HEALTHY AND SUSTAINABLE CITIES

Issues and opportunities in
Melbourne's knowledge system
to transition to a healthy and
sustainable city

PROJECT TEAM

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

This research report is based on a cooperation between the Melbourne Sustainable Society Institute (MSSI) and the Connected Cities Lab at the University of Melbourne. The goal of this report is to inform the Lord Mayor's Charitable Foundation (LMCF) on potential future themes and activities to support Melbourne transitioning toward a more sustainable and healthier city.

To create an overview of Melbourne's knowledge system in the context of sustainability and health, we identified key stakeholders and topics through desktop research and expert consultations in November and December 2018. As a result of this screening, we identified 90 organisations and 130 publicly available reports. Based on this data we identified main themes and opportunities which could help Melbourne transition toward a more sustainable and healthier city.

These are the key findings and recommendations:

1

THE KNOWLEDGE SYSTEM HOSTS HIGH-QUALITY, AND IN SOME INSTANCES, WORLD-LEADING EXPERTISE AND KNOWLEDGE IN PARTICULAR DOMAINS AND AREAS OF SUSTAINABLE AND HEALTHY CITIES. THE SYSTEM IS HOWEVER FRAGMENTED AND DISCONNECTED. TO AVOID EXPERTISE REMAINING PIECEMEAL AND LOCKED WITHIN DISCIPLINARY SILOS, MELBOURNE NEEDS MORE INTER-DISCIPLINARY KNOWLEDGE CREATION THAT INTEGRATES VARIOUS TOPICS AROUND URBAN SUSTAINABILITY AND HEALTH.

RECOMMENDATION:
The LMCF could further support interdisciplinary and transdisciplinary research in the context of urban sustainability and health that helps to break down silos between disciplines and find innovative ways of initiating new project approaches.

2

IN ADDITION TO DISCIPLINARY SILOS, THE KNOWLEDGE SYSTEM IS ALSO LIMITED BY FRAGMENTATION ALONG SECTORAL FAULT-LINES. AS A RESULT, RESEARCH TRANSLATION AND ACTIONABLE RESEARCH REMAIN UNDER-EXPLOITED. MELBOURNE WOULD BENEFIT FROM COLLABORATIVE APPROACHES THAT BRING TOGETHER STAKEHOLDERS FROM PUBLIC, PRIVATE AND ACADEMIC SECTORS.

RECOMMENDATION:

The LMCF could support applied research projects which build new networks of researchers, private sector actors, and policy partners. Furthermore, the LMCF could support specific collaborations between universities but also between universities and policy makers to further bundle knowledge and expertise. The City of Melbourne Chair of Resilient Cities at the University of Melbourne is an example of a closer cooperation between public sector and academia. Furthermore, the support of approaches such as 'Urban Living Labs' could help to break down these silos through new partner constellations which could include local government, NGOs, non-profit organisations, consultancies, artists, business and entrepreneurs.

3

FASTER TRANSLATION OF KNOWLEDGE INTO ACTION WOULD BENEFIT FROM MORE POLICY-RELEVANT DEMONSTRATION PROJECTS THAT HELP TO TRIAL, TEST AND SHOWCASE MISSION-ORIENTED INNOVATIONS (TECHNOLOGIES, POLICIES, INFRASTRUCTURE, BUSINESS MODELS).

RECOMMENDATION:

The LMCF could support embedded research and impact activities in demonstration projects at different stages: development, assessment, knowledge translation and communication of results of learning-by-doing processes in demonstration projects. The support of intermediaries which connect all sectors and leads projects in an open way is needed. The Resilient Melbourne Delivery Office is a good example of such an intermediary cutting across sectors across the whole of Metropolitan Melbourne.

4

MELBOURNE WOULD BENEFIT FROM MORE EVIDENCE-BASED AND INNOVATIVE URBAN PLANNING APPROACHES IN VARIOUS FIELDS RELATED TO SUSTAINABILITY AND HEALTH (EG HOUSING, TRANSPORT, URBAN GREENING).

RECOMMENDATION:

The LMCF could support new and experimental approaches in the public sector which seek to foster cooperative projects with stakeholders from academia and private sector. Moreover, the LMCF could support research endeavors which seek to produce a collation of best practice examples of completed projects. This knowledge would help Melbourne to drive and scale up experimental approaches.

5

THERE IS PARTICULAR PLACE-BASED OPPORTUNITY FOR MELBOURNE TO COMBINE ITS WORLD-CLASS KNOWLEDGE IN RELATION TO A NUMBER OF SPECIFIC THEMES TO GENERATE A RANGE OF SOCIAL AND ENVIRONMENTAL OUTCOMES AND CO-BENEFITS:

- Sustainable and healthy urban built environments
- Urban greening for a cooler and more active city
- A healthier and sustainable food system
- Digitalisation as a driver of urban sustainability and health.

RECOMMENDATION:

The LMCF could support interdisciplinary and transdisciplinary research and applied projects that seeks to further explore these topics. New collaborations could be initiated through the support of Urban Living Labs.

ABBREVIATIONS

ARC	Australian Research Council
AURIN	Australian Urban Research Infrastructure Network
ACHR	Australian Centre for Health Research
AHURI	Australian Housing and Urban Research Institute
C40	C40 Cities Climate Leadership Group
CAUL	Clean Air and Urban Landscapes Hub
CHIA	Community Housing Industry Association
CRC	Cooperative Research Centres
CREEL	Centre for Resources, Energy and Environmental Law
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DELWP	Department of Environment, Land, Water and Planning
DHHS	Department of Health and Human Services
EnSuRe	Centre for Environmental Sustainability and Remediation
EPA	Environmental Protection Agency
HNSRG	Health Nature and Sustainability Research Group

ICLEI	Local Governments for Sustainability
IPCC	Intergovernmental Panel on Climate Change
ISILC	Institute for Sustainable Industries & Liveable Cities
ITS	Monash Institute of Transport Studies
LMCF	Lord Mayor's Charitable Foundation
MMIHR	The Mary MacKillop Institute for Health Research
MSDI	Monash Sustainable Development Institute
MSPGH	The Melbourne School of Population and Global Health
MSSI	Melbourne Sustainable Society Institute
SBi Lab	Sustainable Building Innovation Lab
SDG	Sustainable Development Goals
THUD	Transport, Health and Urban Design Research Hub
UN	United Nations
UNEP	United Nations Environment Programme
VEIL	Victorian Eco Innovation Lab
VCCCAR	Victorian Centre for Climate Change Adaptation Research

1. REPORT OVERVIEW

The Lord Mayor's Charitable Foundation (LMCF) called for a cross-sectoral research project to explore Melbourne's knowledge system and identify themes and opportunities to help the city transition toward a healthy and sustainable city. The Melbourne Sustainable Society Institute (MSSI), in collaboration with the Connected Cities Lab (both at the University of Melbourne), was pleased to respond to this request by conducting a short-term research project.

This report should help the LMCF to identify and support future projects that will help to drive Melbourne's transition toward a more sustainable and healthy city. The goal of this report is to inform the LMCF about:

1) *the knowledge system* that produces and diffuses knowledge to shape and transition Melbourne to a healthy and sustainable city

2) *issues and opportunities* for future activities of the foundation which combine interdisciplinary, cross-sectoral activities with a range of social and environmental outcomes and co-benefits.

1.1   Scope and research design

THE RESEARCH PROJECT FOLLOWED A TWO-STEP APPROACH WHICH INCLUDED AN ENVIRONMENTAL SCAN OF MELBOURNE'S RESEARCH AND CITY-SHAPING ECOSYSTEM (STEP I) AND THE EXPLORATIVE IDENTIFICATION OF KEY CURRENT AND POTENTIAL FUTURE ISSUES AND OPPORTUNITIES IN THE CONTEXT OF SUSTAINABLE AND HEALTHY CITIES (STEP II).

Step I started in November 2018 with an initial consultation meeting with the LMCF. Discussed was a preliminary list of organisations and research institutes that should be considered in the scan. It was agreed that the scan should be open and transparent so as to include other institutions identified during the investigations. Further discussion covered an overview of potential topics that bring together multiple outcomes and social and environmental benefits.

Following this briefing, explorative desktop research and specific web/document searches via publicly available information from identified organisations commenced, combined with consultations of Melbourne-based experts. A key starting point was the screening of research projects

funded by the Australian Research Council (ARC). The website of the ARC[1] provided the opportunity for a detailed search.

A key goal of this explorative search was the identification of key actors in the knowledge system to generate an understanding about *who* participates in the system and creates and shares knowledge on health and sustainability issues that is instrumental to Melbourne's urban future. As a result of this first step, 90 organisations could be identified in Melbourne.

After completion of this scan, developed in Step I, the goal of Step II was the identification of current and potential future issues and opportunities for Melbourne to transition to a sustainable and healthy city. Based on 130 publicly available research reports which were found on the organisations' websites, and additional insights from Melbourne-based experts, we identified nine key themes in different urban sectors.

These insights, from scanning reports and expert consultations, led to identifying knowledge gaps within single themes and, more importantly, pointed to gaps in relation to the connections and relationships between these themes.

The report provides ideas and opportunities for the LMCF in supporting Melbourne-based research in transitioning toward a

more sustainable and healthy city by following a more connected, systemic and interdisciplinary approach of city shaping.

A METHODOLOGICAL NOTE
Both the scan of the knowledge system and the overview of issues and opportunities are based on a point-in-time and explorative search of publicly available information through reports and background expert interviews. To keep the investigations in a manageable range, the study was carried out without exploring the activities of individual city councils in producing and circulating knowledge.

The presented results in this report are a snapshot. It is not an exhaustive investigation of all existing entities of Melbourne's knowledge system and its themes.

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[1] https://rms.arc.gov.au/RMS/Report/Download/Report/d6b15b2b-3a50-4021-8e6f-6c7ef1cba553/0

1.2   Toward a sustainable and healthy Melbourne

During the last few years, the important role of cities in tackling urgent ecological and socio-economic challenges through innovative and experimental solutions has been addressed by a number of international organisations and researchers.[2] Cities are increasingly seen as the key arenas for sustainability transitions by providing platforms for testing and adapting new ways of socio-technical innovations and policy-making approaches in the context of climate change, green technologies or other environmental and social issues.[3]

The UN has highlighted the fundamental role of cities in the Sustainable Development Goal (SDG), agreed universally by countries in 2015: SDG11 commits states to 'make cities and human settlements inclusive, safe, resilient and sustainable'.[4]

While the SDG 11 focuses on various urban sustainability-related key topics – including mobility, public transport, affordable and safe housing, risk/disaster management, resilience, waste, water, air quality, social inclusion, resource efficiency, green space, buildings – issues around health are implicitly highlighted.

Increasing amounts of evidence suggest urban contexts have significant influence on citizens' health and wellbeing. The relationship between urban health and sustainable urban development is receiving more attention.[5] In the face of climate change, physical and mental health issues have been linked to traffic accidents, air and noise pollution and extreme weather events. Various international organisations and major United Nations efforts on this front, like the UN Urban Health Initiative or the World Health Organisation Healthy Cities networks, argue that cities should initiate actions that minimise health risks from air

pollution, traffic injury and physical inactivity, while also mitigating climate change. Mitigating urban health risks can have important co-benefits for multiple policy objectives.

Strategies for cities with significant health outcomes were identified in the following sectors:

• energy-efficient transport
• urban planning
• urban diets
• healthy, energy-efficient housing
• improved urban waste management.

(recognised by *UN-Habitat and WHO in the 2016 Global Report on Urban Health*[6], as well as in the *WHO Shanghai Declaration on the SDGs*[7]).

[2] Bulkeley, H., Castán Broto, V., & Maassen, A. (2011). Governing urban low carbon transition. In H. Bulkeley, V. Castán Broto, M. Hodson, & Marvin, S. (Eds.), Cities and Low Carbon Transition (pp. 29-41). London: Routledge.
Fastenrath, S., Coenen, L., & Davidson, K. (2019). Urban Resilience in Action: the Resilient Melbourne Strategy as Transformative Urban Innovation Policy? Sustainability, 11, 693.
Fuenfschilling, L., Frantzeskaki, N., Coenen, L. (2019). Urban experimentation & sustainability transitions. European Planning Studies, 27, 219–228.
Moore, T., de Haan, F., Horne, R., & Gleeson, B. J. (2018). Urban Sustainability Transitions: Australian Cases- International Perspectives. In T. Moore, F. de Haan, R. Horne, & B. J. Gleeson (Eds.). Singapore: Springer Singapore.
[3] Bos, A. J. J., & Brown, R. R. (2012). Governance experimentation and factors of success in socio-technical transitions in the urban water sector. Technological Forecasting and Social Change, 79, 1340-1353.

Bulkeley, H., & Castán Broto, V. (2013). Government by experiment? Global cities and the governing of climate change. Transactions of the Institute of British Geographers, 38, 361-375.
Bulkeley, H., Marvin, S., Palgan, Y. V., McCormick, K., Breitfuss-Loidl, M., Mai, L., von Wirth, T., & Frantzeskaki, N. (2018). Urban living laboratories: Conducting the experimental city? European Urban and Regional Studies.
Evans, J., Karvonen, A., & Raven, R., (Eds.) (2016). The Experimental City. London: Routledge.
Sengers, F., Berkhout, F, Wieczorek, A.J., Raven, R. (2016). Experimenting in the city. Unpacking notions of experimentation for sustainability. In: J. Evans, A. Karvonen & R. Raven, (Eds.). The Experimental City (pp. 15-31). London: Routledge.
Turnheim, B., Kivimaa, P., & Berkhout, F. (2018). Beyond Experiments. In B. Turnheim, P. Kivimaa, & F. Berkhout (Eds.), Innovating Climate Governance: Moving Beyond Experiments (pp. 1-26). Cambridge: Cambridge University Press.

[4] UN (2015). United Nations. Transforming our world: the 2030 Agenda for Sustainable Development. Available online: http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E
[5] Giles-Corti, B. et al. (2016). City planning and population health: a global challenge. The Lancet, 388, 2912–2924.
Stevenson, M. et al. (2016). Land use, transport, and population health: estimating the health benefits of compact cities, The Lancet, 388, 2925–2935.
[6] https://unhabitat.org/books/global-report-on-urban-health-equitable-healthier-cities-for-sustainable-development/
[7] https://www.who.int/healthpromotion/conferences/9gchp/shanghai-declaration.pdf?ua=1

SDG 11 – TARGETS AND SUB-TARGETS

TARGET 11-1

Safe and affordable housing

Indicator 11.1.1: Proportion of urban population living in slums, informal settlements, or inadequate housing

TARGET 11-2

Affordable and sustainable transport systems

Indicator 11.2.1: Proportion of population that has convenient access to public transport, by sex, age and persons with disabilities
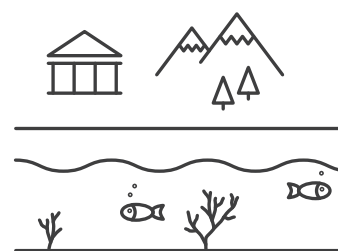
TARGET 11-3

Inclusive and sustainable urbanisation

Indicator 11.3.1: Ratio of land consumption rate to population growth rate

Indicator 11.3.2: Proportion of cities with a direct participation structure of civil society in urban planning and management that operate regularly and democratically

TARGET 11-4

Protect the world's cultural and natural heritage

Indicator 11.4.1: Total expenditure per capita spent on the preservation, protection and conservation of all cultural and natural heritage, by type of heritage, level of government, type of expenditure and type of private funding

TARGET 11-5

Reduce the adverse effects of natural disasters

Indicator 11.5.1: Number of deaths, missing persons and persons affected by disaster per 100000 people

Indicator 11.5.2: Direct disaster economic loss in relation to global GDP, including disaster damage to critical infrastructure and disruption of basic services

TARGET 11-6

Reduce the environmental impact of cities

Indicator 11.6.1: Proportion of urban solid waste regularly collected and with adequate final discharge out of total urban solid waste generated, by cities

Indicator 11.6.2: Annual mean levels of fine particulate matter in cities

TARGET 11-7

Providing access to safe and inclusive green and public spaces

Indicator 11.7.1: Average share of the built-up area of cities that is open space for public use for all, by sex, age and persons with disabilities

Indicator 11.7.2: Proportion of persons victim of physical or sexual harassment, by sex, age, disability status and place of occurrence, in the previous 12 months

TARGET 11-A

Strong national and regional development planning

Indicator 11.a: Proportion of population living in cities that implement urban and regional development plans integrating population projections and resource needs, by size of city

TARGET 11-B

Implementation policies for inclusion, resource efficiency and disaster risk reduction

Indicator 11.b.1: Proportion of local governments that adopt and implement local disaster risk reduction strategies in line with the Sendai Framework for Disaster Risk Reduction 2015–2030

Indicator 11.b.2: Number of countries with national and local disaster risk reduction strategies

TARGET 11-C
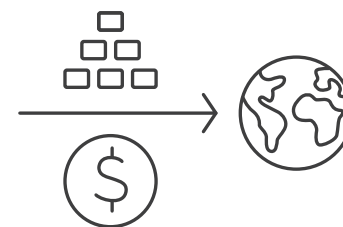
Support least developed countries in sustainable and resilient building

Indicator 11.c: Proportion of financial support to the least developed countries that is allocated to the construction and retrofitting of sustainable, resilient and resource efficient buildings utilising local materials

HOW CAN MELBOURNE BECOME A MORE SUSTAINABLE AND HEALTHY CITY?

Further basic and applied research is needed to identify Melbourne's context-specific health topics as they interrelate to other urban sustainability topics. During the last few years, dominant topics discussed in Melbourne are: rapid population growth and related environmental pressures and degradation; energy transitions; challenges in transport; and increasing social inequalities.[8] These topics also have a strong relationship to health.

While research and policy-driven actions have been initiated in various fields to tackle a range of these challenges (eg affordable/ social housing strategies, urban forest strategies, active transport strategies), a systemic and transdisciplinary approach is often missing. As with other dynamic cities, Melbourne needs to identify its challenges (current and future) and find solutions to remain a liveable city. As the current 'Plan Melbourne'[9] points out:

Due to increasing uncertainty and complexity of urban systems there are no straightforward answers and actions that should be applied. The governance of cities is challenging, related to growing complexity across sectors, actors and policy instruments which can also lead to ineffective policies or unintended consequences. **Therefore, system thinking and collaboration is needed to cope with non-linear processes of actions and outcomes.**

This report provides insights into Melbourne's sustainability and health knowledge system to provide opportunities for new cross-sectoral and interdisciplinary collaboration. To do so, we seek to highlight the key actors involved in the knowledge system and the discussed topics, and based on these insights, potential areas/themes which would benefit from cross-sectoral and interdisciplinary and transdisciplinary cooperation.

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"TO REMAIN THE WORLD'S MOST LIVEABLE CITY, MELBOURNE MUST ADDRESS CHALLENGES AND CREATE OPPORTUNITIES."

2. MELBOURNE'S KNOWLEDGE SYSTEM ON SUSTAINABILITY AND HEALTH

Our explorative research, based on desktop research and expert insights, identified 90 Melbourne-based organisations (research groups and other institutions) which generate and distribute knowledge on sustainability and/or health related topics in Melbourne. These organizations (the full list can be found in Appendix 2) can be differentiated into 6 sectors:

1. RESEARCH INSTITUTES

2. PRIVATE SECTOR (CONSULTANCIES)

3. PUBLIC SECTOR

4. PHILANTHROPY

5. NOT-FOR-PROFIT

6. NGO

KEY FINDINGS

While a large number of Melbourne-based research institutions conduct research in specific fields, our screening of reports leads to the observation that interdisciplinary approaches are often missing. Similarly, our expert consultations confirmed that the interconnections between different academic disciplines are generally considered to be weak.

Experts pointed out that Melbourne's knowledge system would benefit from more intersectoral collaboration and transdisciplinary research to break down silos between disciplines but also within the public sector. Discussed were new mechanisms in the policy sphere to overcome siloed thinking within the public sector, and to better connect with private sector and academia in tackling wicked problems.

Furthermore, Melbourne's knowledge system is lacking demonstration projects, 'testbeds' where innovations can be applied, tested and evaluated, particularly projects which involve the 'end users' (eg tenants, energy consumers, cyclists). Research linkages between universities and public sector are often lacking or weak. Consulted experts suggested that more applied research on different areas of urban sustainability and health is needed to better inform urban planners and policy-makers about results and possible ways forward.

Experts suggest that Melbourne-based research and policy-makers need a more holistic understanding of urban sustainability and actions that brings together environmental, social, economic dimensions, and delivers co-beneficial outcomes. Melbourne's knowledge system needs to establish new ways of incorporating ongoing, interactive and cooperative research and results in urban planning and policy-making processes.

Even though there is wide agreement that comprehensive, integrated research is needed to cope with the health and sustainability challenges that Melbourne is facing, there are still challenges for researchers to receive funding for interdisciplinary and transdisciplinary projects through established public research funds in Australia (eg through the ARC). Mainstream research bodies still tend to favour discipline specific scholarship which may or may not have direct application to urban challenges. Therefore, there is an opportunity for philanthropic and charitable organisations to address these gaps and support new ways of initiative and knowledge production, sharing and translating.

3. THEMES

Based on the explorative analysis of 130 identified reports published within Melbourne's knowledge system on sustainability and health (see appendix 2) and through additional information gained by expert consultations, we identified nine key themes in the context of urban sustainability and health.

These themes, which will be highlighted and discussed in this report, are:

- Built environment/housing
- Climate change
- Energy
- Food
- Transport/mobility
- Urban green infrastructure
- Urban planning/governance
- Waste
- Water

The key goal was to identify the dominant topics and sub-topics around these nine themes and the exploration of connections between the nine themes, and identifying opportunities for new cross-themes which could help Melbourne to transition toward a more sustainable and healthy city.

The following chapters provide an overview of these nine themes and their dominant sub-themes, how these themes are already linked and, also, opportunities for further interconnectedness that potentially lead to co-benefits.

3.1   Built environment/housing

The built environment plays a key role in discussions around transitions to more sustainable and healthy cities.[10] Buildings and precincts are places where people mostly live, work and play. They have direct environmental impact, and influence economic, social and cultural processes. Therefore, the built environment is an area that demonstrates the intersection between numerous sectors such as energy, water, green infrastructure, food and waste.

Apart from ongoing housing affordability discussions in Melbourne, there are debates around the role of building in the context of climate change and zero-carbon energy transitions. There is a need for more context-specific knowledge about how the built environment could reduce environmental impact and carbon emissions, and create inclusive, healthy environments to live and work in.

Around one third of the final energy is consumed in buildings. Therefore, the Intergovernmental Panel on Climate Change (IPCC)[11] and the United Nations Environmental Program (UNEP)[12] specifically highlight the significance of buildings in the context of climate protection and energy efficiency.

Today, there is wide agreement that buildings should be affordable, inclusive and resource-efficient to minimise socio-economic pressures, health issues and ecological footprint. To decrease the environmental impact and increase healthy conditions in the building sector, an intersectoral and holistic sustainability understanding is needed.

Further, what is needed to lower buildings' ecological and climatic impact, is a combination of innovative urban planning and building designs as well as energy-efficient, environmentally friendly and non-health-threating materials. Buildings and precincts should be more integrative and socially inclusive to prevent socio-cultural and health challenges. Considerations of housing and the planning and management of communities have the potential to develop new models of living. Experimental, transdisciplinary projects are needed to test and evaluate new forms of low-carbon and socially inclusive living.

In Melbourne, a lot of research has been conducted in the diverse fields around housing and the built environment. The most recent and prominent example is the Cooperative Research Centre (CRC) for Low Carbon Living[13] which includes a number of Melbourne-based institutions. This CRC conducts research on a wide range of topics on building and precinct sustainability, with a special focus on energy efficiency, and technological and planning aspects.

The Australian Housing and Urban Research Institute (AHURI)[14] is conducting applied research on housing and urban planning policy. RMIT University's School of Property, Construction and Project Management[15] conducts research on socio-technical transition processes. The School of Design at the University of Melbourne[16] is looking at affordable and social housing, health, resilience and community engagement.

Fig. 1: Key themes in Melbourne's housing/built environment context

Community Engagement

Energy-Efficiency (Building Design)

Environmentally Friendly and Healthy Building Products

Social / Affordable Housing

Carbon Neutral Buildings / Communities

Financing, New Business Models

Urban Planning

Loneliness and Mental Health

Housing / Built Environment

[10] IEA/OECD 2013. Transition to sustainable buildings: Strategies and opportunities to 2050. Paris. Fastenrath, S., Braun, B. (2018). Sustainability transition pathways in the building sector: Energy-efficient building in Freiburg (Germany). Applied Geography, 90, 339–349.
[11] IPCC. https://www.ipcc.ch/report/ar5/wg3/buildings/

[12] UNEP. https://www.unenvironment.org/explore-topics/resource-efficiency/what-we-do/cities/sustainable-buildings
[13] CRC Low Carbon Living http://lowcarbonlivingcrc.com.au/research/program-1-integrated-building-systems

[14] AHURI https://www.ahuri.edu.au/
[15] https://www.rmit.edu.au/about/our-education/academic-schools/property-construction-and-project-management
[16] https://msd.unimelb.edu.au/research/directions/healthy-communities-and-infrastructure

3.2 Climate change

The IPCC, a scientific body of the United Nations, predicts the effects of climate change worsening over the next few decades. This has spurred research in understanding the implications of temperature changes across the globe, and proposing mitigation strategies.[17] Because Melbourne is situated in a coastal region, it has the additional security threat of sea-level rises.[18]

Climate change adaptation is mentioned often in the international context, and also features in this ecosystem scan for public reports related to Melbourne. The institutions that undertake research on climate change are varied, from government departments such as the EPA, DELWP and City of Melbourne through to research organisations such as the CSIRO, ClimateWorks Australia and the Australia Institute.
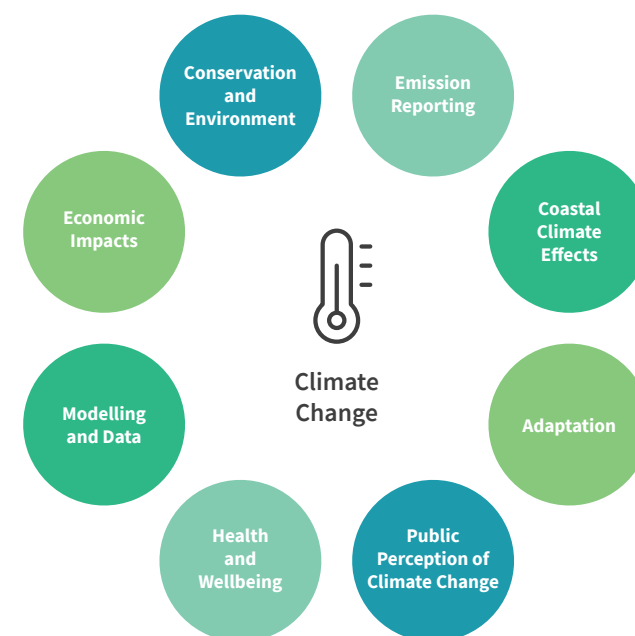
Climate change research relating to Melbourne is largely based on modelling and tracking climate conditions. The studies are technical in nature and predominantly undertaken by either the CSIRO or the Bureau of Meteorology. While much of the research is still centered on longitudinal measurement of climate change data, there is a significant amount of research that moves into adaptive strategies for cities such as Melbourne.

A special role has been played by the Victorian Centre for Climate Change Adaptation Research (VCCCAR)[19] which brought together a wide range of Melbourne-based researchers from different disciplines and the public sector. Furthermore, organisations such as C40[20] and ICLEI[21] have guided the City of Melbourne on work on climate change adaptation over the last couple of years. Experts suggested the need for even more effective internationalisation mechanisms between major international programmers and Melbourne.

Other research areas of note include:

- Public perceptions of climate change (periodically undertaken by the Australia Institute to gauge public attitudes on the issue)
- The effect of climate change upon people's health
- Climate change effects on Coastal areas such as Melbourne
- Emission reporting and tracking
- The effect of climate change upon the environment and ecosystem.

Fig. 2: Key themes in Melbourne's climate change context

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[17] IPCC. https://www.ipcc.ch/reports/

[18] Melbourne Water 2017. Planning for Sea Level Rise Guidelines. https://www.melbournewater.com.au/sites/default/files/Planning-for-sea-levels.pdf

[19] VCCCAR 2019. http://www.vcccar.org.au/

[20] C40. https://www.c40.org/cities/melbourne

[21] ICLEI https://www.icleioceania.org/

3.3   Energy

Research on energy in the context of Melbourne focuses upon the analysis of existing energy sources, with reference to future sustainability and demand, while also further exploring alternative future energy options.[22] Publications from the City of Melbourne provide 'how-to' guides for developers and designers to ensure energy sustainability in practice[23], while other state and federal government departments assess the current energy market and outlook.

Research institutes within universities instead consider future opportunities in alternative energy sources such as geothermal, hydro and wearable solar. These have been further explored and tested to determine viability in practice.
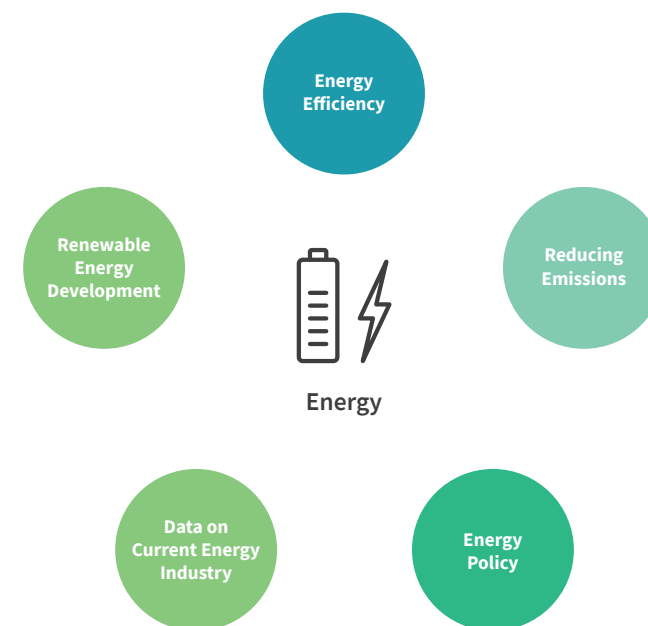
Together with the technical research, many publicly available reports also focus upon policy mechanisms to encourage emission reduction in the energy sector while also considering the impact of the cost of energy prices on consumers.[24]

In an interdisciplinary approach, research is also shifting toward the promotion of adopting electric and low-emission vehicles.

Some of the reports, such as those put forward by the Electric Vehicle Council together with Monash University's Climate Works Australia[25], explores the level of take up of electric vehicles, and its impact on the electricity grid. Further studies are undertaken to determine solutions to the electricity issue if electric vehicles were taken up in large numbers.

In addition to these areas, other research areas of note include the economics of energy policies, alternative energy solutions and energy security. The fiscal impacts on households due to the fluctuating electricity market is a highly discussed issue in the media, leading to the politicisation of the issue. Furthermore, the social and political reverberations of sudden changes, such as the closure of Hazelwood Power Station in Victoria, have prompted a look into the question of energy security, especially in light of the disruption of electricity in South Australia in 2017. Therefore, studies of smart grids, energy distribution and energy regulation in Victoria are also reflected in current publicly-available research.

Fig. 3: Key themes in Melbourne's energy context

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[22] For example work at the Energy Institute, https://energy.unimelb.edu.au/#research or the Climate and Energy College, http://climatecollege.unimelb.edu.au/publications, both University of Melbourne
[23] https://www.melbourne.vic.gov.au/building-and-development/sustainable-building/Pages/sustainable-building.aspx

[24] Melbourne Sustainable Society Institute on energy transitions. https://sustainable.unimelb.edu.au/research/research-projects/australian-coal-transitions-research-and-dialogue-on-the-future-of-coal
[25] https://www.climateworksaustralia.org/

3.4   Food

For around ten years, projects and research have focused on different aspects of food production and consumption in Melbourne. Food security, food supply, food systems, healthy nutrition, food waste, food policy and interactions with economic and social aspects are core issues around food research in Melbourne.

VicHealth, the City of Melbourne and the LMCF have funded a number of projects at Deakin University and the University of Melbourne over the last couple of years. Especially, the Victorian Eco Innovation Lab (VEIL), at the University of Melbourne, who conducted a number of projects around Melbourne's food sector[26].

Projects such as Foodprint Melbourne[27] have analysed a variety of aspects, including the locations of food production at the urban fringe and their interrelation to the city. Questions of how food production is embedded in systems of land use, water, energy and the environmental impact through food waste and greenhouse gas (GHG) emissions have been assessed. This Foodprint assessment estimated how much land, water and energy is required to feed Melbourne, and the amount of GHG emissions and waste generated.

Based on that produced knowledge, the project is modelling policy actions and interventions to protect food security in the face of environmental sustainability challenges. It also generated data about Australian diets and the impacts of environmental challenges to Australia's food supply.

Fig. 4: Key themes in Melbourne's food context

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[26] https://veil.msd.unimelb.edu.au/
[27] https://research.unimelb.edu.au/foodprint-melbourne/home

3.5   Transport/Mobility

Transport planning in Melbourne represents a highly politicised arena within which the State Government and local councils play a key role. As Melbourne's urban growth boundary continues to expand, and the population increases, it is of no surprise that road congestion becomes a key issue in politics. Exploring the reports and literature available, it is clear that researchers and strategists are exploring alternative methods to ensure that citizens are able to effectively make their way around the city efficiently and economically.

Two of the largest themes in the publicly available research center on ways of encouraging alternative forms of transport, and tackling road congestion, a notable outcome of the politicisation of the issue. Both of these sub-topics are closely connected, even if they do take differing approaches to combat the same issue.
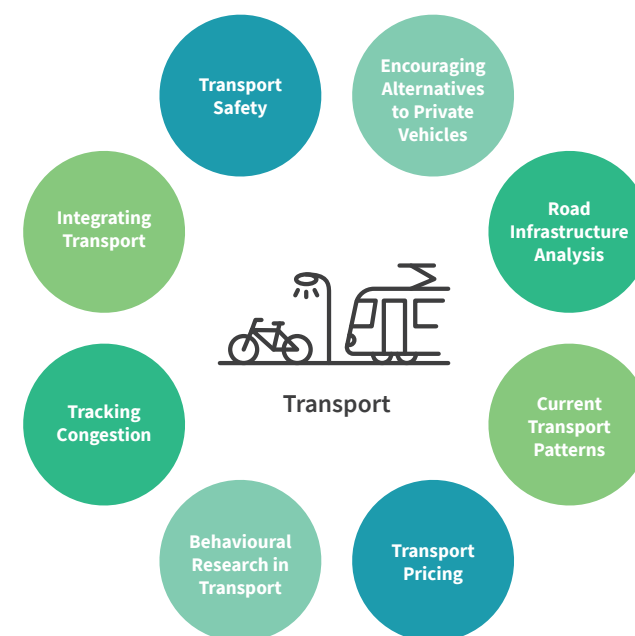
Understanding behavioural elements of decision making in the community, with regard to both choosing public transport options is also a topic that is explored well within the Melbourne context. This rides in tandem with understanding perceptions of personal safety while en route. Data-based reporting is also included in the work already completed, in particular assessing existing

transport patterns and also undertaking road infrastructure analyses. As part of the CRC on low-carbon living, The Transport, Health and Urban Design Research Hub (THUD)[28] at the University of Melbourne, provides a Co-Benefits Calculator[29] that provides information about the interplay of transport and health in Melbourne. A final research area of note is the research undertaken on low emission vehicles, in particular in encouraging and implementing their use in cities.

Opportunities for Melbourne can be found in the fast approaching digitalisation processes in transport and mobility. Mobile phone apps are promising tools in transforming the usage of urban public transport and active transport. However, little is known about the interactions of users with these new technologies and its effects. Applied research is lacking on the social, economic and environmental implications of mobile phone apps which are increasingly used to find various modes of transportation or are used to organise car-sharing.

Furthermore, as experts in this field explained, the role of urban planning in increasing inclusiveness and accessibility of public transport are important issues in Melbourne that need further investigation.

Fig. 8: Key themes in Melbourne's transport/mobility

Transport Safety

Encouraging Alternatives to Private Vehicles

Road Infrastructure Analysis

Integrating Transport

Current Transport Patterns

Tracking Congestion

Transport Pricing

Behavioural Research in Transport

Transport

[28] https://thud.msd.unimelb.edu.au/home#projects
[29] https://thud.msd.unimelb.edu.au/tools-and-models/compact-cities

3.6   Urban green infrastructure

Over the last few years, greener urban environments have, globally, become a key topic for researchers and policy-makers. There is increasing evidence that 'nature-based solutions' in its various forms (forests, parks, gardening, plants on balconies and rooftops, green facades, sporting facilities) have a significant impact on the urban environment, health and wellbeing, and economic development.[30]

Particularly, increased tree canopy is seen as a great potential to tackle a number of environmental and social challenges in city contexts. Urban forests provide temperature regulation, air quality improvements and greenhouse gas reduction, and can maintain or increase biodiversity.

Furthermore, greener urban environments can help to improve physical and mental health through better air quality and reduced noise, by providing infrastructure for recreational activities and active transport, and reducing heat stress.

Investments in urban greening can also create economic benefits. Reduced temperatures in community areas can lead to lower energy costs and reduced costs for public health services. Cleaner air and green spaces can lead to increased physical activities which then can result in a lower number of physical and mental diseases. Trees and soils can store water during extreme weather events. This could save costs for investment in new or maintaining classical stormwater infrastructure. Furthermore, greening can increase property values and the attractiveness for tourists.

For almost ten years, initiatives in Melbourne have sought to increase Melbourne's greening. Supporting measures to green the city is a growing range of stakeholders – from grassroots movements[31], to local governments[32] and state government authorities. Research has been conducted by the Clean Air and Urban Landscapes Hub (CAUL)[33] which consists of researchers from the University of Melbourne and RMIT. With a focus on greening and air quality, the goal of the Hub is to take a holistic view on the sustainability and livability of urban environments.

In the public sector, alliances of local councils have been driving greening processes for years. However, the City of Melbourne plays a key role in knowledge generation and sharing and providing platforms for engagement. Most recently the Resilient Melbourne Strategy has developed a metropolitan wide greening strategy, called Living Melbourne[34].

Fig. 5: Key themes in Melbourne's urban green infrastructure context

[30] Kabisch, N., N. Frantzeskaki, S. Pauleit, S. Naumann, M. Davis, M. Artmann, D. Haase, S. Knapp, H. Korn, J. Stadler, K. Zaunberger, and A. Bonn. 2016. Nature-based solutions to climate change mitigation and adaptation in urban areas: perspectives on indicators, knowledge gaps, barriers, and opportunities for action. Ecology and Society 21(2):39.

Kabisch N., Korn H., Stadler J., Bonn A. (eds) 2017. Nature-Based Solutions to Climate Change Adaptation in Urban Areas. Theory and Practice of Urban Sustainability Transitions. Springer, Cham
[31] https://greeningthewest.org.au/
[32] https://www.melbourne.vic.gov.au/community/parks-open-spaces/urban-forest/Pages/urban-

forest-strategy.aspx
[33] CAUL, https://nespurban.edu.au/
[34] https://resilientmelbourne.com.au/living-melbourne/

3.7   Urban planning/governance

Cities are seen as important arenas for addressing and acting on sustainability-related topics.

Urban planning decisions and governance play a crucial role in the day-to-day business of city-making and, also, in transitioning cities, particularly in triggering ideas and actions toward more sustainable and healthy environments.[35] Local governments are increasingly seen as key players for transformational change by influencing, initiating and coordinating actions in environmental, social and economic contexts[36].

Policy decisions have direct impact on infrastructure (energy, water, transport, green), housing and other built environments, and other land uses. Therefore, in this era of quickly changing city contexts and environments, as well as mounting uncertainty, the role of policy-making and urban governance is more important than ever before.

The urgent challenges cities face today – such as climate change, ongoing environmental degradation, increasing societal disadvantages, and economic issues – call for innovative urban governance.

The public sector needs to find ways to break down silos within their various departments and better collaborate with academics and the private sector. Alternative models of policy-making and urban governance are required that are based on cooperation and an open understanding of innovation as a process consisting of more than new technologies.

Reports such as the 'Creating Liveable Cities in Australia' (2017)[37], co-developed by RMIT and ACU highlight the role of policy-making in supporting cities transitioning in areas such as transport, green space, housing, employment and food.

UNDERSTANDING THE ROLE OF MELBOURNE'S CITY NETWORKS AS INNOVATIVE TRANSFORMATIONAL GOVERNANCE

Melbourne is part of 16 international city networks such as ICLEI, C40 and 100 Resilient Cities (100RC). These networks support cities to find and implement solutions for urgent and future challenges[38]. This new approach to urban planning and governance, often initiated by philanthropic organisations, can be seen as new governance approaches which seek to catalyse transformational change through collaboration and co-design in contexts such as mobility, energy, green space or housing.

In Melbourne, the Resilient Melbourne initiative[39], as part of 100RC, is the most prominent example. Based on a strategy released in 2016, numerous actions have been implemented to tackle a wide range of context-specific challenges outlined as 'chronic stresses' and 'acute shocks'. The Metropolitan Urban Forest Strategy demonstrates a new governance approach, bringing together stakeholders from public, private and academic sectors and following open-ended and processual thinking.[40]

[35] UN (2015). United Nations. Transforming our world: the 2030 Agenda for Sustainable Development. Available online: http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E
Frantzeskaki, N., Castán Broto, V., Loorbach, D., & Coenen, L. (2017). Urban Sustainability Transitions. New York: Routledge.
Moore, T., de Haan, F., Horne, R., & Gleeson, B. J. (2018). Urban Sustainability Transitions: Australian Cases- International Perspectives. In T. Moore, F. de Haan, R. Horne, & B. J. Gleeson (Eds.). Singapore: Springer Singapore.

[36] Bulkeley, H., & Castán Broto, V. (2013). Government by experiment? Global cities and the governing of climate change. Transactions of the Institute of British Geographers, 38, 361-375.
Bulkeley, H., Castán Broto, V., Maassen, A. Governing urban low carbon transition. In Cities and Low Carbon Transition; Bulkeley, H., Castán Broto, V., Hodson, M., Marvin, S., Eds.; Routledge: Abingdon, VA, USA, 2011.
[37] http://cur.org.au/project/national-liveability-report/
[38] Davidson, K., Gleeson, B. 2017. New Socio-ecological Imperatives for Cities: Possibilities and Dilemmas for Australian Metropolitan Governance. Urban Policy Res., 36, 230–241.

Smeds, E., Acuto, M. 2018. Networking Cities after Paris: Weighing the Ambition Urban Climate Change Experimentation. Glob. Policy, 4, 549–559.
[39] Resilient Melbourne. https://resilientmelbourne.com.au/
[40] Fastenrath, S. Coenen, L. Davidson, K. 2019. Urban Resilience in Action: the Resilient Melbourne Strategy as Transformative Urban Innovation Policy?. Sustainability. 11, 693.

The goal of this action and the other Resilient Melbourne Strategy actions is to tackle challenges with consideration of co-benefits. In this case, the Urban Forest Strategy seeks to develop a metropolitan-wide approach to increase the city's tree canopy and overall vegetation by linking existing urban green infrastructure initiatives, reforestation and other environmental initiatives. This urban greening approach is linked to multiple goals and expected co-benefits: increasing biodiversity; reducing hazards such as heatwaves and flooding; and increasing physical and mental health.

Research on urban resilience as a new governance approach has been initiated by the City of Melbourne Chair in Resilient Cities at the Melbourne Sustainable Society Institute (University of Melbourne) as well as researchers from RMIT, Monash University and other research institutions. The recently initiated Connected Cities Lab[41] at the University of Melbourne will also explore topics around urban governance.

However, little is still known about how urban resilience strategies are implemented in practice and how urban planning in Melbourne can benefit from these activities. More embedded research on the implementation processes of the Resilient Melbourne Strategy would provide a great opportunity to learn from this promising but highly contested concept. Furthermore, a research focus on learning processes within cities through the platforms of the city networks, and also between cities, is necessary to further understand city networks as a transformational governance approach.

Experts articulated opportunities in further understanding the role of city networks in transitioning Melbourne toward more sustainable and resilient outcomes. One concrete example could be the Resilient Melbourne initiative which would benefit from further guidance through applied, interactive, and interdisciplinary research. Such collaborative research can help identify and showcase new ways of governance that explicitly include the cooperation between public and private sectors and academia.

Fig. 6: Key themes in Melbourne's urban planning/governance context

Urban Planning / Governance — Transport, Participatory Planning, City Networks, Urban Resilience, Urban Health and Wellbeing, Infrastructure Planning, Housing, Homelessness

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[41] Connected City Lab. https://msd.unimelb.edu.au/connected-cities-lab

3.8   Waste

The management of waste has presented an ongoing and increasingly salient issue in Melbourne. Media articles have recently reported landfill sites of nearby states reaching peak capacity[42], prompting a question regarding the extent to which Melbourne, and Victoria, can effectively manage its waste to avoid a similar situation. These approaches consider changing consumer behavior, such as curbing the ongoing trend of fast fashion, resulting in lower loads sent to landfill each year. Another approach then considers whether the waste can present an opportunity for harvesting to be used for other purposes through either recycling, or resource recovery.

As a result, the research surrounding waste revolves around three key themes: its management, resource recovery and recycling. There are few reports that are relevant to the Melbourne context while also being readily available to the public. For this reason, there may be sufficient scope to undertake further research into the area of waste. Much of the research initialises predominately from government departments, not from research institutes (there is one report from CSIRO that is available).

Waste to energy facilities are popular at the moment, and they involve undertaking projects that harness energy from waste by-products, such as Methane, to convert into usable energy elsewhere. There are few waste-to-energy facilities in Melbourne[43] which serve to divert a substantial amount of waste away from landfill.

Opportunities exist in the field of waste management, and especially understanding the impact within supply chains. Through highlighting issues within a supply chain, an organisation can more readily take steps in sustainable practices rather than offloading the issue to suppliers further down the chain.

As Melbourne has developed a stronger culture of recycling, there still exists a gap in knowledge in understanding recycling practices of consumers. Furthermore, promoting behavior change in this area through understanding could provide a pathway for governments and local decision makers to promote better recycling practices.

Fig. 9: Key themes in Melbourne's waste context

[42] https://www.abc.net.au/news/2018-03-17/waste-could-become-fuel-source-in-big-australias-future/9550082
[43] e.g. Yarra Valley Water. https://www.yvw.com.au/help-advice/waste-energy

3.9   Water

The majority of publicly-available recent research in the water sector in Melbourne has been undertaken by Monash University research lab Water Sensitive Cities CRC.[44] Focusing predominantly on issues of urban water resilience and its subsequent management, the water literature relating to Melbourne is extensive.

Other research labs, such as those at RMIT and the University of Melbourne, have stated projects that fall under this theme, however are not publicly available at this stage. Fig. 7 highlights the major themes in the literature.

Management of stormwater, groundwater and flooding issues is the area that is most concentrated upon in the water literature, which is also closely linked to research centered on scenario predictions on rainfall and Water Sensitive Urban Design (WSUD). [45]

All of these elements propose management approaches to ideal ways of harnessing and distributing water sources. These management approaches are then backed by economic analyses undertaken to highlight and explore any fiscal barriers associated with alternative

water approaches, proposing an ideal mix of water sources that is most economically feasible.[46]

The economic analysis also considers what users would be willing to pay for alternative water systems, such as stormwater harvesting and sewer mining to produce recycled water.[47] Water treatment research has also been undertaken extensively in this field, highlighting many alternative treatment options to reduce the demand for potable water sourced from above ground storages.[48] In order to implement many of these well-researched practices in water treatment, further economic analysis has been completed to test its viability in conjunction with research on statutory planning practices.[49]

Finally, research in water has moved away from purely technical issues, but towards social-based questions. Ways of encouraging higher water literacy among the community, combined with further understanding of cultural uses of water provides the pathway to the adoption of water projects that are not only technically possible, but also accepted by the community.[50]

As discussed in the previous section, much research has been undertaken in the water resource space in Melbourne. Data collection systems and planning scenarios have been particularly well done, in addition to a considerable increase in understanding groundwater and stormwater systems in an urban setting.

There are nevertheless a number of opportunities for further research in water. The first is the consideration of cyber risks in water security in Melbourne. As water control systems increasingly become digitised and remotely controlled, it presents a risk to potentially malicious actors gaining access to vital water system controls. Understanding these risks, while also enacting suitable mitigation measures helps to create a safe, more secure water supply for the city.

In addition to this, there is much energy use in the water sector through the use of pumps, treatment plants and general controls. A gap in the research exists in understanding the optimal economic energy usage in planning of water systems, to ensure that it is more sustainable, while also ensuring ongoing security.

44 Monash University research lab Water Sensitive Cities CRC. https://www.monash.edu/mada/research/labs/monash-urban-lab/water-sensitive-cities
45 Melbourne Water. https://www.melbournewater.com.au/planning-and-building/stormwater-management/introduction-wsud
46 Pannell, D. "Review of existing Benefit: Cost Analysis (BCA) tools relevant to water-sensitive cities," 2017. CRC for Water Sensitive Cities. Accessed via: https://watersensitivecities.org.au/wp-content/uploads/2017/12/WP3.1-Milestone-Report.-Review-of-existing-BCA-tool_FINAL.pdf

47 Leonard, R., Iftekhar,S., Green, M and Walton, A. (2018). Community perceptions of the implementation and adoption of WSUD for stormwater systems. In: Approaches to Water Sensitive Urban Design. Chapter 24.
48 Grant, S. B., Saphores, J., Feldman, D. L., Hamilton, A. J., Fletcher, T. D., Cook, P. L. M., Stewardson, M., Sanders, B. F., Levin, L. A., Ambrose, R. F., Deletic, A., Brown, R. R., Jiang, S. C., Rosso, D., Cooper, W. J. and Marusic, I. (2012). Taking the "waste" out of "wastewater" for human water security and ecosystem sustainability. Science, 337(6095), pp. 681-686.

Zhang, K., Deletic, A., Page, D. and McCarthy, D. T. (2015). Validation framework for water-sensitive urban design treatment systems. Water: Journal of the Australian Water Association, 42(6), pp. 70-73.
49 Choi, L and McIlrath, B (2017) Policy Framework for Water Sensitive Urban Design in 5 Australian Cities. Melbourne, Australia: Cooperative Research Centre for Water Sensitive Cities.
50 Lindsay, J. (2014). Changing water cultures to achieve water sensitive cities: The importance of communities and households. In: XVIII ISA World Congress of Sociology: Facing an unequal world: Challenges for global sociology, 13-19 July, Yokohama, Japan.

There is a clear distinction between the management of stormwater and groundwater (a council issue) and the management of other water systems (water authorities). However, there are a number of schemes proposed that could incorporate both of these areas to reduce the amount of potable water use. This presents a governance problem, as understanding how two entities can interact to achieve a common goal, especially surrounding differing approval mechanisms is an area that should be further explored.

Water treatment systems have an impact (at times positive, at other times negative) on the ecology of waterways within Melbourne. A research gap exists in highlighting the ecological literacy of those operating and planning treatment plant systems, to ensure the understanding of ecological impact among decision makers in this area.

Finally, another potential area of exploration exists in developing a terminology of sustainable water design. There are many ways of describing this practice that ranges from creating a 'Water Sensitive City' to 'Sustainable Urban Water Management' and many others. A shared lexicon would provide unified understanding of a problem, furthering discussion in water planning.

Fig. 7: Key themes in Melbourne's water context
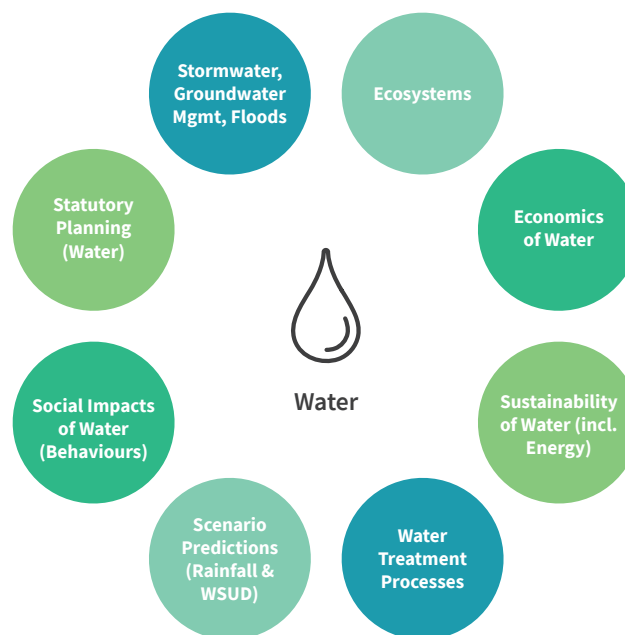
4. OPPORTUNITIES

Our explorative assessment of Melbourne's knowledge system in the context of sustainability and health identified a number of opportunities to create positive environmental and social change through new impactful research endeavours and support of new forms of collaboration across a variety of sectors.

The assessment of Melbourne's knowledge system shows that there are undoubtedly opportunities for more integrated, cross-sectoral knowledge creation and sharing. More collaborative governance approaches are needed that bring better together stakeholders from public, private and academic sectors to tackle Melbourne's sustainability and health challenges. Interdisciplinary and applied research could help to break down silos between researchers and within public sectors, and to find innovative ways of initiating new project approaches.

Particularly policy-relevant demonstration projects could help to test and showcase innovations (technologies, policies, infrastructure, business models) in transitioning to more sustainable and healthier outcomes. Melbourne-specific and evidence-based urban planning and governance approaches in various fields related to sustainability and health (eg housing,

transport, urban greening) could help to overcome the lack of cross-sectoral cooperation.

Experimental governance approaches in the public sector which seek to foster cooperative projects with stakeholders from academia and private sector are needed to identify challenges and solutions for Melbourne. Intermediaries such as Resilient Melbourne play an important role in bringing together public and private sector, and academia to translate knowledge into action.

Other promising approaches to foster experimentation in urban contexts are so called Urban Living Labs in which new actor constellations can emerge to design, test and learn from social and technological innovations in real time.[51] These new forms of urban governance can be understood as arenas for change and spaces for collaborative experimentation including new actor constellations between local government, academia, consultancy, artists, cultural festivals, business and entrepreneurs or NGOs.

However, little is known about how demonstration projects generate output (eg formation of new visions or the integration of formerly isolated perspectives) and how output can be

reproduced and embedded in new contexts, for example within the metropolitan scale of Melbourne. Therefore, producing a collation of examples (best practice and challenges) of completed projects would help to overcome the lack of knowledge and enable Melbourne to drive and scale up experimental approaches.

Based on our insights, we identified knowledge gaps and disconnections between many themes. These gaps were identified through the scanning of the identified reports and through the insights from experts. Based on our insights, we identified knowledge gaps and disconnections between many themes. We developed a matrix (see Appendix 3) that visualises the thematic connections between these themes. As a result, we identified four promising future clusters of themes in supporting Melbourne's sustainability and health transitions:

• Sustainable and healthy built environments
• Urban greening for a cooler and more active city
• Healthier and sustainable urban food systems
• Digitalisation as a driver of urban sustainability and health

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[51] Marvin, S. (Ed.), Bulkeley, H. (Ed.), Mai, L. (Ed.), McCormick, K. (Ed.), Voytenko Palgan, Y. (Ed.). (2018). Urban Living Labs. London: Routledge

Handbook Urban Living Labs. McCormick, K. & Hartmann, C. http://lup.lub.lu.se/search/ws/files/27224276/Urban_Living_Labs_Handbook.pdf

4.1   Sustainable and healthy built environments

NEW WAYS OF DEVELOPING BUILDING PROJECTS AND
NEIGHBOURHOODS THAT BRING TOGETHER DIFFERENT
FUNCTIONS, SECTORS AND PRINCIPLES OF RESOURCE-
EFFICIENT BUILDING AND AFFORDABLE/SOCIAL HOUSING,
INTEGRATING RENEWABLE ENERGY, AND URBAN PLANNING.

There are opportunities to integrate the physical and socio-
economic elements of housing in future projects. Approaches
that bring together functions of (low carbon) living, recreation,
food production, working, gardening and health services are
rare. Demonstration projects would be particularly well-suited
to generate practice-relevant knowledge that cuts across these
different domains.

Buildings are large consumers of energy and building materials,
they influence the indoor environment through building design
and technologies. Indoor air and light quality have great impact
on our health. Furthermore, buildings are places of economic
development and employment.

The following list provides an overview of possible topics that
are linked to buildings or precinct projects and need further
consideration in future projects:

BUILDING-RELATED ASPECTS

- Retrofitting of existing buildings
- Green roofs and facades
- Urban gardening
- Prefabricated buildings
- Smart-grid
- Temporary modular buildings
- Net-zero neighbourhoods

SOCIAL ASPECTS

- Affordable housing for vulnerable groups
- Participatory planning
- Elderly, intergenerational living
- Resilience-building through community engagement
- Integration of living and working (co-working spaces)
- Linking medical and educational services in the building/
  precinct development for deprived population
- Testing models of non-for-profit developers

To initiate innovative projects, stakeholders from academia,
public and private sector are needed to collaborate. To inform
urban planners and policy makers, knowledge needs to be
gained through demonstration projects and shared about
environmental, social, health and economic co-benefits.

4.2   Urban greening for a cooler and more active city

**NEW WAYS OF PROVIDING GREEN INFRASTRUCTURE
WHICH BRING TOGETHER ASPECTS OF ACTIVE
TRANSPORT, RECREATION AND WATER MANAGEMENT.**

Metropolitan Melbourne can lead the way in tackling a number
of environmental and health challenges by developing and
scaling up actions to increase the city's green infrastructure.
Urban greening (ie forests, parks, sport fields and wetlands) is
an important part of the urban ecosystem. Green space creates
places for physical activity and relaxation, and protection from
noise. Plants produce oxygen, help to reduce air pollution and
reduce greenhouse gas emissions. Urban forests, parks and
gardens play a critical role in cooling cities as well as community
interaction. Furthermore, green infrastructure can provide
safer spaces for active transport such as walking and cycling,
thus reducing congestion on streets. So, green infrastructure
can reduce the city's exposures during extreme weather events
such as heat waves, flooding and droughts. It can also improve
physical and mental health and well-being and provide the
opportunity to integrate infrastructure for active transport.

There is a strong opportunity to further understand and actively
drive the urban green–mobility–water nexus through collaborative
research that involves the public and private sectors. In the context
of manifest climate change, this prospective theme holds abundant
potential to further develop Melbourne toward a more sustainable
and healthier city.

New policy mechanisms are needed that inform and encourage
both public and private land owners to maintain and extend urban
green through government provision and incentives.

More demonstration projects and empirical research are needed
to further translate knowledge to policy-makers. Special attention
is needed to understand the challenges and barriers in providing
more urban green and connecting urban greening projects for the
whole city region.
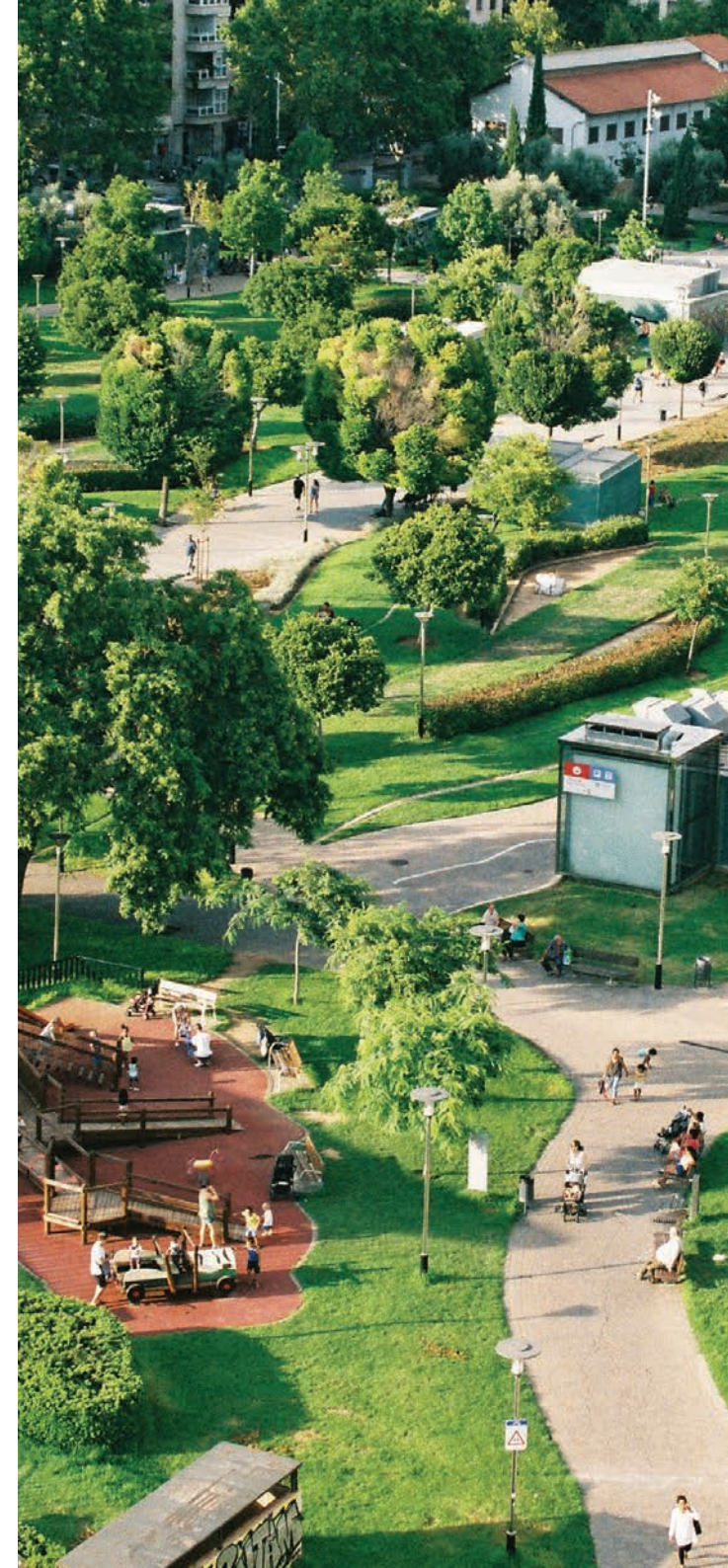
4.3   Healthy and resilient urban food systems

NEW WAYS OF PRODUCTION, CONSUMPTION AND RECYCLING IN HEALTHY, SUSTAINABLE AND RESILIENT FOOD SYSTEMS.

Food production, consumption and recycling are closely related to aspects around water, energy and health. Food production relies on suitable land for farming around the city, and requires access to water, energy and transport infrastructure. Food consumption is closely related to health issues: obesity and overweight, cancers, diabetes and cardiovascular diseases can be linked to unbalanced nutrition, often based on high-sugar and saturated-fat consumption. Food waste is then eventually recycled at landfills.

In times of continual urban growth, declining farm land and increasing food waste, transformational change is needed in these complex food systems. There are opportunities to bring together a number of issues around food production and consumption, and build up resilience of existing urban food systems. More knowledge is needed to understand the environmental, social and economic impacts and benefits through potential changes of food systems.

Improved understanding of the underlying mechanisms of the food–water–energy–waste nexus would potentially create multiple environmental, social and economic co-benefits. There

are opportunities for interventions from further evidence-based knowledge through experimental demonstration projects led by a wide range of stakeholders from academia and the public and private sectors.

There is a lack of research on how food systems are connected to and embedded in urban and regional sustainability and resilience strategies. This is linked to the question of what kind of policy interventions are needed to change single or interlinked components. In this context, an urgent question needing addressing is how food waste could be avoided and better recycled.

Interdisciplinary research that combines science and social science is needed to further investigate the interrelations between environmental aspects and socio-cultural and economic aspects of the complexities of Melbourne's food system.

National and international comparative case-study research could also help to understand learning processes and the role urban planning can play in building resilience to environmental, social and economic challenges. To develop more sustainable, healthy and resilient food systems in Melbourne, innovative approaches need to be tested and evaluated.

4.4   Digitalisation as a driver of urban sustainability and health

NEW WAYS OF INTEGRATING TECHNOLOGIES AND DATA INTO SUSTAINABLE AND HEALTHY CITY-SHAPING.

As indicated in several thematic sections of this report, digitalisation is already playing a crucial role in city-making processes. Data and new technologies function as drivers of change in sectors such as transport where data on traffic flows and congestions helps urban planners in decision-making. Transport becomes more flexible and heterogenous through multimodal systems that includes new ways such as car-sharing. Information and communication technologies, 'Big Data' and 'Open Data' as well as social media, offer opportunities to create transparent, socially just transition processes. Data, algorithms and new technologies increasingly disrupt our lives by shaping the way we travel, use energy, and work.

On the other hand, digitalisation carries risks such as the increased vulnerability of urban infrastructure (eg water, energy) through 'cyber crime' as well as through an increasing vulnerability to technological glitches and hazards. Furthermore, aspects of social exclusion are critically debated in the context of urban digitalisation, with many international commentators and initiatives lamenting the unequal bases of the 'smart city' revolution and its accountability limits.

Therefore, key questions for Melbourne and other cities are:

How can digitalisation contribute to sustainable and healthy urban development in an inclusive way? What are the risks and who manages these? How can digital inclusion in the sustainable city succeed? How can digital participation be promoted? How is better and more accurate information mobilised effectively to inform urban development and planning?

There are strong prospects to further explore and assess how urban sustainability and health can benefit from the digital age. Applied and transdisciplinary research is needed to understand the social, economic and environmental implications of the ongoing digitalisation of cities. A promising field is the use of mobile phone apps and their potential to influence the transition toward sustainable and healthy cities. For example, more and more people use mobile phone apps to find alternative ways of transportation, including car-sharing or car-pooling.

Mobile phone apps are promising tools to reduce traffic congestion and carbon emissions, and increase the health and wellbeing of citizens. Apps are seen as an approach to convince people to increase their travel on foot, by bike or public transport and, thus, positively influence their health and reduce congestion and greenhouse gas emissions. New models of rewards are needed that include new stakeholders such as health insurance companies, local businesses and local governments. A current example is the winning app of the 'Citymart Challenge' run by the Resilient Melbourne initiative. Innovators were invited to submit conceptual ideas to reduce traffic congestion and improve health and social connectivity.

Appendix 1: Identified organisations as part of Melbourne's knowledge system

INSTITUTES AT MELBOURNE'S UNIVERSITIES	
INSTITUTE/RESEARCH UNIT	**ORGANISATION**
ARC CENTER OF EXCELLENCE FOR ENVIRONMENTAL DECISION (CEED)	The University of Melbourne, Royal Melbourne Institute of Technology (RMIT)
ARC FOR CLIMATE SYSTEM SCIENCE	The University of Melbourne, Monash University
AUSTRALIAN HOUSING AND URBAN RESEARCH INSTITUTE (AHURI)	RMIT
AUSTRALIAN URBAN RESEARCH INFRASTRUCTURE NETWORK (AURIN)	The University of Melbourne
CENTRE FOR CONSTRUCTION WORK HEALTH AND SAFETY RESEARCH	RMIT
CENTRE FOR DEVELOPMENTAL DISABILITY HEALTH VICTORIA	Monash University
CENTRE FOR ENVIRONMENTAL SUSTAINABILITY AND REMEDIATION (ENSURE)	RMIT
CENTRE FOR FRESHWATER ECOSYSTEMS	La Trobe University
CENTRE FOR HEALTH ECONOMICS	Monash University
CENTRE FOR HEALTH EQUITY	The University of Melbourne
CENTRE FOR HEALTH POLICY	The University of Melbourne
CENTRE FOR HEALTH THROUGH ACTION ON SOCIAL EXCLUSION	Deakin University
CENTRE FOR POPULATION HEALTH RESEARCH	Deakin University
CENTRE FOR RESOURCES, ENERGY AND ENVIRONMENTAL LAW (CREEL)	The University of Melbourne
CENTRE FOR URBAN RESEARCH	RMIT
CENTRE FOR YOUTH MENTAL HEALTH	The University of Melbourne
CLEAN AIR AND URBAN LANDSCAPES HUB (CAUL)	The University of Melbourne/RMIT
CLIMATE AND ENERGY COLLEGE	The University of Melbourne
CRC FOR LOW CARBON LIVING	Swinburn University, The University of Melbourne, City of Melbourne, Sustainability Victoria
FOOD POLICY RESEARCH GROUP	The University of Melbourne
FOOD RESEARCH AND INNOVATION CENTRE	RMIT
FOODPRINT MELBOURNE	The University of Melbourne
HEALTH NATURE AND SUSTAINABILITY RESEARCH GROUP (HNSRG)	Deakin University

HEALTHY LIVEABLE CITIES GROUP	RMIT
HYDROLOGY AND WATER RESOURCES LAB	The University of Melbourne
INSTITUTE FOR SUSTAINABILITY AND INNOVATION (ISI) - PART OF ISILC	Victoria University
INSTITUTE FOR SUSTAINABLE INDUSTRIES & LIVEABLE CITIES (ISILC)	Victoria University
MELBOURNE DISABILITY INSTITUTE	The University of Melbourne
MELBOURNE ENERGY INSTITUTE	The University of Melbourne
MELBOURNE INSTITUTE	The University of Melbourne
MELBOURNE SCHOOL OF DESIGN	The University of Melbourne
MELBOURNE SOCIAL EQUITY INSTITUTE	The University of Melbourne
MELBOURNE SUSTAINABLE SOCIETY INSTITUTE (MSSI)	The University of Melbourne
MICHAEL KIRBY CENTRE FOR PUBLIC HEALTH AND HUMAN RIGHTS	Monash University
MONASH CENTRE FOR HEALTH RESEARCH AND IMPLEMENTATION	Monash University
MONASH CENTRE FOR OCCUPATIONAL AND ENVIRONMENTAL HEALTH	Monash University
MONASH FOOD INNOVATION CENTRE	Monash University
MONASH INSTITUTE OF TRANSPORT STUDIES (ITS)	Monash University
MONASH SUSTAINABLE DEVELOPMENT INSTITUTE (MSDI)	Monash University
MONASH URBAN LAB	Monash University
PUBLIC TRANSPORT RESEARCH GROUP	Monash University
SMART ENERGY CITY (PROJECT)	Monash University
SOCIAL RESEARCH CENTRE	Australian National University
SUSTAINABILTY SCIENCE LAB	The University of Melbourne
SUSTAINABLE BUILDING INNOVATION LAB (SBI LAB)	RMIT
THE MARY MACKILLOP INSTITUTE FOR HEALTH RESEARCH (MMIHR)	Australian Catholic University
THE MELBOURNE SCHOOL OF POPULATION AND GLOBAL HEALTH (MSPGH)	The University of Melbourne
THE POLICY LAB	The University of Melbourne
THE SCHOOL OF GEOGRAPHY	The University of Melbourne
THRIVE RESEARCH HUB	The University of Melbourne
TRANSFORMING HOUSING	The University of Melbourne
TRANSPORT, HEALTH AND URBAN DESIGN RESEARCH HUB (THUD)	The University of Melbourne
VICTORIAN CENTRE FOR CLIMATE CHANGE ADAPTATION RESEARCH (VCCCAR)	RMIT, The University of Melbourne, Latrobe University, Monash University, Deakin University, Victorian Government
VICTORIAN ECO INNOVATION LAB (VEIL)	The University of Melbourne

PUBLIC SECTOR	
ARTHUR RYLAH INSTITUTE FOR ENVIRONMENTAL RESEARCH	Victorian Government
BETTER HEALTH CHANNEL	Victorian Government
CITY OF MELBOURNE	City of Melbourne
CSIRO FOOD INNOVATION CENTRE	CSIRO
DEPARTMENT OF ENVIRONMENT, LAND, WATER AND PLANNING (DELWP)	Victorian Government
DEPARTMENT OF HEALTH AND HUMAN SERVICES (DHHS)	Victorian Government
DEPARTMENT OF HEALTH VICTORIA	Victorian Government
EPA VICTORIA	Victorian Government
INFRASTRUCTURE VICTORIA	Victorian Government
RESILIENT MELBOURNE	Hosted by City of Melbourne, supported by metropolitan Melbourne Councils and the Victorian Government
SUSTAINABILITY VICTORIA	Victorian Government
TRANSPORT ACCIDENT COMMISSION (TAC)	Victorian Government
VICTORIAN CATCHMENT MANAGEMENT COUNCIL	Victorian Government
WASTE MANAGEMENT RESEARCH	EPA Victoria
WATER INFORMATION RESEARCH AND DEVELOPMENT ALLIANCE	CSIRO

PRIVATE SECTOR
ARUP
COMMUNITY HOUSING INDUSTRY ASSOCIATION (CHIA)
DELOITTE
E2 DESIGN LAB
ERNST AND YOUNG (EY)
GRATTAN INSTITUTE
PRICE WATER COOPERS (PWC)
SGS ECONOMICS AND PLANNING

PHILANTHROPY	
BROTHERHOOD OF ST LAURENCE	
LORD MAYOR'S CHARITABLE FOUNDATION (LMCF)	
THE PARTNERSHIP FOR HEALTHY CITIES	City of Melbourne, Bloomberg, WHO

NOT-FOR-PROFIT/NGO
AUSTRALIAN CENTRE FOR HEALTH RESEARCH (ACHR)
C40
ICLEI

THINK TANKS
BEYOND ZERO EMISSIONS
LOWY INSTITUTE

Appendix 2: List of identified reports published within Melbourne's knowledge system

CLIMATE CHANGE				
REPORT/STUDY	**ORGANISATION**	**RESEARCH UNIT**	**YEAR**	**THEMES**
Emission Reporting				
City in Focus: City of Melbourne	C40		2013	Climate change data reporting for the City of Melbourne
Victorian Greenhouse Gas Emissions Report 2018	The Victorian State Government		2018	Reporting on annual GHG emissions
Zero Net Emissions by 2020	City of Melbourne		2002	Strategy to lower carbon emissions by 2020 for the City of Melbourne
Climate Change Adaptation				
Climate Change Adaptation Strategy 2017	City of Melbourne		2017	Adaptation strategy for the City of Melbourne
Resilient Cities Report 2018	ICLEI		2018	Outcomes of Resilient Cities 2018 congress. Tools for promoting urban resilience and adaptation
Victoria's Climate Change Framework	The Victorian State Government	DEWLP	2018	Future strategy for the State of Victoria on climate change adaptation
Climate Change Effects (Conservation and Environment)				
City of Melbourne WSUD Guidelines	City of Melbourne		ND	Water sensitive urban design guidelines for councils to adopt
Evidence of the Benefits of Green Roofs, Walls and Facades	City of Melbourne		2011	Highlights the benefits of green roofs

Climate Change Effects (Coastal)

Climate Change Adaptation in Delta Cities	C40 Cities		2016	Sustainable development of coastal cities, such as Melbourne, in planning to reduce vulnerabilities to climate change risks and impacts
Coasts and Extremes: CAWCR Technical Report No. 078	CSIRO		2014	Predictions of coastal conditions in Australia

Climate Change Effects (Health and Wellbeing)

Facilitating Adaptation: Lessons Learnt from Engaging and Supporting the Primary Health and Community Services Sector in Climate Change Adaptation	RMIT	Centre for Urban Research	2014	Climate change impacts on health of community

Climate Change Economics

Creditworthiness	C40 Cities		2016	Helps cities access international capital to help mitigate impacts of climate change
The Garnaut Review 2011	The University of Melbourne		2011	Impacts of climate change on the economy in Australia
The Global Transition to a Two-Degree Economy Has Begun	ClimateWorks Australia		2017	Guidance on how businesses can adapt to climate change while encouraging net-zero emissions

Climate Change Modelling and Data Analysis

Climate Action: The Path to 1.5 Degrees	ICLEI	2018	Measuring, reporting, and verification of climate action. How data can be used to create subnational alignment
Data Speak Louder Than Words	ICLEI, C40 Cities, SDI, UN-Habitat, 100RC	2018	Guidance for local and regional govts in planning, measuring and reporting on climate change adaptation
Global Climate Goals for Temperature, Concentrations, Emissions and Cumulative Emissions: CAWCR Technical Report No. 042	CSIRO	2011	Impacts of temperature targets for climate change
State of the Climate 2019	CSIRO Bureau of Meteorology	2018	Monitoring, analysing and interpreting Australia's observed and future weather patterns
Understanding the Anthropogenic Nature of the Observed Rainfall Decline Across South-Eastern Australia: CAWCR Technical Report No. 026	Bureau of Meteorology	2010	Categorises climate changes in south-east Australia during the last 10 years

Public Perception of Climate Change

Climate of the Nation 2018	The Australia Institute	2018	Australian public's attitude on climate change and energy

CLIMATE CHANGE

REPORT/STUDY	ORGANISATION	RESEARCH UNIT	YEAR	THEMES
Data on Current Energy Industry				
2018 Gas Statement of Opportunities	Australian Energy Market Operator		2018	Predictions on demand and forecasting of gas reserves
A Review of Current and Future Methane Emissions	The University of Melbourne	Melbourne Energy Institute	2016	Current understanding of methane emissions by the oil and gas industry
Five Years of Declining Annual Consumption of Grid-Supplied Electricity	The University of Melbourne	Melbourne Energy Institute	2015	Reasons for declining consumption of demand for grid-based electricity
Energy Efficiency				
Estimating the Value of Electricity Storage in an Energy-Only Wholesale Market	The University of Melbourne	Melbourne Energy Institute	2015	The economics of energy storage
Sharing in Renewable Energy Development	Tokyo Metropolitan Government and C40		ND	A guide for renewable energy development
Victoria Harbour Climate Positive Experience – Implementing District Energy Solutions	City of Melbourne Climate Positive Development Program		ND	Implementing a district energy solution using trigeneration technology in Victoria Harbour
Energy Policy				
Environmental Norms and Electricity Supply	The University of Melbourne	Melbourne Energy Institute	2016	A policy-based report analysing normative change in electricity supply to understand the challenges associated with the introduction of a non-negotiable environmental norm, a change necessary to ensure long-term environmental sustainability of the supply system
Heatwaves, Homes & Health: Why Household Vulnerability to Extreme Heat is an Electricity Policy Issue	RMIT	Centre for Urban Research	2017	Extreme heat and its effect on electricity policy

Policy Options for Australia's Electricity Supply Sector: Special Review Research Report	Climate Change Authority		2016	Options to reduce emissions from the electricity generation supply sector
Switching Off Gas Report	The University of Melbourne	Melbourne Energy Institute	2015	Examining the future of domestic gas across the interconnected gas market in eastern Australia
Energy Security				
Power System Security Assessment of the Future National Electricity Market	The University of Melbourne	Melbourne Energy Institute	2017	Future security of the national electricity market
Reducing Emissions				
Light Vehicle Emissions Standards for Australia	Climate Change Authority		2014	Proposing an emissions standard for all new light vehicles
The State of Electric Vehicles in Australia	Electric Vehicle Council ClimateWorks Australia		2017	Data on electric vehicle uptake
Using international Units to Help Meet Australia's Emission Reduction Targets	Climate Change Authority		2014	Using international offset units to meet emission targets
Fossil Free: The Development and Significance of the Fuel Divestment Movement	University of Melbourne	Melbourne Sustainable Society Institute	2016	Energy transition
Renewable Energy Development				
A Guide for Renewable Energy Developers	United Nations Environment Programme		2016	Key legal issues associated with efficiency and renewable energy resource development. Provides legislative options for dealing with these
Community Engagement and Benefit Sharing in Renewable Energy Development	The Victorian State Government		ND	A guide for renewable energy development

FOOD

REPORT/STUDY	ORGANISATION	RESEARCH UNIT	YEAR	THEMES
Food System, Food Security, Healthy Food				
Sustainable and Secure Food Systems for Victoria	The University if Melbourne	VEIL	2008	Sustainable and secure food systems
Food City: City of Melbourne Food Policy	City of Melbourne/ The University of Melbourne	VEIL	2012	Food policy
How Can Food Hubs Catalyse Healthy and Resilient Local Food Systems in Victoria: Developing a Food Hub in the City of Casey	The University of Melbourne		2012	Resilient food systems
Melbourne's Foodbowl	The University of Melbourne	VEIL	2015	Food systems
The Economic Contribution of Melbourne's Foodbowl	Deloitte		2016	Food systems
Melbourne's Food Future: Planning a Resilient City Foodbowl	Deakin University The University of Melbourne	VEIL	2016	Resilient food systems
Melbourne's Foodprint: What Does it Take to Feed a City?	Deakin University The University of Melbourne	VEIL	2016	Food security
Food for thought: Challenges and Opportunities for Farming in Melbourne's Foodbowl	The University of Melbourne	MSSI	2018	Food systems

HOUSING/BUILT ENVIRONMENT				
REPORT/STUDY	**ORGANISATION**	**RESEARCH UNIT**	**YEAR**	**THEMES**
Housing/Built Environment				
Precarious Housing and Health Inequalities: What are the Links?	The University of Melbourne, RMIT, VIC Health	AHURI	2011	Health and housing
Housing Strategy 2014 -2018	City of Melbourne		2015	Housing, built environment, housing challenges, future living
Implementing Sustainability in the Built Environment	RMIT	Centre for urban research	2017	Energy efficiency, resource efficiency, urban planning
How Will the NDIS Change Australian Cities	The University of Melbourne	MSSI	2017	Housing affordability, urban planning, governance, disability
Plan Melbourne 2017	City of Melbourne		2017	Energy efficiency, resource efficiency, urban planning
Better Apartments 2016	Victorian Government		2016	Planning, housing, energy efficiency

URBAN GREEN				
REPORT/STUDY	**ORGANISATION**	**RESEARCH UNIT**	**YEAR**	**THEMES**
Urban Green				
Urban Forest Precinct Plans (various)	City of Melbourne		various	Urban forest
Open Space Strategy	City of Melbourne		2012	Open space, urban green, urban planning policy
Urban Forest Strategy	City of Melbourne		2012	Urban forest, biodiversity
Growing Green Guide: A Guide to Green Roofs, Walls and Facades	VIC Government		2014	Green roofs/walls/facades
Nature in the City	City of Melbourne		2017	Biodiversity, urban ecosystems
Greening the West: Assessment of the Functioning and Implications of Collaborative Efforts to Achieve Urban Greening in Melbourne's West	RMIT	Centre for Urban Research	2017	Urban green/forest
Green Our City Action Plan 2017-2021	City of Melbourne		2018	Green roofs/facades

URBAN PLANNING/GOVERNANCE				
REPORT/STUDY	**ORGANISATION**	**RESEARCH UNIT**	**YEAR**	**THEMES**
Urban Planning and Governance				
Melbourne Sustainability	The University of Melbourne	MSSI	2013	Urban planning, interdisciplinarity, governance
Alternative Futures for Melbourne's Peri-Urban Region	RMIT University		2014	Urban planning, rural areas
Making Connections: Housing, Productivity, and Economic Development	RMIT	Australian Housing and Urban Research Institute	2015	Housing, markets, prices
Entries and Exists from Homelessness: A Dynamic Analysis of the Relationship Between Structural Conditions and Individual Characteristics	RMIT	Australian Housing and Urban Research Institute	2015	Homelessness
The Structural Drivers of Homelessness in Australia 2001-11	RMIT	Australian Housing and Urban Research Institute	2015	Homelessness
Resilient Melbourne Strategy	City of Melbourne		2016	Urban resilience, disaster management, urban governance
Urban Health and Wellbeing Profile	City of Melbourne		2016	Urban health, physical and mental health, built environment
Resilient Melbourne: Implementing the Rockefeller Foundation 100 Resilient Cities Project in Melbourne	RMIT	Centre for Urban Research	2016	Urban resilience, urban planning
Cities of the Future: What Should Be Their Form?	The University of Melbourne	MSSI	2016	Urban planning, transport, socio-economic outcomes

Creating Liveable Cities in Australia: A Scorecard and Priority Recommendations for Melbourne	RMIT, ACU, UWA		2017	Various, urban health, planning, transport, food, employment
The Case for Investing in Last Resort Housing	The University of Melbourne	MSSI	2017	Homelessness
Flipping the Table: Toward an Indigenous-led Urban Research Agenda	University of Melbourne	Clean Air and Urban Landscapes Hub (CAUL)	2018	Urban planning, urban governance, indigenous
Understanding the Role of the Water Sector in Urban Liveability and Greening Interventions. Case studies on Barcelona, Rotterdam, Amsterdam, Copenhagen and Melbourne	RMIT	Centre for Urban Research	2018	Water security, urban greening, urban planning, stormwater infrastructure
Transformational Infrastructure Projects: Australia's Fast Growing Outer Suburbs	RMIT University of Melbourne	Centre for Urban Research	2018	Urban planning, cost benefit analysis

TRANSPORT				
REPORT/STUDY	**ORGANISATION**	**RESEARCH UNIT**	**YEAR**	**THEMES**
Behavioural Research in Transport				
Perceptions and Realities of Personal Safety on Public Transport for Young People in Melbourne	Monash University	Public Transport Research Group	2010	Perceptions of safety on public transport
Understanding Ridership Drivers for Bus Rapid Transit Systems in Australia	Monash University	Public Transport Research Group	2010	Understanding choice to use express bus services
Modelling the Causes and Consequences of Perceptions of Personal Safety on Public Transport Ridership	Monash University	Public Transport Research Group	2011	Perceptions of safety on public transport
The Relative Priority of Personal Safety Concerns for Young People on Public Transport	Monash University	Public Transport Research Group	2011	Perceptions of safety on public transport
Nudging Towards A More Efficient Transportation System: A Review of Non-pricing (Behavioural) Interventions	UNSW		2017	Behaviour change interventions in transport
Current Transport Patterns				
Exploring Priorities in Transit Scheduling Between Small and Large Bus Companies	Monash University	Public Transport Research Group	2010	Efficient scheduling of public transport
City Wide Bus Network Restructuring Using An Inclusive Planning Approach	Monash University	Public Transport Research Group	2010	Efficient scheduling of public transport
Bicycle Plan 2016-2020	City of Melbourne		2016	Increasing bicycle using while making Melbourne safer for cyclists
Good Practice Guide - Bus Rapid Transit	C40 Cities		2016	Ensuring high quality bus rapid transit system for cities through developing a BRT corridor

Low Emission Vehicles	C40 Cities		2016	Successful programmes for implementing and encouraging the use of low emission vehicles
The Benefits of Level Crossing Removals	RMIT/ The University of Melbourne		2016	Level crossing congestion analysis
The Road Ahead: How an Efficient, Fair and Sustainable Pricing Regime Can Help Tackle Congestion	Infrastructure Victoria		2016	Transport network pricing
Travel Demand and Movement Patterns Report	Infrastructure Victoria	Arup and KPMG	2017	Transport activity patterns, current and future
Model Calibration and Validation Report	Infrastructure Victoria	Arup and KPMG	2017	Most efficient way of implementing a transport pricing regime
West Gate Tunnel: Another Case of Tunnel Vision?	RMIT/ The University of Melbourne	Centre for Urban Research	2017	Examines current planning decisions in transport
Five Year Focus: Immediate Actions to Tackle Congestion	Infrastructure Victoria		2018	Improving travel time and reliability along melbourne's transport routes
Transit Oriented Development	C40 Cities		ND	Reducing private vehicle travel
Integrating Transport Approaches				
Access Docklands	City of Melbourne		2013	Strategy for docklands transport network
Transport Strategy	City of Melbourne		2012	Integrated approach to transport

WATER				
REPORT/STUDY	**ORGANISATION**	**RESEARCH UNIT**	**YEAR**	**THEMES**
Stormwater/Groundwater Management				
Managing Water in a Changing and Variable Climate	The University of Melbourne	Hydrology and Water Resources Lab	ND	River basin, surface water and groundwater responses to climate change; water forecasting
Exploring the Potential of Knowledge Brokering to Enhance Natural Resource Management	Victorian Catchment Management Council		2011	Knowledge exchange in catchment management
Cities as Water Supply Catchments: Green Cities and Microclimate	Monash University	Water Sensitive Cities CRC	2014	Green infrastructure and stormwater harvesting to help with increased heat in urban areas
Infiltration Understanding Improves Urban Stormwater Management	The University of Melbourne	Waterway Ecosystem Research Group	2014	Impact of urban karsts on stormwater flows and local waterway quality
Preliminary Assessment Method (PAM) for Integrated Water Management Strategies	DEWLP, Western Water, Hume City Council	E2Design Lab	2015	Assessment of Integrated Water Management for new growth areas
Cities as Water Supply Catchments: Economic Valuation	Monash University	Water Sensitive Cities CRC	2016	Economic analysis of using stormwater harvesting
Optimizing Flow Regimes in the Context of a Suberabundance of Water	The University of Melbourne	Waterway Ecosystem Research Group	2016	Whether flows can be maintained at levels that sustain healthy ecosystems
Social-technical Flood Resilience in Water Sensitive Cities – Quantitative Spatial-Temporal Flood Risk Modelling in an Urban Context	Monash University	Water Sensitive Cities CRC	2016	Urban flooding; flood risk management
Integrated Multi-functional Urban Water Systems	Monash University	Water Sensitive Cities CRC	2017	Hybrid WSUD system that can treat a number of water sources in urban areas

Ecosystem Analysis

Cities as Water Supply Catchments: Stream Ecology	Monash University	Water Sensitive Cities CRC	2014	Impact of stormwater management on stream ecology
Protection and Restoration of Urban Freshwater Ecosystems: Informing Management and Planning	Monash University	Water Sensitive Cities CRC	2017	Determine ecological drivers for stream health

Statutory Planning (Water)

City of Melbourne WSUD Guidelines	City of Melbourne	NA	ND	Water sensitive urban design guidelines for councils to adopt
Evidence of the Benefits of Green Roofs, Walls and Facades	City of Melbourne	NA	2011	Highlights the benefits of green roofs
Better Governance for Complex Decision-making	Monash University	Water Sensitive Cities CRC	2016	Governance models to foster water sensitive cities
Better Regulatory Frameworks for Water Sensitive Cities	Monash University	Water Sensitive Cities CRC	2016	How regulation can promote transition to water sensitive cities
Catchment Scale Landscape Planning for Water Sensitive City-regions in an Age of Climate Change	Monash University	Water Sensitive Cities CRC	2016	Growth scenarios relating to climate change; statutory planning processes
The Design of the Public Realm to Enhance Urban Microclimates	Monash University	Water Sensitive Cities CRC	2017	Heat mitigation using green infrastructure; urban planning analysis
Statutory Planning for Water Sensitive Cities	Monash University	Water Sensitive Cities CRC	2017	Integrating statutory planning with water sensitive urban design

Water Economics

Economic Incentives and Instruments	Monash University	Water Sensitive Cities CRC	2016	Promote uptake of water sensitive practices, economic analysis and policy mechanisms
Valuation of Economic, Social and Ecological Costs and Benefits	Monash University	Water Sensitive Cities CRC	2016	Cost and benefit analysis of new water systems and infrastructure; ideal economic mix of water sources
Social Impacts of Water (Behavioural)				

Accelerating Transitions to Water Sensitive Cities by Influencing Behaviour	Monash University	Water Sensitive Cities CRC	2017	Household behaviour for water consumptions and run-off
Engaging Communities with Water	Monash University	Water Sensitive Cities CRC	2017	Increase water literacy among the community
Intelligent Urban Water Systems	Monash University	Water Sensitive Cities CRC	2017	Real-time monitoring of water consumption behaviours and patterns
Understanding Social Processes to Achieve Water Sensitive Futures	Monash University	Water Sensitive Cities CRC	2017	Exploring the culture of water use in Australia
Scenario Predictions (Rainfall and WSUD)				
Cities as Water Supply Catchments: Urban Rainfall in a Changing Climate	Monash University	Water Sensitive Cities CRC	2016	Rainfall predictions
Socio-technical Modelling Tools to Examine Urban Water Management Scenarios	Monash University	Water Sensitive Cities CRC	2016	Tools for planning scenarios for integrated water systems
Water Information Research and Development Alliance	CSIRO	NA	2016	Data collection and analysis on water balance and streamflow forecasts
Mapping Water Sensitive City Scenarios	Monash University	Water Sensitive Cities CRC	2017	Tools for transitioning to a water sensitive city; bringing in the community
Sustainability in Water				
Cities as Water Supply Catchments: Sustainable Technologies	Monash University	Water Sensitive Cities CRC	2014	Stormwater harvesting technologies that are more sustainable than current practices
Fit-for-purpose Water Production	Monash University	Water Sensitive Cities CRC	2017	Decentralised treatment of water that is low-cost and low-energy
Resource Recovery from Wastewater	Monash University	Water Sensitive Cities CRC	2017	Nutrient recovery from wastewater to use for other purposes such as fertilisers

WASTE

REPORT/STUDY	ORGANISATION	RESEARCH UNIT	YEAR	THEME
Waste				
A Review of the Scientific Literature on Potential Health Effects in Local Communities Associated with Air Emissions from Waste to Energy Facilities	EPA Victoria	Environmental Risk Sciences	2018	Health effects of waste to energy plants
Investing in a More Sustainable Future (Victorian Government Sustainability fund) 2015-2017	Victorian Government		2017	Waste management; climate change
Lithium Battery Recycling in Australia - Current Status and Opportunities for Developing a New Industry	CSIRO		2018	Recycling, battery, future
Sustainable Solid Waste Systems	C40 Cities		ND	Solid waste management
Waste and Resource Recovery Plan 2015-2018	City of Melbourne		2015	Waste strategy report
Waste To Resourcest	C40 Cities		NDt	Solid waste management

Appendix 3: Identified cross-sectoral interrelations (based on screening of reports)

	BUILT ENVIRO/ HOUSING	CLIMATE CHANGE	ECONOMICS	ENERGY	FOOD	TRANSPORT/ MOBILITY	URBAN GREEN	URBAN PLANNING	WASTE	WATER	HEALTH
BUILT ENVIRO/ HOUSING	X										
CLIMATE CHANGE	Reducing greenhouse gases through design, materials and technologies	X									
ECONOMICS	New business models for sustainable building, renting models, co-housing	Costs through impacts of climate change on infrastructure, health, nature.	X								
ENERGY	Energy efficiency	Renewable energy; reducing emissions; low emission vehicles; emissions from fossil fuel industry	Security of electricity market; value of electricity storage in an energy-only wholesale market	X							
FOOD		Reducing commercial vehicle travel through support of regional products	Economics of Melbourne's foodbowl.	Waste to energy plants	X						
TRANSPORT/ MOBILITY		Reducing private vehicle travel; implementing low emission vehicles	Pricing regime in transport to tackle congestion	Encourage low emission vehicles; reducing private vehicle travel	Reducing commercial vehicle travel between production, markets and consumers	X					
URBAN GREEN	Cooling buildings through trees, green roofs, walls	Climate change impact on urban environment; adaptation			Food production integrated in urban green to reduce transport costs		X				
URBAN PLANNING/ GOVERNANCE	The role of urban planning in green building	Climate change and impacts on coastal areas; climate change adaptation for cities			Protection of food production in areas close to the city	Efficient scheduling of public transport; examining planning decisions in transport; reducing congestion		X			
WASTE		Waste to energy approach could reduce greenhouse gas emissions		Waste to Energy Plants; lithium battery recycling	Reducing food waste in supermarkets and households				X		
WATER	Green infrastructure to reduce heat in buildings	Rainfall decline; climate change adaptation planning for water resources	Economic evaluation of stormwater harvesting; CBA of new water systems; economic incentives for water sensitive practices	Harvesting heat from aquifers; harvesting electricity from hydro power; resource recovery from waste water; Low energy water production			Urban stream ecology; protection of urban freshwater ecosystems; heat mitigation using green infrastructure	Urban stormwater planning; flood resilience; statutory planning for water sensitive cities	Resource recovery from wastewater	X	
HEALTH	Indoor air quality through healthier materials and natural ventilation through building design	Impacts on health through heatwaves, droughts, other extreme weather events		Health effects of waste to energy plants						Increase water literacy among community	X

A NOTE ON APPENDIX 3:

In this study it became clear to us that the themes identified and discussed above have potential for further interconnections through new cross sectoral and integrated research endeavours. For example, a clear case of this exists in studies surrounding waste to energy facilities, in the management of waste together with the harnessing of energy for future use. Capturing these types of intersections provides a fuller overview of current and potential research in sustainability and health.

With this in mind, the researchers within this project conducted a systematic review of the collated reports, noting the intersectoral themes addressed in each. These have been summarised and tabulated in Appendix 3.

For the specific purpose of this relational analysis two extra analytical dimensions have been added: Economics and Health. The research led to many of the previously-discussed topics having crossed into both the fiscal nature of their field, and also the safety/health aspects. As this was so extensive across all of the themes, it was crucial to include this as part of the analysis. It is important to note, however, that the very broad nature of health research in Melbourne has not been fully incorporated into this review. This intersectoral review only considered the research that has been documented in previous sections, and where it has an underlying health theme.

The intersectoral interrelations table provides a well-informed snapshot into the existing and potential interdisciplinarity of existing publicly available research. Gaps in the crossovers between topics shows additional opportunities in these fields.