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Issues and Methods in Incorporating Environmental Externalities into the Integrated Resource Planning Process

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NOTICE

Preface

This report was prepared by the Analytic Studies Division (ASD) for the Integrated Resource Planning and Performance Based Regulation (IRP/PBR) Program, Office of Utility Technologies (OUT), the Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy. It is intended to assist the IRP/PBR Program and OUT staff in gaining a comprehensive understanding of the issues involved in considering environmental externalities within the utility regulatory process, as well as the methods adopted or proposed for addressing environmental externalities and their applications. It is also intended to help disseminate among IRP stakeholders useful information on public utilities commission (PUC) practices related to environmental externalities. This study was performed as a task under the National Renewable Energy Laboratory's (NREL's) project to assist OUT in the area of IRP.

Production and consumption activities at every level of society, including energy resources, give rise to environmental impacts. Some of these impacts are covered by existing laws and regulations, and the associated costs and benefits are reflected in the prices charged on the products or services of the electric and natural gas industries. However, a portion of the costs and benefits associated with the environmental impacts may be beyond current regulations and are not factored into the costs and prices of the products or services. These are environmental externalities. This report attempts to present the pros and cons of incorporating environmental externalities into the IRP process in a balanced manner. It contributes to the understanding of the issues and practices by providing a summary of the status of state PUCs' actions on environmental externalities; describing their practices with respect to potential future environmental regulations, qualitative versus quantitative treatment, offsets, policy coordination, full-cost dispatch, and treatment of uncertainty; developing a taxonomy of the methods for addressing externalities; and characterizing stakeholders' interests in the subject.

The authors hereby acknowledge the support of Andrew Krantz, Manager of the IRP/PBR Program, OUT/DOE. The authors also wish to thank the following individuals for their review and comments on earlier versions of the report: Mark Bernstein, Dan Packey, Kevin Porter, David Renne, and Ron White of NREL; Tom Grahame of DOE; Robert M. Schnapp of the Energy Information Administration; David Iliff of the Wisconsin Public Service Commission; Commissioner Renz D. Jennings of the Arizona Corporation Commission; Stuart Chaitkin of the California Public Utilities Commission; Commissioner Karl R. Rabago of the Public Utility Commission of Texas; Chairman John F. Mendoza of the Public Service Commission of Nevada; Grace Hu of the Public Service Commission of the District of Columbia; John Busch, Chris Marnay, and Steve Wiel of Lawrence Berkeley Laboratory; Victor Niemeyer of the Electric Power Research Institute (EPRI); John Hughes of the Electricity Consumers Resource Council (ELCON); Kenneth P. Linder of the Edison Electric Institute; C.D. Long, IV of Southern Company Services, Inc.; Bradley Spooner of the New England Electric System; Julie Hashem of Barakat and Chamberlin, Inc.; and Richard Scheer of Energetics. Jan Eckert provided research assistance at the early stage of the project. The comments and suggestions provided by these individuals helped to improve this report. However, the authors take sole responsibility for the report's content.

Approved for the
NATIONAL RENEWABLE ENERGY LABORATORY

Thomas D. Bath, Director Analytic Studies Division	Eldon C. Boes, Manager Programmatic Studies Office

Abstract

This report is a review of current practices and policies in considering environmental externalities in the integrated resource planning and performance based regulation (IRP/PBR) process. It has been prepared for the IRP/PBR Program administered by the Office of Utility Technologies (OUT), Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy (DOE). The purpose of this report is to assist the IRP/PBR Program and OUT in gaining a comprehensive understanding of the issues involved in addressing environmental externalities within the utility regulatory process, as well as the methods proposed for addressing environmental externalities and their applications. It is also intended to help disseminate useful information on state public utilities commission (PUC) practices related to environmental externalities.

The following issues are presented and examined: What are the pros and cons of treating environmental externalities in the IRP process? How are potential future environmental regulations being treated? Are externalities being qualitatively or quantitatively considered, or monetized? Are offsets being allowed? How are externality policies being coordinated among different levels and branches of governments? Should environmental externalities be considered in dispatching a utility's existing resources? What are the procedures for addressing uncertainty in incorporating environmental externalities into IRP? How are externalities valued? What are other approaches to addressing environmental externalities?

This report describes seven major approaches for addressing environmental externalities in the IRP process: qualitative treatment, weighting and ranking, cost of control, damage function, percentage adders, monetization by emission, and multiattribute trade-off analysis. The discussion includes a taxonomy of the full range of alternative methods for addressing environmental externalities, a summary of state PUC actions, the role of state laws, the debate on environmental adders, and the choice of methodologies.

In addition, this report characterizes the interests of stakeholders such as the electric industry, fuel suppliers, energy consumers, governmental agencies, public interest groups, consultants, and others. It appears that the views, positions, and interests of these stakeholders are affected by their perceptions of the potential impacts on their economic interests or the viability of their position on environmental policy, by the societal perspective they take, and by the orientation of the analysts toward market competition and their respective accumulated expertise.

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List of Acronyms

ACC	Arizona Corporation Commission
AEP	Alternate energy production
AGA	American Gas Association
ASE	Alliance to Save Energy
BPA	Bonneville Power Administration
Btu	British thermal unit
C	Carbon
CAA	Clean Air Act
CAAA	Clean Air Act Amendment (of 1990)
CEC	California Energy Commission
CECA/RF	Consumer Energy Council of America Research Foundation
CFC	Chloroflourocarbon
CH_4	Methane
CLF	Conservation Law Foundation
CO	Carbon monoxide
CO_2	Carbon dioxide
DC PUC	District of Columbia Public Utility Commission
DEP	Department of Environmental Protection (Massachusetts)
DOE	Department of Energy
DPU	Department of Public Utilities (Massachusetts)
DPUC	Department of Public Utility Control (Connecticut)
DSM	Demand-side management
E.C.	European Community
EDF	Environmental Defense Fund
EEI	Edison Electric Institute
ELCON	Electricity Consumers Resource Council
EPA	Environmental Protection Agency
EPAct	Energy Policy Act of 1992
EPRI	Electric Power Research Institute
ERGI	Energy Research Group, Inc.
FCCC	Framework Convention on Climate Change (United Nations)
FERC	Federal Energy Regulatory Commission
FGD	Flue-gas desulfurization
GNP	Gross National Product
HL&P	Houston Light & Power Company
INC	Intergovernmental Negotiation Committee
INGAA	Interstate Natural Gas Association of America
IOU	Investor-owned utility
IPP	Independent power producer
IRP	Integrated resource planning
IRP/PBR	Integrated resource planning and performance based regulation
kWh	Kilowatt-hour
LAW Fund	Land and Water Fund of the Rockies
MMBtu	Million British thermal units
MW	Megawatt
NAAQS	National Ambient Air Quality Standards
NARUC	National Association of Regulatory Utility Commissioners
NCC	National Coal Council
NEEDS	Not easily expressed in dollars

NEES	New England Electric System
NIEP	National Independent Energy Producers
N_2O	Nitrous oxide
NO_x	Nitrogen oxide
NRDC	Natural Resources Defense Council
NREL	National Renewable Energy Laboratory
NUSAP	Numeral/notation/name/note, Unit, Spread of value, Assessment of value, and Pedigree
OEC	Office of Energy Conservation (Colorado)
OER	Off-site emission reduction (offset)
ORNL	Oak Ridge National Laboratory
OUT	Office of Utility Technologies
PEPCO	Potomac Electric Power Company
PG&E	Pacific Gas and Electric Company
PM_{10}	Particulate matter (<10 mm)
PSC	Public Service Commission
PSE&G	Public Service Electric and Gas Company
PUA	Public Utilities Act (Illinois)
PUC	Public Utilities Commission
RAMPP	Resource and Market Planning Program (PacifiCorp)
RFF	Resources for the Future
ROG	Reactive organic gases
SCE	Southern California Edison Company
SDG&E	San Diego Gas and Electric Company
SEA of O	Solar Energy Association of Oregon
SO_2	Sulfur dioxide
SO_x	Sulfur oxide
TBS	Temple, Barker, & Sloane, Inc.
TSP	Total suspended particulates
VOC	Volatile organic compound

Executive Summary

This report is a review of current practices and policies in considering environmental externalities in the integrated resource planning and performance based regulation (IRP/PBR) process. It was prepared for the IRP Program in the Office of Utility Technologies (OUT), Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy (DOE). The purpose of the report is to assist the IRP Program and OUT in gaining a comprehensive understanding of the issues and methods involved in addressing environmental externalities within the utility regulatory process. It is also intended to help disseminate useful information on public utility commission (PUC) practices on the subject. The report has three specific objectives: (1) identify and review major policy, regulatory, and technical issues regarding the treatment of environmental externalities; (2) identify, review, and characterize the primary methods being proposed or employed to address environmental externalities; and (3) identify stakeholder interests in the issues and the methods that have been proposed or are in use.

The emphasis of this review is on reports, studies, and state PUC decisions released since 1992 pertaining to the treatment of environmental externalities. The approach of the report is to identify and describe the issues, including the pros and cons, and explain what actions individual state PUCs have taken. The report explains alternative approaches used or proposed for use, develop a taxonomy of the full range of alternative methods for addressing environmental externalities, and presents a summary of state PUC actions related to environmental externalities. This summary is based on information contained in existing surveys and data bases, and is updated with information from recent PUC orders. When appropriate, the authors attempt to put the issues in context and identify their interrelationships.

Environmental externalities are defined as the costs and benefits reflecting the effects on the physical-biological environment caused by the production and use of a product or service that are not reflected in its price. Such environmental effects can be either detrimental or beneficial, and are referred to as either external environmental costs or external environmental benefits. Because environmental externalities are not reflected in the prices of goods and services, they are not taken into consideration in the production and consumption decisions of businesses and consumers. Economic theory suggests that, in the idealized case of the perfectly competitive market, the existence of environmental externalities will result in misallocation of the society's resources; i.e., too many of some and too few of other goods and services will be produced and consumed. Under such circumstances, society does not derive maximum benefit from the use of available resources. In this sense, environmental externalities are often regarded as a barrier to achieving efficient allocation of societal resources.

Major Findings

1. As of March, 1994, 29 states and the District of Columbia required electric utilities to consider environmental externalities in their resource planning processes. Only 17 states had such a requirement in 1990. Three other states are considering adopting similar requirements: Kansas, New Mexico, and Oklahoma.

2. Ten of the 29 states and the District of Columbia ask for only a qualitative treatment: Arkansas, Colorado, Connecticut,[1] Delaware, Idaho, North Carolina, Pennsylvania, South Carolina, Washington, and West Virginia. Nine states require a quantitative approach without specifying which

[1]The Connecticut Department of Public Utility Control adopted the multiattribute trade-off analysis in a report submitted to the General Assembly in December 1993 (Connecticut DPUC 1993).

method is to be used: Arizona, Georgia, Hawaii, Illinois,[2] Missouri, Montana, Ohio, Texas, and Utah.[3] Two states currently use percentage adders: Iowa (10% for electricity and 7.5% for gas) and Vermont (5%). New Jersey uses specified values per unit of energy: $0.02/kWh for electricity and $0.95/MMBtu for gas. Seven states have monetized values by emission: California, Massachusetts, Minnesota, Nevada, New York, Oregon, and Wisconsin. Table ES-1 presents the specific values.

3. The remaining 18 states do not require explicit consideration of environmental externalities. Some have not taken action at all while others have explicitly rejected imposing such a requirement. The major reasons given for the latter action are: (1) a perceived lack of legal authority, (2) the perception that methodologies for quantification and monetization are still uncertain and speculative, and (3) lack of state-specific estimates of environmental damages and benefits. Figure ES-1 presents a graphical representation of these results.

4. State practices on environmental externalities are still evolving. Seven approaches for addressing environmental externalities in the resource planning process are in use or have been proposed: qualitative treatment, weighting and ranking, cost of control, damage function, percentage adders, monetization by emission, and multiattribute trade-off analysis. The relative merits of the methods are shown in Table ES-2. The damage function approach is often regarded as conceptually the most appropriate. However, because of extensive data requirements, the need for diverse expertise, and substantial resource and staff commitments, only California and Minnesota have adopted damage-cost-based values for some of the specific emissions, relying on existing estimates developed by others. In California, the values for sulfur oxides (SO_x) and particulate matter <10 mm (PM_{10}) for Pacific Gas and Electric are derived from the estimates provided in the Pace University Study,[4] which are damage-cost estimates. In Minnesota, the values for nitrogen oxides (NO_x) and PM_{10} are from Bonneville Power Administration's estimates, which are damage-cost based. Research on the damage function is being conducted in New York by a consortium, in Wisconsin by a group of utilities, and for the DOE - European Community by Oak Ridge National Laboratory and Resources for the Future. The multiattribute trade-off analysis, which avoids the controversial aspect of assigning monetary values to emissions, was endorsed by the Connecticut DPUC in December 1993. Other states such as Illinois and Kansas are in the process of adopting specific approaches for their purposes.

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[2]The purpose of the ongoing Illinois Commerce Commission Docket 92-0274 is to adopt a specific methodology for addressing environmental externalities in the IRP process.

[3]The distinction made in this report between qualitative and quantitative approaches is based on the survey conducted by Houston Light & Power Company (1993). It differs from the distinction made in another NREL report (Swezey, Porter, and Feher 1993).

[4]It should be noted that the estimates presented in the Pace University Study are subject to several limitations. Specifically, its authors enumerated the following: (1) By contract terms, the study relied only on available existing studies. (2) The estimates did not include the front-end external costs of the fuel cycle such as those associated with mining, oil drilling, equipment manufacturing, and transport to the site. (3) They excluded estimates provided by a control cost approach. (4) Nonenvironmental externality costs were also excluded. (5) Other limitations associated with the original studies were cited in the report (Pace University 1990, pp. 16-18). The authors then state (Pace University 1990, p. 18): **"These limitations mean that the costing figures in this report must be used with great caution.** They are a starting point for valuing damages. They do not purport to be a complete estimate of damage values. These reported values do show that the environmental externality costs of producing electricity clearly are significant and are worth pursuing through more definitive research." (Emphasis original.)

Table ES-1. Monetized Values for Environmental Externalities by Emission

State	NO_x	SO_2	PM_{10}	TSP	VOC	ROG	C	CO	CO_2	CH_4	N_2O	Water	Land
California PUC (1992$/ton)[a]													
SCE/SDG&E	31,568	23,579	6,829			22,548	34						
PG&E	9,155	4,493	2,634			4,252	34						
Out-of-State/ Attainment Area	7,526	1,726	4,626			1,306	34						
Massachusetts DPU (1992$/ton)	7,200	1,700[c]		4,400	5,900			960	24	240	4,400		
Minnesota PUC ($/ton)[b]	68.8–1,640	0–300	166.6–2,380		1,180–1,200				5.99–13.60				
Nevada PSC (1990$/ton)	6,800	1,560	4,180		1,180			920	22	220	4,140		
New York PSC (1990$/ton)	1,832	832		333					1.1			0.1[d]	0.4[d]
Oregon PUC (1990$/ton)	2,000–5,000			2,000–4,000					10–40				
Wisconsin PSC (1992$/ton)									15	150	2,700		
BPA (1990$/ton)													
East	69	1,500[c]		167								0.2[d,e]	f
West	884	1,500[c]		1,540								0.2[d,e]	f

Sources: Compiled from Hashem and Haites (1993), HL&P Company (1993), Mass. DPU (1992), Oregon PUC (1993), Minnesota PUC (1994), Chaitkin (1993), BPA (1991), and Putta (1990).

Notes:

To convert $/ton to $/metric ton, divide the $/ton amount by .9071847.

NO_x = nitrogen oxide; **SO_2** = sulfur dioxide; **PM_{10}** = particulate matter; **TSP** = total suspended particulates; **VOC** = volatile organic compound; **ROG** = reactive organic gases; **C** = carbon; **CO_2** = carbon dioxide; **CH_4** = methane; **N_2O** = nitrous oxide.

[a] The values originally adopted by the California PUC have been escalated at the rate of 5.2% per year through 1992. This is in accordance with the information provided by Chaitkin (1993).
[b] The Minnesota PUC did not specify which year the values were in. Note, however, that the order was adopted in March 1994.
[c] For SO_x.
[d] cents/kWh.
[e] Combined land, water, and other impacts of coal-fired plants. No distinction between East and West.
[f] See the "Water" column.

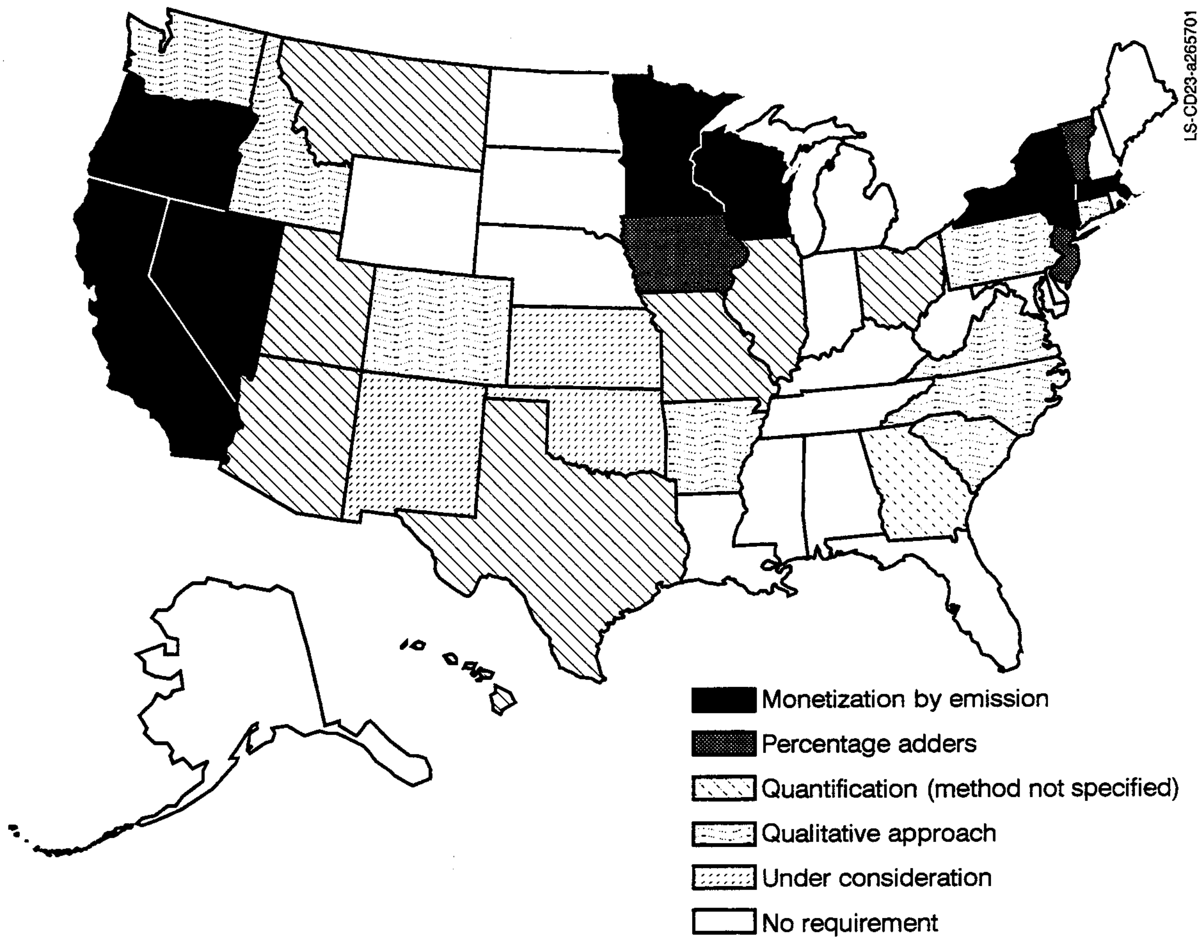

Figure ES-1. State PUC actions on environmental externalities

5. A taxonomy of all alternative methods for addressing environmental externalities was developed using the following three criteria: (1) whether the method falls under the jurisdiction of state PUCs, (2) whether there is an externality focus, and (3) whether it is a valuation method or an application method. Table ES-3 shows such a classification scheme. The cost-of-control and damage function methods are valuation methods, while qualitative treatment, weighting and ranking, percentage adders, monetization by emission, and multiattribute trade-off analysis and offsets are application methods. This report focuses on those methods that are under the jurisdiction of the state PUCs and that have an externality emphasis. Other alternative methods are described only briefly.

6. The views, positions, and interests of stakeholders are affected by their perceptions of the potential impacts on their economic interests or the viability of their position on environmental policy, by the societal perspective taken, and by the orientation of the analysts toward market competition. Those stakeholders who would be adversely affected generally oppose it, i.e., the electric utility industry, the coal industry, and large industrial users of energy. Those who would be favorably impacted or whose policy preference would be enhanced support the requirement: the natural gas industry, environmentalists, and advocates of energy efficiency, demand-side management (DSM), and renewable energy. Some government agencies and analysts believe that environmental externalities are real costs that should be included in the benefit-cost calculations and reflected in the prices of goods and services. Therefore, they support incorporating environmental externalities in the IRP

Table ES-2. Relative Merits of Alternative Methods for Treating Environmental Externalities in the IRP Process

Method	Strengths	Weaknesses
Qualitative Treatment	• Simple and easy to apply • Applicable to nonquantifiables	• Subjective • Implicit trade-off among options • Cannot be replicated by others
Weighting and Ranking	• Some quantitative elements • More transparent than qualitative method • Easy to implement • Eliminates the need for large data requirements	• Subjective in assigning scores and weights • Additional judgment involved if converted into cost adders
Cost of Control	• Yields a cost-based quantitative measure • Easier to apply than the damage function approach	• Control costs not equal to damage costs • Different locations may have same control costs, but different damage costs • Piecemeal problems (when applied to electricity only)
Damage Function	• Integrate physical and social sciences • Conceptually correct • Can consider both costs and benefits • Fuel cycle analysis	• Extensive data requirements • Needs substantial resources to implement • Estimating value of non-market goods and services is difficult • Piecemeal problems (when applied to electricity only)
Percentage Adders	• Easy to apply and update • Allows acknowledgment of judgment	• Judgmental and subjective • Arbitrary: does not correspond to damages • Piecemeal problems (when applied to electricity only)
Monetization by Emission	• Identification and estimation of major pollutants and their impacts • Reflects impact on costs • See "Cost of Control" or "Damage Function" methods	• See "Cost of Control" or "Damage Function" methods • Piecemeal problems (when applied to electricity only)
Multiattribute Trade-off Analysis	• Allows explicit trade-off between emissions and systems costs • Involves all stakeholders • Explores all lower cost alternatives • Allows use of judgment	• Use of judgment in final portfolio selection • Replication problem • Costly and time consuming • May fail to reach consensus

Table ES-3: Taxonomy of Alternative Methods for Addressing Environmental Externalities

I. Methods Not Under PUC Influence

  a. Command and control
  b. Emission standards and targets
  c. Taxes
  d. Emission fees
  e. Offsets (CAAA-mandated)
  f. Tradeable emission allowances

II. PUC-Influenced Methods

  A. With Externality Focus

    1. Valuation Methods
      a. Direct-cost estimation
      b. Indirect-cost estimation
      c. Contingent valuation
      d. Damage function
      e. Cost of control

    2. Application Methods
      a. Qualitative treatment
      b. Weighting and ranking
      c. Percentage adders
      d. Monetization by emission
      e. Multiattribute trade-off analysis
      f. Offsets

  B. With Other Focus

      a. Bonus rates of return
      b. Shared savings
      c. Set-asides

process. Those who believe that the market mechanism is a better regulator than the state PUCs oppose this approach.[5]

Summary by Chapter

Chapter 2 presents the pros and cons of treating environmental externalities in the IRP process. The pros are: (1) when accurately applied, it can help the society move toward efficient allocation of its resources;

[5]Because of resource and time constraints, this finding is based on the review explained in Chapter 5, which is limited to those stakeholders whose views are documented in materials that are readily available to us. This review is not a comprehensive survey of all stakeholders and should not be regarded as a complete and exhaustive characterization of stakeholders' interest.

(2) it is a way to consider potential future environmental regulations; and (3) it permits equal treatment of supply- and demand-side resource options. The cons are: (1) the approaches and methodologies adopted may be improper; (2) state actions tend to lead to piecemeal issues that may surface as transboundary problems, fuel switching or bypass, and migration of industries; and (3) there are questions about a PUC's authority, expertise, and resources. The discussion identifies some discrepancies between the assumptions made in the competitive model underlying the social costing approach and the real world situation and points out the weaknesses of the argument for the efficient allocation of resources. It also presents some points and counterpoints regarding the piecemeal issues and related arguments.

Chapter 3 addresses several policy and regulatory issues, including potential future environmental regulations, qualitative treatment versus quantification or monetization, offsets, policy coordination, and full-cost dispatch. A growing number of states are requiring incorporation of environmental externalities for the purpose of managing the risk of potential future environmental regulations. Since 1990, Missouri, California, Connecticut, Oregon, Minnesota, and Wisconsin have either implemented or endorsed this approach, and it is under consideration in Illinois. Some states have decided to require only qualitative treatment rather than quantification or monetization. They offered three reasons for this decision: (1) the methodologies for quantification or monetization are in need of further development; (2) they perceived a lack of legal authority for imposing the requirement; and (3) there is a lack of good data for estimating damage cost.

Offsets are used by utilities and PUCs in place of application of externality values. Offsets can be regarded as an approximation to a market-based mechanism to control pollution because they allow utilities and industries to seek the most cost-effective ways to meet pollution abatement objectives. In addition, offsets can also include the requirements mandated by the 1990 Clean Air Act Amendments (CAAA) for equal or larger reductions in emissions for new sources for sulfur dioxide (SO_2), NO_x, and ozone as well as unregulated pollutants such as greenhouse gases. For many emissions including carbon dioxide (CO_2), however, the reliability and durability of offset results, the costs of offsets, and the feasibility of enforcement are issues that need to be critically examined. States that allow offsets are Oregon, Massachusetts, Wisconsin, and California (NO_x and SO_2 at present, potentially other pollutants in the future), along with the Bonneville Power Administration (BPA; for SO_2). Offsets are being considered in Arizona. Rhode Island appears to require CO_2 offsets for new generating facilities. When applied across international boundaries, offsets are called joint implementation and are just being worked out on a formal basis by the Intergovernmental Negotiation Committee of the United Nations Framework Convention on Climate Change.

Achieving the desired pollution reduction (an external environmental benefit) while avoiding the unexpected adverse effects associated with the piecemeal problems can be pursued through coordination among economic and environmental regulators and among federal, state, and local governments. However, there are costs as well as benefits associated with coordination. Costs include the required time and resources, delays, and, in the extreme, inaction when the coordination process fails to reach consensus.

Full-cost dispatch means that, in operating their existing resources, utilities consider the total societal costs, which include external environmental costs. While some stakeholders argue for requiring full-cost dispatch, only Oregon and Ohio have included any such provisions. Oregon directed utilities to identify their preferred strategies under the assumption that the external costs of operating their resources were internalized. Ohio requires regulated utilities to address the viability of SO_2 emission dispatch as a potential strategy for complying with the CAAA in their 1992 IRP filings. Such limited state experience in full-cost dispatch may be due to the complexity of monitoring the operation, the PUCs' lack of expertise and capability in monitoring such an operation, utilities' opposition due to their concern for stranded investment, and the concern about potential increases in rates.

Chapter 4 describes the seven major approaches to treating environmental externalities in the utility resource planning process. It also provides a taxonomy of all the alternative methods of addressing environmental externalities; a summary of state PUCs' actions to date; and a discussion on the role of state laws, the debate on environmental adders, and the choice of methodologies. The language of state laws and their interpretations are important factors in a state PUC's decision to require utilities to incorporate environmental externalities into the IRP process. When explicitly directed by state laws, the PUCs will be on a stronger legal ground in adopting such a requirement. Alternately, the PUCs may decide not to impose such a requirement if state laws contain only general language on environmental quality and protection.

The points and counterpoints presented in the debate over environmental adders[6] highlight the controversial nature of such an approach. Although the debate clarifies some issues, substantial differences still exist between the two sides of the debate. In the context of taxonomy discussed in Item 5 in the Major Findings subsection, it is possible to characterize the controversy with the first classification criterion: the degree of PUC influence. Many analysts believe in the efficacy of the methods not under PUC influence, especially those associated with the market mechanism or the price system, such as taxes, fees, and tradeable emission allowances. They question the need for state PUCs to impose an externalities requirement for resource planning purposes. Others perceive that state laws grant certain responsibility and authority to the state PUCs to ensure that electric and gas services are provided on the most environmentally sound basis and, therefore, state PUCs can justify requiring incorporation of environmental externalities into resource planning for utilities. In addition, because most states with monetized externality values and the BPA also allow offsets, there appears to be an emerging trend: offsets are an efficient way of dealing with the externality issue in the face of uncertainty.

State PUCs' choice of methods for considering environmental externalities are varied. Although the damage function approach is often regarded as the most appropriate, implementation experience is still quite limited. Major research projects on the approach are expected to be completed in 1994 in Wisconsin and New York, and for DOE. Most of the existing environmental adders are based on the cost-of-control method and have been the subject of intensive debate. In Massachusetts and Wisconsin, they are being challenged in state courts. In adopting specific approaches, the PUCs sometimes indicate that they would consider other techniques as the methodologies and estimates are further developed. Thus, the process of choosing the appropriate methodologies and estimates will continue to evolve.

Chapter 5 characterizes stakeholders' interests and positions concerning environmental externalities. There are three broad variations in the electric utility industry's view. First, the industry is generally opposed to being required by state PUCs to consider environmental externalities in the IRP process. Electric utilities feel they are being unfairly singled out and their ability to compete will suffer because other fuels, cogeneration, customer self-generation, and even other electricity suppliers would not be subject to the same requirement. Second, if state PUCs decide to impose such a requirement, some utilities will request to choose their own approaches, present alternative estimates of externality values for specific emissions, or favor the damage function approach that covers all benefits and cost and all economic sectors. Third, in some instances, individual utilities such as New England Electric System (NEES) and Public Service

[6]In the literature, the term "environmental adders" refers to the practices of assigning dollar values to environmental externalities in the resource planning process. Such adders may be applied in accordance with either the percentage adder or the monetization by emission methods. The values for either methods can be derived from the cost of control or the damage function approaches. For the percentage adder approach, the values can also be mandated by legislation.

Electric and Gas Company may actively consider beneficial environmental effects of energy efficiency, DSM, and renewable resources in their long-term resource planning.[7]

The coal industry and the large industrial energy consumers such as Electricity Consumers Resource Council (ELCON) are opposed to treating environmental externalities in the IRP process. Some natural gas utilities, state and local governments, environmentalists, and advocates for energy efficiency, DSM, and renewable energy resources favor requiring consideration of environmental externalities in the IRP process. Federal Energy Regulatory Commission (FERC) staff believe that, to internalize environmental externalities, "market-based" approaches such as emission charges and permits are preferable to nonmarket approaches such as set-asides and emission standards in terms of both efficiency and equity. For computing net environmental benefits, FERC staff prefer the damage function method and caution states to be aware of potential pitfalls in the piecemeal approach to internalization. DOE supports research and development in externality issues and attempts to be an unbiased source of information on the subject. Other consultants and analysts are divided in their views on the subject. Some favor, while others oppose, the requirement to consider environmental externalities in the IRP process. Much depends on the analysts' philosophical orientation and their respective accumulated expertise.

Chapter 6 explains the treatment of uncertainty, valuation methods, and all the methods not under PUC influence. Three ways of addressing uncertainty in environmental externalities are discussed: a case-by-case approach that distinguishes among three different levels of uncertainty, sensitivity analysis, and a system that indicates the quality associated with various estimates or assumptions made in deriving the values of externalities.

The three valuation methods discussed are direct-cost estimation, indirect-cost estimation, and contingent valuation.[8] Direct-cost estimation uses market prices for such commodities as crops, fish, building maintenance cost, medical expenses, and wages. Direct-cost estimation can lead to underestimating external costs if it does not take into account the fact that consumers are often willing to pay more than they actually do pay. Indirect-cost estimation uses observed market prices or behaviors that are indirectly related to the targeted goods or services to infer their values. For example, the difference in the property values of a house located near a park and an identical house not located near a park, after adjusting for other factors, provides an estimate of the value of being near the park. In contingent valuation, respondents are asked open- and closed-ended hypothetical questions to assess their willingness to pay to avoid emission impacts or willingness to accept payments for tolerating emission impacts. Two examples of contingent valuation are the estimated value of endangered species and the value of visibility near a national park.

Methods for addressing environmental externalities not under PUC influence include command and control, emission standards and targets, CAAA-mandated offset policy, emission fees, fuel taxes, and emission allowance trading. Because these methods are not the focus of this report, they are only briefly described. In command and control, the government specifies what should be done to reduce emissions or control pollution. With emission standards and targets, the regulatory agencies set the maximum allowable emission or pollution level and let the utilities and industries seek ways to meet them. A CAAA-mandated offset policy requires a new source of emissions to obtain an equal or larger amount of

[7]Note, however, Massachusetts Electric Company, a subsidiary of NEES, is challenging in state courts the legality of the monetized values for greenhouse gases adopted by the Massachusetts Department of Public Utilities.

[8]Two special evaluation methods have been discussed in Chapter 4 and are not repeated here: cost of control method and damage function approach.

emission reduction elsewhere, particularly in areas where emission levels already exceed the specification of the National Ambient Air Quality Standards. In the emission fees and fuel taxes approaches, sources of emissions are required to pay fees according to the amount of pollution in excess of allowable levels or to pay taxes according to the amount of fuels used. In emission allowance trading, total emissions are capped, and individual utilities are required to hold enough allowances to cover the emissions from their facilities for any one year. The allowances can be traded or banked. It is generally believed that the total cost of controlling pollution using emission allowance trading, taxes, or fees will be lower than that with the command and control approach. However, questions arise as to whether state PUCs have the authority to apply these alternative approaches. Such policies are set by federal law, and the costs are presumably internalized.[9]

The Appendix briefly summarizes state PUC actions that are taken for other purposes, such as promoting energy efficiency, DSM, and renewable resources, and that are sometimes treated in the literature as being related to incorporating environmental externalities in the IRP process. These actions include bonus rates of return, shared savings, and set-asides. With bonus rates of return, utilities are allowed a higher rate of return on investment in DSM, energy efficiency, and renewable resources. Connecticut, Kansas, Montana, Nevada, Washington, and Wisconsin have used this approach. New Jersey and Wisconsin have allowed utilities to retain a portion of the savings realized from their DSM programs (the shared savings approach). California has used set-asides for renewable energy options.

[9]However, there are offset policies that are under PUC jurisdiction. They are discussed in Chapter 3.

1.0 Introduction

As integrated resource planning (IRP) processes have become more accepted by state public utilities commissions (PUCs),[1] as well as electric and gas utilities, incorporating environmental externalities into the IRP process continues to be an important and controversial issue. In practice, many PUCs have required utilities to explicitly consider environmental externalities in their resource planning processes. Different approaches, each with its own strengths and weaknesses, have been tried. Because the Energy Policy Act (EPAct) of 1992 requires all states and utilities to consider IRP and its related issues, the Integrated Resource and Planning Performance Based Regulation Program (IRP/PBR Program) administered by the Office of Utility Technologies (OUT), Office of the Assistant Secretary of Energy Efficiency and Renewable Energy, U.S. Department of Energy (DOE), seeks to promote better understanding of states' experience with environmental externalities in the IRP process and to facilitate adoption of locally appropriate approaches by other utilities and PUCs. DOE intends to achieve this goal by disseminating information on useful practices already implemented by some states or being proposed (DOE/OUT 1994). The National Renewable Energy Laboratory (NREL) is supporting the IRP/PBR Program by conducting an initial review of current approaches to treating environmental externalities in utility resource planning.

1.1 Objectives and Approach

The purpose of this report is to assist IRP Program staff in gaining a comprehensive understanding of the issues involved in considering environmental externalities **within the utility regulatory process**, as well as the methods proposed for addressing environmental externalities and their applications. Note that this report focuses on those aspects that fall within the influence of state PUCs; aspects and policies not within their influence are described only briefly for the sake of completeness. The report is also intended to help disseminate useful information on PUC practices related to environmental externalities. Given these purposes, the study has three specific objectives: (1) Identify and review major policy, regulatory, and technical issues regarding the treatment of environmental externalities; (2) Identify, review, and characterize the primary methods being proposed or employed to address environmental externalities; and (3) Identify stakeholder interests in the issues and the methods that have been proposed or are in use.

A review of the relevant literature was conducted, with an emphasis on recent reports and studies on environmental externalities and decisions by state PUCs pertaining to the subject released since 1992. Earlier studies are also referenced as necessary. Based on the review, relevant issues are identified and alternative approaches used or proposed for use in treating environmental externalities in the IRP process are described. A summary of state PUC actions related to the subject is provided, based on information contained in existing surveys and data bases, and updated with information from recent PUC orders.

It should be noted that this is an initial review intended to accurately portray the concerns presented by stakeholders so that the IRP/PBR Program and OUT can achieve a basic understanding of the methods in use or being proposed. It will also provide others with an understanding of the issues and methods involved. This report focuses on descriptions and explanations, not on "what should be," and does not propound a specific policy or approach. To the extent that observations are offered, they represent an attempt to set the issues and their interrelationships into context from the authors' understanding and perspective. It should also be noted that this is an introductory review and some topics may not be treated

[1]Other names such as "Public Service Commission," "Commerce Commission," "Department of Public Utilities," and "Utility Control Board," and so forth are also used to refer to a state government agency that has primary responsibility for regulating electric, natural gas, telephone, and other utilities. For the purpose of this report, the term "PUC" is used generically to refer to any such agency.

in depth. In addition, although many of the externality issues also apply to IRP for gas utilities, much of the existing literature focuses on electric utility issues. This report generally reflects this focus.

Recent studies and reports reviewed here include the Consumer Energy Council of America Research Foundation study (CECA/RF 1993a), a report by the Federal Energy Regulatory Commission (FERC Staff 1992), the National Association of Regulatory Utility Commissioners (NARUC) study (ECO Northwest 1993), the U.S.-European Community (E.C.) Fuel Cycle Study (ORNL and RFF 1992), a contractor report for Edison Electric Institute (EEI) (ERGI 1992a), and a survey of monetization practices conducted by Houston Light & Power Company (1993).[2] The Pace University study (1990) is also referenced. For existing state PUC practices, the study relied heavily on the externality data base contained in EPRINET (Hashem 1993) and on recent state PUC orders, including those by Oregon PUC (1993), Colorado PUC (1992), Massachusetts Department of Public Utilities (DPU) (1992), Minnesota PUC (1994), and Wisconsin PSC (1992).[3]

1.2 Environmental Externalities Defined

Environmental externalities are the costs or benefits associated with the effects on the physical-biological environment from the production and use of a product or service that are not reflected in its price. The effects can be either detrimental or beneficial, and are referred to as either external environmental costs or external environmental benefits. Because environmental externalities are not reflected in the prices of goods and services, they are not taken into consideration in the production and consumption decisions of businesses and consumers. Economists argue that, in the idealized case of the perfectly competitive market, the existence of environmental externalities prevents society from deriving maximum benefits from the use of available resources; i.e., too many of some and too few of other goods and services will be produced and consumed. In this sense, environmental externalities are often regarded as a barrier to achieving efficient allocation of societal resources. One way to remove this barrier is to "internalize" the external costs and benefits in the price of a good or service.

Environmental externalities can result from production and consumption activities at every level of society, including energy resources. Focusing on electricity, the 1993 NARUC study lists 12 categories of environmental externalities for electricity generation, transmission, distribution, and end use: impacts on agricultural crops, timber, and livestock; catastrophic accidents; ecosystems and biodiversity; environmental-cultural icons; global climate change; human morbidity and mortality; land use; materials; recreation; regional economic structure; visibility; and visual and audio aesthetics (ECO Northwest 1993). The U.S.-E.C. Fuel Cycle Study (ORNL and RFF 1992) distinguishes three major categories of externality impacts: ecological impacts, health impacts, and impacts on production and economic assets. Ecological impacts include crops and suburban landscape, livestock, timber, commercial fishing, recreational fishing, hunting, recreation, and biodiversity. Health impacts cover cancer; asthma attacks, irritation symptoms, and respiratory insufficiency; mortality; and neurological, cardiovascular, and reproductive effects. Production impacts include increased production costs associated with the use of decontaminated water, and changes in crop yields, timber harvests, and fish harvests. Impacts on economic assets refer to changes in property values as a result of pollution, such as damages to water pipes and mains and

[2]Initially, the authors also planned to review reports from several other projects on externalities, such as those by the National Regulatory Research Institute, Keystone Center, and the individual fuel cycle reports in the U.S.-E.C. study. However, delays in their release prevented them from being reviewed for this report.

[3]For other studies and reports not specifically mentioned here, please see the references at the end of the report.

buildings (ORNL and RFF 1992). As another example, the New York State Environmental Externalities Cost Study has adopted five categories of externality impacts: human health, materials, biological resources, climate change, and other. Human health impacts include mortality, morbidity, accidents and injuries. Impacts on biological resources are those affecting crops and vegetation, forests, fisheries, and aquatic, terrestrial, and groundwater resources. Other impacts cover visibility, aesthetics, and other (RCG/Hagler, Bailly, Inc. 1993).

1.3 Report Organization

This report contains six chapters. Following Chapter 1, Introduction, Chapter 2 addresses the threshold issue of whether environmental externalities should be incorporated into the IRP process. Chapter 3 explores some policy and regulatory issues, including the treatment of potential future environmental regulations; qualitative treatment versus quantification and monetization; use of offsets; policy coordination among different agencies and levels of government; and full cost dispatch. Chapter 4 describes the alternative approaches to incorporating environmental externalities in the IRP process and explains their strengths and weaknesses. The chapter also presents a taxonomy of all alternative methods of addressing environmental externalities; a summary of state PUCs' actions on the matter; and discussions of the role of state laws, the debate on environmental adders, and the choice of methodologies. Chapter 5 characterizes stakeholders' interests in the subject, including those of the electric industry, fuel suppliers, energy consumers, government agencies, public interest groups, and others. Finally, Chapter 6 covers treatment of uncertainty, valuation methods, and other methods not under the influence of state PUCs. The Appendix briefly discusses state PUC actions that are taken for other purposes and that are sometimes treated as being related to environmental externalities.

2.0 Environmental Externalities and Integrated Resource Planning

The threshold issue is whether environmental externalities should be treated in the IRP process. Only if the answer to this question is "yes" will the issue of how to incorporate environmental externalities into the IRP process become relevant. The arguments for and against explicit treatment of environmental externalities in the IRP process are described and discussed in this chapter.

2.1 Pros

The argument for incorporating environmental externalities into the IRP process has three themes: efficient allocation of society's resources, potential future environmental regulations, and equal treatment of demand-side and supply-side resource options. These three themes are briefly explained below.

2.1.1 Efficient Allocation of Society's Resources

According to classical economic theory, efficient allocation of societal resources in the idealized case of the perfectly competitive market requires that, at the margin, the price of a good or service reflect the true social cost of producing the good or providing the service (marginal social cost). If the price is not equal to the marginal social cost, society's resources will be misallocated; i.e., allocation of resources among different uses will be less efficient than if prices are equal to marginal social costs. Those who favor addressing environmental externalities in the IRP process argue that environmental externalities are real costs and benefits to society and should be reflected in the price of electricity so that proper market signals are given to the producers and consumers. As such costs are taken into consideration, the proper amount of environmental resources will be used in production and consumption decisions, resulting in environmental protection, as opposed to not incorporating environmental externalities. This is the social costing argument.[4]

Most participants on both sides of the debate accept this argument,[5] and some state PUCs have explicitly enunciated it in their orders. For example, the Massachusetts DPU (1990) stated (in DPU 89-239) that emissions from new power plants will potentially create high environmental costs that will not be reflected in the prices submitted in the resource bidding process and, therefore, will not be considered in the resource selection process. Based on this reasoning, the Massachusetts DPU adopted its policy to incorporate environmental externalities into the new resource selection process (Massachusetts DPU 1992). In its order on the guidelines for treating external environmental costs, the Oregon PUC stated that:

> The goal of least-cost planning is to assure an adequate and reliable supply of energy at the lowest cost to a utility and its customers consistent with the long-term public interest. Long-term public interest was included in the goal because not all costs of a supply-side or demand-side resource are necessarily borne by the utility and its ratepayers. These

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[4]Implicit in this argument is the reasoning that, other things being equal, efficient allocation of resources requires that pollution abatement is carried out up to the point where marginal cost of abatement is equal to marginal benefits of abatement. Some make this point in arguing against excess pollution abatement.

[5]Both sides of the debate generally recognize the important proviso of "in the idealized case of the perfectly competitive market." However, the proponents tend to use the argument as the ideal case for use in comparison. Others would emphasize that the lack of realism in the assumptions underlies the perfectly competitive model, when compared to the real world. Such points are further discussed in Section 2.3. In this section, the pro argument is described.

"external" costs should be considered in the planning process to the fullest extent practical and quantifiable.... (Oregon PUC 1993, p. 1).[6]

In the same vein, the Pace University report on externalities stated that environmental costs imply a social cost perspective and that "failure to include all costs, regardless of who bears those costs, distorts price signals and impedes economic efficiency improvements that could result from selection of the least social cost resources" (Pace University 1990, pp. 63–64).

Paul Joskow, a critic of state PUCs' treatment of environmental externalities, asserts that the debate is not about whether or not environmental costs should be factored into a firm's decisions, but about how to "do it right." In Joskow's view:

> Emission of wastes into the environment is an "externality problem" because there is no market for the use of clean air and clean water and, as a result, the associated costs are "external" to polluting firms' production and pricing decisions. If polluting firms do not take these costs into account when they make production and pricing decisions, then excessive pollution will result both from too little investment in abatement and too much consumption of the final goods whose production results in emissions (Joskow 1992, p. 54).[7]

Similarly, the Electricity Consumers' Resource Council (ELCON), an association of large industrial consumers of electricity, which opposes state PUCs' effort to address environmental externalities of electricity, made the following statement:

> The concept of external costs and benefits, or externalities, is derived from economic theory. Theory states that resources are optimally allocated when markets are perfectly competitive 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 (ELCON 1991, pp. 7–9).[8]

2.1.2 Potential Future Environmental Regulations

A power plant has a useful life of 30 to 40 years. During that time, it is likely that more stringent environmental regulations will be issued. Hence, proponents argue that incorporating environmental externalities in resource planning and acquisition decisions would, in the long run, lower the cost of complying with increasingly stringent environmental regulations, thereby reducing total pollution cost to society (Pace University 1990). Some PUCs have implemented policies to account for potential future environmental regulation. For example, the Wisconsin Public Service Commission (PSC) requires utilities to include the externality costs for three greenhouse gases (carbon dioxide [CO_2], methane, and nitrous

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[6] According to the Oregon Department of Justice, the Oregon PUC "may consider external environmental costs in a utility's least cost plan but is not authorized to require a utility to make a resource decision based on total resource cost which includes external costs" (Oregon PUC 1993, p. 2).

[7] Some would interpret this citation as intended to apply to the broader concept of externality for the society as a whole, rather than the narrower focus of incorporating externalities into the IRP process.

[8] See the previous footnote.

oxide) in new resource selection. In the Wisconsin PSC's view, utilities and independent power producers will be at risk of incurring additional costs for retrofitting their power plants if they ignore the likelihood that, in the near future, either a carbon tax or new regulations on controlling greenhouse gases will be adopted (Wisconsin PSC 1992).[9] Similarly, the California PUC implemented a policy requiring utilities to obtain assurances from electricity suppliers that the suppliers alone would bear any future cost associated with a carbon tax, the acquisition of tradeable carbon emission permits, or any other carbon emission control strategy (Hashem 1993). In Oregon, state law permits the PUC to require utilities to consider the likelihood that external costs may be internalized in the future (Oregon PUC 1993). The Bonneville Power Administration (BPA), in adopting monetized values for specific emissions, also considered future regulatory constraints on operations or fuel use, as well as taxes on emissions, fuels, carbon, or other substances (Buchanan 1992).[10]

There are two interpretations in considering potential future environmental regulations. In one interpretation, such regulations address some impacts of energy production and consumption that exist at the time utilities are conducting resource planning or when they consider resource acquisition decisions. At the time of planning, there are either no regulations or the regulations are not as restrictive as they will be in the future. Hence, the cost and benefits of the incremental impacts are externalities. When new regulations are put in place, however, the costs or benefits of the effects become internalized. The other interpretation is to treat potential future regulations as one method to address uncertainty concerning current regulation on a specific emission. Dealing with such uncertainty involves costs, and the externality information is a good predictor of the need for, and the potential stringency of, future regulations. That is, the externality information helps to estimate future internal costs.[11] Nevertheless, either interpretation leads to the same end result—the costs or benefits associated with an emission will be included in the benefit-cost analysis; i.e., they will become internalized.

2.1.3 Equal Treatment of Supply-Side and Demand-Side Resource Options

The third argument for including environmental externalities in the costs of all demand-side and supply-side options is that it would permit "consistent comparisons between different resource options with different prices, environmental impacts, and nonprice features" (ECO Northwest 1993, p. 40).[12] Proponents of this position argue that options such as demand-side management (DSM), energy efficiency, and renewable resources are environmentally benign relative to traditional electricity generation technologies. Incorporating external environmental costs and benefits in the resource selection decision process requires that both demand-side and supply-side options receive equal treatment, removing the imbalance that exists when only private costs are considered. In other words, proponents argue, traditional environmental accounting tends to treat environmental costs as zero, assigning no credit for low environmental impacts of renewable resources and energy efficiency, resulting in the selection of

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[9]Electric utilities are challenging the decision in the court. As will be noted in Section 4.3, the utilities had successfully challenged an earlier Commission order requiring a 15% adder to account for environmental externalities.

[10]See Section 3.1 for further discussion on the issue of potential future environmental regulations.

[11]A comment on an earlier draft argues that potential future environmental regulations should not be treated as externalities; instead, it should be treated as the second interpretation explained here. However, the authors decided to present both perspectives as alternative interpretations.

[12]See also Energy Research Group, Inc. (1992a, p. 37).

inappropriate resources for generating electricity. The new environmental accounting recognizes such factors, thereby treating all potential resources equally (Wiel 1991).

2.2 Cons

Arguments opposing incorporation of environmental externalities into the IRP process can be grouped into three categories: (1) the approaches and methodologies adopted by the PUCs are not appropriate; (2) "piecemeal problems" are likely to arise with the implementation of externality policies; and (3) there are questions about the state PUCs' authority, expertise, and resources. These arguments are discussed below.

2.2.1 Improper Approaches and Methodologies

Those opposing the incorporation of environmental externalities into the IRP process argue that the approaches taken by state PUCs to implement externality policy are unbalanced; i.e., they concentrate only on the adverse environmental impacts of air emissions in the electricity generation stage, and largely exclude the benefits of electricity generation and end use. A report prepared for EEI cites several benefits associated with electricity use. For example, deploying high-efficiency electric rail engines, rather than diesel trains, potentially reduces emissions in CO_2, sulfur oxides, and other particulates. In addition, electricity can be used to help clean up the environment, such as the Boston Harbor (ERGI 1992a, pp. 62–64). Those who hold this view believe the proper methodology should be comprehensive, taking into account all possible costs and benefits. In other words, the methodology should account for all emissions, including air, water, and solid waste emissions, and should include all possible environmental, social, and economic losses and gains.[13]

Opponents also argue that some of the methodologies used to derive estimates of environmental costs are inappropriate and suffer from major drawbacks. In their view, the direct estimation of damages[14] (including benefits) is, conceptually, the more appropriate method. However, because of the complexities involved in the damage valuation approach, the cost-of-control method is often used when monetization is required. This method uses the costs of abating pollution to the desired or regulated level as a proxy for the values of environmental externalities. Opponents of the cost-of-control method argue that it is not appropriate to use abatement costs as a proxy for the true value of environmental externalities. Economic theory suggests that if there were no environmental standards set by laws or regulatory agencies, if income were equally distributed, and if the market mechanism were allowed to operate freely, among other things, then the cost of abating the pollution would be equal to the value of damages at the margin. Because, in reality, current laws and regulations set standards concerning the best available control technologies, the cost of control would generally not be equal to the damage cost at the margin. In this view, empirical estimates of control cost have several shortcomings: they have not been verified with empirical estimates of damages; they often cover only the electricity generation stage without considering the total impacts of the cycle of fuel utilization; and they fail to consider all the efficiencies of different fuels (ERGI 1992a). A variation of this argument is that assigning imprecise values of externalities based on the

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[13]FERC Staff (1992, p. 36) have included the lack of consideration of "non-environmental externalities" such as employment, economic, and national security impacts in state PUCs' treatment of environmental externality of electricity as part of a broadly defined "piecemeal problem." Section 2.2.2 provides more details on the piecemeal problems.

[14]Various terms have been used in the literature to refer to the method of direct estimation of damages, including damage function approach, damage valuation method, or damage cost approach. See Section 4.1.4 for more discussion on this approach.

control-cost approach or on judgment is no better, or could even be worse, than assigning the value of zero (Joskow 1992).

2.2.2 Piecemeal Problems

Opponents argue that incorporating environmental externalities into the IRP process can lead to various problems. According to this argument, emissions can involve different fuels, localities, states, regions, and nations, as well as different economic sectors such as electric and gas utilities, commercial businesses, industries, and transportation. Because a state PUC often has no jurisdiction over some fuels, geographical areas, or sectors, imposing an externality requirement on only the regulated electric utilities under its jurisdiction potentially creates a host of related problems, collectively referred to as the "piecemeal problem." The broadly defined piecemeal problem encompasses dispatch of older plants with more emissions, fuel switching or bypass, and transboundary and economic development problems (FERC Staff 1992; CECA/RF 1993a; ECO Northwest 1993).

Some electric utilities argue that including environmental externalities in an electric utility's resource planning and acquisition decisions could result in more pollution. As newer, cleaner power plants are deferred because of their higher costs after accounting for externalities, existing units with more emissions are kept in the resource mix longer and are dispatched more frequently, causing an increase in emissions. In addition, efforts to avoid higher costs may result in increased self-generation and out-of-state generation. If these unregulated sources of electricity are not subject to the same environmental externality requirements, an increase in pollution could result.[15] In some cases, industries may move out of the United States to less developed countries with less stringent environmental regulations leading to increased pollution.

Opponents argue that such piecemeal internalization of externalities does not necessarily lead to an improvement in overall economic efficiency, but instead may impose net costs to society (ELCON 1991). Economic activities that rely on electricity would be hurt relative to those that rely on other fuels (the **piecemeal problem**).[16] Moreover, if the price of electricity supplied by regulated utilities becomes higher than that of other suppliers, independent power producers will be inclined to deal with retail customers directly. Similarly, there would be an incentive for customers of electric utilities to switch to other fuels or alternative sources of electricity supply such as self-generation or nonregulated electricity. This is referred to as the **fuel switching** or **bypass problem** (ELCON 1991).[17]

Another piecemeal problem is that emissions originating in one area can often cause damages in other areas, leading to differential incentives to abate and control the emissions. Efforts by one jurisdiction to control emissions when others choose not to can affect the location of new generating facilities (the

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[15]For example, Massachusetts Electric Company, Boston Edison Company, and other utilities made this argument before the Mass. DPU (1992, p. 13).

[16]This is a narrowly defined "piecemeal problem." A broadly defined "piecemeal problem," as used by the FERC staff, encompasses most of the problems discussed in this section. FERC staff (1992, pp. 36-38) use the term piecemeal problem to cover problems associated with nonenvironmental externalities, inefficient fuel competition, jurisdictional boundaries, inefficient siting, operational considerations, and pollutant interactions.

[17]This was also mentioned in Section 2.2.1, Improper Approaches and Methodologies.

transboundary problem).[18] This can lead to the migration of industries and jobs out of the area with externality requirements and into areas without such requirements, including overseas, that allow more CO_2 per kWh from fossil-fueled power plants. Thus, actions by state PUCs to impose externality requirements on jurisdictional electric utilities can have economic development consequences (the **economic development problem).**[19]

Underlying the various piecemeal problems in this section is the concern that electricity costs and prices will rise when environmental externalities are considered explicitly. Such potential price increases will affect the competitive position of utility-generated electricity vis-á-vis other fuels and other suppliers of electricity, and will affect the competitiveness of the businesses and industries served by regulated utilities. Although such concerns were raised in state PUC proceedings in the past, they are being heard now in the current debate concerning the restructuring of the electricity industry. Some counterpoints to this argument are included in Section 2.3.

2.2.3 Questions on the PUCs' Authority, Expertise, and Resources

Those opposing the treatment of environmental externalities in the IRP process argue that the responsibility for setting environmental standards and accounting for environmental costs rests on the legislative bodies and the designated environmental regulatory agencies, not the state PUCs. Existing environmental laws and regulations reflect the decisions of congressional and state legislators on the extent to which environmental impacts ought to be considered. When electric utilities comply with existing regulations, the environmental impacts of electricity generation are internalized into the cost and price of electricity. Therefore, opponents reason, additional unilateral actions by state PUCs are not warranted (ELCON 1991; FERC Staff 1992).

Others argue that PUCs lack the expertise and resources to properly value environmental externalities. In their view, the direct estimation of environmental costs and benefits is a highly complex procedure and requires expertise in many different disciplines. State PUCs are not likely to have the full complement of such expertise and resources, and therefore are not in a position to derive comprehensive and accurate estimates of damage costs. Instead, PUCs often resort to inaccurate approximations and substitutes such as "adders" and estimates of pollution control costs, which lead to unintended adverse effects (Joskow 1992).

Whether state PUCs have the authority to require consideration of environmental externalities in the resource planning process depends on the language of state laws. Commissions in Alaska, Florida, and Maine have considered the issue and concluded that they lack the legal authority. In contrast, PUCs in California, Nevada, New York, and Wisconsin have decided that they do have the authority to act. Oregon and Illinois have also derived findings in this area. Section 4.4 provides additional discussion on the influence of state laws on PUC actions.

2.3 Discussion

Several aspects of the arguments for and against considering environmental externalities in the IRP process merit further discussion. First, as described above, both proponents and opponents of the PUC requirement on environmental externalities generally accept the concept of economic efficiency underlying

[18]FERC staff (1992, p. 37) use the term "improper siting" to refer to this problem. See also ECO Northwest (1993), pp. 37-38.

[19]See ECO Northwest (1993), pp. 38-40.

the social costing approach. The approach posits that, under competitive conditions, when all appropriate costs are factored into the price of electricity, allocation of societal resources with respect to electricity generation and use will be efficient. However, it is worth noting that the competitive model represents the ideal situation whose assumptions (i.e., the perfectly competitive market in long-run equilibrium) are only approximated at best in the real world. For example, while the competitive model postulates that prices are set to be equal to marginal costs, the electric utility industry traditionally has been regulated with embedded, average-cost pricing. In addition, whereas the competitive model assumes that the prices of all factor inputs are competitively determined, the prices of labor (wages) are subject to distortions as a result of labor unions and negotiations between unions and management. Further, the prices of oil and other commodities are often subject to short-run manipulations.

Given such limitations, the social costing approach may be regarded as depicting the ideal for comparison purposes. Thus, using the competitive market model as the underpinning of the policy for incorporating environmental externalities may suffer from two related weaknesses: (1) The arguments can be countered by demonstrating how unrealistic the model's underlying assumptions are. (2) Given that distortions occur in many places in the economy, the simple act of including environmental externalities in the decision-making process for resource acquisition may not automatically lead to improvement in economic efficiency. Critics further argue that proponents for incorporating environmental externalities in IRP are motivated neither to protect the environment nor to achieve efficient allocation of resources, but to deliberately bias resource selection in favor of DSM and renewable resources. Moreover, critics characterize PUCs' efforts to internalize environmental externalities as an attempt to fix prices, resulting in "administered prices." They point out that attempts to administer prices often suffer from lack of full information and may lead to higher prices, shortages, and black markets.[20]

Second, while the piecemeal problems need to be addressed, counterarguments have been put forth by proponents. In the proponents' view, society is already paying for the impacts of residual emissions in the form of additional illness and discomfort, a degraded environment, polluted water, and so on. These costs are being borne by those who are impacted by the emissions, and they are not necessarily the same individuals who enjoy the benefits of electricity generated from the power plant in question. Thus, there is often a discrepancy between those who benefit and those who pay. In addition, because utilities and their customers do not pay for residual emissions, the costs are not included in the price of electricity and there is little incentive to avoid pollution (Wiel 1991). According to this view, incorporating environmental externalities into the resource planning process simply corrects such inequities from past practices. As noted above, opponents counter with the argument that it is unfair to single out utilities for special attention while other industries and sectors are not subject to the same treatment. Moreover, proponents argue that it is unlikely that including externalities in resource planning and acquisition decisions would lead to more emissions because, while less-emitting power plants may be deferred, they are likely to be replaced by less-emitting DSM and renewable resources. Proponents also question the validity of the argument that self-generation induced by the increased cost of including environmental externalities would lead to a net increase in emissions.

Further, electric utilities often argue that they are being placed at a disadvantage because they are required to incorporate externalities while independent power producers (IPPs) and alternative fuels are not. Proponents counter that IPPs are often subject to the same requirements when they participate in resource bidding. Further, proponents may acknowledge that, in the ideal case, both beneficial and harmful effects of various emissions and pollutants should be included; that, optimally, an externality policy should be consistently applied to regulated electric utilities, IPPs, industries, businesses, other fuels, and the transportation sector; and that, in theory, externality policies at different levels of government should also

[20]Part of this discussion is culled from comments on an earlier draft.

be coordinated to capture the transboundary scope of the pollution problem. However, proponents argue that strict adherence to the ideal case would result in the PUC doing nothing. They assert that, although state PUC actions may not be ideal, they are necessary to induce the environmental regulators, state legislatures, and Congress to act (ECO Northwest 1993).

Proponents also offer several counterpoints to the contention that state PUCs lack authority to impose an environmental externality requirement. As franchised monopolies with a mandate to serve the public interest, utilities are responsible for protecting the environment (Pace University 1990). The PUCs are charged with regulating utilities in such a way that serves the public interest. In some cases, state law may have explicit language directing the PUCs to act. Utilities assert that this is a weak argument because, as a general rule, all businesses have the responsibility to protect the environment.

Furthermore, proponents argue that, by requiring utilities to consider externalities, the PUCs are not setting new standards, but are carrying out the legislative mandate that utilities be regulated so as to provide the most economic and environmental benefits to the states (Wiel 1991). Opponents counter that, if legislated requirements are already met, then additional PUC requirements would constitute new regulations that are not warranted.[21]

[21]The debate on environmental adders, discussed in Section 4.4.2, is also presented as a series of pros and cons. Some of the points mentioned here surface in that debate as well.

3.0 Policy and Regulatory Issues

Fundamental to the issue of incorporating environmental externalities into a utility's resource planning process are a series of policy and regulatory questions that must be answered: Should potential future environmental regulations be considered? Should environmental externalities be treated in a qualitative manner or be quantified, monetized, or both? Should offsets be allowed? How should federal, state, and local environmental policies be coordinated? Would externalities be better implemented through regional planning? Should consideration of environmental externalities be applied to the dispatch and operation of a utility's existing resources?

This chapter first explains the approach of treating potential future environmental regulations as a risk management strategy. The issue of qualitative treatment, quantification, or monetization of environmental externalities and the reasons some state PUCs have decided to require only qualitative considerations are then discussed. Finally, the chapter addresses states' treatment of the offsets issue, policy coordination among different government levels and agencies, and the pros and cons of full cost dispatch, which includes external environmental costs in utility operations. The purpose of these discussions is to present the information on current practices of individual states, not to advocate a particular approach.

3.1 Potential Future Environmental Regulations

As explained in Chapter 2, reducing the risk associated with potential future environmental regulations is an argument for incorporating environmental externalities into the IRP process. Because electric generating plants and demand-side resources generally last for many years, and because the electricity planning horizon spans 15 to 20 years, additional environmental regulations may be imposed during the planning horizon or lifetime of the demand-side and supply-side technologies. If utilities do not factor such potential regulations into their resource planning, they run the risk of incurring higher-than-necessary emissions control costs in the future, possibly facing the need to raise rates much more than might otherwise be necessary. In this sense, planning for potential future environmental regulations can be regarded as a risk management strategy, not strictly an environmental adder or subtractor.

Missouri, Wisconsin, California, Oregon, and Minnesota explicitly require consideration of future environmental regulations. BPA also has considered potential future regulations, and Connecticut recently found it appropriate to consider them. Illinois is in the process of adopting a methodology for treating environmental externalities in which potential future environmental regulations figure prominently. Missouri defines "probable environmental cost" as follows:

> (46) Probable environmental cost means the expected cost to the utility of complying with new or additional environmental laws, regulations, taxes or other requirements that utility decision makers judge may be imposed at some point within the planning horizon which would result in compliance costs that could have a significant impact on utility rates (Missouri Rule 4 CSR 240-22.020).

The Missouri rule requires utilities to identify a list of pollutants that are, in their opinion, likely to be regulated in the planning horizon, calculate the probable environmental costs associated with each resource option, and rank all supply-side resource options in terms of both utility costs only and utility costs plus probable environmental costs (4 CSR 240-22.040). It further requires the utilities to screen demand-side resources using a total resource cost test that includes utility costs, participant costs, and probable environmental costs (4 CSR 240-22.020 [55] and 240-22.050).

Wisconsin has adopted specific monetized values for greenhouse gases on a dollars-per-ton-of-emission basis. This strategy is intended as a more accurate accounting of the **total societal costs** of a resource option, not as a means of imposing emissions standards on utilities. The Wisconsin PSC indicated that its purpose is to manage the financial risks associated with potential future regulations. In its view, this is a prudent method for hedging the risk of increased regulation on greenhouse gases (Wisconsin PSC 1992). As noted earlier, the Wisconsin PSC adopted this policy after electric utilities successfully challenged a 15% adder for externalities in state courts. Wisconsin utilities are also challenging the current rule in court.

In California, the anticipation that either a carbon tax would be levied or some regulations would be imposed led the California PUC to adopt a policy requiring utilities to obtain assurances from electricity suppliers that the suppliers alone would bear any future cost associated with the carbon tax, the acquisition of tradeable carbon emission permits, or any carbon emission control strategy (Hashem 1993). A new California law that became effective in January 1993 also reflects the consideration of potential future environmental regulations in the new resource planning process. It restricts the use of environmental adders when a carbon tax is imposed on carbon emissions or when a market-based emission trading system is adopted for any pollutant (ECO Northwest 1993).

In Oregon, the PUC adopted specific monetary values for nitrogen oxide (NO_x), sulfur dioxide (SO_2), and total suspended particulates (TSP) because it believes that reasonable estimates for the costs of such emissions are "large enough to conclude that there is a likelihood that they will be internalized in the future" (Oregon PUC 1993, p. 6).[22] In adopting the interim rules, the Minnesota PUC concluded that because there is serious national and international concern over CO_2, future regulations or taxes will likely be imposed on the emission, raising the direct cost of electricity (Minnesota PUC 1994). Similarly, BPA adopted the monetized values for SO_x, NO_x, TSP, and land and water impacts, partially based on its concern about potential future regulations, including taxes on emissions, fuels, carbon, or other substances (Buchanan 1992).[23] Connecticut DPUC found that "the doctrine of prudent anticipation of reasonably certain future regulations is a valid basis for consideration of actions to internalize potential externalities" (Connecticut DPUC 1993, p. 55).

The consideration of likely future environmental regulations appears to play an important role in the on-going process in Illinois to adopt a methodology for incorporating environmental externalities in the IRP process. A proposal by the staff of the Illinois Commerce Commission would require electric utilities to develop a trade-off curve[24] of future environmental regulations (or, in reverse, pollution abatement levels) and a present value of revenue requirements (direct costs) for use in the final resource mix selection process (Stutsman 1993). A proposal by the staff of the Illinois Department of Energy and Natural Resources is also based on the concept of potential future environmental regulations (Bishop 1993).

There are also some arguments against considering potential future regulations. Generally, such arguments repeat what have been described in Section 2.2. Specifically, utilities are concerned about the high cost of complying with existing environmental regulations. Including potential future environmental regulations would further raise electricity costs and, hence, rates. Utilities are concerned about ratepayers' response to higher rates and the utilities' competitiveness in the marketplace. They also are concerned about potential disallowance of the costs incurred to address such potential future environmental regulations.

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[22]However, the Oregon PUC allows offsets. See Section 3.3.

[23]BPA also allows offsets.

[24]See Section 4.1.7 for further discussion on trade-off curves.

This discussion illustrates that a growing number of states are requiring consideration of potential future environmental regulations in utility resource planning as an approach to managing risk. It would be useful to monitor and analyze the results of implementation to derive lessons learned.

3.2 Qualitative Treatment versus Quantification or Monetization

If a PUC decides to require consideration of environmental externalities in the IRP process, it must also decide whether qualitative treatment is sufficient, or whether quantification or monetization is necessary. In qualitative treatment, the utility is asked to describe and characterize, in qualitative terms, the environmental effects of electricity production and use over and above those already covered by existing regulations. The utility then qualitatively or subjectively takes such effects into account in making the final resource portfolio selection.

With quantification, the pollutant and emission amounts are estimated in physical terms. For example, they may be expressed in tons of SO_2 per megawatt-hour of electricity generated; pounds of emissions per million Btu; acres of land affected; the volume of water needed for cooling; changes in water temperature in a lake; percentage reduction in visibility due to an increased concentration of pollutants; loss of habitat due to land and water pollution; or increases in noise level due to electricity generation, mining, and related activities.

Monetization requires that environmental costs or benefits be expressed in terms of dollars. Monetization goes beyond quantification by converting the quantitative measures into dollar values. This necessitates consideration of how to value environmental damages and benefits.[25] Without monetization, incorporating externalities into the resource planning process is largely qualitative or subjective.[26] In practice, however, quantification and monetization are sometimes used interchangeably. As an example, see the Colorado PUC order cited in the following paragraph.

As will be discussed in Chapter 4, among the 29 states and the District of Columbia that require consideration of environmental externalities in the resource planning process, ten states and the District of Columbia require only qualitative treatment, without quantification or monetization. One reason that state PUCs have decided not to require quantification or monetization appears to be the uncertainty concerning the state of the methodologies for quantification and monetization. For example, in deciding to require only qualitative treatment of environmental impacts, the Colorado PUC stated:

> In any event, the evidence in the record indicates that the methods for quantification of externalities are highly complex, and, at this time, still speculative. Even the main proponents of monetization, the LAW Fund and OEC, suggested a "dry run" at quantification in the initial IRP filings. Given this current state of knowledge, it would be premature to mandate utilities to monetize externalities. The adopted Rule 5.11, consistent with comments of the utilities, requires only a qualitative consideration of externalities in the plan (Colorado PUC 1992, p. 9).

Idaho is another example. The Idaho PUC, in approving DSM programs for the Washington Water Power Company in Order No. 24417 (July 16, 1992), refused to assign a 10% adder to the avoided costs for

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[25]Valuation methods and issues are discussed in Section 6.2.

[26]However, see Section 4.1.7 for a description of the multiattribute trade-off analysis, an approach that allows systematic and well-documented decisions without monetization at the individual emission level.

environmental externalities in the cost-effectiveness test of DSM programs. In the PUC's view, "the quantification method requires further exploration and development before its use in avoided cost calculations" (Hashem 1993).

Another reason PUCs resist requiring quantification or monetization is the perceived lack of legal authority. Virginia state law prohibits making speculative adjustments to electricity rates that are based on the cost of serving customers. In the Virginia Commission's view, including environmental externalities in resource planning, which potentially could lead to higher rates, would be "speculative" and is prohibited by state law. The commission suggests that such issues are best left with the U.S. Congress and the General Assembly of Virginia (Hashem 1993).

A third reason for not requiring quantification or monetization is the lack of good data on damage cost estimates. Some state PUCs are not comfortable with using the cost-of-control estimates and would wait until better data or estimating procedures become available before requiring quantification or monetization.

3.3 Offsets

Offsets are measures to mitigate or reduce emissions from other sources to compensate for, or offset, an increase in emissions generated by the specific source in question. Massachusetts used the term "off-site emission reduction" (OER) (Mass. DPU 1992, p. 92). Planting trees and junking old cars are examples of offsets. A utility may invest in a tree planting program, or a program to substitute gas or oil, that would help to reduce the net amount of CO_2 or equivalent in the atmosphere and use the credits generated to offset the increased CO_2 emissions from its own power plants. Because there is currently no mandatory requirement to reduce CO_2, no official "credit" has been established for CO_2. However, AES Corporation, an independent power producer, has initiated three voluntary CO_2 offset projects in Guatemala, Paraguay, and the Amazon regions of Peru, Ecuador, and Bolivia, respectively, for each of its three new power plant projects (Sturges 1993). Many electric utilities in the United States have participated in DOE's Climate Challenge Program to voluntarily reduce their greenhouse gas emissions through DSM programs, use of renewables, high-efficiency generation, electrotechnology and electrification with net greenhouse gas reductions, forestry and other sink-related activities, as well as international activities. In addition, industries and utilities may buy up older cars with high emissions and junk them to obtain credits that offset emissions from their smokestacks.[27]

A number of state PUCs acknowledge or allow offsets in the utility resource planning process. Oregon allows its utilities to use offsets in their least-cost plans. Guideline #5 in Oregon PUC's Order 93-695 states: "A utility may propose the use of offsets in its plan. That is, the utility may reduce the net emissions expected from a resource by bundling it with relatively low-cost offsets (measures to reduce emissions elsewhere)" (Oregon PUC, 1993, p. 11). However, because the quality of available information on the cost of offsets is uncertain and the approach is largely untested, the Oregon PUC would require a high level of proof that the bundled resource is a preferred option.

Massachusetts specifies five general criteria for acceptable OERs: real, permanent, surplus, verifiable, and enforceable. These criteria are defined as follows:

[27]UNOCAL Corporation employs this offset approach to compensate for emissions from its marine terminal operations in the Los Angeles Harbor. In 1993, UNOCAL planned to buy and junk 500 pre-1979 cars and light trucks in order to receive a 1.2 : 1 credit for emissions of hydrocarbons and NO_x for 3 years (CECA/RF 1993b, p. 5).

Real - Reduction must actually reduce airborne pollutants.

Permanent - Reduction must be assured for the lifetime of the relevant increase in the pollutant.

Surplus - Reduction must be in excess of what is required, or what would otherwise occur, over the expected lifetime of the OER.

Verifiable - In order to verify the quantity of the proposed reduction, it must be possible to assess with a reasonable degree of accuracy the emission or pollutant reduction that will result from the source or activity proposed. In addition, it must be possible to ensure that the expected reductions are achieved and that the technology or activity continues to produce the expected reduction over time.

Enforceable - The OER must be approved through a review mechanism that will enable verification of its acceptability and imposition of penalties and/or additional reduction requirements to ensure that the promised OER is achieved in the event that pollution reduction provisions in contracts and permits are not met. (Mass. DPU 1992, pp. 107–108).[28]

Massachusetts DPU distinguishes between two category of OERs: Clean Air Act (CAA) related and optional. CAA-related OERs are those pursued for compliance with environmental regulations related to the CAA. Because environmental regulatory agencies such as the U.S. Environmental Protection Agency (EPA) and the Massachusetts Department of Environmental Protection (DEP) will develop mechanisms for verification and enforcement, the DPU will generally accept the offsets on a one-to-one ratio up to, but not beyond, the full quantity of a resource's emissions (Mass. DPU 1992, pp. 108–110). Optional OERs are those in excess of regulatory requirements, such as for pollutants not yet regulated (CO_2, methane, and nitrous oxide); regulated under the National Ambient Air Quality Standards (NAAQS) but with no state or federal OER provisions (TSP and CO); or regulated under state and federal requirements (SO_x, NO_x, and volatile organic compounds [VOCs]). For optional OERs, the DPU will accept only those that "DEP or another environmental agency documents (through a permit or other enforceable document) as meeting the necessary OER criteria" (Mass. DPU 1992, p. 113). The DPU states that it "supports establishment of OER monitoring and certification mechanisms and will work with the DEP and other agencies to establish and promote certification efforts." (Mass. DPU 1992, p. 113).

The California PUC allows offsets for NO_x only in resource planning and acquisition. Further, considering the newness of the offset market, the California PUC has decided to limit the use of offsets to cases in which they are acquired to comply with the requirements of the air quality management districts to avoid a subtractor relative to the "identified deferrable resources" (California PUC 1991, pp. 37–38; 1992, pp. 78–79). In addition, a 1992 law provides that the PUC shall not apply externality values for emissions for which the utilities have obtained tradeable allowance or offsets approved by environmental regulators. This provision applies to SO_2 and NO_x now and possibly to other pollutants in the future. The Wisconsin PSC finds that "it is reasonable for a utility to use reliable and persistent offsets to reduce the cost of a resource plan, by offsetting associated greenhouse gas emissions." (Wisconsin PSC 1992, p. 95). "Offsets are a market mechanism that encourages utilities to use the lowest cost options. In this way, offsets are similar to the marketable permits Congress created for sulfur dioxide

[28]For comparison, another set of criteria for CO_2 offsets has been suggested by an analyst: credibility, reliability, verifiability, measurability, and cost-effectiveness (Trexler and McFall 1993, pp. 63-64).

emissions in the CAAA of 1990. The cost of the offset is part of the cost of the resource plan." (Wisconsin PSC 1992, pp. 51–52).

Rhode Island appears to require CO_2 offsets for new generating facilities. The Energy Coordinating Council issued a policy statement in August 1989, entitled *Rhode Island's Options for Electric Generation.* One recommendation was for the state to require "implementation of mitigative measures, such as tree planting, so that CO_2 emissions from generating facilities within Rhode Island will not contribute to global warming" (Rhode Island Energy Coordinating Council 1989, p. 41). This recommendation was subsequently incorporated into the January 1990 revision of Rhode Island Energy Facility Siting Board Rules of Practice and Procedure:

> 21) The applicant must provide evidence to show that the project conforms with Rhode Island Energy Coordinating Council's policy statement entitled *Rhode Island's Options for Electric Generation* dated August 1989, including any revisions or any successor to that document that may replace it as state policy (Rhode Island Energy Facility Siting Board 1990, p. 10).

BPA also allows offsets for SO_x. Although BPA has adopted a \$1500 per ton value for SO_x, it will consider substituting the lower cost of offsets in evaluating a resource bid. "If the cost of purchasing offsets is contemplated by the sponsor of a resource proposal, evidence is offered that such offsets can and will be purchased at a specified cost, and that cost is included in the bid price. BPA will not assign a cost of SO_x emissions to that resource. In such cases, the sponsor must show the bid price reflects the costs of offsets" (BPA 1991, p. 4). If any sponsor of a resource proposal has purchased offsets for SO_x and offers evidence of that purchase to BPA, BPA will not apply a cost to SO_x emissions (BPA 1991, p. 4).

A task force formed in 1991 by the Arizona Corporation Commission (ACC) recommended that utilities should have the flexibility to employ offsets as a means to provide electric energy services at the lowest cost to society. In March 1993, the ACC accepted the task force's recommendations and initiated a rulemaking proceeding (Hashem 1993).

For some offsets such as those for SO_2 and for NO_x in ozone nonattainment areas, programs are already in place under the CAAA to ensure that offsets are reliable, durable, and accurately calculated. These offsets are legally required, and PUCs allowing such offsets generally do so to recognize that there will be no net increases in emissions when the legally required offsets are included.

When offsets are applied across national boundaries, it is called **"joint implementation."** This often requires bilateral agreements. Joint implementation is an area of contention in the effort to reduce CO_2 emissions. Electric utilities and other potential emitters of CO_2 in the United States and other developed countries see the potential cost savings that can be realized from joint implementation and argue for its use. Developing countries stand to benefit substantially from projects involving more efficient power generators, distribution systems, renewable energy sources, improved forest management, and land rehabilitation. Thus, they were expected to be in favor of joint implementation. Nevertheless, in the eighth meeting of the Intergovernmental Negotiation Committee (INC) (INC 8) of the United Nations Framework Convention of Climate Change (FCCC), held in 1993, developing countries raised three major concerns. First, because developing countries currently have few obligations under the FCCC, they are concerned that participation in joint implementation projects will advance the imposition of emissions reduction requirements on them. Second, there is no assurance that investments made by developed countries in the name of joint implementation will not be only a diversion from existing foreign aid funds, rather than a true incremental investment. Third, there is no assurance that joint implementation will not become the only method that developed countries implement for emissions reductions, hence, there may be no actual transition to alternative energy sources and changes in lifestyle. In addition, environmental groups and others are concerned about the lack of monitoring and verification processes and the potential for abuse (Trexler and McFall 1993, p. 67; *Electric Utility Week* 1993).

The previous discussion shows that offsets appear to be both within and outside the influence of state PUCs. In varying degrees, commissions in Oregon, Massachusetts, Wisconsin, and California allow the use of offsets. Rhode Island appears to require CO_2 offsets for new generating facilities. On the other hand, environmental laws and regulations may set forth requirements with which utilities would have to comply and which PUCs would have to accept. For this reason, offsets would appear in both the categories of "methods not under PUC influence" and "PUC-influenced methods" in the taxonomy of alternative methods for addressing environmental externalities discussed in Section 4.2.

In short, offsets can be regarded as an approximation to a market-based mechanism to control pollution by allowing utilities and industries to seek the most cost-effective ways to meet pollution abatement objectives. However, for many pollutants, including CO_2, the reliability and durability of offset results, costs of offsets, and feasibility of enforcement are issues that need to be critically examined.[29] In addition, joint implementation is just being worked out on a formal intergovernmental basis.

3.4 Policy Coordination

Environmental externalities often involve specific local and state conditions. It is therefore necessary to measure environmental impacts, and to implement pollution control or abatement measures, at the local and state levels. The effects from some activities, such as releasing emissions from smokestacks or using water from a river flowing through several states, are widely distributed geographically. Thus, environmental impacts from energy production and use often cross political boundaries and require regional, federal, and even international responses.[30] Some of these wide-ranging pollutants may be covered by federal regulations and are already internalized into production and consumption decisions. In such cases, regulators need to avoid double counting environmental damages. For these reasons, externality policies must be coordinated at all levels of government.

Furthermore, a distinction needs to be made between local and global pollutants. A global pollutant such as CO_2 influences the climate of the entire planet, necessitating a coordinated response to control emissions and mitigate impacts. Uncoordinated local control of global pollutants would likely impose high costs on the locality without yielding any discernable benefits. On the other hand, controlling local pollutants at the local level does yield benefits to the locality, and there is less need for coordination.

One area requiring coordination is between environmental regulators and economic regulators. In June 1989, the EPA sponsored a 2-day workshop on the then-proposed CAAA provisions. State PUCs and environmental regulators were brought together to discuss policy and coordination issues. The topic was also discussed by the Committee on Energy Conservation at both NARUC's annual meeting in November 1993 and its winter meeting in February 1994.

Massachusetts has initiated such policy coordination in the area of offsets. The Massachusetts DPU has stated that it will accept offsets that are certified by the DEP and other environmental regulatory

[29]See Section 6.3.4 for a short discussion on the mandatory offset policy under the NAAQS.

[30]Some would note that electricity also flows across political boundaries.

agencies.[31] FERC staff have also considered the need for such coordination. In its view, environmental regulators are better situated to acquire and interpret the complex data on emissions and are more accustomed to making trade-offs between environmental and economic goals than are economic regulators. In addition, FERC staff believe that environmental regulators have authority over all potential polluters, including industries, transportation, businesses, and individuals, whereas economic regulators such the PUCs usually have jurisdiction over only regulated utilities. For these reasons, FERC staff recommended that environmental regulators establish environmental quality standards and economic regulators implement those standards for jurisdictional utilities (FERC Staff 1992, pp. 31–32 and p. 52).

The Consumer Energy Council of America Research Foundation (CECA/RF) also developed a similar recommendation:

> 23. State should establish coordinated environmental policy-making between relevant agencies including PUCs, state EPAs, state licensing authorities and other relevant state and local agencies (CECA/RF 1993a, p. 47).

Other areas of policy coordination involve different levels of government. CECA/RF has developed several recommendations relating to such coordination:

> 6. Appropriate authority at the federal and state levels should embrace a public responsibility to work for lowest total social cost. Total social cost is the sum of the private and external costs and benefits of a given economic activity.
>
> 7. Policymakers should recognize that there is room for diversity in externalities policy across levels of government. The federal government should play an important role in formulating policy responses to environmental externality problems. States and local governments have an important role in implementing national policies, as well as in complementing or supplementing federal actions (CECA/RF 1993a, p. 31).
>
> 19. Pursuit of lowest total social cost should include efforts to achieve coordination across levels of government and between agencies at each level of government, where appropriate. International, national, regional, state, and local agreements should be negotiated to implement this coordination, where appropriate (CECA/RF 1993a, p. 42).
>
> 22. Where state authorities act on externalities, they should analyze whether federal policies fully reflect local conditions and environmental values. The decision of whether to incorporate externalities varies from state to state (CECA/RF 1993a, p. 46).

Recommendation 6 advocates explicit consideration of externalities in public decisions and suggests social cost is the metric of concern. Recommendation 7 stresses the federal role in policy formulation and the state role in implementing environmental policies formulated at the federal level. It does, however, allow for local and state diversity. It goes further to suggest state and local entities should have the authority to set policies to accommodate specific local conditions, presumably when they are consistent with federal policies. Recommendation 19 explicitly sets out the goal of policy coordination across all levels of government. In the ideal situation, there would be perfect coordination and it would be achieved in a timely and efficient manner. In reality, coordination across different levels of government, across different agencies at the same governmental level, or both, is usually time consuming. Attempts to achieve perfect

[31]See Section 3.3, Offsets.

coordination sometimes result in inaction. Recommendation 22 is a necessary and appropriate practice for assessing current situations. If federal regulations completely cover local conditions, additional state regulations lead to double counting and should be avoided.

The regional approach to addressing environmental externalities is one form of policy coordination. The six New England PUCs (Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont) began to develop a regional approach in July 1991. They formed the Core Group on Regional Coordination and Environmental Externalities (The Core Group) with representatives from each of the six New England PUCs "to explore options for regional coordination in addressing environmental issues in utility resource planning and procurement decisions and to develop practical policy recommendations for consideration by each New England State" (The Core Group 1993, p. 1). The Core Group issued a draft final report in December 1993. It recommends formation of a standing committee with staff appointed by each of the region's PUCs in order to conduct coordinated research, analysis, and policy development on regional environmental issues and the impacts of electric generation. It also makes specific recommendations concerning environmental externality policy analysis, compliance with the CAAA, prudent anticipation of greenhouse gas regulations, the regional nature of the power supply in New England, and interagency coordination (The Core Group 1993, pp. 31–48).

Policy coordination between economic and environmental regulators and among federal, state, and local governments, as well as the regional approach, can yield benefits by achieving the desired pollution reduction while avoiding some of the unintended piecemeal problems discussed in Chapter 2. There are, however, associated costs in terms of the required time and resources, delays, and, in the extreme, inaction when the process fails to reach consensus. Thus, there is a potential trade-off between the benefits and costs of policy coordination. Both the potential benefits of policy coordination and the costs of undue delays and inaction that might result from coordination need to be considered.

3.5 Full-Cost Dispatch

Whether or not environmental externalities are treated in the IRP process affects what kinds of resources are added to the utility's resource portfolio, i.e., resource planning and acquisition. In contrast, considering environmental externalities in utility operations affects a utility's use of existing resources. Including externalities in utility operation decisions is referred to as full-cost dispatch or environmental dispatch.

Traditionally, the generating system of an electric utility or a regional system is operated by economic dispatch. Power plants in the system are ranked according to their incremental direct operating costs and dispatched in ascending order until all customers' loads are met. Hydro and nuclear units usually have the lowest operating costs and are put on line first; these are the base-load units. Coal-fired plants have somewhat higher costs and are dispatched next. Most coal-fired plants are treated as base-load units, but some are cycled to follow the variations in customer loads (the cycling units). Oil- and gas-fired plants normally have the highest incremental direct variable costs and are called into action only during the peak periods of customer loads; these are the peaking units. Ranked generally in increasing order of their operating costs, oil- and gas-fired plants include gas combined-cycle, gas steam, residual oil steam, gas combustion turbine, and oil combustion turbine plants (Bernow, Biewald, and Marron 1990).

Under economic dispatch, the measure of concern is direct operating cost. To the extent that existing environmental regulations require utilities to install pollution abatement measures, those costs are part of the variable operating costs and are included in the calculations for dispatching different generating units.[32] In contrast, the costs of residual environmental effects are not part of the operating costs and, therefore, are not considered in economic dispatch. Taking into account external environmental costs in dispatching generating units to serve customer loads is called "environmental dispatch," "full-cost dispatch," or "social dispatch" (Bernow, Biewald, and Marron 1990; ECO Northwest 1993; Krause, Busch, and Koomey 1992).

There are two arguments for full-cost dispatch. First, the external environmental costs of operating existing plants are real costs to society that should be reflected in the variable cost structure used by utilities to dispatch resources in order to ensure optimal allocation of resources. For the same reasons that the social costing approach is appropriate in the selection of future generating resources, it is appropriate in the operation of existing generating systems. Applying social costs to resource acquisition planning and not to operations of the existing system could result in inefficiency in the allocation of society's limited resources. Second, full-cost dispatch would result in more immediate payoff in terms of emissions reductions than applying the externalities to new resource acquisition decisions. In many cases, plants with less emissions have a comparative advantage over plants with more emissions and will be dispatched more frequently under full-cost dispatch. Without full-cost dispatch, this comparative advantage for plants with less emissions disappears, and plants with more emissions are dispatched more often, raising the overall pollution level. Moreover, emissions are reduced almost immediately when a less-emitting unit is fired up in place of a more emitting unit. In applying the social costing approach in the resource acquisition planning process, pollution abatement benefits can be realized only over a period of years after new plants are built and placed in service.

The main argument against full-cost dispatch is that it will raise the direct cost of electricity, increasing rates and harming electricity's competitiveness in the marketplace.[33] Results from modeling the operation of utility systems confirm that the average system operating costs are indeed raised because some gas- or oil-fired units may replace coal units as the base-load plants (Bernow, Biewald, and Marron 1990, p. 13; Van den Berg et al. 1993, p. 8; Krause, Busch, and Koomey 1992, p. 61). Technical constraints also could contribute to additional increases in costs if the plants are operated in order to achieve full-cost dispatch. If, on the other hand, technical constraints are recognized as truly limiting, the level of emissions reduction that can be achieved under full-cost dispatch would be lowered. For example, coal plants are generally designed to serve the base loads and must meet some minimum loading requirements. Under full-cost dispatch, such coal plants may serve as intermediate or cycling units to be cycled in and out of the grid according customers' loads. This would necessitate changes in planned maintenance scheduling requirements, forced outage characteristics, and routine operating and maintenance costs. In addition, units designed for base load as cycling units could result in premature degradation of such units. At the same time, gas- and oil-fired plants originally designed to serve peak loads may not be operated continuously for long periods without breakdown (Bernow, Biewald, and Marron 1990, pp. 161–163; Van den Berg et al. 1993, p. 8).

Other arguments against full-cost dispatch include PUCs' lack of legal authority, potential "stranded assets," and the difficult task of monitoring and enforcing the requirement. For example, PacifiCorp (1993) stated that Oregon PUC has no authority in requiring environmental dispatch. Analysts with EEI contend that their modeling results show there is a potential for stranded investment:

[32]A caveat is that such pollution abatement costs are often treated as fixed costs and are therefore not considered in the dispatch decision.

[33]Proponents of full-cost dispatch would view this result as reducing the societal subsidy to electric utilities in the form of free clean air.

> An externality policy would also disproportionately injure utilities with significant undepreciated coal-fired generation. In particular, recently installed flue-gas desulfurization (FGD or "scrubber") equipment could become "stranded assets." Coal units with FGD, even with their low sulfur dioxide emission rates, are quite vulnerable to an externality policy. The capacity factors of the low-sulfur coal units in our case studies fell off dramatically when externalities were incorporated in unit commitment and dispatch. Indeed, coal units with FGD, because of their relatively high heat rates, are especially sensitive to the effect of high externality adders for carbon dioxide (Van den Berg et al. 1993, p. 9).

Van den Berg et al. (1993) further argue that PUCs face a major barrier to implementing a full-cost dispatch policy for treating externalities in the resource acquisition planning process. Resource planning decisions are typically made annually or even less frequently, enabling PUC staff to properly review and monitor the decision-making process. In contrast, full-cost dispatch requires that dispatch decisions be made in real time, several hundred or even more than 1000 times per year. PUC staff may not be in a position to fully understand the system and properly monitor and review the numerous decisions made. Van den Berg et al. point out, however, that the continuous emission monitoring requirement of the 1990 CAAA may offer an opportunity for state PUCs to follow such decisions (Van den Berg et al. 1993, p. 9).

Although not requiring full-cost dispatch, the Oregon PUC has a guideline directing electric utilities to identify "what its preferred strategies would be if the external costs of operating its resources were internalized, using the values for NO_x, TSP, and CO_2 specified in the second guideline" (Oregon PUC 1993, p. 10). Part of Oregon PUC's justification is as follows:

> Electric utilities face the business risk that the external costs of operating their resources will be internalized. In that case, dispatch decisions would change to reflect the new utility costs. This guideline directs them to address that risk. Although operations would not actually change until taxes or other limits were imposed, resource acquisition decisions today might be affected by the chance that external costs will be internalized and resources dispatched in a different order in the future. For example, recognizing this possibility would increase the value of lost opportunity efficiency measures installed today (Oregon PUC 1993, pp. 10–11).

Ohio required that regulated utilities address the viability of SO_2 emissions dispatch as a potential strategy for complying with the 1990 CAAA in their 1992 resource plans (Hashem 1993). In particular, "the desired effect is to run those generating plants with the lowest sum of direct costs plus the costs of SO_2 allowances at full capacity before bringing on line plants with higher costs" (ECO Northwest 1993, p. 23). New York has an ongoing proceeding (Case 92-E-1187) on environmental externalities that will assess the potential use of environmental dispatch as part of its objectives (ECO Northwest 1993, pp. A-25 and A-26).

In short, there are two main theoretical arguments for requiring full-cost dispatch: (1) external environmental costs are real costs to society and should be factored into production and consumption decisions and (2) the impact on reducing emissions levels is much more immediate when compared to requiring social costing in the resource planning process. Nevertheless, actual state PUC experience on the approach is still quite limited because of the complexity in monitoring the operation, PUCs' lack of expertise and capability in this area, and the utilities' concern for stranded investment potential and for potential adverse impacts on rates.

3.6 Summary

This chapter examines the policy and regulatory issues of potential future environmental regulations, qualitative treatment versus quantification or monetization, offsets, policy coordination, and full-cost dispatch. With regard to potential future environmental regulations, Missouri, Wisconsin, California, Connecticut, Minnesota, Oregon, and BPA have decided to treat the incorporation of environmental externalities as a strategy for managing the risk of potential future regulations or possible future taxes on greenhouse gases. Illinois is considering such a strategy. Therefore, it appears that a growing number of states are requiring consideration of future costs or regulation as an approach to managing risk. Because several states have already adopted such an approach, it would be useful to monitor and analyze their results to derive lessons learned.

Some states have decided to require only qualitative treatment of environmental externalities, while others require either quantification or monetization. State PUCs have given three reasons for not requiring quantification or monetization: (1) methodologies for quantification or monetization are in need of further development; (2) there is a perceived lack of legal authority to enforce such a requirement; and (3) utilities are concerned about potential increases in electric rates in states requiring quantification relative to states without such requirements.

Offsets are measures used to reduce emissions from other sources to compensate for the increases in emissions generated by the specific source in question. Offsets can be regarded as an approximation of market-based mechanisms to control pollution by allowing utilities and industries to seek the most cost-effective ways to meet pollution abatement objectives. For some offsets, such as those for SO_2 and for NO_x in ozone nonattainment areas, programs are already in place under the CAAA to ensure that offsets are desireable, durable, and accurately calculated. These offsets are legally required, and PUCs allowing such offsets generally do so to recognize that there will be no net increase in emission when the legally required offsets are included. For other emissions, including CO_2, however, the reliability and durability of offset results and the feasibility of enforcement need to be critically examined. States and others that allow offsets are Oregon, Massachusetts, Wisconsin (for greenhouse gases), BPA (for SO_2), and California (NO_2 and SO_2 only), and it is being considered in Arizona. Rhode Island appears to require CO_2 offsets for new generating facilities. Applying offsets across international boundaries, called joint implementation, is just being worked out on a formal basis by the INC of the United Nations' FCCC.

Policy coordination among economic and environmental regulators and among federal, state, and local governments, as well as the regional approach, can yield benefits by achieving the desired pollution reduction while avoiding some of the unintended effects of the piecemeal problems. However, coordination requires time and resources, and may result in delays and even inaction if the process fails to reach consensus.

In full-cost dispatch, utilities consider the total societal costs of operating their existing resources, including external environmental costs. Although some argue for requiring full-cost dispatch, only Oregon and Ohio have limited experience in this area. Oregon directed utilities to identify what their preferred strategies would be if the external costs of operating resources were internalized. Ohio requires that regulated utilities address the viability of SO_2 emissions dispatch as a potential strategy for complying with the 1990 CAAA in their 1992 IRP filings. Arguments against full-cost dispatch include the complexity in monitoring its operation, the PUCs' lack of expertise and capability in monitoring such operations, as well as the utilities' concern for stranded investment and for potential increases in electric rates.

4.0 Alternative Approaches and State Activities

There are several different ways to include consideration of environmental externalities in the utility resource planning process. Since 1989, state PUCs have experimented with various approaches. This chapter first describes the main methods adopted or proposed for adoption by PUCs, then provides a summary of state PUC actions. It also develops a taxonomy of the full range of alternative methods for addressing environmental externalities and touches on several related issues.

4.1 Description of Alternative Approaches

Seven main approaches have been identified for addressing environmental externalities in the IRP process: qualitative treatment, weighting and ranking, cost of control, damage function, percentage adders, monetization by emission, and multiattribute trade-off analysis.[34] This section briefly describes these approaches and discusses their relative strengths and weaknesses. Another alternative, the offset approach, was covered in Section 3.3 and is not described here. A taxonomy of all alternative methods to address environmental externalities is presented in Section 4.2 to clarify the relationship between the alternatives discussed in this section and those that will be briefly noted in other parts of this report.

4.1.1 Qualitative Treatment

The qualitative approach to incorporating environmental externalities generally follows informal and loosely defined guidelines. Under this approach, a utility lists the types and rates of emissions and pollutants, describes the potential impacts, and characterizes the externalities using categories such as "no impact," "moderate impact," or "substantial impact." This information is then judgmentally or subjectively factored into the resource selection process (Destribats et al. 1990; Temple, Barker, & Sloane, Inc. [TBS] 1991, pp. IV-1; CECA/RF 1993a, p. 86).

An example of the qualitative approach is Northern States Power Company's evaluation of factors not easily expressed in dollars (NEEDS). For each potential project or option, Northern States Power uses a series of worksheets to assess the impacts on factors such as health, safety, reliability, the environment, fuel, society, economics, politics, flexibility, and technical innovation. Several elements are considered for each factor. For example, the health elements include particulate emissions, toxic emissions, carcinogenic emissions, radon/indoor air pollution, hazardous waste discharges, proximity to population centers, and electromagnetic fields. Environmental elements include wetlands, forestry, agriculture, recreation areas, endangered species habitat, water quality, acid deposition, fish and wildlife, aesthetics/viewsheds, noise levels, and construction impacts. The levels of severity are "none/no," "light," "moderate," "significant," and "great/yes." In addition, if there is a "fatal flaw" in the project or option, it will be emphasized (Prestin 1990).

Some state PUCs have specified that environmental impacts should be qualitatively considered in the resource selection process. For example, Colorado's rule is as follows:

> For each resource considered for inclusion in the utility's portfolio of resources to be acquired in the action plan or projected to be acquired in the IRP, the utility shall identify environmental and other impacts of the resource and any other resources considered but

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[34]The literature also mentions other approaches such as bonus rate of return, shared savings, and set-asides. Strictly speaking, they are not externality policies per se but are energy efficiency, DSM, or renewable energy promotion policies with some implications for environmental externalities. For this reason, they are not included in the main text but are discussed in the Appendix.

not selected. The utility shall show how qualitative consideration of these factors was utilized by the utility in developing its plans (Colorado PUC, Electric Integrated Resource Planning Rules, Section 5.11).

The primary advantage of the qualitative approach is that it is relatively easy to apply, even when there is a general lack of data on the potential impacts of resource options. It can also be used to assess various nonquantifiable externalities such as the value of endangered species and biodiversity. The disadvantages of the qualitative approach are that it is subjective and, other than the broad impact categories mentioned above, does not estimate the degree of impacts associated with different externalities. This lack of specificity makes it difficult to compare the environmental impacts of different resource options. As a result, the trade-offs made by decision makers among different externalities are implicit, rather than explicit or transparent (Destribats et al. 1990; TBS 1991). Therefore, it is difficult for a third party to independently replicate and verify results obtained from application of the qualitative approach (Galen and Porter 1993).

4.1.2 Weighting and Ranking

The weighting and ranking approach is a hybrid between the qualitative approach and the quantitative damage function approach. This method ranks and assigns scores to the emissions and other externality factors associated with a resource option. These scores are then combined to derive an overall score for the resource options under consideration. The assignment of scores and weights is based on available data (such as previous studies) and, to some extent, on judgment. The weighted environmental scores for each resource option may also be combined with other price and nonprice factors such as reliability, dispatchability, and fuel diversity (TBS 1991; ERGI 1992a).[35] If desired, the total resource option score can be linked to an adder term to translate the relative impacts into changes in costs (Destribats et al. 1990; Illinois Commerce Commission 1992, p. 60).

The weighting and ranking method has been implemented in New York and by the New England Electric System (NEES) (CECA/RF 1993a, Destribats et al. 1990). NEES initially included ten environmental concerns: global warming, acid rain, land use, solid waste, water use/quality, air emissions, aesthetics, indoor air quality, fuel use, and ozone. For each environmental concern, there may be one or more pollutants of interest, such as CO_2, methane (CH_4), and chlorofluorocarbons (CFCs) for global warming, or VOCs and NO_x for ozone (Destribats et al. 1990). Following review and comments, NEES dropped aesthetics from its list because it appeared to be more of a siting issue than an environmental issue. In addition, indoor air quality was excluded because it was covered in the company's DSM program design and implementation efforts. Finally, fuel use was deleted because those concerns were already addressed in other categories (Destribats et al. 1990).

In contrast to qualitative treatment, the weighting and ranking method introduces a quantitative element into the consideration of environmental externalities in the IRP process. The use of weights and scores makes the judgmental component of the weighting and ranking approach more transparent. If the procedures and instructions are explicit, then the approach is fairly easy to implement and the substantial data requirements of the direct estimation or damage-cost approach can be avoided (TBS 1991).

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[35] An example of such weighting is provided by New Jersey. According to the Board of Regulatory Commissioners order in Docket No. 8010-687B, environmental externalities are to be considered as part of the "non-economic issues" category, which is one of three categories of weighting factors for all-source bidding. The other two categories are economic issues (55% maximum) and project viability (25% minimum). A utility may propose for the board's approval its own weighting system as long as it is consistent with these guidelines.

The primary weakness in the weighting and ranking approach is the degree of subjectivity and judgment involved in assigning scores and weights. If the aggregate weighted scores are converted into changes in costs through percentage or absolute cost adders, there is an additional element of judgment involved. However, these judgments are relatively transparent because they are documented in the methodology used.

4.1.3 Cost of Control

The cost-of-control method is based on the assumption that the value of damages to the environment and human health due to emissions and pollution can be approximated by the costs of controlling pollution to the desired abatement level. In the literature, several terms are used to designate the control-cost approach (Cohen et al. 1990; ERGI 1992a; ECO Northwest 1993): the **abatement-cost approach** (ORNL and RFF 1992; CECA/RF 1993a), the **revealed-preference approach** (CECA/RF 1993a), and the **implied valuation** method (Mass. DPU 1992). The term "revealed preference" refers to the idea that existing environmental regulations reveal the preferences of legislators and regulators to balance the costs and benefits of pollution abatement.

Some define marginal control cost as the cost associated with the last unit of control or abatement measure, while others define it as the lowest cost or the most economically efficient option available to reduce the pollutants of interest. The former definition tends to yield the highest cost of control, which is often several times that of the latter definition (Galen and Porter 1993).

The 1993 NARUC externality report identifies three variations of the control-cost approach. According to the **mitigation-cost** version, electric utilities can take actions at other sites, such as planting trees in the tropics or other forest preserves, to mitigate the environmental damage caused by generation and transmission facilities.[36] In the **regulation-cost** version, electric utilities are required by state and federal laws and regulations to install specific equipment or measures to reduce pollution. Under the **risk-management** strategy, a utility may be required to compute the present value of all potential future liabilities associated with potential future environmental regulations or litigations and spend up to that amount to control the pollutants of interest (ECO Northwest 1993, pp. 28–30).[37]

California, Massachusetts, New York, Nevada, Oregon, and Wisconsin have used the cost-of-control method to derive monetized measures of environmental externalities for some pollutants for different reasons. Massachusetts, Nevada, and New York adopted externality values that are based on marginal costs of control (regulation costs) for pollutants other than CO_2. For CO_2 the values are based on various estimates of how much CO_2 must be mitigated and at what costs. As mentioned in Section 3.1, the values adopted by Wisconsin are based on managing the risk of potential future environmental regulations. In August 1990, the Massachusetts DPU decided in DPU 89-239 to direct electric utilities to use the control-cost estimates "as proxy to environmental damages in the absence of comprehensive damage cost estimates" (Mass. DPU 1990, p. 70). In 1992, the DPU again considered, in DPU 91-131, the evidence and information concerning appropriate methods and concluded that the previously derived control-cost values, after adjusting for inflation, were still valid. It retained the control-cost values mainly because proponents of the damage-function approach (discussed in Section 4.1.4) failed to present estimates that met the DPU's comprehensiveness and reliability criteria for accepting new values. However, a concurring opinion stated that the control-cost values adopted by the commission were never tested with the same criteria and that they were accepted partly on the basis that they would have little impact on resource

[36]This appears to be the offset or off-site emission reduction (OER) approach discussed in Section 3.3.

[37]Issues concerning potential future environmental regulations are discussed in Section 3.1.

procurement decisions in the near term (Mass. DPU 1992). In Order No. 93-695, the Oregon PUC endorsed the control-cost framework and adopted values for NO_x, TSP, and CO_2 (Oregon PUC 1993).

In general, the cost-of-control approach is simpler to implement than the damage-function approach. The external cost can be set equal to the cost incurred by the electric utility to meet an environmental regulation, a number that is relatively easy to derive. Proponents argue that, if the regulation is set optimally, the cost of control may be a good proxy for the value of damages because, according to economic theory, the cost of abating the emission at the margin should be equal to the benefit of reducing the last unit of emission.

However, this method has several weaknesses. First, because environmental regulations are rarely set at the optimal level (where marginal cost of control is equal to marginal benefit of emission reduction), the marginal cost of control cannot be equated with the value of marginal damages. Second, when the same environmental standard is set for the same type of plant in different regions of the country (such as requiring installation of scrubbers for all coal-fired plants) the abatement costs are likely to be of the same order of magnitude, while the environmental damages from these power plants will generally vary according to local conditions. For example, a coal-fired plant located in the Midwest is likely to cause quite different environmental impacts than the same type of plant located in New England because of variations in regional geography. The same holds true for health damages because of varied population concentrations. An oil-fired plant located in New York City will have greater adverse impacts on health than an oil-fired plant located in a sparsely populated region. Finally, application of the cost-of-control method, which equates the highest cost of control with the cost of marginal damages, may lead to the selection of a mix of resources that is quite different from that selected when true damage costs are applied (ORNL and RFF 1992).

4.1.4 Damage Function

An alternative to the judgmental or indirect methods outlined above is to assess **directly** both the beneficial and damaging effects of electricity generation and use on the environment and society. This approach is referred to as the **direct costing** approach (CECA/RF 1993a) or **direct impact assessment** (ERGI 1992a); both terms emphasize the "direct" aspect of the method. The "damage" aspect is more prominently highlighted in terms used by some analysts in the field: the **damage valuation** approach (Mass. DPU 1992), the **damage cost** approach (ECO Northwest 1993), and the **damage function** approach (FERC Staff 1992; ORNL and RFF 1992; CECA/RF 1993a; Rowe 1993).[38] The term **damage function** approach will be used here.

In the simplest terms, the damage function approach identifies the specific beneficial and harmful impacts of emissions or pollutants for each resource option, measures the damages and benefits in physical terms, assigns economic values to each impact, and sums the values of all impacts to derive the total impact value of a resource option. The assigned economic values may be based on market prices, published values, damage awards in court cases, approximations based on some observed behaviors or other market prices, as well as estimates derived for willingness to pay to avoid the damages or willingness to accept compensation for the damages sustained (ECO Northwest 1993).[39] When applied to electricity, the damage function approach considers the entire cycle of each of the fuels used in generating electricity. In a complete analysis, the impacts covered include those occurring at all stages of the fuel cycle,

[38]Although the word "damage" is used, the damage function approach usually takes beneficial impacts into account as well.

[39]See Section 6.2 for a discussion on the valuation methods.

from fuel extraction, transport, and conversion to end use, waste disposal and recycling, and decommissioning.[40]

The U.S.-E.C. Fuel Cycle Study (ORNL and RFF 1992) is one example of how the damage function approach is applied. This study adopts the "impact-pathway" damage function approach, which has the following four components: (1) naming the activities and estimating their emissions and other residuals; (2) quantifying the physical impacts of the emissions and residuals; (3) translating the physical quantities into economic damages and benefits; and (4) distinguishing externalities from internalized costs and benefits (ORNL and RFF 1992, p. 2–5). The study covers four conservation options and the following eight fuel cycles: coal, small hydroelectric, natural gas, oil, biomass, photovoltaic, uranium, and wind. The fuel cycle of coal-fired electricity is used to illustrate the application of this method in the following discussion.

The coal fuel cycle includes coal mining, coal cleaning and beneficiation, transport, electricity generation, transmission, distribution, and end use. The emissions of each of these activities are listed and characterized first in physical terms (the source terms). The transport and transformation of the source terms are then described and modeled to derive the dose of exposure to humans and the environment, and human and environmental responses are ascertained (the response rates). The impacts are subsequently grouped into different categories of production, consumption, and health effects: crops and suburban landscapes; livestock; timber; commercial fishing; recreational fishing; hunting; recreation; biodiversity; accidents; cancer; mortality; respiratory diseases (such as asthma attacks, irritation symptoms, and respiratory insufficiency), neurological, cardiovascular, reproductive, and immunological effects; and occupational impacts such as mining accidents, black lung, and progressive massive fibrosis (ORNL and RFF 1992). Finally, the impacts are valued using available measures and estimates derived from applying the "willingness to pay" or the "willingness to accept" concepts, when appropriate. An accounting framework is used to implement the damage function approach. Because the damage function approach is complex and involves many disciplines and the availability of data and information is limited, only the major impact pathways are usually considered.

The U.S.-E.C. study is the most prominent of the current efforts to apply the damage function approach. It began in February 1991, and the basic background document was published in December 1992 (ORNL and RFF 1992). The individual fuel cycle studies are expected to be published in 1994. A number of states have also initiated activities to explore the feasibility of the damage function approach. In December 1991, New York began a multiyear collaborative project to apply the damage function approach (Rowe 1993); Report 1 on externalities screening and recommendations was published in December 1993 (RCG/Hagler, Bailly, Inc. 1993). In Wisconsin, a utility-sponsored and initiated study based on the damage function approach is expected to be completed in 1994. The California Energy Commission has developed a set of externality values based on damage functions, but these have not yet been adopted by the California PUC. The South Coast Air Quality Management District has also developed damage-cost-based values (ECO Northwest 1993).

One major strength of the damage function approach is that it is based on the integration of physical and social sciences (ORNL and RFF 1992). It is recognized by many analysts as being conceptually correct. The approach also allows consideration of both benefits and damages and permits explicit treatment of full fuel-cycle impacts. It is therefore regarded as the most comprehensive method to assess the external impacts of electricity resource options.

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[40]For this reason, some analysts use the term "fuel cycle analysis." For example, see BCS, Inc. (1993).

The primary weakness of the damage function approach is that it requires an extensive set of data to fill the accounting framework. Substantial staff and financial resources are needed to adequately and appropriately implement this approach. For this reason, some state PUCs have decided not to implement it, although they agree that it is theoretically the most appropriate of the existing alternatives. Another weakness of the damage function approach is that it involves estimating the values of nonmarket goods and services, which is often extremely difficult and controversial (ECO Northwest 1993, pp. 28–29).[41]

4.1.5 Percentage Adders[42]

In the **percentage adder** approach, a fixed percentage is either added to, or subtracted from, the estimated cost of a resource option, depending on whether environmental and other damages or benefits are being considered. The values of the adders (or subtractors) are sometimes set by law, sometimes based on judgment, and sometimes based on estimates of control or damage costs (or benefits). For example, Northwest Power Planning Council, following the mandate of the Pacific Northwest Electric Power Planning and Conservation Act of 1980, a federal statute, applies a 10% credit to conservation and renewable energy options (Cohen et al. 1990). Two states currently have percentage adders in place: Iowa adds 10% for electricity and 7.5% for natural gas, and Vermont adds 5%.[43]

The adders may also be expressed in terms of dollars per unit of energy. Two states have specified adder values of this type. New Jersey assigns $0.02 per kWh in 1991 dollars for electricity DSM programs and $.95 per million Btu saved in natural gas for gas DSM programs. In Iowa, a value of $0.007 per kWh is added to the avoided cost of "alternate energy production" up to the first 120 MW.[44] As mentioned in an earlier footnote, this practice is a pro-alternative-energy policy and not strictly an externality policy.

When the adder value is based on judgment, the "judgment" element is both a strength and a weakness of the approach. Adders can be applied easily and immediately and, if necessary, can be readily acknowledged as being based on judgment. As better information concerning externalities becomes available, the values can be easily adjusted to incorporate the new information. On the other hand, the adder approach is judgmental and subjective; the values selected are often criticized as arbitrary, bearing no or little relationship to damages caused by the pollution (Joskow 1992). In addition, as mentioned in Section 2.2, electric utilities argue that applying adders to electric generation only leads to so-called piecemeal problems.

It should be noted that, in the literature, the terms "adders" and "environmental adders" are used to refer to both the percentage adder method and the monetized values by emission method described in the next section.

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[41]See Section 4.4.3 for additional discussion on the difficulties in implementing the damage function approach.

[42]In an earlier draft, the term "adders" was used to refer to both the percentage adder approach described in this section and the monetization by emission method described in the next section. Following comments by peer reviewers, it was decided to separate the two methods.

[43]See Section 4.3 for more detail and citations on the percentage adders adopted.

[44]Again, see Section 4.3 for more details and citations on state PUCs' actions on the adder approach.

4.1.6 Monetization by Emission

In the monetization by emission approach, externalities are expressed in dollars per ton of the specific type of emission or in cents per kilowatt-hour. The values can be based on the highest marginal costs of controlling pollution or of mitigating it. They can also be derived from the damage cost estimates. The more important emissions are CO_2, NO_x, SO_2, TSP (or PM_{10}), VOC (or ROG), CH_4, and N_2O.

Oregon, California, Nevada, Massachusetts, New York, and Minnesota employ such an approach. For example, the values adopted by the Oregon PUC are (in 1990 dollars): $2,000 to $5,000 per ton for NO_x, $2,000 to $4,000 per ton for TSP, and $10 to $40 per ton for CO_2 (Oregon PUC 1993). The values adopted by the Massachusetts DPU are (in 1992 dollars per ton): SO_2, $1,700; NO_x, $7,200; TSP, $4,400; VOC, $5,900; CO, $960; CO_2, $24; CH_4, $240; and N_2O, $4,400 (Mass. DPU 1992). In New York, the PUC adopted cost-of-control values for NO_x, SO_2, TSP, CO_2, water, and land for the purpose of evaluating alternative risks in resource acquisition decisions. These values are based on a combination of the costs of advanced control technologies and low-cost controls for abating air emissions at existing coal-fired plants (Putta 1990).[45]

In Arizona, a task force appointed by the ACC recommended that "the preferred method for quantifying externalities is monetization using damage costs." The task force further recommended that "damage costs should be estimated using hedonic pricing models, travel cost models, contingent valuation methods, and other appropriate methods depending on the nature of the externality" and that "monetized values of externalities should be expressed as dollars per unit of pollutant, dollars per MMBtu, dollars per therm, or dollars per kilowatt-hour, rather than as percentage adders" (ACC 1992, pp. 68–69). These and other implementation issues and recommendations will be decided in Arizona's current rulemaking docket.

The strengths of the monetization approach include explicit identification and estimation of the major pollutants and their impact, and the ability to reflect such impacts in the costs and prices of the resulting energy supply. Further, because the values can be derived from the control cost or the damage function methods, the strengths and weaknesses of these two methods can also be applied to the monetization method. This last point also suggests there is a need to distinguish between the methods for valuing externalities from the methods for applying the externality values to decision making. This will be discussed further in Section 4.2.

4.1.7 Multiattribute Trade-off Analysis

The multiattribute trade-off analysis is based on the concept of "undominated strategies." A strategy is "undominated" if there is no better strategy that accounts for all attributes of concern (Oregon PUC 1993, p. 4). In the context of IRP, a utility's strategy is its planned resource portfolio, consisting of generating plants of different types, demand-side resources, purchased power, and so on. For each resource portfolio, two important attributes are the direct (system) costs and the emissions level. Thus, a resource portfolio is "undominated" if no other resource portfolio has both lower direct costs and lower emissions. For any desired level of incremental generating capacity, a trade-off curve or an efficiency frontier for an electric utility is defined by the set of undominated resource portfolios. A preferred resource strategy can then be selected from the trade-off curve.

Connors (1992) suggests a "scenario-based multiattribute trade-off approach" as an alternative to the environmental adders approach. This is also known as "trade-off analysis." The approach consists of four basic steps: (1) Identify issues and attributes, (2) Develop scenarios, (3) Analyze scenario data and invent

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[45]For monetized values for other states and entities, see Section 4.3 and, in particular, Table 5.

better strategies; and (4) Assess trade-offs and seek consensus. The first three steps lead to a trade-off curve. Step 4 results in the selection of the preferred strategy from the trade-off curve. Connors' proposed approach requires extensive public involvement and collaboration. At the beginning of the process, the utility would convene a panel or advisory group with the broadest possible representation of stakeholders. This advisory group would participate in all four steps of the process. In Step 4, the panel would decide on the preferred strategy, which may or may not be accepted by the utility. If the utility accepts the preferred strategy selected by the panel and if the panel can be regarded as a good representation of society, then the outcome of Connors' trade-off analysis is the "explicit valuation" of society's willingness to pay to avoid pollution (Connors 1992; CECA/RF 1993a). If the utility rejects the preferred strategy selected by the panel, then it would need to explain its reasons for rejecting it.

PacifiCorp applied the multiattribute trade-off analysis approach to develop its most recent Resource and Market Planning Program (RAMPP-3) (PacifiCorp 1994). The company had argued before the Oregon PUC that this approach can be used to derive the preferred resource mix without explicitly assigning dollar values to environmental externalities (Oregon PUC 1993). In RAMPP-3, PacifiCorp analyzed 155 cases, including 103 base study cases, 23 environmental cases, and 29 sensitivity cases. Of the 23 environmental cases, 21 involved using adders required by the Oregon PUC, one case placed a limit on the CO_2 emission, and one case assessed the outcome on environmental dispatch (PacifiCorp 1994).

Connecticut and Arizona also have endorsed this approach. In December 1993, the Connecticut PUC submitted a report to the General Assembly in response to a statutory requirement to conduct a generic investigation of the external costs and benefits of energy use. The report concluded that the regulatory cost-of-control method is inappropriate and indicated a preference for the trade-off analysis suggested by Connors as a flexible method to compare the cost of implementing different strategies and the quantitative measures of their impacts (Connecticut DPUC 1993). In Arizona, a task force appointed by the ACC recommended that multiattribute trade-off analysis be used when reliable data are not available to monetize damages or where trade-offs between state economic impacts and efficiency are necessary (ACC 1992). As noted in Section 4.1.6, however, the task force recommended monetization using damage costs as the preferred method.

The multiattribute trade-off analysis has several advantages. First, it allows explicit consideration of the trade-off between emissions and system costs (Oregon PUC 1993). Second, involving all stakeholders in the process of issue and attribute identification, scenario development, and the search for better strategies can lead to a better understanding of all stakeholders' concerns and has the potential for reducing conflict when the final preferred strategy is chosen (Connors 1992). Third, because developing the trade-off curve requires that a strategy with lower costs and emissions be chosen over one with either higher costs or emissions, other factors being equal, this approach forces participants in the collaborative process to explore all potentially better strategies (CECA/RF 1993a). Another advantage from the utilities' perspective is that, in cases without a broadly representative advisory panel, the approach allows utilities to use judgment in selecting the preferred strategy rather than performing the difficult and controversial task of actually assigning dollar values to specific externalities. This last point is also a potential weakness in the multiattribute trade-off approach—without assigning dollar values to externalities and without a broadly representative advisory panel, the final step of selecting the preferred resource strategy becomes a subjective exercise that may not be replicated by independent analysts. Another potential weakness of this approach is that the involvement of an advisory panel may make the process difficult, costly, time consuming, and sometimes even infeasible if participants fail to reach consensus.

4.1.8 Relative Merits of Alternative Methods

Table 1 compares the strengths and weaknesses of the seven alternative approaches discussed previously. In general, methods that are easy to apply or implement, such as qualitative treatment, weighting and

Table 1. Relative Merits of Alternative Methods for Treating Environmental Externalities in the IRP Process

Method	Strengths	Weaknesses
Qualitative Treatment	• Simple and easy to apply • Applicable to nonquantifiables	• Subjective • Implicit trade-off among options • Cannot be replicated by others
Weighting and Ranking	• Some quantitative elements • More transparent than qualitative method • Easy to implement • Eliminates the need for large data requirements	• Subjective in assigning scores and weights • Additional judgment involved if converted into cost adders
Cost of Control	• Yields a cost-based quantitative measure • Easier to apply than the damage function approach	• Control costs not equal to damage costs • Different locations may have same control costs, but different damage costs • Piecemeal problems (when applied to electricity only)
Damage Function	• Integrate physical and social sciences • Conceptually correct • Can consider both costs and benefits • Fuel cycle analysis	• Extensive data requirements • Needs substantial resources to implement • Estimating value of non-market goods and services is difficult • Piecemeal problems (when applied to electricity only)
Percentage Adders	• Easy to apply and update • Allows acknowledgment of judgment	• Judgmental and subjective • Arbitrary: does not correspond to damages • Piecemeal problems (when applied to electricity only)
Monetization by Emission	• Identification and estimation of major pollutants and their impacts • Reflects impact on costs • See "Cost of Control" or "Damage Function" methods	• See "Cost of Control" or "Damage Function" methods • Piecemeal problems (when applied to electricity only)
Multiattribute Trade-off Analysis	• Allows explicit trade-off between emissions and systems costs • Involves all stakeholders • Explores all lower cost alternatives • Allows use of judgment	• Use of judgment in final portfolio selection • Replication problem • Costly and time consuming • May fail to reach consensus

ranking, and percentage adders, suffer from being subjective, lacking quantitative information, or both. The cost-of-control, damage function, and monetization by emission methods all yield quantitative information. While the damage function approach is recognized as being conceptually correct, it is difficult to implement because it requires extensive data about impacts on human health and the environment. The cost-of-control method is regarded by some analysts as unrealistic because it is highly unlikely that the cost of abating the emissions will be exactly equal to the costs of damages caused by the resource options. The monetization by emission method depends on either the cost-of-control or the damage function methods, so it shares the same strengths and weaknesses. The strength of the multiattribute trade-off analysis is that it does not require monetization of environmental externalities, but allows explicit trade-off between emission levels and system costs as well as the use of judgment in the final selection of resources. Its weaknesses are that it may be time consuming and costly, or it may fail to reach consensus on the ideal or exact point of the efficiency frontier (trade-off curve) of a given utility or state.

4.2 A Taxonomy of Alternative Methods

The seven alternatives discussed in Section 4.1 are methods for addressing environmental externalities that have been tried by utilities and state PUCs in the IRP context and are usually subject to state PUCs' jurisdiction. The literature on environmental externalities, however, refers to other methods that have broader scope and other approaches that have different focus. To set alternative methods into perspective, it is useful to introduce a scheme for classifying the different methods for addressing environmental externalities.

Table 2 provides such a taxonomy. It is based on three criteria: (1) whether the alternative is under the influence of state PUCs; (2) whether it has a focus on externalities; and (3) whether it is a valuation method or an application method. The first level distinguishes between methods not under PUC influence and those under PUC influence. Methods not under PUC influence are those that can be applied directly through environmental regulation or other policy measures without going through the PUC process; i.e., they do not fall within the jurisdiction of state PUCs. The authority of such methods rests with the environmental regulatory agencies, state legislatures, or the federal government. In the literature, a distinction is often made between the command and control approaches and the market- or price-based approaches. The former group includes strict command and control, as well as emission standards and targets.[46] The latter group includes taxes, emission fees, offsets, and tradeable emission allowances.

The PUC-influenced methods are those that can be substantially influenced by the decisions made by state PUCs. This category can be further divided into two groups: with externality focus or with other focus. Alternatives that are under PUC influence with externality focus are further divided into two subgroups: valuation methods and application methods. Note that the offset method appears in both the not under the PUC influence category and the PUC-influenced category. Some offsets are determined by federal or state laws or by environmental regulatory agencies, whereas state PUCs can also permit additional offsets in their externality policies. In addition, fuel cycle analysis, or life-cycle analysis, is not separately listed in this taxonomy because it applies the damage function approach to the different stages of the fuel cycle in the production and use of electricity and natural gas and, as such, can be viewed as a variation of the damage function approach. The group of PUC-influenced methods with other focus includes bonus rates, shared savings, and set-asides. In taking these actions, state PUCs are generally concerned with promoting DSM, energy efficiency, or renewable energy, rather than dealing with environmental

[46] Some analysts treat standards and targets as part of a broadly defined command and control approach. Others define the command and control approach narrowly and would exclude standards and targets.

Table 2. Taxonomy of Alternative Methods for Addressing Environmental Externalities

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I. Methods Not Under PUC Influence

- a. Command and control
- b. Emission standards and targets
- c. Taxes
- d. Emission fees
- e. Offsets (CAAA-mandated)
- f. Tradeable emission allowances

II. PUC-Influenced Methods

A. With Externality Focus

1. Valuation Methods
   - a. Direct-cost estimation
   - b. Indirect-cost estimation
   - c. Contingent valuation
   - d. Damage function
   - e. Cost of control

2. Application Methods
   - a. Qualitative treatment
   - b. Weighting and ranking
   - c. Percentage adders
   - d. Monetization by emission
   - e. Multiattribute trade-off analysis
   - f. Offsets

B. With Other Focus
   - a. Bonus rates of return
   - b. Shared savings
   - c. Set-asides

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externalities. However, these actions do have some environmental consequences and are generally under the jurisdiction of state PUCs.

The seven methods described in Section 4.1 fall under the "PUC-Influenced Methods" category. In that discussion, they were lumped together with no distinction between valuing the impacts and applying those valuations to decision making. The cost-of-control and damage function approaches are valuation methods, whereas qualitative treatment, weighting and ranking, percentage adders, monetization by emission, and multiattribute trade-off analysis are application methods. Both valuation methods can be applied to the percentage adders or the monetization by emission methods.[47]

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[47]These concepts were suggested by David Iliff of Wisconsin PSC following a review of an earlier draft.

The valuation methods need further explanation. As will be discussed in Section 6.2, the three general methods of assigning monetary values to environmental effects are (1) direct-cost estimation, (2) indirect-cost estimation, and (3) contingent valuation.[48] In this context, the control-cost method assigns the highest marginal cost of controlling pollution or of mitigating it as a proxy for the value of the damages caused by the marginal pollution. In addition, the damage function approach can be loosely equated to the direct-cost estimation method. In actual application of the damage function approach, however, there may be a need to combine results from both the indirect-cost estimation and the contingent valuation methods. From this perspective, the damage function approach is a hybrid method, not a pure direct-cost estimation method.

The methods not under PUC influence are covered in Section 6.3, and the PUC-influenced methods with other focus are discussed in the Appendix. The emphasis of this report is on the PUC-influenced methods with externality focus, which are primarily discussed in Section 4.1. Valuation methods are briefly described in Section 6.2.

4.3 Summary of State Actions[49]

Table 3 and Figure 1 present a broad summary of the current status of state PUC actions with respect to requiring treatment of environmental externalities in the resource planning process. A total of 29 states and the District of Columbia require utilities under their jurisdiction to consider environmental externalities in the IRP or resource planning processes in some manner. (By comparison, a 1990 survey conducted for NARUC reported that 17 states had an externality requirement [Cohen et al. 1990]). The other 21 states do not require direct treatment of environmental externalities. Among these states, Kansas, New Mexico, and Oklahoma are in the process of considering the need for such a requirement. Alaska, Florida, Maine, and Michigan considered but rejected a requirement to incorporate environmental externalities in the IRP process. The Alaska PUC concluded that imposing such a requirement is beyond its current authority; incorporating environmental externalities is an issue that must be decided by the legislature. Florida stated that the PUC lacks the expertise, staff, resources, and statutory authority to impose an externality requirement. Maine cited four reasons for rejecting such a requirement: (1) lack of information on Maine-specific externalities; (2) lack of staff or financial resources; (3) the state's involvement in developing environmentally responsible sources; and (4) no anticipated need for new generating resources in the future (HL&P Company 1993, pp. 2, 18, and 33).

In July 1992, in a case establishing a framework for capacity solicitations by Detroit Edison Company from qualifying facilities, the administrative law judge of the Michigan PSC rejected the PSC staff's proposal to consider environmental externalities for three reasons: (1) inadequacy of the commission to evaluate the environmental impacts of resource options; (2) lack of "rigorous scientific evidence" in the record of the relationship between emissions and the environmental harm observed; and (3) existence of other state and federal agencies better able to address the issue. The Michigan PSC simply concluded that, at that time, it was not appropriate to implement a system to evaluate the environmental factors in resource bidding (Michigan PSC 1992, pp. 57–58).

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[48]Please refer to Section 6.2 for a discussion of the valuation methods.

[49]This summary is based on existing surveys and data bases such as Hashem and Haites (1993), Houston Light & Power Company (1993), and Hashem (1993), supplemented by information from recent PUC orders. For a few states, the status of current practice is somewhat ambiguous because the surveys do not agree with one another. This discussion is based on the authors' interpretations of the best available information, short of conducting a direct survey.

Table 3. State PUC Actions on Environmental Externalities

State	No Action/ Requirement to Date	Rejected	Under Consideration	Qualitative[a]	Quantitative[a]
Alabama	X				
Alaska		X			
Arizona					X
Arkansas				X	
California					X
Colorado				X	
Connecticut				X[b]	
Delaware				X	
District of Columbia				X[c]	
Florida		X			
Georgia					X
Hawaii					X
Idaho				X	
Illinois					X
Indiana	X				
Iowa					X
Kansas			X		
Kentucky	X				
Louisiana	X				
Maine		X			
Maryland	X				
Massachusetts					X
Michigan		X			
Minnesota					X[d]
Mississippi	X				
Missouri					X
Montana					X
Nebraska	X				
Nevada					X
New Hampshire	X				
New Jersey					X
New Mexico			X		
New York					X
North Carolina				X[e]	
North Dakota	X				

Table 3. State PUC Actions on Environmental Externalities (continued)

State	No Action/ Requirement to Date	Rejected	Under Consideration	Qualitative[a]	Quantitative[a]
Ohio					X
Oklahoma			X		
Oregon					X
Pennsylvania				X	
Rhode Island	X				
South Carolina				X[f]	
South Dakota	X				
Tennessee	X				
Texas					X
Utah					X
Vermont					X
Virginia				X	
Washington				X	
West Virginia	X				
Wisconsin					X
Wyoming	X				
TOTAL	14	4	3	11	19

Sources: Compiled from Hashem (1993), Hashem & Haites (1993), HL&P Co. (1993), Illinois Commerce Commission (1992), Oregon PUC (1993), and Minnesota PUC (1994).

Notes: [a]See Section 4.2 for more details and citations on the percentage adders adopted.
[b]A PUC report recommends quantitative treatment, Docket 92-09-29 (Connecticut DPUC 1993).
[c]The District of Columbia PSC (1993).
[d]Interim monetized values adopted in March 1994 (Minnesota PUC 1994).
[e]See HL&P Company (1993), p. 62.
[f]See HL&P Company (1993), p. 72.

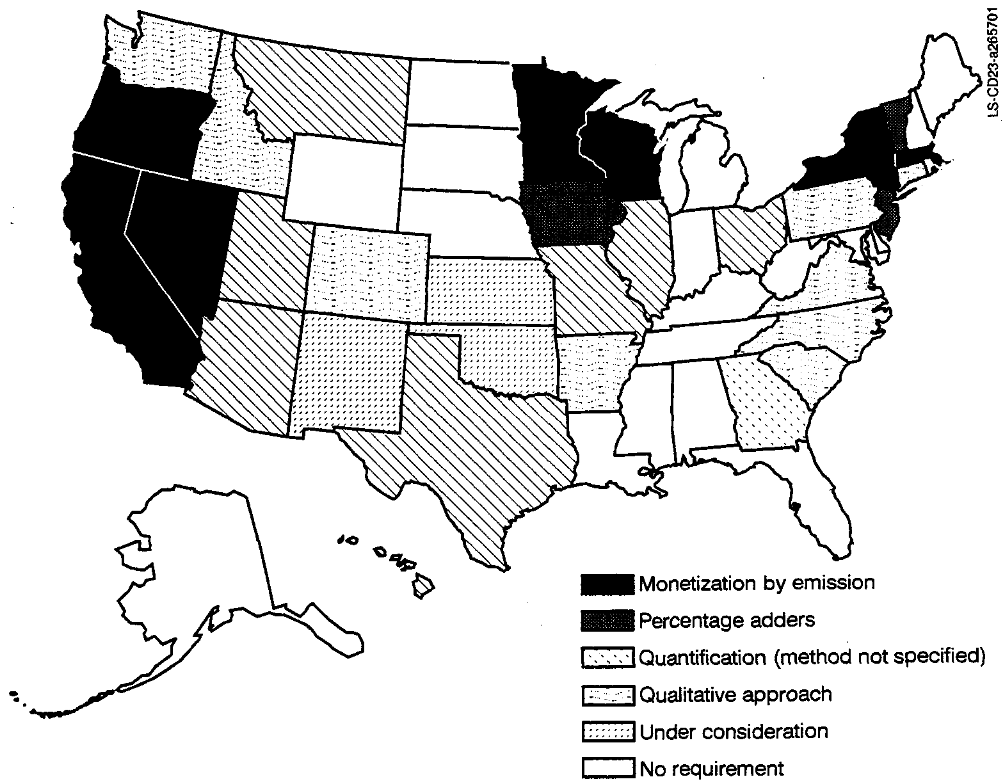

Figure 1. State PUC actions on environmental externalities

Among those states that require explicit consideration, ten states and the District of Columbia ask for only a qualitative treatment; the remaining 19 states require the use of quantitative approaches (see Table 4).[50] The District of Columbia PUC (DC PUC), in Order No. 10155, rejected a proposal to explicitly require Potomac Electric Power Company (PEPCO) to consider environmental externalities, questioning the usefulness of an "isolated approach" to the issue. Instead, it directed PEPCO to work with DC government representatives to present the externality issue to a regional task force and to present task force activities and include the company's reports on atmosphere pollution and environmental externalities in its next least-cost plan. The DC PUC order further directs that future CAA compliance plans "more thoroughly address the potential costs of limiting NO_x and toxic air emissions." As future regulations on such pollutants are set forth, PEPCO should include their impacts on its operation in the next least-cost plan or, if judged to be prudent, in an updated compliance plan (DC PUC 1993, pp. 237–239).

Included among the states requiring quantitative approaches are those states that do not specify a particular quantification or monetization approach or method but simply direct a utility to quantify environmental externalities to the extent possible and practicable. Nine states are in this "no specified quantitative approach" category. The other ten states have adopted specific approaches with monetized externalities,

[50]The distinction between qualitative and quantitative approaches adopted in this report is based on the survey conducted by HL&P Company (1993). It is different from the distinction made in another NREL report (Swezey, Porter, and Feher 1993). As shown in Table 4, the "quantitative" category encompasses percentage adders, adders in terms of dollars per unit of energy, monetized values by emissions, and "approach not specified."

Table 4. Quantitative Approaches to Incorporate Environmental Externalities in the IRP Process

	Monetized Values			
State	Approach Not Specified	Percentage Adder	$/Energy Unit	By Emission
Arizona	X			
California				NO_x, SO_x, PM_{10}, ROG, C
Georgia	X			
Hawaii	X			
Illinois	X			
Iowa		10% Electric 7.5% Gas	$0.007/kWh for AEP[a] < 200 MW	
Massachusetts				NO_x, SO_x, TSP, VOC, CO, CO_2, CH_4, N_2O
Minnesota				SO_2, NO_x, VOC, CO_2, Particulates
Missouri	X			
Montana	X			
Nevada				NO_x, SO_x, PM_{10}, VOC, CO, CO_2, CH_4, N_2O
New Jersey			$0.02/kWh Electric $0.95/MMBtu Gas (In 1991 dollars)	
New York				NO_x, PM_{10}, CO_2, SO_2, Water, Land
Ohio	X			
Oregon				NO_x, TSP, CO_2
Texas	X			
Utah	X			
Vermont		5%		
Wisconsin				CO_2, CH_4, N_2O
Northwest Power Planning Council		10%		
Bonneville Power Administration		10%		NO_x, SO_x, TSP

Sources: Compiled from Hashem (1993), Hashem and Haites (1993), HL&P Company (1993), Oregon PUC (1993), Minnesota PUC (1994).

[a]Alternate energy production.

including percentage adders, specific dollar values per unit of energy or savings involved, and monetized values for specific emissions.

Two states have adopted the percentage adder approach.[51] For resource planning purposes, the Iowa Utilities Board requires electric utilities to apply a 10% adder to avoided energy and capacity costs to account for externalities and a 7.5% adder for gas utilities (Hashem 1993; HL&P Company 1993). Vermont applies a 5% adder to all supply-side resources in the planning process but deems the magnitude of the adder to be a rebuttable presumption (Hashem 1993; HL&P Company 1993).[52] Maryland approved a 5% adder for one utility but has not adopted an overall policy concerning treatment of environmental externalities (Hashem 1993). The Wisconsin PSC had previously directed that utilities apply a 15% credit to noncombustion technologies to account for air emissions externalities in new resource decisions. This requirement was subsequently challenged by utilities and eventually overturned by state courts. In the opinion of the courts, state laws constrain the PSC's authority to impose more stringent requirements than those of the state legislature and the Wisconsin Department of Natural Resources. The PSC cannot deny a certificate of public necessity and convenience on the basis of air emissions if the plan meets all state and federal environmental standards. The courts ruled that potential elimination of proposed generating options in the planning process through the use of the 15% adder is equivalent to the same denial (Hashem 1993; ECO Northwest 1993).

In two states, the adder is expressed in terms of dollar per unit of energy. New Jersey requires that electric utilities value environmental externalities at $0.02 per kWh for DSM programs and that gas utilities value externalities at $0.95 per million Btu saved. These values are in 1991 dollars and are to be adjusted annually at the rate of change of the Gross National Product (GNP) deflator. In Iowa, an environmental factor of $0.007 per kWh, which represents both environmental and socioeconomic effects and is based on the avoided external cost of a coal-fired power plant, is added to the contract energy rate for the purchase of the first 120 MW of alternative energy production power (Hashem 1993; HL&P Company 1993).[53]

Seven states have specified monetized values for individual emissions: California, Massachusetts, Minnesota, Nevada, New York, Oregon, and Wisconsin. The emissions covered include NO_x, SO_2, TSP or PM_{10}, ROG or VOC, C, CO, CO_2, CH_4, N_2O, water pollution, and land pollution; however, not all seven states have specified values for the emissions listed above. New York is the only state with specific values for land and water pollution. Oregon and Wisconsin each have specified values for only three types of emissions (see Table 4). The specific values by emissions are shown in Table 5. Most of these values are based on the control-cost approach.

Oregon PUC does not have the authority to require utilities to base their acquisition decisions on societal costs (including external environmental costs) but can allow utilities to recover costs of implementing a resource plan that is less polluting but has a higher revenue requirement than an alternative plan. It also can disallow future compliance costs when utilities make imprudent decisions with respect to external

[51]Only adders or subtractors directly associated with treating environmental externalities are included in this count. Credits with the primary emphasis on promoting energy efficiency, DSM, or renewable resources, such as the 10% credit for conservation resources in Oregon and the Northwest Power Planning Council, are not included.

[52]The Vermont Public Service Board is currently involved in looking at alternative approaches for incorporating environmental externalities.

[53]Note that Iowa also has percentage adders.

Table 5. Monetized Values for Environmental Externalities by Emission

State	NO_x	SO_2	PM_{10}	TSP	VOC	ROG	C	CO	CO_2	CH_4	N_2O	Water	Land
California PUC (1992$/ton)[a]													
SCE/SDG&E	31,568	23,579	6,829			22,548	34						
PG&E	9,155	4,493	2,634			4,252	34						
Out-of-State/ Attainment Area	7,526	1,726	4,626			1,306	34						
Massachusetts DPU (1992$/ton)	7,200	1,700[c]		4,400	5,900			960	24	240	4,400		
Minnesota PUC ($/ton)[b]	68.8–1,640	0–300	166.6–2,380		1,180–1,200				5.99–13.60				
Nevada PSC (1990$/ton)	6,800	1,560	4,180		1,180			920	22	220	4,140		
New York PSC (1990$/ton)	1,832	832		333					1.1			0.1[d]	0.4[d]
Oregon PUC (1990$/ton)	2,000–5,000			2,000–4,000					10–40				
Wisconsin PSC (1992$/ton)									15	150	2,700		
BPA (1990$/ton)													
East	69	1,500[c]		167								0.2[d,e]	f
West	884	1,500[c]		1,540								0.2[d,e]	f

Sources: Compiled from Hashem and Haites (1993), HL&P Company (1993), Mass. DPU (1992), Oregon PUC (1993), Minnesota PUC (1994), Chaitkin (1993), BPA (1991), and Putta (1990).

Notes: To convert $/ton to $/metric ton, divide the $/ton amount by .9071847.

NO_x = nitrogen oxide; SO_2 = sulfur dioxide; PM_{10} = particulate matter; **TSP** = total suspended particulates; **VOC** = volatile organic compound; **ROG** = reactive organic gases; C = carbon; CO_2 = carbon dioxide; CH_4 = methane; N_2O = nitrous oxide.

[a]The values originally adopted by the California PUC have been escalated at the rate of 5.2% per year through 1992. This is in accordance with the information provided by Chaitkin (1993).
[b]The Minnesota PUC did not specify which year the values were in. Note, however, that the order was adopted in March 1994.
[c]For SO_x.
[d]cents/kWh.
[e]Combined land, water, and other impacts of coal-fired plants. No distinction between East and West.
[f]See the "Water" column.

environmental impacts (Oregon PUC 1993). Minnesota has adopted only interim values for SO_2, CO_2, NO_x, VOC, and particulates in order to meet the deadlines imposed by legislative mandate; the PUC will start a proceeding to make a formal decision on the matter (Kaplan 1994).

Although many state PUCs acknowledge the superiority of the damage function approach, only California and Minnesota have adopted damage-cost-based values for some emissions. In California, the values for SO_x and PM_{10} for Pacific Gas and Electric Company (PG&E) are derived from estimates provided in the PACE University study,[54] which are damage-cost estimates. In Minnesota, the values for NO_x and PM_{10} are from BPA's estimates, which are also damage-cost based. Outside the PUCs, the California Energy Commission developed damage-cost estimates for different regions of the state (South Coast, Bay Area, San Diego, San Joaquin Valley, Sacramento Valley, North Coast, North Central Coast, South Central Coast, and Southeast Desert) in its 1992 Electricity Report (Hashem 1993; HL&P Company 1993). However, these values have not yet been formally adopted by the California PUC. New York is in the process of a multiyear collaborative effort to apply the damage function approach. The purpose is to develop a methodology and model that allows the user to analyze the externality damages of various electricity supply-side and demand-side management options. The project is scheduled to be completed in November 1994 (Rowe 1993). Wisconsin utilities have a joint project to develop externality values based on the damage function approach. In its Order 05 EP-6 (September 18, 1992), the Wisconsin PSC expressed interest in the damage function approach to estimate the damage cost of air emissions other than CO_2, CH_4, and N_2O, but indicated that the record in the case did not contain sufficient information. The utilities in the state formed a group to develop externality values based on damage costs for future consideration (Hashem 1993).

4.4 Discussion

Given the different approaches for considering environmental externalities, and the previously described state PUC actions, three factors deserve further discussion: the role of state laws, the debate on environmental adders, and the choice of methodologies.

4.4.1 Role of State Laws

Among the four states that have explicitly considered the issue and decided not to impose an externality requirement in the IRP process, Alaska, Florida, and Michigan concluded that they lacked the legal authority to require the utilities to address the issue. On the other hand, states that have imposed the externality requirement often cite explicit statutory language requiring such treatment or, at the very least, point to provisions in the law that can be interpreted to mean that the PUC has the authority to require such consideration.

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[54]It should be noted that the estimates presented in the Pace University Study are subject to several limitations. Specifically, its authors enumerated the following: (1) By contract terms, the study relied only on available existing studies. (2) The estimates did not include the front-end external costs of the fuel cycle such as those associated with mining, oil drilling, equipment manufacturing, and transport to the site. (3) They excluded estimates provided by a control cost approach. (4) Nonenvironmental externality costs were also excluded. (5) Other limitations associated with the original studies were cited in the report (Pace University 1990, pp. 16-18). The authors then state (Pace University 1990, p. 18): "**These limitations mean that the costing figures in this report must be used with great caution.** They are a starting point for valuing damages. They do not purport to be a complete estimate of damage values. These reported values do show that the environmental externality costs of producing electricity clearly are significant and are worth pursuing through more definitive research." (Emphasis original.)

For example, California law explicitly requires quantification of environmental externalities, minimization of the societal costs of utility resource planning, and inclusion of environmental costs in the cost-effectiveness calculations of energy resources. Nevada law directs the PSC to consider environmental and economic impacts of utility resource plans and to determine whether and how to give preference to those resources that provide the greatest economic and environmental benefits to the state. In New York, state law requires that the State Energy Plan reflect environmental factors. Wisconsin statutes direct the PSC to consider both economic and environmental factors in determining whether a utility's resource plan is in the public interest. Maine law directs the PUC to study the issue and report back to the legislature on whether utilities should be required to consider environmental impacts. However, in 1991, the Maine PUC concluded that it was not appropriate to impose such a requirement at that time (ECO Northwest 1993). In Oregon, the law allows the PUC to consider environmental externalities in a utility's least-cost plan but does not authorize the PUC to require utilities to make a resource acquisition decision based on a total resource cost that includes external costs (Oregon PUC 1993).

In some states, the law may contain only references to protecting the environment or to improving environmental quality as a goal of utility regulation, without explicitly requiring incorporation of environmental externalities. In such cases, the legal wording is likely to lead to conflicting interpretations in contested proceedings. Illinois is a case in point. Section 1-102 of the Illinois Public Utilities Act (PUA) states that "the health, welfare and prosperity of all Illinois citizens require the provision of adequate, efficient, reliable, and **environmentally safe** and least-cost public utility services at prices which accurately reflect the long-term cost of such services and which are equitable to all citizens" (emphasis added). The PUA further lists "environmental quality" as one of the goals of utility regulation. Sections 8-401 and 402 of the PUA, which require implementation of least-cost planning, also use the term "environmentally safe" in referring to the provision of utility services. Part 440.100 of the Illinois Administrative Code 440 (the rule implementing least-cost planning) defines "least cost" as "the lowest possible present value revenue requirements subject to the provision of adequate, efficient, reliable, and environmentally safe energy service." Further, service is deemed to be environmentally safe if it conforms with the regulations of other regulatory bodies with environmental jurisdiction (such as the Illinois EPA and the U.S. EPA). These provisions became the basis for the arguments of both proponents of and opponents to incorporating environmental externalities in the IRP process in a case involving the adoption of a statewide electric energy plan (Docket 91-0050). The Illinois Commerce Commission eventually concluded that "environmentally safe" and "environmental quality" are coterminous, and that the PUA does require explicit consideration of significant environmental impacts of utility resource additions but does not mandate how such impacts are to be valued (Illinois Commerce Commission 1992, pp. 5–9 and 37–46).

In short, the language and interpretation of relevant state laws are important factors in a state PUC's decision on whether to require utilities to incorporate environmental externalities into the IRP process. When explicitly directed by the law, state PUCs are on firm legal ground in adopting such requirements. On the other hand, the PUCs may decide not to impose a requirement if the state laws contain only general language in terms of environmental quality and protection.

In some cases, states have changed their laws regarding the treatment of environmental externalities after the state PUC began implementing certain requirements. For example, in 1991, conforming to the mandate of 1990 legislation, the California PUC adopted externality adders for use by utilities in analyzing the cost-effectiveness of DSM programs and supply-side bids. In January 1993, new legislation restricted the application of the adders when a carbon tax is imposed on carbon emissions or when a market-based emission trading system or offset requirement is adopted for any pollutant. The new law also limits the use of environmental externalities to advancing the need for new facilities to no more than 15 months. According to the law, environmental externalities cannot be used to force a utility to retire or to decommission a power plant. In addition, the new law authorizes the PUC to approve a utility-designed alternative plan to bid solicitation if such a plan offers equivalent environmental benefits at lower costs (ECO Northwest 1993; Hashem 1993).

4.4.2 Debate on Environmental Adders

In the literature on environmental externalities, the term "adders," or "environmental adders," refers to both the values derived from the percentage adders method and those associated with the monetization by emissions method. The environmental externality adders adopted by states such as California, Massachusetts, Nevada, and New York have been at the center of the debate between those who oppose PUCs requiring utilities to consider externalities and those who support state involvement in this issue. The most well-known critic of the adders approach is Paul Joskow. He has identified nine conceptual and practical problems associated with the use of such adders:

1. State PUCs are poorly situated to develop and apply sound environmental policies and can cause adverse unintended effects if they act unilaterally.

2. PUCs have selected arbitrary adders that bear no plausible relationship to environmental damages.

3. The highest cost of control of various pollutants is not a reasonable proxy for the residual environmental damages caused by these pollutants.

4. Even if the PUCs accurately could measure "residual" environmental damages, it will often not be appropriate mechanically to transform these numbers into adders.

5. Failure to fully account for the complexities of environmental laws and regulations will lead to adverse environmental consequences as it increases the cost of electricity.

6. The wrong number is not necessarily better than zero.

7. The infatuation with adders is diverting PUC attention from activities that can help to promote truly least-cost environmental compliance.

8. Excessive focus by state PUCs on regional and global societal costs is undermining the integrity of the regulatory process in ways that will burden consumers and local economies.

9. The use of adders by state PUCs has reduced pressures on the federal government to come up with a reasonable greenhouse gas policy (Joskow 1992, pp. 59–64).

Joskow argues that state PUCs should abandon efforts to adopt such environmental adders and, instead, seek to create a regulatory climate that encourages utilities to meet environmental constraints at the lowest possible cost as well as to consider potential future environmental regulations. He also thinks PUCs should become more involved at the state and federal levels in promoting efficient mechanisms to reduce emissions, particularly the market-based approaches (Joskow 1992). Joskow further suggests that if state PUCs continue to consider adopting environmental adders, then they should pay special attention to the following guidelines:

a. The values for the adders should be based on, but not necessarily equal to, the best estimates of the environmental damages caused by various emissions.

b. Good damage numbers are only the first step in computing adders that are likely properly to reflect the extent to which residual emissions are not "priced" properly.

c. The effects of using the adders should be evaluated in the context of the actual operation of existing environmental regulations, as they affect both new and existing sources, to ensure that the adders do not have unintended adverse environmental effects.

d. The adders should carefully account for unintended effects resulting from the fact that the constraints individual PUCs can place on emissions are limited to electricity produced for sale by IOUs (investor-owned utilities) and sold within a single state's boundaries (Joskow 1992, pp. 64–65).

In response, Freeman and Krupnick (1992) argue that Joskow goes too far in asserting that the use of environmental externality adders is a "bad idea." In their view, one reasonable objective of the PUCs is to ensure that utilities choose an electricity supply portfolio that will minimize societal costs when making future resource acquisition decisions. Thus, it is necessary and appropriate for the PUCs to adopt environmental adders for use by utilities. Requiring utilities to factor in environmental adders ensures that the right price signals are given in the market. They also believe that in incorporating environmental adders, utilities and PUCs should take existing environmental regulations as given and consider the potential adverse impacts of such a requirement.

According to Freeman and Krupnick, Joskow makes two unsubstantiated assertions: (1) the use of environmental adders would result in higher electricity prices without a commensurate improvement in environmental quality, and (2) the residual health damages from pollution are likely to be zero in attainment areas. With respect to the first assertion, Freeman and Krupnick argue that although prices may actually rise in some cases, the empirical significance of any price increases remains to be demonstrated. With respect to the zero-damage assertion, they contend that Joskow's argument is based on several unproven assumptions. They suggest that there is evidence that some nonzero damages to health and crop harvest do exist. Freeman and Krupnick conclude that, under the command and control approach to regulating environmental externalities, the appropriate adders should equal marginal residual damages (Freeman and Krupnick 1992).

Freeman and Krupnick agree with some of the criticisms and suggestions made by Joskow. In particular, they agree that it is not appropriate to use the highest cost of control as a proxy for marginal damages (Joskow's Item 3). They agree that most PUCs do not have the legal authority or the expertise required to set environmental policies and standards (Joskow's Item 1) and, hence, state PUCs should take existing environmental standards and policies established by the environmental agencies as given (Joskow's Items 5 and c). They further agree that PUCs should account for the potential unintended effects of applying environmental adders to only the IOUs (Joskow's Item d). In addition, Freeman and Krupnick agree with Joskow that the PUCs and others should strive for more efficient environmental regulations at the federal and state levels and should support market-based schemes such as the SO_2 emission allowance trading program (Freeman and Krupnick 1992).

With respect to Joskow's point that the wrong number is not necessarily better than zero (item 6), proponents disagree, arguing that if there are external environmental effects, it is wrong to assign a value of zero. For example, Wiel has characterized the old environmental math as follows: "(1) Residual pollution damages our human and physical environment. (2) This damage has real, finite value. (3) We can place an upper limit on that value, but cannot identify it with precision. (4) So we treat the damage value as if it doesn't exist" (Wiel 1991, p. 47).

Wiel's characterization of the reasoning behind the traditional treatment of environmental externalities highlights an aspect that deserves to be noted further—the relative degrees of uncertainty associated with environmental externalities and other areas of utility regulation such as demand forecasting, cost calculation, estimation of energy savings from DSM programs, and so forth. All these subjects are also fraught with uncertainty, and yet they are dealt with regularly in the regulatory process. Some would regard the degree of uncertainty associated with residual environmental effects as on the same order of magnitude as that for other issues considered in the regulatory process. From such a perspective, proponents assert, there is no reason to hold environmental externalities to a higher standard.[55] Opponents, however, question the validity of the assertion that the degree of uncertainty concerning environmental externality is no greater than the uncertainties associated with other utility matters that fall under regulatory concern. They point to the data base on monetized values of emissions assembled by the Energy Research Group, Inc., (ERGI) that shows that the variations are in the range of 380,000% for NO_x and 300,000% for particulates (ERGI 1992a, p. 52 and p. 54). Opponents also counter the "no need for higher standards" argument by referring to the concurring opinion in the Massachusetts DPU Order DPU 91-131, which states that estimates for damage costs are being held at a higher standard than are existing estimates for control costs.

This discussion highlights the controversial nature of environmental adders. Although some aspects have been clarified as a result of the debate, substantial differences still exist between the two sides of the debate. In the context of the taxonomy discussed in Section 4.2, it is possible to characterize the controversy with the first classification criterion: the degree of PUC influence. Many analysts believe in the efficacy of the methods not under PUC influence, especially those associated with the market mechanism or the price system, such as taxes, fees, and tradeable emission allowances. They question the need for state PUCs to impose an externalities requirement for resource planning purposes. Others perceive that state laws grant certain responsibility and authority to state PUCs to ensure that electric and gas services are provided on the most environmentally sound basis and, therefore, state PUCs can justify requiring incorporation of environmental externalities into resource planning for utilities. In addition, because most states and the BPA, which use monetized externality values, also allow offsets, there appears an emergent trend: offsets are an efficient way of dealing with the externality issue in the face of uncertainty.

4.4.3 Choice of Methodologies

Among the alternative methods described, there is broad agreement that the damage function approach is based on the integration of physical and social sciences. Many analysts and PUCs regard it as being conceptually correct. The method allows simultaneous consideration of both benefits and damages and permits explicit treatment of full fuel-cycle impacts. Hence, it is regarded as the most comprehensive among the alternatives considered.

As noted above, however, actual state PUC experience with this approach is still quite limited. Only California and Minnesota have adopted damage-based values for some emissions, and even these are based on estimates derived previously by others, rather than on independent estimates by the states adopting them. One of the reasons for the limited experience with this approach is its extensive data requirements. The damage function approach requires expertise in many disciplines and a variety of models to project the distribution of emissions, the doses of exposure, biological and environmental responses, and the economic valuation of those impacts. A substantial resource commitment is needed to derive the necessary estimates of damages and benefits. Resource constraints on the PUCs and the need to base their decisions on the evidence presented into the proceeding at hand have induced the PUCs to adopt other approaches, including the control-cost method, adders, or qualitative treatment. From this perspective, additional data collection and research on the procedures for implementing the damage function method are needed. Results from current studies, including the individual fuel-cycle studies of the U.S.-E.C.

[55]See Section 6.1 for methods of treating uncertainty with respect to environmental externalities in the IRP process.

externality project, the New York State study, and the efforts of the Wisconsin utilities, should be carefully reviewed to derive lessons learned.

Some states have adopted monetized values for environmental externalities using either the percentage adder or control-cost methods. Even though these methods are relatively easy to apply, they have been criticized for several reasons: (1) the percentage adder approach is viewed as overly judgmental and subjective; (2) the assumption in the cost-of-control method that marginal cost of pollution abatement is equal to marginal damage cost is seen as unrealistic; and (3) the practice of equating the highest cost of control to the externality values may not be appropriate. In addition, some PUCs do not require quantitative treatment or monetization of environmental externalities in the IRP process because they regard themselves as lacking legal authority to require quantitative treatment of externalities; they regard the methodologies for quantification and monetization as still uncertain and speculative; there is a lack of state-specific estimates of external environmental damages and benefits; and they are concerned that electricity rates will rise, hurting businesses and consumers alike.

The multiattribute trade-off analysis avoids assigning dollar values to specific emissions. It is a collaborative process with the broadest possible representation of stakeholders and can potentially promote consideration of strategies incorporating both the adverse and beneficial effects of electricity production and use. It may also facilitate better understanding of stakeholders' concerns and help promote consensus building. Further, utility personnel often have had experience in conducting similar scenario analyses. In Oregon, PacifiCorp has applied the multiattribute trade-off approach in its latest least-cost plan, and the Connecticut PUC endorsed the approach in its report to the General Assembly.

It is clear from the previous discussion that state PUCs have a variety of choices of methods for considering environmental externalities. In adopting specific approaches, the PUCs sometimes indicate that they would consider other techniques as the methodologies and estimates are further developed. Thus, the process of choosing the appropriate methodology to address environmental externalities in the utility resource planning process will continue to evolve. In the context of the taxonomy described in Section 4.2, this discussion has been limited to PUC-influenced methods with an externality focus. In the broader debate on the most appropriate ways to address environmental costs of energy production and use, references are often made to those methods included in "methods not under PUC influence," especially those that are market or price based, such as taxes on fuels and pollutants, permit fees, and tradeable emission allowances. However, state PUCs' jurisdiction over these methods are generally quite limited. But, when the PUCs have the authority to require consideration of externalities, they seem to be able to require market-based offsets, which are a form of tradeable allowances. In addition, what state PUCs might do to complement federal and state environmental regulations is a policy coordination issue and was discussed in Section 3.4.

5.0 Stakeholders' Interests

The previous chapter discussed state PUC actions on incorporating environmental externalities into the IRP process and related issues. The actions adopted by state PUCs generally reflect the weighing of diverse views and interests presented by various parties, including the electric utility industry, fuel suppliers, energy consumers, government agencies, and public interest groups such as environmentalists, DSM advocates, and renewable energy interests. This chapter presents a summary of the stakeholders' interests as gleaned from the literature, PUC proceedings, and other available published sources.

A caveat is in order: because of resource and time constraints, this review of stakeholder interests was limited to those views and positions that have been documented and are readily available. As a result, although many stakeholder groups are identified, this is not a comprehensive survey of stakeholders and should not be regarded as a complete or exhaustive characterization of stakeholder interests.

5.1 The Electric Industry

Because the electric industry is directly affected by the requirement to treat environmental externalities in the IRP process, it has been very active in presenting its views and advancing its interests in various forums and formats. The views and actions of individual electric utilities, the Edison Electric Institute (EEI), the National Independent Energy Producers (NIEP), the Electric Power Research Institute (EPRI) and the Bonneville Power Administration (BPA) are presented below.

5.1.1 Electric Utilities

Individual utilities have testified in PUC proceedings, issued position papers, and commented on proposals put forth by PUC staff, state energy offices, and public interest groups. In general, electric utilities perceive that the requirement to quantify or monetize environmental externalities would raise utilities' costs of providing electric services, forcing them to raise rates, putting unfair burden on ratepayers, and placing utilities at a comparative disadvantage vis-á-vis other fuels. Hence, the general approach of utilities is to oppose treatment of environmental externalities in the IRP process. They argue that it is unfair to impose such a requirement on them and not on other industries or economic sectors. Utilities stress the piecemeal problems discussed in Section 2.2. They question the appropriateness and adequacy of the various methodologies proposed for use, especially the cost-of-control approach. In addition, they argue for a comprehensive and balanced treatment of externalities; i.e., treating all environmental, economic, and other externalities, not just environmental externalities; treating both benefits and costs, not just costs; and requiring all industries and end users to "internalize" externalities, not just electric utilities.

For cases in which the PUCs have decided to require treatment of environmental externalities, electric utilities often argue against monetization in favor of the qualitative approach or allowing utilities the flexibility to decide on the most appropriate methodology. Some utilities may challenge the specific values for individual emissions proposed by other parties in the proceedings as being too high and argue for lower values. They may also favor the damage function approach, which can cover all benefits and costs as well as all economic sectors. Electric utilities may even challenge PUC decisions on externalities in state courts.

In some cases, individual electric utilities may go to greater lengths in considering environmental issues in their resource planning. For example, in 1991, the New England Electric System (NEES) declared that it intended "to continuously reduce the environmental impacts of its electric service by reducing net emissions including greenhouse gases from its operations by an estimated 45%, continuing the nation's leading energy conservation programs, and purchasing renewable energy and emission offsets" (NEES 1991, p. 1). Two years later, the company declared in NEESPLAN 4 that Goal No. 1 is to "develop approaches to provide electric service in a more environmentally sustainable manner by: (1) pursuing renewable energy projects, including a new biomass gasification facility targeted to be in service by 1996; (2) stabilizing greenhouse gas emissions in the post-2000 period of levels 20% or more below 1990 levels and validating carbon offset options; (3) reducing air emissions from its existing fossil-fired generation, in part by making use of advanced technologies such as selective catalytic reduction on coal-fired units; (4) accounting for and reducing all of its wastes, including recycling 100% of its coal ash by 2000; and (5) maximizing the efficiency of its operations and its customers' operations, thereby reducing costs and the use of resources" (NEES 1993, p. 2). Note, however, that Massachusetts Electric Company, a NEES subsidiary, is challenging the Massachusetts DPU monetization requirements for emissions.

In early 1994, electric utilities have responded to DOE's Climate Challenge Program and have agreed to voluntarily reduce greenhouse gas emissions. A formal memorandum of understanding has been signed by DOE and representatives of 771 utility systems that agree to reduce emissions (*Electric Utility Week* 1994b). In particular, Public Service Electric and Gas Company (PSE&G) agrees to let the Environmental Defense Fund (EDF) monitor its efforts to scale back stationary source emissions by repowering older plants and switching fuel seasonally, reducing peak demand through aggressive implementation of DSM programs, and converting 60% of its motor vehicle fleet to natural gas and electric vehicles by 2000. PSE&G further agrees that, if the targets will not be met by such actions, it will work with DOE and EDF to identify alternative measures to achieve the goals (*Electric Utility Week* 1994a).

5.1.2 Edison Electric Institute

EEI is a trade association of investor-owned electric utilities. On September 12, 1991, EEI's board of directors approved the following policy statement on externalities in resource planning:

> The process of developing the appropriate approach to externalities will not be easy in its design or its implementation. Attempts to value externalities must accurately depict <u>all</u> external costs and benefits, a particularly difficult process. Using externality cost only for utility resource planning will lead to inefficient resource allocation, pricing and use of energy and could reduce beneficial uses of electricity as well as harm the international competitive posture of the U. S.
>
> It is the position of the Edison Electric Institute that the consideration and balancing of total costs and benefits can assist in making proper energy planning decisions. The process includes appropriate and consistent consideration of external as well as internal costs and benefits of <u>all</u> energy choices, and the uncertainties associated with these determinations. EEI objects to proposals which require only one element of the economy—utilities—to focus on only one element of the externality question—"environmental externalities"—and only one side of that equation—external costs—in the planning process (EEI 1991). (underlines original)

EEI contracted with the Energy Research Group, Inc. to conduct a critical review of the issue in the report entitled, *Environmental Externalities: An Issue Under Critical Review* (ERGI 1992a). The report critiques the ways in which PUCs attempt to internalize environmental externalities into the utility planning process. It concludes that present practices may be based on incomplete research, inappropriate methods, and unbalanced approaches. The approaches may be unbalanced because they are confined to the valuation of impacts of one type of externality from one form of energy, i.e., air pollution from electricity generation. This neglects the potential benefits of electricity generation and the impacts of other fuels and other sectors. In addition, the report contends that the control-cost approach that is favored by some PUCs does not necessarily yield proper estimates of the damage costs (ERGI 1992a).

Also for EEI, ERGI prepared a summary of 18 different testimonies presented by utility personnel, consultants for electric utilities, independent producers, environmental groups, and government agencies in proceedings before PUCs in Delaware, Florida, Illinois, Massachusetts, Texas, and Wisconsin, as well as the California Energy Commission (ERGI 1992b). EGRI found that "there is a lack of agreement among researchers as to the proper way of evaluating environmental externalities. Many times the soundness of the data and the methodologies used to derive evaluation techniques and estimates are in question" (EGRI 1992b, Introduction).

5.1.3 National Independent Energy Producers

NIEP is a trade association representing independent power producers (IPPs) and cogenerators. The group has adopted a two-level position concerning environmental externalities. At the overall, long-term level, NIEP favors a comprehensive strategy of covering all economic sectors that have significant environmental impacts, including societal benefits as well as damages of electricity generation, and conducting the assessment on a national scale rather than at the state and regional levels. In other words, NIEP is opposed to piecemeal implementation of environmental externality policies that treat electricity generation separately from other economic activities and that could create regional inequities. The group believes that acceptable methods for assigning values to externalities have not yet been designed. Therefore, it supports continued research at the federal level to develop the most appropriate policies.

At the nearer-term level, NIEP realizes that state PUCs will continue to develop externality policies. Thus, it urges regulators to consider emissions from existing electric generating plants, as well as from new generating plants. As discussed on Section 3.5, Full-Cost Dispatch, plants with less emissions have a comparative advantage over plants with more emissions. Because member companies of NIEP often have newer plants with less emissions, NIEP's position on full-cost dispatch is consistent with its economic interest when the PUC has already decided to impose an externality requirement. NIEP further advocates establishing aggregate emissions targets, patterned after the SO_2 scheme under the CAAA of 1990, and allowing emission offset programs. In its view, these are more efficient ways to reduce overall emissions levels (NIEP 1992, pp. 11–14).

Similar to some electric utilities, IPPs may pay considerable attention to environmental externalities and voluntarily engage in offset activities. An example is AES Corporation. In 1988, AES started its Guatemala agroforestry projects to offset CO_2 emissions from its Thames power plant in Connecticut. In 1991, it started the Mbaracayu Project in Paraguay to offset the emissions from its Barbers Point plant in Hawaii. In 1993, the company funded the South America Amazon Project to offset its Shady Point plant emissions (Sturges 1993).

5.1.4 Electric Power Research Institute

As the major organization conducting research and development in the generation, transmission, and end use of electricity, EPRI has taken no official position on the externality issue. It did contract for a study entitled *Environmental Externalities: An Overview of Theory and Practices* that provides a comprehensive overview of the externality issue, including the analytic techniques and potential implications for utility planning (TBS 1991). EPRI is conducting additional research on electricity use and the environment in order to understand the role of end-use technologies in addressing environmental issues. It is also investigating environmental-damage costing in least-cost planning to assess the impact of including environmental externalities in utility planning.

5.1.5 Bonneville Power Administration

BPA is a power marketing authority serving the Pacific Northwest states of Washington, Oregon, Idaho, and Western Montana. It is considered by many to be a pioneer in addressing environmental externalities in resource planning and acquisition. In 1991, BPA was one of the first entities to develop and specify monetized externality values by emission, based on the damage function approach but limited to the effects of power plant operation. BPA took the action because the Northwest Power Act requires it to make resource acquisition decisions based on a resource's system cost and to include environmental costs in determining a resource's system cost (BPA 1991). The values adopted by BPA for NO_x and CO_2 have subsequently become part of the basis of interim values adopted by Minnesota (Minnesota PUC 1994).

5.2 Fuel Suppliers

The coal and natural gas industries are two energy groups that have a large stake in the environmental externality policy debate. The coal industry is a major fuel supplier to the electric industry and is affected by the externality policy adopted by state PUCs. The views of the coal industry may be characterized by a position paper issued by the National Coal Council (NCC). The natural gas industry is both a potential fuel supplier to electric utilities for generation purposes and a competitor at the end-use level.

5.2.1 National Coal Council

The NCC is a federal advisory committee to the Secretary of Energy; its sole purpose is to advise, inform, and make recommendations to the Secretary of Energy on any matter requested by the Secretary relating to coal or the coal industry. The NCC is concerned about the high potential for misuse of the externality requirement imposed by state PUCs. In its view, the application of externalities by state PUCs is often biased, arbitrary, unsubstantiated, redundant, discriminatory, and inappropriate. In the words of the NCC:

- **Biased** - The current use of externalities will reduce coal's role in the nation's energy supply. In most cases, the positive externalities associated with coal use are ignored, the negative impacts are dramatically overstated, and the full external costs of other energy sources are not considered.

- **Arbitrary** - Incorporation of externalities into decision making is difficult and subjective. For example, externality values for CO_2 range from \$1 per ton to \$30 per ton, and can comprise up to three-quarters of the total externality values used in some states. Individual states are adopting widely variant externality values for similar levels of a given emission.

- **Unsubstantiated** - PUCs are imposing externality values for CO_2 based upon its alleged contribution to assumed global warming and its associated impacts without adequately considering testimony from climate scientists on the issue of global climate change and its effects.

- **Redundant** - Externality values are being used without regard to those costs that have already been internalized. The clearest example is provided by externality values that some states are imposing on SO_2 emissions for new power generation. These emissions will be fully internalized during implementation of the CAAA of 1990.

- **Discriminatory** - Current state externality programs are directed only at the electric power industry and their ratepayers, not at direct energy use in the industrial, commercial, residential, and transportation sectors.

- **Inappropriate** - The issue of global climate change is both national and international in scope. The result of independent action by states is rapidly becoming an uncoordinated, economically inefficient patchwork of regulations. Furthermore, it is becoming a set of state policies that run counter to the international energy policy objectives of the United States. (National Coal Council 1992, p. 2, emphasis original.)

The NCC recommended that DOE emphasize to state regulators "the need for extreme caution and thorough study of all facets of the externality issues including economic impacts before implementing specific externality programs," and that DOE "continue actions which promote public understanding of the potential cost and adverse impacts of externalities if improperly used" (National Coal Council 1992, p. 2).

5.2.2 Natural Gas Industry

The natural gas industry has not been as involved in the environmental externality debate as has the electric industry. For example, the Gas Research Institute, as the research arm of the gas industry, has not conducted studies on environmental externalities. Similarly, the American Gas Association (AGA) has not taken an official position on the issue. The natural gas industry seems to feel that natural gas is a cleaner fuel in terms of extraction and production than electricity and that imposing externality requirements may have a favorable impact on the amount of gas that may be used by electric utilities and other end users. The Interstate Natural Gas Association of America (INGAA) Foundation contracted for "an objective, introductory paper for leaders in the gas industry and supporting organizations that would summarize and comment upon environmental externality requirements now being developed for electric utilities" (Schleede 1992, p. 1). The report suggests that the gas industry take steps to be better prepared to participate in the environmental externality arena by monitoring the debates; intervening in state proceedings; participating in conferences; preparing for IRP requirements applicable to local gas distributing companies; addressing environmental impacts associated with the production, transportation, and use of natural gas; monitoring the U.S.-E.C. individual fuel-cycle studies; and conducting data-intensive analyses (Schleede 1992). The INGAA Foundation has not yet followed up on the study with any specific actions.

Some natural gas utilities have intervened in PUC proceedings addressing environmental externalities. For example, Boston Gas Company participated in both Massachusetts DPU's original and updated proceedings in 1990 and 1992, respectively. In the original proceedings, Boston Gas presented cost-of-control estimates of externality values for NO_x and CH_4 that were significantly higher than those presented by the Massachusetts Department of Energy Resources (Mass. DPU 1990, pp. 70–71).

5.3 Energy Consumers

Two different energy consumer groups have addressed the environmental externality issue in published reports: a group of large industrial companies represented by the Electricity Consumers Resource Council (ELCON) and a public interest group known as Council of Energy Consumers of America Research Foundation (CECA/RF). The ELCON report is essentially a position paper. The CECA/RF report is a policy analysis using the consensus-building approach. Large industrial customers of electric and gas utilities in various states also have registered their interests in the environmental externality issue through their participation in PUC proceedings. Residential, commercial, and agricultural consumers usually are represented in such proceedings by public agencies such as the office of consumer or ratepayer advocates, office of public counsel or attorney general, or consumer groups. This section describes the interests of energy consumer groups only; views and actions of state and local governments will be covered in Section 5.4.

5.3.1 ELCON and Other Large Industrial Groups

ELCON, an association of large industrial consumers of electricity, has been very active in the entire IRP area. ELCON published a series of papers called *Profiles in Electricity Issues*, covering topics on IRP, fuel adjustment clauses, and environmental externalities, and makes presentations at regulatory proceedings, regulators' meetings, and professional conferences. Because ELCON is concerned that incorporating environmental externalities into the IRP process would raise electric rates for its members, it is opposed to state PUC formulation of environmental externality policies. In its view, decisions concerning internalization of external costs should be made by legislative bodies, not economic regulatory entities. According to ELCON, electric utilities should address, in their least-cost planning, only compliance with existing environmental laws and regulations, not externalities beyond those regulations. ELCON contends that attempts to include externalities should address all positive and negative impacts. In its view, states usually cannot identify all externalities or, if identified, cannot measure them with any degree of precision or confidence. These selective measurements of externalities can lead to economic distortions. In addition, the multistate, regional nature of the externalities tends to remove them from the individual state PUC's jurisdiction. Moreover, ELCON believes the piecemeal application of externality policy by PUCs could shift electricity production to nonutility sources and encourage the displacement of electricity at the end-use level, distort relative prices, shift production and jobs to regions or states without similar regulation, impose costs on ratepayers who are not responsible for the negative externalities, and discourage use and development of beneficial electrotechnologies, clean coal technologies, and so forth (ELCON 1991).

Large industrial users of electricity and natural gas in individual states have coordinated their efforts through a statewide group to intervene in PUC proceedings dealing with externalities. In general, they are concerned that including externalities would increase their electric rates; hence, their views and position on this matter generally mirror those of ELCON. For example, the Illinois Industrial Energy Consumers group has participated in both the statewide plan proceeding conducted in 1991-92 and the ongoing process for adopting a rule to address environmental externalities in the IRP process (Illinois Commerce Commission 1992; Johnston 1994).

5.3.2 Consumer Energy Council of America Research Foundation

CECA/RF is a nonprofit public interest energy policy organization that serves as a nationwide resource for information, analysis, and technical expertise on a wide variety of energy initiatives. It is committed to ensuring reliable and affordable energy for all sectors of the economy. It "provides a forum for consensus-building for a broad cross-section of interests including public and private sector organization, state and local groups, businesses, utilities, consumers, environmentalists, government agencies, academicians, and others on a wide variety of energy policy issues in furtherance of the public interest" (CECA/RF 1993a, inside cover).

For its externality project, CECA/RF formed an advisory committee representing a broad range of key stakeholders. The composition of the committee was as follows: the electric industry, 12; the natural gas industry, 4; energy consumers, 5; federal government, 9; state government, 10; environmental group, 2; conservation group, 1; and research organizations, consultants, and others, 9. Although the advisory committee attempted to reach consensus on as many issues as possible, it neither accepted nor rejected the resulting report. CECA/RF takes full responsibility for views and recommendations presented in the report (CECA/RF 1993a).

CECA/RF believes that getting the price of electricity right is an important issue to consumers and electric utilities alike. In CECA/RF's view, electricity prices should ideally include the costs to society of such things as damage caused by pollution. In exploring the implications of attempts to internalize externalities for final consumers of electricity, however, CECA/RF has taken no position on whether regulators should adopt environmental externality policies on specific pollutants. Instead, CECA/RF's externality project report offers a useful framework for approaching the task of treating environmental externalities in the IRP process through a series of 27 recommendations. The recommendations are the results of 1 year of consensus-building efforts among the group of 50 advisory committee members noted above. The recommendations define externalities; explain two views of improving social welfare; and address issues of uncertainty, nature and scope of policy analysis, choosing policy instruments, piecemeal problems, the need for policy coordination, specific policy steps, state actions, the PUC policy process, and the PUC perspective on piecemeal problems and policy implementation (CECA/RF 1993a).

The decision tree approach to reaching a policy conclusion through a series of 27 recommendations seems to be comprehensive and potentially useful to decision makers. However, the CECA/RF report was published in July 1993 and, as of March 1994, there are no specific examples of application of the approach attributable to the report.

5.4 Government Agencies

Various state and local government agencies (other than PUCs), such as state energy offices, ratepayers advocates, public counsel, environmental protection offices, and city governments, have expressed interest in the externality issue, mainly in state PUC proceedings. Staff of the Federal Energy Regulatory Commission (FERC) have prepared a report on the subject. DOE has funded surveys, studies, and conferences. The views and interests of these agencies are summarized in this section.

5.4.1 State and Local Governments

Some state and local government agencies support explicit treatment of externalities, and some have even proposed a specific methodology or externality values for consideration by PUCs. In states that have imposed specific environmental externality requirements, state energy offices often support such requirements. For example, Massachusetts DPU adopted the externality values for specific emissions presented by the Massachusetts Department of Energy Resources (Mass. DPU 1990 and 1992). The California PUC adopted some of the externality values developed by the California Energy Commission, which has also developed damage-cost estimates of externality values. The staff of the Oregon Department of Energy worked with Oregon PUC staff to recommend specific values for individual emissions (Oregon PUC 1993). In Colorado, the Office of Energy Conservation suggested that utilities be required to conduct a "dry run" at quantifying environmental externalities in their initial IRP filings (Colorado PUC 1992). In Illinois, the Department of Energy and Natural Resources has argued for incorporating environmental externalities. The city of Chicago also has been an intervenor in proceedings before the Illinois Commerce Commission, arguing for adopting the control-cost approach to monetizing environmental externalities (ERGI 1992b).

5.4.2 FERC Staff

In preparing its report on renewable energy and energy conservation incentives in response to Section 808 of the 1990 CAAA, FERC staff identified three broad categories of approaches to address environmental externalities: (1) nonmarket approaches such as set-asides and emission standards; (2) quasi-market approaches such as adders and social cost dispatch; and (3) market-based approaches such as emission charges and permit systems. In the FERC staff's view, the nonmarket approaches will yield the least efficient outcome, the market approaches the most efficient results, and the quasi-market approaches the intermediate results (FERC Staff 1992). FERC staff further indicated that market-based policies are preferable to nonmarket policies on both efficiency and equity grounds.

The FERC staff report made the following recommendations: (1) The damage function approach is the preferable approach to calculate the net environmental benefits of renewable resources. (In fact, FERC staff joined DOE in sponsoring the U.S.-E.C. project on the application of the damage function.) (2) States should proceed cautiously with plans to internalize environmental externalities and should consider local conditions, current environmental regulations, and the impacts of the piecemeal approach. (3) States should realize that no one model for internalizing externalities is superior in all cases. (4) More research is needed on methods to estimate environmental impacts and approaches to internalize environmental externalities (FERC Staff 1992, pp. iii–iv).

5.4.3 Department of Energy

DOE has an ongoing interest in the issue of environmental externalities, and DOE has supported several studies and activities on environmental externalities by funding different organizations. DOE-funded studies include a NARUC survey (Cohen et al. 1990), the PACE University Study (PACE 1990), the NARUC study (ECO Northwest 1993), and the U.S.-E.C. study (ORNL and RFF 1992). Individual fuel cycle reports of the U.S.-E.C. study are expected to be released in 1994. DOE also supported the 1990 conference on environmental externalities and IRP conferences sponsored by NARUC, which usually include sessions on environmental externalities. DOE does not necessarily support the results of the studies or analyses that it helps fund. In December 1992, DOE released the peer review comments on the PACE University Study. The review found the PACE Study to be "substantially flawed," especially the externality values associated with nuclear plant operations and the health effects of sulfate. DOE further indicated that "externality values derived from presently available reports and surveys are based on flawed scientific calculations of damage, and are in any case inappropriate for general use because such values can only be accurately calculated for specific localities" (DOE/DIEP 1992). DOE also indicated that the U.S.-E.C. study by ORNL and RFF will derive damage-cost estimates using consistent methodology (DOE/DIEP 1992).

In a September 1993 advance notice of proposed rulemaking concerning energy conservation standards for three types of consumer products, DOE sought comments and data on, among others, "methods of calculating the dollar value of reduced atmospheric emissions of SO_2, NO_x, and CO_2 from reduced energy consumption" (DOE/EERE 1993, p. 47338). DOE wants to determine if an appropriate methodology can be developed. The process is still ongoing as of June 1994. In early 1994, DOE's Draft IRP Program Plan stated that the IRP Program intends to achieve its objective in disseminating useful information on treating environmental externalities by developing an information clearinghouse and conducting fuel cycle analyses, surveys, and related analyses (DOE/OUT 1994, pp. 30–32). In short, DOE supports the research and development of externality issues, and attempts to be an unbiased source of information on the subject.

5.5 Public Interest Groups and Other Analysts

Public interest groups such as environmentalist groups and other advocates for energy efficiency, DSM, and renewable energy have actively participated in PUC environmental externality proceedings. Consulting organizations, academicians, and other analysts also are players in this arena. The interests, views, and activities of these groups are briefly noted in this section.

5.5.1 Environmentalists

With their primary focus on protecting the environment and improving its quality, environmental groups generally support requiring explicit treatment of environmental externalities in the IRP process. The Natural Resources Defense Council (NRDC) is a prime example. NRDC is a nationwide nonprofit environmental organization that has actively participated in the debates concerning many energy-related issues. In 1990, NRDC and Pacific Gas and Electric Company (PG&E) jointly submitted a set of comments on DOE's National Energy Strategy, contending that it "should provide a framework that ensures market forces and state and local regulatory processes deliver reliable energy services at lowest cost **including recognition of environmental effects**," and that "the cost of continued emissions of greenhouse gases, including CO_2, cannot be zero in all future scenarios" (PG&E and NRDC 1990, p. 2 and 26; emphasis added). In 1993, NRDC staff further argued that there is an increasing risk that CO_2 emissions from new fossil-fired power plants will be taxed or capped. Thus, prudence demands that utility managers consider alternative strategies to address the issue (Cavanaugh et al. 1993).

NRDC also worked with other environmental groups and state consumer advocacy agencies to prepare an open letter to managers of U.S. utilities, urging them to anticipate future CO_2-emission cost increases in their planning decisions (Cavanaugh et al. 1993). In addition, NRDC worked with BPA to develop a strategy in place of assigning specific values to individual emissions (Cavanaugh et al. 1993).

The Conservation Law Foundation (CLF) was involved in Massachusetts DPU 89-239 (1990) and DPU 91-131 (1992), arguing for monetization using the costs of actual damages whenever such estimates are available, and supporting the control-cost estimates adopted in DPU 89-239. CLF also collaborated with the NEES to develop the latter's NEESPLAN 4, incorporating energy efficiency, renewable energy supplies, development of efficient distributed generation, waste recycling, and environmental accounting in NEES' long-term resource plan (NEES 1993). In Colorado, Land and Water Fund of the Rockies, participating in the PUC's Docket 91R-642E, supported quantification of externalities and recommended that utilities be required to conduct a dry run on quantification (Colorado PUC 1992). In Wisconsin, Citizens for a Better Environment sponsored testimony recommending the use of monetized adders for incorporating environmental externalities in Wisconsin's Advance Plan process (ERGI 1992b).

5.5.2 Advocates of Energy Efficiency, DSM, and Renewable Energy

Advocates of energy efficiency, DSM, and renewable energy realize that incorporating environmental externalities could yield a comparative advantage for energy efficiency, DSM options, and renewable energy resources when compared to fossil-fueled supply-side options, thus leading to greater penetration of these options in the preferred resource portfolios. Therefore, they favor requiring explicit treatment of environmental externalities in the IRP process. Some such groups have participated in state PUC proceedings.

In Oregon, the Solar Energy Association of Oregon (SEA of O) was active in the proceeding to adopt guidelines for environmental externalities (Oregon PUC Docket UM 424) and presented written comments. Specifically, SEA of O argued that the control-cost approach may underestimate potential damage costs. For CO_2, it supported the PUC staff's proposed range ($10 to $40 per ton) and suggested that if zero is included in the range, then the upper bound should also be extended to well beyond the $40-per-ton value in the staff proposal. The PUC eventually adopted the staff's proposal. SEA of O also unsuccessfully advocated monetary adders for methane. SEA of O and the Coalition for Energy Efficiency and Renewable Technologies contended that SO_2 emissions can cause damages unrelated to regional acid deposition and that the current price of allowances under the 1990 CAAA does not cover all compliance costs or damages caused by the acid deposition. SEA of O also believes that external costs of the entire fuel cycle should be included. The Oregon PUC decided not to complicate and delay the decision until all these additional issues can be settled, and, instead, adopted monetarized values for NO_x, TSP, and CO_2 only (Oregon PUC 1993).

The Alliance to Save Energy (ASE) has developed a spreadsheet-based method for quantifying reductions in SO_2, CO_2, and NO_x attributable to DSM programs. The method takes into account variations by time of day for three day types (peak day, week day, and weekend day) and by month. ASE suggests that utilities apply the results from this method to benefit-cost calculations for DSM programs. ASE expects that this practice would result in more DSM options being implemented and greater reductions in air emissions realized (Fenichel 1993).

5.5.3 Consultants and Others

Different consulting firms and analysts, including academicians, have different perspectives and orientations; hence, their views on treating environmental externalities in the utility resource planning process differ. To those who believe that the market mechanism is a better regulator than the state PUCs, it is unnecessary and inappropriate for state PUCs to impose an environmental externality requirement. Others see that the market is not completely free and competition is imperfect. In their view, the costs of environmental externalities are significant and should be included in the overall benefit-cost calculations. They believe that it is proper for the state PUCs to act. In addition, some analysts have developed expertise in a specific approach or methodology for monetization or quantification. Because of their respective orientations, views, and expertise, these consultants and analysts have been, and will continue to be, engaged by various stakeholders and interest groups in the continuing debate.

5.6 Summary

In summary, the interests of stakeholders with respect to the issue of addressing environmental externalities in the IRP process are as follows:

- The electric utility industry's view on the matter has three broad variations. First, it is generally opposed to the requirement that environmental externalities be considered in the IRP process using either adders or monetized values by emission. Utilities perceive an inequity in being singled out for separate treatment and in potentially losing competitiveness vis-a-vis other fuels, cogeneration, customer self-generation, and even other electricity suppliers not subject to the same requirement. Some utilities oppose it out of concern for their ratepayers. Second, if state PUCs decide to impose an externality requirement, some utilities will request to choose their own approaches, present alternative estimates of externality values for specific emissions, or favor the damage function approach that can cover all benefits and cost and all economic sectors. Third, in some instances, individual utilities such as NEES and PSE&G may actively consider the beneficial environmental effects of energy efficiency, DSM, and renewable resources in their long-term resource planning.[56] EEI and NIEP appear to share generally the first and second views. In addition, NIEP favors extending the externality requirement to the operations of existing plants (social cost dispatching). There are also examples of IPPs voluntarily investing in projects to offset greenhouse emissions from their new power plants. BPA is a pioneer in incorporating environmental externalities into resource planning and acquisition.

- The coal industry and the large industrial energy consumers such as ELCON are opposed to treating environmental externalities in the IRP process. The coal industry thinks that such practices are biased and discriminate against the electric utilities and their ratepayers; that the monetized values for CO_2 are arbitrary and unsubstantiated; that the values for SO_2 are redundant; and that the methods are inappropriate. ELCON emphasizes the piecemeal problems and questions the authority, expertise, and capabilities of PUCs to treat externalities.

[56]Note, however, that Massachusetts Electric Company, a subsidiary of NEES, is challenging in state courts the legality of the monetized values for emissions adopted by the Massachusetts DPU.

- Some natural gas utilities, state and local governments, environmentalists, and advocates for energy efficiency, DSM, and renewable energy resources are in favor of requiring consideration of environmental externalities in the IRP process. FERC staff favor the "market-based" approaches, such as emission charges and permit systems, to internalize environmental externalities. With respect to calculating net environmental benefits, FERC staff prefer the damage function approach and caution states to be aware of potential pitfalls of the piecemeal approach to internalization. DOE supports research and development in externality issues, and attempts to be an unbiased source of information on the subject.

- Other consultants and analysts are divided in their views on the subject. Some are in favor of, while others are opposed to, the requirement to consider environmental externalities in the IRP process. Much depends on the analysts' philosophical orientation and their respective accumulated expertise.

It appears that three factors affect the views, positions, and interests of stakeholders with respect to incorporating environmental externalities into the utility resource planning process. The first factor is the perceived adverse or favorable impacts on the stakeholders' economic interests or the viability of their position on environmental policy. Those who would be adversely affected generally oppose it: the electric utility industry, the coal industry, and the large industrial users of energy. Those who would be favorably affected or whose policy preference would be enhanced support the requirement: the natural gas industry, environmentalists, and advocates of energy efficiency, DSM, and renewable energy. The second factor involves the concept of social costing. Some government agencies and analysts believe that environmental externalities are real costs to society and should be included in the benefit-cost calculations and reflected in the prices of goods and services. They therefore support incorporating environmental externalities into the IRP process. The third factor is the orientation of the analysts on market competition and their respective accumulated expertise. Those who believe that the market mechanism is a better regulator than the state PUCs oppose the externality requirement imposed by the PUCs.

6.0 Other Aspects

This chapter covers the treatment of uncertainty, valuation methods, and other approaches to address environmental externalities. Treatment of uncertainty is a technical or analysis issue and, therefore, was not discussed with in Chapter 3, which addresses policy and regulatory issues. Valuation methods, while generally related to the damage function and cost-of-control approaches to internalizing environmental externalities, were not discussed in Chapter 4 to avoid complicating the descriptions of methodologies directly associated with treating environmental externalities in the IRP process. Because other approaches that address externalities are not directly associated with IRP processes, they will be described only briefly to complete the picture in this review.

6.1 Treatment of Uncertainty

Uncertainties abound in the process to address environmental externalities. Measurements of actual emissions and pollution may not be precise in many cases and are not attempted in others. Even if total emissions can be accurately measured, the distribution or concentration of the emissions is uncertain because they are affected by climatic conditions. In addition, the impacts on health, ecological resources, and output and production vary, and our knowledge of them is either incomplete or imprecise. Further, the values used to translate damages and benefits from physical terms to dollar values are often imprecise and sometimes based on judgment and estimates.

Some opponents to monetization of environmental externalities have used the uncertainty aspect as an argument against state actions on this matter. This is reflected in part in the contention that zero is the appropriate value to apply to the external costs of emissions. As discussed in Section 4.4.2, however, proponents argue that the order of magnitude in the uncertainty associated with environmental externalities is more or less the same as for uncertainties associated with other subject areas being addressed in the utility regulatory process. According to this view, there is no need to treat uncertainty in environmental externality differently from other issues in the utility regulatory process. Opponents point to the extremely wide range of the estimates of monetized externalities to question the validity of the proponents' argument.

What are the appropriate policy responses to uncertainties in environmental externalities? How should the quality and uncertainty of the data and estimates be represented so that users can easily interpret them? The following discussion presents the framework suggested by the CECA/RF, the sensitivity analysis approach adopted by the Oregon PUC, and a system of indicators for designating the nature, quality, and confidence level of the data used in the analysis.

6.1.1 The CECA/RF Proposal

As noted in Section 5.3.2, CECA/RF has developed a decision tree approach to reaching a policy decision on issues relating to the treatment of environmental externalities in the IRP process through a series of 27 recommendations. Among the 27, 4 specifically deal with recognizing and responding to uncertainty:

8. Policymakers should recognize that the decision to move to social costing is surrounded by uncertainty and analytic complexity in estimating the damages from environmental externalities and the costs and benefits of internalizing them.

9. As in other areas of utility planning and regulation, the uncertainties and complexities surrounding some externalities are considerable. However, CECA/RF believes that they are not large enough to rule out action appropriate to the circumstances.

10. Action to deal with specific externalities should vary according to the nature of uncertainty surrounding individual pollutants and the possible severity of impacts to society if there is no remediation for the pollutants. Appropriate policy actions may vary from strong immediate action, where there is clear evidence of potential improvements in social welfare, to gradualist long term action where problems are less pressing or uncertainties are larger, to further study of potential harm, where uncertainty and complexity are large enough to cast doubt on the value of taking regulatory actions.

11. Policymakers should conduct aggressive research programs to resolve uncertainties where possible and to manage uncertainty where not (CECA/RF 1993a, p. 32, 33).

In the CECA/RF framework, the need to recognize uncertainty in addressing environmental externalities is emphasized first (Recommendation 8). CECA/RF believes that the uncertainty associated with environmental externalities, though considerable, is within reasonable limits and that some regulatory action is appropriate (Recommendation 9). It advocates a case-by-case determination of the appropriate approach to address the uncertainties associated with specific emissions. It would distinguish among three types of action in relation to the level of uncertainty. The first involves cases in which the degree of uncertainty is relatively low and there is evidence of possible large net benefits to society in general. In such cases, the PUCs should take immediate action. The second type covers cases in which the need for action is less pressing and there is a higher level of uncertainty. Here, the PUC should take "gradualist long-term actions." The third type of action is to conduct further study on cases for which knowledge is very incomplete and there is a high level of uncertainty (Recommendation 10). CECA/RF also calls for additional research to reduce uncertainty wherever possible and to manage the uncertainty when it is not possible to reduce it (Recommendation 11). However, CECA/RF warns against complete inaction that might result from undue emphasis on uncertainty (CECA/RF 1993a, pp. 32–35).

6.1.2 Sensitivity Analysis

Oregon has adopted the sensitivity analysis approach to addressing the uncertainty issue. As shown in Table 5, the Oregon PUC adopted a range of dollar values for three specific emissions in its guidelines for the treatment of external environmental costs: \$2,000 to \$5,000 per ton of NO_x, \$2,000 to \$4,000 per ton of TSP, and \$10 to \$40 per ton of CO_2.[57] Guideline No. 2 further states as follows:

> The figures for NO_x and TSP apply to attainment areas only. Higher values, to be determined on a case-by-case basis, would apply if nonattainment or Class I areas (such as wilderness areas designated before 1984) were affected.
>
> Utilities should, at a minimum, examine six sets of adders, determined by combining the low and high values for NO_x and TSP with the low, middle, and high values for CO_2:
>
> In adopting the above approach to treating uncertainty in the monetized values of the three emissions in question, the Oregon PUC rejected a suggestion to require more extensive sensitivity analysis using Monte Carlo simulations. It was not persuaded that the additional information, if any, would be worth the trouble of conducting the additional analysis (Oregon PUC 1993).

[57]In 1990 dollars.

	$/Ton					
	1	2	3	4	5	6
NO_x	$2,000	$2,000	$2,000	$5,000	$5,000	$5,000
TSP	$2,000	$2,000	$2,000	$4,000	$4,000	$4,000
CO_2	$10	$25	$40	$10	$25	$40

[Note: To convert $/ton to $/metric ton divide the $/ton amount by .9071847.]

> Each utility should conduct its sensitivity studies, e.g., with respect to variability in loads and fuel prices, for at least one of these six combinations of adders. Furthermore, the utility should report what its preferred strategy would be with the adders for NO_x, TSP, and CO_2 set to zero and without consideration of other external environmental effects (Oregon PUC 1993, p. 5).

Minnesota has recently adopted a similar approach. In an interim rule issued in March 1994, the Minnesota PUC directed utilities to present cost estimates for three scenarios: assuming no externalities, incorporating the low rate, and using the high rate (Minnesota PUC 1994).

6.1.3 NUSAP

As explained in Section 4.1.4, the damage function approach adopted by the U.S.-E.C. Fuel Cycle Study is implemented by using an accounting framework to organize the needed information for each impact pathway from initial emission through final impacts. The information is derived using different methods that reflect different levels of quality and confidence. Single entries in cells of the accounting framework could give rise to a false sense of precision and would not inform the readers of what was involved in arriving at the specific value. To deal with this uncertainty problem, the study team adopted a quality message system called NUSAP, which represents the following:

Numerical entry (i.e., information on quantification)
  Numeral, or Notation, or Variable Name, or Note on practice

Unit
  U1: Units of measurement
  U2: Statistic used for value, e.g., mean (ME), mode (MD), median (MN), lower bound (LB), upper bound (UB), expected value (EV), or no distribution (ND)

Spread of value
  S1: Level of confidence
  S2: Spread lower and upper bound (S[LB, UB])

Assessment of value
  I1: Informative value based on spread
  I2: Informative value based on application

  G: Generalizability to other application
  R: Robustness of value over time

Pedigree
T: Theoretical basis (and application of theory)
D: Data inputs
E: Estimation methods
M: Estimation metric

Notation: (N, U1, U2): (S1, S2[LB, UB], A[I1, I2, G, R]): (P[T, D, E, M])
(ORNL and RFF 1992, pp. 2-23–2-26).

By looking at the notations, readers can determine the entries, units of measurements, measures of central tendency and dispersion, level of confidence associated with the values, and their origins. They can also see how the values are derived, how applicable they are to other situations, and how robust they are over time. It should be noted that the application of this scheme is based on the judgment of the researchers and peer reviewers.

6.2 Valuation Methods

If external environmental effects are to be monetized, it is necessary to assign values to specific physical impacts. Environmental externalities often involve public goods, making it difficult to exclude those who do not pay from enjoying the benefits of the product or service being consumed. Public goods can provide three types of value: (1) direct use of a public good gives rise to **use value**[58]; (2) when people simply value the option to use a public good, regardless of whether they actually use it or not, it is an **option value**; and (3) when people derive pleasure from knowing that certain species are preserved, even if they never expect to see the species themselves, this is a **preservation value**[59] (TBS 1991, p. III-1).

There are three general valuation approaches to assigning dollars to these services: direct-cost estimation, indirect-cost estimation, and contingent valuation. In Section 4.2, two other valuation methods were mentioned: cost of control and damage function. For the purpose of this section, the cost-of-control method assigns the highest marginal cost of controlling pollution or of mitigating it as a proxy for the value of damages caused by the marginal pollution. In addition, the damage function is classified as a hybrid method that is primarily direct-cost estimation with some indirect-cost estimation and contingent valuation applied as needed. These two methods were covered in Section 4.1 and will not be repeated here except to clarify their relationship with the other methods.

6.2.1 Direct-Cost Estimation

For cases in which there are market transactions, market prices are the appropriate values to use. Examples are reduced crop yields due to air emissions; smaller fish harvests due to water pollution; and increased frequency in cleaning, painting, or otherwise maintaining the exterior of buildings and houses. The appropriate values in such cases are the prices of the crops, fish, and building maintenance supplies

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[58]ECO Northwest adopts a slightly different classification scheme in which the "use value" is further separated into two subcategories: consumptive use and nonconsumptive use. Consumptive use services are those on-site activities such as fishing and hunting that reduce the quantity and quality of the same services that are available to others. Nonconsumptive use services are those activities, such as bird-watching or enjoyment of the scenery, that generally do not reduce the availability of the same services to others (ECO Northwest 1993, p.31).

[59]In the ECO Northwest classification scheme (see the previous footnote), the term "non-use value" refers to both the option value and the preservation value (ECO Northwest 1993, pp. 31-32).

and labor. In cases involving adverse health effects, actual medical expenses and wage rates are used, the latter for estimating lost wages. Conceptually, the direct-cost estimation approach for evaluating externalities should also include the "consumer surplus,"[60] which is not captured by the simple application of market prices in the calculations. Therefore, other things being equal, market prices (without accounting for consumers surplus) tend to underestimate the true external costs. Direct-cost estimation is fully applicable to measure use value and partially applicable to derive option value (TBS 1991).

6.2.2 Indirect-Cost Estimation

Many environmental effects involve services without actual market transactions; hence, there are no market prices to use in valuing those externalities. Examples of such services or impacts are on-site enjoyment of scenic areas or monuments; hunting, fishing, and other recreation activities involving natural resources; as well as the curtailment of activities such as avoiding going outdoors during high air pollution days. However, some related activities or behaviors may be reflected in market prices, which may be used to derive approximations of the values of the services. For example, if the values of houses located near a park are higher than comparable houses elsewhere, the difference in property values gives a good estimate of the use value and option value of the park, other things being equal. Similarly, wage differentials can be used to estimate the value of air pollution exposure in a job, or the difference in the risk of death. Travel costs can be used to estimate the benefits of recreational areas. This approach is also called "shadow pricing," "hedonic pricing," or "revealed preferences." This approach is fully applicable to estimating the use value and partially applicable to deriving the option value of services from public goods or natural resources. It is not applicable to compute preservation value (TBS 1991; ORNL and RFF 1992).

6.2.3 Contingent Valuation

The value of many natural resources, such as the survival of individual species and biodiversity through preservation of natural habitat, cannot be estimated through either direct- or indirect-cost estimation methods. In such cases, contingent values can be derived by "asking either open- or close-ended questions of individuals about their willingness to pay in response to hypothetical scenarios involving reductions in health or environmental risks or effects" (ORNL and RFF 1992, p. 5-5). Similarly, questions can be phrased to estimate respondents' willingness to accept a compensation to induce them to tolerate increased emissions and the attendant health and environmental risks. This is the contingent valuation approach. The method does not make use of market prices; it measures the values placed on environmental externalities by the respondents. In addition to estimating the value of preservation, the contingent valuation method is applicable to estimating use and option values. Two common applications of the approach are to estimates the value of endangered species and the value of visibility (TBS 1991).

6.3 Other Approaches to Address Environmental Externalities

As noted in Section 4.2, methods not under PUC influence include the command and control approach, emissions standards and targets, offset policies, and the imposition of emission fees and taxes. In addition, a mechanism for complying with emissions standards is to engage in emission allowance trading. As utilities attempt to meet new regulations, standards, or pollution reduction targets, they incur additional costs. Similarly, the fees, taxes, or costs associated with obtaining the necessary offsets or emission

[60]The economic concept of consumer surplus refers to the difference between the maximum amount of money that consumers are willing to pay for a given quantity of a product or service and the amount that they actually pay.

allowances become part of the utility costs. As a result, the cost of utility services increases when environmental effects are internalized. However, questions are often raised as to whether state PUCs have authority over these options. The discussion presented here is intended only as a brief introduction. Interested readers may refer to other studies such as CECA/RF (1993a) for more complete treatment.[61]

6.3.1 Command and Control

With the command and control approach, the regulatory authority prescribes what the utilities shall do to abate emissions. Individual utilities have no choice but to follow the prescribed action. For example, utilities may be required to install flue-gas desulfurization equipment (FGD or scrubbers) in their coal-fired power plants. If a utility or an industrial firm has several source points, each source point would be directed to install certain abatement equipment. While this approach is the most direct, it lacks flexibility and is likely to be more costly than alternative methods.

6.3.2 Standards and Targets

Regulators may impose emissions standards, fuel quality standards, or emission reduction targets. Emissions standards specify the maximum allowable emissions by type of facility. The utilities can choose different options to comply with the standards, such as installing scrubbers, switching to different fuels, or buying emission allowances to offset the emissions from their generating plants. Fuel quality standards are aimed at controlling emissions from the input side. For example, the sulfur content of fuel oil or coal used in commercial and industrial facilities cannot exceed a certain level. An example of the emission reduction target is to reduce CO_2 emission to 1990 levels by the year 2000.

6.3.3 Emission Fees and Fuel Taxes

In the emission fee approach, utilities and other industries are required to pay fees to the government according to the amount of measured pollution in excess of allowable levels. The fuel tax approach requires energy users to pay a tax according to the amount of fuel or energy used. Both the emission fees and fuel tax approaches will allow the costs of environmental effects to be internalized to the extent that fees or taxes are collected. The fees may take the form of user charges, deposit-refund systems, performance bonds, or noncompliance fees (CECA/RF 1993a). The taxes may be in the form of a product tax, tax differentiation, or carbon tax (CECA/RF 1993a).

6.3.4 Offset Policy (CAAA-Mandated)

The offset policy requires a new emission source to obtain an equal or larger amount of emissions reductions, particularly in areas where current emissions levels already exceed the specification of NAAQS (CECA/RF 1993a; Joskow 1992). It is similar to the offset approach discussed in Section 3.3, except that the offset policy in the current context is a prerequisite for new plants (the emission sources) being built and is either prescribed by law or by environmental regulatory agencies. The offset approach discussed in Section 3.3 is an option that a state PUC may decide to allow in treating environmental externalities in the IRP process.

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[61]The discussion in this section is, to a large extent, based on CECA/RF (1993a), pages 57 through 77. Note, however, that the CECA/RF report uses a broadly defined category of the "command and control" approach, which encompasses the narrowly defined command and control approach, standards, and targets discussed here. In addition, the CECA/RF report uses the term "market approach" to refer to those approaches associated with emission allowance trading, taxes, fees, liability, and subsidies.

6.3.5 Emission Allowance Trading

As a mechanism to comply with emissions standards, emission trading starts with a cap in total allowable emissions and creates a market for emission allowances. An allowance is the right to emit a fixed amount of pollutant. With the total emissions capped, a utility that can reduce its emissions cheaply may over-control and earn credits; these credits can be sold for use by others or saved (banked) for use in the future or in other facilities. Utilities facing expensive emissions control options may elect to buy allowances in the market at a lower total cost than taking the abatement action for the specific facility in question. The market for the allowances will determine their price. Presumably, utilities and industrial firms will buy allowances only in cases when the prices they have to pay for the allowances are less than the cost to install abatement equipment themselves. In this sense, emission allowance trading can achieve the same level of pollution reduction more efficiently than the command and control approach. Ideally, the cap on the allowable emissions should be set at the point where marginal social costs of pollution abatement equals the marginal societal benefits of the abatement. The SO_2 allowance trading established pursuant to the CAAA of 1990 is an example of emission trading.

6.4 Summary

There are at least three ways to address the uncertainty associated with treating environmental externalities in the IRP process. First, as suggested by CECA/RF in its Recommendation 10, state PUCs may take actions on a case-by-case basis. For cases in which the degree of uncertainty is relatively low and there is evidence of large potential benefits to society, the PUC should take strong immediate actions. For cases in which the problem is less pressing and uncertainty is higher, the PUC should take a gradualist approach with long-term actions. When uncertainty and complexity are large enough to cast doubt on the value of taking regulatory actions right away, the PUC should conduct further studies on the potential harm. Second, utilities may be required to conduct sensitivity analyses, using probable ranges or probability distributions of emission values specified. An example is given in the Oregon PUC's Guideline No. 2 in its Order No. 93-695 (May 17, 1993). Third, to the extent that dollar values assigned to specific emissions are based on different methodologies, using different metrics and sources of data with different quality and precision, a quality message system such as NUSAP can be used to designate the quality, confidence, and origin of the estimate, thus avoiding the unjustified sense of precision and exactness in the estimates.

Public goods can provide three types of value: use value, option value, and preservation value. Among the three valuation methods, the direct-cost estimation approach uses market prices and can lead to underestimation of external costs if consumer surplus is not considered. The indirect-cost estimation approach uses observed market prices or behaviors indirectly related to the services of concern to infer the values of the services. Both direct- and indirect-cost estimation approaches are fully applicable to estimating use values and are partially applicable to deriving option values. Only the contingent valuation approach is applicable to estimating the preservation values of a public good. It is also applicable to estimating use and option values.

The other methods of addressing environmental externalities not under PUC influence include command and control, emissions standards and targets, emission fees, fuel taxes, offset policies mandated by the CAAA, and emission allowance trading. It is generally believed that the total cost of controlling pollution using emission allowance trading, taxes, or fees will be lower than that with the command and control approach. However, questions are often raised as to whether state PUCs have the authority to implement these measures. Such policies are set by federal law, and the costs are presumably internalized.[62]

[62]However, there are offset policies that are under PUC jurisdiction. They are discussed in Section 3.3.

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Appendix
Methods Under PUC Influence with Other Focus

In the literature, three other approaches have been mentioned: bonus rates of return, shared savings, and set-asides. In taking such actions, the primary objectives of state PUCs are often to promote DSM, energy efficiency, and renewable resources, rather than to treat environmental externalities. However, such actions do have implications in terms of environmental externalities, and the environmental benefits are sometimes also mentioned. In the classification scheme discussed in Section 4.2, they are "methods under PUC influence with other focus." This Appendix briefly describes these methods and discusses state PUC actions concerning them.

A.1 Bonus Rates of Return

With bonus rate of return, utilities are allowed a higher rate of return on investments in DSM, energy efficiency, and renewable resources. For example, a 1980 legislation passed in Washington State directed the Washington Utilities and Transportation Commission to add an incremental 2% on the allowed rate of return to utility investment in energy efficiency improvement measures, cogeneration, or renewable energy resources. The provision was applicable to investments made between 1980 and 1990 (ECO Northwest 1993). Connecticut, Kansas, Montana, Nevada, and Wisconsin have tried to encourage utilities to implement DSM and renewable resource options by using the bonus rate of return approach. In Connecticut and Montana, state law authorizes the PUCs to add a bonus to the allowable rate of return for cost-effective DSM investment to reflect their environmental benefits: 1%–5% in Connecticut and 2% in Montana. The Kansas State Corporation Commission may grant utilities an added 0.5%–2.0% in their rate of return for projects that use renewables, conservation, or high-efficiency equipment in recognition of the potential environmental benefits of such projects (Hashem 1993). The Public Service Commission of Nevada (1993) adopted a regulation on October 11, 1993, allowing utilities to add 5% to the approved rate of return for DSM and energy efficiency investment.

A.2 Shared Savings

In the shared savings approach, utilities are allowed to retain a portion of the savings realized from their DSM programs. In New Jersey, utilities can choose either to retain some of the net benefits (including environmental benefits) from DSM programs other than the core program or to engage in DSM bidding. If utilities opt for shared savings, "they must offer to purchase energy and capacity savings from ESCOs, contractors, and customers for DSM programs not specifically covered and sufficiently different from utility programs. Utilities that do not opt for shared savings must file a DSM bidding proposal that includes weighting for non-price factors including environmental externalities" (Hashem 1993). Wisconsin approved an incentive program for renewable energy sources, with an increase in earnings based on the amount of electricity generated by or purchased from different renewable sources: 3/4 cent per kWh for wind and solar resources, and 1/4 cent per kWh for other renewable sources. The incentive period applies to facilities built or renewable fuel burned through 1998. Payments for new facilities can apply for up to 20 years from the date of construction (Hashem 1993).

A.3 Set-Asides

The set-aside approach simply specifies that a certain proportion of a utility's resource additions should be in the form of DSM and renewable resource options. California has used this approach for renewable energy sources. A new state law (effective 1992) requires that electric resource acquisition programs recognize the value of resource diversity provided by renewable resources and that prior to the state PUC adopting a methodology for setting values for fuel diversity and environmental externalities, a portion of the new resources to be acquired should be set aside for renewable energy options. To implement this legislative directive, the California PUC adopted new rules for bidding:

> Each utility has its own set-aside, given its resource need and current fuel mix. Under the set-aside policy, all technologies may compete against a utility's proposal to develop renewable resources. Bidders are ranked in ascending order of their transmission-adjusted bid. If at any point in the selection process nonrenewable bidders win 50 percent of a utility's renewable project, the utility will skip over subsequent nonrenewable bidders and fill the set-aside with renewable bidders only, again in ascending order of cost, starting with the least-cost renewable resource" (ECO Northwest 1993, p. A-8).

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13. ABSTRACT *(Maximum 200 words)*
The authors review current practices and policies concerning the consideration of environmental externalities in integrated resource planning and performance-based regulation. They present the issues involved in addressing environmental externalities within the utility regulatory process as well as the methods proposed for addressing these externalities and their applications. In addition, the authors characterize the interests of stakeholders such as the electric industry, fuel suppliers, energy consumers, government agencies, public interest groups, and others. Among the externalities questions examined are the following: What are the pros and cons of treating environmental externalities? How are potential environmental regulations being treated? Are externalities being qualitatively or quantitatively considered or monetized? Are offsets being allowed? How are externality policies being coordinated among different levels and branches of governments? Should environmental externalities be considered in dispatching existing resources? How is uncertainty addressed when incorporating environmental externalities? How are externalities valued?

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