BEFORE THE
The Mississippi Public Service Commission

Docket No. 2008-AD-158

In: Re Proceeding to Review Statewide Electric Generation Needs

PREPARED REPLY TESTIMONY OF WILLIAM STEINHURST ON BEHALF OF THE SIERRA CLUB

July 30, 2008

I. Introduction

Q. Please state your name, title and business address.

A. My name is William Steinhurst, and I am a Senior Consultant with Synapse Energy Economics (Synapse). My business address is 45 State Street, #394, Montpelier, Vermont 05602.

Q. Are you the same William Steinhurst who prefiled testimony in this proceeding on June 10, 2008?

A. Yes, I am.

Q. What is the purpose of your reply testimony in this proceeding?

A. The purpose of my prefiled testimony is to inform the commission about a number of aspects of the Mississippi Power and Entergy Mississippi pre-filed testimony. Specifically I discuss: (1) the importance of public and stakeholder involvement in the planning process, (2) proper cost-benefit tests for use in demand side management (DSM) potential assessment, as well as in DSM program planning and implementation, (3) ratemaking issues, (4) shortcomings in the utilities' past and current resource planning and DSM programs, and (5) appropriate planning horizons for utility comparison of resources alternatives.

Q. What filings from other parties to this proceeding have you reviewed?

A. I have reviewed the June 10, 2008, prefiled testimony of the other parties, as well as the discovery responses provided by Entergy Mississippi, Inc., (EMI) and Mississippi Power Company (MPC).

Q. Have those filings caused you to alter any of the conclusions or recommendations in your own June 10 prefiled testimony?

A. No, they have not. I still conclude that the Commission should implement a policy of least-cost integrated planning for Mississippi electric utilities providing a level playing field for all resources, including energy efficiency and renewable energy resources, in order to ensure that the utilities' resource plans provide the maximum benefit to ratepayers.

2. Public and Stakeholder Involvement: The Commission Should Require Transparency and Encourage Collaboration in Resource Planning.

Q. You mention "public and stakeholder involvement." Please explain in more detail what you mean and why it is important.

A. The recommendation that the Commission and Mississippi electric utilities seriously pursue least-cost integrated resource planning implies that the utilities will undertake a number of activities that may be new to them, to their regulators, and to the public or are performed at levels that are new to them. Among these activities are the assessment, design and implementation of expanded DSM programs, DSM program evaluation, development of renewable and distributed generation, improved risk management, and ongoing attention to line loss reduction.[1] Becoming efficient and providing least cost service is challenging.

[1] While often ignored or relegated to a small part in transmission and distribution (T&D) engineering studies, reducing line losses can be a valuable part of energy efficiency resource planning, even though it takes place on the utility's side of the meter. Average and peak hour losses should be measured and reported regularly. (Peak hour losses are often around twice the annual average loss percentage, possibly nearing 20% in some cases, and can contribute greatly to system peak loads and total cost of service.) Engineering studies to identify cost-effective measures to reduce those losses should be a required part of least cost integrated planning and should consider the full range of available measures. Those measures include, but are not limited to, transformer and capacitor purchasing standards, transformer and capacitor upgrades and placement, line size selection, voltage upgrades for circuits, and reconfiguring circuits.

The question before the Commission is how shall the utilities meet that challenge. Public and stakeholder involvement has two features are crucial to the utilities' success.

The first feature of a sound public and stakeholder involvement process is transparency. Regulators, interveners and the public must be provided with all the information needed to understand what resource choices need to be made, the resource alternatives available, the bases for choosing among them, and the calculations and analysis underlying these choices. Without such understanding, the Commission cannot be expected to make decisions that are in the best interest of the public, interveners cannot fully participate or lend their expertise, and the public cannot be expected to understand and support those decisions.

The second key feature of public and stakeholder involvement is collaboration. Collaboration on DSM program design and oversight can lead to better programs, lower levels of conflict, shorter proceedings, and more rapid rollout of savings for ratepayers.

Collaboration has many meanings, but in the world of DSM as part of least-cost planning, it means a type of structured settlement process where normally adverse parties (not including the Commission) can reach agreement on new or ongoing program plans. The hallmarks of this type of collaboration are (1) launching of the collaborative pursuant to an enforceable Commission Order, (2) establishing agreed upon ground rules for scope, timelines, and access to information for the participating stakeholders, (3) independent technical support chosen by the stakeholders and accountable to them directly but funded by the utility, and (4) Commission recognition that it will give program plans agreed to by those normally adverse parties a degree of deference.

This model of collaboration has been generally successful for many utilities for the better part of the last twenty years. I believe it may be possible to extend this

model to include collaboration on other aspects of least-cost integrated planning, such as development of renewable energy and distributed generation programs, risk management policies and more. Whether the Commission adopts or encourages such collaboratives, it should ensure that there is adequate provision for stakeholder review and input on proposed plans and programs. Such provisions will broaden the perspective and range of options considered, help to ensure that errors are avoided and the best choices made, and assure the public that its interests are being looked after.

In California, a process has been used that provides for a similar, but more limited form of collaboration regarding the implementation of approved least-cost plans. Each major utility meets regularly with a group of stakeholders (not including the Commission) to review implementation progress, to inform the stakeholders about new developments relevant to those plans, and to obtain input on specific implementation decisions, such as the selection of winners in competitive procurements or the methodology for a proposed procurement. In some cases, approved plans specify that the stakeholder group is to be consulted whenever certain events occur such as when indicators (e.g., portfolio volatility measures) move outside a Commission-approved range.

3. The Commission Should Require Use of the Proper Cost-Benefit Tests by Utilities in Assessing DSM Potential and in Planning and Implementing DSM Programs.

Q. Is there another aspect of DSM program development you wish to explain, given your review of the utility filings to date?

A. Yes, there is. Other Sierra Club witnesses have explained in their prefiled reply testimony that comprehensive assessment of all potential DSM resources would likely reveal that substantial economic benefits could be acquired through DSM

programs. However, to ensure sound resource planning that maximizes benefits for Mississippi ratepayers, it is vital that those assessments employ the correct cost-benefit tests. If they do not, even the best program designs and implementation will fail to result in least cost provision of service.

Q. To your knowledge, has the Commission or Legislature required utilities to employ any specific cost effectiveness test in their evaluation of potential DSM resources?

A. No.

Q. Should the Commission provide such guidance and why? What are the implications of utilities using one test versus another?

A. Yes, to avoid confusion and error, and to assist the utilities in their work, the Commission should specify and define acceptable cost-benefit tests for DSM measure and program screening and evaluation. The costs and benefits of energy efficiency are, in some ways, qualitatively different from those of supply-side resources, and have different implications for the various parties. As a result, a number of cost-benefit tests have been devised to consider efficiency costs and benefits from different perspectives. Before setting out the details and implications of the various tests, I will briefly explain each one and the differences between them. (Their primary features are summarized in Table 1, below.)

- The *Participant Test* considers whether the customer receiving a DSM measure will save more money than her share of the measure's cost. For example, if a customer receives a $5 rebate for the purchase of an energy efficient light bulb that costs $10 retail, but saves at least $5 in power costs over the life of the bulb, then that measure would pass the Participant Test.

- The *Energy System Test* considers whether the direct cost of providing electricity (or natural gas, in the case of gas utilities) is increased or decreased by a given measure. To use the same example as above, if the utility paid $5 towards the cost of a $10 efficient light bulb that reduced the utilities cost of service by $5 per year over a three-year bulb life, the net cost of service would go down by $10, and that measure would pass the Energy System Test.

- *The Total Resource Cost (TRC) Test* considers whether the cash savings from a measure are greater than the cash costs of that measure, regardless of who pays and benefits from it. If, as in the previous example, the efficient light bulb costs $10 and reduces utility power costs by $5 per year for three years, and the net cash savings would be $5. The measure would pass the TRC Test, but not by as much as it would pass the Energy System Test.

- *The Societal Test* considers all the costs and benefits of efficiency to all of society, including more difficult to quantify benefits such as environmental benefits. Following the TRC example, this test would add to the benefits the monetary value of the generator emissions avoided by the efficient bulb. The size of those avoided emissions would need to be determined for each utility's generation mix, but if they were 10% of the avoided power cost, that would add $1.50 to the net savings in the TRC Test.

- Finally, the *Ratepayer Impact Measure (RIM) Test* considers only the impact on ratepayers who *do not* participate in a program. Using the above again, suppose that participants installed enough energy efficient light bulbs to reduce overall consumption by 1%, but that avoidable energy costs were only ½ of the utility revenue requirement. Then, leaving aside the program's cost to the utility, average rates would go down only ½%. If the cost of the program (rebates on the bulbs, marketing, administration, etc.) exceeded that savings, the program would fail the RIM Test. Typically, such effects are

small enough that even minor efficiency improvements put customers ahead of the game. For that reason and others explained in detail below, the RIM Test is not recommended for use in determining whether a measure or program should be considered cost-effective.

Table 1. Components of the Energy Efficiency Cost-Effectiveness Tests

	Partici-pant Test	Energy System Test	TRC Test	Societal Test	RIM Test
Energy Efficiency Program Benefits:					
Financial Incentive to Customer	X	---	---	---	---
Customer Bill Savings	X	---	---	---	---
Avoided Generation Costs	---	X	X	X	X
Avoided Transmission and Distribution Costs	---	X	X	X	X
Resource Benefits (e.g. oil, gas, water)	---	---	X	X	---
Non-Resource Benefits (e.g. O&M savings)	---	---	X	X	---
Benefits to Low-Income Customers	---	---	X	X	---
Avoided Environmental Costs	---	---	---	X	---
Economic Benefits	---	---	---	X	---
Energy Efficiency Program Costs:					
Program Administrator Costs	---	X	X	X	X
Participating Customer Costs	X	---	X	X	
Lost Revenues to the Utility	---	---			X

Benefits to low-income customers are a subset of the resource and non-resource benefits.

Q. In your June 10 prefiled testimony, you mentioned two types of cost-benefit tests that the Commission could adopt for use in electric utility resource planning. Have you been satisfied that the utilities are following one of those tests in their resource decisions?

A. The tests I recommended for consideration by Commission were the Energy System Test, the Total Resource Cost Test (TRC) and Societal Test. From my review of the filings in this proceeding, I cannot conclude that either utility is using correctly defined TRC or Energy System Tests. It is evident that neither is using the Societal Test. In its response to MPUS EMI 1-5, Sec. III, Entergy mentions that ICF's forthcoming potential study for Entergy will report results

from the TRC, Utility and RIM tests, but in Sec. IV of that response states that no cost-effectiveness tests were conducted prior to operation of its existing Mississippi DSM programs. In its response AGO MPC 1-11, MPC states that it has used the RIM, Participant and TRC tests. Neither utility provides sufficient information to confirm the correctness of either the methods or data used in any such tests.

Q. Where can the Commission find more detailed definitions of the cost-benefit tests you describe?

A. As explained above, there are five commonly cited cost-benefit tests for least-cost planning. They are the Total Resource Cost Test, Energy System Test and Societal Test, already mentioned in my June 10 prefiled testimony, plus the Participant Test and the Ratepayer Impact (RIM) Test. The TRC and Societal tests are the tests commonly used in U.S. jurisdictions.

I recommend and adopt the definitions presented in the California Public Utilities Commission *Standard Practice Manual* (Manual). I have attached a copy of the 2002 edition of the Manual to this prefiled testimony as Exhibit WS-2. The Commission should adopt the definitions in that Manual. Again, I recommend that the Commission adopt the Energy System Test, the TRC Test or the Societal Test as its standard for judging whether DSM measures or programs are cost-effective.

As explained in more detail below, the RIM Test excludes any resource that would increase per-unit rates *even if that resource reduces the cost of service or has net benefits to society*. Therefore, I conclude that the RIM Test has *no place* as a tool in identifying least-cost resource portfolios. The Participant Test is most useful in designing marketing techniques for DSM, such as setting rebate levels, rather than for screening DSM measures or programs.

The Societal Test is considered by some states to be the best standard for evaluating the overall cost-effectiveness of efficiency programs. This is the only test that includes all benefits and costs to all members of society. Ideally, environmental impacts from avoided resources (generation, transmission and distribution) should be quantified, monetized and included as part of the avoided costs of energy efficiency. If environmental costs are not monetized, then a proxy for avoided environmental costs could be used instead.

The Energy System measures the extent to which total electricity costs will be reduced as a result of the program administrator's efficiency investments.[2] This test is consistent with the methodology that vertically integrated utilities use to evaluate the cost-effectiveness of various power supply resources. This test does not include the participant costs and, so, will generally result in more cost-effective efficiency measures than the TRC Test.

The TRC Test has been adopted by many states. It has disadvantages compared to the Societal Test or the Energy System Test. The TRC Test does not quite account for all the costs and benefits of energy efficiency programs, excluding as it does avoided environmental costs (aside from a few like SO2 emission permit costs that are paid in cash). In a similar way, the TRC Test will result in fewer cost-effective efficiency measures passing the test than the Energy System Test, because the participant costs are easy to quantify and can be material, while the other benefits (such as other resource and non-resource benefits, such as low-income benefits) are difficult to quantify and typically omitted. However, as explained by Sierra Club witness Hausman, the likely cost of greenhouse gas emissions can be reasonably forecast and included in resource planning decisions, so it would be reasonable and useful to incorporate those costs into the TRC Test.

(This is the version of the TRC Test that I recommended in my June 10 prefiled testimony.)

Q. Earlier in your reply testimony, you criticized the RIM Test. Please explain in more detail why you recommend against its use in least-cost planning.

A. The RIM Test has significant flaws and should not be used to decide whether a given measure or program is cost-effective. Some of those flaws include:

1. The RIM Test will not result in the lowest cost to society.
2. Rate impacts and lost revenues represent a *transfer payment* between non-participants and participants. Consequently, they are not a new cost, and should not be applied as such in screening a new energy efficiency resource. Rate impacts and lost revenues may create equity issues between customers. However, these equity issues should not be addressed through the screening of efficiency programs, but through other means, as described below.
3. Screening efficiency programs with the RIM Test is inconsistent with the way that supply-side resources are screened and fails to create a level playing field for the consideration of supply- and demand-side resources. There are many instances where utilities invest in new power plants or transmission and distribution facilities in order to meet the needs of a subset of customers, (e.g., new residential divisions, an expanding industrial base, geographically-based upgrades, customers with high reliability requirements). These supply-side resources are not evaluated on the basis of their equity effects, nor are the "non-participants" seen as cross-subsidizing the "participants." Energy efficiency resources should not be subject to different screening criteria than supply-side resources.
4. Consumers, in the end, are more affected by the size of their electric bills (the product of rates and usage) than by the rates alone. The RIM Test does not provide any information about what happens to electric bills as a result of program implementation.
5. A strict application of the RIM Test can result in the rejection of large amounts of energy savings and the opportunity for large reductions in many customers'

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[2] If the local utility is vertically integrated, this test indicates the amount that revenue requirements will be reduced as a result of the program administrator's efficiency investments. This is key from the perspective of consumer advocates.

bills in order to avoid *de minimus* impacts on non-participants' bills. From a public policy perspective, such a trade-off is illogical and inappropriate.

Q. Are there any effects of DSM cost-benefit testing related to rates that the Commission should take into account?

A. Yes. While the RIM Test should not be relied on to screen energy efficiency programs, there are two rate effect issues that may be of concern: (1) the importance of rate impacts of any size, and (2) concerns about equity between efficiency program participants and non-participants.

The first of those issues should be addressed by:

- Evaluating the package of energy efficiency programs as a whole, including those programs that might increase rates and those that might decrease rates.
- Including all avoided costs in the rate impact estimate: avoided energy, avoided capacity, and avoided T&D. Also, the potential for increased off-system sales should be considered.
- Quantifying the potential rate impacts over time. Efficiency programs will have lower (and, possibly, downward) rate impacts in later years. This latter effect is particularly likely if DSM is used aggressively enough to mitigate or defer the need for investments in new high cost generation.
- Presenting the rate impacts in terms of percent increase, per year, by sector. This is necessary to make a meaningful assessment of the impacts on customers.

These rate impacts should then be compared to the expected reductions in total electricity costs, so that the portfolio manager and regulators can evaluate the trade-off that might have to be made between lower costs and higher rates.

Experience with energy efficiency programs in the past has demonstrated that significant reductions in costs can be achieved with very small increases in electricity rates. With due care in DSM program design, any residual impacts and inequities among ratepayers can be mitigated. Among the ways to do so are the following program design principles:

1. Efficiency programs should be designed to provide opportunities to all customer classes and subclasses, and to address as many electric end-uses and technologies as possible within cost-effectiveness guidelines.
2. Efficiency programs should be designed to minimize the costs incurred by the program administrator while still acquiring all cost-effective DSM resources.
3. Efficiency programs should be designed to maximize the long-term avoided costs savings for the electricity system, and up-to-date avoided costs should always be used.
4. Efficiency programs that result in lower rates should be combined with those that might increase rates, to lower the overall rate impact.
5. If there are concerns about interclass cross-subsidies, budgets for efficiency programs targeted to a specific customer class (i.e., low-income, residential, commercial, industrial) could be allocated in some fair manner while recognizing that DSM resources exist to be acquired from all customer classes and subclasses.
6. As efficiency programs are expanded, there will be more participants and fewer non-participants, thereby mitigating any residual equity problem.

4. The Commission Should Consider Ratemaking Issues Related to Utility Energy Efficiency Programs.

Q. Are there aspects of traditional ratemaking that are a concern for least-cost integrated planning and DSM programs?

A. Yes, there are several. They include (1) DSM program cost recovery, (2) the throughput incentive, (3) possible consideration of shareholder incentives for superior performance (e.g., authority to ratebase DSM expenditures or providing return on equity adjustments), and (4) allocation of DSM costs among ratepayers.

Each of these is a complex matter with deep implications for ratemaking. However, the Commission should address them in whatever venue it determines is appropriate. I have attached as Exhibit WS-3 a 2006 report by the American Council for Energy Efficient Economy that reviews the first three of those issues conceptually, provided examples from around the country, and discusses some of the issues that would need to be addressed in resolving them.

5. The Commission Should Take Note of the Shortcomings of the Utilities' Past and Current Resource Planning, Especially Regarding DSM Programs and Should Act to Remedy those Failings Promptly to Maximize Future Benefits for Mississippi Ratepayers.

Q. Do you wish to respond to any other material filed by the utilities?

A. Yes. Other Sierra Club witnesses have presented extensive evidence showing that the utilities' resource planning has been inadequate. They have offered several recommendations responding to those shortcomings. I recommend that the Commission act to remedy those failings promptly to maximize future benefits for Mississippi ratepayers. Here, I will only point out a few additional concerns that support those recommendations.

Q. Do the filings by the utilities in this proceeding give you confidence that their DSM programming and implementation is up to the job of meeting the public's needs at the least-cost to Mississippi?

A. No. I have some real concerns. For example, in AGO MPC 1-14, quoted in full below, the Company suggests that a proprietary methodology is being used for comparing costs of DSM to cost of generation.

> MPC utilizes an internal tool that compares the costs of new supply side generation with the revenue and cost impact of new DSM programs. This

> proprietary tool is called Price/Reliability Incremental Cost Evaluation Model (PRICEM), and it uses the marginal costing concepts as developed by National Economic Research Associates (NERA) for the Electric Utility Rate Design Study for National Association of Regulatory Utility Commissioners (NARUC). This tool compares DSM programs against the latest generation and fuel cost assumptions as used in the supply side resource evaluations.

The discovery response does not explain the nature of the methodology or provide access to the computer model or assumptions that drive results. This creates confusion as to which if any of the standard cost-benefit tests described above is being implemented and how. No citations to the literature are provided.

In addition, I believe that current MPC DSM programming needs to be enhanced considerably. The programs are very small, have low participation levels, and do not seem to be well matched to the anticipated future resource needs as described by Mississippi Power. Please see testimony by Hale Powell for a more complete assessment MPC and EMI program offerings.

For example, in AGO MPC 1-5, Att. A., the Company states that one part of the GoodCents Home program is restricted to all-electric subdivisions. On its surface, this appears to be a load building measure and not a proper part of a DSM program design. Furthermore, the incentive offered appears minimal, and while it is not clear what standard of efficiency is required to earn that incentive, the program has been in place since 1992 and no updates were mentioned. Also, the Change-a-Light program appears to be arbitrarily crippled in the manner explained below and to create lost opportunities and cream skimming. The low-income weatherization program appears limited by its narrow focus on infiltration, domestic hot water heating and lighting; also, it is not clear if those items are provided in limited quantity or as needed for whole dwellings, nor if they are professionally installed. (See answer to AGO MPC 1-9.)

Q. Do you have any similar observations regarding Entergy?

A. Yes, I do.

- In EMI MPUS 1-5, the Company briefly describes its use of DSM supply curves for resource planning. It is not clear how the cost per unit savings is calculated to produce these curves, e.g., will it be levelized and if so with what discount rate? Also, there are fundamental concerns about the use of those DSM supply curves. Such curves typically are constructed so that they slope upward (when plotted with price on the vertical axis and quantity on the horizontal axis), whereas the opposite may be the case, at least up to a point. In some situations, the more DSM you do, the lower the per-unit cost.

- In the same discovery response, the Company describes its low-income energy efficiency programs in Mississippi. One cited program has "weatherized" 415 homes (apparently over a10 year span), hardly a genuine response to the need, even leaving aside that it appears to exclude appliance retrofits or fuel switching. It is supported by community work days which suggests non-professional staff are doing the work during release time, a practice that may, itself, raise accounting issues. I also have concerns about the Company's apparent reliance on a prepackaged "weatherization kit." The kits' contents are unknown, but such kits often have limited amounts of materials per home and rely on amateur installation. Similarly, the Low Income Residential CFL "program" apparently provides an unknown number of bulbs per household and a narrow distribution channel–community meetings—even though the most vulnerable ratepayers may not be able to attend. The Habitat Program appears to impact only one new low income home per year. While that one home may be built to Energy Star standards, this is not a reasonable, comprehensive or effective low income new construction program, nor is it clear what Entergy actually contributes to the Habitat program.

Please see the testimony of Sierra Club witness Powell for more analysis of Entergy DSM offerings.

6. The Commission Should Require Appropriate Long-term Planning Horizons for Utility Comparison of Resource Alternatives.

Q. Certain parties' prefiled testimony or exhibits describe a five-year time frame for resource planning in Mississippi. Is that an appropriate time frame for the integrated resource planning process you recommended in your prefiled preliminary testimony or for evaluating DSM and renewable generation resources in general?

A. No, it is not. Of course, I am not saying that the utilities were wrong to submit five-year action plans. As explained in my prefiled preliminary testimony at page 5, Mississippi statute (MC § 77-3-14. Construction of electrical generating and transmitting facilities) requires each electric public utility to

> submit to the commission its forecasts and plans for the addition of generating capacity planned by the utility for an ensuing five-year period and shall furnish to the commission such documents and proof with respect to the need therefor as the commission may reasonably require.

Note, however, that this language calls for submission of five years worth of planned generation capacity additions, but does not restrict the relevant *planning horizon*. In strategic planning, the planning horizon is the time period over which forecasts and analyses extend. Those forecasts and analyses include, for example, assessments of the life-cycle costs and benefits of each resource option so that they can be compared on a level playing field. Those comparisons are then used to select the steps to be included in the action plan. For example, a utility might develop an action plan for a five-year period, but choose the investments to be made during that five-year action plan based on how the different options compare over a twenty-year analysis period.

Q. What planning horizon do you recommend the Commission adopt and why?

A. I recommend a planning horizon for electric utility resource planning of at least 20 years and, perhaps, 30 years for two reasons. The first reason is that a shorter analysis period would not provide a fair comparison between traditional generation resources and DSM or renewable generation resources. That is mainly because DSM and renewable generation resources require up-front investments, but may have markedly lower operating costs, and those operating costs are not affected by increases in fossil fuel prices. The second reason is that experience has shown that a 20-year planning horizon or more is feasible to implement.

Q. Does choosing a planning horizon of 20 years cause any problems?

A. There are two areas that might be of concern. One is the challenge of preparing forecasts and other input data extending for twenty years. The other is the appearance of so-called "end effects." I will address each in turn and explain why choosing a 20-year planning horizon is reasonable.

It is difficult to project or analyze energy resource choices over a 20-year horizon. Uncertainties in load growth, fuel prices, construction costs, costs of capital, unit lifetimes and availability, and many other important planning assumptions can be daunting. However, ignoring the "out years" of that planning horizon (years 6 and beyond) is the only planning methodology that is *guaranteed* to be wrong. Even worse, ignoring these years introduces a bias against DSM and renewable generation by omitting the time period when they will be most beneficial, so it will always be wrong in the direction of favoring traditional generation resources. There are many standard planning techniques that can account for those uncertainties. Therefore, the proper choice for a planning horizon will be long enough to capture differences in the life-cycle costs and benefits of different resource options and their impact on the risk profiles of candidate resource portfolios. In my opinion, a 20 year planning horizon best balances the challenge

of handling uncertain projections against the value added by capturing the life-cycle differences of the candidate resources.

End effects arise when comparing resources that may have residual costs and benefits beyond the planning horizon in the analysis. For example consider a comparison of two resource options: one with a useful life of 20 years and the other with a useful life of 15 years. Comparing their costs and benefits over five years clearly does not give a fair picture of the outcome. Using a planning horizon of 15 years ignores the additional benefit from the last five years of the first option's life. A 20-year planning horizon tends to reduce the importance of such end effects without unduly complicating the projections.

Q. Does this complete your testimony at this time?

A. Yes.