

Economic Issues in Emission Trading

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This paper discusses some of the economic issues likely to be encountered when establishing an emission trading scheme and highlights some design options for Australia. Some of the material in this paper has been drawn from Cornwell, Travis, and Gunasekera (1997), Mullins and Baron (1997), Fisher et al. (1995) and EPA Victoria (1995).

1 Defining the product

The first step in implementing an emission trading scheme would be to define the nature of the tradeable permit. Considerations would need to include: the duration of the permit; the allowable emissions per permit; the overall emission cap; and the greenhouse gases (GHGs) covered under the scheme.

Duration of permits

In an emission trading scheme, a designated central authority would issue permits to any number of potential market participants. The frequency with which permits expire and are re-issued can influence both the cost-effectiveness of the scheme and its ability to mitigate any adverse environmental consequences associated with GHG emissions.

The duration of permits will, to some extent, depend on the overall time frame in which it is desired to reduce emissions to a certain level. The duration of permits would need to represent a balance between the requirement to allow the designated central authority sufficient control over the desired level of emission abatement and the need to provide participants flexibility in meeting reduction targets.

The advantage of a short lived permit is that it gives the central authority greater control over ensuring the achievement of a desired level of emission reduction. The advantage of a longer lived permit is that it provides participants with a higher degree of certainty and more flexibility to comply with the emission limit and so enables them to plan, for example, the required capital investment on abatement measures to achieve future emission abatement commitments. An emission trading scheme needs to be designed from the outset to be flexible enough to facilitate any changes that might be required to the overall emission limit and yet still allow sufficient time for planning and implementing GHG abatement strategies.

Emission load

The emission load is the amount of GHGs that a single permit entitles its holder to emit over a period of time (the 'permit period'), and this can take various possible forms. For instance, a load can be expressed as a rate of emissions, or as an amount of emissions that can be emitted at any time over a multiple year period.

The advantage of having an emission load based on a rate of emissions is that the central authority can tightly control the flow of pollutants. The advantage of a multiple year emission load is that it provides participants with greater flexibility in meeting their emission reduction targets, because they can pollute at whatever annual rate suits their operation, provided the total level of their emissions over the designated number of years does not exceed the allowable level.

The emissions allowable under each permit could be a single, measurable unit of emissions (such as one tonne of carbon dioxide (CO₂) equivalent) or multiple units of emissions (such as 100 000 tonnes of CO₂ equivalent). However, in a sense this decision is arbitrary.

Emission cap

The emission cap is the level of total emissions that can be emitted nationally during a permit period. The central authority would have the power to change the emission cap over time, either in accordance with a predetermined plan of emission reduction (for example, agreed upon as a result of international climate change negotiations) or in response to changes in technology or information concerning any environmental consequences of emissions of various GHGs.

Changes in the emission cap could most easily be achieved at the time at which a stock of permits is retired and a new stock issued. However, it may be desirable to introduce changes during a permit period. In this case options include:

- empowering the central authority to announce changes in the emissions allowed under each permit;
- empowering the central authority to repossess compulsorily a number of permits from permit holders at any time (where compensation could be considered) or to issue more permits to holders; and

- having the central authority actively participate in the market, buying and/or selling emission permits until the allowable total emission load is changed to the desired level (EPA Victoria 1995).

However, confidence in the market may be undermined by large and unexpected changes to the emission cap. This may reduce the willingness of buyers and sellers to engage in trading, and may result in the hoarding of permits to guard against possible reductions in future total emission caps (or quick use if increases are anticipated) (EPA Victoria 1995).

Coverage of greenhouse gases

As well as defining duration, permits should specify the type of emission they represent. Permits would ideally be standardised so that they are fully exchangeable (Mullins and Baron 1997). In the United States sulphur dioxide (US SO₂) emission trading scheme each permit represents one tonne of SO₂ which may be emitted during the permit's life span of one year.

The challenge for an emission trading scheme for GHGs is that there are several gases that need to be covered. A solution is to have a weighting index which translates GHGs into CO₂ equivalent units for trading, given that CO₂ represents the majority of GHGs emitted. Ideally, all sources of GHGs should be included in an emission trading scheme. From an economic perspective, the total cost to all the participants in an emission trading scheme of achieving a certain reduction in emissions would be lower because the burden would be spread across more sources. Furthermore, from an equity and polluter pays perspective, including all sources in the scheme would ensure that all sources are treated in the same way and all participants are made to take responsibility for the environmental impact of their activities (EPA Victoria 1995).

On the other hand, a comprehensive trading scheme would be more difficult to monitor and could have higher transaction costs than, for example, a trading scheme covering only CO₂ from fossil fuel combustion (Mullins and Baron 1997). Furthermore, the sources and sinks of methane and nitrous oxide emissions are as yet poorly understood (Fisher et al. 1995). It may be necessary to start with a less comprehensive scheme in which participants are limited to trading only in CO₂ and allow trades in other GHG sources and sinks, such as those associated with agriculture, land use change and forestry, once their GHG emissions and removals can be adequately verified and monitored.

2 Market participants

In defining the market, the widest number of participants should be allowed to trade. Experience from the United States has shown that in cases where markets have been narrowly defined few transactions have taken place and the commensurate gains have been less than they

could have been. The question of who participates in an emission trading scheme is also a key determinant in whether the number of traders in the market will be large enough to ensure competition (IC 1997).

There can be two types of market participant — compulsory and voluntary.

Compulsory participants

Compulsory participants are those who are required by legislation to hold permits to cover their emissions of specified GHGs. In principle, emission permits should be linked to the level of GHGs actually released into the atmosphere. In this way, all emitters would have an incentive to reduce their emissions. Therefore, an ideal GHG emission trading scheme would target all emitters of GHGs. However, in practice this would involve everyone in the community. Obviously, monitoring emissions from so many individual sources with current technology is not practicable.

There are likely to be significant administrative advantages if participation in the permit market is restricted to large emission sources. The challenge is to achieve an economical balance between the number of participants (and associated administrative costs), emission coverage and abatement opportunities. For example, targeting energy suppliers (such as petroleum refineries) rather than end users of energy (such as motorists) may result in efficiency losses, but these may be outweighed by the lower administration, monitoring and transaction costs associated with an emission trading scheme.

Given that energy related CO₂ emissions are the easiest of all GHG emissions to measure and monitor, it is worth considering how permits might be issued initially to cover these emissions. Permits could be issued to energy producers and suppliers, namely electricity generators, petroleum refineries, oil and gas suppliers and other fuel transformers. Under this scenario, permits would cover not only emissions released during the generation and transformation processes but also emissions resulting from fuel combustion by end users. The fact that energy producers and suppliers are easily identified is a significant administrative advantage in setting up a permit scheme. An alternative is to issue permits to large emitters within the sector. For example, permits could be issued to electricity generators, the transport sector and industry (particularly iron and steel producers and cement manufacturers). If a comprehensive scheme is not established initially, the introduction of other sources and gases at a later stage would need to be clearly identified and work toward their gradual introduction encouraged.

Voluntary participants

Voluntary participants include any other parties who wish to participate in the permit market. Voluntary participants could include:

- relatively low cost emitters who are not required to be participants initially;
- individuals who have an opportunity to 'earn' permits by sequestering carbon; and
- any person or entity who wishes to buy, sell and hold permits — for example, brokers facilitating the trading of permits, public interest and environmental groups wishing to purchase permits to reduce the overall level of GHG emissions and investors wishing to purchase and hold permits for future sale.

3 Allocating permits

Once the nature of the permit, the total number of permits and the compulsory participants are determined, permits would need to be allocated amongst the compulsory participants. This simply means that participants would need to be informed of the number of tonnes of emissions they are permitted to emit or trade in the first permit period, whether this has been determined through auctioning permits, distributing permits free of charge or by other measures.

With a perfectly competitive domestic emission trading scheme, no matter to whom the initial permits are allocated, equilibrium permit prices will be the same and the final allocation after domestic trade will be the one that minimises the cost of reducing emissions. Emitters will want to buy permits if abatement costs exceed the permit price and sell permits in the opposite case. Trade will continue until all firms reach a position of indifference between buying and selling permits. When this state is reached, an ex post distribution of permits that minimises the costs of reducing emissions has also been reached (Fisher et al. 1995).

There are two main methods by which permits may be allocated initially. Auctioning involves selling permits to the highest bidders, and thus involves payment of money by purchasers to government. Alternatively permits may be issued free of charge (or at low cost) to incumbent emitters. There is a number of ways in which free permits could be issued. Permits could be 'grandfathered', whereby incumbent emitters are allocated permits based on their emissions in an historical period. In principle, permits could also be issued free of charge (or at low cost) based on some other historical record such as marginal costs of emission abatement.

Auctioning permits

Under auctioning, each emitter would determine its optimal emission control strategy in order to decide how many permits to purchase and how much to invest in emission control measures. As a result of the initial allocation of permits being more closely aligned with relative abatement costs, few external trades would be expected to take place following an auction.

Permits may be auctioned in a variety of ways. Examples of different auction methods include the English, Dutch and Vickrey methods (for a discussion of these methods see McAfee and McMillan 1987). Auctioning of permits would continue until all available permits have been sold.

There is also the issue of how big should be the block of permits auctioned at any one price call. The system of auction of permits in the US SO₂ emission trading scheme allows for any number of permits to be bought, down to single units.

If permits are auctioned, the impact of the permit scheme on the economy may depend on what government does with the revenue. There is a number of options available to government. For example, government could use auction revenue to offset cuts in other taxes such as income taxes or payroll taxes (this is called 'revenue recycling'). No direct impact on government revenue would occur if the tax revenue were to be redistributed to emitters, or if permits were grandfathered (Fisher et al. 1995).

Auctioning permits is likely to be resisted by some potential participants of an emission trading scheme as the method of allocating the initial stock of permits. To sell permits removes the 'property right' which emitters have had in the past. Emitters are likely to be more amenable to a system of initially issuing permits to existing emitters free of charge (or at low cost). However, even if such grandfathering were a significant basis of allocation, auctions could still have an important role in making available, to participants and the public, extra permits on a regular basis to stimulate trade. In the US SO₂ emission trading scheme the percentage of total permits held for auction is about 3 per cent.

Issuing permits free of charge

Issuing permits free of charge (or at low cost) explicitly recognises the property rights which emitters have had in the past. This recognition is reflected in the value of the permits to existing emitters. There are different ways of allocating permits free of charge.

Some have argued that, under the approach of issuing permits free of charge, because new (and expanding) firms who manage to enter the market are required to purchase all necessary permits incumbent firms may have a distinct competitive advantage. All else being equal, it is argued that incumbent firms will be able to produce a given level of output for a lower unit

cost than potential new entrant firms. This reduction in the competitiveness of new entrants is called 'new source bias'.

However, this discussion of new source bias does not appear to take opportunity costs into account. New firms will have to purchase permits, which is a cost. Incumbent emitters, with the permits, have an asset they can sell — the permits. Choosing not to sell the permits and to use them incurs a cost — the foregone revenue from not selling them. There is no efficiency bias necessarily associated with to whom the permits are allocated, as was noted earlier. When opportunity cost is taken into account, the costs of new and incumbent firms will not differ according to who receives the permits.

4 Administering the scheme

There is a need for a designated central authority to administer an emission trading scheme. Where possible, use should be made of existing institutions and infrastructure to administer the scheme, rather than setting up new institutional structures which are likely to add to the cost of the scheme. The administrative set up would need to be clearly set out in legislation relating to the scheme.

Once the scheme is operating the administering authority would have three main tasks: to keep track of permits; to keep track of emissions; and to respond to violations of the scheme in a way which ensures that it is always in the interests of participants to comply.

Monitoring permits and emissions

In keeping track of permits the central authority would need to record the number of permits issued and held by participants (and in reserve), permits deducted for compliance purposes and transfers of permits between participants.

The process for monitoring emissions could utilise existing methods, if appropriate, which are currently in place in some states to monitor emissions of other pollutants. For example, the New South Wales Environment Protection Authority already has in place a system of monitoring air and water pollutants (including sulphur oxides, nitrous oxides and particulates in the air and nitrogen, phosphorus and salinity in water) for its load based licensing scheme. This system involves polluters filling in a compliance return giving details of the monitoring they have undertaken and the results from this monitoring. The returns may be subject to audit. In the United States, participants in the SO₂ emission trading scheme already monitor and report CO₂ emissions along with their emissions of SO₂ (DFAT 1997).

Enforcing compliance

Spot checks of emissions from participants could be conducted on a regular basis with a dual purpose — to ensure that monitoring systems are working well and that participants are

on track to match emissions with permits at the end of the period. It may be necessary, in order to avoid the risk of too many participants having large deficits of permits at the end of period reconciliation, for there to be a rule relating to the size of the deficit (between permits held and emissions) that a participant is allowed to run in any given year without penalty.

At the end of each permit period there would need to be a reconciliation of permits held against emissions over the period for each emitter. If a participant's emissions are less than the number of permits it holds, the remaining permits could be carried forward (or 'banked') into the following period's account. If a participant's emissions are greater than the number of permits held there could be a penalty, in the form of a fine per excess tonne of emissions and/or a requirement to surrender permits for the following year equivalent to the excess of emissions. In the US SO₂ emission trading scheme the fine is about 20–30 times the market price for permits (DFAT 1997).

'Borrowing' permits from future periods could potentially introduce a number of problems relating to participants meeting their emission abatement commitments. However, these problems would need to be weighed up against the benefits in terms of flexibility to participants and potentially lower economic costs. A possibility is to allow borrowing to occur, but to place limits on the number of permits that could be borrowed from future permit periods and to impose a charge on borrowing. The United States has suggested, in the context of an international GHG emission trading scheme, that a charge, or interest rate, of 20 per cent might be applied on borrowings from future periods (DFAT 1997).

5 Market issues

A number of market issues need to be considered when designing an emission trading scheme. These include the market mechanisms which will facilitate trading and market power. Market mechanisms which facilitate trade in emission permits are likely to emerge once a scheme's rules have been finalised. So long as participants notify the central authority of their level of emissions and their trade in permits, there is no reason for the central authority to be concerned how trade in permits actually takes place.

The Sydney Futures Exchange and the Australian Stock Exchange are examples of existing market mechanisms which could serve as a trade centre. Permits could then be traded in the same manner as other commodities. It is likely that initially permits would be traded in a cash (or spot) market, but that eventually the market would develop to include derivatives such as swaps, futures and options. Brokers and information exchanges are likely to arise in response to the establishment of the permit market. However, particularly in the initial stages

of the tradeable permit scheme, there may be an additional role for government to enhance information flows to facilitate the establishment and operation of the permit market.

6 Incorporating carbon sequestration

Not only are GHGs such as CO₂ emitted into the atmosphere from a variety of activities, such as burning fuels, but CO₂ is also absorbed (or sequestered) by 'carbon sinks'. Carbon sinks include vegetation (such as forests), which absorb carbon through their biomass, and soil.

Vegetation absorbs carbon so long as it is growing. When vegetation decomposes, while still in the soil or once removed, the stored carbon is released back into the atmosphere. Soil releases carbon when it is disturbed, such as through cultivation.

There are several key issues that would need to be addressed in incorporating sequestration in an emission trading scheme. These are outlined below.

Defining the activities for which emission permits may be earned

Permits could be earned for tree planting alone, or for both tree planting and improved agricultural practices. This could be determined in a contract between the regulatory body and the proprietor of the sequestering activity.

Defining the number of permits to be earned from different activities

The number of permits earned would be related to the rate at which the activity chosen sequesters CO₂ over time and the total amount of carbon the sink will sequester in its lifetime. For example, different trees have different store values of carbon and sequester CO₂ at different rates over time.

An issue that arises with tree plantations is how to deal with the continual planting and harvesting of trees that occurs with managing a commercial plantation. Whilst a new plantation will absorb a net amount of carbon in the set up phase, a mature plantation has, on average, a zero net effect on the level of CO₂ in the atmosphere. The issue, then, is when in the life cycle of the plantation to recognise the sequestration benefits and issue permits.

The Intergovernmental Panel on Climate Change (IPCC) and the United Nations Framework Convention on Climate Change (FCCC) Secretariat have yet to make firm recommendations on when in the life cycle of sequestration activities carbon permits should be issued.

Establishing methods of verifying amounts of carbon sequestered

Accurate monitoring is important for the integrity of an emission trading scheme. Currently there is uncertainty in the measurement of carbon sequestered from activities relating to forestry, agriculture and land use change. However, the measurement of sequestration is improving, mainly due to the availability of improved data (NGGIC 1997).

Whilst accurate measurement of sequestration is difficult at present, it is possible to obtain rough figures. There are numerous studies which provide estimates for the amount of CO₂ that is sequestered by various sinks — see IPCC (1996) for a discussion of some of these studies.

As well as obtaining adequate estimates of the carbon sequestered by various activities it is important that methods of measuring and monitoring are cost-effective — that is they are not too costly for the effect they achieve. Where methods are too costly they may outweigh the benefits from including sequestration in an emission trading scheme.

It is likely that improved and more cost effective measuring techniques will develop with the establishment of an emission trading scheme and the associated incentives to include carbon sequestration. Therefore, it is important that a scheme is flexible enough to incorporate new methods of measuring as they become available and new sequestering activities as measuring improves.

Establishing provisions for natural disasters

Natural disasters, such as bushfires, may destroy sequestering activities, such as tree planting, which have been established to earn emission permits. This could be a problem for the authorities if permits had already been given to the owner of the sequestering activity. However, where there is contract between the central authority of the permit scheme and the owner of the sequestering activity this contract may specify some form of repayment of the permits to the central authority in the case of the activity owner not meeting the requirements of the contract. It is also likely that, as a permit market develops, the market may increase the value of fire prevention and owners of sequestering activities may seek to implement measures to reduce the risk of damage and/or to insure their activities against natural disasters. There may also be a role for financial instruments, such as options, in hedging risks.

7 Areas for further work

There are a number of issues relating to a domestic GHG emission trading scheme that require further work and analysis. Some of these issues would require ongoing work, even after the introduction of an emission trading scheme. Other issues would need to be resolved before the implementation of an emission trading scheme.

Areas of ongoing research in the main revolve around the need to develop more reliable methods of measuring and monitoring GHG emissions, of all types from all sources, and carbon sequestration. It would be desirable to have a comprehensive emission trading system

as this would allow the market to realise the greatest efficiencies in reducing emissions and thus achieve overall emission reductions at least cost to participants and the economy.

Some of the important issues that would need to be resolved before the implementation of an emission trading scheme include:

- the permit period and the schedule of emission reductions over periods;
- the initial participants;
- the method of allocating permits initially; and
- the trading environment, including the type and level of government involvement required and the need for, and level of involvement of, a stock or futures exchange or other financial trading body.

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