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INCENTIVE MECHANISMS AS A STRATEGIC OPTION FOR ACID RAIN COMPLIANCE*

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1 INTRODUCTION

Title IV of the Clean Air Act Amendments (CAAA) of 1990 (P.L. 101-549) establishes the use of flexible emission compliance strategies for electric utilities to reduce the emissions of acid precursors (SO_2, NO_x). To control SO_2 emissions, tradeable emission allowances will be used; NO_x emissions will be controlled by an emission standard, but a utility is permitted to average NO_x emissions systemwide to meet the standard. Both of these policies promote flexibility and cost savings for the utility while achieving the prescribed emission reduction goals of P.L. 101-549.

The use of SO_2 emission allowances has two notable benefits (other than the projected reduction in acid deposition) first — a utility has the choice of a wide range of compliance methods allowing it to minimize compliance costs and second, the use of transferable emission allowances promote technological innovation with respect to emissions reduction/control.[1]

The traditional means of pollution control has been through technology requirements, uniform emission standards and site-specific standards (McDermott and South, 1990). None of these options allow a utility or system of utilities (e.g., power pool) to truly minimize the costs of pollution compliance. Through the market mechanism of a tradeable allowance, compliance costs can be minimized by allowing utilities to take advantage of interfirm control cost differences. In addition, traditional regulation has provided little incentive for

[1] See Hahn and Noll (1982) for a discussion on different means of implementing allowance trading programs and the theoretical outcomes. For a discussion of technological innovation and the use of environmental policy instruments, see Milliman and Prince (1990).

technology innovation due to the relatively low rewards and uncertain acceptance of the technology. The use of allowances give greater rewards to the innovating firm for reduced emissions in the form of allowances freed for other uses. The use of incentive- or market-based regulation for the control of pollution generates two important outcomes:

1. The market may not achieve the desired outcomes of compliance cost minimization, technological innovation and reduction in acid deposition. State regulations, price/quantity uncertainty in the allowances market, and other forces may cause the market to under-perform leading to greater compliance costs and less technological innovation. In this case, regulatory incentives may play a potential role in augmenting the market incentives (embodied in Title IV, P.L. 101-549) and encourage technological development and compliance cost minimization.
2. The use of emission allowances and command and control (CAC) emission regulation is analogous to the use of regulatory incentives and traditional rate-of-return regulation for public utilities. Incentive regulation or incentive mechanisms (such as emission allowances) give the targeted firms rewards for such actions as minimizing operation (or compliance) costs and encouraging the development of innovative generating (emission control) technologies.[2] When traditional regulation fails to provide sufficient incentives for cost minimization or cost saving innovations, incentive regulation may be applicable for the achievement of these goals in the public utility industry.

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[2] Note that emission control technology and electricity generating technologies are not mutually exclusive. Renewable technologies such as solar, photovoltaic, hydro, wind, and geothermal, clean coal technologies (CCTs), and second generation nuclear plants all generate much less pollution (or negative production externalities) while lowering the incremental cost of electricity.

This paper will examine how regulatory incentives can aid in the achievement of a Title IV goal: cost-effective reduction of SO_2 emissions. In addition, the ability of regulatory incentives to encourage the development of clean, electricity generating technologies will be examined. Section 2 of the paper will describe why incentives are adopted, and present a synopsis of the historic adoption of incentives. In Section 3, desirable properties of regulatory incentives are outlined along with how to evaluate the success of regulatory incentives. Section 4 delves into the issue of regulatory incentives for deploying/adopting innovative electricity generating technologies to help meet the goals of the CAAA of 1990. To conclude, Section 5 indicates the possible benefits of a well-functioning allowance market and the use of incentive regulation to achieve the goals of improved air quality and cost-effective compliance with Title IV of the CAAA of 1990.

2 INCENTIVE REGULATION: ADOPTION AND HISTORY

Traditional regulation of the electric utility industry has typically been concerned with reliability of service, and established tariffs so that a utility's total costs are compensated. Also, a rate of return is specified for a utility's capital expenditures in order to attract the necessary financial capital. During the decades of the 1950s and 1960s, the electric utility industry took advantage of increasing returns to scale as demand grew. This resulted in continually declining rates, increased shareholder returns on equity, and satisfied customers. Cost-plus regulation worked fairly well during a relatively stable period of demand growth and low inflation.

During the 1970s, however, a series of supply shocks, many plant cost overruns, and declining demand resulted in an increase in the price of electricity. In response, state public utility commissions (PUCs) reacted by initiating retrospective prudency review, disallowances of capital costs, and excluding abandoned construction (even partially) in ratebase. These actions placed the utility industry in serious financial jeopardy as earned rates of return fell and prices rose (Seretakis, South and Rogers, 1988).

To cope with the problem of increasing construction costs, the belief that utilities were failing to operate in a least cost manner (i.e., gold-plating or x-inefficiency) and increasing electricity rates, two important solution were proposed. First — the use of incentive mechanisms — was based on the theory that the utility, given "cost-plus" regulation, has little incentive to minimize costs and in fact may attempt to increase costs to generate greater profits.[3] The second idea — the introduction of competitive forces — was to take advantage of new technologies associated with the cogeneration of process steam and electricity under the Public Utility Regulatory Procedures Act (PURPA) of 1978. PURPA would require a utility to purchase excess electricity from a cogenerator at the utility's avoided cost. In this way, the ratepayers would not bear the risk of utility plant construction and would potentially receive lower electricity prices.

But before we delve into the actual state and federal programs using incentive regulation it may be useful to consider why incentives are adopted and examine some misconceptions about incentive regulation.

2.1 Adopting Regulatory Incentives

As can be surmised from the experience of the 1970s, incentives have been considered as an alternative means of regulation because of the failure of traditional regulation to cope with a rapidly changing industry and world.[4] The chief failure of traditional regulation has been in terms of *not* encouraging the efficient production of

[3] See Averach and Johnson (1962), Kahn (1970), and Joskow and Schalmensee (1986) for the tip of voluminous literature on incentive regulation.

[4] This statement is not meant to imply that tradition regulation has been a complete failure. Traditional regulation has done a fine job in ensuring reliability and "fairness", but lacks the necessary mechanisms to ensure the efficient production of electricity. It is an encouraging sign that over the years regulators have adopted numerous mechanisms designed to enhance the traditional regulatory incentives to encourage efficiency.

electricity given the changing economic environment. Many sources have indicated that tradition regulation fails to assure efficiency in production as indicated by Kahn (1970):

> *regulation as such contains no built in mechanism for assuring efficiency. To the extent that it effectively restrains public utility companies from fully exploiting their monopoly power, it tends to take away any supernormal return they might earn as a result of improvement in efficiency, thereby diminishing their incentive to try.*

The changes in the structure of regulatory and technological risk, as well as the increase in environmental regulation and the change in the philosophy of regulation towards deregulation, imply the need to explore alternative means of regulating the utility industry. The structure of technological and regulatory risk has been altered due to the asymmetry in the reward and penalty structure of current regulatory procedures. If the utility adopts an innovative technology and reduces costs these savings are passed onto ratepayers, while an innovative action taken by the utility which fails results in the shareholders assuming all its burden. Moreover, the use of ex post prudency reviews for new construction projects, originally considered to have been prudent, has led to higher capital costs paid by customers as financial markets react to the increased perceived risk. In addition, environmental regulation has resulted in higher electricity rates with the use of inefficient rollback and technology standards that do not promote efficiency. Finally, traditional regulation has not allowed utilities to compete effectively in the more workably competitive market created by PURPA. Utilities find it difficult to respond to competition by reducing tariffs to the incremental cost of service for one group (industrials) in order to minimize rate increases for other classes of customers (e.g., residential, commercial).

Incentive regulation is designed to improve efficiency, rather than as some perceive of merely rewarding the monopoly power of a utility through additional profits. Incentive regulation attempts to provide rewards (penalties) for operations and construction which are efficient (inefficient). Those firms maintaining a business-as-usual approach to operations will not receive the benefits of the incentive and may in fact incur some penalties. The incentive is designed to provide temporary profit from cost-reducing actions that will then be translated into lower rates for customers over time. The incentive mechanism simply applies standard economic motivations that recognize that a firm will not undertake an action unless the marginal benefit (profit) it receives is greater than the marginal cost of the action. If the actions taken are irreversible, the benefits to customers are permanent since the cost reductions are passed-through to rates.

In the history of incentive regulation, three general cases of their use can be identified: (1) to establish parity between different activities; (2) to compensate for technological risk and the public goods aspect of information; and (3) to control operating and construction costs. The most relevant case associated with creating parity can be seen in the utility choice between implementing a supply-side option, such as new power plant to meet load growth, or using demand-side management (DSM) to reduce load growth to that equivalent with existing capacity. Why would their be a difference between the two options in terms of utility choice?

Under traditional regulation, capital expenditures receive a return through rate base, and operating and other variable expenses receive a direct passthrough to rates. The utility's tariffs are based in part on the need to cover these expenses. The utility generates revenues to cover expenses through the sale of electricity. Any program, such as DSM, which reduces sales, and thus reduces revenue and results in lower profits, will not be implemented. If a new plant is built to meet increased load requirements, it can be expensed through rate base and thereby be incorporated into customer rates, resulting in continued profits. As traditional regulation provides no incentives for a reduction in sales, DSM would result in utility expenditures to reduce demand. The result is that the utility cannot recover DSM costs or its lost sales, further reducing net revenue. In order to put these relatively equivalent options on equal footing, incentive regulation attempts to provide a means through which the utility is reward for DSM to compensate for some of the negative effects generated by its use.

Incentives can also be used to compensate for technological risk and the public goods aspect of information. There are currently several technologies, which if developed and commercialized, could provide electricity at lower costs and with much less damage to the environment than conventional technologies. These technologies include: renewable resources such a solar, photovoltaic, wind, and geothermal; clean coal technologies (CCTs); and second generation nuclear reactors. Both traditional regulation and the effects of competition have discouraged innovative technology adoption by creating an asymmetry of risks and rewards, and by the existence of information externalities (Zimmerman, 1988). There are significant risks associated with the commercialization of a technology, and the initial design and operation costs of a new plant. If regulators treat cost overruns in a strict fashion there is little possible reward for developing the technology. Moreover, once developed, competitors can learn from the first project and thereby receive a comparative technological advantage that can be used against the original developer/builder. This form of learning externality or "free rider" effect is present in both competitive and regulated industries. It is this free-rider problem that becomes a force in slowing and/or hampering technological growth.

Such an effect is unfortunate since it requires only 4-5 projects to perfect our knowledge of a technology and its costs (Flaim, Seretakis and South, 1989). The capital cost learning curve (Figure 1) depicts the possible gains from waiting in the case of free riders, or the gains to society from accelerating adoption of new technologies. To cope with the risk asymmetries and free rider problem, incentives can be designed to compensate or encourage utilities (and non-utility generators, NUGs) to adopt these technologies (McDermott et al., 1992). These incentives attempt to create a level field in terms of risks and costs of

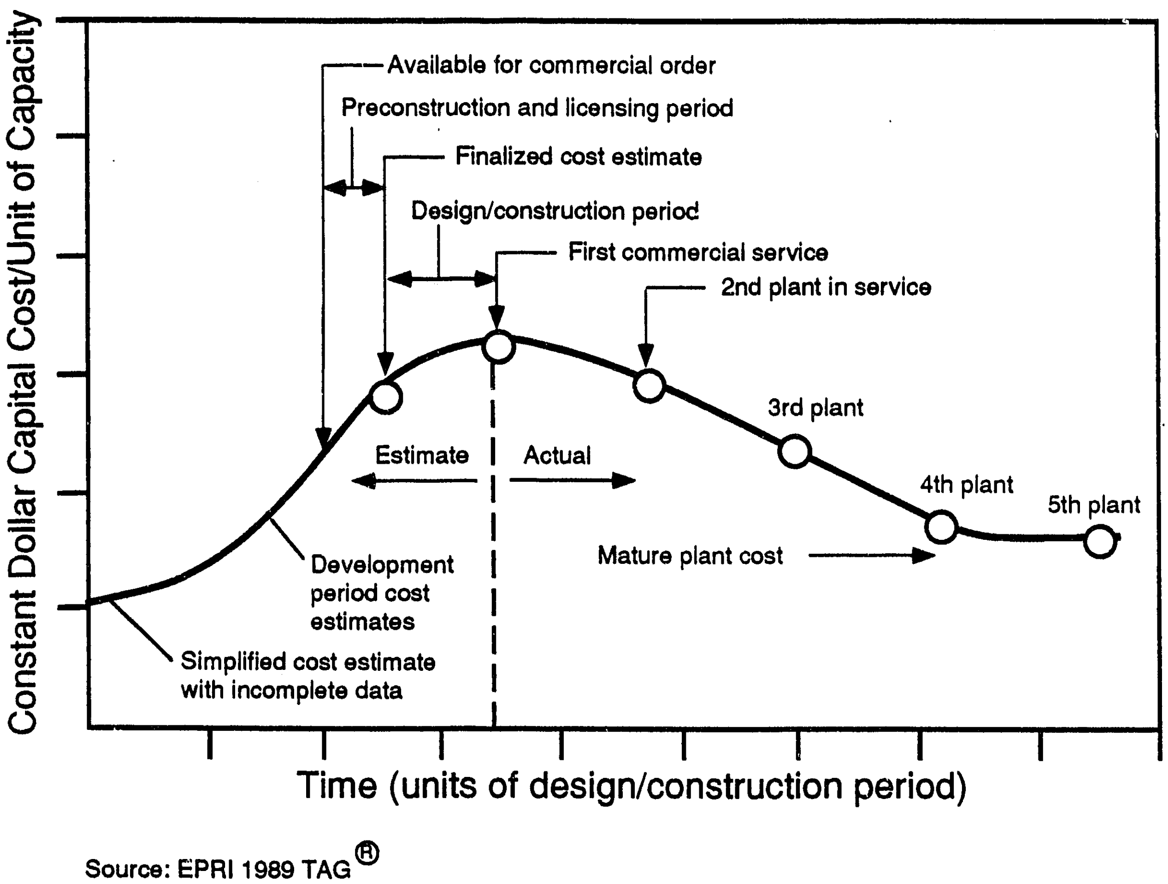

FIGURE 1 Capital Cost Learning Curve (Source: EPRI, 1989)

innovative and traditional technologies. In addition, it is the innovative technology that may best aid the electric power industry (and every boiler-using sector of the economy) to comply with the requirements of the CAAA of 1990.

Lastly, incentive regulation can be (and has been) used to encourage efficiency in operation and construction. The incentive regulation provides an impetus for the utility to minimize costs in order to receive greater net revenues. Greater efficiency by the utility results in a cost savings for society as a whole. Incentives can also provide a means of limiting the risk associated with new project construction. By providing a reward to control costs efforts will be expanded to minimize cost overruns and promote a level of stability in capital cost forecasts. These effects are depicted in Figure 2.

2.2 Historical Use Of Incentive Mechanisms

The use of incentive regulation can be traced back to 1855 with use of the sliding scale rate-of-return approach by the Sheffield Gas Act of 1855 (Evetts, 1922). However, incentive regulation has never been adopt in any wholesale manner, but more in a piecemeal manner aiming at encouraging efficiency (Johnson, 1985). Regulators in the past have used the following incentives:

- regulatory lag
- automatic rate adjustment
- zone-of-reasonableness rate-of-return
- prudency/used and useful tests
- fuel adjustment clauses
- operating incentives
- construction incentives
- incentive rate of return/sliding scale plans.

2.2.1 Programs and Description

Among the generic approaches, state regulators have attempted to formalize the concept of the zone-of-reasonableness for rate-of-return calculations as a means of stimulating

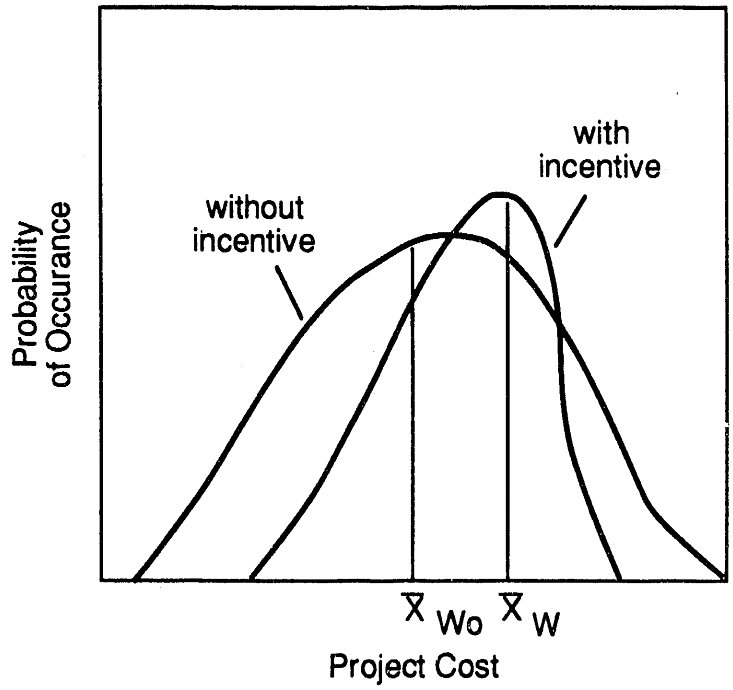

FIGURE 2 The Effect of Incentives on Expected Project Costs and Variances

efficiency.[5] Florida, Michigan, South Carolina, and Virginia have all employed rate-of-return adjustment mechanisms that are considered to produce returns that are still fair but provide for penalties and rewards (Nolan, 1981). Perhaps the most formal zone of reasonableness mechanism was that developed by New Mexico known as the COSI plan (Cost of Service Index) where a formal zone of reasonableness for equity returns was defined along with a

[5] Prior to the Hope Natural Gas Case, it was established that a "fair" rate of return would lie within a "zone of reasonableness" that would be determined as a question of fact by an administrative tribunal, see Federal Power Commission V. Natural Gas Pipeline Co., 315 US 575, 585-86 (1942) where it was noted that:

> *By long standing usage in the field of rate regulation the 'lowest reasonable rate' is one which is not confiscatory in the constitutional sense . . . assuming that there is a zone of reasonableness within which the commission is free to fix a rate varying in amount and higher than a confiscatory rate, . . . the commission is also free under Section 5 (a, 15 USCA Section 717d a) to decrease any rate which is not the 'lowest reasonable rate'. It follows that the Congressional standard prescribed by this statute coincides with that of the constitution, and that the courts are without authority under the statute to set aside as too low any reasonable rate adopted by the commission which is consistent with constitutional requirements.*

From this it would seem the rate-of-return must be set equal to the cost of capital in order to ensure a chance that the companies market value will equal book value and hence avoid the issue of confiscation. But, it is only the chance to earn this return and not a guarantee.

formal lag adjustment period which allowed the utility to reap the reward of returns above the maximum for a specific period and which punished the utility for returns less than the minimum. At the time of adjustment the rates are adjusted to bring the utility back within the zone; see Kaufman and Profazich (1979).

The so-called "sliding scale" approach was employed in England during 1855 where the Sheffield Gas Act of 1855 permitted the company to pay a dividend of 8% if gas prices were over 84 cents (Evetts, 1922). It could, however, declare dividends of 10% if the price was less than this level. In the United States the Washington Plan was employed from 1925 to 1955 to regulate Potomac Electric Power Co (Holthausen, 1979). If the companies earnings rose above 7.5% the rates would be lowered in the following year to absorb half the excess. If earnings fell below 7.5% for five years, 7% for 3 years or 6.5% for one year, rates would be increased to allow a 7.5% return.

The FERC has contemplated a sliding scale type mechanism in the Alaskan gas pipeline case. There the incentive rate of return (IROR) mechanism explicitly accounted for the risks created by the introduction of the mechanism itself with the result that a "risk premium" would be included to compensate in part for this additional risk in order to maintain capital attraction and compensate for the business risk associated with the project.[6]

Besides the incentive mechanism focusing upon the rate-of-return, states began in the late 1970's to employ lag mechanisms in the treatment of automatic fuel adjustment clauses. These lags were designed to induce efficient fuel choice and to minimize the fuel cost and purchased power expenditures of the utilities (FTC, 1977; ICC, 1979). The problem facing regulators in the 1970's involved rapidly rising fuel costs due in part to the OPEC oil embargo. Regulatory lag as an incentive, in effect, transferred more of the risks to utilities than warranted by conditions. Likewise, an automatic fuel adjustment clause resulted in the

[6] Order No. 31, *Determination of Incentive Rate of Return, Tariff and Related Issues,* June 1979.

consumer bearing the full cost of fuel purchasing decisions, insulating utility management from the cost of errors. Automatic adjustments also did not provide any incentive to utility management to investigate ways to minimize costs.

Two approaches were employed in order to assure a sharing of these specific and unique risks arising in the fuel supply market. One approach was a time-employed lag in the adjustment process that forced the utility to cover the difference between the present revenue allowed for fuel costs and actual fuel costs (Violette and Yokell, 1982). This ostensibly created an incentive for utility managers to employ management techniques that would minimize the difference in costs and thereby reduce the future price increases faced by consumers. The second technique was the establishment of a target fuel price based on appropriately weighted market prices for boiler fuels. This was then combined with an adjustment process that would allow a partial pass-through or price reduction that was based on the difference between the actual and target fuel costs. For example, if actual fuel costs were higher than target fuel costs by one cent per kWh, the adjustment mechanism would allow a one-half cent increase in fuel costs. Likewise, if actual fuel costs were below the target a one-half cent decrease would be passed-through to the customer.

This is an example of how specific incentive mechanisms can be employed to address unique risks associated with specific aspects of a utility's decision-making process. Such mechanisms can have a profound effect on both short-and long-run decisions. The fuel adjustment incentives influence the dispatching of power, the maintenance scheduling of plants, and fuel purchasing strategies in the short-run. In the long-run such mechanisms influence the plants selected for future construction, long-term purchasing strategies on the bulk power market, and the speed of new plant construction. In designing such incentive mechanisms, care must be taken to evaluate both the short-and long-run implications to ensure that a strategy is adopted that minimizes long-run utility service.

Many states are beginning to analyze and adopt objective efficiency standards that are used as a basis for adjusting a utility's allowed rate-of-return upward or downward.[7] In some cases management audits are used as the basis of evaluation,[8] while in other cases measures of overall productivity are employed to evaluate a utility's success in controlling costs and managing operations correctly (Crew and Kleindorfer, 1987; Seagraves, 1984; Baumol, 1982; Gale, 1982; Costello, 1984). More recently, measures of total factor productivity have been examined by both state commissions and utilities. For example, Otter Tail Power Company has been employing a total factor productivity program internally since the early 1980s.[9] The employment of such mechanisms and measures is indicative of the industry's recognition of the need to provide rewards to offset risks, and rewards (punishment) to management for making good (bad) decisions.

Risk asymmetries and the level of risk has also been regulated. Whereas in the past risk analysis was relegated to the analysis of the allowed rate-of-return, in today's environment risk analysis is employed in construction, fuel choice, conservation, and other important policy decisions of both companies and PUCs.

Risk sharing mechanisms are employed to lower the ultimate costs of transactions.[10] Risk sharing issues arise before regulatory commissions on a broad range of questions from rate design, fuel cost recovery, excess capacity and construction planning. One of the most frequently employed forms of risk sharing used in regulation today is the phase-in of rate base additions. By adopting a phase-in approach regulators achieve a number of objectives, including the sharing of new plant costs between utility stockholders and consumers. If it

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[7] See Standards for Public Utility Management Efficiency, 1985, 65 PUR 4th 189, Iowa S.C.C.

[8] See Management Audits, Electric Utilities, 1986, 73 PUR 4th 66, 68, West Virginia P.S.C.

[9] See Kjellerup (1984, 1985, 1988) for an in-depth discussion of the Otter Tail program and references therein.

[10] See Stutz (1986) and for a counter perspective see Markham (1988) — this article lists 21 examples of risk-sharing cases heard before regulatory commissions.

is known in a prospective fashion that costly plants will be phased-in rather than placed in rate base all at once, the utility will have an incentive to minimize construction costs. Phase-ins are also used to (1) reduce rate shock, (2) maintain rate stability, (3) match benefits and costs of a plant to customers over time, and (4) preserve the financial integrity of a utility.

Another approach to risk sharing is the use of prudence reviews, where the reasonableness of construction expenses are evaluated and any part disallowed is considered to represent the stockholders share of expenses. The problem with prudence reviews lies in the ambiguity surrounding the definition of prudence.[11]

The risk that a full recovery of costs may not occur can lead some utilities not to undertake investments that are of a legitimate nature. As much as 35.9% of a plant's construction costs have been disallowed from rate base in the case of Nine Mile Point Unit 2 in New York, with an average of 15.9% disallowed for the twelve plants considered as of 1987 (Laros and Houbould, 1987).

2.2.2 Initiatives Promoting Development of New Incentive Mechanisms

Historically, incentive regulation has concentrated on construction and production efficiency; the appropriate mechanisms were used to further these goals. Today, incentive regulation is needed for a wider range of problems involving resource choice and technology adoption. The growth of integrated resource planning (IRP), passage of the Clean Air Act Amendments of 1990 (P.L. 101-549), and increased federal interest in a national energy policy has led to a recognition that new incentives are needed to address these initiatives' goals.

[11] The first attempt at such a definition was given by U.S. Supreme Court Justice Brandeis:

The term prudent investment is not to be used in a critical sense. There should not be excluded from the finding of the vase, investments which, under ordinary circumstances, would be deemed reasonable. The term is applied for the purpose of excluding what might be found to be dishonest or obviously wasteful or imprudent expenditures. Every investment may be assumed to have been made in the exercise of reasonable judgement unless the contrary is shown.

Separate, Concerning opinion of Justice Brandeis, Missouri ex rel. Southwestern Bell Telephone Co. V. Missouri Public Service Commission, 262, US 276, PUR 1923C 193, 1923.

Like least cost planning, IRP attempts to choose the mix of electricity conservation and capacity supply resources that generates the maximum amount of net benefits to the citizens of the state in question.[12] These benefits not only include efficient electricity production, equity, and reliability, but also concerns over local/state/regional (even global) pollution, the use of state produced resources (i.e., coal, oil, natural gas), and overall effects of IRP on the state economy. As mentioned previously, there is a disparity of value between utilities choosing capacity versus DSM. Incentive regulation to balance these options has already been enacted in several states such as New York, Colorado, Wisconsin, Michigan, California, and Washington to name a few (NERA, 1991).

Title IV of the CAAA provides utilities with an incentive to reduce SO_2 emissions in the most cost-effective manner as possible. Regulatory treatment of SO_2 allowances will create important incentives for differing compliance options. The treatment of allowances and compliance options will have important implications for the future development of this market and will effect the costs of compliance. Compliance costs in turn will impact rates and the state economy.[13]

At present three important incentive regulations can be considered under the CAAA of 1990: first is the treatment of allowances within a utility's cost structure; second is the issue of preapproval and prudency reviews; and third is incentives for technological adoption.

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[12] IRP has also been examined on a regional scale to deal with problems such as cross-border pollution and multistate utility holding companies. The IRP issue on a regional scale may be a more divisive project because of individual state's attempts to maximize their own welfare with less concern for other states in the region. Regional planning has occurred in the northeast states covered by NEPOOL (Vine, Crawley and Centolella, 1991).

[13] An extremely important issue is the potential conflict between the goals of the CAAA of 1990 and state IRP. From the Act's perspective, cost-effective compliance and achievement of SO_2 reduction is the chief goal. For the state, utility compliance actions such as scrubbing or fuel switching may come in conflict with the state's least cost plan. An example where the goal of the Act and IRP come into conflict is the issue of fuel switching to low sulfur coal in high sulfur coal producing states. While it may be optimal from the utility perspective to fuel switch, the cost of this fuel switching may impact the state's economy greatly. The state may find that restricting compliance choices will lead to a more optimal solution. This issue remains to be resolved and will have important implications for the success of both the Act and IRP.

Optimally, allowances should be included in a utility's total cost in such a manner as to prevent distortions in the choice of compliance option.[14] Preapproval and prudency reviews provide an important incentive for purposes of risk sharing and reducing compliance costs. Through the use of preapproval, the utility can be assured that a chosen option (which is favored by the state) will be allowed into rates, thereby mitigating any inefficient hedging behavior on the utility's part.[15] The third incentive encourages certain technological options that may be optimal from a state and even a utility perspective, but may not be optimal in terms of aggregate compliance costs for the Title IV program. These incentives include: preapproval of technology choice (scrubbers), tax credits for using local coal, and accelerated deprecation on certain technologies (CCT, scrubbers).[16]

The National Energy Strategy (NES) as envisioned by Congress and the Administration will attempt to:

> *reduce the Nation's dependance on imported oil, to provide for the energy security of the Nation and for other purposes...* (S.1220)

The NES attempts to achieve a wide range of goals including, (1) the development of new, cleaner, innovative electricity generating technologies, (2) improving competition in the natural gas and electricity supply markets through the "Mega-NOPR" and revisions to PUHCA and PURPA, (3) improved transmission access, (4) improved corporate average fuel economy (CAFE), (5) open additional lands for exploration of oil and gas reserves, and (6) reduced emissions of criteria and greenhouse gas pollutants through these measures.

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[14] For further details on the various methods of allocating the value of SO_2 allowances, see Rose and Burns (1991). In addition, some states may find it optimal to distort compliance option choice.

[15] This behavior could include a wide variety of compliance options that the utility may expend manpower and capital to examine instead of choosing the option that best fits the utility's needs.

[16] In addition, legislative mandates have been passed requiring scrubber use and local coal use. See Section 5.

Of particular interest to incentive regulation is the desire to promote innovative electricity generating technology.[17] Within Senate Bill 1220, Title XIV, Section 14204, the FERC is authorized to allow incentive regulation including incentive rates-of-return (IROR) and accelerated depreciation along with other incentives of its choosing in determining wholesale rates for the development of CCTs. The FERC is also prompted to encourage states to adopt incentives for CCTs. The incentive program would run for 5 years which could be extended. Cost caps and preapproval prudency for CCT projects that fall within these caps would be allowed along with prohibiting states from including CCT demonstration projects within a utility's avoided cost.

In addition to the incentives indicated in S.1220, the CCT program solicitations have allowed joint federal, state, and private funding for the development of CCTs. The use of regulatory incentives in this case is to overcome risk asymmetries, technological risks, and the "free rider" problems associated with any innovative technology.

Several states have already implemented CCT incentive regulations within their responses to the CAAA of 1990. The high sulfur coal state's incentives are listed in Table 1. These regulatory incentives can be seen as addressing the problems of IRP, least cost compliance with the Act, and furthering the NES. Section 4 will more fully describe the issue of incentive regulation for technological development and issues surrounding CCTs.

3 PROPERTIES OF INCENTIVE MECHANISMS

Incentive regulation is able to address a wide variety of efficiency issues through a varied array of mechanisms. However to be effective, the incentive mechanism must have certain desirable properties (see McDermott, 1980). Without these properties the incentive at least will be nothing more than wasted work hours spent drafting the regulation, and at

[17] Revisions to the structure of the industry (PUHCA), competitive procurement, and transmission are all extremely important regulatory issues. In particular, incentive regulations applied to the procurement of power and the opening of transmission grids may be particularly interesting as an incentive application. These issues, however, will not be addressed in this paper.

Table 1 High Sulfur Coal States and Compliance Responses to Title IV

State	Incentive Programs
Illinois	Preapproval of scrubber technology CWIP allowed for scrubber installation Mandating scrubber and state coal use at certain facilities
Indiana	Utilities may seek preapproval for acid rain compliance plans CWIP is allowed
Ohio	CWIP for utilities participating in scrubber program Tax incentive for state coal use
Pennsylvania	CWIP for scrubber and innovative technology Utilities may seek preapproval of acid rain compliance plans Tax incentive for state coal use
West Virginia	CWIP for scrubbers and innovative technology construction IROR for CCT projects Accelerated depreciation for scrubbers and CCT type projects

Source: Illinois Senate Enrolled Act 621; West Virginia Code Chapter 24,-2-1g, Article 2g; Clean Coal/Synfuels Letter, *Pennsylvania Coal Plan Provides Support for Newer Technologies*, May 6, 1991, p. 1,3; Indiana Senate Enrolled Act 514; and Ohio Senate Bill 143.

worst distort the market causing undesirable effects on reliability and rates. The regulatory incentive mechanism should be (McDermott and South, 1991):

1. symmetric
2. non-distortionary
3. administratively feasible
4. rewards and penalties tied to managerially controllable outcomes
5. forward looking, not historic
6. easy to monitor and evaluate performance.

One factor that must be recognized with incentive regulation is that all penalties and all rewards can distort the behavior of the affected party.[18] The regulatory incentive should reward the utility for good performance while imposing penalties for bad performance. Traditional regulation has tended to distort the performance/reward risks of the utility industry. Cost savings on the part of the utility have resulted in the savings being passed on to ratepayers. Poor performance, however, has always been penalized by the regulators, stifling potentially cost-saving attempts by utilities. If a firm manages to generate cost savings because of greater efficiency or taking a risk, the shareholders should be entitled to keep a significant share of the benefits. Conversely, bad performance should be penalized and not treated in a business-as-usual fashion. The symmetry of rewards and penalties will push firms towards operating in a more efficient manner.

An important issue that the regulatory community has not addressed is the tendency to apply incentive regulations in a piecemeal fashion (Johnson, 1985). The tendency has been to concentrate the incentive on individual cost components such as fuel costs, capital costs, the rate of return, construction costs, etc. While these incentive programs are valuable for assuring efficiency in these areas, there may be a case for too much effort being applied to

[18] The magnitude of the distortion in many cases is uncertain. One of the chief problems of policymakers is determining by "how much" a policy will alter behavior. With little knowledge about the magnitude of effects, the policymaker may find costly projects having too little effect or having effects much larger than desired (i.e., Federal Reserve Board open market operations).

a particular utility component (such as fuel purchases) while ignoring other areas where no incentive is offered, but savings could be made. Incentive regulation which is tied to a narrow target or activity may result in distortion of management effort allocation.[19]

Administrative feasibility of the incentive is also extremely important for its success. Factors such as ease of estimation, understandable outcomes, flexibility, ease of implementation, ease of monitoring, "dovetailing" with current regulation, and legality are all factors that must be considered before and during the period that the incentive is implemented.

Ease of estimation embraces determining the magnitude of the incentive required for program success, and relative easy by which the incentive-to-impact magnitude can be determined. Incentive mechanisms that are extremely difficult to calculate may result in too many resources being devoted to a project with relatively little gain. Understandable results are necessary to determine program success (i.e., was this effect caused by the incentive or something else?), and if the incentive should be altered in type or magnitude. A incentive program with demonstratable success may indicate that this mechanism can be applied to other problems successfully.

Flexibility of the incentive is required in order for successful implementation. An incentive program that is not able to be applied in most typical utility situations (general construction, operations, fuel purchases) may be useless. Excessive reporting requirements and restrictions on when the incentive can be used also reduces flexibility. The ease of incentive program implementation will effect both regulator and utility costs. Low start-up costs will reduce the resource burden on the regulator and allow the utility to take advantage

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[19] An analogy can be drawn with respect to the Averach-Johnson argument that rate-of-return regulation encourages over-capitalization. Traditional regulation allows a return only on capital expenditures, all other expenditures are simply passed through with no gain to the utility. Therefore, the utility has an incentive to purchase more capital because of its greater rewards. This is similar to the misallocation of managerial effort on "parts" of the utility where additional returns may be generated. Time allocated to these sectors results in too much effort being allocated while other efforts may suffer. A point can be made for incentives tied to a narrow target if the target is so important that distortions of effort would result in tremendous efficiency (or similar goal) gains.

of the incentive as soon as possible with lower adjustment costs. Program delays, slow starts, and expensive start-up costs may prove too labor intensive for regulatory agencies and will encourage utilities to continue operations as before because of the greater costs to adopt the incentive.

The ability to monitor progress and evaluate performance is essential. Monitoring combined with penalties and rewards constitute the major input by regulators into the process. Without penalties for noncompliance or the ability to engage in false reporting of results, the regulated agent has an incentive to avoid compliance. The result in the case of incentive regulation for public utilities would be little progress towards more efficient operations and greater costs to ratepayers. With monitoring present, incentives to evade compliance or "cheat" are reduced. An incentive program that is difficult to successfully monitor (high probability of nondetection of violation) and costly should not be implemented, but rather a simpler program with possibly more modest goals and greater chances of success should developed.

The ability of the program to dovetail or fit into the present regulatory regime is also necessary for program success. The regulatory incentives should complement each other to aid in the reaching the goal of greater efficiency. Contradictory regulations and incentives will produce greater costs for ratepayers, shareholders and regulators, and result in uncertain program results. Finally, the program must be legally viable. Illegality resulting from improper restrictions on property use, methods of accounting, conflict with federal law, or unjust favoritism will result in wasted effort on both the regulator and utility's part. An incentive that results in extensive (and expensive) litigation because of its faults results in a loss to all the parties concerned.

The regulatory incentive should also be linked to factors that the utility management has control over. For events such as fuel shocks, recessions, high inflation, or acts of God, the management of the utility has very little ability to diversify away from the risks of these occurrences (with the possible exception of some fuel risks). The incentive should attempt to isolate these effects and render them neutral for purposes of assigning rewards and penalties.[20] Management still should maintain prudent levels of reliability and precautions against force majeure events to minimize costs, but the incentive should not penalize if prudent preventions were taken.

Lastly, incentives must be forward looking in order to preserve fairness and encourage efficient behavior. Retrospective incentives which punish firms for actions not taken in the past is clearly unreasonable.[21]

Finally, the results and performance of the incentive program should be evaluated. Questions regarding the achievement of improved performance, minimization of risk, and elimination of distortions in investment, activities and effort should all be examined. Those regulatory incentives which showed success in one or any of these categories may be able to be applied successfully to other problems. If the incentive failed to act as desired then the issue of what can be done to improve the instrument, or the need to discard the incentive, can be discussed.

Incentive regulation can (and has shown itself to) be a powerful tool to achieve more efficient utility operations. For the incentive to be effective, the regulator must address a variety of potentially difficult questions about its function and effect on the regulated party. To determine if the incentive was able to achieve desired outcomes, the incentive program must be evaluated.

Section 4, will present the regulatory problem of innovative technological adoption and regulatory incentives needed to achieve the implementation of the technology. Incentive

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[20] This, however, is easier said than done. For example, construction of a capital-intensive plant will be affected by events such as inflationary trends, changes in the cost of capital, labor problems, and technological difficulty. A cost cap incentive could be adjusted for inflationary pressures or unforseen spikes in interest rates, or labor unrest by raising the cost cap to match the price increases.

[21] This is true as it may pertain to projected construction, fuel supply contracts, and similar activities. Retrospective regulation when one considers issues of hazardous waste disposal penalties for improper disposal may be entirely reasonable such as EPA's Superfund program.

regulations for the adoption of CCTs serves as a means of commercializing a valuable technology and achieving some of the goals set forth in the Title IV of the CAAA of 1990, namely the reduction of SO_2 in a cost-effective manner.

4 CLEAN COAL TECHNOLOGY INCENTIVES AND THE CLEAN AIR ACT AMENDMENT OF 1990

The central problem with the development and commercialization of innovative, electricity generating technologies has been the exposure to excessive technological risk and the associated regulatory risks. Given the uncertainty regarding construction and operating costs, and the risks of under-performance or failure to operate in terms of heat rates, downtime, and pollution control, the innovative technology faces significant hurdles in the traditionally conservative utility industry. Under traditional regulation, reliability and an asymmetry of risks and rewards tends to force capacity choice away from riskier technological options. In addition, regulators will be concerned that insufficient incentives exist for the utility to control the construction costs of a new plant. In effect, a dual incentive mechanism must be created — it must offset the technological risks and provide an incentive to cost-effectively complete the project.

In part, the Clean Coal Technology Program (CCTP) solicitations has helped advance the development and deployment of CCTs in industrial boiler, independent power producer and utility applications. With the CCT solicitations some of the development and implementation risks have been reduced by federal and state funding grants. However, the widespread commercialization of CCTs may still be years away.[22] In order to compensate for the extraordinary risks associated with CCTs, and the presence of free rider behavior,

[22] The incentives and barriers to CCTs should be considered the same as most types of innovative technologies. The central difference separating these coal technologies from other innovative technologies is the fuel. The general perception of coal is as a fuel that results in high emissions of SO_2, NO_x, particulates, and CO_2. The CCT project may find siting difficult due to these perceptions, although siting may be easier in the face of perceptions rather than technical needs associated with wind, solar, and geothermal energy; the perception problem also affects second generation nuclear reactors.

regulatory incentives are needed to promote the commercialization of CCTs. The eventual commercialization of CCTs is desired due to perceived low operation costs, CCTs use a plentiful, low cost fuel, and CCTs generate significantly less SO_2, NO_x, particulate, and CO_2 emissions relative to conventional coal-burning technologies. The availability of CCT as a compliance option for Title IV of the CAAA of 1990 would greatly aid utility compliance and could generate additional benefits for the utility.

The regulatory incentives for CCT commercialization can be divided into two categories: regulatory incentives to reduce the risks of adopting CCT (innovative technology) and incentives that reward risk taking. The ICTAP (1989) report indicates four central risks associated with adopting an innovative technology, and in particular CCTs: capital risk, operating risk, regulatory risk and environmental risk.

These risks can be described briefly as follows: Capital risks are associated with the possible loss of either or both the return on capital and/or the return of capital. This can occur when a PUC disallows all or portions of the utility's construction costs, or reduces the allowed rate of return on its investments. Operating risks are associated with the potential failure of the plant to perform up to its expected efficiency or fails to operate entirely. Regulatory risk is a generic term encompassing the PUCs treatment of operating and capital expenses within the regulatory process; for example, prudency or used and useful disallowances. Environmental risk entails the possibility that the technology adopted or construction site will not meet local environmental standards. Each of these risks or a combination of them are faced by a utility adopting a new power plant technology.

Incentive regulation can serve a mitigating role for the risks faced by innovative technology development. The following incentives are proposed to aid in the reduction of risks and presenting rewards for risk taking. The incentives are:

1. Prospective prudency
2. Prudent abandonment rules

3. Accelerated depreciation
4. Rate-base treatment of deferred taxes
5. Construction work in progress
6. Avoided cost rate adjustments
7. Expensing demonstration costs
8. Incentive rates of return
9. Amortization of abandon/canceled plants
10. Pre-approved capital expense caps

In Table 2, each of the alternative incentives are classified with respect to the risk addressed and whether they are risk reducing or reward incentives. In some cases the incentive is capable of mitigating more than one type of risk and could serve as either a risk reducing or reward incentive. As mentioned in Table 1, the states producing high sulfur coal have implemented some of these incentives, with West Virginia the farthest ahead in implementing regulatory incentives.

Prudency rules, whether they cover new capital costs, or the abandonment or cancellation of a plant, are essentially designed to reduce the capital cost and regulatory risks. If utility management understands the rules under which they are making investment decisions, the elimination of these uncertainties will result in a more cost-effective set of decisions. Preapproved capital expense caps act in a similar fashion with the additional advantage that a financial reward can also be earned if construction costs can be kept below the cap level. This could be achieved by allowing the utility to place in rate base the expense cap when actual construction costs are less than that level.

The amortization and depreciation programs provide an accelerated return of capital to the stockholders which, in a present discounted value sense, increases the reward to stockholders and shortens the payback period of the investments. Construction work in

TABLE 2 Risk Classification

	Capital Risk	Performance/ Operating Risk	Regulatory Risk	Environmental Risk
Reduce Project Risk	Prospective Prudency Preapprove Capital Expense Caps.	Rapid Amortization of CCT Expenditures	Eliminate Retroactive Used and Useful Tests	Pre-approval Accelerated Siting Process
	Construction Work in Progress (CWIP)			
Reward Risk Taking	Incentive Rate of Return	Immediate Cost Recovery through FAC's of CCT Expenditures	Prudent Abandonment Rules	Discretionary Use of Bonus Emission Allowances
			Amortization of Abandoned/ Canceled Plants	
		Additional Cost Recovery via Avoided Cost Pricing for CCT		

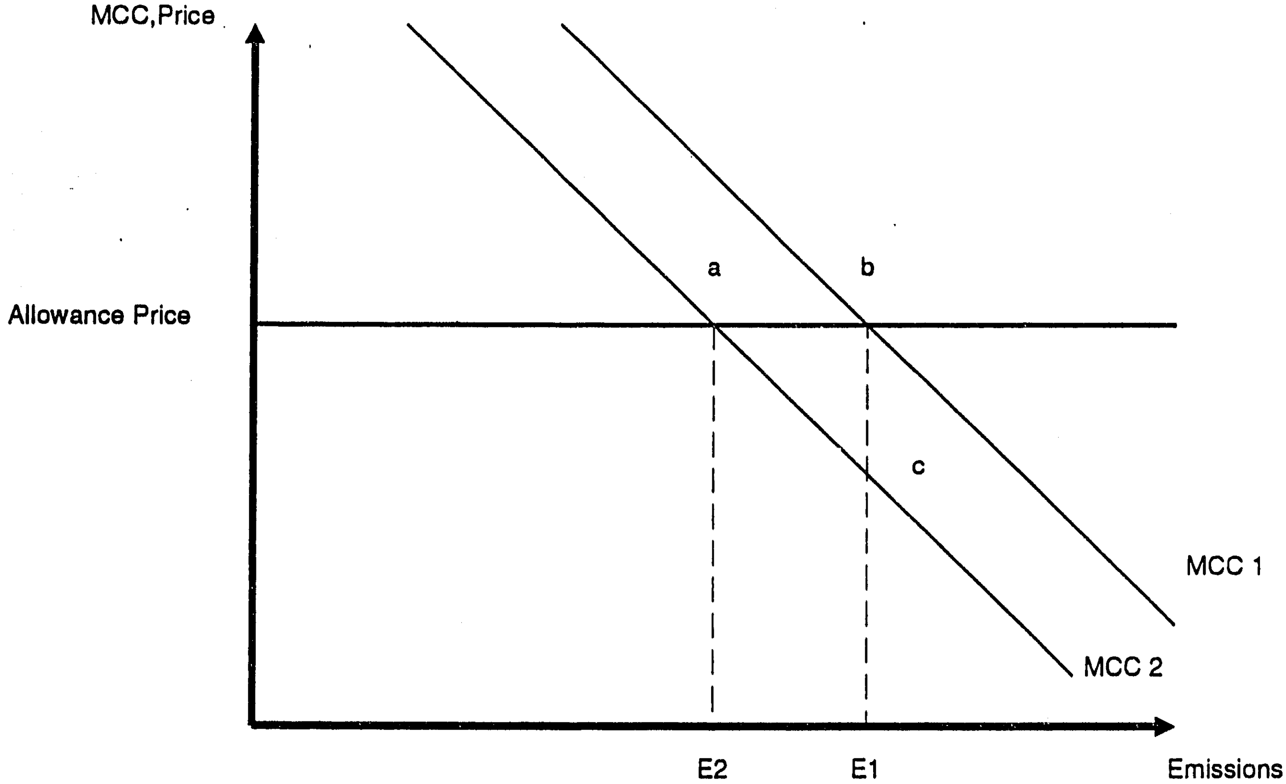
progress (CWIP) works in a similar fashion but has the added advantage that the cash flow occurs during the construction period, while the amortization/depreciation programs provide cash flow after the projects completion. By providing cash flow during construction additional savings can occur from reduced borrowing needs.

Under the accelerated depreciation program intertemporal cash flows are altered by the change in the timing of the companies tax bill. If the deferred taxes that accumulate are treated as a rate-base item the stockholders will earn an additional return on the project. By expending some or all of the project's costs, a utility reduces the investment payback period and acquires an accelerated cash flow. Once again, if these costs are passed through to customers during the project it acts like CWIP in reducing the overall financing costs of the project.

With regard to IROR, regulators have a number of options available. They could estimate what the premium for undertaking similar risks is within the capital market and allow the utility to earn this rate on that portion of the companies rate base associated with the CCT plant. Alternatively, they could simply prescribe a return that is sufficient to induce utilities to adopt CCT projects.

In many cases a combination of these policies is available that simultaneously offset risks and provide rewards for controlling project costs. In some cases, regulators may allow utilities to reveal their own preferences by selecting the incentives of their choice to either offset risks or be rewarded for bearing risks in conjunction with cost control incentives. Since not all firms or managers have the same preferences towards risk bearing, allowing a choice of incentives will reach a larger portion of the utility marketplace.

How does the use of regulatory incentives aid in achieving the goals of Title IV/CAAA of 1990? In Section 1, we briefly characterized Title IV as having two goals: the first goal is the reduction of acidic precursors which cause acid rain, the second is the compliance flexibility granted utilities by the use of transferable SO_2 allowances. The flexibility generated by the allowance program results in an overall savings with respect to compliance costs. One of the important properties of allowances envisioned by economists is the additional incentive created for technological innovation of pollution control technology. If the innovator is able to control emissions at a much lower cost he would control emissions until the marginal cost of control is equal to the market price of the allowance. So, the firm reduces emissions and has allowances available for sale. The firm has created value by reducing emissions (see Figure 3).



Allowances held = level of emissions (E2 or E1)

Net Benefits form Innovation = abc

FIGURE 3 Excess Allowances Create Value

The incentive for cost minimization and innovation through the use of the market may, however, be stifled if (1) regulatory barriers to trading, (2) utility hedging of allowances, or (3) distortion-causing regulatory incentives (i.e., scrubber incentives, mandating technologies and fuel use) are employed. A danger exists that incentives, which explicitly distort economic choices facing a utility, will limit the ability of the market to develop, and consequently, the utility will rely less on the market to achieve compliance. The result may be greater costs for shareholders, ratepayers, and society. Regulatory incentives, if properly applied, can help to achieve cost-minimizing compliance with Title IV and help promote innovation of more environmentally-benign technologies. The way to achieve lower compliance costs with Title IV is to directly reward the innovation of such technologies.

Regulatory incentives for the reduction of risk and the encouragement of risk taking for promoting innovative technologies is desirable. The regulatory incentive will be nondistorionary since it reduces uneconomic risks, such as technological and regulatory risks, and creates a level playing field. Incentive regulation can be used to overcome the free rider problem as innovative firms are able to reap greater rewards. And repowered or greenfield CCTs (or other innovative technologies) result in allowances being freed for other uses creating value.[23]

5 SUMMARY AND CONCLUSIONS

The use of tradeable SO_2 allowances fundamentally alters the means by which pollution will be regulated. Additional market/incentive-based instruments for environmental protection have been proposed for the control of greenhouse gasses, stratospheric ozone depleters, tropospheric ozone control, water-borne pollutants, and solid waste disposal. The harnessing of private information and the market should encourage cost-effective compliance with the mandated standards. In addition, incentive mechanisms stimulate greater innovation as emission reduction can generate greater cost savings than command and control approaches.

In terms of Title IV of the CAAA of 1990, incentive regulation can also play almost as important of a role as emission allowances. Two scenarios can be envisioned. In the first, the market fails to develop in a timely manner resulting in greater compliance costs and less technological innovation. Incentive regulation can serve several mitigating roles. Regulation

[23] It is possible that the use of innovative technologies via repowering or new construction (greenfield) will not be the least cost solution to compliance. In these cases, incentive regulation from a societal point of view is still optimal as it reduces risk asymmetries and reduces the free rider problem. However, the use of CCTs (or other innovative technology) may not be the optimal compliance method for a utility system when compared to fuel switching or scrubbing.

can be promulgated insuring nondistorionary treatment of allowances. This will in-turn encourage cost-effective choices of control equipment, which should transfer this cost information into allowance market price signals, hopefully reducing market uncertainty. Prospective prudency review may also encourage quicker and lower cost market formation. Early approval of compliance choices will aid the utility cost minimization without having to devote efforts to hedging behavior to protect against unfavorable prudence reviews. Incentive regulation can serve the role of promoting innovative technology via "level playing field" for all compliance options where the individual costs and merits of each technology can be judged. Technologies such as CCTs can greatly aid in utility compliance, controlling SO_2 emissions to a point where excess allowance are freed for other uses.[24]

The second scenario is the allowance market for SO_2 does development in a timely manner and results in compliance cost savings (as compared to command and control) for the electric utility industry. What role can incentive regulation play? Incentive regulation can be used to further promote efficient utility operations in terms of power procurement, operations, fuel procurement and the like. Incentive regulation can also aid the development of innovative technologies. The combined incentives from regulation and the SO_2 market may result in a faster adoption of technologies such as CCTs.

The issue of IRP and Clean Air Act compliance has already been alluded to. The conflict between state goals of achieving the maximum welfare from it energy use and the cost minimizing goal of Title IV may conflict. The PUCs will encourage the use of compliance options which, for example, maintain their high sulfur coal markets by the use of scrubbers. While this policy may be judged the best form the state's view, from a utility and social standpoint, if scrubbing is not the least cost option, the policy is nonoptimal. Technology

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[24] A variant of Scenario 1 is that the PUC creates distortionary incentive regulations that results in greater compliance costs for the state's utilities. In this case, the motivation to use incentive regulation to aid the development of a allowance market with efficient prices and optimal compliance option choices is limited. Incentive regulation may, however, be used by states to encourage the development of technologies that fosters state IRP and is optimal from a compliance cost standpoint.

forcing and trading restrictions by PUCs may limit the effectiveness of the SO_2 allowance market.

Incentive regulation may be used to achieve IRP goals and Clean Air Act goals even when they are in conflict. For high sulfur coal states, incentive regulation for the promotion of CCTs may serve the purposes of continuing maintenance of high sulfur coal markets and offering a least cost compliance option for the state's utilities. The allowances freed by developing CCTs may then be used to offset the cost of the incentive for shareholders and ratepayers.

Incentive regulation provides a powerful tool that can be used to achieve greater efficiency in the public utility industry. Through balancing resource choices, promoting cost efficiency, and reducing asymmetric risks, incentive regulation has the potential to reduce the societal cost of producing energy. Incentive regulation is also an important tool for compliance with Title IV of the 1990 CAAA. The nondistorionary use of incentives can aid the formation of a well functioning allowance market and promote innovative technology. In the event of market failure, incentive regulation can in many ways "jump start" the market buy encouraging trading and cost-effective compliance, and aid in the development of low cost control options. Thus, incentive regulation has important role to play in Clean Air Act compliance and all the potential conflicts that may arise between it and state interests.

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