Unbundling and tradeable water entitlements

A report for SunWater

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1 Introduction

The creation of tradeable water entitlements (TWEs), and with it, water markets, brings several significant economic benefits. The most significant of these economic benefits is the more productive allocation of water. The normal operation of the market will typically result in those users whose use of water has the highest marginal productivity securing TWEs on account of their preparedness to pay more for it.

Another more subtle but nevertheless significant benefit is that the risks associated with investments that are highly dependent upon a reliable source of water will be alleviated by virtue of users being able to source additional water from the market. This greater security will encourage investment in downstream markets.

Accordingly, the process of trading in TWEs will enhance economic output and encourage socially desirable investment in industrial and agricultural as well as downstream commercial enterprises.

Moreover, those who hold TWEs but whose use of water is relatively less productive will benefit to the extent that they are able to sell their entitlements to others if doing so leaves them better off. Of course, sellers will only relinquish their TWEs if the sale price is higher than their own valuation of the TWE.

Accordingly, the creation of TWEs overcomes the distortions that arise where holders of water allocations do not pay a market value for their allocation. This is especially the case in the previous environment where infrastructure charges were set at below incremental costs. In such an environment, entitlement holders had strong incentives to use available water allocations irrespective of the productivity of that use.

The reform of the water industry, including the creation of TWEs creates a number of interesting issues for pricing and market trading arrangements. To some extent, these issues mirror those that arise in the reform processes for other infrastructure industries. However, many issues are unique to the water industry owing to the characteristics of water infrastructure and TWEs.

The purpose of this paper is to:

- examine the attributes of water infrastructure and explain how it differs from other infrastructure industries;

- highlight the necessity of separating between the services provided by the infrastructure and the TWE itself for the TWE market to operate effectively;
- consider the factors that affect the value of water; and
- highlight the appropriate role for regulation in such an environment.

2 Role of storage infrastructure

2.1 Comparison with electricity or gas

Typically, regulated infrastructure, such as gas and electricity transmission and distribution facilities, provides a physical connection and as such is involved in the delivery of gas or electricity. Notice that the production and sale of the commodity that is conveyed through this infrastructure (be it electricity generation or gas extraction and processing) is generally unregulated.

In the water industry, the main transportation mechanism is provided by the existing river system. In some cases, channels have been constructed providing for the reticulation of water to irrigation farms. Whilst the channel infrastructure performs a role analogous to electricity distribution infrastructure, it is the storage infrastructure that distinguishes water from other infrastructure industries.

This is because the storage infrastructure, which will be the subject of economic regulation, is inextricably connected with the creation of the underlying product, the TWE, which is itself tradeable in a competitive market.[1]

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1 It is true that rivers are able to provide water for consumptive uses in the absence of storage infrastructure. However, if this were to occur, it would be almost impossible to accomplish development on the scale that occurs in the case of regulated streams. For example, it would be necessary for individual users to either individually or collectively build storage infrastructure and take water at designated times when environmental flows would not be compromised. The construction of this storage infrastructure would not benefit from the scale economies and natural locational advantages that exist for on-stream storage infrastructure. Moreover, such infrastructure would also involve significantly higher operating (and transaction) costs due to the complexities associated with regulating the harvesting of water from the river by numerous entitlement holders whilst constantly monitoring the flow of water in the river. In practice, these complexities would complicate water entitlement trading.

2.2 Economic role of storage infrastructure

The regulation of natural river flow by water storage infrastructure does not "create" water but does create a set of water allocations which have more desirable attributes than allocations in unregulated rivers. The most significant attributes are as follows:[2]

- reliability and differing levels of reliability;
- flexibility in the timing of consumption;
- tradability.

2.2.1 Reliability

The most obvious benefit from storage infrastructure is the reliability it provides to users. Water reliability refers to the probability that a customer will secure a given allocation within a defined time.[3]

For many industrial processes, the availability of a reliable water supply is a pre-requisite for production. Similarly, the first test of a site's suitability for intensive livestock production will be its access to reliable water. In many regions, few horticultural or tree crops would be attempted without irrigation and in some parts of Queensland the cash crops that underpin the region's economy are reliant on irrigation supplies. Accordingly, the availability of a reliable water supply allows much higher value uses of water to be attempted than would otherwise be the case, and in so doing, fundamentally changes the nature of production possibilities and economic activity in that region.

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2 Other benefits from water infrastructure include recreational benefits and flood mitigation.

3 For example, a reliability of 90% suggests that a user is likely to secure the whole of its allocation in 9 out of 10 years, with it receiving some proportion of its allocation in the remaining year.

Even where the cropping patterns in a region do not fundamentally change from the availability of water, the ability to apply water as required will substantially improve the yield of the land.

Water supply infrastructure facilitates different customers gaining differing reliability levels according to the value they place on that reliability. This enables users to secure water entitlements appropriate to the desired reliability levels. For example, SunWater provides urban and industrial customers, as well as some irrigators in particular schemes (such as those with high value tree or vine crops), with a high reliability product. In contrast, many irrigators typically receive a medium reliability water supply. The water trading rules will facilitate users trading between high and medium reliability levels.

Moreover, in times of drought, those who are most dependent on water are able to enter the market, and secure water, albeit at a higher price. Accordingly, TWEs provide a form of insurance to water users as well as allowing users to optimise their water consumption patterns. The availability of this “insurance” encourages greater investment in downstream uses, and is no doing, tends to increase the value of TWEs.

2.2.2 Flexibility in timing of uptake

A related, but distinct, benefit provided by water infrastructure is flexibility. This is because, subject to availability, customers can secure water on demand. This arises because the storage infrastructure provides an inventory that enables the timing of supply to meet demand.

This is particularly valuable given that many production processes, such as crop growing, have clearly defined seasonal characteristics. The existence of water storage infrastructure enables holders of TWEs to apply water to a crop when it will secure an optimal yield response, allowing for other factors, such as rainfall.

2.2.3 Supporting a trading environment

Finally, the existence of storage infrastructure, and where it exists, distribution infrastructure, supports an environment incorporating TWEs. However, it should be noted that a trading regime may operate in isolation of the existence of storage infrastructure. For example, the *Water Act 2000* (the Act) recognises the capacity for water harvesting rights and unregulated flow entitlements to be traded.

Nevertheless, the reliability and flexibility in extraction afforded by water storage infrastructure facilitates trading in TWEs to the extent that enlarges the field of potential transactions. For example, the storage services provided by water infrastructure allows a user, whose consumption occurs early in the year, to trade with another whose consumption occurs later in the year – there is no need to match the timing of consumption when making the trade or for either party to secure storage of the water. Consequently, these attributes not only enhance opportunities to trade, but with it, the value of TWEs.

This, in turn, raises a further issue for the efficient allocation of water – to the extent that the infrastructure services associated with any particular form of water entitlement (be it a regulated entitlement from a storage facility or an unregulated entitlement), the subsidisation of the services provided by any particular infrastructure facility will distort the allocation of water. The consequence of such a distortion is to undermine the extent to which the reforms to the water sector can contribute to national income and economic wellbeing.

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3 Unbundling

The creation of tradeable rights associated with water entitlements necessitates the unbundling of complementary products, being the TWEs, from the associated infrastructure services that underpin the value ascribed to a TWE in the market. Indeed, it is not even necessary for there to be infrastructure associated with an underlying water entitlement for that right to be traded. For example, in the case of harvesting rights, the Act recognises the scope for trading to occur even in the absence of the existence of any storage or distribution infrastructure.

The definition and realignment of property rights associated with the various inputs that were previously "bundled' has formed part of the reform processes in all of the infrastructure industries. In the context of the water industry, a TWE represents the right to a share in the available water from a storage facility and for that entitlement to be traded in the market.

In order for such an environment to operate effectively, it is critical that there be a separation between the TWE and the associated infrastructure charges. This is recognised in the Water Reform Unit's price paths. Notice, however, that the change that has occurred with the water reform process is less dramatic than some of the other industries (such as electricity).

For example, the separation between the water allocation (or entitlement) itself (being the right to take a quantity of water in a certain time, whether expressed as an allocation or a TWE) and the underlying provision of infrastructure has always existed in the Burdekin region (and, as noted above, complementary infrastructure services are not necessary for equivalent rights to be traded).

In the case of the Burdekin, the original sale of water allocations took place against a backdrop of separately determined water infrastructure charges. Hence, the concept of unbundling existed even in the context of these original allocations. The nature of the property rights that were specified as part of that process involved the water allocation forming effectively "part of the land".

The key difference therefore to emerge with the COAG water reform process is that the water allocation is separated *from the land* rather than *from the infrastructure*. This is highlighted by clause 4(a) of the 1994 COAG Strategic Framework, which provides:

> The State government members of the Council, would implement comprehensive systems of water allocations or entitlements backed by separation of water property rights from land title and clear specification of entitlements in terms of ownership, volume, reliability, transferability and, if appropriate, quality.

In other words, the key difference to emerge from the COAG reforms involves the severing of the water entitlement from the land. Previously, an owner of an allocation could only sell that allocation via the sale of the land to which the allocation was attached. This is reflected in the commercial arrangements associated with the acquisition of land in the Burdekin.

However, with the reforms that have, and will, emerge from the *Water Act 2000*, holders of TWEs need not buy or sell any part of their property in order to buy or sell an entitlement to a water at a defined reliability. Indeed, the water reforms associated with the creation of TWEs have materially increased the value of the original water allocations because it substantially enhances the prospect of water being applied to higher value uses. At the same time, these reforms ought to increase the (unbundled) value of the land to which the water was previously attached, as a better allocation of water makes land more productive.

For example, the value of the original water allocations purchased in the Burdekin can be expected to increase by virtue of the conferral of a right to trade those entitlements under the *Water Act 2000*. This is because the right to trade (be it to sell or purchase TWEs) can be expected to change the nature of water use in the region and with it the marginal productivity of water, and, in turn, the value of a TWE. This can be expected to become increasingly clear over time as the market evolves.

A corollary of unbundling is that the market will determine the transfer price for a TWE between a buyer and a seller. In such an environment, a range of factors will determine that transfer price (which are discussed in the following section). It should therefore be noted that the charges for the use of storage and distribution infrastructure will only be one factor that affects the value of a TWE.

4 The value of water entitlements

The price that is paid for a TWE will be a reflection of supply and demand for TWEs in the competitive market. The following are the most significant factors affecting the market value of a water entitlement:

- reliability;
- the returns from the TWE;
- market arrangements (including liquidity);
- income; and
- scarcity values.

These are considered in turn.

4.1 Reliability

Other things being equal, the higher the reliability of a TWE, the higher its market value. The trading rules that are being developed will allow users to transform a TWE with one reliability level into another. For example, an allocation of x ML/annum with a 90% reliability could be transformed into y ML/annum with a 95% reliability (in accordance with defined rules).[4]

In addition, the greater the variability of rainfall in a region, the higher the price for which a TWE is likely to be traded. In particular, in systems vulnerable to prolonged periods of below average rainfall (such as during a period of El Nino), the value of a TWE is likely to increase on account of it allowing the continued productive use of land.

4 This assumes that the ratio of high to medium reliability water is y:x.

4.2 Returns from the TWE

Just as is the case for any share, there are two distinct sources of return from a TWE:

- yield from the TWE over the period (equivalent to a dividend in the current year); and
- growth in the capital value of the TWE over time (equivalent to growth in the value of the share in future years).

4.2.1 Yield within the period

The yield within a period from the application of water is a function of several parameters including the value of the production that the water enables.

The first consideration in identifying the value of a TWE to a user is to identify the commercial activities creating its demand for reliable water. As mentioned above, the availability of a reliable water source fundamentally changes the nature of commercial activity in a region. [5]

Over time, the nature of commercial activity in a region will adapt to the availability of reliable water (so that new investment will increasingly seek to exploit higher value opportunities for the water).[6] For example, the availability of a reliable source of water is an essential input to many production processes, such as electricity generation and mining activities. Accordingly, the availability of a reliable water supply provides new production possibilities in the region (as well as enhancing the productivity of existing uses).

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5 Note however that even in such a case, the availability of irrigation provides a critical option value in that it allows higher value uses of land to be attempted where they would not otherwise be feasible.

6 This in turn is one reason why the market value of TWEs would be expected to rise over time.

The value of a TWE to a user will then be determined by the marginal productivity of the water entitlement embodied in the TWE. Where water is an absolute determinant of production, such as is the case with many industrial processes, including electricity generation, that marginal productivity will be high, by virtue of the fact that the water availability enables the commercial activity to occur.

Moreover, the relationship between the availability of additional water and the value of additional industrial production will often not be linear. For example, the availability of additional water may enable scale economies to be realised in production. In such a case, where water availability is an absolute determinant of production, increased water availability could also increase the value of water in that use.

In the case of agricultural production, the marginal productivity will be determined by the yield response to the application of the water relative to the next best option based on rainfed conditions (which may be an entirely different use).[7] Where it is technically and commercially possible to grow a crop without irrigation, the yield response to added water is the yield over and above that provided by rainfed conditions.[8] Where water availability changes cropping possibilities (such as higher value tree crops), the value of the TWE will incorporate these changed production possibilities.

Additional considerations affecting the value of a TWE include seasonal factors. For example, the yield contribution from the availability of water is determined not just by the absolute availability of water, but the availability of that water at the critical times it is required by growers to maximise crop yields. This can be seen in the high prices that can be paid in temporary trades made at critical times of the growing cycle for particular crops.

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7 One substitute for TWEs is the ability of a landowner to invest in infrastructure to harvest water falling on its property. The ability to harvest water provides a possible substitute for TWEs.

8 The yield response for crops rarely exhibits a linear relationship to the application of water – it is common for a yield response to exhibit both increasing and reducing returns as successive increments of water are applied in a given period. Whilst the yield response may not be known with precision for some crops, the market will create incentives for individual participants to economise on the costs of acquiring this information.

The additional yield from the application of water can then be considered in the context of the value of production that it allows. One way of estimating the value of additional production is the gross margin of additional output. Gross margins represent income net of variable production costs but before fixed costs. Accordingly, the value of the TWE depends, not only on the yield response, but also on the other costs of inputs and the value of the output at the farm gate. However, infrastructure prices are but one of a myriad of factors determining the price of a TWE.

Table 4.1 identifies the gross margins for a selection of irrigated crops.

Table 4.1 Gross margins for a cross section of irrigated crops

Crop	Water applied	Gross Margin	
	ML/ha	$/ha	$/ML
Beans	1.25	1,460	1,168
Capsicum (red)	3.5	30,580	8,737
Rockmelon	2.5	6,096	2,438
Tomatoes	2.5	26,195	10,478
Zuchini	1.25	4,000	3,200
Mandarin	8	19,894	2,487
Macadamia	4.5	8,136	1,808
Table grapes	2.5	18,709	7,480
Lucerne	10	1,972	197
Peanuts	6	1,992	332
Cotton	6	1,823	304
Soybeans	5	598	120

Source: Taken from the CARE report, The Economic Impact of Additional Irrigation Supplies in the Burnett River Catchment (June 2000) prepared for DNR

It should be noted however that the gross margins represented in table 4.1 do not provide any allowance for the costs of on-farm infrastructure associated with the production of a crop, including additional distribution works, development costs of crop establishment and on farm infrastructure. In practice, a major factor in the cost of production concerns the existence of this infrastructure to support the application of water.

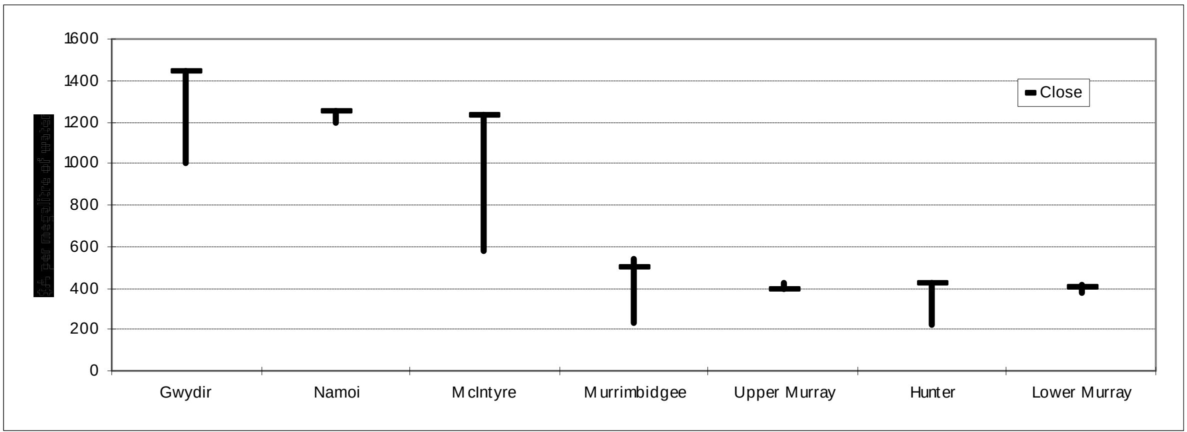
Accordingly, gross margins for additional water will be relatively high compared to a situation where substantial investment on land development is required in order to plant crops that would take full advantage of the additional reliability arising from the storage infrastructure. This is reflected in the relatively higher prices for TWEs in regions where there are already tree crops.

4.2.2 Expectation of future prices

The other component of the price of a TWE is the capitalised value of anticipated increases in the value of the TWE over time.

In regions of Australia where tradeable water entitlements are well established, the pattern has consistently seen market values rise over time, in some cases, substantially. This is indicated by figure 4.1 which illustrates the trading range and closing values of water entitlements in selected valleys of New South Wales over the last 3 years.

Figure 4.1 Trading range (high, low and close at 3 December 2001) for NSW water prices traded on the Waterexchange, for various periods in selected valleys.



Source: http://www.waterexchange.com.au/flash/map.html

This evidence is also supported by the values attached to permanent and temporary trade:

- Megalogenis (2001)[9] notes examples of the value of TWEs in Victoria rising from $400/Ml in 1997 to $800/Ml in 2001, with the price of TWEs in South Australia rising from $300/Ml in 1986 to $1,000/Ml in 1998;

- The National Competition Council 2001 NCP assessment for the Murray-Darling basin notes that prices over $10,000 have been recorded for permanent transfers in McLaren Vale in South Australia, with permanent trades in River Murray licences costing between $1,000 and $1,150/Ml compared with an upstream range of around $750 to $1,000/Ml.

This data clearly illustrates substantial increases in the price of TWEs since trading has commenced, with prices doubling over this period in some cases. This is an interesting development, since, at any point in time, the price of a TWE will reflect the stream of income expected from the entitlement, including any expected growth in the value of the entitlement.[10]

The growth in the value of TWEs may reflect a number of underlying causes, including:

- the immaturity of the market;
- the market generally becoming more informed as to the value of a TWE;
- cultural considerations in relation to the values users have traditionally placed on water;
- changing preferences;
- perceptions about the future productivity of water in response to future prices and new crop varieties (including higher yielding crop varieties);
- the taking of positions by market participants; and

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9 Megalogenis, George (2001) "Liquid Gold", The Australian newspaper, 19 May 2001

10 Or in economic terms, future expectations from the quasi-rent from scarcity values.

- perceptions and expectations of future conditions concerning a range of factors, including product prices, input prices, and so on.

Note that all of the factors that influence the value of a TWE at a point in time also affect expected future returns over time from the TWE, and therefore affect the value of the TWEs today. Over time, all input costs and output prices vary, at times substantially.

The price that is paid for water entitlement at a point in time will be a function of the contribution of that entitlement to production, as well as any increases in the expected value of that entitlement over time. The combination of these factors represents the returns to an entitlement holder from its water entitlement.

4.3 Market arrangements

Under the legislative provisions governing the transferability of water entitlements, separate sectors are recognised across which trades may not be affected. It is not clear whether this policy of prohibiting inter-sectoral trade will continue with growing acceptance of the market and the benefits it can bring to those that currently hold TWEs.

Another consideration relates to the transaction costs associated with effecting trades of TWEs. These transaction costs include the ease with which trades can be completed, the costs associated with the trades, including delay, and the certainty of efficacious completion of the trade.

A related consideration involves the liquidity and depth of the markets for TWEs. The depth and liquidity of the market will also affect the price for TWEs. Other things being equal, the deeper and more liquid the market for TWEs, the smaller the bid/ask spread and the lower the risk that a seller (buyer) would be required to sell (buy) an entitlement at a substantial discount (premium) in order to realise (acquire) an entitlement in a short period of time.

Similarly, the greater the depth and liquidity of markets, the greater the willingness of holders to trade their TWEs on account of the fact that the risk of that holder being required to pay a substantially higher price if it subsequently seeks to acquire a TWE is lessened (to the extent that volatility in the traded price is due to thin trading).

4.4 Income

Income affects the value of a TWE in several ways. The capacity of a user to separate ownership of land from the ownership of a water entitlement creates a wealth effect. This is because the ability to separate and transfer a water entitlement whilst retaining ownership of land increases the wealth of the holders of TWEs. All other things being equal, the greater the income of those seeking TWEs, the higher the likely price of TWEs.

Another factor concerns the impact of infrastructure charges affecting the behaviour of the holder of an entitlement – for example, the introduction of cost reflective infrastructure charges is likely to have the impact of water efficiency on farms – encouraging the more efficient use of water. In addition, income effects associated with higher infrastructure charges may well have the effect of encouraging water users to attempt to apply available water to higher value uses.

4.5 Scarcity

The physical limit of water availability and the need for environmental flow requirements to be observed in river systems impose a constraint on the amount of water that may be extracted for consumptive uses. This means that the supply (or availability) of TWEs is effectively fixed (or inelastic) and can be contrasted with most other markets where supply is itself responsive to price. Here it is largely fixed.[11]

This constraint is critical to the assessment of market prices for TWEs as it will ultimately exert enormous influence on the market price of TWEs. This is because the limited availability of water results in more marginal water users being displaced by others who can apply the limited amount of available water to higher value uses.

It is this scarcity that could cause the price of water entitlements to be bid up over time. The value of TWEs in a competitive market will be responsive to the forces of demand and

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[11] As the market price for a TWE increases, it would be expected that the effort and investment directed to water harvesting would also increase. It is understood that government policy in relation to water harvesting is being developed and consequently this issue is not considered further in this paper.

supply. For example, if there is an unanticipated increase in demand over time, the fixed supply of TWEs will mean that the market price for TWEs would be expected to increase.[12] Moreover, the market price for a TWE will (subject to discounting) reflect any anticipated scarcity values emerging over time. Indeed, there is nothing to prevent the market value of TWEs being bid up to a point that exceeds the equivalent upper bound price for infrastructure.

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[12] The consequences of anticipated increases in demand would be expected to be incorporated into the price of a TWE at a point in time.

5 Role of scarcity values

There is a critical difference between water infrastructure and the other regulated infrastructure industries. Prices for the services provided by electricity and gas transmission and distribution infrastructure are typically regulated at prices that equate to the SCARM upper bound. Prices for the underlying commodity are set in a competitive market.

In the case of water and TWEs, it is the regulated infrastructure that creates the commodity (being the TWE) that is traded in a competitive market. As such, the value of the TWE in the market and the charges that are levied by the infrastructure provider are inextricably linked. This does not occur in the other markets involving regulated infrastructure.

This linkage between the value of TWEs and infrastructure charges highlights a further issue that is unique to the water industry – to the extent that infrastructure charges are below upper bound prices, there will be a transfer from the infrastructure provider to the holders of the TWEs. The extent of this transfer will be equivalent to the capitalised value of the discount from the upper bound infrastructure charge (so long as the discount rate for the infrastructure provider and the holder of the TWE are equivalent). Moreover, the capital value of this transfer is equivalent to the diminution of the infrastructure provider's asset base (relative to that which would be consistent with upper bound pricing).

A situation where the value of a TWE is positive with upper bound infrastructure charges applying suggests the existence of scarcity rents. This in turn suggests that the economic rent that arises from resource scarcity in water markets belongs with the licence to create TWEs which would normally be secured through the right to construct the water storage infrastructure. This is clearly seen when considered in the context of new infrastructure – to the extent that scarcity rents exist, Governments, as grantors of the resource licence, are well placed to extract these rents when the infrastructure is first established (for example by tendering the right to build the storage infrastructure and sell the TWEs it creates).

For existing storage facilities, scarcity rents will accrue to those who secure TWEs. It is submitted that in such a case there is no case for intervention – to do so would simply distort the market for TWEs. This is illustrated by considering the types of regulatory interventions that could be attempted.

One possible means of regulatory intervention may be to require that transfers be effected at a zero price (assuming upper bound charges are to apply). However, this would simply result in a transfer from existing holders of TWEs to the beneficiaries of the regulatory intervention. As such, if it is applied to only one market participant, the likely result is competition for the transfers induced by regulatory intervention rather than competition in the market for TWEs. If it is applied to all market participants, it will simply create a situation where no trades occur (unless the holder of a TWE is better off avoiding incurring infrastructure charges).

Alternatively, a tax equivalent to the estimated scarcity rent could be levied on holders of TWEs. Where it is applied to all users, it results in a situation where holders of TWEs are taxed on an asset that they have acquired. It would also distort the trading in TWEs in the future – ultimately it could be expected to have the equivalent effect to requiring trades to occur at a zero price. Again, where a tax is levied on a single market participant (such as the infrastructure owner) there will be, in addition to this retrospectivity, an additional distortion induced into the market.[13]

Accordingly, there would appear to be no case for regulatory intervention in relation to the possible existence of scarcity rents secured in association with the holding of TWEs. The existence and, in turn, the ability of market participants to internalise scarcity rents is ultimately critical to the accomplishment of the objectives of establishing TWEs, being the efficient allocation of scarce water resources. Equally fundamental to the accomplishment of these goals is the unbundling of the infrastructure charges from the TWEs.

13 In any event, it would be an issue for the terms of the licence granted by the Government to the owner of the storage infrastructure. - such taxing decisions ought to be the province of the State Government rather than regulatory agencies.