RAINWATER TANKS

Key stats

Up to 15 x more energy intensive. The average rainwater tank has a higher energy intensity per water volume than some alternatives. In Melbourne, for example, rainwater tanks are up to 15 times more energy intensive than conventional large-scale water supply systems, given the nature of that city's water system; in Sydney that figure is lower but still around 5-6 times more energy intensive.

100MWh. For each new 1400 rainwater tanks encouraged by government programs, roughly 100MWh of additional power will be required per annum. This is equivalent to roughly 100 tonnes of additional greenhouse gases released per annum.

1.5kWh/kL. The average energy intensity of rainwater tanks is 1.5kWh/kL. The energy intensity of existing supply systems differs greatly by location and conditions (eg. Sydney's long-term average w/out desalination is 0.33kWh/kL, Adelaide's is 1.84 kWh/kL and Melbourne's is 0.09kWh/kL)[1]. Desalination has an energy intensity of 3-4kWh/kL, which is 30-40 times more energy intensive than Melbourne's conventional water supply and 9-12 times more energy intensive than Sydney's.

80 - 90 % of water-related energy use in the home comes from heating water for use, regardless of the source of supply. Greater efficiencies in water heating systems and simple changes in behaviour (eg. shorter showers) would quickly be enough to compensate for the increased energy demands associated with rainwater tanks (Kenway et al. 2008).

Introduction

The last decade has witnessed a rapid increase in the adoption of rainwater tanks in urban Australia. Some responsibility for this can be attributed to the Millennium Drought, which affected much of south-eastern Australia for much of the last decade, but many householders were also encouraged by supportive government policies (particularly rainwater tank rebates and legislative requirements for households to reduce their water usage).

Rainwater tanks give homeowners more control over their water use, potentially ameliorating the effects of water restrictions and reducing expenses. They can also assist governments and water suppliers through supplementing the water supply, in turn allowing the deferment of further investments and improving environmental outcomes. It is these factors that have led Australian governments to encourage the uptake of rainwater tanks.

[1] These latter two figures are taken from 2006-07, when the drought had made it more difficult (and energy intensive) for Adelaide to pump water from the Murray River.

Significance for the Climate-Energy-Water nexus

While there are many potential positives to be realised in the dramatic adoption rates for rainwater tanks, there are also reasons to be wary of continuing this trend. Two of these relate to the water supply itself: firstly, it is not always the case that rainwater tanks are the most cost-effective solution to water supply shortfalls (NWC 2007), and secondly, the water efficiency dividends from rainwater tanks are often only partially realised (Retamal et al. 2009).

Most importantly for this document, however, is the fact that rainwater tanks can involve a direct trade-off between reduced water use and an increase in the intensity of energy use. In the case of Sydney, for example, the energy intensity of water from an average rainwater tank could be as much as 6 times greater than conventional supply in a non-drought year (when no water is pumped from the Shoalhaven River). Rainwater tanks have an energy intensity which is also greater (by 1.5 times) than conventional water supply augmented with the Kurnell desalination plant running at full capacity (Retamal et al. 2009), meaning that the further rollout of rainwater tanks still raises the energy intensity of Sydney's water supply. It should of course be noted that the much higher energy intensity of the Kurnell desalination plant is 'diluted' in these figures by the relatively small volume of water it supplies. A decision to augment Sydney's water supply further should therefore weigh the expanded energy demand from rainwater tanks and desalination plants evenly, recognising the latter's much higher energy intensity.

Management options for rainwater tanks

Research conducted by the Institute for Sustainable Futures at the University of Technology, Sydney, indicates that the extent of the increase in energy demand from rainwater tanks, and indeed of water savings, depend on three factors:

- the configuration of the rainwater system, including the type of pump installed and the parameters of 'top-up' settings,
- the uses to which the water is put, with low flow uses (toilet flushing, hand basin use) having higher energy intensity than high flow uses (showers, baths, garden watering), and
- water use behaviour and the presence of water and energy-efficient appliances (Retamal et al. 2009).

These findings indicate that some perverse outcomes can be avoided through careful design, configuration and calibration of pumps and rainwater tanks. Many householders are already coming to these conclusions on their own, with fixed-speed (and lower energy intensity) pumps an increasingly chosen option. The many other decisions that need to be made in the course of choosing and installing a rainwater tank, such as its position in the house and its connection to likely uses, have a further bearing on energy usage. The implications of these decisions need to be explained to potential customers and tailored to their circumstances to minimise both water and energy usage.

Recommendations for the Australian Government

Australian governments have an obligation to investigate the cost-effectiveness of rainwater tanks as a means to augment supply vis-à-vis the alternatives (which include demand management, stormwater capture, water recycling and desalination). As part of this role governments should make further efforts to examine and compare the relative energy demands of the water savings that are available through each of these alternatives, and to make this information publicly available. This will prevent the emergence of perverse financial and environmental outcomes from policies which promote an already chosen strategy.

Given the steps already taken by Australian governments to promote rainwater tank adoption, it is imperative that the opportunities be considered to leverage this policy pathway for maximum water and energy savings. This may mean that minimum standards and guidelines on pump and tank design, configuration and calibration are increasingly incorporated into government policies to ensure positive outcomes. In a similar vein, governments could consider doing more to provide minimum energy and water efficiency standards for household appliances, including through ratcheting these standards up transparently and predictably over time.

Rainwater tanks can augment water supply and allow households greater control over their water demands. Smart meters are a highly promising technology for realising the potentially transformative benefits of the latter, through providing near real-time usage and pricing information to householders. Combining water and energy smart meters in a single location can motivate householders to change their behaviour to use less of both resources, and governments have a key role to play in facilitating the uptake of this technology.

Conclusion

Decisions made now about the relative attractiveness of using rainwater tanks (and even more so, desalination plants) as a water supply solution could lock cities into higher energy intensity options for some time to come. Governments should be cognisant of the potential for perverse outcomes and take proactive measures to avoid them. Government decisions to wind up many of Australia's rainwater tank programs – eg. in NSW, QLD and at a national level – could be interpreted as recognising the need for an evenly assessed approach. The same could not be said for the decisions over the last decade by many Australian governments to commission desalination plants.

With a focus on reducing energy usage in urban areas, one area worthy of much more attention and government effort is water heating in the home. Efficiency savings and changes in behaviour in this area hold the potential to more than compensate for the additional power demands, and associated greenhouse gas emissions, of the effectiveness of rainwater tank adoption schemes in the last decade.

Key references
Kenway, S.J. et al., 2008. Energy use in the provision and consumption of urban water in Australia and New Zealand. CSIRO: Water for a Healthy Country National Research Flagship.
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National Water Commission. 2007. Cost-effectiveness of rainwater tanks in urban Australia: National Water Commission Position. March 2007.
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One thing I'd like to flag though, is the possible misrepresentation of desal vs rainwater tanks. It's important to compare rainwater tanks with the alternatives. I'm concerned that presenting them like this is accidentally providing a good news story for desalination when really, desal is much more energy intensive.

Desal energy intensity is typically 3-4 kWh/kL, which is still really high compared to rainwater tanks 1.5 kWh/kL.
So you need to compare them on the same terms…

The figures that get quoted for Sydney's water supply with desal e.g. 0.9 kWh/kL are low because desal only represents a small fraction of sydney's water supply. If you did the same calculation assuming no desal and the same volume of water made up with rainwater systems, it would be even lower than 0.9.

Also, it's not correct to say that rainwater tanks are 5-6 times more energy intensive than city water supplies. Some cities in Australia have existing energy intensities close to 1 kWh/kL, so raintanks are only a bit more.

Queensland is the state with the highest promotion and uptake of rainwater tanks.