



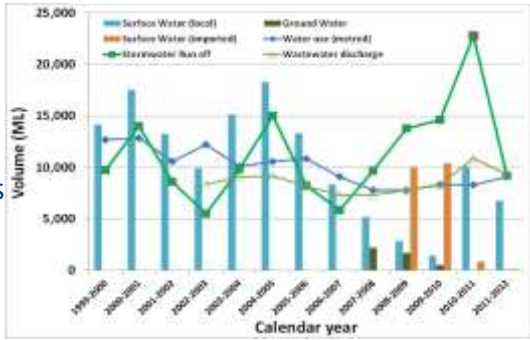
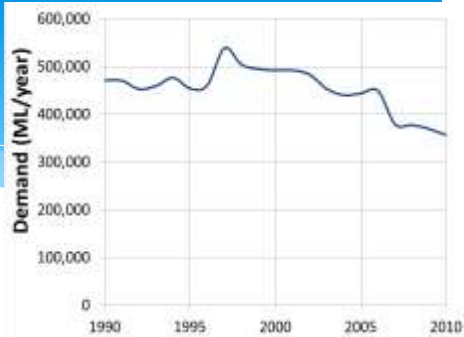
Introduction

- * Building scale water efficient appliances and behaviours, and rainwater harvesting ensured many Australian cities did not run out water during the drought
- * Nevertheless, benefits of sustainable buildings is contested.
- * Used metadata from government agencies and utilities with systems analysis to reveal historical benefits
 - * BOM, ABS, NWC, Regulators and Office of the Chief Economist
- * Ground truth provided by real projects
- * **We live in a system, our dwellings are systems**



Water efficiency and source control

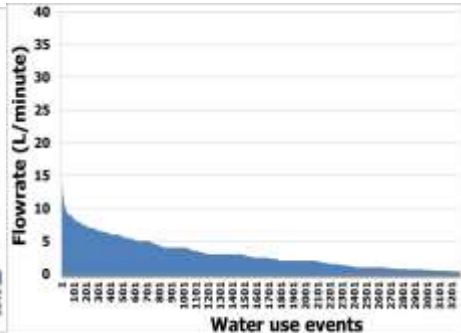
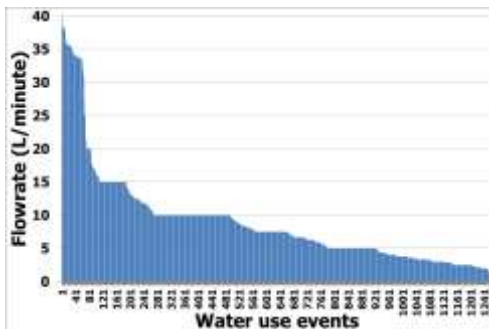
- * Contested and not viable? But.....
- * Data shows that many cities halved their water use
- * See Melbourne and Ballarat Examples
- * A timely and effective contribution
- * Largely provided by buildings households
- * Also united each community



SEQ Monitoring during drought

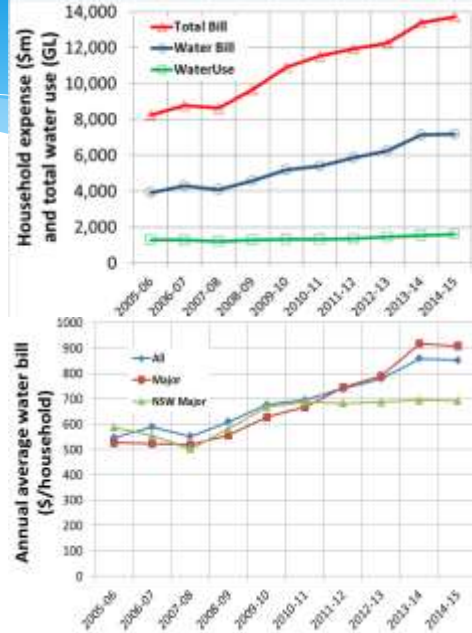
Houses with no rainwater harvesting or water efficient appliances: water use patterns

Houses with rainwater harvesting and water efficient appliances: water use patterns



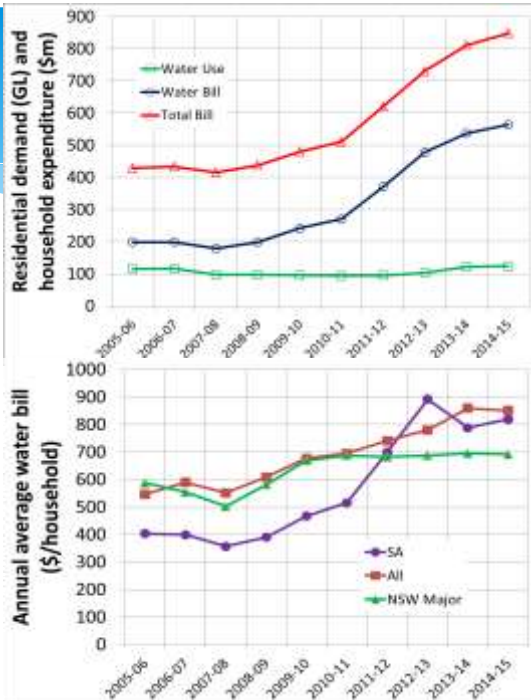
Household Expenditure for Water

- * Household expenditure is an indicator of economic welfare
- * Examined total water bill (water and sewerage) & the water proportion revenue
 - * Total bill increased by 67% (\$2.8 billion) since 2007
 - * Water bill increased by 84% (\$2 billion) since 2007
 - * Water demand increased by 23%
- * However, household water bills increased by 91% for major utilities and only 51% for NSW utilities
 - * Impact of BASIX
 - * \$277/hh/year benefit
 - * \$1.75 billion since 2005



South Australian household expenditure

- * Household expenditure on water proportion of water bills increased by 184%
- * Household expenditure on total water bills increased by 98%
- * But residential water use only increase by 8%
- * Average expenditure on water increased by 103%



Operating costs of Water Utilities

- * Water operating costs of NSW utilities substantially less the other areas
 - * BASIX, Sustainable Buildings
 - * Better investment decisions
 - * Benefit: \$1282/property/yr
 - * \$1.27 billion to 2004



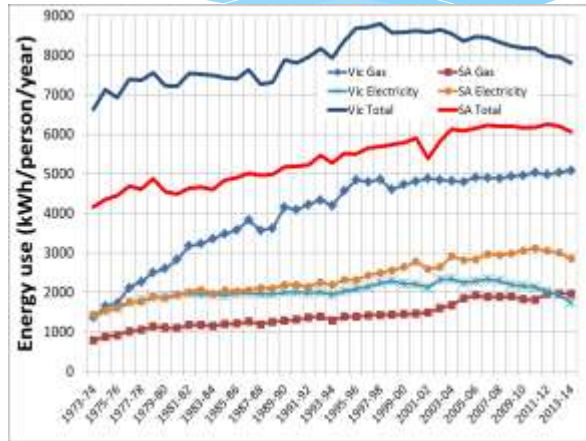
Water operating costs of SA utilities

- * SA water operating costs have increased by 120%
- * NSW (BASIX) water operating costs increased by 54%



Household energy

- * MetaData from the Office of the Chief Economist and ABS
- * Changing energy mix
 - * Different across the country
- * Significant reductions or stablization since mid 1990s
 - * Driven by household behaviour and efficiency
 - * Vic: 9% reduction since 2004
 - * SA: 1% reduction since 2004



Rainwater harvesting and water efficiency in capital cities (ABS)

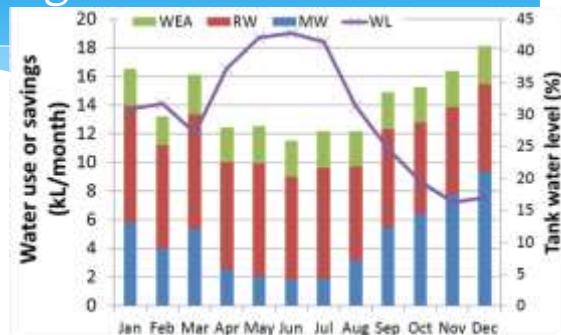
Capital City	HHs with RW	Proportion HHs with RW (%)	Water savings (ML)	Estimated Value (\$m)
Sydney	249,900	14.6	10,458	30.1
Melbourne	376,900	23.9	13,438	45.6
Brisbane	237,600	31	11,861	38.7
Adelaide	165,800	33.7	6,875	29.5
Perth	51,600	7.4	2,999	5.9
Hobart	12,100	13.5	590	2.1
Darwin	6,384	12	554	1.2
Canberra	25,922	21.3	1,296	2.8
Total	1,126,206	20.4	47,726	155.9

Rainwater harvesting and water efficient appliances – calibrated systems analysis

Capital City	RW supply (kL/yr)	WEA savings (kL/yr)	Total RW supply (ML/yr)	Total WEA savings (ML/yr)	RW value (\$m)	WEA value (\$m)	Total value (\$m)
Sydney	70	49	17,493	25,948	50.4	75	125
Melbourne	53	31	19,976	10,051	67.7	34	102
Brisbane	66	25	15,682	12,963	51.1	42	93
Adelaide	43	26	7,129	2,751	30.6	12	42
Perth	54	50	2,786	6,928	5.5	14	19
Hobart	41	27	496	1,317	1.7	5	6
Darwin	61	34	389	841	0.9	2	3
Canberra	50	27	1,296	1,793	3.9	5	9
Total			65,248	62,592	212	188	400

Source control benefits: ground truth Carrington NSW

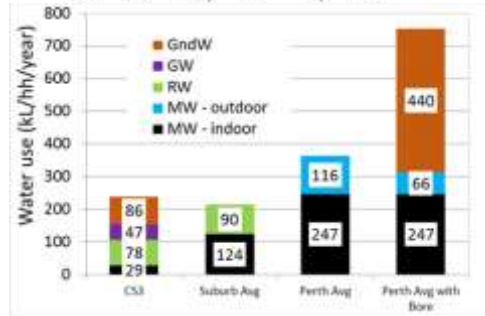
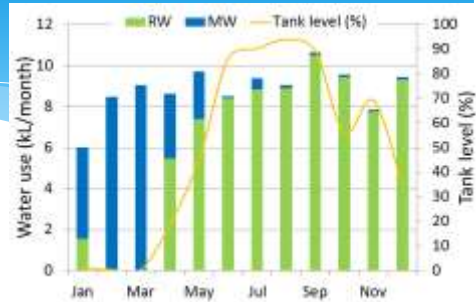
- * Small inner city house
- * 5 kL rainwater tank, 95 m² roof, water efficient appliances
- * Supplies entire house
- * 85% stormwater to kitchen garden
- * Solar panels
- * 15% less energy due to water strategy
- * 61% less energy due to solar power



Criteria	Water use (kL/yr)	Proportion (%)
Leak detection and behaviour change	35	17
mains	48	24
rainwater	87	43
Water efficient appliances	34	17
Total (circa 1998)	204	100

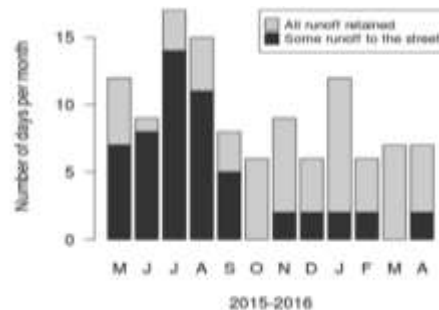
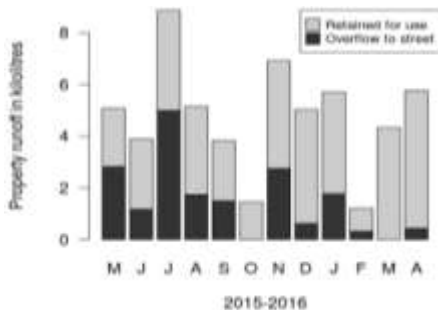
Fremantle: Western Australia

- * Suburban property: rainwater supply to all uses from 20 kL tank supplied by 200 m² roof
- * Edible rain gardens
- * No stormwater runoff
- * Greywater and groundwater supply also
- * Water efficient appliances
- * Solar energy
- * 53% reduction in energy use
- * With solar energy makes more energy than uses
- * Comprehensive monitoring



Richmond: inner city Melbourne

- * Small inner city property with solar energy.
- * 120 m² roof connected to two 2.75 kL slimline rainwater tanks
- * Supplies toilet and laundry – overflows to edible raingardens
- * No additional energy use but 31% reduction due to solar energy
- * About 40 kL rainwater supply each year



Stormwater benefits of water conservation

(integrated solutions with edible raingardens)

Capital City	Reduced runoff (ML/yr)	Reduced pollutant loads (Tonnes/yr)		
		TSS	TP	TN
Sydney	17,493	4,523 (7,790)	8.5 (11.1)	54.5 (96.6)
Melbourne	19,976	3,807 (26,681)	7.5 (34.3)	52.4 (258.9)
Brisbane	15,682	2,756 (9,098)	5.5 (11.5)	36.1 (113.1)
Adelaide	7,129	829 (6,460)	1.7 (9.0)	11.8 (65.5)
Perth	2,786	630 (773)	1.2 (1.1)	7.84 (9)
Hobart	496	122 (361)	0.24 (0.5)	1.56 (4.7)
Darwin	389	144 (178)	0.26 (0.7)	1.47 (2)
Canberra	1,296	233 (2,162)	0.47 (1.0)	5.96 (22.5)
Total	65,248	13,044 (53,501)	25 (69)	172 (572)

Water security benefits (2014)

- * Used the calibrated Systems Framework for each city
- * Determined the net present value of water security provided by existing households
- * For each capital city for 2014

Capital City	Total savings (ML/yr)	Security Value (\$m)
Sydney	43,441	69
Melbourne	30,027	86
Brisbane	28,645	139
Adelaide	9,880	31
Perth	9,714	89
Hobart	1,813	21
Darwin	1,230	3
Canberra	3,089	45
Total	127,839	483

Greenhouse gas benefits

- * Reductions in GHG emissions from existing “sustainable dwellings”
- * Results from Systems Framework
- * Derived from reduced water heating, local efficiency and reduced transport of mains water

City	Utility distribution energy (kWh/ML)	RW & WEA Nett GHG savings (tonnes CO ₂ e)	
		With RW energy	Without RW energy
Sydney	373	128,740	151,369
Melbourne	54	38,843	73,605
Brisbane	2,447	101,027	120,106
Adelaide	2,031	14,823	20,971
Perth	3,163	53,369	56,630
Hobart	2,458	1,442	1,534
Darwin	423	2,985	3,326
Canberra	233	8,447	10,123
Total		349,675	437,663

Conclusions

- * There is now sufficient timeline of metadata to reveal substantial multiple benefits of local solutions – such as sustainable dwellings
- * Systems analysis and local ground truth projects confirms these benefits – **we live in a system!**
- * Also reveal other hidden “whole of society” benefits
 - * Community involvement and wellbeing
- * There are also important stormwater and climate change benefits
- * These benefits easily outweigh implementation costs – **not cost +**
- * There is a need to seriously include sustainable dwellings in government policy and strategy

