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THE ECONOMICS OF ENERGY AND THE ENVIRONMENT: THE POTENTIAL ROLE OF MARKET-BASED INSTRUMENTS

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I would like to add my appreciation for the chance to participate in this stimulating, concentrated, and very well-organized conference. As a newcomer, perhaps struck by some of the things that people who are frequent attendees take for granted, I am grateful for Professor King's hospitality, the fine meals, one fine breakfast, good accommodations, and the efficiency and friendliness of the people working with Professor King. They have been ready to offer help whenever I looked lost or needed assistance; my particular thanks to Donovan Steltzner for special assistance on the computer side on the first day of the Conference.

A number of speakers have discussed aspects of the economics of energy. I am going to focus on the economics of certain environmental issues that tend to be linked to energy production and use. More particularly, I will focus on a sub-group of energy-related environmental issues – air pollutants, especially criteria contaminants such as SO_X and NO_X, and greenhouse gases. I will be mainly concerned with what are often called market-based instruments as a potential approach to address such pollutants. Much of the discussion will be at a fairly high level of generality.

Market-based instruments are generally viewed as consisting firstly of taxes or fees on either emissions or activities that create emissions – this can be viewed as directly setting a price or charge on emissions, and secondly of what are known as "tradable emissions allowances or permits." The fact that the allowances are "tradable" means, as will be discussed, that they too can be used to put a price or charge on the emissions and/or on the activities that cause emissions. Along with sketching the development of these approaches, I will note some of the issues that are raised by their use, and conclude with certain observations on the application of these market-based instruments in an increasingly integrated North American energy system.

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THE EVOLUTION OF MARKET-BASED SOLUTIONS TO ENVIRONMENTAL PROBLEMS

Use of market-based instruments to address environmental problems is relatively recent and far from pervasive. Probably the oldest approach to addressing environmental issues has been to rely on voluntary adoption of good practices, reinforced by ethics. Another approach involves property rights and litigation. I certainly do not want to discount the usefulness of these approaches in some situations, but I believe it would be widely agreed that there are also many situations in which they have not proved sufficient.

The next level of response to environmental problems has traditionally involved regulation; this is probably the most commonly-used approach in many of the air-pollution and other energy-related environmental areas. I will, however, not deal with regulation except to consider a limited number of areas of evolution from regulation to market-based approaches.

I am going to portray what seem to me to be the key elements in this evolution through the use of two fables. I use the term "fable" because I am providing two somewhat oversimplified histories: first, the history of the development of some academic thinking as to how market-based approaches might operate; and, second, an oversimplified history of how practical policy experience has evolved and, to some degree, intertwined with academic thinking.

First, the academic side. Matt Schaefer used the term "externality,"[1] and I do not think that term needs much explanation in this group (which is reassuring for my purposes). However, just briefly: an "externality" refers to the notion that some production or consumption activities involve impacts on third parties, creating benefits and detriments for those who are not involved in the production or consumption activity. Under these circumstances, economists have recognized that the price system – that is, the invisible hand of the markets – cannot be expected to work very well, and cannot achieve the efficient allocation of resources or the patterns of production and consumption activity in the economy that might otherwise be expected. While the term itself was put forward by the British economist A.C. Pigou in the first quarter of the last century,[2] the general point has been understood, at least implicitly, for a long time. The formalization of regulation based on this idea had its genesis in the early part of the 20th Century.

Pigou suggested that, as a potential response and as an alternative to regulation, one might address the perceived problem with the price system directly. This problem is that there are costs that are not borne by the people

[1] The concept was at least inferred. *See generally* Matthew Schaefer, *Waste Management in the U.S. Context: Trade or Environmental Issue?*, 28 CAN.-U.S. L.J. 105 (2002).

[2] A.C. PIGOU, THE ECONOMICS OF WELFARE (4th ed. 1932).

who are making decisions on how, and how much, to produce or consume; in response one might try to find means of making those decision-makers bear such costs. This might be done through regulation that required reduction in pollution; but it might in principle also be achieved by putting a price on the externality. For example, to cut back on emissions, one might place a tax on emissions or a tax on the production or consumption activities that result in those emissions.

Now, to be able to do this in a way that will achieve the basic objective with any precision, you must be able to assess the environmental damage that occurs per unit of emissions or output. This may not be easy; there will often be an issue as to the acceptable degree of approximation. It is fair to say that, while Pigouvian theory was rapidly picked up in economics textbooks as part of the conventional wisdom, there was limited use of Pigou's approach in North America though perhaps somewhat more use in Europe. Even the limited use of pollution-related taxes and fees that did occur in Europe and North America tended to involve rates of such fees that were set not so much in relation to estimated value of the damages associated with emissions or other polluting activities, but rather as a way of covering the cost of, say, whatever level of clean up or waste disposal that the government chose to implement. Such costs may be more readily ascertainable, and the public case for imposing such costs on the polluter may be more straightforward

A second potential way to deal with externalities, initially put forth in a book by the Canadian political economist John Dales of the University of Toronto[3] in the 1960s, is to create a system of "tradable quotas" for units of pollution, somewhat similar to tradable or transferable catch quotas that have been used in some fisheries. Under this approach, rather than setting fees at specified levels per unit of pollution, governments would provide a fixed supply of allowances to emit or to conduct particular activities with which emissions were associated. The total supply of allowances would be fixed at the target level of emissions that the government authority judged corresponded to an acceptable amount of pollution or emissions. These allowances might be distributed initially on a *gratis* basis. One would expect a market to develop and a price to be established. This would then provide an alternate way of putting a price on emissions and giving an incentive to polluters to find the least expensive ways of achieving the target reduction.

Early in the 1970s, W. David Montgomery provided a more rigorous analysis of the implications of this idea.[4] A few years later, Martin Weitzman pointed out an elementary but important contrast in the two approaches. Under the fee approach, the government sets the price of the

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[3] J.H. DALES, POLLUTION, PROPERTY AND PRICES (1968).

[4] W. David Montgomery, *Markets in Licenses and Pollution Control Programs*, 5 J. ECON. THEORY 395 (1972).

pollutant; consumer and industry response to that price then determines how much emissions are reduced and the quantity of emissions that remain. Alternatively, under the tradable allowance system, government in effect sets the quantity of the pollutant, and consumer and industry response then determines the price of allowances, *i.e.*, of emissions. You can have certainty regarding the price of emissions in the first case, and certainty regarding the target quantity of emissions to be achieved in the second, but – unless you know the exact extent to which industry and consumers will respond to price – you cannot have certainty regarding both. Some combinations of uncertainty as to the costs consumers or industry will face in reducing emissions, and uncertainty as to the benefits from achieving a given emissions target, may create a case for using an approach that fixes the price or charge per unit of emissions that polluters have to pay, and some combinations may create a case for fixing the quantity of emissions to be achieved.[5]

From the start, there was recognition that these pricing approaches – of whichever type – were only appropriate in some circumstances. It is certainly easiest to conceive of their use in a situation in which the exact location or timing of the emissions does not affect the extent of environmental damage. This will be true of some pollutants – it is probably the case for sulfur dioxide, and almost certainly the case for greenhouse gases – but it is not true for many other types of emissions. Moreover, the approaches are only applicable in situations where a substantial continuing level of emissions is acceptable given the environment's absorptive capacity. The approaches would not be candidates for pollutants whose toxicity is such that the objective of policy is to reduce the levels down to zero. Also, the approaches are only applicable in those instances where emissions can be measured with reasonably accuracy and at reasonable cost. Finally, in the case of the tradable allowances approach, it is helpful to have a substantial number of emitters subject to the specific regime – *i.e.*, whose allowances can trade. If there are only a small number of emitters in a particular system, there may be problems of monopolistic behavior in the allowance market.

REGULATORY REFORM

Turning from the academic to the applied policy fable: in the 1970s, the regulation of emissions was substantially expanded, especially in the U.S. A notable step was the passage of the Clean Air Act in 1970.[6] This was initially a purely regulatory (or what is sometimes called a "command-and-control") approach. At first, the more common approach was to impose

[5] *See* Martin L. Weitzman, *Prices vs. Quantities*, 41 REV. ECON. STUD. 477 (1974).
[6] Clean Air Act, Pub. L. No. 91-604, 42 U.S.C. §§ 7401-7671 (1970).

technology standards on major point sources of emissions. Sometimes, instead of mandating that specific technologies be used, the regulation set a standard in terms of the total level of emissions from a given source or the total level of emissions per unit of output from a given source.[7] This allowed more flexibility than a pure technology standard, because the emitter had some choice in determining how to meet the standard.

Fairly soon thereafter, an additional degree of flexibility was added: emitters with large facilities containing multiple point sources were subject to what is commonly referred to as a "bubble" on their total emissions.[8] This, again, gave emitters more flexibility as they could substitute reductions at one of the point sources within their facility for another. Emissions "banking" was then introduced in certain cases; if emissions were brought below the constraint at one point in time, that over-achievement could be used to offset future overages in emissions. The flexibility thus permitted in the timing of emissions had the potential to further reduce costs of achieving an overall average target.

These degrees of flexibility within an organization were subsequently extended, in certain situations, by allowing the trading of surplus emissions reductions among firms. These approaches permitted significant reductions in the costs of achieving emissions targets, but the extent to which firms made use of trading seemed small relative to the opportunities for cost savings that it potentially offered. As of 1995, the U.S. took another large step, creating a formal system of tradable allowances under the sulfur dioxide or acid rain program.[9] The system required that the emitters submit allowances equal to their emissions on an annual basis. Allowances were issued in advance, in fixed numbers to each emitter, based roughly on the emitters' historical emissions levels.[10]

Government-issued allowances that were identical – each providing the right to emit a specified amount of SO_2 anytime after the start of the system, and that were initially distributed to emitters in advance of the year for which they would be used, proved to lend themselves to trading to a much greater extent than had been the case for the individual reductions that were subject to trade under the previous system. A well-functioning market in allowances has developed with a well-established price prevailing at any point in time. The approach is generally viewed as successful and as having lessened the overall costs of reducing emissions to (or below) the target level.

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[7] *E.g.*, 42 U.S.C. § 7411 (Standards of Performance for New Stationary Sources).

[8] *See* Recommendations for Alternative Emission Reduction Options Within State Implementation Plans, 44 Fed. Reg. 71,780 (Dec. 11, 1979) (codified at 40 C.F.R. pt. 52), *available at* 10 Envtl. L. Rep. 30001 (1979).

[9] *E.g.* 42 U.S.C. § 7651b (Sulfur Dioxide Allowance Program for Existing and New Units).

[10] 42 U.S.C. § 7651d.

With this step, one could thus view the regulatory system as having more or less converged with the academic notion of the full pricing of emissions, and potentially with the objective of full correction of the market failure associated with some types of externalities.

Previous speakers have mentioned that the Kyoto Protocol contains provisions for emissions trading at the international level that have broad parallels to, and were at least in part inspired by, the SO_2 emissions trading system. Domestic tradable allowance systems for certain sources of greenhouse gases are under active development in a number of the countries that have indicated an intention to ratify the Protocol, as means of helping achieve the reductions in such gases to which the countries would commit should they ratify the Protocol and should it go into force. These domestic systems could be linked to the Protocol's provisions for international trading in greenhouse gas emissions rights created by the Protocol.

ISSUES RAISED BY TRADABLE ALLOWANCE SYSTEMS

Having used the fables to attempt to indicate the basic nature of the tradable emissions allowance approach, let me offer a series of brief observations on more applied issues that are relevant to the use of this approach.

Nature of Emissions

As already mentioned, simple versions of the approach are only appropriate from an environmental point of view if the location and timing of emissions does not matter in terms of environmental damage. If location or timing were to matter, trading would have to be restricted; this would both complicate the system and may reduce the number of participants in any given trading market below the level required for a well-functioning market.

With some qualifications, environmental issues associated with SO_2 emissions in the U.S. met these conditions. Greenhouse gases fully meet these conditions, although emissions of certain other substances that often occur jointly with greenhouse gases may fail to meet them.

Preceding Regulatory Experience Established a Favourable Context for the U.S. SO_2 Program.

The evolution of U.S. regulatory experience with SO_2 turned out to be very helpful in establishing the conditions for successful introduction of the SO_2 tradable allowance program. Firms subject to regulation had acquired experience in measuring and reporting emissions. The regulatory authorities had acquired good data on emissions per facility. Further, I think it is reasonable to speculate that those subject to regulation may well have

experienced the biggest increase in costs right after the regulation's enactment. The subsequent steps leading to the full-scale tradable allowances system offered more flexibility and ways of reducing the cost of meeting requirements although some tightening of the overall cap on emissions accompanied the introduction of tradable allowances. Introduction of the emissions trading system may well thus have been viewed as a relatively easy pill to swallow.

Potential new domestic tradable allowance systems for greenhouse gases would present some important contrasts. Such systems couple a new basic requirement to reduce these emissions, with an approach that should offer advantages in terms of costs and flexibility. Understandably, many of those who are potentially subject to the new system focus on the costs it would impose on them relative to the cost-free situation in respect to greenhouse gases that has been their experience to date. They may be less impressed by the fact that the system may be less costly than some other way of achieving the same reduction in greenhouse gases.

The Supply of Tradable Allowances

The U.S. SO_2 system involves a fixed supply of tradable allowances, the vast majority of which are provided at no charge to existing emitters. There were some concerns that this fixed supply might impose an excessive constraint on the growth in electricity generation, and/or that it might lead to instability in permit prices – a point related to our earlier mention of price-versus-quantity uncertainty. These concerns are in part related to the fact that the demand for electricity is generally viewed as not being very responsive to price in the short run. Thus, in the event of an unanticipated shortage of allowances, prices of allowance might have to rise very sharply before causing an increase in electricity prices sufficient to reduce the amount of electricity demanded by an amount that would bring electricity emissions, and thus the demand for allowances, into balance with the fixed supply of allowances. Thus far, however, no major problems of these types seem to have developed under the SO_2 program; the substantial reserve of banked permits that has accumulated may have been an important contributing factor to dampening potential allowance price instability.

How Far Does the SO_2 Program Go in Fully "Pricing Emissions," or "Internalizing the Externality"?

This is perhaps more in the nature of a return to the academic discussion than an applied point, but it may still be of some interest. Without going into the details, it is the case that when a generator receives a gratis allocation that is fixed in amount, *i.e.*, the allocation is not related to the generator's current output, the generator experiences costs at the margin equal to the full price of

emissions. In standard economic analysis, this is generally regarded as a good thing, especially if these costs are passed on to these consumers of electricity so that they must also face the full price of emissions in the cost of electricity. Reductions in emissions achieved through reducing the amount of electricity demanded are likely to be part of a cost-effective approach to reducing emissions, along with abatement actions by generators that reduce emissions at a given level of output.

Electricity price regulatory systems may, however, inhibit the passing on of the marginal abatement and allowance costs when a substantial fraction of required allowances are acquired at no cost. As a result, consumers may not face the incentive to reduce electricity consumption by an amount consistent with full internalization of the externality.

Providing Allowances Gratis, versus by Auction

Gratis allocation of allowances (for example, under some form of "grandfathering" as under the U.S. SO_2 system) is almost certainly of major help in gaining the acquiescence of the industry subject to the allowance requirement. It can be viewed as paralleling the general regulatory approach, under which firms must meet the costs of reducing emissions down to the required level, but do not face any costs with respect to the remaining, allowable level of emissions. This contrasts sharply with an auction approach to allocation (or with an emissions tax), under which firms face a similar need to reduce emissions and to pay the costs of their reduction to a point consistent with the overall target level, but where they must also pay for allowances (or taxes) to cover remaining emissions.

Gratis versus auction allocation of permits is, understandably, a very sensitive issue. Views on the relative merits and fairness of the two approaches tend to be affected, among other things, by views as to the nature of the product market in which the emitter operates. If the market is basically "domestic," in the sense that a firm's competition comes mainly or entirely from other domestic suppliers, it is reasonable to expect that a substantial fraction of the cost of allowances will, sooner or later, be reflected in higher product prices. This will benefit the producers, especially the electricity generators in an unregulated market, and suggests that a full gratis allocation of allowances may not be required to hold such producers harmless from the emissions allowance requirement. In fact, some recent analyses of the U.S. electricity sector suggest that provision of gratis permits equal to as little as 10 percent of historical emissions might be sufficient to hold shareholders in power generators harmless, although this result also depends on assumptions as to the operation of electricity price regulatory systems.

On the other hand, if the market for the emitter's product is international in nature, and if most competitors do not face comparable environmental costs, little or no adjustment in product prices is to be expected. Allocation by auction could be expected to be subject to extraordinarily strong opposition by relevant industry sectors in these circumstances.

EMISSIONS TRADING SYSTEMS AND CANADA-U.S ECONOMIC INTEGRATION

This final section offers a few comments on the way trading systems may interact with economic integration in North America, especially in the energy sector.

You have heard from David Drinkwater that Ontario has just introduced the first major tradable allowance system in Canada for SO_X and NO_X.[11] As he mentioned, one specific feature under this system is that covered Ontario emitters will be allowed to meet their requirement in part by purchasing emission reduction credits or allowances from regulated U.S. emitters that are able to reduce their emissions below regulated levels.[12] This is the first form of cross-border trading in emissions rights that we have seen in the Canada-U.S. context.

Among other things it illustrates the point that a jurisdiction can generally decide to what extent it will allow its emission reduction objectives to be met by reductions that occur outside its jurisdiction

The Ontario action might also be viewed as taking a partial step towards leveling playing fields with respect to the cost of meeting environmental requirements. Ontario generators will have the option of meeting a portion of their emissions reduction requirements at costs that presumably will reflect costs of emissions reduction in the United States. With the increased integration of our electricity systems, there is pressure to have level playing fields with respect to environmental requirements, and especially with respect to the costs of meeting those requirements. Now, if all the jurisdictions composing an integrated electricity market use tradable emissions allowance systems to achieve environmental targets, permitting trade in allowances among the jurisdictions would be expected to equalize the prices of the allowances. This, together with common coverage of emissions subject to the allowance requirement, would contribute to leveling the playing field. The European Union has also been emphasizing the idea of level playing fields for competitors in various areas. It is very concerned with electricity integration, and is working to ensure that its emissions

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[11] David Drinkwater, *New Electricity: Regulation, Pricing, Wheeling & Regulation*, 28 CAN.-U.S. L.J. 267, 281 (2002).

[12] *Id.*

trading system in the electricity sector, as in other covered sectors, will result in common emissions allowance prices and coverage across national boundaries.

Another related issue noted in our first session may be worth recalling, although it relates to environmental regulation in general not just to regulation through use of market-based instruments. When one country imposes requirements (and thus costs) on its entities, impacts on competitiveness can be expected which can be important if the entities are producing for sale in an integrated product market. What means, if any, may be legally available, and appropriate for use, by such a country if it wishes to attempt to achieve some leveling of the playing field through its own actions by imposing comparable costs on entities from other countries selling into its market?

GENERAL CONCLUSIONS

To conclude, tradable emissions allowances or permits are a promising approach in some environmental areas, including the area of achieving reductions in greenhouse gas emissions for countries that adopt fixed targets for such gases, whether or not the targets are those in the Kyoto Protocol.

While they offer advantages of overall cost effectiveness, tradable allowance systems also raise questions of the distribution of benefits and losses for different players in the system, especially when a new system is started. As noted, the United States tradable allowance system for sulfur dioxide evolved from an existing regulatory system. The existing system was already imposing costs on SO_2 emitters to which they had more or less adjusted. The further evolution to a tradable allowance system offered covered firms more flexibility, allowing them more opportunities to reduce costs to which they were already subject or which they anticipated they would face if requirements were tightened using the existing approach. It seems a fair generalization that covered firms did not complain very strenuously about the introduction of a tradable allowances approach in this situation.

But opposition to a new tradable allowance system for greenhouse gases, when no current restrictions on emissions of such gases apply, would likely be stronger in spite of the potential advantages in terms of costs and flexibility relative to other means of achieving the same reduction in such gases.

Finally, with respect to the brief discussion of potential cross-border trade in emissions allowances in areas where product markets are integrated, the key point I wanted to advance was that such cross-border trading in emissions allowances can contribute to leveling playing fields. At the same time, achieving the potential for such a contribution would no doubt require

the appropriate meshing of underlying environmental regulatory systems and appropriate provisions for international trading in allowances.