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Regulation versus pricing in urban water policy: the case of the Australian National Water Initiative

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The Australian National Water Initiative (NWI) builds on the foundations of earlier water reforms, attempts to correct earlier errors in both policy and its implementation, and seeks to better define some of the policy aims with the benefit of hindsight. However, despite the deliberate effort to improve on earlier reforms, the NWI still embodies a significant economic paradox. Although policymakers have shown their faith in the market insofar as allocating water between competing agricultural interests is concerned, they have not shown the same degree of faith in the ability of urban users to respond to price signals. This paper attempts to shed at least some light on this question by examining the responses of a number of State governments across Australia to the NWI. The paper specifically explores the rationale for non-price regulation in the urban context but challenges the long-term viability of this approach.

Key words: water reform, urban water, water market.

1. Introduction

The National Water Initiative (NWI) displays considerable faith in market forces to address the allocation of water between competing agricultural interests. However, the same policy has much less faith in the ability of urban users to respond to price signals. Market forces are continually championed as 'moving the resource to its highest value use' in an irrigation context and yet bureaucratic intervention is used to distinguish profligate and acceptable water uses in an urban setting. Although a comprehensive assessment of the water reforms in both sectors is beyond the scope of this paper, we seek to shed some light on the policy response in the urban domain by examining the reactions of a number of state governments across Australia to the dwindling bulk water supplies of major capital cities. In particular, the paper explores the tendency of state governments to rely relatively more heavily on quantity control in response to shrinking urban water supplies, rather than on the price mechanism.

The paper is divided into four main sections. Section 2 briefly outlines the policy setting that acts as a background to the period under consideration,

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while Section 3 examines a number of the states' responses to the changing policy landscape. Section 4 attempts to develop a conceptual model to enhance our understanding of the current policy settings. The paper ends in Section 5 with some brief concluding remarks.

2. Policy evolution of the national water initiative

In February 1994, a major milestone was reached in Australian water policy when the Council of Australian Governments (COAG 1994) agreed to the 'Water Resource Policy'. The policy was an Australia-wide effort to turn back the tide on the natural resource degradation resulting from a century of exploitation of the nation's water resource (MDBC 2000). In essence, the new mantra to arise from this policy was 'efficiency and sustainability' – a catch cry that has permeated the Australian water debate ever since.

Setting the continuation of water reform as an agenda item for the Howard government's third term, (then) Deputy Prime Minister John Anderson argued that 'if the community now wishes to change [the] balance in favour of environmental responsibility, the community must address the question of who should pay' (Anderson 2001). In this context, sharper focus was being placed on urban water users whose behaviour, under the initial reforms, had been subject to relatively modest scrutiny.

2.1 Urban water reform in the NWI

The purported aim of the NWI with regard to urban water reform is to encourage the reclamation, re-use and recycling of wastewater, make water trading between rural and urban users viable, increase water efficiency, and improve pricing for metropolitan water (COAG 2004).

The means by which the states and territories will meet these objectives are broadly separated into efforts designed to reduce demand and policies that encourage innovation in water use. At the national level, four specific measures have been identified as part of the NWI. In the first place, the 'Water Efficiency Labelling Scheme' will come into effect, requiring mandatory labelling and minimum standards for certain household appliances. Second, the states will implement a 'Smart Water Mark' for appliances and products used in household gardens. Third, water authorities will upgrade supply and discharge systems, including the repair of leaks and overflows. Finally, jurisdictions will consider the extension of temporary water restrictions and associated public education strategies into permanent low-level arrangements (COAG 2004).

3. States' responses to the NWI

The responses of most state governments to the NWI's broader requirements on urban water reform can be summarised as either being aimed at managing demand for or supply of urban water. The Governments of New South Wales

(NSW), Victoria (Vic.), Queensland (Qld), South Australia (SA), and the Australian Capital Territory (ACT) have been active in developing long-term strategies for the management of urban water, releasing detailed policy documents applicable to their jurisdictions. The Western Australian (WA) government has also examined the issue, and recently reorganised the executive management of water in that state. However, it has yet to release a formal policy. The remaining states have been relatively less concerned with this particular aspect of the NWI.

3.1 Demand management

In essence, policymakers have two generic tools at their disposal: changes in the price paid for water and restrictions on how water can be used. We have examined the demand management policies in place for six jurisdictions summarised in Table 1.

3.1.1 Pricing

All of the states, with the exception of Qld, have introduced pricing structures in metropolitan areas termed 'inclining block tariffs'. This results in increasingly rising prices as the quantity of water consumed increases. These range from a two-stage block in Sydney and SA, to a nine-stage block in regional WA. Regional areas in Vic. and NSW are characterised by varying pricing structures, with some implementing inclining blocks, and others maintaining a conventional fixed 'connection' charge and a single variable usage tariff.

3.1.2 Non-pricing

Non-price demand management techniques usually take the form of prohibitions on certain types of water usage, such as watering gardens during the middle of the day, and incentive programs that encourage residents to make more efficient use of water, such as installing low-flow shower heads. Although some states currently impose water restrictions on a temporary basis, others have moved to make them permanent. For example, in Vic. cleaning paved areas by hose is now prohibited regardless of the volume of water held in a given water storage.

3.2 Supply management

In the context of urban water provision, efforts to maintain and/or increase supply can be grouped into three initiatives: (i) increasing the efficiency in the storage and management of existing supplies; (ii) recycling previously consumed potable water; and (iii) investment in new infrastructure. Once again we have examined the policies in place for six jurisdictions, with the results summarised in Table 2.

Most states are either investigating or actively pursuing water recycling schemes, such as using partially treated waste water in order to irrigate playing

Table 1 Demand-side responses to the national water reform policy

Jurisdiction/ Policy	Demand side	
	Pricing	Non-pricing
NSW/ Metropolitan Water Plan	Sydney Water Corporation Two-stage inclining block tariff: • 0–400 kL per year at $A1.20/kL • > 400 kL per year at $A1.48/kL Regional Various pricing regimes determined by individual councils	Sydney temporary water restrictions • Watering of lawns and gardens by handheld hose and/or drip irrigation restricted to Wednesdays and Sundays, before 10 AM and after 4 PM • Permit required to fill pools • Hosing of hard surfaces prohibited Efficiency measures • Mandatory labelling system indicating the relative efficiency of water appliances • Extending the 'retro-fit' scheme • Sale of single-flush toilet systems will be prohibited • From 2007 residential dwellings must be accompanied by a water-efficiency certificate when sold • All new houses must reduce water consumption by 40%
Vic./Securing Our Water Future Together – The White Paper	Metropolitan Water Authorities Three-stage inclining block tariff: • 0–160 kL per year at $A0.78/kL • 160 kL–321 kL per year @ $A0.91/kL • > 321.56 kL per year at $A1.3554/kL Various Regional Water Authorities Eight of 17 authorities have introduced inclining block tariffs Remainder have increased existing water-use charges and lowered fixed charges	State-wide permanent water restrictions • Cleaning paved areas by hose banned • Hand-watering of gardens and washing of cars to be by use of trigger nozzle only • Automatic sprinkler systems must be fitted with rain sensors • Pools cannot be filled without permission from water authority Efficiency measures • Two water-saving schemes (Water Smart Gardens and Home Rebate Scheme) to be extended • Water-sensitive design to be implemented in new urban developments • Education and awareness campaign: water bills more informative and public reporting of water authority's progress in meeting water-saving targets • Support of water efficiency labelling for household appliances • New dwellings must meet water-efficiency plumbing measures
SA/Water Proofing Adelaide	State-wide pricing Two-stage inclining block tariff: • 0–125 kL per year at $A0.46/kL • > 125 kL per year at $A1.06/kL	Permanent water restrictions • Restricted hours for watering gardens • Hosing of hard surfaces prohibited • Cars can only be washed with bucket or trigger-activated hose Efficiency measures • Government offers voluntary water audits

ACT/Think water, act water	Territory-wide pricing Three-stage inclining block tariff: • 0–100 kL per year at $A0.515/kL • 100–200 kL per year at $A1.00/kL • > 300 kL per year at $A1.35/kL	Permanent water restrictions • Use of sprinkler and irrigation systems prohibited from 9 AM to 6 PM • Paved areas may only be cleaned using high-pressure hoses or mop and bucket • Car washing by trigger hose, high-pressure cleaner or from bucket Efficiency measures • Government to support the minimum standards and efficiency labelling scheme for water consuming appliances • Subsidises installation of efficient appliances • Government offers 'water tune-up service'
WA/Our Water Future	Metropolitan Five-stage inclining block tariff: • 0–150 kL per year at $A0.425/kL • 151–350 kL per year at $A0.689/kL • 351–550 kL per year at $A0.93/kL • 551–950 kL per year at $A1.226/kL • > 950 kL per year at $A1.533/kL Regional Nine-stage inclining block tariff: • 0–150 kL per year at $A0.425/kL • 150–350 kL per year at $A0.689/kL • 350–450 kL per year at $A0.851–$0.876/kL • Following six blocks not uniformly priced across state – dependant upon cost of supplying water to each town	Temporary water restrictions • Watering of lawns and gardens by sprinkler restricted to two allotted days per week, either in the morning or evening, but not both • Hand-watering permitted at anytime • Hosing of hard surfaces prohibited Efficiency measures • Rebates for the installation of water-efficient shower heads and washing machines rated AAA or better
Qld./ Waterforever	Brisbane Water Single-usage charge: • $A0.89/kL	Temporary water restrictions • Watering of lawns and gardens by sprinkler prohibited • Handheld hosing and topping up of pools only permitted on three specified days a week, depending on house number, and only outside of daylight hours • Some relaxation for new lawns and gardens • No watering permitted on Mondays • Watering with handheld buckets permitted at any time • Washing of cars permitted at anytime with a handheld hose fitted with trigger nozzle or with high-pressure water cleaning unit • Hosing of hard surfaces prohibited • Use of hoses and sprinklers for water play toys not permitted at any time

Sources: Department of Premier and Cabinet (2003); Department of Infrastructure, Planning and Natural Resources (2004); Department of Sustainability Environment (2004); Department of Urban Services (2004); Hopgood *et al.* (2004); Brisbane City Council (2005).

Table 2 Supply responses to national water reform policy

	Supply side		
Jurisdiction/policy	Efficient use	Recycling	New Infrastructure
NSW/Metropolitan Water Plan	• Tap deeper water of existing dams • Divert flows of neighbouring rivers into main supply dam • Investigate ground water as a new supply source	• Supply recycled water to meet the needs of Sydney's growth areas by releasing greenfield development sites adjacent to existing sewerage treatment plants • No plans to recycle by pumping treated effluent into major dams	• 'No need for a 12th dam' • Construct a desalination plant when dam storage falls below 30 per cent of capacity.
Vic./Securing Our Water Future Together – The White Paper	• All urban water authorities will be required to prepare Water Supply–Demand Strategies • Interconnecting water supply systems • Reconnect Targo Reservoir • Distribution losses to be stemmed through leakage reduction programs	• Fit-for-purpose use: Various regional urban water authorities supply recycled water for irrigation purposes No plans to place treated water into Melbourne's drinking water supply system • A number of new developments have included so-called third pipe systems, however, government will not mandate such systems • Government support for selected recycling schemes	• 'New dams are not the solution' • Investigate desalination
SA/Water Proofing Adelaide	• Reduce government business water consumption • Continue leakage reduction program	• Pursue aggressive water recycling program	• Nil

ACT/Think water, act *water*	• Subsidises installation of rainwater tanks	• Require the separation, in new houses, of washing machine and bathroom drainage pipes to facilitate recycling	• Investigating the construction of a new dam
WA/Our Water Future	• Rebates for the installation of garden bores and rainwater tanks • Piping of irrigation channels	• Investigating the recharge of aquifers with treated wastewater	• Construction of a seawater desalination plant in Perth • Two new dams at Samson Brook and Wokalup Creek • Three deep bores and nine shallow bores
Qld./Waterforever	• Fix valve and pipe leakages • Reduce pressure of water supply	• Investigate use of treated recycled water for industrial use • Investigate mixing highly treated recycled water into existing rainwater storages	• Investigate desalination • Investigate further extraction of groundwater • Dam recommissioning

Sources: Department of Premier and Cabinet (2003); Department of Infrastructure, Planning and Natural Resources (2004); Department of Sustainability and Environment (2004); Department of Urban Services (2004); Hopgood *et al*. (2004); SEQWater Corporation (2005).

fields and golf courses. Many are mandating or encouraging new housing developments to include so-called third-pipe systems, whereby waste water from the laundry is used to water the garden or flush the toilet.

WA is planning the construction of a desalination plant in order to supplement dwindling supplies, NSW recently announced plans to construct a plant should Sydney dam storages fall below 30 per cent of capacity, whereas two other states (Qld and Vic.) are investigating desalination as a supply management option. Perhaps reflecting the perilous state of its urban water supply, WA has also built two new dams as well as sinking a number of new bores. By contrast, Vic. and NSW have ruled out the construction of new dams.

4. Searching for a policy rationale

The tendency of state governments across Australia to impose a combination of variable pricing and direct quantity regulation to reduce the quantity of water consumed by urban constituents seems at odds with the corresponding policy stance on rural water allocation. Most state governments have relied relatively more heavily on the price of rural water to determine both where it goes and the quantity demanded. An important exception is the allocation of bulk water to rural and regional town water supplies. In NSW and Vic. this is determined by regulation and usually expressed in pre-determined volumetric terms. Despite this exception, it is useful to explore the potential rationale for such a policy stance. Accordingly, in this section we develop a conceptual model of a stylised market for urban water in an effort to shed light on the market for water by speculating on what form the individual demand and supply curves for a 'typical' household might take. We then examine the role policy instruments, such as direct quantity controls and prices, can play as allocative tools, and seek to develop an explanation for why governments have chosen to employ this dual policy response to the problem.

In developing a model for an individual household's demand and supply of water, it seems reasonable to assume that in the limit the demand curve is totally price inelastic for essential water use, and progressively becomes more elastic as one moves to less essential and more discretionary uses. Thus, for an individual household their demand curve for water can be approximated by a series of piecewise linear segments, as illustrated in Figure 1.

The reforms of the 1990s saw the progressive introduction of the various pricing regimes, as outlined in Table 1. Thus, for a given household, they now perceive their water supply curve as a series of horizontal curves shifting vertically at the quantity where the price of water increases – illustrated in Figure 1.

The number of segments is determined by the number of blocks in a state's inclining block tariff structure. For example, in NSW the supply curve would consist of only two segments, whereas a rural household in WA would perceive their supply curve as consisting of nine segments. A limiting factor to note here is that post-consumption charging for domestic water is likely

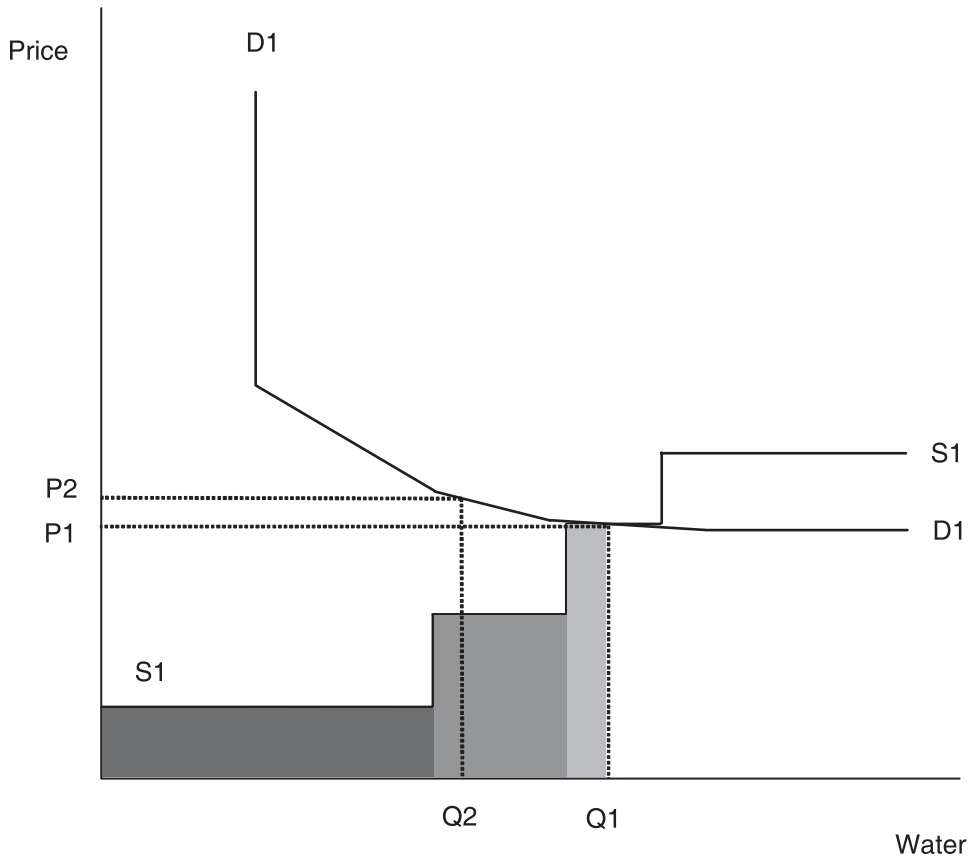

Figure 1 Stylised model of individual household water supply and demand.

to dampen the impact of inclining block tariff structures, as households are unlikely to go to the trouble of noting when their consumption has moved from one block to the next per period. As a result, the perceived supply curve illustrated in Figure 1 is probably best thought of as an extreme example.

4.1 The effect of an aggregate water shortage

We now assume that the relevant bulk water supply has reduced because of a prolonged reduction in rainfall. As a result, the aggregate quantity of water available for supply has diminished. In a 'first principles' analysis of markets, we would expect this to result in a shift left of the supply curve. However, at least two factors suggest that this will not be the case. First, the supply curve faced by households is essentially a construct of the regulatory regime that governs the pricing of urban water. For instance, in NSW the Independent Pricing and Regulatory Tribunal determines the structure of the relevant pricing regime. In the past these determinations have been heavily influenced by production costs associated with urban water provision and not the

immediate scarcity of the water resource. As a result, a substantial change would be required in the pricing policy of the regulator for it to shift the household's perceived supply curve in the face of a water supply shortage.

Second, it seems reasonable to expect that the individual household, without any direct control from a central authority, is unlikely to perceive the supply curve it faces as having changed so long as the price schedule is unchanged and water continues to flow from the tap. If both these assumptions hold, then the water supply authority must resort to other methods of decreasing aggregate water consumption by households.

One option is to request more frequent increases in the rate at which tariffs are adjusted. However, pricing determinations are typically drawn-out affairs, requiring exhaustive and transparent consultation with stakeholders, resulting in significant time lags between changes in pricing structures. In contrast, the executive arm of government is able to implement direct quantity control methods, such as water restrictions via regulation, relatively free from the requirements to consult that are placed upon independent price regulators.

By way of illustration, assume that policymakers want the household depicted in Figure 1 to decrease its consumption from Q1 to Q2. This could be achieved by moving the point at which the third tariff begins so that it aligns with a point equal to Q2. Another option is to implement water restrictions in the hope that they will reduce consumption to Q2. Alternatively, the government could make use of a combination of price and quantity controls to achieve its desired outcome.

A third consideration in this context is the relative uncertainty of price adjustments and quantity controls. Given that the supply curve in this case is a manifestation of negotiations between the water authority and the economic regulator, there is a risk that the resulting price may not bring forth the required adjustment in water consumption. Put simply, getting the price 'right' in this 'market' depends upon the information available to the parties and their capacities to accurately predict demand. There is also no guarantee that the demand function will remain static throughout this process. Thus, quantity restriction represents a less risky option for water authorities insomuch as any miscalculation of the price required to dampen demand will likely attract severe political costs – either because the price remains too low and thus threatens minimum subsistence supplies, or the price is set so high as to raise serious equity concerns.

As Table 1 demonstrates, most state governments have implemented a combination of both price and quantity controls in order to reduce aggregate domestic water consumption. However, it is also apparent that relatively more weight has been given to direct quantity controls. A number of useful insights advanced by Weitzman (1974) can assist in explaining this policy response. He examined the general case of regulating a well-defined commodity either by central control or use of the price mechanism, and developed a model in order to measure the comparative advantage of each method.

Weitzman (1974) found that the price mechanism could have detrimental consequences 'when marginal costs are nearly flat [since] the smallest miscalculation or change results in either much more or much less than the desired output' or 'if benefits are almost kinked at the optimum level of output, [as] there is a high degree of risk aversion and the centre cannot afford being even slightly off the mark.' Both observations seem particularly relevant to our model given our specification of the individual household supply and demand curves. Weitzman (1974) contends that under these circumstances 'the quantity mode scores a lot of points because a high premium is put on the rigid output controllability which only it can provide under uncertainty.'

In a later paper, Weitzman (1977) found that in a situation where a limited supply of a quantity must be supplied to those who need it most, rationing is relatively more effective if the demand for the good is relatively uniform and the given society is characterised by relative income inequality, because it 'essentially prevents those with relatively large incomes from monopolizing consumption of the commodity in question.' Although we have expressly sought to leave the influence of income in abeyance throughout this analysis, the government may prefer to place relatively more weight on rationing mechanisms for this reason.

In this vein, Weitzman (1977) observed that although rationing does impinge on consumer sovereignty, 'there is a class of commodities whose just distribution is sometimes viewed as a desirable end in itself,' and for these goods the open violation of consumer sovereignty is justified by seeking distributional equity. Furthermore, governments may simply prefer quantity control as it is less likely to incur income losses arising from higher prices.

A number of institutional impediments may also present a barrier to the reliance upon the price mechanism to ration dwindling supplies of water. First, urban water prices are typically exogenously determined by a price regulator, subject to periodic review. As a consequence, price is generally unable to respond to short-run supply constraints such as drought. Second, water has traditionally been priced in order to recover some portion of the costs of provision. To switch to a pricing philosophy that more fully embodies a price to reflect immediate scarcity may require a significant change in the institutional setting, implying large transactions costs, the quantum of which may be even greater where the predominant policy paradigm has been to rely on water restrictions in times of short supply (Berk *et al*. 1980).

Although theoretical models such as those developed by Weitzman (1974, 1977) have been helpful in explaining why governments have relied more heavily on quantity controls, empirical evidence on the effectiveness of water restrictions, at least as they are applied in the USA, has been mixed. Berk *et al*. (1980) found that conservation programs are generally effective in changing consumer behaviour and often induce reductions in urban water use at a time of a water supply shortage. However, they also concluded that it is possible to alter water consumption by manipulating its price. Conversely, Nieswiadomy (1992) concluded that conservation measures do not appear to reduce water

use. In a similar finding to Berk *et al.*, Renwick and Archibald (1998) found that combined price and conservation measures – which as Table 1 demonstrates is becoming the dominant policy setting in Australia – resulted in a reduction in water usage, although the degrees of relative reduction varied across differing household groups.

Perhaps the most powerful finding from a policymakers' point of view was established by Martin *et al.* (1984); they showed that, in order for conservation measures to be effective in the long run, they must be accompanied by a price increase, otherwise consumers will reduce water consumption in some activities, like fitting a low-flow shower head, but then use the 'saved' water on other uses, such as hand watering the garden for longer periods on allowable days. Without an increase in price to provide an incentive for households to reduce consumption, in the long run consumers tend not to reduce the aggregate quantity of water consumed. Thus, in the face of a long-run supply constraint, such as that arising from a lengthy change in rainfall patterns, conservation measures alone are unlikely to meet the aims of the policy.

5. Concluding remarks

A review of the response of state governments to the NWI shows that non-price regulation of urban water use is widespread and often prominent as a policy response. The rationale for this approach arguably resides in the difficulties of amending price to reflect the immediate scarcity of water in storages within the present regulatory environment and the potentially delayed or uncertain response of households to price signals. In these circumstances, non-price controls of water-use behaviour appear justified in the short term.

Unfortunately, it seems that the current use of water restrictions to curb excessive water consumption in Australia's capital cities is set to continue in a number of cases *ad infinitum*. For example, as outlined in Section 2, the Vic. government intends low-level water restrictions to remain in place regardless of the state of the local water supply. The SA government has also implemented so-called permanent water restrictions that bear no relation to dam levels. Furthermore, the NWI specifically calls for the conversion of temporary low-level water restrictions into permanent features of state water policy. One might be forgiven for concluding that the use of water restrictions has been transformed from a policy instrument aimed at delivering a short-term rapid response to an aggregate water shortage, to a policy designed to deal with water deficits stemming from long-term changes in rainfall patterns.

Martin *et al.* (1984) and others have concluded this policy stance is likely to fail. It is often the case that constituents find ways and means to defeat regulation. For example, given that state governments rely heavily on citizens to report breaches of water restrictions, it is not inconceivable that after a period of time neighbours may agree not to report one another's breaches in order to avoid detection. By contrast, it would be difficult for the same

neighbours to avoid the increased expenditure on water should the price mechanism be relied upon in the long term.

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