BEFORE THE NORTH CAROLINA UTILITIES COMMISSION

In the Matter of
Application of Duke Energy Carolinas, LLC, for Approval for an Electric Generation Certificate of Public Convenience and Necessity to Construct Two 800 MW Pulverized Coal Units for Cliffside Project

Public Testimony of Matthew F Wasson, Ph.D.
11 January, 2007

**Q: Please state your name, position and business address.**

My name is Matthew F. Wasson, Conservation Director of Appalachian Voices, located at 703 West King St. Suite 105, Boone, NC, 28607. I also teach classes as an adjunct, part-time professor in the Biology Department at Appalachian State University.

**Q: Please describe your educational background and relevant experience.**

I received a B.S. in Zoology from the University of Washington in 1995 and a Ph.D. in Ecology and Evolutionary Biology from Cornell University in 2002. In December, 2001, I began working for Appalachian Voices and have focused primarily on energy-related issues for the last 5 years. I have also taught courses in advanced ecological modeling at Cornell University and now teach courses part time in the Biology Department at Appalachian State University.

**Q: On whose behalf are you testifying?**

I am testifying on behalf of Appalachian Voices, representing more than 1500 members across the region including several hundred individual and several hundred business members in North Carolina.

**Q: Please Summarize your testimony.**

Appalachian Voices has serious concerns about the process, assumptions and lack of transparency of the cost estimation models that Duke Energy is using to advocate for an expansion of the Cliffside Plant in their 2006 Annual Plan[1]. Although Duke Energy has chosen not to make many of the assumptions that went into their models public, the testimony of Duke Energy representatives, and an assessment of the results of their sensitivity analysis, indicate that the models may be missing important factors regarding coal prices that are widely understood by energy analysts and agency scientists, while also including assumptions that are both confusing and misleading. Specifically,

1. Duke Energy appears to project the future cost of coal feedstock based on either historic prices and price variability over the past 10-20 years (when almost no new coal plants were built), average prices across the nation rather than regional prices, or both. Either of these methods would be fallacious based on factors

widely accepted by geologists and energy industry analysts such as declining coal production in the Appalachian Basin, rapidly increasing demand for coal domestically and worldwide, and capacity limitations in transportation infrastructure to deliver western coal to eastern states. These factors are already putting upward price pressure on coal supplies, a trend that is widely projected to continue for decades into the future.

2. The methodology and presentation of Duke Energy's cost models violates accepted standards of modeling employed by scientists, the medical community, and engineering fields worldwide. Questionable practices and assumptions in their sensitivity analysis, such as failing to examine the combined effects of higher than expected costs of coal plant construction and coal feedstock without also including the price of natural gas (which would both confound and obfuscate the combined effects of coal investment) might unduly favor investment in coal-based electricity generation. Duke Energy's failure to justify such questionable practices and assumptions raises the possibility that model results were selectively reported, or worse, that model inputs were determined to achieve desired results.

3. It is universally recognized by researchers in all scientific fields that models are only as good as the assumptions that go into them and that the results of any model can easily be configured or selectively reported in a manner that achieves a desired result. Accordingly, it is an essential practice of modeling that the data selection and incorporation be justified and results be reported in a transparent, and thus reproducible manner. Because Duke Energy is assured of cost recovery and stands to gain if the plant is built, but will lose revenue if demand is met by other means such as demand side management, their opinions or those of their agents cannot be considered unbiased in this matter. The already demonstrable failure of Duke's assumptions regarding construction costs underscores the need for thorough and unbiased economic analysis. It appears, however, that there has been no external (and possibly no internal) validation of their models, as applied to their 2006 report. Moreover, Duke Energy's unwillingness to make the assumptions behind their models public prevents Appalachian Voices or other interested parties from commissioning an independent analysis or validation by a team of independent economic experts within a reasonable time frame.

4. The experience of utilities in neighboring states is increasingly demonstrating that investments in coal-based generation are risky at this time. For example, Dominion testified before a legislative committee in Virginia on January 8th, 2007, that the escalating costs of building and operating additional coal-fired generation capacity, and the unacceptable risks imposed by those costs, are reasons the state should re-regulate the energy market (just 8 years after they won the fight for deregulation). Given these conditions, it is highly unlikely that Duke Energy would invest in additional coal-fired generating capacity if the risks were borne by their shareholders rather than rate-payers and tax-payers. Their entire application for public convenience and necessity ought to be viewed in this light.

As a result of possible biases and clear failures of Duke Energy's cost estimation models, new evidence of risks of coal investments from neighboring states, and the lack of independent economic analysis, the following remedies would be appropriate:

1. Consideration of Duke Energy's CPCN application be suspended for a period of 6-12 months to allow time for independent analysis of Duke's models to be commissioned either by the NCUC, or by other formal interveners in this matter.
2. The assumptions of Duke's cost estimation models be made publicly available, at least in terms of their justifications and assumptions for data input and their decision making process for reporting of results.
3. That Duke Energy's CPCN application be rejected if items 1 and 2 are unacceptable to the company.

Considering the evidence in this testimony and the increasingly compelling evidence that demand side management combined with increased investment in renewables could manage demands more quickly and cost-effectively than new coal-fired electricity generation, it is the opinion of Appalachian Voices that the NCUC already has sufficient reason to reject Duke Energy's CPCN application. As such, Appalachian Voices urges the NCUC to reject Duke Energy's application.

**Q: How would a delay in certification be in the interest of North Carolina's electricity consumers?**

While any delay in Duke Energy's certification process admittedly creates the risk of additional costs for rate-payers, as Duke representatives have suggested in their prior testimony[2], those costs are relatively small compared to the already massive $3 billion price tag for the expansion and the potential for skyrocketing fuel costs if Duke Energy's cost estimation models prove significantly off the mark - not an unreasonable concern given that their worst case scenario for construction costs has already increased 250% over their initial assumption of +/- 20%. Moreover, with 61% of North Carolina's electricity already supplied by coal that is almost entirely imported from other states[2], rate payers are at immense risk should supply shortages and cost increases materialize.

**Q: Why do you consider the inclusion of higher-than-expected and lower-than-expected coal prices in the sensitivity analysis in Duke's 2006 cost estimation models insufficient to account for fuel price changes in the future?**

Based on testimony provided by their representatives to the NCUC and based on even a cursory look at the results of their sensitivity analysis, it is clear that their consideration of fuel costs fails to consider factors that are currently leading to upward price pressure on coal supplies and are projected to lead to dramatically increasing prices in the near future. These factors can be boiled down to:

a. **Declining Coal production** and recoverable reserves in nearby coal-bearing regions, particularly the Central and Northern Appalachian Basins[3,4,5,6,7,8], which are the source of nearly 100% of North Carolina's current coal supply[9].

b. **Transportation** constraints that are preventing supplies of coal from the Powder River Basin (the only major coal basin in the nation that has been increasing production in recent years[11]) from meeting current customer demand. Coal consumers depending on these supplies, particularly those in the East, are facing sharply increasing transportation costs that are projected to increase even more sharply in the future. [7,10,11,12]
c. **Demand and competition** from huge new investments in domestic and international coal-fired electricity generation that has already caused a 50% increase in Duke's cost projections for the Cliffside facility.[2,6] The costs and cost variability for coal feedstock once this new generation of power plants come online are projected to be quite different than what electricity generators have grown accustomed to over the last 20 years when almost no new coal-fired power plants were built and there was an excess capacity of coal production and transportation capacity[6].
d. **Subsidies and tax credits** for mine operators in the Appalachians that are supplying North Carolina's coal [16,17,18] have also helped depress coal prices over the last 2 decades. The largest of these subsidies for synthetic fuel is set to expire in 2007[17,18]. If Duke's cost estimation models are based on recent prices and price fluctuations, then the assumption that these subsidies will be renewed is already built into the models, for which the onus is on Duke to explain why these programs are likely to be renewed. In addition, there is widespread concern among energy analysts that the favorable regulatory environment in recent years for controversial mining practices such as mountaintop removal and valley fill could change quite suddenly[21], which would put coal consumers such as North Carolina (the nation's second largest consumer of coal from the region where mountaintop removal and valley fill occur[9]), at significant risk of supply shortages and dramatic price spikes.

As will be demonstrated, all of these problems are widely reported and well understood by experts in the coal, electric and transportation industries as well as agency scientists in the US Geologic Survey and the Energy Information Administration.

**Q. Please elaborate on the issue of coal supply.**

Currently, 61% of North Carolina's electricity supply is generated by coal, almost 100% of which comes from the Appalachian Coal Basin[11]. This region, while historically accounting for about 70% of America's coal production, has been steadily declining in its share of overall coal production – a pattern almost entirely attributable to increases in production from the Powder River Basin and decreases in production in the Appalachian Basin[3]. The USGS, the Energy Information Administration, and many state geologic surveys all agree that both Northern and Central Appalachian Basin coal reserves have peaked, that the bulk of the remaining coal is in thinner and in less accessible seams and thus the supply of economically, technologically and legally recoverable coal will last for only one to two decades more at current production rates if current economic and social trends continue[3,4,5,6,7,8]. Within the next decade, the decline in Appalachian coal

production is projected to accelerate significantly[3,4]. The following statements by agency officials and energy industry advisors summarize the issue succinctly:

*"Sufficient high-quality, thick, bituminous resources remain in [major Appalachian Basin] coal beds and coal zones to last for the next one to two decades at current production. After these beds are mined, given current economic and environmental restrictions, Appalachian Basin coal production is expected to decline."*

- U.S. Geological Survey Professional Paper 1625–C, 2001[3]

*"[2002-2005] is the first time the Appalachian Region has experienced four consecutive years of coal production of less than 400 million short tons since the 1960s."*

- DOE/EIA-0584 (2005) Annual Coal Report 2005[19]

*"Central Appalachia proved-in-place production capacity declined by 8 million tons per year in 2005, despite record level price signals since late 2003. Since 2001, Central Appalachia proved in-place production capacity has declined at a rate of 5 percent per year, and a total of 73 million tons of capacity has disappeared...the lack of capacity growth in some key regions despite sharp upward price shocks indicates that the cost of new supply may be much higher than even current prices—and certainly much higher than the embedded costs that domestic power generators are accustomed to paying for coal supplies."* [6]

- Gary L. Hunt and Hans Daniels of Global Energy Advisors, 2006.

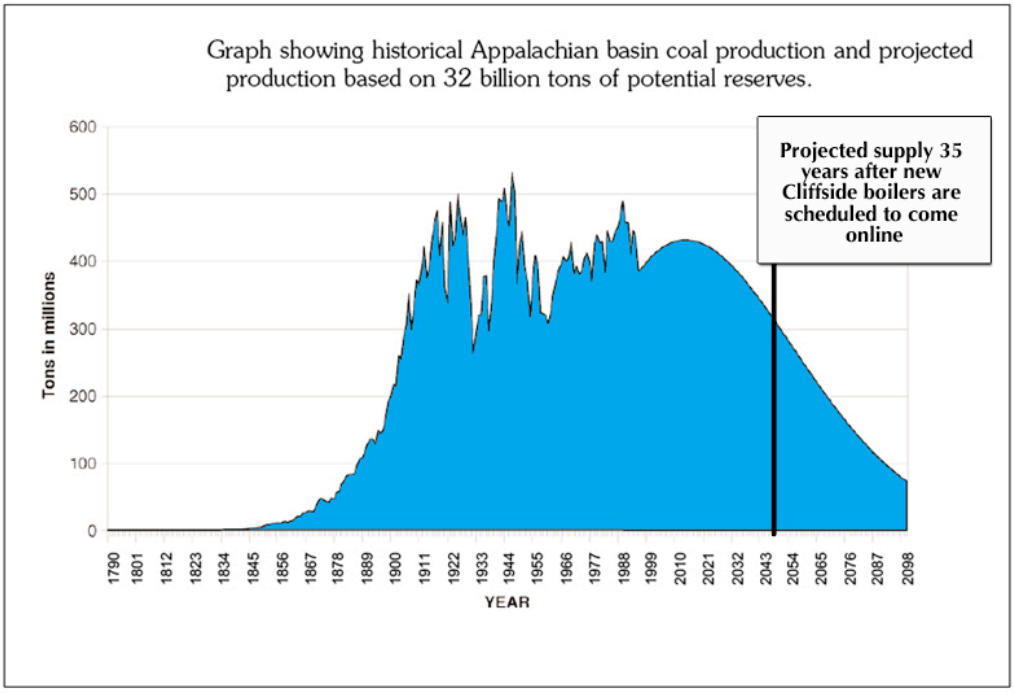
*"Since 2003, mining costs in Central Appalachia have risen roughly 45% from the upper $20.00s per ton to the lower $40.00s per ton, establishing a new base platform for coal pricing."*[8]

- Hill and Associates, Central Appalachian Coal Supply Study Summary, 2006

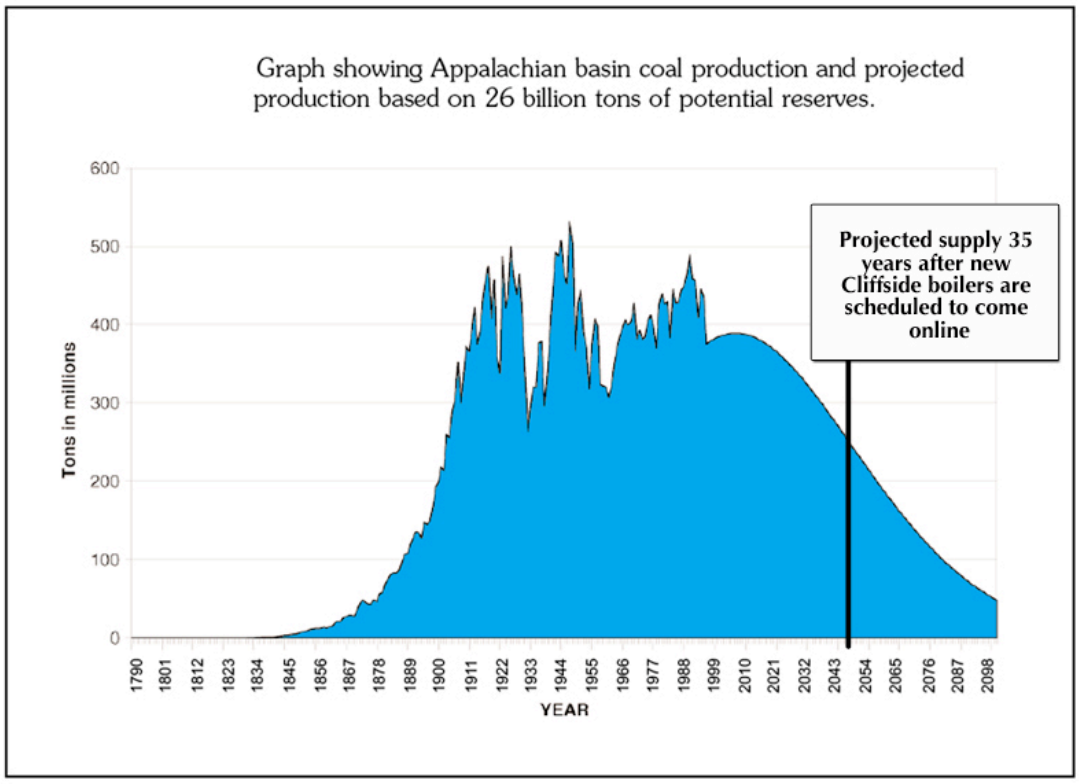
*"Replacing the Decline in [central Appalachian coal production] as coal demand grows is the central challenge facing U.S. steam coal markets."*[7]

- William P. Wolf, Director, Business and Market Analysis, John T. Boyd Company, 2006

In their assessment of northern and central Appalachian coal reserves, the USGS projected coal production would begin to decline between 2010 and 2020, based on a median projection of available coal reserves[3,4]. The graphs on the following page show two projections for combined northern and central Appalachian coal production from USGS studies.




However, between 2002 and 2005, Appalachian coal production has not exceeded 400 million short tons[15] and is widely believed to be already on the decline, suggesting a more pessimistic model is more accurate:



While the actual amount of coal underlying the Appalachians is enormous, only a fraction of this coal can be profitably and legally extracted. Physical factors such as the thickness of coal seams and the thickness of bedrock overlying those seams are major determinants of the feasibility and profitability of mining them[3,5,19]. There are also significant legal and social factors that can influence where mining can occur such as land ownership, proximity of towns and proximity of national parks and other protected land.

In addition, there are a variety of short-term factors that can influence the profitability and feasibility of mining. According to the EIA, major factors that affected coal production in 2005 were "weather, environmental, legal challenges, and global economics," while, "the overriding issue for the U.S. coal industry in 2005 was transportation of coal from the mines to the consumers." Additional factors cited by the EIA in their 2005 Coal Report included: "The combination of reserve degradation in the region, along with the legacy of past lawsuits that had either temporarily halted or extended the review time for the issuance of needed permits for new mines or to expand current operations," as well as "increased operating costs (fuel, steel, explosives, training of new miners, etc,), along with some geological issues (roof falls, sandstone intrusions, and high methane gas levels)."[19]

**Q: America has been called the "Saudi Arabia of coal," with reserves projected to last for hundreds of years, how could coal supplies be a significant factor?**

The perception that our nation is the "Saudi Arabia of Coal" is the result of a remarkably successful public relations effort by coal supporters. As a result, few Americans doubt that coal will be an abundant and cheap fuel to supply our electricity production for the foreseeable future. This is partly true – there is no doubt that America's coal reserves are huge, representing bout 26% of known reserves worldwide. One of the ways that the analogy to Saudi Arabia falls short, however, is in the fact that, while Saudi Arabia is a large exporter of oil, the Department of Energy predicts the US will become a net importer of coal in the next 5-10 years and will continue to import an ever larger proportion of coal into the forseeable future.[20]

The problem is that not all parts of the country have equal access to recoverable coal reserves, which are mostly located in the western US, particularly Wyoming's Powder River Basin. The nation's transportation infrastructure (particularly railroads) is already unable to meet demand and has nowhere near the capacity to meet projections of skyrocketing future demand for western coals as a new generation of coal-fired power plants is built in the eastern U.S. and across the country (see next section).

In short, the equation is very different for states containing or neighboring coal basins that still have the capacity to increase production for decades or centuries into the future – and innovations such as building mouth-of-mine plants help utilities in those regions keep down transportation costs. North Carolina, unfortunately, has no such advantages.

**Q. Please elaborate on the issue of transportation infrastructure.**

While US coal production is increasing as a result of major development in Wyoming's Powder River Basin (PRB), this coal will be mostly unavailable to meet North Carolina's demand because the infrastructure for transporting coal (mostly railroads) is already stretched to the point that, in recent years, the demand for coal at power plants in both the West and the East has been limited by transportation[7,10,11,12]. As the only other major source of low-sulfur coal, this constraint on Powder River Basin coal supplies is significant.

While it may be possible to increase national transportation capacity to allow for shipments of PRB coal to supply North Carolina and other eastern states, there are currently no plans to create such capacity and any such plans would require long periods of time and massive costs to implement.[7,11,12] According to a recent white paper entitled "The New Normal" by Lee Clair and Dean Wise, partners in the energy and transportation consulting firm, Northbridge Associates, the costs of transporting coal supplies from the Powder River Basin and other major coal basins is going nowhere but up. According to Clair and Wise:

*"The chronic long-term capacity issue is the capital required to add fixed infrastructure capacity – ports, rail lines, rail terminals, and highways – and those challenges will be with us well into the next decade. In addition to the absolutely large price tag, there are physical, environmental, and political barriers that will lengthen the process by years, not months. It's certainly not clear that the carriers, nor the public sector, have either the wherewithal or the right plan to put the requisite billions of capital dollars into the right projects at a fast enough pace to bring us back to the "old normal" of widespread excess capacity... So we should expect the "new normal" to be a pretty lengthy state of increasing costs, tight capacity, and related service performance challenges."*[11]

It's important to note that these projections of inadequate transportation capacity are common knowledge among coal industry professionals. The Energy Information Administration reported in their December 20th, 2006 Coal Report:

*"A Bear Stearns survey of more than 1,000 shippers confirmed what coal-fueled power plant operators believe and the railroad industry says is necessary – that rail transportation rates are rising and expected to continue."*[5]

As such, factoring these projections into cost models would be quite valid by any standard of modeling. On the other hand, if Duke Energy's cost estimation models do not factor in transportation constraints from the Powder River Basin and elsewhere, but do assume coal supplies from those regions will materialize at close to current costs, then there is an unstated assumption in their models that tens or hundreds of billions of dollars will materialize for such projects in the next few years. It is incumbent on Duke Energy to explain to the NCUC and the public where such funds will come from.

**Q. Can't Duke Energy procure high-sulfur coal from other regions and still meet regulations given the state of the art pollution controls they propose?**

The proposed new Cliffside burners incorporate the ideal technology for burning high-sulfur coal, but supplying this coal may not be nearly as cheap or reliable as Duke appears to project (see below). The inclusion of a wet electrostatic precipitator will help control problems with sulfur trioxide, a gas that has plagued the efforts of other utilities using FGD systems to switch to high sulfur coal as a result of the so-called "blue plume" phenomenon, which both causes problems with meeting opacity limits and has generated numerous complaints in downwind communities resulting from discomfort and "burning sensations" from high levels of sulfuric acid in emissions.[22]

The degree to which Duke's other power plants will be able to switch to high sulfur fuels is questionable, however, as I have been unable to find any plans to install wet ESPs on other plants and have been unable to get a response from Duke on the subject despite several requests. North Carolina's rate payers may well be better served by ensuring the ability of Duke's other power plants to safely burn high sulfur coals rather than spending a far greater amount building the new Cliffside units from the ground up.

In the testimony of Mr. William McCollum before this commission, Duke Energy stated they would obtain coal from a variety of sources including the Central Appalachian Basin, the Northern Appalachian Basin, the Illinois Basin, the Powder River Basin, and international imports.[2] With costs escalating and supplies declining, however, the Northern and Central Appalachian Basins cannot be considered to be reliable and cost-effective suppliers even a decade into the future, much less 30-50 years into the future.

Also, the transportation factors listed above rule out the Powder River Basin as a reliable source unless massive unforeseen investments in transportation infrastructure arise. That leaves the Illinois Basin and international imports, both of which are subject to some of the same transportation factors as the Powder River Basin.

As with the Appalachian Basin, the Illinois Basin has been in decline for a number of years as the result of numerous factors. In the most thorough independent assessment of the Illinois Basin coal reserves published to date, the US Geologic survey states:

*"...coal availability and coal recoverability studies in the Illinois Basin show that only a part of the original coal resources within the 7.5-minute quadrangles studied is available for development. Even less of the original resource is actually recoverable, and only a small percentage of the original coal resource is economically recoverable (13 percent of the resource for eight Illinois quadrangles, 7 percent for three Indiana quadrangles, and less than 1 percent for five quadrangles in western Kentucky)."*[23]

It's important to note, however, that demand for high sulfur coal, as sulfur controls are installed on power plants across the country and demand for coal for new coal-to-liquids plants in the Midwest increases, are projected to reverse this declining trend and make a

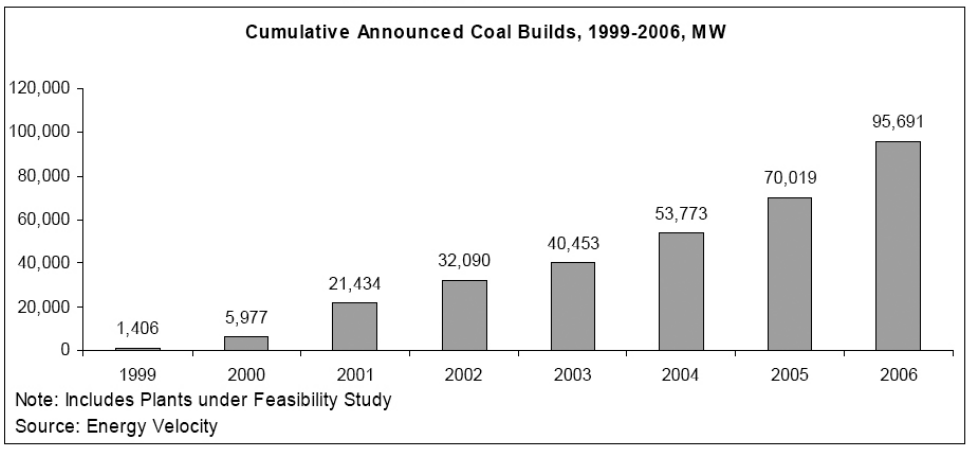
greater proportion of Illinois Basin reserves economically recoverable[22]. It is precisely this increased demand and associated upward price pressure, however, that is likely to lead to increases in coal prices for Illinois Basin coals in the coming decades. Furthermore, the infrastructure for transporting Illinois Basin coals is considered by industry insiders as "limited"[14] and as a result, there is a substantial benefit to building power plants in close proximity to those mines - particularly a number of new "mouth of mine" plants proposed for the region[14]. A significant proportion of the new proposed generation capacity tracked by the EIA is in the six state encompassing or in close proximity to the Illinois Basin (see below). Unfortunately, North Carolina has no such natural advantages and, given the huge new demand from midwestern states that do, North Carolina's ability to procure Illinois Basin coal both reliably and at low cost is questionable and not addressed at all by Duke, at least in the public record.

**Q. Please elaborate on the problem of increasing demand**

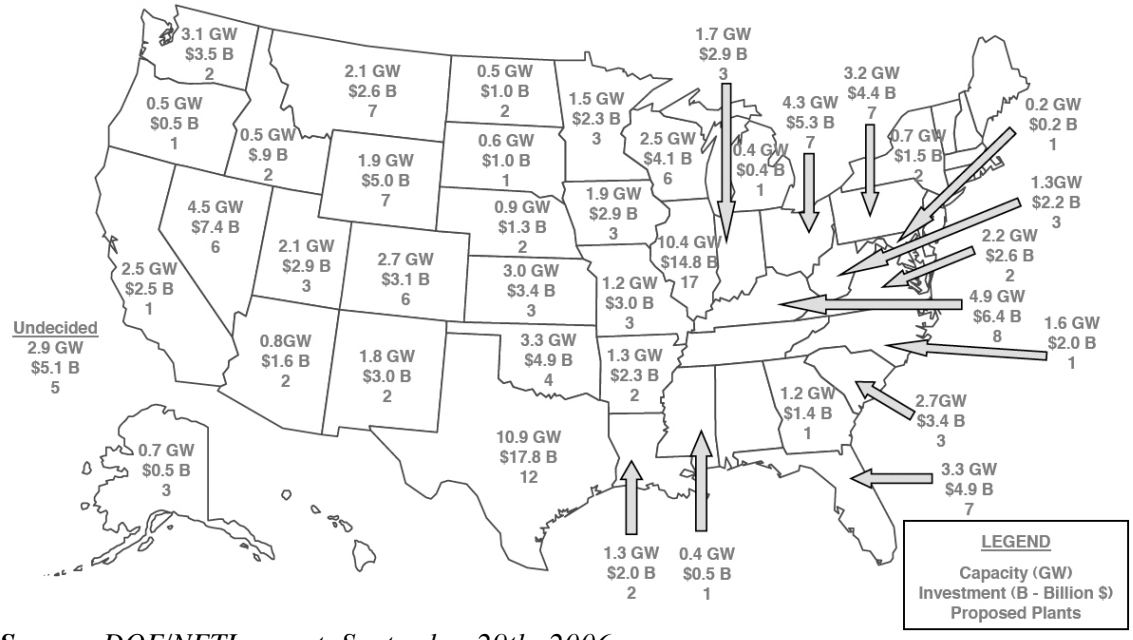
Demand for the increasingly limited coal supplies is predicted to escalate as a new generation of domestic power plants come online. The National Energy Technology Lab of the DOE has tracked 154 new coal-fired power plants that are proposed, in the permitting process, or currently under construction across the U.S.

In the testimony of Mr. Judah Rose to the NCUC on behalf of Duke Energy, Mr. Rose speaks directly to this issue of increasing domestic and international demand for materials and labor needed for construction. In terms of domestic demand, he presents this graph:

**Exhibit JLR-3**




Much of this new capacity is planned for the Midwest and eastern U.S., which, given transportation constraints, will dramatically increase demand on the dwindling Appalachian reserves as well as Illinois Basin reserves. The following graph shows the locations of projected increases in coal-based generation capacity:




***Source:*** *DOE/NETL report, September 29th, 2006*

Unfortunately, international demand for both coal power plant components and coal supplies is escalating even more rapidly than domestic demand. According to an article in the May-June issue of Harvard Magazine:

*"China plans to build 168 traditional coal plants in the next two years alone. The economic lifetime of those plants might be 50 years or more."*

Moreover, China faces precisely the same transportation issues that the US faces, with most of their coal reserves in the North and West of the country and most of their demand in the South and East. As with the US, this is increasing the attractiveness of imports.

Given the well-known volatility of energy markets, even a minor shortage in supply or perceived risk of shortages can send energy prices skyrocketing. These escalating demands virtually ensure more than a "minor" shortage in supplies.

**Q: What other factors influence Duke Energy's ability to obtain low cost coal from overseas suppliers?**

Declining coal production in the East is already making international imports look more attractive. According to the Energy Information Administration:

*"With declining productivity and mining difficulties in Central Appalachia and rising demand for coal in the Southeast, imports become increasingly competitive with domestic U.S. coal production."*[19]

Indeed, Dominion is already importing coal for their plant in Chesapeake, Virginia.[24,25] The question is whether the cost of imports will remain attractive well into the future.

The assumption that sufficient imports will be available to meet increasing demand in the East, and that their cost will remain relatively low, depends on a number of unpredictable factors such as international relations and global power dynamics. These assumptions also depend on the continuation of unrealistically low values of currencies in many of the exporting countries that could supply North Carolina's demand over the 30-50 year lifespan of the Cliffside Plant.

More significant, and more predictable, is the fact that the capacity of ports, as with that of railroads, is already tight and projected to get tighter. The ability of Duke to procure regular shipments of international coal will depend on increases in capacity at both eastern ports and the railroad infrastructure necessary to deliver coal at low cost from major eastern ports to the proposed Cliffside plant. It is incumbent on Duke Energy to explain from where the funds for necessary expansions in this transportation infrastructure are going to materialize - if they are projecting a significant role for coal imports in their cost estimation models, which is unclear from their public documents.

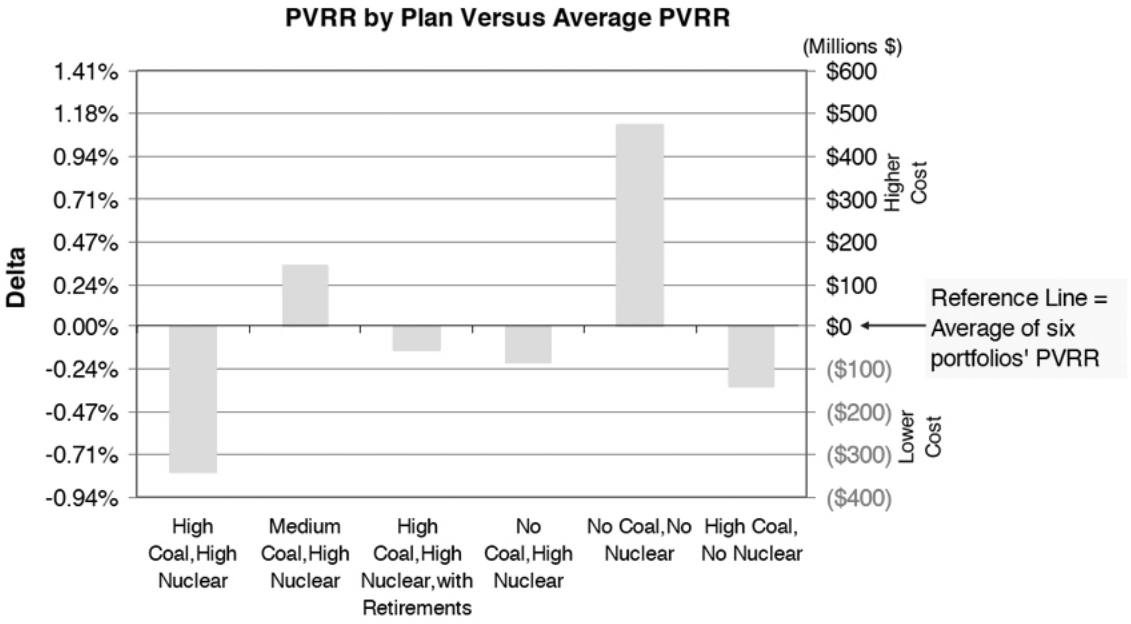
**Q: If Duke Energy has not made public the assumptions underlying the variables in their cost estimation models, how do you know they have not considered the factors you mention in their expected cost of coal?**

Clearly it is impossible to know the specific assumptions that went into Duke Energy's cost estimation models when they refuse to make those assumptions public. Moreover, Duke has very little to say publicly about the nature of the inputs into their models. The entire extent of Duke's discussion of coal procurement policies in their 2006 Annual Plan, dated September 20, 2006 is as follows:

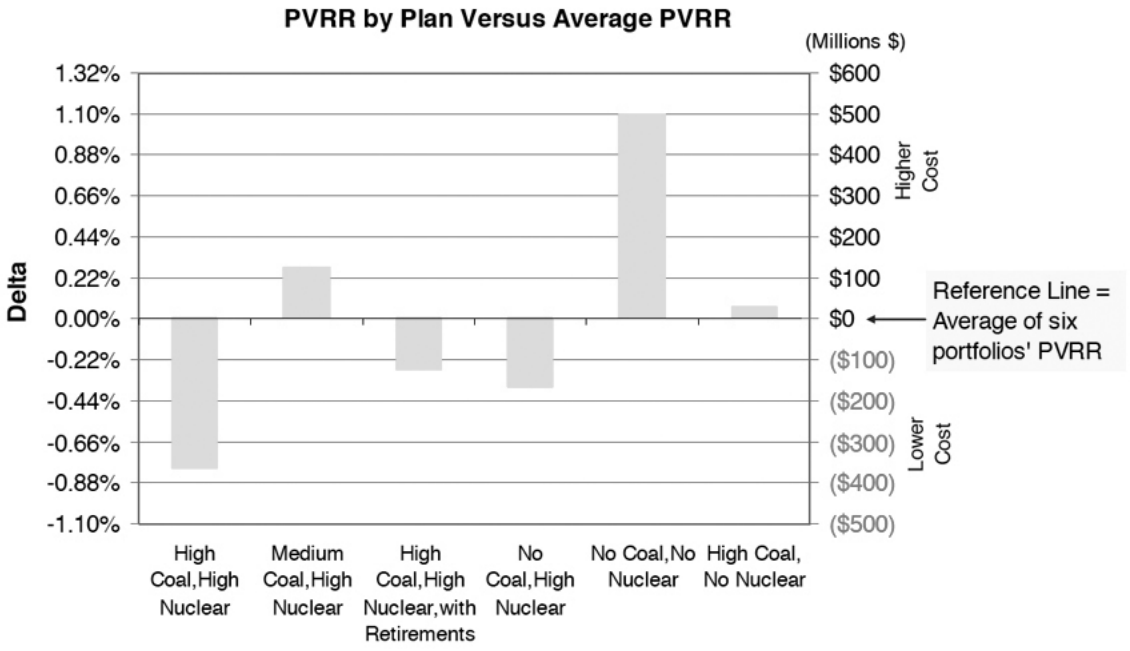
*"Duke Energy Carolinas burns approximately 18 million tons of coal annually. Coal is procured primarily from Central Appalachian coal mines and delivered by Norfolk Southern or CSX railroads. The Company assesses coal market conditions to determine the appropriate mix of contract and spot purchases in order to reduce the Company's exposure to the risk of price fluctuations. The Company will evaluate its diversity of coal supply going forward from sources throughout the United States and international sources."*[1]

This evasive and opaque language does little to help us in evaluating Duke's coal procurement plans. Based on the results of Duke's sensitivity analysis, however, it is clear that they assumed only small variation in potential coal prices, as evidenced by comparing the following "Base Case" sensitivity analysis of various resource mix options to an alternative case of higher than expected coal prices in Duke Energy's cost model:

# Base Case



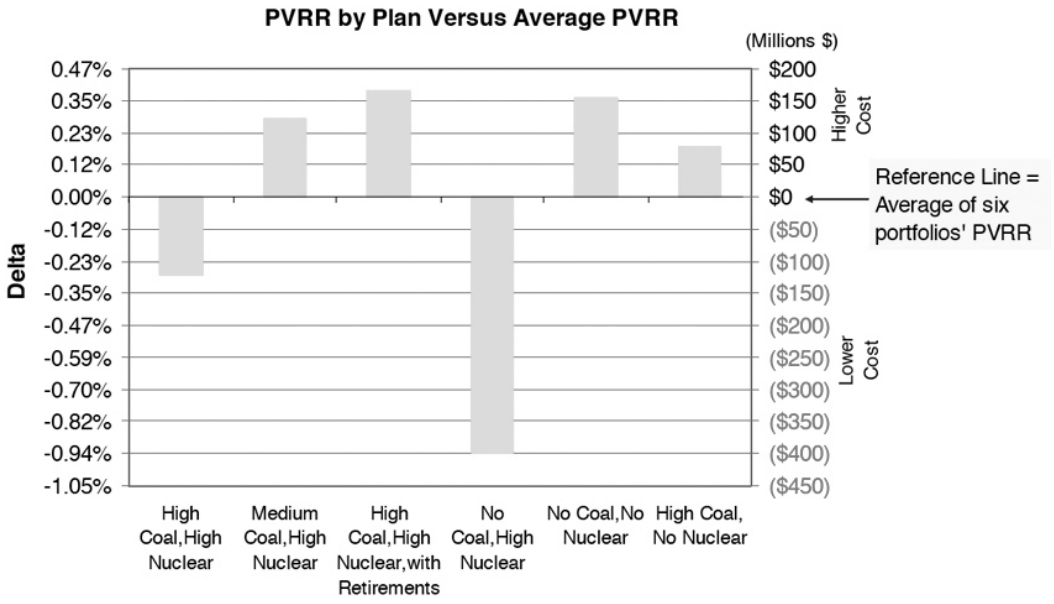

# Higher than Expected Coal Prices



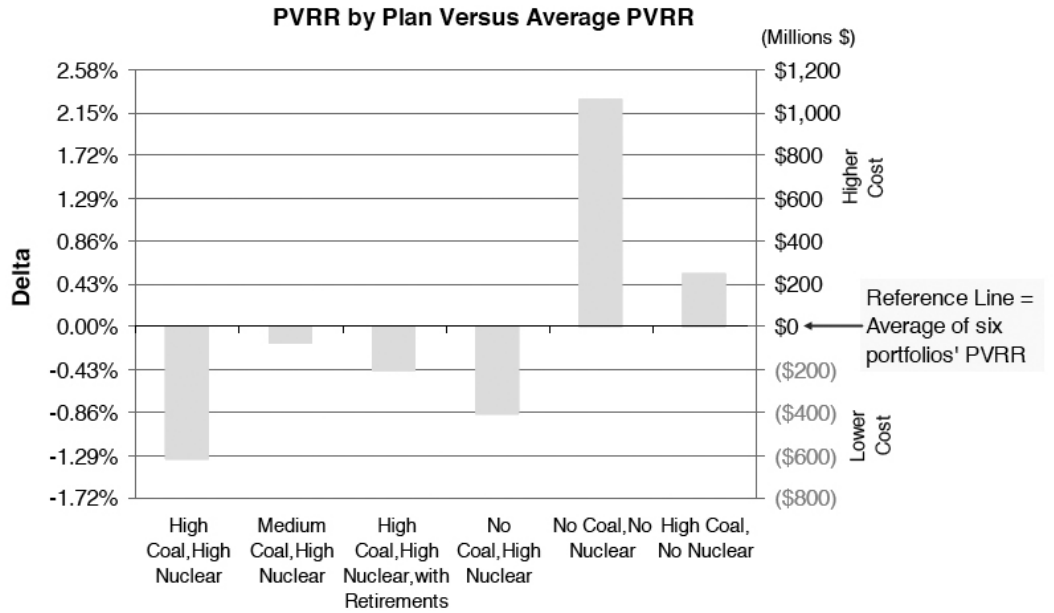

The miniscule differences between these two models indicate that either Duke expects almost no variability in coal prices over the 35 year time frame of their models, or that their projections of coal prices are so low as to be insignificant. An even more interesting

pattern is evident when comparing the results of higher than expected coal and gas prices combined with higher than expected construction costs:

# Higher than Expected Construction Costs




# Higher than Expected Construction Costs and Costs of Coal and Natural Gas



Focusing on the differences between models in the "High Coal, No Nuclear" option, which is the most useful case for comparing the differences caused by the combined effects of both high construction and high fuel prices for coal because it has the fewest number of complicating factors, the difference between models is all but imperceptible. It's hard to imagine the results of these two sensitivity analyses could occur unless one or more of the following were true:

1. The addition of higher than expected natural gas prices works in opposition to higher than expected coal prices to obscure the overall effect of coal investment from both higher construction and higher fuel prices.
2. The price of coal for the next 35 years is projected to be so low as to be insignificant.
3. The projected range of coal prices is so small as to be insignificant, at least in comparison to variation in natural gas prices.

Any of these cases would raise serious questions about the believability of Duke's models as well as Duke's intentions in choosing which sensitivity scenarios they chose to supply to the NCUC and the public.

Further evidence that Duke Energy failed to consider well understood factors that would indicate drastic increases in regional coal prices comes from the testimony of Duke Energy's consultant Judah Rose to the NCUC in November, 2006. In that testimony, Mr. Rose states that "coal prices are very stable," and provides two charts comparing the trends and standard deviations in coal prices to natural gas prices. While it's true that average US coal prices did not increase as rapidly as natural gas prices between 1995 and 2005, the difference is attributed by most energy analysts to the nationwide surge in construction of natural gas plants that started a decade ago and which led to a run on supplies of natural gas in subsequent years. At the same time, until recently, almost no new coal plants had been built in the US, while mine capacity continued to increase in efficiency and overall production leading to an overcapacity of coal relative to demand.

Mr. Rose attributes the "unexpected" increase in costs of constructing new coal-fired power plants to the "unexpected" increase in demand for supplies. If we go a step further and allow that the sharp increase in natural gas prices over the last decade was "unexpected," because the spike in construction of new gas-fired plants was also "unexpected," wouldn't it at least by prudent to "expect" an increase in coal prices, given that we know the building of new coal-fired power plants is skyrocketing and those plants are projected to come online between 2010 and 2013? Consider the following statements by Mr. Rose in his testimony but think of the cost of and demand for coal where he references the cost and demand of coal fired power plants:

*"In 2000, there was practically no construction of new coal power plants in the US. This was the continuation of the pattern of the last twenty years when almost no new coal power plants were built. Today, the amount of coal plants under construction or very recently*

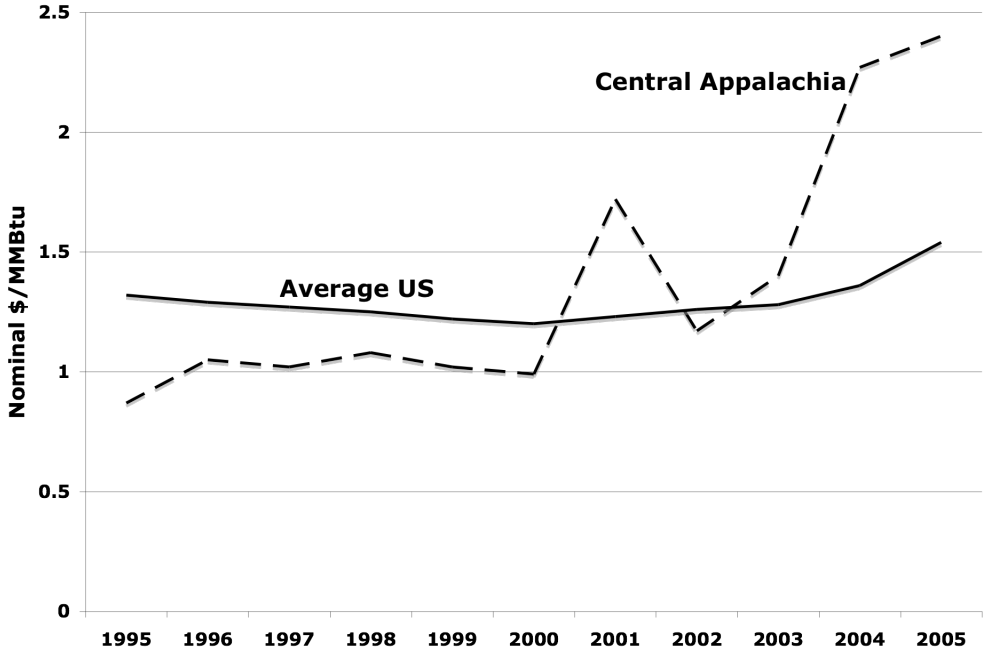
*completed is approximately 11,300 MW. Until recently, the estimates of the costs for building new coal power plants were not based on the actual contracted prices for new coal units, but reflected estimates of the costs from a period of very or extremely depressed demand for new coal power plants. Today, better information is now available on costs."*

The stage is clearly set for coal prices to follow a similar trajectory as that of natural gas starting a decade ago. As Mr. Rose also stated in his testimony:

*"In the 1990s, all that was built was essentially natural gas plants and modeling showed gas as the dominant option. The recent increases in natural gas and oil prices and the expectations that they will continue to be high cause baseload coal power plants to be more economic than they were in the 1990s as their fuel savings offset their higher initial costs."*

After suffering through the natural gas bust so recently, it would be a colossal failure of judgment to continue putting our electricity "eggs" in the coal "basket," (in which 61% of our "eggs" already reside) at the same time so many other utilities that are better positioned to procure low-cost coal supplies are doing the same.

Of equal concern regarding Duke Energy's cost estimation model is that Mr. Rose mentions nothing about differences between trends in regional coal prices (Appalachian Basin) versus trends in average prices nationwide when looking at patterns in coal costs. Graphing out the trends in spot prices of Central Appalachian coal as compared to spot prices of coal nationwide, based on the data provided by Mr. Rose, is quite informative:



**Q: What do you conclude from your analysis of Duke Energy's sensitivity analysis?**

Both the testimony of Mr. Rose and the miniscule effect of different coal price scenarios on the results of the sensitivity analysis indicate that the methods Duke used to project coal prices were unrealistic. If projections were based on any of the following data sets, they would be in violation of accepted modeling standards requiring the use of the most accurate data available for model inputs. Faulty data sets might include:

- Variation and/or trends in national averages of coal prices, rather than regional prices where, realistically, coal will have to be procured;
- Variation and/or trends in historic coal prices when, as Mr. Rose states, there were almost no coal plants being constructed, particularly since it is clear that those price trends are changing and that those changes are projected to continue.
- Price projections that intrinsically include unjustified assumptions such as billions of dollars of investments in railroad infrastructure over the next few years that are not currently promised or even projected.

Whether or not such data sets were used, however, Duke's models fail to meet accepted standards for scientific models in a number of other ways.

**Q: Please elaborate on why you believe, overall, that Duke Energy's cost models fail to meet accepted standards of modeling.**

In a recent presentation to the International Society For Pharmacoeconomics and Outcomes Research, three respected researchers and modelers outlined commonly accepted modeling standards in as systematic and thorough manner as I've seen[26]. According to these scientists, commonly quoted problems with modeling include:

- Lack of standardization and quality control in the development and reporting of modeling based studies.
- Potential for 'hidden' assumptions and data hard-coded into the model structure.
- Variation in quality of data, including use of 'expert' opinion.
- Difficulty in communicating results in an effective and balanced way to a non-modeling audience.

They also expressed concerns about bias that can be introduced in a number of ways that can be difficult to detect, including:

- Model structure (representation of time, dynamic relationships between variables, decision path)
- Data selection
- Data quality

Their primary recommendation to resolve these issues was transparency – in all phases of analysis from model development to data selection to results interpretation. In particular:

- Criteria used to select, prepare and include data in models and sub-analyses within those models (including a clear justification of criteria for including or excluding each input, methodological details for pooling of effect data and accounting for cost inflation, and details of the chronological development of the model)
- Methods used for validation of the model and details of a quality assurance plan.

They conclude that essential factors in the value of a model for decision-making purposes, what they call the "ABC's" of modeling, are whether the model is:

- Appropriate
- Believable
- Clear

As demonstrated in the previous sections, Duke has failed, at least in the procedures, assumptions and results they made public, to meet any of these three criteria.

On a personal note, as someone who has submitted, published, and reviewed a number of scientific papers, I find it disturbing that a model such as Duke has presented, which would never pass muster in a peer review process, could be used to justify billions of dollars in coal-based infrastructure investment and billions more in fuel costs – particularly since the public, not Duke Energy or it's shareholders, bear all of the risk. I am quite certain that a paper based on Duke's 2006 Annual Plan, would not pass the "laugh test" should it arrive on the desk of the editor of a peer-reviewed journal.

**Q: What do you propose as a remedy to the alleged problems in Duke Energy's models.**

An appropriate remedy, as mentioned in the summary, would be:

1. Consideration of Duke Energy's CPCN application be suspended for a period of 6-12 months to allow time for a thorough economic analysis of Duke's cost estimation models to be commissioned either by the NCUC, or by other formal interveners in this matter.
2. The assumptions of Duke's cost estimation models be made publicly available, particularly in regard to fuel costs and the costs and benefits associated with alternatives such as demand side management.
3. That Duke Energy's application for Certification of Public Convenience and Necessity be rejected if items 1 and 2 are unacceptable.

**Q: Does this conclude your testimony?**

Yes.

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