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**PUTTING MARKETS TO WORK:
THE DESIGN AND USE OF MARKETABLE PERMITS AND
OBLIGATIONS**

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Organisation for Economic Co-operation and Development

FOREWORD

Regulations are the sinews of modern government, the legal instruments that connect abstract government policies with the day-to-day activities of commerce and private life. In the highly-developed administrative states characteristic of OECD countries, government effectiveness has become to a significant degree dependent on the quality of the systems that develop, enforce, adjudicate, and terminate regulations. As an instrument of governance, regulations will continue to be used to meet a wide variety of legitimate social and economic needs.

In the past 20 years, few modern reforms of the public sector have received more attention, and stimulated more controversy, than has regulatory reform. Few governments are satisfied with the quality, effectiveness and cost of regulation. New demands -- from opening world markets and international integration, from problems of unprecedented scale such as environmental degradation and high non-cyclical unemployment, and from emerging interest groups such as consumers, to mention only a few -- have focused considerable attention on the role of regulation in causing and solving problems. There is growing evidence that reform of regulation, properly designed and carried out, can improve economic performance and government effectiveness in addressing pressing public concerns.

Today, regulatory reform has become a core element of modern, effective government. Almost all OECD countries have regulatory reform programmes, up from perhaps three or four in 1980, and more and more the debate focuses on how to reform rather than why reform is needed. The new initiatives are aimed at improving the performance, impact, and institutions of regulation. These initiatives vary greatly in objective and design, but they have distinctive features that mark them as genuinely new management capacities enabling governments to regulate more carefully by answering key questions: Are regulatory costs justified by benefits? Does regulatory intervention produce more social and economic benefits than would alternatives? Are regulations designed to achieve policy objectives at lowest cost?

The work of the OECD Public Management Committee (PUMA) on regulatory reform, carried out by the Group on Regulatory Management and Reform, attempts to respond to the specific needs of the new reform initiatives. The purpose is to provide better information -- drawn from practical experience, comparisons, and international exchanges -- on the benefits, costs, and risks of reform in the policies, management, processes and institutions of regulation.

The series of occasional papers on regulatory management and reform is intended to disseminate more widely the background papers, reports, and preliminary results prepared for the programme. The regulatory management and reform work and series of papers is led by Scott Jacobs of the Public Management Service.

Among other areas, the Group is examining alternatives to traditional regulation to better understand the benefits, costs, and risks of applying a wider range of instruments to policy issues. This work has been based on a series of case studies and other papers prepared by Member countries and experts. This report is one of the papers in this series. It was prepared by Brent M. Haddad, Ph.D, Visiting Professor of International Environmental Policy at the Monterey Institute of International Studies, and by Hans Huigen, Administrator, PUMA. Technical assistance was provided by Marthe Wambaugh, PUMA.

The papers are published on the responsibility of the Secretary-General of the OECD. The views expressed in the papers are those of the authors, and do not commit or necessarily reflect those of governments of OECD Member countries.

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EXECUTIVE SUMMARY

The expanding need for regulation coupled with pressures to reduce the cost of compliance has led to interest in marketable permit or obligation programmes (MPOPs). This paper presents the potential benefits and risks of MPOPs, offers practical insights into their design and implementation, and presents illustrative case studies.

The theoretical cost savings of MPOPs in relationship to traditional regulations are briefly presented, followed by a discussion of practical benefits and drawbacks of MPOP reforms. An example of a practical benefit is the potential for improved cooperation between regulators and regulated firms in achieving regulatory goals. Problems that may arise include having a programme that imposes unfair regional distribution of harm.

Criteria that shed light on whether an MPOP reform is appropriate in a given regulatory circumstance are presented. Among other criteria, one should examine the regulatory goal; the potential object of trade; and the financial condition, numbers, and compliance opportunities of the potential participants in the market.

With respect to MPOP design, practical ways of dealing with the conflicting themes of achieving the regulatory goal while promoting market-like trading conditions are presented. An open-but-guided design process is suggested, elements of property-rights design are discussed, and a mechanism for regulatory feed-back, review, and incentives is recommended.

A series of case studies then illustrates the points made above. Categories span programmes for trading air-pollution-permits, water-rights, fishing-rights, landing slots, and spectrum licenses, as well as obligations to purchase renewable-resource electricity, and to provide affordable housing. Marketable obligations are presented as a direct answer to the NIMBY (“Not In My Back Yard”) dilemma that inhibits the siting of locally-undesirable, but regionally-necessary facilities.

A concluding section further links the case studies with the previous text, highlighting practical lessons for MPOP design and implementation. One such lesson is that programmes with well-defined boundaries and limits on participation have a better chance of succeeding than programmes with doors to participation wide open.

PUTTING MARKETS TO WORK: THE DESIGN AND USE OF MARKETABLE PERMITS AND OBLIGATIONS

*by Brent M. Haddad**

I. Introduction

In a recent Southern California auction, rights to emit the air pollutant “Oxides of Nitrogen” in 1999 traded for US\$0.41/lb. In New Zealand, rights to catch Spiny (Red) Rock Lobster recently traded at NZ\$36 000/tonne of catch. Major U.S. airlines are trading landing slots at busy airports at prices in the range of US\$1 million per slot. And in New Jersey, the obligation to provide affordable housing has recently been traded at a cost of US\$27 000 per unit. All of the above transactions are examples of a recent and growing trend in regulation. In every case, governments have designed and established a market whose purpose is to achieve a regulatory goal as efficiently as possible. In most cases, companies or municipalities are trading permits -- rights to take some action -- but in some cases, an obligation -- a requirement to take some action -- is the object of trade. The design, uses, and potential risks associated with this form of market-based regulation is the subject of this paper.

Marketable permit or obligation programmes (MPOPs) provide administrators with an alternative to traditional regulatory techniques. In some cases, MPOPs supplement existing regulatory programmes; in others they stand alone. If developed and applied appropriately, MPOPs can reduce the cost of regulation, increase compliance flexibility, support economic-growth goals, and reduce the adversarial nature of regulation while still achieving regulatory goals. When applied on national scales, cost savings from individual MPOPs are measured in tens-to-hundreds of millions of dollars, with total savings in the billions of dollars. The following introductory comments offer justifications for the expanded interest governments have shown in MPOPs in recent years (OECD, 1994, 1993, 1992*a*, 1991), and then present a road map to the paper.

Opportunities for the use of MPOPs are growing both within and beyond their historic uses in pollution and natural-resource management. With respect to historic uses, governments throughout the world share the challenge of regulating the management and allocation of natural-resource systems. For example, forest-clearing for farming, grazing, or timber production is proceeding at a rate somewhere between 100 000 and 200 000 km²/year, introducing new territories into market economies, and raising new forest-management issues (Holdren and Harte, 1993). Meanwhile, airborne pollutants including acids, ozone-destroying chemicals, and greenhouse gases are exerting

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stresses on urban, rural, and natural regions. In the greater Los Angeles airshed, approximately 2 000 tons of oxides of nitrogen and hydrocarbon emissions enter the air every day (Lents, 1993). Ocean fisheries also are experiencing stresses from highly-capitalised fishing fleets pursuing declining stocks of fish (*Financial Times*, 1995). MPOPs present a viable alternative for regulation in these areas.

Beyond natural-resource and pollution venues, marketable permit programmes have been introduced in such areas as the right to land a commercial airline at a busy airport, and rights to use the electromagnetic spectrum for communications purposes.

Marketable obligation programmes have the potential of moving the cost-minimising benefits of market-based regulation out of pollution and natural-resource fields to a much broader array of applications. For example, a marketable-obligation programme helped break a political deadlock over provision of low- and moderate-income housing in the state of New Jersey, and has accounted for over \$80 million of housing upgrades throughout the state since 1988. In Vermont and Arizona, a marketable-obligation programme has been adopted that would require electric utilities and other retail sellers of electricity to demonstrate ownership of Renewable Energy Credits equivalent to a percentage of their total energy sales. The programme aims to ensure that a minimum percentage of each state's power comes from renewable resources while promoting market competition and cost-reduction among renewable-energy generators.

In addition to generating overall cost savings, MPOPs also reroute the flow of costs. Instead of the historic regulatory pattern of money being collected by a central authority and then routed by the authority to various government uses, MPOPs cause money to flow directly between regulated entities. The central authority takes on an oversight role. Instead of the cost of regulation being measured in terms of the size of government budgets, market modelers estimate costs of regulation based on private-sector activity. While the modeling approach may appear to be less accurate or less "controlled" than the centralised budget approach, in fact very accurate predictions can be made of programme cost. Cost-capping mechanisms can also be designed into MPOPs to avoid cost overruns. Meanwhile, MPOPs offer the potential for significant, additional, unexpected cost savings, as has occurred in the U.S. acid-rain-mitigation programme.

There is roughly a decade of experience with regulatory MPOP applications, although marketable permit programmes for water rights in the western United States have been active for many decades. The growing record of actual performance provides opportunities to develop practical insights to design, implementation, and management issues. This paper attempts to provide such practical insights. Following this Introduction (Section I), Section II presents some of the economic arguments in favor of MPOPs, and then lists practical benefits and drawbacks associated with their implementation. Section III sheds light on when an MPOP programme is a feasible alternative to traditional regulatory practices, and includes a checklist to aid in specific assessments. Then, practical aspects of MPOP design and implementation are discussed in Section IV. Sections V and VI look at case studies of actual MPOP programmes, and feasible potential MPOP applications. Section VII offers concluding remarks. Two Annexes follow the body of the work. The first briefly presents an example of the economic theory behind MPOP cost-savings, and the second provides a guide to the numerous acronyms used in the paper.

II. What are Marketable Permits and Obligations?

A marketable permit is a transferable right to take a defined action (e.g. catch X kilograms of fish).¹ A marketable obligation is a transferable duty to take a defined action (e.g. construct Y units of low-income housing). Markets for permits and obligations differ from each other based on whether what is transferred has positive or negative value. For "goods" (permits), money flows in the opposite direction of what is transferred; for "bads" (obligations), money accompanies what is transferred.

The balance of this section distinguishes MPOPs from privatisation reforms, and then briefly discusses the economic theory supportive of MPOP regulatory approaches. A description of practical benefits and drawbacks associated with MPOP design and implementation follows.

II.A *Theoretical justifications for Marketable Permits and Obligations*

MPOP reforms are distinctly different from privatisation reforms. With privatisation, ownership of infrastructure and organisations that provide social services shifts from public to private hands. Cost reductions are related to the introduction of a profit motive for owners and managers. The incentive of receiving a share of potential cost-savings motivates owners and managers to reduce the cost of providing the same social services. With MPOPs, a new tradable commodity is introduced, along with institutions to facilitate trading. Ownership of the trading or regulating institutions -- public or private -- is not an important issue.

The economic justifications for regulatory MPOPs is that they can both reduce and allocate efficiently the cost of compliance. They reduce the cost of compliance by providing financial incentives to find innovative low-cost compliance strategies, and by concentrating the choices and incentives in a decision-maker (business manager) who stands to benefit from a least-cost approach. Private firms, as well as public agencies, are allowed to operate in a market-like, competitive environment when pursuing regulatory objectives. Annex 1, Economic Theory of Cost-Savings Associated with MPOPs, summarises the theoretical argument for cost savings.

Gains from trade, which lower the cost of compliance, are a key reason for instituting MPOPs. A programme need not realise all possible gains from trade to be a success. As long as enough trading is occurring to justify the effort and cost of creating the programme, with minimal undesirable side-effects (discussed in Section II.C below), then the programme can be considered a success.

The other benefit, efficient reallocation of the cost of compliance, occurs because firms and agencies are provided with additional choices as to how to meet a regulatory objective. By shifting or taking on additional compliance responsibilities, a company or agency can take advantage of its unique circumstances to develop and implement a least-cost compliance strategy.

II.B *Practical reasons for Marketable Permits and Obligations*

Practical benefits also can accompany a well-designed and well-executed programme. The benefits listed below are summarised in Box 1. One potential benefit is an **improvement in the adversarial relationship between regulators and regulated entities**. This benefit arises since MPOPs provide regulated entities with additional autonomy in deciding how to comply with

regulations. There is less intrusiveness into operating decisions on the part of regulators, as well as a recognised appreciation built right into the programme that governments are sensitive to the costs of compliance. During the programme-design stage, the strongest positions typically are taken by regulated companies when deciding how to allocate the new property right, since it represents both wealth and access to market opportunities. But many other elements of programme design and management take the form of shared efforts to improve the efficiency of the regulatory endeavour.

Similarly, MPOPs create **incentives for self-regulation** since parties who have received new property rights now have a financial stake in a well-run programme. The transferability of a permit or obligation gives buyers and sellers an interest in maintaining its value, which is done both by honoring the terms of the permit or obligation, as well as by fending off programme-reform efforts. Further, parties that are playing by the rules do not want to see a competitor gain an unfair advantage.

Another practical benefit is that the selection of a market-based regulatory programme may be **a product of, or provide means for, a political compromise** that enables achievement of regulatory goals. Interested parties might otherwise be at an impasse in devising regulatory mechanisms to carry out public mandates. A market-based solution with its combination of increased autonomy, incentives for cost reduction, and achievement of regulatory goals, could satisfy enough base needs of the parties to forge a consensus.

A final practical benefit is that MPOPs provide **an opportunity for economic growth to occur** where a traditional regulatory programme might limit such growth. MPOPs do so by creating incentives for technology innovation, for forging new competitive alliances, and for adjusting production activities to take advantage of the market in its new form.

II.C Potential drawbacks associated with MPOPs

There are several potential drawbacks with MPOPs that in some cases serve to limit the applicability of this regulatory tool. The drawbacks stem from the social, physical, regulatory, and other circumstances surrounding the potential application. The following discussion presents some of these drawbacks, and offers examples where appropriate. Potential drawbacks are summarised in Box 2.

Box 1. Practical benefits from Marketable Permit and Obligation Programme

In addition to savings in the cost of regulation, the following practical benefits often accompany MPOPs.

1. More co-operative relationship between regulators and regulated companies.
2. Incentives for self-regulation.
3. Possible means of political compromise to break a regulatory deadlock.
4. An opportunity for economic growth and innovation.

Box 2. Potential drawbacks of Marketable Permit and Obligation Programmes

1. Market results that are unfair to particular individuals, groups, or companies
2. Inconsistencies with other policy goals.
3. Adverse social, cultural, or labor impacts.
4. Limited physical transportability of the traded good.
5. Unfair geographical distribution of harm.
6. Inappropriate venue for a trading programme.
7. Weak or inappropriate programme design limits effectiveness.
8. Risk of regulatory "capture."

Market outcomes (that is, who sells and who buys) depend in part on the financial resources of potential traders. Legitimate questions arise: why should rich parties or heavy polluters be allowed to buy their way out of requirements such as pollution control? Would not a tax on all polluters, for example, be a more fair way of distributing costs associated with environmental protection?

The issue of fairness sets boundaries around appropriate uses of MPOPs, and ultimately depends upon the details of the MPOP and the social, cultural, and political norms of the nation or region. Following are ways to think about the fairness issue. First, in terms of rich companies or heavy polluters being able to buy their way out of social obligations, one can start with the assumption that the company will act in an economically rational way -- that it will regard the permit or obligation market as a means for minimising its costs. It may or may not buy its way out of an obligation, depending on its other compliance options. If it does, this cost-minimising behavior may enable the company to retain employees or upgrade equipment to improve its competitive standing, with regionally-beneficial impacts. Further, since MPOPs require voluntary participation, the other party to any transaction must also be better off for trading. The other party's profits from trading also could go to additional employment and/or improved competitiveness. Ultimately, the society as a whole is paying less to achieve a valued social goal.

A second important issue related to fairness is the possibility of a rich company "cornering the market," or purchasing so many permits that smaller competing companies are financially damaged or thrown out of business. This could be described as anti-competitive strategic behavior. The potential for strategic behavior can be addressed in programme design either by limiting to a certain percentage the total number of permits one company can hold, by applying an MPOP only where there are large numbers of potential buyers and sellers, or by providing special protections to at-risk firms that do not have the level of market access or resources held by more established companies.

When such provisions are in place, one is unlikely to witness such behavior. Companies view MPOPs as a cost-reducing regulatory-compliance mechanism, not as a strategic element of core-business operations. Further, not only would an effort to monopolise a market lead to a rapid response from the agency overseeing the programme, but it would also result in frayed relations with other companies in the same business who no doubt work together on public-policy issues. One airline representative, for example, described a collegial relationship between the airline firms that enabled them to efficiently trade landing slots that provide rights to land and take off from busy airports (Sayre, 1997). So while patterns of ownership and movements of permit/obligation prices

cannot be predicted in advance, the risk of exploitation of an MPOP to achieve market power appears to be minimal.

Lastly, with respect to fairness, one must view proposed MPOP reforms in a comparative light. What is the alternative proposal? Does it also raise fairness concerns? Does a feasible alternative even exist to achieve the social goal? Do an MPOP's cost savings provide social benefits that out-weigh the potential normative drawbacks? Answers to these questions are specific not only to the MPOP, but also to the society considering it. A good example of an existing programme that encountered deep divisions on the issue of fairness, and where ultimately a satisfactory compromise was reached, involves the state of New Jersey's creation of tradable obligations to provide affordable housing (described in Section V.D below).

Turning to other drawbacks, it is possible that **other policy goals may not be satisfied by a market-based distribution**. One example concerns marketable permits for water rights. Urban areas and rich agricultural areas can afford to purchase them, but environmentalists may not be able to generate enough money to purchase rights for wetland protection or in-stream uses (fish protection, etc.). If the society as a whole values wetlands and in-stream uses, it may have to subsidise environmentalists so they can compete in the same market for water rights as do urban and agricultural interests.

Another potential drawback concerns **possible adverse social, cultural, or labor impacts** due to the economic efficiency promised by MPOPs. MPOPs save a society money by reallocating a right or obligation to the most efficient party. If a trading programme is established, traditional communities or indigenous peoples² could lose historic rights or acquire new obligations that are incompatible with their ways of life. Also, cultural and social patterns may be disrupted if a right or obligation that historically was common property is concentrated into one individual or company for purposes of tradability. An example might involve a coastal fishing village with historic rights to fish. The nation might prize the culture preserved in the village. An MPOP aimed at efficient distribution of rights to catch fish might disrupt the economic organisation that supports the culture. If the individuals or companies who receive marketable rights choose to sell them, the primary economic base of the village could be lost. If a nation wishes to preserve the historic economic organisation and culture of villages like these, it will have to design such preservation into MPOP rules.

With respect to labor impacts, if reducing labor costs can make a sector of the economy more efficient, then MPOPs will help increase the competitiveness of the more efficient firms. Demand for labor will decline as permits or obligations are concentrated in an efficient manner. If there are impediments to efficient reallocation of the labor force (unavailability of retraining, regional lack of employment alternatives), labor impacts could result. Again, to the extent such impacts can be anticipated they can be mitigated.

Some goods have limited physical transportability, which reduces access to the market to those who are linked to transportation nodes. Again, water provides a good illustration of a good that can only be traded by those with access to rivers, canals, reservoirs, pumping facilities, and other physical infrastructure. New users may need to have the cost of their access to the good (such as the cost of extending canals) subsidised if they are to participate in the market.

Market distribution of a good or bad may result in **unfair geographical distribution of harm**. For example, in the U.S. if mid-western coal-fired power plants purchase surplus SO₂

emission allowances generated in New England, even though overall SO₂ emissions are declining, regions like the Appalachian Mountains that are in the plume of the coal plants' stacks will be adversely affected. In the programme-design stage, many of these kinds of impacts can be predicted and stopped. A strong data-gathering, review, and revision process can also help resolve unanticipated problems.

And finally, an **inappropriate venue for a trading programme** could result in no trading or provide opportunities for regulated entities to avoid compliance. Inappropriateness could be due to many reasons: lack of adequate compliance-monitoring budgets or technologies, a desire by companies to protect trade secrets, unavoidably-high transaction costs, ineffective penalties, or a social desire that regulated entities not buy their way out of physical compliance. In terms of compliance monitoring, if a thorough, clear, and relatively low-cost compliance-monitoring system is not available, an MPOP may not be appropriate. Monitoring may require installation of technology and/or access to contracts or other company records, as well as the right to unannounced audits and inspections. When these elements are unavailable or not feasible, there are no grounds for enforcement.

A **poorly-designed programme** can grind regulatory compliance to a halt as parties try to sort out who owns what and what everybody's obligations are. No trading probably indicates problems in venue or design, but scant trading may not. Even though economic benefits are accrued from the trading mechanism, if alternative compliance methods arise that are more economical than trading, as has occurred in U.S. SO₂-permit markets, then the thinly-traded market could be viewed as a success for stimulating such innovations.

A final potential drawback is the **risk of regulatory "capture"**. That is, the most powerful companies might be able to take control of key aspects of the MPOP design and implementation process, and use it to reduce its compliance obligations, create unfair gains from trade, or block competitors' entry to the market. Capture is a possibility no matter what the form of regulation. If regulators, competitors, and other parties with an interest in the regulatory process (e.g., consumer advocates, environmental groups) are aware of the possibility of capture, as well as of the potential dynamics of a new market-based regulatory programme, the likelihood of capture occurring is reduced. Section III provides more detail on how to identify appropriate circumstances for using MPOPs.

III. When Can Marketable Permits and Obligations be Used?

It is understandable to look around at all the well-functioning markets found in industrialised nations and believe that market-creation would be a simple task. In fact, modern-day market institutions have slowly evolved over 350 years (Toulmin, 1990). Creating a new market for a new commodity in a matter of months or a few years is extremely challenging. This section sheds light on the preliminary question of whether an MPOP reform is appropriate in a given regulatory circumstance. The content of the section is summarised in Box 3, Checklist for Determining Whether to Pursue Creation of a Marketable Permit or Obligation Programme.

- 1) The **regulatory goal** must be clearly-stated, quantifiable, and supported by legislative, judicial, or other mandate. If there is ambiguity, no deadline, a perceived willingness not to enforce the requirements, or a perception that penalties for non-compliance are trivial, then there will be

minimal incentive to participate in a market. Companies or public agencies will not bother to trade.

- 2) One must also address the concern **that risks associated with non-compliance, or with the decentralised decision-making that accompanies MPOP reforms, will outweigh the financial benefits** from rights trading. Risks could be to public safety, the financial health of public or private institutions, human health, or environmental quality. Of course, risks of these kinds applies to all regulatory approaches, traditional or otherwise.
- 3) The **object of trade** deserves careful consideration. First, an object of trade (as defined in a permit or obligation) must be identified that, if traded, could reduce the cost of compliance. For example, a marketable obligation to do something that is trivial or that companies or government agencies would do anyway does not lead to meaningful cost savings. Sections V and VI below offer several examples of existing and possible objects of trade.
- 4) Part of the challenge of market creation is that the object of trade must be evaluated for certain characteristics before it has been formally defined. For example, the object must be **divisible**. That is, it must have identifiable boundaries that can be used to apportion it among different owners. For example, companies cannot trade an obligation to provide clean air, but can trade a permit to emit specific amounts of air pollutants.

**Box 3. Checklist for determining whether to pursue creation
of a Marketable Permit or Obligation Programme**

- (1) Is the regulatory goal clearly-stated, quantifiable, and adopted?
- (2) Do potential benefits exceed potential costs associated with decentralising compliance decisions?
- (3) Can a permit or obligation be identified that, if traded, would reduce the cost of compliance, or provide economic benefits?
- (4) Is the object of trade divisible?
- (5) Is the object of trade measurable?
- (6) Is the object of trade verifiable?
- (7) Can potential permit purchasers or obligation transferors afford to pay the expected market price of the permit/obligation?
- (8) Can certain rights-holders afford not to sell their rights?
- (9) Are there sufficient numbers of traders to make market creation a worthwhile investment?
- (10) Does the regulated entity have several alternative compliance paths?
- (11) Can transaction costs be held down?
- (12) Do market-oversight institutions have potential conflicts of interest with a trading programme?
- (13) Is there an institutional culture that might lead regulators to weaken market mechanisms?

(14) Is there a regulatory authority with sufficient administrative and enforcement powers to carry out the programme?
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5, 6) The object of trade must also be **measurable** and **verifiable**. While many potential objects of trade can be measurable under ideal circumstances, such as in a laboratory, the need for regulatory verifiability means there has to be a low-cost non-intrusive way for regulators to verify that the object of trade is being utilised in accordance with its ownership rights and duties, and regulatory constraints.

For example, rights to emit quantities of oxides of nitrogen (NO_x) can be traded because there are non-intrusive continuous-monitoring technologies available. These technologies verify that when the right to pollute X tonnes per year of NO_x has been sold, the seller has truly reduced NO_x output by the appropriate amount. But efforts to develop a similar trading scheme for rights to emit volatile organic compounds (VOCs, or hydrocarbons) have been stalled since there is no cost-effective way to monitor all of the sources of VOCs. Likewise, measuring the amount of a particular species of fish caught not only requires counting the tonnage brought in by ships in pursuit to that species, but also counting the incidental, or "bycatch" of vessels pursuing other species, as well as estimating what quantity of the species may have been discarded at sea as relatively unprofitable.

7) Turning to the potential participants in the market can potential purchasers afford either to buy the permit or to transfer the obligation? This is a difficult estimation to make since in advance of the market, one cannot say with certainty who the traders will be, what the traded object will be, and what its general value will be. Estimations from surveys and modeling are the only recourse, yet their results should be greeted with ample skepticism.

8) Conversely, can certain sellers afford not to sell? A nation may wish to preserve a cultural heritage or way of life that now exists among a subset of its citizens. It is possible that the object of trade (fishing rights or certain land uses, for example) already is subject to historical property-rights arrangements and resource-use patterns that are inextricably bound up with the traditional culture. It is further possible that the traditional culture is not highly monetised, and is subject to economic fluctuations associated with resource availability. During the inevitable down years, those who receive the new right to sell the object of trade should be able to afford not to sell. Once sold, it is unlikely the members of the traditional culture could ever afford to repurchase the right from the larger market-based economy. Loss of the historic use-rights could be damaging to the culture as a whole. So to the extent a nation wishes to preserve certain historical ways of life, and simply absorb the loss of economic efficiency that results from leaving some historic property-rights and use patterns alone, it should make special provisions in the design of its MPOP.

9) Are there sufficient numbers of potential participants to create a market? If there are less than ten potential participants, then cost-minimising compliance programmes probably can be handled by regulators on a case-by-case basis. Small numbers also introduces the possibility of collusion on pricing or trading rules in order to limit entry into the market by new companies. If there are more than 30 potential participants, then there may be enough for a voluntary trading programme to arise, provided other conditions are met. If there are between 10 and 30, the particular circumstances will influence the decision of whether to pursue an MPOP reform. These numbers are based on review of actual trading experiences; some observers would estimate the minimum number of potential participants to be significantly higher (Palmisano and

Neves, 1994). Increasing the number of potential participants should be carefully weighed against other rationales for limiting programme size, such as adhering to the boundaries of a watershed, a sustainable fishing zone, or a single political unit.

- 10) Are there several alternative compliance paths that would enable certain companies or agencies to overcomply and create marketable permits or acquire obligations? This condition relates to the two separate cost curves found in Table A.1 of Annex 1: are the marginal costs of compliance sufficiently different to create the opportunity for gains from trade? One might examine how varied are the industrial processes of potential traders in a given market, what is the mix of ages of machinery, and how diverse are the intended outputs of the industrial processes. For obligations, one might examine the relative costs and benefits of siting facilities in a number of regions. As long as the costs differ, there is an opportunity for gains from trade.

Another way of stating the above concern is: are there sufficient potential cost savings available to justify pursuing the MPOP reform? There is a tendency to over-estimate the potential benefits of reform (Stavins, 1995) and under-estimate its potential costs. Such optimism puts regulators charged with carrying out an MPOP in a difficult position since they may be held responsible for the economic results of the programme. Realism when estimating both benefits and costs is necessary to make the appropriate decision.

- 11) Can transaction costs be kept low enough that trades take place? The concern here is not only that trades occur, but that they can be negotiated in a timely manner in case there are regulatory deadlines or seasonal demands for the object of trade.

There are two kinds of transaction costs. The first kind deals with negotiating and executing agreements: how expensive is it for one party to verify the claims of the other party? And if carrying out the transaction requires one party to make some specialised prior investments (in conveyance facilities, for example), how can that party secure its investment in case the agreement falls through, or the other party wants to change the terms of the agreement? Transactions that can be executed in a short period of time -- an exchange is made and no further dealings are necessary -- have lower transaction costs than those requiring ongoing performance and monitoring (Williamson, 1985).

A practical example of transaction-cost impacts can be found in a choice of design for a marketable-permit programme for air-pollution emissions. If a company over-controls a pollutant and sells the excess permits, who is responsible for on-going monitoring to ensure that the reduction remains valid? If the purchaser of the permits is responsible (that is, the purchaser could lose its permits if the original seller increases its emissions), the purchaser would likely insist on a protective long-term contract. Some contract mechanism would have to be created that spells out monitoring activities and recourse for the purchaser should the seller increase its emissions. Then the purchaser would face on-going costs of verifying the seller's compliance. An air-pollution-permit market organised in this way would entail very high transaction costs compared to one in which the two parties need have no further dealings once the permits are sold. In this latter case, a government agency might take over compliance monitoring. One reasonably would expect to find more market activity in the latter low-transaction-cost market than in the former market.

Another form of transaction costs is the financial investment a company makes in filing

applications, undertaking environmental impact assessments, attending meetings, and other steps necessary to transfer a good that is subject to public scrutiny (Colby, 1990). This type of transaction cost is easier to quantify than the one discussed above. Programme designers should seek to minimise these costs, fully aware that some level of cost is necessary since the market exists as part of a regulatory process. As discussed in Section IV below, programme designers should resist the temptation to expropriate as transaction fees the gains from trade available through MPOPs.

- 12) Turning to market oversight, one should evaluate in advance whether there is a potential conflict of interest between the likely oversight body and the efforts of participants to trade. This conflict of interest could take two troublesome forms. The oversight body could have a regulatory requirement to dispose of the object of trade in a way different from trading. For example, if fishing rights are being traded, and the oversight body has a mandate to reduce the overall fish harvest, the oversight body has a clear incentive to stop trades involving permits that otherwise would not be utilised. If otherwise valid trades are blocked, the market could lose its credibility among potential traders.
- 13) There might also be an institutional culture that does not agree with the transfer of decision-making power from the regulatory body to the regulated companies. This aversion could manifest itself in transfer applications being rejected on trivial grounds, transfer applications languishing for months in a review process, neglect of the regulatory mechanisms of transfer, and lack of incentives or rewards to administrators who promote MPOPs.
- 14) Finally, and perhaps more fundamentally, there must exist an oversight body with sufficient administrative and enforcement power to carry out the programme. Resource flows often ignore political boundaries; in such cases, coordination may be necessary to develop a programme that benefits all participants. At a minimum, a political climate that would allow for creation of an appropriately-empowered administrative body must exist.

The above list, summarised in Box 3, should help regulators determine whether a particular regulatory context is appropriate for MPOP reform. Not every item must favour a market in order to proceed, but if enough do not, or one element emphatically does not favor a market, then a market probably is not the appropriate regulatory tool. In the next section, Section IV, issues surrounding MPOP design and implementation are raised and discussed.

IV. Designing and Implementing a Marketable Permit or Obligation Programme

As mentioned briefly at the beginning of Section III, one encounters unexpected complexity in designing and implementing MPOP reforms. Among the sources of the complexity are two themes that underlie design and implementation, and that sometimes come into conflict. The first theme is that the primary purpose of the undertaking is to achieve a regulatory goal. Whatever its substantive content (affordable-housing construction or purchase of renewable-resource electricity, for example), achieving the goal calls for regulation and enforcement, and an MPOP is no more than a means of achieving that goal. The second theme is that for an MPOP to succeed, it must generate private-sector-like conditions in which trading can take place. Potential conflicts arise when the first theme calls for restricting economic freedoms while the second calls for extending economic freedoms. In practical terms, these conflicts often take the form of intrusive monitoring procedures in a context of decentralised, market-based competition among private companies.

Another source of design and implementation problems is the inherently political nature of the undertaking. Issues of political contention could include how property rights to the new class of permits or obligations will be distributed, what the expected total cost of compliance will be under the trading programme, what level of intrusiveness is allowed for purposes of verification, how much of one's compliance duty can be transferable to another party, and to what extent geographic redistribution of impacts is permissible. Design and implementation decisions that come out of political compromises may not be the best in terms of facilitating trading. Some parties may remain dissatisfied with the decision to implement an MPOP, and may persist in efforts to block the programme. It should be noted, however, that all regulatory programmes, not just MPOPs, face politics-related difficulties in their design and implementation.

Yet another challenge is that a trading programme could be affected by legislative, executive, and judicial decisions that were not made with the programme in mind. A mandate that was promulgated for a reason completely separate from the goals of the MPOP could block trading. For example, efforts to trade water rights could be blocked by environmental restrictions on uses of a key waterway. Administrators may then be given the task of administering a trading programme that is subject to immovable constraints.

As great as the challenge is, a number of MPOPs have been established and have lived up to their potential as cost-saving alternatives to traditional regulatory programmes. They include markets for affordable-housing obligations, for fishing quota, for water rights, and for air-pollution permits. The balance of this section lists and discusses elements of successful creation and implementation of MPOP reforms. A list of the elements is presented in Box 4.

- 1) **The programme-design process should be consultative and open, but guided.** The fact that MPOPs decentralise compliance decision-making means that the new conditions in which compliance decisions are made must be considered. Potential sellers and purchasers of the object of trade, as well as other stakeholders (e.g., non-governmental organisations concerned with the regulatory goal), should be included in substantive discussions over all aspects of programme creation. Certainly interest groups will promote their interests, but they also will provide data and perspectives that need to be considered so that institutions are realistic, and the legality and legitimacy of future permit or obligation trading is not constantly challenged. The risk of an open process is that it could take two years to reach agreement on a programme that otherwise would take eight months to design and implement. As suggested above, an open-but-guided process could yield thorough input from stakeholders in a relatively short period of time.
- 2) Private-sector-like conditions for trading are related to property rights and transaction costs. In **designing property rights** that accompany the permit or obligation, administrators first must provide enough substance that the rights have value -- that somebody would be willing to buy them. At the same time, the rights associated with the permit cannot be so strong that administrators lose their ability to achieve the social goal. In other words, administrators should create property rights with enough flexibility to evolve as the regulatory programme evolves, but to be inflexible enough to have the lasting value needed to provide an incentive to purchase them.
- 3) Following the preliminary evaluation of the object of trade, discussed in Section III above, the permit or obligation must now be made tangible. If traded, it should help achieve the regulatory goal. It should be quantifiable, real, permanent, and enforceable. In order to be traded, the permit/obligation in some cases must be shown to be surplus or not less/greater than what

otherwise would have been achieved under traditional regulation. This latter condition essentially means that a marketable permit or obligation can only arise from efforts beyond what would have occurred under traditional regulation, and presumably has arisen because of the new incentive of trading the permit or obligation on the market.

**Box 4. Elements of successful creation and implementation
of Marketable Permit or Obligation Programmes**

1. The design process should be “open but guided.”
2. New property rights should combine substance (so they have value) with flexibility (so the programme can adjust to achieve its regulatory goals over time).
3. The object of trade should, if traded, help achieve the regulatory goal.
4. Early transactions should be studied for guidance in reducing future transaction costs.
5. Performance feedback, evaluation, and incentive mechanisms should be created for the regulatory-oversight bodies.
6. A regulatory culture consistent with oversight of market-based programmes should be fostered.
7. The programme should provide meaningful penalties for non-compliance.
8. The programme should include a teaching component so regulated companies are aware of their options.
9. Programme participants should be allowed to retain a substantial portion of their gains from trade.
10. Programme administrators should refrain from instituting quick or unexpected changes in order to retain participants’ confidence in the programme.

- 4) Also described in Section III, the type and extent of transaction costs can have a strong impact on the success of any MPOP reform. Transaction costs are extremely practical considerations that are discovered when an effort to transact is made. To design a transaction-cost-minimising programme requires the input of market participants, as well as careful examination of the first set of transactions. Efforts by regulators to minimise transaction costs should extend from the design phase to the implementation phase, and will be discussed below in the latter context.
- 5) An important design element that should be explicit, well-integrated, and receive core funding from the beginning is a **feedback, evaluation, and incentive mechanism**. In terms of feedback, the mechanism should specify what MPOP performance data will be collected, as well as how and from whom it will be collected. It should further state how the data will be evaluated, and who will evaluate it. The mechanism also should identify clear, quantitative goals for the MPOP, who is responsible for reaching the goals, and what their incentives are. A high-ranking individual should be made responsible for the programme: someone with the power to make necessary changes. There should be tangible rewards for excellent programme performance, and penalties for a substandard programme.

One of the attributes of a well-functioning programme is a fast turnaround time on transfer applications. Many (but not all) MPOPs require that trades be reported, and some require trades to undergo regulatory review and approval. Such programmes may have a legislated time limit for the evaluation period (such as 90 days). At the end of the time period if no decision has officially been made, the transfer could be automatically approved. When the "default" favors the transaction, it takes away the power of regulators who oppose MPOP reforms to block the

market through inaction. Whether or not veto power should also be vested in interest groups depends on the particular regulatory context. For example, efforts to create a market for rights to federally-supplied water in California have been stymied in part because so many parties have potential veto power over proposed transactions (Haddad, 1996).

The purpose behind the feedback and evaluation mechanism is to institutionalise the effort to constantly improve regulatory performance. A tendency with any innovative programme is to put the best staff members on the development team, and as soon as the programme is launched, to push it onto other staff members that are less results-oriented. If a regulatory agency is going to make a commitment to maintain an active market, it must keep its commitment active through feedback, evaluation, and improvement.

The feedback and evaluation process could benefit from active participation of outside interest groups, including both those promoting achievement of the regulatory goal as well as those interested in lowering the cost of compliance. These groups can help both provide and evaluate the data necessary to judge MPOP performance.

To conclude, once an MPOP is operational, regulators must remain sensitive to the two competing themes introduced above: achieving a regulatory goal while facilitating private-sector-like transactions. Regulators must maintain an open attitude to suggestions and/or criticisms from programme participants and other interested parties. Processes and budgets for formal feedback and evaluation must be defended.

- 6) Related to administrative self-evaluation is the challenge of renewing the organisational culture of the regulatory agency. A culture resistant to MPOPs could be deadly to the programme. A number of techniques exist, ranging from presenting to employees a new image, agency-wide set of goals, and/or "orientation" to promoting younger employees that do not share possible historical biases that favor centralised regulatory control. The most senior management must agree with and actively support shifts in organisational culture if the shifts are to proceed quickly and smoothly.
- 7) Another design issue is that MPOPs usually do not replace existing regulatory programmes but rather facilitate cost reduction in the context of the existing programmes. Among the most important elements of an existing programme that should be retained are the penalties for non-compliance. Credible, significant penalties for non-compliance with the regulatory goals create the underlying incentive to find least-cost compliance solutions. If the underlying incentive is weakened when the MPOP is created, achievement of the regulatory goal may be put in jeopardy.
- 8) Some effort must be made to educate potential traders, although nothing teaches better than a successful trade. The dissemination of case studies documenting cost reductions is a valuable education tool. One of the first companies to facilitate air-pollution-permit trading in the U.S., AER*X, prepared and widely disseminated case studies of successful transfers. One can expect initial trades to involve senior management, but as the market becomes more routine, evaluation, negotiation, and trade execution should move lower in a company's hierarchy.
- 9) Another positive attribute is the lack of a "predatory" inclination on the part of regulators when it comes to distributing the gains from trade. Gains from trade can be expropriated by regulators either by matching the level of transaction fees to the estimated level of gains from trade, or by

requiring that some additional increment of permits/obligation be retired/satisfied without compensation in order to approve the transfer. If either is done, participants will quickly reevaluate the gains they can expect to keep, and probably de-emphasize trading. This response has occurred in air-pollution-permit markets as well as in water markets.

- 10) One final attribute of a well-functioning programme is stability of the laws and regulations on which the MPOP is based. Stability does not mean a complete lack of change, but rather an evolution that is slow enough and/or predictable enough that participants can adjust their expectations and market positions either to minimise losses arising from change or exploit a new opportunity. A side benefit of formal feedback mechanisms from market participants to regulators is that participants can more easily predict and prepare for changes in law and regulation.

To conclude, creation, implementation, and operation of an effective MPOP is a challenge. Some attributes have been identified in this section that, if present, increase the chances of success. The following section describes actual MPOPs, and links their experiences, successful and problematic, with the many attributes discussed above.

V. Examples of Current Uses: Successes and Problems

After a decade of experimentation, some empirical data is emerging on MPOP performance. This section seeks to illustrate and deepen the points made above by describing programme activities and results in three marketable-permit venues: air-pollution permits; water-diversion and end-use permits; and fishing permits, as well as one marketable-obligation programme: provision of affordable housing. After brief descriptions of the programmes, their strengths, weaknesses, and design/implementation challenges are highlighted in relationship to Sections I through IV. Table 1, Guide to References to Theoretical Points in the Case Studies, summarises the explicit links between the case studies and the previous boxes, especially Boxes 3 and 4. Table 1 can serve as a reference to help a reader identify which cases specifically illustrate which points raised in previous sections.

Table 1. **Guide to references to theoretical points in the case studies (*)**

Programme	Box 3	Box 4	Other Boxes	
	<i>Items</i>	<i>Items</i>	<i>Box</i>	<i>Items</i>
Air-Pollution Permits				
RECLAIM	7, 10	1	1	2
SO ₂	2, 10	7		
OMTP	11, 12, 13			
Water Rights				
Colorado	3, 10, 12, 13	6	1	2
SO ₂	2, 3, 5, 10, 11, 12	2	2	3
Fishing Rights				
New Zealand	2, 5, 6, 11	3, 5, 7, 9		
Iceland	3, 4, 8, 9, 14			
Affordable Housing				
New Jersey	1, 5, 6, 12, 13	3, 7	2	1, 2
Air Traffic Control				
Landing slots		7, 9		

* Programmes discussed in the case studies are listed on the left. When theoretical points made earlier in the paper are explicitly referenced in a case study, the Box-and-Item location are then presented. Boxes and items are summarised. This format creates an opportunity for the reader to reference in a case study an example of the theoretical point made previously.

V.A *Air pollution permit trading*

Trading of air-pollution permits is taking place in the United States on both local and regional levels. This section introduces elements of three programmes: southern California's Regional Clean Air Incentives Market (RECLAIM), the national SO₂ emissions trading programme, and a general set of rules for local air-pollution-permit trading proposed by the U.S. Environmental Protection Agency (USEPA). This latter set of rules is called the Open Market Trading Programme (OMTP).

V.A.1 *Trading of air-pollution credits in Southern California*

Southern California's South Coast Air Quality Management District (SCAQMD) regulates air quality in the greater Los Angeles area, which has the worst air pollution in the United States. In order to achieve compliance with federal pollution laws, SCAQMD needs a way to reduce industrial emissions by 80 per cent from early-1990s levels by 2010. With nearly 10-years prior experience with a limited emissions-trading programme involving offsets for new sources of air pollution, the District designed and launched its ambitious RECLAIM programme to aid in reductions of oxides of sulfur (SO_x) and oxides of nitrogen (NO_x) emissions. Any company or agency emitting more than 4 tons/year of SO_x or NO_x since 1990 qualifies for participation in RECLAIM. This amounts to roughly 350 NO_x emitters, of which roughly 40 also emit SO_x.

Only NO_x and SO_x are part of RECLAIM, and not other air pollutants, primarily because of technologies called Continuous Emissions Monitoring Systems (CEMS). NO_x and SO_x emissions are by-products of combustion, and CEMS can be installed directly at combustion emissions points. Emissions data is transferred directly to SCAQMD computers, which can immediately verify that actual emissions do not exceed permitted emissions. CEMS currently is economically infeasible for other air pollutants, including Volatile Organic Compounds (hydrocarbons).

Each regulated entity has been granted 17 annual blocks of permits to pollute, called RECLAIM Tradable Credits (RTCs). RTCs apply to an entire facility, not individual emission points. Each RTC, denominated in pounds (weight), specifies both a pollutant and a single year, through 2010, in which the RTC is valid. The first year's (1994's) allocation of RTCs was given to companies and agencies based on their historical rates of emissions. Each subsequent year's allocation has been reduced by roughly 5 per cent, which means that by the year 2010, when the RECLAIM programme ends, total existing permits for industrial emissions of NO_x and SO_x in the greater Los Angeles airshed will have declined by 80 per cent from its early-1990s level.

If Company A in 1995 adopts a control technology that reduces NO_x emissions by 15 per cent, that means it has over-complied in the years 1996-7, and can sell its excess RTCs for 1996 and 1997. By 1998, Company A will again need all of its (declining quantity of) RTCs, and will again have to find new ways to reduce emissions, or purchase RTCs from another company.

The RECLAIM system allows companies and agencies to plan and begin implementing their compliance strategies well in advance, since it is possible today to buy or sell pollution permits for any future year. To trade RTCs, firms, agencies, or others (investors, environmental groups, etc.) must register with SCAQMD. There is a US\$ 50 fee to register. Once a trade is made, SCAQMD is notified, and enters the changes in the two parties' computerised RTC inventories. CEMS data are then matched to the updated RTC inventory to monitor whether both parties remain in compliance.

With respect to RTC prices, one SCAQMD regulator feels that prices for 1994, 1995, and 1996 RTCs have been lower than expected since many companies and agencies successfully argued for generous original allocations. Prices may rise in the future, he feels, since all entities will soon feel the pinch of on-going annual reductions in RTCs (Muehlbacher, 1995).

In fact, data on recent trading of RTCs confirm this expectation, showing a steadily-increasing value for later-year permits (Margolis, 1995a). At the July/August 1995 RTC auction, which is sponsored annually by a private brokerage firm and a private consulting firm, 500 000 lbs of 1999 NO_x RTCs were traded at a price of US\$0.41/lb. 2005 NO_x traded at US\$0.845/lb, and 2010 NO_x traded at US\$ 0.853/lb. Same-year RTCs (1995) sold for only US\$ 0.089/lb. The increasing price probably reflects the increasing scarcity of RTCs in the later years of the programme. In total, 5.8 million pounds of NO_x were transferred between 18 sellers and 9 buyers. The auction represents roughly half of all RECLAIM trading, the rest involving company-to-company trading, often through a broker.

Planning for RECLAIM began in 1990. After an introductory public meeting, the District prepared a concept paper, held public meetings, and in 1991 received permission from its Governing Board to prepare a full feasibility study. By 1993, 40-50 full-time staff members were working on RECLAIM in a process that was open and consultative (Haddad *et. al.*, 1994). That year, VOCs were dropped from RECLAIM, substantially reducing the number of entities that would be involved. The programme was launched in 1994 for NO_x and SO_x. As of 1995, roughly 50 engineers and 50 inspectors worked on RECLAIM (Muehlbacher, 1995).

In establishing RECLAIM, the South Coast Air Quality Management District faced a number of challenges. First, the former permitting system, which targeted pieces of equipment and which was not computerised, had to be transferred to a computerised system covering entire facilities. This required long hours of skilled engineering work. Second, this regulatory approach had to be "sold" both to the entities that were to participate, as well as to other stakeholder groups (environmental groups, federal regulators, small businesses, etc.) Third, SCAQMD had to integrate RECLAIM into its own organisational structure, budget, information systems, career paths, staff allocation, training, evaluations, and culture.

The strengths of the RECLAIM trading programme are that it has reduced and simplified rule-making, given industry more autonomy and flexibility in long-term compliance planning, and created incentives for over-compliance. These benefits are consistent with the discussion of Box 1, Item 2, above, that the incentives for self-regulation provided by MPOPs yield practical benefits in addition to cost-saving.

Weaknesses include that RECLAIM is limited in its scope by the lack of availability of CEMS technology for smaller NO_x and SO_x sources, as well as for other important pollutants such as VOCs (hydrocarbons) and particulate matter. Second, original allocation of RTCs was extremely difficult as firms and agencies argued for higher levels. This process threatened to derail

establishment of the programme (Lents, 1993), and one result is that in the early years of the programme, RTCs have been abundant, requiring fewer physical steps to reduce emissions. Third, RECLAIM required over three years and a great deal of regulatory resources (financial and human) to develop. If in a few years the RECLAIM programme is successfully challenged and comes to an early end (a plausible scenario), then both the planning years and early years when ample RTCs were available would have been better spent pursuing other pollution control regulation opportunities. In other words, the results of the RECLAIM experiment (in terms of achieving cleaner air) will not be known for at least a few more years.

Every item in Box 3 currently is satisfied for the RECLAIM program. Over time, two elements, (7) ability to pay, and (10) several alternative compliance paths, may cease to be met. If new technologies do not create opportunities for significant reductions in NO_x and SO_x emissions, the price of RTCs could skyrocket, and the currently-numerous options for compliance disappear. This scenario could severely undermine the rationale for a tradable-permit approach to air-pollution control in southern California. With respect to Box 4, RECLAIM provides a good example of Item 1: an “open but guided” design process.

V.A.2 SO₂-allowance trading: a national programme

RECLAIM is limited geographically to the Los Angeles area airshed. A national (inter-state) trading market has been established to fight acid rain. USEPA is operating a programme in which emitters of SO₂, a precursor to acid rain, have been issued a finite number of allowances (permits) that can be used over the next 50 years. SO₂ allowances are denominated in tons of SO₂, but not by year. This is because acid rain is a cumulative problem, so the absolute amount deposited matters more than the timing of the deposition. Although participants (predominantly coal-fired power plants) may use up their allowances at any rate they wish, their incentive is to spread them out over the 50-year period envisioned by the programme. Further, a participant could not use up all its allowances at once, since power plants have finite capacity and finite demand for their energy output.

There are two deadlines for individual plants to reduce emissions: at the end of 1995, SO₂ emitters had to achieve a first level of emissions reductions. A second round of reductions must be achieved by 2000. The number of allowances issued to individual plants reflects these reduction targets. As with RECLAIM, plants that over-comply and have excess allowances may sell them.

SO₂ trading regulations were developed from 1991 to 1992, with the programme launched in 1992. They were authorised in Title IV of the 1990 Clean Air Act amendments. Strict enforcement measures are built into the federal legislation, including automatic fines (indexed to inflation), plus a requirement to purchase the missing allowances in the next period, for failure to demonstrate ownership of sufficient allowances. For intentional (criminal) non-compliance, heavy fines and jail terms are possible consequences. Each firm must designate a representative who oversees all aspects of the programme, and signs all official documents related to the programme. The penalties for criminal non-compliance are focused on this representative, who naturally becomes a strong advocate within the company for complete compliance. As of March, 1996, there have been no violations (Kruger, 1996). The performance underscores the point made in Box 4, Item 7, regarding meaningful penalties for non-compliance.

As with RECLAIM, CEMS technology enables USEPA to match output with allowances. When allowances are traded, the buying and selling entities must register the trade with USEPA. The

traders' computerised inventories are updated so that compliance in terms of the new levels of allowances can be monitored. There is no process for review and approval of trades.

An important design feature of the SO₂ programme that was debated in Congress concerned how much electric utilities should have to spend to reduce SO₂ emissions. To estimate cost, an estimate of the value and volume of tradable allowances was needed. Utilities predicted that a one-ton allowance would cost roughly US\$1 000; USEPA thought between US\$500 and US\$600. In fact, allowance prices originally (in 1992) traded for \$250, and as of June 1995 were trading for \$140, well below any prediction (Wald, 1995).

The original over-estimation of allowance prices had important public policy implications. Part of Congress's decision on how much acid rain reduction to require was based on predictions of how much the clean-up would cost. That is, Congress not only considered the health, ecological, and other impacts of acid rain when choosing a target for reductions, but it also had in mind a reasonable spending target for electric utilities. Because the cost of allowances was over-estimated, the overall SO₂ reduction goal is lower than it might have been. While some criticism has been leveled at the programme for this reason, it overall has been viewed as a success, since compliance costs have fallen dramatically, and to date there have been no violations.

There is a great deal of speculation as to why the cost of SO₂ allowances fell so far below its predicted levels. Among the possible explanations are that utilities purposely overestimated allowance cost, aware of the link between allowance cost and total obligation to reduce SO₂ emissions (Wald, 1995), that the cost of natural gas, a low-sulfur substitute for coal, has fallen more than expected, that costs of low-sulfur-coal mining and transport by rail are lower than predicted, making low-sulfur coal a more attractive substitute for high-sulfur coal, and that the price of technologies that reduce sulfur emissions, such as scrubbers, has fallen (Palmisano, 1995). Because several alternative compliance paths have become cost-effective, the SO₂ programme is consistent with Item 10 of Box 3.

Another design issue arises from the programme's regional nature. When a utility recently reduced its SO₂ emissions enough to generate excess allowances, it then negotiated to sell the allowances to another utility in the mid-western U.S. The state of New York tried (unsuccessfully) to intervene and stop the trade since the transfer means that more acid rain will blow from the mid-west into New York than would have without trading. Thus, the size of the trading area (several states) means that while overall impacts may be beneficial, some local areas may suffer disproportionate benefit or harm. This kind of concern falls under Item 2 of Box 3: whether potential benefits outweigh potential risks.

V.A.3 *Generic emissions trading rules*

The U.S. federal government is advancing another marketable permit programme related to air pollution. USEPA is preparing a set of generic rules for emissions trading. Any state whose air quality problems and planning for compliance with federal air-pollution-laws are consistent with emissions trading will be able to adopt these rules without a lengthy EPA review process. EPA calls this effort its Open Market Trading Programme (OMTP).

As of November, 1995, OMTP was still in the comment and revision stage. Some key problems have emerged that may reduce significantly the quantity of trading on future OMTP markets. An important flaw in the proposed rules concerns validation of the objects of trade:

emission reduction credits (ERCs) (Applied Energy Services *et. al.*, 1995). ERCs must represent reductions in air pollution emissions that are real, permanent, surplus, quantifiable, and enforceable. There currently is no process to verify the validity of an ERC in advance of trading. The lack of a pre-verification mechanism creates for a potential buyer additional transaction costs. The buyer must undertake its own costly verification process of the seller's claims, which is a disincentive to trade. This situation does not satisfy the transaction-cost concern found in Item 11 of Box 3.

The verification process introduces uncertainty another way. Buyers must describe for regulators "what environmentally favorable action" was used to create the ERC (Section D.4.iv of the proposed rules). This requirement creates the possibility that a particular regulator will not agree that a particular action that yielded an emissions reduction was "environmentally favorable." (Margolis 1995b) This possibility relates to Item 13 of Box 3, concerning regulatory-institution culture.

The disincentive to trade is compounded since the proposed rules give regulators leeway to confiscate ERCs after they have been traded if the seller's emission-reduction performance is not found to be satisfactory. The buyer could find its compliance strategy ruined by the behavior of another completely separate and perhaps distant company. With this kind of risk attached to the purchase of ERCs, potential buyers probably would only take an interest in the small portion of ERCs that can be verified and monitored easily over time.

An alternative programme design would be to allow for pre-verification of ERCs either by a government body or by authorised private firms. Pre-verification shifts compliance costs and responsibilities away from end-users onto generators/sellers. It requires different rules and enforcement procedures, but promotes ERC trading, without which there are no cost-savings. Buyers that purchase pre-verified ERCs can be confident that that element of their compliance strategy is intact.

Another concern for OMTP is that it is a generic set of rules that is intended to complement unique sets of existing rules in many different states and localities. A design benefit in one state could create a conflict in another. For example, a local programme may allow ERCs to be created and sold when a company ceases operations, a practice currently forbidden under OMTP proposed rules. The reasoning may be related to legislatively-mandated requirements to show "reasonable further progress" and "prevention of significant deterioration" in air quality standards, which can be accomplished by retiring ERCs from closed facilities. This is an example of Item 12 in Box 3, related to potential conflicts of interest involving the regulatory body and the trading rules.

If local and national rules conflict, an opportunity may arise for local regulators to apply their own interpretation to the circumstances in question. Their interpretation may or may not be sympathetic to a market-based regulatory programme.

The above problems in general can be attributed to the thematic conflict between achieving air quality goals and promoting private-sector-like trading. On the one hand, regulators should be able to "confiscate" false, flawed, or double-counted emission reductions. On the other hand, this regulatory power must take a form that allows for low-transaction-cost trading. Similarly, just as EPA hopes to accelerate implementation of market-based regulatory programmes by creating generic trading rules, their generic nature may lead to conflicts with states' individual industrial, regulatory, geographical, or other circumstances.

To summarise, the above discussion of air pollution permit markets describes a local and a national programme, as well as a proposed set of rules for local programmes. With respect to the two existing programmes, both are functioning: companies and agencies are in compliance with the air regulations, and trading of permits is taking place. For RECLAIM, it is too soon to tell if it can effectively operate when more severe cuts in emissions are required. In the case of national SO₂ trading, if one accepts the validity of the original SO₂ reduction targets, then the programme is an outstanding example of companies finding least-cost compliance paths such as installing low-cost scrubbers or switching to low-sulfur coal. An alternative interpretation is that in the design phase, the SO₂ programme was too lenient, and the nation is not getting the amount of investment in acid rain control from electric utilities that it should. The resolution to this latter interpretation lies in the potential impacts of the targeted SO₂ reductions: how much will the planned reductions improve human health, ecosystems, and the economy? Is this level of improvement satisfactory, or will more be required? In other words, was the theme of cost-reduction placed ahead of the social goal of reducing harms associated with acid rain?

Finally, the success so far of the OMTP rulemaking process is that it is open to outside comment and includes opportunities for revision and improvement.

V.B Water rights trading

This section contrasts an effective regional water market programme found in the state of Colorado with as-yet unfruitful efforts to create a state-wide market for water in California. Although successful district-level water markets also exist in California, Colorado's market is highlighted because its simplicity of design helps reveal its strengths.

V.B.1 Water markets in the State of Colorado

The general policy in Colorado is that water should be put to its maximum beneficial use. Property rights for water are based on the "prior appropriations" doctrine. To acquire a property right in surface water, one must declare an intention to divert a certain quantity of water from a stream for some beneficial use, divert the water, and then apply it to that use. The appropriator then has a permanent annual right to divert the stated quantity from that location and apply it to that use. Two principles govern how water rights are allocated. The first is the rule that "first in time is first in right." That means that the earliest appropriators have the right to take all of their water allocation in dry years, and later appropriators must wait their turn and take what is left. This principle in practice creates a queue of water users based on seniority of rights.

The second principle is the "no injury" rule: one appropriator's use cannot harm another appropriator's use. This rule arises both when a new appropriator attempts to establish a property right on a stream that is already appropriated, as well as when an appropriator attempts to transfer a water right.

Many aspects of appropriative water right have value. A buyer may value the seller's early appropriation date (which increases security of supply), the place of diversion, or the quantity diverted. As long as no other water users are injured, a transfer of water rights is allowed.

Colorado's Division of Water Resources has its headquarters in Denver, and seven field offices spread throughout the state. Each field office administers a region defined by the state's

hydrogeology. For example, Division V, with headquarters in Steamboat Springs, administers the Colorado River. Division II includes the Arkansas River Basin, and is headquartered in Pueblo. Because the regions are divided according to watersheds, there is little water trading between divisions. Each Division Office has an engineering and monitoring staff, as well as a Water Court devoted to settling water claims and conflicts, and reviewing water transfers.

Water rights are considered to be true property rights, not permits. Their status as property rights gives potential buyers confidence that they are paying for something of value, which satisfies Item 3 of Box 3. Knowledge of how to negotiate and transfer water rights resides in the private sector, among attorneys and engineers who help negotiate and execute transfers. A typical transfer may require US\$5 000 to US\$6 000 in attorneys' fees, and the same amount for engineers (Martellaro, 1995). The engineer's job is to verify the diversion and use claims made by the seller, as well as to demonstrate that no injury will be done to other appropriators along the river.

Once a transfer has been negotiated, the parties submit a standard form to the Water Court, along with a US\$ 125 fee plus publishing costs. The court sends one copy of the form to the state engineer, and publishes another copy in a local newspaper. The state engineer performs a "no injury" review, while the court evaluates any claims of potential injury arising from the publication of the intended transfer. If the water right is found to be valid and any claims of potential injury found to be unjustified, then the transfer is approved. Otherwise, the state engineers and court work with the parties to find ways to mitigate the injury and allow the trade to occur.

Water rights have been traded in Colorado for decades. In Division V, usually between 5 and 15 applications to change water rights are submitted each month to the Water Court. Prices for water depend on the region and on the characteristics of the right. Water rights near rural Grand Junction trade for roughly US\$0.06/cubic meter, while rights near rapidly-developing Summit City trade for as much as US\$65.00/cubic meter. (The acre-foot is the local unit; 1 af = 1 234 cubic meters.) Transfer quantities vary, but a common scenario involves a small metropolitan water district buying water rights for new housing. Quantities sold typically range from 300 cubic meters per year (enough for 5 new homes) to 54 000 cubic meters per year (either for a large residential/commercial development or for agriculture). The entire potential trading arena in Division V involves 22 000 water rights located in 11 000 diversion structures (dams, canals, reservoirs), easily satisfying Item 10 of Box 3, related to numbers of market participants.

Regional office operations are financed by the state treasury, and supplemented by application fees for permits to drill new wells. These fees do not approach the cost of administering the well-permit or water-trading programmes. The rationale behind state funding of the local operations is that it allows the water courts and engineers to remain as neutral representatives of the state's interests, consistent with Item 12 of Box 3.

Neutrality extends to uses of water, as well. If the state wishes to promote ecological uses, such as additional diversion of water to wetlands or in-stream uses, other branches of government must purchase water rights. The Division of Water Resources treats all parties, public or private, the same in terms of evaluating proposed transfers. This satisfies both Items 12 and 13 of Box 3, related to market oversight, as well as Item 6 of Box 4, concerning the importance of a regulatory culture that is comfortable with overseeing a market-based programme.

V.B.2 Water markets in the State of California

Since the 1980s, California has been attempting to create a state-wide market for water. The underlying goal is to move water from the agricultural sector, which uses about 85 per cent of the developed fresh water supplies, to the growing urban sector. Despite one of the world's most developed hydrologic systems and over a decade of legislative effort, as of March 1996, only a few trades have been finalised, and no water from long-term inter-regional transfers has actually been delivered from rural to urban areas.³

A number of reasons may explain the lack of trading. First, in addition to the prior appropriations doctrine (used in Colorado), California also integrates the riparian doctrine, which grants water-use rights to owners of land that borders waterways. To complicate matters further, water rights that predate the state-wide registration requirement (pre-1914 water rights) are exempt from much of the oversight and administrative processes of post-1914 water rights. Item 5 of Box 3, Measurability, is therefore not satisfied.

Second, the content of water rights, embodied in water use permits issued by the State Water Resources Control Board, has slowly eroded throughout the 20th century as additional environmental protections and area-of-origin protections have been introduced. Environmental protections include the Public Trust doctrine, which allows the state (usually through the courts) to repossess water rights without compensation, and redirect them to environmental, navigation, or other public purposes. Legal protection of water quality and endangered aquatic species also have reduced the content of private water-rights. Area-of-origin protections allow undeveloped counties with high rainfall (in the northern and eastern parts of the state) to take back water rights they have transferred away if they can prove that lack of water is limiting their economic growth. Both Item 3, Box 3, and Item 2, Box 4, are concerned with the substantive value of a permit. Neither item is satisfied since the property rights attached to a water permit are neither strong nor well-defined.

Third, numerous administrative bodies may get involved in reviewing and approving a water transfer. In addition to the State Water Resources Control Board, the state Department of Water Resources (DWR) may review a trade if it involves DWR pumps and aqueducts, and the federal Bureau of Reclamation may get involved if the trade uses facilities or water from the federally-owned Central Valley Project. The National Fish and Wildlife Service, Environmental Protection Agency, and state Department of Fish and Game may also review the proposed transfer for its environmental impacts. This both raises transaction costs (Item 11), and increases the possibility of administrative conflicts of interest (Item 12).

Fourth, the "no-injury rule" in California provides broad avenues for input from numerous parties, including selling-area governments, neighboring irrigation districts, associations of family farmers, environmental groups, and others. Similarly, nearly all proposed transfers require an Environmental Impact Statement to be prepared. This is an open, multi-month process that provides numerous opportunities for parties with opposing viewpoints to express concerns about the potential transfer. While this is a valuable process in terms of environmental protection and rural-society protection, it slows down and increases the expense of water trading, in effect limiting feasible participation to a small number of large irrigation districts and urban water agencies. So while there are thousands of rights holders, only a small number are large enough to engage in water transfers, calling into question Item 10 of Box 3.

Fifth, while the individual rural water user (usually a farmer or farm business) benefits from selling its water rights, the community could suffer. Many rural dwellers believe that losing water is equivalent to losing a way of life, and so they vigorously oppose other farmers' efforts to sell their water away from the region. Item 2 of Box 3, whether benefits outweigh costs, therefore remains unresolved, as well as Item 3, Box 2, concerning the loss of social, cultural, or labor values.

Finally, for numerous reasons, in California the volume of water involved in proposed transfers is vastly larger than typical Colorado transfers. For example, the two transfers lasting longer than two years that have been completed to date (all but delivery) involve 123 million cubic meters per year for 35 years from a southern agricultural region to the Los Angeles area, and a permanent transfer of 15.7 million cubic meters from a central California cotton producer to an expanding suburb just north of Los Angeles. The magnitude of these transfers amplifies their potential benefits and costs.

V.B.3 Comparing Colorado and California

As with Colorado, it is California state policy to promote the transfer of water to its most beneficial use. Colorado's trading programme is facilitated by neutral administrators, has relatively simple trading rules, a secure property right, and administrative regions consistent with the hydrological constraints on transferring water. In contrast, California's efforts to create a state-wide market face the challenge of complex property rules, numerous oversight bodies, long transfer distances requiring the coordination of several institutions, and individual transfers large enough to have significant local impacts. While it is possible that California could establish a market for long-term inter-regional trading, it first should simplify its legal regime and oversight structure, and create additional incentives for rural regions to give up water. Since many of the laws and institutions that currently stand in the way of water marketing in California serve other valid social purposes, policy makers will have to decide if more is gained or lost from creating a market.

V.C Fishing quota trading

Market-based reforms to carry out government policies may first have been introduced to nations' fishing sectors (Lacasse, 1992:11). As early as 1979, Iceland was experimenting with limited trading of rights to herring quota (Arnason, 1995:105). Today, a number of nations use tradable quota systems. A literature on tradable fishing quota programmes exists (for example, OECD, 1992b; Arnason, 1995, 1996). This section focuses on practical issues of programme design and implementation. New Zealand's quota trading system is examined in some detail, and then is contrasted with the experience of Iceland.

V.C.1 New Zealand's ITQ system

The two themes that New Zealand's commercial fishing participants and regulators have merged in their ocean fisheries Quota Management System (QMS) are strengthening the economic performance of the fishing industry while maintaining the Total Allowable Catch, measured in tonnes per species per season, at levels sustainable to the fisheries.

New Zealand is a small island nation of roughly 3.5 million people. Its commercial fishing activities generate about 5 per cent of the national GNP (Shallard, 1990). Roughly 17 000 people are

employed in the fishing industry, in which 3 000 commercial vessels participate. 10 per cent of the vessels take 80 per cent of the catch. The government agency responsible for regulating ocean fishing is the Ministry of Agriculture and Fisheries. The nation divides its fisheries into nine distinct regions, based on the presence and migratory patterns of various species.

As Clark, Major, and Mollen describe (1988), 1983 was a turning point for ocean fisheries management in New Zealand. First, both economic and biological (sustainability) problems reached a critical level and could no longer be ignored. These problems included a combination of over-fishing and over-investment in the fishing industry. The necessity for fishing companies to meet increased fixed costs was in turn putting additional pressure on the fisheries. Second, the Fisheries Act of 1983 was passed, recognising both biological (fisheries sustainability) and economic interests in fisheries management. And third, a fisheries management system involving Individual Transferable Quotas (ITQs) was created.

Officially, the ITQ system "allocates to individuals the transferable or tradable right to harvest a specific quantity of the surplus fish stock production." In 1986, ITQs were first applied to stressed species found close to shore. In creating ITQs, the government's goals were to introduce tradable property rights into fisheries management, reduce the level of regulatory intervention, allow fishing companies to respond to market forces and compete internationally, and to generate public revenue through resource "rental" fees. With ITQ rights, fishers can spread fishing effort out over the entire year, be more selective in bypassing juvenile schools in favor of higher-valued mature schools, and can purchase or lease additional quota to expand catch instead of resorting to poaching. ITQ trading appears to have successfully achieved its dual goals of restoring fisheries and improving the economics of the fishing industry, a performance consistent with the advice in Item 3, Box 4: create a market that furthers the regulatory goal.

Original allocation of ITQs for stressed coastal species was based on averaging of recent years' tonnage caught. Nearly 80 per cent of the 1 800 fishers offered ITQs appealed their original allocations; the appeals were eventually resolved. In an effort to scale back the total catch to a sustainable level, the government on two occasions entered and bought back on a willing-seller basis portions of the quotas fishers had just been granted. The government paid out \$45 million to retire 15 800 tonnes of annual catch in 1986. It should be noted that by basing ITQ allocation on recent years' catch records, the largest companies stood to benefit the most, and therefore had an incentive to shepherd the new programme into existence. This incentive is consistent with the benefit #1 listed in Box 1, concerning the possibility of easing adversarial relationship between regulators and regulated companies.

The ITQ programme is administered with the help of three documents. The Catch Landing Log is completed by the skipper of the fishing vessel as soon as the catch is landed, and includes the date, species, area, on-board processing, to whom the catch was transferred, the weight, and other data. This log must be available for inspection at all times. Next, all companies that receive fish from quota-holders must fill out and submit monthly the Licensed Fish Receivers Return, which lists fishermen, species and tonnage delivered, date, and other data. A receiving/processing company that receives fish from a fisher that is unlicensed or without adequate ITQ could suffer severe penalties, including loss of its license to operate. These potential penalties spread the incentive to comply with the quotas to on-shore facilities as well as to fishing vessels.

The third document is the Quota Management Report, filed by quota holders at least once per month. It describes the species, area, and quantity caught. In addition to the above tracking

documents, participants must retain supporting documentation, such as receipts, for a period of three years. Thus, fishers, quota holders, and on-shore fish receivers all provide information that can be verified and cross-checked, with discrepancies duly investigated. Another layer of documentation is available through fish export records, records pertaining to the national Goods and Services Tax, boat registration forms, and ITQ trading records. Item 6 of Box 3, verifiability, is therefore satisfied.

Trading of ITQs takes place on a national fish quota exchange operated by the New Zealand Fishing Industry Board, and supported by the government and other industry associations. After a founding grant from the government, the exchange is funded by annual membership fees. Traders can enter the computerised trading system directly or use the services of specialised fish-quota brokers.

Records from the 1992-3 fishing year reveal active trading: over 600 tonnes of quota were traded on a permanent basis, involving 31 species and all nine fishing regions. This represents about 10 per cent of the year's total allowable commercial catch. Looking at one species, 14.6 tonnes of permanent quota for Spiny (Red) Rock Lobster in Region 3 was traded with a low price of NZ\$ 36 425/tonne and a high price of NZ\$ 204 016. The total value of trading for this quota was NZ\$ 804 141. Similar activity was recorded in the market for annual leases of ITQs. There, the same Region 3 Spiny (Red) Rock Lobster quota leased for a low of NZ\$ 6 000/tonne and a high of NZ\$ 22 500/tonne. Overall, 12 tonnes were leased for a total cost of NZ\$ 108 700 (New Zealand Seafood Industry, 1993, Appendices 7,8). The wide range in prices in part reflects that ITQ transfers are often part of complex inter- and intra-firm deals that transfer fishing equipment as well as fishing rights. While it is difficult to distinguish what portion of the total transaction price went exclusively for ITQs (Peacey, 1995), this pattern of trade suggests that market participants are finding innovative least-cost ways to manage their fishing investments, satisfying Item 11 of Box 3, related to transaction costs.

The transfer system includes elements favorable both from economic and from biologic perspectives. Trading is anonymous and flexible: permanent sales, leasing, subleasing, forward trading, and even retroactive trading to balance catch against quota are allowed. Because fishing is not so precise that quotas can exactly be filled, opportunities exist for pooling of quotas between fishers, and to a limited extent, over time. Procedures also exist for "bycatch:" non-targeted fish that are brought in as a by-product of harvesting fish for which one holds an ITQ.

With respect to fisheries management, the government can purchase and sell quotas in order to maintain a sustainable Total Annual Catch (TAC). The government can also increase or decrease the Total Annual Catch by proportionally increasing or decreasing the tonnage values of outstanding ITQs. No compensation is given or fees charged for these changes. This latter approach to TAC management replaced the former approach in which ITQs were purchased by the government to reduce the catch, and then auctioned off in years when an increased catch was allowable.

Enforcement of the government's policy goal of limiting Total Annual Catch is less costly and more effective under QMS since fishers seeking extra harvest may now buy additional quota rather than face the sole option of illegal fishing. The traditional fishery-enforcement system of game wardens patrolling fisheries and apprehending non-permitted vessels has been replaced with on-shore monitoring of the paper trail from fishing vessels through approved landing places to retail markets. Heavy penalties provide a deterrent to illegal fishing. For major offenses, the maximum fine as of October 1995 is NZ\$ 250 000 per offense. It is unusual for a fisher to be charged with a single offense. Further, upon conviction there is automatic forfeiture of vessel and quota, although the

Minister of Agriculture and Fisheries may choose to set a redemption fee for the vessel and/or quota (Peacey, 1995). The stringency of these penalties is consistent with the recommendation in Box 4, Item 7, that non-compliance penalties be meaningful.

As the programme evolved, the government's first effort was to assure adequate information was generated to enable oversight and monitoring. A second phase then attempted to streamline evaluation and analysis of data to reduce the cost and increase the accuracy of oversight. These efforts can be seen as attempts to satisfy Item 5, measurability, and Item 6, verifiability, of Box 3, as well as Item 5 of Box 4, concerning the performance of oversight agencies.

A number of physical, commercial, and institutional features support enforcement efforts. Fishing can be monitored effectively due to New Zealand's physical isolation and the relative lack of migratory species, the industry's unified support of a long-term commercial fishery, a fish export rate of 85-90 per cent, a national Goods and Services Tax (that provides additional on-shore tracking capability), and strong legislative backing of the programme (Shallard, 1990).

In addition to the creation of bycatch rules, one aspect of the programme has stirred considerable controversy. The government feels the QMS has provided taxable benefits to commercial fishing interests since it creates secure access rights to a public resource. The government argues that "(rents) are generated as a consequence of the secure nature of (the ITQ) property right..., which allows fishers to capture the benefits of the reduced costs of fishing and favourable market movements. (The taxable portion equates) to the difference in the rents with a QMS management regime less the rents which may have been captured by fishers in the absence of management." (New Zealand Seafood Industry, 1993). The government therefore believes the public is entitled to the value-added that accrues as a direct result of the ITQ system.

While the New Zealand fishing industry agrees that cost-recovery is a valid goal of fishing-industry taxation, it is resisting efforts to impose additional fees based on the above justification. The industry argues that it is government's duty to secure property rights, that the value-added provided by QMS is not as high as people think, and that this kind of tax plan would discourage investment in the fishing industry. It appears that the government is no longer pursuing the goal of value-added taxation, in part due to the complicating factor of integrating the historic fishing rights of the indigenous Maori people into the QMS system. This challenge is consistent with Item 9, Box 4, which suggests that market participants retain a substantial of their gains from trade.

However the taxation of rents issue is resolved, the overall experience of QMS has been quite successful. Trading is active, and the fishing industry is economically healthy and has a goal of becoming a \$2 billion export industry by 2000, up from \$1.7 billion in 1993. The fisheries have effective harvest limits that should ensure biological and ecosystem health for years to come, satisfying Item 2 of Box 3, which calls for MPOPs only when potential benefits outweigh risks.

V.C.2 Iceland's ITQ system

Iceland is far more dependent upon its fishing industry than is New Zealand, Arnason (1996:65) reports that the fishing industry's direct contribution to GDP is roughly 15 per cent, but economic linkages and multipliers raise this amount perhaps as high as 45 per cent. Abundant fisheries help provide the nation's 270 000 citizens with one of the OECD's highest per capita incomes.

By the 1970s, a number of important fisheries were in decline. According to Arnason (1996:69ff), herring stocks had declined to such a level that a complete moratorium on catch was introduced in 1972, with a limited resumption of catch in 1975. With respect to capelin stocks, this fish was subject to intensive fishing in the 1970s, and by 1980 the stock was thought to be seriously threatened by overfishing. The cod fishery also was severely reduced during this period, with a sharp drop in catch and stock occurring in 1983. The combination of declining fish stocks and declining economic returns from fishing, Arnason believes, prompted stakeholders to seek new administrative arrangements for Icelandic fisheries.

Iceland was not able to enforce its 200-mile Exclusive Economic Zone until 1976. Until that time, trawlers from many European nations freely fished this zone (Arnason, 1996:68). Without unified authority over these ocean regions, it is unlikely that any kind of species management would have been possible before 1976. Item 14 of Box 3, the existence of an empowered regulatory body, was therefore not satisfied until 1976. Individual quotas on herring catch were quickly established, and made tradable in 1979. Similar controls on other species followed in the 1980s.

The structure of Iceland's fishing industry is that there are numerous relatively small firms. There is a high degree of vertical integration between harvesting and processing, but little horizontal integration. No firms dominate either harvesting or processing (Arnason, 1996:65). This industrial organisation minimises the opportunity for one firm to exercise market power and drive up the price of quota, satisfying Item 9 of Box 3, sufficient numbers of traders.

Both permanent quota (shares of the Total Annual Catch) and annual vessel quotas are fully divisible. Permanent quota shares are fully transferable, while annual vessel quota transfers are freely transferable between vessels within the same geographic region. Transfers outside geographic regions have some restrictions for purposes of protecting regional employment patterns, but in practice, few transfers are actually blocked (Arnason, 1992:79). Box 3, Item 4, divisibility, is therefore satisfied, while the protections against undesirable employment impacts is an example of an effort to address the concerns of adverse impacts on labor, found in Box 2, Item 3.

One potential weakness of the ITQ system is that, since Total Allowable Catch is biologically-determined, and serves as an upper limit of catch each year, fishermen cannot adjust their harvesting upward in response to favorable market conditions. Usually the entire TAC is used up, which means that annual catch is tracking biological estimations of species availability instead of market demand (Arnason, 1995:73). This tendency of the TAC to block over-fishing in response to favorable market signals is, of course, exactly what the mechanism is supposed to accomplish. By limiting catch, the ITQ system ensures that future stocks of fish will be available, which is of far greater value to the Icelandic public than the additional profits harvesters would receive in a good year. The critical element of species protection is the requirement that the annual TAC-level be set based on biological-sustainability criteria, not on political or economic pressure to expand the catch.

Another controversy involves social and labor impacts of Iceland's ITQ system. Numerous coastal villages depend upon the fishing industry. The controversy pits those who advocate an economically-efficient allocation of quota (promised and provided by the ITQ system) against those who prefer the historic allocation of fishing rights, even if it is less efficient. With respect to the latter group, one argument, summarised in Item 8 of Box 3, is that loss of fishing rights will disrupt the social and cultural life of the villages more than what is gained by the more efficient allocation of the rights. With respect to labor, to the extent labor costs are an important component of fishing costs, and to the extent the most efficient fishing companies acquire more and more quota through

unrestricted trades, the demand for labor in the fishing industry will decline. If demand for labor declines faster than supply of labor, a downward pressure is put on wages. Resistance to Iceland's ITQ system appears to have developed along these general lines. Similarly, New Zealand was required to adapt its ITQ system to accommodate the historical, treaty-protected fishing rights of its indigenous Maori people.

V.D New Jersey market for Regional Contribution Agreements (RCAs) for low- and moderate-income housing

The above case studies all have involved marketable permits -- to emit air pollutants, to divert water, and to harvest fish. This case study deviates from the above three. First, it involves marketable *obligations*, not permits. Second, it moves away from the fields of pollution control and natural-resources management. The New Jersey programme of tradable Regional Contribution Agreements is an example of how a state government has confronted directly the NIMBY ("not in my back yard") problem. It further provides insight into how MPOPs can help achieve a broad array of social goals. Finally, it provides lessons on the mechanics of an effective trading mechanism.

"Mount Laurel" is a familiar name in the United States to individuals involved in urban and regional planning. It refers to a series of lawsuits decided by the state Supreme Court of New Jersey between 1975 and 1986. New Jersey is a small state located along the New York-Washington, D.C., corridor, with a population of roughly 8 million. The Supreme Court decided that every township (municipality) in New Jersey was required, through zoning or other incentives, to provide a realistic opportunity for the construction of its fair share of the regional need for low- and moderate-income housing. The Court provided a numerical fair-share formula, as well as a stringent penalty for townships that did not alter their zoning ordinances accordingly. From a state-wide attitude of "not in my back yard," the Supreme Court replied that a fair share of affordable housing would henceforth be made available in *everybody's* "back yard." The Court's action also satisfied Box 3, Item 1's requirement that the regulatory goal be clearly-stated and quantifiable.

The Court's decisive action broke an impasse among legislators, and led to passage of the Fair Housing Act of 1985. This Act provided a comprehensive planning and implementation process for townships to provide adequate incentives for low- and moderate-income housing development, and established the New Jersey Council on Affordable Housing (COAH), a bipartisan body representing all sides of the housing issue. COAH was given responsibility to define housing regions throughout the state, and to estimate the present and prospective need for low- and moderate-income housing. COAH was further required to create a means for townships to determine their own fair share of the regional affordable housing need, and to implement plans to provide their fair share.

One of the seven available methods for meeting a township's fair share obligation is to transfer the housing requirement to another willing municipality through a regional contribution agreement (RCA). An RCA is a cash payment from one municipality (usually suburban) to another municipality (usually urban) for the purpose of building or refurbishing low- and moderate-income housing in the receiving municipality. Because of lower per-unit costs, RCAs often target for refurbishment substandard (even abandoned) rental units in apartment complexes. Only municipalities can participate in the buying and selling of RCAs. At least half of an RCA must be targeted at low-income housing. COAH must approve RCA transfers before they are executed.

RCAs are attractive to a providing township since it can reduce by up to 50 per cent its local requirement to make low- and moderate-income housing available. RCAs are attractive to receiving municipalities, which usually are larger cities with decaying central neighborhoods, since they provide funding expressly for refurbishing sub-standard housing in the worst parts of town. Without RCA funding, it is highly unlikely the units would have been improved by any other mechanism, public or private. This aspect of the New Jersey programme is consistent with Box 4, Item 3's suggestion that trading help achieve the regulatory goal.

RCAs were the most controversial part of the Fair Housing Act package (Mitchell, 1995). Interest groups focusing on the social goal of making low- and moderate-income housing available throughout the state felt that a transferable obligation was a moral violation of the "fair share" concept, and would lead to a continuing concentration of poor neighborhoods in urban areas, along with the associated racial segregation. In contrast, groups favoring planning autonomy for suburban townships called for an ability to transfer all of an obligation to areas where housing was badly in need of improvement. An additional justification for transferable obligations was that it did not matter exactly where low- and moderate-income housing was built as long as enough existed along the major commuter routes so that workers had a decent place to live. In short, New Jersey grappled with the issues of fairness and consistency with other state policies, as described in Items 1 and 2 of Box 2.

The compromise involved allowing transfer of up to 50 per cent of a fair share obligation, combined with strict oversight so that the money transferred actually is spent on the proposed housing plans. Further, a municipality that receives new obligations (and the accompanying payment) does not have its own fair-share obligation reduced as a result of the transfer.

Trading regions were designed around the concept of a "commutershed." Patterns of where people live and where they work were studied, and five regions were established, each comprising from two to four counties. A municipality can transfer up to half of its fair share obligation to any other willing municipality in its region.

A municipality must pass many hurdles before qualifying to participate in RCA transfers. First, the municipality must prepare and submit to COAH a regional planning document that includes a housing element that satisfies the "fair share" requirement. COAH must then approve the planning document, and then the municipality must officially adopt it.

Once a sending municipality is qualified, it must locate a willing receiving municipality, and then:

- determine the number of units to be transferred,
- determine how the receiver will provide those units,
- agree on a price-per-unit and schedule of payments,
- agree on how any excess funds will be used if the project comes in under budget,
- determine how money will be appropriated by the sending municipality, and
- finalise a contractual agreement with the receiving municipality.

The receiving municipality is actively involved in identifying housing to be refurbished and the cost of doing so. In addition to COAH, county planning departments and the state housing

mortgage and finance administration must also approve of the transfer. And once the physical activities of refurbishing housing are underway, an annual progress report must be submitted to COAH. If the money is not being spent on housing, or if other issues are stopping actual refurbishment of the targeted units, COAH can cancel the transfer and re-impose on the sending municipality its original obligation. All of these activities serve to satisfy Items 5 and 6 of Box 3, related to measurability and verifiability.

The first RCA transfer was approved early in 1988. The town of Tewksbury in Hunterdon County transferred an obligation to refurbish 45 units of low- and moderate-income housing to the town of Perth Amboy in Middlesex County. The cost per unit was US\$26 667, and the total payment was \$1 200 015 (New Jersey Council on Affordable Housing, 1995). Through June 1995, 40 RCA transfers have occurred, ranging in size from 4 to 500 units per RCA (with an average of 104 units), and ranging in cost from US\$15 000 to US\$27 500 per unit (with an average of nearly US\$20 000). In total, US\$80 500 000 has been invested to refurbish 4 180 units of substandard housing in some of New Jersey's most desperate neighborhoods. This is a remarkable performance, considering first that the parties paying for the refurbishment had for decades provided almost no money for, and often discouraged through zoning and other laws, the construction of low- and moderate-income housing in their own townships. Second, the strict oversight and enforcement mechanisms that accompany RCA payments have hindered the tendency for under-funded city governments to divert some of the housing funds to other worthy civic purposes. The money has truly been spent on affordable housing (Mitchell, 1995). This is consistent with Box 4, Item 7, which calls for strict enforcement of rules.

In all of the Mount Laurel-inspired reforms, RCAs are the only mechanism that actually mandate investment in affordable housing. All other requirements only create incentives for developers to invest in low- and moderate-income housing. For this reason, RCAs have provided the bulk of actual housing results arising from the two-decade Mount Laurel process.

Among the elements of the RCA trading programme that have made it successful are that first, the obligation that all municipalities provide their fair share of low- and moderate-income housing is no longer an issue, but rather an accepted fact of life for New Jersey townships. The obligation was mandated by the New Jersey Supreme Court, and no higher civil authority can overrule its decision, again supporting Box 3, Item 1, requirement of a clearly-stated and adopted regulatory goal.

Second, the penalty for non-compliance is severe. Called the "builder's remedy," it essentially gives land developers the right to bypass all zoning and planning laws and build any amount of low- or moderate-income housing anywhere in a township, if the township is not in compliance with its fair-share requirements. This massive imposition on the rights of municipalities to plan for their own future growth has been enough for most municipalities to come into compliance with Fair Housing Act requirements, and is also consistent with Box 4, Item 7 (meaningful enforcement).

Third, as described above, incentives exist for both sending and receiving parties to trade.

Fourth, trading rules are clear (although somewhat complex), and COAH oversees the programme in a neutral, bipartisan manner. COAH has no conflicts of interest and no desire to expropriate any of the gains from RCA trade, satisfying Items 12 and 13 of Box 3, related to administrative oversight.

This section has presented brief descriptions of practical aspects of a number of MPOPs. Its purposes have been to highlight practical considerations in MPOP design and execution, as well as to stimulate thinking on potential applications. Section VI presents shorter descriptions of other uses of MPOPs, and suggests areas of potential application.

VI. Other Actual and Potential Uses

As mentioned in the Introduction, as the scope of human management of natural-resource systems grows, and as public pressure grows for least-cost programmes to achieve regulatory goals, the opportunity for application of market-based regulatory programmes grows as well. This section presents shorter descriptions of other existing programmes, as well as a discussion of where MPOP reforms might be utilised in the future.

VI.A Pesticide use over a groundwater aquifer

The sciences of aquifer modeling and water-quality monitoring have grown to the point that a marketable-permit programme is possible to limit pesticide loading into an aquifer. The social goal would be to limit the amount of harmful pesticides entering an aquifer, and a market mechanism would allow farmers to allocate in an efficient way a fixed amount of pesticides for application over the entire aquifer region. Compliance monitoring could include soil sampling, groundwater-monitoring wells, monitoring the paperwork of buying and selling pesticides, and monitoring the pesticide-application equipment. Farmers could then buy or sell annual pesticide-use permits depending upon their crop selection, their use of alternative unregulated pesticides, market prices for crops, the extent of the pest problem in their fields, and other factors. This approach is likely to be less costly to farmers than non-tradable per-hectare limits on pesticide applications, or pesticide bans in cases where limited use would be acceptable.

VI.B Groundwater allocation

Sophisticated uses of aquifers as underground reservoirs are growing. Tradable permits for annual pumping rights are issued, and water users can also store surplus surface water in an aquifer for later use. By identifying the hydrogeologic characteristics of the aquifer (e.g., which way water is flowing, what the sustainable pumping yield is, what role the aquifer plays in blocking saltwater intrusion or maintaining overlying wetlands), use rights can then be brought into a sustainable balance with the resource. If an aquifer is overdrafted (i.e., has a declining water table), a tradable permit system can provide heavy users with an alternative source of water (purchasing additional pumping rights), while overall pumping is reduced. Marketable permit programmes of this type already exist in southern California and elsewhere.

VI.C Airport landing slots

For domestic flights into and out of the busiest airports in the U.S., airline companies must own “landing slots.” Landing slots serve to limit and spread out air traffic throughout the day, easing the government’s air-traffic-control burdens. Since 1986, landing slots have been fully tradable among the passenger air carriers. Trading takes place at quarterly meetings of airline companies, as well as by telephone between the companies. The industry’s Air Transport Association serves as a

clearinghouse for the trades and as an intermediary with the Federal Aviation Administration (FAA), which must approve all transfers.

Although landing restrictions at high-density airports have been in place for decades, tradability was introduced only in 1986. Some landing slots trade in the range of US\$1 million each. Slots can be purchased on a permanent basis or a short-term basis, but typically not for periods less than 6 months. Roughly 20 airlines are involved in this market (Sayre, 1997).

It is possible for new entrants to acquire landing slots without purchasing them from existing slot-holders. A company can apply directly to the FAA for landing slots. Typically, it must prove that it is providing a socially-valuable service but that the economics of the service does not allow it to purchase the expensive slots. An example of a socially-valuable service might be to provide new airline service to small, difficult-to-access cities. The FAA might recognise that the company's plans might be viable but only if it does not have to purchase landing slots, and so will grant the slots to the company. This provision is consistent with the concern expressed in Box 3, Item 7: ability to pay.

From an administrative perspective, a challenge arises in evaluating both the price and the quantities of landing slots held by airlines. Are they fair in the sense that no strategic pricing or inventory behavior is being demonstrated by the firms that control the majority of landing slots? If the market is fair, a "high" price might simply be reflecting the true value airline firms place on landing slots. Sometimes a unique system of economic organisation that appears on the surface to be unfair is actually a least-cost adaptation to unique and complex circumstances (Williamson, 1985). The only way to know with certainty is to undertake detailed case studies of what appear to be anomalous situations. One can also study patterns of trade to help determine whether there seems to be enough traders in the market to limit the possibility of collusive practices, consistent with Box 3, Item 9 (sufficient numbers of traders).

VI.D USEPA lead (Pb) phase-down

By the mid-1980s, leaded gasoline was still in use by older vehicles in the U.S. The EPA created a short-term market to phase-in lower lead standards for gasoline. The January 1985 standard of 1.1 grams per gallon was to be reduced to 0.5 grams per gallon in July 1985, and then to 0.1 grams per gallon by January, 1986. As Goodstein (1995:289) describes, EPA created a lead banking programme in which any refiner who reduced Pb content by more than the standard in a given quarter during the phase-down could bank the difference in the form of lead credits. The credits could then be used or sold in subsequent quarters during the phase-down. Without the trading programme, estimates of total compliance costs were to be \$3.5 billion. The programme is estimated to have saved \$228 million by allowing the most efficient refiners to take the lead in reducing the Pb content of their fuels (Hahn, 1989).

VI.E Electromagnetic spectrum

Recent reports of high-priced U.S. spectrum auctions point toward another use of market-based distribution of a publicly-owned good. The government has made available use-rights (licenses) to portions of the electromagnetic spectrum previously held back for emergency uses. The auctions earned the government billions of dollars, and now provide the winners exclusive (but not permanent) use-rights to portions of the spectrum.

These use rights are tradable between companies, although the Federal Communications Commission (FCC) reviews all transfer requests. The buyer must be legally qualified to receive an FCC license in order to own spectrum rights. Before issuing a license, the FCC will examine among other things the extent of foreign ownership, whether the owner has been convicted of felonies, and whether the owner has the financial resources needed to provide telecommunications services. This review takes place under all transfer circumstances, including both separate sale of spectrum rights, as well as acquisition of one company that owns spectrum rights by another company.

VI.F Renewable energy market-within-a-market

Another marketable-obligation programme already adopted by some U.S. states and under consideration at the national level involves electricity generation and is called the Renewables Portfolio Standard (RPS). Under the RPS, all retail sellers of electricity have a marketable obligation to purchase a minimum percentage of their electricity from renewable-resource generators.⁴ The social purposes include providing price stability in case fossil-fuel prices sharply climb, and pollution-reduction benefits associated with renewable-resource generation.

The accounting mechanism used to demonstrate compliance with the RPS is the Renewable-Energy Credit (REC). A REC is denominated the same as electricity -- in kilowatt-hours -- and is created when a kilowatt-hour of renewable-resource electricity is (1) produced and then (2) sold into the electricity market. Once created, RECs are just like any financial instrument: they can be freely traded. Compliance with the RPS is achieved when a retail provider of electricity demonstrates ownership of RECs in a quantity equivalent to a certain percentage of overall electricity sales. Retail sellers can comply with the RPS either through bundled purchases of renewable-resource electricity and RECs, or through separate purchases of RECs through a secondary market.

One benefit of the RPS is that it treats renewable-resource generators, whose electricity is currently above the market price, not as charity cases but as competitive enterprises striving to lower their costs and make the RPS unnecessary. Another benefit is that retail sellers of electricity, on whom the obligation to purchase RECs would be placed, have the flexibility to create least-cost power portfolios while at the same time meeting the minimum percentage of renewable-energy purchased (Rader and Norgaard, 1996 ; Haddad and Jefferiss, 1997).

VI.G Numerous social goals

New natural-resource-based uses of MPOPs do not constitute a break-through in thinking about this regulatory mechanism. But the potential for marketable-obligation programmes to facilitate provision of a wide variety of social services could increase the presence of MPOPs considerably in regulatory arenas. Marketable-obligation programmes present a direct and practical answer to the NIMBY ("not in my back yard") problem. If each individual region has the political ability to block imposition of a locally-undesirable social obligation, a state or nation can respond with a rule that divides the obligation and assigns it in some fair manner to everyone. Then, the state or nation can allow some or all of the obligation to be traded. The obligation is fulfilled at the least economic cost to society.

Among the myriad of potential applications of marketable-obligation programmes could be an obligation to provide shelter and care for the homeless or mentally ill, to provide children's day-care centers, to set aside parkland or build recreational facilities, to protect watersheds from over-

development, to establish hazardous-waste sites or landfills, to build jails, or, as in New Jersey, to provide affordable housing.

As described in the New Jersey case study (Section V.D above), a moral issue that must be settled is that parties must be willing to accept as a practical necessity that some regions will substitute cash payments for physical fulfillment of a regulatory obligation. In New Jersey, this was one of the most difficult compromises of the entire affordable-housing debate. Their solution was to allow up to (and no more than) half of a township's obligation to be transferred. But having launched the programme, cities receiving RCA payments are delighted, and the result of over US\$ 80 million having been allocated and spent on refurbishing some of the state's worst housing speaks for itself.

The use of marketable-obligation programmes to achieve social goals also raises a philosophical issue. Some social theorists believe that "NIMBY" is not a *syndrome* but instead a valid expression of resistance by individuals and communities to government interference in their daily lives. The philosophical issue hinges on whether one has faith in the policy process that resulted in the obligation. If the process was democratic, fair, and consistent with the values of the nation, then the resulting obligation is likely to be valid as well. If the policy-process was flawed, then local (NIMBY) resistance to the obligation carries additional validity. In either case, marketable-obligation programmes could assist public administrators in carrying out a range of policies.

VII. Lessons Learned/Conclusions

In this section, common lessons from the case studies are highlighted and linked with the earlier theoretical discussion. The lessons are summarised in Box 5. Some concluding remarks follow.

Box 5. Common Characteristics of Successful Marketable Permit or Obligation Programmes

1. Physical features that affect the market are taken into account.
2. Access to the market is limited through pre-qualification.
3. The market may be designed to be a temporary mechanism.
4. The market is stimulated by strong, credible regulatory enforcement measures.
5. Distribution and other fairness issues are addressed effectively.

All of the **successful MPOPs** reviewed **take physical features into account** that ease the logistics of trading. The boundaries of the South Coast Air Quality Management District generally follow the boundaries of the region's airshed. Colorado's water-management regions are divided by watershed. New Zealand's fisheries are divided into ITQ trading zones. And New Jersey is divided into five regions based on home-to-work commute patterns ("commutersheds"). On the one hand, this geographical restriction on trading limits the theoretical maximum gains from trade if everybody everywhere were invited into the market. On the other hand, the limits provide focus and manageability. A challenge for a programme designer is find a way to rationalise a region's existing administrative boundaries with an MPOP's appropriate physical boundaries.

Another shared feature of successful trading programmes is that **many limit the number of traders and require some form of pre-qualification**. RECLAIM scaled its programme down to include only about 340 companies and agencies out of the thousands doing business in the greater Los Angeles area. These entities must then register if they want to trade air-pollution rights. Colorado water-law requires rights holders to physically divert water, and then “use-it-or-lose-it.” This effectively blocks speculators from trading water. New Zealand sets a five-tonne minimum on initial purchases of ITQs to discourage micro-scale or under-capitalised operations from entering the commercial fishing business. And New Jersey limits trading of RCAs to municipalities that either have satisfied COAH's requirements for inclusionary development plans, or that have been referred to the programme by a judge. Again, curtailing access to a programme limits theoretical gains from trade, but facilitates both the policy goals behind the programme as well as the market-like trading mechanism.

Another lesson from the case studies is that **markets need not last forever**. The life span of USEPA's lead-phase-down programme was measured in months. RECLAIM will sunset after fifteen years, if all goes well. In New Jersey, the rate of RCA (affordable housing) transactions has slowed considerably, from 17 approved in 1988, down to 7 in 1993, 2 in 1994, and only one by the mid-way point of 1995. In contrast, water trading in Colorado has gone on for decades, and the New Zealand ITQ market seems to be settling in for a long life span. Programme longevity is a design factor. If a reallocation is needed in the medium-term or longer, a market may be the instrument of choice. But a short-run or one-time-only reallocation may or may not be worth the trouble of creating the necessary institutions.

The importance of providing an incentive to trade **through strong, credible regulatory enforcement measures** (noted in Box 4, Item 7) is another feature of successful programmes. New Zealand's fines and seizures of equipment, New Jersey's "builder's remedy," and the stringent enforcement measures in RECLAIM and the national SO₂ market make compliance the preferred option. Cost reduction then becomes the focus of regulated entities. Similarly, successful programmes have low-cost monitoring systems that preserve the autonomy of regulated entities while providing sufficient monitoring information. Clear rules, strict penalties, and good monitoring systems ease the administrator's oversight burden.

In terms of fairness, the successful programmes described above in Sections V and VI **successfully handle distribution and other fairness issues**. In the case of New Jersey, it was the most difficult aspect of negotiating a programme. In New Zealand and Iceland, fishing interests worried that the largest firms might buy up all the tradable quota. In California, large-scale, long-term water trading awaits resolution of fairness issues, among other things.

In conclusion, this paper offers a practical discussion of the design and implementation of MPOPs. On the one hand, market-based regulatory reform can provide numerous benefits, including significant cost reduction, consensus building, expanded cooperation between regulators and regulated parties, and new approaches to address some seemingly intractable social problems. On the other hand, if poorly conceived and applied, it can grind compliance to a halt, raise heated debate where underlying issues (such as fairness or the proper scope of government regulation) are not settled, upset regulatory agencies, and provide new opportunities for non-compliance. We are likely to see more frequent applications of MPOPs in the coming years in a wider range of policy areas, not least of which may be their application to efforts to reduce emissions of greenhouse gases. In determining whether to pursue an MPOP reform (large or small), an administrator should keep an open mind and an open door. With respect to the huge theoretical cost-saving promise of MPOPs,

administrators should also keep in mind that a medium-scale programme that works effectively will certainly be judged a large-scale success.

NOTES

1. Permit programmes are sometimes called allowance programmes. Typically, when one speaks of allowance programmes, one is referring to programmes modeled after USEPA's successful SO₂-allowance-trading programme, which places a declining national cap on SO₂ emissions, and then allocated several decades worth of tradable SO₂-emission rights to regulated companies. Section V.A.2 offers details on this programme.
2. The larger society could ascribe symbolic, intrinsic, or other value to the traditional or indigenous way of life. Also, some indigenous groups have special rights to natural systems that must be respected and may not be consistent with market-based reallocation.
3. There are efficient local markets for water, often involving trades between farmers within a single irrigation district, but almost no long-term inter-regional rural-to-urban transfers.
4. Renewable energy uses wind, solar energy, geothermal hot springs, and biomass (agricultural trimmings and wood chips) as fuel. Hydropower is also renewable but may not be covered by RPS programmes since it already is a low-cost source of electricity.

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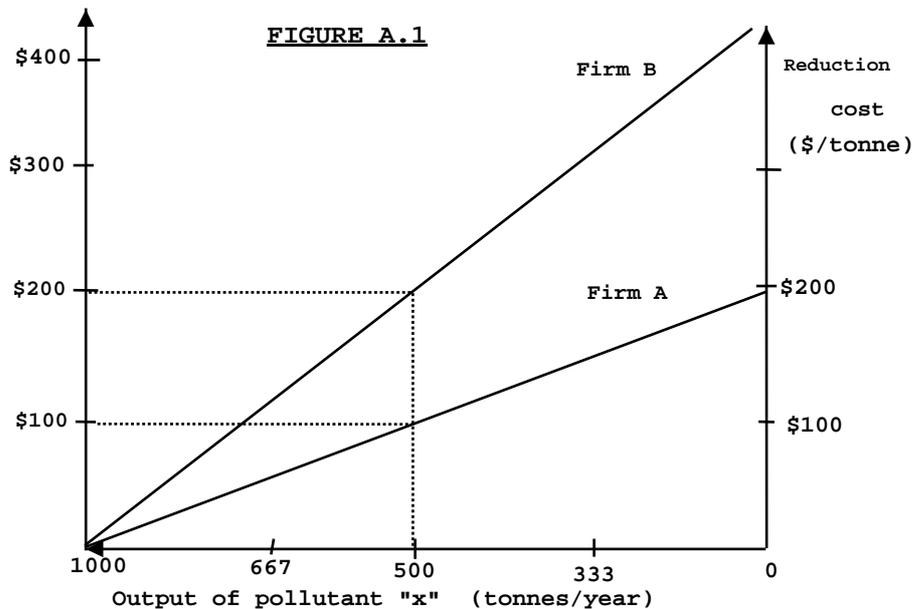
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**ANNEX 1. ECONOMIC THEORY OF COST-SAVINGS ASSOCIATED WITH
MARKETABLE PERMIT OR OBLIGATION PROGRAMMES**

The expanding array of applications of marketable permit or obligation programmes means that the usual explanation of cost-savings related to pollution-permit trading, while straightforward, does not cover everything. This theoretical discussion starts with a simple pollution-control example involving marketable permits, turns to other permit-trading examples, and then examines marketable-obligation examples.

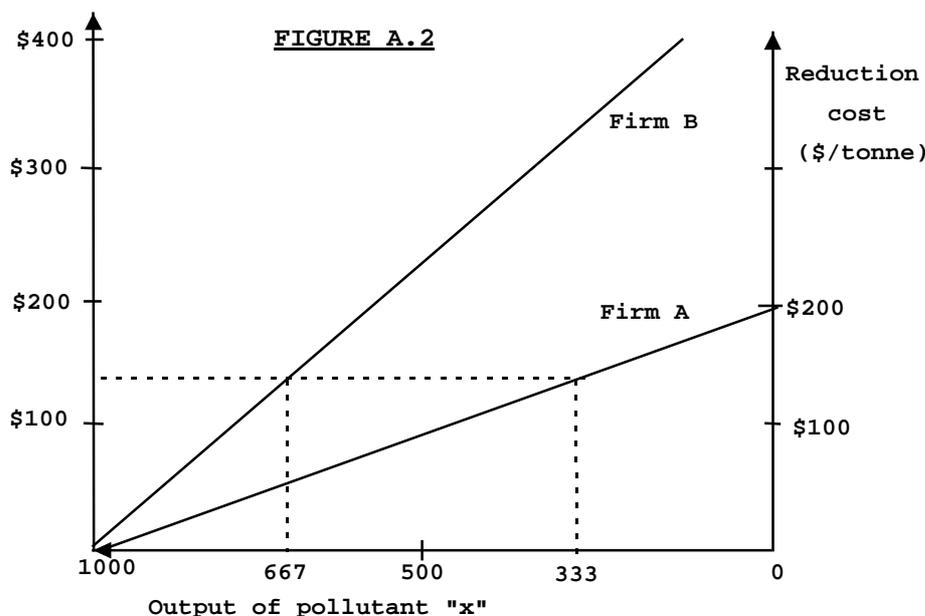
One of the key assumptions behind claims of cost reductions is that companies have varying costs of compliance. This could be due to different firms having machinery of different age, output mix, maintenance schedules, and other factors, but sharing a common pollution by-product. Figure A.1 maps the cost of reducing output of a pollutant (called "X") with the amount reduced for two companies, Firm A and Firm B. Assume that, with no controls, both companies are producing 1 000 tonnes per year of pollutant X. That is why in Figure A.1 the cost of reducing output of pollutant X to 1 000 tonnes per year is zero: no reductions are taking place at that level of output. Costs rise as more pollution is controlled since it generally is cheaper to reduce initial tonnes of pollution than it is to reduce additional tonnes.



Note that Firm A's cost of reducing pollution is significantly less than that of Firm B. In a given year, the 500th tonne of pollutant X can be controlled at a cost of \$100 to Firm A, but \$200 to Firm B.

Traditional regulatory strategies impose across-the-board reductions, often in the form of a standard applied to all point sources of pollution. (A point source typically is a smoke stack or an effluent pipe.) Assume a regional health-based standard of no more than 1 000 tonnes per year output of pollutant X is allowed. If the rules call on Firms A and B each to limit output of pollutant X to 500 tonnes per year, the total cost of pollution reduction is represented by the areas under each firm's cost curve between 1 000 and 500 tonnes reduced. This amounts to:

$$\begin{aligned}
 &\text{Firm A's total cost:} && \$25\,000 \\
 + &\text{Firm B's total cost:} && + \$50\,000 \\
 = &\text{Total Compliance Cost:} && \$75\,000
 \end{aligned}$$



A marketable-permit programme would issue each company tradable permits to produce 500 tonnes/year of pollutant X. Since Firm A can control more than 500 tonnes per year at a cost cheaper than Firm B can achieve its goal of 500 tonnes per year, there is an opportunity for Firm A to reduce its output of pollutant X below 500 tonnes per year and sell its extra unneeded permits to Firm B. In terms of pollution, the net result is that a total of 1000 tonnes per year is still emitted, only Firm A is emitting less than 500 tonnes per year, and Firm B more. Optimally, as Figure A.2 shows, Firm A will control 667 tonnes per year and Firm B will control 333 tonnes per year. Permits to emit 167 tonnes of pollutant X will be sold by Firm A to Firm B for a price of \$133/tonne. Under this scenario, the health-based standard is achieved, both companies have saved money, and the total cost of compliance has been reduced. The following table, Table A.1, shows the projected market-based costs and savings.

Table A.1. Market-based costs of Compliance and Comparison to Traditional Regulation (\$)

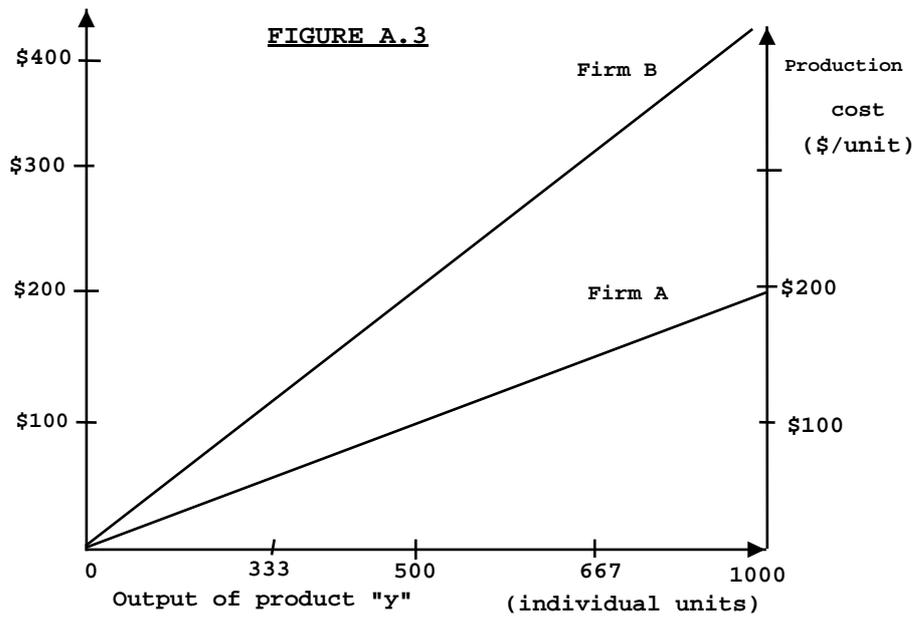
	Pollution Reduction	Permit Sale	Total Cost	Traditional Regulation Cost	Savings w/ mkt
Firm A	44 356	- 22 266	= 22 090	25 000	2 910
Firm B	22 146	+ 22 266	= 44 410	50 000	5 590
Total			66 500	75 000	8 500

The marketable permit approach has reduced the cost of equivalent compliance by \$8 500, or just over 11 per cent. Further cost savings are possible since Firm A, with its opportunity to profit from trading, may look for innovative ways to reduce its cost of compliance (reduce the slope of its compliance curve), and sell even more permits to Firm B for additional profits. Firm B, of course, faces a similar incentive to find innovative ways to reduce its own cost of compliance.

When the above scenario, involving two companies and a regulatory requirement to reduce pollution, is extended to include more companies and more pollutants, potential cost savings also grow.

The example above focuses on equalising marginal costs of compliance by trading pollution permits. If the object of trade is a use permit for a good, such as fresh water, the market mechanism can also help sort out the most economically-valuable uses of the water and help allocate it to those uses. Alternatively, the object of trade could be a permit to take a portion of a common resource, such as a permit to take a given percentage of a fishery's total allowable catch. In this case, the trading system is likely to substitute for effort-restricting regulations, such as limiting the length of fishing seasons, or imposing bans on certain types of fishing equipment. Without a marketable-permit system, fishers must invest heavily in new equipment that will maximise their harvest in a short period of time. With the time constraint, fish are caught in the order they are found, even if smaller, primarily-juvenile schools are discovered first. A marketable-permit programme relaxes most or all of the effort restrictions. The technology-development incentive returns to attempts to catch the most economically-beneficial fish, and the fishing behavior changes from first-found first-caught to an effort to catch the most valuable (largest) members of the species first, leaving the smaller members to replenish the stock. Thus, the choice of regulatory system has both technology-development impacts and resource-management impacts, in addition to cost-reduction/profit enhancement impacts.

In the case of marketable obligations, the theoretical discussion above holds, except now the focus is on minimising the cost of providing (or acquiring) a required amount of a service or product that is either locally-undesirable but regionally-desirable, or above market cost. This service or product is called Product Y below. (In the New Jersey case described in Section V.D above, Product Y is units of affordable housing.) The only changes to the graphic presentation in Figures A.1 and A.2 above are that the decreasing units of pollution output on the X-axis are reversed to become increasing output of Product Y. Also, the Y-axis is re-labeled as "Production cost." These changes are illustrated in Figure A.3. In the previous (permit) scenario, Firm A was over-controlling (reducing) output of pollutant X and selling its marketable permits. Now Firm A has an incentive to produce additional units of Product Y, and receive from Firm B both some of Firm B's marketable obligation to produce Product Y as well as some money for doing so. Savings arise since it is cheaper for firm A to produce Product Y than it is for Firm B to do so. Both firms are better off economically if Firm B pays Firm A to produce additional units of Product Y.



ANNEX 2. LIST OF ACRONYMS

CEMS	Continuous Emissions Monitoring System. Technology that enables real-time monitoring of pollution output.
COAH	New Jersey Council on Affordable Housing. An agency that oversees implementation of the Fair Housing Act of 1985 and its market for RCAs.
ERCE	Emission Reduction Credit. A tradable air pollution right created when a company reduces pollution output beyond required levels. Part of OMTP proposals.
FAA	U.S. Federal Aviation Administration. Oversees the market for airline landing-slots that was established in 1986.
FCC	U.S. Federal Communications Commission. Oversees the auctions for rights to portions of the electromagnetic spectrum, and any subsequent transfers of rights.
ITQ	Individual Transferable Quota. A tradable right to catch a certain tonnage of fish in New Zealand waters.
MPOP	Marketable Permit or Obligation Programme. A regulatory mechanism that allows trading of permits or obligations in order to lower the cost of compliance.
NIMBY	"Not In My Back Yard". A syndrome in which each locality has the political strength to block the nearby siting of an undesirable but regionally-necessary facility.
NOx	Oxides of nitrogen. A class of air pollutants.
OMTP	Open Market Trading Programme. USEPA's proposed rules for local air pollution credit trading.
QMS	Quota Management System. The fisheries management system of New Zealand that includes a market for ITQs.
RCA	Regional Contribution Agreement. A transferable obligation to provide affordable housing in New Jersey.
REC	Renewable Energy Credit. The name of the marketable obligation that is used to show compliance with California's proposed RPS.
RECLAIM	Regional Clean Air Incentives Market. A southern California air pollution marketable permit programme.

- RPS Renewables Portfolio Standard. A proposed California marketable-obligation programme to ensure that a specified percentage of electric power generated in the state comes from renewable resources such as wind, solar, biomass, and geothermal.
- RTC RECLAIM Tradable Credit. A tradable right to emit NO_x or SO_x air pollutants.
- SCAQMD South Coast Air Quality Management District. The regulatory oversight body for the greater Los Angeles airshed, and creators of the RECLAIM programme.
- SO_x Oxides of sulfur. A class of air pollutants, of which SO₂ is a predominant member.
- TAC Total Annual Catch. The sum of all ITQs for a particular fish species, and the sustainable yield for that species in a given region.
- USEPA United States Environmental Protection Agency. A national regulatory body that oversees the regional SO₂ allowance trading market and is currently preparing a set of generic rules for local emissions trading programmes, called OMTP.
- VOC Volatile Organic Compound. A class of hydrocarbon air pollutants.