CLEAN COAL TECHNOLOGY AND ACID RAIN COMPLIANCE: 
AN EXAMINATION OF ALTERNATIVE INCENTIVE PROPOSALS

by

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1 INTRODUCTION

The Clean Air Act Amendments (CAAA) of 1990 rely primarily on the use of market incentives to stimulate least-cost compliance choices by electric utilities. Because of the potential risks associated with selecting Clean Coal Technologies (CCTs) and the public-good nature of technology commercialization, electric utilities may be reluctant to adopt CCTs as part of their compliance strategies. This paper examines the nature of the risks and perceived impediments to adopting CCTs as a compliance option. It also discusses the incentives that regulatory policymakers could adopt to mitigate these barriers to CCT adoption.

2 RATE-OF-RETURN REGULATION: AN OVERVIEW OF THE PROCESS AND INCENTIVES

Electric utilities operate in an environment in which their business decisions are directly influenced by the set of rules established by law and enforced by the state public utilities commission (PUC). This environment has typically reflected a risk adverse attitude, coupled with a level of control over the rewards available to utilities, that creates a static as opposed to a dynamic environment. The static approach to controlling the earnings of utilities adopts a historic view of the costs associated with providing services. This method of regulation employs two stages: in the first stage, the cost data are used to establish the utilities’ revenue; in a second stage, prices are determined. In the first stage, referred to as the determination of the utilities total revenue requirements, the historic costs of service are calculated using the following equation:

\[ TR = [RB - D] \times ROR + d + T + OE \]

where:

\begin{align*}
TR & = \text{Total Utility Revenue} \\
RB & = \text{Value of Plant} \\
D & = \text{Accumulation Depreciation} \\
ROR & = \text{Rate of Return} \\
d & = \text{Annual Depreciation} \\
T & = \text{Taxes} \\
OE & = \text{Operation Expenses}
\end{align*}

The right-hand side of the equation represents the costs of providing service, inclusive of a fair profit or return; regulators adopt the approach that fairness dictates that total revenues be equated with total costs. The second stage of the process assigns each customer class a share of the costs and calculates prices that would, given the customers’ elasticity of demand, generate revenues that match the assigned cost share.

In theory, rate base rate-of-return regulation, or cost-of-service regulation, is designed to provide incentives to firms subject to regulation to produce output in the most efficient manner possible.
within a market characterized by natural monopoly conditions. In addition, when the regulatory process is interpreted as a cost-of-service regulatory mechanism, the prices consumers pay will be fair if they are based only on the cost of production and do not reflect the monopoly power inherent in a natural monopoly market. In order to achieve fairness for utility stockholders, the cost-of-service must also include a fair return or profit commensurate with the evaluation by the financial markets of the firms’ riskiness. If the allowed return or profit is equal to the market return, then the market value of the utilities assets will equal its book costs.

A regulated utility operates within an environment radically different from that of a competitive market. In particular, the utility faces an obligation to serve all of its customer demands at the existing price. Hence, if demands fluctuate from hour to hour or day by day, the utility must have sufficient capacity to supply these demands. The requirement that an excess supply capability be installed by the utility exposes the utility to costs higher than those for a

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1 Natural monopoly occurs when a single firm can meet total market demand at lower cost than two or more firms (see William W. Sharkey, The Theory of Natural Monopoly 73, 1984). Natural monopoly can occur when the extent of the market or demand in relation to the technology of production, or supply, is such that only one plant supplies the market efficiently, at least cost (see generally id. at 12-20. R.A. Posner, Natural Monopoly and its Regulation, 21 Stan. L. Rev. 548, 1969). Natural monopolies may also occur when efficiencies can be obtained through concentration of production within one firm that cannot be achieved through reliance on the market (see R. N. Coase, The Nature of the Firm, 4 Economica 386, 1937).

2 One way to view this issue is that the allowed rate of return granted should be equivalent to the market cost of capital in order that the market value of the utility equals its book value. If this market-to-book equality is achieved, confiscation has not occurred.

If MV = Market Value, BV = Book Value, PV = Present Value, 
I = Income, ROR = Allowed Return, and r = Cost of Capital, then we have:

\[
MV = PV \\
PV = \frac{I}{r} \\
I = (BV) \times ROR
\]

Substituting we obtain:

\[
MV = \frac{(BV) \times ROR}{r}
\]

If the allowed return (ROR) is set equal to the cost of capital, which includes all the effects or risk, then:

\[
MV = BV
\]
competitive firm. In addition, the utility must anticipate the economic, weather, and other
conditions over time that will affect load growth and plan capacity construction in advance to
meet these needs. All of these conditions introduce risks that a private unregulated competitive
firm does not face. A competitive firm does not have to supply its customers in times of
shortages, but rather employs the price mechanism to ration the available supply.

Regulated firms also face risks associated with the regulatory process itself. A PUC has the
power to review the prudence of all capital expenditures and operating costs in order to assess
the reasonableness of these expenditures and to allow or disallow them. Looking at the risk
exposure then in another way, it is the regulator and not the market place that, in part, determines
the factors influencing the level and timing of revenue flows and costs incurred by a utility.
Decisions regarding depreciation, treatment of construction work in process, and the inclusion
or disallowance of construction expenditures or fuel costs, all have an effect on the riskiness of
the utility's flow of revenue. As a result, the utility faces a complex set of incentives in its
decision-making process as it attempts to meet its customer demands in a reliable and least-cost
manner.

3 BARRIERS TO CLEAN COAL TECHNOLOGY ADOPTION

Regulation has typically served as a buffer, insulating both the customer and stockholders from
dramatic changes. The process outlined above serves as a means to mitigate risks and, through
policy choices, regulation has minimized the incentive for utilities to undertake risky projects.
Table 1 identifies five basic regulatory barriers that serve to dampen utility incentives to adopt
CCTs. Each of these examples is discussed in more detail below.

3 See L. Buck and J. Growth, Regulatory Uncertainty and the Cost of Capital for Utilities, Public
Utilities Fortnightly, February 20, 1986, and P. Fanera and J.R. Gorman, The Effects of Regulatory
Risk on the Cost of Capital, Public Utilities Fortnightly, March 6, 1986.

Research that attempts to empirically identify the effects of alternative regulatory conditions
includes T. Pelsoci, Organizational Correlates of Utility Rates in Steinman (ed.), Energy and
Commissioner Selection: Does It Matter, Illinois Commerce Commission, May 1985; P. Navarro,
Public Utility Commission Regulations: Performance, Determinants and Energy Policy Impacts,
Discussion Paper E-80-05, J.F. Kennedy School of Government, Harvard University; and
R. Smiley and W. Greene, Determinants of the Effectiveness of Electric Utility Regulation, Cornell
University Working Paper No. 172. The findings vary across studies; however, a general result
is that, in the short term, appointed commissions create a more favorable and effective regulatory
environment than elected commissions.
Table 1 Regulatory Barriers to CCT Adoption

- Slow depreciation rates preclude rapid adoption of new technology.
- Inability to capitalize the returns from commercialization of new technologies dampens the incentives to innovate.
- Obligation to serve promotes maintaining older plants to ensure that adequate reserve margins are maintained.
- Historical use of prudence disallowance and penalties for technologies that exhibit poor performance or are over-budget discourages technologies with uncertain production costs and output.
- General perception among management that excessive risk-taking involving innovative technology can result in lower allowed returns.

The first example of how regulation can create a barrier to adopting innovative technologies is exemplified in the regulatory policy towards depreciation. It is typically the case that regulators will adopt depreciation rates that do not match technological obsolescence or economic conditions.

By adopting long lives for depreciation purposes, the regulators can minimize the cost impact on consumers (annual depreciation, \(d\), is kept low) while maintaining returns for stockholders (accumulated depreciation, \(D\), increases at a lower rate). If dramatic technology changes do occur, utilities will not have received a return of existing capital (the investment is not fully depreciated); thus, they are reluctant to scrap existing plants in favor of new technologies. Furthermore, if a flash cut depreciation policy were adopted, allowing the utility to depreciate in one or two periods the remaining value of existing plants, the rate shock would create a public outcry. Thus, historic depreciation policy has served as a barrier to adopting innovative technologies.

Current regulatory rules have treated the gains from technology development as a benefit to rate-payers and not as a source of profits for stockholders. Given the riskiness of technology development, utilities are reluctant to undertake commercialization projects when little or no reward exists to offset the risk. In addition, if construction costs, operating costs, or other problems arise, the stockholders may be punished by regulators disallowing the full cost in the rate base or lowering the allowed return. In addition, a "free-rider" problem may also exist in

\[4\] The traditional economic decision criteria for switching technologies suggests that, if the total cost of the new technology is less than the total variable cost of the old technology, then a switch should occur.
that, once a technology is developed, other firms can benefit from this information without rewarding the developers. As a result, there is an incentive for utilities to take a wait-and-see attitude toward new technologies.

Under current regulatory policy, each utility is obligated to serve all customer demand that is forthcoming at the current price. As a result, utilities are required to maintain excess reserves and reliable plants in order to maintain supply and service continuity. If new technologies are perceived as having uncertain reliability characteristics, or as subject to potential construction delays, then these technologies will be avoided by utilities in order to avoid failing to meet their service obligation.

Failure in almost any respect in the building and operating of power plants has, over the last decade, resulted in prudency reviews, management audits, and cost disallowances. Given this type of environment, utility executives tend to avoid undertaking any project that could subject the company to the adverse reaction of state regulators. Rather than expose the company to additional risk, utility decision makers will select known technologies with proven track records of construction and operational effectiveness. In addition, if the utility is perceived as undertaking risky projects by the financial community, the resulting market adjustment may raise the returns required to attract investors and raise the cost of acquiring new capital.

Finally, regulators have the ability to adjust a utility's allowed rate-of-return based on efficiency and management control of costs. Utility executives are very suspicious of any project that could result in the company management being perceived as unnecessary risk takers or poor decision makers. In general, regulation is often perceived as asymmetric in its effects and as being used to punish companies for perceived mistakes and not to reward companies for success. Under these conditions, some form of explicit incentive mechanism may be required to induce utility executives and/or independent power producers to adopt innovative CCT projects. In the next section, these potential incentive mechanisms are identified and discussed.

4 REGULATORY RECOGNITION OF RISK

The Federal Energy Regulatory Commission (FERC) has recognized numerous times in the past the potential inadequacy of traditional cost-of-service regulation to provide incentives for investment and cost-reducing innovations.5 The cost-based methodology of FERC has generally precluded regulated companies from reaping the benefits of improved service or reduced costs. Instead, the benefits of improved service or lowered costs must be passed on to ratepayers. This obviously creates problems of incentives for both innovation and maintenance of service through investment in incremental supply projects.6 This is especially true in today’s environment in which the perceived risk associated with undertaking major construction projects serves to deter

5 8 FERC ¶ 61, 244 at 61, 502.

6 Order 138, 18 FERC ¶ 61,244 at 61, 502.
utilities from adopting innovative strategies. The electric supply market has suffered a series of "shocks" throughout the 1970s and 1980s. Inflation raised the cost of both fuels and plant construction. Rising prices helped to reduce the quantity demanded of electricity and to introduce conservation habits that reduced the overall level of electricity demand. The result has been a decline in the growth rate of demand from approximately 7% before 1974 to 3% after 1979.7

As a result of this decline in demand growth, utilities began to cancel generating stations under construction that were planned to operate in the late 1970s and 1980s. Even with these cancellations, productive capacity exceeded demand for many utilities, and state PUCs began to conduct prudency reviews of utility decisions. As a result, utilities now question the presumption that investment costs will be approved and recouped through retail rates.

There is a perception today that the regulatory environment treats the risks faced by utilities in an asymmetric fashion, exposing the utilities to the downside risks and potentially lower returns while eliminating the benefits of upside risks and higher returns that may arise. FERC has recognized this problem with respect to innovative projects in the past:

If regulated companies cannot reap the benefit of good fortune, they should not be expected to bear the burdens of bad fortune. If the best that they can hope for are rates that just cover their costs (including a fair return), they cannot be expected to undertake projects that carry a significant risk of falling short of covering those costs. Thus, either such projects will not be undertaken by the regulated companies, or the risk must be at least shared between investors and consumers.8

The central question that must then be addressed is how much risk the consumers are exposed to and the mechanism for implementing the risk sharing.

Given the state of surplus supply that presently exists in various local electricity markets, the question arises as to the specific need for conducting projects designed to stimulate additions to supply capacity. FERC has noted in the past that there is a need to identify both the undertaking of experimental projects and the sharing of risks.9 The consumer interest in this case is twofold: first, the slowdown in construction and cancellation of new construction imply a growing gap in our knowledge concerning the efficiency and environmental characteristics of new technologies

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8 18 FERC ¶ 61,244 at 61, 502.

9 In the Ozark Gas Transmission Case (16 FERC ¶ 61,099), the interest of the consumers was defined as the secure, long-term supply of natural gas under the National Gas Act. This reasoning applied as well to the Alaskan Natural Gas Transportation System Case and the Great Plains Case, among others.
that would have been coming on-line but now are not. As technology advances, the potential gains in efficiency that result, as well as emission reductions that can arise, provide significant potential benefits to the ratepayer. This information cannot be gained without practical experience in constructing and operating innovative technologies. FERC has recognized the importance of information output in the past:

The major output from the Great Plains project will not be coal gas; it will be information. Information, first, about the problems arising from the construction and commercial operation of a full scale coal gasification plant, problems which might occur, or be of a different nature, or require different solutions in a smaller scale facility; second, accurate, reliable information as to the cost of gas produced at the lowest level of a commercial size plant...third, information that the necessary regulating approvals for the commercial size plant can be secured, and fourth, information that such a facility can be built and operated to supplement, as and when necessary, other more conventional sources of energy supply.

There is also the perception that the regulatory process is asymmetric in the treatment of excesses and shortfalls in earned returns. It is generally perceived that utilities are forced to bear the brunt of the shortfalls while unable to receive the benefits of any excess returns. This reduces any incentive to take risks regarding new technologies that might expose the utility to great downside financial risks. The irony of adopting an asymmetric approach to rate-of-return regulations is that the closed-loop nature of the system results in increasing costs for the consumer if the utility stockholder is forced to bear all of the costs. The reason for this is that the financial markets will reassess their perceptions of the riskiness of any utility, which results in a rise in the cost of capital. Thus, punishing a utility for undertaking risks will only ultimately hurt the

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10 Between 1974 and 1984, seventy-five coal-fired plants planned for operation in the late 1970s and early 1980s were canceled, see RM-88-4-0000 p. 13, footnote 22.

11 Without data on the costs of construction and operation, the relevant comparisons concerning the costs of each supply option cannot be made. If it can be shown that the total cost of a new technology is less than the total variable cost of existing technologies, utilities and regulators will not have clear guidance as to how to achieve a least-cost energy supply system.

12 10 FERC ¶ 61,146, Great Plains Case.

13 This asymmetry has been recognized by FERC in the Trailblazer Case and, more to the point, it noted the relationship to undertaking risky projects. If regulated companies cannot reap the benefit of good fortune, they should not be expected to bear the burdens of bad fortune. If the best that they can hope for are rates that just cover their costs (including a fair return), they cannot be expected to undertake projects that carry a significant risk of falling short of covering those costs. Thus, either such projects will not be undertaken by the regulated companies, or the risk must be at least shared between investors and consumers (18 FERC ¶ 61,244, at 61,502).
customer. Regulation must develop methods that promote a least-cost method of bearing risk that promotes the long-run reduction in or minimization of the costs-of-service.\textsuperscript{14}

The traditional incentives provided by cost-of-service regulation do not seem sufficient to compensate for the new types of technological risk that utilities are being exposed to, nor do they seem to promote behavior that would reduce costs through adopting innovative techniques.\textsuperscript{15}

In the short run, financial markets allocate risks across those individuals holding financial assets and goods. Markets allocate risks through prices that reflect costs. In the long run, the consumer cannot avoid bearing the ultimate burden of risk, since the goods/services purchased will always reflect the opportunity cost of capital in the price of commodities. Any changes in the perceived risk of the utility ultimately ends up as a cost reflected in the price of its goods/services as a result of either (1) the increased cost of capital\textsuperscript{16} or (2) through exit by firms that cannot compete at market prices, which results in a fall in the supply of goods and increased prices. In either event, consumers will adjust their purchases as a result of the price change.

\textsuperscript{14} This delicate tradeoff between the ratepayer bearing costs directly or indirectly has been noted by FERC (Opinion No. 49, 8 FERC ¶ 61, 054 at 61177 reaffirmed in Opinion No. 134, 17 FERC Paragraph, 61,196 at 61, 383). It is evident that unless security holders have shielded against risk of losses resulting from aborted projects by way of inclusion in the cost of service, the cost of capital will be higher to an extent necessary to compensate for the additional risk. Thus, if the rate of return is required to be sufficiently high to enable the public utility to attract capital, then risk of such losses must be borne by ratepayers either directly (through cost of service) or indirectly (through rate of return).

\textsuperscript{15} Traditionally, incentives might be characterized as follows:

- (1) Contract design for constructing new plant
- (2) Regulatory lag
- (3) Zone of reasonableness
- (4) Prudency evaluation of expenses

In each case problems arise. If fixed price contracts are sought, in order to shift risk to builders, the price of the contract will rise, shifting the costs back to the ratepayer. If regulatory lag is perceived by the finance market to increase the risk of reduced earnings, the cost of capital will rise. Likewise in the case of cost denials and low allowed returns.

\textsuperscript{16} The effects of market shocks on capital market have been clearly demonstrated by N. Boim, \textit{The Effects of Consolidated Edison's 1974 Dividend Omission Upon the Common Stock Returns of the Utilities' Industry}, The Chicago MBA, (1) No. 1, Spring 1977. The dividend omission was taken as a signal concerning industrywide profit potential in an era of rising costs, energy conservation, pollution abatement, and gaining capital needs. The ultimate effect was to raise capital costs, which in turn resulted in higher rates for consumers.
5 ALTERNATIVE INCENTIVE PROGRAMS

The basic rationale for the development and implementation of CCT incentive programs is twofold: (1) to offset the inherent risks facing utilities or provide a reward for risk taking, and (2) to develop a base of information on the cost and efficiency characteristics of CCTs that can be used by utilities seeking to deploy these technologies.

The set of possible regulatory incentives can be divided into two basic categories: those that reduce the risk faced by utilities and those that provide a reward for risk taking. The types of risks facing a utility adopting an innovative technology were identified in the ICTAP report. These consisted of 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 regulatory commission disallows all or portions of the utilities 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 treatment of operating and capital expenses by the PUC 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 environmental standards. Each of these risks, or a combination of them, are faced by a utility adopting a new power plant technology.

To reduce the negative effects of the various risk categories, it is possible to develop incentive mechanisms that reduce or eliminate the impact of these risks. Among the possible incentive approaches that exist, the following set could be employed:

1. Prospective prudence
2. Prudent abandonment rules
3. Accelerated depreciation
4. Rate-base treatment of deferred taxes
5. Construction work in progress (CWIP)
6. Avoided cost rate adjustments
7. Expensing demonstration costs
8. Incentive rates of return
9. Amortization of abandoned/canceled plants
10. Preapproved capital expense caps
11. Discretionary use of bonus emission allowances

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Each of these approaches will be discussed briefly below. In Table 2, each of the alternative incentives is classified with respect to the risk addressed and whether it is a risk-reduction or reward-incentive mechanisms. In some cases, the incentive is capable of mitigating more than one type of risk and could serve as either a risk-reduction or reward-incentive mechanism.

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 the capped expenses in the rate base when actual construction costs are less than the approved expenses.

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. 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 project’s 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 company’s tax bills. 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 this cost is passed through to customers during the project, it acts like CWIP in reducing the overall financing costs of the project.

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

Under the new Clean Air Act Amendments of 1990, the adoption of CCTs can result in bonus emission allowances being granted to the utility.\(^{18}\) State utility commissions could choose to allow the utility the freedom to sell, bank, or use these allowances as offsets in an unrestricted fashion. This could result in additional revenues that serve to reward the utility.

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\(^{18}\) See § 404, P.L. 101-549, for details.
Table 2 Risk Classification

<table>
<thead>
<tr>
<th>Capital Risk</th>
<th>Performance/Operating Risk</th>
<th>Regulatory Risk</th>
<th>Environmental Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reduce Project Risk</strong></td>
<td>Rapid</td>
<td>Eliminate retroactive used and useful tests</td>
<td>Pre-approval accelerated siting process</td>
</tr>
<tr>
<td>Prospect Prudency Preapprove Capital Expense Caps.</td>
<td>amortization of CCT expenditures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction Work in Progress (CWIP)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Reward Risk Taking</strong></td>
<td>Immediate cost recovery through FACs of CCT expenditures</td>
<td>Prudent abandonment rules</td>
<td>Discretionary use of bonus emission allowances</td>
</tr>
<tr>
<td>Incentive Rate of Return</td>
<td></td>
<td>Amortization of abandoned/ canceled plants</td>
<td></td>
</tr>
<tr>
<td>Additional cost recovery via avoided cost pricing for CCT</td>
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In many cases, a combination of these policies is available that simultaneously offsets risks and provides rewards for risk taking. In some cases, regulators may allow the utilities to reveal their own preferences by selecting the incentives of their choice to either offset risks or be rewarded for bearing risks. Since not all firms or managers have the same preferences toward risk bearing, allowing a choice of incentives will reach a larger portion of the utility marketplace.

6 CONCLUSIONS

The adoption of an innovative technology is associated with significant risk: these risks take the form of capital risks, operating risks, regulatory risk, and environmental risk. In order to induce utilities to undertake innovative CCT projects, regulators must employ incentive mechanisms that either reduce the risk or reward the utilities for bearing risks. Regulatory policies that allow
utility managers to select their own incentive plans will receive wider acceptance and offset the risks that particular companies feel are most critical.