Water Trading in Australia
Current & Prospective Products

Current trends & prospective instruments
to improve water market function

Prepared for the
Water Reform Working Group

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ACIL Tasman

Economics Policy Strategy

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Overview

Purpose

ACIL Tasman has prepared this paper for the Water Reform Working Group (WRWG). It is a discussion paper that has emerged from probing existing water entitlement and trading arrangements across Australia – with an eye to possible innovations in market design, products and transactions that might enhance the efficiency of water trading. Efficiency has been interpreted broadly, to encompass the range of values the community does, or could, derive from this natural resource.

Key conclusions

Markets can be instruments for discovery

Some improvements in the efficiency of water usage can readily be envisaged as the result of a combination of changes to the structure of entitlements and the form of trading rules and trading approval processes.

- However, in an area with a pressing need to discover smarter ways of dealing with resource pressures, usage conflicts and social impacts, it may well be that the main gains from a more efficient water market will be in ways and directions, and involve products and transactions, that have not yet been thought of.
- *The main cost of limitations in current market arrangements may be the suppression of market incentives to discover and develop such opportunities* – including options for better natural resource management.

Significant value emerging

Recent emergence of serious opportunities for water trading in Australia has already allowed for significant resource redirection, delivering significantly greater value from the extractive uses of water; and

- contributing to the funding of the significant transitional costs involved in redressing river flow and other resource management requirements in many parts of Australia.

…but some transaction classes are constrained

- These trends are continuing and will deliver further value in the future – but the trends are coming up against substantial institutional constraints on the emergence or take-up of some classes of products and transactions that could be expected to deliver greater value.

Balance between markets and regulation

The complexity of the issues and systems that engage our water resources and the associated environmental, social and economic dependencies caution strongly against prescriptions based on too much confidence in the capabilities of either markets or regulation.

- Both have serious limitations and substantial progress is likely to depend on a combination of hybrid vigour and a willingness to confront the costs as well as the benefits of both classes of instruments.

Efficiency requirements that are set too high could impede useful change

- It is also important not to set expectations of water outcomes too high, to the point of it becoming a barrier to useful change – any useful target of 'water use efficiency' must incorporate recognition of the technical and administrative limitations on what can be achieved cost effectively.

Reasons for intervention beyond normal levels

There is a range of reasons why water markets are likely to require a significantly greater level of regulatory involvement than most other markets for many years to come.

- these could be attributed to difficulties in defining entitlements that meet the 'textbook' standards for efficient tradeable rights, a historical legacy of now regrettable allocation and use decisions with lasting equity consequences, substantial limitations in the attribution of the costs externalities, and still poor information on long-term resource impacts of different patterns of resource use.
- alongside these important sources of *market failure* is the likelihood of significant *regulatory failure* given the strong regulation involved, the complexity of the trading possibilities and the legacy of existing usage patterns that continue to have damaging impacts, directly and through impacts on flows.

Variations in market design across jurisdictions

While there has been a broad commonality of approach to the emergence of water trading markets in the various jurisdictions, conditioned in part by the requirements of the COAG agreement, there have also been notable variations – in the nature, degree of unbundling, duration and tradeability of the rights.

- This has some, probably manageable, implications for the continued emergence of inter-jurisdictional trading, where compatibility, if not identity, of arrangements is needed; but
- Tends also to highlight the extent to which constraints deemed necessary in one jurisdiction are not considered necessary in another.

Four features of the way the trading market appears to have developed, in respect of the creation of primary tradeable entitlements, and the regulatory process behind approval for trade, are of particular importance:

Market design too narrowly focused

- Development of entitlement structures and transfer rules appears to have been done almost solely with an eye to the *primary market*, in which there are prescribed physical water trades taking place – in a predictable form and essentially at the point in time at which a contract to trade is agreed;
  - we strongly suspect that, in the future, *secondary markets* offering composite physical and financial risk management products, based around the rights to transfer water, and not necessarily tied to a

requirement to transfer, will assume a much greater role in extracting full value from the resource.

  - unfortunately, many aspects of the design of the primary market mitigate against the emergence of strong and effective secondary markets; in many cases these constraints are more likely to be unintended consequences of the focus on prescribed primary market transactions than deliberate policy intentions.

Scope for adapting usage to support trading activity

- Similarly, there appears to have been little attention paid to the scope for usage patterns of entitlement holders to be adapted to take account of new *on-going* trading opportunities, and their direct value as part of the enterprise mix;
  - The emphasis is more on a mix of permanent transfers and opportunistic spot market operations to shore up risks and long-term demands, without any attention to the opportunities to adapt usage patterns to deliver a physical hedge that might allow more flexible, predictable and valuable on-going market trading, outside periods of severe water shortage.
  - Of course, the work has been predicated on water moving to higher value applications, but within an existing smorgasbord of such applications, and usually exclusive of the potentially important application of delivering risk services to others.

Constraints on tapping synergies between hydro- and other uses

- Limitations applying to the scope for active trading – in timing of releases and water destination – between hydro-generation and downstream irrigation, urban and industrial uses further limit the incentives for secondary markets to seek out ways of maximising the value obtained from the water resource.
  - More flexible markets in which end users could influence water flow timing could be enhanced by, and in turn enhance the opportunities available to, one or more environmental traders seeking more cost effective ways of meeting the flow requirements of river systems.

Excessive precaution can be counterproductive

- In many cases, restrictions on trading designed to guard against accidentally increasing damage may be having the effect of preventing trades that would reduce existing rates of damage;
  - This is likely as a result of any measures that slow or prevent trades that are subsequently deemed appropriate;
  - Past a certain point, impediments to trading based on well-intentioned precaution in respect of damage minimisation could prove counterproductive.
  - A similar effect could also occur as a result of new site usage approval processes that focus on damage at the new site without also taking into account the effects of water usage leaving the old site – looking at *gross* as opposed to *net damage*;

– These comments in no way argue against sensible precaution in the context of sustainable resource management and development strategy.

Options instruments may be necessary components of efficient water resource usage, given inherent volatility.

Given the inherent hydrological uncertainty in much of Australia, and the volatility of major commodity markets, efficient trading arrangements may need to place an emphasis on ways of *extracting value from volatility and uncertainty*, rather than delivering best outcomes under static comparisons of water usage patterns.

- Markets designed around flexibility, providing options for responding to volatility and for creating value out of 'arbitrage opportunities' as they emerge may well be needed if maximum value is to be gained.
- Markets might be engaged to work with the inherent volatility – and to identify and extract value from the associated periodic arbitrage opportunities – rather than necessarily seeking to minimise the volatility.
- In other areas, options instruments have emerged to fill this role – in extracting value from the upside of volatility while limiting the costs of the downside.

Relatively 'light-handed' role for government.

In terms of active government involvement in the *direct* development and roll-out of fundamentally new, especially secondary market, instruments and products, we see a relatively limited but role – but do see a crucial and challenging role in adjusting the institutional settings to be more compatible with such developments, while protecting the resource base.

- This will include modifications to the existing entitlements, to expand flexibility, and where possible relaxing constraints on potentially valuable classes of trades.
- Some of these changes would expand the scope for primary market trading, especially in respect of delivery timing and between classes of use, as well as facilitating secondary market operations.

Strategies: Constraints, products and transactions

Against this background, the following areas of action for government, and likely response from markets, especially via the role of intermediaries in trading and product packaging in respect of water-based products, are proposed for serious consideration. We stress that, with increased incentive and scope for markets to deliver new products, and with associated scope for adaptation of demand patterns to match the opportunities afforded by the new instruments, any attempt to script the ultimate outcome is likely to prove very short-sighted.

We believe the following sets out a series of feasible (in time) initiatives and likely developments that could add significantly to the efficiency of water markets through progressive improvement.

By the same token, there is need for a level of realism. Water markets are likely always to be much thinner than other 'analogous' markets, such as electricity markets and financial derivatives markets – trading volumes will remain relatively low and mitigate against size economies and some of the intensive investment in innovation, risk taking and head-on competition between intermediaries.

Institutional changes

- Move to expand the approvals processes to recognise potential for conditional or futures trades several years ahead – ie trades involving the transfer for a proportion of future time.
  - If a permanent trade would be permissible, then such trades should generally be allowed;
  - Even where permanent trade would not be permitted, some such trades may well be sensibly approved;
    - ⋯ For example, trading might be approved under a contract with a maximum, or expected, effective level of transfer over the next 5 years of less than 20 per cent.
    - ⋯ A generic range of such approvals may be possible on a prior approval basis,

Externality attribution

- To the extent possible, look to the increased use of *externality pricing* and other instruments as means of relaxing some requirements for strong regulatory requirements that suppress market incentives, and that suppress the generation of information on the true costs of constraints;
  - The emphasis here should be on pricing the *marginal* externality costs, not average or total externality costs; the distinction is of considerable importance, reflects what we see as the clear priority for sound usage incentives and offers scope for managing some of the equity consequences of such a shift in approach.
  - Great accuracy need not be a requirement in looking for an improvement over strong regulation that is suppressing market innovation and development – a better emphasis would be on seeking to establish incentives to move in the right direction, accompanied by clear notice of intended future strategy and a commitment to moving towards increasingly accurate pricing over time.
  - Externality pricing is not an 'all or nothing' proposition – there is scope for early introduction of externality prices in respect of marginal impacts in some areas, while retaining non-price measures in respect of other impacts; from this point the system can be allowed to evolve as it contributes to the production of better information on which to base estimates.

  - The role of externality pricing could be complemented (and its costs limited) through the introduction of active environmental trading that would, in effect, price marginal changes in environmental flows.
    - ⋯ Similarly, unbundling and separate trading of well-defined delivery and drainage rights, may offer better instruments for some other classes of externality.
    - ⋯ These measures are, in fact, pricing instruments because they post an explicit and avoidable cost of not allowing the water to flow, or not trading the delivery or drainage rights.
  - Externality pricing, based on marginal impacts, offers a direct instrument for addressing the threat of 'sleeper and dozer license' water to the efficiency of water trading – and that has been a key constraint on market development.
    - ⋯ Effectively, bringing water out of environmental flows and into extractive use should entail greater incremental (and avoidable) costs than shifting the pattern of extractive use.
    - ⋯ Conversely, the same instruments might encourage greater transfer of water into lower rates of normal usage, with greater emphasis on insurance services than normal use services – so that a price instrument might contribute to the equilibrating function, between use and non-use of entitlement, now achieved through the cost of regulatory constraint.

Unbundling land & water

- Complete the separation of entitlement from land
  - In the absence of strong arguments to the contrary, remaining links – notably the requirement in some jurisdictions that water entitlement be held by holders of land to which the water could be applied – should be broken or at least eased.
    - ⋯ Such restrictions stand in the way of some strategies to develop portfolio products via intermediaries prepared to accept some of the risks.
    - ⋯ However, if breaking the link should be unacceptable, there would be scope for achieving most of the gains through the use of leases and derivatives of reasonably long duration.
  - Such separation would recognise the *value of non-use* as well as use of the resource – facilitating entry of market participants who may be keen to encourage a shift in water use patterns to ones that deliver more water to the environment as a spin-off from the delivery of tailored risk-management services.

Move towards tagging

- Seek to commit to medium-term implementation, where practical, of water trading based on *source tagging* rather than *exchange rates*;

– We accept this approach involves some complexity but it also has strong advantages, would address what will otherwise be lasting problems with exchange rates – and its potential contribution to facilitating new product and transaction possibilities to extract greater value from water is considered to be considerable.

Support for new products and transactions

Compatibility with a range of desirable developments

– The broad compatibility of tagging with soundly structured water accounts, the scope for longer term logical evolution towards capacity-based entitlement (with separate delivery or release entitlements) and the removal of on-going monitoring/exchange adjustment measures, with associated uncertainty all suggest such arrangements would have greater commercial attraction and could be used to underpin more powerful products over time.

More beneficial inter-state trading

– Tagging also affords a direct approach to addressing constraints on inter-state trading without the need identity of arrangements and philosophies across jurisdictions or the limitations that flow from the use of exchange rates.

Exchange rates reduce the value of out-of-region water in building risk products.

⋯ Including the tendency of exchange rate to adjust out of the system one of the key attractions in inter-jurisdictional trading – access to a water product with supply and reliability attributes different from those sourced locally and capable of complementing existing products.

Intermediaries could reduce complexity

– Market intermediaries, with a stake in gaining increased flexibility and creating value for customers out of the complexity of the water system, could have a key role to play in keeping the end user complexity down.

Capacity-based entitlement as feasible

- The above concept of capacity-based entitlement, in respect of regulated rivers and recharge-constrained groundwater, has significant attraction, despite the immediate complexity.
  - Entitlements based on such an approach would be substantially sounder than entitlements based on rights to extract, would create individual incentives for resource husbanding and would be much more supportive of some secondary market opportunities.
  - We see merit in a progressive move towards such arrangements.

Unbundling use & delivery

- Look where possible to the scope for separating entitlement to source water from delivery entitlement.
  - Such a shift offers potentially valuable opportunities to relax regulatory constraints as a means of addressing delivery capacity limits, may open up access to innovative ways of relaxing the physical constraints themselves and could feed into a wide range of possibilities for extracting value from the scope for trading on differential impacts on different uses of shifting the timing of effective access to resource.

Addresses 'stranded asset' concerns

  - This separation could also help to address another source of 'inertia' in trade relaxation – concern with the management of fixed costs and potentially stranded or under-utilised assets.

- ⋯ It would not be efficient if water were moving because of false economics, based on an individual's ability to avoid a set of costs unavoidable by the system as a whole; equally, it would be inefficient to prevent the transfer of the water usage pattern, even though it would deliver a net gain.
- ⋯ Entitlements to delivery capacity would allow separation of water usage economics from commitment to sunk infrastructure costs.
- ⋯ Theoretically, the same 'false economics' could be attacked through externality pricing instruments – the transfer of delivery system costs to users who are not party to the trade contract would constitute an externality associated with the trade.
- ⋯ The relevance of these considerations will depend heavily on the commercial model applied to the ownership of the water businesses.

Trade between hydro and other uses

- Address direct constraints on market transactions to derive greater value from the combined electricity/other water uses sector in relation to Snowy Hydro activities.
  - Active trading between uses to build value;
  - Shifting timing of releases to increase value;
  - Shifting flows across the interconnected Snowy system, to seek out ways of delivering value to the discretionary market operations of the generator, while offering wider options to downstream holders of entitlement;
  - This could also serve to bring into the Murray-Darling Basin systems a highly experienced derivatives trader.
  - Such trading would be greatly facilitated by a move to capacity shares combined with release/delivery entitlements.

Leasing

- Move to allow entitlement leasing in jurisdictions where this is not currently permitted, subject to approvals requirements that reflect any of the above changes.

Conditional transfers

- More generally, move to allow, in all jurisdictions, approvals for temporary transfer of water for periods spanning more than one year, or for shorter period, but on a conditional basis at a point in time in the future that is defined by a trigger (water price, allocation level, commodity price index etc) that implies uncertainty as to timing.
  - Removal of any arbitrary time limits on whether and when a transfer needs to be effected, once approval is granted;
    - ⋯ The ease with which this (and the variants below) could be safely allowed could be enhanced considerably by the earlier proposals in respect of separation of delivery rights.
    - ⋯ This recommendation does not imply a guarantee of delivery rights, and it may be necessary to enter the market to achieve delivery.

  - Tailoring approval requirements and costs to a level appropriate to a class of transfer – eg, recognising that forward sales to deliver 'drought insurance' on a low probability of triggering basis could reasonably be less onerous than approvals for permanent transfer.
  - The key rationale in such changes lies in their contribution to the provision of water options as instruments for managing price or access risk through time.

Environmental traders

- Give serious consideration to developing the role of environmental traders in the system, even if done within the context of prescribed minimum flows and a break-even budget.
  - In effect, this would involve seeking to adapt the pattern of environmental flows, across all catchments, in such a way as to deliver an improved aggregate environmental outcome, financed out of differentials between point of time usage and non-usage values across catchments.
  - For example, there would be scope for arbitrage between one system where an increment in environmental flows would be valued highly, relative to the extraction value of water at that point in time, and one where the converse applied.
  - Such traders could be expected to become active participants, and important contributors to the development of, derivative products.
  - Such trading would explicitly price marginal extractions (by posting an opportunity cost for extraction) and should be seen as addressing one of the system externalities in a more flexible manner than is possible with catchment-level regulated flows.
  - At the same time, their activities would produce valuable information regarding the true marginal cost of flow constraints that could feed into improved market design.

New products and transactions

The above changes alone could be expected to result in a range of new, or currently rare, primary market products and transactions. This could include bilateral and multilateral trading in delivery rights and timing; active trades between electricity, irrigation, industrial and town usages; increased use of leasing to manage long-term water access risks, especially during farm or industry development phases; and a shift towards end users composing a portfolio of water products with an acceptable cost and risk profile, reducing reliance on regulator prescribed reliability products. It would contribute to individual incentives for demand management – and, if there is an environmental trader involved, this could translate into support for aggregate demand management.

However, the transactions costs involved in a series of bilateral contracts to achieve some of these outcomes – matching stakeholders, analysing portfolio and product characteristics, establishing compatible financing arrangements, managing multiple water supplies etc – are likely to be quite daunting. In this setting we see scope for the increasing presence of intermediaries able to deliver a more broadly based product creation, risk management and administration activity.

Components in the expanded product range could well include:

Widened water options

- A wider range of accessible water options, with differing levels of reliability and different exercise rights.
  - This would include entitlement holders being paid to surrender temporary usage of entitlement under prescribed conditions, as well as other users willing to pay for access to the rights to water under these conditions.
  - For example, users with low water supply tolerance could approach the market, away from immediate drought-based pricing, and seek to cover their requirements in a range of ways:
    - ⋯ As now, they could acquire more water, of specified reliability, than their normal needs dictate and could trade the surplus on a temporary basis;
    - ⋯ They could enter the spot market to top up supply requirements as needed;

Price caps

    - ⋯ They could buy options to place a price cap on what they would pay for water in a drought – smoothing input prices.

Option sculpting to enterprise needs

    - ⋯ They could 'sculpt' a portfolio of options under different terms to deliver reducing quantities of access to water at rising but predictable prices, and base their production system, from business as usual to extreme drought survival strategy, around this greater certainty.
    - ⋯ They might incorporate volume, weather or commodity price, hedges as below.

Diversification into supply of risk products

  - Conversely, water users with high supply tolerance, or willing to adapt their usage patterns to deliver this, could generate an ongoing income stream out of their willingness to surrender some of their water under well-understood conditions – and could organise their own enterprise around this known contract, and an established contract for temporary transfer should the option be exercised.

Separation of financial from physical hedges

- Using this physical options market as a hedge, we may well see the emergence of an expanded range of financial hedge products that allows individuals to cover some water price risk, but without delivery guarantee – the water may come from a different source from the financial payment, or it may prove either infeasible or not cost effective to access the water.

  - These products could be used for pure financial insurance, or could provide added financial resources to enter the spot market if the economics of doing so add up.
  - It may well be that such products could be linked to commodity price derivatives or indexes, as well as to water prices, to deliver a product better attuned to enterprise risk.
  - Such products could effectively allow trading of risk across catchments unconnected other than via the correlated probability of both catchments being in drought simultaneously – or could exploit the risk diversification offered by the probability that they are not both in drought simultaneously.

Other instruments, such as weather derivatives, could enhance the product range and appropriateness

- As with energy markets, the development of these derivatives, that primarily manage price risk, could enhance the role of other hedge instruments, such as weather derivatives, that correlate closely with *volume risk*.
  - While probably of limited value on their own, they may well add substantially to the scope for sculpting portfolio products to meet market demand for risk management, and could help intermediaries to manage the risks of their own positions.
  - To be effective, these products would probably need to be based around medium-term patterns – such as cumulative rainfall indexes or the Southern Oscillation Index.

Mixed energy and irrigation

- Scope would exist for the emergence of products that effectively allow irrigation farmers and other downstream users to diversify their 'enterprise mix' into mixed farming and electricity generation, via derivatives being traded, directly or indirectly, with hydro-generators.
  - This could provide access to some of the profitability associated with increased value of discretionary water to the generators, could incorporate effective access to in-storage entitlement husbanding services, supplied by the generators, and could offer a diversified income stream during droughts.
  - As with the other possibilities, it would also encourage looking to changes to the design of the enterprise to increase the value of its flexibility to support engagement in these markets.

Trading in constrained delivery slots

- We might see the emergence of markets trading in 'slots' to provide access to passage through physical constraints in the delivery system – and encouraging the development of smart ways to relax, or reduce the effective cost of, such constraints.
  - In effect, this would imply a form of market-based congestion pricing as an alternative to regulated restrictions on trade through a point of congestion.
  - In this case, the benefits of such pricing could largely accrue to those already allocated access to the constrained passage – while allowing

more efficient direction of water resources and increasing the scope for multilateral trades through (and around) the constraint.

Indicative action agenda

The following table sets out an overview of our assessment of an agenda for making progress with the main tractable issues set out here where progress must fall to governments. The nature of the study undertaken limits the level of detail that can be attached to the agenda.

The 'priority' column relates to the absolute importance attached to the initiative, not to any sense of priority in timing. Timing is itemised separately. 'Feasibility' refers to the practicality of making substantial progress. We judge that some useful progress can be made with all the indicated measures, but in some cases there are likely to be political and informational limits on how far it is possible to progress cost effectively.

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Initiative	Priority	Feasibility	Timing
Review and revise approval processes/trading rules to cater for flexible forward trading	High	High	Progressive, starting ASAP
Unbundling, particularly separation of delivery rights from entitlement (priority shifts to high if a prerequisite to flexible forward trading)	Medium-high	Low-medium (vary by system)	Progressive
Removal of other artificial restrictions – leasing, trade out of districts, trade across sectors etc	High	High	ASAP
Policy commitment to a principle of progressive attribution of marginal external costs to deliver progressive improvement in water market efficiency	High	High	ASAP
Progressive attribution of external costs – using several instruments (prices, net impact assessment, environmental trading; marginal price impacts possibly partially offset by fixed cost clawback)	Medium-High	Low-High	Early action on some, but staged over a few years, and on-going improvement; phase-back in some water resource management as pricing and environmental trading introduced
Facilitate intermediary entry by removing remaining ownership restrictions to landholders – removal of any constraints on the use of derivatives/leases to approximate, if full removal not acceptable	High	High Possible political constraints	ASAP
Interim tradeable instruments for time shifting, with trades between hydro and other uses permitted	Medium	High	ASAP Progressive and phased with capacity shares
Capacity shares and release rights – resource husbanding – hydro/extractive use trading – derivatives backing	Medium-high	High for some sources	Progressive – already started Conditionality likely for most groundwater Early prioritisation for cost effectiveness – simple systems or high value
Tagging of entitlements for interstate/region trade to enhance risk management options	Medium	High with some complexity	Progressive implementation or transition via exchange rates
Other measures to increase market confidence (eg central exchanges, price posting, titling/registration systems)	High	High	Continuing, but increase focus on future opportunities

1 Introduction

This paper has been prepared for the Water Reform Working Group (WRWG).

ACIL Tasman has been commissioned to review the range of transactions that can be made with respect to water entitlements in Australia, and in particular:

1. Identify and describe the existing range of transactions/products with respect to water entitlements that can currently occur in all jurisdictions within Australia.
2. Explore what additional transactions/products may be devised and which may act to enhance water trading opportunities.
3. Assess the feasibility, desirability and timing for implementing these transactions.

In effect, it is a discussion paper, designed to stand back from the currently emerging water markets across Australia and to probe prospects for improving the effectiveness of these processes. The emphasis is on opportunities for water trading, to allow greater value to be obtained from this often scarce resource. This needs to be set against the backdrop of concerns for the values associated with the resource base itself – environmental and amenity – as well as with the value of the flow of commercial, domestic and social services associated with active (often extractive) use of the water systems.

Coverage is of surface and groundwater sources, spans the various jurisdictions and addresses cross-jurisdictional trading possibilities. It does not probe particular water systems, though clearly local hydrology and opportunities are highly relevant to the form of efficient markets. As much as possible, this paper works with the broad product and design issues that need to be addressed in establishing the infrastructure for a sound water market.

The paper is not intended to recommend the design of these water markets, though clearly we hope that it provides valuable input to these design processes. It will be one of many studies feeding into these processes, and it might best be viewed as a check against accidentally missing out on valuable opportunities. In highly regulated, or poorly priced, systems there is always a risk that opportunities will remain unnoticed because the incentives for discovery and testing have been depressed.

Similarly, the paper is not intended to advise on wider water resource management strategy – though it seems highly likely that well designed water trading markets can be engaged but to encourage water to be directed in less damaging ways and to increase the affordability of justifiable water resource

management costs. Sound strategies for increasing the accountability of water users for third party impacts are going essential for both efficiency in water markets and cost effective water resource management – the paper does provide some suggestions for this aspect of resource policy.

The paper's emphasis is on transactions and products that might allow greater value to be obtained – if appropriately brought into the design of these markets or if allowed to emerge within them. This includes a consideration of possible impediments, within the existing regulatory structures, to the emergence of useful products or transactions.

In the spirit of this purpose, we have adopted the approach of risking the inclusion of some concepts that may, on closer examination, prove infeasible or misplaced – rather than risk omitting concepts of potential value. In effect, we offer a smorgasbord, from which choices might, over time, be made – and provide some guidance as to possible priorities and process.

To assist with this process, and to provide a context for the development and presentation of these choices, the paper begins with:

- A brief statement of background and policy context, directed at an audience wider than the WRWG;
- A summary of present approaches to water trading applying in the various jurisdictions, along with some comparisons of terminology that might otherwise cloud comparisons; and
- Presentation of a framework for addressing resource value issues that we believe can assist in addressing the complex risk management trade-off questions inherent in striking a balance between different forms of value extraction.

2 Background

Until very recently, across Australia the ability to transfer water from one use and user to another was heavily constrained. In general, access to water use entitlements in relation to irrigation, stock and domestic use were tied specifically to ownership of the land, while rights to use water for urban, commercial and industrial purposes were controlled by regulated utility planning processes.

As demands on the water resource grew to the point where there was usage conflict – one person's usage was starting to encroach on the feasibility or cost of another person's usage – forms of quantitative limits were introduced in some cases. The detail of these varied substantially across jurisdictions and water systems – but were still subject to substantial constraints on any

movement between points of application. Even on approved land, there were commonly restrictions on the forms of use to which the water could be put.

The economic case for allowing water usage rights to trade separately from land – to find higher value uses for an increasingly scarce resource – has been recognised for many decades. However, until the 1980s there was relatively little movement towards opening up serious opportunities for trading water entitlements separately from land.

There have been two separate drivers (on top of the already recognised 'economic' case) of the subsequent emergence of trading rights across Australia:

- Growing technical and community awareness of the environmental damage associated with current and growing patterns of water usage in some parts of Australia;
  - with an associated recognition that 'smarter use' of water could help to compensate for the pain of pending necessary restraint; and
- Increased government policy emphasis on competition policy, most strongly reflected in the 1994 COAG agreement across all jurisdictions;
  - This entailed a generic commitment to the wind-back of unnecessary regulatory constraints on market activities – as underpinned by a test of *net benefits* to the community;
  - And specific commitments in respect of water, including:
    - ⋯ separation of water entitlements from land title, clear specification of entitlements in terms of ownership, volume, reliability, transferability and, if appropriate, quality;
    - ⋯ development of water markets so that water maximises its contribution to national income, subject to the physical, social and environmental constraints of catchments.
    - ⋯ establishing formal allocation of water for the environment based on the best scientific information available;
    - ⋯ adoption of consumption-based pricing and full cost recovery for urban and rural water services; and
    - ⋯ institutional reform including separation of the roles of service provision, regulation and water resource management.

There is now strong commitment across jurisdictions to the encouragement of sensible trades in water entitlements. This has been accompanied by extensive regulatory change, especially in the jurisdictions where the resource tends to be under greatest stress. However, the details of the approaches used differ substantially across jurisdictions and more generally opportunities for trades between jurisdictions have been slower to emerge. This tends to reflect both issues with the compatibility of the arrangements and probably, in some cases,

political and social resistance to having a scarce resource traded out of a jurisdiction or specific regions.

Relevant differences include not just the detail of the definition of the entitlements, and the rules that apply to the tradeability of entitlements, but extend also to the philosophy underpinning water supply management – in terms of supply reliability and inter-seasonal husbanding of the resource. While this may prove to be a strength as scope for serious inter-jurisdictional trading increases – widening the opportunities for individuals to define their supply reliability by blending different reliability products – it is also necessarily a source of some tension and has implications for implied contribution to environmental flows across jurisdictions.

Despite the limitations, within jurisdictions, and progressively also between jurisdictions, the elements are increasingly in place to allow and expect continuing significant movements in the pattern of water usage. This will be as a result of the combination of increasingly cost-reflective pricing and the increased scope for moving water, so-priced, to locations and uses that afford better aggregate value to the trading parties.

Nevertheless, substantial constraints remain. While some are likely to remain, with justification, for a long time, there is growing concern to ensure that the market and regulatory frameworks established by governments do not unnecessarily or unwittingly constrain opportunities for water trading that may generate value.

3 The Existing Framework

Government plays a key role in defining the nature, terms and conditions of the primary 'products' or entitlements to access water; as well as closely regulating trading in these entitlements. This section provides an overview of the existing entitlements and transactions in water markets in Australia. A more detailed description is provided in Appendixes A and B.

3.1 Existing products

In Australia, rights to control and use water are vested in the State. The way in which Governments then provide conditional entitlements to access water to users define the primary 'product' that, can, in some circumstances, be traded.

There is a wide array of different types of entitlements to water currently applying in jurisdictions in Australia. These can be usefully seen as having various (not mutually exclusive) dimensions or characteristics, including:

- The use or purpose of the entitlement.
  - Entitlements for consumptive purposes generally distinguish between irrigation, stock and domestic, urban supply, mining and industrial use. In addition, specific entitlements apply for non-consumptive uses (principally environmental flows and hydro-electric power generation).
- The source of the water
  - regulated rivers and supply systems, diversions from unregulated rivers and streams, groundwater systems (subartesian and artesian), and overland flows.
- The legal form of the entitlement
  - Such as primary and subordinate legislation (eg 'as of right' entitlements such as riparian rights), licences, contracts or agreements, and – increasingly – tradeable instruments.
- The level of devolution in the supply chain
  - In urban settings, the level of devolution is generally at the bulk supply level, while in rural settings, individual irrigators often have more clearly defined subsidiary entitlements.
- The nature of the entitlement – ie the benefits (and obligations) it bestows:
  - rights to take or receive water; use the water; build or operate associated works; and return the water.
  - Rights to a share of the resource at the harvesting source and hence a choice to hold water in storage (a "source entitlement"); or an

entitlement to receive water at the point of delivery (a "delivery entitlement") generally defined as a volume of water over a defined timeframe, with a specified reliability or probability of delivery.

- The timing of the delivery of water to the entitlement holder (often governed by specific rules and rosters applying at the local level).
- Responsibilities in respect of system costs, including capital and operating costs;
- Tenure and security: the nominal duration of the entitlement, and processes for renewal or modification of entitlements.
- Ownership and transferability: entitlements vary as to the extent to which they are tradeable or transferable to other parties.

The current system of entitlements across Australia is something of a moving feast, as jurisdictions progressively convert from 'old' forms of licensed entitlements to 'new' more clearly defined, secure and tradeable entitlements. In doing so, allocation of entitlements is now being undertaken within broader planning frameworks involving scientific input and community consultation designed to ensure more sustainable management of the resource. In most States, provision of water for the environment is now given priority over allocation of water for consumptive uses through these processes.

The key elements of this conversion, across all jurisdictions, has been the specification of entitlements with clearly defined volumes and reliability, separation of entitlements from land, and "unbundling" of various components of entitlements such as the associated works and use approvals and delivery capacity. There are, however, some significant differences:

- Separation from land: while basic water access entitlements are no longer tied to particular parcels of land, there are still restrictions in several jurisdictions that prevent water being held by persons other than those with ability to use it on land.
- In South Australia only, the link to land has been removed to a greater extent in that even basic landholder rights such as riparian rights for stock and domestic use, are separable and tradeable.
- In Queensland and New South Wales, the access entitlement to water has been separated from the approvals for works.
- There are differences in the reliability of basic irrigation entitlements, with the 'general security' entitlements held by NSW irrigators being of much lower reliability than those of other States, reflecting different water management approaches.

Table 1: Overview comparison of water entitlements and trading instruments, conditions and terminology across jurisdictions

Water Property Rights		Queensland	Western Australia	Victoria	New South Wales	South Australia	Tasmania	Australian Capital Territory	Northern Territory
Measure	*Bulk Water*	See 'Individual Use'[1]	See 'Individual Use'[1]	Volume	Volume	Volume	Volume	n.a.	n.a.
	Individual Use	Entitlements being converted to volumes.	Generally volume	Depends on type of entitlement.	Typically volume. Exception is unregulated streams, which are being converted to volume.	Depends on type of entitlement, but generally volume.	Volume	Volume.	Volume
Duration	*Bulk Water*	See 'Individual Use'	See 'Individual Use'	Indefinite	*15 year licence for irrigation corporations.* 20 years for town water entitlements	Indefinite	Indefinite for Rivers and Water Supply Commission, 10 years for Regional Water Authorities.[2]	n.a.	Indefinite
	Individual Use	Water Allocations are indefinite. The licences they replace were typically for 3-10 years.	Can be for a fixed or indefinite period	Generally renewable after 15 years	Generally 15 year terms.	Indefinite	Normally 10 years	*Licences typically valid for 1-5 years. Allocations indefinite.*[3]	Generally 2 years up to 10 years, but are renewable.

[1] No Bulk Entitlements as such. Water service providers governed by same rules as ordinary water allocations.

[2] Rivers and Water Supply Commission provides water for three irrigation districts, Regional Water Authorities for a combination of household and industry use.

[3] ACT legislation stipulates that to use water it is necessary to hold both an allocation *and* a current licence.

Table 1 continued

Security	*Bulk Water*	See 'Individual Use'	See 'Individual Use'	Subject to modification by the Minister under certain circumstances.	Town and major utility supply reviewed every 5 years.	High security	Similar to individual use.	n.a.	n.a.
	Individual Use	May be amended during review of Water Resource Plans every 10 years. Otherwise, compensation is payable if allocation changed.	Licences may be changed at any time, with compensation payable where the burden of change is unfairly distributed.	*May be changed without compensation if there is a water shortage.*	May be changed at the end of 10 year Water Sharing Plans. Compensation may be payable for any other changes.	Generally high security, but conditions of access may be altered periodically according to Water Allocation Plans	Review of conditions after 5 years. *Most entitlements existing on 1 January 2000 cannot be changed.*	*In accord with the Water Resources Act 1998, allocations may be reduced if deemed necessary by the Environment Management Authority,*	High
Reliability of Supply	*Bulk Water*	See 'Individual Use'	See 'Individual Use'	*Varies, but specified for each bulk water entitlement.*	Same as for individual users, with an additional measure of high security water.	Full allocation available except in extreme drought.	Water for household and hydro use very reliable, remaining water prioritised just above irrigation use.	n.a.	n.a.
	Individual Use	*Specified as part of Water Resource Plans*	Varies depending on restrictions in drought periods.	Very high, typically 96-99%	Depends on region, but basic irrigator entitlements of lower reliability than Vic and SA..	High reliability with full allocation available almost every year. Volumes may be reduced by the Minister in extreme drought.	Once environmental flow requirements are introduced, is expected to be low over summer months	*Supply is highly variable: no guarantee.*	Generally high (supply is via dams in the Top End, and groundwater in rest of N.T.) .

Table 1 continued

Restrictions on Trade	*Bulk Water*	See 'Individual Use'	See 'Individual Use'	Obligations to deliver subsidiary entitlements must be met first.	*May trade on a temporary basis only after commitment to individual members met.*	Trade subject to agreement of all trust members	Trade will not be permitted on household water supplies, no specific restrictions on trade otherwise.	n.a.	n.a. (Power and Water is monopoly supplier)
	Individual Use	Tradeable, but trades must not be inconsistent with Water Allocation Security Objectives	Must be approved by the Water and Rivers Commission or a local water management committee.	Some restrictions between defined trading zones. A 2% limit on trade out of regions applies.	Free trade within irrigation districts. Trade between irrigation districts is subject to irrigation company rules.	Transferable subject to assessments.	*Water transfers require the approval of the Minister on a case by case basis.*	*Allocations fully tradeable, licences not tradeable.*	Allowed within Water Control Districts but only after a Water Allocation Plan is in place
Licences attached to land?		Water allocations not attached to land.	No.	Not attached to specific parcels of land, but only landholders may hold entitlements	No	'Taking Allocations' approved for use on a specified title, 'Holding Allocations' not attached to land.	Licences issued under Water Management Act 1999 not attached to land.	*Licences are site specific, allocations not attached to land.*	Yes
Entitlements linked to approval for works?		No	Yes	Yes	No	Yes	Yes	Yes	Yes
Can unused entitlements be carried forward for future us?		No	No	No	In some irrigation schemes, where water accounting has been introduced.	No	No	No	No

Note: 'Individual use' comprises allocations of regulated water, unregulated streams, groundwater

- There are considerable differences in the tenure of entitlements, from short term entitlements to use of off-quota water, through to indefinite licences.
- There are some differences in the precise nature of entitlements held by irrigators in irrigation schemes, depending on the nature of the contractual relationship between individual irrigators and the irrigation authorities.
- In regulated systems, entitlements held by end users (that may in fact be an irrigation business) are generally delivery entitlements providing access to a certain amount of water each season, but with no ability to carry forward any unutilised water into the next period (except in some NSW irrigation schemes where water accounting has been introduced).
- There are considerable differences in the extent to which entitlements can be traded, often reflecting variations in trading rules at the local level.

A summary of some of the key features of the water entitlements across jurisdictions is provided in Table 1. A more detailed description of the existing range of water entitlements in each jurisdiction is at Appendix A.

3.2 Existing transactions

The existing range of transactions in the water market is governed by the policy, legislative, and institutional frameworks at the national, state, and local levels. The broad policy frameworks for water trading in Australian jurisdictions have many common elements. These include provisions about:

- Types of transactions that are permitted or not permitted:
  - Temporary transfers of seasonal water assignments (the transfer to another person of some or all of the water that may be taken under a water entitlement in a given year – usually for the remainder of the season). Because this transaction involves only the transfer of water for a short time period, the approvals processes required are generally relatively straightforward.
  - Permanent trades or transfer involving the transfer of all or part of a water access entitlement (encompassing entitlements to all future water allocations) to another party are generally subject to stringent approval processes to ensure no adverse impacts on third parties or on the environment.
  - Leasing (the transfer to another person of some or all of the water that may be taken under a water entitlement for a defined period) is currently permitted under legislation in some States (eg South Australia, NSW, Tasmania), but not in others (eg Victoria). The approval processes for leases are akin to those required for permanent trades.
  - Changes to the specification of the entitlement (eg subdivsion or amalgamation) either with or without also effecting a transfer in its

ownership are generally permitted subject to approval processes if there may be an impact on third parties or the environment.

  - While the focus of the transactions is typically on end-user to end-user trades, it is important to note that States' policies and legislation also countenance or allow transactions involving a range of other parties. These include trades of bulk water entitlements between water supply authorities; and trades between authorities and individuals. Some types of transactions between hydro-power generators and other users are possible – if not facilitated – under current arrangements.
  - While environmental water allocations have generally been established as priority allocations to be provided outside of the market, trade in environmental entitlements is possible (and has occurred) under some circumstances.
  - A number of other types of transactions are specifically not permitted under State legislation or subordinate instruments. In particular, trading between uses is often not permitted, and in some States, 'speculation' in water entitlements is not condoned.
  - Rules set at the local level also have a major effect on what trades are permitted and what are not. Some restrictions on trade have been imposed because of socio-economic/equity concerns, primarily relating to the economic and financial impacts of trade out of certain regions. For example, trading rules and policies set in a number of NSW and South Australian irrigation schemes limit or prohibit permanent trades out of the district.
  - There is however anecdotal evidence of informal trades occurring that fall outside the official rules.

- Products that can be traded
  - Under states' legislation, only water entitlements that are clearly defined in terms of volume may be traded. Some products are permitted to be traded on a temporary but not a permanent basis. Individual end user entitlements that have been defined in clear volumetric terms in areas where a planning process to share the resource in a sustainable way has been undertaken will generally be fully tradeable, whereas other entitlements may not.
  - Basic landholder rights (eg riparian rights for stock and domestic use) cannot generally be traded separately from the land to which they attach.
  - Environmental water cannot usually traded – although there have been some cases where environmental entitlements have been issued in tradeable form, and where trade has occurred.
- State approvals processes and trading rules that:
  - Ensure that the trade does not lead to adverse environmental impacts, (for example unacceptable changes to river flows, or if use of the

entitlement at its new location may have adverse salinity or drainage impacts);

- Ensure that the trade does not diminish the entitlements of other users (eg in terms of ability to deliver their entitlement or through impacting water quality), and whether any exchange rate should apply to reflect differences in reliability of the entitlement or losses in delivery;
- Specify resultant constraints such as
  - trade may only be downstream;
  - trade may be allowed downstream past a channel capacity constraint only if there has been trade the other way first;
  - trade into or between certain zones (eg salinity impact zones) may not be permitted;
  - specific exchange rates that apply for trade between zones, reflecting losses in rivers or channels, or different reliability entitlements.

Special arrangements have been developed in relation to interstate trade, particularly within the Murray Darling Basin. Temporary trades between Victoria, New South Wales, and South Australia have been permitted and taking place since the mid-1990s. A pilot trial interstate water trading project for permanent trades commenced in 1998 in the Mallee region. Permanent trades have been restricted to one high security product in each State. A 1:1 exchange rate applies to all trades except those from South Australia to New South Wales or Victoria, reflecting the reduced security of supply upstream of the Darling River and Lake Victoria. Interstate trades must satisfy the approval processes in each relevant jurisdiction.

More details on the range of existing transactions is set out in Appendix B.

4 Trends, opportunities and constraints

4.1 An evolving market

Since the commencement of water trading with the first temporary transfers, the market has evolved and grown considerably. Key observations on trading to date include:

- Temporary trades/seasonal water assignments between individual water users have accounted for the major part of activity in the market.
- Initially, most water traded was water that was previously unused (ie "sleeper entitlements"), but as these are exhausted, increasingly trade of water is from low water value agricultural activity to activities able to extract greater value from the water, such as dairying and horticulture.

- The extent of permanent trading has gradually increased as understanding of the opportunities provided by the market has developed. In Victoria, for example, permanent transfers each year now represent around 1% of all water rights and licences.
- The vast majority of permanent trade takes place in regulated systems, although trading activity on unregulated streams is starting to emerge in some areas.
- While markets remain very thin in some areas, in others there is increasing depth and sophistication (eg the development of centralised exchanges such as WaterMove, the internet-based notice board service provided by the Department of Water, Land and Biodiversity Conservation in South Australia, and private water broking services).
- Most transactions have been within regions, although there is now increasing trading activity between systems, and interstate
- The level of trading activity in the market has varied between years, with the most activity generally occurring at times when the availability of water has been low.
- The level of market activity varies across jurisdictions, depending on the extent to which water is scarce. However, even in States where there are relatively low general levels of utilisation of the resource, such as Western Australia, there are areas where trading is developing.

All of these observations are fairly predictable, given the nature of the trading environment.

4.2 Taking stock

The advent of markets in water entitlements has generated, and continues to generate, considerable value-creation activities. In Victoria alone, it has been estimated that water trading has resulted in the ongoing return from irrigation increasing by as much as $12 million per annum, or a net present value of trade of over $100 million[4]. Similarly, in New South Wales, the benefits of trade were conservatively estimated to be between $60 million and $100 million per year in agricultural output[5]. The Australian Bureau of Agricultural and Resource Economics has estimated that the more widespread use of water trading in the Murray-Darling Basin would increase output by around $48 million annually[6].

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[4] Department of Natural Resources and Environment, *The Value of Water: A Guide to Water Trading in Victoria*, December 2001, p.17.

[5] Marsden Jacob Associates (1999), *Water Trading Development and Monitoring*, report prepared for the Department of Land and Water Conservation.

[6] Bell, Rosalyn and Athena Blias (2002), *Capturing Benefits from the Removal of Impediments to Water Trade*, ABARE Conference Paper 02.01, 46th Annual Conference of the Australian Agricultural and Resource Economics Society, Canberra.

These benefits have primarily arisen from using water markets to transfer water from low-valued to high-valued uses. The critical driver is the divergence in the value of water entitlement between different users and/or uses – *as seen by those users*.

Nevertheless the question remains as to whether further value could be created through enhanced trading opportunities, with a particular focus here on the range of products (including water entitlements) and types of transactions. The challenge is to ensure that the market and regulatory frameworks established by governments keep pace with emerging trends and demands of the burgeoning water market.

There is wide recognition that the existing operation of water markets is accompanied by substantial market failure, and regulatory, failure:

- Historically, and probably well in the future, there are likely to be significant elements of 'natural monopoly' in respect of water capture, husbanding and supply systems – associated with size economies in respect of major capital assets and in system monitoring planning and coordination.
- Current implementations of cost reflective pricing tend to fall well short of attributing to water uses the full costs of their usage on other users and on the environment.
- The rights that have been created, and that receive institutional support, fall short of the requirements for an ideal 'property right' from the point of view of trading.
  - This includes, in the case of a number of systems, effective 'over-allocation' so that the real character of an individual's rights is heavily conditioned by uncertain take-up by others, including of 'sleeper' and 'dozer' licences.
  - An analysis of current water entitlements against a theoretical benchmark for efficient property rights is contained in Appendix C.
- There remains a very high level of uncertainty regarding future resource costs of different patterns of resource use – making accurate assessment of the external costs and benefits of a trade very difficult to quantify.
  - Freer trading has tended – at least initially – to favour bringing into use water currently unused or under-used – perhaps bringing forward the pressures on the resource deriving from "over-allocation".
- Current entitlements have, to a large extent, emerged within a philosophy of managing extraction from river flows, with little regard for individual incentives to husband the resource in storage across time, including across seasons.
  - such husbanding has largely been done by system regulators, by hydro-system operators and by some limited usage of on-site storage by users.

  - this has tended to occur in ways that have limited the ability of the market to reveal the real the value of shifts in the timing of releases.
- Community attitudes and values, as expressed through policy and political processes, may well favour a greater emphasis on precaution, in relation to further risks to the environment, than individuals would be prepared to express in their individual choices.
  - In which case, there may well be some divergence between the incentives in the political marketplace, and those that would apply even in a textbook 'perfect' water market.

Most, but not all of these, issues can be linked to potentially changeable features of the regulatory arrangements, and have been addressed in this study. However, the poor information, and the risks and community concerns for threats to the resource base probably mean that a mix of regulation (over and above 'entitlement administration' and basic market instruments) will be features of water trading for a long time to come.

4.3 Adequacy of existing market instruments

As noted in the previous section, official transactions permitted in water markets have been largely restricted to temporary (ie, within current season) and permanent trades, although some jurisdictions now permit leasing of entitlements.

There are two ways in which the current range of transactions in the market may be constrained.

The first is simply by directly preventing certain types of transactions by law or regulation. As noted above, these include restrictions on inter-sectoral transfers, prohibitions on trading out of certain irrigation districts, prevention or discouragement of holding of water by water traders/speculators, etc. These restrictions – while often aimed at addressing legitimate concerns – nevertheless are likely to prevent many primary trades that would have generated greater value by transferring water to a more highly-valued use.

The second is by indirectly inhibiting the autonomous development of new types of transactions by participants in the market as it deepens and matures. In this sense, any factors that restrict trading opportunities may impede the development of new types of transactions. Constraints identified in previous reviews of water markets in Australia include lack of market information, confidence, and understanding (eg confusion over exchange rates), uncertainty over trading rules, administrative inefficiencies and/or the time taken for

regulatory approvals, costs of trading such as brokers' fees, existence of exit fees, stamp duty etc[7].

Where these processes add to costs, risks and speed of transactions, their effect is to introduce impediments to the transactions and impediments in investing in more sophisticated systems that would draw on these transactions.

More fundamentally, aspects of the basic institutional arrangements, including the nature of entitlements and allowable transactions can make some classes of transaction effectively impossible.

It is quite possible, for example, that existing approaches to regulation may inadvertently restrict the ability of the market to develop and devise innovative transactions. For example, current approvals for trades typically are for limited time periods, and may effectively prevent the adoption of options and other future hedging instruments that may improve risk management and capital efficiency.

While limited forms of leasing are now permitted in some States, a much wider range of transactions on a spectrum between the existing temporary and permanent trades could potentially offer considerable value to users, particularly when these transactions are thought of as risk management tools, not simply ways of transferring water to highest valued use at a point in time. These could allow greater scope for longer-term changes to enterprise management.

A flavour of the types of instruments that might be devised to better suit the needs and demands of water users and other market participants is presented in subsequent sections.

4.4 Regulatory impediments

By any measure, water markets in Australia are heavily regulated. There are, of course, understandable reasons for this – reflecting legitimate concerns to protect the environment and the interests of third parties from adverse impacts that may result from certain trades.

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[7] See, for example, ARMCANZ *National Framework Guidelines for the Implementation of Property Rights in Water*, October 1995; and High Level Steering Group on Water, *A National Approach to Water Trading*, November 2001; Mike Young and Darla Hatton MacDonald, Policy and Economic Research Unit, CSIRO Land and Water, "Who Dares Wins": Opportunities to improve water trading in the south-east of South Australia, *Final Report to the South East Catchment Water Management Board*, November 2000; Mike Young, Darla Hatton MacDonald, Randy Stringer and Henning Bjornlund, CSIRO Land and Water, *Inter-State Water Trading: A Two Year Review*, December 2000.

Governments have therefore sought to carefully manage the development of the markets. In doing so, onus of proof has tended to fall on demonstrating benefits from opening up the market, rather than on retaining restrictions. For example, the onus of proof is often placed on the proponents of a trade to demonstrate that it will not exacerbate resource damage – aided, where reasonably achievable, by block approvals for certain classes of transfers deemed non-damaging.

This could be viewed as involving a reversal of the onus of proof present in the general COAG/competition policy approach to regulation. This in itself may be understandable, given apparent community concerns for precaution in respect of risks to the resource base – and commitments to sustainable development may well involve some reverse onus. However, sensible though the approach may appear, it is not obvious, that it will in fact lead to better environmental outcomes, overall.

This is because, while preventing trade until it can be demonstrated that there will be no additional damage should prevent damaging trades, it may also prevent or slow trades that may *reduce* environmental damage. If anything, there may be reasons to expect that those willing to pay substantial sums to acquire additional water would look closely at efficient complementary investments in application technologies, with the likelihood of a reduction in damaging impacts, for example in pass-through to high water tables, with associated salinity and waterlogging implications.

This reasoning does suggest a challenge to the *wisdom of a specific onus of proof approach*. Rather than defining allowable trades on the basis of no likely damage, it is arguable that the resource management objective might be better addressed, while also allowing for greater trading, through an approach that focus on defining which trades will not be allowed on the grounds that they are likely to entail an increase in damage. The appropriate concept in relation to increase in damage is probably one of *net damage*, taking into account impacts at the site of origin and in-stream, as well as at the site of destination rather than just *gross damage* at the site of destination. The need to consider the difference in external costs of irrigation between the source and destination is supported by analysis elsewhere into alternative policy instruments for addressing externality impacts of water trading[8].

In practice, many jurisdictions are incorporating elements of both approaches, but in many cases probably based on different reasoning and rarely with an

[8] See, for example Stephen Beare and Anna Heaney, Australian Bureau of Agricultural and Resource Economics, 'Externalities and water trading in the Murray Darling Basin, Australia', Paper for the Australian Conference of Economists, Adelaide, 30 September - 3 October 2002, ABARE Conference Paper 02.19.

explicit focus on net damage. We suspect that there is a significant issue here – we are certainly not suggesting wholesale withdrawal from approvals processes, but there may be a greater role, even assessed purely in terms of environmental impact, for approaches that incorporate elements of:

- Conditional approval for a transfer, possibly subject to either withdrawal, or attenuation under specified monitoring and performance requirements;
  - to an extent this could be approximated through the use of temporary transfers while a longer-term or permanent transfer was approved; and
- As noted above, a greater emphasis on defining unacceptable trading, based on net damage, than on defining acceptable trading based on gross damage at destination site.

Appropriate externality pricing or other form of cost attribution, if feasible, would address many of these concerns – but this strategy is likely to remain limited by the uncertainties that apply.

The trend towards block usage approvals should help to facilitate more rapid approvals. Even here though, some care is needed in ensuring that measures designed to meet the needs of the environment do not prove counterproductive. Fur example, usage approval for an area of land, if based on acceptable net environmental impacts on site, may be systematically biased against environmentally beneficial trades that would source water from existing uses that are seen as entailing environmental damage. A problem that might disappear in the presence of reasonable environmental charging, might in its absence be a significant impediment to a beneficial trade occurring.

Beyond this proposition there is the wider question of whether some resource degradation might be admitted on the basis of the large benefits offered in other ways as a result of a redirection of the resource – a wider interpretation of the net benefit principle. While this question has unpalatable aspects, it should be approached with a recognition that degradation *is continuing to occur* in some areas and that such trade-offs are being made. The policy challenge is to *move efficiently* to a sustainable and socially desirable pattern of usage, and pattern of adaptation of usage, that takes full advantage of the range of options provided by the natural resource base, and water in particular.

So-called 'option theory' provides a framework in which the loss of risk management capability, including the risk from resource depletion, is afforded explicit value in addressing resource/income trade-offs and becomes integral to the determination of efficiency. In this setting, the choice is not between efficiency and resource protection – but rather the choice of a mix of trading rights and regulation that delivers the greatest option value to the community. This approach can redress the common bias, in favour of early development, that can flow from the application of traditional investment analysis methods –

while recognising the value of development-based wealth generation in enhancing the community's options and welfare.

Options can be generated through the use of water to generate wealth and fund investment, or through investments in research on which sound decisions can be based. Equally, options can also be extinguished through degradation to the natural capital base, through elimination of the scope for other uses before the information becomes available on which to change the merits, or by irreversibly committing capital investment when the long-term economics of an investment are clouded. To an extent, sunk capital costs have tended to eliminate some government options for responding to resource degradation.

Without some such framework, there are substantial difficulties in addressing the types of trade-off questions that are central to the determination of more efficient water trading – and even in defining an efficient trading instrument in a manner that is not inclined to prove counterproductive. An options framework seeks to factor in loss of flexibility to respond to future information and demands on resources – and to factor in the value of the flexibility offered by market-driven exploration of smarter ways to extract value from the resources, or to redress existing damage.

An options framework has a range of attractions in approaching these complex resource management issues and trade-offs. Of particular interest in the context of this study is the way that an options approach places information uncertainty, strategy flexibility and the management of risk at the centre of the policy framework. A strong theme that emerges later in this paper is the scope for water markets to emerge in ways that emphasise the value of water trading as a risk management strategy in its own right – and the associated incentives for adapting business strategy to allow for the sale of risk management services as well as the sale and purchase of 'surplus' water. Traditional assessments of the gains from trade, being based on changes in average earnings, are likely to underestimate the value of trade through better risk management – and similar to underestimate the extent of changes in water-using enterprises designed to exploit these opportunities.

More information on the potential role for an options-based policy framework in guiding water resource management is set out in Appendix D.

While the broad approach to market development and regulation is ultimately a matter for policy judgement, an overly conservative approach carries with it the risk of stifling market growth and the development of innovations that could never be foreseen by outside observers.

4.5 Conclusion

It is inherently difficult to estimate or even identify what value-creating opportunities may be being foregone because of limitations on the current range of products/transactions in water markets.

Nevertheless there are strong *prima facie* grounds for concluding that the current range of products and transactions available, or able to emerge under current policy settings, are constrained in a way that also constrains the ability to generate value. Importantly, the nature of the regulatory controls may, in some cases, also be stifling user pressures to relax the constraint – so that policy adaptation based on the 'squeaky wheel' approach may be misleading. Such circumstances could readily arise out either or both of poor externality pricing and impediments to the emergence of secondary markets from a thin demand base.

- In the former case, the price signals could be pushing the incentives in the opposite direction;
- In the latter, the critical mass to deliver strong incentives may never arise.

5 Lessons from other markets

In the course of this study we have examined the operation of water markets in jurisdictions outside Australia, and of other markets with analogous features markets – notably electricity and gas.

In some cases, products and transactions have emerged in these markets where it is not obvious that analogous products would add to the efficiency of our water markets. However, it is stressed again that one of the key reasons for encouraging markets is the scope they offer for *discovering strategies* that have not occurred to, or been given adequate weight by, more central planning processes – and that may well never occur in the absence of the information and ideas testing processes that a market can bring.

More generally, this line of argument further reinforces the caution against a policy approach that relies on the 'squeaky wheel' to indicate any constraints that should be relaxed, as opposed again to the use of the reversed onus of proof principle. Constraints can have the effect of suppressing the squeak. Reflecting this fact, the review of products and transactions in other markets has been allowed to extend somewhat more widely than the ones with obvious application to Australian water markets.

5.1 Water markets in other countries

Details of the review of other water markets are set out in Appendix E.

Although there are considerable differences in the nature of the underlying rights and institutional arrangements for their transfer, examination of experience in water markets in other countries, some broad conclusions may be drawn:

- Most active trading, at least initially, tends to involve temporary or short-term transfers between individuals within districts or basins, where there is a higher degree of confidence and information.
- Trades involving transfer between uses and/or between basins have been slower to develop.
- All jurisdictions have struggled to develop regulatory processes that provide an appropriate balance between promotion of efficient trade and addressing third party and environmental impacts.
  - While there have been concerns that inadequate regulation led to adverse impacts in countries such as Chile, equally there have concerns in other jurisdictions (eg California) that inflexible regulatory systems

have prevented clearly beneficial trades that would match supply and demand at least cost.

- Nevertheless, water markets have played an important role in re-allocation of water, particularly between agricultural and urban uses. Often this has occurred through 'bartering' arrangements whereby urban suppliers pay for improvements in water efficiency in irrigation systems.
- A range of derivative trades – futures and options – has emerged, spanning several of the jurisdictions, many of these trades dependent on the ability to forward commit access to water several seasons ahead.
- Overall, Australia appears to be as advanced as any other country in relation to most aspects of water markets.
- However, there are some examples of products/transactions in other water markets that would appear of potential value for application in Australia.
- In Colorado in particular, the regulatory framework appears to be more facilitative of a greater range of futures and derivatives transactions. For example:
- options contracts have developed between the cities and agricultural users whereby the farmer is paid for an options contact where he agrees in advance to temporarily relinquish water on an annual basis during dry seasons.
- Another derivative contract, that is more of a futures contract than an option, involves the municipalities in paying farmers an annual fee in return for access to their water in a fallow year, with agreed (typically 5 yearly) periodicity. A spread of contracts across different properties, with different phasing of fallow periods, offers farmers a secure secondary income stream aligned with their production needs while providing the municipalities with secure access to water with reasonably stable aggregate supply reliability.
- In addition, intermediaries appear to play a much larger role in developing creative transactions. Indeed, the State Engineer in Colorado told us that "we have found the number and scope of options and/or intermediaries to be limited only to the extent of a creative mind – rarely are only two parties involved in a water trade".

Another interesting type of product/transaction in Cariri in Brazil is the establishment of water rights by time and flow, and where trades take place for the right to a certain number of telha-hours (a telha is a defined amount of water) per week or for a certain number of telha-hours several time a week. Certain rights provide for flows during weekends, while others only provide rights to flows during the week. Application of this concept to channel capacity constraints in certain systems in Australia would also appear both feasible and of potential value.

The advent of active environmental traders in parts of the Western United States is another development that appears pertinent to the Australian situation. The Oregon Water Trust (OWT) is a not-for-profit organisation that purchases water on the market for in-stream flow purposes, primarily for fish habitat. The OWT has negotiated over 50 temporary and permanent transfers since its inception and protected flow in over 450 river miles throughout Oregon. It has focussed attention on basins that have historically supported significant fisheries where low flows are affecting a significant aquatic resources, where there is a high likelihood of ecological benefit, and where it can measure, monitor and enforce its rights. Following on from the OWT's perceived success, similar trusts have now been established in other western States including Washington, Nevada and Montana. Again, the concept of an environmental trader – potentially in addition to minimum flow regimes – would appear to be a concept of potential application in Australia.

5.2 Energy markets

Experience in energy markets emphasises the potential scope for secondary markets to separate physical system from commercial risk management in ways with fundamental implications for the long-term structure of both demand and demand management.

These markets also provide some alternative models for using market instruments to manage capacity constraints at a point in the system. There is also some experience in the management of dynamic losses in the system – paralleling the highly variable losses that can occur with water, depending on the state of the system. Energy markets have also been leading players in using weather derivatives and real options to integrate volume risk hedging with a range of price risk instruments.

Of course, there are substantial differences between water and energy markets. Energy demand and supply tend to be substantially more time sensitive, and exhibit much greater price volatility. Energy trades are typically between generators/producers and retailers or users, whereas with water trade is typically between users. Nonetheless, there are a number of insights of relevance to water.

Details of the review are set out in Appendix F.

Key insights to emerge from the review include:

- With the opening of wide trading opportunities, major operators in electricity markets have undergone a fundamental rethink as to the nature of the businesses in which they operate:

  - Generators have moved from a core focus on generation, to business with a multi-output product mix, the principle component of which is, for many businesses, the provision of *energy market risk management services*.
    - ⋯ Companies sell financial price-risk management products, in the form of hedge products that typical guarantee a price or provide a price cap to their customers.
    - ⋯ They invest in and operate physical generation capacity to provide a physical hedge with which to back their financial products, and to provide themselves with real options for benefiting from occasional price spikes in the spot market for which there is uncontracted demand.
  - Electricity utilities have shifted from pure supply utilities to sophisticated market contracting and risk management agencies;
    - ⋯ They buy options to cover their own price risks, and compete with generators to supply risk management services to major customers.
    - ⋯ In some cases, they make direct investments in generation capacity, to provide additional hedge cover and/or to cover risks of failure in transmission.
    - ⋯ They have moved increasingly to supply both electricity and gas, and energy advisory services, to customers.
  - Major end users of electricity, such as smelters, have discovered the value that lies in flexibility to reduce their demand when the spot price of energy rises high enough.
    - ⋯ This has involved actively selling price cap options, through their ability to reduce their demand and the fact that they have already contracted for supply of energy at a low price.
    - ⋯ It has also favoured enterprise configurations that enhance such flexibility, even where these add to the costs of their primary businesses.
- Options and market risk management thinking now pervades these markets.
  - The majority of trades takes the form of options contracts (1-way and 2-way hedges)
  - The structure of investment in capacity has moved away from investment that *minimises unit costs* of production, and towards investments that *maximise the value of the options created.*
    - ⋯ This favours investments with the flexibility to respond rapidly to unanticipated shits in market demand (or supply capacity) and investments in the form of modest increments in system capacity to limit the magnitude of the financial exposure, and to limit the impact of the new investment on market prices.

  - Weather derivatives have established a rapidly increasing role as complementary volume risk management instruments, alongside the mainstream price risk instruments above.
    - ⋯ Weather derivatives are a form of option with payments between contracting parties being triggered by extreme weather conditions that correlate strongly with demand for energy for heating or cooling.
    - ⋯ These contracts are commonly formulated as swaps.
    - ⋯ Interestingly, the rapid emergence of a weather derivatives market in the US was substantially triggered by the consequences of a severe El Niño event in the US in 1997.

- Hydro generation, with its scope for very rapid ramp-up speeds and with its costs being less in the form of input costs and more in the form of the opportunity cost of used water, has carved out a crucially important niche in the electricity market, and key linkages back to hydro-scheme water entitlements:
  - To the extent a hydro generator has discretion as to the timing of water releases, it is able to derive value from the sale of price caps and options to deliver 'ancillary services' – system quality control services to regulate voltage etc.
  - The capacity to pump water up, at times when power prices are low, and to generate when prices are high, affords a price smoothing capability and relaxes the hydrology constraints that apply.
  - A large hydro generator, such as Snowy, is well placed to offer hedge products to generators to cover their exposures in the event of an unanticipated loss of portfolio generation capacity.
    - ⋯ Essentially, these take the form of 'reinsurance' services.
    - ⋯ An interesting feature, with possible application to water, is the selling of such cover to multiple generators, but subject to a constraint on the total volume of hedge cover – in the event of multiple 'claims', the level of cover is attenuated across all claimants in a manner analogous to the management of supply reliability in our water systems.

6 Overview of major possibilities

A key focus of this consultancy is to explore what additional transactions and products might be devised that may enhance water trading opportunities and allow greater value to be obtained if appropriately brought into the design of water markets of if allowed to emerge within them.

The interrelated possibilities can be loosely categorised as:

- those involving the "unbundling" or re-definition of the primary product or entitlement;
- permitting and/or facilitating an expanded range of transactions; and
- facilitative measures to enhance beneficial water trading opportunities.
- While some of the possibilities are presented below, the very nature of market processes suggests that products and transactions may emerge that were never previously thought of.

6.1 Greater unbundling/re-defining of primary entitlements

A key insight is that water access entitlements themselves comprise various bundles of (conditional) rights to access water such as:

- The right to take or receive water;
- The right to a defined quality of water;
- The right to have the volume and timing of water delivered;
- The right to use the water;
- The right to build, operate or have an interest in works to take and control the water;
- The right to return the water.

Each of these components may have value, and that value may vary between users and uses. For example, hydro-electric generators and irrigators may place different value on the timing of releases from dams at different times. This implies that there may be merit in "unbundling" the various constituent elements so that they can be traded separately.

How far it is sensible to go will depend on a number of factors, including the costs in defining and trading in these "unbundled" elements. However, it would seem that there are several areas where there are particular pressures or need for further unbundling.

6.1.1 "Full" separation of water from land

In some jurisdictions, vestiges remain of the bundling of land and water, while the water rights themselves commonly involve a bundle of services that cannot be readily traded separately.

The requirement of some jurisdictions, that holders of irrigation water rights must also hold land, has an understandable history but may well impede the emergence of intermediaries in the market – as is common in may other areas – who can play a valuable role in acquiring, packing and making available composite services in ways that add value.

At the same time, it is recognised that there are significant sensitivities in respect of these matters. Some of the benefits of this unbundling could be achieved through the use of derivatives and lease instruments, without the need for fundamental ownership of entitlement to move away from the land base. The remaining restrictions may not be very severe – but they would constitute restrictions and could probably be expected to impede the rate of emergence of secondary markets.

Perhaps the final step in completely separating land and water would be to remove the link between 'basic' water rights (eg stock and domestic riparian rights) and the land to which it attaches. In principle, allowing even these entitlements to be traded may offer an opportunity to generate value (eg where a landholder has unused basic entitlements in areas where there is keen competition for water.

6.1.2 Delivery capacity entitlements

The combination of natural hydrology of river systems and variations in flows brought about by system regulation mean that there can at times be points in a river or channel system that 'fill' – preventing further flows passing through that point.

Not surprisingly, one response to such a constraint is to limit or prevent trading of entitlement from above to below the constraint – presumably to limit the effective attenuation of the reliability of rights below the constraint. In principle, if the limit of flow below the constraint has been reached, any attempts for an individual to access more water will need to be at the expense of someone else below – or the environmental flows below – so the trade opportunity should, in principle, lie amongst entitlement holders below the constraint.

However, if the market is encouraged to seek creative ways of trading in the timing of releases, and is seeking options trading opportunities designed to better allocate risk across the system, and recognises the scope for demand

patterns to be adjusted to the new opportunities afforded by a changed market structure, then this logic starts to unravel.

It may well be more efficient to match above-constraint to below-constraint sources of demand and supply of entitlement for the purposes of forward trading – and to address separately the delivery capacity issue through some instrument relating directly to the capacity constraint. The combination of such instruments might well allow for the identification of multilateral trade that delivers a better result for all, and that respects the system constraint.

As was noted earlier in respect of unbundling, congestion pricing might go some way towards meeting these objectives – though active trade in 'slots' in river or channel capacity would in principle have significant advantages – and would deliver its own market-based congestion prices. Not the least of these advantages would be the scope for the initial allocation of these rights to be used to address equity issues concerned with the rights of existing holders of downstream entitlements. One approach would be to allocate capacity entitlements based on peak (rather than average) flows.

Attaching a financial obligation to the delivery capacity entitlement (whether it is used or not) is another mechanism for addressing the concern about "stranded assets" if water is traded out of an area, as discussed further in Appendix G. It would also provide a mechanism for financing new investments in channel capacity, which would only go ahead if users themselves valued the removal of the capacity constraint sufficiently highly to justify the investment cost.

The desirability of establishing tradeable entitlements in delivery capacity is likely to vary across systems. Where capacity constraints in a channel affect only a few entitlement holders, establishing a formal market is unlikely to be cost-effective. In situations where capacity constraints affect a large number of users, or where the capacity constraint in fact has some flexibility for relaxation, timing shift etc, the benefits could be substantial.

6.1.3 Timing of release

Electricity provides more than an analogy here. Hydro-electric generation represents one of the key uses of our water systems. The Snowy Scheme provides approximately 8% of the generation in the National Electricity Market, is a key supplier of options to the market to cover the risks of price spikes or loss of system integrity – and interacts strongly with the hydrology of the Murrumbidgee and Murray River (not to mention the Snowy) systems.

The value of its options lies in the flexibility it has to influence the timing of releases from the dams feeding through its generators. Within the constraints

under which it operates, its incentives are to maximise the value it produces through these resource husbanding practices – assessed solely within the context of its electricity business. It faces no effective commercial incentives to maximise value over the combination of generation and all potential downstream demands for changes in the timing of its releases. Non-electricity demand normally only enters the strategy via regulated release requirements and, occasionally, negotiated modifications to strategy, typically on a 'no net cost' basis.

These considerations strongly suggest that there may be value in tradeable entitlements to the resource 'husbanding' activities undertaken in regulated systems, allows release timing to be varied to minimise net costs across electricity and other downstream demands. Analogous considerations also apply to other resources where there is a 'husbanding' option – including many groundwater sources. Present entitlements tend to involve a 'use it or lose it' approach to resource access, in the sense that water not used this year is unavailable for use next year.

The effect of opening up these incentives could be expected to range quite widely. If owners of downstream delivery entitlements faced strong financial inducements to consider a variation in the timing of their extraction options, it could reveal economic incentives to consider alternative farm water storage investments, or otherwise to explore enterprise structures more suited to access that value. In terms of release, and which river system water travels down, Snowy Hydro has substantial theoretical flexibility – its is more constrained by the flow requirements it faces and the associated variable level of discretionary water. Discretionary water is the key asset on which it can base its engagement in secondary markets, and its role in providing a range of products designed to deliver system integrity to electricity generation – and recover its costs.

In effect, it is possible to envisage a move towards a situation in which downstream holders of water entitlements, including delivery entitlements that could be tradeable, engage actively in extracting maximum combined value from their use of water, from their sale of water to other uses and from their willingness to vary delivery times to underpin a more effective electricity activity. We would not envisage this happening on the basis of a raft of bilateral arrangements between individual irrigators and Snowy Hydro – but we could see attractive portfolio products emerging that would have this type of effect.

Delivering greater flexibility here might be assisted by the use of some innovative options or swaptions products, or at least concepts, as is discussed in Box 1 below. The analogy between an fixed to variable interest rate swap that is designed to have a neutral impact on the principal, and a swap of release

timing from a regulated to a more flexible/discretionary pattern, while respecting the overall hydrology constraint and entitlement 'principal' is an interesting one.

6.1.4 Capacity share entitlements

At present most end-user entitlements are specified as delivery entitlements that entitle the holder to defined volumes of water at a specified off-take point over a certain timeframe. This makes them dependent on the actions of others (ie storage management decisions made by the storage operator). It also means that, unless carry-over is permitted, an entitlement holder may not reap the full benefits from conserving water.

Box 1 Capacity Sharing in the St.George Water Supply Scheme

In response to demands by users for more control over allocation decisions, the St George Water Supply Scheme is now operated as a capacity share scheme. Under the arrangements, the four scheme storages (as a whole) are conceptually partitioned into vertical shares. The shares distinguish between Individual Capacity Shares (ICS) and the Bulk Share (BS). Individual users who have chosen to hold individual capacity shares effectively manage these shares independently by issuing instructions to the storage operator. Other users continue to be supplied by SunWater out of the Bulk Share, according to traditional allocation processes based on the scheme operator's assessments of future demands and supply. A system of water accounting keeps track of the volume in each individual user's share, and the Bulk Share in accordance with defined rules for measuring inflows, releases, evaporation, seepage and transmission losses etc. There is also scope to shift between the two capacity share types within defined rules.

The introduction of capacity shares has had significant impact on behaviours, with individual users who are able to do so making much greater use of on-farm storages rather than keeping water in Beardmore Dam and incurring higher evaporation losses. This is almost a reversal of the approach under announced allocations managed by the operator, where water harvesting was used in preference to water in bulk storage. This reflects the incentives for managing the system to maximise overall yields under individual capacity shares. Against this, however, the system involves higher administrative costs in managing the water accounts (one full-time staff position) and compliance costs in reconciling water ordered and used. These costs could be expected to increase for more complex systems (the St.George system supplies around 120 users and there are no tributary inflows between storages).

Source: 'Capacity Sharing – A New Water Management System for the St.George Water Supply Scheme', Ian Ryan, Rob Keogh, Neranjala Fernando and Peter Boettcher (State Water Projects). Paper presented to ANCID 2000 Conference, Interim Resource Operations Licence for St George Water Supply Scheme, Issued to SunWater March 2002, Pers. Comm, Rob Keogh, SunWater.

While an entitlement holder may be able to sell excess water in the temporary market, it may be that the water would have more value (to the entitlement holder or someone else) being held in storage. However, a delivery entitlement

provides no incentive to do this, since any entitlement not used or sold is effectively lost.

In theory, a capacity share entitlement (that defines the access entitlement as a share of the available inflows, storage capacity, and off-take capacity) represents a more efficient form of entitlement, but may entail high costs and inefficiencies in coordinating storage management and release decisions.

However, in some situations, there may be merit in exploring the possibility of specifying entitlements in this form. Capacity shares, possibly combined with other derivatives or an explicit swap, offers a theoretically clean approach to dealing with trading in release timing as discussed above.

The approach adopted in the St.George Water Supply Scheme in the Condamine-Balonne Basin in south-west Queensland provides an interesting example of capacity sharing (see Box 1). As a fallback, establishment of water accounting with carry-overs and under-draws represents a step in this direction that may be easier to implement.

The same principle applies quite explicitly in the case of groundwater sources where supply is constrained by recharge rate. In effect, the move would parallel the shift from the use of input controls to catch quota as a device for managing a fishery – again engendering incentives to husband the resource by redressing an externality.

6.1.5 Drainage rights

The use of water under a water entitlement may have adverse impact on third parties or on the environment (eg adverse salinity or drainage impacts). Indeed, a prime rationale for the current trade approval processes is to prevent such external impacts. The issue then becomes one of ensuring that the regulatory intervention represents the most efficient way of addressing the concern, and that it does so without unanticipated side-effects. Since these adverse external impacts reflect the absence of clearly defined rights (eg not to pollute the environment), an alternative solution in some circumstances may be to establish a new product (ie drainage diversion rights) in the market.

Well-based and tradeable drainage rights may well have substantial advantages over attempts at direct externality pricing – provided that the basis for determining the aggregate block of rights is sound. At present, irrigators have implicit rights to return flows and are able to trade without consideration of the downstream impacts (eg salinity) – these impacts are meant to be addressed through the regulatory approval processes and rules. A system of tradeable pollution rights (eg salt credits) represents a market-based mechanism that may enable these external impacts to be addressed at lower economic cost. In

theory efficient outcomes requires spatially differentiated property rights that reflect site specific differences between external cost of water use at the source and receiving locations. In practice, a partially differentiated system (eg defining salt credits at irrigation area level rather than individual site level) may represent an effective second best solution[9]. A system of trading in salt credits is being considered for potential application in the Murray-Darling Basin.

6.2 Expanded transaction range

6.2.1 Leasing

Leasing is the transfer to another person of some or all of the water that may be taken under a water entitlement for a defined period (typically a number of years), but with the ownership of the entitlement remaining with the original holder. Leasing of entitlements is permitted in some States but not in others. It is difficult to see why legal restrictions on leasing should not be removed in those jurisdictions where they remain.

6.2.2 Secondary markets

To date, most of the development of water trading has been directed at primary trading – the permanent or temporary transfer entitlement from one user/use to another. This is understandable. However, the processes that have led to the institutional changes that have allowed such trades appear to have been predicated almost entirely on the notion of facilitating these forms of trade.

Some secondary market products have begun to emerge, and more advanced secondary markets have developed overseas. Secondary markets, especially a range of forward price-based options, have features that could, in principle be bring substantially increased flexibility to the market, and that could encourage significant shifts in the patterns of water usage. As has already been discussed, important synergies could be expected to lie between different forms of irrigated agriculture, with different vulnerabilities to drought, and with hydro-generation and other uses.

Options could offer alternative (with substantially lower up-front cost) or expanded mechanisms for individuals pursuing supply reliability and manageable price risk; reduce the need for regulators to manage different classes of supply reliability; and could insert into existing entitlement structures

[9] See Stephen Beare and Anna Heaney, Australian Bureau of Agricultural and Resource Economics, 'Externalities and water trading in the Murray Darling Basin, Australia', Paper for the Australian Conference of Economists, Adelaide, 30 September – 3 October 2002, ABARE Conference Paper 02.19.

some of the features of entitlement based on volumes in storage, with the associated incentives for resource husbanding across seasons. They could encourage a more coordinated strategy across irrigation regions, involving changes in enterprise mix and an expansion in designing farm systems for their value in backing flexible water trading over time as well as for the value of production.

As with the energy market effects discussed earlier, such a market would attach greater value to flexibility to substantially reduce demands for water in times of drought. In the case of irrigated agriculture, the opportunity for better matching pastures and annual crops against perennial crops, for example, suggests value opportunities that are likely to be only partially satisfied through different classes of water reliability. In a sense, such market instruments could eliminate the need for and value in multiple classes of water reliability – because these price capping products would allow users to blend entitlement and differently configured caps to meet their own risk profiles.

Secondary markets, in derivatives, options etc, face substantial hurdles in becoming a more important feature of the market. These markets will probably always be significantly 'thinner' than markets in financial or energy derivatives. In many cases, the entitlements have been designed in a way that effectively prevents the forward sale of a wide range of options – contracted willingness to deliver water at some time in the future under prescribed trigger conditions – despite the fact that, *prima facie*, such transactions could extract significant value from the resource.

We doubt that there is any lasting role for government in driving the development of secondary markets – though the likely thinness of early markets may suggest some form of 'start-up' role. However, we do strongly suspect there is a significant role for government in looking to minimise any artificial constraints on the development of these markets – flowing from the nature of the institutional arrangements. At present, these constraints are extremely limiting.

Were the role of environmental trader to emerge, then access to an effective market in options could be of very substantial interest to such traders. As new information emerged regarding dynamic requirements of the rivers for flows, and of the implications of variations in these flows, then options markets could provide powerful instruments for modifying effective flow regimes cost effectively – and for establishing a source of revenue for such activities.

As was discussed earlier, in some other sectors such as energy, secondary markets have become the dominant trading instrument – and the ability to sell or purchase options is shaping demand patterns in significant ways designed to increase overall market efficiency. This market has resulted in some interesting

multi-party price cap products that still seek to share some of the risks extreme demands (on hydro-generation capability) across contract participants.

We do not envisage a comparable level of derivatives trading in water, but do believe it has an important role to play – and that some important changes are needed in the institutional environment if this is to occur. These relate especially to the nature and duration of approvals for transfers, to the scope for active trading between hydro and downstream activities, and with urban demand; and possibly to a longer term move to greater use of water tagging as an alternative to the exchange rates now being implemented.

A range of secondary market products and transactions might reasonably be expected to emerge in time, in the absence of market constraints. Some are already present in Australia, while others have arisen in overseas markets, as discussed in Section 5.1 above. Some generic types of instrument with good prospects for application to water markets include:

- Futures contracts that allow forward sale/purchase of access to water at an agreed price;
- Call options that allow the forward sale to a buyer of the right to acquire access to water on a agreed basis, if the buyer wants to exercise the option at the time;
- Put options that provide the holder of water entitlement with the right to sell access on agreed terms, at a time in the future, should the water holder want to exercise the option at the time;
- Swaps contracts designed to allow trading in the release pattern of water in a manner paralleling financial market uses of swaps to exchange, for example, fixed interest repayment terms for variable interest ones;
- Swaptions, that involve sale of options in respect of the right to enter into a swap contract at some time in the future.

Box 2 Futures contracts

- Commitment to a trade at *agreed price* at a *nominated time* in the future, eg:
  - forward sell water 5 years out, to coincide with planned fallow rotation (being done in Colorado).
  - Forward purchase tranches of water, at a known price, over several years to coincide with expected patterns of demand as a farm development matures – allows the developer to lock in costs of a key input
- Buyers could source futures contracts from a range of sources to produce a *portfolio* with significant stability over time, or with a specified supply profile suited to needs.
  - Colorado utilities can compile a stable increment to town supply via a series of futures based around different phases of farm rotation patterns.
- In return for both price and volume security, a fee would typically be paid, up-front, to the seller of the water, allowing holders of water to bring forward some of the benefits of the water at a future time, at the cost of some loss of flexibility.
  - Depending on the price struck for the contract, payments could be structured to flow the other way, with the seller of the water paying to lock in a future price.

Box 3 Call options – conditional commitment to supply

- Holder of water entitlement sells to another party the right to acquire water at a nominated time, or under nominated conditions, if the buyer of the option wishes to proceed with the sale.
  - The seller of the option is committed to supplying the water if wanted by the buyer; but
  - The buyer of the option has the right not to exercise the option.
- The conditions could be linked to drought declarations, rainfall, commodity price indexes etc – or might simply nominate a price that would normally be unattractively high to the buyer of the option, but that might become attractive in the event of a drought, for example.
- Can be used to provide a price ceiling to buyers of the option, in return for up-front payment of an option fee.
- Can allow the sellers of the option access to option fee income and allow enterprise planning based on reduced access to water when the price is very high.

Box 4 **Put Option – conditional commitment to accept water**

- An enterprise might sell to the holder of water entitlement the right to require the enterprise to purchase access to a volume of water, at a nominated time, or under nominated conditions, if the buyer of the option wishes to proceed with the sale.
  - The seller of the option is committed to supplying the water if wanted by the buyer; but
  - The buyer of the option has the right not to exercise the option.
- The conditions could be linked to rainfall, commodity price indexes etc – or might simply reflect periodic or temporary surplus of water in the enterprise holding the entitlement.
- Can be used to secure a guaranteed market for water that is surplus to needs
- Can provide the sellers of the option access to option fee income and access to water on known terms around which to plan opportunistic usage:
  - Cash crops;
  - On-farm storage for later use;
  - Storage in dam for later hydro or other use.

Box 5 **Swaps and Swaptions**

- Swaps are normally financial derivatives used in relation to interest rate or currency risks.
- A common application of an interest rate swap is to allow 2 parties to convert the nature of the interest payments they face – for example, they might swap a fixed interest schedule for a variable interest schedule, without changing the underlying principal.
- If underlying water entitlement is viewed as principal, compulsory release requirements on dam operators as fixed interest payments and discretionary releases as variable interest payments, then there is an interesting analogy.
- Swaps-like contracts might be useful in negotiating time-shifting arrangements between multiple parties, including hydro/other uses.
- A swaption is simply the option to require another party to enter into a swap contract.
  - Swaptions could add to the flexibility of swaps instruments for use in time shifting and could be structured to provide additional hedge cover in respect of other options being sold.
  - The right to exercise a swaption could be held by parties upstream or downstream from the other contracting party – or conceivably in another catchment.

6.2.3 More trading across uses/sectors

Under existing arrangements, there are limitations on the ability of users to trade entitlements across certain uses, particularly when such a trade would

involve water moving from ,say, agriculture to another sector. While the majority of trades to date have been, and are likely to continue to involve, trades between irrigators, relaxing such restrictions may open up even more opportunities to generate value through an even wider range of divergence in the value of water entitlement between different users and/or users at different times.

Wider opportunities for trade across uses and sectors finding complementary trades that would favour the use of secondary market instruments. Overseas experience certainly points to the scope for futures and options being beneficially traded between irrigation and urban usage, while trades between hydro power and irrigation or urban usage could add greatly to the depth of these secondary markets.

6.2.4 Trading in groundwater

Comment was made earlier on the question of managing groundwater, possibly through entitlement based on water in-storage. Such an arrangement would need to be based on a system of groundwater source water accounting, inclusive of recharge monitoring or modelling and extractions. Options trades, as well as temporary and permanent transfers amongst extractors from a single groundwater source could facilitate efficient allocation of the resource, again accompanied by incentives to look to changes in demand patterns to deliver trading flexibility.

6.2.5 Inter-jurisdictional trading

Considerable attention has been focussed on the issue of interstate trading, with concerns in some quarters that this market has been slow to develop.

While there are a number of relevant underlying factors, one concern that has sometimes been expressed is that the large number of different types of entitlements that exist might itself be an impediment to trade. Alternative ways of dealing with this issue include: attempting to get uniformity in entitlement definition; use of exchange rates to enable trade between entitlements in different locations and/or of different inherent and policy-induced reliability, and "tagging" of water.

Achieving uniformity is infeasible: water comes from different sources with different reliability characteristics reflecting both physical and storage management variations. In any event, uniformity is not a pre-requisite for trade: all that is required is for the ability to convert one entitlement to another – or to retain the entitlement in its original form, with all the associated features.

The approach to date has involved the use of exchange rates where there is a need to reflect different reliabilities or system losses. However, with around 14 different types of entitlement in the Murray Darling Basin, there is an understandable concern that an exchange rate system will get very complicated. They will almost necessarily require on-going monitoring and fine tuning. Similar issues albeit on a lesser scale, arise in relation to trade of entitlements between Queensland and New South Wales in the Border Rivers Catchment.

An alternative and possibly less complex solution is to avoid the need for exchange rates by permitting entitlement holders in one State to hold water entitlements issued in another. In effect, a user could hold a portfolio of entitlements (eg relatively high security Victorian entitlements and lower security NSW entitlements) to suit their risk preferences and needs. This would require a system of "tagging" water so that at any point in time it could be determined whether a user was using, say, their Victorian or NSW entitlement. While there are some administrative and financial issues to resolve in establishing such a system, these would not seem to be *necessarily* more onerous than those in a system of exchange rates, though they are likely to be loaded more heavily towards the implementation end of tagging relative to exchange rates that will fall as an ongoing cost.

In principle, having the ability to accumulate water from different sources, with different characteristics, adds to the flexibility users have to sculpt a mix of entitlements, and their demand patterns, to deliver a cost effective outcome. In practice, tagging would involve added complexity at the user end – but complexity that might be avoided through the activities of intermediaries seeking access to the same range of sources, but using size economies to allow delivery of a mix of products with different features – and allowing spreading of the costs of managing the information.

Tagging links more naturally to the above discussion of groundwater sources, could conceivably evolve towards wider application of entitlements based on water in storage, and could certainly complement development of stronger water accounts and water bank concepts. In the case of MDBC, we understand that policy is proceeding with the use of exchange rates. A medium term move towards tagging, coupled possibly with some of these other elements, all of which could underpin sounder water trading, would make sense.

6.2.6 Active trading in environmental entitlements

The externality cost of affecting river flows as a result of extractive use is being addressed through the implementation of environmental flow regimes, typically in the form of prescribed river flow requirements. An alternative or

complement to such an arrangement could be the introduction of active trade in these flow entitlements, either absolutely or above some specified base regime. The could well permit a resource manager the flexibility to adapt the flow regime to changing information and hydrology conditions, to effectively transfer flows from one river system to another unlinked system – through complementary sale and purchase etc.

In doing so, such an agent would be explicitly positing a marginal value of environmental flows in a way that could add significantly to the quality of the information available to the market – and hence to encouraging more efficient trades amongst extractive users, as well as between extractive users and environmental demands.

Box 6 The Oregon Water Trust

The Oregon Water Trust (OWT) was founded in 1993 by a coalition of agricultural, environmental, legal and tribal interests. It is a not-for-profit organisation that purchases water on the market for in-stream flow purposes, primarily for fish habitat. Its mission is to acquire water rights "through gift, lease or purchase and commit these rights under Oregon law to in-stream flows in order to conserve fisheries and aquatic habitat and to enhance the recreational values and ecological health of watercourses".

The ability of OWT to become a participant in the market was only made possible by a change in the legislative definition of 'beneficial use' under Oregon's water code in 1987 to include leaving water in-stream. This change reflected concerns about the impacts on salmon and trout populations of insufficient in-stream flows. Previously only extractive uses such as irrigation, mining or domestic use were included within the definition. However, in-stream flow rights were defined to be held in trust by the Water Resources Department.

The OWT has negotiated over 50 temporary and permanent transfers since its inception and protected flow in over 450 river miles throughout Oregon. It has focussed attention on basins that have historically supported significant fisheries where low flows are affecting a significant aquatic resources, where there is a high likelihood of ecological benefit, and where it can measure, monitor and enforce its rights. Within each basin OWT identifies priority streams for which stream flow is a limiting factor for fish habitat and water quality and there is potential for acquiring water rights to convert to in-stream use to enhance flows.

Although on several occasions legislators have proposed prohibiting the transfer of agricultural water to any other use, these have been rejected. One change that has occurred, however, is that in-stream flow rights may now be held directly by private organisations.

The scope for an environmental trader to build the aggregate value of environmental flows through cross system and through time trades in actual river flows, reflecting differentials in the marginal value of flows in different parts of the system at different points in time – and variations in the

commercial value of the same water – could be considerable. Experience in the United States provides practical demonstration of the potential benefits of this approach.

In principle, such activity could be possible on a 'self funding basis' – with a requirement that sales match purchases. Alternatively, there would be scope for various forms of additional funding to be used over time to grow the total pool of environmental flows.

6.3 Facilitative Measures

A number of measures can be identified that would indirectly facilitate the development of new products/transactions in the water market.

6.3.1 Attribution of externality costs

There is nothing original in our stressing the value in improving pricing and/or other instruments to reduce the severity of any externalities by bringing users to account better for the impacts of their demands on the resource – in allowing more efficient trading. There are two dimensions to this:

- Unlimited freedom to trade can be quite counterproductive where there are major externalities – unpriced or underpriced impacts on other stakeholders, with inadequate facilities for the affected parties to resolve the problem by entering the market; and
- The presence of substantial pricing limitations has been used as an argument for slowing the creation of more flexible trading instruments – restriction on trade has been seen as an instrument for managing externalities;
  - and more generally has probably produced distorted signals as to where the important pressures for improved specification lie.

Externality pricing represents the textbook solution to the problem of externalities, but clearly feasibility and cost effectiveness have been major problems, and there have also been concerns with the equity consequences of its introduction into an existing set of allocations and approvals. Accurate externality pricing is not currently feasible in respect of many impacts.

There has been a lot of emphasis in post-COAG reform processes in moving to cost reflective pricing, but an issue that has received relatively little attention has been that of getting the *marginal cost* of water to the point where it reasonably reflects the costs the system saves as a result of a user reducing usage – the incremental (and avoidable) cost of marginal water usage. These are the costs that should underpin trading.

Note also that the distinction between marginal and average cost of water may offer scope for pursuing efficiency, through better marginal pricing, while still dealing with equity concerns through the average, fixed or cost of basic supply parameters – in respect of existing infrastructure, the pricing of these is less important to the efficiency objective.

An important issue here is the level of accuracy demanded of pricing before there is a willingness to place greater faith in the market – and less reliance on tight hands-on regulation. The earlier discussion regarding onus of proof is relevant here, while a second important point is the need for a set of incentives that generally start to push usage patterns towards the most valuable mix. Given that we appear to be starting a long way away from the optimal point, their may be scope for a fair level of error in measurement, while still posting a set of incentives consistent with moving in the right direction.

Pricing instruments are not the only instruments that can be brought to bear on externalities. Regulation can be used limit or prevent external impacts – but this commonly results in constraints on market development, and is again prone to serious information deficiencies that mean regulation may well prevent desirable trades – even trades that reduce external impacts. Careful balancing of regulatory and pricing instruments with an eye to cost effectiveness would seem appropriate.

The discussion in Section 6.1.2 and Appendix G of the risks of technically inefficient trading because of the bundling of delivery rights with entitlement is another example of externality costs of a sort, though in principle those affected can enter the market – with some equity consequences. The ability of someone to sell entitlement out of an irrigation area, and in doing so to transfer a set of capital cost responsibilities to others in the area who are not parties to the sale contract, lies at the heart of the issue. Well-designed unbundling of the delivery rights from the water entitlement might therefore also be seen as a useful instrument for management of one class of externalities[10].

6.3.2 Reform of approval processes and trading rules

The regulatory framework governing the operation of water markets has a major impact on the pace and form in which they develop, and has the potential to either frustrate or facilitate the emergence of new

[10] However, it is important not to overstate the severity of these issues – asset stranding is not in itself an indication of inefficiency, and customers are not normally held responsible for the costs of their suppliers. Much depends on what is assumed about the allocation of risk and responsibility for system costs, as is discussed in Appendix G.

products/transactions. Measures here that may indirectly facilitate the development of innovative value-adding transaction include:

- Ensuring that the administration of the current arrangements is efficient, and not subject to excessive delays in approval that may inhibit trading.
- A broader review of the current trading and site use approval systems examining the "onus of proof' issues.
- Developing alternative means of addressing the socio-economic/equity concerns underlying current restrictions on trading out at the local level.

6.4 Other measures

A range of other measures may serve to deepen the market and hence aid the development of innovative products /transactions by providing greater confidence and information to its participants. Many of these were identified in the HLSG report, and include the establishment of (voluntary) centralised exchanges with formalised trading protocols and posting of prices; efficient and effective systems of entitlement registration; clarity of trading rules etc.

7 An Indicative Action Agenda

As was set out earlier, the key purpose of this exercise was to examine constraints and market opportunities, and to assemble a smorgasbord of products and transactions that may be helpful in improving the efficiency of the emerging water markets. This has been done in the material above.

This section is concerned with the practical processes of decision and implementation. Its purpose is advisory only. Its main value probably lies in the scope it offers for the authors to set down the views that have developed as to feasibility, cost effectiveness and timing in respect of a reasonably coordinated set of initiatives. It focuses specifically on government initiatives, reflecting the view that the primary function of government in this area should be to provide the institutional settings that will allow the market to develop appropriate transactions.

However, we have also recognised that the markets we are dealing with are currently thin, and will probably remain so for some time; that government linked trading agencies are already in place, with some having indicated a keenness to work with some of the prospective new instruments; and that such activities could be helpful in kick-starting some of these market activities.

We also see potentially important roles for prospective environmental traders, and for energy market intermediaries, including hydro traders, on bring to the market both greater depth and substantial experience with some of the derivative instruments that have been discussed. Water business themselves probably have an important intermediary role to play, but it would seem important that they face competition from other sources – there is potential for conflict of interest to emerge that would sensibly be balanced by the presence of other suppliers of these services.

7.1 Overview of proposed agenda

The following table provides an overview of the initiatives that are proposed. Each item is then discussed in more detail below. Note that there are significant interactions involved. Progress with unbundling, and better attribution of externality costs, will add substantially to the value of several of the other initiatives.

Table 2: **Overview of indicative Action Agenda**

Initiative	Priority	Feasibility	Timing
Review and revise approval processes/trading rules to cater for flexible forward trading	High	High	Progressive, starting ASAP
Unbundling, particularly separation of delivery rights from entitlement (priority shifts to high if a prerequisite to flexible forward trading)	Medium-high	Low-medium (vary by system)	Progressive
Removal of other artificial restrictions – leasing, trade out of districts, trade across sectors etc	High	High	ASAP
Policy commitment to a principle of progressive attribution of marginal external costs to deliver progressive improvement in water market efficiency	High	High	ASAP
Progressive attribution of external costs – using several instruments (prices, net impact assessment, environmental trading; marginal price impacts possibly partially offset by fixed cost clawback)	Medium-High	Low-High	Early action on some, but staged over a few years, and on-going improvement; phase-back in some water resource management as pricing and environmental trading introduced
Facilitate intermediary entry by removing remaining ownership restrictions to landholders – removal of any constraints on the use of derivatives/leases to approximate, if full removal not acceptable	High	High Possible political constraints	ASAP
Interim tradeable instruments for time shifting, with trades between hydro and other uses permitted	Medium	High	ASAP Progressive and phased with capacity shares
Capacity shares and release rights – resource husbanding – hydro/extractive use trading – derivatives backing	Medium-high	High for some sources	Progressive – already started Conditionality likely for most groundwater Early prioritisation for cost effectiveness – simple systems or high value
Tagging of entitlements for interstate/region trade to enhance risk management options	Medium	High with some complexity	Progressive implementation or transition via exchange rates
Other measures to increase market confidence (eg central exchanges, price posting, titling/registration systems)	High	High	Continuing, but increase focus on future opportunities

7.2 Forward trading rules

Here we are recommending that the various jurisdictions cooperate in reviewing and modifying the nature of approvals process to allow substantially greater flexibility for forward trading over time periods of several years. Essentially, this would involve processes designed to eliminate unnecessary impediments to such trades and should, if possible, encompass:

- Removal of time limits for effecting permanent trades;

  - This is likely to be easier to do while retaining confidence in system management capability if accompanied by progress on separating delivery rights.
    - ⋯ This would allow forward approval of transfer of water entitlement and create a separate responsibility for the parties to a trade to ensure access to appropriate delivery capability.
- Reviewing the scope for approving conditional or low frequency trading over several years, even if there are good reasons for not approving a permanent transfer.

There are system management issues involved here, but we consider the potential benefits to be very substantial. Substantial progress can probably be made via established usage approval process, with some modifications to reflect these wider needs.

We rate the value, and priority, of such an initiative as very high; believe that it is likely to prove quite feasible to make substantial progress; and recommend a progressive review and implementation process, starting as soon as possible.

7.3 Extended unbundling

This initiative would be designed to progress the range of unbundling issues identified above, with particular emphasis on the unbundling of delivery rights from water entitlement where feasible. We consider it to be of medium priority in its own right, but should the lack of such separation prove a serious impediment to the forward trading initiative, then its priority would be high.

There are complexities, and there will be a need for clear allocation of responsibilities in respect of established costs. The initiative should not be a way of locking in an elevated value for a set of assets – tradeability of the rights would have significant use in establishing and maintaining a fair market value.

Feasibility is considered likely to vary by system, ad will depend on the character of the water businesses.

7.4 Reduction in other restrictions

This initiative would focus on restrictions on leasing, trade out of area, trade between sectors and restrictions on ownership/effective access to entitlement.

Technically, significant progress in these areas should be possible immediately and the value to market operations could be reasonably high. In some cases, there may be political constraints on what can be achieved. In respect of ownership rights, should there be problems here, a valuable fallback would be

to ensure leasing and options facilities are in place to allow the trading benefits to be gained, even if some forms of ownership transfer remain constrained.

7.5 Marginal externality costs – policy position

We recommend an early commitment to a policy of progressive attribution of marginal externality costs, as cost effective instruments can be developed. In line with the earlier discussion and the capitalisation that has already occurred, this may be more about restructuring costs to improve incentives – by making these costs 'avoidable' – than about raising the level of costs.

The purpose of this initiative is to ensure that these trends are themselves capitalised into future trading, reducing the need to unravel some trades in the future, and probably posting incentives for early trading in ways that will reduce externality costs.

The commitment need only be to a package of instruments designed to improve attribution. This could include active involvement by environmental traders, greater development of discharge rights, separation of delivery rights from basic entitlement and selective use of marginal externality pricing instruments. All of these initiatives should be seen as partial substitutes for existing regulatory measures that are likely to involve significant economic cost.

The priority and feasibility of this initiative are rated as high – and early commitment should be possible.

7.6 Marginal externality costs – implementation

Actual implementation of an attribution process will necessarily take longer and be progressive. However, the use of a range of instruments, coupled with existing jurisdictional processes for examining externality attribution methods in more detail should allow for early progress. Introduction of some of these instruments will in turn provide better information with which to refine estimates of costs and assessments of cost effective policy settings.

There will necessarily be some areas where information constraints remain severe. This will constrain the ability to deliver a 'good' solution with either market or regulatory instruments, but it will remain appropriate to consider whether an improvement is possible.

This initiative does include as a key component introduction of environmental trading. This would require some reassessment of the nature of environmental flows and the flexibility that might attach to them – possibly entailing a discretionary element in respect of individual system components, subject to aggregate requirements for the systems as a whole. Trading could be on a

'revenue neutral' basis – involving trades between systems to increase aggregate environmental value, but where sales would need to be sufficient to fund purchases. Clearly some budget discretion, or an emerging role for environmental trusts, could deliver greater flexibility.

Unbundling of delivery rights from entitlement may sensibly precede a strong move in this direction.

7.7 Intermediary facilitation – ownership restrictions

To enhance the ability of intermediaries to take market positions (including possible risk sharing) and to compose portfolio products, we recommend that remaining restrictions on non-landholders owning entitlement be removed. As with the earlier recommendation for easing of restrictions, we recognise that there are sensitivities in respect of such a policy, at least in some jurisdictions. Again, as a fall-back position, substantial relaxation of leasing and options capabilities would be needed. This does, however, still limit the ability for an intermediary to assume risk in relation to the equity value of entitlement.

Technically, there seem few impediments to implementation, and we see significant progress as a high priority.

7.8 Time shifting – interim instruments & facilitation

Allowing wider trading across uses is already being addressed, but we are proposing a specific initiative concerned with time-shifting requirements, why trade with a hydro-supplier is the prominent, but not only possible, example.

We would see this initiative as focusing on delivering instruments that could facilitate trades in the timing of releases, even before significant progress is made with formal capacity shares. Significant progress towards implementing the concept of capacity sharing has been made in the Snowy system, and with the opening of incentives for the electricity business to actively engage the market, there should be scope for innovative trading without a need for a major rewriting of the trading rules.

Existing experience with negotiated early releases, and valuation processes, provides the building blocks for instruments that could delay as well as advance releases – with the altered levels of discretionary water being available for both generation and downstream uses.

As was noted earlier, we see an important element here as creating incentives to explore 'smarter' system management, taking into account all storages and sources that might be influenced to lower the costs of providing greater flexibility.

Priority is seen as medium, but the potential gains could be considerable.

7.9 Capacity shares and release rights

Successful implementation of a capacity sharing system would simultaneously address a wide range of market issues. However, it is recognised that for many systems the approach would be complex and perhaps not cost effective – and could even border on the infeasible.

Priorities would lie naturally with water sources where forms of capacity share are already in place – which is true of many systems with hydro or major urban supply functions – and with groundwater sources. For groundwater, capacity will commonly not be measurable with great accuracy, and a level of conditionality is likely to attach to the shares.

Capacity shares need not be managed at the level of individual landowners – though notional allocation early may be sensible if it is likely that progress towards lower level management will be feasible in the future. We have set the priority as Medium-high, reflecting a judgment across the range of systems.

7.10 Tagging

We do see tagging as an alternative to exchange rates as offering valuable support for inter-jurisdictional trading and for the development of risk products of greatest value. As was set out earlier, we also recognise the complexity, but believe that this complexity can be reduced through the growing role of intermediaries and that its costs should be spread over a wider base – because the information requirements for tagging will also support a wider range of water resource management strategies, such as fuller water accounting and water banking. We do recognise the substantial legislative implications.

Our recommendation is for progressive movement in this direction, ideally on the basis of an early public commitment to this as a policy objective. The real value will emerge after the derivatives markets have matured somewhat.

7.11 Other facilitation measures

This initiative provides a home for a range of measures identified earlier that are likely to be of assistance in developing these markets. We see a continuing role for trading exchanges, at least as the kurnel for the emergence of a wider range of intermediaries. They can assist markets through price posting and help in the brokering of multi-party trades. There may well be constraints on the extent to which government-based exchanges can and should be allowed to

take risk positions, but this facility should emerge as private intermediaries enter a strengthening and increasingly sophisticated market.

We note that both the environmental traders, and electricity traders, offer the potential to add greatly to the strength of the market and to bring sophistication on respect of the types of risk markets envisaged.

Most of these activities will represent sensible extensions of existing measures, appear feasible and could be implemented early. We see them, in aggregate, as high priority.

APPENDICES

A Existing Entitlements/Products

A.1 Introduction

This Appendix documents the major features of the existing range of products and transactions occurring in Australia

For the purposes of this report, the term 'products' has been taken to mean the various types of entitlements to access to water.

In Australia, rights to control and use water are vested in the State. The way in which Governments then provide conditional entitlements to access water to users defines the primary 'product' that, can, in some circumstances, be traded.

There is a wide array of different types of entitlements to water currently applying in jurisdictions in Australia, not all of which are able to be traded.

Rather than attempting to provide a complete list and description of every one of the hundreds of individual types of entitlement that currently exist in all locations across Australia, the approach here is to provide a synthesis of the key entitlement/products, with a particular focus on those that are tradeable, or which may generate value creation opportunities were they to be tradeable.

In addition, the underlying nature of entitlements is something of a moving feast, as jurisdictions continue the process of progressively converting previous entitlements to water to a form that is tradeable by removing the direct link between water and land. Previously, the only way that water could be traded was by buying or selling land with a linked water entitlement.

A.2 Dimensions of entitlements

Against this background, the existing array of water entitlements can be usefully seen as having various (not mutually exclusive) dimensions or characteristics, including:

The use or purpose of the entitlement.

At the highest level, a distinction can be made between consumptive and non-consumptive uses of water. In most Australian jurisdictions, allocation of water for the environment has prior right to be satisfied before allocation to consumptive use, and is generally defined as environmental flow obligations

imposed on supply authorities. As such, environmental allocations are generally not tradeable with other uses[11].

Existing entitlements for consumptive purposes generally distinguish – explicitly or implicitly – between uses such as irrigation, stock and domestic, urban supply, mining and industrial use. In addition, specific entitlements apply for other non-consumptive uses (principally hydro-electric power generation).

The source of the water

Existing entitlements can be distinguished according to the source of water to which they relate. At a generic level this includes regulated rivers and supply systems (ie where the flow of the river is regulated by large structures such as dams or weirs), diversions from unregulated rivers and streams (ie where the flow of rivers or streams is not regulated by large structures such as dams or weirs), groundwater systems (subartesian and artesian), and overland flows. At a local level, entitlements relate to specific water sources.

The legal form of the entitlement

Entitlements to access water may be specified in a variety of legal forms including primary and subordinate legislation (eg 'as of right' entitlements such as riparian rights), licences, contracts or agreements, and – increasingly – tradeable instruments.

The ability to take water or interfere with waterways is generally governed by various forms of licenses that are issued, monitored and enforced by government agencies responsible for water resource management. Some activities are not licensed or monitored in some areas within jurisdictions that have not yet been) 'declared' or 'prescribed'. This typically involves activities or areas not seen to be raising major resource management concerns.

The level of devolution in the supply chain

Different types of entitlement apply at the bulk level (ie those held by urban and irrigation supply authorities), to those held at the level of individual users. In urban settings, the level of devolution is generally at the bulk supply level (ie urban supply authorities hold entitlements to bulk water, together with obligations to supply individual domestic and non-domestic customers who themselves have no separate entitlements). In rural settings, irrigation supply authorities also typically hold some form of entitlement to bulk water, but

[11] See Elizabeth Siebert, Doug Young and Mike Young, Policy and Economic Research Unit, CSIRO Land and Water, *Market-based Opportunities to Improve Environmental Flows: A Scoping Paper, Report to Environment Australia*, June 2000.

individual irrigators often have more clearly defined subsidiary entitlements – for example individual water rights and/or "shares" in the irrigation company entitlement, and, in some cases, contractual rights to delivery.

The nature of the entitlement

Water entitlements can also be distinguished on the basis of the underlying nature of the entitlement – what are the benefits (and obligations) provided by the entitlement.

What the entitlement entitles

Existing entitlements govern the ability of water users to:

- Take or receive water (the "access" entitlement)
- Use the water (use consent)
- Build, operate or have an interest in works to take and control the water (works consent)
- Return the water (drainage diversion permit)

Previously, entitlements to access water were tied to particular uses of that water on specific sites. In a number of jurisdictions, the access entitlements have now been separated from the site use and works consents.

The nature of rights to take or receive water themselves may have various dimensions or be specified in various ways.

Source (resource shares) versus delivery entitlements (volume and reliability)

- One distinction is between access entitlements specified as source entitlements and those specified as delivery entitlements.
- A source entitlement specifies a share of the resource at the harvesting source. For example, a source entitlement might define the access entitlement as a share of the available inflows, storage capacity, and off-take capacity. Generally, this type of entitlement is more common at the bulk level (eg entitlement held by a supply authority). On unregulated systems, however, individual users' entitlements may be specified in terms of extraction rates.
- In contrast, a delivery entitlement specifies an entitlement to receive water at the point of delivery. Water entitlements held by end users (eg irrigators) generally take this form. This will generally be defined in the form of a volumetric entitlement of water over a defined timeframe, with a specified reliability or probability of delivery. The actual volume of water available to entitlement holders in a season will depend on allocation decisions made by the supply authority given the water supply situation at the time.

- The level of reliability of a delivery entitlement reflects both the inherent uncertainty associated with the availability of water at the source (because of rainfall variability etc), and the storage management policies adopted by the storage operator. Thus, for example, water rights held by Victorian irrigators have a higher level of reliability or security than do those of their NSW counterparts, reflecting the more conservative storage management policies adopted in Victoria. Within jurisdictions, there are different entitlements with different levels of reliability (ie high versus low security entitlements). Specification of the level of reliability requires hydrological modelling of likely yields utilising long term rainfall data.
- A delivery entitlement generally provides entitlement to a maximum volume of water each season, but with no ability to carry forward any unused entitlement into future years. In contrast, a capacity share entitlement that provides a share of inflows and storage capacity in a dam enables users to maintain an account of water over time. In some cases, however, delivery entitlements have been adapted to have some ability to carry forward unused water through a set of water accounts reflecting 'under-draws' and 'over-draws'.

Delivery

- Implicit within a standard delivery entitlement is the entitlement to have the water delivered from its source to the point of delivery (and for which separate charges are payable to the supply authority). In some cases, more specific arrangements for delivery capacity have been developed (eg in Queensland explicit delivery contracts exist between SunWater and irrigators).
- Another important aspect of delivery is the timing of the delivery of water to the entitlement holder. Generally, this is not specified in the entitlement itself, but is governed by specific rules and arrangements (eg rosters) applying for the particular supply scheme.

Tenure and Security

- Another key aspect of entitlements is their tenure and security – in terms of the extent to which they may be subject to attenuation. While many irrigation entitlements are issued for periods in the order of ten to fifteen years, in some cases they are of unlimited tenure. While all entitlements in Australian jurisdictions are ultimately subject to attenuation by virtue of the right to water vesting in the Crown, there are defined processes for renewal or modification of entitlements. Formal periodic water planning processes now apply in several jurisdictions, and in some cases legislative provisions provide for compensation to entitlement holders for any attenuation of entitlements within the period of the plan.

Ownership and transferability

- Another key aspect of the nature of water entitlements relates to ownership and whether entitlement to water can be held separately from land. Some entitlements still attach to land in the sense that they must be owned by a landholder that could use that water on the land, whilst other entitlements in some jurisdictions have now been fully separated from land and are able to be owned by non-landholders.
- Finally, entitlements vary as to the extent to which they are tradeable or transferable to other parties. The tradeability of existing entitlements and current trading rules are discussed in more detail below.

A.3 Specific entitlement types

Although there is some variation between jurisdictions in their precise characteristics (in terms of the features outlined above), the main types of entitlements can be classified as:

Bulk allocations

- Bulk Water allocations/entitlements for Irrigation Districts/authorities
- Bulk Water allocations/entitlements for urban supply authorities

Regulated Water

- Irrigation district end user entitlements – general
- Irrigation district end user entitlements – low security/off allocation
- Diversion licences
- Stock and domestic licence

Unregulated streams

- Licence for direct diversions on unregulated systems
- Stock and domestic

Groundwater

- Groundwater licence
- Stock and domestic

Overland flows

- Right to overland flow
- Farm dams

A.4 A.3 Jurisdictional overview and comparison

The following discussion identifies and describes the main types of water entitlement currently applying or being introduced in each jurisdiction in Australia. This culminates in a summary of the key similarities and differences in entitlement regimes.

Queensland

The *Water Act 2000* established a new regime for water allocation and management in the State and provides for the progressive transition from previously defined entitlements to a new tradeable form of entitlement.

Water allocations are now defined and managed within broadly-based planning processes designed to ensure the long term sustainability of the resource. This involves the progressive development of Water Resource Plans (WRPs) for catchments across the State that define environmental flow and water allocation security objectives, followed by Resource Operations Plans (ROPs) that seek to give effect to these objectives through establishing detailed allocations and operating and trading rules. The conversion of previous forms of authorisation to new forms of entitlement is closely linked to this process.

At the bulk level, SunWater now holds Interim Resource Operations Licences (defining relevant infrastructure, operating and water sharing rules, and reporting requirements) and Interim Water Allocations (entitlements to water after allocations to customers and to cover distribution losses) – both of which will no longer be 'interim' after finalisation of ROPs. However, the entitlements of some local government suppliers are still in the form of Order-in-Council regulations.

Individual irrigation licences are to be converted to Water Allocations when the relevant ROP for the area is completed. Water Allocations will be of indefinite tenure, tradeable, volumetric, fully separated from land and from use permits, and liable for compensation if they are changed during the life of a plan. In the meantime, Interim Water Allocations have been issued, which are also volumetric and, in some schemes, are tradeable[12], but attach to land (except for those held by a supply authority). In some schemes, SunWater holds IWAs that have not yet been allocated, and which are able to be sold to new or existing customers. Significantly, for supplemented users, the relationship between the owner of the Water Allocation and the headworks or system operator is governed by contracts.

[12] Trade is permitted in certain schemes (Mareeba Dimbulah , Mary River, and Nogoa McKenzie) where a ROP has not yet been completed but there is confidence that trade will not adversely affect environmental values, and there is a perceived need and demand for trading.

A variety of licences currently exist in relation to unregulated (known in Queensland as 'unsupplemented') rivers and streams. Irrigation licences, which are currently mostly area-based, are to be converted under ROP processes to volumetric Water Allocations. Water harvesting licences that currently allow holders to harvest water based on flow conditions are also to be converted to volumetric limits. Licences are also required for stock and domestic use of water that is taken other than by riparian right. Again, for all unsupplemented users, works approvals are separated from entitlement to water.

Various types of groundwater licences (which attach to land and usually specify a volume for high users) are required in respect of sub-artesian and artesian sources that have been 'declared'.

Finally, entitlements to take overland flows will be required in declared areas.

Western Australia

The framework for water allocation and management in Western Australia Rights is provided in the *Water and Irrigation (RIWI) Act 1914*, as amended in 2001. The amendments formalised the key policy principle that environmental water provisions are determined first, with any allocations for development then made within the associated sustainable yield. Water allocation plans are developed with scientific, environmental and stakeholder input.

A number of licences are issued under the Act, which define the purpose, location and resource from which the water can be extracted. The two principal types of licences are Take Groundwater licences and Take Surface Water licences. These are held by both water service providers (ie supply authorities such as Water Corporation) and private users (eg irrigators, mining companies etc) in proclaimed areas. While generally specified in volumetric terms, these licences have various reliability levels reflecting their restriction during drought periods.

Subject to water availability and environmental constraints defined in trading rules, the entitlements associated with these licences may be traded, provided they are clearly defined in volumetric terms.

Water can generally be taken from watercourses in unproclaimed areas without a licence. Landholders can generally take water from wetland wholly on their land, and build a dam or tank on their land provided it is not on a watercourse.

Riparian right allocations, stock and domestic supplies, and environmental water provisions are linked to land and are non-tradeable.

Victoria

The legislative framework governing water allocation and entitlements in Victoria has been in place for somewhat longer than other jurisdictions, and has some important differences.

A hierarchical entitlement structure exists whereby Bulk Entitlements (usually source entitlements) are defined in precise quantitative form and issued to water authorities, which are obligated to supply the subsidiary delivery entitlements held by their customers, and environmental flows. A notable exception is the Melbourne system, where Melbourne Water still has rights to harvest water under its legislation. Authorities are able to trade 'spare' Bulk Entitlements, provided that they are able to fulfil their obligations to deliver subsidiary entitlements. Some Bulk Entitlements are also held by electricity companies for hydro-electric power generation.

Unlike other jurisdictions, Victoria does not have in-built periodic planning review processes to determine high-level allocations between consumptive and environmental uses. The conversion of previous water entitlements into Bulk Entitlements is generally a one-off process leading to perpetual entitlements, although entitlements are subject to modification by the Minister under certain circumstances.

End user entitlements in irrigation schemes are known as water rights and are of unlimited tenure, specified in volumetric terms, and have very high levels of reliability (around 96 to 99 per cent).

Private diversion licences entitle holders to take and use water direct from regulated streams. These are generally of around 15 years duration.

Both water rights and diversion licences are able to qualify for 'sales water' which is excess water within a Bulk Entitlement to that required to meet basic entitlements in the current and following year offered as a proportion of the basic entitlement. It therefore represents an additional low security entitlement to water right and diversion licence holders.

Water rights and diversion licences are tradeable (subject to approvals), but are still attached to land in the sense that only landholders who are potentially able to use water on their land may hold such entitlements. Restrictions have been imposed on trade of "sales" water allocations.

Irrigators also have non-tradeable 'as of rights' to take water for domestic and stock purposes.

Diversion licences are also required to take and use water directly from unregulated streams. These licences are usually of a one year duration but subject to an expectation of renewal.

Licences are also required to take water from groundwater sources. These are tradeable between users of a common aquifer.

New South Wales

The *Water Management Act 2000* established a new framework for the integrated and sustainable management in the State and a new water allocation regime that links licences to 10-year water management plans.

A key principle of the new Act is that water for the environment is to be provided as first priority. Water Sharing Plans for each water source are to define water required for fundamental environmental health, supplementary environmental water that may be used for other purposes under nominated circumstances, and adaptive environmental water that is granted under an access licence but committed for specified environmental health purposes.

Beyond this, the Plans also detail the major rules and parameters to govern the granting and management of access licences in the Plan area, and the allocation of water to these licences.

The Act provides for the progressive transition from previously defined entitlements to a new tradeable form of access entitlement. Water access entitlement are now fully separated from land. In addition, access entitlements for water are now also clearly separated from works and water use approvals. They will generally have 15-year terms. If changes are made during the term of a ten year plan that results in reduce water allocations, compensation may be payable.

At the bulk supply level, access licences will be held directly by supply authorities. All town water entitlements will be converted to a volumetric licence (previously some towns were exempt from licensing or licence were specified by the size of works ie the pump). Licences for towns and major utilities will be of 20 years duration, but are to be reviewed every five years and varied according to population changes.

Private Irrigation companies also hold access entitlements directly so that the licensing relationship with the Department of Land and Water Conservation is with the irrigation company. Individual irrigators hold share rights in the irrigations company's entitlement after allowance for losses, and have contracts for supply of specified volumes. In some cases, carry-overs between years is permitted via water accounting.

These access entitlements comprise both:

- 'high security' entitlements, where full volumetric allocations can be expected to be available in all but extreme droughts; and

- 'general security' entitlements, of much lower reliability and subject to seasonal allocations depending on the water supply situation at the time.

The level of reliability of general security entitlements is variable between systems and have been quite low in most systems during drought periods. As noted earlier, the NSW general security entitlements are of a significantly lower reliability than those of Victoria in areas of potential trade such as the Murray Darling Basin. The Act provides that if water allocations have to be reduced, local water utility, major utility and domestic and stock entitlements have higher priority than regulated high security entitlements, which in turn have priority over general security and supplementary entitlements.

While individual irrigators can generally trade within irrigation districts, trade in or out to trade of the district is governed by the rules of the irrigation company (discussed further shortly).

Private diverters on regulated streams hold their own access entitlements, which again are specified in volumetric terms and again may be either 'high or 'general' security. These entitlements are tradeable, subject to approval.

Access licences are also required for taking water on unregulated streams. Irrigation licences are specified in volumetric terms, while others are being converted to this form.

Access licences are also required to take groundwater via high yielding bores. Entitlements are specified in volumetric terms, and are tradeable between entitlement holders within a common aquifer.

Landholders have a riparian right for stock and domestic use to be taken from rivers and lakes, which is to be maintained and extended to groundwater sources. They also continue to have a harvestable right to capture 10% of run-off on their land without the need for an access licence. These basic landholder rights however remain tied to the land and are not tradeable.

South Australia

In South Australia, water entitlements, licensing and permits are governed by the *Water Resources Act 1997*. This provides for the development of Catchment Water Management Plans by Catchment Boards across the State.

Within this framework, water allocation plans are prepared for each prescribed water resource, incorporating the principle that water for the environment has priority over consumptive use. Licences are required for the taking of water from a prescribed watercourse, lake or well, or taking surface water from a surface water prescribed area.

At the bulk level, volumetric water licences are held by supply authorities (eg SA Water and Irrigation Trusts). These can be traded, subject to agreement of the members of the Trust.

Individual end user irrigation water entitlements may be specified as either a 'Taking Allocation' approved for use on a specific land title or a 'Holding Allocation' not attached to a particular land title, but not yet approved for use. Licences are issued in perpetuity, but are subject to conditions of access determined by Water Allocation Plans that may be altered periodically. These licences are tradeable subject to assessments.

These licences represent high security entitlements, with full allocation being available virtually every year, provided South Australia receives its full entitlement under the Murray-Darling Basin Agreement. There are therefore no 'seasonal allocations' as in other States. Licence volumes may however be reduced by the Minister in extreme drought (this may occur in the forthcoming season) or to comply with the MDBC Cap. Stock and domestic rights are also specified in volumetric terms and are also fully tradeable.

Tasmania

The *Water Management Act 1999* provides for the management and allocation of water resources. Access to water is controlled through a new licensing and allocation system in the context of a formal planning process for the sustainable development of the resource.

A water licence is required before water can be taken from a water resource, except for riparian rights, water for firefighting, and other specific uses.

Licences issued under the new Act specify an allocation in volumetric terms and is not attached to land. A water licence is normally issued for 10 years, with provisions for review of conditions after 5 years. Water licences and/the allocations within them may be traded either permanently or temporarily to another person who holds a licence, subject to an approval process. These new licences are gradually replacing the previous Commissional Water Rights issued to irrigators and other commercial water users, but tied to particular parcels of land.

During times of high flows in a watercourse, a temporary water allocation may be issued for up to three months allowing a user to take more water than permitted by a licence.

Separate permits are required for dams on land and for discharge of wastewater.

Special licences apply for the purpose of hydro-electric power generation.

Australian Capital Territory

Access to water is controlled under the *Water Resources Act 1998*. The Act requires that a Water Resource Management plan be developed for each catchment that identifies how much water is required for the environment and how much is available for consumptive use.

Licences are required to take and use surface water. This applies both to ACTEW (the water supply authority) and to commercial and irrigation users (other than as ACTEW customers). Before a licence can be issued, a person must hold an allocation of a volume of water that can be used under the licence.

Licences are also required to take and use groundwater (except for groundwater under land subject to a lease existing prior to December 1998).

Water used for stock or domestic purposes does not require a licence.

Permits are required for the construction of bores and water control structures such as farm dams and weirs.

Northern Territory

The Northern Territory *Water Act 1992* covers investigation, use, control, protection, management and administration of water resources throughout the Northern Territory including those on Aboriginal and Commonwealth Lands.

The Act also covers general provisions, water resource investigation, use of surface water, use of groundwater, and water quality protection.

Landholders have the right to take groundwater and surface water on their land for domestic purposes, watering stock and for a domestic garden no larger than a half-hectare. Water extraction licences can be granted to take groundwater and surface water for uses other than stock and domestic purposes. These licences are normally issued for between two and ten years and are renewable. When the land changes ownership any licence issued is automatically transferred with the title.

Water extraction licences are tradeable within Water Control Districts provided that a Water Allocation Plan to manage water extractions to sustainable levels has been declared.

A permit is required for any interference with a waterway or obstruction of flow. This includes damming creeks or pumping from springs, creeks or rivers. Construction of a rural dam of less than three metres in height and less than five square kilometres catchment does not require a permit.

Water bore drilling must be undertaken by a driller licensed under the Act. A permit is required for any bore constructed in a Water Control District. Bores pumping more than 15 litres water per second anywhere in the Northern Territory require an extraction licence.

Waste discharge into, or pollution of, waterways is prohibited unless specifically authorised. The Controller may grant waste discharge licences allowing controlled discharge of wastes into waterways. These licences are normally only for two years but may be renewed.

A.5 A.4 Summary

Examination of the existing range of water entitlements in Australia reveals some important similarities and differences.

All jurisdictions are progressively converting previous administrative licences to more clearly specified tradeable entitlements.

In doing so, allocation of entitlements is now being undertaken within broader planning frameworks involving scientific input and community consultation (instead of incrementally issuing licences with little regard to the capability of the catchment to cope) designed to ensure more sustainable management of the resource. In most States, provision of water for the environment is now given priority over allocation of water for consumptive uses through these processes.

These planning frameworks affect the security of existing entitlements in a number of ways. Those entitlements that emerge from these processes should be more secure in the sense that they are less likely to be arbitrarily attenuated simply from increasing utilisation of water by others (eg uptake of sleeper licences that undermine the reliability of existing users), or by government actions to respond to unacceptable environmental impacts arising from unsustainable use of the resource. Indeed, in New South Wales and Queensland, compensation is now payable if entitlements are reduced during the course of a plan. On the other hand, the knowledge that entitlements are subject to formal reviews every ten years may affect the perceived security of these entitlements, particularly as the end of the current plan period approaches.

The current system of entitlements across Australia is therefore somewhat of a moving feast as jurisdictions progressively convert from 'old' forms of licensed entitlements to 'new' more clearly defined, secure and tradeable entitlements. In doing so, priority has sensibly been given to those catchments where competition for the resource is most acute and where systems are seen to be under stress.

The key elements of this conversion, across all jurisdictions, has been the specification of entitlements with clearly defined volumes and reliability, separation of entitlements from land, and "unbundling" of various components of entitlements such as the associated works and use approvals and delivery capacity. There are, however, some differences that extend beyond terminology:

- separation from land: while basic water access entitlements are no longer tied to particular parcels of land, there are still restrictions in several jurisdictions that prevent water being held by persons other than those with ability to use it on land.
- In South Australia only, the link to land has been removed to a greater extent in that even basic landholder rights such as riparian rights for stock and domestic use, are separable and tradeable.
- In Queensland and New South Wales, the access entitlement to water has been separated from the approvals for works.
- There are differences in the reliability of basic irrigation entitlements, with the 'general security' entitlements held by NSW irrigators of much lower reliability than those of other States, reflecting different water management approaches.
- There are considerable differences in the tenure of entitlements, from short term entitlements to use off-quota water, through to indefinite licences.
- There are some differences in the precise nature of entitlements held by irrigators in irrigation schemes, depending on the nature of the contractual relationship between individual irrigators and the irrigation authorities.
- In regulated systems, entitlements held by end users are generally delivery entitlements providing access to a certain amount of water each season, but with no ability to carry forward any unutilised water into the next period (except in some NSW irrigation schemes where water accounting has been introduced).

B Existing Transactions

This appendix outlines the range of transactions that can be and are currently being undertaken with respect to these entitlements.

In identifying and describing the existing range of transactions in the water market, a broad interpretation has been taken to include a wide range of types of transactions with various possible dimensions. These include:

- The product being traded: for example, the product may be a physical quantity of water this season, an ongoing entitlement to access water, or a derivative product. A transaction may entail the simple transfer of an entitlement from one party to another, or it may involve the conversion of one product into another (eg from a high security product to a low security product or vice-versa through applying 'exchange rates').
- The spatial nature of a trade: for example, a trade may be within a system, to another system, or inter-state.
- The identity of the transactors and use of the water: for example, between individual irrigators, between supply authorities, or between supply authorities and individuals. Others who may be involved in water transactions include other primary or commercial producers, town water supply authorities, hydro-electric generators, or governments (eg in purchasing water for environmental purposes). Thus, in principle at least, water may transfer between one agricultural use and another, or between agricultural, urban, industrial or environmental uses.
- The nature of the transaction: for example a simple physical sale/purchase, a lease, a derivative transaction, or a subdivision or amalgamation of an entitlement.
- The temporal dimension of a transaction: for example whether it relates to an immediate transfer of water or to transfers over a longer time frame.
- The method of execution: for example transactions may be bilateral, facilitated by brokers, or undertaken through centralised exchanges.

B.1 B.1 Existing water trading policy frameworks

The existing range of transactions in the water market are governed by the policy, legislative, and institutional frameworks at the national, state, and local levels.

COAG Policy framework

At the national level, the 1994 National Competition Policy Agreement included obligations on jurisdictions to promote trading in entitlements so that water maximises its contribution to national income, subject to the physical,

social and environmental constraints of catchments. Compliance with these obligations is overseen by the National Competition Council. Various reports and guidelines have been developed to facilitate the adoption of best practice in water trading across jurisdictions[13].

States' water trading policies

- Primary responsibility for water trading, however, rests with State and Territory Governments. The broad policy frameworks for water trading in Australian jurisdictions have many common elements. These include provisions about:
- Types of transactions that are permitted
- Products/entitlements that can be traded
- Approval processes and trading rules that apply to these transactions

Permitted transactions

State legislation defines formal transactions that are permitted (subject to approvals by Government agencies responsible for water resources management):

- Temporary transfers/seasonal water assignments

A temporary transfer or seasonal water assignment is the transfer to another person of some or all of the water that may be taken under a water entitlement in a given year (usually for the remainder of the season). The ownership of the entitlement to access water in future season remains with the original entitlement holder. Because this transaction involves only the transfer of water for a short time period, the approvals processes required are generally relatively straightforward.

- Permanent trades

A permanent trade or transfer involves the transfer of all or part of a water access entitlement (encompassing entitlements to all future water allocations) to another party. Permanent transfers are generally subject to stringent approval processes to ensure no adverse impacts on third parties or on the environment.

A distinction can be made between permanent trades that essentially involve transfer of title of a water access entitlement, and those that involve a change in the underlying entitlement (eg a change in the location from which the water may be taken or purpose of use). In Queensland, for example, such transfers

[13] See, for example, ARMCANZ *National Framework Guidelines for the Implementation of Property Rights in Water*, October 1995; and High Level Steering Group on Water, *A National Approach to Water Trading*, November 2001.

of ownership of the former type (eg a sale to someone else in the same zone) can be completed through the Registrar of Water Allocations without the need for approval from the Department of Natural Resources and Mines.

- Leasing

Leasing is the transfer to another person of some or all of the water that may be taken under a water entitlement for a defined period (typically a number of years), but with the ownership of the entitlement remaining with the original holder. Leasing is currently permitted under legislation in some States (eg South Australia, NSW, Tasmania), but not in others (eg Victoria). The approval processes for leases are akin to those required for permanent trades.

- Change to a water entitlement

In some cases entitlement holders may wish to change the specification of the entitlement, either with or without also effecting a transfer in its ownership. For example, entitlement holders may seek to subdivide or amalgamate entitlements. Again, these are generally permitted subject to approval processes if there is a change in the underlying entitlement that may impact on third parties or the environment.

- Other transactions

While the focus of the transactions described above is typically on end-user to end-user trades, it is important to note that States' policies and legislation also countenance or allow these and other transactions involving a range of other parties. These include:

  - Trades of bulk water entitlements between water supply authorities (eg in Victoria trading of Bulk Entitlements between urban authorities and between urban and rural water authorities is permitted, subject to Ministerial approval, and has occurred).
  - Trades between authorities and individuals: for example in Queensland supply authorities are able to sell unallocated water to users, while in Victoria both urban and rural water authorities can and have bought entitlements from irrigators).
  - Although there are no standardised products to facilitate a formal market, and outright sale of entitlements may be prohibited, some types of transactions between hydro power generators and other users are possible – if not facilitated – under current arrangements. For example, in Victoria irrigators have paid to obtain earlier access to water from Snowy Hydro[14].
  - While environmental water allocations have generally been established as priority allocations to be provided outside of the market, trade in

[14] See Department of Natural Resources and Environment, *The Value of Water: A Guide to Water Trading in Victoria*, December 2001, p.84.

environmental entitlements is possible (and has occurred) under some circumstances.

It should also be noted that there is anecdotal evidence of informal trades occurring that fall outside the official rules. For example, it is likely that some private secondary/derivatives transactions already occur, for example options whereby the parties agree to a transfer of water entitlement in the future under certain defined conditions (eg if the price of water entitlements in the market reaches a pre-defined level). These contracts must necessarily be either conditional on approval of the transfer at the time, or involve the seller of the option in taking on a risk of default. In either case, their potential as risk management instruments is constrained.

A number of other types of transactions are specifically not permitted under State legislation or subordinate instruments. In particular, trading between uses is often not permitted.

In some States, 'speculation' in water entitlements is not condoned. For example, the Western Australian Policy specifically states that:

> the use of TWEs as speculative investment alone will be discouraged, "as this my lead to water not being used productively…Sleeper licensed entitlements that have not been used are non-tradeable and will be re-allocated..[15]

It is arguable that such a position does not fully take into account the potential non-use value of water and the role that might be played by a position that keeps water out of extractive use until its value rises high enough. It might also complicate some risk management uses of water.

Products that can be traded

Under states' legislation, only water entitlements that are clearly defined in terms of volume may be traded. Some products are permitted to be traded on a temporary but not a permanent basis.

There is a close connection between the specification of water access entitlements under water management planning processes and the permissibility of trading. This is because Governments have greater surety that trading of clearly specified entitlements, if undertaken within the rules established by such plans (see below) will not have adverse third party or environmental impacts. Thus, individual end user entitlements that have been defined in clear volumetric terms in areas where a planning process to share the resource in a sustainable way has been undertaken will generally be fully tradeable, whereas other entitlements may not. For example, in Queensland

[15] WA Water and Rivers Commission, *Statewide Policy No. 6, Transferable (Tradeable) Water Entitlements for Western Australia.* P.5

Water Allocations are fully tradeable, while Interim Water Allocations and existing licences are generally not.

Basic landholder rights (eg riparian rights for stock and domestic use) cannot generally be traded separately from the land to which they attach.

Environmental water cannot usually traded – although there have been some cases where environmental entitlements have been issued in tradeable form, and where trade has occurred. For example, governments have on occasion entered the market to purchase entitlements from consumptive users to then utilise for the environment. As noted earlier, some types of environmental allocations in New South Wales are tradeable.

State approvals processes and trading rules

A notable feature of existing water markets is that agreement between private parties is not sufficient to finalise a transaction – governmental approval is also required.

The implicit rationale for these approvals and potential to disallow trades is the desire to protect the interests of third parties or the environment (known in economics as 'externalities'). Existing approval processes are aimed at one or more of the following:

- that the trade does not lead to adverse environmental impacts, (for example unacceptable changes to river flows, or if use of the entitlement at its new location may have adverse salinity or drainage impacts);
- that the trade does not diminish the entitlements of other users (eg in terms of ability to deliver their entitlement or through impacting water quality);
- that the trade is hydrologically possible, and whether any exchange rate should apply to reflect differences in reliability of the entitlement;
- that there is sufficient delivery capacity to deliver the water to the new entitlement holder and if so, whether any exchange rate should be applied to take account of losses;
- that the trade does not result in adverse social or equity impacts on specific regions (eg by trades out of a region leaving remaining users having to pay more for 'stranded' assets because of the associated loss of revenue).

The resultant rules may specify, for example:

- trade may only be downstream;
- trade may be allowed downstream past a channel capacity constraint only if there has been trade the other way first;
- trade into or between certain zones (eg salinity impact zones) may not be permitted;

- specific exchange rates that apply for trade between zones, reflecting losses in rivers or channels, or different reliability entitlements.

The exact processes and institutional arrangements for approvals of trades varies across jurisdictions.

Where regional water management plans exist, any trades that are not consistent with the environmental and water security objectives and associated rules under these plans are not permitted. Certain types of trades that fall within pre-defined parameters can be approved automatically; otherwise a case-by-case assessment is required. A cautious approach to approving trading in entitlements to groundwater entitlements has generally been adopted, reflecting the relatively poor state of scientific knowledge on these systems. As discussed further below, the time taken to approve trades on a case-by-case basis has sometimes been cited as a significant impediment to water trading.

An important difference across jurisdictions is the extent of "unbundling" of the different types of approvals and who is responsible for each. For example, in Victoria the rules are determined and applied by the rural water authorities on behalf of government. In other States, approvals for site use and construction of works, and arrangements for access to delivery capacity, have been separated from the water access entitlement, and approvals processes for each undertaken separately. For example, in Queensland the Department of Natural Resources and Mines undertakes assessments relating to environmental and resource security impacts, whilst issues associated with supply delivery capacity are a matter for the relevant supplier (eg SunWater). In order for a trade of an entitlement to supplemented supply to be registered, a buyer must provide evidence of a supply contract with the water supply scheme operator.

Interstate trading

Special arrangements have been developed in relation to interstate trade, particularly within the Murray Darling Basin.

Temporary trades between Victoria, New South Wales, and South Australia have been permitted, and have been taking place, since the mid 1990s. A pilot trial interstate water trading project for permanent trades commenced in 1998 in the Mallee region. It was decided to limit the pilot project to permanent trade of high security entitlements held by private diverters in order to avoid the complexity of converting different security products. The pilot project was later extended to include certain irrigation districts.

Exchange rates apply to trades between the zones in the existing pilot trading project. Permanent trades have been restricted to one high security product in each State. A 1:1 exchange rate applies to all trades except those from those

from South Australia to New South Wales or Victoria, reflecting the reduced security of supply upstream of the Darling River and Lake Victoria.

Trades must satisfy the approval processes in each relevant jurisdiction.

Local level trading rules

As noted above, various trading rules apply to trade within or between specific areas to take into account relevant resource availability and environmental constraints in that region.

In addition, however, some restrictions on trade have been imposed because of socio-economic/equity concerns, primarily relating to the economic and financial impacts of trade out of certain regions.

Rules set at the local level may have a major effect on what trades are permitted and what are not. For example, in a number of NSW and South Australian irrigation schemes, trading rules and policies set by irrigation companies, and subject to approval of their members, limit or prohibit permanent trades out of the district. In Victoria, a rule allows a water authority to refuse a trade if it would mean that trade out of a defined irrigation area would exceed 2% of the water rights in that area (although this rule has had little effect in practice).

C Economic Analysis of Water Entitlements

A fundamental feature of any market is the underlying framework of 'property rights' or entitlements. The establishment of the framework for defining and enforcing property rights is generally seen as a role for government. The term 'property right', as used in this context, does not imply ownership of the associated water, land etc – the term applies much more widely to rights in respect of these resources, with the terminology reflecting its origins in land law.

Economic theory suggests that efficient markets, in an ideal world, require property rights (entitlements) that are:

- Clearly specified: so that owners and potential entitlement holders understand exactly what benefits and obligations the entitlement brings.
- Secure: the entitlement is not subject to modification or extinguishment at the discretion of others.
  - This is not the same as saying that access to water should be secure – it applies to the security of the access rights, not the access.
  - Nor does it preclude rights of limited duration, provided that the duration is clear, along with the principles that would apply to review of any application for renewal.
  - Nor does it preclude attenuation under well-understood principles, whether policy, regulatory or common law, that are reasonably recognised and taking into account in the context of any trading of the entitlements.
- Exclusive: the direct benefits and the costs associated with the use of the entitlement accrue solely to the holder.
  - This precludes significant externality costs – or 'unpriced spillovers'.
- Enforceable and enforced: it must be possible to determine when an entitlement has been infringed and to have legally binding ways of preventing this or providing redress.
- Transferable and divisible: the entitlement can be traded in whole or in part to others.

This provides a theoretical benchmark for assessing whether water access entitlements currently in place or being developed possess, as far as possible, the necessary features to ensure that market transactions will allocate water to its most valuable use. An important qualification to this is that where costs or benefits from use of the entitlement extend beyond the holder of the entitlement, there may be a case for regulatory intervention to avoid sub-

optimal market outcomes. In the case of water, one major 'externality' of concern is the impact of water use on the environment.

A major thrust of the 1994 COAG water reform package was to convert previous administratively-based water entitlements to entitlements with many of the characteristics described above as a precondition for trading in entitlements, by:

> …establishing a comprehensive system of water allocation and entitlements backed by the separation of water property rights from land title and clear specification of entitlements in terms of ownership, volume, reliability and , if appropriate, quality (clause 4(a)).

Considerable progress has been made towards this goal. By and large, the newer forms of entitlements that jurisdictions are progressively establishing possess most of the ideal features outlined above, or reasonably close approximations. An area of continued weakness is that of externality costs, where regulatory measures are used – but where this tends to have the effect of undermining security.

Clear specification

Those entitlements that have undergone a conversion process (often in the course of developing resource management plans) are much more clearly specified in terms of volumes/reliability. While priority has sensibly been given to converting entitlement in areas where there is greater competition for water, in principle all entitlements (even including stock and domestic entitlements) should be more clearly specified in this way and made tradeable.

Security

- There continues to be an active debate on the appropriate balance between providing security for entitlement holders and providing for adaptive management of the resource in light of emerging scientific knowledge. However, the fact that new entitlements have been established with explicit consideration of sustainable resource management with defined and predictable processes for review (and in some cases compensation if reduced during the life of a plan) could reasonably be said to make them more secure than previous entitlements which were always subject to potential attenuation by government.
- In any case, it is quite feasible to define a secure entitlement, that is readily tradeable while still subject to modification or attenuation via regulatory processes – as long as the rules and processes by which such changes will occur are understood.
- For example, risk of attenuation as a result of scientific advance leading to regulatory change within a sound policy assessment process is not

fundamentally different from the security of a mining company's exploration rights. In the latter case, test drilling or assay work – advances in the available scientific knowledge – may well have the effect of dramatically reducing the value of these rights. This uncertainty, that is inherent in the nature of the resource and our knowledge, need not impede an efficient market trading in those rights – where one of the incentives for trade may well be to shift the risks to a firm better placed to bear those risks.

- Taking this logic a step further, it may be quite efficient to allow trade in entitlements where there is substantial uncertainty regarding the long term characteristics of the underlying quantum of resources to which the entitlements afford access – provided that the rules are understood, and capitalised into the value of the entitlement. These rules may well embody monitoring and review processes, adjustments to the balance between environmental and other uses based on cost effectiveness principles etc. They may include specification of circumstances in which compensation would be payable – but the theory does not require that compensation be payable.

Exclusivity

Current water access entitlements provide for many, but not all, of the benefits and costs from ownership and use of the entitlement to accrue to the entitlement holder (although the interdependencies associated with the storage, delivery and use of water may mean that it is impossible or too costly to ever do so). There are a number of dimensions to this:

- Most end-user entitlements are specified as delivery entitlements that entitle the holder to defined volumes of water at a specified off-take point over a certain timeframe. This makes them dependent on the actions of others (ie storage management decisions made by the storage operator). It also means that, unless carry-over is permitted, an entitlement holder may not reap the full benefits from conserving water. While an entitlement holder may be able to sell excess water in the temporary market, it may be that the water would have more value (to the entitlement holder or someone else) being held in storage. However, a delivery entitlement provides no incentive to do this, since any entitlement not used or sold is effectively lost. In theory, a capacity share entitlement represents a more efficient form of entitlement[16], but may entail high costs and inefficiencies in coordinating storage management and release decisions. However, in

[16] See, for example, Paterson,J., 'Rationalised Law and Well-Defined Water Rights for Improved Water Resource Management', in Renewable Natural Resources: Economic Incentives for Improved Management, OECD, 1989.

some situations, there may be merit in exploring the possibility of specifying entitlements in this form[17].

- A second important issue here is that the use of water under a water entitlement may have adverse impact on third parties or on the environment (eg adverse salinity or drainage impacts). Indeed, a prime rationale for the current trade approval processes is to prevent such external impacts. As discussed further below, the issue then becomes one of ensuring that the regulatory intervention represents the most efficient way of addressing the concern, and that it does so without unanticipated side-effects. Since these adverse external impacts reflect the absence of clearly defined rights (eg not to pollute the environment), an alternative solution in some circumstances may be to establish a new product (eg drainage diversion rights) in the market..

Enforcement

The newer forms of water access entitlement are generally enforceable and enforced. In Victoria, for example, people have been successfully prosecuted for stealing water. In some areas (eg parts of Queensland), installation of meters is a prerequisite for establishing enforceable entitlements over water.

Transferability

There has clearly been significant progress in all jurisdictions towards introducing water access entitlements that are readily transferable.

Nevertheless, there are still many constraints on trading water entitlements, such as restrictions on trading between uses and prohibitions on permanent trades out of certain irrigation districts. Such constraints clearly inhibit potentially valuable trading opportunities. Again, the issue becomes one of whether the objectives of these constrains can be achieved in ways that do not forego the benefits of trade.

One concern that has sometimes been expressed is that the large number of different types of entitlements that exist might itself be an impediment to trade. Alternative ways of dealing with this issue include: attempting to get uniformity in entitlement definition; use of exchange rates to enable trade between entitlements in different locations and/or of different reliability, and "tagging" of water.

[17] In Victoria, Bulk Entitlements held by water authorities are often specified in this form. A system of individual user capacity share entitlements has been introduced in the St George Supply Scheme in Queensland.

Divisibility

Water access entitlements – at least those that have been specified in volumetric terms – are generally able to be amalgamated or subdivided.

Another, arguably more important aspect of divisibility relates to the recognition that water access entitlements themselves comprise various bundles of (conditional) rights to access water[18] such as:

- The right to take or receive water
- The right to a defined quality of water
- The right to have the water delivered
- The right to use the water
- The right to build, operate or have an interest in works to take and control the water
- The right to return the water

Each of these components may have value, and that value may vary between users and uses. For example, hydro-electric generators and irrigators may place different value on the timing of releases from dams at different times. Similarly, various derivative products are likely to be of value to water users as a risk management tool. This implies that there may be merit in "unbundling" the various constituent elements so that they can be traded separately.

As discussed previously, while all jurisdictions have made the critical step of largely unbundling water access entitlements from land, the extent of further unbundling varies.

How far it is sensible to go will depend on a number of factors, including the costs in defining and trading in these "unbundled" elements. However, it would seem that there are several areas where there are particular pressures or need for further unbundling. For example, delivery capacity constraints in some areas are emerging as a big issue. A water entitlement may be of little value if the holder cannot ensure delivery of the water. Tomato growers in Victoria have reportedly resorted to buying up entitlement in excess of their needs, simply to ensure that they have access to guaranteed delivery capacity. This in itself is evidence of unsatisfied demand for a particular type of entitlement.

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[18] For further discussion, see M.D. Young CSIRO Land and Water, Policy and Economic Research Unit, *Robust Separation: A search for a generic framework to simplify registration and trading of interests in natural resources*, September 2002.

D A value-based framework for planning

This appendix has been written to lay out the elements of what we believe constitutes a reasonable framework within which to address the complex questions of balance between regulatory and market-emphasis in allocating water. It is predicated on the assumption that we will continue with a 'mixed economy', in which trading is only allowed with specified constraints, but where it may make sense to relax/modify some constraints, to invest in an assessment of the costs and benefits of some constraints and/or actively encourage the emergence of some forms of trading not yet present or common.

The style of this appendix is deliberately somewhat provocative – it challenges some principles that have been well established, but does so specifically from the perspective of their effectiveness in meeting their stated objectives, or the costs they may impose on the overall level of value obtained from the resource.

Importantly, we do not see this framework as an economist vs environmentalist showdown. We see it as a framework for addressing complex decisions involving multiple, and sometimes conflicting, values and substantial uncertainty. When we seek to increase value, it is value expressed across the range of dimensions of importance to the community – economic (narrowly defined), social and environmental. It incorporates cost attributable to risk; just as many in society are prepared to insure their house for a premium that exceeds the expected claim, we may attach a premium to risk reduction. It also incorporates value associated with 'upside' opportunities.

This framework is not a required deliverable from this study, but some such framework is needed if any deliberations over changes to water markets to improve their efficiency are to be considered. The strong emphasis we have placed on the potential role of options and other derivative instruments in the new markets, and the emphasis on giving the delivery of better risk management services a central position in the policy processes, strongly favour an approach to efficiency that explicitly recognises option value.

A key notion presented here is that the real value of our natural water resources lies in the *options* they afford society – support for the production of food and fibre, to underpin out lifestyles, to support the ecosystems within which we live, and to support the amenity and existence values we associate with these systems. Building and operating dams can open up new and valuable options, while simultaneously extinguishing others – such as the ecosystem and amenity values linked to a natural water system. So too can

allowing or restricting water transactions designed to better match water to water demand – or altering the pricing of water for the same purposes.

Value drivers

Our water systems deliver value in a range of ways – some of which can conflict:

- Extractive water usage in 'normal' conditions
  - Demands for water as a normal service flow, for domestic, commercial, industrial, non-drought agricultural and recreational application.
    - ⋯ Essentially these involve reasonably predictable demands for water, accompanied by reasonably predictable time of day, day of week and time of year profiles.
  - The value can be derived through:
    - ⋯ Financial benefits to the final direct user of the water as an input to the production of other goods and services – eg, by using the water to grow crops with a market value – and to the purchaser of these goods and services;
    - ⋯ Direct enjoyment of the 'end use' in swimming pools, clean drinking water etc; and
    - ⋯ Lower cost to governments etc in providing water-dependent public goods, such as parks and gardens.
  - These values could be viewed as lying in *normal input demand*.
- Abnormal shortage of water
  - Demands for water to top up low soil moisture, stock water supply etc etc, such as during a drought.
    - ⋯ These demands are not highly predictable as to timing, but tend to be highly correlated regionally.
    - ⋯ The commercial value in this water demand can lie both with securing a crop/production, and in protecting the capital base – permanent crops, breeding stock, business viability etc.
  - Strategies aimed at securing water availability for shortage periods, through conservative dam management, can have implications for environmental flow outcomes – through, for example, increased likelihood of dam spills.
  - Here, the value lies predominantly in *risk management services*.
- Non-extractive variations in timing of flows
  - The most prominent example being hydro-electricity generators who can create value by varying the timing with which water passes through its generators;

⋯ The value of this flexibility, in allowing rapid ramp-up in generation at times when the rest of the system is stressed can be very large – with the price of electricity being capable of varying by a factor of 200 or more in the space of a few minutes, and with much shorter time interval demands for occasional service delivery to smooth the quality of power supply.

⋯ This value can be realised through a combination of reactive sales of services at these elevated prices and through forward sale of hedge instruments, with the risks covered by this generation capability – in both cases these mechanisms can serve to limit the volatility of power prices and to shore up system reliability.

– Increasingly there is also recognition of the scope for altering the value of environmental flows through timing changes.

– These shifts can be quite short-term – to track daily peaks and troughs in power demand or to respond to a generation system failure for example; inter-seasonal to better track winter/summer peaks in electricity demand or normal seasonal flow variation in river systems; or between years to allow smoothing of the resource between wet and dry years.

- Environmental demands for water
  - With increased recognition of the requirements of the environment, and increased community demands to protect these values, there has been demand to direct water, in forms such as in-stream flow requirements, to service these values.
  - These demands can conflict with some extractive use, especially upstream use – equally shifts in the usage of water towards downstream locations can prove complementary with other sources of environmental flows.
  - The profile of these demands can vary from flat across wet and dry years, through to demands that are highly sculpted to help recreate flow patterns that would have occurred naturally – including low (even zero) as well as high flows.
  - A more immediate value in river flows can lie in their ability to flush river systems to help manage problems such as algal growth or to dilute a severe contamination problem.
    - ⋯ Here, the value lies primarily in risk management in respect of threats to natural capital and public health.
- Environmental impacts of usage
  - More generally, extractive use of water can result in environmental damage beyond the direct impact of the extractions – for example by contributing to rising water tables (with possible salinity or waterlogging impacts etc) or by bringing pollutants with return water flows.

    - ⋯ Again, the values lie primarily in risk management in respect of threats to natural capital and public health.

- Social structures
  - Access to water has conditioned human social structures in Australia since man first arrived here. With European settlement, such access was a critical determinant of location and patterns of activity from the start.
  - More recently, investments in irrigation infrastructure have been undertaken with the specific objective of 'developing' areas of Australia and have resulted in complex social as well as economic regions based around, but not restricted to, irrigation-based agriculture.
  - In similar ways, expansion of water supplies to areas such as the Western Goldfields in WA has been a key input into the development of such regions around mining and minerals processing – with resultant sizeable and growing communities.
  - These values, linked into the value in maintaining stable established communities, and to perceptions of the value embedded in the 'sunk costs' in these regions, have tended to work against the pressures and incentives for trading of water into new areas.
- Risk attitudes
  - In the main, people prefer to limit their exposure to risk, even at the expense of lowering expected wealth – they will pay a premium to bring risk levels closer to their 'comfort zone'.
  - This willingness to pay for risk mitigation reflects real societal values, and market transactions that deliver such services, whether through the sale of insurance policies or through bilateral or multilateral water trades, will generally deliver greater economic efficiency – in the sense of increasing the value society attaches to the outcomes.
  - To the extent that market instruments can share risks more acceptably, it may actually result in increased output in the form of measured net value of production – by allowing individuals to use market-based risk instruments instead of more costly enterprise management instruments to limit risk.

Trade-off considerations

Increased efficiency in water markets involves, in some sense or other, a better balancing of these demands in ways that deliver a greater net value. This might be achieved through coordination of complementary demands (eg, timing releases from dams for downstream use in a way that balances generation value and downstream use value), or through the transfer of water from a low value to a high value use – and thus growing the cake. It might involve husbanding the resource to underpin higher reliability in entitlements, but with the

likelihood that this will reduce the volume of water actually used in extractive applications. It might involve 'discovering' smarter ways of meeting end user demands, for example for risk management, that allow these needs to be met at lower cost.

In almost cases, there will be some trade-off involved, though a feature of markets (in which externalities are small or controlled) is that they are constantly probing for strategies to develop a package of trades that make all participants better off. Sacrifice on one dimension of value does not necessarily disadvantage any participant, after the payments and the changes in other value dimensions are factored in.

Of course, where there is a trading opportunity that will not disadvantage any stakeholder exists, then the main challenge is to ensure that nothing stands in the way of the opportunity being realised. This includes regulatory constraints to it happening, but perhaps even more importantly regulatory constraints to the opportunity being discovered.

In practice, a requirement that a policy ensure that no one is made worse off, especially when starting from a position of serious concerns about inappropriate and unsustainable use of a resource, would be far too restrictive. In respect of some water resources hard decisions have been made, and will continue to be made. A *net benefit test* does not require that there be no losers.

Externalities – equity and efficiency considerations

This is not the place for a treatise on externalities. We recommend in the report that priority attention be paid to addressing the marginal cost of externality through pricing and other cost attribution instruments. Nonetheless, it is appropriate to recognise that markets have the capability to address some classes of externality problem – and that the more market flexibility is enhanced, especially through risk instruments such as options, the more capable the market is likely to be in this respect.

This is not an argument for using markets alone in addressing these problems. In respect of continuing environmental damage, caused by a subset of uses of a resource, the equity and efficiency consequences of relying on market mechanisms are likely to be less than ideal.

However, there is an important range of externalities that fall mainly to other extractive users of water. Appendix G considers a special case where an entitlement holder sells water out of an irrigation region – and is able to transfer costs associated with the regions system capital to other entitlement holders who were not party to the sale. This could be viewed as an externality.

Similar considerations apply to altered upstream usage patterns that impact on downstream reliability or quality.

In an unrestricted market setting, other entitlement holders would not be prevented from being participants in the negotiations, and would be entitled to enter the market and prevent trades that would be detrimental to their interest. In theory, they would be competitive in preventing trades that would reduce whole of system efficiency (assessed in terms of costs and benefits to extractive users). If a trade occurs anyway, it may make some water users worse off, but it need not entail a loss of efficiency.

As long as water rights are traded with the knowledge that other users could modify their behaviour in ways that reduce the value of the entitlement, these risks could, in principle, be capitalised into the value of entitlement. Anyone buying a small business must factor in the risk of increased competition, volatile markets etc – ie, the behaviour of others, including competitors. The same is true if water markets.

However, in the context of a transition in the nature of the institutional arrangements, in which new trading opportunities are emerging as a result of regulatory change, it is likely that some of these impacts would be seen as inequitable. Similarly, short-term financial constraints, uncertainty about future policy change or general system inertia (including poorly developed skills for operating in the new environment) may induce some inefficient outcomes during the market transition. These considerations favour explicitly addressing the major externalities in the context of designing new market instruments.

Option values

A key principle in this framework is that of *option value*. Degradation of the natural resource base involves the extinguishment of options for the community – options to later use the resources lost, to protect against risks of wider system collapse, to leave to subsequent generations these options or variants on them. Conversely, the consumption of a resource in generating an income stream delivers its own set of options to the community through the investment opportunities that follow.

In the development of a mineral resource, depletion of the resource is fundamentally a part of the costs of extracting value. With a renewable resource like water, this need not be the case. In both cases, threats to long-term sustainability might be addressed through investments in R&D and technology development that can underpin increasingly effective use of the diminishing physical resource or a progressive shift of demand into less

constrained resources – in a Brundtland sense[19], the value of the option set might be sustained through the creation of new options.

A key principle in option theory – that the greater the uncertainty, then the stronger the case for deferring a decision to extinguish an option or to make an irreversible commitment to costs – has clear application in guiding these trade-offs and to providing a basis for addressing the appropriate level of precaution in dealing with these trade-off questions.

In this framework, the loss of risk management capability, including the risk from resource depletion, is afforded explicit value in addressing resource/income trade-offs and becomes integral to the determination of efficiency. In this setting, the choice is not between efficiency and resource protection – but rather the choice of a mix of trading rights and regulation that delivers the greatest option value to the community.

The natural response to emerge from the application of this options approach, that is firmly rooted in sound economic and policy principles, is justification for an adaptive management regime that keeps alive options, even at the expense of short-term economic benefits based on 'expected values' of usage alternatives, and that undertakes simultaneous investment in reducing the uncertainties on which the option values are based.

In brief this framework allows a sound matching between mainstream economic and policy principles and the adaptive management regime that has sensibly emerged within natural resource agencies. The underlying concept of efficiency remains one of maximising net benefit but in form of the *value of the set of available options, inclusive of the uncertainties*. Without some such framework, there are substantial difficulties in addressing the types of trade-off questions that are central to the determination of more efficient water trading – and even in defining an efficient trading instrument in a manner that is not inclined to prove counterproductive.

Of course, adoption of such a framework does not magically reveal the right decisions – but it does offer:

- a coherent set of concepts that need to be brought to bear on the decision;
- a central role for risk management, especially in respect of risks with scope for seriously undermining future community options;

[19] The 1987 report from the World Commission on Environment and Development, *Our Common Future* (widely known as the Brundtland Report) defined sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." Essentially it involved handing on a set of options in respect of natural and man-made capital at least as valuable those inherited by the present generation – and required due attention to risk management.

  - but extending also to the value individuals attach to containment of risk, even at the expense of some reduction in expected returns.
- deliver a sound paradigm within which the options to defer or abandon specific resource development initiatives, and the rules that would trigger such decisions, emerge naturally, coupled with a discipline on those proposing such deferment to address the opportunity costs of doing so;
- Provide a framework in which land or water quality degradation, especially largely irreversible degradation (such as land salinisation) can be addressed in the same terms – as option extinguishment;
- Provide a basis on which the precautionary principle might be approached on a more firmly empirical basis[20] that again is less divisive between economic and environmental perspectives.

This study is not about providing a general framework for natural resource management. The above has been provided because attempting to work through the complex trade-offs involved here within a traditional cost/benefit framework, without access to the insights that come from an options-based approach was likely to be less helpful, given the special characteristics of the issues being addressed here.

The case for looking to relax regulatory constraints is all about creating new options and incentives to discover options – to find more valuable resource usage patterns, including less damaging ones, to better absorb the costs of necessary adjustment etc. Equally, the case for tight constraint has been predicated on a demand to protect existing options. A sensible balance almost certainly requires management of a process over time, investment in reducing uncertainties and, probably, care in ensuring that restrictions do not unnecessarily keep water in uses where there is continued extinguishment of options.

[20] See, for example, Morel and Farrow (2000), *The Precautionary Principle and Real Options Analysis: Whose Right to Continue and Whose Irreversible Risk?* Paper to the 2000 Annual Meeting of the Society for Risk Analysis.

E Observations from Overseas Water Markets

In identifying potential new products and transactions to enhance the efficiency of water markets in Australia, it was considered useful to examine relevant development in water markets in jurisdictions outside Australia.

While a comprehensive review and/or critique of the development of water markets in other countries is beyond the scope of this brief, and allowance needs to be made for the particular social, legal, institutional and cultural characteristics of different jurisdictions, there are nevertheless some pertinent observations to be made from examining water markets in other countries.

The application of market mechanisms for the allocation of water has been most prevalent in countries or regions where water is, or is becoming, scarce. The following discussion highlights aspects of the experience in the western United States and in South and Central America where formal water markets have developed. Less formal markets have also arisen in parts of Asia.

E.1 Western United States

Reflecting its aridity, water law in the Western United States is based on the 'appropriation doctrine' whereby water users are issued with permits or licences to divert, store and use defined quantities of water, for specified beneficial uses. This is in contrast to the 'riparian doctrine' applying in the eastern states whereby users have rights to access water only on land adjacent to the river.

More specifically, water rights in the western United States have been issued by a state water court under a 'prior appropriation' system that assigns an order of seniority to rights based on date of issue (known as "first in time, first in right"). In times of shortage, senior rights receive their allocation of water before 'junior' rights. This differs from Australia where entitlements are issued by a government agency predominantly under a 'proportional appropriation' system whereby all entitlements of a defined class share equally in any shortages or surpluses, regardless of their date of issue. The "first in time, first in right" approach addresses the problems that arise with the issue of new water rights effectively attenuating the rights of others. It does not, however, address the problem of effective attenuation as 'sleeper' rights become active – sleeper rights generally retain their seniority.

Unlike riparian rights, the rights established in the western United States represent an independent property right that can be traded under certain

circumstances (in some Sates, water is still intrinsically linked to land). The key issue is that there is no 'injury' to others. Thus, a trade or change in beneficial use can be challenged in court by others on the basis that it damages their rights (sometimes a lengthy process). While the 'prior appropriation' system provides for a clearly-defined property right to underpin market transactions, the way in which water markets have developed varies considerably between States.

Colorado

Colorado is generally seen as a jurisdiction that has successfully implemented water trading.

The "water market" is very active in Colorado. Water decreed for agriculture use is often marketed for use by municipalities, private drinking water suppliers, recreation interests, and also designated for environmental purposes and left in the natural stream. The aforementioned transfers may occur on a temporary or permanent basis, and are only examples of a host of options available to creative water users. The State Engineer approves/denies approximately 200 of these plans each year[21].

There is also a variety of mechanisms to achieve the water transfer. They range from a permanent change as part of a formal court proceeding; substitute water supply plans that operate on a one-year basis (they may be renewed for 5 years); transfer within a water bank that limits the amount/time of transfer based upon demands of individual buyers/sellers; to water exchanges between reservoirs, ditches, and canals that occur on a daily basis for all recognised beneficial uses of water (approximately 80-100 different exchanges occur on a daily basis during the summer months).

A pilot water banking scheme has been established in the Arkansas River Basin to facilitate leasing of water for interim purposes (ie without permanent transfer).

A particularly notable example of water trading is that which emerged in the Northern Colorado Conservancy District following the construction of the Colorado-Big Thomson (C-BT) Project to provide storage reservoirs for reliable irrigation supply. The District, which evolved from water users' associations, assumed an obligation to repay the cost of the water supply component of the project (there was also a hydro-electric power generation component), in return for the perpetual right to use all of the water from the project. The District was also responsible for the allotment and distribution of the water to users, which was based on assessed needs of users given past use

[21] Personal communication, Ken Knox, Colorado State Engineer

and their ability to make beneficial use of additional water. The initial allocations (defined as a proportion share in the water declared available each year, but with the ability to carry over water between seasons) were free, but holders were required to guarantee the repayment obligation via a lien on their property.

Soon after the scheme commenced, it was realised that water demand was growing and the District decided to allow water allotments to be leased or sold within the District. After an initial period when farmers failed to fully appreciated the value of their water allotments, activity in the market grew with prices escalating significantly and then the price dropping with the advent of several new supply schemes (Windy Gap and City of Thornton schemes). While a comprehensive analysis is not appropriate here[22], some salient points to observe from the operation of the market include:

- The transaction mechanism for temporary trades is very simplified, effectively operating as a banking account;
- Permanent trades require some approvals from the District (mainly related to verifying 'beneficial use').
- Water users retain rights to return flows, (ie downstream users may receive the benefits of return flows but have no legal rights to them) so trading has occurred without concern for third party impacts;
- The District operates a Dispatch Center to process orders, while a private broking industry has developed;
- There are restrictions on holding allotments, in that buyers must demonstrate beneficial need and ability to use the water.
- Trade of C-BT water can only be within the District;
- Trade of water from non C-BT sources has also been permitted, on what is effectively a tagged basis, resulting in trades at different prices reflecting different underlying reliability.
- Permanent trading has resulted in gradual transfer of water from agricultural to urban and industrial use.
- Seasonal trading has tended to be in the opposite direction, except during periods of scarcity. Municipalities have tended to build up permanent water rights to prepare for droughts and future demand, and lease annual surplus water back to farmers in reasonably wet years.

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[22] More detailed discussion may be found in Marino, M. and Kemper, K., 'Institutional Frameworks in Successful Water Markets: Brazil, Spain and Colorado, USA', *World Bank Technical Paper No. 427*, February 1999; and Joe Mentor Jr, 'Trading Water, Trading Places: Water Marketing in Chile and the Western United States', Globalization and Water Resources Management: The Changing Value of Water, AWRA/IWLRI-University of Dundee International Specialty Conference, August 6-8, 2001; Simpson,L. and Ringskog.K., *Water Markets in the Americas*, The World Bank, Washington, D.C., December 1997.

- More recently, options contracts have developed between the cities and agricultural users whereby the farmer is paid for an options contact where he agrees in advance to temporarily relinquish water on an annual basis during dry seasons.
- Another derivative contract, that is more of a futures contract than an option, involves the municipalities in paying farmers an annual fee in return for access to their water in a fallow year, with agreed (typically 5 yearly) periodicity
  - A spread of contracts across different properties, with different phasing of fallow periods, offers farmers a secure secondary income stream aligned with their production needs while providing the municipalities with secure access to water with reasonably stable aggregate supply reliability.
- Outside of trades within this scheme, however, trades between uses and/or locations is subject to the legal processes associated with public hearings if others object which can represent a significant impediment to trade.

Colorado also has an active government agency-run program for acquiring in-stream flows in the market.

California

Water markets have developed more slowly in California. Indeed, until 1980 the law effectively precluded such transactions since technically a person seeking to sell their rights no longer had a beneficial use for the water, and therefore was required to relinquish it.

The water law in California is quite complex. Although the doctrine of prior appropriation also applies in California, riparian rights also apply in the Colorado River in the north of the State. Moreover, there is a distinction between pre- and post- 1914 appropriative rights, and separate types of rights in relation to groundwater. There are also several other types of rights including federal reserved rights and Pueblo rights. Individual water rights may take the form of contractual rights to be supplied by a supplier (eg a water district) which itself holds a water right.

Traditionally in California there has been a greater tendency to rely on administrative interventions to allocate water. Arguably, there the scope for using market mechanisms to re-allocate water has been under-utilised, despite what has often been described as the "water crisis" in California. Projections by the Department of Water Resources continually highlight major shortages in light of burgeoning urban demand in the south of the State.

During the 1990s, however, attempts were made to amend the water law to allow a greater role for water trading. Thus, the Water Code states that

"voluntary water transfers between water users can result in a more efficient use of water, benefiting both the buyer and seller". The DWR now has an obligation to establish an ongoing program to facilitate the voluntary exchange or transfer of water, including the development of a water transfer guide and the coordination of activities among state agencies.

However, the marker remains heavily regulated. In addition to the legal provision associated with the prior appropriation doctrine that protects the interests of other legal users of water through the "no injury" rule, California has imposed several other restrictions on water trading, particularly in relation to permanent trades. For example, the Water Code requires that transfers of post-1914 rights not result in "unreasonable" effects on fish or wildlife or other in-stream beneficial uses. Similarly, the Water Code prevents the use of a state or local water conveyances system to effect a trade if the transfer would unreasonably affect the overall economy or the environment of the county from which the water is being transferred.

A number of commentators have cited the approvals process as a major impediment to development of efficient water markets in California. A report from the Water Efficiency Working Group of the Western Governors' Association suggested that many potential transfers are "probably thwarted simply because the procedures for making the transfers and the Bureau's willingness to approve them are not clear". A report by the Legislative Analyst's Office in 1999 found that there was inconsistent and unclear treatment of transfers: for example depending on the particular circumstances it was possible that either no agency, a single agency, or multiple public agencies may be required to review certain third party impacts of a proposed transfer[23].

Recently the issue of water transfers has been examined by a working Group reporting to the California Sate Water Resources Control Board[24]. The report recommended that:

- streamlined approvals should apply to pre-defined types of transfers including intra-basin transfers, transfers similar to those that have previously been approved and implemented without adverse impacts, instream flow transfers, and transfers within the Central Valley Project (CVP) and State Water Project (SWP) areas.
- Certain water transfers that have inherently minimal potential to injure other water users, adversely affect third-party interests, or result in

[23] Legislative Analyst's Office, 'The Role of Water Transfers in Meeting California's Water Needs', September 8, 1999.

[24] 'Water Transfer Issues in California: Final Report to the Californian State Water Resources Control Board by the Water Transfer Workgroup, June 2002.

significant environmental impact should be allowed to proceed based on minimal studies and analyses; and

- Inter-basin transfers should also be facilitated using a pre-approval approach where possible, although it considered that because of the increased complexity of issues involved, both state and federal agencies would need to take an active role in the approval studies required.

Nevertheless, a number of water markets exist in the State.

In 1992, following four years of drought, the California Department of Water Resources instituted a State Water Bank to purchase and re-sell water to willing participants at a specified price. In that year it transacted in some 821 000 acre-feet of water. The concept of a water bank is still officially in place.

This was not a true market in that there was only one buyer of water, the Department of Water Resources, at a price set by it. It involved only temporary transfers. Although the Water Bank did result in significant re-allocation of water, only around half of the water assembled in the Bank was sold, because the drought broke in the following year.

One of the most advanced regional markets is in the Westlands Water District, which in 1996 established an electronic water marketing systems called WaterLink. While there is a sophisticated and active market within the District, trades outside the District are not permitted without the approval of the District.

Several major transfers have occurred between agricultural and urban systems as demand for urban water supply grows. In particular, water has been transferred from northern California to southern California. One of the first transfers occurred in 1989 when the Metropolitan Water District (MWD) which provides water to over 16 million people in Southern California secured 106 000 acre-feet of water over 35 years in return for funding conservation improvements in the Imperial Irrigation District (IID). The MWD subsequently entered into agreements with various other water agencies. Another agreement to which it was party was the sale of water by the IID to the San Diego County Water Authority entailing a payment to the MWD for the transport of the water through its system en route. More recently, it has been reported that the Palo Verde Irrigation District is proposing to sell water to the MWD for 35 years for around $337 million.

Another issue that is emerging in transfers relates to the availability of sufficient conveyance facility capacity such as aqueducts. Under existing law, the "wheeling statute" provides that a state or local agency may not deny a party the use of a conveyance facility that has unused capacity to transfer water if "fair compensation" is paid for that use. To date, however, this term has not been clearly defined.

Other States

The extent of water trading in other Western U.S.A. states varies considerably. One development of interest relates to trading in environmental flows.

The Oregon Water Trust (OWT) was founded in 1993 by a coalition of agricultural, environmental, legal and tribal interests. It is a not-for-profit organisation that purchases water on the market for in-stream flow purposes, primarily for fish habitat. Its mission is to acquire water rights "through gift, lease or purchase and commit these rights under Oregon law to in-stream flows in order to conserve fisheries and aquatic habitat and to enhance the recreational values and ecological health of watercourses".

The ability of OWT to become a participant in the market was only made possible by a change in the legislative definition of 'beneficial use' under Oregon's water code in 1987 to include leaving water in-stream. This change reflected concerns about the impacts on salmon and trout populations of insufficient in-stream flows. Previously only extractive uses such as irrigation, mining or domestic use were included within the definition. However, in-stream flow rights were defined to be held in trust by the Water Resources Department.

The OWT has negotiated over 50 temporary and permanent transfers since its inception and protected flow in over 450 river miles throughout Oregon. It has focussed attention on basins that have historically supported significant fisheries where low flows are affecting a significant aquatic resources, where there is a high likelihood of ecological benefit, and where it can measure, monitor and enforce its rights. Within each basin OWT identifies priority streams for which stream flow is a limiting factor for fish habitat and water quality and there is potential for acquiring water rights to convert to in-stream use to enhance flows.

Although on several occasions legislators have proposed prohibiting the transfer of agricultural water to any other use, these have been rejected. One change that has occurred, however, is that in-stream flow rights may now be held directly by private organisations.

Following on from the OWT's perceived success, similar trusts have now been established in other western States including Washington, Nevada and Montana.

Interstate transfers

Another aspect of water markets that has become an increasingly important issue is that of transfers of water between States.

The headwater of many rivers that subsequently flow into others States is in Colorado. Apportionment of river flows between States was historically determined by adjudication of the courts. Subsequently, the States negotiated compacts for the apportionment of flows of the South Platter River, the Rio Grande and the Colorado River. These compacts have also been subject to various litigation actions and court adjudications. In particular, California has tended to use far more of its share of the Colorado River than is provided for under the relevant compact.

A major issue here is whether transfers of water rights between States either by the states or by individuals would void the provision of the compacts.

Nevertheless, there is clearly significant scope for interstate trade between those States with excess water to those where demand exceeds supply. In Arizona, for example, a large water banking system is in operation that uses water from the State's allocation of the Colorado River Compact for recharges into aquifers for subsequent sale to Nevada and California.

E.2 The Americas

Chile

As part of broad-ranging market reforms introduced by the incoming government, the 1981 Water Code established property rights in water that were fully separate from land, fully tradeable at freely negotiated prices, and not linked to particular uses (or indeed any 'beneficial' use). While ownership of the water remains with the State, the water rights, once granted, are fully protected under the Constitution. The rights distinguish between consumptive and non-consumptive uses, and between surface water and groundwater.

While trades had to be approved by water user associations, government agencies were given virtually no role in planning and assessing any third party impacts associated with trades.

A number of analyses suggest that the introduction of water market in Chile led to some significant benefits, noting that:

- In the arid areas north of Santiago, voluntary trades resulted in water being transferred to more productive uses
- When faced with a market price of water, the water supply company in Santiago chose instead to reduce leakage in its system;
- Urban water demand can now be met, through the purchase of water from farmers.
- Agriculture in Chile grew six per cent a year in the decade following introduction of the new water law.

The relatively free market has evolved some sophisticated transactions. For example, it has been reported that some Chilean farmers have used options contracts as a way to avoid buying water that they may not need, by paying for the options of buying water in the future at a pre-negotiated price in case of a drought[25].

At the same time, however, a number of issues arose with the operation of the market that were seen as unsatisfactory:

- Conflicts between farmers and hydro-electric power generators arising from release and/or non-release of water at times suitable for farmers (ie obligations of non-consumptive water users to release water for consumptive use).
- The monopolisation of water rights by one company, and other concerns about speculation and hoarding.
- Resolution of disputes over water rights under the administrative and judicial system were slow, costly and unpredictable.

A number of initiatives were undertaken to address these issues, including the amendment of the legislation to require environmental impact assessments, and for forfeiture of water rights if they are not exercised with a defined period. From the early 1990s water markets were complemented by a river basin water resource management approach.

Mexico

In 1992 Mexico introduced water laws that enabled water users to convert their previous, somewhat insecure rights, into more secure tradeable "concessions", typically of 30 years duration but with a general expectation of renewal. While individual farmers' surface water rights were area-based, those of non-agricultural users, farmer associations and groundwater users were defined volumetrically, although were effectively proportional.

These concessions can be traded provided there are no adverse third party impacts. The Comisión Nacional de Agua (CNA) oversees transfers, particularly in relation to intersectoral transfers, inter-basin transfers, and any transfers that might create adverse environmental impacts.

The majority of trades has between individual irrigators, and, since many of the water rights were issued to irrigation districts rather than individual irrigators, trades outside the district often requires the approval of the district. Nevertheless, there have been some significant inter-sectoral transfers such as the transfer of water from farmers to the City of Queretaro, whereby the City

[25] See Thobani, M., 'Formal Water Markets: Why, When, and How to Introduce Tradable Water Rights', in *Research Observer*, World Bank, Vol. 12, No.2, August 1997.

paid for 70% of the costs of improvements to the irrigation system in return for a portion of the water saved.

Other countries

Water markets have also developed in countries such as Brazil and Peru.

An interesting type of product/transaction in Cariri in Brazil is the establishment of water rights by time and flow, and where trades take place for the right to a certain number of telha-hours (a telha is a defined amount of water) per week or for a certain number of telha-hours several time a week. Certain rights provide for flows during weekends, while others only provide rights to flows during the week.

E.3 Conclusions

Although there are considerable differences in the nature of the underlying rights and institutional arrangements for their transfer, examination of experience in water markets in other countries, some broad conclusions may be drawn:

- Most active trading, at least initially, tends to involve temporary or short-term transfers between individuals within districts or basins, where there is a higher degree of confidence and information.
- Trades involving transfer between uses and/or between basins have been slower to develop.
- All jursidictions have struggled to develop regulatory processes that provide an appropriate balance between promotion of efficient trade and addressing third party and environmental impacts.
- Nevertheless, water markets have played an important role in re-allocation of water, particularly between agricultural and urban uses. Often this has occurred through 'bartering' arrangements whereby urban suppliers pay for improvements in water efficiency in irrigation systems.
- A range of derivative trades – futures and options – has emerged, spanning several of the jurisdictions, many of these trades dependent on the ability to forward commit access to water several seasons ahead.
- Australia appears to be as advanced as any other country in relation to most aspects of water markets.

F Insights from Energy Markets

Domestic energy markets have a lot in common with water – and some fundamental differences. Electricity, gas and water markets are all emerging from an historical 'hands on' utility regulation environment. All rely on extensive capital investment in delivery infrastructure; all have to deal with seasonal and time of day variation in demand patterns, and with unpredictable surges in effective demand or loss of system capability; all are grappling with growing requirements to contain adverse environmental impacts; all deal with a 'fluid' that is infinitely divisible and that is typically drawn down on a continuous basis.

All deal with a structure of demand that includes a large group (essentially household and commercial, and some irrigation in the case of water) where there are no regulated controls over volumes consumed – users connect to a supply system and draw product as and when needed on the basis of a known price regime. Some parts of Australia have, in the context of the continuing drought, moved to limited non-price controls over household water use, but these remain reasonably light-handed, relying on time-of-day or day-of-week limitations on certain external usage patterns. They rarely intrude into usage patterns or volumes within the home. All are also dealing with large industrial (including irrigation) customers with whom special arrangements apply.

In contrast to water, electricity and gas do not face anything analogous to the rainfall/hydrology constraint on total quantity available – though long term theoretical limits to supplies under current mainstream technologies are, in a sense, more binding than water – which is technically renewable. Hydro-electric generation does, of course, face a rainfall constraint within the existing dam systems, but the majority of electricity consumed is generated from fuel for which a long-term stock is already in existence.

All need to grapple with problems of system losses and capacity constraints. Power is dissipated in the course of transmission over long distances or at points of voltage conversion. Interconnectors, linking separate parts of the distribution network, can fill. Pumping requirements for gas (with their own energy demands) have an economic impact in respect of long-distance transmission very similar to losses – and 'bottlenecks' can essentially constrain increased supply.

All involve shared use of delivery infrastructure, carrying product from a range of sources – rivers, dams, entitlement holders in the case of water; generators in the case of electricity; gas sources in the case of gas.

The dams, groundwater sources and even in-stream and in-catchment flows of the water systems afford a level of storage capacity – with scope for shifting the time match between production and supply. The same role is played by the dams in respect of hydro-generation and even coal or gas generation via the scope for pump storage of water for future generation – current generation can, to an extent and with losses, be deferred for later consumption by using the dams as batteries.

Under some circumstances, when there are large and predictable differences in the price of electricity across time periods, it can make sense to run hydro generation during the high price periods, and to draw on the grid to allow water to be pumped back up into higher storage during the low electricity price periods. This is despite the substantial losses associated with such cycling.

These differentials can apply to time periods as short as a few hours. For example, during heatwave conditions (with high demand encouraging high prices) or during a major and prolonged system outages (such as the 2000 and 2001 loss of a units at Loy Yang B and then A for several months, reducing supply capacity and hence encouraging higher prices) such pump storage during off-peak periods, by hydro suppliers, is common. Even with a short-lived system failure, pump storage after hydro-generation can be attractive as a means of delivering system stability and covering hedge contracts, while managing regulatory or commercially sensible management of water in storage.

For gas, there is scope for storage in the form of pressure in the pipes, and using explicit storage vehicles, including in-ground storage. Complex system management is required, though generally with shorter lags.

All three products involve values for marginal changes in supply that can vary substantially over time. For water, this can involve cycles between droughts, over a number of years. For gas, daily and seasonal profiles of demand are important, but are reasonably stable and can usually be managed through pipe storage capacity. For electricity, the value to a stakeholder can alter dramatically in milliseconds, as the result of an unexpected system failure, but can also be highly sensitive to extreme heat or cold conditions. Some generation systems – hydro more so than gas, more so than coal – can respond to these changes much more rapidly than others can. The scope for very rapid response by hydro-systems is one of the sources of value tied up in hydro access to discretionary volumes of water – noting that hydro use is essentially non-extractive, though it can involve diversions between catchments and will involve variation in the timing of flows below the dams.

All have to grapple with issues of system integrity, not just case-by-case supply. To differing degrees, there are also issues of managing the quality of the product for end use. Demands for high consistency of product specification

are greatest for electricity – resulting in a range of innovative products emerging in electricity markets to underpin these quality requirements. Next in order of stringency of quality requirements is probably town water supply (in respect of public health attributes more so than aesthetic or reliability aspects).

Gas (and more generally petroleum) production shares with water the need to manage multiple demands on an in-ground source – groundwater and underground reserves of gas. Here there are issues both of managing resource shares, and of dealing with the pressure/cost of access issues associated with extraction by others.

In general, gas and electricity are not characterised by concerns with over-allocation, nor with sleeper and dozer licences.

All have sought to respond with products for meeting demand, managing risks, complying with environmental requirements and containing costs. All have been proceeding towards markets, with substantial remaining regulation, in which end users increasingly see the costs of their patterns of demand on the system. The gas and electricity markets have, for good reason, developed far further than water markets – they are inherently more controllable and predictable and environmental concerns have generally be seen as less prominent in the planning process. It is useful to look at the way these markets have been moving, and the types of responses and products that have emerged.

F.1 Changes to physical production/delivery systems

In the electricity market there has been a pronounced change in the approach taken by the market to production. When the market was 'launched' there was an excess of capacity in the system – a legacy of a history driven by engineering principles in which large, coal-fired plant offers lowest whole-of-life costs per unit of generation. In a monopoly world with significant market growth, the risks associated with such investments were deemed small.

From very early in the life of the market, investment in new capacity swung in favour of smaller, lower up-front cost and more flexible gas-fired units, more closely geared to growth in market demand and better placed to take advantage of price spikes – as a result of much greater capacity to ramp-up production quickly. The same units offered less exposure to new environmental requirements. Despite higher unit costs of production, these investments provided substantially better option value – in terms of risk management, financing capability and access to up-side opportunities.

A key point is that market incentives encouraged investment to move in favour of flexible options in production, and have now started to do the same in respect of demand. This flexibility has fed through into an increasingly sophisticated range of products and transactions that allow individuals operating in the market to tailor a mix of products to their needs – and increasingly to tailor their demands to extract maximum value from the market. It has not been simply a case of seeking lower cost ways to meet established demands for power – we are seeing substantial change in the way electricity usage is trending.

For example, an aluminium smelter can look to operating in the electricity market in a manner that looks a lot like introducing a new peaking power station – by offering to sell to someone the rights to have it switch off when power is short. A smelter with an ability to remain switched off for extended periods without damaging the smelter – a function of the particular smelting technology adopted – has extra option value as a result. The responsiveness of such loads is in fact greater than of a gas-fired peaker – near instantaneous and automatic reduction in load can be achieved.

The direct parallels between the trend to more flexible power generation and water may not be striking, unless consideration is being given to building another dam. However, in an environment in which market discovery may produce very different solutions to primary requirements in respect of risk management services for water users, the underlying options principle that cautions against superficially least cost solution, if this involves substantial up-front commitment and reduced flexibility, may well have relevance.

The analogy with water is perhaps strongest in comparing the entry of small tranches of flexible generation capacity – sometimes installed deliberately on the user side of potential transmission constraint – and the active selling of demand management services with investments deliberately designed to increase water market flexibility to respond to user needs. It might include investments in on-site storage (water or production inventory), for own use and/or to create flexibility to trade entitlement when prices are high. The same might be pursued through a shift to crops that are less water sensitive, or through fallow rotations, or other changes to production patterns that afford access to more discretionary water.

With the opening of the market, the existing hydro capacity, especially Snowy and other mainland hydro generators, has found itself in a fundamentally different business. While it continues to be used to generate electricity and will, over time, generate as much electricity as its hydrology constraints allow, it is now very actively engaged in the business of selling risk management services to other generators and utilities. Its access to water and generation capacity affords it a physical hedge to cover these risk service products – that

take the form of a range of derivatives, including price caps. Here, its flexibility to determine when it uses the water becomes a key determinant of the value of the water to generation – hence the potential value for it in being able to enter a market to influence the release constraints under which it operates.

A key function offered by hydro that is not fundamentally new but that is now actively marketed, is for so-called ancillary services. These rely on the rapid responsiveness of hydro to support the quality of the supply – primarily through voltage regulation.

Just as electricity generators have developed strategies to reduce the risk of large stranded assets in respect of new investment, analogous issues have arisen in the gas sector. Concerns with by-pass can deter new investment in pipeline capacity, though there are signs of increasing recognition the option value of alternative transmission capacity.

F.2 Contracting structures – traded products

2-way contracts

These products may have little direct application to the water market, but provide a basis for considering the derivatives that have subsequently emerged to allow finer management of risk service requirements. They are also of interest in that they demonstrate a market in which a 'seller' and a 'buyer' may do a deal that delivers price certainty without actually delivering power from the seller to the buyer.

A key feature of the electricity market has been the separation of physical from financial contracting strategies. Individual generators typically do not guarantee to supply electricity to a user or wholesaler – instead, they commonly guarantee the price at which the user will be able to source electricity. They can achieve this with manageable risk as a result of the physical hedge they hold in their generation capacity.

The typical 2-way hedge product works roughly as follows:

- A generator enters into a contract with a large user of electricity, or with a wholesale or retail business, for example for a price of $40.
- The contract guarantees the price of electricity via a 2-way contract for difference in price between $40 and the actual spot price at the time of purchase.
- The user purchases the power form the spot market.
  - If the spot price is $30, then the user must pay the generator $10;

- ⋯ This is true whether the generator is producing or not – the effective price for the user is $40;
- ⋯ If the generator produces to cover the contract, he will sell for $30 into the spot market, and receive $10 from the user, for an effective price of $40.
- ⋯ If the generator does not produce, deliberately, or as a result of an unplanned outage, he still received the $10.

– If the spot price is $50, then the generator must pay the user $10;
  - ⋯ Again, this is true whether the generator is producing or not – the effective price for the user is $40;
  - ⋯ If the generator produces to cover the contract, he will sell for $50 into the spot market, and pay $10 to the user, for an effective price of $40.
  - ⋯ If the generator does not produce, deliberately, or as a result of an unplanned outage, he still pays the $10, and is out of pocket.

The net effect is that the buyer has a fully hedged price, and the generator also has a fully hedged price, provide he generates. If not, and the spot price exceeds the contract price, the generator will be out of pocket. In a market where the price could suddenly leap by several thousand dollars, the exposure could be considerable. Typically, generators will seek to ensure that they are able to generate sufficient to cover these contracts – and may well take out additional financial hedges to cover the risk of a failure in their equipment. The ability to generate involves both the physical ability, and a dispatch bid into the spot market at or below the market clearing price – the generator has an incentive to bid to ensure dispatch whenever the spot price exceeds the generators marginal cost of production.

This instrument provides a base level of price certainty to both generators and users/wholesalers/retailers. However, these contracts have limitations. They tend to limit a generator's access to the benefits of selling into a high spot price market.

Baseload generators, with low marginal costs and high costs of varying their level of generation, will tend to use these instruments heavily for much of their generation – relying on their low marginal costs to deliver an adequate return.

Intermediate stations, with somewhat higher marginal costs, will typically be able to sell a level of their generation on this basis, across peak demand periods.

However, peaking stations are unlikely to be in a position to sell high levels of two-way hedge contracts because their costs of production tend to be too high. Instead, they look to covering their investments out of the returns from very

high price points – the electricity sector equivalents of droughts At the same time, they seek an income stream from the value they offer the market, from being there and providing risk management services, even when the prices are not high.

Similarly, distributors will be keen to secure the cost of sourcing predictable levels of demand by their customers, but do not want to lock into 'take or pay' contracts for quantities in excess of their demand levels. Given the uncertainty regarding marginal demand for power, there is demand for contracts that offer greater flexibility – and optionality.

Price caps

A generator may well have a high level of confidence in its ability to generate to cover a position – and will in any case be quite relaxed about spot prices that fall below the contract price. However, failure to generate when the price is high – and for a major generator, if they fail unexpectedly this may be the very reason why the price is high – can entail significant risk. Such a generator may well be keen to limit this exposure by buying a price cap. This will typically take the form of a true financial option – involving a fixed payment for the insurance services, that will limit the effective spot price faced by the generator to no more than a specified 'cap'.

For example, the generator might cover the risk of the spot price exceeding $200 through the purchase of an option. These would typically be sold by hydro- or dedicated peaking generators, which are well placed to ramp up production for marginal costs below this cap level. Exercise of the caps would typically be based, in addition to the spot market outcome, on some specified failure in the generation portfolio that limits the ability of the portfolio to cover its own risk.

These sellers of caps will be keen to have the fuel – water or gas – at the time the option is exercised and this can generate very high value for water at times when the market price is spiking – or they in turn will be exposed to the extent of the excess of the spot price over the cap price.

Why would a peaking or hydro generator agree to supply power, on demand, to a customer at a price below the spot price? Two reasons arise – one is an assessment that failure to satisfy this demand for risk management would possibly result in a fallback to greater investment in physical generation capacity – real hedges instead of financial ones, designed to limit the exposure. The effect would be to lower the peak prices that these generators seek to tap in order to cover the costs of their own investment.

A second reason that probably more applicable to water is the fact that normally the prices paid by generators or others wanting a cap will generally include an option premium – a payment to the option seller that is sufficient to raise the expected financial returns to the seller. As with any insurance market, premiums are typically pitched at levels above expected claims. The benefit to the average buyer of such an option lies not inn the reduction in expected costs, but in a reduction in the risks of a large blow-out in costs.

By agreeing a level of price cap, and by covering a variable proportion of planned generation, a generator can determine a level of exposure that is acceptable given the nature of its portfolio, its contract positions and its attitude to risk. Conversely, a generator can seek to adapt its contracts and generation plans to better fit the available hedge options.

Equally utilities and major end users of power can enter the market to buy price caps to limit exposure in the event of higher than expected levels of demand emerging.

In most cases, unexpected loss of capacity within a portfolio is a reasonably random process, so there is an opportunity for a peaker or hydro generator to sell caps to a range of generators, even to the point of exceeding its capacity to generate should all caps be exercised. This is somewhat akin to an airline over-booking, on the basis that there is usually a level of no shows. However, it is also analogous to the issuing of water entitlement when there is a chance that it will not be possible to meet all the demand.

The peaker could, of course wear this risk of occasional excessive claims and the associated exposure. However, the market has tended to evolve derivative products that share this risk in a manner still analogous to water entitlement. The caps may apply only up to a specified level of loss of system capacity, and beyond that the price is effectively clawed back on a pro-rata basis. We have here an instance of the market developing multi-party risk management instruments – where the risks of extreme system-wide failures are shared across all participants in the contracts.

How might this fit into water trading?

Certainly there is scope for price caps emerging. There is some evidence to suggest that isolated trades have occurred, though in many jurisdictions the physical hedge cannot be guaranteed because of limitations on the approval process. Price caps could afford some investors a level of price certainty very different from relying on entering the spot market for water in the middle of a drought. Similar price certainty might be achievable by acquiring 'excess' water and entering into temporary trades on the surplus. However, this would entail the up-front cost of permanent transfer, coupled with the on-going costs of

administering the surplus water – either of which might tax the resources of some businesses looking only to limit price exposure. It might also involve excessive costs, if a series of individual transactions sacrificed the size economies and lower transactions costs than might be possible through a more central operation. eg a centralised exchange such as WaterMove may be able to offer 'standardised' contracts.

The measures to share the risks of multiple 'claims' could well be important here, given the likelihood that many users would be seeking to exercise options simultaneously in the middle of a drought, but equally this likelihood would influence the extent to which 'overselling' of options could be expected to make commercial sense.

From a seller point of view, such a market would attach greater value to flexibility to substantially reduce demands for water in times of drought. In the case of irrigated agriculture, the opportunity for better matching pastures and annual crops against perennial crops, for example, suggests value opportunities that are likely to be only partially satisfied through different classes of water reliability. In a sense, such a market instrument could eliminate the need for and value in multiple classes of water reliability – because these price capping products would allow users to blend entitlement and differently configured caps to meet their own risk profiles.

Weather derivatives

While options character price caps can, to an extent, be used to manage uncertainty regarding demand levels, it remains primarily a price uncertainty instrument. An interesting and potentially important development in (energy and non-energy) over the past several years has been the emergence of weather derivatives as a direct device for managing weather-linked volume uncertainty. The potential for application in complementing water trades, and allowing greater value to be derived from water trading positions, is compelling.

A range of weather derivative products have emerged, and recent growth has been phenomenal. For example, Price Waterhouse[26] estimate that, between 1997 and 2000 trades in weather derivatives in the US grew at an average annual rate of about 1000%, with the US market at the end of 2001 being valued at $US11.5b. The emergence in 1997 was accelerated by the very strong El Niño effect in Pacific North America at the time, associated with significant economic cost. The early demand came from the energy sector and remains

[26] Price-Waterhouse-Coopers (2002), *The Weather Risk Management Industry: Survey Findings for April 2001 to March 2002*, presentation to the Weather Risk Management Association; and analogous report in 2001.

strong there – though more recently a range of other sectors, notably agriculture and tourism, have broadened the demand base.

The essence of a weather derivative is a specification of an objectively measurable feature of weather outcomes that is closely correlated with the volume uncertainty to be hedged. In the energy sector, where short-term energy demand is the key consideration, this typically involves triggers based around 'heating days' and 'cooling days' – ie days of extreme temperature likely to trigger abnormal use of air conditioning and space heating. Sometimes, allowance is also made for humidity on the basis that this reduces the temperature at which air conditioning tends to be turned on.

Generators can look to blending energy price caps with heating- and cooling-days based weather derivatives to introduce much finer control of exposure to temperature extremes. Conversely, access to such risk management instruments frees the generators, utilities and major energy users to develop more flexible business strategies.

In relation to water, longer term correlated patterns are of greater importance. Conceptually, at least, derivatives could be based around such triggers as dam levels (though this could involve some moral hazard), rainfall patterns of extended time periods or some measure related to trends in the Southern Oscillation Index. There is no suggestion here that government should provide such a product – but the scope for such a product being incorporated in risk management portfolio products, should the more direct water derivative markets emerge more strongly, is noted.

Other demand volatility options

Other instruments are in active use in the energy sector to help manage the risks of volume uncertainty:

- Demand management-based options are offered by major system loads, such as electric-powered metals smelters.
  - These businesses are characterised by very large, usually stable energy loads than can be switched off in the event of enough compensation being offered.
  - Since the electricity market sets prices on a basis in which a reduction in demand has effectively the same impact as the equivalent increase in supply, these smelters can bid their capacity into the market, in the form of a willingness to cut their demand for a high enough price.
    - ⋯ This parallels a major water user agreeing to temporarily transfer entitlement when water prices get high enough.
  - Alternatively, or as well, the same capability can be used to provide a physical hedge to underpin the sale of price caps.

- The scope is recognised for aggregating much smaller loads – such as aggregation through an intermediary and using smart metering, of household loads that are not time critical to deliver a comparable capability in real time.
  - Similar capability, though within somewhat longer time frames, could be envisaged for water usage.

Long-term contracts to hedge new entry risk

As demand in the market grows, and as a result the surplus of generation capacity over demand is squeezed, price volatility rises along with concerns for system reliability. These combine to create a system demand for new entry. A problem for a new entrant is that it is necessary to incur a significant up-front cost, in a market where the spot price is probably only just approaching the break-even price for the new entrant, and where the spot price will probably drop as soon as the new investment is fired up. There is a need for the system to manage the risks of the new entrant, to the point of making the investment commercially attractive.

In electricity, this will sometimes involve longer-term contracts, sufficient to lend significant underwriting of the risks for the new entrant. This might be achieved by having the investment commissioned by a retailer, or through the wider sale of contracts – and will normally involve efforts to also bring predictability to the cost of the main input – fuel – through negotiated long term supply arrangements. The nature of these arrangements will often largely determine the way in which the new generator is used in the system.

In the water context, there is not the same need, or scope, to build supply capacity. There may, however, be individual investors in new or expanded enterprises involving a substantial up-front cost and vulnerability to high water prices. Here, the ability to forward contract to cover price risk, without the need to acquire enough entitlement to cover all future eventualities, could have attraction as part of a business strategy.

F.3 Interconnector management

Electricity markets commonly – in some cases almost normally – need to deal with system interconnectors that are full – in the sense that no more power can pass through them. Most of these interconnectors are regulated interconnectors, with prescribed rules for accounting for system losses for passing through the interconnector. As long as the interconnector is not full, the markets on both sides are effectively treated as a single market, with trading allowed. If it fills, the two markets 'separate' and prices are determined within each separate market.

There are no restrictions on 2-way contracts, price caps or other derivatives being sold forward without knowledge as to whether the interconnector will be binding or not at the time the option is exercised. However, a generator selling such products across the interconnector needs to accept a risk that it will fill, with the markets separating, and that the price in the buyer market may be higher than that in the seller market. Unless the contract was designated in terms of the seller market price (leaving the buyer exposed), this will entail a seller risk.

It is left to the market to determine whether the risk is worthwhile. A trading strategy based on a combination of careful analysis of the nature of the risk, and some complementary hedge cover within the target market, might create a situation in which trades across the constraint make sense – but sensibly and predominantly, long-term contracts are typically written between buyers and sellers on the same side of these constraints.

A different model under consideration in electricity – especially in relation to the proposed 'BassLink' between Tasmania and the mainland market, but potentially applicable to any new interconnector capacity, is that of the 'entrepreneurial interconnect'. Under this model, the interconnector could be viewed as a 'generator', sitting at the junction between the two markets and capable of 'generating' into either market at the capacity of the interconnector. The operator of such a generator could trade in a range of possibly quite sophisticated options to cover price risks associated with market separation, and could sell 'slots' in the interconnector in an attempt to direct the flows to where they deliver the greatest value.

Perhaps significantly, the BassLink proposal appears to have stalled on economic grounds (cheaper to build extra generation capacity in Victoria) and the one operating entrepreneurial interconnect, MurrayLink, has recently received approval to become regulated. It is proving easier to demonstrate potential systems gains than to demonstrate how an investor can recover enough of the gains to make an investment worthwhile.

In a water context, the notion of a market, separate from basic entitlement, in the rights to pass through a restriction in the delivery system is probably of more interest than an operator of the choke point. An exception could arise if someone were to invest in capacity to by-pass a restriction in the system and were seeking to compete the extra capacity into the market.

From a current water entitlement point of view, this does highlight questions of the value in preventing trades through a restriction in the system that is not always full. It is understandable, given the nature of current entitlements that such a requirement might arise – because of the need to manage excess demands on that point, and the possible attenuation of the reliability of supply

to existing users. On the other hand, unbundling of rights of passage through the system from basic entitlement, possibly accompanied by a bequeathing of the delivery rights to existing title holders, would open scope for the market to explore more innovative, probably multilateral, trading opportunities while protecting existing interests.

Circumstances that could create value out of such trading possibilities would include a different pattern of water demand, and reliability sensitivity, above and below the restriction.

G Observations on 'Stranded Assets'

Concerns are sometimes raised, in respect of trade on water out of an irrigation scheme area, with a set of issues sometimes grouped under the somewhat misleading title of 'stranded assets'. The issues are complex and are only partially relevant to the purpose of this paper. However, there are some important linkages that warrant discussion here – because they involve questions of efficiency in trading and point to a role for separation of delivery rights. They are also relevant because these arguments have been used to limit trading between reasons when this is likely, in fact to be less efficient.

G.1 The central concern

The following is a generic discussion, designed to set out the key issues of relevance to this study. It does not focus on specific differences in detail between jurisdictions and irrigation schemes.

Most irrigation schemes were developed before significant trading, and especially trading out of the area, was allowed. Water rights were typically tied to land. Much of the system capital in regulated systems – in the form of shared infrastructure for water delivery, administration systems etc – was installed by government. Coverage of the capital and operating costs is typically via charges linked to water entitlement and extractions. In general,, extraction charges relate to the incremental system costs involved in water usage, while fixed costs are covered via charges against entitlement.

In some cases the water is held collectively by the water business, with access being gained through the acquisition of shares. In most cases, the structure has many of the elements of a cooperative – with contribution to costs and access to benefits being proportional to system usage. This can distort incentives in choosing between different business strategies with different implications for use of the system.

In effect, this mechanism enabled irrigation schemes to recover from entitlement holders a share of the system costs. However, this requirement to pay was, for understandable historical reasons, not formally contracted with the entitlement holder – the requirement was 'bundled' into the water entitlement, as long as the entitlement was exercised within the scheme. Charges to users were effectively set on a cost recovery basis.

Introduction of trading within a scheme did not threaten these arrangements. The requirement to cover these system costs would have been factored into the capital value of entitlement, and the funding base would be sustained by

transferring these commitments with entitlement. In fact, efficiency-based trades could probably increase the reliability of the scheme's ability to support the capital charges – by shifting water in ways that increase scheme profitability.

Introduction of rights to trade out of the scheme has unravelled this arrangement to an extent. However, AT believes that it is important to keep these effects in perspective. The discussion of externalities in Appendix D is relevant here. Amongst the possible effects where entitlement is traded out of the area, in the form of a net loss of entitlement, are:

- Decreased utilisation of system capital, probably implying a need for a capital write-down.
- System operating costs being shared across a smaller usage base, and possibly avoided by the seller of the entitlement.

These effects may be unfortunate, but need not be fundamentally different from the normal consequences of dynamic economies. They need not imply inefficiency, any more than one company losing business to another in a competitive market need be a sign of inefficiency – with a strong analogy existing where emerging technologies (railways, internet etc) have altered the locational advantages of a business. The result *may* include 'stranded assets', in the sense of essentially immovable assets that could not now be justified as investments if there were a choice. Nonetheless, such an outcome may still be efficient.

However, an efficiency issue can arise under plausible conditions. To clarify the nature of this, consider two separate models:

1) the situation as discussed above, with financial responsibilities for the system capital linked to entitlement used in the scheme area; and

2) a variant where each entitlement holder owns a separate delivery entitlement, providing access to the system capital and entailing a responsibility for the costs of the system.
   - ⋯ This could, for example, arise through use of a 'joint venture' investment vehicle, with a cost-sharing agreement in respect of fixed capital investment.

The second model may entail quite different incentives from the first. Under the first model, sale of entitlement effectively extinguishes the individual's responsibilities for the sunk costs of the system. The economics of the sale will depend on the *sum* of the price paid by the buyer and the capitalised value of the reduction in future payments, from the perspective of the seller. This second item, while real from the seller's point of view, is not an economic cost – these costs are simply being transferred to the remaining water users in the

region. Under the second model, this cost item does not enter into the economics of the transaction.

It follows that a sale of entitlement could make commercial sense under the first model but not the second – the additional incentive arising from the scope for transferring a financial cost to others in the scheme. This may be seen as inequitable; it could also conceivably be inefficient. Under the second model, the potential seller needs to take into account impact on the value of the remaining delivery rights as well as realised value of the entitlement sale – ie, the net value realised from the sale.

There is no simple answer as to which is more efficient. This question needs to be approached *ex ante*, with a view to the intended and actual allocations of responsibilities and risks within the commercial model adopted. In incentive terms, there is a big difference between a customer walking away from a supplier, and an investor avoiding responsibilities that were intended as part of the commercial model implemented.

In reality, with the substantial changes that have occurred in the regulatory environment, but also with the significant times involved, the truth probably lies between these extremes. Shareholder irrigation schemes, where entitlement is held by the schemes, can in theory redress any such concerns by taking a collective decision, inclusive of all impacts within the business. In practice, the link between share of entitlement and share of cost contribution that is common could be expected create some distortions – but probably not distortions great enough to justify heavy intervention.

G.2 Responses

One response to this problem is to limit the volume of entitlement that can be traded out of an area. This approach is understandable, but is unlikely to be efficient – espe3cially if implemented on the basis of an absolute limit rather than one that is varied with shifts in the offer price.

The source of the issues in the allocation of financial responsibilities and risks and the fact that these allocations have effectively been changed by allowing trade out of regions. Bundling of assets – delivery rights with entitlement and system cost/benefits rights and responsibilities with shares – is prone to distortion when circumstances change. Unbundling would be likely to increase system flexibility, and to diminish any perverse incentives – but would entail formalising the allocation of these responsibilities through to the individual level. Restoring the pre-trade opening allocations would probably now entail adverse equity effects, adding to the complexity..

G.3 Market compensation

Another important point is to recognise that the market in entitlement may well, in any case, be capable of managing the efficiency threat – though probably at the expense of what might be viewed as greater inequity.

If the economics of transferring the water outside the region are dependent on the resultant scope for the seller avoiding system capital costs – while leaving those costs in the system – then it should be economically attractive for others in a region to acquire the water (for which they should be able to compete if they have scope for applying it) or to 'cut a deal' with the prospective seller that makes the seller no worse of, and leaves the water and the responsibility for the capital charges, in the area.

Every entitlement holder in a region trying to leverage off a flaw in the market design is probably not a desirable long-term solution, while any early deals would have some adverse equity effects. However, if water is leaving a region, and there are insufficient incentives for a deal to be cut, then this would appear to provide *prima facie* evidence that the trade will result in water moving to a more valuable use. This would caution against any arguments for controls over sales out of an area on efficiency grounds.

Pragmatically, trying to control for perceived 'stranded asset problems', other than through wider opening up of market flexibility, may do more damage than good.