CONSUMER-BASED CARBON REDUCTION INCENTIVES

by

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Consumer-Based Carbon Reduction Incentives

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Abstract

Australia’s ability to meet its commitment to reduce greenhouse gases under the Kyoto convention will probably require at least some government intervention. Traditionally, approaches to reducing pollution in Australia have tended to focus on the adoption of emission standards. Theoretical criticism by environmental economists has, in part, resulted in a movement toward the adoption of market based mechanisms for pollution abatement; and flirtations with carbon taxes and tradeable permits to reduce greenhouse gas emissions. Each instrument is subject to significant weaknesses. Tradeable permits are administratively complex for both polluter and administrator and can lead to production bottlenecks where polluters cannot find requisite permits. A carbon tax is simpler to administer and offers much more flexibility, but can have regressive and inequitable economic impacts. Of these approaches, tradeable permits offer greater potential for achieving set emissions reductions, but tend to be restricted in application to large emitters such as industry. It is argued here that to be truly cost effective, incentives to reduce emissions need to be targeted as close as possible to the point of fuel consumption—and hence greenhouse emission: by both industry and the household consumer. This paper explores the benefits and limitations of adopting a mixed incentive scheme applied to the energy consumer to reduce greenhouse gas emissions. The proposed consumer carbon reduction incentive (CBCRI) incorporates elements of tradeable permits, carbon taxes and emission reduction subsidies.
INTRODUCTION

Although the protracted debate over global warming and the likely impact of greenhouse gases continues, the Kyoto convention represents an acknowledgment of the importance of the greenhouse issue. The convention resulted in participating countries committing to reductions of projected greenhouse emissions. In terms of policy, this has shifted the emphasis from determining how much should be abated to what approaches should be adopted to achieve set emissions for each participating country, including Australia.

In recent years, debate regarding suitable mechanisms for reducing pollution has progressed from the adoption of regulatory approaches such as standards to economic instruments such as pollution taxes and tradeable permits. Given the pervasiveness and importance of fossil fuel use, which produce a significant proportion of greenhouse emissions, the choice of instrument is critical. Apart from an ability to deliver results, other important considerations include cost, equity and political acceptability of any proposed measure. Analysis of commonly proffered instruments reveals that each have their strengths and weaknesses.

Another dimension to the choice of instrument is the targeting of such instruments and who should bear the cost of abatement. Provisionally, a least cost approach requires that all emissions sources should abate to a level commensurable with their abatement costs—both industrial and household. However, while tradeable permits are most desirable in many respects, it is not administratively possible to apply on such a broad scale. Alternatively, carbon taxes are much simpler, but are undesirable on other grounds.

This paper proposes another possibility, coined under the name Consumer-Based Carbon Reduction Incentives (CBCRI). CBCRI is a mixed instrument applied at the level of energy consumer whereby individuals are allocated a proportion of a total greenhouse emission target and subjected to a tax or subsidy depending on whether their emission exceed or fall below their permitted levels.

The paper proceeds with an outline of existing policy instruments, and their strengths and weaknesses. This is followed by an investigation of mixed schemes. The merits of applying such a scheme at the level of energy consumer
is then explored under the rubric of a CBCRI scheme. The paper then goes on to briefly consider the economic, equity and political impact of this approach in contrast to existing instruments.

A SURVEY OF POLICY INSTRUMENTS FOR REDUCING GREENHOUSE GASES

In view of the Kyoto protocol, which requires that Australia contain the growth in its forecast greenhouse emissions at a predetermined level, it is arguable that in order to comply it will be necessary to implement some form of regulatory framework. Such a regulatory scheme might take the form of the imposition of an abatement or technological standard, or cooperative emission reduction targets, which are the traditional approach to pollution abatement (James, 1990). Certainly such an approach has the advantage of transparency and comprehensibility which, if properly enforced, leads to a predetermined outcome (Berttram, 1992, p.432).

However, it has been well established that uniform regulatory approaches are unsatisfactory, at least from a theoretical perspective. The most common criticism of the imposition of regulatory standards is that the marginal cost of abatement is not uniform across all polluters, therefore with a standard an efficient outcome will not be achieved and there will be a loss in welfare (Baumol and Oates, 1988, p.188; Russel, 1981, p.24). The result will be a high cost to the community and economic inefficiency (James, 1990, p.17). Uniform standards are also criticised for their inflexibility in the face of changing circumstances such as economic growth, requiring regulators to be constantly rewriting the rules, which is generally politically unacceptable (Baumol and Oates, 1979, p.2; Russel, 1990, p.24). Regulation can be a sound approach where the environmental costs are considerable, highly inelastic and well known such as in the case of lead in petrol (see Pearce, 1990). However, the greenhouse issue is characterised by a great degree of uncertainty as to the damage function of greenhouse gases. Further, regulation provides little incentive for individuals or firms to develop innovative technologies, which reduce abatement costs, since there is no economic gain in doing so (Russel, 1990).

Market based approaches to pollution abatement are a commonly proffered solution to the optimality, or cost issues associated with standards. These approaches usually fall under the rubric of pollution charges (taxes) or tradeable
emission permits. Both approaches have their strengths as well as weaknesses. While a carbon tax spreads the cost of pollution abatement evenly among polluters, they are criticised for their potential to impair economic growth (see DASET, 1991, pp. 23-35). A more significant criticism is their uneven impact on welfare depending on socioeconomic status (see OECD 1995). Moreover, a carbon tax does not guarantee significant reductions in greenhouse emissions (Burgess, 1990).

Tradeable emission permits, on the other hand, are better suited for achieving set emission reduction targets, since they specify a permissible aggregate level of pollution (Kling, 1994). However, although a permit scheme appears to be the better of the existing policy options for achieving specified greenhouse emission targets, other significant problems are encountered. One of the most significant of these is administrative.

A trading scheme is plausible where there are a small number of polluters involved, but administrative complications increase by orders of magnitude when pollution sources are diffuse—as they are in the case of greenhouse emissions. Practical issues emerge even where there are relatively few polluters, as evidence from the United States suggests. Problems which detract from such schemes include ‘thin markets’, high transaction costs and hoarding of permits which have considerably reduced the potential advantages of a permit system in terms of cost savings (Hahn and Hester, 1989a; Hahn and Hester, 1989b).

Another issue is objection to tradeable permits on the grounds of an ideological position that ‘property rights’ to pollution should not be countenanced at all—particularly where rights are given to large industries (Steidlmeier, 1993; Owen, 1991, p. 4). Many such objectors believe such a scheme detracts from air being a common property resource to which all have equal rights of access. Right or wrong, the inclusion of certain sections of the polluting community and not others does raise an important questions regarding the targeting of greenhouse policy instruments, on the basis of both rights and efficiency.

**Targeting of Instruments at all Fuel Consumers**

In terms of targeting instruments for abating greenhouse emissions, two important criteria apply. To be effective targeting should:
1) directly impact on the point of emission—that is, at the point of fuel or energy consumption; and

2) be spread across all sources of emission such that the abatement costs are equal at the margins.

Together, these two points suggest that minimising the cost of greenhouse abatement measures requires that all polluters—industrial and household—contribute to greenhouse reductions according to their ability to abate. As such, the use of economic approaches applied to industrial sources, while an improvement on standards, are flawed because they do not target the entire spectrum of final energy consumption. In general, where possible, a decentralised market-based approach is desirable for the reduction of greenhouse gases (Hahn, 1995).

To date, greenhouse reduction initiatives that have been countenanced in Australia which do impact household consumption do so only indirectly. Such measures are principally aimed at increasing fuel efficiency—through producing fuel efficient cars, energy efficient appliances and so on (see Wilkenfeld, 1995). Instead of achieving a desired target, these indirect approaches could actually result in increased emissions because improvements in efficiency are offset by increasing household consumption if there is no direct incentive for them to reduce emissions, according to the second criteria above (Tietenberg, 1995, pp.19-20).

Targeting instruments at the whole spectrum greenhouse sources, and at the point of consumption enhances the ability to achieve desired abatement targets. Further, such an approach provides a strong incentive for technological innovation without the need for regulatory prescription where consumer demand for energy efficient products increases in response to a strong enough incentive (Wilkenfeld et al., 1995, p. 17). However, of the instruments outlined so far, a carbon tax is the only instrument which can feasibly be applied across the spectrum of greenhouse emitters, but is undesirable on a number of other grounds. In view of this it is worth exploring other possibilities.

**MIXED INSTRUMENTS**

The bulk of the literature on greenhouse abatement has tended to focus on standards versus economic instruments; and, within the latter, carbon taxes
versus tradeable permits (see Tisdell, 1993; Kling, 1994a; Biglaiser et al., 1995). However other possibilities do exist which combine these approaches. One alternative to standards, taxes or permits involves a mixture of all three. Roberts and Spence (1976) have suggested such a scheme. Their ‘mixed incentive scheme’ operates much like a tradeable permit scheme, with the added flexibility for polluters to exceed or fall short of permit quotas if required by circumstances. Where polluters who exceed their entitlements they are subject to a tax for each addition unit of emission. Conversely, those polluters who do not use all their entitlements are reimbursed via a subsidy for each unit of excess allocation. This mixed approach introduces flexibility such that firms are not locked into specific emission targets where there is uncertainly as to abatement costs or private benefits such that they do not possess the ‘optimal’ allocations required to minimise cost or maximise profit.

**Target Setting Under a Mixed Incentive Scheme**

In the case of reducing greenhouse emissions, where a specific abatement target is already established, using a mixed incentive scheme the parameters can be set such that an incorrect estimation of the marginal net private benefit (MNPB) function will still allow a target to be reached. This is illustrated in Figure 1. From the figure, the curve MNPB₁ designates the marginal net private benefit curve anticipated by the regulator. P₀ is the existing level of emissions which the regulator seeks to reduce to Pₜ. A charge c is applied to emissions that exceed a ceiling and a subsidy s is given with respect to those which fall below. For MNPB₁ the optimal tax for a carbon tax scheme is represented by p, which, is also the price for emission permits under a permit trading scheme allocating Pₜ permits.
A mixed scheme, such as that proposed by Roberts and Spence (1979), reduces transaction costs while still approaching an outcome of a tradeable permit system, provided the change and subsidy are set such that:

\[ s < p < c \]

where

- \( s \) is the level of subsidy, or rebate per unit of emissions produced under allotted allocations;
- \( p \) is the price of permits that would have been attained via the market mechanism; and
- \( c \) is the charge applied to each unit of emission beyond the acceptable level.

Roberts and Spence (1976, pp. 193) argue that this mixed approach can potentially provide a ‘once and for all’ solution to an emission problem. This is because even if the initial parameters—number of permits, level of charge and level of subsidy—are set incorrectly, the result should still approximate an optimal solution. This mixed approach reduces the chances of having to make iterative changes to accommodate miscalculations and changed circumstances.
From Figure 1 it can be seen that if regulators miscalculate the position of the benefit curve, or if this curve shifts due to long-term adjustments to a tax scheme, to either MNPB$_2$ or MNPB$_3$, the target reduction should still be achieved. Thus adopting a mixed approach significantly reduces the informational requirements of regulators. As such, the cost of the required level of information for this type of scheme is far less prohibitive than alternative policy options of a carbon tax or permit system (Roberts and Spence, 1979, pp. 196-200).

**CONSUMER BASED CARBON REDUCTION INCENTIVES**

A feature of Roberts and Spence’s (1976) mixed approach is the significant reduction in transaction costs and flexibility for polluters to choose not pursue a requisite number of permits through the market system. Given this flexibility, there is an emerging possibility to apply such a scheme to diffuse sources of greenhouse gases at the household level—where it is otherwise not possible for a tradeable permit scheme. One such a scheme is coined here as consumer based carbon reduction incentives (CBCRI).

In terms of achieving prescribed emission reduction targets, a CBCRI scheme involves the setting of a target as part of an overall strategy for reducing greenhouse emission from energy use. Such a target can take a number of forms. While a uniform target reduction across all emissions is conceptually simplest, for reasons which will be outlined below, targets can be differentiated between types of use—commercial and household, for example. Different emitters can then be further differentiated on a sector-by-sector basis, for which existing administrative regimes are responsible for administering—a transport authority for transport emissions, energy authority for energy emissions, and so on. These sectors would reflect major categories of greenhouse emissions, such as transport and electricity generation for which a separate greenhouse emission reduction target is set.

Emission rights are then allocated to consumers such that the sum of allocation is equal to the abatement target for that sector. Such allocations could be pro rata, but there would be a good case for differentiating allocations between consumers on the basis of economic impact. In terms of household consumers, which is the main focus of discussion here, allocations could also be
differentiated on the basis of other considerations such as income inequality or regional considerations—such as rural versus urban fuel consumption.¹

**Implementing CBCRI**

Once a specific target is set, the main administrative consideration for the implementation of a CBCRI scheme is the setting of the levels of tax and subsidy. This task could become much simpler in view of emerging possibilities for international trading of greenhouse emissions, which are the focus of discussion below. Where a CBCRI scheme coexists with international trading, the market price of permits provides a value of the parameter $p$ which will help guide the setting of the other parameters. The relationship between tax, subsidy and price has already been identified above.

Caution would need to be exercised in view of fluctuating world prices for emissions permits. Any fluctuations in price which fall outside the level or tax or subsidy would tend to undermine the effectiveness of a CBCRI scheme, unless transaction costs are low enough to induce trading—an option unlikely to be feasible at the household level. As a general rule, the difference between tax and price and price and subsidy would need to be big enough to cover administrative costs.²

**Tracking Emissions**

The most expensive aspect of a CBCRI scheme is likely to be the tracking and verification of emission levels of millions of individual consumers. With the use of emerging technologies, and integrating a CBCRI scheme with the existing tax system, it could be possible to reduce administrative costs to level low enough to make such a scheme feasible.

¹ However, any differentiation needs to be weighed up against the administrative cost which it would then create.

² However, it is worth noting that as the difference between these parameters grows, the scheme begins to adopt more closely the dimensions of a regulatory approach—that is, an effective standard which is very expensive to exceed, and little incentive to abate below—with its inherent drawbacks discussed above. The challenge then is to keep the administrative costs down to preserve the market characteristics of the scheme as far as is possible.
One way of achieving this could be using smart cards. With the adoption of smart cards capable of storing up to 16,000 characters of information regarding consumer transactions it would be possible to store information about fuel consumption by type of fuel (Choice, 1996). Depending on the type of card used, there is no need for the information to be stored centrally (Choice, 1996). In the case of transport, information regarding fuel use, which is converted into carbon equivalents depending on the type of fuel used, could be stored on the card at the pump. Incentive to participate in the scheme is provided by charging the full tax rate when a purchaser does not present a smart card, effectively acting as a carbon tax for non-participants. Those who participate are exempted from the tax so long as their cards still retain a surplus level of emission permits. The repayment of subsidies could be integrated with the existing tax system, such that a receipt for surplus allocations from a card reader is submitted as part of a yearly tax statement.

**An Integrated Approach to Greenhouse Abatement**

While it has been mentioned that mixed incentives can be used to provide a 'once and for all' approach which tend to provide a predetermined outcome this is not automatically the case there the MNPB curve fluctuates wildly, or the difference between charge and subsidy are relatively small. In figure 1 above it can be seen that if the charge was set lower than shown, or the subsidy set higher, then the MNPB$_2$ and MNPB$_3$ cases would result in surplus emissions and permits respectively. At the aggregate level, such a scenario will result in either exceeding or falling short of the desired abatement target.

However, in view of emerging possibilities for an international permit trading scheme, the above outcome does not preclude achieving a target in effect, if not in fact, through the trading of permits internationally, or even nationally at the sectoral level. Where a specified target has been exceeded, if the initial parameters are correctly set, the revenue collected would more than offset the cost of buying additional permits to cover the abatement shortfall. (Revenue could also be funnelled into forestry as a carbon sink which would, in turn, be used as an emission credit.\textsuperscript{3}) The same is true where surplus permits are sold to

\textsuperscript{3} The economics of offsetting greenhouse emissions from transport with forest plantations have been investigated the Bureau of Transport and Communication Economics (BTCE, 1996).
fund the payment of subsidies. This is shown in figure 2. Figure 2A shows the case where net emissions exceed the target $P_t$ to the level $P_a$. In figure 2B the achieved emission level $P_b$ is better than the target level such that surplus allocations are available. The cost of buying permits, or paying the subsidy is shown by the hatched areas in both figures while surplus revenue is shown is shown in the dark area.

Figure 2. Revenue raising in a CBCRI scheme

ANALYSIS OF CONSUMER BASED CARBON REDUCTION INCENTIVES

Attention is now turned to analysing the implications of implementing a CBCRI scheme. This is done with a view to the effectiveness of a the scheme and its ability to achieve prescribed targets, economic impact, equity and redistributive impacts and the likely political reaction to such a proposal. The analysis compares the scheme to command-and-control and market-based incentives such as a carbon tax or a pure permit scheme.

Effectiveness of a CBCRI scheme

A CBCRI scheme is not as reliable in achieving desired emission objectives as tradeable emission permits or command-and-control because it does not lock polluters into meeting established targets. However, it is far more desirable on other grounds, not least of which is the major problem of enforcement which accompany regulatory-based schemes and the administrative problems associated with a tradeable permit scheme.
A CBCRI scheme should provide a much stronger incentive to reduce emissions than a carbon tax, which simply raises costs irrespective of the level of emissions produced and simply becomes a part of a range of taxes and charges applied to fuels. A feature of adopting a mixed approach combining a subsidy and a tax for different levels of emissions is that the cost functions of consumers are not linear, as it is in the case of a carbon tax. Instead, there is a change in costs at the threshold level of emissions.

The effectiveness of a CBCRI scheme would be enhanced with a permit trading scheme at the national or international level. As discussed above, the scheme can readily be integrated with permit trading and remain revenue positive.

**Economic Impact of CBCRIs**

Depending on the form in which it is implemented, a CBCRI scheme appears to involve a smaller net burden on economic activity and conform to conditions of optimality better than either a carbon tax or a permit system alone. The principal reasons are threefold. First, for those who participate, a CBCRI scheme should involve a lower tax burden then under a carbon tax, since charges only apply once allocations have been exceeded.

Second, a CBCRI scheme provides flexibility in response to changing economic circumstances. It would avoid potential bottlenecks associated with tradeable permits if polluters were not able to obtain permits due to market rigidities and transaction costs. Any policy which produces bottlenecks in production and consumption will have a deleterious economic impact which may exceed the benefits of that policy (Koutstaal and Nentjes, 1995). Mixed instruments such as CBCRIs provide an escape route whereby polluters who exceed allocations are subject to a tax instead of having to search out additional permits to purchase. While there are a number of other approaches available to overcome permit supply bottlenecks - such as overlapping permit systems, leasing arrangements, and extending permit life - they are administratively complex (Grubb and Sebenius, 1992).

Finally, while a CBCRI scheme introduces flexibility, it retains the stabilising influence typical of tradeable permit schemes on energy prices. A sudden increase in energy prices and a consequent fall in fuel consumption, may be compensated for either as an increase in the level of total rebate, or a reduction in total tax for excess emissions. An important issue, discussed above, is the
desirability for differentiation between types of fuel users to minimise the economic impact of the scheme—between commercial and private users, for example. This is administratively possible since the proposed CBCRI scheme is integrated with the tax system, which is already geared up for differentiation on this basis and others such as income and location. Similarly, the distribution of permits can be tailored according to the same principles.

**Equity and Redistributive Implications**

A carbon tax has been found to entail a significantly higher burden on low income earners compared to high income earners (OECD, 1995). This finding has been confirmed by a number of studies—although the level of impact depends on whether changes in income or in expenditure are used to determine impacts (Hamilton and Cameron, 1994; OECD, 1995, p. 21).

Unlike carbon taxes, the net distribution of revenue from a CBCRI scheme is from high to low emitters of C0₂, not from low to high income earners. While further analysis is needed to determine the precise distributional impacts in specific cases, it is plausible that the distributional impacts of a CBCRI scheme will be lower than that of a carbon tax alone. Should the distributional impacts be significant, the parameters of a CBCRI scheme can be tailored to minimise these in much the same way as for economic reasons discussed above.

Distributional impacts aside, other equity implications of the scheme are favourable. The potential for payment to those who do not exceed their allocation of carbon emissions is an important aspect of CBCRI. In this sense the scheme satisfies the strong Pareto criterion because those who choose not to produce emissions are compensated via the rebate mechanism by those who pollute (Layard, 1972, p.16).

**Political Acceptability a CBCRI Scheme**

Another important consideration is the political acceptability of a CBCRI scheme. One consideration that often impedes the popularity of tradeable emission permit systems or Pigouvian taxes is inequitable distribution of costs (OECD, 1995, p. 7; Becker and Shechter, 1996, p.10). A CBCRI scheme is less likely to have significant redistributive impacts than a tax, and as such would be seen to be more acceptable. Further, the potential for compensation will provide a strong level of support for those who stand to gain from such a proposal.
Those who will be encumbered with the tax might more readily accept a CBCRI than a carbon tax alone because it will only be applied once the quota of emissions is exceeded. Assuming that the tax on excess emissions is no greater than for a carbon tax, the cost of the scheme for those fuel consumers is less because the additional tax only applies to a part of their fuel consumption.

A mixed scheme such as CBCRI is likely to prove more popular than a pure tradeable permit scheme with those environmentalists who oppose the allocation of property rights to pollute for two reasons. First, rights are consigned to individuals rather than companies. Second, those rights are not ‘pure property’ in the sense that they can be bought and sold. There may still remain problems resistance to the scheme by the public who perceive it as another bureaucratic imposition, but the ability of the scheme to fit within existing administrative regimes will help with the adoption process.

CONCLUSIONS

This paper has proposed CBCRI as an alternative instrument for reducing greenhouse gas emissions to commonly proffered approaches such as regulation, taxes and tradeable permits. CBCRI is a mixed incentive scheme, which incorporates elements of tradeable permits with taxes or subsidies applied to emissions which exceed or fall short of allocated or acquired emission rights.

The CBCRI scheme discussed here in has focussed on its application across the spectrum of energy users, both household and firm—with emphasis on the former, given its neglect under alternative proposals. A CBCRI scheme could operate concurrently with an international tradeable permit scheme where emission permits are bought and sold collectively by the administering authority to supplement allocated emission targets for a sector, or to pay for subsidies where a particular target has been exceeded. In each case there should be a surplus of revenue to cover the administrative costs of the scheme. However, these costs need to be kept to a minimum to maximise the scheme’s economic benefits. It is plausible that costs could be significantly reduced by adopting smart card technology and streamlining a CBCRI scheme into the existing tax system.

Analysis of CBCRI reveals that it potentially captures the advantages of tradeable permits, by facilitating the meeting of abatement targets, while
reducing its administrative and transaction costs. While it is flexible, it avoids the worst redistributive effects of a carbon tax, and reduces the overall tax burden associated with a level of tax required to achieve a substantial level of abatement. Further, it is democratic in nature, by allocating emission rights across the population; and satisfies the strong Pareto principle, by charging polluters and compensating pollutees. It is also argued here that such a scheme is likely to meet less political resistance than its existing counterparts.
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