



The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search
<http://ageconsearch.umn.edu>
aesearch@umn.edu

Papers downloaded from AgEcon Search may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.

No endorsement of AgEcon Search or its fundraising activities by the author(s) of the following work or their employer(s) is intended or implied.

Bringing competition to urban water supply*

Hugh Sibly and Richard Tooth[†]

This paper proposes a market-based reform that would introduce competition into the provision of urban water. This proposal calls for a decoupling of infrastructure control and ownership of water whereby the property rights to water would be transferred to private hands. The proposal involves periodically allocation (e.g. by auction) of existing water stock held in urban catchments to virtual suppliers who then compete in providing bulk water. This change when coupled with effective third party access and retail competition would lead to a competitive market for the provision of urban water. The approach aims to address concerns over inefficient pricing and infrastructure provision under the current arrangement.

Key words: urban water, water utilities, efficient water pricing, market power mitigation, introducing competition.

1. Introduction

There are growing concerns about the state of water supplies in all mainland Australian capital cities. The fear amongst some commentators is that there will remain a persistent fall in water storage levels due to the combination of population driven growth in demand and reductions in environmental supply due to drought and the (uncertain) effects of climate change. A universal response by local authorities has been to impose water restrictions. Although water restrictions have appeared to reduce water use, demand continues to outstrip long-term supply. Furthermore restrictions can impose significant costs on society.¹ In parallel, governments are evaluating substantial investments in alternative water provision such as recycled water plants and desalination plants. These investments are themselves the subject of significant political controversy.

Not surprisingly, many economists have argued for using price measures to ration available water rather than rely on water restrictions.² As most urban

* Authors would like to thank the editors and two anonymous referees for their helpful comments on an earlier draft. All errors remain our responsibility.

[†] Richard Tooth (email: richardtooth@jinet.net.au), Centre for Law and Economics, ANU College of Law, Australian National University, Canberra, Australia and Hugh Sibly, School of Economics, University of Tasmania, Tasmania, Australia.

¹ These costs include significant deadweight losses. Grafton and Ward (2007) provide recent estimates for the cost of water restrictions in Sydney. These welfare costs are found to be considerable. Mansur and Olmstead (2006) estimate the deadweight loss associated with water restrictions in urban areas in North America, and also find that these are considerable.

² For example, see Sibly (2006a,b) and Grafton and Kompas (2007).

water use in major urban areas is metered, the introduction of flexibility in setting the volumetric rate is simply implemented. An efficiently set price would provide market incentives for investment in new infrastructure, which would alleviate both the impact of population growth driven demand and reductions in environmental supply.

There are, however, two major challenges to the use of market based policies under the current institutional arrangements. First, the regulators face complexity in determining an efficient price. The efficient price needs to balance current demand for water against future demand, and also account for changes in future supply, such as variations in dam inflows caused by the erratic Australian rainfall patterns and the introduction of alternative sources of supply such as recycled water plants and desalination plants.³

Second, there are concerns that both the water authorities and regulators do not have sufficient independence from governments and that governments are unwilling to price efficiently. The current institutional arrangements encourage the politicisation of water provision, particularly the provision of new supply infrastructure. Infrastructure projects may be chosen by government for their political appeal rather, because they are the least cost method of delivering a particular quantity of water. The controversial nature of investment decisions has led to considerable delays, and there is little reason for confidence that those investments undertaken represent the least cost method of augmenting network capacity.

It is thus clear that the current arrangements have not delivered efficient urban water provision. More concerning, there are no reasons to suppose that this institutionalised unresponsiveness of pricing and capacity decisions will change. Even if significant rainfall alleviates the current situation, under the current arrangements the country will face the same set of circumstances when the next drought occurs.

This paper proposes a market based institutional solution to these challenges. This proposal calls for a decoupling of control of infrastructure and ownership of water. In particular, it is suggested that management of catchments for urban water supply (e.g. dams or ground water, hereafter simply referred to as 'catchments') be separated from the ownership of water stock held by the catchment. In effect, the various owners of water in the catchments would act as competing suppliers of water. In addition it is argued that water networks be required to allow 'third party' access to the water networks, that is, to allow private water producers to supply water through the operation of (for example) recycling or desalination plants.⁴ This arrangement would encourage an efficient and timely expansion of water supply and give rise to both an efficient allocation of water across different uses and time.

³ Environmental externalities may also need to be considered. These issues are independent of scope of the proposal in this paper.

⁴ Although national competition policy requires government business enterprises to allow third party access, this has not been effectively pursued in practice.

It is often argued that water is unique and a fundamental good and thus should be priced differently to other goods. However it is more useful to think of water as a particularly simple agricultural product, with an unusual distribution system (i.e. delivered by a network rather than road or rail). Apart from this distribution system, water is in essence no different from (for example) wheat. A competitive market for wheat ensures that the efficient amount is stored, and that the un-stored wheat is efficiently allocated. As is often discussed, wheat markets become distorted and thus inefficient when governments intervene, particularly by providing subsidies to producers. This is essentially the same for water. The absence of a competitive market has resulted in a very inefficient allocation of urban water (see for example Grafton and Ward 2007).

The proposed reforms would result in a price of water which would fluctuate. This may raise concerns over social equity in the access to water. Indeed there may also be public health concerns if some members of society are effectively denied access to water. It is argued below that these concerns should not cause the reforms to be abandoned. Indeed price regulation (particularly of the volumetric rate) is a very poor method of addressing these social equity concerns. Social equity, it is argued below, can be effectively addressed by rebates of the fixed charge to appropriately identified disadvantaged groups.

This paper is divided into three further sections. The following section provides a background that describes the typical Australian urban water supply system and current regulatory and pricing arrangements. Section 3 discusses some details concerning the introduction of virtual water suppliers. Section 4 discusses regulation, welfare and the administration of the water markets. Section 5 concludes the paper.

2. Background

The typical Australian urban water supply system is depicted in Figure 1. In Australian capital cities some or all of the supply of urban water is surface water which is stored in dams or reservoirs. Water may also be abstracted from rivers, ground water basins or potentially extracted from sea water using a desalination plant.⁵ Water taken from dams, rivers and ground water is pumped to water treatment plants. Once the water is treated it is delivered to the end users directly or via bulk storage facilities. Waste water from the end users is captured and treated before being discharged or recycled for further use.

⁵ Brisbane, Canberra, Melbourne and Sydney receive their water from dams. Adelaide and Hobart receive most of their water from rivers (the Murray and Derwent, respectively) however, both also utilise dams to store some water. The majority of Perth's water is supplied by ground water, though approximately 27 per cent is supplied by surface water stored in dams (See the Water Corporation of Western Australia's website for detail: <http://watercorporation.com.au/>).

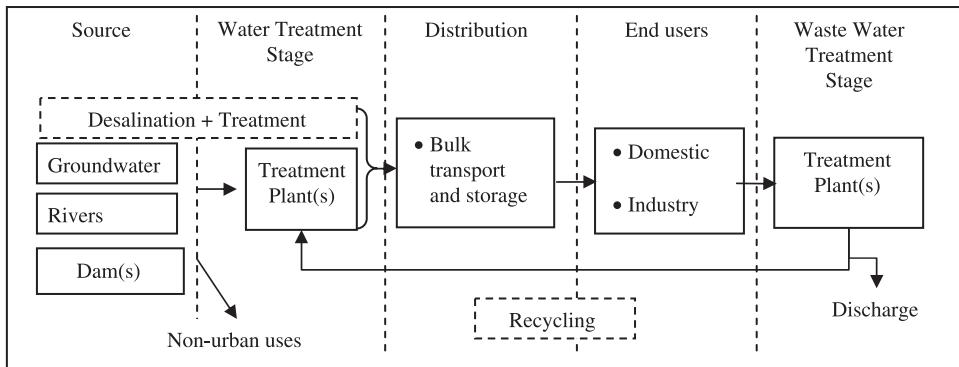


Figure 1 A typical urban water system. Adapted from NWI Steering Group on Water Charges (2007).

In Australia there is a small amount of recycling of water. A number of jurisdictions plan the introduction of desalination plants. Water urban water sources may also be diverted to non-urban water uses such as irrigation or for environmental release purposes.

Urban water suppliers are often described as natural monopolies; they typically involve large fixed costs, small variable costs and fixed capacity in the short term. There are significant fixed costs in building infrastructure (e.g. dams, treatment plants and pipe networks) and ongoing maintenance and administration. The variable costs primarily include some costs associated with the cost of pumping, treating water and the opportunity cost of the alternative uses including irrigation and environmental purposes. There are capacity constraints in both the treatment and distribution and in the bulk supply. In terms of bulk water supply, which is the focus of this paper, the capacity constraint relates to capacity of the reservoirs and the associated available stock of water.

The water supply in Australia's major urban areas is provided by state or local government owned water authorities. The management of the water catchments and the network is conducted by a single authority (for example in Western Australia) or by separate authorities (for example in Sydney).

In Australia, the pricing and regulation of water authorities is conducted by state regulatory agencies.⁶ Since the implementation of national competition policy the main objective of regulation has been to achieve cost recovery. Most regulators aim to set the volumetric charge for water equal to long-run marginal cost. Their pricing methodology has the advantage of yielding price stability. However this methodology yields an inefficient pricing as no

⁶ For example, in Sydney the NSW Independent Pricing and Regulatory Tribunal regulates the bulk water price set by the Sydney Catchment Authority and the retail price set by Sydney Water.

consideration is given to short-term shortages (or excesses) of stored supply. Furthermore, the volumetric rate calculated with this methodology will not be efficient if (as is common in Australia) efficient infrastructure augmentations are not undertaken. The result of using the methodology in the current environment is that volumetric rate for water is likely to be dramatically under-priced (for a full discussion see Sibly 2006a,b).

3. The proposed reforms of the urban water market

The concerns raised over the inefficiency involved in the current management of urban water supplies would largely not arise if there were a competitive market for the supply of urban water. If such a market existed the market price of water would quickly adjust to a level that adequately reflected available knowledge on long-term supply and demand and the need for price regulation would be limited to other functions of the water supply system. Furthermore, competition would encourage private investment in new infrastructure for water supply.

There have been a number of other proposals to develop markets for water in Australia (see ACIL Tasman (2003) for a summary). Many of these existing and prospective approaches have focused on the rural and industrial markets and for trading between urban and non-urban uses. We are unaware of any proposal that create competitive markets for urban water usage for all end users.

3.1 Overview of the proposal

The aim of the reforms suggested in this paper is to introduce competition into bulk water supply, retailing and potentially other aspects of the value chain through allocating rights to portions of water stock in water catchments to new owners. This would, in effect, create virtual suppliers who compete with each other, and operators of alternative sources (such as desalination plants), in the provision of bulk water. Retailers act as middle men between the bulk water suppliers and the end users. A competitive market for retail water is then formed by allowing competing retailers to sell water services to end users.

A summary of the proposal showing water flows and potential payments flows is displayed in Figure 2 below. This figure shows that, as today, water moves from being under the management of a catchment operator (e.g. while it is in a dam) to that of a network operator who manages the water treatment (including bulk transport to local reservoirs) and distribution (local storage and retail reticulation) through to end users. As is today the functions of the catchment operator and network operator may be combined into a single entity or further disaggregated. Alternative bulk suppliers may exist to provide other (i.e. non-catchment) sources of supply such as a desalination or a recycling plant.

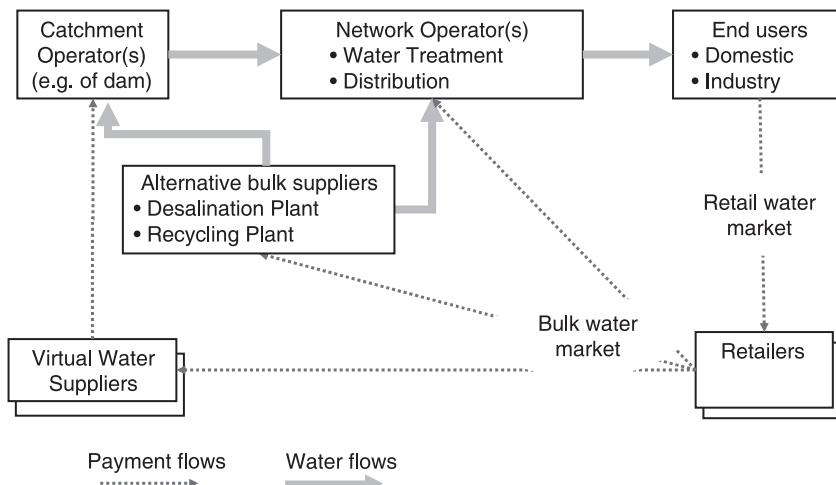


Figure 2 Potential model of water and payment flows.

The figure shows two new market participants, virtual suppliers of water, and retailers.⁷ Note that neither of these parties have any physical involvement in delivering water to the end-users. Their role is financial: it is limited to conducting the trade in water.

Under the proposed model, the catchment operator is required to sell rights to the water stock in its catchment via a competitive process to the virtual suppliers. The rights enable a supplier to hold the water, trade with other suppliers or to sell into the market.

The arrangement described removes market power in the bulk supply and retailing sections of the value chain. The catchment operator loses its market power via the compulsory sale of water stock. Due to low barriers of entry for suppliers, the market for selling the water into the system will be very competitive. Similarly there will be low barriers of entry for retailers.

Competition among buyers and sellers in each of the bulk water and retail water markets establishes a market price for bulk and retail water supply. In determining current supply decisions, virtual water suppliers would compare the benefit of supplying water now (the current volumetric rate) with the benefit of leaving the water in the storages (the future volumetric rate). If, for example, a drought is predicted, suppliers would expect the future volumetric rate to rise, and would tend to leave water in the storages. This would drive up the current volumetric rate. In this fashion, competition for bulk water ensures that the price supplied from each dam will come to reflect the opportunity cost of keeping the water to meet future demand.

⁷ The retail function exists in existing water markets, however, typically there is a single retailer, for example, Sydney Water.

3.2 Similarities and comparisons with other schemes

The approach has some similarities with other water management schemes such as capacity share schemes for water markets and tradeable water rights and similar virtual schemes established for electricity markets.

SunWater, a Queensland government owned corporation that owns and operates a number of dams (and weirs and other water supply infrastructure), runs a system whereby water entitlement holders effectively share in the storage capacity of a dam and have an associated water account.⁸ Water entitlements can be sold, transferred or seasonally assigned between water users located within the water supply scheme. The system has been successful and provides a useful example that allocation of water entitlements within a dam can be effectively put in place.⁹

The general approach is similar to the concept of Virtual Power Plants (VPPs) that are used in the electricity industry. VPPs have been implemented by European regulators as a means of mitigating market power.¹⁰ Effectively these involve requiring the incumbent power plant to sell part of its future production capacity. The sale of the capacity is virtual as no operational control changes hands. The VPPs then compete in the provision of electricity with the physical owner of the power plant. Competition from the VPPs mitigates the physical power plant's market power and encourages more allocative efficient pricing.

A virtual arrangement is possible because, like electricity, water in a dam is a commodity¹¹ whereby each unit is indistinguishable from other units. Furthermore, there are some characteristics of the water industry that make it more conducive than electricity to the use of virtual suppliers to manage market power and introduce competition.

Unlike electricity, water is very durable in that it has very low marginal storage costs. The high storage costs of electricity mean that electricity is generated to meet current demand.¹² In contrast water is typically collected significantly in advance of its consumption. This characteristic means that whereas VPPs need to be allocated a level of future production capacity. In the case of water, virtual suppliers can be allocated a portion of existing water stock, instead of, or in addition to, future catchment inflow (analogous to production).

Another common feature in Australia is that there are water catchments with a large capacity that can meet the demands of existing users for long

⁸ See www.sunwater.com.au for more information.

⁹ A number of commentators including Allen Consulting (2007) and ACIL Tasman (2003) have also argued for increased use of water trading.

¹⁰ For a discussion of Virtual Power Plants and their use in Europe see Willems (2005).

¹¹ There are however, differences between water from different sources. The water from different sources are only perfect substitutes after treatment, as only potable water could be placed into the existing water mains.

¹² Electricity is commonly described as a commodity which 'cannot be stored for future use' NEMCO (2005), pg. 4 but as described by Hunwick (2005) there are a variety of alternative, albeit expensive storage options.

periods. This feature means that rights can be allocated such that under normal conditions no single supplier will have market power.

The durability and large stocks of water also mean that, unlike electricity markets, water pricing can be established for long intervals. In Australia, offers of supply to the National Electricity Market are made every 5 min so as to match generating capacity with fluctuating demand throughout the day. Due to the high storage costs and fluctuating demand the wholesale price of electricity fluctuates significantly.¹³ Even though water demand may fluctuate, due to its low storage costs the market price for water is unlikely to fluctuate significantly unless water stocks are very low.

3.3 The role of market participants

This section describes the role, design considerations and implications for each of the industry participants contained in Figure 2.

3.3.1 *Catchment operators*

Under the proposed approach, the role of the catchment operator would be similar to that of today. It incorporates maintaining the catchment, managing the water release and activities to prevent loss of water and/or augment the water catchment. The key change for a catchment operator is that it is required to auction off rights to its water.¹⁴

The catchment operator would incur the costs of the operations and management of the catchment. These could be covered by the revenue generated from the sale of the water rights and charges (discussed further below) imposed on virtual water suppliers for storage.

Under the proposed approach, it is assumed that the catchment and its management remain in government hands. Potentially, however, the management of the catchment could be sold as a going concern or outsourced as a concession.¹⁵ There are potential efficiency gains from a competitive tendering for the operation of this infrastructure, though the realisation of these gains will depend on the contract conditions imposed on the eventual operators. Consideration of these possibilities is outside the scope of this paper.¹⁶

¹³ The National Electricity Market Management Company, NEMCO reports Regional Reference Price (RRP) for NSW and other regions. According to NEMCO price tables from 1–23 March 2007 the daily average RRP for NSW varied from \$27/MWh to \$128/MWh with a peak as high as \$178/MWh.

¹⁴ The catchment operator may also operate purification plants, in which case purified water is delivered to the bulk water. This is currently the case in Tasmania. Alternatively the catchment operator may deliver untreated water to the network operator, in which case the network operator is required to treat the water. This is the case in Sydney. The proposed reforms can be implemented equally well in either case.

¹⁵ The revenues from auctioning water rights could go directly to the State or to the outsourced catchment operators. We propose the catchment operator receives these revenues so as to provide incentive for the operator to maximise the value of the catchment.

¹⁶ See Guasch (2004) and Lobina and Hall (2003) for a discussion of private management of water infrastructure.

3.3.2 *Virtual suppliers*

The role of virtual suppliers of water is to simply buy and trade limited water rights. Rights to water stock simply allow holders to sell water for release, trade to another party or hold. There appears no reason to limit these rights. The rights should be divisible (within practical limits), transferable and permanent.

In the most basic design a virtual supplier simply has a water account and a financial account. These would be updated as a result of trades and costs of water storage. A potential extension is to also allocate rights for future allocations of flows into the catchment. The costs of water storage and the issue of allocating rights for flows into the catchment are discussed further in the section on design considerations below.

Virtual suppliers can contract with retailers for the supply of their water at a given time and price. There is no further requirement of any activity for a virtual supplier. The execution of the release of the bulk water and administration of the supplier accounts is conducted by the catchment operator. The quantity sold by each supplier is simply updated against each supplier's account. Water not sold by a supplier is retained in the bulk water supply and recorded against the supplier's water account. Each supplier's water and financial account is then updated to reflect the quantities sold and retained and the storage and administration costs.

There would be a very easy entry and exit. To enter, a new entrant simply needs to participate in an auction of new water stock. Exit is simply a case of selling the existing water rights in a secondary market. There is no apparent reason to limit entry other than to impose some maximum ownership restriction to prevent a supplier having market power.

3.3.3 *Retailers*

Retailers act as middle men between end users and the water suppliers. An important aspect of this role is to provide billing services for customer. Retailers are likely to offer a range of value added services including pricing plans which help to manage the water price risk for their customers. For example, retailers could provide a plan with fixed or variable pricing plans. They may also compete in providing different payment options.

Retailers who provide pricing plans that buffer their customers from pricing fluctuations will also want to take an active interest in price fluctuations of bulk water. For this reason retailers may also invest in bulk water supply directly or support financing of alternative sources.

The retail market should be very competitive as there will be very easy entry and exit. The main requirements to compete are an effective billing system and a customer base. For example, we would expect other utilities to be well placed to operate as retailers. To prevent a potential abuse of power it may be preferable to exclude the distribution network owner from also being a retailer. From a consumer's viewpoint, all that may change is the billing arrangements.

3.3.4 Network operators

The core elements of this proposal do not involve any direct changes to the functions of the network operator (i.e. water treatment and distribution functions) other than separation of these functions from the trading of water.

There are some potential improvements to these functions that come as a result of the core proposal and other opportunities for reform that may be considered. The core proposal may have a number of indirect benefits over the management of the water treatment and distribution functions. First, there would be a better understanding of the opportunity cost of water and thus of the cost-benefit of infrastructure improvements. Second, retailers would have a stake in the quality and cost of services supplied and might help in providing better oversight of these functions. Finally, private sector involvement in alternative sources of supply, such as a desalination plant, may incorporate water treatment and bulk distribution and thus provide some competition to the existing organisations performing these functions.

Management of the water treatment and/or reticulation network could also be undertaken either by a government business enterprise or be delegated to a private operator.¹⁷ In either case in order to achieve efficiency the variable costs of reticulation and relevant purification costs incurred by the network operator must be imposed on the end user (possibly via the retailer) and incorporated into the volumetric retail price. The remaining fixed costs, primarily infrastructure spending (such as capacity augmentation) and operations and maintenance cannot be directly attributable to units of water. In order to satisfy the National Competition Policy requirements for cost recovery, these costs must ultimately be recovered from the consumers of water. The efficient manner to do this is via a fixed charge.¹⁸ Although, price regulation is still likely (particularly if government ownership of the network is retained) to achieve economic efficiency, there may efficiency gains from the tendering for private operation of the network. Consideration of such contracts is outside the scope of this paper.

3.3.5 Alternative bulk suppliers

This proposal will have significant implications for private investment in alternative bulk supply. To date investment in alternative urban bulk water supply is at the discretion of government. Private investment has been effectively blocked by existing authorities, and in any event has been held back by a pricing system that does not provide appropriate incentives. The proposed reforms would lead to a clear efficient pricing process and thus remove the need for government funding of supplementary urban bulk water supply infrastructure.

There is considerable risk associated with a private investment in alternative bulk supply largely due to the significant uncertainty as to the future supply

¹⁷ Concessions have been used internationally in water services with mixed success. Lobina and Hall (2003) and Guasch (2004) discuss some of the experiences.

¹⁸ See Sibly (2006b).

of water from the existing catchment. To manage the risk of a significant fall in the price of bulk water, we would expect alternative suppliers to contract with retailers and even potentially directly with large customers. A number of risk sharing arrangements are possible (e.g. fixed price contracts, options) and there appears no reason to put any limit on these.¹⁹

3.4 Additional design considerations

While relatively simple in operation, there are a number of design considerations. These include the allocation of future catchment flows, storage costs, length of trading period, how much water should be allocated and social objectives.

3.4.1 Allocation of future catchment flows

Potentially in addition to water stock, virtual suppliers could be allocated future catchment flows. This approach is attractive in it potentially removes the need for periodic auctioning of additional water stock. If rights to future catchment flows were allocated then it in the interests of efficiency it would be desirable that these be permanent, fully transferable and divisible.

There are however, a number of reasons why allocation of future flows is not preferable. First, the benefits are likely to be small. As discussed below, the repeat auctions may only be required very infrequently. Furthermore the transaction costs associated with repeated auctions of water stock should be very low. The administration of the auction would be largely automated and so costs should be extremely low once a process and a system has been established. The costs to participants will also be small due to the use of an automated system and because the cost of valuing water is an activity that would be conducted regardless.

Second, there may be significant costs associated with allocation of flows. There are four main reasons. Firstly, if dam operators do not receive the benefits of additional flows then they will have less incentive to optimise the dam capacity and flows. Secondly, once rights to flows are allocated, any change to the catchment capacity or rate of intake into the dam may necessitate complex adjustments to the allocated rights. Third, an auction of future flows may result in an inefficient transfer of risk from the public to the private sector. The value of future flows is subject to great uncertainty. As private sector firms are not totally risk neutral,²⁰ such a transfer may be inefficient. The cost of the uncertainty may, however, be mitigated through repeated

¹⁹ Some households may be reluctant to sign long-term contracts with retailers (which in turn may limit the extent retailers will wish to share risk with investors in alternative supply). This should not be a significant issue – many households currently have multiyear contracts with electricity retailers. Furthermore there are a many large industrial users who could be interested longer term contracts to secure an affordable supply of water.

²⁰ Doherty (2000) notes that risk is costly to firms due to a number of reasons of tax nonlinearities, managerial compensation, direct costs of financial distress and agency conflicts between shareholders and creditors.

auctions of water stock. Finally, allocating rights to future flows reduces the ease at with which new suppliers can enter the market and thus increases the risk that suppliers may collude.

3.4.2 Storage costs

To encourage efficient choice between holding and selling water stock, virtual suppliers should be charged the marginal storage cost associated with storing their water stock.²¹

There are three basic types of storage costs:

- Direct storage costs.
- Loss from evaporation and leakage.
- Loss from risk of overflow/release.

Direct storage costs are those cost relating to the maintenance and operation of the catchment. Although for a dam the maintenance and operation costs are significant, it is expected that these costs are primarily fixed and do not change with the level of water of in a dam. Thus the marginal storage costs (i.e. with respect to an additional unit of water) are likely to negligible.

Evaporation and leakage from a dam can be significant.²² The rate of evaporation depends on a number of factors including the weather²³ and the surface area of the water supply. The decision of a virtual supplier to retain an additional unit of water will only have a marginal impact on the surface area of the water supply because the physical nature of dams is such that the surface area of the dam increases with the volume held. Thus an efficient charge would involve some, albeit small, marginal evaporation charge levied against the virtual suppliers. The remaining evaporation cost would be borne by the catchment operator by way of loss of auction revenue from future inflows.²⁴

The final storage cost considered is the loss from overflow/release. If for example, dam levels rise significantly the dam operator may be required to release water for overflow. Although the value of the water lost will be low, a question arises as to how overflows impact on supplier accounts. An optimal arrangement will be such that the catchment operator has incentive to optimise the catchment capacity and suppliers have incentive to optimise the risk of loss of overflow. A simple arrangement that would meet such optimal

²¹ The remaining costs should be the responsibility of the catchment operator who then has incentive to minimise these. The catchment operator's costs should be paid out of revenues from auctioning of water stock. These revenues should be sufficient if there is value in the operation of the catchment.

²² Evaporation from dams in Australia is estimated to be in excess of 2000 GL per year. See http://www.connectedwater.gov.au/framework/water_efficiency.html (accessed 4 February 2008).

²³ Evaporation rates increase with higher wind speeds, higher temperatures and lower humidity.

²⁴ This also gives the catchment operator incentive to minimise evaporation and leakage.

arrangements is to make the catchment operator a supplier of water when there is some risk of overflow and for the catchment operator to bear any loss associated with the overflow.

3.4.3 How much water stock should be sold and how often?

There appears no reason to limit the amount of water stock sold. Typically there is a need for water for environmental uses but there is no reason why this cannot be purchased in competition with other water suppliers.²⁵

A minimum amount needs to be allocated to ensure that no single supplier has market power. Under normal conditions this should be easily achieved by ensuring that for any trading period, the ownership of stock is such that no single supplier is required to meet expected demand for the trading period. If this were not the case, the largest supplier may hold back on release so as to increase the market price.

Given this one constraint, the allocation of water need not be done frequently. While there is no risk of a supplier having market power there is no benefit to allocating additional water stock and so to reduce transaction costs it may remain in the catchment unallocated for some time. Some simple rules could be established to the timing of water stock auctions.

An associated issue is around the transparency of the available water stock. Ultimately the value of a virtual supplier's stock is determined by the total volume of available supply. If there were a limitless supply, the marginal value of water stock effectively becomes zero.

There are challenges in determining the total volume of available supply. First, there is some uncertainty as to what will be available and at what price. For example, there is an uncertain amount of water residing at the bottom of dams that may only be accessible by installing pumping or alternative access points.²⁶ Second, the catchment operator who receives revenues from the sale of water stock has incentive to make it appear initially that stocks are limited but then to 'discover' additional stocks when other stocks are close to exhaustion.

4. Regulation and market design issues

4.1 Regulation of participants

Provided there is sufficient competition in the bulk water and retail markets there should be no need for any special regulatory oversight of the setting of

²⁵ See the Productivity Commission (2003) for a discussion on approaches to allocating water for environmental uses. They report that in California and Colorado, environmental agencies purchase water rights for environmental purposes.

²⁶ For example, the Sydney Catchment Authority (SCA) is currently modifying existing and installing supplementary infrastructure to access 'deep water storage' at its Warragamba and Avon/Nepean Dams.

the volumetric rate. Competition should be sufficient to ensure that price is set efficiently. As with any market participants would be subject to the provisions of the Trade Practices Act.

Virtual suppliers will compete in a very competitive market so long allocation rules are, as discussed above, used to ensure that no supplier has market power. This can be simply achieved by imposing limits on the share of water that one supplier can acquire. Such a requirement may not be necessary in practice, as competition is likely to undermine any attempts to monopolise the water stocks.

Another concern may be that in periods of drought a privately owned and operated alternative bulk water supplier, such as a large desalination plant, may have excessive market power. It should be noted that the presence of virtual water suppliers helps undermines this possibility. If virtual suppliers believe there is an increased risk of drought they have an incentive to hold back their water stocks in anticipation of higher future prices. To the extent that drought is correctly predicted, this has the effect of increasing competition in the drought period.

Another regulatory solution to the excessive market power of the alternative supplier would be to require the supplier to, in advance, auction off part of their output to other suppliers. This would ensure that the alternative supplier faced competition.²⁷ Regardless of regulation, an alternative supplier may wish to enter long-term contracts to manage their own risk.

Under the proposed reforms, the catchment and network operators may continue to have some market power in setting fees for storage, treatment pumping and network access. As such there is likely to be a role for regulatory oversight of the setting of these fees and charges. Similarly the network operator could increase their market power by refusing to accept water from one or more bulk water suppliers. To avoid such attempts at creating market power the network operator would be obliged to transport all water of an appropriate quality standard.

A common concern about third party access to the water network is the maintenance of quality standards. It would appear appropriate that physical water suppliers be responsible for demonstrating to the network operator, the quality of the water they are introducing to the network. However given the importance of maintaining quality standards, there is a case for regulatory oversight of quality standards and the processes used to monitor them.

In public debate there is often concern expressed about the environmental impact of urban water supply decisions. Clearly there is a role for government in managing environmental outcomes. Such issues are complex and outside the scope of this paper. However there is no reason to view the development of urban water infrastructure any differently to that of other industries.

²⁷ This is the process discussed above which is used in the European power industry.

4.2 Meeting social welfare objectives

There is likely to be concern about the social impact of the proposed reforms. The volumetric rate is likely to be relatively high in times of drought, and in any case will tend to fluctuate over time.²⁸ However these concerns can be simply and efficiently addressed following the proposed reforms in ways which provide greater benefits to the socially disadvantaged households, and at a lower cost to society, than the policies that are currently in place.

The current inefficiently low volumetric rate in effect provides a subsidy to all households irrespective of their level of social advantage or disadvantage. It is hence costly because it is so poorly targeted. Social welfare objectives would be more effectively and transparently achieved by providing fixed subsidies on the water bill to those households that are identified as disadvantaged (Sibly 2006a). Such a subsidy would be more equitable and give the disadvantaged an opportunity to benefit more at no cost to society.

4.3 Market operator

The above discussion has abstracted from the institutional structure of the bulk and retail water markets. There are a number of ways these may be constituted. Potentially retailers could contract directly with virtual suppliers and other parties in the value chain. Another possibility is to introduce a market operator to determine spot prices for the supply of bulk water and to facilitate payments between industry participants. This role would be similar in function to that of the National Electricity Market Management Company (NEMCO) which supports the Australian electricity market.

Under this proposal the market operator would, for each trading period, match the supply bids from the water suppliers with forecast demand requirements to establishing a spot price (that suppliers receive) for bulk water by each catchment.

The market operator could also facilitate payments. This would involve collecting funds from retailers based on each retailer's volume of sales and distributing funds to virtual suppliers and other parties involved in water treatment and distribution. As such the price paid by retailers would need to account for water losses and financial costs involved in water treatment and distribution.

Introducing a market operator is advantageous if it lowers market participants' transaction costs. A market operator model may avoid higher than necessary transaction costs for retailers in establishing and managing supply contracts particularly given the uncertainty of volumes that are consumed. Note that other mixed models are possible. For example the market operator could facilitate payments between retailers and virtual suppliers but the retailers could contract directly with the water treatment and distribution functions. Another scenario is that installation and maintenance of the

²⁸ It is possible that some retailers will offer stable water prices in long-term contracts.

reticulation network could be paid for directly by end-users (as this cost is not related to volumes purchased) or by the local council.

5. Conclusion

The current institutional arrangements have not efficiently delivered urban water in major Australian metropolitan areas. Neither price nor infrastructure has efficiently adapted to changing demand and supply conditions for water. The reforms suggested in this paper are a practical method of introducing competition into urban water markets. This competition would ensure that price and capacity adjusted to established efficiency in urban water supply. The introduction of market forces would not only establish efficient production in the short term, but provide a degree of flexibility in the face of changing demand and environmental supply conditions.

By ensuring an efficient pricing process, the approach removes the need for existing costly water restrictions and the need for any government funding of supplementary bulk urban water supply. Households and businesses will gain from the removal of restrictions, the more efficient delivery and allocation of water, and the benefits competition in water retailing.

In this paper we have focused only on water provided via the existing urban water networks. This water has been treated as a homogenous commodity, which is a reasonable assumption given the way in which urban water networks currently operate. However water from different sources has different properties. The requirements of some industrial customers, for instance, may differ from residential customers. These industrial customers, in particular, may have processes in place for further treatment of the source water to their specifications, so may have preference for particular source of water. Indeed some industrial customers may prefer to treat water themselves, thus would prefer the cheaper, untreated water. Our proposal, which encourages opening up the water market to competing suppliers, provides potential for the introduction of new water supplies that are best for a range of different purposes. The effect would be to increase the efficiency of the urban water market.

The approach may not completely remove the need for price regulation over the catchment and network authorities. However, by providing price signals, these reforms have some benefits for the management of these authorities. Furthermore, through more effective subsidies, disadvantaged households would be better targeted by social policies. Finally, the approach does not compromise the quality of water provision as there are no required changes to the operation of water services.

References

ACIL Tasman (2003). *Water Trading in Australia: Current and Prospective Products*. Report prepared for the Water Reform Working Group. ACIL Tasman. Available from URL: <http://www.aciltasman.com.au/images/pdf/WRTG%2030%20June%202003.pdf> [accessed 21 July 2008].

Allen Consulting Group (2007). *Saying goodbye to water restrictions in Australia's cities: Key priorities for achieving water security*. A Report to Infrastructure Partnerships Australia, February. Available from URL: <http://www.infrastructure.org.au/research/publications.htm> [accessed 21 July 2008].

Doherty, N.A. (2000). Innovation in corporate risk management: the case of catastrophe risk, in Dionne, G. (ed.), *Handbook of Insurance*. Kluwer, London. (Ch. 15).

Grafton, Q. and Kompas, T. (2007). Pricing Sydney water, *Australian Journal of Agricultural and Resource Economics* 51, 223–357.

Grafton, Q. and Ward, M. (2007). *Prices versus Rationing: Marshallian Surplus and Mandatory Water Restrictions*. Crawford School of Economics and Government Working papers IDEC07-05. Available from URL: http://www.crawford.anu.edu.au/degrees/idec/working_papers/IDEC07-05.pdf [accessed 6 November 2007].

Guasch, L.J. (2004). Granting and renegotiating infrastructure concessions: doing it right, World Bank Institute Development Studies, available from URL: http://www-wds.worldbank.org/servlet/WDSContentServer/WDSP/IB/2004/05/06/000090341_20040506150118/Rendered/PDF/288160PAPER0Granting010renegotiating.pdf [accessed April 2007].

Hunwick, R. (2005). The economics of electricity storage, Paper presented to the Australian Institute of Energy, Sydney Branch, Energy Storage Symposium, 1 November 2005. Available from URL: <http://www.aie.org.au/syd/downloads/> [accessed 25 March 2007].

Lobina, E. and Hall, D. (2003). *Problems with private water concessions: a review of experience*. Available from URL: <http://www.psiru.org/> [accessed April 2007].

Mansur, E.T. and Olmstead, S.M. (2006). *The Value of Scarce Water: Measuring the Inefficiency of Municipal Regulations*, AEI-Brookings Joint Center for Regulatory Studies, Available from URL: www.aei-brookings.org [accessed 23 February 2007].

NWI Steering Group on Water Charges (2007). *Water Storage and Delivery Charges in the Urban Water Sector in Australia*, February 2007, Available from URL: http://www.nwc.gov.au/nwi/docs/UrbanWaterChargingStocktake_Feb%2021.pdf [accessed March 2007].

Productivity Commission (2003). *Water Rights Arrangements in Australia and Overseas*, Commission Research Paper, Productivity Commission, Melbourne.

Sibly, H. (2006a). Urban water pricing, *Agenda* 13, 17–30.

Sibly, H. (2006b). Efficient urban water pricing, *Australian Economic Review* 39, 227–237. Available from URL: <http://ssrn.com/abstract=909833> or DOI: 10.1111/j.1467-8462.2006.00415.x

Willems, B. (2005). *Physical and Financial Virtual Power Plants*. Available from URL: <http://ssrn.com/abstract=808944>.