



## Energy Supply and Demand (ESD) Quantification Memorandum

**To:** Florida Governor's Action Team on Energy and Climate Change  
**From:** The Center for Climate Strategies (CCS)  
**CC:** Jeremy Susac, Brenda Buchan  
**Subject:** Proposed approach for the quantification of greenhouse gas (GHG) emission reductions and costs associated with energy supply and demand mitigation options in Florida  
**Date:** July 29, 2008 – updated August 4, 2008

---

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

- A. Premises
- B. Outputs
- C. Methodology
- D. Assumptions
- E. Cost Inclusion

### 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 ESD TWG offers to undertake an analysis of any of the options, we assume that we (i.e., CCS) will undertake the analysis of the ESD options. In the case where an ESD 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 net present value [NPV]) analysis, as widely applied to GHG mitigation policy options.<sup>1</sup> We include direct, economic costs from the perspective of the state as whole (for example, we base the

---

<sup>1</sup> See, for example, Section 2.4 of the IPCC Fourth Assessment Report, Working Group III, for more discussion of various economic analysis approaches. [http://www.MDp.nl/ipcc/pages\\_media/AR4-chapters.html](http://www.MDp.nl/ipcc/pages_media/AR4-chapters.html)

net costs or savings of options that reduce electricity usage on the avoided costs of electricity, rather than consumer electricity prices).

- **Bottom-up analysis:** We adopt a bottom-up approach that is transparent (and thus amenable to easy review) 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, costs, or benefits that fall disproportionately on specific groups or actors, as well external costs and benefits, are 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 of carbon dioxide equivalent (MMtCO<sub>2</sub>e) using Intergovernmental Panel on Climate Change (IPCC) 100-year global warming potential, reported annually for the years 2015 and 2025, and cumulatively for the period 2009–2025. 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 cost** (or cost savings) for the period 2009–2025 in 2006 constant dollars, using a 5% real discount rate.<sup>2</sup> Positive numbers represent options with net costs; negative numbers represent options with net cost savings.
- **Cost per metric ton of CO<sub>2</sub> equivalent** emissions reduced (or removed) in units of dollars per metric ton of carbon dioxide equivalent (\$/tCO<sub>2</sub>e). This figure represents the NPV cost divided by the cumulative emission reductions, both over the 2009–2025 timeframe.

## 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 to suggest adjustment by the analysis team. In order to ensure consistent results across options (including options evaluated by different TWGs), common factors and assumptions will be used for items such as

- **Electricity avoided costs and emissions:** Common values such as \$/MWh (dollars per megawatt-hour) and tCO<sub>2</sub>/MWh (metric tons of carbon dioxide per megawatt-hour) are being developed based on available studies. Now that a complete set of options has been identified, each option will first be analyzed individually and then be 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 U.S.

---

<sup>2</sup> Capital investments with lifetimes longer than 2025 are represented in terms of levelized or amortized costs, in order to avoid “end effects.”

Department of Energy (DOE) projections as indicated in their most recent Annual Energy Outlook.

- **Overlap with other TWGs:** There are some ESD options that may overlap with options being considered in other TWGs. The analysis for these options will take place in close coordination with other TWGs to ensure that the assumptions used are consistent and to reduce the degree to which options overlap.
- **Consumption-based approach:** The approach used will reflect the emissions associated with electricity sources that deliver electricity to consumers in Florida. This approach is distinct from a production-basis approach that considers the emissions from Florida 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* where existing studies are sufficient to enable estimation.

#### D. Assumptions

As much as possible, the analysis will seek to rely on data sources that are Florida-specific and that 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 Florida-specific information cannot be readily obtained, the analysis will rely on published data from DOE, national laboratories, and other state climate change processes. Specific assumptions that will be needed to undertake the analysis are outlined below. Some of the following assumptions can be obtained from non-Florida sources.

- Avoided costs associated with the most recent electric capacity expansion plans in Florida;
- New centralized renewable installation energy cost and performance assumptions;
- New centralized fossil power station cost and performance assumptions;
- Fossil fuel price forecasts for electricity generation through 2025 (i.e., distillate, residual oil, natural gas, coal, and biomass);
- Any studies that provide spatial and temporal (as appropriate) quantitative estimates of renewable resource potential in Florida (wind, solar, biomass, and animal wastes);
- Any studies that provide an indication of the technical and economic potential of combined heat and power systems in Florida (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 Florida that have considered decoupling profits from sales, lost revenue adjustments, inverted block rates for residential consumers, and/or use of carbon adders; and
- Any studies that examine the installation and operating costs of integrated gasification combined cycle (IGCC) systems in Florida.

## **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):**
  - Capital costs levelized (amortized) where appropriate (e.g., for new energy supply facilities and associated infrastructure);
  - Operations and maintenance (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, and electricity transmission and distribution); and
  - Other direct administrative costs and other costs (where readily estimated), such as the grid integration costs for renewable energy technologies.
- **Costs excluded (examples):**
  - External costs, such as the monetized environmental or social benefits/impacts (e.g., value of damage by air pollutants to structures and crops), quality-of-life improvements, improved road safety, or other health impacts and benefits;
  - Energy security benefits; and
  - Macroeconomic impacts related to the impact of reduced or increased consumer spending, jobs impacts, and shifting of costs and benefits among actors in the economy.

## Current Assumptions – August 4, 2008 (Information has not been reviewed by TWG members)

This section provides the values currently used/suggested for analysis and a preliminary list of data sources to be considered for each Tier I option.

### Estimate of Mitigation Option Costs and Benefits for State ESD GHG Analysis Common Assumptions

Date Last Modified: 8/5/2008 A Bailie

#### Common Assumptions

Real Discount Rate **5%**

#### Levelized, Avoided Costs (2006-2020, 2005\$)

Electricity - Sales-Weighted Average **\$60** \$/MWh  
*Placeholder, waiting input from Florida Public Service*

Electricity - Residential **\$60** \$/MWh

Electricity - Commercial **\$60** \$/MWh

Electricity - Industrial **\$60** \$/MWh

*Levelized Costs not differentiated by sector for this analysis.*

Natural Gas **\$7.6** \$/MMBtu

*Note: In the absence (as of 8/1/08) of specific avoided gas costs, we derive a placeholder estimate for avoided gas costs by starting with average 2007 citygate gas costs and escalating costs based on escalation in weighted-average regional AEO2008 estimates for gas cost by sector. These values should be replaced by state-specific costs when and if available.*

#### Prices

Electricity Price - Sales-Weighted, Levelized **\$102** \$/MWh

*Prices are based on DOE data for prices in 2007 [http://www.eia.doe.gov/cneaf/electricity/esr/esr\\_sum.html](http://www.eia.doe.gov/cneaf/electricity/esr/esr_sum.html). Changes from 2008 to 2025 are based on the relative changes in projected Florida ERC reliability Corporation region prices in US DOE Annual Energy Outlook 2008 (same % changes). AEO 2008 projects prices to declining to below 2005 levels from 2013 onward.*

Electricity - Residential Prices (Levelized, 2008-2025) **\$112** \$/MWh

Electricity - Commercial Prices (Levelized, 2008-2025) **\$96** \$/MWh

Electricity - Industrial Prices (Levelized, 2008-2025) **\$74** \$/MWh

Natural Gas (Delivered, RCI sales-weighted average) **\$13.2** \$/MMBtu

*Natural gas prices are estimated as described for electricity above.*

Natural Gas - Residential Prices (Levelized, 2008-2025) **\$20.2** \$/MMBtu

Natural Gas - Commercial Prices (Levelized, 2008-2025) **\$12.8** \$/MMBtu

Natural Gas - Industrial Prices (Levelized, 2008-2025) **\$10.6** \$/MMBtu

Biomass - All Users **\$3.0** \$/MMBtu

*Estimate based on national study of state-by-state biomass resource assessments--see worksheet "Biomass\_Data" in this workbook. Price equivalent of \$47/dry ton at 16 MMBtu/dry ton. Replace with more State-specific estimates (for example, from AF group when available).*

**Coal - Industrial Users**

**\$3.1** \$/MMBtu

average coal heat content of 26.75 MMBTU/ton, based on 2001 USDOE/EIA data. USDOE/EIA figures for 2006 from suggest average coal price of \$84.16 per ton for coal for "Other Industrial Users" in Florida. [www.eia.doe.gov/cneaf/coal/page/acr/table34.html](http://www.eia.doe.gov/cneaf/coal/page/acr/table34.html)

**Oil - Distillate/Diesel**

**\$14.7** \$/MMBtu

USDOE/EIA data gives average annual spot prices for heating oil of \$2.03 per gallon in the 2007 heating season. This cost does not include fuel taxes. An appendix to the [2006 Annual Energy Outlook](#) by USDOE/EIA (see <http://www.eia.doe.gov/oiaf/aeo/pdf/appendixes.pdf>) lists an energy content for distillate oil of 5.799 MMBtu/bbl, or 0.138 MMBtu/gallon.

**LPG**

**\$13.2** \$/MMBtu

USDOE/EIA data gives average annual spot prices for propane of \$1.21 per gallon in 2007. This cost does not include fuel taxes. Prices expressed on \$/MMBtu basis a conversion factor of 0.09133 MMBtu/gallon (see "Fuel Data" woksheet)

**Landfill Gas - All Users**

**\$5.0** \$/MMBtu

Placeholder Estimate

**Biogas Gas - All Users**

**\$5.0** \$/MMBtu

Placeholder Estimate

Emission Rates, etc.	2015	2025	Units
<b>Electricity T&amp;D losses (fraction of total generation)</b> <i>placeholder, input needed from Inventory and Forecast</i>	5.0%	5.0%	

**Avoided electricity emissions rate**

**TBD** **TBD** tCO<sub>2</sub>/MWh

Assumes that reductions in electricity generation requirements through 2015 will come from the average emissions rate of then-existing fossil-fueled sources; by 2025 the predominant effect is assumed to be a reduction in reference case new fossil fuel plant builds during the 2015-2025 period.

**Costs for New Power Plants**

This sub-section presents preliminary estimates for power plant cost data for Florida. Florida-specific power plant data are available from the Florida Public Service Commission's (the Commission) website.<sup>3</sup> The data were submitted to the Commission by various stakeholders in response to the Commission's data request resulting from a renewable portfolio standard (RPS) workshop held on July 11, 2008. The purpose of the questionnaire was to provide the Commission with cost and technical potential information of renewable energy technologies within the State of Florida. Section 366.92(3)(a) of Florida Statutes directs the Commission to evaluate the current and forecasted installed capacity and levelized cost for each renewable energy generation method through 2020 as part of developing RPS requirements for the state. Both regulated electric utilities and interested parties were invited to provide information to the Commission. Completed questionnaires are available on the Commission website.<sup>4</sup>

Participants of the RPS workshop included representatives from

- Decker Energy International
- Florida Public Utilities Company

<sup>3</sup> [http://www.floridapsc.com/utilities/electricgas/RenewableEnergy/07\\_11\\_2008\\_index.aspx](http://www.floridapsc.com/utilities/electricgas/RenewableEnergy/07_11_2008_index.aspx)

<sup>4</sup> [http://www.floridapsc.com/utilities/electricgas/RenewableEnergy/07\\_11\\_2008\\_index.aspx](http://www.floridapsc.com/utilities/electricgas/RenewableEnergy/07_11_2008_index.aspx)

- OUC
- Progress Energy Florida, Incorporated
- Florida Industrial Cogeneration Association
- Tamp Electric Company
- Wheelabrator Technologies
- BioMass Gas and Electric, LLC
- Lakeland Electric
- Regensis Power, LLC
- Southern Alliance for Clean Energy
- Solid Waste Authority of Palm Beach County
- Florida Power and Light
- Gulf Power Company
- Professional Timber Harvesting Business Owners in Florida
- Covanta Energy
- Florida Solar Energy Center
- Seminole Electric Cooperative
- City of Clewiston
- City of Tampa
- Pinellas County Resource Recovery Facility
- Integrated Waste Services Association
- Florida Solar Coalition
- Florida Crystals

Participants were provided with a specific data entry form, available at the Commission's website.<sup>5</sup> The data submitted contain several types of data on both renewable energy and some conventional power plants including capital and O&M costs, levelized cost, capacity rating, capacity factor, and emission factors. Included renewable energy sources are solar, wind, biomass, hydro, biomass, landfill gas, municipal solid waste, ocean current, and chemical processing heat.

Table 1 summarizes median values and the range of capacity rating as well as capital costs of the response data.<sup>6</sup> Median and the range values were estimated because capacity rating and/or capital costs for some types of power plants are significantly different among data sources.<sup>7</sup>

---

<sup>5</sup> [http://www.floridapsc.com/utilities/electricgas/RenewableEnergy/RPS\\_Data\\_Collection.pdf](http://www.floridapsc.com/utilities/electricgas/RenewableEnergy/RPS_Data_Collection.pdf)

<sup>6</sup> Other important information such as O&M costs, capacity factor, project life, and weighted average cost of capital will be presented in the next documentation.

<sup>7</sup> We did not include some data sources for this summary table when they present data in an inconsistent unit such as \$/kW per year for capital costs or when the respondents did not provide specific data because such data are not

**Table 1. Summary of the capital cost data on renewable energy power plants submitted to Florida Public Service Commission in its RPS Workshop (2006\$)**

Fuel	Energy source	Median capacity (MW)	Capacity range (MW)	Median capital cost (in 2006\$)	Capital cost range (in 2006\$)
<b>Biomass</b>	Biodiesel	Oil CT	Oil CT	Oil CT	Oil CT
	Biomass-direct combustion and plant matter	63	35-80	\$2,519	\$2,000-\$3,040
	Biomass-animal waste	50	50	\$4,199	\$4,199
	Biomass-anaerobic digester	0.15	0.15	\$4,152	\$3,440-\$4,860
	Biomass-gasification	43	35-50	\$5,416	\$2,960-\$7,870
<b>Landfill gas</b>	Landfill gas	5	3-6	\$1,576	\$1,470-\$1,950
<b>Waste</b>	Municipal solid waste	50	15-95	\$6,311	\$2,940-\$7,874
<b>Solar</b>	Photovoltaic - small scale	0.006	0.005-0.25	\$7,417	\$6,490-\$7,870
	Photovoltaic - over 1 MW	5	1-11	\$5,201	\$4640-\$6490
	Solar water heating	0.002	0.0015-0.002	\$1,854	\$1,530-\$2,780
	Solar thermal electric	75	2-100	\$4,217	\$1,520-\$5,690
<b>Chemical processing heat</b>	Sulfuric acid waste heat	35	5-250	\$2,846	\$1,180-\$3,330
<b>Water</b>	Hydro dam (incremental)	41	2-81	\$1,131	\$770-\$1,740
	Run of river hydro	26	2-50	\$2,035	\$880-\$3,190
	Hydro pumped storage	383	1-770	\$1,462	\$882-\$2,040
<b>Ocean current</b>	Ocean thermal gradients	10	10	\$12,455	\$12,455
	Ocean tidal change	10	10	\$2,573	\$2,573
	Ocean wave action	5	0.75-10	\$4,337	\$3890-\$4,790
<b>Wind</b>	Wind coastal	102	3.25-200	\$2,640	\$2560-\$2,720
	Wind inland	39	3.25-75	\$2,203	\$1847-\$2,559
	Wind offshore	102	4-200	\$3,334	\$2,720-\$3,950

Note: all dollar values are converted to 2006\$ using 2.5% inflation rate.

available, unknown, or confidential (e.g., some biomass plants and municipal solid waste plants). We also excluded a few data sources on the ground that they appear as outliers, presenting extremely low or high values compared to others (e.g., \$13,000 per kW in one case for offshore wind). Also note that specific cost of biodiesel plants were not provided, but instead were referred by the respondents to the cost for oil combustion turbines (Oil CT).

## Data Sources for Analysis of Options (preliminary list)

### ESD-3. Renewable Energy Incentives and Barrier Removal

- Renewables definition – Florida legislature, 366.91 in 2008
- Renewable resource potential – TBD
- Renewable plant costs – TBD
- Avoided cost and emissions for electricity – see common assumptions

### ESD-5. Renewable Portfolio Standard (RPS)

- Renewables definition – Florida legislature, 366.91 in 2008
- Renewable resource potential
  - Navigant Consulting Inc. October 2007. *Renewable Systems Interconnection: Rooftop PV Market Penetration Scenarios* (draft), available at: [http://www1.eere.energy.gov/solar/solar\\_america/pdfs/14\\_rsi\\_rooftop\\_pv\\_market\\_penetration\\_draft\\_103007.pdf](http://www1.eere.energy.gov/solar/solar_america/pdfs/14_rsi_rooftop_pv_market_penetration_draft_103007.pdf)
  - FPL. January 2007. “Renewable Energy Potential in Florida,” available at: [www.psc.state.fl.us/utilities/electricgas/RenewableEnergy/Hartman-FPL.ppt](http://www.psc.state.fl.us/utilities/electricgas/RenewableEnergy/Hartman-FPL.ppt)
  - Florida Public Service Commission. March 2008. *PSC Staff Summary of the Information Gained from Public Service Commission Workshops on a Renewable Portfolio Standard*, available at: [http://www.psc.state.fl.us/utilities/electricgas/RenewableEnergy/2008\\_03RPSSummaryFinal.pdf](http://www.psc.state.fl.us/utilities/electricgas/RenewableEnergy/2008_03RPSSummaryFinal.pdf)
- Renewable plant costs (2010–2025)
  - State of Florida Public Service Commission’s (FL PSC’s) renewable energy database.<sup>8</sup>
    - Decker Energy. RPS Data Forms 1 to 6.
    - Florida Phosphate Fertilizer Manufacturers CF Industries, Mosaic, and PCS. RPS Data Forms 1 to 6.
    - Florida Solar Coalition. RPS Data Forms 1 to 6.
    - Florida Crystals. RPS Data Forms 1 to 6.
    - Gulf Power Company. RPS Data Forms 1 to 6.
    - Hillsborough County Resource Recovery Facility–Existing–Covanta Hillsborough. RPS Data Forms 1 to 6.
    - OUC. RPS Data Forms 1 to 6.
    - Progress Energy Florida, Inc. RPS Data Forms 1 to 6. July 21, 2008.
    - Pinellas County Resource Recovery Facility. RPS Data Forms 1 to 6.
    - Regensis Power LLC. RPS Data Forms 1 to 6.

---

<sup>8</sup> [http://www.floridapsc.com/utilities/electricgas/RenewableEnergy/07\\_11\\_2008\\_index.aspx](http://www.floridapsc.com/utilities/electricgas/RenewableEnergy/07_11_2008_index.aspx)

- Solid Waste Authority of Palm Beach County. RPS Data Forms 1 to 6.
- Florida Power & Light Company. RPS Data Forms 1 to 6.
- Tampa Electric Company. RPS Data Forms 1 to 6.
- Wheelabrator South Broward Inc. RPS Data Forms 1 to 6.
- National Renewable Energy Laboratory, National Wind Technology Center. November 19, 2007. “Wind Integration Impacts: Results of Detailed Simulation Studies and Operational Practice in the U.S.,” (presents data on wind integration costs). Available at: [http://www.neo.ne.gov/renew/wind-working-group/milligan\\_wind-integration-nppd.ppt](http://www.neo.ne.gov/renew/wind-working-group/milligan_wind-integration-nppd.ppt)
- Wisner, R. and M. Bolinger. May 2007. *Annual Report on U.S. Windpower Installation, Cost, and Performance Trends: 2006*, U.S. DOE, Lawrence Berkeley National Laboratory. Available at: <http://www.nrel.gov/docs/fy07osti/41435.pdf>
- Wisner, R., M. Bolinger, P. Cappers, and R. Margolis. January 2006. *Letting the Sun Shine on Solar Costs: An Empirical Investigation of Photovoltaic Cost Trends in California*, LBNL-59282, U.S. DOE, Lawrence Berkeley National Laboratory. Available at: <http://eetd.lbl.gov/ea/EMP/reports/59282.pdf>

#### **ESD-6. Nuclear Power**

- Nuclear plant costs (2010–2025)
  - Florida Power & Light Company. RPS Data Forms 1 to 6. [http://www.floridapsc.com/utilities/electricgas/RenewableEnergy/07\\_11\\_08\\_Staff\\_to\\_FPL.pdf](http://www.floridapsc.com/utilities/electricgas/RenewableEnergy/07_11_08_Staff_to_FPL.pdf)
  - Moody’s Investors Service. October 2007. “New Nuclear Generation in the United States: Keeping Options Open vs. Addressing An Inevitable Necessity.”
  - Morris, C. et al. June 2007. *Nuclear Power Joint Fact-Finding*, The Keystone Center. Available at: [http://www.keystone.org/spp/documents/FinalReport\\_NJFF6\\_12\\_2007\(1\).pdf](http://www.keystone.org/spp/documents/FinalReport_NJFF6_12_2007(1).pdf)

#### **ESD-8. Combined Heat and Power (CHP) Systems**

- Costs and potential of CHP systems
  - ACEEE. June 2007. *Potential for Energy Efficiency and Renewable Energy to Meet Florida’s Growing Energy Demands*.
  - US EPA, recent analysis to be posted in early August, contact Katrina Pielli.
  - GRI and NREL 2003—Gas Research Institute and U.S. DOE National Renewable Energy Laboratory. 2003. “Gas-Fired Distributed Energy Resource Technology Characterizations: Bringing You a Prosperous Future Where Energy Is Clean, Abundant, Reliable, and Affordable,” available at: [www.eea-inc.com/dgchp\\_reports/TechCharNREL.pdf](http://www.eea-inc.com/dgchp_reports/TechCharNREL.pdf)

#### **ESD-9. Power Plant Efficiency Improvements**

- Utility reports to Florida Public Service Commission

### **ESD-11. Waste-To-Energy (WTE)**

- Costs and potential of landfill gas systems
  - EPA Landfill Methane Outreach Program. Available at: <http://www.epa.gov/lmop/proj/index.htm>

### **ESD-12. Demand-Side Management (DSM)/Energy Efficiency Programs, Funds, or Goals for Electricity**

- Costs and potential of DSM programs
  - ACEEE. June 2007. *Potential for Energy Efficiency and Renewable Energy to Meet Florida's Growing Energy Demands*.
- Costs and potential of DSM programs in other states
  - GDS Associates, Inc. December 2006. "A Study of the Feasibility of Energy Efficiency as an Eligible Resource as Part of a Renewable Portfolio Standard for the State of North Carolina," Report for the North Carolina Utilities Commission. Available at: <http://www.ncuc.commerce.state.nc.us/reps/NCRPSEnergyEfficiencyReport12-06.pdf>
  - GDS Associates, Inc. 2007. "Electric Energy Efficiency: Potential Study for Central Electric Power Cooperative, Inc.: Final Report," updated September 21, 2007. Available at: [www.ecsc.org/newsroom/EfficiencyStudy.ppt](http://www.ecsc.org/newsroom/EfficiencyStudy.ppt)
  - Forefront Economics, Inc., H. Gil Peach & Associates LLC, and PA Consulting Group. July 24, 2007. Duke Energy Carolinas DSM Action Plan: South Carolina Draft Report.
- Experience in other states on cost of energy efficiency
  - Prindle, B. 2007. "Energy Efficiency: The First Fuel in the Race for Clean and Secure Energy," presentation at the National Action Plan for Energy Efficiency Southeast Energy Efficiency Workshop on September 28, 2007. Available at: [http://www.epa.gov/solar/pdf/southeast\\_28sep07/prindle\\_new\\_napee\\_presentation\\_atlanta\\_9\\_28\\_07.pdf](http://www.epa.gov/solar/pdf/southeast_28sep07/prindle_new_napee_presentation_atlanta_9_28_07.pdf)
  - Kushler, M., D. York, and P. White. April 2004. *Five Years In: An Examination of the First Half-Decade of Public Benefits Energy Efficiency Policies*, Washington, DC: American Council for an Energy Efficient Economy. Available at: <http://www.aceee.org/pubs/u041.htm>
  - Fry, G. 2003. "Massachusetts Electric Utility Energy Efficiency Database," Massachusetts Department of Telecommunications and Energy, 2003 edition. (Not available online.)
  - Heschong Mahone Group, Inc. June 2005. *New York Energy Smart<sup>SM</sup> Program Cost-Effectiveness Assessment*, prepared for New York State Energy Research and Development Authority. Available at: [http://www.nyserda.org/Energy\\_Information/ContractorReports/Cost-Effectiveness\\_Report\\_June05.pdf](http://www.nyserda.org/Energy_Information/ContractorReports/Cost-Effectiveness_Report_June05.pdf)

- WGA 2006—Energy Efficiency Task Force Report to the Clean and Diversified Energy Advisory Committee of the Western Governors’ Association. January 2006. *The Potential for More Efficient Electricity Use in the Western United States*. Denver, CO: Western Governors’ Association. Available at: <http://www.westgov./wga/initiatives/%20Efficiency-full.pdf>.
- GDS Associates, Inc. December 2006. A Study of the Feasibility of Energy Efficiency as an Eligible Resource as Part of a Renewable Portfolio Standard for the State of North Carolina, Report for the North Carolina Utilities Commission. Available at: <http://www.ncuc.commerce.state.nc.us/reps/NCRPSEnergyEfficiencyReport12-06.pdf>
- GDS Associates, Inc. 2007. “Electric Energy Efficiency: Potential Study for Central Electric Power Cooperative, Inc.: Final Report,” updated September 21, 2007. Available at: [www.ecsc.org/newsroom/EfficiencyStudy.ppt](http://www.ecsc.org/newsroom/EfficiencyStudy.ppt)
- Forefront Economics, Inc., H. Gil Peach & Associates LLC, and PA Consulting Group. July 24, 2007. Duke Energy Carolinas DSM Action Plan: South Carolina Draft Report.

State/Utility	CSE (\$kWh)	Program Year	Source
Western Utilities	0.025	1978–2004	WGA 2006 <sup>9</sup>
Northwest Energy	0.02	2006	Montana PSC Docket No.: D2005.5.88 07/12/06 <sup>10</sup>
New York	0.03	2004	Heschong Mahone Group, Inc. 2005 <sup>11</sup>
Massachusetts IOUs	0.038	2002	Gene Fry 2003 <sup>12</sup>
California	0.03	n/a	ACEEE 20004 <sup>13</sup>
Connecticut	0.023	n/a	ACEEE 20004
New Jersey	0.03	n/a	ACEEE 20004
Vermont	0.03	n/a	ACEEE 20004
North Carolina	0.029		GDS Associates, Inc. 2006

<sup>9</sup> Energy Efficiency Task Force Report to the Clean and Diversified Energy Advisory Committee of the Western Governors' Association (January 2006), *The Potential for More Efficient Electricity Use in the Western United States*. Denver, CO: Western Governors' Association. Available at: <http://www.westgov./wga/initiatives/%20Efficiency-full.pdf>.

<sup>10</sup> Available at <http://www.psc.state.mt.us/eDocs/>.

<sup>11</sup> Heschong Mahone Group, Inc. (June 2005), *New York Energy Smart<sup>SM</sup> Program Cost-Effectiveness Assessment*, prepared for New York State Energy Rresearch and Development Authority. Available at: [http://www.nyserda.org/Energy\\_Information/ContractorReports/Cost-Effectiveness\\_Report\\_June05.pdf](http://www.nyserda.org/Energy_Information/ContractorReports/Cost-Effectiveness_Report_June05.pdf).

<sup>12</sup> Gene Fry, “Massachusetts Electric Utility Energy Efficiency Database,” Massachusetts Department of Telecommunications and Energy, 2003 edition. (Not available online.)

<sup>13</sup> Martin Kushler, Dan York, and Patti White (April 2004), *Five Years In: An Examination of the First Half-Decade of Public Benefits Energy Efficiency Policies*, Washington, DC: American Council for an Energy Efficient Economy. Available at: <http://www.aceee.org/pubs/u041.htm>.

### **ESD-13a. Energy Efficiency for Existing Residential**

- Costs and potential of DSM programs
  - ACEEE June 2007. Potential for Energy Efficiency and Renewable Energy to meet Florida's Growing Energy Demands
  - Additional information provided by Florida Solar Energy Center (Philip Fairey)

### **ESD-14. Improved Building Codes for Energy Efficiency**

- Florida HB 697 and HB 7135
- Building Codes Assistance Project, [www.bcap-energy.org](http://www.bcap-energy.org)
- Building Codes Assistance Project (BCAP), "Code Status Detail," available at: [http://www.bcap-energy.org/code\\_status.php?STATE\\_AB=SC](http://www.bcap-energy.org/code_status.php?STATE_AB=SC)
- Lucas, R.G. January 2007. "Analysis of Energy Saving Impacts of New Residential Energy Codes for the Gulf Coast," PNNL 16265, Richland, WA: U.S. DOE, Pacific Northwest National Laboratory. Accessed January 2, 2008, at: <http://www.energycodes.gov/pdf/pnnl16265.pdf>
- Halverson, M.A., K. Gowri, and E.E. Richman. December 2006. "Analysis of Energy Saving Impacts of New Commercial Energy Codes for the Gulf Coast," Pacific Northwest National Laboratory. Accessed January 6, 2008, at: <http://www.energycodes.gov/pdf/pnnl16282.pdf>
- BCAP, personal communications with Aleisha Khan with Jennifer Kallay, January 2008.
- Katz, G., and J. Braman. 2008. "Greening Buildings and Communities: Costs and Benefits." Draft Findings on the Cost Premium, Energy and Water Savings by LEED Level.
- ICC Code Website. Building Valuation Data. Accessed March 13, 2008, at: <http://www.iccsafe.org/cs/techservices/>