Designing Market Based Instruments: Beyond Round One of the Australian MBI Pilot Program

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Abstract

Most markets have evolved as buyers and sellers constantly search for ways to create value, however this has not occurred naturally in all areas of the economy – markets are missing for some goods, including the environment. In such cases, transaction costs linked to property rights, asymmetric and hidden information and packaging problems have often prevented otherwise valuable deals from being negotiated in relation to the environment. However new capabilities and a better knowledge and understanding of the problems at hand now mean that where the objective is clear, and the knowledge, skills and capability exist to understand, model and measure the relevant characteristics of the problem transaction costs are low enough that economists can, in certain cases, design market based instruments that match demand with supply. In general the findings from the National MBI Pilot Program indicate that cap-and-trade systems, auctions and offsets systems can be effective tools to achieve natural resource management. The type of mechanism that is appropriate in a particular circumstance will depend on the transaction costs involved, which are strongly influenced by the features of the problem at hand. Mechanisms therefore require careful design to ensure they are tailored to each particular case.

[1] Much of this paper is based on extractions from the National Market Based Instrument Pilot Grogram Round One: An Interim Report (2005) which was compiled and edited by the authors of this paper with and on behalf of the National Market Based Instrument Working Group, based on interviews conducted with the pilot managers, pilot reports and further research and analysis.

JEL Classifications

Transaction Costs, Property Rights, Asymmetric and Private Information, Public Goods, Government Policy.

1. Introduction

In open decentralised economies, markets are the primary institution through which individuals and firms engage in transactions that create value. Markets facilitate interactions between buyers and sellers by offering a cost-effective and reliable way of transacting.

Most markets have not been designed. They evolve and are shaped by the interests of buyers and sellers who are constantly looking for ways to create value. This evolutionary process discards inefficient ways of making transactions, i.e. those with uncompetitive transaction costs. Different types of transactions emerge to suit the particular characteristics of the goods and services in question. Transactions in commodity markets, for example, are quite different from those that occur in risk markets.

Markets have not evolved in all areas of the economy – they are missing for some goods and services. However, this does not necessarily diminish the potential value of the transactions that would occur if a lower cost way could be found for them to occur.

Environmental and natural resource management (NRM) problems are usually at the difficult end of the policy spectrum. There are often complex spatial and temporal interactions between the causes of environmental problems and their effects; similar actions tend to generate different (non-standard) environmental impacts in different locations and at different times. Some environmental benefits tend to be generated in association with others. For example, biodiversity enhancement through revegetation retention may be jointly produced with water quality improvements and salinity mitigation. Many different stakeholders, each with potentially different objectives, expectations, motivations and cost structures, are involved in the production and consumption of environmental outcomes.

Markets in this area tend to fail in part because of the public good nature of environmental goods and services. There are two characteristics of public goods that prevent markets from emerging. The first is *non-excludability*. Individuals do not own environmental amenities, such as clean air or clean water. Yet it may not be possible to exclude them from enjoying the benefits of these environmental amenities, and similarly from experiencing costs for example due to their pollution. Secondly, many environmental goods and services are *non-rival*, which means that enjoyment of the environment by one individual does not preclude enjoyment by others (at least up to certain levels).

We know that, in aggregate at least, society is willing to pay for an increase in the supply of environmental goods, and that the potential suppliers of these environmental goods exist. Yet markets do not necessarily develop. Willingness to pay for environmental goods and the cost of supplying these goods varies. Environmental goods often lack definition and the benefits from a potential exchange with suppliers of these goods may be uncertain or risky. Harnessing or collecting information about society's willingness to pay for environmental goods is problematic, individuals may expect to 'free-ride' the benefits produced by others purchasing environmental goods resulting in the under investment of that good.

As a result governments have intervened to increase the level of investment in conservation activities in order to meet society's expectations. Government addressed society's demand for environmental goods or services' using the tools it understood were available at the time, given the information and technology available. In the past this has meant that governments have tended to approach environmental problems through regulatory approaches, education and awareness programs, industry supported voluntary approaches and various types of relatively simple incentive schemes delivered by government or by catchment bodies. For example, regulations have been used to restrict activities such as the clearing of native vegetation and to require firms causing air pollution to adopt particular technologies, whereas incentives schemes have been used to promote voluntary participation and behavioural change leading to improved environmental outcomes.

Although these programs have raised community awareness of environmental issues, in many cases they have not been sufficient to solve the complex environmental issues currently experienced in Australia, such as decreasing water quality, increasing salinity and biodiversity decline.

New market based approaches involve the design and implementation of a system whereby those who have the best:

- access to information about taking actions that deliver benefits;
- information about the opportunity and direct costs of taking those actions;
- information about the benefits of those actions; and,

- ability to access information about aggregate willingness to pay for benefits;

interact to make exchanges that benefit themselves and deliver environmental benefits at lower cost than alternative mechanisms. Those with information about benefits and willingness to pay, or potential buyers of environmental goods and services include society (through government and catchment bodies) and groups of individuals such as farmers who would choose to take action to, say, protect land from salinity threats. Given appropriate incentives, many landholders, who have information about the opportunity cost of supply, could change land-uses in ways that will increase the supply of environmental goods and services. Where there are willing buyers and willing sellers, it is reasonable to suggest that deals between buyers and sellers would benefit both groups. In economics terms, these exchanges are the basis of wealth creation in society.

Unfortunately there have been gaps and limitations in our knowledge and understanding that have meant the implementation of market systems whereby these players interact to achieve the efficient outcome may have involved excessive transaction costs in order to deliver the necessary benefits.

2. Transaction Costs and NRM Policy

2.1 Previous Impediments to Markets for Environmental Outcomes

Transaction costs, the costs that are attached to the (potential) transactions that could enhance the provision of environmental goods, include costs due to:

- **property rights** such as costs associated with the definition, monitoring and enforcement of property rights and determining previously hidden information in order to define or monitor a property right and the cost of enforcement due to the communities understanding and acceptance of the property right and its allocation;

- **asymmetric and hidden information**, through either having to estimate or reveal supply or demand related information held by one group or party and not another, or not held by anyone, and the risk associated with making a deal without full information;
- the **packaging** of actions, outcomes or preferences of players within the economy in order to determine the efficient aggregate outcome.

The significance of some of these types of transaction costs has often been enough to prevent otherwise valuable deals from being negotiated in relation to the environment. As a result, impediments to naturally occurring markets for environmental goods and services developing have included:

2.1.1 Inappropriate Property Rights

The lack of or inappropriate specification of property rights for environmental goods is known to result in inefficient or missing markets for these goods. Coase (1960) suggested that if property rights were clearly specified, and there were no transaction costs, firms would trade to arrive at an efficient outcome. However, in the case of environmental goods, property rights and transaction cost issues are linked, and the transaction costs cannot be ignored. In order for the transactions, or the exchange of rights, to be sufficiently credible for agents to be willing to participate, there must be high acceptance of the link between the rights specified and the environmental outcomes sought as well as acceptance of the security of those rights.

For some goods property rights have not been well defined because in the past the science and information necessary to define or monitor and enforce them was not available at an acceptable cost. In other cases demand for an environmental good may not have been realised when the relevant property rights were being shaped.

For example, a conservation agency attempting to reconstruct a wetland to satisfy the community's demand for local native wildlife may require farmers whose water extraction impacts the wetland to take certain actions twice yearly that would result in the wetland flooding to simulate natural conditions. However, the property rights for the water used by farmers are in the form of annual licences that are significantly more expensive than the benefits to be gained from flooding the wetland. Purchasing the licences outright is costly, considering the agency only requires water twice yearly. However, altering the property right to pay farmers not to extract water at a certain time twice yearly could be risky if it is costly for the agency to monitor and enforce whether the local farmers do as they agreed.

2.1.2 Asymmetric and Hidden Information

Information asymmetry refers to a situation where one party to a deal has more relevant knowledge than the other party. This can mean that it is hazardous for the uninformed party to do business with the party who has the hidden information. Akerlof (1970) showed that the existence of asymmetric information (that is, where one party is informed about certain aspects of the economics problem and the other is not) can render some seemingly competitive markets inefficient. In extreme cases, this phenomenon can prevent markets being formed because the uninformed party is liable to be exploited and may therefore be unwilling to participate. As a result, the potential benefits of doing business (which may be very large) may not be realised.

Latacz-Lohmann and Van der Hamsvoort (1997) explain how information asymmetry affects the functioning of markets for environmental goods and services associated with private land. There is a "clear presence of information asymmetry in that farmers know better than the program administrator about how participation (in conservation auctions) would affect their production plans and profit."

In the wetland example, the conservation agency may not have information about the community's willingness to pay for native wildlife (held by individual members of the community). Ecological and hydrological information about the different possible actions farmers could take to contribute to creating the wetland, and information about how much native habitat those actions would deliver and how much that habitat would contribute to an improvement in native wildlife may be hidden from the agency. Information asymmetry may also exist as the agency does not have information about the opportunity costs to farmers of taking actions that will deliver the wetland. Without this information it is risky for the agency to engage in transactions in an attempt to deliver habitat for native wildlife through the wetland, as it is unable to determine whether any deals it makes are valuable or not.

2.1.3 Packaging Problems

In some situations, markets may be missing because firms do not have the right combination and/or critical mass of assets or access rights to conduct their business. This is sometimes referred to as 'the packaging problem' (Ausubel and Milgrom 2002).

Asset aggregation problems arise in many parts of economy, including the allocation of access to infrastructure such as transport networks, gas pipelines, airport landing slots, mobile phone spectrums, sales of real estate to developers, access to certain mineral deposits, and the creation of wildlife corridors.

For the economy at large, sub-optimal allocation can occur due to failing to adequately address packaging problems. If firms risk being unable to achieve a satisfactory package and do not want to be left with a subcritical package (i.e. a package that will not be sufficient to create a viable business), they are unlikely to participate in the market. For example, key players may choose not to participate in resource allocation events in which they cannot be certain of securing combinations of resources critical for business viability and resources may remain underdeveloped. Addressing the packaging problem offers increased value from resource allocation through allowing resources to be combined in the most valuable way.

In the wetland example, if the conservation agency can not be sure of securing the simultaneous action of enough land holders coordinated at an appropriate time to simulate a naturally occurring flood of the wetland area, it may not consider making any deals.

2.2 Reductions in Transaction Costs

Fortunately, new information and capabilities open up the prospect of developing new approaches that complement the suite of current policy mechanisms. Transaction costs that have previously impeded such approaches are being reduced through new capabilities and better knowledge and understanding of the problems at hand. Economists have shown that, in certain circumstances, they are now able to design and implement new types of market mechanisms that allow previously missing transactions to occur.

Recent developments that are being used to overcome the problems that have previously prevented the evolution of markets for environmental goods and services include:

2.2.1 Property Rights

Developments in scientific models now provide us with information that assists in determining more appropriate forms of property right and in many cases it is clearer what characteristics of a property right may impact on the environmental outcome. Consider again the wetland example, where better science and hydrology models now provide the agency with information that it is not only the quantity of water used by landholders upstream that is important, but the timing of that use in conjunction with rainfall events, and the extent of groundwater extraction close to stream. Now it is not only clear that purchasing an annually renewable licence to extract water is not appropriate due to the duration of the right, but that the timing of the forgone extraction in relation to rainfall events is important, as is the timing of the separate right to extract groundwater.

The ability to monitor environmental outcomes, or actions that predictably impact on environmental outcomes, provides the opportunity to design property rights that better enable valuable environmental deals to be made. Environmental goods are often jointly supplied with many other goods, or serve to achieve different outcomes. For example, the efficient property right for water used exclusively for irrigation purposes will be very different to the efficient property right for water used exclusively for aquatic health. Where water has multiple uses redefining the property right to achieve what may be the efficient outcome in relation to one use may cause excessive costs in relation to other uses. However, the ability to monitor environmental outcomes and actions at lower cost means that deals can be made to alter the standard property right in certain cases using well designed contracts that are monitored at low cost. This enables tailored transactions to be made to suit the different types of uses.

The community's increasing understanding and acceptance of the importance of many environmental issues also means the cost of enforcing both standard property rights and contracts designed to achieve environmental outcomes is reducing. Where community understanding and acceptance is poor, enforcement costs are likely to be high due to political costs of imposing tough penalties for actions the community does not see as significant, in addition to the logistical costs of catching those deliberately disregarding the property rights set in place.

2.2.2 Asymmetric and Hidden Information

Economic theory involves the application of theoretical frameworks that explore aspects relating to the exchange of goods and services, including analysis of the efficiency of markets and the reasons why they may be inefficient or missing. The evolution of this form of analysis, which can include game theory and information economics, (the analysis of the economic incentives that result in trades and markets and the information necessary to allow the relevant parties to participate in a way that creates value) is enabling economists to design mechanisms that overcome impediments to exchange. Economists can now design new mechanisms that specifically target asymmetric information problems. These mechanisms induce the use or revelation of asymmetric information in order to identify transactions that have the potential to create the most value (provide the greatest benefit at least cost).

As potential participants in environmental transactions become familiar with these mechanisms they realise that the risks previously associated with making such transactions due to information asymmetry diminish and they are more likely to enter the market.

The improvement in transparent and replicable scientific models and measurement techniques also reduces transaction costs due to hidden information problems associated with exchanges involving environmental goods as outcomes (or actions) are able to be confirmed at lower cost.

Using the wetland example, developments in science may help inform the agency about landholder actions that will cause flooding of the wetland, and the extent to which the provision of this habitat is likely to translate to an increase in local wildlife. Economists can design a mechanism that the agency can implement that use the relative opportunity costs of surrounding landholders to determine the transactions necessary to deliver the wetland objective at least total cost.

Arguably a current gap exists in our capability to reveal hidden information in that the accurate revelation of the willingness of the community to pay for native wildlife remains problematic. Public good characteristics, a lack of familiarity with purchasing environmental goods, and lack of information and understanding about the contribution that different amounts of different environmental goods make to their utility mean that individuals' abilities and incentives to identify and reveal this information are weak. Government may make assumptions using information revealed through the political process in order to determine the funding for the agency to create the wetland, or the agency may be forced to use member donations to fund the wetland, knowing that many within the community are likely to be free-riding. To date stated preference and contingent valuation techniques have generally been unable to provide willingness to pay estimates with a significant degree of confidence.

2.2.3 Packaging Problems

New computational capabilities can overcome some of the impediments that may be preventing markets from evolving. This is particularly relevant to the asset packaging problem.

Economists can now design special types of auctions to resolve many packaging problems (for examples, see Plott et al. (1981) and Rassenti et al. (1982)). The capacity to hold auctions that involve relatively simple bidding systems and use computer algorithms to analyse preferences for packages of items over single items or alternative packages and determine the combination of packages that create the most value (electronic combinatorial auctions, sometimes called 'smart auctions') now exists. This capacity provides those who have packaging problems with the potential to use 'smart auctions' to greatly reduce the large transaction costs previously associated with revealing the necessary information. This process allows participants in markets to get the exact package of assets or access needed to create viable businesses.

Many of the problems associated with aggregating the community's preferences remain. As discussed in the previous section, revelation of willingness to pay for a public good is problematic. Unless they are identical individuals' relative preferences may not usefully be aggregated.

Consider once more the wetland example. The agency may have a number of options available to solve the packaging problem of needing to engage the right combination of landholders for the same period to deliver the flood in order to make any one deal worthwhile. Achieving an aggregate quantity of water flow is important, and that requires individual landholder actions/outcomes to occur all at the same time. Designing a system that allows the agency to determine the time at which it is able to achieve the wetland flood at least cost (through making a simultaneous deal with a combination of landholders at a particular time) is needed to solve the aggregation problem. Solving aggregation problems generally requires a greater two way exchange of information about supply and demand, this may be delivered for example through a continuous simultaneous process, or through the use of multiple rounds. If the benefits delivered from using a mechanism designed to solve the aggregation problem, such as a computer software system or a multiple round bidding process, are likely to be significantly greater than the costs, the agency may be able to deliver the wetland where otherwise the packaging problem may have posed too great a risk for the agency to consider making deals.

2.2.4 Mechanism Design Methodology

Recent developments, including new ideas about mechanism design, science and technology and contract design create the prospect of designing specific procedures that enable individuals to interact in ways that allow potentially valuable transactions to proceed. However, designing these mechanisms so that they are efficient and effective is not an easy or costless task.

Roth (2001) observes that a methodology has been evolving to assist economists to design policy mechanisms where markets or other institutions are missing. This new methodology, called mechanism design, is being used to assist with the design and testing of these new approaches. Pioneered by Plott and Smith (as noted in Roth

2001), this systematic approach identifies the root causes of missing markets, proposes specific mechanisms that will allow transactions to proceed, and tests and modifies these mechanisms in economics laboratories and field pilots. It provides tools to road-test and refine mechanisms and to examine whether they are practical, efficient and effective. Experiments and field pilots are particularly useful when policy makers are faced with specific problems for which economic theory is unclear and there is no practical, relevant experience.

3. The National Market Based Instrument Pilot Program

3.1 Market Based Instruments

Market based instruments (MBIs) are "tools" that use a range of market-like approaches to influence the behaviour of people, in the case of the National Market Based Instrument Pilot Program (NMBIPP), in order to achieve environmental and NRM outcomes.

To influence the behaviour of individuals within the economy MBIs generally involve systems that allow parties to make individual choices based on the information that is relevant to them. Informational requirements and exchange are often larger for a MBI than for alternative policy tools. Revealing or exchanging this information may require a sophisticated process or technology. Outcomes must be measurable in order to evaluate cost-effectiveness and attain dynamic efficiency. Measuring outcomes involves converting scientific data into what is referred to as a "metric", this is something that informs the party with a demand for an environmental good about the estimated quantum of environmental good provided through an exchange.

In the past in many cases the technology and information necessary to design and implement instruments that could achieve the potential gains from trade was not available except at excessively large transaction costs. New ideas and capabilities now mean that MBIs can be designed to allow players to interact to achieve society's environmental objectives at considerably less cost than has previously been possible. As society's consumption of traditional goods increases, and as incomes grow causing society's demand for conservation to increase, ensuring that markets for environmental goods are designed to deliver environmental benefits efficiently will become increasingly important and failing to do so will become increasingly costly.

MBIs do not stand alone. To be cost-effective they require the appropriate regulatory setting and in many cases a level of education of the parties involved. MBIs will not be cost-effective means of delivering all environmental outcomes. For example, where opportunity costs are not large and some demand for the NRM outcome lies with potential suppliers it may be that voluntary approaches will continue to be important. Government grants based systems may be cost-effective where there is no heterogeneity in the environmental goods produced by potential suppliers, and so on.

Some argue that the level of transaction costs involved in MBIs, for example through modelling and measuring environmental outcomes, making field visits or through entering individual contracts, make them less cost effective policy tools than they appear. This is not necessarily the case. The additional level of benefits that MBIs are able to deliver as a result of incurring the transaction costs, where there is some heterogeneity, can reduce the net transaction costs of a well designed MBI compared to available alternatives.

3.2 Pilots in the National MBI Pilot Program

The NMBIPP investigates MBIs through funding pilots conducted in the field to demonstrate, familiarise and refine these instruments. Other pilots are being conducted in the laboratory with human participants participating in economic experiments to test new policy settings or design aspects of MBIs, often where implementation in the field would be costly without testing and refining them first.

Eleven pilots were funded for a total of approximately five million dollars under the National Pilot Program throughout Australia. More detail on the pilots and their findings can be found on the website http://www.napswq.gov.au/mbi/pubs/interim-report.pdf. Table 1 illustrates the spread of the pilot characteristics.

The NMBIPP funded cap-and-trade approaches (salinity and water quality), auction approaches (biodiversity, water quality, carbon sequestration and salinity), offsets (salinity), an insurance approach (wind erosion) and a leverage fund approach (salinity, biodiversity, carbon sequestration and water quality). Cap-and-trade and offsets are alternative approaches to an environmental problem associated with a set limit or critical target that society wishes to meet at least cost. The Program also funded three alternative approaches to address the objective of cost-effectively achieving quantifiable environmental outcomes: the leverage (gap funding) approach, insurance and auctions.

3.4 Findings Related to Mechanism Types

In general the findings from the National MBI Pilot Program indicate that, in certain conditions, with prerequisites satisfied, cap-and-trade systems, auctions and offsets systems can be effective tools to achieve NRM objectives. This section presents a brief summary of the key findings of Round One of the NMBIPP in relation to auctions, cap and trade systems and offsets. For information on leverage and insurance mechanisms and for further information on auctions, offsets and cap and trade systems see the NMBIWG Interim Report and the pilot final reports, available on http://www.napswq.gov.au/mbi/index.html.

3.4.1 Auctions

An auction is a mechanism designed to maximise the value created from allocating a resource (usually an asset or a contract) to competing firms or individuals. It does this through creating a short-lived market with a set of rules that regulate the way buyers and sellers interact.

Auctions have been used to allocate resources for centuries. However it was only in 1997 that Latacz-Lohmann and Van der Hamsvoort contended that auctions could be designed to efficiently achieve land-use change for natural resource management.

Given limited resources, choosing the actions that will maximise environmental benefit requires information about the costs of different management actions, the environmental benefits available from the different actions and their relative importance. This information is asymmetrically distributed: landholders know their opportunity costs, but government may be in the best position to estimate the relative importance, or benefit to society, of different aspects within and between environmental outcomes. Well-designed auctions harness competition between landholders to reveal information about the costs to landholders of producing environmental outcomes so that the agency can pursue those contracts that provide the most value.

Round One of the NMBIPP found that auctions can be a cost-effective means by which to increase the provision of diffuse-source environmental outcomes, including terrestrial biodiversity, salinity mitigation, aquatic biodiversity and water quality. The auction-based MBI pilots investigated whether auctions for services to provide environmental goods offered by landholders have the ability to outperform instruments previously used to obtain these goods, such as grants and fixed input price schemes. The pilot auction run in Western Australia was found to be almost three times more cost–effective than a hypothetical input-based scheme (White and Burton, 2005). Another pilot found that moving from the current fixed price scheme to an auction for biodiversity and water quality services in Onkaparinga (SA) would cost an estimated $100 000 up-front, but that the auction would be between 23 and 34 per cent more cost-effective once in place (NMBIPP Working Group 2005). These estimates involve and number of assumptions and should be interpreted with caution.

3.4.2 Cap and Trade

Where the environmental objective involves a common threshold, markets for point-source emission problems can be created by placing a ‘cap’ or limit on the production of an unwanted environmental outcome. Clearly defined shares of the cap, often referred to as permits, are then allocated between landholders (including firms) in the area. These actions create a market in which individuals will trade permits to maximise their returns, minimising the total cost of meeting the cap.

Cap-and-trade systems rely on a regulatory cap and the powers necessary to enforce that cap. In a cap-and-trade system, each firm uses private information about opportunity costs and private values to determine the best combination of output and emissions (or consumption). Private firms can purchase rights to emit as they expand, or sell rights to emit as they discover ways to reduce pollution, or scale back on production. As rights are bought and sold for firms to expand or reduce pollution, information exchange occurs between buyers and sellers and through this process prices for emission permits are discovered.

Cap and trade systems require a legal partial property right be specified. The implementing agency requires adequate legal authority and jurisdiction to enforce the cap, and must have the capacity to administer and monitor the system. Property rights must be assigned to individuals or firms. A system must be designed to enable trade in the property rights, including conditions for trade and processes for exchanging information. For the cost of setting up a trading system to be worth incurring, trades must occur. This requires sufficient sources of potential environmental damage, and abatement cost heterogeneity among these sources.

Where science enables sources of environmental damage to be monitored or modelled, there are numerous examples of the successful employment of cap-and-trade systems to meet a regulatory cap. Previous successful applications, such as the Hunter River salinity trading scheme, water markets in Australia and other countries, and the nitrogen oxide and regional clean air markets in the United States, have been subject to stringent regulations prior to the introduction of the cap-and-trade system (Whitten et al. 2005).

3.4.3 Offsets

A pure command-and-control approach prohibits actions leading to a certain outcome. An offsets system allows a firm to take those actions, provided the firm also takes compensatory action so that the overall environmental outcome at least remains the same. For example, where expanded production is expected to result in increased nutrient emissions into a river, a regulatory approach may refuse to grant the permit to expand. An offsets system grants permission (for example, through a permit or a licence) to increase production and direct emissions, provided the firm also takes action such that total nutrient emissions into the river either improve or remain unchanged. To implement an offsets system, an agency requires a regulatory hook to enforce the offsetting of environmental damage.

As there are many potential ways that offsets may be sourced, offsets systems may look very different to one another. Where the demand for offsets is sufficient more sophisticated mechanisms to source offsets are likely to reduce the transaction costs associated with an offsets system.

Scientific rules that qualify offsets must be stringent because the primary objective in cases where offsets may be considered is ‘no net loss in an environmental outcome’.

Because offsets systems limit a particular type of environmental damage but allow firms to meet that limit with greater flexibility, offsets bear some similarities to and can form part of a cap-and-trade systems.

4 Designing Market Based Instruments

4.1 MBI Design Considerations

One of the biggest risks with the current enthusiasm for MBIs arguably lies in the popularity of well known “trademark” MBIs, such as the BushTender auctions. There is a tendency for agencies to believe they can pick up and use exactly the same design as a previously applied MBI to address environmental problems that they face in their region or to achieve a different environmental outcome. This entails the risk that although some situations may appear similar, changes in different characteristics including among many other things, the functioning of the ecosystem, the characteristics and number of landholders involved, the institutional setting, and the information held by different parties that can have significant implications for the effective design of the mechanism, will not be recognised and the mechanism will fail to deliver the environmental objective cost effectively. Other agencies may then observe this failure as one due to that type of market based instrument not being cost effective, whereas it was actually a failure of the agency to design the instrument to achieve their objective given the particular characteristics of the problem they faced.

It is therefore important to ensure the appropriate skill and capabilities are involved in determining the appropriate instrument design to achieve the objective given the characteristics at hand. An efficient market based instrument can be designed by people with the appropriate knowledge, skill and experience applying the following basic principles:

i Objective

Before a mechanism can begin to be designed, the objective must be clearly identified and articulated. Examples of environmental objectives include the desire to meet a critical threshold, or to satisfy a willingness to pay for an environmental good.

ii Characteristics of the Problem

To be cost effective, a mechanism must be designed to achieve the desired objective at least total (including transaction) cost. To do this, the characteristics of the problem that have the potential to impact significantly on the transaction costs involved in different design features must be recognised and understood. This includes understanding the landscape, the players involved, the science available, the interactions within the landscape and between players, and the institutional setting.

iii Matching Demand and Supply Cost Effectively

Designing the mechanism that will match demand and supply cost effectively will require consideration of the appropriate property right or form of contract, the information held by or available to the respective parties, the transaction costs that the use of different design features will involve, and the benefits that different design features are likely to achieve. An understanding of the transaction costs that are likely to be incurred on the ground for different mechanism designs may be important, field officers may have the most accurate estimate of this information. The inclusion of field officers in the mechanism design phase therefore becomes important.

Science and technology is used to measure or model the unit of exchange involved in transactions that occur through the mechanism. Without being able to measure the environmental good or to model the environmental good that will arise as a result of an action, the benefits of different transactions can not be identified and the cost effective transactions are not apparent. In cases where general rules of thumb provide accurate estimates, the transaction costs of employing sophisticated science may not capture a significant increase in benefits such that the use of that science is worthwhile. However, where rules of thumb do not provide good estimates of the environmental outcome, incurring increased gross transaction costs from the use of sophisticated science and modelling is likely to produce a substantial increase in benefits, thus result in lower net transaction costs (a lower cost-benefit ratio overall).

The Catchment Modelling Framework used in the EcoTender pilot (an auction for multiple outcomes run in Victoria) found rules of thumb did not provide good estimates of environmental benefit at all in the area in which the pilot was applied (Eigenraam et al. 2005).

4.2 The Appropriateness of Different MBIs

There are many different forms of MBIs that have potential to be cost effective in situations with different characteristics. Auctions, offsets and cap and trade systems will each be appropriate in different circumstances. Other mechanisms, for example labelling systems, taxes, fees, subsidies and grants may be cost effective in other situations. In this paper the focus is placed on those mechanisms that round one of the NMBIPP showed, given good design and the right situation, are ready to be implemented more widely, this section continues to do so.

As discussed in the preceding section, for each application a mechanism must be carefully designed to suit the circumstance at hand. However, there are a number of common characteristics that can inform the basic form of mechanism (for example, auction, offset or cap and trade) that is likely to be suitable in a particular case. This section discusses some of these characteristics. Although it may be clear that a particular mechanism is likely to be suited to a particular problem there are many subtle design features within a basic type of mechanism that if not correctly interpreted and addressed can cause the mechanism to fail where it could otherwise have been successful.

Some common characteristics that can inform whether an auction, cap and trade or offset type mechanism is likely to be appropriate are:

- The nature of public understanding and acceptance of the objective;
- The extent of costs associated with measuring and monitoring the unit of exchange;
- The extent of land holder knowledge about alternative methods of production of the environmental good; and,
- The number of players involved in the supply and/or demand of the environmental good.

Some of the implications that these characteristics can have on the appropriateness of the mechanism are discussed below.

4.2.1 Public understanding and acceptance of the objective

Where public understanding and acceptance of the environmental objective is low regulation that makes participation in the mechanism compulsory may entail high transaction costs, for example due to high monitoring and enforcement costs. Cap and trade and offsets systems both involve regulation that causes the relevant parties to interact to achieve the objective. The extent of public understanding and acceptance of the environmental issue and objective influences the transaction costs associated with the regulation, and thus the mechanism. Where there is not necessarily widespread understanding and acceptance of the need for the land holders involved to bare the costs of achieving the objective an MBI that uses voluntary participation to determine the lowest cost provision of the environmental outcome, such as an auction, may be more likely to achieve the objective at minimum transaction cost.

4.2.2 Costs associated with measuring the unit of exchange

Different mechanisms involve trades of different magnitudes of the environmental outcome occurring with different regularity. In a cap and trade system for example, a small quantity of an environmental good may be traded frequently by many participants in the mechanism. Offset and auction systems tend to involve once-off trades to exchange a contract that will deliver the environmental good. Some transaction costs are fixed for the implementation of a mechanisms, whereas others are attached to individual trades. Where transaction costs associated with each trade or exchange are higher, the impact on the net cost of a mechanism that requires frequent trading that each have a small impact on the environmental outcome will be greater than the impact on the net cost of a mechanism that makes fewer trades to reach the environmental objective.

Where complex or time-consuming processes are required in order to trade or exchange contracts transaction costs of mechanisms that rely on frequent small scale trades will increase disproportionately compared to other mechanisms. If it is costly to measure the unit of environmental good, for example where trades must be made on a 'like for like' basis and it is complex (costly) to determine a 'like for like' unit, the net cost of a mechanism relying on frequent small scale trades becomes very high compared to the net cost of mechanisms such as auctions and offsets systems that are based on once-off exchanges.

4.2.3 Land holder knowledge of producing the environmental good

Where land holders have access to good knowledge about the production of environmental outcomes, for example, about the alternative actions that produce environmental outcomes and the relative amount of environmental good produced by different actions, it will be less costly for them to make trade decisions based on the production of private goods relative to that of environmental goods. Here transaction costs associated with each trade decision may be small enough that land holders will determine the most valuable trades and a cap and trade system may be cost effective. Where land holders do not have access to this information the transaction costs associated with a mechanism that relies on frequent trades increase disproportionately.

4.2.4 The number of players involved in supply and/or demand

Different mechanisms require different numbers of participants on the demand and/or the supply side to create the competition necessary to deliver an efficient outcome. For example, auctions for conservation contracts require sufficient supply to ensure opportunity costs are revealed truthfully. Cap and trade and offsets systems require sufficient heterogenous participants to create trades that produce enough value for the mechanism to be cost effective.

4.3 Summary of the Appropriateness of Mechanisms

Table 2 summarises the implications that each of the above commonly relevant characteristics may have on auctions, offsets and cap and trade systems. Where:

- **Public Acceptance** – relates to the impact that public understanding and acceptance of the environmental objective and the policy tool influences the extent to which parties adhere to regulation and contracts.
- **Landholder Production Knowledge** – relates to the impact that the extent of landholder knowledge about producing the environmental good has on the transaction cost required to transfer this information.
- **Cost of each trade** – relates to the extent of costs associated with measuring and monitoring the units of exchange (the environmental good).
- **Number of participants** – relates to the number of players needed to be involved in supply and demand within the mechanism.

This should be interpreted as a guide to the potential transaction cost obstacles that these types of mechanism may face if applied in a situation where the characteristic was one way or another.

5 Conclusion

We now know that where there is a degree of heterogeneity well designed market based instruments have the potential to deliver greater benefits at less cost. Transaction costs associated with policy tools designed to achieve NRM outcomes include those associated with:

- defining and maintaining property rights such as the cost of monitoring and enforcing contracts;
- addressing information asymmetries including scientific measurement costs and the cost of implementing the economic instrument employed; and,
- solving packaging problems through allowing increased information exchange, such as software systems involving continuous and simultaneous allocations, or the use of multiple rounds.

As the transaction costs associated with new mechanisms continue to decrease market based instruments will offer greater efficiency gains to the economy.

Where the objective is clear, and the knowledge, skills and capability exist to understand the relevant characteristics of the problem and model and measure the environmental outcome involved economists now have better potential to design market based instruments that efficiently match demand with supply.

Transaction costs associated with identifying and aggregating individual members of the community's preferences remain. Public good characteristics, a lack of familiarity with purchasing environmental goods, and lack of information and understanding about the contribution that different amounts of different environmental goods make to their utility mean that individuals' abilities and incentives to identify and reveal this information accurately are weak. Political processes, voluntary contributions, stated preference and contingent valuation techniques may provide estimates, however they are often costly and may not provide estimates with a significant degree of confidence. The increased adoption of market based instruments highlights the need to improve our ability to identify willingness to pay for different environmental outcomes. Without the ability to better identify demand, the overall efficiency of environmentalpolicy tool may be questioned.

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Tables

Table 1. Summary of Pilot Characteristics

	Method		Natural Resource Management Focus				Funding
MBI type	Field pilot	Experiment/ workshop	Salinity	Water quality	Biodiversity	Carbon	(% total)
Auction	4	1	✓	✓	✓	✓	33
Cap and Trade**	1	3	✓	✓			17
Offset	1		✓				12
Insurance*	1						2
Leverage	1		✓	✓	✓	✓	36
Total	7	4					100

* The insurance pilot's focus was primarily wind erosion, and this was a desk based pilot.

** One cap and trade pilot involved both experiments and a field component.

Table 2. The Appropriateness of Cap-and-Trade, Auctions and Offsets Systems

		Cap and Trade	Offsets	Auctions
Public Acceptance	**High**	May be appropriate (low TCs from regulation)	May be appropriate (low TCs from regulation)	May be appropriate (should get sufficient interest for supply)
	Low	Not likely to be appropriate (cost of regulation high)	Not likely to be appropriate (cost of regulation high)	May be appropriate (as long as get sufficient interest)
Landholder Production Knowledge	**High**	May be appropriate (lower cost of landholder trades)	May be appropriate	May be appropriate
	Low	Less likely to be appropriate (trades more costly)	May be appropriate (if info can be provided at reasonable cost given one-off trades)	May be appropriate (if info can be provided at reasonable cost given one-off trades)
Cost of each trade	**High**	Not likely to be appropriate	May be appropriate	May be appropriate
	Low	May be appropriate	May be appropriate (given one-off trades)	May be appropriate (given -off trades)
Number of participants	**Demand**	Sufficient heterogeneous participants needed to capture value from trades	Sufficient demand needed to warrant addressing with regulation requiring offset	One or more demander necessar.
	Supply	Same as above	Sufficient supply to meet demand	Enough supply to create comypetition necessary