STATE OF INDIANA

INDIANA UTILITY REGULATORY COMMISSION

PETITION OF PSI ENERGY, INC PURSUANT TO IND. CODE § 8-1-2-6.8 AND 170 I.A.C. 4-6-1 *ET. SEQ*. REQUESTING THAT THE COMMISSION APPROVE THE USE OF CERTAIN QUALIFIED POLLUTION CONTROL PROPERTY	)	CAUSE NO. 42622
PETITION OF PSI ENERGY, INC. PURSUANT TO INDIANA CODE §§ 8-1-2-6.1, 8-1-2-6.7, 8-1-2-6.8, 8-1-2-23, 8-1-8.7, 8-1-8.8, 8-1-27, 8-1-1-42(a), 8-1-2.5, AND 170 I.A.C. 4-6-1 *ET. SEQ*. REQUESTING THAT THE COMMISSION: (1) APPROVE PSI'S "PHASE 1" PLAN FOR COMPLYING WITH PENDING SO2, NOX, AND MERCURY EMISSIONS REDUCTION REQUIREMENTS; (2) APPROVE THE USE OF CERTAIN QUALIFIED POLLUTION CONTROL PROPERTY AND CLEAN COAL AND ENERGY PROJECTS; (3) GRANT PSI CERTIFICATES OF PUBLIC CONVENIENCE AND NECESSITY FOR CLEAN COAL TECHNOLOGY; (4) APPROVE THE USE OF CONSTRUCTION WORK IN PROGRESS RATEMAKING TREATMENT; (5) APPROVE CERTAIN FINANCIAL INCENTIVES IN CONNECTION WITH PSI'S COMPLIANCE PLAN, INCLUDING THE TIMELY RECOVERY OF COSTS INCURRED DURING THE CONSTRUCTION AND OPERATION OF THE CLEAN COAL TECHNOLOGY PROJECTS, AND THE USE OF ACCELERATED DEPRECIATION; (6) GRANT PSI AUTHORITY TO DEFER POST-IN-SERVICE CARRYING COSTS, DEPRECIATION COSTS, AND OPERATION AND MAINTENANCE COSTS ON AN INTERIM BASIS UNTIL THE APPLICABLE COSTS ARE REFLECTED IN PSI'S RATES; (7) AUTHORIZE THE RECOVERY OF OTHER RELATED COSTS; AND (8) CONDUCT ONGOING REVIEW OF THE IMPLEMENTATION OF PSI'S COMPLIANCE PLAN	)	CAUSE NO. 42718

Testimony of
BRUCE E. BIEWALD,
Synapse Energy Economics, Inc.

Prepared on Behalf of
THE CITIZENS ACTION COALITION OF INDIANA
AND
HOOSIER ENVIRONMENTAL COUNCIL

Confidential Information is Highlighted

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1. INTRODUCTION AND QUALIFICATIONS

Q. PLEASE STATE YOUR NAME, BUSINESS POSITION AND ADDRESS.

A. My name is Bruce Edward Biewald. I am president of Synapse Energy Economics, Inc., 22 Pearl Street, Cambridge, Massachusetts, 02139.

Q. PLEASE DESCRIBE YOU EMPLOYMENT, QUALIFICATIONS, AND EXPERIENCE?

A. I am president and owner of Synapse Energy Economics, Inc., a consulting company specializing in economic and policy analysis of the electricity industry, particularly issues of restructuring, market power, electricity market prices, consumer protection, stranded costs, efficiency, renewable energy, environmental quality, and nuclear power. I graduated from the Massachusetts Institute of Technology in 1981, where I studied energy use in buildings. I was employed for 15 years at the Tellus Institute, where I was Manager of the Electricity Program, responsible for studies on a broad range of electric system regulatory and policy issues. I have testified on energy issues in more than eighty regulatory proceedings in twenty-five states and two Canadian provinces. I have co-authored more than one hundred reports, including studies for the Electric Power Research Institute, the U.S. Department of Energy, the U.S. Environmental Protection Agency, the Office of Technology Assessment, the New England Governors' Conference, the New England Conference of Public Utility Commissioners, and the National Association of Regulatory Utility Commissioners. My papers have been published in the *Electricity Journal*, *Energy Journal*, *Energy Policy*, *Public Utilities Fortnightly* and numerous conference proceedings, and I have made presentations on the economic and environmental dimensions of energy throughout the U.S. and internationally. I also have consulted for federal agencies, including the Department of Energy, the Department of Justice, the Environmental Protection Agency, and the Federal Trade Commission. Details of my experience are provided in Exhibit BEB-1.

Q. HAVE YOU TESTIFIED PREVIOUSLY IN INDIANA?

A. Yes. I most recently testified before the Commission in August 2003, in PSI's rate case, Cause No. 42359. Previously, I testified in July, 2002, regarding a proposed settlement of a pending NIPSCO rate investigation (Cause No. 41746). Prior to that, I testified before the Commission regarding NIPSCO system reliability and excess capacity in Cause No. 38405 in November, 1986. I made a presentation regarding stranded costs in the Commission's Forum on Electric Industry Competition in November, 1996. I also made presentations regarding various aspects of electric utility restructuring before the Indiana Energy Conference in October, 1996 and the Regulatory Flexibility Committee of the Indiana General Assembly in September, 1997. I also prepared and filed testimony regarding the proposed termination of the operating agreement between PSI Energy, Inc. and Cincinnati Gas & Electric Company in Cause No. 41952 in June, 2001, but the case was settled before my testimony was admitted.

Q. ON WHOSE BEHALF DO YOU APPEAR IN THIS PROCEEDING?

A. On behalf of the Citizens Action Coalition of Indiana, Inc. and the Hoosier Environmental Council, Inc.

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?

A. The purpose of my testimony is to comment on PSI Energy, Inc.'s ("PSI" or the "Company")[1] environmental compliance plan filing.

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[1] Note that the "Company" may refer to either PSI or Cinergy.

Q. HOW IS YOUR TESTIMONY ORGANIZED?

A. My testimony is organized as follows. Section 1 contains my qualifications. Section 2 is a summary of my key conclusions and recommendations. In Section 3, I provide some context with regard to Cinergy and PSI planning and the proposed environmental compliance plan in this case. I discuss key planning concepts in Section 4 along with some discussion of the application of computer models in utility planning. In Section 5, I present and compare various control cost estimates for sulfur dioxide (SO2), nitrogen oxides (NOx), and mercury (Hg). Section 6 discusses the status of climate policy and the impact of carbon prices upon utility planning and decision-making. I also present my own forecast of carbon prices including low, mid, and high cases. In Section 7, I discuss efficiency and renewables, and how they should be treated in PSI's compliance planning. Section 8 deals with issues of generating unit additions and retirements. And, finally, in Section 9, I address aspects of the Company's proposed cost recovery and approvals.

2. SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

Q. PLEASE SUMMARIZE YOUR PRIMARY CONCLUSIONS.

A. PSI has proposed a plan with estimated capital investment of $1.4 billion in existing coal generating units. (Esamann testimony page 18, lines 16 to 18, includes phase 1 and phase 2). In support of this plan, PSI has conducted a complex set of analyses using several different computer models, thousands of input assumptions, and multiple regulatory scenarios in developing its compliance plan (testimony of Rose, Moreland, and Jenner).

My overall conclusion is that the Company's analyses are influenced by critical flaws with regard to (1) cost estimates for emission control technologies, (2) climate policy and carbon prices, (3) energy efficiency as a compliance options, (4) renewable generation as a compliance option, and (5) plant retirement analysis. I will elaborate on each of these five categories of deficiencies individually, and then comment on cost recovery and offer my overall recommendations to the Commission in this case.

Cost Estimates for Emission Control Technologies

Q. PLEASE SUMMARIZE YOUR CONCLUSIONS WITH REGARD TO COST ESTIMATES FOR EMISSION CONTROL TECHNOLOGIES.

A. My key conclusions are:

- The Company has used inadequately documented and inconsistent estimates for the cost of emission controls. Because of these flaws the IURC cannot determine in this case that the Company's compliance plan is reasonable. Indeed, there is ample reason to believe that it is not reasonable.
- The emission control cost estimates used for Cinergy's generating units in the Company's analyses are higher than those typically used by ICF, and S&L has expressed concerns about the level of the cost estimates. The total estimated investment of $1.40 billion would, at more standard prices per kW for the control technologies (i.e., the ICF control cost curves used for the non-Cinergy units) would amount to only $872 million.
- The control cost estimates in the Company's requested approval (Exhibit G-1) are different in some cases from the cost estimates that were actually used in the Company's analysis.
- The cost estimates used for Cinergy units and for non-Cinergy units in the Company's analysis are inconsistent, and that inconsistency will tend to produce an uneconomical compliance plan. Specifically, the technology costs for controls at Cinergy generating units are much higher than the costs for controls at non-Cinergy units, and this discrepancy will show up in the comparisons of the costs of controls relative to the cost of emission allowances. That comparison is at the heart of compliance planning, and consistency with regard to the costs of installing controls and the costs of purchasing (or selling) emission allowances is crucial.

- The Company should be required to fully justify all of the emission control cost estimates used in its analysis, and should be required to conduct its analysis with the same control costs that it is using in its presentation of the costs of the plan for approval, and should be required to conduct its analysis with a consistent set of control cost assumptions for its own generating units and the generating units owned by others.

Climate Policy and Carbon Prices

Q. PLEASE SUMMARIZE YOUR CONCLUSIONS WITH REGARD TO CLIMATE POLICY AND CARBON PRICES.

A. My key conclusions are:

- Climate change has been well established as an urgent global concern. While there are many uncertainties about the timing and specifics of such regulations, it is clear that regulations in the U.S. that address carbon dioxide emissions from electric utilities will be established.

- The Company's planning in this case, almost entirely ignores carbon dioxide, treating it merely as one sensitivity analysis run of the IPM model. It does not figure into the specifics of the compliance plan technology selection. It does not figure into the projected capacity factors of the existing units. It does not figure into the evaluation of efficiency and renewable resource options. It does not figure into unit retirement evaluations.

- The Company does not even rely upon the "expected" carbon price forecast developed by its consultant, ICF, except to look at one sensitivity case using that forecast. This approach completely avoids consideration of any high carbon price sensitivity analysis. And it trivializes the potential impact of carbon policy upon the Company's planning decisions.

- Utility planning should be done with a reasonable reference case forecast of carbon prices. And then sensitivity analyses should be done to test the sensitivity of the planning decisions to variations in that reference case forecast, specifically to high and low case carbon price trajectories.

- I have reviewed the available information on carbon prices from newly established carbon markets, from utility planning and regulatory prices for carbon, and from computer modeling analyses. Based upon this information, presented in the report provided as Exhibit BEB-2, I am recommending three specific carbon price forecasts for Cinergy planning. These are the low, mid, and high forecasts described in Section 6 of this testimony. The mid case forecast increases from $5 per ton of CO2 in 2010 to $25 per ton of CO2 in 2025 (these figures are both in 2004$). The mid case forecast price, levelized over this 15year period, is $12.4 per ton of CO2. My low and high case forecasts, on a levelized basis over the same period are $6.1 per ton on CO2 and $23.9 per ton of CO2, respectively.
- The Company should be required to conduct its compliance planning analysis with a reasonable carbon price forecast, and then to do sensitivity analysis with low and high case forecasts that span a reasonable range of prices.

Energy Efficiency as a Compliance Option

Q. PLEASE SUMMARIZE YOUR CONCLUSIONS WITH REGARD TO ENERGY EFFICIENCY.

A. My key conclusions are:

- PSI's compliance analysis does not appropriately consider energy efficiency as a compliance option. It does not recognize the ability of energy efficiency to lower air emissions and to contribute to a lower cost compliance plan.
- I have estimated the marginal air emissions reductions for a near term year (2002) and an out year (2010). These provide some measure of the value of energy efficiency investments as part of an environmental compliance plan.
- Based upon comparisons of PSI to utilities in other states, I conclude there are additional demand-side management opportunities beyond PSI's current DSM programs that PSI should implement as part of a cost-effective environmental compliance plan.

- The Company should be required to conduct DSM potential studies, and then to evaluate the available incremental DSM options, with consideration of the air emissions reduction value (including carbon dioxide emissions), in order to identify, design, and then implement a full set of cost-effective DSM programs as part of a cost-effective environmental compliance plan.

Renewable Generation as a Compliance Option

Q. PLEASE SUMMARIZE YOUR CONCLUSIONS WITH REGARD TO RENEWABLE GENERATION.

A. My key conclusions are:

- PSI's compliance analysis does not appropriately consider renewable generation as a compliance option. It does not recognize the ability of renewable generation to lower air emissions and to contribute to a lower cost compliance plan.
- My estimates of marginal air emissions for 2002 and 2010 would apply to renewable energy (as well as to DSM). They provide a measure of the value of renewable energy as part of an environmental compliance plan.
- The Company rejects wind and biomass from consideration as promising resource options, with insufficient or inappropriate justification of its decision.
- The Company should be required to conduct a complete, detailed, and up to date analysis of the potential, performance, and cost of available renewable generating options, with consideration of the air emissions reduction value (including carbon dioxide emissions), in order to identify, design, and then implement a full set of renewable generating projects as part of a cost-effective environmental compliance plan.

Plant Retirement Analysis

Q. PLEASE SUMMARIZE YOUR CONCLUSIONS WITH REGARD TO PLANT RETIREMENT ANALYSIS.

A. My key conclusions are:

- The issues about planning methods, emissions costs, and carbon policy that apply to decision making about control technologies, energy efficiency, and renewable options also apply to analysis of plant additions and retirements.
- It is essential to do unit retirement analysis as part of compliance planning in order to make sure that the investments in controls are cost-effective and that they are not being installed at units that should instead be closed.
- PSI has several older, smaller, less efficient units that are candidates for retirement. These include the Edwardsport, Gallagher, and Wabash River units.
- The modeling done by the Company's consultant in this case, ICF, shows that certain PSI units are not economical to continue operating over the long term, and should be retired. Specifically, in the regulatory cases analyzed without carbon regulation the [redacted] plant and [redacted] units [redacted] through [redacted] are retired. In the case analyzed with carbon regulation (ICF's "Expected" carbon price forecast) [redacted] would be retired as well. In total, up to 10 coal units could be retired. It does not generally make sense to invest in pollution controls for generating units that are not generating.
- The Company should be required to conduct rigorous studies of continued operation compared with retirement for its older, smaller, less efficient units. The studies should include the costs of environmental compliance in the cases where the units are operated, and the costs of carbon emissions should be included in an appropriate manner.
- The Commission should indicate that investments in emission controls installed at units that should have been retired will not be considered to have been prudently incurred.

Cost Recovery Issues

Q. PLEASE SUMMARIZE YOUR CONCLUSIONS WITH REGARD TO COST RECOVERY ISSUES.

A. My key conclusions are:

- The Company has requested approval of its plan, provisions for incentive or bonus returns on the investments in emission controls.
- I recommend that the Commission ***not*** approve the plan as requested by the Company.
- I recommend that the Commission ***not*** grant the favorable cost recovery as requested by the Company.

Recommendations

Q. WHAT DO YOU RECOMMEND THAT THE COMMISSION DO IN THIS CASE?

A. I recommend that the IURC reject PSI's filing in this case. Before the Commission approves the Company's plan it needs to have before it a proper analysis that can serve as the basis for an informed and reasoned determination of whether the plan is reasonable and prudent. With the current filing and supporting materials it is simply not possible to reach a well informed conclusion about what a reasonably optimal environmental compliance plan would include for PSI. Some specific recommendations with regard to what a proper and complete analysis would include are contained my conclusions on the specific topic areas, summarized above, and discussed in the balance of my testimony.

Q. THIS CASE HAS TO DO WITH COMPLIANCE WITH EMISSIONS REGULATIONS AND THE COSTS OF PSI'S POLLUTION CONTROLS. GIVEN THAT, WHY DOES YOUR TESTIMONY DISCUSS CARBON EMISSIONS AND EFFICIENCY AND RENEWABLES?

A. The issues of compliance with regulations dealing with "criteria pollutants" are not reasonably separable from carbon dioxide and system planning. It makes no sense to do detailed planning for several pollutants while ignoring another that is at least as important in its implications for PSI costs and risk exposure. The Company's filing recognizes that controls for some pollutants have implications for others (e.g., FGD and SCR while mainly considered SO2 and NOx controls, also reduce mercury emissions significantly). Technologies and resource options to reduce carbon dioxide emissions (e.g., fuel switching, efficiency, and renewables) can significantly reduce SO2, NOx, and CO2 emissions. Those clean generating technologies, as well as the inclusion of a carbon price in the dispatching decisions, will change the capacity factors for the existing units, thereby changing the economics of emission control retrofits at those units. Also, investments in retrofits to existing units have an important connection to plant retirement decisions, in that the control costs can add significantly to the forward-going costs of operating a unit. And conversely, a unit that is marginal in an economic sense and a candidate for retirement is not likely to be a good choice for major new capital investment in emission controls, particularly in light of the expected costs associated with future carbon dioxide regulations.

3. OVERVIEW OF CINERGY AND PSI PLANNING AND PROPOSED PLAN

Q. HAVE YOU REVIEWED PSI'S PROPOSED CASE-IN-CHIEF FILING IN THIS CAUSE?

A. I have.

Q. WHAT DO YOU UNDERSTAND TO BE PSI'S PROPOSAL?

A. PSI's proposal would result in the installation of post-combustion emission controls for SO_2, NO_X and mercury and of fuel switching capability on the following plants:[2]

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[2] Revised Testimony of Douglas Esamann, page 11.

Table 3-1. PSI's Environmental Compliance Plan

Station	Compliance Plan	In-Service Date
Gibson Station	Unit 1 – wet scrubber/high sulfur fuel	Fall 2007
	Unit 2 – wet scrubber/high sulfur fuel	Spring 2007
	Unit 3 – wet scrubber/high sulfur fuel	Fall 2006
	Unit 4 – scrubber upgrade	Fall 2005
	Unit 5 – scrubber upgrade	Spring 2008
Cayuga Station	Unit 1 – wet scrubber/high sulfur fuel	Fall 2008
	Unit 2 – wet scrubber/high sulfur fuel	Spring 2008
	Unit 2 – SCR	Spring 2010
Gallagher Station	Units 1 & 2 – common ACI-baghouse	Fall 2006
	Units 3 & 4 – common ACI-baghouse/lower sulfur fuel on Units 1-4	Spring 2007
Wabash River Station	Units 2-5 – common ACI-baghouse/lower sulfur fuel	Fall 2007
	Unit 6 – ACI baghouse/lower-sulfur fuel on Units 2-6	Spring 2008
	Unit 6 – Dry Scrubber	Fall 2012
Edwardsport Station	Unit 8 (2 boilers) – ACI-baghouse	Fall 2008

Q. WHAT IS THE COST OF PSI'S PROPOSED EMISSIONS CONTROLS?

A. The Company has estimated the capital cost for its proposed emission controls to amount to $1.4 billion. This includes phase 1 and phase 2 controls. It also includes some other miscellaneous costs. In addition, there will be operating costs associated with this equipment.

Table 3-2. PSI's Environmental Compliance Plan Capital Costs[3]

Station	Compliance Plan	Cost
Gibson Station	Unit 1 – wet scrubber	[redacted]
	Unit 2 – wet scrubber	
	Unit 3 – wet scrubber	
	Unit 4 – scrubber upgrade	
	Unit 5 – scrubber upgrade	

[3] From Revised Confidential Exhibit G-1 sponsored by John Roebel.

Plant Sub-total		[redacted]
Cayuga Station	Unit 1 – wet scrubber Unit 2 – wet scrubber Unit 2 – SCR	[redacted]
Plant Sub-total		[redacted]
Gallagher Station	Unit 1 – common ACI-baghouse Unit 2 – common ACI-baghouse Unit 3 – common ACI-baghouse Unit 4 – common ACI-baghouse	[redacted]
Plant Sub-total		[redacted]
Wabash River Station	Unit 2 – common ACI-baghouse Unit 3 - common ACI-baghouse Unit 4 - common ACI-baghouse Unit 5 - common ACI-baghouse Unit 6 – ACI baghouse Unit 6 – Dry Scrubber	[redacted]
Plant Sub-total		[redacted]
Edwardsport Station	Unit 8 (2 boilers) – ACI-baghouse	[redacted]
Plant Sub-total		[redacted]
Total Cost of Controls		**$1,338,677,000**
Other Costs[4]		$ 56,923,000
Total Plan Costs		**$1,395,600,000**

Q. CAN YOU EXPLAIN HOW PSI FORMED ITS COMPLIANCE PLAN?

A. Yes, I can. Exhibit BEB-3 graphically depicts the modeling steps of the compliance planning process. PSI requested that ICF use its Integrated Planning Model (IPM) to "model the various proposed environmental policy scenarios on a national and regional basis and provide [Cinergy] with key price forecasts, for emission allowances (SO2, NOx, and where applicable, mercury), power, and fuels."[5] Mr. Robert Moreland then used "ICF price forecasts as inputs, along with various compliance alternatives, unit-specific operating data, and unit-specific estimated compliance costs [in its] internal Engineering Screening Model to rank various compliance alternatives on a unit-by-unit basis, and in the case of Hg

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[4] "Other costs" include landfill development, land purchase, compliance engineering or mercury removal study costs.

[5] Testimony of Douglas Esamann, page 7, lines 14-17.

MACT command and control, verify generating station-wide compliance."[6] The most "economical alternatives" were provided to Ms. Diane Jenner for use in STRATEGIST modeling. STRATEGIST performs "environmentally-affected dispatch" of the Cinergy system resulting in environmental compliance plans that are ranked by PVRR (including capital, O&M and production costs).[7] Mr. Roebel developed "optimum construction timing and outage scheduling"[8] resulting in the current plan.

Q. WHAT DOES THE COMPANY PROPOSE FOR COST RECOVERY IN THIS CAUSE?

A. The Company, in the testimony of Stephen Farmer requests the recovery of the costs of the environmental compliance plan in various trackers. The proposed cost recovery includes provisions for recovery of construction work in progress (CWIP), for accelerated depreciation, and for bonus return on equity (ROE).

Q. IS THE COMPANY'S PLANNING ANALYSIS AND RATE REQUEST IN THIS CAUSE REASONABLE?

A. No. The Company and its consultants have done a tremendous amount of analysis, including dozens of model runs and consideration of many technology options and combinations of options. But the Company's analysis suffers from many critical deficiencies. I will elaborate on these flaws and their implications in the sections of my testimony that follow.

4. INTEGRATED RESOURCE PLANNING CONCEPTS

Q. WHAT IS INTEGRATED RESOURCE PLANNING FOR AN ELECTRIC COMPANY?

A. Integrated resource planning is a process in which an electric company analyzes alternative ways for serving its customers in future years, considering a broad range of resources options, and developing plans that meet demand at an acceptable level of reliability, and at a reasonable cost with consideration to risk.

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6 Testimony of Douglas Esamann, page 7, lines 20-23 and page 8, line 1.
7 Testimony of Diane L. Jenner, page 8.
8 Testimony of Diane L. Jenner, page 15, lines 13-14.

Environmental compliance planning is an important part of IRP. PSI's last IRP report was dated October 31, 2003, and the environmental compliance planning done at that time is described in Section 6 of that document.

PSI summarizes the IRP process, objectives and purpose as follows:

> An integrated resource planning process generally encompasses an assessment of a variety of supply-side, demand-side, and emission compliance alternatives leading to the formation of a diversified, long-term cost-effective portfolio of options intended to satisfy reliably the electric demands of customers located within a franchised service territory. The purpose of this Integrated Resource Plan (IRP) is to outline a strategy to furnish electric energy services in a reliable, efficient, and economic manner while factoring in environmental considerations.
>
> The major objectives of the IRP presented in this filing are:
> - Provide adequate, reliable, and economical service to customers while meeting all environmental requirements
> - Maintain the flexibility and ability to alter the plan in the future as circumstances change
> - Chose a near-term plan that is robust over a wide variety of possible futures
> - Minimize risks (such as wholesale market risks, reliability risks, etc.) (page 1-4)

Q. ARE PSI'S STATED PURPOSE AND OBJECTIVES REASONABLE?

A. Broadly speaking, yes. I think that it is important to clarify that is not adequate to simply meet ***existing*** environmental requirements, but that it is important to anticipate ***future*** environmental requirements. Satisfying the other objectives such as economic service, robustness, and risk minimization requires that future environmental requirements be anticipated and factored into the planning, even if such future requirements are uncertain.

Q. HAS THE IURC INDICATED THAT PSI SHOULD FACTOR FUTURE ENVIRONMENTAL REGUALTIONS INTO ITS PLANNING?

A. Yes. In its May 18, 2004, order in the PSI rate case (IURC Cause No. 42359), the IURC stated the following:

> It is very clear for the record in this proceeding that major coal burning utilities such as PSI face significant environmental compliance costs and challenges. We agree with the CAC that it is prudent for PSI to begin evaluating options and planning to address environmental compliance issues well before the specific requirements are known with absolute certainty. Due to PSI's reliance on coal, the development of an improved resource mix, including the implementation of cleaner generating resources in conjunction with the utilization of energy efficiency programs, must be undertaken by PSI in order to ensure long term benefits to its customers. Accordingly, we anticipate and expect that future environmental compliance issues will come before us for review, and anticipate that PSI will take the steps necessary to address environmental compliance issues in a proactive manner consistent with our findings herein. (Order, page142)

Q. IS PSI COMPLYING WITH THAT LANGUAGE FROM THE RATE CASE ORDER?

A. No. With regard to SO_2, NOx, and mercury emissions regulations, PSI has conducted a detail, if flawed, analysis in a serious attempt to anticipate future environmental compliance costs and challenges. With regard to CO_2, however, PSI has presented to the Commission only a superficial analysis. The Company is not dealing with carbon and climate change in a "proactive manner" and has, apparently decided to put its head in the sand, while making various pronouncements that are inconsistent with its actions. This leaves the IURC without the information that it needs to make reasonably informed decisions, and it puts the Company's shareholders and customers at risk. Indeed, for the Company's planning to continue to address carbon policy with a token sensitivity analysis only assures that the Company's resource planning and compliance decisions will not be reasonable and prudent.

Q. DOES CINERGY'S LAST IRP RECOGNIZE FUTURE ENVIRONMENTAL REQUIREMENTS?

A. Yes, to some extent. However, for carbon dioxide emissions, the IRP merely examines the impact as a sensitivity analysis to the screening (see page 5-41 of

PSI's "2003 Integrated Resource Plan Volume I," October 31, 2003). It has no apparent impact upon the results. I will return to this and explain why the Company's 2003 IRP analysis is inadequate and does not provide a sound basis for decision-making with regard to environmental compliance and other system planning decisions in Sections 6 and 7 of my testimony.

Q. PLEASE DESCRIBE THE ROLE OF COMPUTER MODELS IN ELECTRIC UTILITY RESOURCE PLANNING.

A. Computer models play a central role in electric utility resource planning. This is true of system planning, evaluating capacity additions and retirements, compliance planning, and other aspects of utility decision-making. There are various types of models used, and sometimes more that one model is employed in different aspects of a planning analysis. In general, the models can be helpful in their ability to simulate complex aspects of the operation of the system (e.g., transmission constraints, generating unit commitments, forced outages) and also in their ability to manage large amounts of data. Typically there will be thousands of input data items used by a planning model, and handling those inputs in a manageable way is one of the challenges to planners.

Q. IS IT IMPORTANT FOR INPUT ASSUMPTIONS TO PLANNING MODELS TO BE CONSISTENT?

A. In general, accuracy and consistency in modeling inputs, are desirable. This can be more important for some inputs than for others. For example, in environmental compliance planning one of the central themes is the tradeoff between complying at one's own generating units by installing emission controls and complying by purchasing emission allowances – effectively purchasing compliance at generating units owned by others elsewhere in the region covered by the cap and trade policy. Since the projected cost of emission allowances will depend directly upon the costs of installing controls at those other generating units, it is essential that the control costs for those other units be consistent with the control costs assumed for one's own units.

Q. DOES THE POINT THAT YOU ARE MAKING HAVE TO DO WITH OVERALL OPTIMIZATION OF THE EMISSIONS CONTROLS FOR THE FULL FLEET OF GENERATION?

A. Yes. The basic concept is that with an emissions cap and trade policy, the optimal set of emission control decisions can be made regardless of who owns which units, and that the trading will allow that optimal set of controls to be installed to the fleet, while compensating the owners of particular generating units. That is, one company with a lot of relatively attractive options to reduce its emissions may "over-control," and then sell allowances to other companies that "under-control." If a particular company overlooks options to reduce its emissions that are cost-effective relative to allowance trading price, then its overall compliance approach is not least cost – for itself or for society – since it could increase overall net revenues by installing those controls and selling the associated allowances. Similarly, if a company implements control options that cost more than the allowance trading price, then its overall compliance approach is not least cost, since it could increase overall net revenues by not installing those controls and by buying a corresponding number of allowances instead.

Q. HOW ARE RISKS GENERALLY ADDRESSED IN RESOURCE PLANNING?

A. Electric utilities and electric generation in particular is subject to a variety of risks, having to do with uncertain fuel prices, uncertain capital costs, uncertain performance, uncertain demand, and uncertain environmental regulations. One very important way of dealing with such risks is through the development of a diverse resource portfolio. I have written a report the deals with this topic called *Portfolio Management: How to Procure Electricity Resources to Provide Reliable, Low-Cost, and Efficient Electricity Services to All Retail Customers*. It is available on Synapse Energy Economics' web site.

The planning techniques used to evaluate the value of a diverse resource portfolio include sensitivity analysis, scenario analysis, decision tree analysis, option value analysis, and other approaches. In a nutshell, these techniques involve consideration of various different futures, the alternatives available to the utility to react to those futures, and the associated risks and rewards.

Q. CAN YOU GIVE AN EXAMPLE OF HOW SENSTIVITY ANALYSIS WOULD BE USED?

A. Certainly. A typical application of sensitivity analysis might consider uncertainty in future gas and oil prices. The "reference case" planning analyses might be done with a particular forecast of an expected trajectory of gas and oil prices, perhaps based upon modeling by the federal government (EIA's gas and oil price forecasts are commonly used in the industry) or based upon modeling by private firms that specialize in fuel price forecasting. Note that this "reference case" forecast is a best effort predicting the likely future conditions and prices. Because this reference forecast is subject to considerable uncertainty, and because that uncertainty has important implications for planning decisions, it is then reasonably common to conduct sensitivity analyses, in which higher and lower fuel price forecasts are input to the planning model in order to determine whether and to what extent the planning decisions depend upon the input value for future fuel prices.

Q. IS IT GENERAL PRACTICE TO ASSUME SYMMETICAL VARIATION AROUND THE REFERENCE CASE FORECAST, IN DEVELOPING THE INPUTS FOR HIGH AND LOW SENSITIVITY CASES?

A. That depends upon the particular inputs being analyzed, and the sort of uncertainties involved. Some inputs may be subject to uncertainty that is roughly symmetrical. Reference case projections of load growth may, for example, be tested by analyzing high and low case sensitivities that are plus or minus a fixed amount around the reference case values. In other cases, the inputs may be subject to uncertainties that are not symmetrical. For example, projections of carbon prices may be asymmetrical with greater high side potential.

Q. DO THE PSI AND CINERGY SYSTEMS HAVE A DIVERSE RESOURCE PORTFOLIO?

A. No. PSI's resource portfolio is over 76% coal-fired on a capacity basis, and over 90% of the energy generated by PSI units is coal-based.[9]

Q. CAN SOMETHING BE DONE TO RECTIFY CINERGY'S OVERDEPENDENCE UPON COAL?

A. Yes. There are other fossil fuels available for electric power generation, most notably natural gas, which has been the fuel of choice for new fossil-fired power generation in recent years. Gas is higher cost per MMBTU than coal and is subject to significant price volatility, but relative to coal gas generation has several advantages including: (1) gas plants typically cost less to build, (2) gas tends to be converted more efficiently (e.g., in combined-cycle applications with conversion efficiencies in the 50 to 60 percent range as compared with coal steam plants which have conversion efficiencies in the low 30s), and (3) gas has generally lower air emissions values (particularly sulfur, particulates, mercury, and carbon dioxide). Balancing the costs and risks of different fossil fuel types is one aspect of utility resource planning.

Renewable generating resources can also play a very important role in reducing overdependence upon coal. Generating options such as biomass and wind should be incorporated into PSI's system, in order to reduce the overdependence upon coal and the degree of exposure to the costs of future climate change policies that will limit carbon dioxide emissions from power plants.

Likewise, energy efficiency will reduce dependence upon coal and exposure to the costs of future carbon regulation. Energy efficiency is also terrifically cost-effective even without accounting for the diversity and environmental value and, so, incremental investments in energy efficiency can actually reduce air emissions while saving money (i.e., at costs per ton reduced that are negative).

Q. HAVE YOU CONDUCTED A DETAILED PLANNING ANALYSIS SPECIFICALLY FOR THE PSI AND/OR CINERGY SYSTEMS, IN ORDER TO DEVELOP AN OPTIMAL SET OF RENEWABLE GENERATING RESOURCES AND ENERGY EFFICIENCY PROGRAMS TO BE IMPLEMENTED GOING FORWARD?

A. No. Conducting that analysis is the responsibility of the Company. I have, however, conducted a study of the 10 state Midwest region including Indiana, in which we performed detailed simulation modeling using a multi-area chronological electric system model ("PROSYM") and estimated the costs associated with a feasible scenario for clean energy deployment in the region through 2020.

Q. COULD YOU PLEASE IDENTFY THAT STUDY AND SUMMARIZE ITS CONCLUSIONS?

A. Yes. The study was called *Repowering the Midwest: The Clean Energy Development Plan for the Heartland.* It was done by Synapse for the Environmental Law and Policy Center, the Citizens Action Coalition of Indiana, and several other environmental organizations active in the ten-state region. The report is available online at www.repowermidwest.org.

The study was completed in 2001, and hence is somewhat dated, as are some of the specific input assumptions. However, I believe that the conclusions, broadly speaking, are still quite relevant. We found that an aggressive deployment of existing energy efficiency and renewable technologies could reduce coal use in the region significantly, along with SO_2, NOx, and CO_2. For example, in the Clean Energy Plan, carbon dioxide emissions were projected to decrease steadily after the year 2000 such that by 2020 the total relative to year 2000 levels would amount to a 36 percent decrease. We found that the Clean Energy Plan would cost slightly more than the reference case, but only modestly – with total costs impacts in 2010 of 1.5 percent and in 2020 of 3.4 percent. These incremental costs would be more than offset by the value of the carbon reductions.

[9] Testimony of James E. Rogers, page 6, lines 4 – 6.

Q. IS THE REPOWERING ANALYSIS APPLICABLE TO CURRENT PLANNING FOR A SPECIFIC UTILITY SYSTEM SUCH AS CINERGY'S?

A. Yes, but within limits. I would be cautious about relying upon specific assumptions from the "Repowering" projects, because some of the costs and performance inputs have surely changed significantly since the time that the project was done. Also, with a few years gone by without the full aggressive implementation of efficiency and renewbales, I expect that the targets for achieving the specified penetration levels and emissions reductions would need to "slip" accordingly. That said, I believe that there is still much of value in the "Repowering" analysis to inform policy and it is a reasonable starting point for a utility-system specific analysis. I would expect any particular utility to undertake substantial updating and detailed research in conducting a similar analysis of clean energy options for its own system.

5. EMISSION CONTROL COST ESTIMATES IN CINERGY PLAN

Q. HAVE YOU REVIEWED THE COST ESTIMATES OF PSI'S ENVIRONMENTAL COMPLIANCE PLAN AS GIVEN IN REVISED CONFIDENTIAL EXHIBIT G-1?

A. Yes, I have. And I have compared those cost estimates with other cost estimates used elsewhere in the Company's analyses and by government agencies and others.

Q. WHAT CONCLUSION DID YOU REACH REGARDING THE COST ESTIMATES?

A. There is considerable variation in the cost estimates. The costs presented in Mr. John Roebel's testimony (specifically in his Confidential Exhibit G-1) are the high end of the range of available cost estimates, and are inconsistent with the cost estimates used to develop the emissions allowance prices that were also input to the company's compliance planning analysis. I believe that this has important implications for any determination of whether the Company's proposed plan is cost-effective and how the costs should be considered in future proceedings. Specifically, it is simply not possible for the IURC to determine whether the proposed plan is reasonable given the analysis that has been presented by the Company and its consultants.

Q. PLEASE DESCRIBE THE INFORMATION YOU REVIEWED.

A. My review included some consideration of the following information obtained from Cinergy:

- **ICF-IPM.** Control cost estimates developed by ICF and used in IPM modeling the costs of controls at generating units ***not*** owned by Cinergy.
- **Cinergy-IPM.** Control cost estimates provided by Cinergy to ICF for use in the IPM modeling for the costs of controls at generating units owned by Cinergy.
- **Cinergy-Engineering model**. Control cost estimates used by Mr. Moreland in the Company's Engineering and Screening Models.
- **Cinergy-Conceptual Cost Estimate.** Control cost estimates called "conceptual cost estimates" for limited units developed by Sargent & Lundy for Cinergy.
- **Cinergy-S&L.** Control cost estimates specified by Cinergy and commented on and adjusted by Sargent and Lundy.
- **Cinergy-Cost Recovery.** Control cost estimates in Mr. Roebel's Exhibit G-1 for which the Company is requesting approval in this case.
- **CERA.** Control cost estimate ranges developed by Cambridge Energy Research Associates, and summarized in a presentation titled "Cinergy."

In addition, my review included some other sources of cost information:

- **EIA.** Control cost estimates used in the Energy Information Administrations 2004 Annual Energy Outlook analysis.
- **Lime Association.** Control cost estimates for scrubbers prepared by Sargent & Lundy for the Lime Association.

Q. DID PSI PROVIDE THIS CONTROL COST INFORMATION IN ITS FILING IN THIS CAUSE?

A. The cost estimates provided in Mr. Roebel's Confidential Exhibit G-1 were the only quantitative cost-related information provided by PSI in its original filed testimony and exhibits. The rest of the Cinergy and ICF figures were obtained in the discovery process.

Q. WHY ARE THERE SO MANY DIFFERENT COST ESTIMATES INVOLVED IN THE CINERGY-ICF-S&L PLANNING PROCESS?

A. This is a very difficult question for me to answer. I believe that some of the differences have to do with differences in perspective of the three organizations. That is, Cinergy, ICF, and S&L may have different views of what emission control technologies are likely to cost. Also, the estimates were prepared at different points in time. And, in addition, they may have somewhat different assumptions about what costs are included in the scope of the estimate and different treatments of contingencies.

Q. WHAT EVIDENCE IS THERE THAT CINERGY AND ITS CONSULTANTS HAVE DIFFERENT VIEWS OF LIKELY COSTS FOR CONTROLS?

A. The most compelling evidence is in the observed difference in the numbers themselves. I will get back to these differences later in this section of my testimony.

In addition, there are communications from Sargent & Lundy to Cinergy expressing concerns that Cinergy's cost estimates for scrubbers may be high. Specifically, an email dated December 22, 1999 from William DePriest of S&L to George Stevens of Cinergy states:

[redacted]

Q. DID THE COMPANY IN ITS FILING INFORM THE IURC THAT THE CONTROL COST ESTIMATES ARE AT THE HIGH END OF THE EXPECTED RANGE?

A. No. The only mention of the reasonableness of the cost estimates that I found in the Company's testimony in this cause is on page 5 of Mr. Roebel's testimony, in which he states that the cost estimates are reasonable, and he notes a couple of reasons that he thinks that his estimates could be too low. This is the opposite of informing the Commission that the estimates are "[redacted]," as was recommended by Mr. DePriest.

Q. HAS THE COMPANY MADE ANY OTHER MISLEADING CLAIMS REGARDING ITS CONTROL COST ESTIMATES?

A. Yes, it has. You'll recall that the control cost estimates used in the Company's Engineering and Screening Models (Cinergy-Engineering Model) flowed through to the STRATEGIST model and then were modified given construction and outage timing, purportedly forming the Company's current plan and costs (Cinergy-Cost Recovery). Mr. Roebel claims that that the "preliminary estimates [i.e., Cinergy-Engineering Model estimates] used for planning are generally higher, making our modeling conservative."[10] According to information provided by the Company and presented in Exhibit BEB-4, however, the Cinergy-Cost Recovery estimates are uniformly higher with just one exception. In total, Cinergy-Cost Recovery Estimates are about $194 million higher. Some of this difference is surely due to legitimate price inflation (the Engineering Estimates are in year 2000 constant dollars and the Cost Recovery estimates are in as spent dollars) but the translation from one to the other is not well documented and the differences in the estimates on a unit-specific basis do not support a simple and consistent explanation for the differences (see the unit specific figures in Exhibit BEB- 4).

[10] Testimony of John J. Roebel, page 6, lines 1-2.

Q. DID THE COMPANY PROVIDE ALL OF THE INFORMATION THAT YOU REQUESTED?

A. No. The Company claimed that certain documents were "privileged" and would not be provided. This listed included a report by Sargent & Lundy prepared for Cinergy on March 14, 2003 called "Environmental Compliance Program Implementation Plan for Capital Projects." It appears that this document is an update to its October 2002 document called "Emission Control Technology Cost Review." In other words, the Company provided the "Cinergy-S&L" estimates from 2002, referred to above, but has decided that the Commission and parties in this case cannot see the more recent report, despite the fact that we have signed confidentiality agreements.[11]

The Company also claimed that other documents were privileged, including an "asset optimization status report," an "asset optimization modeling update," and an "asset portfolio optimization." I have not seen these documents and so do not know what they contain, but from the titles I expect that they would be relevant to environmental compliance decision making.

Q. WHAT WERE THE ROLES OF CINERGY AND SARGENT & LUNDY AND ICF IN DEVELOPING THE VARIOUS COST ESTIMATES?

A. Cinergy appears to have been very involved in the development of the cost estimates used by its consultants. For ICF's modeling using IPM, Cinergy provided the control cost estimates to be used for all of the Cinergy owned generating units.

With regard to estimates that I refer to as "Cinergy-S&L," Mr. Moreland says in testimony that Cinergy "consulted with engineers from Sargent & Lundy, LLC ('S&L'), a major consulting engineering firm and engineer of record for most of PSI's and CG&E's generating units, on the various types of removal equipment available, their estimated installed capital cost, and the estimated removal efficiencies of each equipment type."[12] The documents produced by

[11] See PSI response to CAC 2.16, and March 14, 2005 Privilege Log.
[12] Testimony of Robert D. Moreland, page 5, lines 16-20.

Sargent & Lundy were requested in CAC 2.16. The Company provided three documents. The first was an analysis of the cost and impacts of switching to Powder River Basin coal at certain PSI units. The other two documents were one entitled "Emission Control Technology Cost Review," dated October 2002 and an update, dated October 2003.[13] According to the first document, it appears that Sargent & Lundy was contracted by Cinergy to:[14]

- Provide a review of Cinergy emission control technology costs developed to date and provide suggested updates where considered appropriate.
- Include a constructability/logistic view (e.g., retrofit factor).
- Establish benchmark data for establishing costs.
- Identify key factors influencing projected costs.
- Include recommended subsequent activities for further refining costs.
- Identify potential emerging technologies which may impact compliance strategies in the future.

Sargent & Lundy's approach was to "(1) review available data from Cinergy for select technologies (FGD, SCR) and adjust the curve fit factors for the cost equations for capital, fixed O&M and variable O&M values or (2) review initial technology equations without available data (e.g., SNCR, ACI) and provide recommended adjustments to the cost equations."[15] Sargent & Lundy then suggested changes to the numbers Cinergy had provided.

Q. DID SARGENT & LUNDY MAKE ANY FURTHER RECOMMENDATIONS TO CINERGY REGARDING THE CONTROL COST ESTIMATES PROVIDED IN THESE DOCUMENTS?

A. Yes, it did. Sargent & Lundy stated "in order to increase the accuracy of cost factors on both an absolute and relative basis, a more detailed review of each of the sites for specific compliance strategies is required." S&L also recommended

[13] Provided in response to CAC 2.16 and sponsored by Robert D. Moreland.
[14] Attachment CAC 2.16-B, page 1.

"evaluation and projection of similar activities/compliance plans for neighboring utilities and regions. This would be useful both for planning, as well as projecting where the compliance requirements are heading as a whole."[16] Prior to this filing, Cinergy did neither.[17] Despite S&L's recommendation, Cinergy appears to have decided that it was not important to perform this detailed review for each of its own sites and explore the compliance decisions of neighboring utilities ***before*** requesting nearly $1.4 billion in cost recovery. I find this decision to be totally insupportable from *any* perspective, but certainly from a ratepayer and regulator point of view.

Q. PLEASE DESCRIBE THE INFORMATION YOU WERE ABLE TO REVIEW.

A. Exhibit BEB-4 summarizes this information both in $/kW and total cost per capital investment. All columns follow the descriptions provided above. Note that the "ICF-IPM" estimates are simply the ICF-IPM cost curves that they used for non-Cinergy units applied to the PSI units. For each source there is wide and often material variation. Table 5-1 shows the variation in estimates for each source and by retrofit technology.

[15] Attachment CAC 2.16-B, page 2.
[16] CAC 2.16-B, page 5.
[17] See responses to CAC 7.6 and CAC 7.7.

Table 5-1. Difference in Control Cost Estimates

	Amount Cinergy – Cost Recovery Estimates are Higher than					
Retrofit Technology	**Cinergy – S&L**	**Cinergy - IPM**	**ICF Equivalent**	**Cinergy – Engineering Model**	**EIA**	**Lime Association**
Wet FGD	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
ACI + PBH	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Dry FGD	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
SCR	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

The emission control cost estimates used for Cinergy's generating units in the Company's analyses are higher than those typically used by ICF. For example, the total estimated investment of $1.40 billion would, at more standard prices per kW for the control technologies (i.e., the ICF control cost curves used for the non-Cinergy units) amount to only $872 million.

Or, as another example, if the planned controls were priced at the cost used in the Company's Engineering Model in this case (Mr. Moreland's analysis) then the total cost of the plan would amount to only $1.20 billion.

The planned controls are costed out using the different sets of cost estimates from the sources mentioned above (i.e., ICF-IPM, Cinergy-IPM, Cinergy-Engineering Model, Cinergy-S&L, and Cinergy-Cost Recovery). The range of estimated total costs for PSI's plan is from $872 million (ICF-IPM) to $1.40 billion (Cinergy-Cost Recovery), 60% more.

Because information for all capital investments was not available from all sources, I've also created individual unit comparisons for each type of major retrofit. Specifically, I illustrate the range of cost estimates for Wet FGD using Gibson Unit 3 (Exhibit BEB-5), the cost estimates for SCR using Cayuga Unit 2 (Exhibit BEB-6), and the cost estimates for ACI Baghouse using Gallagher Unit 3 (Exhibit BEB-7).

For the wet FGD retrofit, Cinergy estimates range from 9 – 90% higher than those of other sources, for SCR, 7 – 85% higher and for ACI Baghouse, 8 – 143% higher.

Q. YOU MENTIONED A SET OF CONTROL COST ESTIMATES BY CERA. WHAT ARE THOSE ESTIMATES AND HOW DO THEY COMPARE TO THE OTHERS?

A. There is very little description about what exactly the estimates by CERA represent. The CERA estimates are from a presentation dated October 2004, and they give a range from low to high cost per kW for scrubbers and SCR. Taken at face value it appears that even the high end of the range for the CERA estimates is lower than any of the Cinergy cost estimates.

Q. ARE THERE FURTHER, SIGNIFICANT INCONSISTENCIES BETWEEN THE SOURCES OF THE CONTROL COST ESTIMATES?

A. Yes. The scope of inconsistencies is not limited to the difference between Cinergy-Cost Recovery estimates and those of all other sources. Control cost estimates were also inconsistent within IPM modeling. There are discrepancies between the ICF-IPM cost estimates for controls available to the non-Cinergy generating units and the Cinergy-IPM cost estimates for controls available to Cinergy generating units. This is, in my view, at the heart of a fundamental inconsistency in the Company's analysis.

Exhibits BEB-9, BEB-10, BEB-11, BEB-12 compare the Cinergy-IPM control cost estimates (given to ICF by Cinergy for Cinergy units) to the ICF cost curve which was used to estimate retrofit costs at all other units. The Cinergy unit estimates are uniformly higher than ICF's cost curves with only one exception (wet FGD at Edwardsport 7). That is, for 75 out of 76 cases the figure for Cinergy's own unit turns out to be higher, often very significantly so.

Table 5-2. Cinergy and ICF Estimates Differential

Retrofit Technology	Amount Cinergy-IPM Estimates are Higher than ICF-IPM Estimates
SCR	[redacted]
SNCR	[redacted]
Wet FGD	[redacted]
ACI + PBH	[redacted]

Under PSI's current compliance plan, wet FGD retrofits will constitute the bulk of the money spent (over $909 million) with ACI Baghouses also making up a significant portion (over $228 million).

Q. WHY SHOULD THE IURC PLACE ANY SIGNIFICANCE ON MATERIAL DIFFERENCES IN THE COMPANY'S CONTROL COST ESTIMATES?

A. Good question. There are two reasons why these differences demand attention from the IURC. First, they are absolutely critical to the Company's compliance decisions. Each step of the modeling process, as depicted in Exhibit BEB-3, depends on the previous step. The marginal cost of retrofits determines whether they are picked by the model or not. Immaterial variation can be tolerated without compromising the results, but the variation seen here (sometimes more than 100%) is by no means immaterial. Consistency in inputs is absolutely essential to producing reliable results. The Company has shirked its responsibility to ratepayers by failing to conduct its analysis with a consistent set of well documented cost estimates.

Second, the Company has not adequately justified apparent increases in control costs. It has ignored the recommendations of its own engineers[18] and failed to notify the parties involved in this cause about Sargent & Lundy's

[18] Specifically, I am referring to the site visits and the comparison to compliance decisions by neighboring utilities.

concerns.[19] These issues are significant, particularly given the scope of the Company's proposal to spend and recover $1.4 billion from ratepayers.

Q. WHAT DO YOU RECOMMEND?

A. I do not see any workable solution other than to reject the Company's analysis and require it to submit another filing. The Company must able to justify the retrofit costs at its plants and use a consistent set of emission control cost estimates as part of an acceptable analysis in order that the Commission could make an informed decision about the proposed compliance plan.

6. CLIMATE CHANGE POLICY AND CINERGY PLANNING

Climate Change, Carbon Emissions Regulation, and Utility Planning

Q. IS CINERGY'S CONTRIBUTION TO WORLD CARBON DIOXIDE EMISSIONS SIGNIFICANT?

A. Yes. In 2000, Cinergy generating units emitted over 1% of the world's carbon dioxide emissions.[20]

Q. DO YOU BELIEVE THAT THE SCIENCE OF CLIMATE CHANGE HAS BEEN ESTABLISHED?

A. Yes, I do. The earth's climate is determined by concentrations of greenhouse gases in the atmosphere. International scientific consensus, expressed in the Third Assessment Report of the Intergovernmental Panel on Climate Change, is that climate will change due to anthropogenic emissions of greenhouse gases. Scientists expect increasing atmospheric concentrations of greenhouse gases to cause temperature increases of 1.4 – 5.8 degrees C by 2100 (the fastest rate of change since end of the last ice age). Such global warming is also expected to cause a wide range of climate impacts including changes in precipitation patterns, increased climate variability, melting of glaciers, ice shelves and permafrost, and

[19] Specifically, I am referring to the December 22, 1999 email.

[20] Cinergy emissions of 69,768,000 tons represents 1.09% of world anthropogenic emissions of 6,378,000,000. These emission figures are from the 2004 Cinergy Air Issues Report to Stakeholders, page 29 and the Worldwatch Institute's "Vital Signs 2003," page 41.

rising sea levels. These changes have already been observed and documented in a growing body of scientific evidence. All countries will experience social and economic consequences, with disproportionate negative impacts on countries least able to adapt.

Q. WILL A POLICY TO ADDRESS CLIMATE CHANGE BE IMPLEMENTED IN THE U.S. IN A WAY THAT SHOULD BE A CONCERN TO COAL-DEPENDENT UTILITIES AND GENERATORS IN THE MIDWEST?

A. Yes. The prospect of Global Warming and changing climate has spurred international efforts to work towards a sustainable level of greenhouse gas emissions. These international efforts are embodied in the United Nations Framework Convention on Climate Change. The Kyoto Protocol, a supplement to the UNFCCC, establishes legally binding limits on the greenhouse gas emissions of industrialized nations and economies in transition.

Despite being the single largest contributor to global emissions of greenhouse gases, the United States remains one of a very few industrialized nations that have not signed the Kyoto Protocol. Nevertheless, individual states, regional groups of states, shareholders and corporations are making serious efforts and taking significant steps towards reducing greenhouse gas emissions in the United States. Efforts to pass federal legislation addressing carbon, though not yet successful, have gained ground in recent years. These developments, combined with the growing scientific understanding of, and evidence of, climate change, mean that establishing federal policy requiring greenhouse gas emission reductions is just a matter of time. The question is not whether the United States will develop a national policy addressing climate change, but when and how. The electric sector will be a key component of any regulatory or legislative approach to reducing greenhouse gas emissions both because of this sector's contribution to national emissions and the comparative ease of controlling emissions from large point sources.

There are, of course, important uncertainties with regard to the timing, the emission limits, and many other details of what a carbon policy in the US will look like.

Q. IS IT REASONABLE TO IGNORE CARBON POLICY IN UTILITY PLANNING, BECAUSE OF THE UNCERTAINTIES?

A. Of course not. In the current scientific and policy context, it is imprudent for decision-makers in the electric sector to ignore the cost of future carbon reductions or to treat future carbon reduction merely as a sensitivity case. Treating carbon emissions as zero cost emissions could result in investments that prove quite costly in the future. The cost of mitigating greenhouse gas emissions, particularly carbon dioxide, must be accounted for in utility planning. For example, decisions about building new power plants, reducing other pollutants or installing pollution controls, portfolio management, avoided costs for efficiency or renewables, and retirement of existing power plants all can be more sophisticated and more efficient with appropriate consideration of potential future costs of carbon emissions mitigation.

PSI and Cinergy Planning With Regard to Carbon Emissions

Q. DOES THE COMPANY ADDRESS CARBON DIOXIDE EMISSIONS AND CLIMATE POLICY IN ITS FILING IN THIS CASE?

A. Yes, but only in a trivial manner. Only one of the Company's twelve witnesses does any analysis of carbon regulation, this is only description of a single sensitivity case that is discussed and dismissed at the very end of Judah Rose's testimony (pages 48 to 51). In other words, the Company does all of its modeling of compliance options – the IPM modeling to get fuel prices and emission prices, the Engineering and Screening models of unit specific compliance options, and the STRATEGIST system modeling – with the assumption that there will be no carbon dioxide policy of a magnitude or in a timeframe that would influence the planning decisions. And then, there is one IPM model case run with a carbon price trajectory, and that case supposedly demonstrates that "CO2 regulation does not change the attractiveness of investing in large baseload coal power plants."[21]

Q. IS THIS A REASONABLE APPROACH AND CONCLUSION?

A. No. The Company's approach to supposedly recognizing climate change and carbon policy in its compliance filing in this case is pitiful and the conclusion it reaches is absurd.

Q. WHAT DOES THE ICF SENSITIVITY CASE ACTUALLY SHOW?

A. The sensitivity case that ICF ran using the IPM model includes a carbon price as shown in the last column of the table in Exhibit BEB-13. That price increases from $[redacted] per ton of CO2 in 2010 to about $[redacted] per ton of CO2 in 2025, and on a levelized basis over the period it amounts to $[redacted] per ton of CO2.[22]

Q. HOW DOES THIS COMPARE WITH ESTIMATES USED BY OTHER UTILITIES?

A. Synapse has prepared a report summarizing the currently available information that is relevant to future CO2 prices in the US. This report is provided as Exhibit BEB-2. The report identifies many sources of information that can form the basis of reasonable assumptions about the likely costs of meeting future carbon reduction requirements. Available sources include market transactions, values used in utility planning, and modeling analyses.

Q. WHAT IS THE PRICE LEVEL OF CURRENT MARKET TRANSACTIONS FOR CARBON?

A. Carbon markets associated with implementation of the Kyoto Protocol as well as voluntary emissions reductions have emerged. In the carbon markets, carbon traded in January 2005 at a range of $8 to $17 per ton CO_2. Additional information about carbon markets is provided in Section 7.1 of Exhibit BEB-2.

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[21] Testimony of Judah Rose, page 51.
[22] These figures are expressed in constant year 2004 dollars.

Q. ARE UTILITIES USING CARBON PRICES IN PLANNING, AND IF SO WHAT VALUES ARE BEING USED?

A. Some utilities in the United States are already incorporating carbon values into their resource planning. The values range from $1 to $12 per ton CO_2. In December 2004, the California Public Utilities Commission directed utilities to include carbon at a value between $8 and $25 per ton CO_2 in their long term resource planning. Additional information about carbon values used in utility planning is provided in Section 7.2 of Exhibit BEB-2.

Q. WHAT DO COMPUTER MODELING ANALYSES TELL US ABOUT THE POSSIBLE FUTURE PRICES FOR CARBON EMISSIONS?

A. There are numerous studies that estimate the possible costs of carbon allowances under various policy scenarios, many of which are identified in this report. Projections of carbon costs for the year 2010 range from $1 to $99 per ton of CO_2 under different policy scenarios. Projections for carbon costs between 2020-2025 range from $7 to $120 per ton CO_2. Modeling results are sensitive to several factors including (1) the emissions reduction target; (2) projections of future emissions in the absence of a greenhouse gas reduction target; (3) geographic scope of trading; and (4) flexibility mechanisms such as offsets and allowance banking.

The sensitivity of the carbon price levels to the emissions reduction target can be seen by grouping the results for 2010 into two groups based upon the level of the target. For studies that analyze the costs associated with returning to the emissions levels of the year 2000 by the year 2010 or thereabouts, costs in 2010 are projected to be between $1 and $44 per ton CO2. Studies that analyze the costs associated with a somewhat more aggressive goal of reducing emissions to near 1990 levels reveal costs in 2010 between $1 per ton CO2 and $99 ton CO2.

Additional information about the computer modeling studies of carbon regulation and price forecasts is provided in Section 7.3 of Exhibit BEB-2.

Q. WHAT DO YOU CONCLUDE FROM THE PRICES DISCUSSED ABOVE, FROM CARBON MARKETS, UTILITY PLANNING VALUES, AND COMPUTER MODELING STUDIES?

A. There is a very wide range of prices for carbon seen in these various sources. I believe that the information indicates that PSI's reference case assumption in its compliance planning and in its integrated resource planning, that carbon emissions are unconstrained and unpriced, is clearly a poor assumption. In addition, I conclude that the available price information is sufficient basis to develop forecasts of possible future carbon prices, as I describe later in this section of my testimony.

Q. DO PSI AND CINERGY CARBON EMISSIONS INCREASE WITH THE PROPOSED COMPLIANCE PLAN?

A. Yes. Cinergy did not model carbon emissions from its power plants in its Engineering and Screening models. And Cinergy did not model carbon emissions from its power plants in its STRATEGIST model. However, I was able to take the projected fossil fuel consumption from the STRATEGIST model results and apply carbon dioxide emissions rates to estimate the future carbon dioxide emissions from Cinergy plants. The results of this calculation are presented in Exhibit BEB-14. From 2004 to 2010, Cinergy's carbon dioxide emissions are projected to rise by 16%, and they are projected to continue to increase gradually thereafter. Not surprisingly, the annual carbon dioxide emissions track closely with system coal use. For example, the projected increase in coal burned between 2004 and 2010 is 15% in the Company's model run. Annual coal use projected for PSI and Cinergy is presented in Exhibit BEB-15.

Q. IS IT SURPRISING THAT CARBON EMISSIONS WOULD INCREASE IN THE COMPANY'S COMPLIANCE PLAN?

A. No. I think that increasing system carbon dioxide emissions is a natural result of leaving the emissions unpriced in the planning and dispatching of resources.

Q. HOW DO YOU RECONCILE THE PROJECTED CARBON INCREASES DESCRIBED ABOVE WITH PSI AND CINERGY STATEMENTS ABOUT CLIMATE CHANGE AND CARBON?

A. I don't see how they can be reconciled. I believe that the company's words and its actions are blatantly contradictory. For example, Cinergy's 2003 environmental report begins with the following (remarkably frank) discussion of global climate change:[23]

> Global climate change is perhaps the greatest environmental challenge for Cinergy as a coal-burning energy company. There is growing consensus among scientists that our planet's climate is warming as a result of human actions. While there is neither consensus on the rate of this warming nor the ultimate impact on Earth, global climate change has become one of the most important scientific and political issues of our time.
>
> The impact of climate change on Cinergy's 13,300 megawatts of coal-fired generation is obvious. We burn nearly 30 million tons of coal in our facilities, emitting 66.5 million tons of carbon dioxide (CO_2) a year. CO_2 is the most common of the "greenhouse gases," so labeled because, when in the atmosphere, they can prevent the sun's heat from escaping back into space. The balance between the heat from the sun and the heat escaping from the earth helps our planet remain habitable. But an atmosphere overloaded with green-house gases could result in a warm planet drastically different from what we now know.
>
> Cinergy is the sixth largest utility emitter of CO_2 in the United States, simply because we burn large quantities of coal. We burn coal because it's the most abundant and, therefore, the most economical way to produce electricity. Our customers want, and our country's economy needs, reasonably priced energy. Our challenge is to meet these needs in a more environmentally benign way.
>
> As yet, there is no technology that removes CO_2 from exhaust gases; there is no scrubber, no selective catalytic reduction (SCR) unit, and no "carbon collector." The short-term answers lie in energy-efficiency and carbon sequestration projects to offset our emissions. The long-term answers beg for technology, both to lighten the environmental footprint of coal and to provide us with other methods of energy generation.

[23] "Cinergy Sustainability Report." http://www.cinergy.com/pdfs/sustainability_report.pdf, page 8.

The Company's treatment of greenhouse gases in this filing cannot be reconciled with statements such as these that recognize the extent of Cinergy's risk exposure and the urgency of climate change.

Q. ARE THERE OTHER EXAMPLES OF COMPANY DOCUMENTS THAT APPEAR TO TAKE CARBON REGULATION AND RISK SERIOUSLY?

A. Yes. For example, a presentation dated July 12, 2004 that appears to be created by ICF for Cinergy or created by Cinergy based on information from ICF includes the following statements:[24]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[24] "CO2 Policy Considerations for Long Term Planning Scenarios," Green Box Meeting, July 12, 2004.

In a 1999 analysis[25] Cinergy has a slide titled "[redacted].

That same presentation has another slide title "[redacted].

Q. DO CINERGY'S SHAREHOLDERS HAVE CONCERNS ABOUT CLIMATE CHANGE?

A. Yes. I have attached "Cinergy Corporation Shareholder Resolution" on climate change as Exhibit BEB-16.[26] As a result of negotiations, it was not included on the Company's proxy statement to the SEC. But Cinergy did agree to conduct the "Air Issues Report to Stakeholders."

Q. WHAT DO YOU BELIEVE TO BE THE RISKS TO CARBON-EMITTING ELECTRIC UTILITIES BECAUSE OF THEIR ROLE IN CAUSING CLIMATE CHANGE?

A. It is my opinion that such utilities are subject to two different risks arising from climate change.[27] The first is risk arising from legislation to control greenhouse gas emissions and civil or tort lawsuits to do the same and/or seek damages. In addition, I believe utilities will face risk from the direct effects of climate change. Such risks might include significant changes in seasonal load or physical damage to utility infrastructure. Utilities must be managing both types of risk as part of their obligations to their customers, and because investors will be asking

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[25] "Cinergy's Environmental Strategy," March 8, 1999. Provided in response to CAC 2.28.
[26] http://www.incr.com/resolutions/cinergy_shr.htm.
[27] "Climate Risk Facing Investors." Institutional Investor Summit on Climate Risk. http://www.incr.com/climate_risk_overview.pdf, page 1.

themselves "Under what circumstances and to what degree will [the value of] my portfolio be affected by climate risk?"[28]

Q. SHOULD PSI ADDRESS SUCH RISKS IN THIS FILING?

A. Absolutely. It is imprudent to plan and operate a utility system as if climate and carbon policy can be ignored for the vast majority of the planning analysis, and then addressed by a single sensitivity analysis that trivializes the issue. It is a particularly imprudent course of action for a company such as PSI that has a resource portfolio in which coal is more than 90% of the fuel mix, and the proposed plan in the case is to invest $1.4 billion incrementally into those existing coal units.

Q. DOES CINERGY RECOGIZE CLIMATE RISKS IN OTHER STATEMENTS AND DOCUMENTS OUTSIDE OF THE FILING AND ANALYSIS IN THIS CASE?

A. Yes. Cinergy recognizes that "[redacted][29] In spite of such statements, there are only a couple of pages of discussion in its filing or and only a superficial analysis concerning how this large degree of uncertainty may impact Cinergy's decision to invest more than $1 billion in post-combustion emission controls on its existing coal-fired power plants. Specifically carbon price implications are addressed in a single sensitivity case run by ICF and presented in the testimony of Judah Rose.

ICF Carbon Price Forecast

Q. HOW DID CINERGY OR ICF DEVELOP THE CARBON PRICE FORECAST FOR THE ONE SENSTIVITY CASE THAT IT DID ANALYZE WITH A CARBON PRICE?

A. Cinergy relied upon ICF to develop a carbon price forecast for the sensitivity case. The carbon price projection that is "a weighted average of no program –

[28] Former White House Chief of Staff and Former New York Stock Exchange Director Leon Panetta at the Institutional Investor Summit on Climate Risk, http://www.incr.com/summit_final_report.pdf, page 3.

[29] Response to CAC 1.3, "CO_2 Policy Considerations for Long Term Planning Scenarios." (no sponsoring witness)

i.e., zero prices and various programs of differing levels of stringency."[30] IN other words, ICF developed several regulatory scenarios with different carbon prices, the "Mild," "Moderate," and "Stringent" prices shown in Table 6-1 below. And then ICF developed probabilities for each scenario (including no regulation) and applied those probabilities by calculating a probability weighted average price. The result is characterized as the "Expected" case. (see Table 6-1 and Exhibit BEB-13).

Table 6-1. ICF's CO_2 Price Trajectories[31]

Year 2003 $/ton CO_2				
Prices:				
Scenario	**2010**	**2015**	**2020**	**2025**
None	[redacted]	[redacted]	[redacted]	[redacted]
Mild	[redacted]	[redacted]	[redacted]	[redacted]
Moderate	[redacted]	[redacted]	[redacted]	[redacted]
Stringent	[redacted]	[redacted]	[redacted]	[redacted]
Probabilities:				
Scenario	**2010**	**2015**	**2020**	**2025**
None	[redacted]	[redacted]	[redacted]	[redacted]
Mild	[redacted]	[redacted]	[redacted]	[redacted]
Moderate	[redacted]	[redacted]	[redacted]	[redacted]
Stringent	[redacted]	[redacted]	[redacted]	[redacted]
ICF Expected CO_2 Price	[redacted]	[redacted]	[redacted]	[redacted]

[30] Testimony of Judah Rose, page 48, line 23 and page 49, line 1.
[31] "Domestic and International Action Continues to Increase the Likelihood of Costly CO_2 Regulation." (no date) provided in response to CAC 1.3

Q. IS THE APPROACH THAT PSI AND ICF TAKE WITH REGARD TO THE CARBON PRICE FORECAST REASONABLE?

A. No. There are at least three major problems with the approach that PSI and ICF use. First, PSI does not use the ICF "Expected" carbon price scenario in its own analysis and modeling. Second, by weighting the different carbon price forecasts together into a single "Expected" price forecast ICF never really has to concern itself with the high case price forecast. Third, I believe that the ICF "Expected" carbon price scenario is too low.

These points are obviously related, but I will consider each of these issues individually.

Q. WHY DO YOU SAY THAT PSI NEVER USED THE ICF "EXPECTED" CARBON PRICE FORECAST IN ITS MODELING?

A. PSI's compliance plan was never evaluated against this projection. The ICF "Expected" carbon price forecast was merely used to evaluate the results of ICF's modeling of the full US coal fleet, in order to enable witness Rose to make some comments on the effect of carbon policy upon the future prices of SO_2 and NOx allowances, and then support his observation that "it is unlikely that if CO_2 control is enacted, that it would be so stringent as to significantly harm coal generation."[32]

Q. YOU IDENTIFIED A SECOND PROBLEM WITH THE COMPANY'S TREATMENT OF CARBON PRICE HAVING TO DO WITH THE WEIGHTING OF THE VARIOUS SCENARIOS INTO A SINGLE PRICE FORECAST FOR PURPOSES OF THE SENSITIVITY ANALYSIS. COULD YOU PLEASE EXPLAIN WHAT YOU MEAN BY THIS POINT?

A. The second problem with the carbon dioxide price forecast is that it is a single weighted average forecast. Carbon policy is subject to considerable uncertainty – as Cinergy itself has said repeatedly. Thus, the high price cases are in many ways the most interesting and important for sensitivity purposes– in that they address the risk exposure that the Company has in a range of possible futures.

[32] Testimony of Judah Rose, page 49, lines 11-12.

With the PSI-ICF approach in this case, the high, mid and low carbon futures are combined into a single carbon price forecast, and then that forecast is the only thing (other than no carbon price) that is analyzed. This approach effectively ignores the true range of risks and costs to which the Company, its investors, and its customers are exposed.

Q. HOW SHOULD A COMPANY ANALYZE ITS SENSTIVITY TO FUTURE CARBON POLICIES AND PRICES?

A. It is essential, first of all, that the Company have a reference case carbon price forecast that represents some reasonable version of what is likely to occur in the future. This should be a "mid" case of some sort, and it should actually be applied in the analysis – not relegated to a sensitivity case that is merely tacked on at the end.

Then, because there is considerable uncertainty, it is important to analyze sensitivity cases that vary that "mid" or "reference" case carbon price forecast. So, one could develop high and low carbon price forecasts, and apply those in sensitivity case. Conceivably – although I would not recommend it – one might even run a sensitivity case with a zero carbon price to see how that influences the economics of a proposed plan. But that "zero" case should not be the basis for the fundamental analysis, as it is with the Company's filing in this cause.

Q. DO YOU BELIEVE THAT A MORE REASONABLE CARBON PRICE FORECAST WILL EVEN HAVE A SIGNIFICANT IMPACT ON CINERGY'S DECISION-MAKING?

A. Yes. I simply don't see how it couldn't. Cinergy's carbon emissions represent about 1 percent of world carbon emissions, and Cinergy plans to *add* fossil-fuel fired plants to its system. Despite the Company's voluntary goal to reduce Company-wide emissions an average of 5% between 2010 and 2012, to my knowledge the Company has not determined how it will be able to achieve its goal. There is *no* evidence that the Company can expect a decrease in carbon dioxide emissions, in the absence of deliberate and aggressive actions to achieve those reductions. Given the scope of the Company's risk exposure, it is clear that even a mild form of carbon dioxide regulation will have a significant effect on the

Company. The manner in which the Company actually does its planning, however, indicates that carbon is not adequately factored into the inputs, the methodologies, or the results.

One measure of how important the carbon price forecast is to the Cinergy system economics is the relative cost of carbon compared with other emissions from the marginal generators on the system. I will illustrate this using my estimates of the emissions that would be displaced from the Cinergy system margin for 2010 from the Companies STRATEGIST model results (see Exhibit BEB-20 and Section 7 of my testimony for further discussion of this and for the rates). Using the ICF forecasts of prices for SO2, NOx, Hg, and CO2, I calculate that the levelized costs per MWh for each type of emissions. The CO2 value will be $[redacted]/MWh, which is greater than the value per MWh of all of the other three emissions ***combined***.

Synapse Forecast of Carbon Dioxide Emission Prices

Q. YOU MENTIONED THAT IN YOUR OPINION THE ICF CARBON PRICE FORECAST IS LOW. DO YOU HAVE A DIFFERENT FORECAST OF CARBON PRICES?

A. Yes. In Exhibit BEB-2 I have summarized the currently available information on carbon policy and prices. This includes information from carbon trading markets, utility planning and regulatory commission decisions, and computer modeling studies. Based upon this information I have developed a forecast of carbon dioxide emission prices.

Q. WHAT IS YOUR FORECAST OF CARBON DIOXIDE PRICES?

A. My forecast is presented in Exhibit BEB-17. Expressed in year 2004 dollars, my mid-case is for $5 per ton of CO2 in 2010 increasing to $25 per ton of CO2 in 2025. The 2010 price is somewhat lower than recent actual trading prices for carbon dioxide in markets where such carbon trading has been established. The figure of $25 per ton of CO2 is a reasonable expectation for the year 2025 assuming that the target emission level for that year is in the neighborhood of year 2000 emissions. It is somewhat higher than the prices from scenarios that include factors such as a high degree of flexibility in compliance options or aggressive policies to promote clean energy development. It is lower than the prices from scenarios that include factors such as strictly limited flexibility, lack of complementary clean energy policies, or high baseline emissions growth.

Q. ARE YOU CONFIDENT THAT THIS FORECAST IS ACCURATE?

A. Of course not. It is, however, reasonable for utility system planning at this point in time. Forecasts of carbon prices depend upon many uncertain factors, most notably regulatory and political uncertainty.

Q. HOW SHOULD UNCERTAINTY IN PRICES AND CARBON REGULATIONS BE HANDLED IN PLANNING?

A. It is important to acknowledge the uncertainty, and proceed with one's eyes open. In some sense the uncertainty is, for climate policy and carbon emissions regulation, the defining characteristic of the problem. On the other hand, there are myriad uncertainties that utility planners have learned to address in planning. These include randomly occurring generating unit outages, load forecast error and demand fluctuations, and fuel price volatility and uncertainty. Also, uncertainty in regulation of criteria air pollutants, which the Company grapples with at length in its filing in this case. As I noted in Section 4 of this testimony, these various uncertainties can be addressed through techniques such as sensitivity and scenario analyses. In the case of carbon prices, I would recommend analysis using low and high case price forecasts.

Q. DO YOU HAVE SPECIFIC LOW AND HIGH CASE CARBON PRICE FORECASTS THAT YOU WOULD RECOMMEND BE USED IN PSI'S PLANNING?

A. Yes. I have presented low and high case carbon price trajectories in Exhibit BEB-17. The low case increases linearly from zero in 2010 to \$15 per ton of CO2 in 2025. The high case increases from \$12 per ton of CO2 in 2010 to \$50 per ton of CO2 in 2025.

Q. WHAT IS THE SHAPE OVER TIME OF THE CARBON PRICE FORECASTS?

A. The low, mid, and high forecasts are defined according to the following equations:

- Price Low Case = x
- Price Mid Case = 5 + x + 0.022 x^2
- Price High Case = 12 + x + 0.102 x^2

Where x is the year, with the starting year, 2010, as zero.

Q. WHY DID YOU CHOOSE THESE PARTICULAR EQUATIONS FOR THE CARBON PRICE FORECAST?

A. These particular functional forms were used because they provide a smooth, reasonable, gradually increasing slope (except in the low case) that fits the starting and ending values. Other types of equations could certainly be used. But it is important to keep in mind that this is not a statistical exercise based upon a large data set, but rather is an attempt to make reasonable projections for planning purposes for a parameter that is crucially important yet highly uncertain.

Q. DOES UNCERTAINTY IN FUEL PRICES OFFER ANYTHING FOR FORECASTING CARBON EMISSIONS PRICES?

A. I think that it is informative to consider the history of gas prices and the record in forecasting those prices. Exhibit BEB-18 shows the annual actual price of natural gas and each of the annual EIA gas price forecasts since 1986. The actual price data over the nearly three decades shows considerable volatility, even on an annual time scale.[33] But the truly striking thing that jumps out of the figure is how wrong the forecasts have sometimes been. For example, the 1986 forecast predicted gas prices would exceed $8/MMBTU by the year 2000. After than the

[33] Gas prices also show terrific volatility on shorter time scales (e.g., monthly or weekly prices).

actual prices, and the forecasts fell, until the late 1990s at which point the actual prices and forecasted prices generally trended upward.

In view of the forecasting track record for gas prices one might be tempted to give up, and either throw darts or abandon planning altogether. But thankfully modelers, forecasters, and planners have taken to the challenge – and have improved the models over time, thereby producing more reliable (although still quite uncertain) price forecasts, and system planners have refined and applied techniques for addressing fuel price uncertainty in a rational and proactive way.

Q. ARE YOU ATTEMPTING TO FORECAST THE "EXTERNAL COST" OF CARBON EMISSIONS?

A. No. I am forecasting the price that will be internalized through a combination of policy, law, and regulation. The "externality" (or "societal cost") of carbon emissions is something distinct, but the concepts are, of course, related. I believe the societal cost of carbon dioxide emissions amounts to something in excess of $25 per ton, today, and that over time, policies, laws, and regulations will gradually internalize some or all of the external costs. In economics, markets that do not internalize costs will be inefficient. In the case of carbon policy the internalization of the external costs is a matter of urgent national and international policy.

Q. ARE YOU FORECASTING WHAT YOU BELIEVE SHOULD HAPPEN IN CARBON POLICY OR WHAT YOU BELIEVE WILL HAPPEN?

A. I offer the low, mid, and high price forecasts in this case as a matter of what I believe is likely, and what frames the reasonably possible scenarios for what ***will happen*** with regard to carbon policy in the United States. This should then serve as a basis for rational and prudent planning to minimize direct costs and risks to PSI, its investors, and its customers.

I will leave discussion of what ***should happen*** with regard to US climate policy and carbon regulation for another day, as that is not directly relevant to my analysis and recommendations in this case.

Q. HOW DO YOUR CARBON PRICE FORECASTS COMPARE WITH ICF'S?

A. My low and mid cases are [redacted] ICF's "mild" and "moderate" cases, with my forecasts [redacted]. My high case [redacted] than ICF's stringent case, but [redacted] ICF's stringent case by 2025.

In order to make comparisons more straightforward, and to aid in applying the price forecasts (as I do in the next section of my testimony), I have levelized all of the ICF and Synapse carbon dioxide price forecasts. The results are summarized in Table 6-3, below:

Table 6-3 Levelized costs of CO2 (in 2004 dollars, levelized over 2010-2025)

	ICF Mild	ICF Moderate	ICF Stringent	ICF Expected
ICF	[redacted]	[redacted]	[redacted]	[redacted]
	Synapse Low	Synapse Mid	Synapse High	
Synapse	6.1	12.4	23.9	

Note that the three ICF's forecasts from the IPM model analyses all increase at an annual rate of exactly 7% in all years. This is an artifact of the IPM modeling approach, which assumes perfect forecast and perfect optimization where the "objective function" is minimizing the present value of total costs over the study period subject to various constraints (e.g., a carbon emissions cap). With a real discount rate of 7% the model finds that the price will escalate at exactly that rate, otherwise there would be opportunities to arbitrage reductions in one year for reductions in another year (i.e., to lower the cost of achieving a particular CO2 emissions target by shifting the investments in time).

Q. WHAT EFFECTS WOULD INCLUDING A CARBON PRICE FORECAST HAVE ON PSI'S PLANNING?

A. I believe that the major effects of incorporating a reasonable carbon price forecast into PSI's planning would have to do with the amount of energy efficiency and renewables that would be reflected in the Company's plans, and the assessment of generating unit retirements. These would all have a bearing upon the planning for emissions controls. In addition, the selection of specific emission control technologies at specific units can involve tradeoffs such as a reduction in criteria pollutant emissions against an increase in carbon dioxide emissions, so the use of a carbon price forecast would influence those decisions as well.

7. EFFICIENCY AND RENEWABLES

PSI and Cinergy's Treatment of Efficiency and Renewables in Planning

Q. DOES PSI CONSIDER EFFICIENCY AND RENEWABLE GENERATING RESOURCES AS ENVIRONMENTAL COMPLIANCE OPTIONS?

A. No. PSI's compliance analysis does not consider efficiency and renewables as environmental compliance options. The Company's planning approach merely looks at two different load forecasts, it does not examine the ability of DSM to cost-effectively reduce system air emissions. DSM and renewables are important and cost-effective ways to reduce air emissions, and should be part of an overall environmental compliance plan. Indeed, leaving these options out of the compliance planning ensures that the result will ***not*** be a reasonable and prudent plan. PSI has DSM and renewable options available to it that are cost-effective, particularly when the costs of air emissions are accounted for.

Q. HOW DOES PSI TREAT EFFICIENCY AND RENEWABLES IN ITS COMPLIANCE PLANNING?

A. For the most part, energy efficiency (or "demand-side management" or "DSM") and renewables are ignored in PSI's compliance planning. The only place where DSM figures into the Company's filing in this case is in a load forecast sensitivity analysis. Renewable generation is not factored into the analysis at all.

Q. WHERE DOES THE COMPANY EXPLAIN THAT DSM IS INCLUDED IN ITS PLANNING?

A. Question CAC 8.1 asked "In evaluating and studying Phase I and Phase II compliance plans, did PSI consider the implementation of any DSM measures as an option for controlling SO2, NOx, and/or mercury emissions?" The Company's answer states that, "As discussed in the testimony of Diane L. Jenner on pages 16-17 and Dr. Richard G. Stevie on pages 13-14, PSI performed a lower load forecast/higher DSM impact sensitivity to evaluate the effect of alternate load/DSM impacts on the plan."

Q. IS THIS A REASONABLE APPROACH?

A. Testing the compliance plan against a different load forecast is a reasonable thing to do, but is hardly adequate. It is reasonable, in that it provides information about how the plan looks (its costs and total emissions) if loads grow differently than is assumed in the base case analysis. This is merely a "sensitivity" analysis, which tests the robustness of aspects of the plan to the demand and energy growth assumptions. It does not, however, provide information about whether or not additional DSM would be part of a cost-effective compliance plan. In effect, the Company's sensitivity analysis asks the question "what if additional DSM were to just happen?" while a proper analysis would address the issue of "whether the Company ***should*** actively implement more DSM?"

Efficiency and Renewables Reduce Fossil Plant Air Emissions

Q. DO EFFICIENCY AND RENEWABLES REDUCE AIR EMISSIONS FROM POWER PLANTS?

A. Yes. In general bringing additional zero or low emission resources such as efficiency and renewables into the system mix will tend to lower system air emissions.

Q. DO YOU HAVE ANY FIGURES FOR THE AMOUNT THAT EFFICIENCY COULD REDUCE SYSTEM AIR EMISSIONS?

A. Yes. I have done some analysis actual data for the Ohio Valley portion of the East Central Area Reliability region ("ECAR OV") for 2002, and I have done some analysis of the Company's projections for 2010.

Q. PLEASE DESCRIBE YOUR ANALYSIS OF 2002 DATA AND EXPLAIN WHAT IT SHOWS.

A. I started with hourly data for fossil plant generating and air emissions from the US EPA's continuous emissions monitoring system data (CEMS). They show a strong correlation between fossil generation (in MW) and system emissions of each of the four emission-types. That is, while there are many factors involved, in general with energy efficiency programs implemented, fossil generation will be lower, and air emissions will decrease. The scatter plots from this analysis are presented in Exhibit BEB-19. The relationships can be complicated, but I believe that the following coefficients are reasonable figures for planning:

Table 7-1. Displaced Air Emissions 2002

	Displaced Emissions ECAR OV 2002
CO_2	909 tons/GWH
SO_2	5.5 tons/GWH
Nox	2.3 tons/GWH
Hg	0.04 lbs/GWH

Q. PLEASE DESCRIBE YOU ANALYSIS OF THE 2010 PROJECTED DATA AND EXPLAIN WHAT IT SHOWS.

A. My analysis of 2010 is described in Exhibit BEB-20. My aim was to estimate the system marginal air emissions for a future year that would include the effect of the proposed emission controls. Based upon outputs from the Company's Strategist model runs, I created the graphs shown in Exhibit BEB-20, by ordering the units according to running cost and plotting their emission rates. This is described in the notes to the exhibit. The graphs show how the emission rates from the marginal generating unit will change at different demand levels. For example, for CO2, the first graph shown in Exhibit BEB-20 the emission rate is a little above 1000 tons/GWH for a large block of capacity up to about 10,000 MW, after which it drops to about 600 tons/GWH. The first block represents Cinergy's coal capacity, and the next block is gas-fired capacity.

To estimate the marginal air emissions of each type, I calculated a weighted average of the air emissions for the top two-thirds of the loads. The resulting estimates, representing the air emissions that would be displaced by DSM on the Cinergy system in 2010 are as follows:

Table 7-2. Displaced Air Emissions 2010

	Displaced Emissions Cinergy 2010
CO2	[redacted] tons/GWH
SO2	[redacted] tons/GWH
Nox	[redacted] tons/GWH
Hg	[redacted] lbs/GWH

These figures are lower than the year 2002 estimates, primarily as a result of the emission controls installed upon the Cinergy plants between 2002 and 2010.

Impact of Air Emissions Costs on the Relative Economics of Resource Options

Q. YOU HAVE PRESENTED ESTIMATES OF DISPLACED AIR EMISSIONS. CAN YOU NOW PUT THESE IN TERMS OF ECONOMIC VALUE AND COMPLIANCE PLANNING?

A. Yes. If a company reduces its system air emissions by investing in DSM or renewables, that would have economic value as part of a compliance plan. Specifically, under an emissions cap and trade system, the clean energy resources would allow the Company to purchase fewer allowances than it otherwise would. Or, if it were long on allowances, then the Company could sell more allowances than it otherwise would.

I have estimated this economic value using my estimates of displaced emissions and ICF's forecast of allowance prices. The value, for efficiency implemented in the year 2010, works out to $[redacted]/MWh.

I have also calculated this economic value substituting my projection of the CO2 price for ICF's projection of the CO2 price. In this case, the value of emissions displacement on the Cinergy system for efficiency in 2010 works out to $[redacted]/MWh. Of this total, $11.2/MWh is the value of carbon dioxide emissions reduction.

Q. HOW DO EFFICIENCY AND RENEWABLES COMPARE WITH THE COSTS OF NEW FOSSIL-FIRED ELECTRIC GENERATION?

A. I have summarized information on the costs of new gas, coal, and wind generation in Exhibit BEB-21. This is based upon inputs that ICF used in its IPM model runs for the Company in this case.[34] The bottom line all-in costs work out to be

[34] I am using these numbers for ICF to illustrate a point about relative economics. This should not be taken to imply that I agree with all of the ICF assumptions.

$[redacted]/MWh, $[redacted]/MWh, and $[redacted]/MWh for combined-cycle gas, integrated gasification combined cycle coal, and wind, respectively. This is does not include the costs associated with air emissions.

Q. HOW DO AIR EMISSIONS COSTS AFFECT THESE RESOURCE COSTS?

A. If we add the costs of air emissions, using emission rates from a report prepared by the NorthBridge Group and emission price forecasts from ICF,[35] the all-in costs for CC gas, IGCC coal, and wind work out to $39.3/MWh, $49.7/MWh, and $41.9/MWh respectively. So, with these assumptions the new gas is slightly more economic than wind, and IGCC is a clear economic loser. The calculation of these air emissions price adders is shown in Exhibit BEB-22.

With the higher CO2 price forecasts (i.e., the "ICF Stringent," "the Synapse Mid," or the "Synapse High") wind would be lower cost than gas, on a levelized basis. The effect of different carbon dioxide price forecasts upon the costs of gas and coal generation is illustrated in Exhibit BEB-23.

Q. WHAT DO THESE COST FIGURES MEAN FOR PSI COMPLIANCE PLANNING?

A. Air emissions, and carbon in particular, have a very significant impact on the relative economics of resources for the PSI system. Because energy efficiency and renewables have the potential to reduce air emissions that would otherwise be emitted from existing and/or new fossil plants these resources should be an integral part of environmental compliance planning.

DSM in PSI Compliance Planning

Q. IS PSI ALREADY DOING ALL OF THE REASONABLY ACHIEVABLE COST-EFFECTIVE DSM?

A. Hardly. PSI's DSM spending and projected savings are small compared to those of many utilities. In Exhibit BEB-24 I have listed efficiency program spending in ten states with relative strong DSM programs. In these ten states, program funding ranges from 1.15 mills/kWh to 3.00 mills/kWh. As a percentage of revenue the range is from 1.3% to 3.4%. By either measure, PSI is well below the low end of this range.

Q. SHOULDN'T THESE COMPARISONS BE ADJUSTED TO REFLECT THE FACT THAT PSI IS A RELATIVELY LOW COST SYSTEM COMPARED TO SOME OF THESE OTHER STATES?

A. The comparison on a percentage of revenue basis, already accounts for differences in cost between the systems.

Q. HOW DO PSI'S DSM PROGRAMS COMPARE WITH OTHERS IN TERMS OF PROJECTED SAVINGS?

A. PSI's programs are near the low end of this group of states in terms of projected savings. See Table 2 in Exhibit BEB-24.

Q. WHAT IS YOUR CONCLUSION WITH REGARD TO PSI'S DSM?

A. PSI can and should be implementing additional DSM, and incorporating DSM explicitly into its compliance plan.

Renewables in PSI Compliance Planning

Q. HAS THE COMPANY DONE A REASONABLE ANALYSIS OF THE RENEWABLE ENERGY RESOURCES AS PART OF ITS COMPLIANCE PLANNING?

A. No. The Company has not done a reasonable analysis of renewables. They did no analysis of renewables in this case. While they did conduct some analysis of renewables in the 2003 IRP, that analysis has the following inadequacies:

- It is not integrated with the compliance planning.
- It did not address EPA's recent or current emission rules (CAIR and CAMR).

[35] Including ICF's "expected" CO2 price forecast discussed previously.

- It did not have an appropriate level of detail.
- It dismissed wind generation hastily and inappropriately.
- The treatment of carbon policy was inappropriate.

I would like to address each of these points in turn.

Q. WHAT IS THE BASIS FOR YOUR STATEMENT THAT PSI DID NO ANALYSIS OF RENEWABLE GENERATING OPTIONS IN THIS CASE?

A. PSI witness, Diane Jenner, discusses renewables in her testimony (page 6) but she is explaining only what PSI did for its 2003 IRP, not any analysis of renewables done more recently or in the context of the environmental compliance planning.

Q. WHY SHOULD PSI HAVE ANALYZED RENEWABLE ENERGY OPTIONS IN THE PRESENT CASE?

A. It is important to analyze renewable energy options in the context of an environmental compliance plan in order to appropriately recognize the air emissions benefits of renewable generation, so that the compliance plan will be reasonably optimal. Also, it is important that the analysis include evaluation of renewables in light of the same set of expected air emissions regulations used for planning the retrofit emission controls.

Q. DID THE COMPANY'S 2003 IRP ANALYSIS INCLUDE THE SAME SET OF EXPECTED AIR REGULATIONS THAT THE COMPANY USED IN ITS COMPLIANCE ANALYSIS IN THIS CASE?

A. No. There are important differences. The 2003 IRP analysis did not consider the EPA's CAIR or CAMR emission rules. Indeed, the Company could not have included those rules, as they were proposed after the IRP was completed. Still, this is important since CAIR and CAMR, which are the focus of the Company's compliance planning, will also influence the economic analysis of renewables.

Q. YOU SAID THAT THE COMPANY'S ANALYSIS OF RENEWABLES IN THE 2003 IRP DID NOT HAVE AN APPROPRIATE LEVEL OF DETAIL. WHAT IS THE BASIS FOR THAT STATEMENT?

A. Diane Jenner states in her testimony that:

> "Based upon the information available and the analysis performed, PSI concluded that, with the current state of technical development and the cost of such technologies (using 'Repowering the Midwest' as the source), these options were not yet economically attractive on a utility scale within the PSI territory."[36]

During discovery, CAC requested that PSI supply "all workpapers, assumptions and memos related to" that statement.[37] The documents provided in response to this request were a copy of True Wind Solutions' Wind Power Map of Indiana, a study of the feasibility of biomass co-firing at Cinergy plants, the EPRI Technical Assessment Guide 2000 and a report entitled "An Assessment of Wind Energy Potential at Cinergy: Interim Report," dated May 2000.

The Indiana Wind Power Map and the EPRI TAG 2000 are not recent or specific enough to allow PSI to perform a thorough and complete analysis of the feasibility of renewables. The wind assessment study concluded that certain areas of Indiana and Ohio showed some technical potential for wind power, but restricted further activities to Cinergy's service territory saying "it is probably prudent and, absent other direction, the study will continue down the path to perform several wind power density calculations (for Indianapolis, Cincinnati and Cayuga) and using the capital installed cost and O&M projections, develop a cost per kilowatt-hour for comparison to other alternatives." Because PSI did not supply the CAC with the follow-up to this report it appears that either Cinergy never performed the follow-up or, if it did, that the follow-up report had no influence on the Company's determination that renewables are "uneconomic."

Q. YOU SAID THAT CINERGY DISMISSES WIND BECAUSE OF SUPPOSED "CAPACITY PROBLEMS." COULD YOU ADDRESS THAT ISSUE?

A. Yes. As I noted earlier, in PSI's 2003 IRP the Company dismissed wind generation as an available and useful resource because of "capacity problems." I believe that they are referring to the intermittency of wind generation. The

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[36] Page 6.
[37] CAC 2.24.

intermittency is ***not*** a reason to conclude that wind has no capacity value. Indeed, the capacity value of wind generation can, at least for the first increments of wind capacity added to the system (up to, say, 5 or 10% of total capacity), can have capacity value, on a per MWH basis, equal to that of fossil plants. In other words, the capacity value of wind expressed in MW can be equal to the ***average*** amount of wind generation (rather than the significantly high "installed" capacity rating of the wind. While at the Tellus Institute, I worked on a modeling project for the Department of Energy that found this to be the case.[38]

Q. YOU SAID THAT THE COMPANY'S TREATMENT OF CARBON POLICY IN ITS IRP WAS INAPROPRIATE. PLEASE EXPLAIN WHAT YOU MEAN BY THAT?

A. In its 2003 IRP, PSI addressed carbon policy in much the same way that it addressed carbon policy in this compliance filing. That is, the Company assumed for most of its analysis that carbon emissions had zero cost. Then a sensitivity analysis with a carbon price was analyzed, but not considered in a way that influenced any planning choices. I believe carbon policy should be factored into utility planning by including a reasonably expected carbon price in the reference case analysis, and then sensitivity analyses should examine higher and lower price forecasts. I have discussed this already above, so I will not elaborate upon this point again here.

Q. YOU SAID THAT THE COMPANY DISMISSED BIOMASS CO-FIRING THAT WOULD BE COST EFFECTIVE WITH A CARBON PRICE?

The biomass co-firing report that was done for Cinergy concluded that a production tax credit of $.005 to $.01/kWh or a carbon tax credit of $45 to $91/ton would "result in significant amounts of co-firing."[39] That price range for carbon emissions works out to a price range of $12 to $25 per ton of ***carbon dioxide***.[40] As discussed in the section of this testimony on climate policy I

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[38] *Modelling Renewable Electric Resources: A Case Study of Wind*, Tellus Institute, October, 1994.
[39] *Biomass Cofiring Feasibility Study*, Burns & McDonnell, February 2004, Page 88.
[40] The conversion factor from carbon to carbon dioxide is 3.67, based on the relative molecular weights.

believe that carbon dioxide prices in this range are reasonably likely. In addition, co-firing with biomass can reduce SO2 and NOx emissions.[41]

Q. WHAT DO YOU RECOMMEND WITH REGARD TO ENERGY EFFICIENCY AND RENEWABLES IN THIS CASE?

A. I recommend that the Company be required to do a complete, detailed, and up to date analysis of the potential for efficiency programs and new renewable generation to be implemented in order to reduce costs of compliance to its customers, and to proactively and prudently manage the risks to which investors and customers are currently exposed.

8. PLANT ADDITIONS AND RETIREMENTS

Q. DO THE CONCERNS THAT YOU HAVE DISCUSSED THUS FAR IN YOUR TESTIMONY ALSO HAVE IMPLICATIONS FOR PSI AND CINERGY CAPACITY ADDTIONS AND RETIREMENTS?

A. Yes. The issues that I have discussed about planning, and about factoring emissions costs into planning, have direct and important implications for planning capacity additions and retirements. A proper planning analysis that treats efficiency and renewable resources appropriately in valuing their capacity would, I believe, indicate that increased reliance on coal (as projected in the Company's compliance planning model runs) is unwise and uneconomic.

Q. DO YOU UNDERSTAND THAT COAL-FIRED ELECTRICITY GENERATION IS A LOW COST RESOURCE?

A. Looking at the fuel and O&M costs associated with existing coal-fired power plants it certainly appears that coal is low cost electric generating technology. However, when the costs of required capital investment for retrofit emission controls is factored in along with the cost of emission allowances for the remaining emissions (particularly but not limited to carbon dioxide) the economics are much less favorable. When capital costs for constructing new

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[41] *Biomass Cofiring Feasibility Study*, Burns & McDonnell, February 2004, Page 76.

coal-fired power capacity are included, then the total package is, I expect, uneconomic, relative to other available resources.

Q. DOES CINERGY HAVE ANY NEW COAL-FIRED POWER GENERATING CAPACITY IN ITS PLAN?

A. In its filing in this case, there is mention of IGCC technology, for example, on page 12 of James Rogers' testimony. My understanding is that the Company has not asked for approval of investment in IGCC in this case. But the compliance planning modeling does include new IGCC capacity. Specifically, the Company's Strategist model runs of the compliance plan has [redacted] MW of IGCC capacity coming online in [redacted] and [redacted] MW coming online in [redacted].[42]

Q. WHAT DO THE COSTS OF NEW IGCC GENERATION LOOK LIKE COMPARED TO OTHER RESOURCE OPTIONS?

A. It is not the purpose of my testimony in this case to get into the details of capacity planning for future resources. I have, however, prepared a levelized cost comparison using information from ICF's modeling assumptions. I believe this example is instructive, in understanding the comparative resource economics and the impact of carbon policy on the relative costs.

In Exhibit BEB-21 I show the levelized costs, without air emissions costs, to be $[redacted]/MWh, $[redacted]/MWh, and $[redacted]/MWh for combined-cycle gas, integrated gasification combined cycle coal, and wind, respectively. With ICF's air emissions costs, and most importantly a carbon price of $[redacted] per ton of CO2 (levelized), the relative costs of IGCC become much higher than the costs of gas-fired generation or wind generation. And in a "high case" for carbon prices (e.g., the Synapse high case price of $23.9 per ton of CO2, levelized) the IGCC costs could exceed those of gas by $[redacted]/MWh and exceed those of wind by $[redacted]/MWh.

[42] This is based upon Strategist model run INPFGDSLIPBASPLN14F.REP.

Q. DOESN'T IGCC TECHNOLOGY HAVE THE CAPABILITY FOR CARBON SEQUESTRATION?

A. Yes. And in Mr. Rogers' testimony where he mentions IGCC it is in the context of what the Company is doing to deal with environmental regulatory uncertainty and carbon dioxide emissions.[43] However, the "potential" for capturing CO2 emissions is quite a different thing from the actual capturing of those emissions. The carbon sequestration technology doesn't work if it isn't installed, and the costs of sequestration technology are expected to quite large, on top of the already inordinate costs of IGCC capacity without carbon capture.

Q. PLEASE COMMENT ON POWER PLANT RETIREMENT ANALYSIS.

A. The Company's filing indicates that its Edwardsport units may be retired (see Petitioner's Exhibits F-3 and F-4). Specifically, Diane Jenner's analysis found that the economics of continued operation of Edwardsport was "extremely close" and that "more study is required" (page 14). I expect that further study will find Edwardsport to be uneconomic to continue operating, given the cost of controlling (or buying allowances for) its emissions of SO2, NOx, mercury, and CO2.

Exhibit BEB-25 and BEB-26 shows the basic data for Cinergy's coal-fired generating units for 2004, from the Company's Strategist model. Exhibit BEB-27 presents analogous emissions information for Cinergy's coal fired-units from publicly available sources for the year 2000.

Of the existing PSI generating units, Edwardsport 7 and 8 are clearly the leading candidates for retirement. They were completed in 1949 and 1951, and have very high heat rates and very low capacity factors. There are other old, small generating units that are also candidates for retirement. These include Gallagher units 1 through 4 and Wabash River units 2 through 5.

Q. WHAT DOES ICF'S MODELING DONE FOR THE COMPANY IN THIS CASE SHOW WITH REGARD TO THE ECONOMICS OF CONTINUED OPERATION OF PSI'S GENERATING UNITS?

[43] Testimony of James Rogers, page 12, lines 10 to 12.

A. ICF's modeling using the IPM model shows that in the reference case only 1 unit is retired ([redacted]) is retired. However, this case is quite unrealistic with regard to air regulations. It includes none of the "new" air regulations analyzed by Cinergy in this case. That is, there is no "Clear Skies Act," no "Clean Air Interstate Rule," no "Clean Air Mercury Rule" (with or without trading), and no carbon regulation.

Q. DOES ICF'S MODELING SHOW ADDITIONAL RETIREMENTS IN THE CASES WITH "NEW" AIR REGUALTIONS?

A. Yes. In all of the cases analyzed by ICF with CSA, CAIR, and CAMR (with and without trading) there are additional retirements of PSI generating units.

Specifically, in all of these cases, in addition to the 1 unit retirement, ICF found that it would be economical to retire 6 more units ([redacted]).

Q. DOES ICF'S MODELING SHOW ADDITIONAL RETIREMENTS IN THE CASE WITH CO2 REGULATION?

A. Yes. In addition to the retirements above, when ICF adds a carbon price to its analysis (the only carbon regulation case run by ICF for this case, and the only case with carbon regulation in the company's filing in this case) then in addition to those, they find that it would be economical to retire ([redacted] units [redacted]).

Q. HOW WOULD A DIFFERENT CARBON PRICE FORECAST INFLUNCE THE PLANT RETIREMENT ANALYSIS?

A. As I discussed in Section 6 of my testimony, I believe the ICF "Expected" carbon price forecast to be too low, and offered my own low, mid, and high case carbon price forecasts. Under my mid and high case carbon price forecasts, the economic analysis of generating unit retirement would, if anything, make the continued operation of the smaller PSI coal units even less economically favorable.

It is, I think, worth noting that in the ICF modeling analysis with its "Expected" carbon price forecast, that US total carbon dioxide emissions are projected to increase substantially (i.e., by [redacted] between 2010 and 2004). So this case, which shows retirement of nearly a dozen PSI generating units is hardly an "extreme case" with regard to carbon policy generally.

Q. WHAT IS THE SOURCE OF THIS INFORMATION ABOUT PSI UNIT RETIREMENTS IN THE VARIOUS CASES THAT ICF MODELLED?

A. This is from the IPM model outputs provided in response to CAC 2.3, and a presentation provided in response to CAC 11.3.

Q. YOU EXPRESS CONCERN THAT INVESTMENTS COULD BE MADE IN EXISTING PLANTS THAT SHOULD INSTEAD BE RETIRED. HAS THIS ACTUALLY HAPPENED THAT EMISSIONS INVESTMENTS HAVE BEEN MADE TO UNECONOMICAL PLANTS?

A. Yes. I was involved in a series of cases in Texas recently, in which the utility planned to invest more than $100 million in emission controls (SCR), the Commission granted the recovery of those costs from customers, and now those units have been permanently retired. Customers in Texas are paying for emission controls for generating units that literally are not operating.

Q. ARE YOU SAYING THAT THE TEXAS CASE IS THE SAME AS THE SITUATION WITH PSI IN INDIANA?

A. Of course, not. There are surely important differences in the economic and regulatory contexts. My point in noting the Texas example is not to imply that the facts are identical, but rather that the concern that I have about wasted investment in retrofit controls installed at uneconomic power plants is not a theoretical matter. It involves real ratepayer money, and has actually occurred in recent years.

Q. WHAT DO YOU RECOMMEND WITH REGARD TO CAPACITY ADDITIONS AND RETIREMENTS?

A. I recommend that the Commission indicate that before any approval of a plan to construct new IGCC capacity is approved, the Company will be required to demonstrate that it is implementing all of the available and cost-effective energy efficiency and renewable generating options. Otherwise, the IGCC capacity would not be part of a reasonably least-cost resource portfolio.

With regard to retirements, I recommend that the Commission require the Company to conduct rigorous studies of the continued operation of certain generating units compared with retiring those units. Those studies should include the costs of environmental compliance in the cases where the units are operated, and the cost of carbon emissions should be included in an appropriate manner. The units for which such studies should be done include units at Edwardsport, Gallagher, and Wabash River. In addition, the Commission should indicate that investments in emission controls installed at units that should have been retired will not be considered to have been prudently incurred.

9. COST RECOVERY AND APPROVALS

Q. WHAT DOES PSI ASK THE COMMISSION TO DO IN THIS CASE?

A. PSI, in the testimony of Mr. Douglas Esamann, explains what the Company is requesting in this case. The request includes a number of Commission "approvals:"

> PSI is requesting that the Commission approve PSI's proposed Phase 1 plan for complying with pending new SO_2, NO_x, and mercury emissions reduction requirements, and provide ongoing reviews and approvals of our plan annually (or more often if circumstances so necessitate). Related to the this overall plan approval, we are requesting that the Commission approve PSI's use of various pollution control equipment contained in our Phase 1 plan; approve

> PSI's use of certain clean coal technology equipment; and approve PSI's use of accelerated depreciation for certain pollution control equipment. Additionally, we are requesting Commission approval of certain proposed testing programs, as well as approval of certain flexibility components built into our plan. (Esamann, page 3)

In addition, Mr. Esamann outlines PSI's of requests of the Commission with regard to cost recovery:

> We are also requesting timely recovery of our compliance costs, specifically: assurance of capital cost recovery (up to approved cost estimates); authority to recover financing, depreciation, operation and maintenance (O&M) and emission allowance costs on a timely basis via PSI's existing CWIP, Senate Bill 29, and Emission Allowance cost tracking mechanisms; authority to earn a potentially enhanced return on qualifying Senate Bill 29 projects (approximately 200 basis points); authority to recover certain equipment testing costs and potential plan flexibility costs, via PSI's Senate Bill 29 Rider; and authority to recover our compliance plan development and presentation costs via the Senate Bill 29 Rider. (Esamann, pages 3 and 4).

Some of the details of the cost recovery requested are spelled out toward the end of Mr. Esamann's testimony (pages 19 to 23) and in the testimony of Mr. Stephen Farmer.

Q. HAVE YOU REVIEWED THE COMPANY'S REQUESTED APPROVALS AND COST RECOVERY PROVISIONS IN DETAIL?

A. I have not. My analysis in this case has focused on the emissions controls and system planning analyses. However, the proposed approvals and proposed cost recovery raise a number of complex regulatory and ratemaking issues. I would like to comment briefly on aspects of the proposed approvals and proposed cost recovery that relate to the planning issues that I have focused on.

Q. WHAT IS YOUR VIEW ON THE COST RECOVERY THAT THE COMPANY REQUESTS IN THIS CASE?

A. The company requests a return on equity that is 200 basis points above the 10.5% ROE approved by the IURC in Cause No. 42359, and the ability to earn as much as 300 basis points extra on ROE to the extent that decreases in the actual cost of debt create room for that increase. The Commission found in the rate case that 10.5% was an appropriate ROE for this Company, given the balance of evidence and the risks that the Company faces. Notably, the Commission in its findings specifically noted the risks associated with heavy reliance on coal (IURC Order in Cause No. 42359, page 52). But now, in the current case, the Company requests that the allowed equity return on its emission control investments be set at 12.5%, possibly increasing to 13.5%. Even if the "enhanced" ROE that the Company requests may be allowed as a legal matter by Senate Bill 29, it is not appropriate as an economic matter to provide the higher return in this case. Returns for regulated utility companies should be set in order to correspond with risks. The 12.5% requested ROE is an outrageously high figure, particularly in light of the approvals and trackers that the company proposes in this case. With those approvals and trackers, there is very little risk to justify even the 10.5% overall ROE granted in the rate case, let alone the 12.5% or 13.5% requested ROE.

Q. ROUGHLY WHAT DOES 300 BASIS POINTS TRANSLATE INTO IN TERMS OF DOLLARS?

A. In rough terms, I believe that with equity at about 44% of the total capitalization, 3 percentage points on the equity-financed share of the $1.4 billion investment in emission controls works out to $28 million per year.[44] This would be an annual cost to PSI customers above and beyond a standard return, paid merely for the privilege of having PSI install equipment on its power plants to comply with Federal laws. Moreover, PSI's emission control plan does not prudently and appropriately anticipate future requirements (e.g., carbon policy), nor does it reduce NOx, SO2, and mercury in a cost-effective manner (e.g., it overlooks cost-effective opportunities for investments in efficiency and renewable resources to reduce those emissions at costs per ton that are lower than the costs per ton being paid for emission control hardware retrofits).

[44] Annual customer cost = ($1.4 billion x 44% x 3%) / (1 – 0.35) = $28 million per year

"Incentive payments" should be used judiciously in utility regulation in situations where there is some behavior that goes beyond standard practice that deserves such encouragement. This could, for example, include the design and implementation of an excellent and comprehensive set of energy efficiency programs. I cannot think of an example in which mere compliance with the law would warrant a bonus.

With customers paying the bill for the control equipment, and paying for it via mechanisms that include accelerated depreciation, CWIP, and various trackers, as well as the generous rate of return authorized in its last rate case, the Company already has sufficient incentive to make investments in emission controls without the bonus return or the extent of the pre-approvals requested in this case.

Q. SB 29 ALLOWS FOR THE IURC TO APPROVE BONUS RETURNS ON INVESTMENTS IN CERTAIN QUALIFYING POLLUTION CONTROL EQUIPMENT. HAVE YOU EVALUATED PSI'S COMPLIANCE PLAN AGAINST THE PROVISIONS OF SB 29?

A. Not in detail. The provisions of SB 29 ***allow*** but do not require the IURC to provide such incentives. I believe that the incentives should not be provided in this case. However, even if the IURC did wish to offer bonus returns, it appears that some of the Company's planned investments would not fit the requirements of SB 29. Specifically, incentives can be granted on equipment that either:

> (A) was not in general commercial use at the same or greater scale in new or existing facilities in the United States at the time of enactment of the federal Clean Air Act Amendments of 1990 (P.L.101-549); or
>
> (B) has been selected by the United States Department of Energy for funding under its Innovative Clean Coal Technology Program and is finally approved for such funding on or after the date of enactment of the federal Clean Air Act Amendments of 1990 (P.L.101-549).

My understanding is that scrubbers and baghouses were in common use prior to passage of the Clean Air Act Amendments of 1990. Scrubbers represent about two thirds of the Company's $1.4 billion of proposed investment. Baghouses are a much smaller, but still significant portion.

It may be that PSI's claim that scrubbers are eligible for incentives under SB 29 is based upon the "innovation" whereby they will use an "enhanced design that will improve the capture of ionic mercury from the flue gas."[45] If that is the case, it seems to me that the costs associated specifically with the incremental improvement might qualify, but scrubber technology in general would not.

Similarly, with the proposed ACI Baghouse installations in the Company's plan, the ACI portion is the only part that might reasonably be considered to qualify, since baghouse technology was widely used prior to the Clean Air Act Amendments of 1990.

Q. WHAT IS YOUR VIEW ON THE APPROVALS THAT THE COMPANY REQUESTS IN THIS CASE?

A. PSI has requested various approvals (see the excerpt from Esamann, page 3, quoted above) which include immediate approval of the Phase 1 plan, and establishment of provisions for ongoing review and approval (at least annually). In my view, the Commission should not approve the Phase 1 plan at this time, but rather should direct the company to prepare an analysis that corrects the major deficiencies of the Company's filing in this case.

Q. Does this conclude your testimony?

A. Yes, it does.

[45] Testimony of John J. Roebel, page 12.