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EO-2011-0271

**REBUTTAL TESTIMONY**

**OF**

**TIM WOOLF**

Submitted on Behalf of  
the Office of the Public Counsel

**UNION ELECTRIC COMPANY D/B/A AMEREN MISSOURI**

**Case No. EO-2011-0271**

October 28, 2011

*OPC* Exhibit No. 47  
Date 12-16-11 Reporter JK  
File No. EO-2011-0271

**MELISSA SCHULTZ**  
**Notary Public**  
**Commonwealth of Massachusetts**  
**My Commission Expires**  
**July 27, 2018**

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1    **1.    INTRODUCTION AND QUALIFICATIONS**

2    **Q.    Please state your name, title and employer.**

3    A.    My name is Tim Woolf. I am a Vice-President at Synapse Energy Economics,  
4        located at 485 Massachusetts Avenue, Cambridge, MA 02139.

5    **Q.    Please describe Synapse Energy Economics.**

6    A.    Synapse Energy Economics is a research and consulting firm specializing in  
7        electricity and gas industry regulation, planning and analysis. Our work covers a  
8        range of issues including integrated resource planning; economic and technical  
9        assessments of energy resources; electricity market modeling and assessment;  
10       energy efficiency policies and programs; renewable resource technologies and  
11       policies; and climate change strategies. Synapse works for a variety of clients,  
12       with an emphasis on consumer advocates, regulatory commissions, and  
13       environmental advocates.

14   **Q.    Please summarize your professional and educational experience.**

15   A.    Before joining Synapse Energy Economics, I was a commissioner at the  
16        Massachusetts Department of Public Utilities (DPU). In that capacity I was  
17        responsible for overseeing a significant expansion of clean energy policies,  
18        including an aggressive increase in ratepayer-funded energy efficiency programs;  
19        the implementation of decoupled rates for electric and gas companies; an update  
20        of the DPU energy efficiency guidelines; the promulgation of net metering  
21        regulations; review of smart grid pilot programs; and review of long-term  
22        contracts for renewable power.

23        Prior to being a commissioner at the Massachusetts DPU, I was employed as the  
24        Vice President at Synapse Energy Economics; a Manager at Tellus Institute; the  
25        Research Director of the Association for the Conservation of Energy; a Staff  
26        Economist at the Massachusetts Department of Public Utilities; and a Policy  
27        Analyst at the Massachusetts Executive Office of Energy Resources.

1 I hold a Masters in Business Administration from Boston University, a Diploma  
2 in Economics from the London School of Economics, a BS in Mechanical  
3 Engineering and a BA in English from Tufts University.

4 **Q. Please describe your professional experience as it relates to energy efficiency**  
5 **policies and programs.**

6 A. Energy efficiency policies and programs have been at the core of my professional  
7 career. While at the Massachusetts DPU I played a leading role in updating the  
8 Department's energy efficiency guidelines, in reviewing and approving the recent  
9 three-year energy efficiency plans, in reviewing and approving energy efficiency  
10 annual reports, in leading a working group on rate and bill impacts, and  
11 advocating for allowing energy efficiency to participate in the New England  
12 wholesale electricity market. I served as a co-chair of the Working Group on  
13 Utility Motivation as part of the State Energy Efficiency Action Network  
14 sponsored by the US Department of Energy and the US Environmental Protection  
15 Agency.

16 As a consultant I have reviewed and critiqued utility energy efficiency policies  
17 and programs throughout the US, and I have testified on these issues in British  
18 Columbia, Colorado, Delaware, Massachusetts, Minnesota, Nevada, Nova Scotia,  
19 Québec, and Rhode Island. My work has encompassed all aspects of energy  
20 efficiency program design and implementation, including efficiency measure  
21 assessment, program delivery options, program budgeting, cost-benefit analyses,  
22 avoided costs, utility performance incentives and other relevant regulatory  
23 policies. I have represented clients on several energy efficiency collaboratives,  
24 where policies and programs were discussed among a variety of stakeholders.  
25 Additional information is provided in my resume, attached to this testimony.

26 **Q. On whose behalf are you testifying in this case?**

27 A. I am testifying on behalf of the Office of Public Counsel (OPC).

28 **Q. Is the Office of the Public Counsel sponsoring other witnesses in this docket?**

29 A. Yes, my colleague at Synapse Energy Economics, Dr. Vitolo, is sponsoring  
30 testimony on behalf of the OPC. In addition, Ryan Kind is sponsoring testimony

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1 on behalf of the OPC. Mr. Kind, Dr. Vitolo and I have collaborated closely in  
2 preparing our testimonies.

3 **Q. What is the purpose of your testimony?**

4 A. On June 23, 2011 the OPC filed a *Review of Union Electric Company's Electric*  
5 *Resource Planning Compliance Filing*, Case No. EO-2011-0271 (OPC Review).  
6 That review identified several significant deficiencies with the Union Electric (UE  
7 or the Company) Integrated Resource Plan (IRP), and recommended that the  
8 Company correct for these deficiencies and conduct its analysis again to select a  
9 more appropriate Preferred Resource Plan and Resource Acquisition Strategy.  
10 That OPC review was accompanied by a technical report entitled, *Review of the*  
11 *Union Electric Company Integrated Resource Plan* (OPC Technical Report),  
12 authored by Mr. Kind, Dr. Vitolo and myself. On August 22, 2011 UE filed a  
13 *Response to Comments of Parties* (Response), including responses to the issues  
14 raised by the OPC.

15 The purpose of my testimony is to rebut the UE Response. In my testimony I  
16 focus on those topics that I was primarily responsible for addressing in the OPC  
17 Technical Report, including: analysis of demand-side resources, analysis of  
18 existing coal facilities, assumptions regarding new nuclear generation options,  
19 and assumptions regarding new wind resources.

20 **Q. How is your testimony organized?**

21 A. My testimony is organized as follows:  
22 1. Introduction and Qualifications.  
23 2. Summary of Conclusions and Recommendations.  
24 3. Analysis of Demand-Side Resources.  
25 4. Analysis of Existing Coal Facilities.  
26 5. Assumptions Regarding New Nuclear Facilities.  
27 6. Assumptions Regarding New Wind Resources.

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1    **2.    SUMMARY OF CONCLUSIONS**

2    **Q.    Please summarize your primary conclusions.**

3    A.    In sum, I find that the UE Response does not sufficiently address the deficiencies  
4           identified in the OPC Review and the OPC Technical Report. I confirm the  
5           OPC's original finding that the UE IRP is fundamentally flawed, does not meet  
6           the requirements of the MO IRP rule (4 CSR 240-22), and does not provide the  
7           Company or the Commission with sufficient analysis and information to identify  
8           an appropriate Preferred Resource Plan or a reasonable Resource Acquisition  
9           Strategy.

10          In particular:

- 11           • The UE Response does not provide sufficient justification for its approach to  
12           modeling demand-side resources, where it essentially limits the analysis to the  
13           Low-Risk DSM scenario on the grounds that this is the only scenario  
14           consistent with its financial objectives.
- 15           • The UE response does not provide sufficient justification for its assertion that  
16           it has analyzed a broad range of demand-side management portfolios.
- 17           • The UE response does not provide sufficient justification for how it modeled  
18           the future costs of operating its existing coal facilities in light of new EPA  
19           environmental regulations.
- 20           • The UE response does not provide sufficient justification for its overly  
21           optimistic assumptions regarding the construction costs of new nuclear  
22           generation facilities.
- 23           • The UE response does not provide sufficient justification for its methodology  
24           and assumptions for modeling new wind resources.

25   **Q.    Please summarize you primary recommendations.**

26   A.    I recommend that the Commission find that the UE IRP does not comply with the  
27          MO IRP rule. In addition, I recommend that the Commission find that the UE  
28          IRP contains so many significant flaws that it cannot be relied upon by the

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1 Company for short-term or long-term resource planning purposes, nor can it be  
2 relied upon by the Commission for regulatory review of resource plans.

3 I recommend that the Commission require the Company to conduct its IRP  
4 analysis again with the following significant modifications:

- 5 • The Company should properly analyze a wide range of DSM portfolios for the  
6 purpose of identifying the Preferred Resource Plan, including a complete  
7 assessment of the so-called Maximum Achievable Potential (MAP) scenario,  
8 as well as a scenario with savings in between the Reasonably Achievable  
9 Potential (RAP) portfolio and the MAP portfolio.
- 10 • The Company should design future environmental scenarios that properly  
11 reflect the expected level of EPA regulations affecting its coal-fired plants.  
12 The Company should also expand its analysis to properly consider the  
13 economics of retiring existing coal plants in light of those more realistic  
14 scenarios.
- 15 • The Company should adopt more reasonable estimates of new nuclear plant  
16 construction costs. The Company should also adopt more realistic  
17 assumptions regarding the probability of nuclear plant construction cost over-  
18 runs.
- 19 • The Company should model wind resources in a way that better reflects how  
20 such resources might be developed on the UE system, including modeling the  
21 wind resources in smaller blocks, and modeling the wind resources without  
22 including associated peaking resources.

23 **3. ANALYSIS OF DEMAND-SIDE RESOURCES**

24 **Q. Please summarize the OPC's concerns about the Company's analysis of**  
25 **demand-side resources.**

26 **A.** In the OPC Review and the OPC Technical Report, we find that UE failed to  
27 develop alternative resource plans that capture the full range of demand-side  
28 resources. We note that the final candidate resource plans in the IRP include only  
29 two levels of demand-side resources: the Low-Risk Portfolio and the Reasonably



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1 Achievable Portfolio (RAP). The former includes less energy efficiency savings  
2 than in the Company's 2008 IRP, and the latter significantly understates the  
3 amount of energy efficiency that is reasonably achievable. The Company's  
4 methodology essentially precludes the selection of all demand-side resource  
5 portfolios except for the Low-Risk Portfolio, by placing too much emphasis on  
6 the financial rewards to the Company and too little emphasis on minimizing the  
7 Present Value of Revenue Requirement (PVRP). (OPC Review, pages 4-5 and  
8 OPC Technical Report, pages 10-13.)

9 **Q. Please summarize the Company's response to OPC's concerns.**

10 A. The Company argues that it has evaluated a broad range of DSM portfolios and  
11 that it has evaluated DSM resources on an equivalent basis with supply-side  
12 resources. UE points to its analysis of five DSM resource portfolios as evidence  
13 that it has evaluated a "broad range" of DSM options. (UE Response, pages 29-  
14 30.)

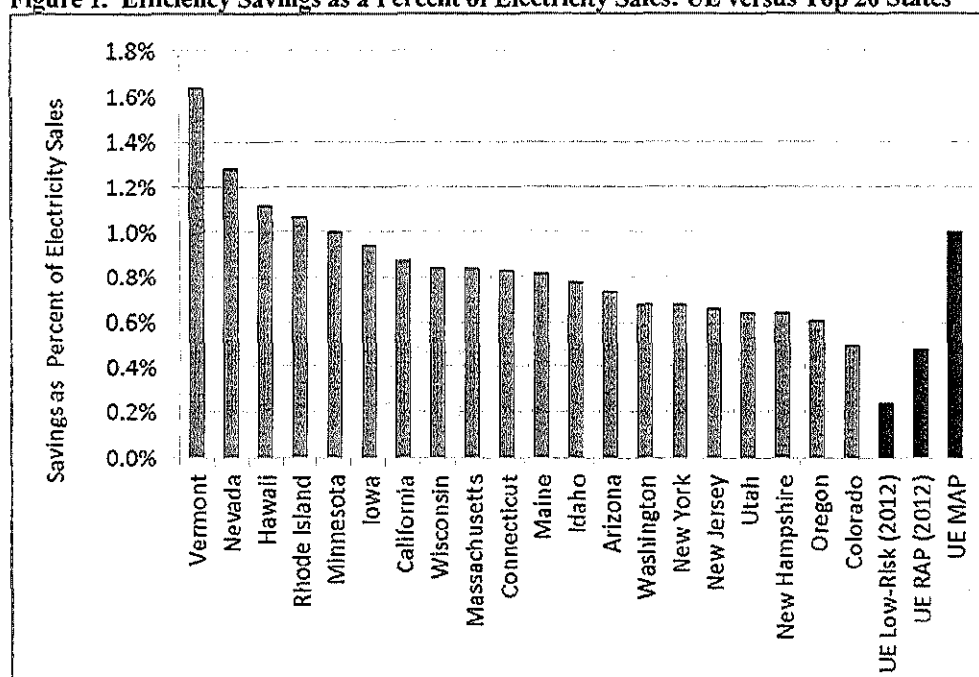
15 **Q. Do you agree with the Company's response on these issues?**

16 A. No, I do not agree. While it is true that the IRP analysis began with five DSM  
17 resource portfolios with varying levels of demand-side resources, the Company  
18 did not apply a *meaningful* analysis to these different portfolios. The Company's  
19 methodology did not properly account for the benefits offered by the different  
20 DSM resource portfolios, and the Company's decision-making process was so  
21 limited that it could only lead to one outcome: the selection of the Low-Risk  
22 Portfolio.

23 First, the Company uses relatively conservative assumptions to develop the RAP  
24 and Maximum Achievable Potential (MAP) scenarios. The RAP savings are  
25 limited by the Company's assumptions regarding customer incentives and  
26 customer awareness rates. (OPC Technical Report, pages 11 and 12.) The MAP  
27 savings are described as essentially the upper limit on what the Company could  
28 possibly save through energy efficiency programs. This portfolio assumes that  
29 the Company is able to achieve incrementally roughly one percent of annual

energy savings each year after 2015.<sup>1</sup> However, by 2009 five states have already achieved efficiency savings equal to roughly one percent of annual sales per year, and another 15 states have achieved efficiency savings of between 0.5 and 1.0 percent of annual energy savings per year. This is indicated in Figure 1 below. The experience of other states suggests that the MAP scenario is not the maximum that could potentially be achieved by the Company. It also suggests that there is a lot more energy efficiency that could be reasonably achieved by the Company beyond the amounts included in the RAP resource plan.

Figure 1. Efficiency Savings as a Percent of Electricity Sales: UE versus Top 20 States<sup>2</sup>



Second, the Company significantly downplays the economic benefits of the demand-side resources. As described in the testimonies of my colleagues Dr. Vitolo and Mr. Kind, the Company does not give sufficient weight to minimizing PVRR in its resource plan selection process. Reducing costs and minimizing PVRR is one of DSM's greatest advantages. The Company's own analysis indicates that the RAP scenario can reduce PVRR by roughly \$1.5 to \$2.5 billion

<sup>1</sup> Union Electric, 2011 Integrated Resource Plan, Chapter 7, page 2.

<sup>2</sup> Information for the other states is from: American Council for and Energy-Efficient Economy, *The 2011 State Energy Efficiency Scorecard*, October 2011.

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1 present value dollars relative to the Low-Risk DSM scenario. (OPC Technical  
2 Report, pages 26-27 and UE IRP Chapter 9, page 24, Figures 9.16 – 9.18.) The  
3 Company’s analysis clearly indicates that the RAP scenario significantly reduces  
4 PVRR relative to the Low-Risk scenario, under all future scenarios and relative to  
5 all alternative resource plans. (OPC Technical Report, pages 26-27 and UE IRP  
6 Chapter 9, page 24, Figures 9.16 – 9.18.)

7 Third, the Company has made it abundantly clear in its IRP and in its response to  
8 comments that that it is unwilling to implement energy efficiency resources that  
9 create financial risk to the Company as a result of lost revenues. (For example,  
10 UE Response, pages 12-15) Throughout its IRP the Company finds that the RAP  
11 scenario offers significant benefits relative to the Low-Risk DSM Portfolio, and  
12 yet in choosing its Preferred Resource Plan the Company is clear that RAP is  
13 “less attractive given the constraints of current state policies and regulations” (UE  
14 IRP, Chapter 10, page 14.) The Company’s description indicates that it is  
15 unwilling to implement any energy efficiency that is more aggressive than the  
16 Low-Risk DSM Portfolio, regardless of the key results of its IRP analysis. This is  
17 clearly not a *meaningful* analysis of a wide range of demand-side resources.<sup>3</sup>

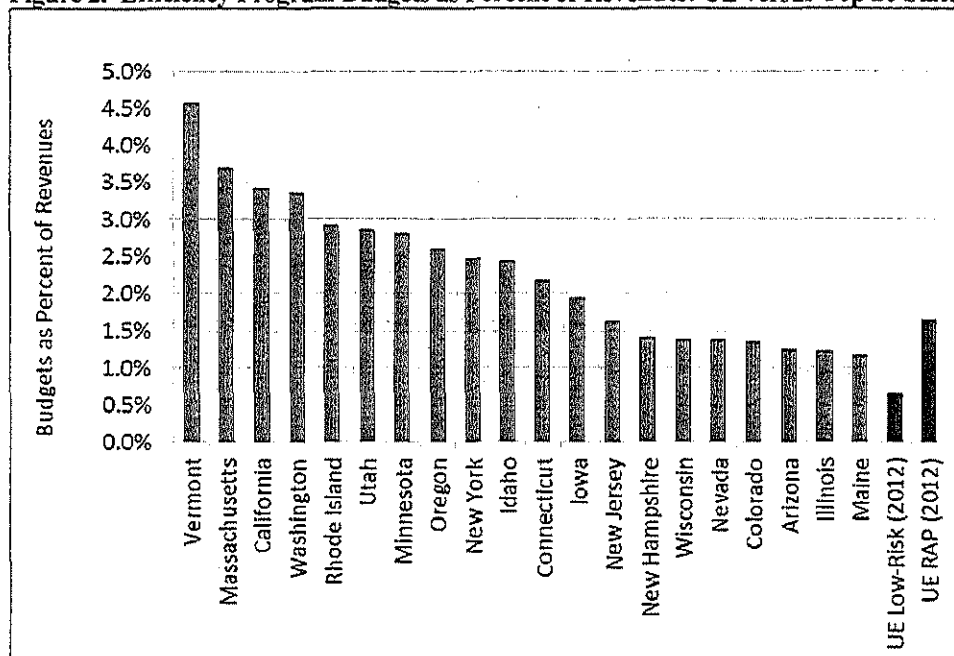
18 Fourth, the Company eliminates the MAP scenario too early in the IRP analysis.  
19 The Company explains that it was “unnecessary to continue to analyze both plans  
20 since the analysis was clear that both were performing similarly and both were  
21 lower cost than supply-side options.” (UE Response, page 13.) However, as  
22 indicated in Figure 1 above, both plans do not perform similarly – the MAP  
23 scenario has considerably more efficiency savings. Also, while it is true that both  
24 scenarios reduce PVRR relative to supply-side options, the Company’s own DSM  
25 potential study that found that the MAP scenario could reduce costs by \$500  
26 million, relative to the RAP scenario. (UE DSM Market Potential Study, Volume  
27 1: Executive Summary, page ES-8.) This is a significant amount of potential  
28 electricity cost savings that is quickly dismissed by the Company as if it were

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<sup>3</sup> In addition, my colleague Mr. Kind addresses how inappropriate this approach is, in light of the IRP rule requirements and the DSM cost recovery framework currently available.

irrelevant. The Company's approach unnecessarily and dramatically limits the full range of cost-effective energy efficiency resources, and cannot be described as a *meaningful* analysis.

**Figure 2. Efficiency Program Budgets as Percent of Revenues: UE versus Top 20 States<sup>4</sup>**



It is instructive to compare the Company's proposed Low-Risk DSM budgets to the energy efficiency budgets that are currently being implemented by other electric utilities in the US. Figure 2 presents the 2010 annual electric energy efficiency budgets for the top 20 states, as a percentage of 2010 annual electric revenues. For comparison purposes it also presents the UE 2012 budgets for the Low-Risk and RAP scenarios, also as a percent of 2010 annual electric revenues. As indicated in the figure, the Low-Risk budgets are well below many of those of other states, and the RAP budget is also well below the budgets of some states as well.

<sup>4</sup> The information for the other states is from: American Council for and Energy-Efficient Economy, *The 2011 State Energy Efficiency Scorecard*, October 2011.

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1 **Q. Are you presenting the data in figures 1 and 2 to imply that Ue should be one**  
2 **of the top states in the us with regard to energy efficiency implementation?**

3 A. Not necessarily. I present the information on other states' efficiency activities to  
4 put the Company's planning assumptions in context. As indicated in Figure 1, the  
5 MAP scenario does not necessarily represent the upper bound of the efficiency  
6 savings that are achievable during the course of the UE IRP study period, given  
7 that many utilities have already achieved this level of savings, in 2009. Similarly,  
8 the data in Figures 1 and 2 demonstrate that in its analysis to select the Preferred  
9 Resource Plan, the Company did not assess a broad range of DSM portfolios, as it  
10 claims to have done.

11 **4. ANALYSIS OF EXISTING COAL FACILITIES**

12 **Q. Please summarize the OPC's concerns about the Company's analysis of**  
13 **existing coal facilities.**

14 A. In the OPC Review and the OPC Technical Report, we find that UE failed to  
15 properly assess how future environmental scenarios for new EPA regulations  
16 affecting existing coal plants will influence the candidate resource plans. In  
17 particular, the Company did not properly account for increased environmental  
18 regulations as a critical uncertain factor. The Company creates resource plans  
19 according to two sets of environmental scenarios – the moderate scenario and the  
20 aggressive scenario. However, the Company's methodology for scoring and  
21 ranking the moderate and aggressive environmental scenarios contains a  
22 fundamental flaw in that it compares costs and benefits of plans across the two  
23 different scenarios, even though the costs of the aggressive environmental  
24 scenario will be higher *by definition*. (OPC Technical Report, pages 15-16.)

25 Furthermore, the Company did not investigate the economics of retirement versus  
26 continued operation of its other three coal fired power plants: Labadie, Rush  
27 Island, and Sioux. Given the potentially significant increase in costs of these  
28 plants associated with complying with anticipated environmental regulations, as  
29 acknowledged by the Company, this represents a significant omission in the  
30 Company's IRP. (OPC Technical Report, pages 6-7.)

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1    **Q.    Please summarize the Company's response to OPC's concerns.**

2    A.    The Company claims that its approach to modeling environmental regulations  
3           using the moderate scenario and the aggressive scenario is appropriate, and that it  
4           would not be appropriate to use the probability tree approach. UE argues that  
5           consideration of different environmental regulation scenarios would "involve  
6           decisions that potentially alter the existing resource mix and thus the future need  
7           for resources within alternative resource plans." The Company claims their  
8           approach to modeling a moderate and an aggressive environmental regulations  
9           scenario is equivalent to including these two scenarios in its probability tree. (UE  
10          Response, pages 55-56.)

11          The Company does not respond to the OPC's finding that the Company's  
12          methodology for scoring and ranking resource plans across the two different  
13          environmental regulations scenarios is fundamentally flawed by definition.

14          The Company claims that it is not appropriate to evaluate the retirement of the  
15          Labadie, Rush Island and Sioux plants at this time. UE claims that the Meramec  
16          plant is the most obvious candidate for retirement, and that its IRP analyses do not  
17          provide a definitive indication of the economics of retiring Meramec. The  
18          Company concludes that "it is prudent to continue to analyze the Meramec  
19          decision and to only evaluate the other coal plants as a result of changed  
20          circumstances in the Meramec analysis." (UE Response, page 41-42.)

21   **Q.    Do you agree with the Company's response regarding its approach to**  
22   **modeling the moderate and aggressive environmental scenarios?**

23   A.    No, I do not. First and foremost the Company does not provide a response to our  
24          finding that the scorecard methodology for selecting the Preferred Resource Plan  
25          contains a fundamental flaw by definition. The Company uses the scorecard to  
26          compare 14 different resource plans, five of which are based in the moderate  
27          environmental scenario and nine of which are based on the aggressive  
28          environmental scenario. The moderate and the aggressive environmental  
29          scenarios are mutually exclusive and based on two significantly different futures.  
30          The nine resource plans under the aggressive environmental scenario will most  
31          likely require higher costs than the five resource plans under the moderate

1 environmental scenario, leading to higher PVRR results. The Company then uses  
2 a scoring system, including PVRR as one of the scoring criteria, to compare and  
3 rank all the different resource plans. The Company assigns each resource plan a  
4 score ranging from one to five, based on how it compares with all of the other  
5 resource plans.<sup>5</sup>

6 The problem with this approach is that skews the ranking in favor of the resource  
7 plans under the moderate environmental scenarios. These resource plans are  
8 likely to have lower PVRRs by definition because they will have lower  
9 environmental compliance costs. It is not appropriate to score and rank resource  
10 plans that are based on mutually exclusive and significantly different futures in  
11 this way, because the resource plans are not comparable by definition. (OPC  
12 Technical Report, pages 15-16.) The Company has provided no response to our  
13 findings on this critical point, and no explanation for why its methodology is not  
14 flawed.

15 **Q. Is the Company's approach to modeling the moderate and aggressive**  
16 **environmental scenarios consistent with the IRP rule?**

17 **A.** No, it is not. First, the IRP rule is clear in the opening section that utilities shall  
18 consider risks associated with "critical uncertain factors that will affect the actual  
19 costs associated with alternative resource plans." (4 CSR 240-22.010(2)(C).1.)  
20 Among all the potential critical uncertain factors that utilities could consider, the  
21 IRP rule lists one in particular that must be considered: "[r]isks associated with  
22 new or more stringent environmental laws or regulations that may be imposed at  
23 some point within the planning horizon." (4 CSR 240-22.010(2)(C).2.) The  
24 Company developed a list of 22 uncertain factors that might be critical to resource  
25 performance, but none of them included the EPA environmental regulations that  
26 the Company considers through its moderate and aggressive environmental  
27 scenarios. (UE IRP, Chapter 9, page 13, Table 9.6.) The Company did include  
28 carbon policy as an uncertain factor, and decided that carbon policy should be

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<sup>5</sup> Note that there are additional flaws with the Company's scorecard methodology for selecting the preferred resource plan, as described in the testimony of my colleague Dr. Vitolo.

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1 modeled in the decision tree analysis as one of the few critical uncertain factors.  
2 (UE IRP, Chapter 2, pages 2-3.) The Company should have considered the EPA  
3 environmental regulations in a similar fashion.

4 **Q. Is there another reason why the Company's approach to modeling the**  
5 **moderate and aggressive environmental scenarios is not consistent with the**  
6 **IRP rule?**

7 A. Yes. The IRP rule is also clear that the utility shall "explicitly state and document  
8 the subjective probabilities that utility decision-makers assign to each of these  
9 uncertain factors." (4 CSR 240-22.070(1).) By modeling the moderate and  
10 aggressive environmental scenarios as they have, the Company has essentially  
11 acknowledged that the EPA environmental regulations are a critical uncertain  
12 factor, but they have declined to state and document the subjective probabilities  
13 associated with this uncertain factor, as they would have to do if they included  
14 this uncertain factor in their probability tree approach. As a result, the IRP does  
15 not provide an indication of the subjective probability that the Company might  
16 assign to this uncertain factor, and readers of the IRP cannot gauge the extent to  
17 which this issue is likely to affect the resource plans or their costs.

18 **Q. Is there a better option available for modeling the moderate and aggressive**  
19 **environmental scenarios?**

20 A. Yes. The Company should have included these two scenarios as branches in the  
21 probability tree analysis. Given the likely magnitude of the impact of anticipated  
22 future environmental regulations on the Company's coal plants, this should  
23 clearly have been considered by the Company as a critical uncertain factor to  
24 model in its probability tree analysis.

25 **Q. But the Company claims in its Response that it would not be appropriate to**  
26 **model these two scenarios in its probability tree analysis because the two**  
27 **scenarios would require different mitigation options and different resource**  
28 **plans. (UE Response, pages 55-56.) Do you agree?**

29 A. I do agree that the Company should create different resource plans that are  
30 expected to perform well under the moderate and aggressive environmental  
31 scenarios. Resource plans should always be designed to meet the particular  
32 constraints and definitions of the relevant scenario.



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1        However, I disagree that probability tree analysis cannot be used for this purpose.  
2        In fact, probability tree analyses are designed to address a variety of different  
3        resource plans. Every branch of the probability tree may need to have its own  
4        unique resource plan in order to best meet the particular constraints or  
5        assumptions associated with that branch. Probability tree analysis would be  
6        meaningless if it were applied to a single resource plan for every branch, which is  
7        what is implied by the Company's response.

8        Furthermore, the branches of the probability tree should be designed so that they  
9        are mutually exclusive. This is important because the combined probabilities of  
10       all the branches must add up to 100 percent by definition. The moderate and  
11       aggressive environmental scenarios are mutually exclusive, and therefore are  
12       well-suited for probability tree analysis.

13    **Q.    Do you agree with the Company's response regarding the need to analyze the**  
14    **economics of retiring the Labadie, Rush Island or Sioux power plants?**

15    **A.**    No. I do not agree with the Company's argument that it is not appropriate to  
16       analyze these other coal plants in light of the IRP not reaching a definitive result  
17       on the retirement of Meramec. First, the OPC has identified several significant  
18       deficiencies with the IRP that make it difficult to rely upon the results with regard  
19       to Meramec retirement. These deficiencies include the following:

- 20       • The Company has not properly modeled the implications of the moderate and  
21       aggressive environmental scenarios, as described above in this section.
- 22       • The Company has not properly modeled the potential for energy efficiency  
23       and demand response, which represent an alternative to the Meramec plant,  
24       as described above in Section 3.
- 25       • The Company has not properly modeled the potential for wind resources,  
26       which represent an alternative to Meramec plant, as described in Section 6.
- 27       • The Company has not used PVRR as the primary criterion for scoring its  
28       alternative resource plans, as described in the testimony of Mr. Kind.

- 
- 1       • The Company has not applied its scorecard properly in selecting among its  
2       alternative resource plans, as described in the testimony of Dr. Vitolo.

3       With so many significant deficiencies in the IRP, it cannot be used to justify the  
4       lack of analysis of retiring the Company's coal plants. A properly performed IRP  
5       might indicate that it would be economic to retire the Meramec plant, and might  
6       indicate that it would also be economic to retire an additional coal plant.

7   **Q.   Is there another reason why you do not agree with the Company's response**  
8   **regarding the need to analyze the economics of retiring the Labadie, Rush**  
9   **Island or Sioux power plants?**

10  **A.**   Yes. EPA environmental regulations are expected to impose substantial  
11       requirements on many coal-fired power plants, leading to significantly increased  
12       capital, operation and maintenance costs. The Company has acknowledged the  
13       potential costs associated with compliance with environmental regulations, in its  
14       annual report to the Security and Exchange Commission, and in the Generation  
15       Initiative established by Ameren, UE's parent company. (OPC Technical Report,  
16       pages 6 and 7.) The lack of analysis of the economics of retiring additional coal  
17       units in light of these expected environmental requirements and costs represents a  
18       glaring omission in the Company's IRP analysis. While it may be true that  
19       Meramec is the most likely candidate for retirement, the Company has not  
20       performed the analysis to assess the economics of retiring any of the other coal  
21       plants.

22  **5.   ASSUMPTIONS REGARDING NEW NUCLEAR FACILITIES**

23  **Q.   Please summarize the OPC's concerns about the Company's assumptions**  
24  **regarding new nuclear facilities.**

25  **A.**   In the OPC Review and the OPC Technical Report, we find that UE failed to  
26       properly identify the full range of likely construction costs for its new nuclear  
27       units, and has not adequately addressed the tremendous financial and economic  
28       risks associated with new nuclear units. (OPC Review, page 6 and OPC  
29       Technical Report, pages 4-6.)

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1    **Q.     Please summarize the Company's response to OPC's concerns.**

2    A.     The Company argues that its assumptions for nuclear resources are reasonable,  
3           and that it has performed the appropriate sensitivity analyses. In particular, the  
4           Company notes that its low, base and high assumptions on capital costs are  
5           roughly equivalent to the assumptions in the 2011 US Department of Energy  
6           Annual Energy Outlook, as well as three nuclear plants being constructed in other  
7           countries (Olkiluoto in Finland, Flamanville 3 in France, and Taishan 1 in China).  
8           (UE Response, page 73.)

9    **Q.     Do you agree with the Company's response with regard to its assumptions**  
10          **regarding nuclear plant construction costs?**

11   A.     No, I do not agree. While the Company has cited some evidence of nuclear cost  
12          estimates that are close to its estimates, it does not account for a great deal of  
13          evidence suggesting that (a) its costs are too low, and (b) there is a very  
14          significant risk of nuclear construction cost estimates increasing over time.

15          First, it is widely recognized that the US nuclear industry has a history of  
16          significant construction cost overruns. A report prepared by Synapse Energy  
17          Economics calculated that for all of the nuclear plants installed in the US, with  
18          construction starting in the years 1966 through 1977, the average construction  
19          cost overrun was 207 percent.<sup>6</sup> In other words, the final costs turned out to be  
20          more than three times the original estimate.

21          Another report presents the range of cost estimates that has been used for new  
22          nuclear power projects, which could be part of what the authors describe as the  
23          "nuclear renaissance."<sup>7</sup> Some of the early (2001-2005) vendors, government and  
24          academic construction cost estimates have been quite low, on the order of \$1,500  
25          to \$2,500/kW. More recently (2007-2009), the utility construction cost estimates  
26          have been in the range of \$3,000 to \$5,500/kW, roughly in line with UE's  
27          estimates. However, Wall Street analysts and independent analysts have recently

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<sup>6</sup> Synapse Energy Economics, *Nuclear Plant Construction Costs*, July 2008. [www.synapse-energy.com](http://www.synapse-energy.com).

<sup>7</sup> Mark Cooper, *The Economics of Nuclear Reactors: Renaissance or Relapse?*, June 2009. See in particular page 3, Figure ES-1.

presented estimates of nuclear plant construction costs of \$5,000 to \$10,000/kW, significantly higher than UE's high nuclear cost estimate.

Furthermore, there is information from new nuclear plants proposed in the US that should be considered in evaluating nuclear plant costs and risks. A recent report from Synapse Energy Economics evaluates the cost estimates associated with new power plants that are currently being planned by utilities in the US.<sup>8</sup> The experience of Progress Energy Florida in planning their Levy 1 and 2 nuclear units is instructive here. In 2006 Progress Energy proposed to build one 1,100 MW unit for a cost of \$2.5 to \$3.5 billion.<sup>9</sup> In 2008 the project was expanded to include two 1,100 MW units, for a total cost of approximately \$17 billion. In 2010, Progress Energy announced another increase in the expected cost of the project, to \$22.5 billion. As indicated in Table 1 below, the current estimate from Progress Energy represents a 221 percent (i.e., more than three-fold) increase over its initial high case estimate, in \$/kW terms. Levy 1 is scheduled to be completed in 2021, and Levy 2 is scheduled to be completed in 2023. It is quite possible that the final construction costs turn out to be even higher than the current estimates.

**Table 1. Construction Cost Estimates at the Proposed Levy 1 and 2 Nuclear Units<sup>10</sup>**

Year of Estimate	Capacity (MW)	Cost (bil.\$)	Cost (\$/kW)	Increase Relative to 2006 - High
2006 - Low	1,100	2.5	\$2,273	---
2006 - High	1,100	3.5	\$3,182	---
2008	2,200	17.0	\$7,727	143%
2010	2,200	22.5	\$10,227	221%

<sup>8</sup> Synapse Energy Economics, *Big Risks, Better Alternatives: An Examination of Two Nuclear Projects in the US*, October 6, 2011. [www.synapse-energy.com](http://www.synapse-energy.com).

<sup>9</sup> Note that the costs presented here for the Levy units include "all-in" construction costs. The other costs presented in this discussion include "overnight" construction costs, and thus cannot be directly compared. The main point here with regard to the Levy experience is in the *increase* in construction cost estimates over time.

<sup>10</sup> Synapse Energy Economics, *Big Risks, Better Alternatives: An Examination of Two Nuclear Projects in the US*, October 6, 2011, pages 9-11.

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1 In determining its base case construction cost estimate for new nuclear units, the  
2 Company should acknowledge the history of nuclear construction costs in the US,  
3 and adjust its base case estimate accordingly.

4 **Q. Has the OPC raised other concerns regarding the Company's analysis of new**  
5 **nuclear units?**

6 A. Yes, the OPC found that the Company has not adequately recognized the potential  
7 for cost overruns in its sensitivity analyses (OPC Technical Report, pages 4-5).

8 **Q. What was the Company's response to these concerns?**

9 A. The Company did not respond to these concerns raised by OPC. However, the  
10 Company did respond to essentially the same concerns raised by the Natural  
11 Resources Defense Council (NRDC). The Company claims that its approach to  
12 developing the uncertain range of nuclear costs estimates, as described in  
13 Chapter 9, is appropriate. (Company Response, page 74.)

14 **Q. Do you agree with the Company's response?**

15 A. No, I do not agree. The Company has assumed low, base and high values of  
16 nuclear construction costs of \$3,563/kW, \$4,222/kW, and \$5,000/kW. (Company  
17 Response, page 73.) The high value is roughly 18 percent higher than the base  
18 value. This is a remarkably narrow range, especially given that US nuclear power  
19 plant construction costs have historically been over 200 percent higher than the  
20 original budget on average, as described above.

21 In addition, the Company apparently used a standardized methodology for  
22 determining the probability of occurrence of low and high values for uncertain  
23 factors. In particular, the Company standardized the meaning of low to be the  
24 value at the 10th percentile of a probability distribution, the meaning of the base  
25 value to be the value at the 50<sup>th</sup> percentile, and the meaning of the high value to  
26 be the value at the 90<sup>th</sup> percentile. (UE IRP, Chapter 9, page 15.) In the case of  
27 nuclear construction costs, these assumptions combined means that UE assumes  
28 that there is only a ten percent chance that the new nuclear facility will be  
29 18 percent or more over the current budget. This range is clearly not

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1 representative of the types of cost over-runs that can occur when constructing new  
2 nuclear power plants.

3 Furthermore, the probability distribution used by the Company implies that a  
4 nuclear plant construction cost over-run of 50 percent would occur at the 99.9<sup>th</sup>  
5 probability percentile. (Company response to OPC Data Request, OPC 2052.) In  
6 other words, under the Company's probability distribution, there is less than a 0.1  
7 percent chance that the project would over-run its original budget by 50 percent or  
8 more. Again, this is a remarkably narrow range of potential cost over-runs given  
9 the history of nuclear plant construction costs. The final cost of a new nuclear  
10 unit for UE could easily be 100 percent higher than this original estimate, but the  
11 probability distribution used by the Company essentially does not include this  
12 possibility.

13 **6. ASSMPTIONS REGARDING NEW WIND RESOURCES**

14 **Q. Please summarize the OPC's concerns about the Company's assumptions**  
15 **regarding new wind resources.**

16 **A.** In the OPC Review and the OPC Technical Report, we conclude that UE failed to  
17 properly characterize and model renewable resources, particularly wind resources.  
18 First, UE overstates the cost of new wind resources by combining 346 MW of  
19 simple cycle combustion gas turbines (CTs) with every 800 MW (nameplate  
20 capacity) of wind facilities. Second, UE applies 205 MW (accredited capacity) of  
21 "build thresholds" to wind resources, which ignores the potential benefits of  
22 adding smaller wind resources to the system. Third, UE uses average capital cost  
23 and capacity factor assumptions for all of its wind resources, which ignores the  
24 potential for some resources to have lower costs or better capacity factors. (OPC  
25 Technical Report, pages 8-9.)

26 **Q. Please summarize the Company's response to OPC's concerns.**

27 **A.** UE claims that it is appropriate to include 346 MW of peaking capacity with  
28 every 800 MW of wind capacity, on the grounds that wind resources currently  
29 receive a capacity credit of eight percent of the installed nameplate capacity and  
30 that each 800 MW of nameplate wind capacity is equal to 64 MW of accredited

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1 wind capacity that can be available to meet reserve margin requirements. The 64  
2 MW of wind resources is combined with the 346 MW of peaking capacity to  
3 provide total accredited capacity of 410 MW to meet reliability needs. (UE  
4 Response, pages 62-63.)

5 In addition, UE claims that its approach to using build thresholds is appropriate,  
6 that "there is no evidence that modeling wind in large amounts biases the results  
7 against wind," and the IRP would be largely the same if wind resources are  
8 modeled in large amounts or if they are spread out over a period of time. (UE  
9 Response, page 61.)

10 Finally, UE claims that its approach to modeling average wind construction costs  
11 and capacity factors is consistent with the IRP rule 22.040(1), which requires that  
12 it model generic wind resources. (UE Response, pages 60-61.)

13 **Q. Do you agree with the Company's response with regard to combining wind**  
14 **resources with peaking capacity?**

15 **A.** No. I do not agree. It is not appropriate to combine every MW of wind capacity  
16 with peaking capacity. The Company's methodology is based on two premises:  
17 (1) that it is only appropriate to add wind resources to the system when there is a  
18 capacity need, and (2) that resources must be added to the system in such a way  
19 that results in little or no excess UE capacity and little or no shortfall of UE  
20 capacity. Both of these premises are flawed, as indicated by the Company's own  
21 IRP analysis.

22 The first premise implies that capacity is the only benefit that wind resources  
23 provide to UE and its customers, and that it is not appropriate to add wind  
24 resources unless there is a capacity need. Of course, all resource plans must have  
25 sufficient capacity to meet reliability requirements. However, capacity need is  
26 not the only reason that resources are added to the Company's system. Wind  
27 resources offer significant benefits in terms of reducing energy costs. It may be  
28 possible to reduce PVRr by adding wind resources to the system in years when  
29 capacity is not needed for reliability purposes. This is comparable to adding  
30 energy efficiency to a resource mix even though there may not be an immediate

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1 capacity need – the energy benefits of the resource are sufficient to reduce net  
2 costs.<sup>11</sup> Furthermore, as indicated by the Company’s scorecard used to select the  
3 Preferred Resource Plan, minimizing PVRR is not the only criterion that is used  
4 to evaluate resource plans. It is quite possible that adding wind resources to the  
5 system in the absence of a capacity need would lead to benefits with regard to the  
6 other scoring criteria, especially the environmental/diversity criteria.

7 The second premise underlying the Company’s methodology is that resources  
8 must be added to the system in a way that results in little or no excess UE  
9 capacity and little or no shortfall of UE capacity. However, this is not how the  
10 Company has developed its resource plans in the IRP. Instead, UE relies upon  
11 capacity purchases and sales to make up for any shortfall or excess capacity in  
12 any one year. This is made clear in the UE IRP in Chapter 9, Appendix A, Table  
13 9.A.1. Note that for every resource plan the Company uses capacity purchases  
14 and sales to make up for any shortfall or excess of capacity. This is indicated in  
15 the last line of the table for each resource plan. In some cases, the capacity sales  
16 are as much as 400, 500 and even 600 MW. In some cases, the capacity  
17 purchases are as much as 200 or 300 MW. It is clear that the Company’s  
18 planning methodology allows for excesses and shortfalls of UE capacity. Thus,  
19 the Company could easily model new wind resources without any associated  
20 peaking capacity in some years when there is no need for capacity, and in some  
21 years when the capacity need is greater than the amount of wind capacity  
22 available. UE’s insistence on combining 346 MW of peaking capacity with every  
23 800 MW of wind capacity is based on overly simplistic premises about resource  
24 planning and will result in significant additional costs associated with the wind  
25 resource plans.

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<sup>11</sup> Note that the RAP DSM resource plans reduces PVRR by roughly \$1.5 – 2.5 billion dollars, relative to the Low-Risk DSM resource plans, even though there is “excess” UE capacity associated with the RAP DSM plans. (OPC Technical Report, page 26.) This is because of the energy benefits from avoiding fuel costs and/or off-system sales margins.



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1   **Q.   Do you agree with the Company's response regarding the build thresholds**  
2   **for wind resources?**

3   A.   No, I do not agree. The Company did not provide a substantive response to the  
4       OPC critique on this point. UE provides no evidence to support its claim that the  
5       IRP would be largely the same if wind resources are modeled in large amounts or  
6       if they are spread out over a period of time. Under the Company's approach there  
7       may be a considerable delay in the introduction of wind resources to the system.  
8       During those years when wind resources might have been added to the system but  
9       were not due to the build threshold, they might be able to reduce PVRR,  
10      especially as a result of the energy benefits of wind.

11      The problem with the Company's approach to applying build thresholds to wind  
12      resources becomes even worse when combined with its methodology of  
13      combining CT capacity with wind capacity. The build threshold for each new  
14      supply-side resource is derived by taking one half of the "full" capacity of the  
15      resource. (UE IRP, Chapter 9, page 4.) While this may make sense for most  
16      thermal power plants that are typically built in large amounts of MW, it does not  
17      make sense for wind resources that can be built in much smaller MW increments.

18      The 205 MW build threshold for wind resources is based on one-half of the 410  
19      MW of new wind resources. As described above, this 410 MW of new "wind"  
20      resources is actually composed of 800 MW of nameplate wind capacity (64 MW  
21      accredited capacity) and 346 MW of new CT capacity. Therefore, the wind  
22      resource build threshold applied by the Company means that no wind is added to  
23      the system until there is a need for 205 MW of capacity. Once this point is  
24      reached, the model includes 346 MW of new CT capacity and 800 MW of  
25      nameplate wind capacity. This approach defies common sense and will clearly  
26      understate the potential and overstate the cost for new wind resources.

27      Note that the one scenario that includes wind and makes it to the final selection  
28      stage, Plan H3, does not include any wind until the year 2024. The wind  
29      resources are added in 2024 because this is the first year where the UE capacity  
30      "shortfall" would reach 205 MW. (UE IRP, Chapter 9, Appendix A, Table 9.A.1,  
31      Plan H3.) The Company's build threshold methodology limits the ability of wind

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1 to play a role on its system for over 12 years. Clearly there may be opportunities  
2 for wind resources to provide cost benefits, energy benefits and  
3 environmental/diversity benefits between now and 2024. The Company has not  
4 conducted its modeling in a way that would identify these benefits.

5 **Q. Do you agree with the Company's claim that its approach to modeling**  
6 **average wind construction costs and capacity factors is consistent with**  
7 **modeling generic wind resources?**

8 A. No, I do not agree. In this context, the term "generic" suggests that the Company  
9 is not obligated to model site-specific renewable resource projects. This would  
10 clearly be burdensome and limit the ability of the Company to evaluate the full  
11 range of potential resources over the study period.

12 However, using a generic assumption for wind resources costs and capacity  
13 factors does not mean the company must use a single, average estimate. If a  
14 certain resource type is likely to have a range of construction costs or a range of  
15 capacity factors, then it may be appropriate to model several estimates within the  
16 range. The Company has not done so. When this simplified approach to  
17 modeling wind is combined with the Company's build threshold and the  
18 Company's method of combining wind capacity with peaking capacity, the result  
19 is an extremely limited analysis of the wind resource potential and does not come  
20 close to optimizing the wind resource potential.

21 **Q. Is there a better approach available for modeling the potential for wind**  
22 **resources in the IRP?**

23 A. Yes. A better approach would be for the Company to model a range of wind  
24 resource types, and to investigate a schedule for installing wind resources that  
25 minimizes PVRR and results in other important benefits to the Company and its  
26 customers. For example, UE could add wind projects in different increments of  
27 50 MW, 100 MW and 200 MW, and could add different quantities in different  
28 years to identify the best combination of wind resources in each year. Each  
29 resource plan would be designed to have sufficient capacity to meet reliability  
30 needs, after accounting for the opportunities for off-system sales and purchases.  
31 If the Company feels that it is necessary to incorporate wind resource build

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1 thresholds for ease of computation, then the build thresholds should be half of the  
2 wind resources' nameplate capacity (e.g., 25 MW, 50 MW 100 MW), not some  
3 inflated value based on an unnecessary CT facility. In the absence of this type of  
4 analysis, UE has not been able to identify the best mix of wind resources to  
5 include in the IRP.

6 **Q. Does this conclude your pre-filed testimony?**

7 **A. Yes, it does.**

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## PROFESSIONAL EXPERIENCE

**Synapse Energy Economics Inc.**, Cambridge, MA. Vice President, 2011 to present.  
Provides expert consulting on the economic, regulatory, consumer, environmental, and public policy implications of the electricity and gas industries. The primary focus of work includes technical and economic analyses, electric power system planning, climate change strategies, energy efficiency programs and policies, renewable resources and related policies, power plant performance and economics, air quality, and many related aspects of consumer and environmental protection.

**Massachusetts Department of Public Utilities**, Boston, MA. Commissioner, 2007- 2011.  
Oversaw a significant expansion of clean energy policies as a consequence of the Massachusetts Green Communities Act, including an aggressive expansion of ratepayer-funded energy efficiency programs; the implementation of decoupled rates for electric and gas companies; an update of the DPU energy efficiency guidelines; the promulgation of net metering regulations; review of smart grid pilot programs; and review of long-term contracts for renewable power. Oversaw six rate case proceedings for Massachusetts electric and gas companies. Played an influential role in the development of price responsive demand proposals for the New England wholesale energy market. Served as President of the New England Conference of Public Utility Commissioners from 2009-2010. Served as board member on the Energy Facilities Siting Board from 2007-2010. Served as co-chair of the State Energy Efficiency Action Working Group on Utility Motivation. Served as co-chair of the Steering Committee for the Northeast Energy Efficiency Partnership's Regional Evaluation, Measurement and Verification Forum.

**Synapse Energy Economics Inc.**, Cambridge, MA. Vice President, 1997-2007.

**Tellus Institute**, Boston, MA. Senior Scientist, Manager of Electricity Program, 1992-1997.

**Association for the Conservation of Energy**, London, England. Research Director, 1991-1992.

**Massachusetts Department of Public Utilities**, Boston, MA. Staff Economist, 1989-1990.

**Massachusetts Office of Energy Resources**, Boston, MA. Policy Analyst, 1987-1989.

**Energy Systems Research Group**, Boston, MA. Research Associate, 1983-1987.

**Union of Concerned Scientists**, Cambridge, MA. Energy Analyst, 1982-1983.

## EDUCATION

Masters, Business Administration. Boston University, Boston, MA, 1993.

Diploma, Economics. London School of Economics, London, England, 1991.

B.S., Mechanical Engineering. Tufts University, Medford, MA, 1982.

B.A., English. Tufts University, Medford, MA, 1982.

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## **TESTIMONY**

**Rhode Island Public Utilities Commission (Docket No. 3790).** Direct testimony regarding National Grid's Gas Energy Efficiency Programs. On behalf of the Division of Public Utilities and Carriers. April 2, 2007.

**Rhode Island Public Utilities Commission (Docket No. 3765).** Surrebuttal testimony regarding National Grid's Renewable Energy Standard Procurement Plan. On behalf of the Division of Public Utilities and Carriers. February 20, 2007.

**Rhode Island Public Utilities Commission (Docket No. 3765).** Direct testimony regarding National Grid's Renewable Energy Standard Procurement Plan. On behalf of the Division of Public Utilities and Carriers. January 17, 2007.

**Minnesota Public Utilities Commission (Docket Nos. CN-05-619 and TR-05-1275).** Direct testimony regarding the potential for energy efficiency as an alternative to the proposed Big Stone II coal project. On behalf of the Minnesota Center for Environmental Advocacy, Fresh Energy, Izaak Walton League of America, Wind on the Wires and the Union of Concerned Scientists. November 29, 2006.

**Rhode Island Public Utilities Commission (Docket No. 3779).** Oral testimony regarding the settlement of Narragansett Electric Company's 2007 Demand-Side Management Programs. On behalf of the Division of Public Utilities and Carriers. November 24, 2006.

**Nevada Public Utilities Commission (Docket Nos. 06-04002 & 06-04005).** Direct testimony regarding Nevada Power Company's and Sierra Pacific Power Company's Renewable Portfolio Standard Annual Report. On behalf of the Nevada Bureau of Consumer Protection. October 26, 2006

**Nevada Public Utilities Commission (Docket No. 06-06051).** Direct testimony regarding Nevada Power Company's Demand-Side Management Plan in the 2006 Integrated Resource Plan. On behalf of the Nevada Bureau of Consumer Protection. September 13, 2006.

**Nevada Public Utilities Commission (Docket Nos. 06-03038 & 06-04018).** Direct testimony regarding the Nevada Power Company's and Sierra Pacific Power Company's Demand-Side Management Plans. On behalf of the Nevada Bureau of Consumer Protection. June 20, 2006.

**Nevada Public Utilities Commission (Docket No. 05-10021).** Direct testimony regarding the Sierra Pacific Power Company's Gas Demand-Side Management Plan. On behalf of the Nevada Bureau of Consumer Protection. February 22, 2006.

**South Dakota Public Utilities Commission (Docket No. EL04-016).** Direct testimony regarding the avoided costs of the Java Wind Project. On behalf of the South Dakota Public Utilities Commission Staff. February 18, 2005.

**Rhode Island Public Utilities Commission (Docket No. 3635).** Oral testimony regarding the settlement of Narragansett Electric Company's 2005 Demand-Side Management Programs. On behalf of the Division of Public Utilities and Carriers. November 29, 2004.

**British Columbia Utilities Commission.** Direct testimony regarding the Power Smart programs contained in BC Hydro's Revenue Requirement Application 2004/05 and 2005/06. On behalf of the Sierra Club of Canada, BC Chapter. April 20, 2004.

---

**Maryland Public Utilities Commission (Case No. 8973).** Oral testimony regarding proposals for the PJM Generation Attributes Tracking System. On behalf of the Maryland Office of People's Counsel. December 3, 2003.

**Rhode Island Public Utilities Commission (Docket No. 3463).** Oral testimony regarding the settlement of Narragansett Electric Company's 2004 Demand-Side Management Programs. On behalf of the Division of Public Utilities and Carriers. November 21, 2003.

**California Public Utilities Commission (Rulemaking 01-10-024).** Direct testimony regarding the market price benchmark for the California renewable portfolio standard. On behalf of the Union of Concerned Scientists. April 1, 2003.

**Québec Régie de l'énergie (Docket R-3473-01).** Direct testimony of Timothy Woolf and Philp Raphals regarding Hydro-Québec's Energy Efficiency Plan: 2003-2006. On behalf of Regroupement national des Conseils régionaux de l'environnement du Québec. February 5, 2003.

**Connecticut Department of Public Utility Control (Docket No. 01-10-10).** Direct testimony regarding the United Illuminating Company's service quality performance standards in their performance-based ratemaking mechanism. On behalf of the Connecticut Office of Consumer Counsel. April 2, 2002.

**Nevada Public Utilities Commission (Docket No. 01-7016).** Direct testimony regarding the Nevada Power Company's Demand-Side Management Plan. On behalf of the Bureau of Consumer Protection, Office of the Attorney General. September 26, 2001.

**US Department of Energy (Docket EE-RM-500).** Oral testimony at a public hearing on marginal price assumptions for assessing new appliance efficiency standards. On behalf of the Appliance Standards Awareness Project. November 2000.

**Connecticut Department of Public Utility Control (Docket No. 99-09-03 Phase II).** Direct testimony on Connecticut Natural Gas Company's proposed performance-based ratemaking mechanism. On behalf of the Connecticut Office of Consumer Counsel. September 25, 2000.

**Mississippi Public Service Commission (Docket No. 96-UA-389).** Oral testimony on generation pricing and performance-based ratemaking. On behalf of the Mississippi Attorney General. February 16, 2000.

**Delaware Public Service Commission (Docket No. 99-328).** Direct testimony on maintaining electric system reliability. On behalf of the Public Service Commission Staff. February 2, 2000.

**New Hampshire Public Service Commission (Docket No. 99-099 Phase II).** Oral testimony on standard offer services. On behalf of the Campaign for Ratepayers Rights. January 14, 2000.

**West Virginia Public Service Commission (Case No. 98-0452-E-GI).** Rebuttal testimony on codes of conduct. On behalf of the West Virginia Consumer Advocate Division. July 15, 1999.

**West Virginia Public Service Commission (Case No. 98-0452-E-GI).** Direct testimony on codes of conduct and other measures to protect consumers in a restructured electricity industry. On behalf of the West Virginia Consumer Advocate Division. June 15, 1999.

---

**Massachusetts Department of Telecommunications and Energy (DPU/DTE 97-111).** Direct testimony on Commonwealth Electric Company's energy efficiency plan, and the role of municipal aggregators in delivering demand-side management programs. On behalf of the Cape and Islands Self-Reliance Corporation. January 1998.

**Delaware Public Service Commission (DPSC 97-58).** Direct testimony on Delmarva Power and Light's request to merge with Atlantic City Electric. On behalf of the Delaware Public Service Commission Staff. May 1997.

**Delaware Public Service Commission (DPSC 95-172).** Oral testimony on Delmarva's integrated resource plan and DSM programs. On behalf of the Delaware Public Service Commission Staff. May 1996.

**Colorado Public Utilities Commission (5A-531EG).** Direct testimony on impact of proposed merger on DSM, renewable resources and low-income DSM. On behalf of the Colorado Office of Energy Conservation. April 1996.

**Colorado Public Utilities Commission (3I-199EG).** Direct testimony on impacts of increased competition on DSM, and recommendations for how to provide utilities with incentives to implement DSM. On behalf of the Colorado Office of Energy Conservation. June 1995.

**Colorado Public Utilities Commission (5R-071E).** Oral testimony on the Commission's integrated resource planning rules. On behalf of the Colorado Office of Energy Conservation. July 1995.

**Colorado Public Utilities Commission (3I-098E).** Direct testimony on the Public Service Company of Colorado's DSM programs and integrated resource plans. On behalf of the Colorado Office of Energy Conservation. April 1994.

## **REPORTS**

*Cape Light Compact Energy Efficiency Plan 2007-2012: Providing Comprehensive Energy Efficiency Services to Communities on Cape Cod and Martha's Vineyard*, prepared for the Cape Light Compact, February 2007.

*Comments on the Potential for Energy Efficiency Resources to Meet the Demand for Electricity in North Carolina*, submitted to the North Carolina Utilities Commission, Docket E-100, Sub 110, prepared for the Southern Alliance for Clean Energy, February 2007.

*Review of the District of Columbia Reliable Energy Trust Fund and Natural Gas Trust Fund Working Group and Regulatory Processes*, prepared for the District of Columbia Office of People's Counsel, January 30, 2007.

*Cape Light Compact Annual Report on Energy Efficiency Activities in 2005*, submitted to the Massachusetts Department of Telecommunications and Energy and the Massachusetts Division of Energy Resources, prepared for the Cape Light Compact, July 2006.

*Integrated Portfolio Management in a Restructured Supply Market*, prepared for the Ohio Office of Consumer Counsel, with Resource Insight, June 2006.

*Incorporating Energy Efficiency into the ISO-New England Forwarded Capacity Market*, prepared on behalf of Conservation Services Group. June 5 2006.

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*Climate Change and Power: Carbon Dioxide Emission Costs and Electricity Resource Planning*, prepared for the Tallahassee Electric Utility, May 2006.

*Study of Potential Mohave Alternative/Complementary Generation Resources*, Pursuant to CPUC Decision 04-12-016, prepared for Southern California Edison, with Sargent and Lundy, November 2005.

*Potential Cost Impacts of a Renewable Portfolio Standard in New Brunswick*, prepared for the New Brunswick Department of Energy, October 2005.

*Feasibility Study of Alternative Energy and Advanced Energy Efficiency Technologies for Low-Income Housing in Massachusetts*, prepared for the Low-Income Affordability Network, Action for Boston Community Development, and Action Inc., with Zapotec Energy, August 2005.

*The Cape Light Compact Energy Efficiency Plan: Phase III 2005-2007: Providing Comprehensive Energy Efficiency Services to Communities on Cape Cod and Martha's Vineyard*, prepared for the Cape Light Compact, April 2005.

*Review of Avoided Costs Used in Minnesota Electric Utility Conservation Improvement Programs*, prepared for the Minnesota Office of Legislative Auditor, November 2004.

*NEEP Strategic Initiative Review: Qualitative Assessment and Initiative Ranking for the Residential Sector*, prepared for the Northeast Energy Efficiency Partnerships, Inc., October 1, 2004.

*A Balanced Energy Plan for the Interior West*, prepared for the Hewlett Foundation Energy Series, with Western Resource Advocates and Tellus Institute, May 2004.

*OCC Comments on Alternative Transitional Standard Offer*, prepared for the Connecticut Office of Consumer Counsel, October 20, 2003.

*Potential Cost Impacts of a Vermont Renewable Portfolio Standard*, prepared for the Vermont Public Service Board, presented to the Vermont RPS Collaborative, October 16, 2003.

*Portfolio Management: How to Procure Electricity Resources to Provide Reliable, Low-Cost, and Efficient Electricity Services to All Retail Customers*, prepared for the Regulatory Assistance Project and the Energy Foundation, October 10, 2003.

*Air Quality in Queens: Cleaning Up the Air in Queens County and Neighboring Regions*, prepared for a collaboration of Natural Resources Defense Council, Keyspan Energy, and the Coalition Helping to Organize a Kleaner Environment, May 2003.

*The Maryland Renewable Portfolio Standard: An Assessment of Potential Cost Impacts*, prepared for the Maryland Public Interest Research Group, March 18, 2003.

*The Cape Light Compact Energy Efficiency Plan: Phase II 2003-2007: Providing Comprehensive Energy Efficiency Services to Communities on Cape Cod and Martha's Vineyard*, prepared for the Cape Light Compact, with Cort Richardson, the Vermont Energy Investment Corporation, and Optimal Energy Incorporated, March 2003.

*Green Power and Energy Efficiency Opportunities for Municipalities in Massachusetts: Promoting Community Involvement in Energy and Environmental Decisions*, prepared for the Massachusetts Energy Consumers Alliance, May 20, 2002.



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*The Energy Efficiency Potential in Williamson County, Tennessee: Opportunities for Reducing the Need for Transmission Expansion*, prepared for the Harpeth River Watershed Association and the Southern Alliance for Clean Energy, April 4, 2002.

*Electricity Restructuring Activities in the US: A Survey of Selected States*, prepared for the Arizona Corporation Commission Utilities Division Staff, March 15, 2002.

*Powering the South: A Clean and Affordable Energy Plan for the Southern United States*, prepared with and for the Renewable Energy Policy Project and a coalition of Southern environmental advocates, January 2002.

*Survey of Clean Power and Energy Efficiency Programs*, prepared for the Ozone Transport Commission, January 14, 2002.

*Proposal for a Renewable Portfolio Standard for New Brunswick*, prepared for the Conservation Council of New Brunswick, presented to the New Brunswick Market Design Committee, December 12, 2001.

*A Retrospective Review of FERC's Environmental Impact Statement on Open Transmission Access*, prepared for the North American Commission for Environmental Cooperation, with the Global Development and Environment Institute, October 19, 2001.

*Repowering the Midwest: The Clean Energy Development Plan for the Heartland*, prepared for the Environmental Law and Policy Center and a coalition of Midwest environmental advocates, February 2001.

*Marginal Price Assumptions for Estimating Customer Benefits of Air Conditioner Efficiency Standards*, comments on the Department of Energy's proposed rules for efficiency standards for central air conditioners and heat pumps, on behalf of the Appliance Standards Awareness Project, December 2000.

*The Cape Light Compact Energy Efficiency Plan: Providing Comprehensive Energy Efficiency Services to Communities on Cape Cod and Martha's Vineyard*, prepared for the Cape Light Compact, November 2000.

*Comments of the Citizens Action Coalition of Indiana*, Workshop on Alternatives to Traditional Generation Resources, June 23, 2000.

*Investigation into the July 1999 Outages and General Service Reliability of Delmarva Power & Light Company*, prepared for the Delaware Public Service Commission Staff, with Exponent Failure Analysis, Docket No. 99-328, February 1, 2000.

*Market Distortions Associated With Inconsistent Air Quality Regulations*, prepared for the Project for a Sustainable FERC Energy Policy, November 18, 1999.

*Measures to Ensure Fair Competition and Protect Consumers in a Restructured Electricity Industry in West Virginia*, prepared for the West Virginia Consumer Advocate Division, Case No. 98-0452-E-GI, June 15, 1999.

*Competition and Market Power in the Northern Maine Electricity Market*, prepared for the Maine Public Utilities Commission, with Failure Exponent Analysis, November 1998.

---

*New England Tracking System*, a methodology for a region-wide electricity tracking system to support the implementation of restructuring-related policies, prepared for the New England Governors' Conference, with Environmental Futures and Tellus Institute, October 1998.

*The Role of Ozone Transport in Reaching Attainment in the Northeast: Opportunities, Equity and Economics*, prepared for the Northeast States for Coordinated Air Use Management, with the Global Development and Environment Institute, July 1998.

*Grandfathering and Environmental Comparability: An Economic Analysis of Air Emission Regulations and Electricity Market Distortions*, prepared for the National Association of Regulatory Utility Commissioners, with the Global Development and Environment Institute, June 1998.

*Performance-Based Regulation in a Restructured Electric Industry*, prepared for the National Association of Regulatory Utility Commissioners, with Resource Insight, the National Consumer Law Center, and Peter Bradford, February 1998.

*Massachusetts Electric Utility Stranded Costs: Potential Magnitude, Public Policy Options, and Impacts on the Massachusetts Economy*, prepared for the Union of Concerned Scientists, MASSPIRG and Public Citizen, November 1997.

*The Delaware Public Service Commission Staff's Report on Restructuring the Electricity Industry in Delaware*, prepared for the Delaware Public Service Commission Staff, Tellus Study No. 96-99, August 1997.

*Preserving Public Interest Obligations Through Customer Aggregation: A Summary of Options for Aggregating Customers in a Restructured Electricity Industry*, prepared for the Colorado Office of Energy Conservation, Tellus Study No. 96-130, May 1997.

*Zero Carbon Electricity: the Essential Role of Efficiency and Renewables in New England's Electricity Mix*, prepared for the Boston Edison Settlement Board, Tellus Study No. 94-273, April 1997.

*Regulatory and Legislative Policies to Promote Renewable Resources in a Competitive Electricity Industry*, prepared for the Colorado Governor's Office of Energy Conservation, Tellus Study No. 96-130-A5, January 1997.

*Comments Regarding the Investigation of Restructuring the Electricity Industry in Delaware*, on behalf of the Staff of the Delaware Public Service Commission, Docket No. 96-83, Tellus Study No. 96-99, November 1996.

*Response of Governor's Office of Energy Conservation, Colorado Public Utilities Commission Questionnaire on Electricity Industry Restructuring*,. Docket No. 96Q-313E, Tellus No. 96-130-A3, October 1996.

*Position Paper of the Vermont Department of Public Service*. Investigation into the Restructuring of the Electric Utility Industry in Vermont, Docket No. 5854, Tellus Study No. 95-308, March 1996.

*Can We Get There From Here? The Challenge of Restructuring the Electricity Industry So That All Can Benefit*, prepared for the California Utility Consumers' Action Network, Tellus Study No. 95-208 February 1996.

---

*Promoting Environmental Quality in a Restructured Electric Industry*, prepared for the National Association of Regulatory Utility Commissioners, Tellus Study No. 95-056, December 1995.

*Comments to the Pennsylvania Public Utilities Commission Regarding an Investigation into Electric Power Competition*, on behalf of the Pennsylvania Office of Consumer Advocate, Docket No. I-00940032, Tellus Study No. 95-260, November 1995.

*Systems Benefits Funding Options*. Prepared for Wisconsin Environmental Decade, Tellus Study No. 95-248, October 1995.

*Achieving Efficiency and Equity in the Electricity Industry Through Unbundling and Customer Choice*, Initial and Reply Comments of the New Jersey Division of Ratepayer Advocate, in an investigation into the future structure of the electric power industry, Docket No. EX94120585Y, Tellus Study No. 95-029-A3, September 1995.

*Non-Price Benefits of BECO Demand-Side Management Programs*, prepared for the Boston Edison Settlement Board, Tellus Study No. 93-174, August 1995.

*Electric Resource Planning for Sustainability*, prepared for the Texas Sustainable Energy Development Council, Tellus Study No. 94-114, February 1995.

## ARTICLES AND PRESENTATIONS

*Managing Electricity Industry Risk with Clean and Efficient Resources*, The Electricity Journal, with John Nielson, David Berry and Ronald Lehr, Volume 18, Issue 2, March 2005.

*Local Policy Measures to Improve Air Quality: A Case Study of Queens County, New York*, Local Environment, Volume 9, Number 1, February 2004.

*Future Outlook for Electricity Prices in Massachusetts*, guest speaker before the Boston Green Buildings Task Force, December 18, 2003.

*A Renewable Portfolio Standard for New Brunswick*, guest speaker before the New Brunswick Market Design Committee, January 10, 2002.

*What's New With Energy Efficiency Programs*, Energy & Utility Update, National Consumer Law Center, Summer 2001.

*Clean Power Opportunities and Solutions: An Example from America's Heartland*, The Electricity Journal, July 2001.

*Potential for Wind and Renewable Resource Development in the Midwest*, speaker at WINDPOWER 2001, Washington, DC, June 7, 2001.

*Electricity Market Distortions Associated With Inconsistent Air Quality Regulations*, The Electricity Journal, April 2000.

*Generation Information Systems to Support Renewable Portfolio Standards, Generation Performance Standards and Environmental Disclosure*, on behalf of the Union of Concerned Scientists, presentation at the Massachusetts Restructuring Roundtable, March 2000.

*Grandfathering and Coal Plant Emissions: the Cost of Cleaning Up the Clean Air Act*, Energy Policy, with Ackerman, Biewald, White and Moomaw, vol. 27, no 15, December 1999, pages 929-940.

---

*Challenges Faced by Clean Generation Resources Under Electricity Restructuring*, speaker at the Symposium on the Changing Electric System in Florida and What it Means for the Environment, Tallahassee Florida, November 1999.

*Follow the Money: A Method for Tracking Electricity for Environmental Disclosure*, The Electricity Journal, May 1999.

*New England Tracking System Project: An Electricity Tracking System to Support a Wide Range of Restructuring-Related Policies*, speaker at the Ninth Annual Energy Services Conference and Exposition, Orlando Florida, December 1998

*Efficiency, Renewables and Gas: Restructuring As if Climate Mattered*, The Electricity Journal, Vol. 11, No. 1, January/February, 1998.

*Flexible Pricing and PBR: Making Rate Discounts Fair for Core Customers*, Public Utilities Fortnightly, July 15, 1996.

*Overview of IRP and Introduction to Electricity Industry Restructuring*, training session provided to the staff of the Delaware Public Service Commission, April, 1996.

*Performance-Based Ratemaking: Opportunities and Risks in a Competitive Electricity Industry*, The Electricity Journal, Vol. 8, No. 8, October, 1995.

*Competition and Regulation in the UK Electric Industry*, speaker at the Illinois Commerce Commission's workshop on Restructuring the Electric Industry, August, 1995.

*Competition and Regulation in the UK Electric Industry*, speaker at the British Columbia Utilities Commission Electricity Market Review, Vancouver, British Columbia, February, 1995.

*Retail Competition in the Electricity Industry: Lessons from the United Kingdom*, The Electricity Journal, Vol. 7, No. 5, June, 1994.

*A Dialogue About the Industry's Future*, The Electricity Journal, June, 1994.

*Energy Efficiency in Britain: Creating Profitable Alternatives*, Utilities Policy, July 1993.

*It is Time to Account for the Environmental Costs of Energy Resources*, Energy and Environment, Volume 4, No. 1, First Quarter, 1993.

*Developing Integrated Resource Planning Policies in the European Community*, Review of European Community & International Environmental Law, Energy and Environment Issue, Vol. 1, Issue 2. 1992.