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Memo

To: South Carolina Climate, Energy and Commerce Advisory Committee

From: The Center for Climate Strategies

CC: Executive Office of South Carolina Governor Mark Sanford
Chairman, the Honorable Representative Ben Hagood, South Carolina Senate
South Carolina Department of Health and Environmental Control; South Carolina Department of Natural Resources

Subject: Methods for quantification of draft greenhouse gas (GHG) benefits and costs / cost savings for policy options

Date: November 30, 2007

This memo describes in brief the methodology the Center for Climate Strategies (CCS) uses in quantifying the greenhouse gas (GHG) impacts and costs / cost savings of policy options, and provides some examples of the distinction between "direct" and "indirect" costs. CCS uses the following general methods, widely accepted among climate change mitigation policy analysts, by customizing the analysis of each policy option to the policy design features and specifications for analysis resulting from facilitated agreement, as follows:

- Focus of analysis: Net GHG reduction potential in physical units of million metric tons (MMt) of carbon dioxide equivalent (CO_2e) and net cost per metric ton reduced in units of dollars per metric ton of carbon dioxide equivalent ($/Mt$CO_2e$). Where possible, full life cycle analysis is used to evaluate the net energy performance of actions (taking into account all energy inputs and outputs to production). Net analysis of the effects of carbon sequestration is conducted where applicable.
- Geographic inclusion: Measure GHG impacts of activities that occur within the state, regardless of the actual location of emissions reductions.
- Direct vs. Indirect Effects: Define "direct effects" as those borne by the entities implementing the policy recommendation. For example, direct costs are net of any benefits or savings to the entity. Define "indirect effects" as those borne by the entities other than those implementing the policy recommendation. Quantify these indirect effects on a case-by-case basis depending on magnitude, importance, need and availability of data. (See additional discussion and list of examples below.)

- Non-GHG (external) impacts and costs: Include in qualitative terms where deemed important. Quantify on a case-by-case basis as needed depending on need and where data are readily available.
- Discounted and "Levelized" Costs: Discount a multi-year stream of net costs (total costs net of any savings) to arrive at the "net present value cost" of a policy option. Discount costs in constant 2005 dollars using a 5% annual real discount rate for the period 2008 through 2020. Capital investments are represented in terms of levelized or amortized costs through 2020. Create a "levelized" cost per ton by dividing the "present value cost" by the cumulative reduction in tons of GHG emissions. This is a widely used method to estimate the "dollars per ton" cost or cost savings of reducing GHG emission (all in CO_2e). A "levelized" cost is a "present value average" used in a variety of financial cost applications.
- Time period of analysis: Count the impacts of actions that occur during the project time period and, using levelized emissions reduction and cost analysis, report emissions reductions and costs for specific target years such as 2012 and 2020. Where additional GHG reductions or costs occur beyond the project period as a direct result of actions taken during the project period, show these for comparison and potential inclusion.
- Aggregation of cumulative impacts of policy options: In addition to "stand alone" results for individual options, CCS will estimate cumulative impacts of all options combined. In this process we avoid simple double counting of GHG reduction potential and cost when adding emission reductions and costs associated with all of the policy recommendations. To do so we note and or estimate interactive effects between policy recommendations using analytical methods where overlap is likely.
- Policy design specifications and other key assumptions: Include transparent notation of timing, goal levels, implementing parties, the type of implementation mechanism, and other key assumptions as determined by the Climate, Energy and Commerce Advisory Committee (CECAC).
- Transparency: Include policy design choices (above) as well as data sources, methods, key assumptions, and key uncertainties. Use data and comments provided by the CECAC and Technical Work Groups (TWGs) to ensure best available data sources, methods, and key assumptions using their expertise and knowledge to address specific issues in South Carolina. Modifications will be made through facilitated decisions, as needed, to improve analysis.
- Cost Effectiveness: Because monetized dollar value of GHG reduction benefits are not available, physical benefits are used instead, measured as dollars per $MMtCO_2e$ (cost per ton) or "cost effectiveness" evaluation. Both positive costs and cost savings (negative costs) are estimated as a part of compliance cost.

For additional reference see the economic analysis guidelines developed by the Science Advisory Board of the US EPA available at:
http://yosemite.epa.gov/ee/epa/eed.nsf/webpages/Guidelines.html.

Examples of Direct/Indirect Net Costs and Benefits

Note: These examples are meant to be illustrative.

Residential, Commercial, and Industrial (RCI) Sectors

Direct Costs and/or Benefits

- Net capital costs (or incremental costs relative to standard practice) of improved buildings, appliances, equipment (cost of higher-efficiency refrigerator versus refrigerator of similar features that meets standards)
- Net operation and maintenance (O&M) costs (relative to standard practice) of improved buildings, appliances, equipment, including avoided/extra labor costs for maintenance (less changing of compact fluorescent light (CFL) or light-emitting diode (LED) bulbs in lamps relative to incandescent)
- Net fuel (gas, electricity, biomass, etc.) costs (typically as avoided costs from a TRC or societal perspective)
- Cost/value of net water use/savings
- Cost/value of net materials use/savings (for example, raw materials savings via recycling, or lower/higher cost of low-global warming potential (GWP) refrigerants)
- Direct improved productivity as a result of industrial measures (measured as change in cost per unit output, for example, for an energy/GHG-saving improvement that also speeds up a production line or results in higher product yield)

Indirect Costs and/or Benefits

- Re-spending effect on economy
- Net value of employment impacts
- Net value of health benefits/impacts
- Value of net environmental benefits/impacts (value of damage by air pollutants on structures, crops, etc.)
- Net embodied energy of materials used in buildings, appliances, equipment, relative to standard practice
- Improved productivity as a result of an improved working environment, such as improved office productivity through improved lighting (though the inclusion of this as indirect might be argued in some cases)

Energy Supply (ES) Sector

Direct Costs and/or Benefits

- Net capital costs (or incremental costs relative to reference case technologies) of renewables or other advanced technologies resulting from policies

- Net O&M costs (relative to reference case technologies) renewables or other advanced technologies resulting from policies
- Avoided or net fuel savings (gas, coal, biomass, etc.) of renewables or other advanced technologies relative to reference case technologies resulting from policies
- Total system costs (net capital + net O&M + avoided/net fuel savings + net imports/exports + net transmission and distribution (T&D) costs) relative to reference case total system costs

Indirect Costs and/or Benefits

- Re-spending effect on economy
- Higher cost of electricity reverberating through economy
- Energy security
- Net value of employment impacts
- Net value of health benefits/impacts
- Value of net environmental benefits/impacts (value of damage by air pollutants on structures, crops, etc.)

Agriculture, Forestry, and Waste Management (AFW) Sectors

Direct Costs and/or Benefits

- Net capital costs (or incremental costs relative to standard practice) of facilities or equipment (e.g., manure digesters and associated infrastructure, generator; ethanol production facility)
- Net O&M costs (relative to standard practice) of equipment or facilities
- Net fuel (gas, electricity, biomass, etc.) costs or avoided costs
- Cost/value of net water use/savings

Indirect Costs and/or Benefits

- Net value of employment impacts
- Net value of human health benefits/impacts
- Net value of ecosystem health benefits/impacts (wildlife habitat; reduction in wildfire potential; etc.)
- Value of net environmental benefits/impacts (value of damage by air or water pollutants on structures, crops, etc.)
- Net embodied energy of water use in equipment or facilities relative to standard practice
- Reduced VMT and fuel consumption associated with land use conversions (e.g., as a result of forest/rangeland/cropland protection policies)

Transportation and Land Use (TLU) Sector

Direct Costs and/or Benefits

- Incremental cost of more efficient vehicles net of fuel savings.
- Incremental cost of implementing Smart Growth programs, net of saved infrastructure costs.
- Incremental cost of mass transit investment and operating expenses, net of any saved infrastructure costs (e.g., roads)
- Incremental cost of alternative fuel, net of any change in maintenance costs

Indirect Costs and/or Benefits

- Health benefits of reduced air and water pollution.
- Ecosystem benefits of reduced air and water pollution.
- Value of quality-of-life improvements.
- Value of improved road safety.
- Energy security
- Net value of employment impacts