Centre for Energy and Environmental Markets

UNSW THE UNIVERSITY OF NEW SOUTH WALES SYDNEY • AUSTRALIA



Low Carbon Model Towns – *Australian insights on possible roles for Universities*

Iain MacGill

Associate Professor, School of Electrical Engineering and Telecommunications
Joint Director (Engineering), CEEM

Second APEC Low-Carbon Model Town Symposium

Da Nang, Vietnam

September 2018

Presentation outline

- Australian cities
  - their living, economic roles.. and environmental impacts
  - Current efforts in low-carbon transition
- Australian Universities
  - their context, capabilities
- Some relevant examples of collaboration between Universities, Government and Industry
  - Cooperative Research Centre for Low Carbon Living
  - The Australian PV Institute
  - Centre for Urban Research
  - Cooperative Research Centre for Water Sensitive Cities
- Possible lessons
  - Stakeholder partnerships - ready, willing and able to contribute
  - Funding partnerships – end-user contributions from Government and Industry, in-kind from Universities
- Facilitating collaboration
  - Open data
  - Open source models
  - Open processes for decision making

Australian cities

EMPLOYMENT

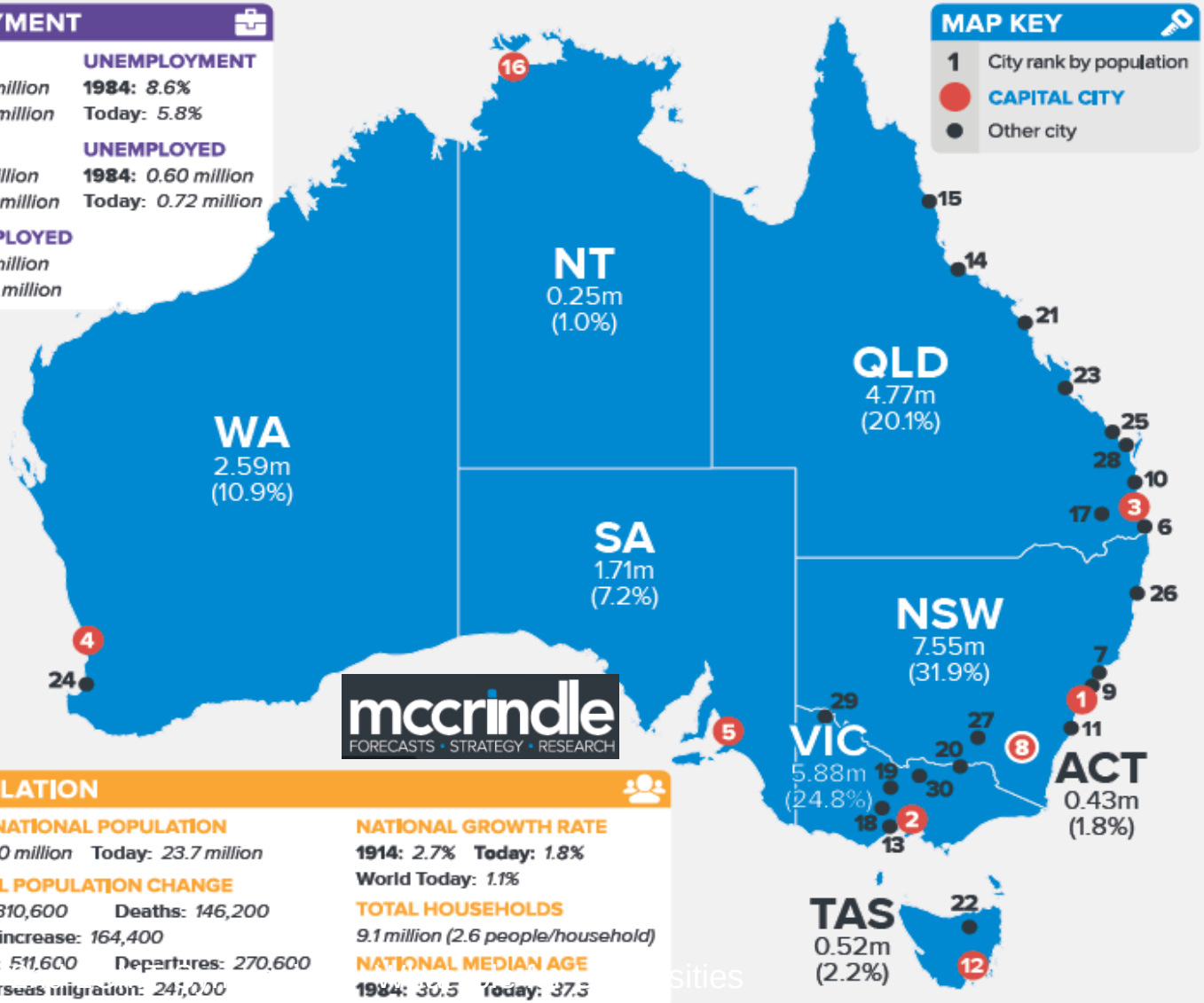
FULL TIME
1984: *5.3 million*
Today: *8.1 million*

UNEMPLOYMENT
1984: *8.6%*
Today: *5.8%*

PART TIME
1984: *1.1 million*
Today: *3.5 million*

UNEMPLOYED
1984: *0.60 million*
Today: *0.72 million*

TOTAL EMPLOYED
1984: *6.4 million*
Today: *11.6 million*



MAP KEY

1 City rank by population
CAPITAL CITY
Other city

POPULATION

TOTAL NATIONAL POPULATION
1914: *5.0 million* **Today:** *23.7 million*

ANNUAL POPULATION CHANGE
Births: *310,600* **Deaths:** *146,200*
Natural increase: *164,400*
Arrivals: *511,600* **Departures:** *270,600*
Net overseas migration: *241,000*

NATIONAL GROWTH RATE
1914: *2.7%* **Today:** *1.8%*
World Today: *1.1%*

TOTAL HOUSEHOLDS
9.1 million (2.6 people/household)

NATIONAL MEDIAN AGE
1984: *30.5* **Today:** *37.3*

CITY BY POPULATION

#	CITY	'000
1	SYDNEY	4,488
2	MELBOURNE	4,375
3	BRISBANE	2,207
4	PERTH	1,995
5	ADELAIDE	1,283
6	Gold Coast	623
7	Newcastle	433
8	ACT/CANBERRA	429
9	Central Coast	324
10	Sunshine Coast	301
11	Wollongong	291
12	HOBART	208
13	Geelong	186
14	Townsville	182
15	Cairns	149
16	DARWIN	124
17	Toowoomba	115
18	Ballarat	100
19	Bendigo	93
20	Albury/Wodonga	88
21	Mackay	87
22	Launceston	86
23	Rockhampton	82
24	Bunbury	76
25	Bundaberg	71
26	Coffs Harbour	69
27	Wagga Wagga	55
28	Hervey Bay	52
29	Mildura	50
30	Shepparton	49

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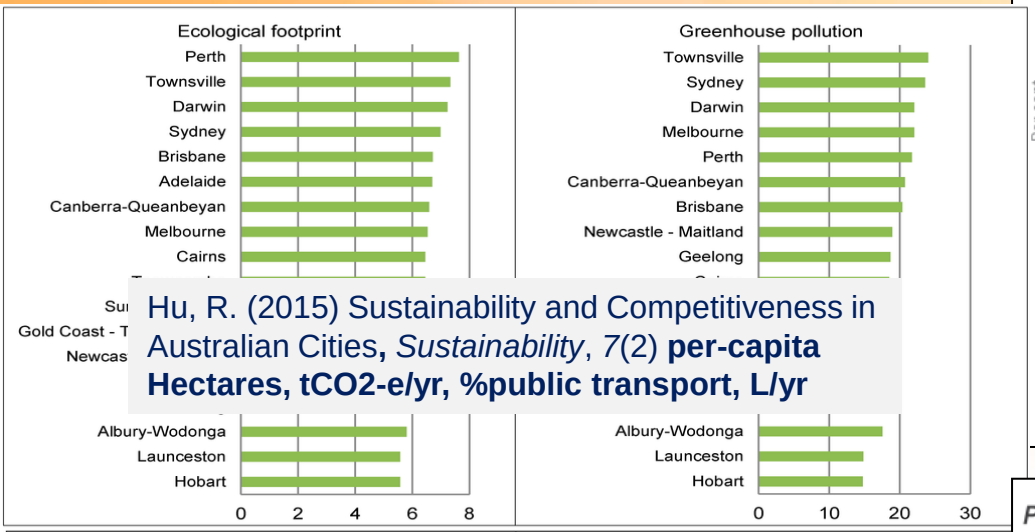
Australian Government
Department of Infrastructure and Regional Development

Their living, economic role .. & environment impacts



Hu, R. (2015) Sustainability and Competitiveness in Australian Cities, *Sustainability*, *7*(2) **per-capita Hectares, tCO2-e/yr, %public transport, L/yr**

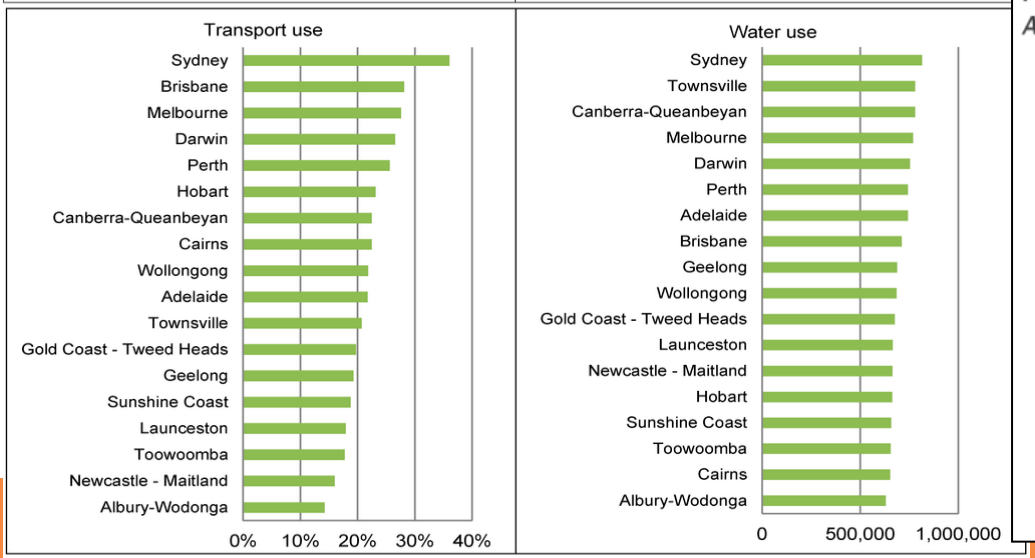
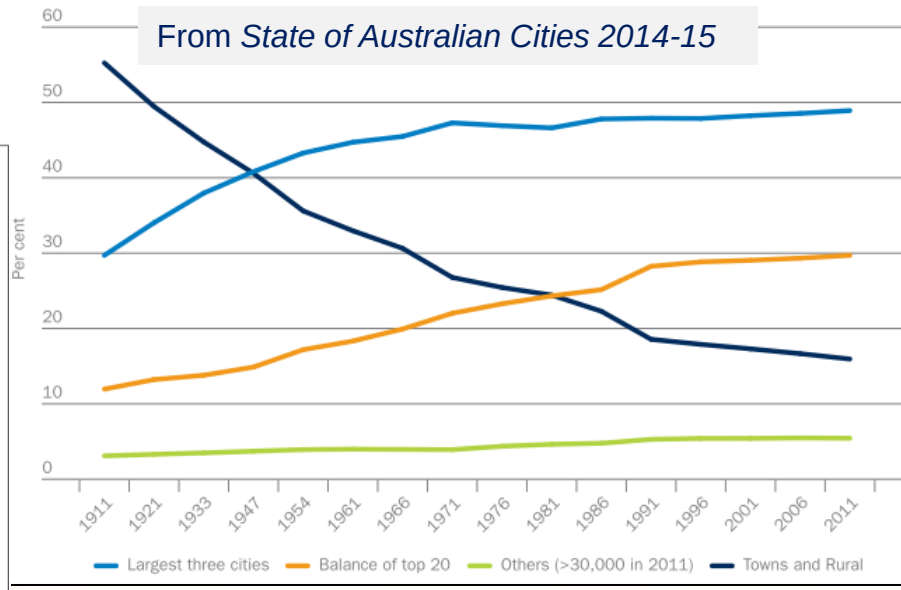
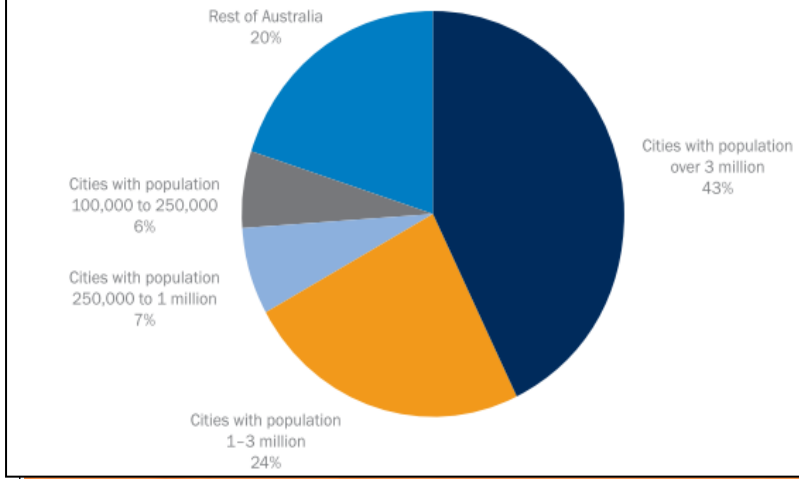


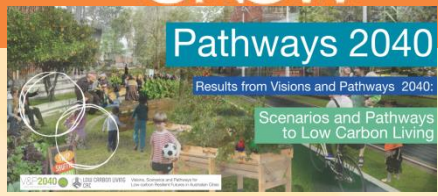
Figure 2.2a Population proportion by settlement type, 1911–2011

From *State of Australian Cities 2014-15*



Proportion of Gross Domestic Product attributed to cities and regional areas of Australia, 2010





Some with ambitious climate targets

Target and Scope[a,b]	*City Jurisdiction*	*Climate change policy framework and planned actions/ goals*	*Progress since baseline and influential policies / actions*
City of Melbourne *Target: zero net emissions by 2020, 25% renewable electricity by 2018; 4.5%/year council emissions (2011/12)* *Scope: CO_2e, cons.*	*Pop. 128K* *Area: 36 km2*	*Zero Net Emissions by 2020* (2002, update 2008 and 2014) actions include: • Council operations: Queen Victoria Market renewal, Urban Forest Strategy • Buildings & industry: commercial building retrofits (1200 Buildings Program) • Energy: Collaborate with CitiPower on energy management & supply system • Transport & freight: implement Bicycle Plan, develop walking plan • Waste: trial precinct solutions that improve resource recovery	Overall emissions increased by 18% since 2008/9. Target of 10% reduction in council operation compared to 2010/11 achieved. Highlights since 2003: • Queen Victoria Market solar array installed (25,000 kW capacity) in 2003 • NCOS Certified Carbon Neutral status for council operations in 2012 • Swanston Street redevelopment increased public transport & cycling access • Melbourne Renewable Energy Purchasing Group with 3 other councils
City of Darebin *Target: zero net emissions by 2020; zero net emissions council by 2022 (2006/7)* *Scope: CO_2e, cons.*	*Pop. 147K* *Area: 53 km2*	*Darebin Climate Emergency Plan* (2017) actions focus on 2017-2022: • Energy: expanded Solar $aver Program to install 11,000kW, Solar Bulk Buy • Buildings: new buildings high ESD standard, streetlights to energy-efficient LEDs • Transport: Darebin Cycling Strategy, explore electric vehicles for council fleet • Consumption and waste: Investigate food waste service options to residents • Other: Climate Emergency campaign, invest with fossil-free financial institutions	Council emissions reduced by 45% from 2006/7 levels. Successful actions: • Solar systems installed for app. 500 pensioners & low-income households • 142 businesses had their lights upgraded to energy-efficient LEDs • Energy efficiency information in several languages • Increased comfort & reduced energy costs in 482 vulnerable households
City of Adelaide *Target: Carbon neutral, i.e. 65% by 2025 (2007); carbon neutral council by 2020* *Scope: CO_2e, cons.*	*Pop. 22K* *Area: 16 km2*	*Carbon Neutral Adelaide Action Plan 2016-2021* (2016) action highlights: • Buildings: support adaptive reuse of commercial buildings, Green City Plan • Transport: encourage 100% renewable energy for all electric vehicle recharging • Energy: increase investment in large scale renewables, battery storage • Waste & water: reduce emissions from solid and liquid waste	Community emissions have reduced by 20% in 2007-2013. Highlights: • City office emissions cut by 23% e.g. through green building design • $2.6 billion invested to extend tram network & electrify the train network • Cycling journeys in and through the city have doubled since 2003 • 43% of State's grid electricity sourced from renewable energy
City of Sydney *Target: 70% by 2030, zero net emissions by 2050; 50% of renewable electricity by 2030; council 44% by 2021 (2006)* *Scope: CO_2e, cons.*	*Pop. 208K* *Area: 25 km2*	*Environmental Action 2016-2021 Strategy and Action Plan* (2017) actions: • Buildings: net zero carbon buildings challenge, non-residential tune-up program • Energy: trigen system at Town Hall House, invest up to $10M in renewables • Transport: update car sharing policy, 10 high-priority regional cycling routes • Waste: review & update waste treatment contracts to avoid landfilled waste • Other: plant 700 street trees each year until 2021	Community emissions reduced by 17% in 2006-2015. Highlights: • Better Buildings Partnership collectively reduced annual emissions by 45% • Over 6,600 LED street lights installed across the local area since 2011 • 650 on-street parking spaces dedicated to car share vehicles • 69% of household waste diverted from landfill each year
Moreland City Council *Target: 22% by 2020 (in line with zero net emissions by 2045, 2011)* *Scope: CO_2e, cons.*	*Pop. 163K* *Area: 51 km2*	*Zero Carbon Evolution Strategy* (2014) actions by 2020: • Energy: low-interest finance for solar PV systems, Community Solar Cooperative • Buildings: energy efficiency retrofits on 36k homes, Green Tradies program • Transport: Improve north-south and east-west bike networks, 500 car share bays • Other: Urban Heat Island Action Plan, minimise food waste	Council operation emissions reduced by 4% in 2011/12-2013/14. Highlights: • 2nd in VIC certified as carbon neutral for its corporate operations in 2012 • Over 1000 low income homes retrofitted in 2012 • Significant energy efficiency improvements of key city buildings since 2009 • 6 public electric vehicle charging stations installed in 2013
City of Perth *Target: 30% by 2030, (BAU baseline), 20% renewable/ low carbon energy by 2030; council 30% by 2030* *Scope: CO_2e, no cons.*	*Pop. 21K* *Area: 20 km2*	*Environment Strategy* (2016) highlights: • Energy: generate renewable energy from city properties • Buildings: retrofitting and improved energy performance initiatives • Transport: work with community to increase the use of public transport • Waste: improved residential & commercial waste, recycling,green waste services • Water: implement and promote water sensitive urban design	Highlights: • 380,000 trees planted in the City's carbon offset tree planting program • Penny Lane Green Star affordable housing project completed in 2013 • $500k invested into the City of Perth Cycle Plan 2029 adopted in 2012

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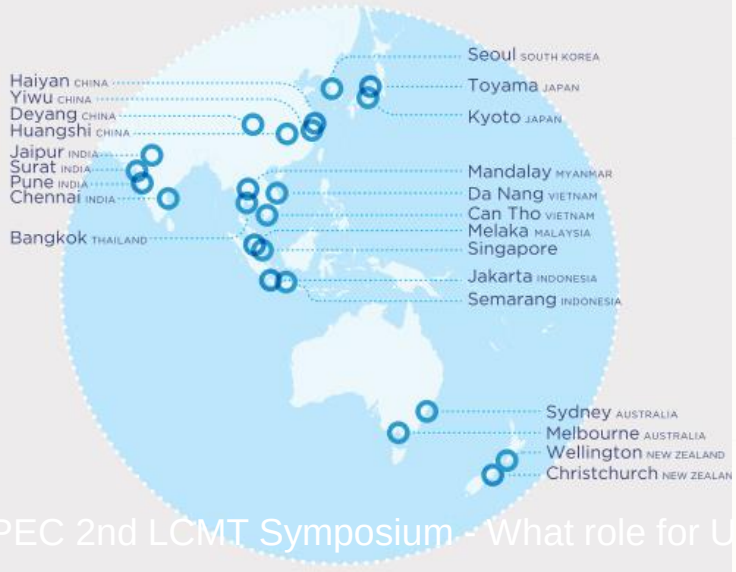
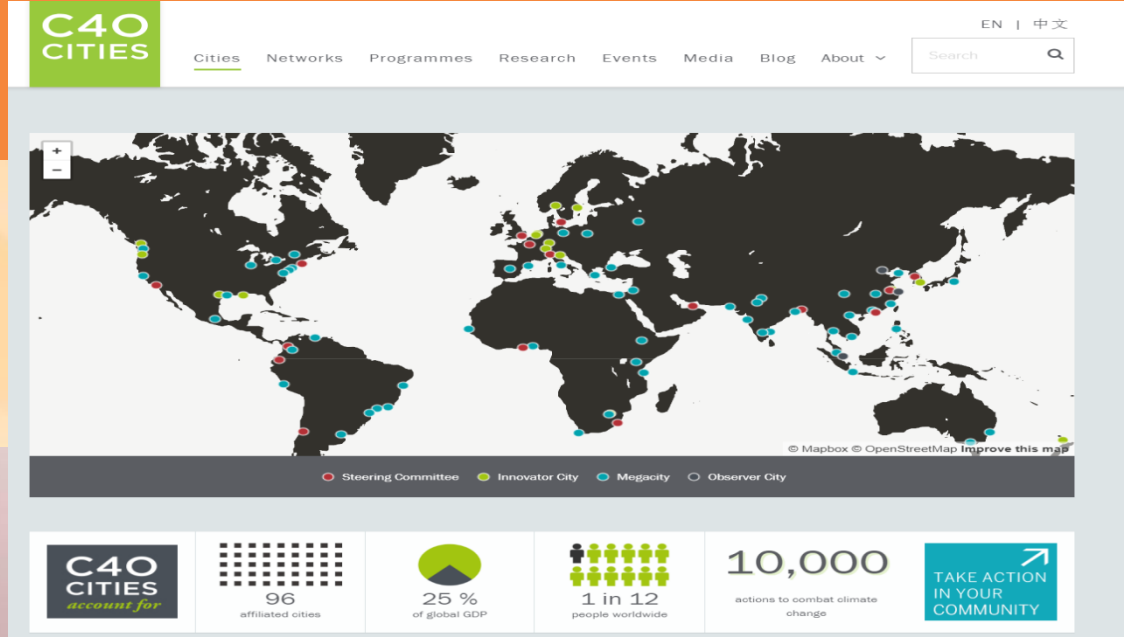
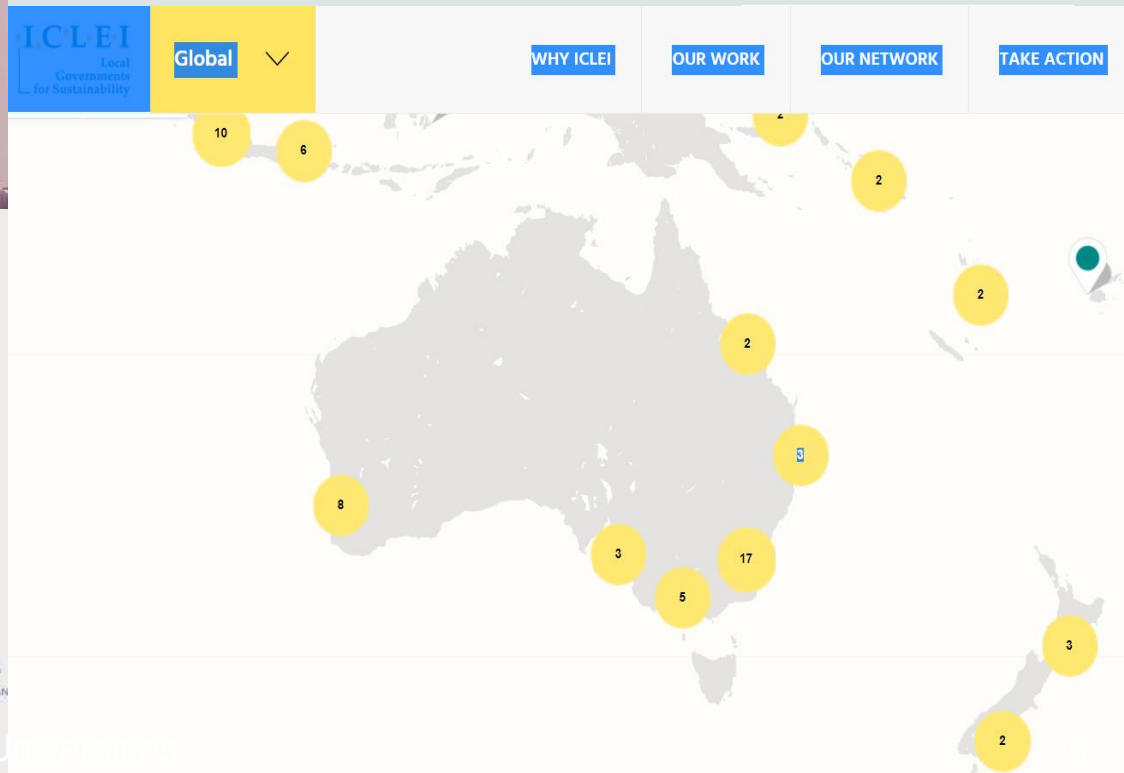
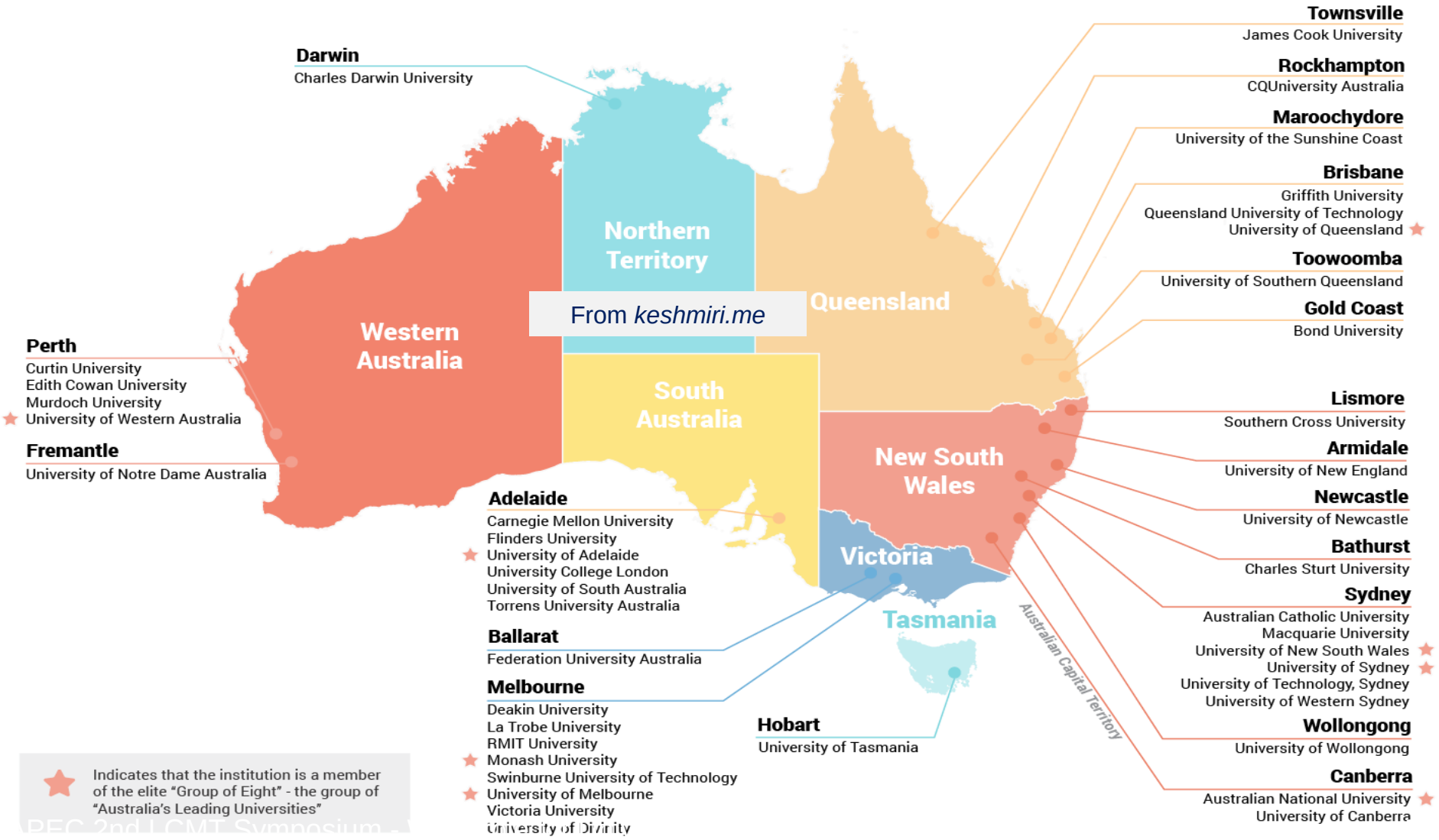
..and international partnerships



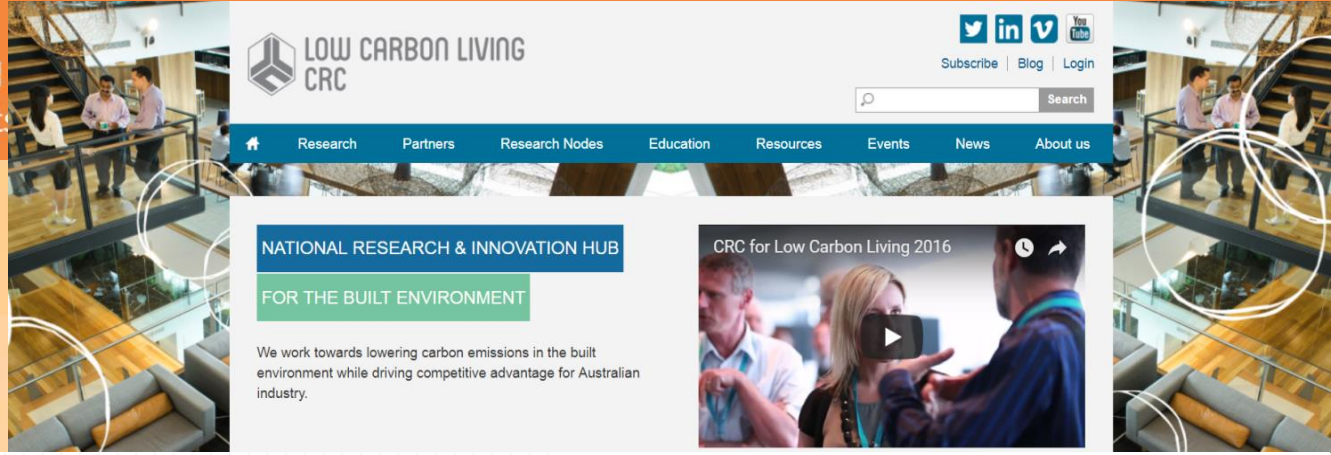


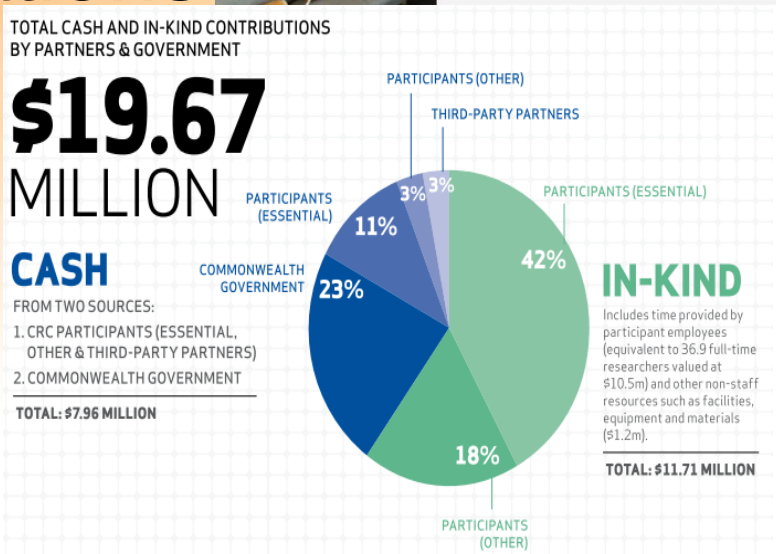


Australian Universities



Some key university collaborations





How: An end-user focus

Government

NSW Government – Office of Environment & Heritage

Government of South Australia

Australian Government – Department of Climate Change and Energy Efficiency

City of Melbourne

City of Sydney 2030

Evidence base for ~$1billion/yr investment in government programs

Manufacturing

CSR

BlueScope Steel

Incubating next generation multi-purpose building products

Development

UrbanGrowth NSW

VBA Victorian Building Authority

Multiplex

RenewalSA – people partnerships progress

Government of South Australia

Enabling world class low carbon property development

Professionals

AECOM

Consult Australia – Business | Engineering | Design

Hassell

asbec – Australian Sustainable Built Environment Council

Australian Institute of Architects

Tools for Australia's building design services industry

CRC LCL - Research program

PROGRAM 1

Integrated Building Systems

1. Harnessing the Australian sun
2. Lowering the embodied carbon in buildings
3. Mainstreaming low carbon buildings

Developing new low carbon embodied products and services, and finding ways to communicate best practice design through rating tools, standards and display homes.

PROGRAM 2

Low Carbon Precincts

4. Designing integrated low carbon precincts

Creating planning techniques and data for delivering low carbon developments at a precinct level. Communicating best practice in sustainable city planning through exemplar precinct developments and tools.

PROGRAM 3

Engaged Communities

5. Evidence base for low carbon living policy
6. Enhancing community engagement

Capturing a new community appetite for low carbon living. Through research, [illegible] the vision of a prosperous, liveable and sustainable society.

7. Living laboratories as low carbon lifestyle narratives
8. Enhance education and capacity building

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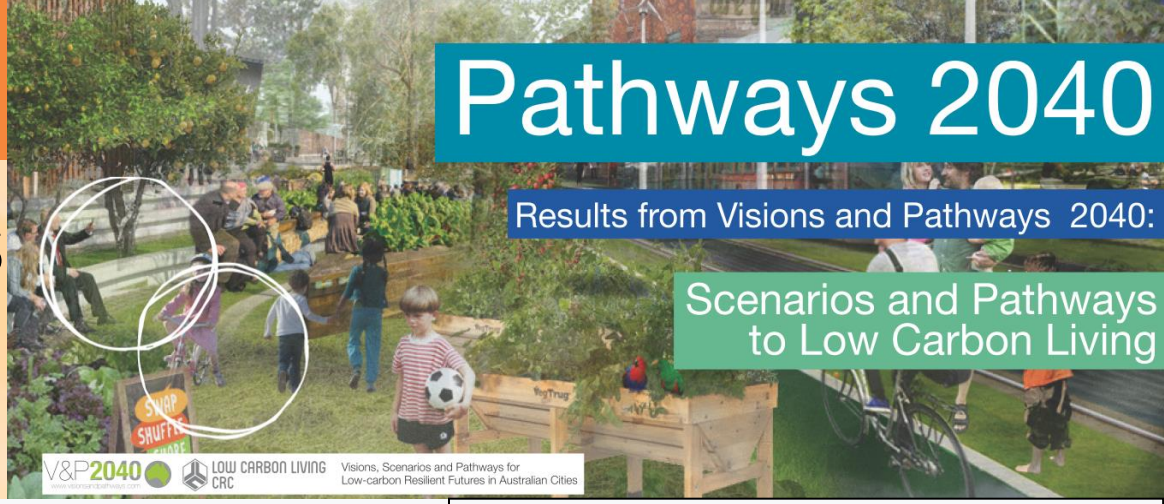
Relevant projects -*some big picture*



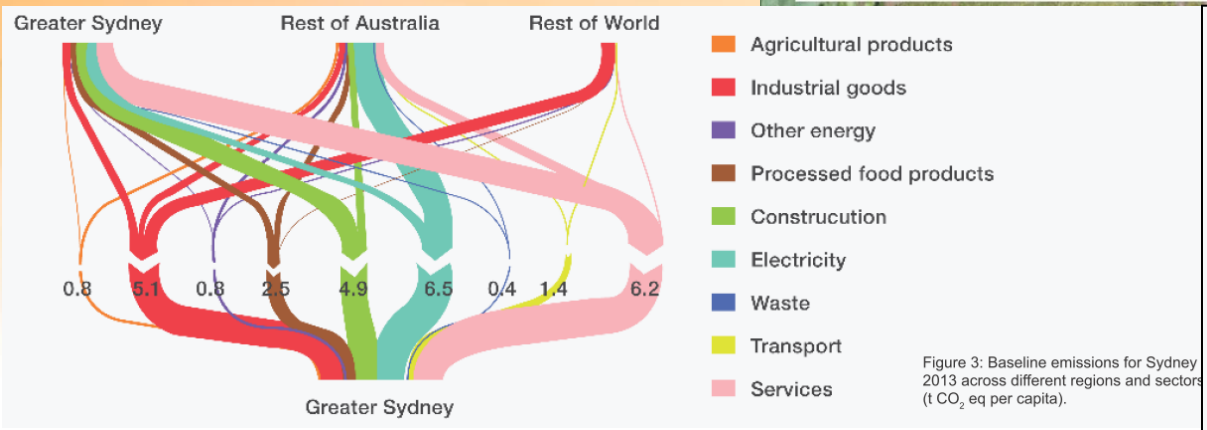
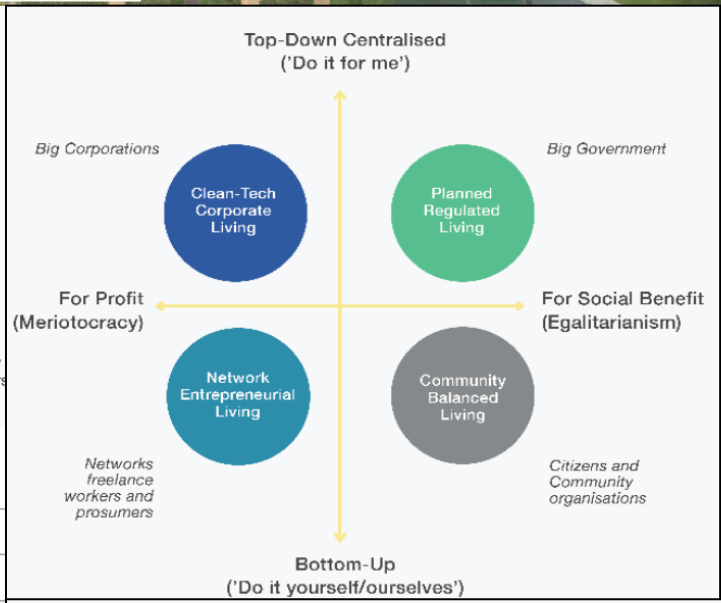


Figure 3: Baseline emissions for Sydney 2013 across different regions and sectors ($t CO_2$ eq per capita).



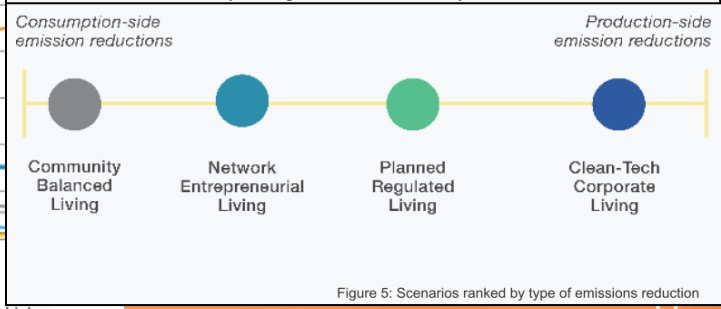
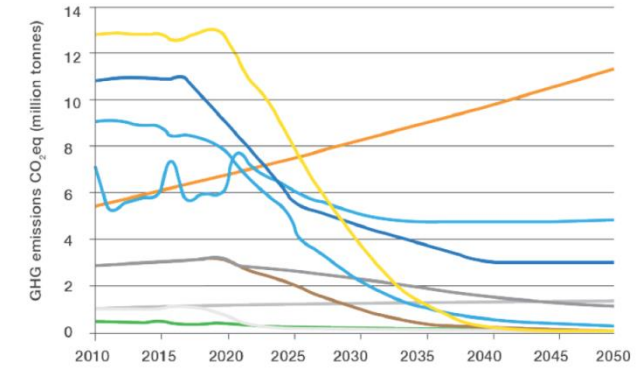
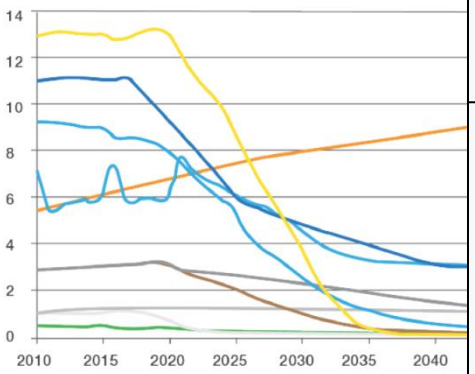


Figure 5: Scenarios ranked by type of emissions reduction

Green Growth



Commons Transition



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Others more specific: *Enhancing National House Energy Rating Scheme*

Review NatHERS assumptions, logic and settings against contemporary data and develop models for

- Ventilation
- Thermal comfort
- Ceiling fans

AusZEH Design (Lite & Heavy)

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Distributed PV

AUSTRALIAN PV INSTITUTE

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AUSTRALIAN PV INSTITUTE

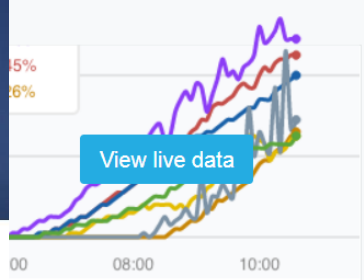
Live Solar PV | PV Performance | Solar PV Status | Market Analyses | SunSPoT | Solar Animation | PV Postcode Data

Solar PV Maps and Tools

Understand the Australian solar PV market with live generation data, historical maps and animations, and tools to explore rooftop PV potential and per-postcode market penetration.

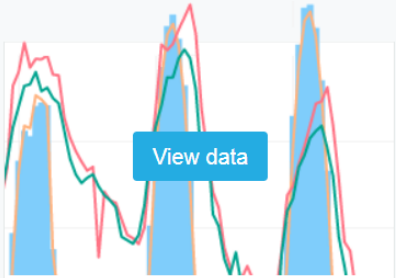
This project has been funded by the Australian Renewable Energy Agency

ARENA Australian Government Australian Renewable Energy Agency



Live Solar PV

Live performance data from nationwide PV installations, with total electricity demand and PV contribution

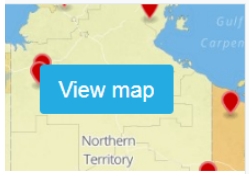


PV Performance by Climate Region

Compare and chart PV generation data from over 50 locations across Australia, and download data for offline analysis

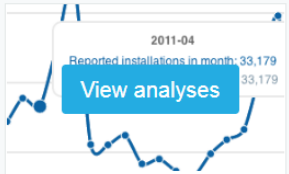
SunSPoT

Rooftop solar mapping tool using 3D data, for assessing annual and per-month PV potential in urban environments



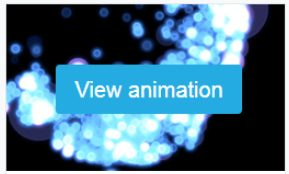
Solar PV Status

Estimated percentage of dwellings with PV systems and total installed capacity, by postcode and LGA



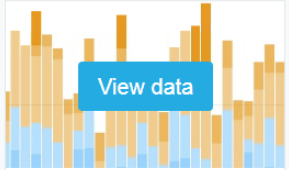
Market Analyses

Charting per-month PV installations registered under the Commonwealth Government's Renewable Energy Target



Solar Animation

Visualise per-postcode PV installations across Australia since January 2007, by average system size and PV penetration



PV Postcode Data

Explore PV installations by postcode and system size, with per-month installation figures since 2007

APVI LARGE CORPORATE MEMBERSHIP

Industry	Government	Research
Origin Energy	Powerlink	Australian Centre for Advanced Photovoltaics
Global Roam	Ergon Energy	Institute for Sustainable Futures
Trina Solar		University of New South Wales
		CSIRO
		Australian National University

APVI MEDIUM CORPORATE MEMBERSHIP

Industry	Government	Research
Solar Analytics		
IT Power Australia		
Green Energy Trading		

APVI SMALL CORPORATE MEMBERSHIP

Industry	Government	Research
Enosi Australia		Murdoch University
QGE		Centre for Renewable Energy, Charles Darwin University
Ingeteam Australia		

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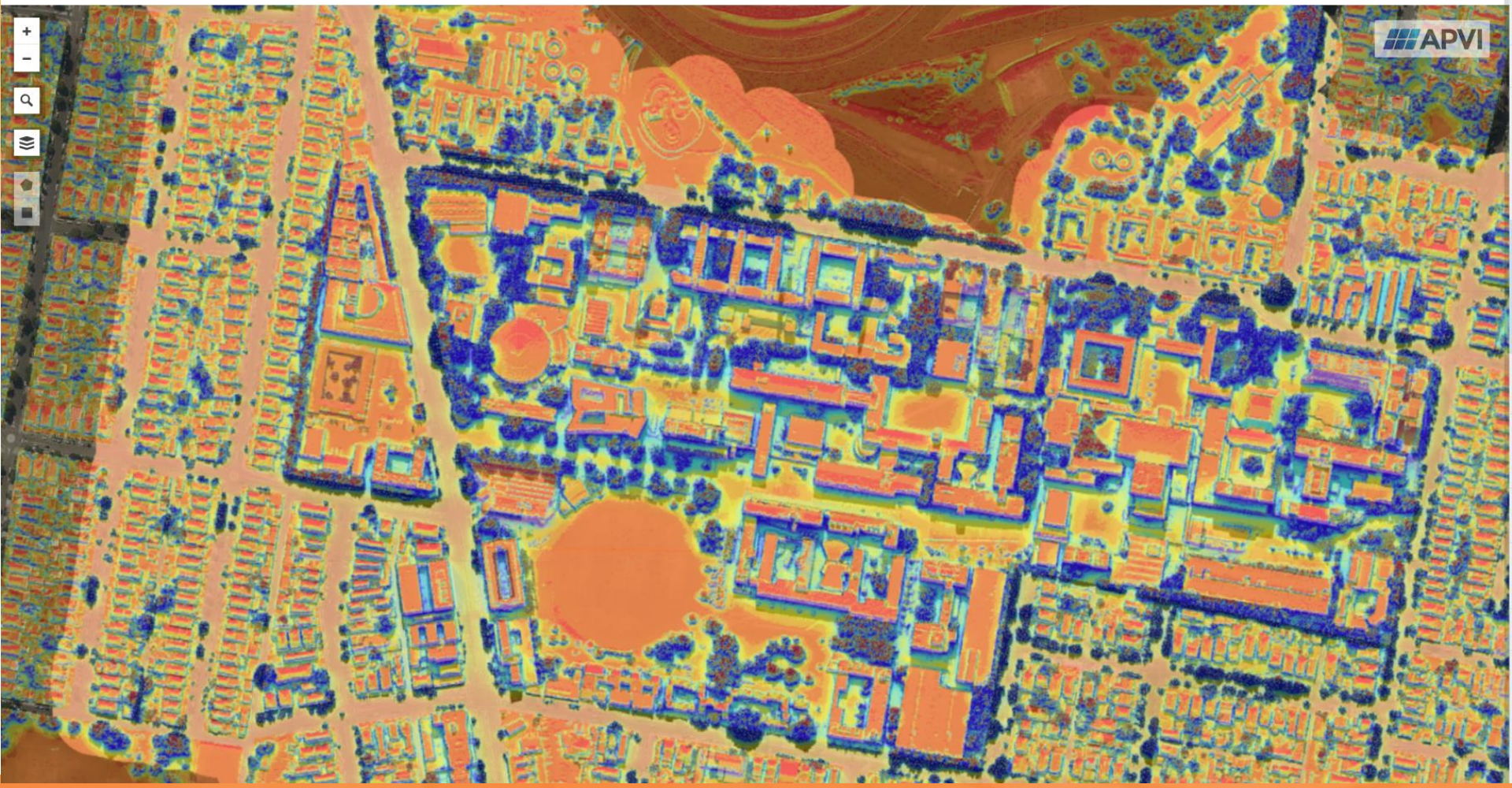
SunSPoT Solar Potential Map

Help

More information on how to use the map is located here



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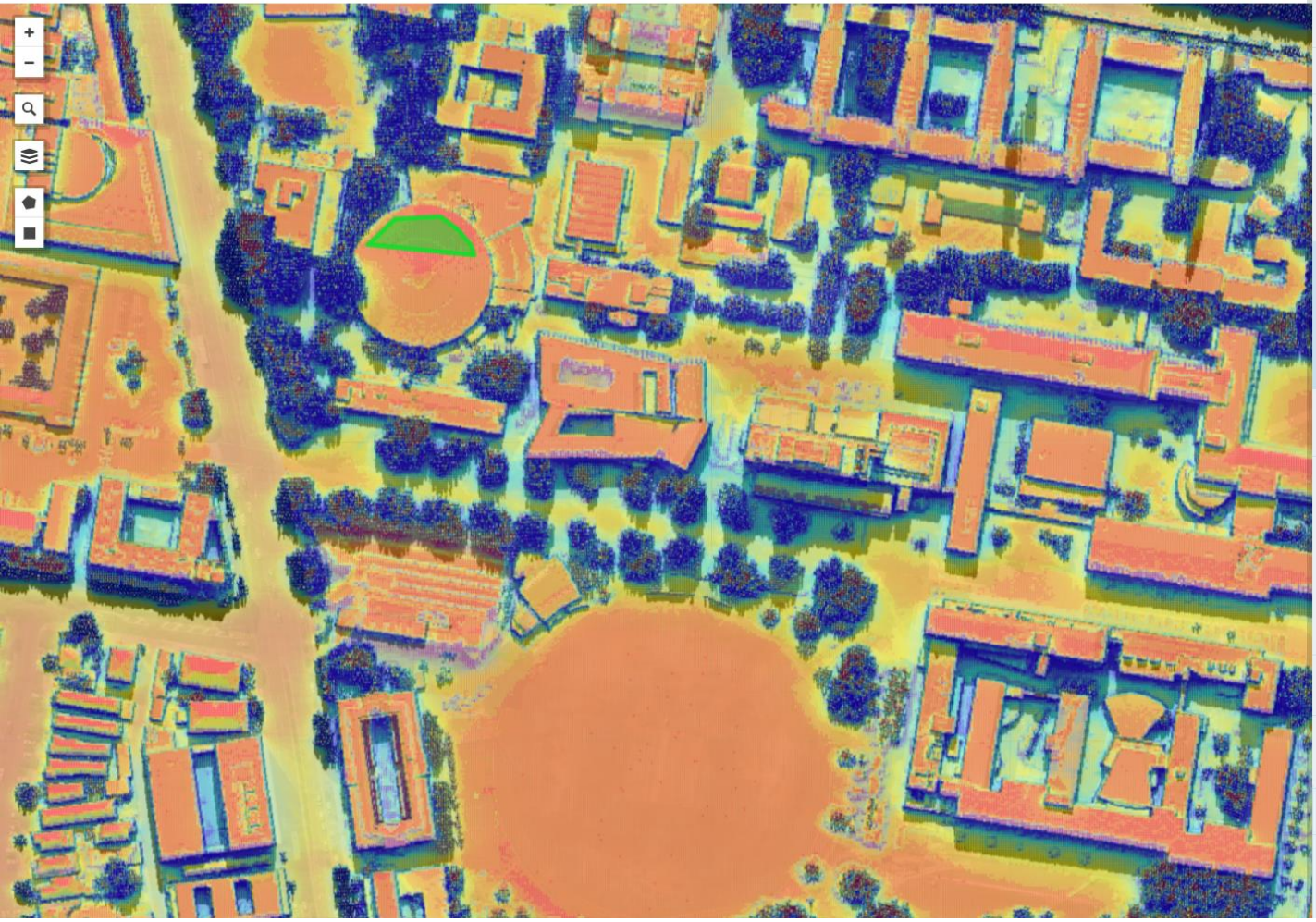
SunSPoT Solar Potential Map

Help



SELECTED AREA — Clear selection

Approximate area	400.58m^2

Insolation	Orientation	Tilt
4.52 kWh/m^2/day	358°	9°

OPTIONS

Flush mounted | Rack mounted

Flush mounted system size 62.5 kW

AC power output per month

Annual AC output	79,295.75 kWh
Annual output per kW of installed capacity	1,268.73 kWh/kW

Estimated annual value	Annual CO_2 offset
$19,823.94	63,040.12 kg
at 25 ¢ per kWh	at 0.84 kg per kWh

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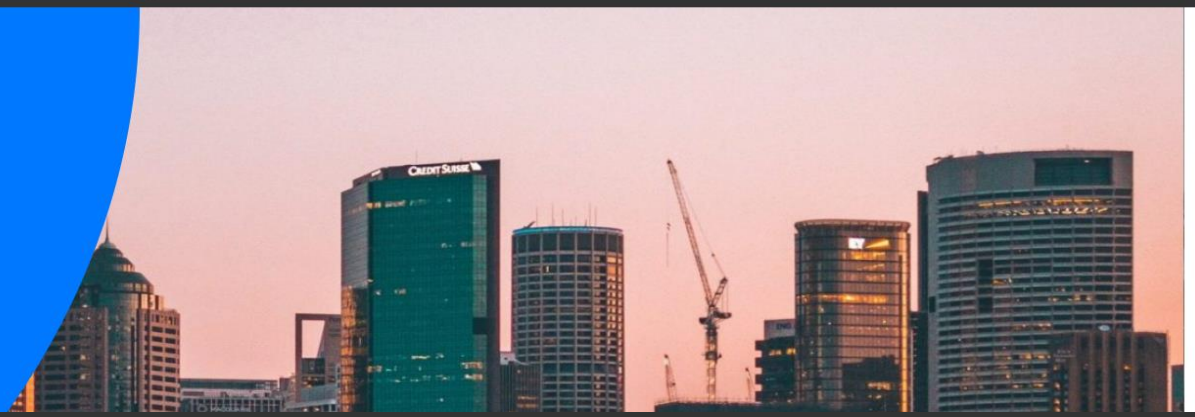

What's the score?

New report reveals Sydney's urban wins and fails

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Research Programs

Beyond Behaviour Change

The Beyond Behaviour Change research program draws on theories of social practice to inform research aimed at reorienting policy and programs intending to achieve social and environmental change.

+ Find out more

Research Programs

Climate Change and Resilience

Engaging with society's climate change challenges

+ Find out more

Research Programs

Critical Urban Governance

The Critical Urban Governance program brings together urban researchers and educators at RMIT to focus critical attention on how cities are governed, and for whom.

+ Find out more

Research Programs

Healthy Liveable Cities Group

Learning more about the relationship between health and the places people live, work, learn and play can better prepare us for the challenges of tomorrow.

+ Find out more

Research Programs

Housing and Urban Economics

Developing a better understanding of how policy and economic activities can be enacted to improve micro- and macro-economic prosperity.

+ Find out more

Research Programs

Interdisciplinary Conservation Science

The Interdisciplinary Conservation Science Research Group is a team of researchers working to understand the interaction between society and our environment.

+ Find out more

Research Programs

Planning and Transport in City Regions

The Planning and Transport in City Regions Program seeks to understand processes of urban development and patterns of mobility at the metro-regional scale.

+ Find out more

Research Programs

Urban Cultures and Technologies

This program examines the interplay of culture, technology and city spaces.

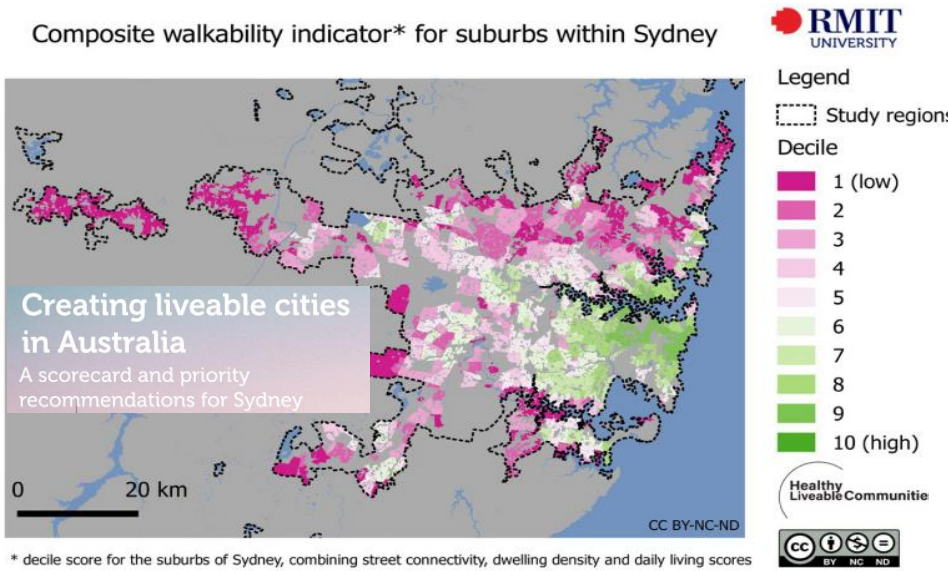
+ Find out more

What makes a liveable city?

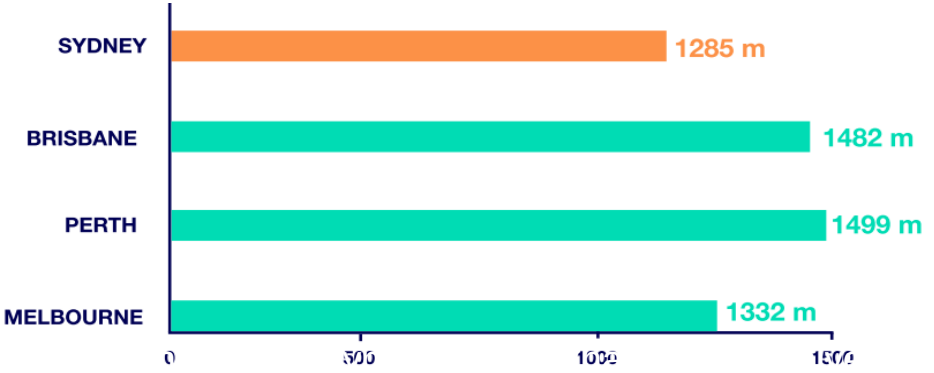
The term 'liveability' is widely used in Australia and across the world, yet it is rarely defined. We define a 'liveable' community as one that is:

> 'safe, attractive, socially cohesive and inclusive, and environmentally sustainable; with affordable and diverse housing linked by convenient public transport, walking and cycling infrastructure to employment, education, public open space, local shops, health and community services, and leisure and cultural opportunities [1].'

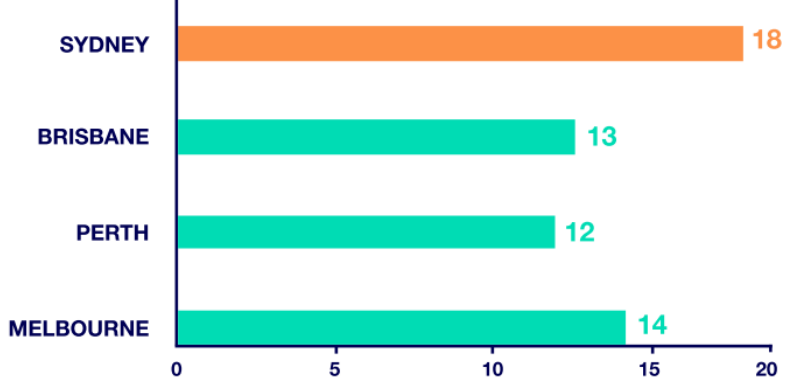
Liveable, walkable neighbourhoods can improve public health, and can increase environmental, economic and social sustainability [2, 3]. Creating healthy, liveable communities will therefore help cities achieve the United Nations Sustainable Development Goals [4] and United Nations Habitat's New Urban Agenda [5]. We have identified seven domains that help make neighbourhoods liveable:



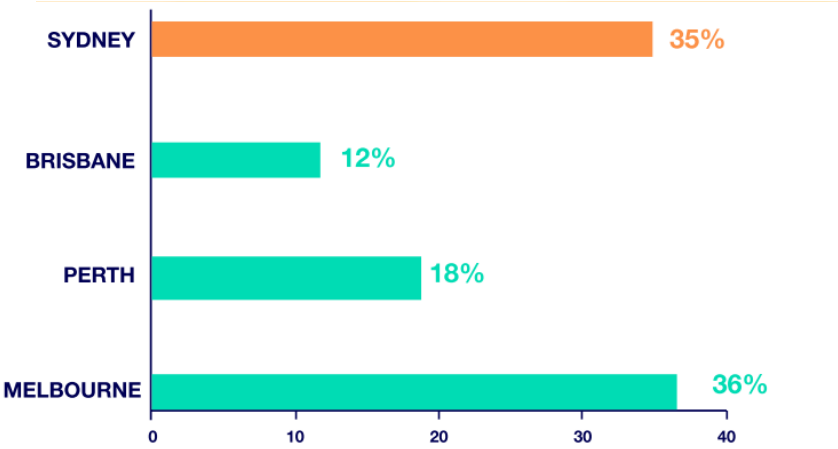
* decile score for the suburbs of Sydney, combining street connectivity, dwelling density and daily living scores



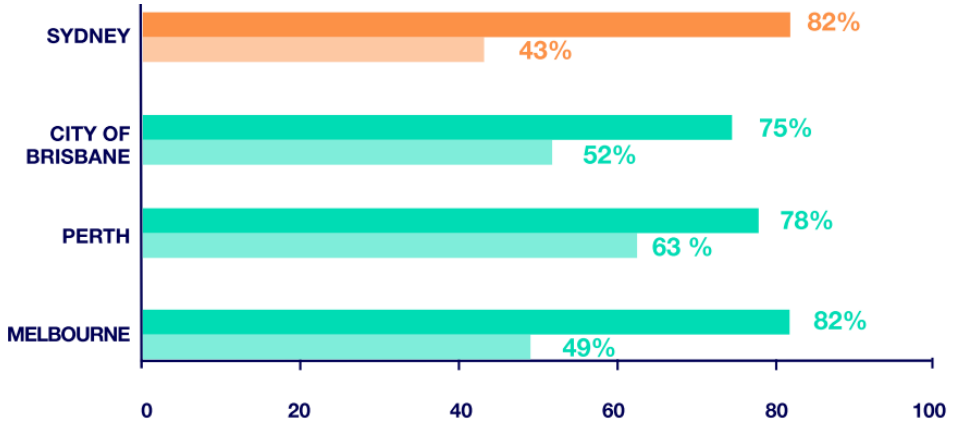
Average distance in meters to the closest activity centre



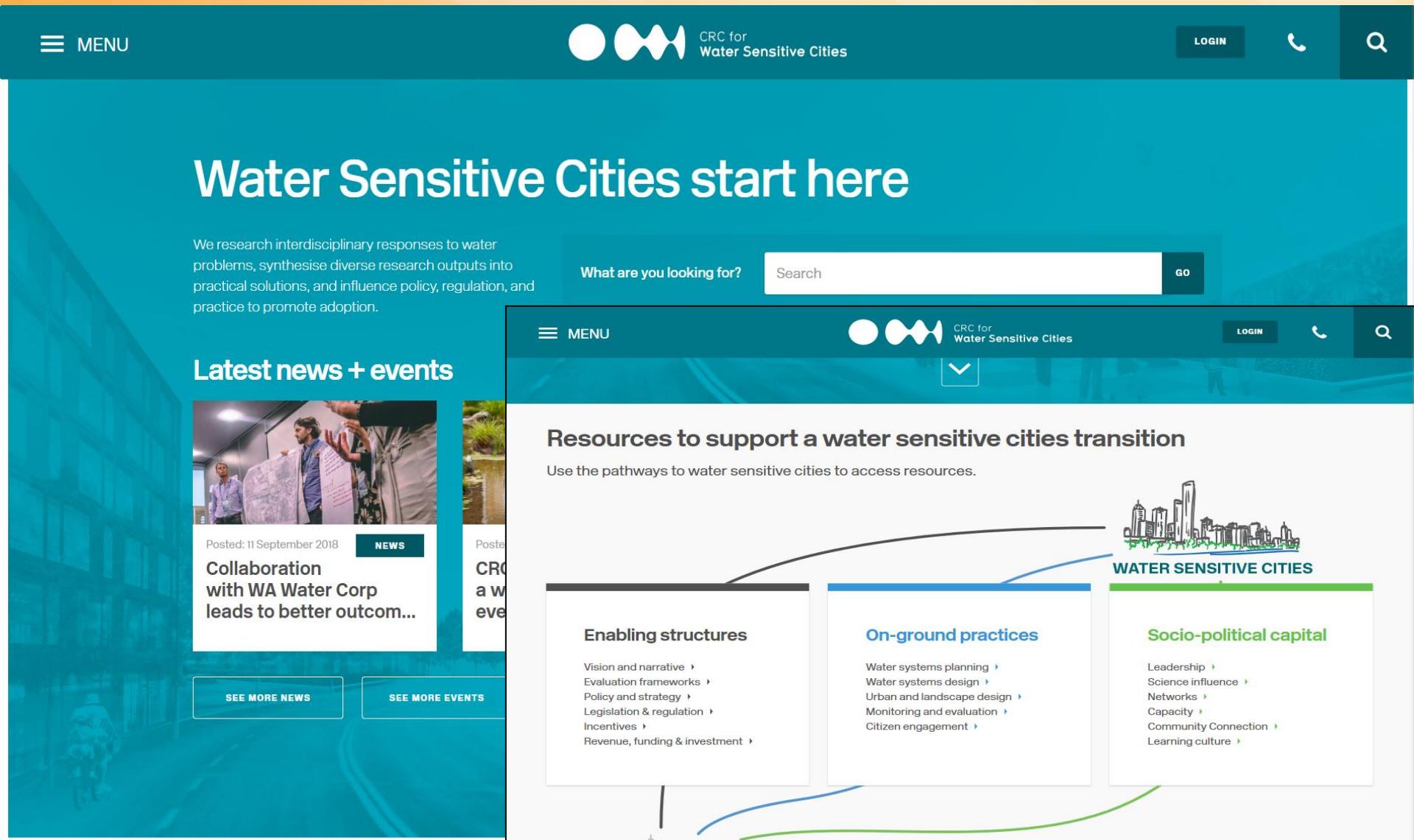
Dwelling density (dwellings per hectare)



Percentage of residences within 400 m of a public transport stop with a service at least every 30 mins



Top bar: Percentage of residences within 400 m of a public open space
Bottom bar: Percentage of residences within 400 m of a public open space larger than 1.5 hectares


MENU
CRC for Water Sensitive Cities
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Water Sensitive Cities start here
We research interdisciplinary responses to water problems, synthesise diverse research outputs into practical solutions, and influence policy, regulation, and practice to promote adoption.
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Resources to support a water sensitive cities transition
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WATER SENSITIVE CITIES
Enabling structures
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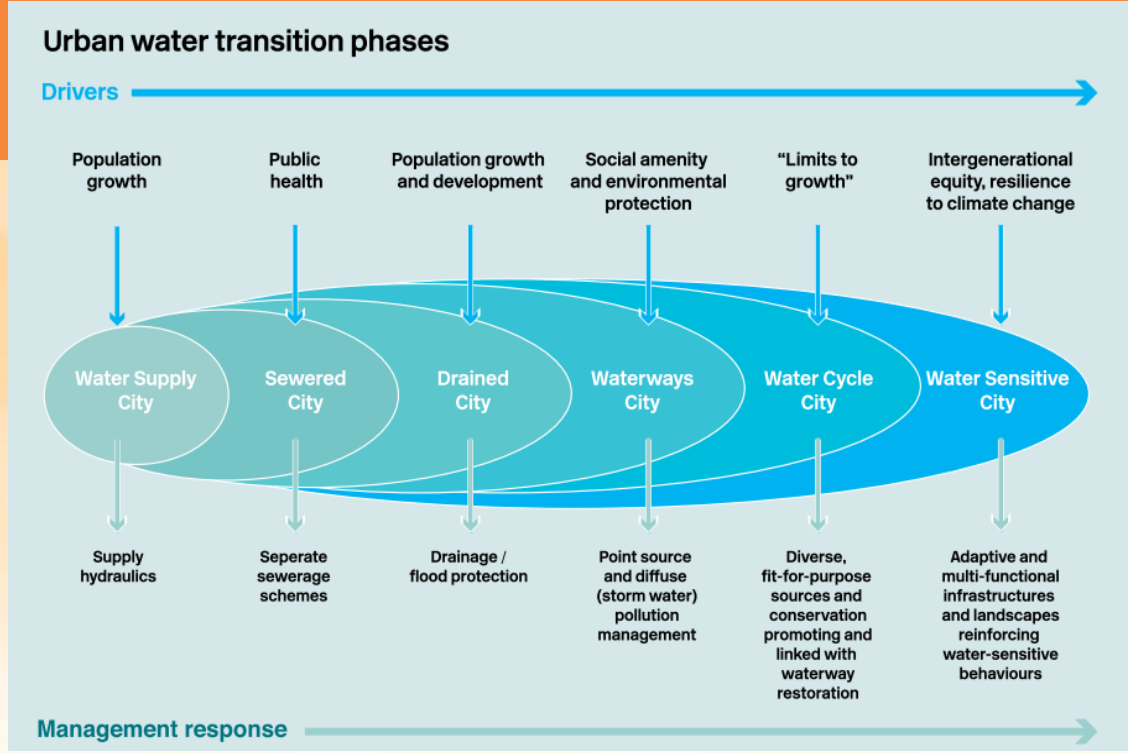
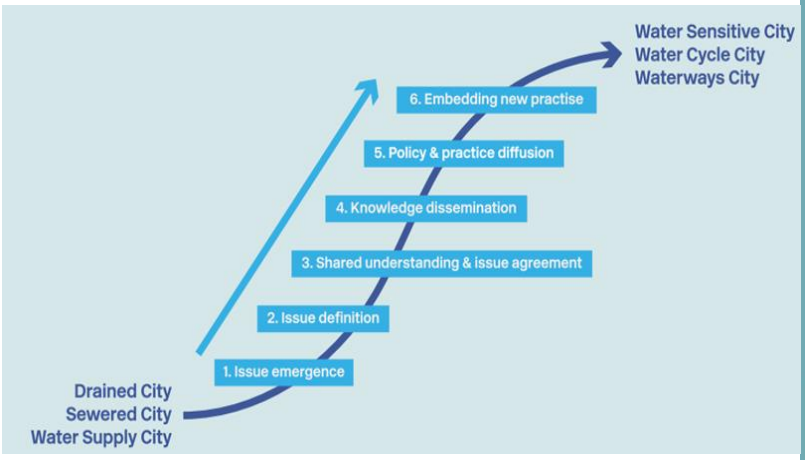
Evaluation frameworks
Policy and strategy
Legislation & regulation
Incentives
Revenue, funding & investment
On-ground practices
Water systems planning
Water systems design
Urban and landscape design
Monitoring and evaluation
Citizen engagement
Socio-political capital
Leadership
Science influence
Networks
Capacity
Community Connection
Learning culture
CURRENT SYSTEMS

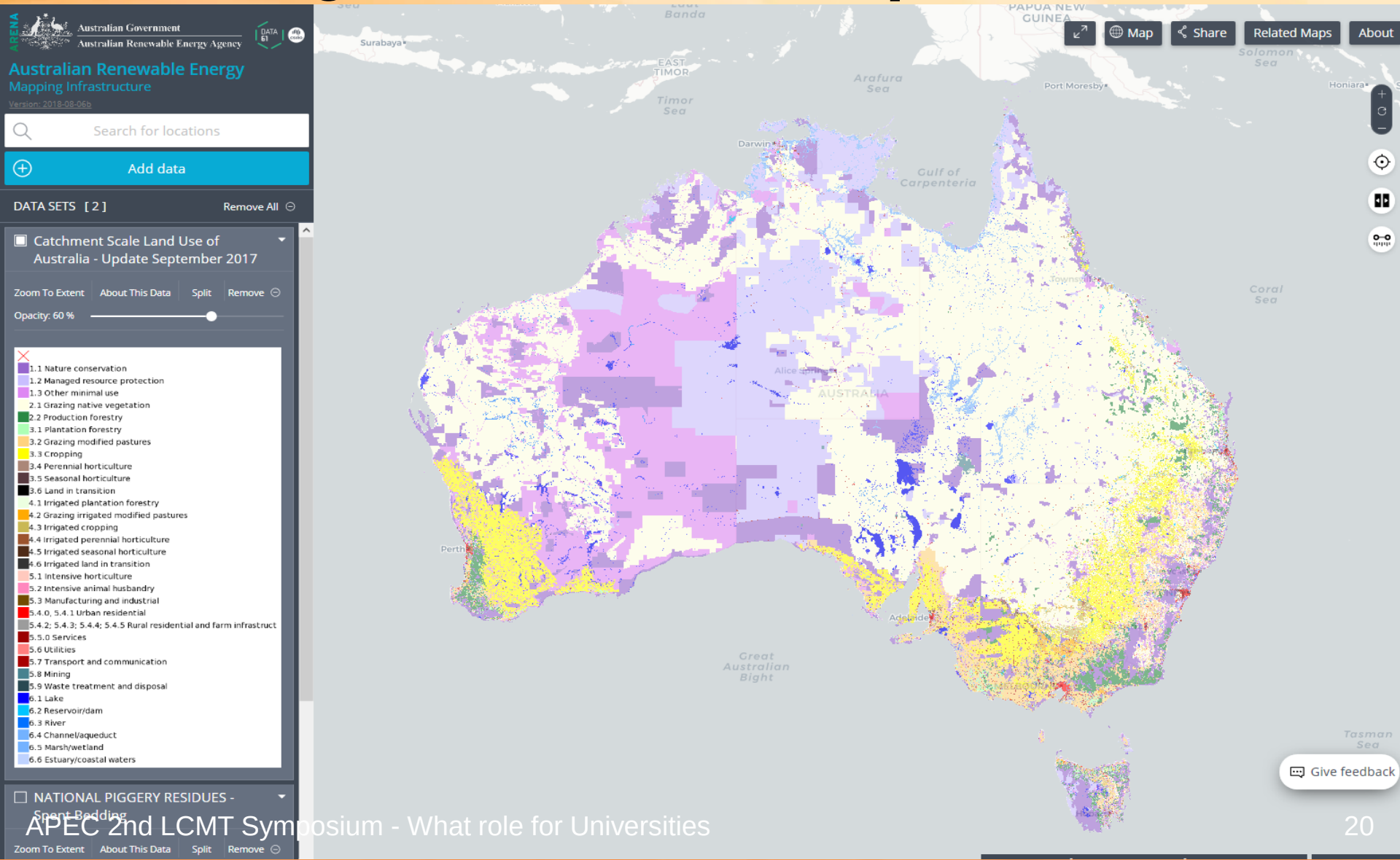

Water Utilities of the Future
Australia's experience in starting the transition
CRC for Water Sensitive Cities
Australian Government Department of Industry, Innovation and Science | Business Cooperative Research Centres Programme
ThinkTank

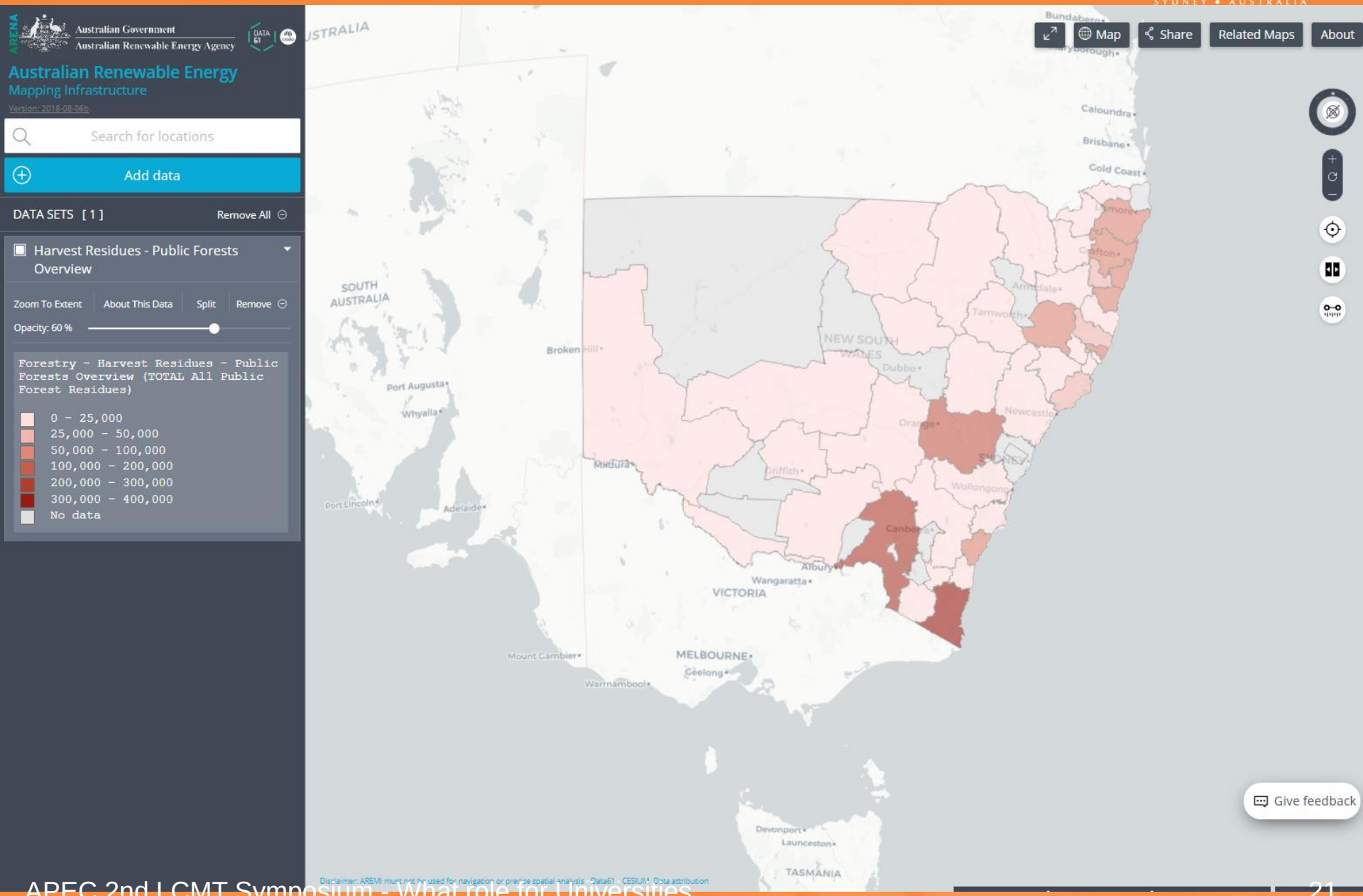

Urban water transition phases
Drivers
Population growth
Public health
Population growth and development
Social amenity and environmental protection
"Limits to growth"
Intergenerational equity, resilience to climate change
Water Supply City
Sewered City
Drained City
Waterways City
Water Cycle City
Water Sensitive City
Supply hydraulics
Seperate sewerage schemes
Drainage / flood protection
Point source and diffuse (storm water) pollution management
Diverse, fit-for-purpose sources and conservation promoting and linked with waterway restoration
Adaptive and multi-functional infrastructures and landscapes reinforcing water-sensitive behaviours
Management response


Water Sensitive City
Water Cycle City
Waterways City
6. Embedding new practise
5. Policy & practice diffusion
4. Knowledge dissemination
3. Shared understanding & issue agreement
2. Issue definition
1. Issue emergence
Drained City
Sewered City
Water Supply City


FUTURE
Urban Water Policy Reform
• Water for Victoria
Working with community
• Involving community in setting prices and service levels
• Mobilising community action during extreme events
• Increasing access to assets to increase community value
Building industry capacity to effect change
• Stormwater quality and flood management
Efficiency and innovation in core services
• Improving the efficiency of existing networks
• Digital innovation
• Diversifying and integrating water sources
• Establishing a culture of innovation and collaboration
State-owned Enterprises
New business models
• Green waste to energy
• Partnering for innovative servicing solutions
EXISTING WATER UTILITIES
"Activism", Demonstration, Proof-of concept and advocacy for policy reform
• Precinct-scale stormwater harvesting
Internal Initiatives
External Initiatives
New authorising environment

Facilitating collaboration – **open data**




Australian Government
Australian Renewable Energy Agency
Australian Renewable Energy
Mapping Infrastructure
Version: 2018-08-06b
Search for locations
Add data
DATA SETS [1]
Remove All
Harvest Residues - Public Forests Overview
Zoom To Extent
About This Data
Split
Remove
Opacity: 60 %
Forestry - Harvest Residues - Public Forests Overview (TOTAL All Public Forest Residues)
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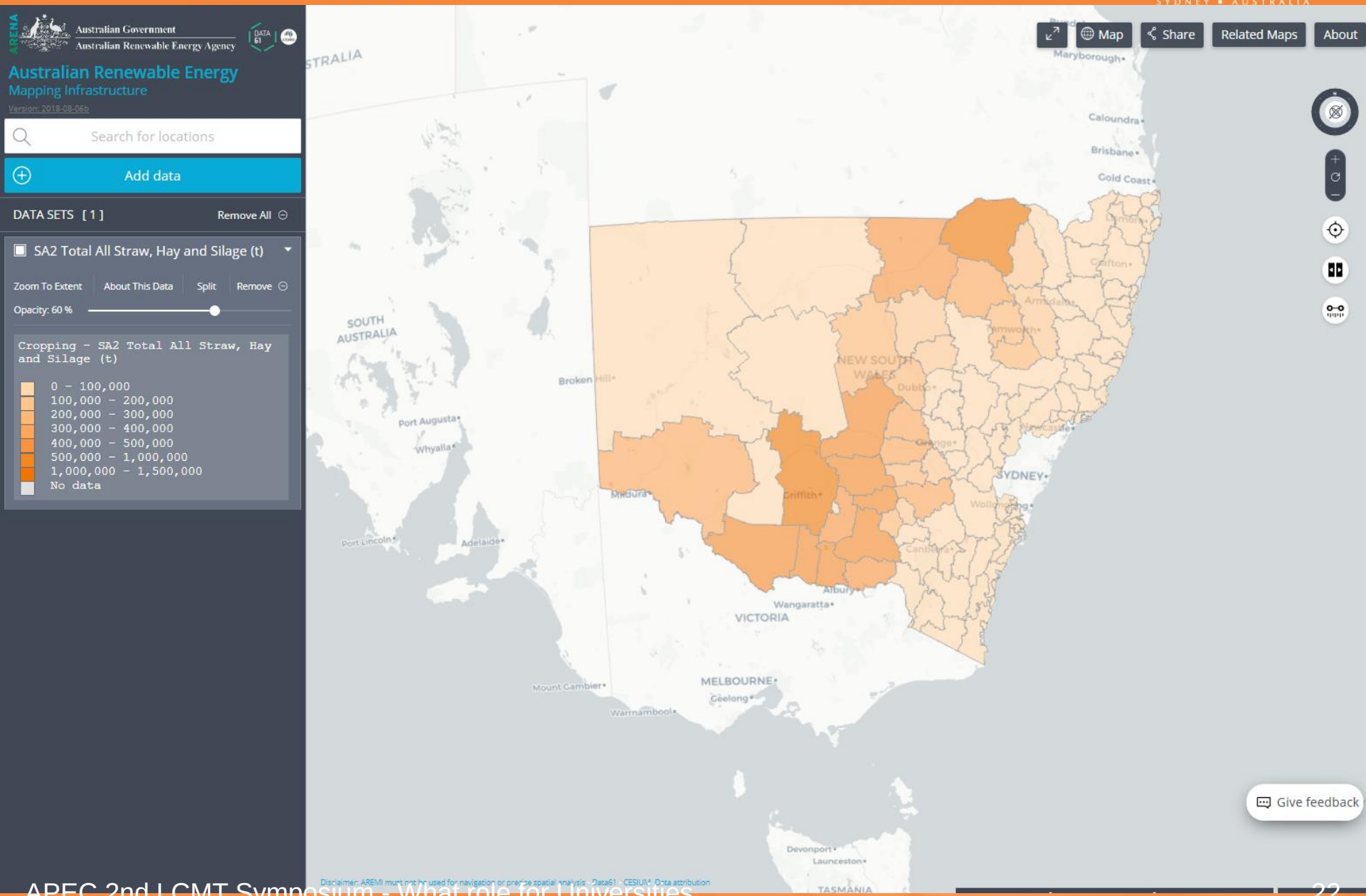
25,000 - 50,000
50,000 - 100,000
100,000 - 200,000
200,000 - 300,000
300,000 - 400,000
No data
Map
Share
Related Maps
About
Give feedback
SOUTH AUSTRALIA
NEW SOUTH WALES
VICTORIA
TASMANIA
Broken Hill
Port Augusta
Whyalla
Mildura
Port Lincoln
Adelaide
Mount Gambier
Warrnambool
MELBOURNE
Geelong
Wangaratta
Albury
Canberra
SYDNEY
Wollongong
Orange
Dubbo
Tamworth
Armidale
Newcastle
Grafton
Coffs Harbour
Gold Coast
Brisbane
Caloundra
Devonport
Launceston


Australian Government
Australian Renewable Energy Agency
Australian Renewable Energy
Mapping Infrastructure
Version: 2018-08-06b
Search for locations
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Remove All
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Opacity: 60 %
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Share
Related Maps
About
Give feedback
SOUTH AUSTRALIA
NEW SOUTH WALES
VICTORIA
TASMANIA
SYDNEY
MELBOURNE
Broken Hill
Port Augusta
Whyalla
Mildura
Griffith
Port Lincoln
Adelaide
Mount Gambier
Warrnambool
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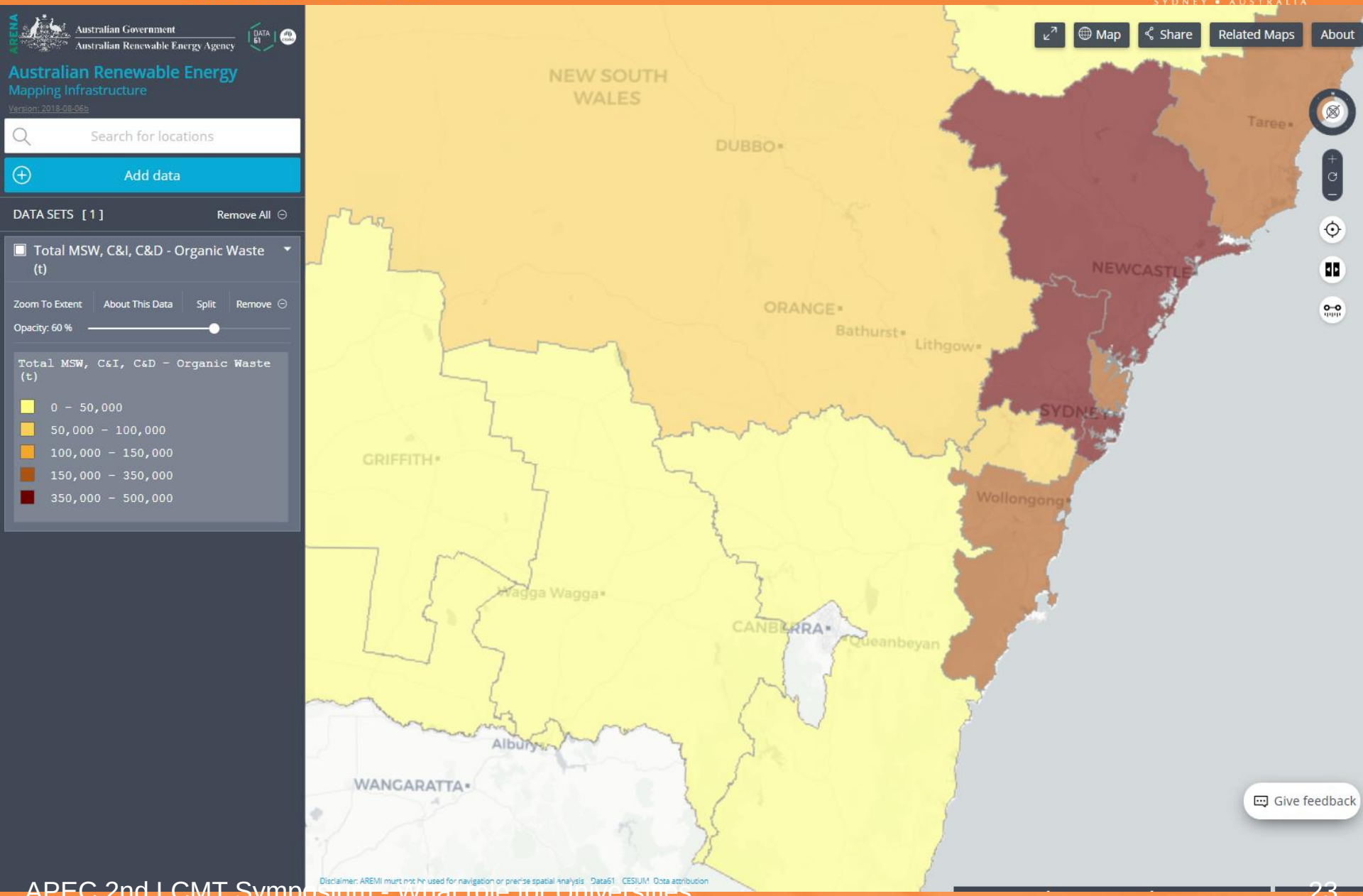
Albury
Wangaratta
Maryborough
Caloundra
Brisbane
Gold Coast
Dubbo
Canberra
Devonport
Launceston


Australian Government
Australian Renewable Energy Agency
Australian Renewable Energy
Mapping Infrastructure
Version: 2018-08-06b
Search for locations
Add data
DATA SETS [1]
Remove All
Total MSW, C&I, C&D - Organic Waste (t)
Zoom To Extent
About This Data
Split
Remove
Opacity: 60 %
Total MSW, C&I, C&D - Organic Waste (t)
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150,000 - 350,000
350,000 - 500,000
Map
Share
Related Maps
About
NEW SOUTH WALES
DUBBO
Taree
NEWCASTLE
ORANGE
Bathurst
Lithgow
SYDNEY
GRIFFITH
Wollongong
Wagga Wagga
CANBERRA
Queanbeyan
Albury
WANGARATTA
Give feedback

Transport Roads & Maritime Services

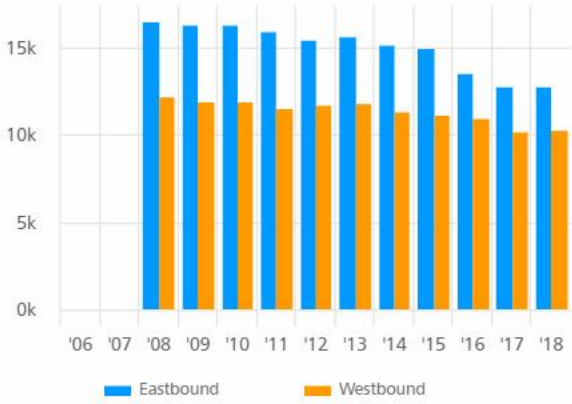
Traffic Volume Viewer

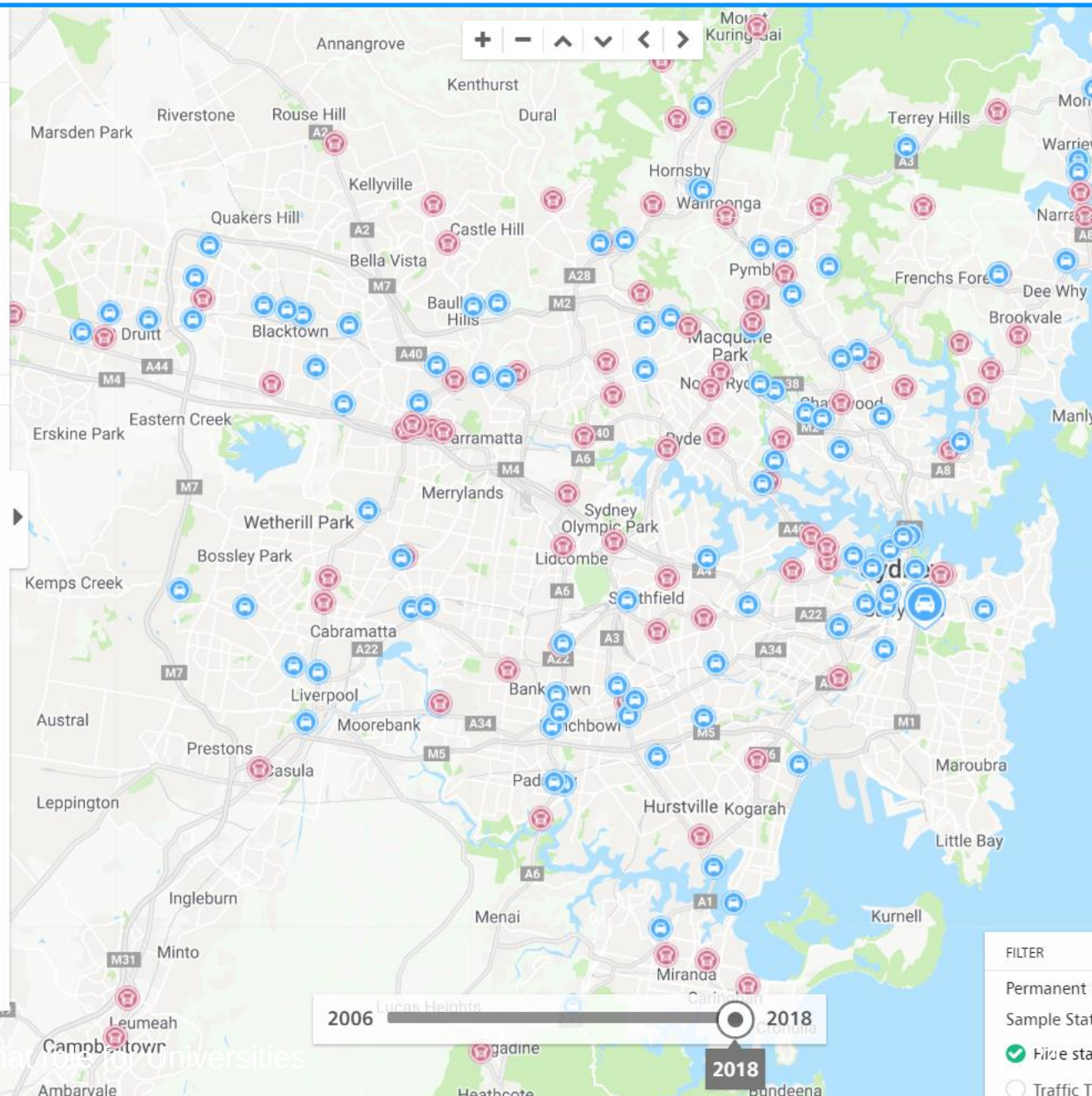
Cleveland Street

Location
60m West of Anzac Parade, Moore Park 2021

★★★★☆
Station Id: 03022

All Days





Centre for Energy and Environmental Markets

…and open-source tools

openmod open energy modelling initiative

Energy scientists must show their workings

Public trust demands greater openness from those whose research is used to set policy, argues **Stefan Pfenninger**.

The global transition towards a clean and sustainable energy future is well under way. New figures from Europe this month show that the continent is on track to reach its goal of a 20% renewable-energy share by 2020, and renewable capacity in China and the ical and economic s used to underpin on, and yet energy t open to scrutiny. ne economic and l NEMS) are met ergy Information onounces: "Most found out that it

that remain hidden, like the costs of technologies, can largely determine what comes out of such models. In the United Kingdom, opaque and overly optimistic cost assumptions for onshore wind went into models used for policymaking, and that may well have delayed the country's decarbonization.

This closed culture is alien to younger researchers, who grew up with collaborative online tools and share code and data on platforms such as GitHub. Yet academia's love affair with metrics and the pressure to publish set the wrong incentives: every hour spent on cleaning up a data set for public release or writing open-source code is time not spent working on a peer-reviewed paper.

Nevertheless, some academic-led projects are pushing towards more openness. The Enipedia project is building a worldwide open database on power plants, with data such as their locations and emissions. The Open Power System Data project gathers data such as electricity consumption from government agencies and transmission-network operators, and pushes for clarity on the licensing under which these data are made available. The Open Energy Modelling Initiative is emerging as a platform for coordinating and strengthening such efforts.

BLACK-BOX SIMULATIONS CANNOT BE VERIFIED, DISCUSSED OR CHALLENGED.

Regulation can also help. The European Union has mandated open access to electricity-market data, resulting in the creation of the ENTSO-E Transparency Platform to hold it, and there are good arguments for the creation of national energy-data agencies to coordinate the collection and archiving of a range of important data.

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tes to policies on n — that produce ny, and so can be driving forces that l and solar power. e not openly avail- er the security of l scrutiny; worries ontext; and a lack

nown that closed mple is the spread- Rogoff paper used y. The European model that could sm. Assumptions

The vast majority of published research is still untouched by these fledgling initiatives. Only one energy journal — *Energy Economics* — currently requires data and models alongside submissions. Other journals should follow suit.

The open sharing of code and data is also important because it permits more meaningful collaboration between academics. Sharing a DNA sequence in an established format is, of course, easier than sharing the unstructured assumptions behind a techno-economic scenario study, for which no standard format exists yet. So the energy community must decide on standards for sharing code, data and assumptions.

A change in journal policies would help to kick-start these discussions. In policy-focused research, where one 'truth' does not exist, one cannot assess whether a modelled scenario is 'correct', so the important yardstick is not truth, but trust. The arrival of the post-truth world shows that trust in experts is lower than ever — and surely this is partly the experts' fault. ■

Stefan Pfenninger *is a postdoctoral researcher in the Department of Environmental Systems Science, ETH Zurich, Switzerland.*
e-mail: stefan.pfenninger@usys.ethz.ch

Openmod in a nutshell

The Open Energy Modelling (openmod) Initiative promotes open energy modelling in Europe.

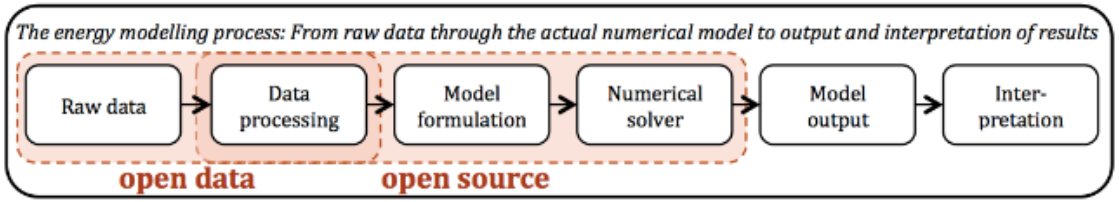
Energy models are widely used for policy advice and research. They serve to help answer questions on energy policy, decarbonization, and transitions towards renewable energy sources. Currently, most energy models are black boxes – even to fellow researchers.

"Open" refers to model source code that can be studied, changed and improved as well as freely available energy system data.

We believe that more openness in energy modelling increases transparency and credibility, reduces wasteful double-work and improves overall quality. This allows the community to advance the research frontier and gain the highest benefit from energy modelling for society.

We, energy modelers from various institutions, want to promote the idea and practice of open energy modeling among fellow modelers, research institutions, funding bodies, and recipients of our work.

The idea of openmod



Open Source Tools

CEEM's researchers believe in the value of open source modelling in the Energy and Environmental research space. In this regard, we have developed a series of open source tools which are listed below. For a list of some of our under development tools you can refer CEEM's Github page.

Nem Data Tool:

Nem-data is a simple tool for creating custom data sets using publicly available information about the Australian National Electricity Market (NEM).

Links: Github

National Electricity Market Optimiser (NEMO) Tool:

NEMO, the National Electricity Market Optimiser, is a chronological dispatch model for testing and optimising different portfolios of conventional and renewable electricity generation technologies. It has been developed since 2011 and is maintained by Ben Elliston through his PhD at CEEM. NEMO is available under a free software license (GPL version 3) and requires no proprietary software to run, making it particularly accessible to the governments of developing countries, academic researchers and students. The model is available for others to inspect and to validate results.

Links: Github, OzLabs

Tariff Design and Analysis (TDA) Tool:

We have developed a modelling tool to assist stakeholders wishing to contribute to network tariff design in the Australian National Electricity Market. It is an open source modelling tool to assist stakeholders in assessing the implications of different possible network tariff designs, and hence facilitate broader engagement in the relevant rule making and regulatory processes in the NEM. Our tool takes public energy consumption data from over 5000 households in NSW, and allows users test a wide range of existing, proposed and possible tariffs structures to see their impacts on network revenue and household bills. Demographic survey data of the households allows you to explore the impacts of these tariffs on particular household types – for example, families with young children. The tool can also show how well different tariffs align these household bills with a households' contribution to network peak demand. The tool and data are open source – you can check, validate and add your own data sets; test existing or even design your own tariffs, and validate and even modify the underlying algorithms.

Links: Project page, Github, Researchgate

Local Solar Sharing Scheme Model:

Intended for modelling embedded networks, local solar and peer to peer electricity networks. This software was developed by Naomi Stringer, Luke Marshall and Rob Passey at CEEM. A working build with a simple user interface for OSX can be found here.

Links: Github

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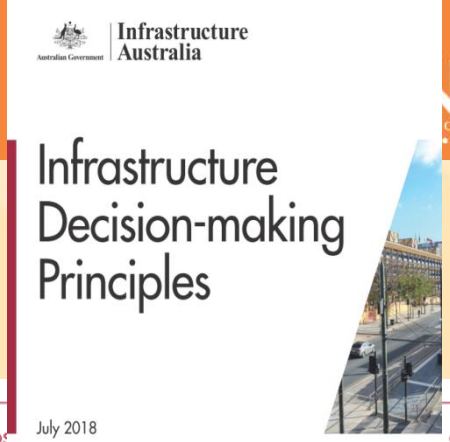
… and **open processes** for decision making



1. **Governments should quantify infrastructure problems and opportunities as part of long-term planning processes.**

   Plans should include analysis of the performance and service levels of existing networks under a range of future scenarios. Plans should also account for interdependencies with other infrastructure, changes in technology, market and regulatory developments that are likely to impact infrastructure services over the coming decades.

2. **Proponents should identify potential infrastructure needs in response to quantified infrastructure problems.**

   These infrastructure needs should be framed as broad potential responses that are likely to be required under several future scenarios. Governments should publicly release information on strategic planning processes to explain clearly to the community what the problem is, the cost of the problem, and proposed solutions.

3. **Proponents should invest in development studies to scope potential responses.**

   These development studies should seek to identify risks to the viability and delivery of these potential responses. As part of these development studies, proponents should consider a range of options, including those that make better use of existing infrastructure, or pursue reform of regulatory and pricing settings. Investment in development studies should be proportional to the scale of the problem.

4. **Where an infrastructure need is identified, governments should take steps to ensure potential responses can be delivered efficiently and affordably.**

   Governments should look to protect sites and corridors for likely future infrastructure investments, and ensure infrastructure needs are appropriately integrated into long-term land use plans.

5. **Governments should undertake detailed analysis of a potential project through a full business case and should not announce a preferred option or cost profile before undertaking detailed analysis involving multiple options.**

   Business cases should include rigorous examination of the potential project's benefits relative to its costs, show the project to be resilient to change under a range of future scenarios, and show the split between public and private benefits.

6. **Proponents should assess the viability of alternative funding sources for each potential project.**

   Proponents should look to minimise the call on public funds through consideration of a range of funding options, and determine a fair funding split between taxpayers, users and other beneficiaries.

7. **Project proposals should be independently assessed by an appropriate third party organisation.**

   For all nationally significant projects, proposals should be submitted to Infrastructure Australia and align with the *Assessment Framework*. For smaller projects or programs of investment, proposals should be independently assessed through structured and transparent review processes in each jurisdiction.

8. **Governments and proponents should undertake meaningful stakeholder engagement at each stage, from problem identification and option development to project delivery.**

   This engagement should seek early input and feedback from a range of stakeholders, including local communities, businesses and industry groups, infrastructure users, private infrastructure owners and operators, and, where public funding is required, taxpayers.

9. **Governments and proponents should publicly release all information supporting their infrastructure decisions.**

   This should include all analysis underpinning long-term plans, option development and assessment, through to full business cases once they have been independently assessed. Governments' and proponents' protection of information should be genuine and justifiable. In particular, commercial-in-confidence protections should only be used where a material commercial risk exists. Where risks are time-limited, governments and proponents should release information in full once risks are no longer relevant.

10. **Governments should commit to, develop and release post-completion reviews.**

    Delivery dates for staged reviews should be confirmed at the outset of a project, and released at set intervals following project delivery, including several years after commissioning. Reviews should focus on:

    - measuring whether the economic case for a project established in its business case is realised over time through performance measures
    - whether the project was delivered on time and on budget
    - whether unforeseen risks emerged and how they were managed
    - extracting lessons to feed into future infrastructure development and delivery processes.

11. **Where projects are funded as part of a broader program, the corresponding decision-making processes should be robust, transparent and prioritise value for money.**

    The objective, scope, scale and expected benefits of a funding program should be defined and reported openly against clear assessment criteria and objectives. Funding programs should be routinely assessed and reviewed to ensure investments are delivering against these objectives.

Summary

- Australian cities
  - A key and growing role in a highly urbanised economy
  - Growing challenges including carbon transition – mixed efforts to date
- Australian Universities
  - A welcome new focus on ‘real world’ impact
- Collaboration between Universities, Government and Industry
  - A growing range of examples in the low carbon, broader sustainability spheres
  - Stakeholder partnerships - are all ready, willing and able to contribute
  - Funding partnerships – end-user contributions from Government and Industry, in-kind from Universities all have a key role
- Facilitating collaboration
  - Open data
  - Open source models
  - Open processes for decision making

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Thank you… and *questions*

Many of our publications are available at:
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