

CHAPTER 3

ECONOMIC RATIONALE FOR AN EMISSION ALLOWANCE TRADING PROGRAM

The basic assumption behind the economic model of allowance trading is that managers of firms are better at solving pollution abatement problems than government overseers. This is because first, firms know more than an environmental regulator about their own operations and second, because the profit motive, rather than direct government mandate of compliance decisions, may be more effective at minimizing emission control costs. The allowance trading program in the CAAA is designed to provide firms with an incentive to make good choices about how to reduce emissions by allowing the firm to reduce compliance cost and profit from trading. By harnessing this powerful incentive, the argument goes, and placing the decision of how to achieve a given environmental goal in the hands of those who pollute, the overall cost of compliance can be lower than with command-and-control measures. This idea as it pertains to pollution control, now nearly sixty years old, has become a part of the intellectual mainstream of economics.¹

Intuitively, the idea has a plausible feel to it. There are many emitting sources out there, each with a different set of circumstances (fuel type availability, generation mix, control strategies, and so on). Some will find it less expensive to cut back their sulfur emissions than others. If a system can be devised to get relatively low-cost sources to reduce emissions, while those for whom cutting back a comparable amount is relatively costly continue to operate as before (except that now they must buy some allowances), then overall compliance costs should be minimized. From the perspective of each plant, then the firm is given a choice of how to comply with a particular environmental standard. If the price of an allowance is lower than the per-ton cost of reducing emissions (such as installing a scrubber or switching fuel), then the utility should buy allowances. Otherwise, the utility should reduce emissions and sell any excess allowances at the

¹ The first version of the marketable permit argument is evidently that found in A. C. Pigou, *The Economics of Welfare*, 4th edition (London: MacMillan and Co., 1932).

market price or bank them for future use.

Benefits of Allowance Trading

The intended benefits of emission allowance trading over a command-and-control type of environmental regulation can be illustrated graphically if several simplifying assumptions are made.² Assume that there are two power plants that each emit 15,000 tons of SO₂ per year for total emission of 30,000 tons. Assume also that there is no economic or profit regulator. In this example, the environmental regulator decides that emissions should be cut by half to 15,000 total tons (it is not important for this discussion to discuss how this was determined). Figure 3-1 illustrates the effect of a proportional reduction in emissions, where each plant is required to reduce its emissions to seven-and-one-half tons per year. MC₁ and MC₂ are the marginal emissions reduction costs for plants 1 and 2 respectively. The origin for plant 1 is the lower left-hand corner of the diagram and the origin for plant 2 is the lower right-hand corner. Assume that the marginal cost of reduction for each plant is different, as represented by the different slope of the curves. The diagram is drawn to show that every point results in the fifteen thousand-ton reduction.

Assume that the environmental regulator decides, on equity grounds, to require each plant to reduce emissions by one half, and emit no more than seven and one-half tons. The result would be that plant 1 would incur a total cost represented by area A at a marginal cost of E and plant 2 would incur a total cost of reduction represented by the total of C + B + D and a marginal cost of G.

Alternatively, the environmental regulator could institute a trading system with a total of 15,000 allowances, which allows the plant to emit one ton of SO₂, and allow the

² This example is based on T. H. Tietenberg, *Emissions Trading: An Exercise in Reforming Pollution Policy* (Washington, D.C.: Resources for the Future, Inc., 1985).

Fig. 3-1. Cost comparison of pro rata versus emission trading environmental control

(Adapted from T. H. Tietenberg, *Emission Trading*.)

plant owners to trade allowances. Under this type of system, where plant 1 has a lower reduction cost than plant 2, plant 1's owner would sell allowances as long as the price is greater than the plant's marginal reduction cost. Plant 2 is willing to purchase allowances provided the price is less than the plant's marginal reduction cost. Therefore, trading would occur until the marginal reduction costs were equal. The allowance price then would be P and the net savings from the allowance program, over the proportional reduction program would be represented by the area D . (This simple example ignores the revenue received by the seller and the transactions costs incurred from allowance trading.)

With trading, plant 1 would reduce by 10,000 tons and emit 5,000 tons, while plant 2 would reduce by 5,000 tons and emit 10,000 tons. These quantities, at the point where $MC_1 = MC_2$, are the lowest cost solution; no other combination can achieve the 15,000-ton emission limit at a lower cost. Note that each plant operator knows both the marginal reduction cost and the allowance price. Note also that the marginal cost curves for each plant can be interpreted as allowance supply curves.

A more realistic marginal-cost structure (although the numbers are hypothetical) is presented in Figure 3-2. In this example, two utilities, firm A and firm B, have affected units requiring a 300-ton and 50-ton SO_2 emission reduction, respectively. In this example, other firms exist (unlike Figure 3-1 with only two firms) and all affected firms together (as noted in Chapter 2, there will be over 2,700 units affected by phase II) determine the market price in a more complex but similar manner as shown in Figure 3-1 (again ignoring other complicating factors). Also assume that these two firms are price takers, that is, their actions alone are insufficient to affect the market price.

Various control options are available to the firms which are characterized as being "lumpy." The pollution control devices can reduce emissions in blocks of fifty tons with increasing incremental or marginal cost of control. To eliminate the first fifty tons of emissions requires a cost of \$100 a ton with the first pollution control device. The next fifty tons of emission reductions will cost \$200 a ton. The next fifty \$300 a ton, and so on. The main point is that pollution control is incrementally more expensive. How

Fig. 3-2. Compliance strategy for two hypothetical firms.

can the utility minimize the cost of pollution control and still meet the required reduction in emissions? The answer, as we have seen, is through allowance trading.

In this example, firm A characterizes a buyer of allowances. If the firm were to incur the entire cost of reducing its emissions by the required 300 tons, the total

cost would be \$105,000 ($\$5,000 + \$10,000 + \$15,000 + \dots + \$30,000$) for the first six lowest cost control options. Suppose that the market price for an emission allowance is \$350. For the first 150 tons of emission reductions the firm will choose the first three (lowest incremental cost) pollution control options for a total cost of \$30,000 ($\$5,000 + \$10,000 + \$15,000$). The next 150 tons, using allowances, will cost \$52,500 ($150 \times \350), for a total cost of \$82,500. The firm saved \$22,500 by reducing the first 150 tons itself and purchasing allowances for the next 150 tons. The available technology would have required an additional \$75,000, but the requirement was met with an expenditure of \$52,500 for allowances instead.

Firm B in Figure 3-2 characterizes a seller of allowances who is required to reduce its emissions by fifty tons. In this case the firm can meet all of its required reduction with its first control option at \$100 a ton for a total compliance cost of \$5,000; no purchase of allowances is required. However, the next two options can be achieved for less than the price of allowances. If the firm were to reduce its emissions by 150 tons for a total cost of \$30,000, the firm would "free-up" 100 allowances that, if sold, would be worth \$35,000 ($\350×100). The last 100 allowances cost the firm \$25,000 to produce, for a net gain of \$10,000. Since it cost the firm \$5,000 to reduce the first fifty tons, the gain on the sale offsets this cost with \$5,000 remaining.

It was assumed here (for the sake of parsimony) that both firms had the same control costs. What varied in this example was the required emission reduction. In reality, of course, firms face different control costs, and this too could cause different firm behavior even with the same reduction requirement. Note also that a sufficiently high allowance price, above \$700, would change firm A from a buyer to a seller of allowances.

Returning to the example in Figure 3-1, it can be shown that the initial distribution of allowances to the two firms does not affect the final distribution of emissions. This fact is a result of the "sunk-costs-don't-matter" argument. That is, firms have an incentive to trade no matter what the original position of the individual firm. Of course, how the 15,000 allowances are passed out at the beginning matters a lot to the profitability of the two plants (assuming the firms are allowed to retain a portion of the gain or incur some of the loss), and this is precisely the basis for efforts by interested parties to change the allowance allocation scheme in the CAAA in their favor. However, the initial allocation of allowances has no efficiency consequences---only equity

ones.

To see this, consider what would happen if both plants (again, from Figure 3-1) were given half the allowances. Since plant 1 can "free-up" some its allowances for less than the allowance price or plant 2's marginal cost, trading would be mutually beneficial. As an extreme example, assume that because of considerable political clout, plant 2 receives the entire allocation forcing plant 1 either to make the entire 15,000 ton reduction or purchase allowances from plant 2. Trading still would be mutually beneficial because of the substantial cost savings plant 1 could achieve and the revenue gain by plant 2's sale of allowances.

The environmental regulator does not need to know the cost information of the firms for this system to achieve the least-cost solution. The implicit assumption is that the environmental regulator does not know and cannot get the information without incurring a large cost. If the regulator did know enough to calculate the outcome under the allowance plan, one might ask what are the advantages. Why not simply tell the regulator to calculate the optimal level of emissions for each plant, and announce what their share of the required abatement will be?

The point is that in a more complex example the computational burden facing the regulator would be immense, even in the unlikely event the regulator was privy to the required cost information for all emitting sources (and could predict future costs as well). In the real world, of course, no government agency has this cost information. Neither do plants know everything about each other. The primary informational advantage inherent in a market for allowances is that each plant needs to know only its own cost structure and the allowance price. The government agency is not required to know very much about the cost structure of any of them. This is also the result of more general mathematical model: For any group of plants and for any existing distribution of emissions across those plants, no alternative regulatory scheme can achieve a given environmental goal for a lower cost than an emission allowance trading scheme.

This is the argument made by economists and others who advocate implementation of market-based environmental regulatory schemes, and who helped to get the CAAA passed. Estimates of the savings that will result from the CAAA allowance market range up to \$3 billion per year.³ Most seem to agree that it will be expensive⁴ to bring the electric utility industry into compliance with the CAAA. (There is much less agreement on the question of whether the expenditures are worth it.) If the estimates of the cost savings due to an effective, working allowance market are remotely accurate, then it would appear that all parties involved--ratepayers and utility shareholders--potentially would benefit if the market works.⁵

Whether or not the higher savings figures ascribed to the allowance trading scheme can be realized given the regulatory foundations that now undergird the utility industries is an important open question. In short, economists depend upon the results of their theoretical models when advocating market-based environmental control. The example just given is emblematic of the kind of argument that people make. That example, and nearly all of the more complicated versions that appear in the literature, leave out the effects of utility regulation by public utility commissions on utilities' environmental compliance decisions. Of course, most firms that would be affected by an allowance trading scheme are also, as public utilities, subject to rate-of-return (ROR) regulation in their output markets. Although many observers have noted its importance,

³ Paul R. Portney, "Policy Watch: Economics and the Clean Air Act," *Journal of Economic Perspectives* 4 no. 4 (1990): 173-81. See also, *Electrical World* (December 1990): 10, which estimated that the cost of complying with the overall emissions cap of the CAAA will be 15 to 30 percent lower than it would be without the allowance trading provisions.

⁴ After passage of the CAAA, the Bush administration put the cost of CAAA compliance at \$10 billion per year by 1995 and between \$22 billion and \$25 billion per year by 2005. The cost to electric utilities of the Title IV provisions was estimated by the industry to be between \$5 billion to \$7 billion per year. ("The Impact of the New Acid Rain Laws," *Electrical World*. Another estimate of compliance with Title IV put the cost at \$4 billion per year *with* trading. Without trading the estimate was \$2 to \$3 billion *more* annually (Portney, "Policy Watch").

⁵ Even within a state, it appears there can be no disadvantage to having the allowance market work. At worst, barring market power abuses, the CAAA is simply a command and control system for bringing emissions down to 8.95 million tons annually; action that reduces the effectiveness of the allowance market in a state or group of states can only add to compliance costs.

there appears to be no formal work investigating the interaction between environmental regulation (whether market-based or not) and the theory of public utility regulation.⁶ Section 403 of the CAAA includes language noting the important link between environmental and utility regulation, and ensuring that the role of state commissions will not be altered by provisions of the CAAA.⁷

Summary of the Economic Literature on Tradable Pollution Rights

The extensive literatures on environmental control and on utility regulation are not very well integrated. A subsequent chapter (Chapter 7) attempts to integrate the two using a model of a regulated utility firm facing environmental restrictions to investigate how these two forms of regulation affect one another and the behavior of the firm. This section summarizes the relevant market-based pollution regulation literature. As such it is a review of what economists have had to say about markets for emission allowances, and spells out how well the CAAA agrees with some recent recommendations on the design of such markets.

A well-functioning market for any good or service works because it accomplishes the task of providing people with information and with the incentives needed to make efficient use of that

⁶ See D. N. Jones and R. A. Tybout, "Environmental Regulation and Electric Utility Regulation: Compatibility and Conflict," *Environmental Affairs Law Review*, Boston College, 14 no. 1 (1986), for an examination of the interface between command-and-control environmental regulation and utility rate regulation; D. T. Stathos and M. S. Treitman, "Using Private Market Incentives for Air Cleanup," *Public Utilities Fortnightly* (July 30, 1989), in which the authors suggest that a utility, before deciding whether to trade allowances, should consider how the purchase or disposition of allowances will be treated by the regulator. David Jones of Temple, Barker, and Sloane Inc., quoted in the December 1990 *Electrical World*, names the role of state regulators in allowance trading as "one of the key issues to be resolved." In particular, he notes, "how will the cost of buying allowances be treated by regulators in setting rates?" Douglas Bohi and Dallas Burtraw also point out that the treatment of allowances by state regulators will have a good deal to do with how the allowance market functions, in "Utility Investment Behavior and the Emission Trading Market," Discussion Paper ENR91-04, Resources for the Future, January 1991, Washington, D.C. Forthcoming in *Resources and Energy*, 1992.

⁷ "Nothing in this section shall be construed as requiring a change of any kind in any State law regarding such State regulation or as limiting State regulation (including any prudency review) under such a State law," (§403(f)). This language did not appear in the original version of S1630.

information. There is no centralized coordination needed--in fact, such coordination will usually be detrimental. Most markets function in this fashion, but very often there are complications that appear to require intervention by a central authority. In much of economics, ideas have been developed by first asking how things would work if markets were organized perfectly, and then by asking how various imperfections affect those outcomes.

The idea of trading licenses to pollute has progressed in this way. It is interesting for our purposes to follow it, noting those difficulties that appear to be troublesome and the manner in which the CAAA addresses them. We can begin with the earliest writing on the value of allowing a market arrangement to limit pollution. Pigou, in his 1932 textbook *Economics of Welfare*, presents the basics of a scheme of this sort. Later, effluent fees were accepted as the preferred method for controlling pollution through market means. Only in 1968, when Dales published his *Pollution, Property and Taxes* did the notion of trade in licenses to pollute, as we now think of the concept, enter the literature. Dales proposed that by issuing tradable licenses and constraining the overall level of emissions, pollution could be reduced more cheaply than by a command-and-control (CAC) approach.

In 1972, Montgomery⁸ proved that under a certain set of conditions, Dales' insight was mathematically correct. That is, no CAC scheme can achieve a given level of air quality at a lower cost. Montgomery considered two alternative permit trading systems. One, an ambient permit system (APS), defined allowable emissions in terms of pollutant levels at a set of monitoring points in a given geographical region. The other, an emission permit system (EPS), allocated to sources of pollution the right to emit pollutants up to a certain rate. His results showed that an APS has desirable efficiency properties, though it demands much of the emitters in that they must acquire information about and make trading decisions in several permit markets. The EPS in its pure form is much less expensive for firms (though much more demanding of the regulator), but it satisfies Montgomery's efficiency criteria only in restrictive cases. The allowance trading system of the 1990 CAAA corresponds to Montgomery's emission permit system (this system is outlined in more detail in Appendix B).

⁸ W. David Montgomery, "Markets in Licenses and Efficient Pollution Control Programs," *Journal of Economic Theory* (1972): 395-418.

The example of the previous section captures the essence of the arguments in favor of allowance trading. If the assumptions are met (allowance price information equally available to all parties, control cost information available, trading between parties not restricted, and so on), then costs are minimized by allowing those firms for whom abating is relatively inexpensive to cut back their emissions and sell allowances to others who find it relatively more expensive to reduce pollution levels. As was noted earlier, total industry costs and profits do not depend on the initial allocation, because what one firm pays in allowance fees the other receives; the expenditures and receipts on allowances is a wash to the industry.⁹ Once again, though, the equity effects of this allocation decision are enormous. That is, for purposes of overall costs and emissions, it matters not at all whether all of the allowances are given to a single firm, or if each receives some portion of the 8.95 million available. Theoretically, the same distribution of emissions will result in any case. Obviously, the manner in which the two firms (and their ratepayers) are affected individually is quite sensitive to the initial allocation and transactions cost.

Numerous studies have extended Montgomery's results. Some of these are very much in the spirit of Montgomery, though they refine his model in one way or another. Atkinson and Tietenberg, for example, explore the empirical properties of the two systems. Krupnick, Oates, and Van De Verg note that, with certain modifications, the EPS may attain efficiency more readily (that is, with lower costs of pollution abatement) than would Montgomery's version.¹⁰ Their

⁹ It is very important to keep this point in mind, for it holds exactly in the allowance trading program of the 1990 CAAA. There, the initial allocation of allowances is extremely important and inspired some of the most spirited political debate. However, if the allowance market is really competitive in nature, then the overall outcome of the system does not depend in the least on how they are divided up (assuming negligible transaction costs).

¹⁰ See Alan J. Krupnick, Wallace E. Oates, and Eric Van De Verg, "On Marketable Air-Pollution Permits: The Case For a System of Pollution Offsets," *Journal of Environmental Economics and Management* (1983). The key difference is that Krupnick, Oates, and Van De Verg allow trades to occur that reduce air quality at sites which previously fell below the ambient air quality standard. Scott Atkinson found that the cost savings which accrue to trading schemes are due largely to this redistribution of pollutants from high- to low-level areas in "Nonoptimal Solutions Using Transferable Discharge Permits: The Implications of Acid Rain Deposition," in E. Joeres and M. David, eds., *Buying a Better Environment: Cost Effective Regulation Through* (continued...)

pollution offset system (POS) is similar to the scheme specified in the EPA's 1986 Final Trading Policy.¹¹ McGartland and Oates refined the Krupnick, Oates, and Van De Verg version of pollution offsets and showed that one of Montgomery's key results--that an equilibrium after emissions trading will satisfy a critical condition on emission distribution across firms--does not always hold.

Others have attempted to discover whether the fundamental arguments in favor of allowance trading still hold when one or more of the usual assumptions are relaxed. Recall that Montgomery's model, though very elegant, does assume that perfect competition prevails in the permit markets and in the output markets of the polluting firms. In many cases, neither of these assumption should be expected to hold. Here we

(...continued)

Permit Trading (Madison, WI: University of Wisconsin Press, 1983). See also Albert M. McGartland and Wallace E. Oates, "Marketable Permits for the Prevention of Environmental Deterioration," *Journal of Environmental Economics and Management* (1985): 210; and Tietenberg, 1985 for a discussion and clarification of this point.

¹¹ See the EPA's *Emission Trading Policy Statement, General Principles for Creation, Banking, and Use of Emission Reduction Credits*, Final Policy, 51 Federal Register, 43,814 (1986).

find that complications taking the model away from the perfect, sanitary world envisioned by Montgomery could affect his results.

In 1984, Hahn looked at how the existence of one firm which holds market power in the permit market affects outcomes. He found that only if the regulatory agency (that is, the EPA) distributes permits in a cost-minimizing fashion will the market equilibrium be efficient (an outcome which could then be achieved with a CAC program anyway). That is, an allowance market might only be helpful if the government does its job perfectly. McGartland showed that if only a few traders enter the market for permits, even the POS may be inefficient. The possibility exists for free-riding by emitting firms who benefit without cost from trades between other firms. Another twist was considered by Malueg, who looked at what happens if the permit market is competitive but the emitting firms are oligopolistic in a single output market. He found that an equilibrium in a permit system may actually reduce social welfare compared to a corresponding and environmentally equivalent command-and-control system.

Others have examined the effect of different schemes for allocating allowances. If the distribution of allowances is achieved through an auction mechanism, for example, then care must be taken to ensure that asymmetries in the affected industry are not worsened due to the allowance program. If there is one firm with monopoly power in the output market affecting prices for a host of smaller price taking firms, then Oehmke has found that the result may not minimize abatement costs, though the inefficiency due to this market power was found to be small in his model.

In summary, then, though many observers seem to agree that there is much to be gained through the implementation of a market-oriented air quality regulation, there are also qualifications to that support. Empirical evidence indicates that the trading schemes employed to date have been very effective in reducing the cost of achieving national air quality standards. Hahn and Hester estimate that cost savings due to emissions trading

activity has amounted to billions of dollars (beginning in 1974 when EPA first began to use trading policies up to 1989).¹²

How, then, should an allowance trading market be designed? The evidence is fairly strong that there are a variety of things that can go wrong, reducing the effectiveness of market-based emission reduction schemes. One might ask whether the Clean Air Act Amendments, which establishes such a scheme on a grand scale for sulfur dioxide emissions in the U.S., has been designed so that it can work. A few authors have also laid out various sets of guidelines for the design of emission allowance programs.¹³ The more recent of these pieces are helpful in evaluating whether the CAAA are likely to perform in the manner that they are intended. Five recommendations seem fairly critical.

First, does the allowance market itself resemble the theoretical version that economists have been talking about all this time? Evidently it does, though there is clearly a good deal of room for the EPA to interpret certain of the trading provisions as it sees fit. It seems reasonable to suppose that the EPA will choose to interpret the 1990 bill in a manner consistent with its 1986 Final Trading Policy.¹⁴ This system of allowance trading would most closely resemble a modified version of the pollution offset system of Krupnick, Oates, and Van De Verg, who claim that such

¹² Hahn and Hester, *Yale Journal on Regulation* (1989). Also see James S. Diemer and J. Wayland Eheart, "Transferable Discharge Permits for Control of SO₂ Emissions From Illinois Power Plants," *Journal of the Air and Waste Management Association* (1988): 997-1005, for estimates of the cost savings that would result from various trading arrangements. They find that savings of up to 60 percent over a uniform decrease program may be possible. For an older estimate, see also Michael T. Maloney and Bruce Yandle, "Estimation of the Cost of Air Pollution Control Regulation," *Journal of Environmental Economics and Management* (1984): 244-63.

¹³ See, for example, Roger G. Noll, "Implementing Marketable Emissions Permits," *American Economic Review* (1982): 120-24; Robert W. Hahn, "Designing Markets in Transferable Property Rights: A Practitioner's Guide," in E. Joeres and M. David, eds., *Buying a Better Environment*; Robert W. Hahn and Gordon L. Hester, "Where Did All the Markets Go: An Analysis of EPA's Emissions Trading Program," *Yale Journal on Regulation* (1989): 109-53; and James T. B. Tripp and Daniel J. Dudek, "Institutional Guidelines for Designing Successful Transferable Rights," *Yale Journal on Regulation* (1989): 369-91.

¹⁴ See the EPA's Final *Emission Trading Policy Statement*, 43,814.

a system performs quite well.¹⁵

Second, will the CAAA allowance trading provisions be successful in minimizing or avoiding the deleterious effects of monopoly power in the allowance market? One important concern is that large holders of emission allowances will choose to withhold their excess allowances rather than offer them for sale to potential entrants into the electric generating industry. It is far from clear under what conditions such a strategy would be advantageous. Misiolek and Elder argue that a large firm can increase its long-run profits (ignoring the economic regulator) by holding onto its allowances, shutting potential entrants out of its product market and perhaps causing some existing firms to fail. This may be true even though the perpetrator's abatement and allowance costs increase. A great deal of interest in whether the allowance market will operate in a competitive manner was demonstrated during the debate on the CAAA. As noted in Chapter 2, however, while there is some concentration in phase I, no single utility or holding company will control a significant portion of the original allocation to control the market price.

Third, the mechanism by which allowances are allocated, depending largely upon past utilization of generation capacity and an auxiliary auction arrangement to guarantee that IPPs and others will be able to acquire allowances, does appear to meet with the recommendations of previous writers. Also, the use of 1985 to 1987 operating dates to determine the allocation of allowances is imperfect, as it discriminates against plants that reduced their emission rates just before 1985 and favors those that took steps to reduce emissions in 1988 or later. However, the CAAA does allow owners or operators to petition EPA for different base years.

¹⁵ Note, however, that McGartland and Oates, "Marketable Permits for the Prevention of Environmental Deterioration," refined the Krupnick, Oates, and Van De Verg version of pollution offsets and showed that one of the key results in favor of emissions trading having to do with the distribution of emissions across firms does not always hold.

Fourth, Tripp and Dudek note the importance of the institutional makeup of the governing agency for trading systems to work. The agency, they say, must have "clear legal authority" to generate allowances, it must have the "technical capability" to design and implement the program, and the resulting program must be "evasion proof." The CAAA appears to give EPA this authority and it has been developing the technical capability since passage of the Act. By evasion proof, Tripp and Dudek simply mean that affected plants cannot employ other legal strategies (possibly administered by government agencies other than the one in charge of emission control) in order to circumvent the program altogether. It would seem that the CAAA does indeed satisfy this requirement as well.

Fifth, does so much uncertainty surround this bill that utilities will simply choose not to take part in the allowance trading program at all? Hahn and Hester regard uncertainty concerning property rights accompanying emission allowances as one of the most important impediments to effective working of past EPA-administered trading systems (as, for example, the bubble, offset, and banking programs). This would seem to run counter to § 403(f) of the CAAA, entitled "Nature of Allowances," which states, as noted earlier, that the issuance of an emission allowance "does not constitute a property right." Will affected units wish to enter a market where they are told expressly that they do not have a property right to the commodity being traded? The issue of property rights was discussed in Chapter 1.

One final, striking note about the allowance trading research that economists, with few exceptions, have carried out little work on how things are affected if the output market (electricity market) is regulated.¹⁶ Title IV of the CAAA will affect electric

¹⁶ For exceptions see R. Hahn and R. Noll, "Barriers to Implementing Tradable Air Pollution Permits: Problems of Regulatory Interactions," *Yale Journal on Regulation* 1 (1983): 63-92; David A. Malueg, "Welfare Consequences of Emission Credit Trading Programs," *Journal of Environmental Economics and Management* (1990): 66-77. In this article the concern is with the effect upon trading behavior of some monopoly power in the output market. He does not consider the additional complication of regulation in the output market. Also, see Robert W. Hahn, "Government Markets and the Theory of the nth Best," CSIA Discussion Paper 91-14 (Cambridge, MA: Harvard University, Kennedy School of Government, December 1991) and footnote 6 above.

utilities almost exclusively. They face incentives of a sort that most industries do not, in that their profits and prices are monitored and regulated by states and FERC. This fact is of concern to, and has been noted by, many observers and industry leaders.¹⁷ As was mentioned earlier, the CAAA contain language designed to ensure that the decisions of state public service commissions will not be interfered with as a result of the new bill. However, the vast work on the economics of utility regulation does not appear to have been consulted in connection with allowance trading. One would think that this literature should be able to give us some guidance in predicting how the bill will work. It seems to be at least as important as any consideration such as market power, and so on. Chapter 7 will provide an overview of the literature on public utility regulation to set the stage for an economic model that integrates the economic and environmental constraints and begins the development of a regulatory framework for commissions and FERC to consider.

¹⁷ See, for example, Marie Leone's "Cleaning the Air the Market-Based Way," *Power* (December 1990), 10.