MEMORANDUM

TO: Energy Supply TWG members

FROM: Bill Dougherty and Donna Boysen

CC: Randy Strait, Tom Peterson

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RE: A brief overview of the proposed quantification approach for all energy supply options except cap-and-trade and carbon tax

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This memo outlines key elements of the approach we (i.e., CCS) plans to adopt methodology for quantifying the GHG impacts and costs for those TWG policy options that are considered amenable to quantification. The list of topics addressed in memo is summarized below. Feedback from energy supply TWG members is encouraged.

A. Premises

B. Outputs

C. Methodology

D. Assumptions

E. Cost Inclusion

F. Proposed Schedule and Process

A. Premises

There are a number of key premises upon which the analysis will be based, as briefly outlined below.

- *CCS role:* Unless a member of the ES TWG offers to undertake an analysis of any of the options, we assume that we (i.e., CCS) will undertake the analysis of the ES options. In the case where an ES TWG member does offer to undertake the analysis of one or more options, we will provide analytical support (e.g., review and technical feedback) as needed.
- *Transparency:* Data sources, methods, key assumptions, and key uncertainties are clearly indicated.
- *Analytical approach:* We adopt the general approach of cost-effectiveness (and NPV) analysis, as widely applied to GHG mitigation policy options.[1] We include direct, economic

[1] See e.g. Section 2.4 of the IPCC Fourth Assessment Report, Working Group III, for more discussion of various economic analysis approaches. http://www.mnp.nl/ipcc/pages_media/AR4-chapters.html

costs from the perspective of the state as whole (e.g. avoided costs of electricity rather than consumer electricity prices).

- *Bottom-up analysis:* We adopt a bottom-up approach which is amenable to transparency and is capable of reflecting the costs (and cost savings) associated with individual policy options, in contrast to macroeconomic analysis, which aims to capture flows and interactions across all sectors of the economy. Potential macroeconomic impacts, cost or benefits that fall disproportionately on specific groups or actors, as well external costs and benefits, should be noted qualitatively where studies or other information are available.

B. Outputs

The analysis of mitigation options will be organized so as to produce the following results:

- *Net GHG reduction potential* in million metric tons carbon dioxide equivalent ($MMtCO_2e$) using IPCC 100 yr global warming potential, reported annually for the years 2015, 2020, and 2025, as cumulatively for the period 2010-2025. Where significant additional GHG reductions or costs occur beyond the project period as a direct result of actions taken during the project period, these will be indicated as appropriate.
- *Net present value* (NPV) *cost* (or cost savings) for the period 2010-2025 in 2007 constant dollars, using a 5% real discount rate.[2] Positive numbers represent options with net costs; negative numbers represent options with net cost savings.
- *Cost per metric ton of CO_2 equivalent* emissions reduced (or removed) in units of dollar per metric ton of carbon dioxide equivalent ($/tCO2e). This figure represents the NPV cost divided by the cumulative emission reductions, both over the 2010-2025 period.

C. Methodology

As much as possible, the analysis will proceed using simple spreadsheet modeling techniques in which assumptions are transparent and readily accessible to any TWG member for review and adjustment. In order to ensure consistent results across options, common factors and assumptions will be used for items such as:

- *Electricity avoided costs and emissions:* Common values ($/MWh and tCO2/MWh) are being developed based on available studies. Now that a complete set of options has been identified, each option will a) first be analyzed individually and then b) addressed as part of an overall integrated analysis.
- *Fuel costs and projected escalation:* Fuel cost estimates will be based on common sources, wherever possible. For example, fossil fuel price escalation will be indexed to USDOE projections as indicated in their most recent Annual Energy Outlook.

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[2] Capital investments with lifetimes longer than 2025 are represented in terms of levelized or amortized costs, in order to avoid "end effects".

- *Overlap with other TWGs:* There are some ES options that may overlap with options being considered in the RCI TWG. The analysis for these options will take place in close coordination with the assumptions other inputs used in the RCI TWG.
- *Consumption-based approach:* this approach will be used which aims to reflect the emissions associated with electricity sources used to deliver electricity to consumers in AR. It is distinct from a production-basis approach which considers the emissions from Arkansas power plants, regardless of where the electricity is delivered.
- *Full fuel cycle approach:* Related to the previous point, a fuel cycle analysis is applied wherever emissions impacts upstream (e.g., production, extraction) or downstream (e.g. waste disposal) from a specific activity constitute a significant fraction of a policy option's emissions impacts *and* studies are sufficient to enable estimation.

D. Assumptions

As much as possible, the analysis will seek to rely on data sources that are Arkansas-specific, and which TWG members are in a good position to obtain and provide. The success of this approach will depend on how accessible the information is to TWG members and the timeliness in which it can be provided to the CCS analysis team.

Where Arkansas-specific information can not be readily obtained, the analysis will rely on published data from the US Department of Energy, National Laboratories, and other state climate change processes. Specific assumptions that will be needed to undertake the analysis are as outlined below. Some of these assumptions can be obtained from non-AR sources:

- Avoided costs associated with the most recent electric capacity expansion plans in AR
- New centralized renewable installation energy cost and performance assumptions.
- New centralized fossil power station cost and performance assumptions
- Fossil fuel price forecasts to electric generator through 2025 (i.e., distillate, residual oil, natural gas, coal, biomass);
- Any studies that provide spatial and temporal (as appropriate) quantitative estimates of renewable resource potential in AR (wind, solar, biomass, animal wastes)
- Any studies that provide an indication of the technical and economic potential of combined heat and power systems in AR (both commercial and industrial applications)
- Any studies that provide the costs associated with integrating large amounts of intermittent renewable technologies onto the system (where integration costs are expected to increase with increasing amounts of intermittent capacity).
- Any studies that examine alternative electric sector expansion plans in AR that have considered decoupling profits from sales, lost revenue adjustments, inverted block rates for residential consumers, and/or use of carbon adders.
- Any studies that examine the installation and operating costs of IGCC systems in AR.

E. Cost Inclusion

There are several types of costs that will be explicitly considered in the analysis and several types that we propose to exclude, as summarized below.

- *Costs included:* Examples include the following:
  - Capital costs levelized (amortized) where appropriate, e.g. for new energy supply facilities and associated infrastructure
  - O&M and other labor costs (or incremental costs relative to standard practice),
  - Fuel and material costs, e.g. for natural gas, electricity, biomass resources, water, fertilizer, material use, electricity transmission and distribution
  - Other direct costs administrative and other costs (where readily estimated), such as the grid integration costs for renewable energy technologies
- *Costs excluded:* Examples include the following:
  - External costs such as the monetized environmental or social benefits/impacts (value of damage by air pollutants on structures, crops, etc.), quality-of-life improvements, or improved road safety, or other health impacts and benefits
  - Energy security benefits
  - Macroeconomic impacts related to the impact reduced or increased consumer spending, shifting of cost and benefits among actors in the economy