CRC for Rail Innovation

Paper 4: The Case for Complementary Policies with Emissions Trading Systems

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Table of Contents

List of Figures and Tables

Executive Summary

A complementary policy is a policy designed to redress a market failure and to influence patterns of energy use or to reduce emissions other than through price mechanisms. This aims to include policies to promote the development of renewable energy and to encourage a modal shift from road to rail transport by non-price means. This definition is broadly consistent with the Government's approach in the CPRS, where complementary policies are described as measures targeted at a market failure that is not adequately addressed in the scheme, or that impinges on its effectiveness in driving emissions reductions (DCC 2008, Chapter 19).

Many economists argue that, if an emissions trading scheme is established, there is no place for such policies, and the role of complementary policies is indeed limited in the CPRS. This is an important issue in the present context, since such a position precludes complementary policies in transport, such as infrastructure and other spending to support a modal shift. This paper develops the contrary case, that complementary policies are necessary to facilitate the most efficient adjustment to a lower-emissions path, and to achieve a given reduction in emissions at least cost and with the lowest carbon prices. The paper includes documentation of the various types of market failure involved and of their relevance to emissions reductions, together with some analysis of the conditions under which complementary policies might produce an economically and socially preferred outcome to pure emissions trading.

In a fully competitive market, individual utility or profit maximising agents take decisions on the basis of price, in the face of demand and supply functions, that clear markets and which generate outcomes that are individually and socially optimal. Market failures occur when these results cannot be achieved; that is, prices do not clear market and/or the outcomes are not both individually and socially optimal. Four types of market failure are most important in the current context:

(i) *Externalities:* An externality occurs when the costs or benefits of an action are not fully borne by, or cannot be fully appropriated by, the agent concerned. One classic type of externality arises from public goods (goods that are non-rivalrous and non-excludable) such as clear air; for example, if one person uses the air, this does not stop others from doing so (non-rivalrous), and it is difficult to stop others making use of the clean air (non-excludable).

(ii) *Sunk costs*: A sunk cost is an expenditure that has been made and cannot be recovered, even if the firm has to sell its assets. Examples of sunk costs include spending on product innovation or R&D, or on fixed assets that have no value outside of their current use (such as railway track or locomotives). Sunk costs are rife in the transport and energy area. For example, much of the spending on tracks, customised vehicles and power stations is sunk, which means that the assets have little value other in their current use.

(iii) *Coordination failures*: Coordination failures occur when the decisions of agents, or their activities in separate markets, are interdependent and various factors hinder the coordination of these decisions or activities. According to free-market theory. agents are independent of one another, but when they are in fact interdependent and the coordination of their activities fails. price adjustment through markets may generate less than optimal outcomes. Interdependence between agents and markets is central to the energy and transport industries, and hence there is a good deal of scope for coordination failures. For example, freight operators can shift from road to rail only if rail track and services are available. Likewise, consumers can shift from road to rail for the journey to work only if there is a train line in their area.

(iv) *Information asymmetries and principal-agent problems*: These market failures occur when participants in markets have access to different levels of information, or when a principal is represented in a transaction by an agent, who may have different information or objectives than the principal or may face different incentives.

The paper develops the case that, in implementing the CPRS, much greater attention to, and investment in, complementary policies will help to achieve a more efficient reduction in emissions, and will also moderate the carbon price generated by the emissions market.

The transport system is riddled with market failures, especially externalities, sunk costs and coordination failures. The presence of such pervasive market failures means that prices will have only a limited role in facilitating structural change and reduced emissions in transport. If such failures are not addressed ,the carbon price will be higher than necessary for a given reduction in emissions, while a less-than-optimal set of emissions reductions will be chosen by the market. By contrast, substantial programs to eliminate market failures will both reduce the carbon price required and generate a more efficient response. A carbon price is necessary but not sufficient to achieve an optimal outcome in the transport sector.

Introducing a carbon price will tend to reduce economic activity since the existing low-cost but polluting technologies are taxed and activity is shifted to higher-cost but less-polluting ones. But if complementary policies create new goods and industries through R&D, revitalised infrastructure and new investment, action to reduce emissions may well be a source of growth. This point is particularly important in the context of the global financial crisis and its aftermath, especially the sharp recession in the USA and some parts of Europe, and its inevitable impact on Australia and other countries. Strong complementary policies would be growth enhancing, both by reducing the market-based carbon price and also by supporting investment in R&D, new infrastructure and plant and equipment. Thus many of the measures necessary to address key market failures would be strongly expansionary and could be a central part of an appropriate fiscal response to the current slowdown.

The central conclusions of this paper are that:

- because of pervasive market failures in areas such as energy, transport and buildings, the CPRS as currently proposed will be much less efficient than would otherwise be the case in reducing emissions, in that the carbon price required for a given reduction in emissions than it needs to be;
- as a result, a broad range of complementary policies are required to achieve a more efficient outcome;
- complementary policies in transport will be required to address relevant market failures and to support the CPRS in pricing, infrastructure investment, rolling stock standards, investment in coordination infrastructure and systems and support for R&D and for investment in new technologies and advanced plant and equipment.

1. Context

Many economists, including those of the Productivity Commission, argue that, if an Emissions Trading System is established, there would be no place for other policies to influence patterns of energy use or to reduce emissions. This argument would rule out , for example, policies to promote the development of renewable energy and to encourage a modal shift from road to rail transport. The basic argument is that, when a carbon price is established through a carbon market, this will lead to a reduction of emissions through inducing the most efficient changes to be adopted. If complementary policies support initiatives that would have occurred anyway, they will have little effect, although there will be a cost to the public purse. If they induce less-efficient forms of adjustment than those than that would have occurred through the carbon price alone, they reduce the efficiency of adjustment as well as incur a cost. This argument may seem persuasive, but it is valid only if there are no market failures to significantly impede the operation of an emissions trading system.

This is an important issue in the present context since such a position precludes complementary policies in transport, such as infrastructure and other spending to support a modal shift. This paper will develop the case that complementary policies are necessary to facilitate the most efficient adjustment to a lower-emissions path.

2. Emissions Trading in Theory and Practice

In theory, emissions trading of the cap-and-trade variety is straightforward. With all emitters required to hold a permit before generating a unit of greenhouse gas, the authorities set the maximum number of permits to be issued and allow these to be traded in free and open markets. In each period, the market price adjusts to bring the demand for permits in line with the available but declining supply, and permits are purchased and used by those to whom they have the greatest economic value. Thus the market selects the most efficient ways of adjusting energy use, and induces other behaviour, so as to reduce emissions. If permits are fully bankable (that is, a permit for a given year can be acquitted in that year or any subsequent year), this should ensure that the process is also efficient over time. If they are fully tradeable in an effective global system, this would also ensure that the most efficient reductions are made on a global basis.

Appealing though it is in theory, there are a number of evident threats to the operation of such markets in practice. Leaving aside design problems for a particular scheme, an emissions trading system may fail to meet the desired outcomes in four main ways:

- If permit prices turn out to be too high, or adjustments costs too severe, the authorities might weaken the cap or limit the operations of the system. Permit prices might be very high if, for example, many sectors are excluded so that adjustment is focused on a few sectors or if market failures block adjustment in some sectors.
- If market failures block adjustment in some sectors in relation to the original cap, less than optimal adjustment will be forced to take place in other sectors.
- In a period of sharp change with sunk costs, lags and other market distortions, the closure and investment decisions of some producers may not be consistent with an orderly adjustment process.
- The profit maximising behaviour of investors might lead to sharp swings or other costs in the emissions market.

This standard position starts with the hypothesis of a competitive economy, without sunk costs or other distortions, in which prices clear the market. Suppose further that, in such an economy, the government needs to limit the production of carbon emissions to achieve broader social objectives. If it does so by a cap-and-trade scheme, the government will require any producer to hold a permit before production of a unit of emissions, will issue a limited number of permits, and allow the price of such permits to adjust until the demand for emissions, through the demand for goods embodying emissions, is equal to the permitted level of supply. The resulting level of output will represent the most efficient way of controlling the output of emissions and, given assumptions about the social optimality of the pure market outcome, is also the socially optimum method.

Suppose that, in such a situation, the government also decides to intervene in the market to influence the supply of or the demand for goods and services generating emissions. This might be by prohibiting one form of emissions-intensive production (e.g., electricity from brown coal), by requiring a minimum level of zero emissions production (e.g., electricity from renewal energy), or by assisting or regulating other forms of production and consumption. These measures will have the effect of either reducing the supply of emissions relative to the permit level or reducing the demand for them, and will reduce the gap between the demand for emissions and the permitted supply. Hence they will reduce the rise in the price of carbon, so that there will be smaller reductions elsewhere. Given that the final level of emissions is determined by the permit level, the only effect will be to reduce the price required to clear at the permit level. However, given that the equilibrium achieved by the full price adjustment is both efficient and socially optimal, these measures cannot achieve a better outcome on these fronts, but may be less efficient and less than optimal outcomes, if the complementary measures bring about changes that are less than optimal. That is, such interventions serve no purpose in terms of final outcomes in an emissions trading regime, but may incur economic and social costs.

Two of the major problems with this position are that it does not recognise the role of sunk costs and other market distortions, and that it does not allow for cases in which the price elasticity of demand for energy-related products is a function of infrastructure or other factors affecting supply. Sunk costs are high in many energy and energy intensive industries (large, irrecoverable costs need to be incurred in building power stations or railway systems). Furthermore, these sunk costs create substantial entry barriers. In addition, the price elasticity of road passenger transport demand will be quite different in an area with good public transport than in an area with none.

To illustrate the role of sunk costs, let us consider an alternative economy. In this economy, 90% of emissions are produced in one sector (electricity), and production in this sector involves long lead times and heavy sunk costs, with marginal costs well below average costs, and the price elasticity of demand for electricity is low. Assume further than existing producers are coal based, many with old plants for which the capital costs have been written off. New, fossil-free forms of production are available, but also require meeting substantial sunk costs. For old producers, production just above marginal cost is economic, but new producers need to recover both capital and marginal costs. When the government introduces the cap-and-trade system and a carbon price is established, at initial levels, new producers cannot compete with the pure marginal cost basis of existing producers and the cost is fully passed to consumers, with little impact on demand. Hence the initial burden falls entirely on other sectors. The result is that, to clear the market the price of carbon must rise further, either to achieve the required emissions reduction in 10% of the economy or to a level that makes the return to new producers adequate to cover both capital and operating costs, and greater than marginal costs of old producers plus the cost of carbon permits. For particular values of the parameters, the carbon price required might be very high, and the impact on non-electricity industries much greater than the optimal.

In this second economy, establishing a regulatory requirement for non-fossil fuel production may have quite different effects. If, by a certain date, all electricity producers are required to produce, say, 20% of their output from renewable energy, they will be forced to invest, directly or indirectly, in generation from renewal sources. The price paid by the consumer for electricity will rise to cover the higher costs of renewal energy, and this will lead to some (small) reduction in demand. But the demand for carbon permits will be reduced. Hence, the carbon price will be lower than it would otherwise have been, thereby reducing the adjustment in other sectors. Relative to the pure emissions trading case, the result will be adjustment to the required level with a lower carbon price and with less adjustment in other sectors. In addition to being achieved with a lower emissions price, the outcomes with complementary policies may well be more efficient and socially desirable outcome than with pure emissions trading.

Similar points apply to cases in which the price elasticity of demand is a function of infrastructure or constrained supply. In transport, both these effects seem to be present. There is limited supply of rail freight and passenger services, for reasons to do with limited investment and infrastructure, themselves linked to the problem of sunk costs. This means that the cross price elasticity between road and rail traffic is relatively low (EMCT 2002), i.e., if road prices increased relative to rail prices, users will have limited ability to shift to rail services. This means that there is a prima facie case that appropriate complementary measures in rail could make the ETS more efficient and improve the social outcome. But the technical issues here need to be further analysed since this will be an important issue in assessing the impact of complementary policies for rail. These issues are explored further in Paper 10.

3. Relevant Types of Market Failure

In a fully competitive market, individual utility or profit maximising agents take decisions on the basis of price, in the face of demand and supply functions, that clear markets and which generate outcomes that are individually and socially optimal. Market failures occur when these results cannot be achieved; that is, prices do not clear markets and/or the outcomes are not both individually and socially optimal. Four types of market failure are most important in the current context:

(i) *Externalities:* An externality occurs when the costs or benefits of an action are not fully borne by, or cannot be fully appropriated by, the agent concerned. One classic type of externality arises from public goods (goods which are non-rivalrous and non-excludable) such as clean air; for example, if one person uses the air, this does not stop others from doing so, and it is difficult to stop others making use of the clean air. One response to externalities is to internalise the costs or benefits, so these costs are borne, or the benefits accrue to, the agent undertaking the activity in question. Emissions trading is an attempt to internalise the external costs of greenhouse gas emissions, by setting a carbon price and making those who produce the emissions bear the cost. As discussed in Paper 2, there are heavy social costs arising from the current pattern of transport provision in Australia, and many of these costs are external costs not fully borne by those creating them. For example, in freight transport, the costs, both social and infrastructure, generated by large, long-distance trucks are not passed through fully to the users of this form of transport.

(ii) *Sunk costs*: A sunk cost is a non-operational expenditure that has been made and cannot be recovered, even if the firm goes out of business. Examples of sunk costs include spending on product innovation or R&D or on fixed assets that have no value outside of their current use (such as railway track or locomotives). Sunk costs are commonplace in the transport and energy area. For example, much of the spending on tracks, customised vehicles and power stations is sunk, and the assets have little value other than in their current use.

When one participant in a market needs to incur a (new) sunk cost that other participants do not need to incur, there will be a market failure, i.e., the market clearing price may be well above the marginal costs of the existing producers without being sufficient to induce new entry. In such a situation, a significant increase in price might occur without generating any new entry, or any increase in supply. Sunk costs are also relevant to consumer purchase decisions. If an individual already has an (inefficient) car, the market value of which is low so the costs are largely sunk, then even in the face of sharply rising fuel prices she may be reluctant to incur the new sunk costs of purchasing a more fuel-efficient vehicle.

(iii) C*oordination failures*: Coordination failures occur when the decisions of agents, or their activities in separate markets, are interdependent and some factors hinder the coordination of these decisions or activities. According to the theory of free markets, agents are independent of one another, but when they are in fact interdependent and the coordination of their activities fails, price adjustment through markets may generate less than optimal outcomes.

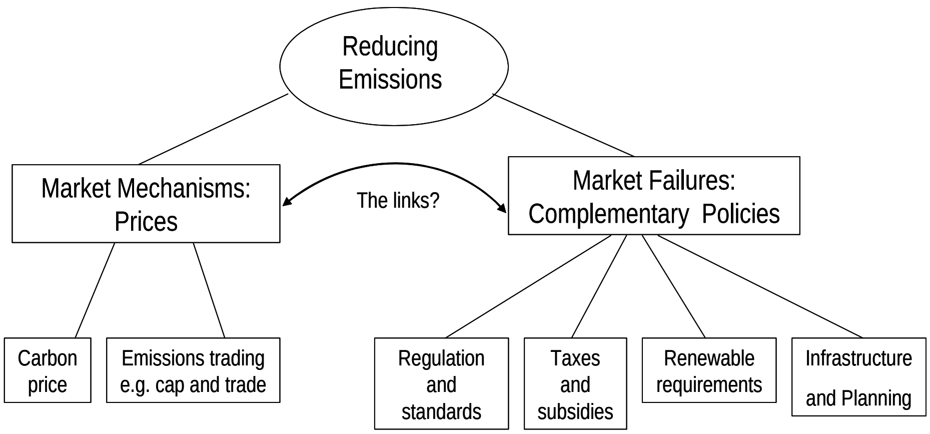
Interdependence between agents and markets is central to the energy and transport industries, and hence there is a good deal of scope for coordination failures. For example, alternative energy supplies can only be added to the grid (and hence supplied to the national energy market) if adequate distribution infrastructure is available. Thus freight operators can shift from road to rail only if rail track and facilities (such as intermodal exchanges) are available, and consumers can shift from road to rail for the journey to work only if there is a train line in their area. Sunk costs can also exacerbate problems of coordination. For example, if there are sunk costs in the electricity distribution industry, these may inhibit the provision of the new distribution infrastructure necessary to facilitate the operation of the energy market in the face of a carbon price.

(iv) *Information asymmetries and principal-agent problems*: These market failures occur when participants in markets have access to different levels of information or when a principal is represented in a transaction by an agent who may have different information or objectives than the principal, or may face different incentives.

4. Two Approaches to Climate Policy: Prices and Complementary Measures

As noted above, in the debate about climate policy, as in other areas of economic and social change, there are two main streams of policy within a market-based approach: prices and complementary policies. Here, a complementary policy refers to a policy designed to address a market failure and to influence patterns of energy use or to reduce emissions other than through price mechanisms. This would include policies to promote the development of renewable energy and to encourage a modal shift from road to rail transport by non-price means. As illustrated in Figure 4.1, prices are an effective instrument to the extent to which markets work effectively. To the extent that markets fail, complementary policies are necessary to achieve the best outcomes.

Figure 4.1 Policy options for reducing emissions: Prices and complementary policies



This is a critical issue for climate policy and emissions trading. Many economists argue that, if an emissions trading scheme is established, there is no place for such policies, and hence that the role of complementary policies is limited in the CPRS. This is an important issue in the case of transport for, as we have seen, the medium -term impact of carbon prices on transport emissions will be limited, and a sharper reduction in emissions is likely to require complementary policies in transport, such as infrastructure and other spending, to support a modal shift. Some of the appropriate complementary policies are considered below.

4.1. The Role of Complementary Policies

As is evident above, the transport system is riddled with market failures, especially those of the first three types: externalities, sunk costs, and coordination failures (some of these have been illustrated in the brief discussion above). Some of the social and environment costs of road transport are internalised through taxes and charges, but many are not. For example, it is widely acknowledged that the full costs incurred by large, heavy-haulage trucks are not fully passed on to users. Many of the key assets involved in transport, such as rail track, locomotives, signalling and other systems and R&D to create relevant know-how, involve sunk costs. This means that market mechanisms driven by prices alone are unlikely to provide sufficient incentive to generate the optimum level of investment in these assets. As noted above, coordination failures can be particularly acute in transport generally, and in rail transport in particular, hence limiting the level of investment in any particular component of the system unless these failures are addressed.

In some instances, the specific design of the CPRS will exacerbate existing market failures in the transport system. For example, when a traveller has to choose between using his or her car or taking the train, most of the costs of travelling by car are sunk, and the only marginal cost is the fuel cost, which is compared to the train ticket cost. In the initial years of the

CPRS, road fuel costs will be held unchanged but railway costs will rise, worsening the impact of this market failure.

The presence of such pervasive market failures means that prices will have only a limited role in facilitating structural change and reduced emissions in transport. If such failures are not addressed, the carbon price will be higher than necessary for a given reduction in emissions and that a less-than-optimal set of emissions reductions will be chosen by the market. By way of contrast, substantial programs to eliminate market failures will both reduce the carbon price required and generate a more efficient response. Thus a carbon price is necessary but not sufficient to achieve an optimal outcome in the transport sector.

In analysing the impact of measures to reduce carbon emissions on the economy, the focus is often on the impact of relative prices within a given industry structure with defined production and investment functions. In such a context, introducing a carbon price will inevitably reduce economic activity since the existing low-cost but polluting technologies are taxed and activity is shifted to higher-cost but less-polluting ones. But if the focus is on the role of complementary policies in creating new goods and industries through R&D, revitalised infrastructure and new investment, action to reduce emissions may well be a source of growth.

The above point is particularly important in the context of the global financial crisis and its aftermath, especially the sharp recession in the USA and some parts of Europe, and its inevitable impact on Australia and other countries. New or higher carbon prices alone may indeed tend to slow growth, but strong complementary policies may be growth enhancing, both by reducing the market-based carbon price and also by supporting investment in R&D, new infrastructure and plant and equipment. Thus many of the measures necessary to address key market failures would be strongly expansionary and could be a central part of an appropriate fiscal response to the current slowdown.

4.2. Some Complementary Policies for Transport

Achieving rapid change in transport thus requires strong but appropriate complementary policies. Furthermore, such policies will both reduce the carbon price necessary for a given reductions in emissions and stimulate growth. An appropriate complementary policy is one that addresses an important market failure in a demonstrably cost-effective manner. In the case of transport, these policies will address market failures in the transport system at key points directly related to the challenges that this industry faces in modernising and competing more effectively with other transport modes. Consistent with the previous argument, and with the more detailed analyses provided in other papers in this series, policy initiatives are needed in the following areas.

Pricing. Where possible, an effective response to an externality is to introduce a price or a tax to internalise the costs and/or benefits involved, as will occur with the internalisation of the social costs of greenhouse gas emissions through emissions trading. In freight transport, the costs, both social and infrastructure generated by large, long-distance trucks are not passed through fully to the users of this form of transport. There is a widely recognised case for mass-distance-location charging to be introduced, as in other countries, to correct this market failure. Mass-distance-location charging also corrects some of the limitations of the existing road charging regime, including averaging of charges, whereby trucks which are more heavily used pay relatively lower charges, and the fact that the full social and environmental costs generated by large trucks are not fully passed on to users.

Infrastructure investment. Major rail infrastructure (such as rail track and associated works and equipment) suffers from three forms of market failure highlighted previously, as does road infrastructure. Constructing a new or enhanced railway involves a heavy sunk cost and provides benefits to many (including, for example, property and business owners) that cannot by fully appropriated by the owner of the infrastructure. The value of a railway system is also highly dependent on its coordination with other systems and facilities (e.g., rail or road connections) and coordination failures can greatly reduce its value. As argued above and in the detailed papers, major investment in the extension and upgrade of Australia's rail infrastructure is necessary. Further steps towards standardisation of rail networks are also required since these would generate many efficiency and capital-cost benefits.

Standards for rolling stock. Uniform standards for rolling stock, perhaps in line with the US AAR (American Association of Railroads) standards, are highly desirable. Such standards would help to reduce both information and coordination failures in the transport system. These standards would require increasing the width and height of the rail corridor to accommodate larger rolling stock and increasing the strength of the rail track to accept heavier rolling stock. This would remove the current impediment of all new rolling stock having to be redesigned and specially built for the Australian market, which prevents the rail market from responding to market growth, increases equipment costs, reduces competitiveness with road, and delays the introduction of new technology. The current waiting time for a purchase of a new locomotive in the United States is 2 months, compared to 2 years in Australia for equipment based on an older design. Significant productivity and energy efficiency gains from carrying a greater mass per train would also be achieved.

Investment in systems, facilitation and coordination. Some similar considerations apply to investments in, for example, signalling and control systems, advanced modal interchanges and many aspects of intermodal and intramodal coordination. In transport, coordination failures can severely inhibit the achievement of required changes. Large-scale investments will be needed both to make rail transport more efficient and to facilitate the modal shift. Both private and public investment will be required, in many cases in joint projects to achieve simultaneously both public and private goals.

Investment in R&D, new technology and plant and equipment. To modernise Australia's rail system and to increase its scale of operations, massive investment, be it public or private, will be necessary by operating companies and by firms in supplier industries in these areas. The prospects for an adequate return on such investments would be greatly increased by the other investments outlined above (such as track extension and upgrading). But in view of the difficulties of appropriability and sunk costs, and of asymmetric information, public initiatives in the form of R&D support programs and enhanced depreciation allowances for certain classes of expenditure are likely to be necessary.

5. Conclusion

The central conclusions of this paper are that:

- because of pervasive market failures in areas such as energy, transport and buildings, the CPRS as currently proposed will be much less efficient than would otherwise be the case in reducing emissions, especially given that the carbon price required for a given reduction in emissions than it needs to be;
- as a result, a broad range of complementary policies are required to achieve a more efficient outcome;
- complementary policies in transport will be required to address relevant market failures and to support the CPRS in pricing, infrastructure investment, rolling stock standards, investment in coordination infrastructure and systems, support for R&D, and investment in new technologies and advanced plant and equipment.

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