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PROFILES IN ELECTRICITY ISSUES:

EXTERNALITIES

OVERVIEW

Externalities are costs and benefits of production or consumption activities that are not borne by producers or consumers. Externalities are "external" costs and benefits because they are external to the transaction and therefore not reflected in the market prices of goods and services. Market prices are said to reflect only "internal" or private costs and benefits. Economic theory states that resource investment decisions based strictly on market prices may not reflect all costs and benefits that impact society, and therefore the allocation of resources may not be optimal.

Some state regulatory commissions are requiring utilities to explicitly consider externalities in their least-cost planning efforts. Typically, in those states, utilities are required to "internalize" certain negative environmental externalities when evaluating new resource options, while ignoring the impacts of other, usually positive externalities. ELCON strongly doubts the effectiveness of such policies to achieve the goals of energy efficiency and environmental protection.

This *Profile* explains what externalities are and discusses the theoretical basis for the so-called internalization of external costs and benefits in prices. Recent efforts to assign monetary values to negative environmental externalities are described, including attempts to factor these values into utility resource plans and operations. Examples of market distortions resulting from the selective internalization of environmental externalities also are discussed. The *Profile* concludes that piecemeal internalization of externalities is a legislative, not a regulatory function and that the appropriate treatment of environmental considerations in utility resource plans is strict, "least-cost" compliance with all applicable environmental laws.

ELCON is an association of large industrial consumers of electricity. Our members have facilities in most of the 50 states and many foreign countries. Our members produce a wide range of products, including steel, petroleum, chemicals, industrial gases, glass, motor vehicles, electronics, appliances, textiles and food. Our member companies account for nearly five percent of all electricity consumed in the United States. Our members require an adequate and reliable supply of electricity at reasonable prices to produce competitive products. For additional copies of this or other PROFILES, write or call ELCON at the above address.

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Summary of ELCON's Position

Externalities are costs and benefits of production or consumption activities that are not borne by producers or consumers. Externalities are "external" costs and benefits because they are external to the transaction and therefore not reflected in the market prices of goods and services. Market prices are said to reflect only "internal" or private costs and benefits. Economic theory states that resource investment decisions based strictly on market prices may not reflect all costs and benefits that impact society, and therefore the allocation of resources may not be optimal. Examples of negative externalities are visibility problems associated with certain air emissions or the uncompensated wages and benefits lost by workers whose jobs were temporarily or permanently displaced by a plant shutdown. Positive externalities include the national security benefits of domestic energy production, health benefits of medical technology such as life-support systems, or improvements to the nation's productivity and competitiveness of industrial innovations. Many of these impacts -- both positive and negative -- already are fully or partially internalized.

Some state regulatory commissions are requiring utilities to explicitly consider externalities in their least-cost planning efforts. Typically, in those states, utilities are required to "internalize" certain negative environmental externalities when evaluating new resource options, while ignoring the impacts of other, usually positive externalities. ELCON strongly doubts the effectiveness of such policies to achieve the goals of energy efficiency and environmental protection.

ELCON believes that any consideration of externalities in a utility's least-cost resource planning should recognize the following principles:

1. Attempts to internalize any external costs, if they are to be made at all, are the responsibility of legislative, not regulatory bodies. Any regulatory attempt -- by FERC or state PUCs -- to internalize selected externalities would usurp the legislative role to make policy. Such actions also would prevent Congress and other legislative bodies from exercising their right to delegate administrative responsibilities for implementing and enforcing policy.

2. Environmental laws should impose only those costs which society as a whole is willing to pay to address environmental concerns, however uncertain social costs and benefits may be.

3. Competition in free markets inherently assures the most efficient use of all resources including energy. Maximizing competition in retail and wholesale energy markets will help all consumers to efficiently use resources consistent with environmental protection.

4. A utility's acquisition of any supply or demand side resource should proceed in accordance with the development of a least-cost resource plan. The resource plan should begin with a determination of need and include consideration of all cost-effective demand and supply options, and compliance with all applicable laws, including environmental laws.

5. Several states are requiring the consideration of environmental and other social factors that go beyond the requirements of existing laws. Such attempts to internalize external costs are misdirected because:

   a. Economic theory states that welfare may be maximized only when all externalities are internalized. Internalization requires compensation both for beneficial and harmful effects, up to the point where all marginal social costs equal all marginal social benefits. Those who receive benefits should pay for them; those who are victims of harmful effects should be compensated for harm done, to the extent external impacts are not remediated.

   b. Environmental externalities typically are multi-regional and multi-national in origin and therefore outside the jurisdiction and control of the states. State regulators cannot collect compensation from entities outside their jurisdiction which receive beneficial effects, nor can they compensate entities outside their jurisdiction who are victims of harmful effects.

   c. There literally are an unlimited number of externalities, both positive and negative, and upstream and downstream. Most can neither reasonably be qualified nor quantified. It is impossible to ascertain whether net external costs are positive or negative, and therefore the presumption that net external costs are zero is not unreasonable.

   d. Nothing in economic theory suggests that the internalization of externalities on a piecemeal basis improves overall economic or social welfare. In fact, internalizing some but not all externalities may impose net costs on society, compared to a situation where no externalities are internalized.

6. Attempts by several states to internalize selected negative environmental externalities only in electric utility resource planning will:

   a. Arbitrarily raise the relative costs of utility-generated electricity by distorting the process by which new resource options are evaluated and selected. This may artificially shift electricity production to non-utility sources and encourage the displacement of electricity at the end-use level.

   b. Distort price signals in retail and wholesale energy markets, resulting in inefficient investment decisions and consumption behavior. This may force the shift in energy consumption and associated economic activities to utilities, states or countries where costs are lower. Such shifts actually may increase adverse environmental impacts, which is counterproductive to the goals of environmental protection.

   c. Unfairly impose costs on ratepayers who may not be directly responsible for the negative externalities.

   d. Unduly discourage the development of potentially important and more environmentally acceptable technologies such as clean coal technologies and innovative industrial electrotechnologies.

Profiles in Electricity Issues:

EXTERNALITIES

INTRODUCTION

Several states are requiring utilities to consider certain external costs, or so-called "externalities" when evaluating new resource options for least-cost plans. Such efforts purport to recognize the full social costs of each option rather than only the private or "internal" costs. Typically, only negative environmental externalities are selected for consideration in these states' least-cost plans and most commonly the values of these externalities are based on estimates of abatement or control costs. Direct incorporation of these externalities, such as with the use of "adders" to increase the relative costs of supply side options, artificially favors the selection of conservation and demand side management (DSM) or renewable energy resources to meet new capacity or energy needs.

Industrial energy users long have been advocates of energy efficiency and conservation. They must be to successfully compete in domestic and international markets.[1] Industrials believe that competition in free markets inherently assures the most efficient use of all resources, including energy. Thus, industrials believe that maximizing competition in retail and wholesale energy markets will help all consumers efficiently use resources consistent with environmental protection.[2] However, industrial users question attempts to achieve the goals of energy efficiency and environmental protection by arbitrary manipulation of resource cost assumptions in least-cost planning. Such attempts may not achieve least-cost goals. It also may result in higher social costs, including increased air emissions.

This *Profile* explains what externalities are and discusses the theoretical basis for the so-called internalization of external costs and benefits in prices. Recent efforts to assign monetary values to negative environmental externalities are described, including attempts to factor these values into utility resource plans and operations. Examples of market distortions resulting from the

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[1]Competition already has forced substantial energy efficiency improvements, with concomitant improvements in environmental quality, by U.S. industry. Between 1975 and 1989, the steel industry has reduced the energy needed to produce a ton of steel by 36% (from 33.6 to 21.5 mmBtus per net ton shipped). Average energy use by the paper and pulp industry has declined since 1972 by over 40% (from 19.2 to 11.5 mmBtus per ton). Since 1974, the chemical industry has reduced its use of fuel and power per unit output by more than 47%. Although energy is a small proportion of their total production costs, since 1972, one auto maker has reduced the amount of electricity used per vehicle by 44%.

[2]For a more detailed description of ELCON's position on the role of competition in utility least-cost planning, see Profiles in Electricity Issues: Integrated/Least-Cost Resource Planning, which is available from ELCON upon request.

selective internalization of environmental externalities also are discussed. The *Profile* concludes that piecemeal internalization of externalities is a legislative, not a regulatory function and that the appropriate treatment of environmental considerations in utility resource plans is strict, "least-cost" compliance with all applicable environmental laws.

WHAT ARE EXTERNALITIES?

Externalities are costs and benefits of production or consumption activities that are not borne by producers or consumers. Externalities are "external" costs and benefits because they are external to the transaction and therefore not reflected in the market prices of goods and services. Market prices are said to reflect only "internal" or private costs and benefits.[3] Externalities, which result from every activity of human life, may impose harmful or beneficial spillover effects on the economy, the physical environment or to human health and welfare. Externalities are associated with everything, i.e., they are ubiquitous.

■ Types of Externalities

There are both positive (beneficial) and negative (harmful), and upstream and downstream externalities.[4] Upstream externalities associated with electricity are those effects which occur prior to the construction and operation of the energy resource. Downstream externalities are effects that occur after the construction and operation of the resource, usually at the point of consumption or thereafter. Tables 1 and 2 illustrate examples of negative and positive externalities associated with electricity generation. Table 1 includes examples of both upstream and downstream negative environmental externalities that are frequently suggested. Many societal impacts already are partially or fully internalized by environmental or liability laws, or the profit motive associated with private ownership of the resources. Some suggested externalities, e.g., "enhanced climate change" or "EMF," merely are alleged effects because of the lack of any incontrovertible scientific evidence in support of the existence of adverse impacts.

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[3]Retail electricity rates are not "market" prices. Electricity rates are administratively established by rate regulation because the provision of retail utility services is a monopoly. Utility regulators attempt to serve as a surrogate for competitive market forces to the extent such forces are lacking in the industry and to exercise oversight to check any abuse of a utility's monopoly power.

[4]One economist gives the following examples of positive and negative externalities: "... an additional car on a crowded highway harms the persons in other cars -- it makes their cars go slower and increases the chances of accidents. Similarly, Con Edison harms the residents of New York City when it pollutes the air. Or, many boats fishing in the same waters can interfere with each other's catch. On the other side, Thomas Edison's many inventions benefitted the whole world's population. Again, education would confer external benefits if more educated persons made wiser political decisions. As a final example, the antiques industry of New York City is mainly located in a particular section because each dealer benefits from locating near other dealers, for customers can then canvass several dealers more conveniently, which indicates why external effects are also called 'neighborhood effects.'" Gary S. Becker, Economic Theory, (New York, NY: Alfred A. Knopf, 1971), p. 84.

Table 1

EXAMPLES OF SUGGESTED NEGATIVE ENVIRONMENTAL EXTERNALITIES ASSOCIATED WITH ELECTRICITY GENERATION, BY FUEL

FUEL TYPE	UPSTREAM EXTERNALITY	DOWNSTREAM EXTERNALITY
Coal	Mining & surface reclamation	Landfills/ash disposal Enhanced climate change Acid rain Powerlines (EMF) Siting impacts
Oil	Drilling Pipelines Offshore Channels Tanker spills	Enhanced climate change Acid rain Powerlines (EMF) Siting impacts
Natural Gas	Drilling Pipelines	Enhanced climate change Powerlines (EMF) Siting impacts
Nuclear	Mining & surface reclamation	Waste disposal Accidents Powerlines (EMF) Siting impacts
Hydro	Erosion Flooding	Powerlines (EMF) Siting impacts

Table 2

EXAMPLES OF POSITIVE EXTERNALITIES ASSOCIATED WITH ELECTRICITY

ECONOMIC ACTIVITY CAUSING THE EXTERNALITY	DOWNSTREAM EXTERNALITY
Domestic energy production	National security Competitiveness
Industrial/commercial innovations	Employment opportunities Competitiveness Productivity Enhanced environmental quality
Clean coal technologies	Competitiveness Employment opportunities
Industrial electrotechnologies	Productivity Competitiveness Enhanced environmental quality
Medical technologies	Health
Electronics (e.g., A/V equipment)	Quality of life

- **Compensation for External Costs and Benefits**

Externalities are uncompensated costs and benefits. The so-called "internalization" of externalities, i.e., converting external costs and benefits into internal costs and benefits, involves compensation both for beneficial as well as harmful effects, up to the point where marginal costs equal marginal social benefits. Beneficiaries of positive externalities would pay for the benefits received. The costs imposed on victims of negative externalities also would be compensated.[5] However, it is impossible to identify all externalities and very few can be quantified with a degree of precision such that any form of compensation could be reasonably implemented. Nonetheless, many externalities are partially or fully internalized and any attempt to quantify externalities must avoid double counting costs or benefits. Insurance, liability laws, health and environmental standards, and Superfund are examples of mechanisms that result in the complete or partial internalization of negative environmental externalities. Economic development incentives, certain tax credits, and rewards and honoraria are examples of mechanisms society uses to internalize certain positive externalities.

IS THE ASSUMPTION THAT NET EXTERNALITIES ARE ZERO UNREASONABLE?

Some environmentalists and advocates of conservation and renewable energy resources argue that while they may be difficult to quantify, it is wrong to assume that environmental costs (not otherwise internalized by law) are zero and therefore they should be further internalized in utility resource planning. However, the social benefits (including positive external effects) of universal electric service and other technological innovations of advanced industrial societies also are difficult to quantify and often assumed to be zero (See Table 3). It is indeterminate whether net externalities are positive or negative, and therefore the presumption that net externalities are zero is not wholly unreasonable. It cannot be argued that only negative environmental externalities are not adequately reflected in market prices and that selective internalization of these costs will result in net benefits to society.[6]

WHAT DOES ECONOMIC THEORY REQUIRE FOR EXTERNALITIES TO BE ACCURATELY INTERNALIZED?

The concept of external costs and benefits, or externalities, is derived from economic theory.[1] Theory states that resources are optimally allocated when markets are perfectly com-

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[5]Economic theory is silent on how compensation should be provided in order to fully internalize externalities. For example, economic theory is indifferent as to whether victims of pollution should be paid to compensate for the costs they incur or whether victims should pay the polluter to stop polluting.

[6]See following section and the Technical Appendix for a more detailed discussion of the necessary theoretical conditions for maximizing social welfare when external effects are internalized.

Table 3

EXAMPLES OF UNCOMPENSATED SOCIAL BENEFITS OF INDUSTRIAL PRODUCTS, CONSUMER PRODUCTS AND INDUSTRIAL PROCESSES [2]

Substantial social benefits are not reflected in market prices, e.g., the private rate of return on innovative industrial products and processes and consumer products. This table compares estimates of the social rate of return to the private rate of return for technological innovations. The median social rate of return (99%) for the twenty innovations reviewed in the study was almost four times the private rate of return (24%). This highlights the substantial social benefits that are associated with technological innovations (almost all of which use energy or are dependent on energy in the manufacturing process) and that innovators or owners of such innovations may not be fully compensated by society. Arguably, this can reduce the level of new innovations that could benefit society.

INNOVATION*	SOCIAL RATE OF RETURN	PRIVATE RATE OF RETURN
	Industrial Products	
A	62%	31%
B	Negative	Negative
C	116	55
D	23	0
E	37	9
F	161	40
G	123	24
H	104	Negative
I	113	12
J	95	40
K	472	127
L	Negative	13
	Consumer Products	
M	28%	23%
N	62	41
O	178	148
P	144	29
	Industrial Processes	
R	103%	55%
S	29	25
T	198	69
U	20	20
Median	99%	24%

*NOTE: Detailed information on each innovation was kept confidential as a condition for participation by the innovators in this study.

Source: J. G. Tewksbury, M. S. Crandall, W. E. Crane, A Survey on Net Rates of Return on Innovations, Report to the National Science Foundation, Volume II, (Springfield, VA: National Technical Information Service, May 1978), p. 36.

petitive and in long-run equilibrium. In such markets, all prices are equal to marginal costs. Social welfare is said to be maximized only when marginal social costs equal marginal social benefits. However, social welfare is not maximized if marginal private costs do not equal marginal social costs, i.e., external costs or benefits exist.

In general, efforts to internalize externalities attempt to price resources based on their "true" marginal social costs. Negative externalities would be internalized by adding a tax to the market price of the good or service to reduce the amount of the externality imposed on others; positive externalities similarly would be internalized with a credit or subsidy to induce a greater level of the externality.[3] With these tax/subsidy adjustments, prices of goods would reflect total social costs. Consumers then, and only then would decide how much to purchase based on the "true" cost of that product.

For example, if a tax was levied on electricity prices to reflect the true "marginal" cost of using the environment for waste disposal, and if all other prices in all sectors also were equal to marginal costs, the "right" amount of electricity would be produced and consumed.[4] The marginal cost would be equal to the value of the foregone alternatives for using the environment, and would be produced at least-cost. Only in this way is the "right" amount of environmental quality provided. However, the "right" amount "implies that there is some positive level of pollution that is permissible, and that there is some positive amount of production of electricity that is optimal as well."[5] Thus, the goal of any attempt to internalize negative environmental externalities cannot be zero emissions or zero wastes, nor should compensation (in the form of taxes or subsidies) be imputed to reflect zero emissions or wastes. Otherwise, excess external costs would be imposed creating a net loss to society.

There is no basis in economic theory for the selective or piecemeal internalization of externalities. Economic theory states that when the marginal social cost of pollution control equals the marginal social benefit of pollution control, external costs and benefits are internalized.[7] Economic theory further requires that <u>all</u> external costs and benefits must be internalized if welfare maximizing benefits can be claimed. Indeed, there is nothing in economic theory that suggests that internalizing externalities in one industry or sector, while not internalizing externalities in all others, will increase social welfare. Theory suggests that such action actually may decrease welfare.

CAN ENVIRONMENTAL EXTERNALITIES BE QUANTIFIED?

Attempts to assign monetary values to negative environmental externalities have been made with two different methodologies: (1) direct estimation of all damage costs associated with the environmental externality, or (2) the use of abatement or control costs as a surrogate for damage costs.

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[7]This statement is subject to other conditions. See the "Technical Appendix" at the conclusion of this *Profile* for a more detailed discussion of the necessary theoretical requirements.

- **Estimating Damage Costs**

Damage cost estimates generally are recognized as being the more theoretically-correct.[6] However, damage cost studies are quite complex and not without considerable controversy. Damage cost studies typically involve identifying and quantifying each polluting emission or waste; determining how each is transported or dispersed into the environment; determining the populations that are exposed and the exposure response (i.e., "dose/response relationship"); and finally, determining the cost of the exposure. This approach faces two major hurdles. First, estimating the direct physical impacts of pollution is extremely difficult and "fraught with uncertainty."[7] For example, the local, regional and global impacts of air emissions are dependent upon "atmospheric, biological, chemical, geophysical, ecological, and physiological relationships across time, space, and socio-economic and cultural conditions."[8] Second, assigning values to environmental damages is "highly judgmental and subjective."[9] Value judgments will vary from person to person. Methodologies exist that attempt to make collective valuations -- e.g., contingent valuation and hedonic pricing -- but results are rarely conclusive. The tremendous difficulty associated with assigning values to human life or health, aesthetics, and quality of life contributes to the fact that these are external costs or benefits in the first place.

- **Control Costs or "Shadow Prices" As Proxies for Damage Costs**

Abatement or control costs widely are used as proxies for true damage costs because of the imponderable difficulties associated with estimating the later. This method, which often is referred to as "shadow pricing," produces values for the externalities which may bear little or no link to actual environmental damages. Shadow prices may be higher or lower than actual damage costs.[10] However, one study demonstrates that published shadow price estimates consistently overstate published damage cost estimates, often by many orders of magnitude. For example: a comparison of the highest damage cost estimates with the highest shadow price estimates, shows shadow price values to be 76% higher for CO_2, 1390% higher for NO_x, 350% higher for SO_2, and 76% higher for particulates.[11] Nonetheless, the use of negative externalities that were quantified using this method is more prevalent.[12]

Shadow prices are based on the "marginal" cost of control, which often is the highest-cost abatement technology.[13] Thus, the external costs associated with SO_2 emissions from a new coal-fired generating unit is the cost to reduce SO_2 emissions below the levels currently required by law.

WHAT ATTEMPTS ARE BEING MADE TO INTERNALIZE ENVIRONMENTAL EXTERNALITIES IN UTILITY LEAST-COST PLANS?

Several methods have been adopted (or proposed) for the consideration of negative environmental externalities in least-cost plans. These are: (1) the use of "adders" when

evaluating new resource options, (2) emissions dispatch, and (3) direct internalization of externalities in rates.[8]

- **Using Environmental Adders to Evaluate New Resource Options**

The most widely used method applies "adders" or "credits" to the levelized costs of new resources depending upon the alleged impact each resource may have on the environment. The method attempts to support the selection of new resources based on their "full societal" costs. In practice, adders or credits may be based either on estimates of actual damage costs or control costs (i.e., shadow prices). A value representing all potential environmental costs associated with coal combustion would be added to the levelized costs of new coal-fired generating units, or a resource that does not burn coal might be credited with this value. The adders or credits are assigned to the actual costs of each resource option that were submitted in response to a competitive bid solicitation. Resources would be selected based on the lowest unit cost plus any adders (See Table 4). Adders/credits also can be used in non-competitive bidding resource procurement processes.

Table 4

EXAMPLE OF NEW RESOURCE SELECTION
USING ENVIRONMENTAL ADDERS [14]

RESOURCE TYPE	ACTUAL UNIT COST (Cents/kWh)	ENVIRONMENTAL ADDER (Cents/kWh)	UNIT COST PLUS ADDER (Cents/kWh)
Coal-Fired Unit	4.3¢	4.1¢	8.4¢
Gas Turbine	11.0	3.2	14.2
Gas Combined Cycle	5.4	2.4	7.8
Purchase Power	5.0	1.0	6.0
DSM	8.0	0	8.0

Table 5 (page 12) illustrates the wide range of estimates for certain monetized negative externalities associated with coal, oil and natural gas fired generators. Monetized values, expressed in dollars per kWh, are presented for SO_2, NO_x, particulates, and CO_2. For each fuel type, the range of values is quite large. For example: an adder for a new coal-fired power plant that meets new source performance standards (NSPS) could be assigned a value anywhere from

[8]A fourth approach also has been proposed, called "weighting and ranking" schemes. This approach assesses the potential environmental impacts of alternative resource options based on subjective rankings and is not dependent on monetized values of externalities.

0.7¢ to 8.6¢. By carefully selecting values within these broad ranges for each fuel type, any resource could "win" in a competitive bidding or other evaluation process that used such adders. Thus, if utilities are required to internalize only selected environmental externalities, there would be almost unlimited opportunities to establish an environmental cost (or adder) for any particular resource option sufficient to eliminate it from the power market. Ironically, efforts to discourage the use of abundant fossil fuels will create a disincentive to the development of more environmentally acceptable technologies that use those fuels (e.g., clean coal technologies).

It also is a misnomer to say that the use of adders or credits in this manner internalizes externalities. It does not because this process only effects new resource choices. Electricity rates would not be equal to marginal social costs as required by economic theory and therefore no so-called welfare maximizing benefits can be claimed by this methodology. Instead, the adder approach only lends itself to the arbitrary manipulation of the resource selection process.

Table 5

RANGE OF ESTIMATED EXTERNAL COSTS (IN CENTS/kWh) FOR SELECTED AIR EMISSIONS FROM FOSSIL-FIRED BASELOAD GENERATORS [15]

FUEL TYPE*	EMISSION	RANGE OF EXTERNAL COST ESTIMATES
Coal	SO_2	0.5 - 7.0¢/kWh
	NO_x	0.005 - 0.04
	TSP	0.005 - 0.1
	CO_2	0.2 - 1.5
	Total	0.7 - 8.6¢/kWh
Oil	SO_2	0.2 - 3.0¢/kWh
	NO_x	0.3 - 2.0
	TSP	0.008 - 0.2
	CO_2	0.2 - 1.0
	Total	0.7 - 6.2¢/kWh
Gas	SO_2	0¢/kWh
	NO_x	0.04 - 0.3
	TSP	0.00004 - 0.004
	CO_2	0.1 - 0.9
	Total	0.1 - 1.2¢/kWh

* NOTE: The coal-fired unit would meet "New Source Performance Standards" (NSPS). The oil-fired unit would burn #6 residual oil with 0.5% sulfur. The gas-fired unit would be a combine cycle unit that meets "Best Available Control Technology" (BACT) standards.

- **Environmental Dispatch of Generation**

Emissions, or environmental dispatch has been proposed as another method for recognizing selected environmental costs in utility least-cost plans.[16] In this approach, variable environmental costs are added to the variable economic costs used to determine the dispatch order of a utility's (or power pool's) generating units. Generation dispatch no longer would be economic dispatch. The entire generating mix would be reordered under this approach. However, the arbitrary reordering of unit dispatch does not, by itself, internalize externalities, and again, no welfare maximizing benefits can be claimed.

Units with lower operating costs (e.g., coal or nuclear) would be displaced by units with higher operating costs (e.g., oil or natural gas). This approach would tend to discourage the use of generating units that produce relatively more air emissions or waste by-products, despite the fact that these units are complying with all applicable air, water and land-use standards. The total direct costs of generation would increase and some units may be forced into duty cycles for which they were not designed. One study has shown that direct costs could increase from 10 to 25%.[17]

Ironically, there is evidence that environmental dispatch may decrease some emissions but increase others. The cost-per-pound to reduce some emissions also may be higher than the value initially added to the dispatch cost.[18]

- **Internalizing Externalities Directly in Rates**

The internalization of externalities in rates (i.e., prices) is considered the theoretically "correct" approach, assuming that all other necessary criteria have been met. This approach presumably would add environmental costs to the historical and embedded costs of existing generating units. As explained below in the "Technical Appendix," attempting such a feat in utility rates raises substantial practical as well as theoretical problems. Specifically, adjusting rates (either upward or downward) to reflect external costs and benefits may result in the over or under collection of the utility's revenue requirement. However, <u>any</u> attempt to reconcile rates to the revenue requirement will violate the necessary criteria established by theory. The right to overcollect the revenue requirement through electricity rates also is tantamount to the power to tax. And taxing is a legislative, not a regulatory function.

HOW CAN ATTEMPTS TO INTERNALIZE ENVIRONMENTAL EXTERNALITIES DISTORT THE GOALS OF LEAST-COST PLANNING?

Utility compliance strategies to address any applicable environmental laws should be developed as part of their least-cost planning efforts. Industrials strongly believe that the same least-cost principles that govern the acquisition of supply or demand side resources should apply to pollution abatement costs, such as the costs required to comply with the acid rain provisions of the Clean Air Act Amendments of 1990. However, for reasons explained in this *Profile*, least-cost plans should not include attempts to internalize environmental externalities (or other external costs) that are not required by law.

In practice, imposing the use of selected negative externalities only in the electricity sector of the economy will severely distort price signals in retail and wholesale energy markets, resulting in inefficient investment decisions and consumption behavior. This may artificially raise the costs of electricity and distort the process by which a utility's capacity expansion options are evaluated with no guarantee that environmental objectives are achieved. For example, a study by a California utility concludes that when selected environmental externalities (in this case only externalities associated with residual air emissions) are considered in the utility's resource plan, increased reserve margins are required. This accelerates the need to add capacity for reliability purposes, leading to the construction of still more costly generating resources.[19] Arbitrarily raising the relative costs of utility-generated electricity also may shift electricity production to non-utility sources (e.g., self-generation) and encourage the displacement of electricity at the end-use level with lower cost fuels.

Price distortions can result in further shifts in energy consumption and associated economic activities to utilities, states or countries where costs are lower.[9] Such shifts actually may increase adverse environmental impacts, which is counterproductive to the goals of environmental protection. For example, some state regulatory commissions have required explicit consideration of negative externalities associated with potential global climate change. These actions result in higher electricity prices in those states. Higher prices tend to increase the relative cost-effectiveness of energy conservation measures and encourage lower energy consumption. However, arbitrarily high prices also can shift economic activities to other states or countries where energy prices are lower or where environmental regulations are less stringent. As a result, these policies actually may increase net emissions of greenhouse gases that some scientists claim are the precursors of climate change.

HOW DOES SOCIETY ADDRESS ENVIRONMENTAL CONCERNS?

The goals of environmental protection attempt to minimize the adverse impacts of human activities on human health and the physical environment. Obviously, the absolute minimization of these impacts would require the cessation of all human activities, which of course is untenable. Society has given representative legislative bodies the responsibility for setting limits on such activities, particularly those involving significant tradeoffs of well-being between different groups or regions within society.

For example, Congress has "internalized" many external costs such as environmental externalities associated with acid rain. However, Congress did not intend to require that the precursors of acid rain be totally eliminated. Instead, it has limited such emissions reductions in recognition of the considerable social benefits associated with the economic activities that

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[9]In terms of the overall trade balance, U.S. manufacturers already face a competitive disadvantage in the use of electricity. Far more electricity is embedded in finished goods that are imported into the United States than is embedded in products that are exported. Margaret B. McCarthy, "Foreign Merchandise Trade and the Demand for Electricity," The Interindustry Economic Research Fund, Inc., December 1985.

produce those emissions. Congress recognized that had it mandated a zero emissions standard, unacceptably high social costs would result elsewhere in the economy and those costs would not be shared equitably across all regions of the country. Congress, in effect, has determined a politically acceptable balance of social costs and social benefits. Congress has established numerous agencies, with clearly defined statutory roles and limits, to address the environmental, health and other societal impacts of using coal to generate electricity.

Many other alleged social and environmental externalities associated with electricity generation have not been legislatively internalized because scientific evidence supporting the existence or scope of such "costs" are lacking or fraught with uncertainty. In the absence of an acceptable balance between social costs and benefits, Congress has not acted. By not acting, Congress essentially has endorsed the notion that further external costs are zero. In such cases, environmental legislation might better focus on long-term solutions that benefit from additional research which further qualifies these environmental concerns. Only in this manner can environmental protection be designed that are truly cost-effective and that achieve appropriate tradeoffs among all societal costs and benefits.

If consideration of the net external costs of electricity is deemed necessary in utility resource plans, the responsibility for enacting such policies rests with Congress and the state legislatures. Any regulatory attempt -- by FERC or state PUCs -- to internalize selected externalities would usurp the legislative roles to make policy and to delegate administrative responsibilities for implementing and enforcing such policy.

HOW SHOULD ENVIRONMENTAL CONSIDERATIONS BE ADDRESSED IN LEAST-COST PLANS?

Utilities have the ultimate responsibility for determining the capacity and energy needs of their native load customers. The acquisition of any supply side or demand side resources to meet those needs, including compliance with all applicable environmental laws, should start with the development of an overall least-cost plan (LCP). Selected external costs should not be internalized in LCP. Resources should be compared and evaluated using actual costs, including the costs required to comply with environmental laws. Utility compliance strategies to address environmental legislation, such as the acid rain provisions in the Clean Air Act Amendments of 1990, should be developed as part of their least-cost planning effort. The same principles of least-cost planning that govern the acquisition of supply or demand resources also should apply to pollution abatement costs.

The internalization of selected environmental externalities clearly would discourage the use of conventional electrical generating technologies and fuels. Yet, these technologies and fuels must be relied upon to provide the major share of our nation's electricity needs well into the next century. The quantity of additional electricity that can be economically and reliably supplied from alternative energy and technological resources (e.g., solar, wind, biomass, and geothermal) is expected to be very limited.[20]

TECHNICAL APPENDIX

THEORETICAL CONSIDERATIONS FOR PRICING ELECTRICITY AT MARGINAL SOCIAL COST [21]

Efforts to internalize externalities attempt to price resources based on their marginal social costs. The rationale for marginal cost pricing is based on the theoretical argument for the efficient use of resources. Economic theory states that if all markets are perfectly competitive and all firms attempt to maximize profit (given full knowledge of alternatives, free entry and exit in the market place, and no externalities), then all prices of inputs and outputs will be equal to marginal costs, outputs will be produced at the optimum level (the point at which the value of the inputs just equals the value of the outputs) and all inputs will be efficiently combined. Since the prices of the inputs and outputs provide the signals that govern usage, the equality of price and marginal cost leads to the appropriate use of resources under the assumed conditions. Obviously, the condition of perfectly competitive markets is not met in the real world. Markets exist where prices do not equal marginal costs due to profit maximization in imperfectly competitive markets.

Since the most important argument for marginal cost pricing is efficiency in resource allocation, and thus welfare maximization, it is worthwhile elaborating on the necessary conditions for marginal cost pricing to be justified as welfare maximizing. If one accepts the argument that prices should be administratively set equal to marginal cost, given the value judgments necessary to do so, then the following conditions are necessary:

1. That all the other optimum conditions of production and exchange be satisfied.
2. The factors are in perfectly elastic supply.
3. That there is no income tax and no indirect taxes or subsidies.
4. That it could be put into effect without adversely affecting the distribution of real income.
5. That there are no external diseconomies of production or consumption.

Condition 1 means that production takes place with the most efficient technology used most efficiently. This by itself defines a long-run situation where the production plant is optimized. It also means that there is perfect knowledge by consumers about their options for purchasing all goods; i.e., there are no inside bargains, consumers have unrestrained access to all markets (e.g., retail wheeling), and there are no monopolies or monopsonies (monopolistic buyers). Another requirement under condition 1 is that there are no sales taxes, or other direct taxes that distort the relationship between cost and price to either the producer or the consumer. Condition 1 also requires that all economic agents (consumers and producers) act to maximize either utility or profit, i.e., they act in their own best interests.

Condition 2 requires that consumption has no effect on supply price, e.g., if coal consumption doubles, there should be no resulting rise in price.

Condition 3 requires that income taxes -- which distort the choice between work and leisure -- and indirect taxes such as property taxes, excise taxes, corporate income taxes, and the like do not exist. It also requires the absence of subsidies such as price supports. In other words, only true economic costs exist.

Condition 4 requires that whatever distribution of income results from the shift to marginal cost pricing is the one preferred by society.

Condition 5 requires the absence of externalities. A way around condition 5 is to charge marginal social costs, but this requires a vast amount of knowledge on the demand and supply curves which is not known.

These are rather formidable requirements. Clearly, they are not met in the real world and likely cannot to be met in a regulated environment. Given this, one might nevertheless speculate that a movement toward marginal cost might at least improve matters. That will not necessarily occur. For example, suppose that not all goods are priced at marginal cost. In this situation economic theory says that moving some, but not all, markets to marginal cost pricing will not necessarily improve the economy-wide use of resources. In fact, there is nothing to guarantee that the resource use that results from moving some, but not all, markets to marginal cost pricing is not less efficient -- hence, less desirable -- than what previously existed. Thus, on an economy-wide basis, attempts at marginal cost pricing (or marginal social cost pricing) only with one or a few commodities or within a single sector such as the electric utility industry cannot be justified.

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ENDNOTES

[1] James M. Henderson and Richard E. Quandt, Microeconomic Theory, 2nd. Edition, (New York: McGraw-Hill, 1971), pp. 267-280.

[2] J. G. Tewksbury, M. S. Crandall, and W. E. Crane, "Measuring the Societal Benefits of Innovation," Science, Vol. 209, August 8, 1980, pp. 658-662. J. G. Tewksbury, M. S. Crandall, and W. S. Crane, A Survey on Net Rates of Return on Innovations, Report to the National Science Foundation, Volume II, (Springfield, VA: National Technical Information Service, May 1978).

[3] Jack Hirshleifer, Price Theory and Applications, (Englewood Cliffs, NJ: Prentice-Hall, 1976), p. 450.

[4] This example and discussion are based on: Kenneth Gordon, "Weighing Environmental Costs in Utility Regulation: The Task Ahead," The Electricity Journal, October 1990, p. 58.

[5] Ibid.

[6] Ibid., p. 58.

[7] Stephen S. Barnow and Donald B. Marron, "Valuation of Environmental Externalities for Energy Planning and Operations," May 1990 Update, (Boston, MA: Tellus Institute, May 18, 1990), p. 3.

[8] Ibid.

[9] Paul Chernick and Emily Caverill, "Methods of Valuing Environmental Externalities," The Electricity Journal, March 1991, p.48.

[10] Bernow and Marron, "Valuation of Environmental Externalities for Energy Planning and Operations," p. 5.

[11] Energy Research Group, Inc., "Environmental Externalities: An Issue in Need of Critical Review," (Washington, DC: Edison Electric Institute, July 1991), p.44.

[12] Chernick and Caverhill, "Methods of Valuing Environmental Externalities," p. 49; Richard L. Ottinger et al., Environmental Costs of Electricity, (New York, NY: Oceana Publications, 1990), p. 42.

[13] Chernick and Caverhill, "Method of Valuing Environmental Externalities," p. 50.

[14] Jennifer Fagan and Rodney Stevenson, "Incorporation of Environmental Externalities into Integrated Resource Planning," Proceedings of the National Conference on Integrated Resource Planning, (Washington, DC: National Association of Regulatory Utility Commissioners, April 1991), p. 530.

[15] The external costs (in cents/kWh) are based on monetized estimates of externalities (in $/lb) reported in Chernick and Caverhill, "Methods of Valuing Environmental Externalities," p. 49. The assumptions for resource heat rates and line losses for coal-, oil-, and natural gas-fired generation are from: Ottinger et al., Environmental Costs of Electricity, pp. 31-33.

[16] Stephen Bernow, Bruce Biewald, and Donald Marron, "Full-Cost Dispatch: Incorporating Environmental Externalities in Electric System Operation," The Electricity Journal, March 1991, pp. 20-33.

[17] Energy Research Group, Inc., "Environmental Externalities: An Issue in Need of Critical Review," p. 39.

[18] Ibid., p. 40.

[19] Fred Mobasheri and Robin J. Walther, "Issues and Implications of Valuing Environmental Externalities," Proceedings of the National Conference on Integrated Resource Planning, (Washington, DC: National Association of Regulatory Utility Commissioners, April 1991).

[20] North American Electric Reliability Council, Electricity Supply & Demand 1991 - 2000, July 1991, pp. 19-20.

[21] The "Technical Appendix" is reproduced, in part, from: Ernst & Whinney, An Evaluation of Ten Marginal Costing Methodologies, (Washington, DC: Electricity Consumers Resource Council, August 1979).