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Droughts and Flooding Rains:

Water Provision for a Growing Australia

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Executive Summary

In the 2010 federal elections, the debate over Australia's population surfaced once again. Groups concerned with the impact of a growing population have focused on water, the life source of any community. Will our water supplies support the forecasted population growth?

Throughout 2010, politicians and commentators largely debated the *extent* of population growth and ways to slow it rather than ways to *prepare* for it. In fact, the newly appointed Minister for Population Tony Burke said some cities had already reached their population capacity due to water constraints. The rhetoric ignores the reality that a certain amount of population growth is inevitable. The Treasury's *2010 Intergenerational Report* projected that Australia's population will increase by 63% to 35 million people by 2050. Even if migration is slashed dramatically, Australia's population will continue to climb for the next few decades.

Most of this population increase is projected to occur in the major cities, raising fears about housing, transportation and water infrastructure. The Water Services Association of Australia (WSAA) predicts that by 2056, urban water demand, which is the focus of this report, will increase by 76%. Infrastructure development, particularly in water resources, is needed to sustain a growing population. The way forward is not to cut population growth, which is inevitable, to consider a range of water sources to meet the growing demand.

Any discussion of Australia's water resources is obscured by myths surrounding the 'driest continent' on Earth and anxiety about an impending water scarcity. Australia does have the lowest average rainfall of all continents (excluding Antarctica); however, we withdraw less than 10% of our renewable fresh water resources. Moreover, 85% of the population live in urban areas within an hour's drive of a coastline—where rainfall is the highest—while very few people live in the most arid areas. The water challenge in Australia is not the amount of rainfall but its extreme variability.

Historically, population growth has not hindered development but rather has been integral to it. The current inevitable challenges of further population growth can be met by better utilising our existing dams; exploring new technological options such as recycling, desalination and water-efficient appliances; and better employing demand management options such as pricing and metering.

Until recently, dams with large storage capacities were the most common and reliable source of water in Australia. However, in the last 20 years new technologies such as water recycling and sea-water desalination have also been developed. Although expensive, these technologies utilise renewable sources of water and reduce our dependence on the highly variable rainfall. Australia's six desalination plants have the capacity to meet the additional demands of our capital cities until 2026.

Rural water sources are another option—and perhaps an overall less energy intensive one—than desalination or recycling. When the agricultural sector comprises 50% of total water consumption compared to households, which comprise only 13%, transferring a certain amount of water can increase water supply in urban centres without dramatically affecting irrigation. Together, these options have the capacity to meet the water demands of a growing population for the next several decades.

To ensure that existing urban water infrastructure will meet our growing population's water needs, prices should continue to reflect operating costs. Scarcity pricing is a variable pricing mechanism; for example, when dam levels fall, the price of water could be raised to meet the costs of turning on desalination plants. Scarcity pricing could enable us to avoid a costly overhaul of water systems or the reintroduction of stringent water restrictions, while still meeting the water needs of a growing population.

The number of households in Australia is anticipated to grow from the current 8.2 million to 11.5 million by 2031. Increased metering where possible, as well as maintaining the volume-based component of water pricing, will provide incentives to households to reduce excess water usage. Technological innovations are already enabling houses and water systems to use less water at a reasonable cost. These solutions all reduce the extent to which our urban water systems will have to be augmented as the number of households increase.

Dams ensure there is enough water for Australia's current population. To support future population growth, we can utilise dams along with a combination of several other available water sources. By considering the costs and benefits of a mix of water sources, drastic changes to the way we use water will not be necessary. Australia can continue to grow as it has in the past—by developing water infrastructure in line with an increasing population.

Introduction

Australians have perceived water scarcity as a serious issue since colonisation. European settlers, discovering the driest continent on earth, dreamed of finding an inland sea.[1] In the nineteenth century, Australians were trying to provide water for a population of only a few hundred thousand. In the twenty-first century, Australia's population has reached 22 million people. To what extent our water resources can meet the needs of a growing population remains a contentious issue. The most recent examination of Australia's growing population was undertaken by the *2010 Intergenerational Report*, which projected that by 2050 our population would increase by 63% from 22 million to 35 million people.[2]

The debate about population growth was a defining issue in the lead-up to the 2010 federal election. Politicians and media sparked fears that population growth would outstrip the core infrastructure of transportation, housing and water.[3] Monash University demographer Bob Birrell said population growth will require capital cities such as Sydney and Melbourne to be 'completely redesigned.' Entrepreneur Dick Smith warned that Australia did not have enough water to support millions more people,[4] and Population Minister Tony Burke stated that some areas of Australia 'have already reached their [population] capacity due to water constraints.'[5]

Projections by the Australian Bureau of Statistics (ABS) of higher birth rates and falling death rates mean that independent of migration, our population will keep growing.[6] Instead of continuing the debate over a 'bigger Australia,' would it not be better to start preparing for the effects of population growth on urban infrastructure? How will population growth affect our water supplies? How does Australia compare to other countries managing urban water systems? What are we not doing? What are other countries doing better?

Australia has the lowest average annual rainfall of all continents (excluding Antarctica), yet we are not water stressed: we extract less than 10% of our renewable fresh water resources. However, rainfall and water demand vary significantly across the country. Average figures of water availability per person show that some inland areas are indeed water stressed while coastal zones collect more water than required. The real challenge is the extreme variability of our rainfall. Past policy has been to build extensive storage in large dams to ensure a reliable water supply. Now that almost every major river in Australia has been dammed, we need to investigate new water infrastructure and technology other than dams.

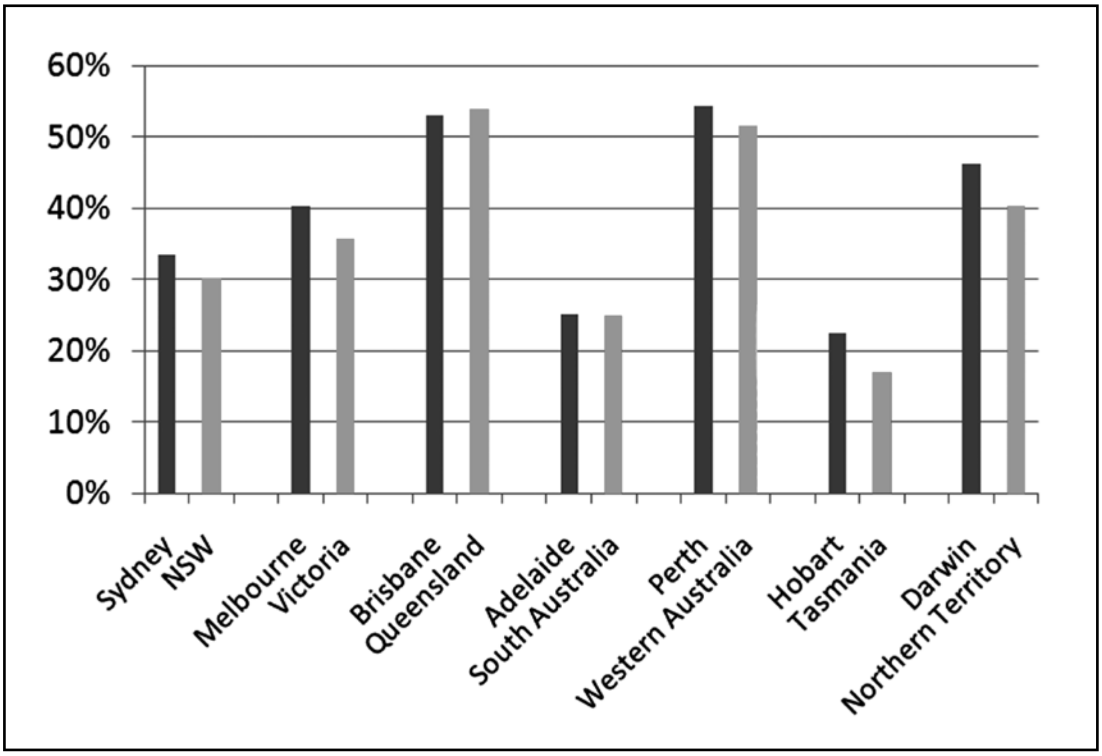
We need to investigate new water infrastructure and technology other than dams.

The Water Services Association of Australia (WSAA) projects that a population increase of up to 35.5 million would result in a 76% rise in urban water demand by 2056, including industry and commercial use.[7] However, this does not require drastically overhauling our urban water infrastructure. For example, by improving water efficiency, Sydney has kept its water use at 1970s levels although its population has increased by 1.3 million since then.[8] We have a range of options to meet the increasing demand for water more effectively, including managing consumption, reviewing pricing and metering, and increasing desalination and recycling. While in the last five years, capital cities have focused heavily on developing desalination, other cost effective measures can also improve water efficiency and reduce water consumption.

Australian water supplies can cope with the projected population growth in the coming decades. With careful planning, the existing water infrastructure can be enhanced to continue to provide a clean, safe and reliable supply of water for a growing population.

This report considers the effects of population growth on Australia's water provision to households, and urban centres generally.[9] Households consume 13% of total the water used compared to agricultural activities, which consume 54%.[10] However, urban areas are projected to grow faster, resulting in the number of households increasing from 8.2 million in 2010 to 11.5 million by 2031, according to the ABS.[11] Australia is also one of most urbanised countries in the world—with 88% of the population living in urban and regional centres.[12] All capital cities, except Adelaide and Brisbane, are projected to experience higher population growth than state averages (Chart 1).

Chart 1: Capital city vs state population growth projections, 2010–31



Source: ABS (Australian Bureau of Statistics), Cat. No. 3101.0 (Canberra: ABS, March quarter 2010).

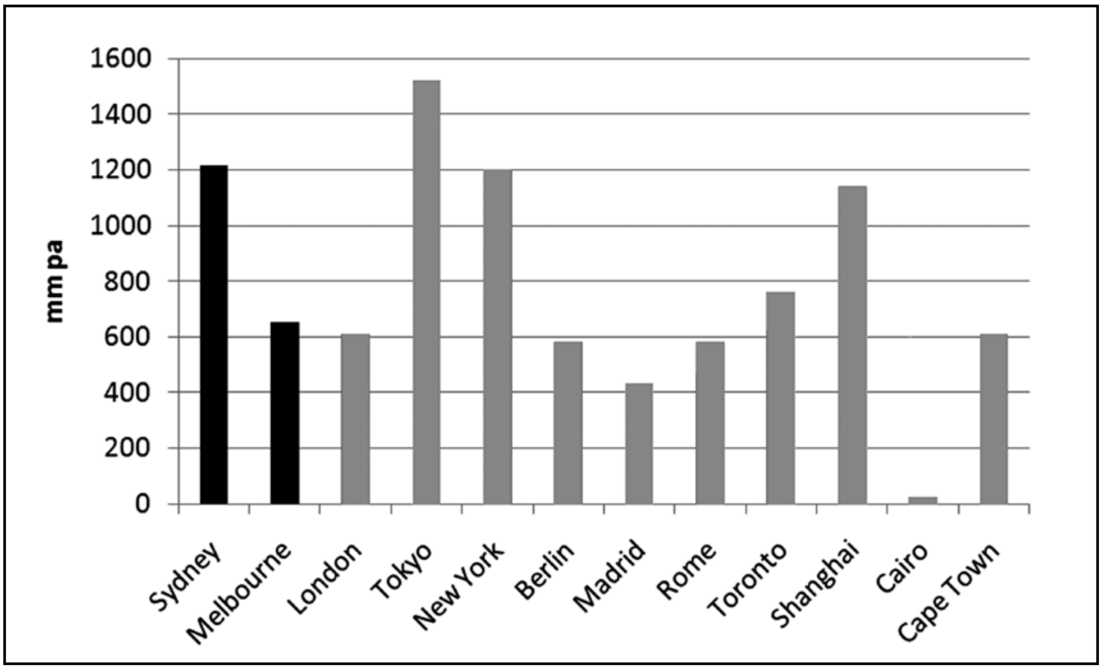
This report first considers dams, Australia's main source of urban water supply. Then it evaluates measures that will not require overhauling existing infrastructure, including managing water consumption, pricing and metering, and technology. Finally, it discusses the relationship between urban and rural water.

Watering Australia

Australia has the lowest average rainfall[13] and the greatest year-to-year rainfall variability of all continents (excluding Antarctica).[14] However, Australia is not water stressed. According to the United Nations Environment Programme (UNEP), 'water stressed' countries have less than 1,700 kilolitres of renewable freshwater per person.[15] The global median is 4,300 kilolitres compared to Australia's 19,700 kilolitres per person per year. Severely water stressed regions, such as North Africa and the Middle East, use more than 40% of their fresh water resources,[16] which include aquifers, rainfall, natural lakes, rivers and man-made reservoirs.[17,18] Australia, by contrast, draws upon less than 10% of its fresh water resources available naturally.[19] Accessing additional freshwater resources may be increasingly expensive; however, further water is naturally available if needed. We are not running out of water.

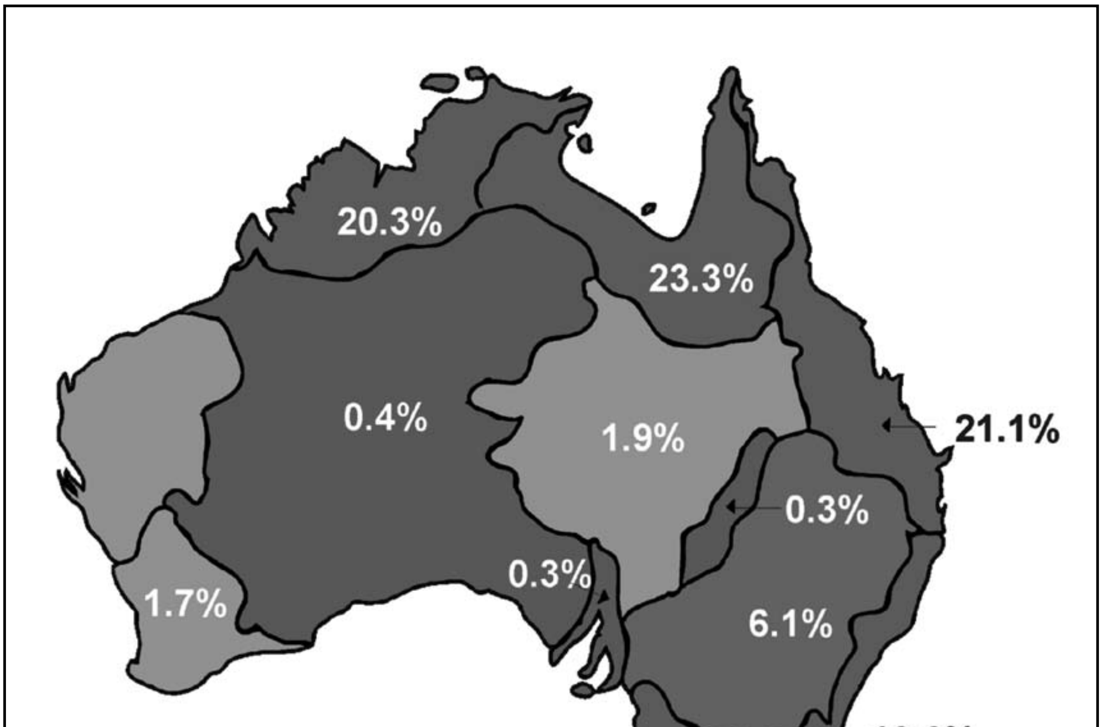
Contrary to common public perception, Australia's largest cities receive more rainfall each year than international capitals like London, Berlin and Madrid (Chart 2). Where Australian cities differ is in the volume and regularity of that rainfall. In response to its high rainfall variability, Australia has developed extensive storage capacities to ensure uninterrupted water provision. Our dams can hold up to three times the annual consumption of water.[20] Dams are situated in coastal areas where rainfall is the highest and population is concentrated (Figure 1).[21]

Chart 2: Annual rainfall in our cities compared to other international cities



Source: FAO (Food and Agriculture Organization), 'Aquastat,' and UNEP, 'Freshwater in Europe' (2004).

Figure 1: Australia's run-off distribution



Source: Colin Chartres and John Williams, 'Can Australia Overcome its Scarcity Problems?' *Journal of Developments in Sustainable Agriculture* (2006), 1.

During the recent drought, Sydney, Australia's most populous city, managed to meet the water demands of a growing population by developing high storage capacities.[22] Due to its high rainfall variability, Sydney's storage holds enough water to supply the city for approximately six years, when dams are 60% full. By contrast London, with its regular rainfall, holds only a three-month supply.[23] Sydney's water storage currently supplies a population of 4.5 million people.[24] By 2036, it will need to support around 6 million people, or an additional 770,000 households.[25] New dams have been proposed (see below); however, other technologies are available to increase the water supply.

The recent floods nationwide have re-ignited the debate as to whether Australia needs more dams. During the dry El Niño weather phase, which caused a decade of drought, state governments viewed dam capacities as adequate, and the primary objective of dam operators was to ensure a steady water supply. Now, with the onset of the high-rainfall La Niña period, flood mitigation has once again become a concern, and states are questioning the adequacy of dam capacities to hold the increasing amount of rainfall. Queensland's Wivenhoe Dam, which was at a low 15% of capacity in May 2007,[26] surpassed 191% of capacity in January 2011.[27] Following the January floods, the Queensland government commissioned a judicial inquiry to examine whether Wivenhoe Dam operators should have maintained such high water levels only to suddenly release a large volume of water two days before the floods peaked, and whether this decision exacerbated the floods rather than prevent them.[28] From 2011, managing dams should involve ensuring that water levels support the current and growing population while not compromising the flood mitigation role of dams.

Flood mitigation has become once again a concern.

Construction of new dams seems to be an obvious solution. Opposition Leader Tony Abbott wonders why Australia, with so many water issues, has not constructed more dams in the last two decades.[29] The reality is dams are no longer the best solution:

1. The majority of dams were built between 1970 and 1990, the most recent in 2002 in Western Australia.[30] The best dam sites have already been taken.[31] In catchments of high rainfall, nearly every major river in Australia has been dammed at least once.[32]

2. Recent dam proposals have been rejected on economic as well as environmental and ideological grounds. The application for the (Hunter Valley) Tillegra Dam in NSW, which was supposed to ensure against the possibility of a one in 100-year drought occurring four times back to back, was rejected in November 2010 as it would cost $477 million and divert significant portions of water from an important water bird habitat.[33] The plan to build a dam 50 kilometres south of Cairns was discarded in September 2010 as it was double the cost of tapping the Mulgrave River underground aquifer. Environmental concerns also played a role as water was to be diverted from the protected Wet Tropics Management Area.[34]

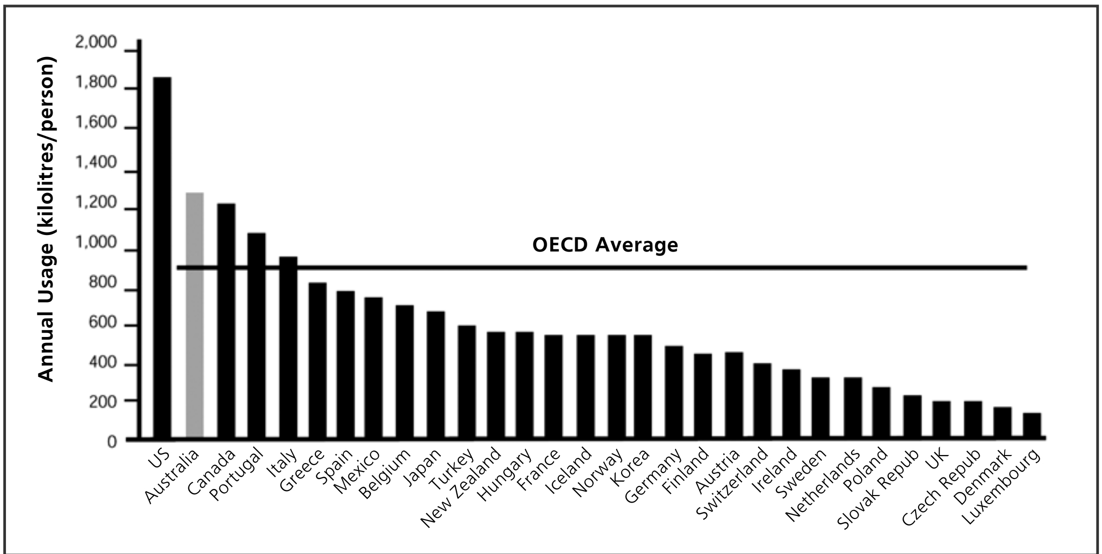
3. Other options to ensure a reliable urban water supply have been developed in the last two decades. Andrew Dragun of Griffith University reminds urban water policymakers that while expensive, desalination and recycling plants are independent of rainfall, would put less pressure on dams, and simultaneously provide a secure supply of water while keeping water levels low enough to mitigate floods.[35]

Of course, Australia's current water storage capacity is adequate for urban areas. New dams may occasionally prove to be environmentally and economically viable; however, to support further population growth while also ensuring the role of dams in flood mitigation, water resources other than dams may be more cost-effective in augmenting urban water supplies if necessary. Households may be willing to pay for operating desalination and recycling plants to keep dam levels low and floods below the footpaths.

Reducing consumption

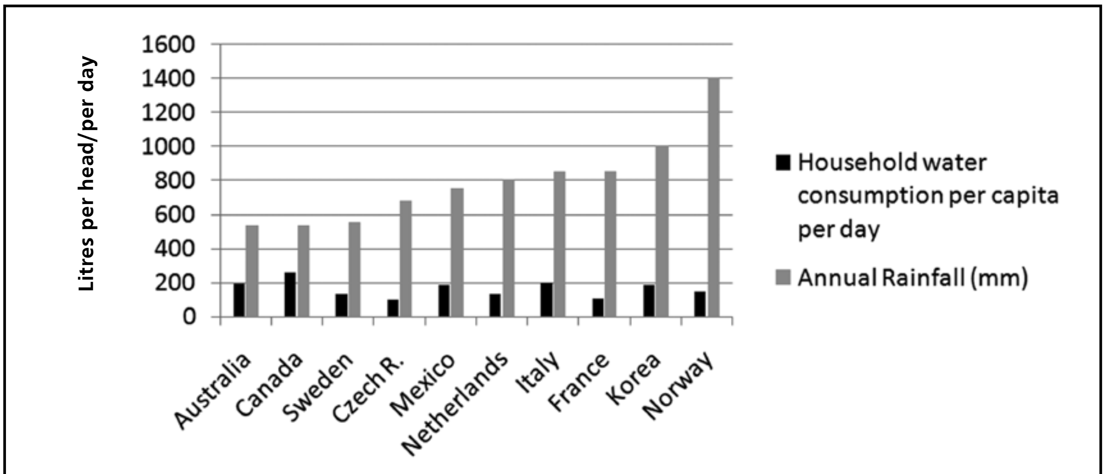
Australia consumes the second highest amount of freshwater per person of OECD nations (Chart 4) and the third highest amount in terms of household use (Chart 5).[36] If households use water more efficiently, we need to only marginally augment water infrastructure for each additional dwelling.

Chart 4: Water usage in OECD countries, 2003



Source: Farmhand Foundation, Talking Water, Part 11: 'Australia's Water' (2004).

Chart 5: OECD per capita household water consumption, 2008

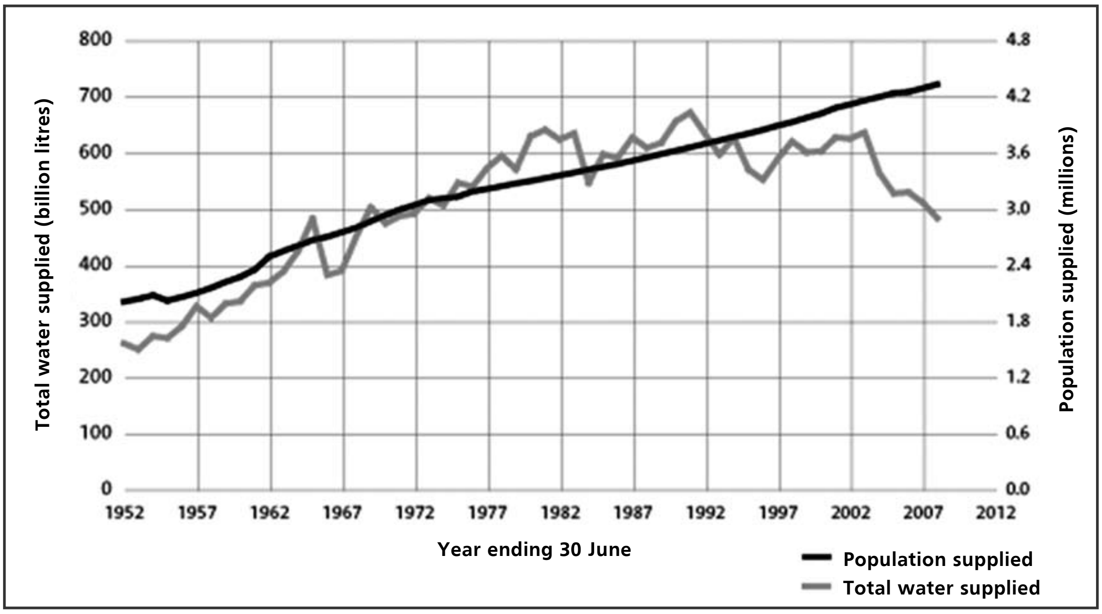


Source: OECD (Organisation for Economic Co-operation and Development), Household Survey on Environmental Attitudes and Behaviour: Data Corroboration (2008).

In fact, Australians have already proved they can reduce consumption. Partly due to price rises and water restrictions imposed during the last decade of drought, per capita consumption has lowered significantly between 2001 and 2009. Water consumption decreased by 14% between 2000–01 and 2004–05[37] and by 25% between 2004–05 and 2008–09.[38] While agricultural water consumption decreased largely due to drought and higher prices, household consumption also fell by 16% since 2004–05 because of lifestyle changes in households (taking shorter showers) or using water-efficient devices (water saving shower heads).[39] During the last drought, households were easily able to cut down water consumption by reducing outdoor water use (83% of percent of households have gardens).[40] Further water savings that do not compromise households' essential water usage can be made with the help of technological innovations.

In the last three decades, Sydney has actually *reduced* its total water use at the same time as it has grown by 1.3 million people (Chart 6)[41]; it has not increased its water use above 1970s levels.[42] Sydney's water infrastructure has been able to accommodate population growth to date and looks well prepared to deal with future growth.[44] Australia's water use has increased by 65% since the 1980s;[43] however, this is mainly due to agriculture. Urban water use has increased by a smaller amount due to leak reduction programs and recycling initiatives.

Chart 6: Total drinking water supplied in Sydney since 1952 compared to population growth

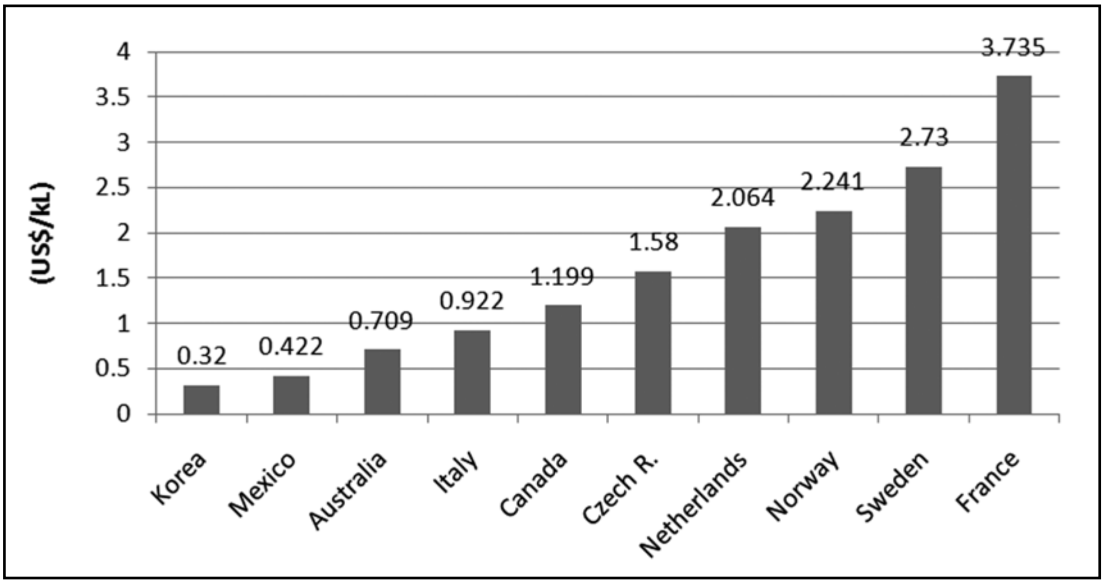


Source: Sydney Water, 'Sydney Water Annual Report 2008' (Sydney: 2008).

Pricing and Metering

Although water has been perceived as a scarce resource in Australia, Australian water prices in 2008 were the third lowest among OECD nations (Chart 7). The more households that use water more efficiently in response to readjusted prices and dynamic charging, the better current water systems will be able to provide for an increasing number of households.

Chart 7: International comparison of average water prices, 2008



Source: OECD (Organisation for Economic Co-operation and Development), 'Household Survey on Environmental Attitudes and Behaviour: Data Corroboration' (2008), Table 6.3, 52.

Pricing

While the cost of water has increased in the last five years, Australia's water pricing is still low by international standards. In Europe, water costs on average €1.2–1.6 per kilolitre (AU$1.65–2.20 per kilolitre using September 2010 exchange rates) compared to about $1 per kilolitre in Australia.[45]

Households do not want to see their water bills skyrocket to accommodate population growth. However, to ensure urban water is valued appropriately, prices should continue to account for the full cost of services delivered, including operating expenses, ongoing maintenance costs, cost of monitoring and research, and cost to the environment or third party impact.[46] Urban water prices, while already higher than Australia-wide averages, will have to increase, not drastically but in line with infrastructure upgrades for a growing population. Australia's two-part tariff includes fixed access fees to recover costs as well as a volume-based usage fee.[47] The volumetric-based charge is important as reflected by OECD nations, which are increasingly implementing a single volumetric tariff to provide greater incentives to consumers to reduce water use.[48] Households can keep track of how much water they are saving by changing their water use habits or by using water efficient appliances.

While water use is not as discretionary as the use of other resources such as energy, the OECD Environment Programme has found that households, businesses and agricultural producers do change their consumption patterns in relation to price levels.[49] The 2010 Australian Water Association (AWA) survey found that 69% of 1,200 water experts think pricing contributes moderately or significantly to efficient water use.[50] In Denmark, demand for water fell by 7% between 1993 and 1996 after a tax equivalent to €0.64 per kilolitre was imposed on households in 1993, increasing by 25% each year.[51] While water restrictions should not be made permanent, their success in reducing consumption is evidence of Australians' ability to change water use behaviour if required. Although the price of water in Australia is relatively low, the actual average price has nearly doubled in the last five years from 40 cents per kilolitre in 2004–05 to 78 cents per kilolitre in 2008–09.[52] Over this period, when water restrictions were in place, household water use declined by 16%.[53] Professor Quentin Grafton, chairman of Australian National University's Water Initiative, says water prices will continue to rise as state governments try to recoup the cost of expensive desalination plants.[54]

Scarcity pricing, can enable desalination plants to continue to meet water demand.

Scarcity pricing is an alternative way to ensure a constant supply of water without enforcing severe restrictions or permanent price increases.[55] Scarcity pricing involves households paying less for water when dam levels are high and more when dam levels decline. Conventional pricing can become too low during drought, necessitating managing water demand through water restrictions.[56] On the other hand, scarcity pricing, by increasing prices when dam levels are insufficient, can enable desalination plants to continue to meet water demand. Just as dam levels have been quoted in weather reports during drought to justify water restrictions, they could inform households of increased prices. Low-income households could be given income support in times of increased prices.

Metering

Comprehensive metering is another option that can lower household demand, reducing the extent to which water systems need to be increased in the long run. Water meters help make households consume water more efficiently by informing and charging consumers according to their use. France, the Czech Republic, and Sweden meter 100% of their households.[57] Australia meters 84% (see Chart 8).[58] By contrast, only 37% of Britain's households have meters, although they aim to meter 80% of households by 2020.[59]

Chart 8: Comparison of the proportion of free-standing dwellings with water metres

	OECD 2008 survey	Other surveys	
	Having water meters (% of households in single dwellings)	Having water meter (% of total population)	Year
OECD (10)	66.74	–	–
Australia	84.67	95-100	1998
Canada	50.65	55	2006
Czech Republic	79.59	100	1998
France	96.03	100	2006
Italy	92.29	90-100	2006
Korea	83.38	100	1998
Mexico	77.45	58	2005
Netherlands	92.29	93	1997
Norway	21.10	10-15	1998

Source: OECD (Organisation for Economic Co-operation and Development), 'Household Survey on Environmental Attitudes and Behaviour: Data Corroboration' (2008), Table 6.5.

There is evidence that demand for water drops routinely by 10% after a meter is installed.[60] Meters with in-home displays allow consumers to compare their consumption to average or target use. If Australia metered 100% of its households (including apartments), with 2.5 people per dwelling and each household consuming 10% less than the current 285 litres daily per capita volume,[61] an additional 33 billion litres of water could be saved per year. This would be equivalent to the annual water use of 149,000 households.[62] However, it must be noted that individual apartments are not metered and it costs around $400 to install a meter, which is usually paid for by the property owner[63] or recovered in the water bill.[64]

From a water engineer's perspective, water efficiency means achieving the same results with less water.

Further, smart metering involves integrating intelligence into water grids. These wireless meters allow greater monitoring and dynamic pricing to improve efficiency.[65] Increasing prices seasonally during peak demand periods rather than quarterly could encourage consumers to alter their water use.[66] This would reduce the need for augmenting a water system to meet peak capacity.[67]

Technology

Technological innovations in the last 20 years have given us recycling, desalination and water efficient technologies that help efficient use of water. Recycling and desalination are new ways to reduce our reliance on dams. As for water saving technologies, according to the WSAA, 'from 2026 to 2056, all capital cities are projected to decrease per capita consumption or maintain 2026 levels due particularly to efficiency gains made through water efficient appliances and the expected trend to [sic] increased density living.'[68] From a water engineer's perspective, water efficiency means achieving the same results with less water. But for economists, water efficiency refers to optimally using water in terms of its costs and benefits, after taking into account alternative uses of both water and capital. While innovations may improve efficient water use, they may also increase the price of water or have to compete with less expensive options. The following section considers the viability of each innovation in terms of overall effect on consumers.

Distribution loss

Technological innovations that reduce water leakage can significantly reduce the amount of wasted water. Water loss amounted to 24% of all water used in 2008–09 in Australia.[69] In Sydney alone, water lost from incorrect metering and tap and pipe leaks accounted for 8.2% (or 30 billion litres per year), which is enough to supply 150,000 households.[70] Despite this, Sydney still performs well by international standards. In 2007, London lost 32% of its total water supply.[71] In 1996, the American Water Works Association's (AWWA) Leak Detection and Accountability Committee recommended 10% as a benchmark for Unaccounted for Water (UFW) or the difference in the water delivered to a network and water consumed.[72] Although Australia's water loss is high at the national level, only 12% of Sydney's water is unaccounted for, third after Nuremburg and Singapore.

Chart 9: Water loss (UFW) in international cities

City/ Country	Year	UFW (%)
Nuremburg, Germany	1997	8.7
Singapore	1989	11
Sydney, Australia	**2005**	**12**[73]
Melbourne, Australia	**2005**	**10**[74]
Barcelona, Spain	1988	23
Petaling Jaya, Malaysia	1996	36
Bogota, Colombia	1991	40
Bandung, Indonesia	1996	43
San Jose, Costa Rica	1990	46

Source: Saroj Sharma, UNESCO-IHE Institute for Water Education, 'Performance Indicators of Water Losses in Distribution System' (Delft, The Netherlands: UNESCO-IHE, 2008).

Box 1: H20 Organiser

Whether the benefits from further reduction in leakage outweigh costs is a consideration for future investment decisions. Perhaps the recently launched H20 Organiser will reduce the costs of leak detection. The Australian innovation monitors the flow of electricity instead of water in pipes to detect leaks. The device stops the water pump after a specified period of time, usually 15 minutes, preventing endless leakages. Inventors of the monitor, which is the size of a human palm, claim the device is capable of saving 180 million litres of water a year nationwide, enough to fill 70 Olympic swimming pools.[75]

Water technology in new dwellings

In NSW, all new residential developments are required to use 40% less potable water than the average residential dwelling consumption.[76] As our housing stock is updated, average consumption is projected to fall. The BASIX Assessment tool calculates the 40% efficiency target of a dwelling based on its size and specifications along with water saving devices.[77] Building approvals are granted condition to compliance with Building Sustainability Index (BASIX) regulations. By 2031, Sydney alone is forecasted to require an additional 770,000 houses.[78] If each of these new dwellings saved 40% of current average water consumption (247.5 litres per person per day), 69 gigalitres of water could be saved per new dwelling per year in Sydney 2031.[79] This is enough to fill 27,000 Olympic swimming pools.[80] If all houses in Australia were able to include water saving measures in their existing homes, many more litres would be saved, allowing existing infrastructure to accommodate many more households.

Box 2: Almost waterless washing machine

One recently designed water-saving innovation is the Almost Waterless Washing Machine. Among *Time* magazine's Best Inventions of 2010, it uses reusable stain removing nylon beads and consumes 90% less water than the average washing machine. Considering that 97% of Australia's 8.1 million households[81] own a washing machine, 1.2 billion tons of water could be saved per year, the equivalent of 17 million Olympic swimming pools.[82] While the cost of nylon beads can be expected to be greater than the cost of water, the technology looks promising for low water innovations.

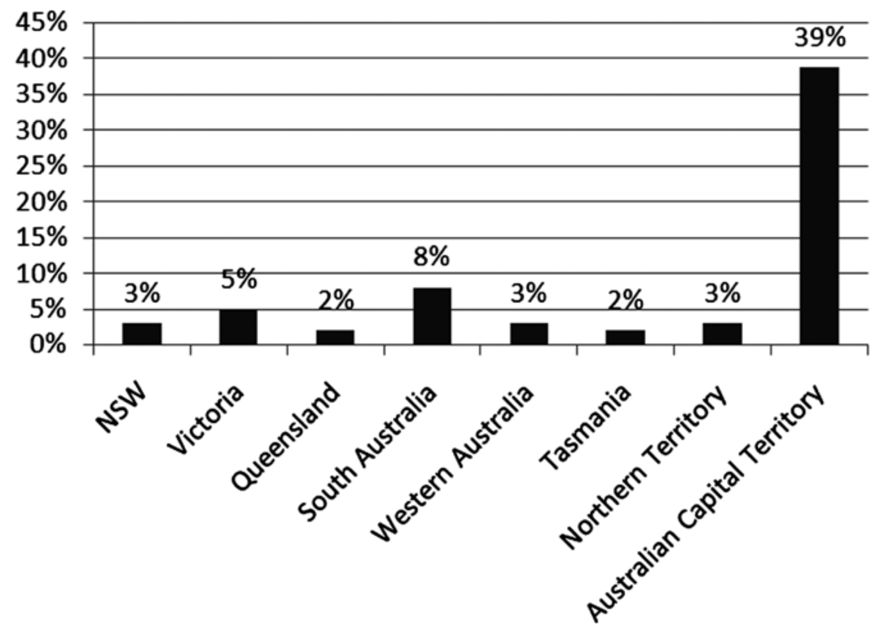
Box 3: Mini-mobile-modular desalination system

The Mini-Mobile-Modular desalination system is a water testing device for assessing locations for desalination plants. Traditionally, planning desalination plant sites involved the expensive and time-consuming creation of a single stationary pilot plant per potential site.[83] As well as testing, the Californian innovation can provide enough drinking water for up to 6,000 to 12,000 people daily.[84]

Reusing water

Australia has been reusing water for drinking and other uses for decades. According to the AWA and Deloitte, 37% of water experts surveyed said reusing water can play a central role in increasing Australia's water supply.[85] While the urban water industry has increased its reuse of water, in 2008–09 the overall proportion of reuse water remained unchanged at 4%.[86] Reusing water allows for the urban sector to develop without reducing fresh drinking water supplies.

Chart 10: Water reused as percentage of total water supplied, 2008–09



Source: ABS (Australian Bureau of Statistics), *Water Account* (Canberra: ABS, 2010), 55.

Until now, recycled water has been used only for non-drinking purposes because communities have been strongly against drinking reuse water.[87] In 2006, 61% of the residents of Toowoomba in Southeast Queensland voted against drinking treated sewage water.[88] However, in 2010, the Managed Aquifer Recharge (MAR), potentially a major source of water for Western Australia, trialled adding reuse water to drinking water by passing sewage water through a three-stage treatment process and then into underground aquifers.[89] California has been using the same process for more than 30 years to recycle 25% of its waste water for drinking.[90] The WA trial will go on until the end of 2012, cost $50 million, and will assess appropriate aquifers and pre-treatment requirements.[91] The process includes storing excess treated water in the aquifer for later use, while improving the aquifer's quality through additions of this fresh treated water. Reverse osmosis and UV light are being used as a disinfectant to meet World Health Organization (WHO) standards. After approval by the Department of Health, the additional water (equal to 10% of Perth's demand) would be fit for drinking.[92]

As water systems, particularly in Southeast Queensland, already have the capacity to supply reuse drinking water, politicians and water authorities should focus on building public trust in the high quality and safety of potable reuse water.[93]

Reuse of treated effluent water (grey water) for non-drinking purposes also considerably reduces demand for fresh water. In 2008–09, major urban water utilities supplied 173 gigalitres of reuse water for non-drinking purposes such as irrigation of sports fields, parks, gardening, and commercial and industrial use.[94] This volume is equivalent to the total water supply to Perth's households in 2009–10.[95]

Nationwide, the reuse water per person has significantly increased from 7 kilolitres in the 1990s to 21 kilolitres 2004–05.[96] Australia supplied 18% less reuse water in 2008–09 compared to 2004–05, largely due to lower rainfall preventing collection of drainage water by the agricultural sector. Household use of reuse water has increased by 24%, although the volumes are still relatively low.[97]

Nationwide, the reuse water per person has significantly increased from 7 kilolitres in the 1990s to 21 kilolitres 2004–05.

Coastal cities face higher costs of reusing water due to expensive transportation from low lying treatment plants to higher urban areas.[98] This is less of a concern for inland regional centres. Overall, reuse water is a legitimate option for augmenting future urban water supplies.

Other countries recycle waste water to a greater extent. In California, which consumes the most water of all the states in the United States, a quarter of its drinking water was recycled by pumping treated water into the groundwater system in 2007.[99] Israel, considered by the United Nations in its Human Development Report as severely water stressed, recycles 80% of its household waste water, accounting for 18% of its water supply.[100] Israel uses a low energy intensive recycling system that uses millions of small plastic rings to breed bacteria and break down organic waste. It exports this highly efficient technology for $1.5 billion a year to North America, South America, Australia and Antarctica.[101] Less energy intensive recycling systems would make reuse water a more viable alternative to depending on current sources of water.

Tanks

Although an expensive option, rainwater tanks are another way of increasing water supply to households to decrease their water demand from the grid by reusing rainwater for non-drinking activities. Rainwater tank use is increasing in urban areas. The ABS reports that in March 2010, 32% of households with a dwelling suitable for a rainwater tank had one installed, compared to 24% in 2007.[102] As tanks cost on average $4,000, the increase in government rebates during the drought (2003–09) contributed to the rise in demand for tanks. At one point, 65 rebate schemes existed. However, with the drought proclaimed over, only four rebates remain.[103] According to the Association of Rotational Moulders Australasia Inc (ARMA), 25% of rainwater tank manufacturers have closed down.

Of all states, South Australia has the largest number of households with rainwater tanks, representing 49% of all households.[104] Assuming a certain proportion of households are apartments, if even half of Australia's 8.1 million households had one average-sized tank (4,000 litres), they could collect up to 16 billion litres of water (or 6,480 Olympic swimming pools) at any one time.

Desalination

As the major urban centres in Australia are coastal, sea-water desalination can augment drinking water supply significantly. Ninety-eight percent of the world's water is in the oceans.[105] Currently, desalination supplies 0.3% of overall drinking water in Australia.[106] According to the WSAA, the current capacity of six desalination plants, located in Sydney, Melbourne, Southeast Queensland, Perth and Adelaide, can provide more than a third of the current needs of our capital cities. The plants also have the potential to increase their output to meet the entire additional water demand of capital cities until 2026.[107]

By 2015, a quarter of Sydney's drinking and non-drinking needs will be sourced from recycling and desalination.

The drawbacks of desalination are its high start-up and power costs.[108] However, as both desalination plants at Kwinana in Perth and Kurnell in Sydney are powered using renewable power supplied by off-site wind farms, desalination will be less affected by uncertainties of energy grid prices and environmental criticisms.[109]

Despite the cost, the 2010 Sydney Metropolitan Water Plan forecasts that by 2015, a quarter of Sydney's drinking and non-drinking needs will be sourced from recycling and desalination.[110] Western Australia, which was the first state to introduce desalination in 2006,[111] now supplies a fifth of Perth's drinking water.[112] Sydney uses desalination when dams are under 70% capacity.[113]

While potentially a costly option, desalination plants powered by renewable energy present an alternative water supply for major urban centres, one that does not reduce fresh water reserves or depend on rainfall.

Cost comparison

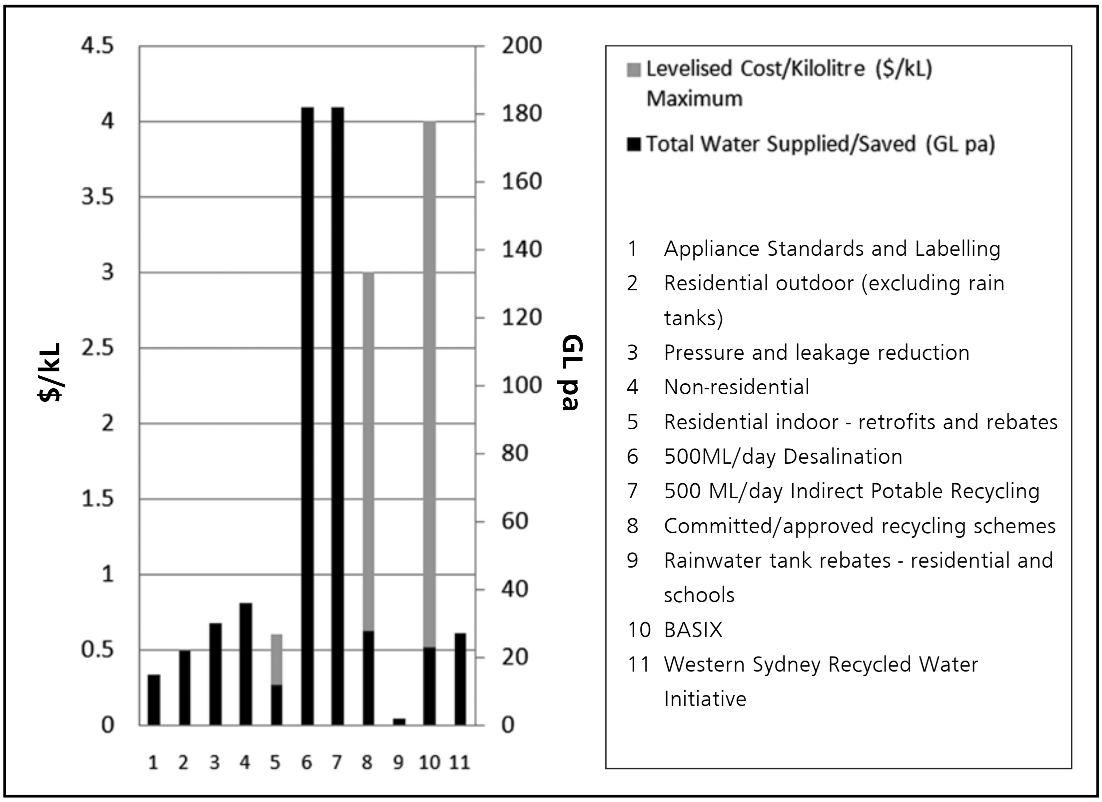
Chart 11 indicates that in NSW, demand management options such as leakage reduction and labelling of appliances (but not BASIX and tank rebates) are notably less expensive than augmenting water supply through new sources.[114] The chart is dated 2006, which means current and future leakage reductions may no longer cost 20 cents per kilolitre. Although desalination is more expensive, it has the potential to be a significant source of water (see Chart 11). Moreover, plants powered by renewable energy need not draw on grid power. Recycling is also comparably expensive; however, the funds saved by delaying infrastructure augmentation must be taken into account.

Chart 11: Cost of water supply/demand options

Option	Total water supplied/ saved (gigalitres/ pa)	Levelised cost/ kilolitre ($/kilolitre)
Appliance standards and labelling	15	$0.04-$0.05
Residential outdoor (excluding rain tanks)	22	$0.10-$0.20
Pressure and leakage reduction	30	$0.20
Non-residential	36	$0.30-$0.50
Residential indoor - retrofits and rebates	12	$0.50-$0.60
500 ml/day desalination	182	$1.73-$1.98
500 ml/day indirect portable recycling	182	$2.23-$2.61
Committed/approved recycling schemes	28	$1.00-$3.00
Rainwater tank rebates - residential and schools	2	$3.00
BASIX	23	$0.30-$4.00
Western Sydney recycled water initiative	27	$5.80

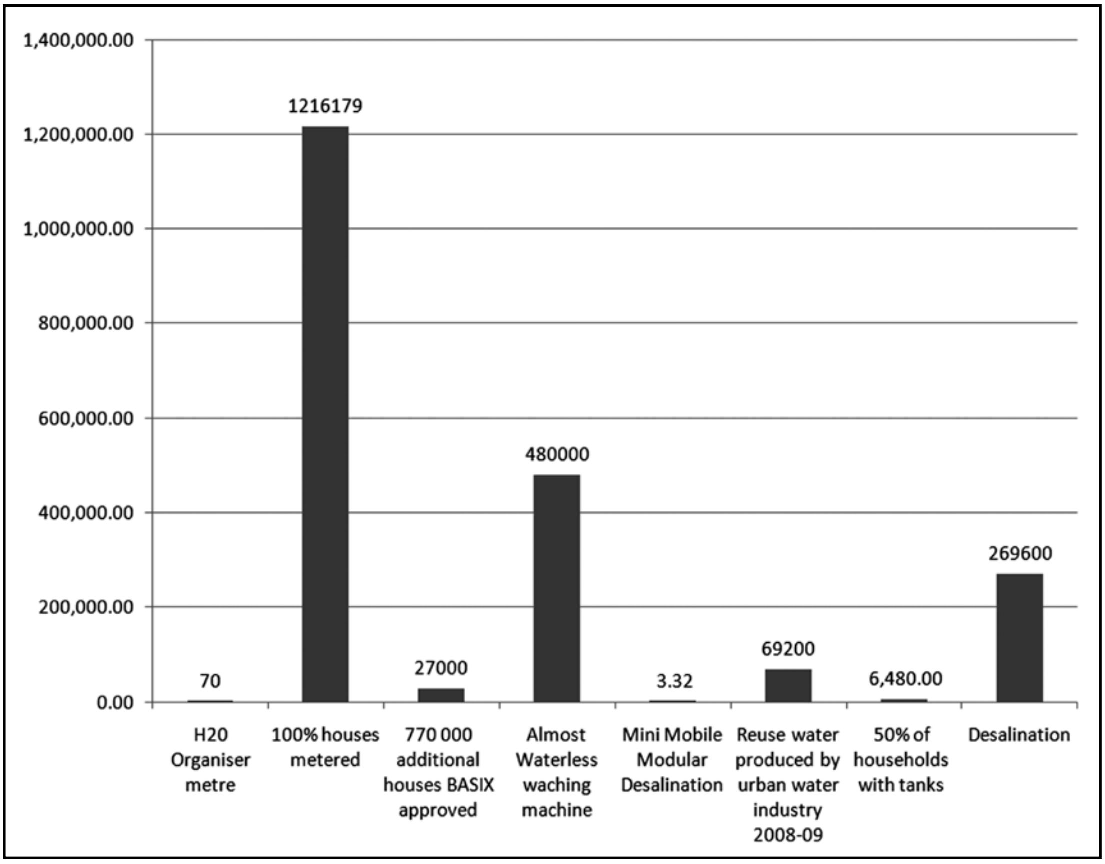
Source: John Marsden, 'Securing Australia's Urban Water Supplies' (Camberwell, Victoria: Marsden Jacob Associates, November 2006), 8.

Chart 12: Cost of options compared to water supplied



Source: John Marsden, 'Securing Australia's Urban Water Supplies' (Camberwell, Victoria: Marsden Jacob Associates, November 2008), 13.

Chart 13: Olympic swimming pools saved per year



Source: In-text information.

Agricultural use

While urban water use is the focus in the population debate, the agricultural sector consumes a much higher proportion of Australia's water. Agricultural water consumption decreased by 32% due to drought and higher water prices in the last five years,[115] but the overall consumption (especially in irrigation) has risen at a faster rate than in urban centres over the last several decades (see Chart 14).

Chart 14: Water consumption by industry, 2008–09

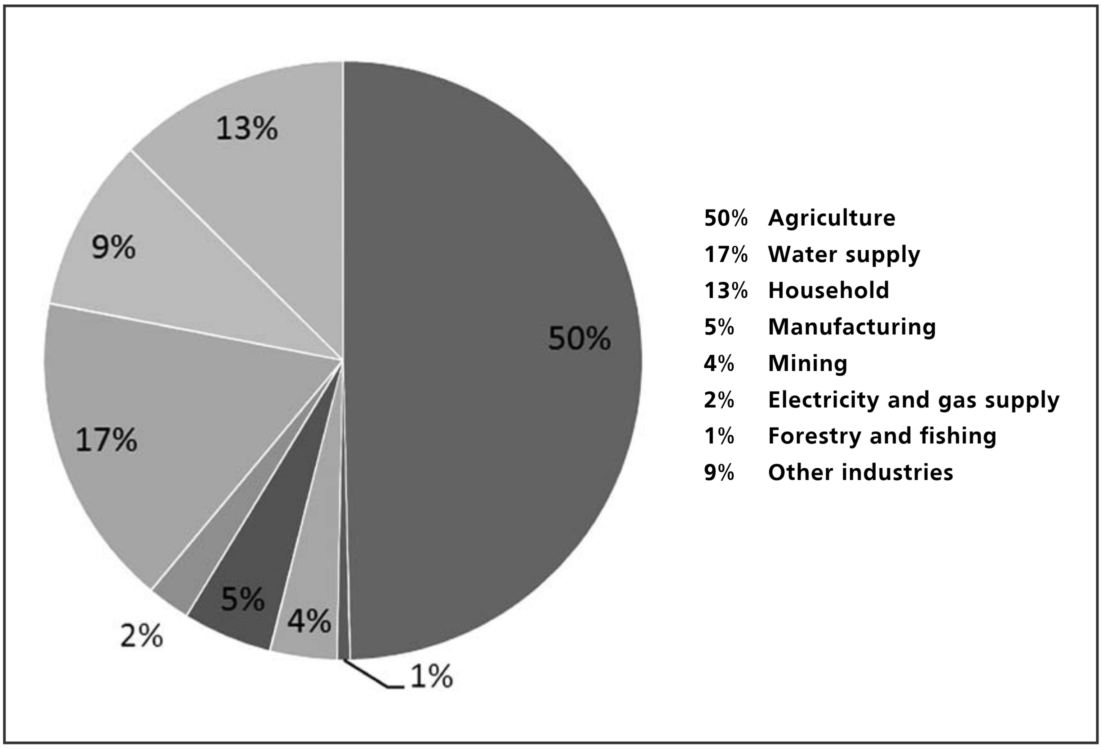


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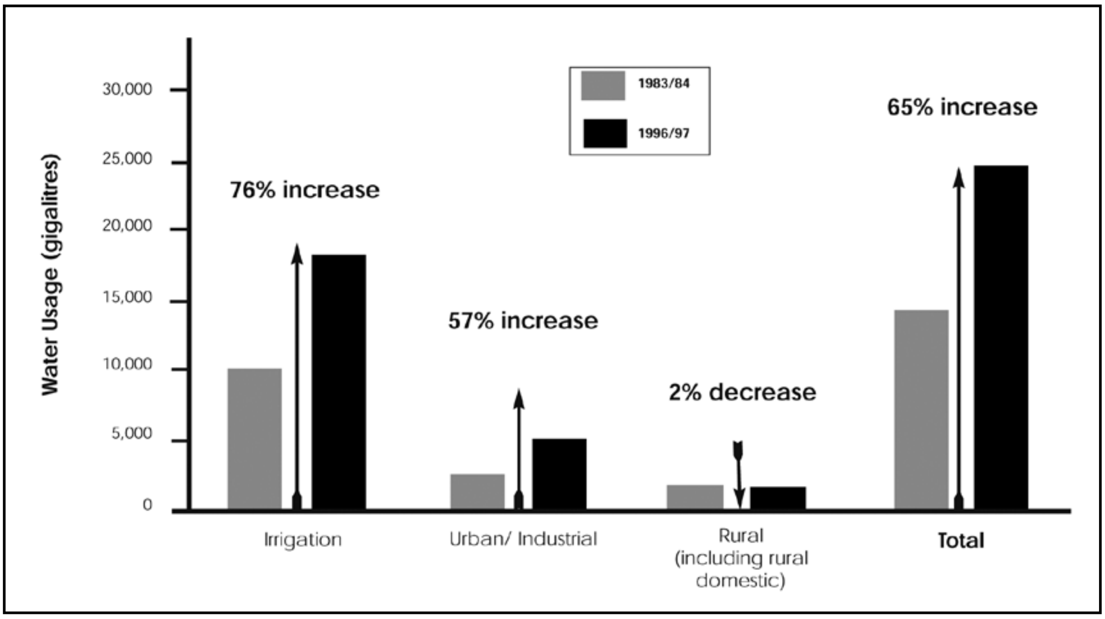
Chart 15: Change in water use, 1984–97



Source: Farmhand Foundation, Talking Water, Part 11: 'Australia's Water' (2004).

The agriculture industry consumed 50% of total water in 2008–09.[116] Much of this was due to irrigation, which amounts to twice the annual consumption of the national urban sector.[117]

Andrew Dragun, Adjunct Professor for the Australian Rivers Institute of Griffith University, argues that agricultural water use generates far less value than urban use.[118] At current prices, there was a 76% increase in the overall Industry Gross Value Added per gigalitre of water consumed between 2004–05 and 2008–09.[119] However, the increase in the gross value of irrigated production was only 13%.[120] Admittedly, the value of agricultural production varies with yields and commodity prices; nevertheless, growth in the value of the irrigated product is substantially lower than that of other industries.

Dragun, along with the WSAA, proposes shifting low-cost water from low-value crops to high-value urban users. In 2009–10, households paid $2 per kilolitre compared to 12 cents per kilolitre paid by the agricultural sector.[121] While admitting that talk of water transfers would trigger powerful political and economic debates, Dragun believes urban water problems can be solved by integrating formerly segregated water sectors.[122]

Rural to urban transfers are already underway. The Sugarloaf pipeline runs from Goulburn River in Victoria to Melbourne, and the Goldfields Superpipe runs from Goulburn to Ballarat in Victoria. Water purchased from Murrumbidgee in NSW is transferred to Canberra. While NSW and Victoria currently limit the amount of irrigation water that can be traded, a progressive shift to dry land farming over irrigated farming may allow restrictions to be lifted, enabling further water transfers to the urban sector.[123]

When focusing on water provision for a growing urban population, an additional concern is the increased water demand per capita embodied in food production and industry, as well as domestic use.[124] Increasing urban water demand would not jeopardise Australia's food security, as two-thirds of the food we produce (in value) is exported.[125] Nevertheless, locating farming in areas with higher rainfall would increase the agricultural sector's productivity. The irrigated agriculture of the Murray-Darling Basin, lies where only 6.1% of the national run-off occurs while the lesser populated tropical north receives 65% of the run-off.[126]

Increasing urban water demand would not jeopardise Australia's food security, as two-thirds of the food we produce (in value) is exported.

Agricultural water use must not be forgotten when planning the upgrading and expansion of urban infrastructure for a growing population.

Conclusion

Water is not a severe constraint on Australia's urban population growth. Over the last three decades, capital cities such as Sydney have been able to accommodate population growth without increasing water supply. Enhancing water efficiency and demand management in urban centres has and will continue to reduce water consumption.

The amount of water used in agriculture is much higher compared to urban centres. Yet, as we currently withdraw less than 10% of the available renewable freshwater reserves, any future water shortage will be less of an actual shortage and more of a politically and technologically determined blockage.[127]

Individual options will be no silver bullet if implemented alone. If water is managed strategically, and a range of solutions from pricing, metering, reuse and desalination are implemented, Australia's water resources can continue to support the inevitable population growth.

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