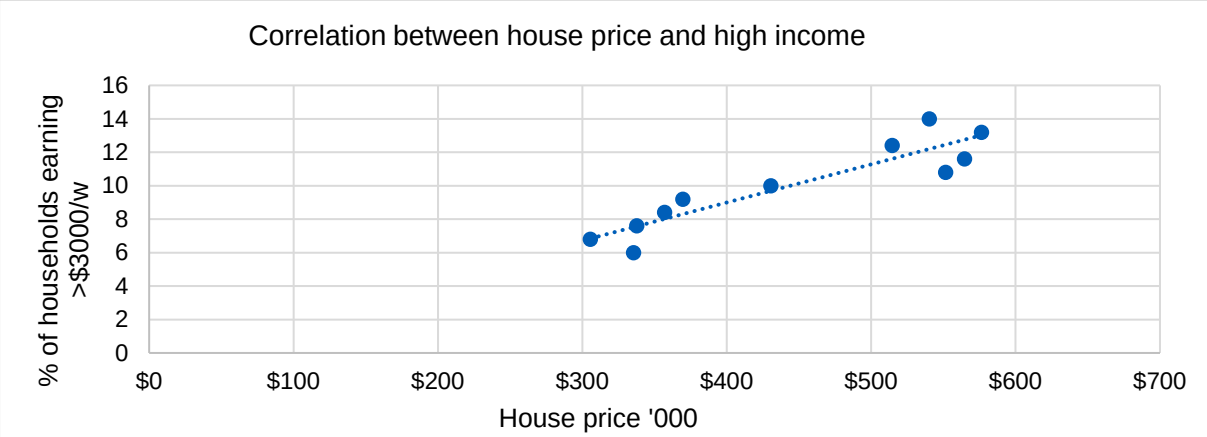
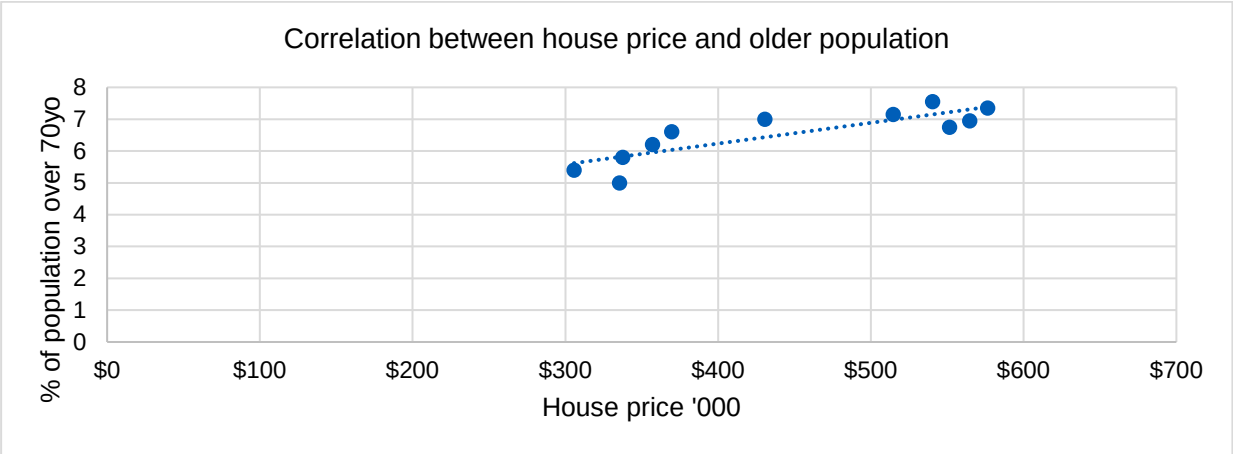


Figure 33 - Correlation between people over 70yo and house prices in Hume

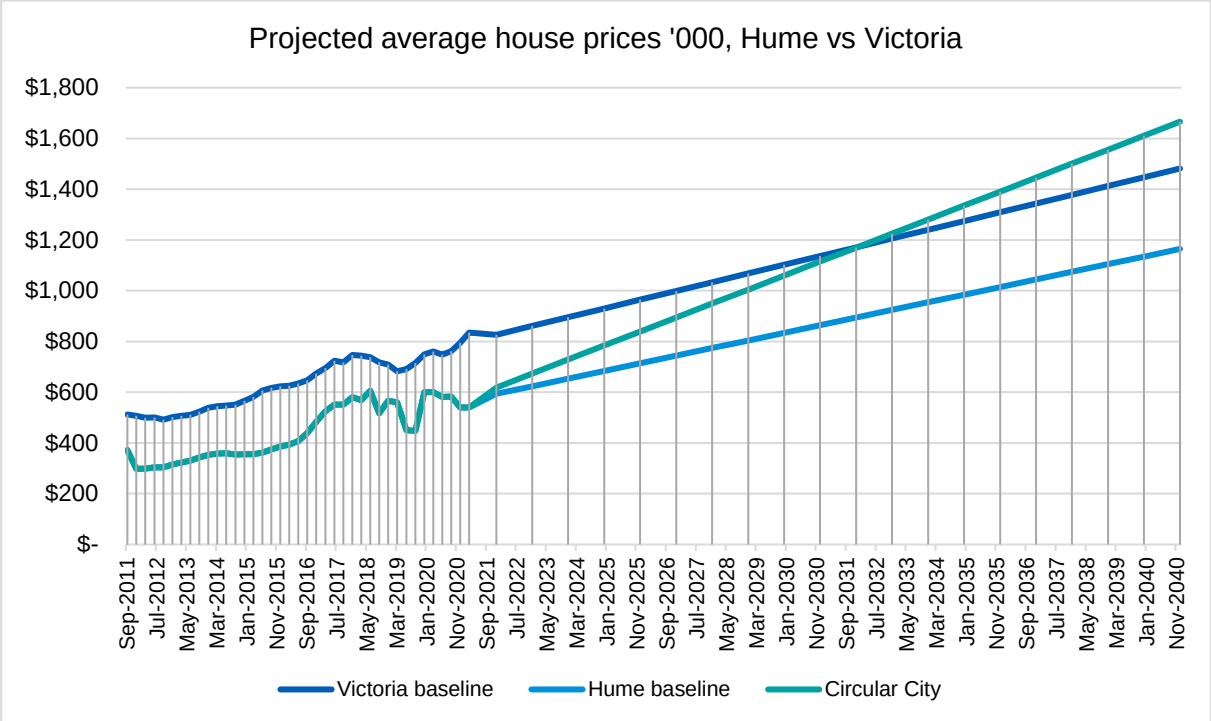


Results

Under the baseline, house prices in Hume stay below-average prices in Victoria and reach around $1.1 million by 2040.

Under the Circular Economy scenario, better living conditions result in a more rapid increase in house pricing in Hume. The prices become compatible with average Victoria values by 2030. By 2040, Hume surpasses Victoria, reaching up to $1.6m per house.

Figure 34 - House price in Hume ($ '000)



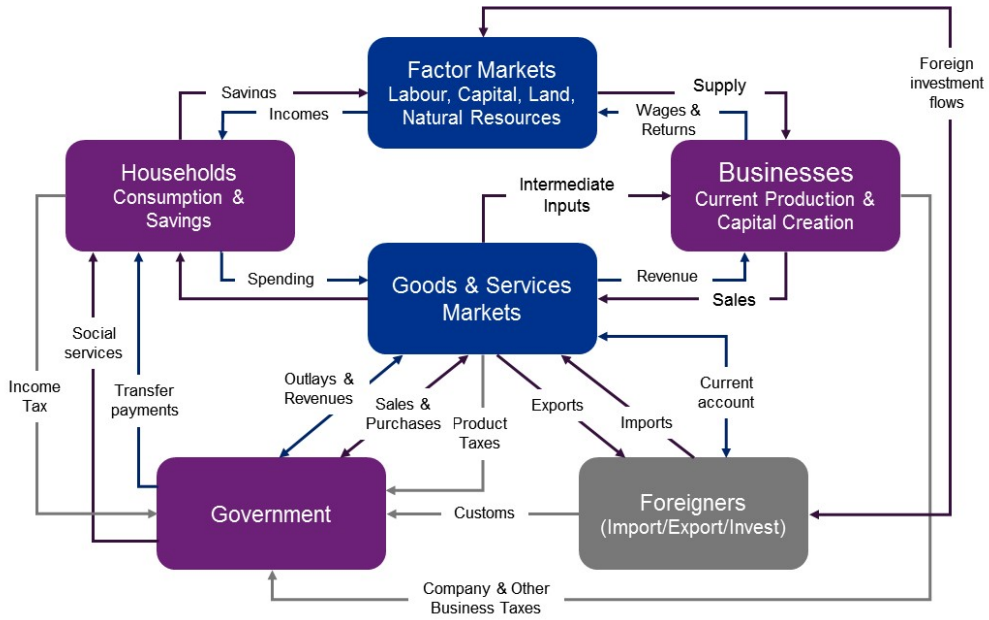
3.5 Economic analysis

KPMG-SD

KPMG-SD is a detailed CGE that disaggregates the Australian economy into regional economies. These regional economies are aligned with the Australian Statistical Geography Standard (AGSG) and can be tailored to a range of Statistical Area regions (e.g., SA4 or SA3) depending on the requirement of the project. The industrial structure of each regional economy within KPMG-SD is represented by 117 sectors based on the IOIG classification used by the Australian Bureau of Statistics (ABS). The database of KPMG-SD is based on the 2017-18 input-output (IO) tables published by the ABS, which quantifies the flows of goods and services between producers and various users (e.g. intermediate inputs to other producers, inputs to capital creators, households, governments and foreigners) and the flows associated with primary factor inputs (i.e. labour, capital and land). Regional detail is provided by the state accounts, labour force survey and census data published by the ABS.

The KPMG-SD presents the economy as a system of interdependent economic agents and thus is capable of tracing and quantifying the change in the economy from one sector to another. Figure 35 shows a stylised representation of the transmission channels through which the changes in one part of the economy affects the whole economy.

Figure 35 - System of interdependent economic agents



Economic theory is incorporated to guide predictive understanding of the behavioural and market responses of economic agents in KPMG-SD. Defining assumptions include:

- behaviour by households and businesses in competitive markets under explicit resource constraints and budget constraints trends toward optimisation;
- the price mechanism operates to clear markets for goods and factors, such as labour and capital, i.e., prices adjust so that supply and demand are equal; and
- marginal costs are equal to marginal revenues in all economic activities.

The KPMG-SD combines data from input-output tables, labour force surveys and other sources and deploys economic theory to quantify sophisticated behavioural responses such as:

- price and wage adjustments driven by resource constraints;
- household and government spending and taxing adjustments driven by budget constraints; and
- allowance for input substitution possibilities in production (e.g., allowing the combination of labour, capital, and other inputs required for production to vary in response to relative price changes).

KPMG-SD takes a 'bottom-up' approach to multi-regional analysis. In each region, economic agents decide the allocation of labour, capital and land to different productive activities. The cost structure of firms in each sector, the composition of investment, the endowments and preferences of households and the level and composition of public expenditures are all region-specific. However, regions are interdependent via bilateral flows of goods and services and connected to the rest of the world. These cross-boundary trades are recognised via a detailed specification of transport margins for goods.

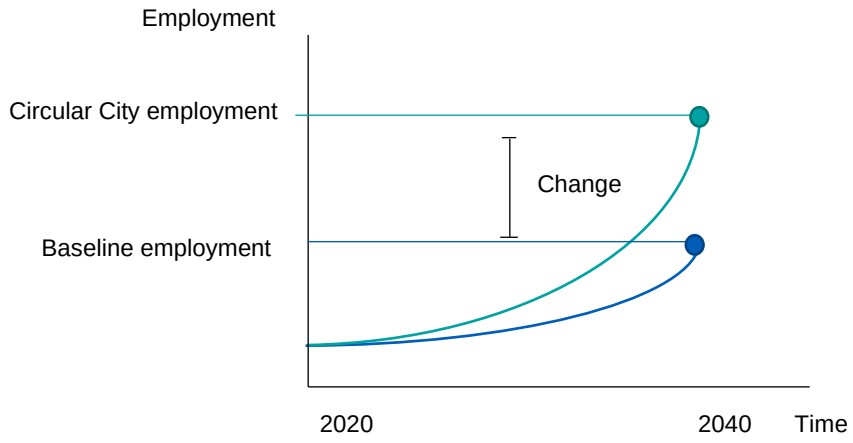
Results

To generate results, we ran KPMG-SD twice for the three scenarios being assessed. First, we ran a baseline simulation that captures a snapshot of the economy in the absence of any of the three scenarios. Second, we ran the counterfactual simulations that represent the evolution of the economy assuming the implementation of each of the three scenarios.

The economic effect of each scenario is measured by the difference between the values of the economic variables predicted under the baseline versus counterfactual scenarios. This process is illustrated in Figure 36. For each economic variable analysed, the baseline amount was compared to the amount predicted under the scenario in question. The figure displays the example of employment.

The difference between the baseline employment and the Circular City employment reflects the change that adoption of the scenario gives rise to. Because each of the subsequent scenarios built on the last, the change became progressively amplified. In this example, the baseline employment has increased from 2020 to 2040. Comparing it to the Circular City scenario, there has also been employment growth, however this has occurred much faster than under Hume's baseline. The difference between the two data points at 2040, is then the change in the employment variable.

Figure 36 - Illustration of interpretation of change in economic variable



In order to obtain estimates of changes in the Hume economy as a result of the three scenarios, various shocks were applied. These are detailed in Table 13.

Table 13 – Shocks

Criteria	Scenarios			Shock implementation
	1. Waste Management City	2. Resource Recovery City	3. Circular City	
Hume waste sector (Waste Collection, Treatment and Disposal Services)	Waste to landfill declines by 72% by 2025; 80% by 2030 and 90% by 2040. Waste value added & total output remain at baseline level.	Waste to landfill declines by 72% by 2025, 90% in 2030 and 93% by 2040. Waste value added & total output by 15% by 2025, 35% by 2030 and 40% by 2040.	Reduce waste to landfill by 72% by 2025; 90% in 2030 and 95% by 2040. Waste value added & total output increases by 20% by 2025, 50% by 2030 and 60% by 2040.	*Increase in output or economic activity of the Waste sector.*
			Worker productivity improves by 10% due to efficiencies from reprocessing	*Labour productivity improvement in the Waste sector.*

Criteria	Scenarios			Shock implementation
	1. Waste Management City	2. Resource Recovery City	3. Circular City	
			and collection hubs.	
Advanced Material Reprocessing	Advanced Reprocessing Sector grows by 2% year on year.	Advanced Reprocessing Sector grows by 5%year on year.	Advanced Reprocessing Sector grows by 8% p.a.	*Output increase for the Manufacturing sector.*
Industry innovation (non-waste related sectors)	Estimated value added per annum: $500,000 by 2025; $1 million by 2030 and $2 million by 2040.	Estimated value added per annum: $1,000,000 by 2025; $2 million by 2030 and $6 million by 2040.	Estimated value added per annum: $4,000,000 by 2025; $10 million by 2030 and $25 million by 2040.	*This is captured via the increase in the output of non-waste related sectors.*
Transport and logistics (Transport, Postal and Warehousing)	Output/total sales for this industry grow beyond current trend (2%).	Output/total sales for this industry perform ahead of trends (4%).	Output/total sales for this industry improve well ahead of current growth trends (8%).	*Increase in output of the Transport, Postal and Warehousing sector.*
Energy use target	Increase in energy intensity in industry by 1%.	Energy use increases by +1% due to large recycling efforts through to 2040.	Energy use declines due to commitment to energy efficiency programs and less reprocessing of materials. A net reduction of 2% on energy use.	*A change in the use of Electricity and Gas inputs by the Waste sector.*
Employment rate	Employment trends continue from the benchmark. A target of 11% unemployment rate in 2025,	Employment increases at a slightly higher proportion. A target of 10% unemployment rate in 2025,	Employment increases at an even higher rate. A target of 9% unemployment rate in 2025, 6% in	*The reduction in unemployment is captured via the employment responses due to the change in real wage rates.*

Criteria	Scenarios			Shock implementation
	1. Waste Management City	2. Resource Recovery City	3. Circular City	
	10% in 2030, 9% in 2040.	8% in 2030, 7% in 2040.	2030,5% in 2040.	
Spatial utilisation	No change to vacancy rates and land productivity in Hume.	Industrial vacancy rate declines by 0.5% Retail and commercial vacancy rate unchanged.	Industrial vacancy rate declines by 1% Retail and commercial vacancy rate reduces by 1%	*Increase in capital productivity.*
Tertiary Education Increase in output as a result of increased research being commercialised in the waste sector.	Trend is consistent with 2019/20.	Small increase (1%) in total output for the tertiary education sector.	Moderate increase (5%) in total output for the tertiary education sector.	*Increase in output of Tertiary Education sector.*
Virtual marketplace Hume adopts both a materials trading platform and a private platform created by a Hume entrepreneur or community-based entrepreneur.	Value added by this service = $500,000 per annum by 2025; $1.5 million per annum by 2035; $2 million per annum by 2040	Value added by this service = $1,000,000 per annum by 2025 ; $3.0 million per annum by 2035 ; $4 million per annum by 2040.	Value added through a materials marketplace = $3,000,000 per annum by 2025; $12.0 million per annum by 2035 and $25 million per annum by 2040.	*Change in input technology in the Waste sector.*
Sharing economy/product-as-service (Rental and Hiring Services Industry)	No change (the sharing economy will continue to be near non-existent in Hume)	No change (the sharing economy will continue to be near non-existent in Hume)	New service and sharing businesses enter Hume - generating an increase of $10 million per annum by	*Increase in output of the Rental and Hiring Service sector.*

Criteria	Scenarios			Shock implementation
	1. Waste Management City	2. Resource Recovery City	3. Circular City	
			2025; $40 million per annum by 2035 and $60 million per annum by 2040.	
Organics savings	Use of compost replaces fertiliser use and avoids product disposal to landfill -> cost savings of $11.9m per annum.	Cost savings of $11.9m per annum on fertiliser. -> added revenue of $5 million (from outside Council organics).	Cost savings of $11.9m per annum on fertiliser. -> added revenue of $5 million (from outside Council organics).	*Input-saving technological change in the use of fertiliser by the agriculture sector.*
Food waste savings	40% of the food sector output is lost yearly due to poor food management practices.	40% of food sector output is lost yearly due to poor food management practices.	Take 40% of food industry as waste: Of that savings of 25% by 2025; 30% by 2030; 50% by 2040 as recaptured value.	*Reduction in household and retail food consumption due to change in preferences.*
Littering costs	Net effect is 5% increase in year on year littering costs based on 2020 levels.	Littering costs decrease by 10% based on 2020 levels, with further reductions of 2% per year through to 2040.	Littering costs decrease by 10% based on 2020 levels, with annual reductions of 5% per year through to 2040.	*Reduced industry demands for Administrative and Support services.*

Contact us

Adrian King
Partner in Charge, Sustainability Services
+61 3 9288 5738
avking@kpmg.com.au

Scott Valentine
Director & Senior Circular Economy Specialist, Sustainability Services
+61 3 9288 6135
svalentine@kpmg.com.au

George Verikios
Director, Economics and Tax Centre
+61 7 3233 3282
gverikios@kpmg.com.au

Marc Mariano
Manager, Economics and Tax Centre
+61 7 3225 6971
mmariano1@kpmg.com.au

Elyse Vaughan
Senior Consultant, Sustainability Services
+61 2 9455 9327
evaughan3@kpmg.com.au

KPMG.com.au