



Adapting urban water supplies to climate change: an Australian experience

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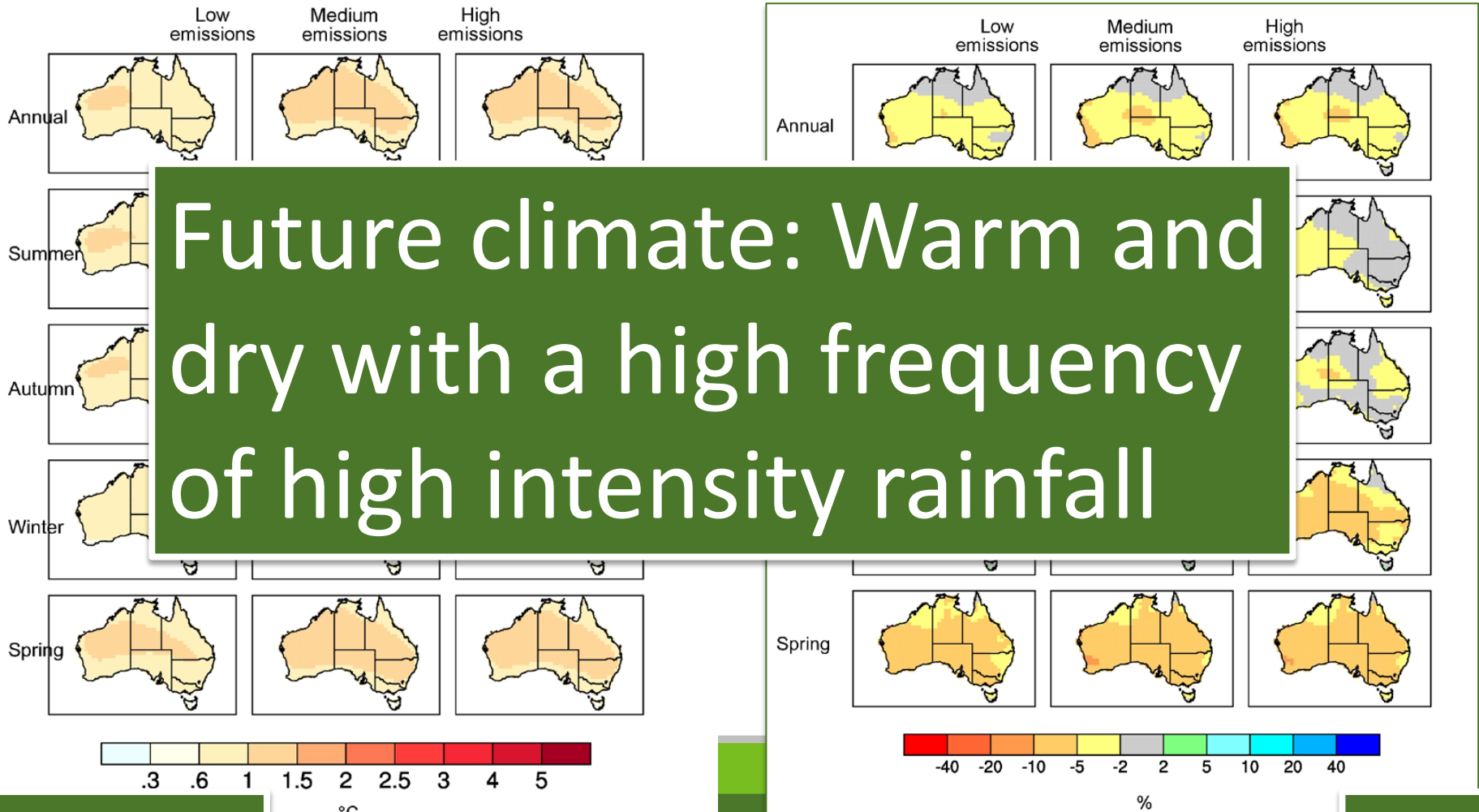
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LAND AND WATER
www.csiro.au



Climate change projections: 2030

- Temp: 0.6 -1.5 C increase; rainfall: 2%-10% decrease in winter/spring



Future climate: Warm and dry with a high frequency of high intensity rainfall

Temperature

Source: <http://www.climatechangeinaustralia.gov.au/>

rainfall

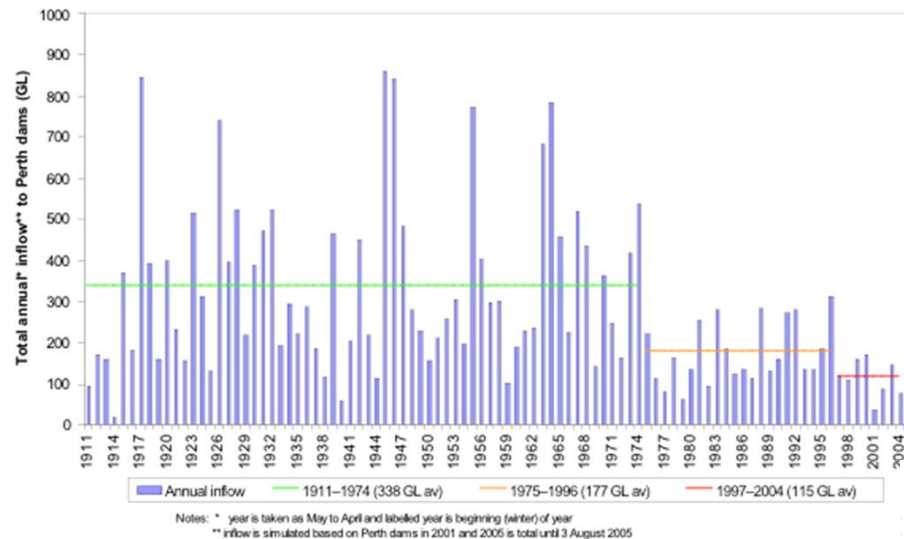
Water supplies in Australian cities

- Major supply of water is surface water stored in reservoirs; some cities use ground water (Perth)
- ~40% of urban water demand is outdoor use



Decreased trend in storage inflows in cities

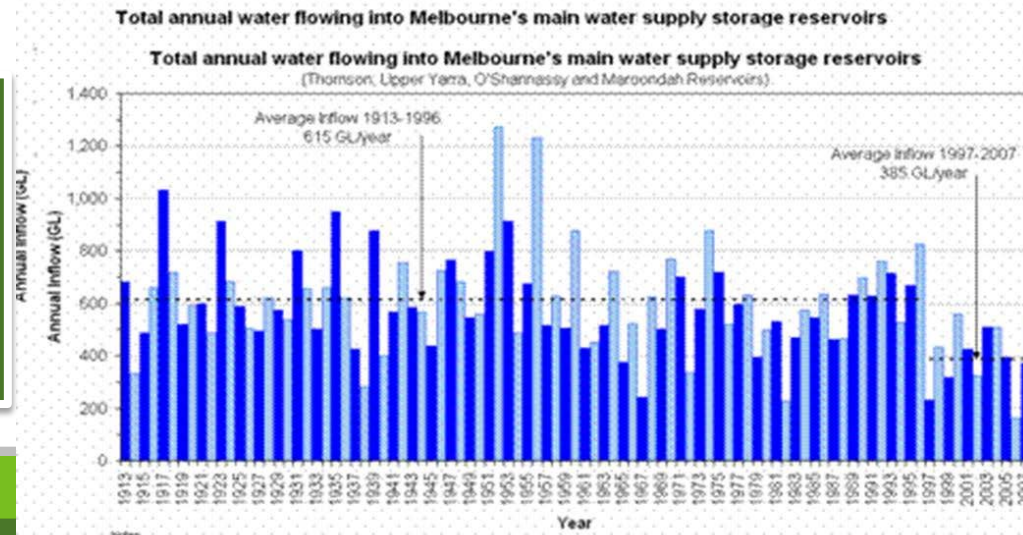
Perth's Annual Storage Inflow GL (1911-2005)



Perth: Since 1974, 47% lower than prior to 1974

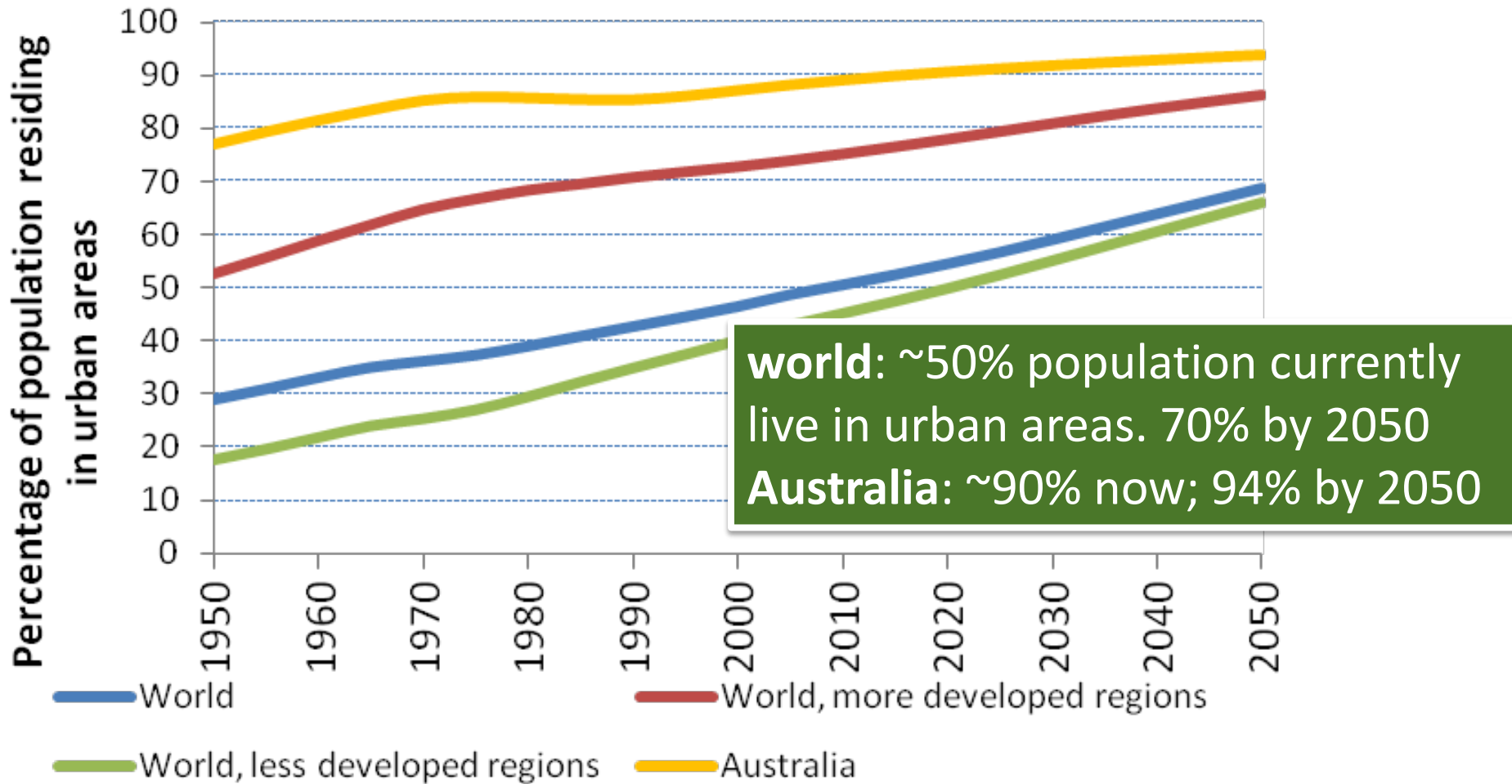
Melbourne: since 1997, 35% lower than prior to 1997

Melbourne's Annual Storage Inflow GL (1913-2007)



In Victoria, last 7 years the driest 7 years since records have been kept. Inflows to Melbourne storages since 1997 35% lower than prior to 1997.

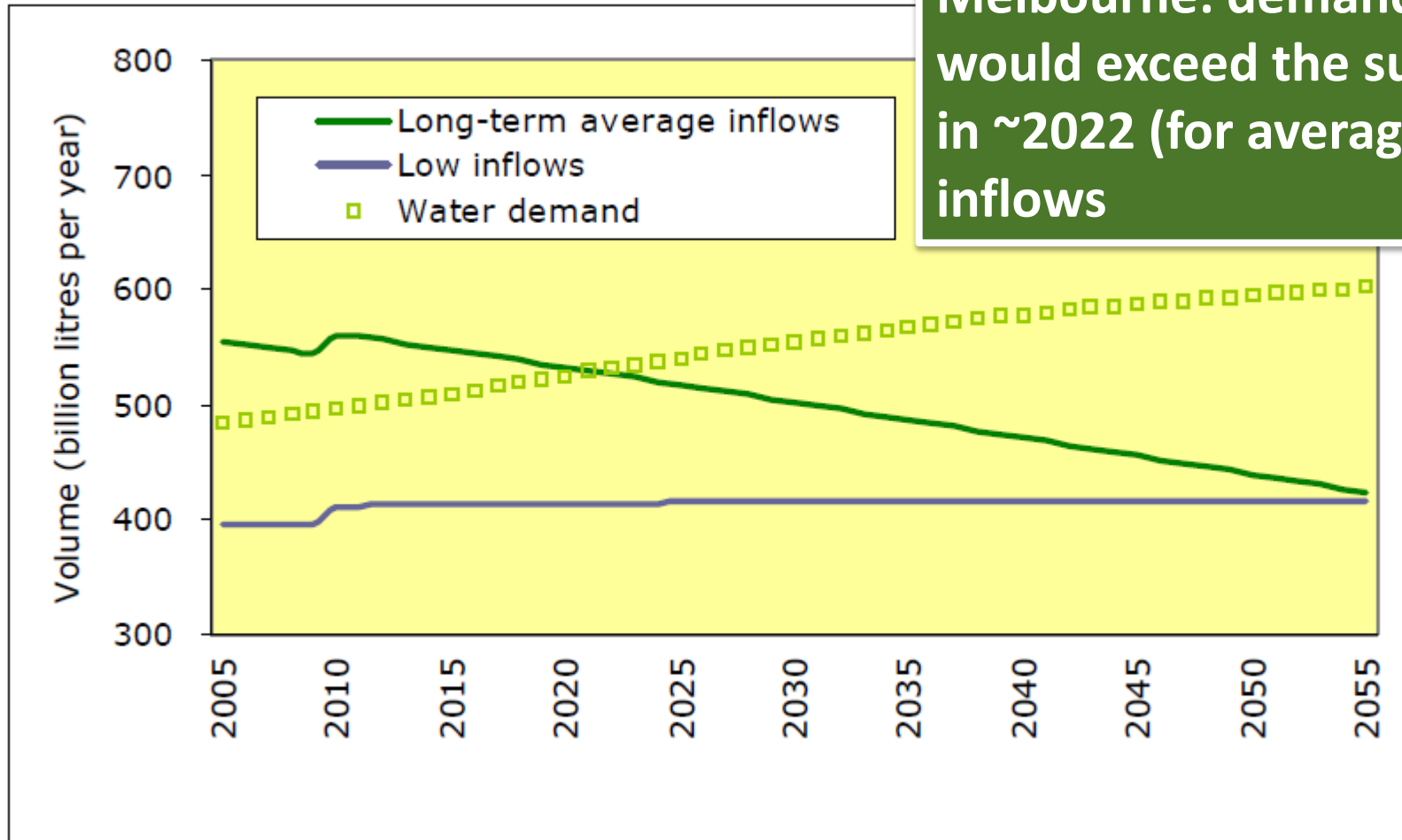
Urban areas are growing!



Data sourced from: United Nations, 2010

Supply and demand imbalance

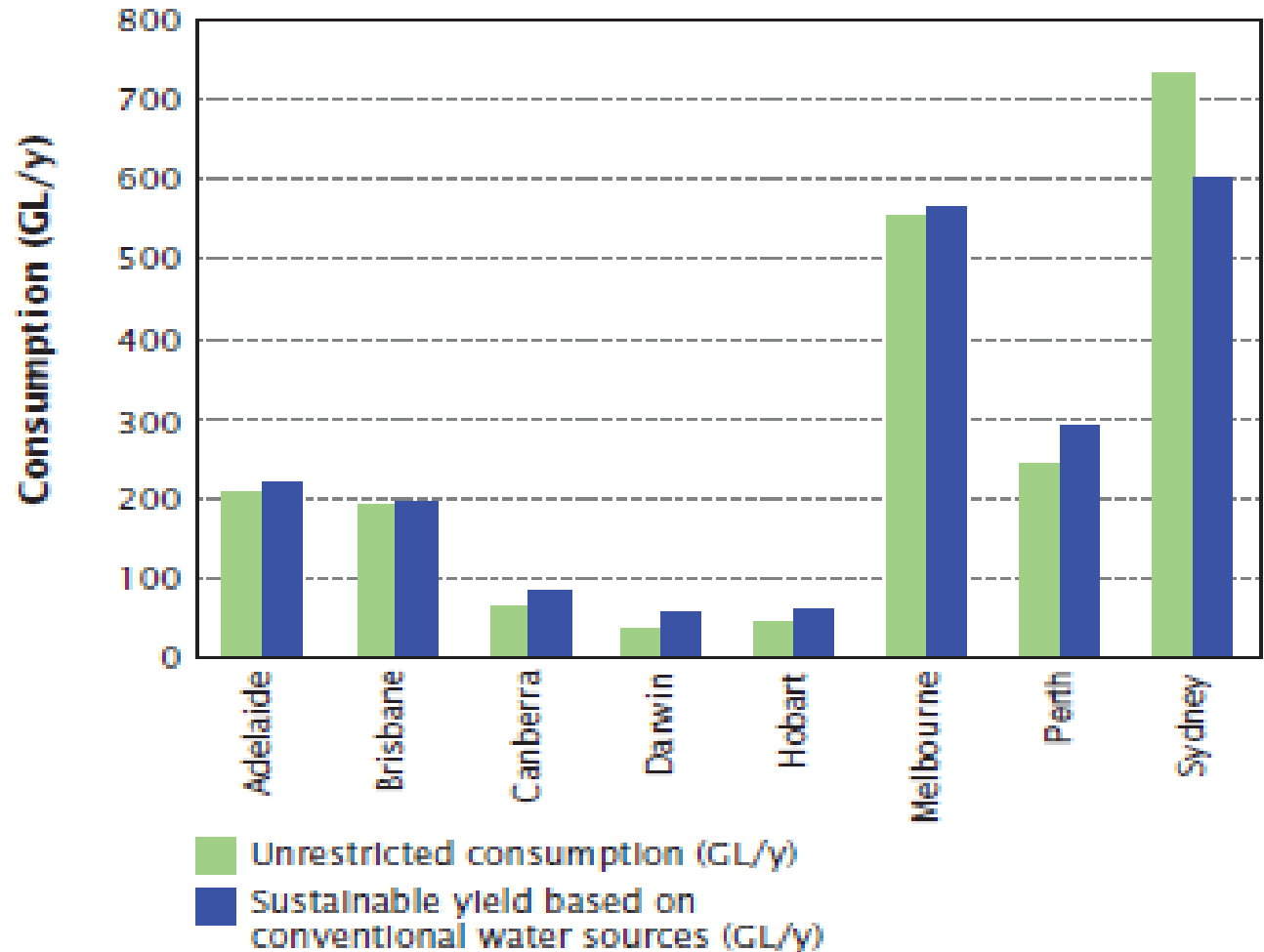
Melbourne: demand would exceed the supply in ~2022 (for average inflows)



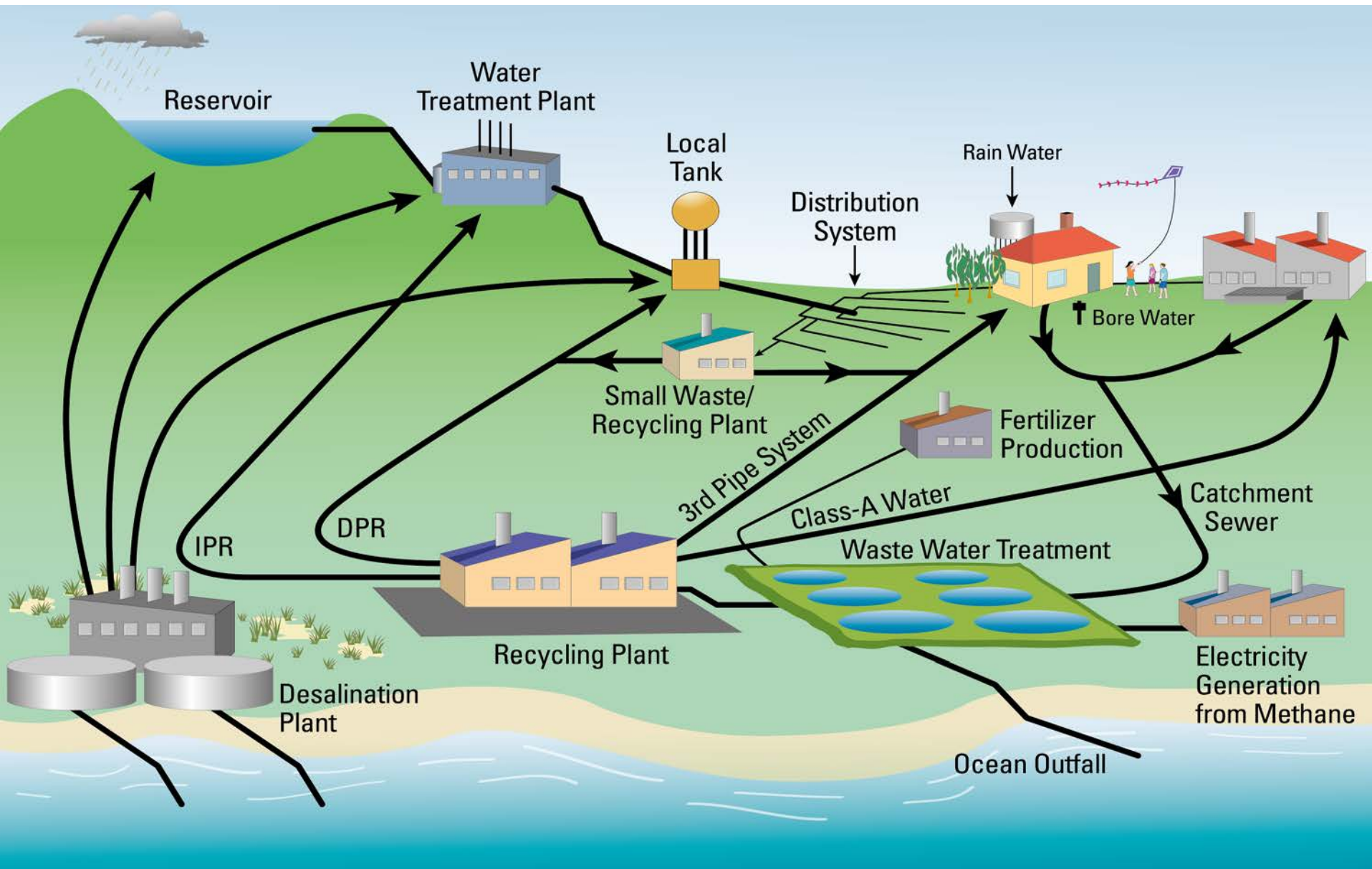
Source: Water supply and demand strategy for Melbourne 2006-2055

Supply-demand imbalance in Australian cities

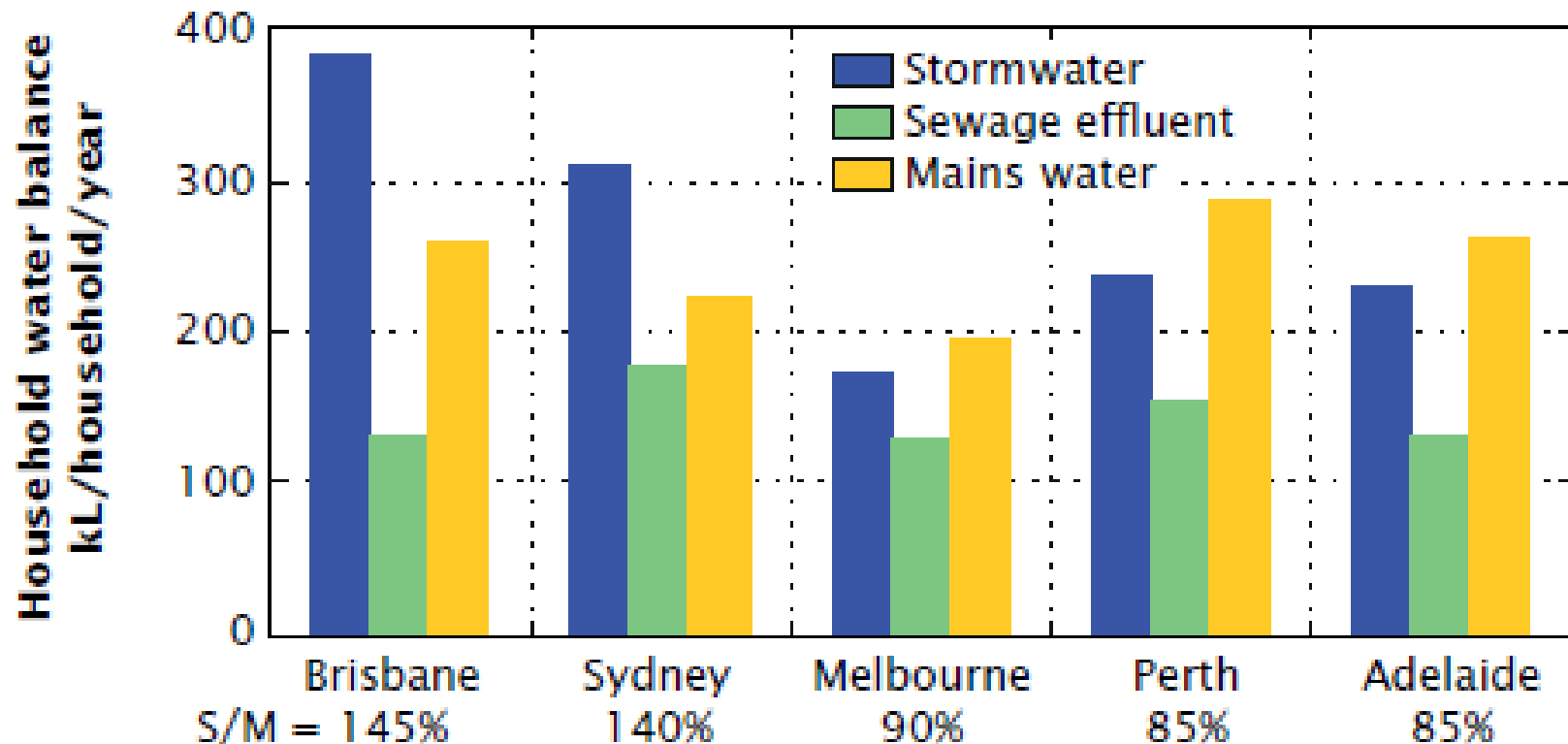
Comparison of unrestricted consumption vs sustainable yield based on conventional sources in 2001-02



Solution: Integrated Urban Water management

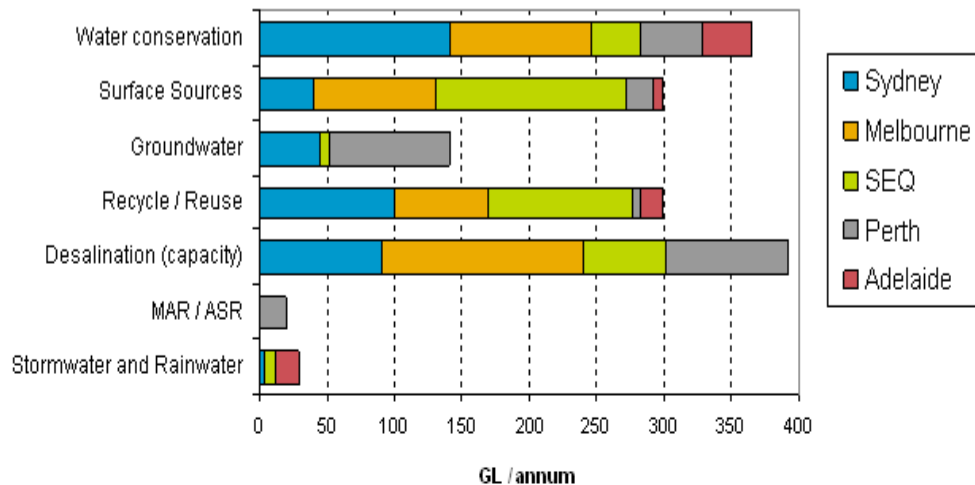


Seeking for alternative sources to balance supply and demand in major cities

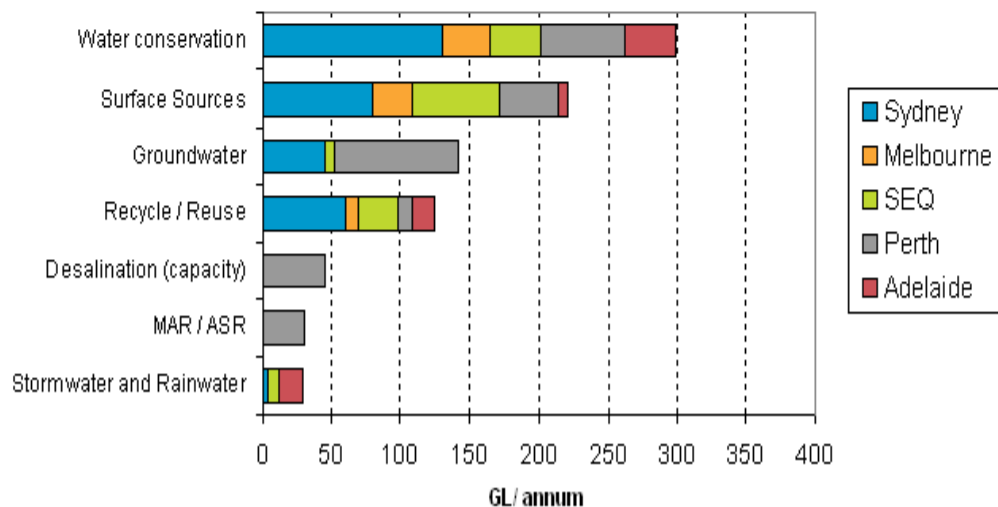


Adaption strategy: source diversification

Urban water strategies - 2007 - additional yields to 2030



Urban water strategies - 2005 - additional yields to 2030



Comparison of urban water strategies adopted in Australian major cities in 2005 and 2007: indicates expansion of supply portfolio, in addition to demand management

Preference for utilising climate-resilient sources

Table 7.2: Predicted water availability (in GL/year) in 2026 for Australia's capital cities.^{5,6,7,8,9}

	Current yield	2026 yield with climate change	Current desalination capacity	Total capacity (2026)	Urban water consumption 2009	Predicted consumption in 2026	Predicted surplus (deficit) 2026
Adelaide	216	194	100	294	138	176	118
Brisbane and SEQ	476	428	49				-22
Canberra	104	80	0				5
Darwin	42	38	0				-17
Hobart	803	723	0				683
Melbourne	555	500	150				134
Perth	256	230	95				38
Sydney	603	543	90				14

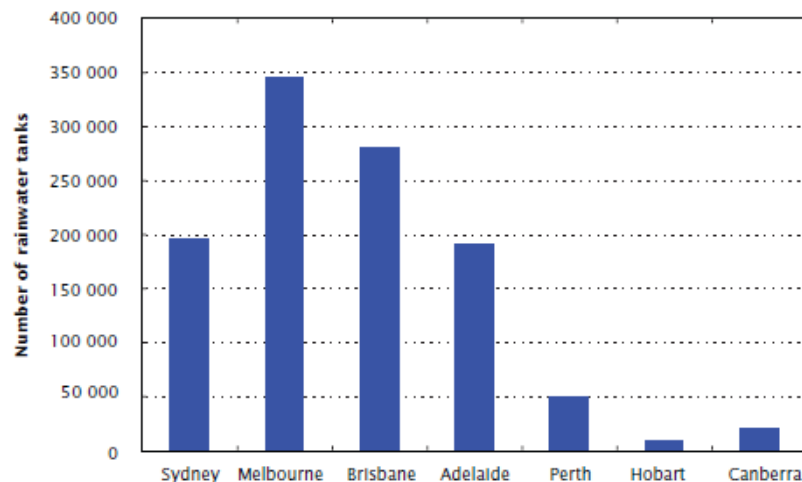
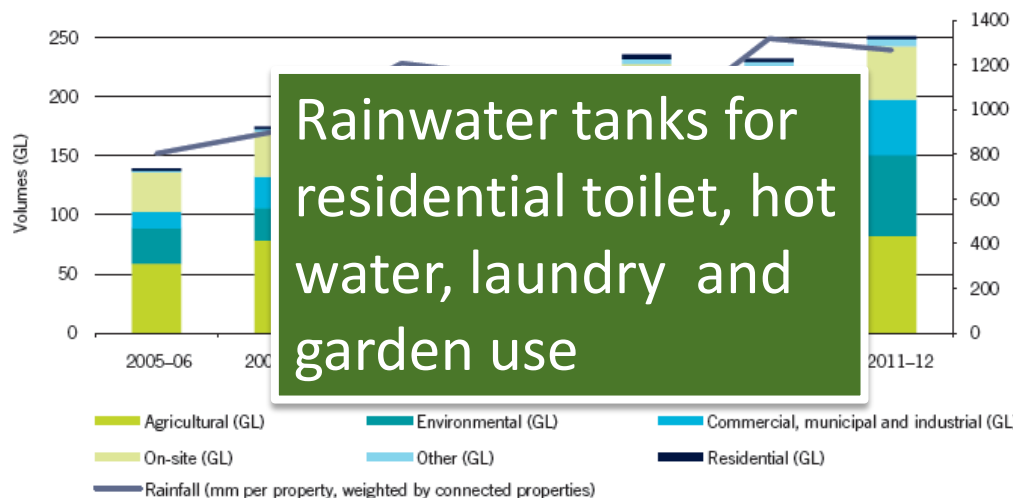
Some major cities now have desalination plants, which secured water supply for the next 10-15 years

Preference for utilising rainwater, recycled water and stormwater for non-drinking uses



Stormwater harvesting using aquifers as storage devices

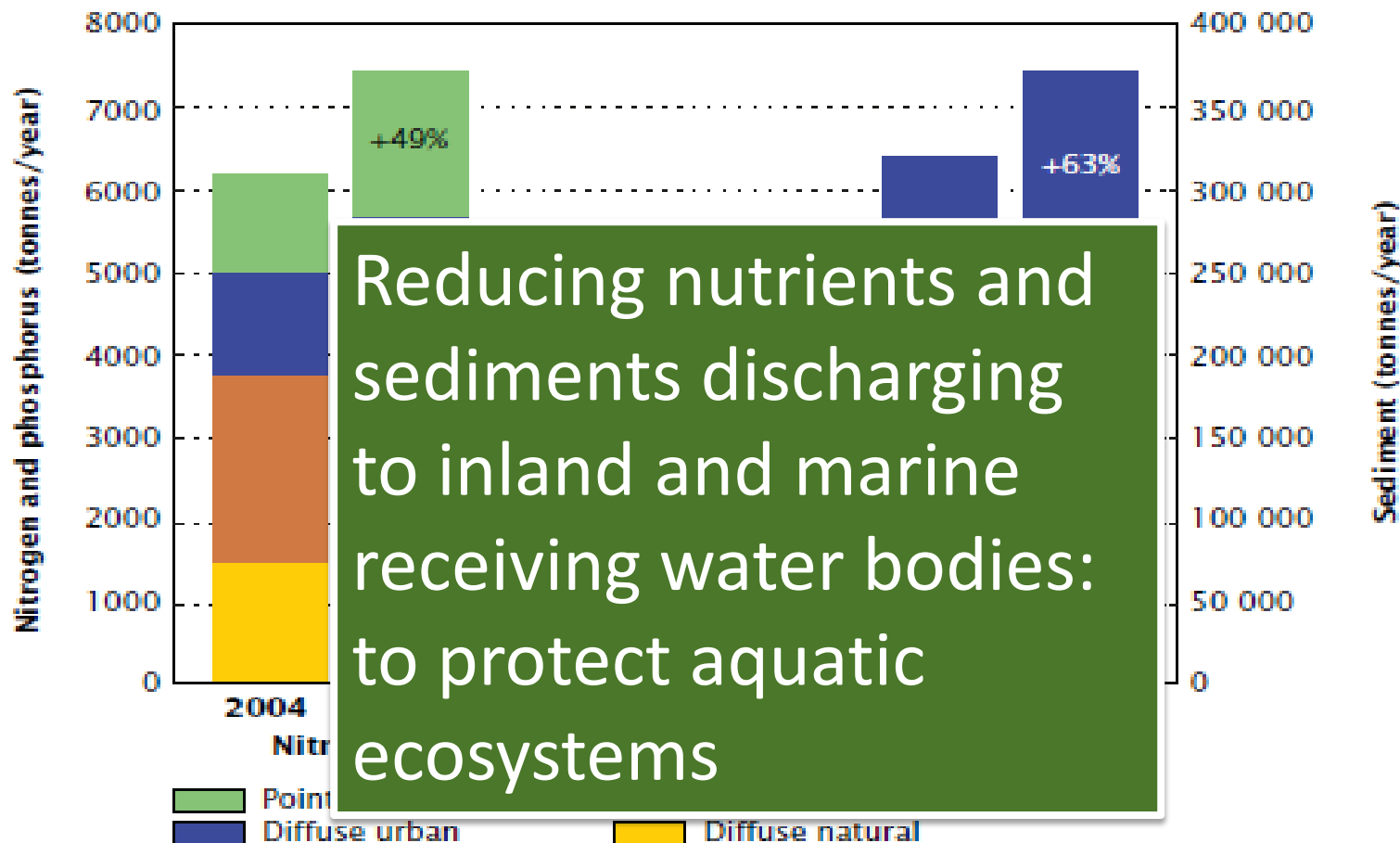
Figure ES5: W26 Recycled water, by end use (GL) and rainfall (mm), 2005–06 to 2011–12



Source for the chart on recycled water: National Water Commission - 2012-13 National Performance Framework, Australian Government

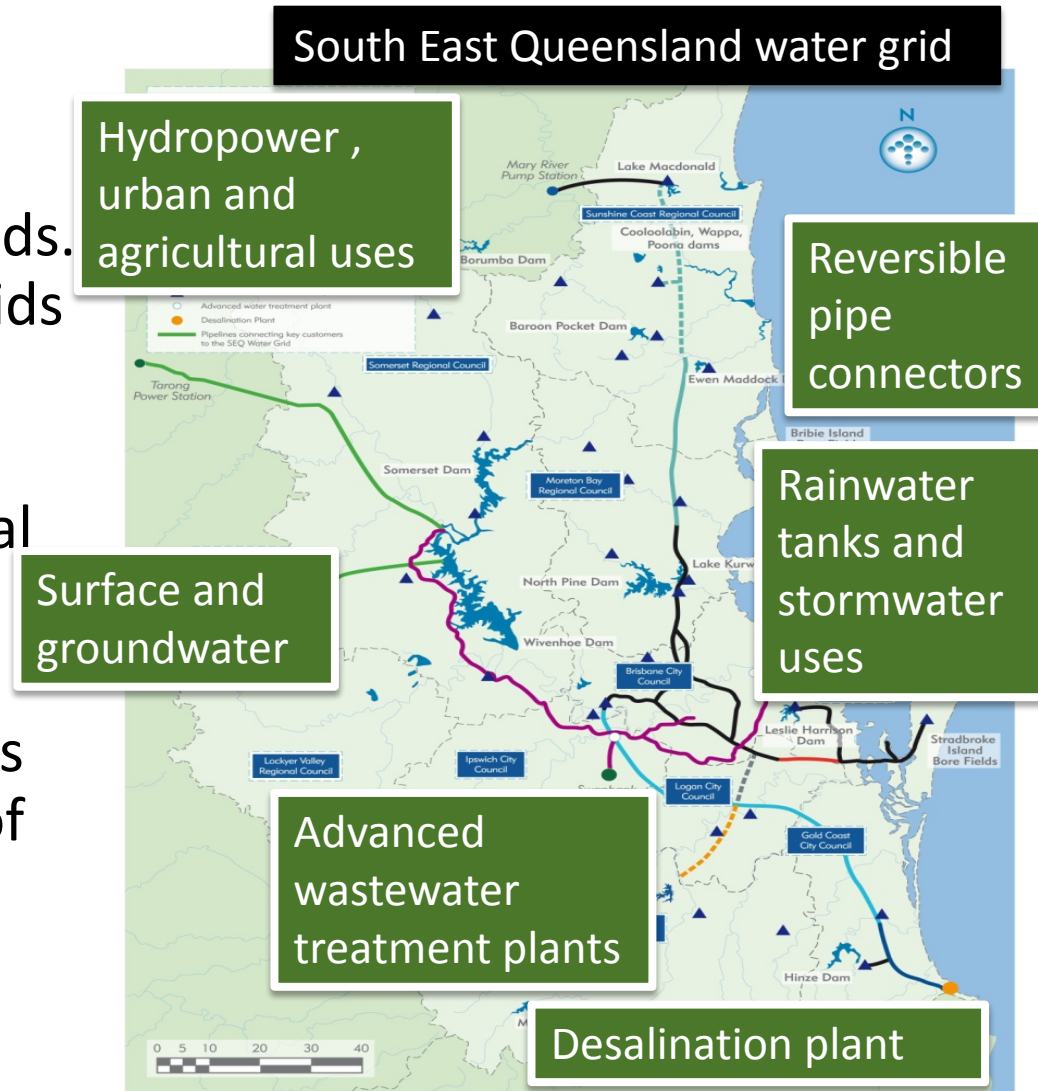
Source for the chart on rainwater tanks: <http://www.csiro.au/Outcomes/Water/Water-Book.aspx>

Source diversification has other benefits



Despite the benefits, source diversification is a challenge

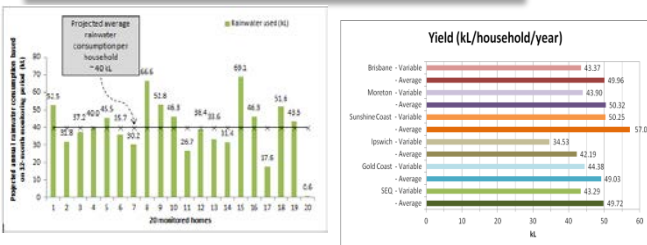
- Introduces complex water grids. Optimal operation of such grids is not trivial
- Different sources are economical at different spatial scales
- Integrating decentralised sources to centralised sources need a good understanding of system scale implications
- Need community support



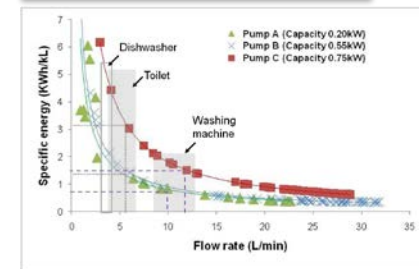
CSIRO's research on rainwater tanks

Understanding harvesting potential, optimal design, energy usage, water quality, regional scale yield, social perception and management models (20 papers)

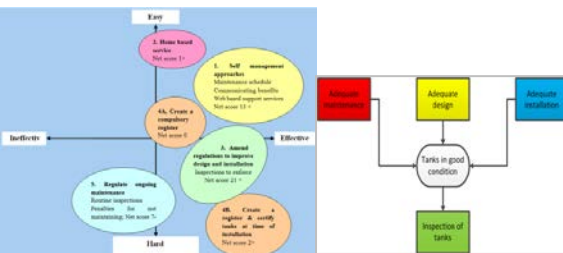
Harvesting potential and regional scale yield



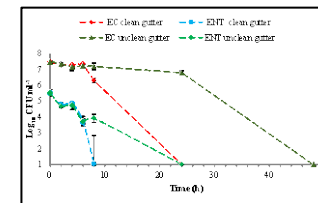
Optimal system design & energy



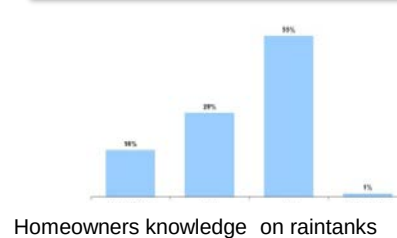
Management models



Water quality



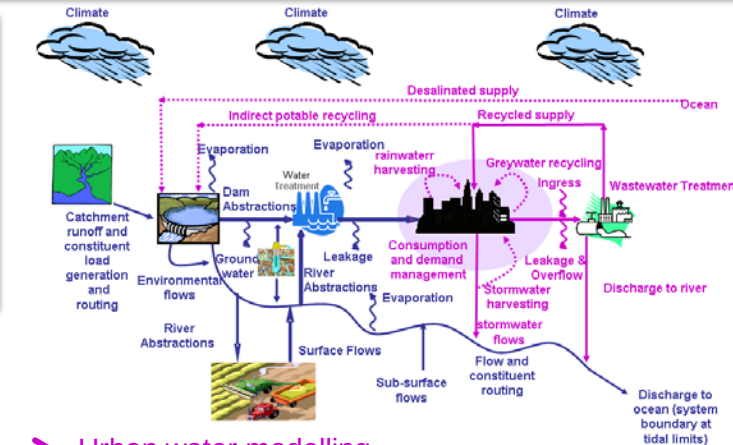
Social perception



CSIRO's Integrated urban water systems modelling and analysis to inform IUWM

Simulation of urban water systems from supply catchments to receiving waters, as a sub-set of a river basin

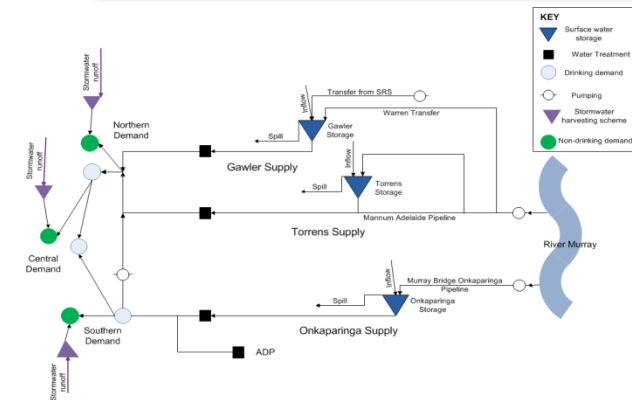
Water quality: Total nitrogen discharge to Moreton Bay for different water management options



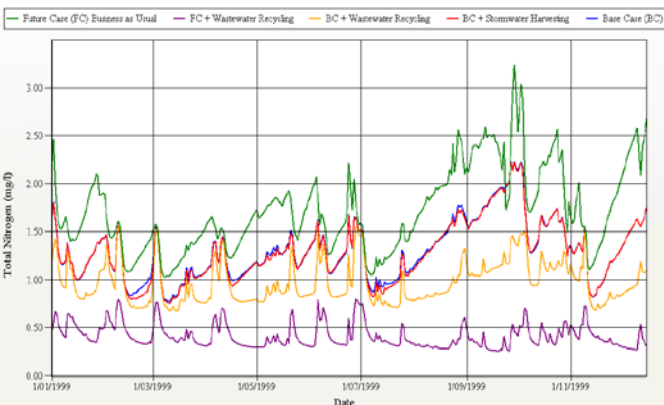
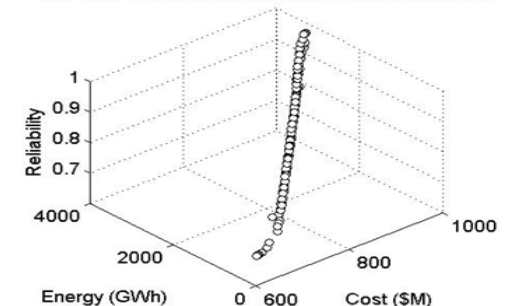
➔ Urban water modelling
➔ River basin modelling



Coupling with multi-objective optimisation/MCA to identify optimal mix of sources in Adelaide



(a) Pareto-optimal front considering three objectives



Conclusions

- Climate change has a significant impact on the urban water supplies, and some impact on the demand
- Australian cities have adopted Integrated Urban Water Management (IUWM), in particular source diversification, as an adaptation measure for climate change
- IUWM however, increases the complexity and interconnectivity, which introduces many knowledge gaps
- Further work is needed to establish IUWM as a viable adaptation measure for climate change

Thank you!

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