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Residential, Commercial, and Industrial Technical Work Group

Summary List of Recommended Priority Policy Options for Analysis

Option No.	Policy Option	GHG Reductions ($MMtCO_2e$)			Net Present Value 2009–2020 (Million $)	Cost-Effective-ness ($/t$CO_2e$)	Level of Support
		2012	2020	Total 2009–2020			
RCI -1	Demand-Side Management/Energy Efficiency Programs, Funds, or Goals for Electricity (Including Expansion of Same) (Residential, Commercial, and Industrial)	1.5	8.2	43.0	–$1,127	–$26	Pending
RCI -2	Demand-Side Management/Energy Efficiency Programs, Funds, or Goals for Natural Gas, Propane, and Fuel Oil	0.1	0.7	3.7	–$256	–$70	Pending
RCI -3	Incentives and Regulatory Reform To Promote Implementation of Renewable Energy Systems, Including Solar Hot Water (Residential, Commercial, and Industrial)	TBD	TBD	TBD	TBD	TBD	Pending
RCI -4	Energy Management Training/Training of Building Operators	*Not quantified*					Pending
RCI -5	Incentives, Resources, and Regulatory Reform To Promote Energy Recycling, Including Combined Heat and Power	1.0	8.2	39.5	–$251	–$6	Pending
RCI -6	Incentives and Policies for Improving Building Efficiency, Including Building Energy Codes	0.9	2.4	16.6	TBD	TBD	Pending
RCI -7	Improved Design and Construction in New and Existing State and Local Government Buildings, "Government Lead by Example"	0.6	5.3	26.9	–$505*	–$19*	Pending
RCI -8	Participation in Voluntary Industry-Government Partnerships (Including Incentives)	0.0	0.0	0.1	N/A	N/A	Pending
RCI -9	Incentives and Policies for Improving Appliance Efficiency, Including Appliance Standards	0.3	0.9	5.6	–$90	–$16	Pending
	Sector Total After Adjusting for Overlaps	TBD	TBD	TBD	TBD	TBD	TBD
	Reductions From Recent Actions	TBD	TBD	TBD	TBD	TBD	TBD
	Sector Total Plus Recent Actions	TBD	TBD	TBD	TBD	TBD	TBD

*Note: includes audits costs only; retrofit and efficiency improvement costs TBD.

The numbering used to denote the above policy options is for reference purposes only; it does not reflect prioritization among these important policy options. Numbering has been changed to reflect Climate, Energy, and Commerce Advisory Committee modifications (recommended priority policy options RCI-8 and RCI-9 were moved to the Cross-Cutting Issues and Energy Supply Technical Work Groups, respectively, and the remaining policies moved up in number).

RCI-1. Demand-Side Management/Energy Efficiency Programs, Funds, or Goals for Electricity (Including Expansion of Same) (Residential, Commercial, and Industrial)

Policy Description

This option focuses on increasing investment in electricity demand-side management (DSM) programs through programs run by utilities or others, energy efficiency funds, and/or energy efficiency goals. These options are typically termed DSM activities, and may be designed to work in tandem with other strategies recommended by the Climate, Energy, and Commerce Advisory Committee (CECAC) that can also encourage efficiency gains.

National studies suggest that South Carolina has substantial potential to improve the efficiency of its energy use, with a 1% annual target being a reasonable and achievable target in the near term. However, South Carolina's efforts to date offer substantial room for improvement from 30th in the country in a 2006 ranking of state efforts.[1] Among states recognized as having strong performance, the Vermont Public Service Board has contracted for over 1% energy efficiency per year from 2006 through 2008. Xcel Energy in Colorado has agreed to achieve savings of 1.4% in 2013, which would offset 55% of forecast annual electricity load growth.[2] Like many other states and utilities, Xcel Energy's commitment matches the benchmark set out in the National Action Plan for Energy Efficiency: "Well-designed energy efficiency programs are delivering annual energy savings on the order of 1 percent of electricity and natural gas sales."[3]

Although there is no statewide energy efficiency market potential study for South Carolina, two recent studies have been conducted by South Carolina utilities on this topic. One evaluated the market potential for energy efficiency in Duke Energy's South Carolina service territory.[4] The draft study identifies a suite of DSM programs and estimates an associated economic potential of 3,600 gigawatt-hours (GWh) of energy savings, or a 16% demand decrease, for this 14-county region in upstate South Carolina by 2026. Another study estimates the market potential in the service territories of the 20 state electric cooperatives represented by Central Electric

[1] Maggie Eldridge, Bill Prindle, Dan York, and Steve Nadel (June 2007), *The State Energy Efficiency Scorecard for 2006*, Report Number E075, Washington, DC: American Council for an Energy Efficient Economy. See http://aceee.org/pubs/e075.pdf?CFID=3003167&CFTOKEN=36848811.

[2] Dan York and Martin Kushler (2006), *A Nationwide Assessment of Utility Sector Energy Efficiency Spending, Savings, and Integration With Utility System Resource Acquisition*, Washington, DC: American Council for An Energy-Efficient Economy. See http://www.eceee.org/conference_proceedings/ACEEE_buildings/2006/Panel_8/p8_29/.

[3] Diane Munns and Jim Rogers (July 2006), *National Action Plan for Energy Efficiency,* p. ES-4, U.S. Environmental Protection Agency and U.S. Department of Energy. See http://www.epa.gov/cleanrgy/documents/napee/napee_exsum.pdf.

[4] Forefront Economics Inc., H. Gil Peach & Associates LLC, and PA Consulting Group (2007), *Duke Energy Carolinas DSM Action Plan: South Carolina Draft Report,* prepared for Duke Energy Carolinas. [not available online]

Cooperative, Inc.[5] The findings pointed to a 20% demand decrease, or 4,000 GWh of energy savings, over a 10-year time frame. These numbers are consistent with findings from other studies in the Southeast.[6]

Considering that South Carolina has "low-hanging fruit" compared with states with well-established energy efficiency programs, the possibility of as much as a 2% annual reduction in demand due to energy efficiency does not seem unreasonable. Therefore, South Carolina may be able to achieve a higher level of energy efficiency than 1% per year.

This policy would take a two-pronged approach to increasing DSM in the state: implementing utility DSM programs for all sectors, and conducting consumer outreach on the value inherent in performance contracting and energy management programs for commercial, industrial, and institutional entities. To implement expanded DSM programs, South Carolina could revise existing statutes to clarify support for utility investments in cost-effective energy efficiency at the levels indicated above. It could also go further and add a value for carbon dioxide (CO_2) emissions to cost-effectiveness evaluations for energy efficiency. South Carolina also may need to clarify how municipal, cooperative, and state agency utilities will be held accountable for expected results.

Policy Design

Goals: Energy efficiency programs to reduce electricity use, adjusted for growth, by 1% per year by 2015 and by 1.5% per year by 2020.

Timing: Legislative and utility commission action in 2008, with an initial target of 0.25% in 2009, gradually increasing to 1% in 2015, and then to 1.5% in 2020.

Parties Involved: All electric utilities (public and private), regulators, and customers (all sectors).

Other: This policy would implement utility DSM programs for all sectors, as well as an educational awareness campaign showing the value inherent in performance contracting and energy management programs for commercial, industrial, and institutional entities.

Implementation Mechanisms

This policy would include an educational awareness campaign targeted at the commercial, industrial, and institutional sectors, to show the value inherent in performance contracting and energy management programs. An energy savings performance contract (ESPC) is a contracting

[5] GDS Associates, Inc. (2007), "Electric Energy Efficiency Potential Study for Central Electric Cooperative, Inc." Retrieved 10/1/07 from http://www.ecsc.org/newsroom/EfficiencyStudy.ppt.

[6] Frederick Beck et al. (2001), *Powering the South: A Clean and Affordable Energy Plan for the Southern United States*, Washington, DC: Renewable Energy Policy Project, available at: http://www.crest.org/articles/static/1/binaries/pts_repp_book.pdf; La Capra Associates and GDS Associates, Sustainable Energy Advantage (December 2006), *Analysis of a Renewable Portfolio Standard for North Carolina*, prepared for the North Carolina Utilities Commission, available at: http://www.ncuc.commerce.state.nc.us/rps/NC RPS Report 12-06.pdf; Jeff Tiller. (2007). Energy Efficiency Opportunities for North Carolina Buildings and Industrial Facilities. Boone, NC: Appalachian State University; Bruce Hedman (2006).

vehicle that allows agencies or other entities to accomplish energy projects for their facilities without up-front capital costs and without special Congressional appropriations to pay for the improvements. The energy service company (ESCO) conducts a comprehensive energy audit, identifies improvements that will save energy at the facility, works with the customer to design and construct a project that meets the agency's needs, and arranges financing to pay for it. The ESCO guarantees that the improvements will generate savings sufficient to pay for the project over the term of the contract. After the contract ends, all additional cost savings accrue to the customer. An ESPC may include lighting improvements; building envelope modifications; chilled-water, hot-water, and steam distribution systems; electric motors and drives; refrigeration; electricity peak shaving or load shifting; and energy-related process improvements.

The Residential, Commercial, and Industrial (RCI) Technical Work Group (TWG) recommends that this policy also implement specific goals and incentives for DSM for all electricity consumers. Policy and administrative mechanisms that might be used to implement residential DSM programs include:

- Regulator-verified savings targets;
- Public benefit charges (option for industry to not participate in funding pool contribution), allocated to a state agency, third-party "efficiency utility," or utilities;
- Portfolio standards;
- "Energy trusts";
- Integrated resource planning;
- Performance-based incentives; and
- Appropriate rate treatment for efficiency.

Among the measures that would be expected to be implemented to achieve the goals in this policy option are:

- Subsidized energy audits for homeowners, businesses, industries, consumer education, and energy end-use surveys;
- Incentives for specific technologies, potentially including lighting, water heating, plug loads, networked personal computer management, power supplies, motors, pumps, boilers, customer-side transformers, water use reduction, ground-source heat pumps, and others;
- Energy efficiency reinvestment funds;
- Economic as well as conservation impact evaluation of incentive programs; and
- Complimentary policies, such as appliance recycling/pick-up programs.

Related Policies/Programs in Place

April 16, 2007, Energy Efficiency Summit, sponsored by Duke Power, South Carolina Energy Office, South Carolina Department of Health and Environmental Control (DHEC), and others.

The state Energy Office tracks utility programs.

South Carolina currently has enabling legislation in place for performance contracting as a result of the South Carolina Energy Conservation and Efficiency Act 1992. A growing number of South Carolina federal, state, and local government agencies as well as private industry have chosen to evaluate potential energy-saving project measures within their facilities and pursue ESPC as a preferred arrangement to fund these projects. Some of the agencies, institutions, and industrial entities in South Carolina that pursued and implemented projects using performance contracting include Winthrop University, Veterans Integrated Service Network 7 hospitals, Fort Jackson, BMW, and the University of South Carolina. Entities that are currently developing DSM projects using performance contracting include The Citadel, the City of Columbia, Columbia Housing Authority, and Medical University of South Carolina.

Type(s) of GHG Reductions

Reduction in greenhouse gas (GHG) emissions (largely CO_2) from avoided electricity production.

Estimated GHG Reductions and Net Costs or Cost Savings

Table 1. Estimated GHG reductions and net costs or cost savings from RCI-1

Option No.	GHG Reductions ($MMtCO_2e$)			Gross Cost (Million $)	Gross Benefits (Million $)	Net Present Value 2009–2020 (Million $)	Cost-Effectiveness ($/t$CO_2$e)
	2012	2020	Total 2009–2020				
RCI – 1	1.5	8.2	43.0	$987	–$2,114	–1,127	–$26

Data Sources:

- *Cost of Energy Efficiency Measures:*
  - 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*, prepared for Duke Energy Carolinas. [not available online]
  - GDS Associates, Inc. (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, December 2006. Available at: http://www.ncuc.commerce.state.nc.us/reps/NCRPSEnergyEfficiencyReport12-06.pdf.
- *Experience in Other States on Cost of Energy Efficiency:*
  - Bill Prindle (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.

- 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.
- Gene Fry, "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 $mart^{SM} 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
- WGA 2006—Energy Efficiency Task Force Report to the Clean and Diversified Energy Advisory Committee of the Western Governor's 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.org/wga/initiatives/cdeac/Energy%20Efficiency-full.pdf.

- *Energy Efficiency Potential:*
  - GDS Associates, Inc. (2007), "Electric Energy Efficiency Potential Study for Central Electric Cooperative, Inc." Retrieved 10/1/07 from 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,* prepared for Duke Energy Carolinas. [not available online]
- *Avoided Cost of Electricity (Delivered):*
  - Duke Energy filing to South Carolina Public Service Commission (SCPSC), "Proceeding for Approval of the Public Utility Regulatory Policies Act of 1978 (PURPA) Avoided Cost Rates for Electric Companies—Letter Regarding Revisions to Schedule PP (SC)," July 27, 2007, Duke Energy Carolinas, LLC. Available at: http://dms.psc.sc.gov/matters/matters.cfc?Method=MatterDetail&MatterID=187531.
  - Progress Energy filing to SCPSC, "Proceeding for Approval of the Public Utility Regulatory Policies Act of 1978 (PURPA) Avoided Cost Rates for Electric Companies—Letter Regarding Revised Schedule CSP-23," November 29, 2007. Available at: http://dms.psc.sc.gov/attachments/8D4605A3-D0C6-1E0B-7E9AFC3D3422E8A0.pdf.

Quantification Methods:

- Project energy savings based on the stated electricity savings target (a 1% per year reduction in total annual consumption by 2015, increasing to 1.5% per year by 2020). Annual consumption will be adjusted each year based on the previous year's DSM impacts.
- Estimate the total cost of electricity savings using state-specific or region-specific data on cost of saved energy from electric energy efficiency measures.
- Estimate the GHG emission reductions through the electric energy efficiency measures.

Key Assumptions:

- *Discount Rate:* 5% real.
- *Avoided Cost of Electricity (Delivered):* $54.96/MWh (2006$), based on SC utility avoided cost filings. The actual implications of avoided electricity may be different for customers.
- *Transmission and Distribution (T&D) Electricity Losses:* 6% (consistent with the Energy Supply (ES) TWG assumptions).
- *Cost of Energy Efficiency Measures:*
  - For Duke Energy: 500 GWh of annual savings in the residential sector and about 300 GWh of annual savings in the nonresidential sector at a cost of about $0.03 per kilowatt-hour (kWh) of saved electricity. For a comparison, Duke's annual electricity sales are 5,440 GWh according to the U.S. Department of Energy's (DOE's) Energy Information Administration (EIA).[7]
  - For North Carolina: See Table 2.

Table 2. Cost of energy efficiency measures for North Carolina

Sector	Present Value of Total Costs (2006$)	Value of Lifetime kWh Savings - Customer Meter Level	Levelized Cost per Lifetime kWh Saved
Residential Sector	$262,528,658	9,673,701,174	$0.027
Commercial Sector	$352,185,339	8,702,321,930	$0.040
Industrial Sector	$124,388,270	6,805,459,342	$0.018
Total—All Sectors	**$739,102,267**	**25,181,482,446**	**$0.029**

Source: GDS Associates, Inc. 2006.

  - For other states: See Table 3.

Table 3. Cost of energy efficiency measures for Other States

State/Utility	CSE ($kWh)	Program Year	Source
Western utilities	0.025	1978–2004	WGA 2006[8]
Northwest Energy	0.02	2006	Montana PSC Docket No.: D2005.5.88 07/12/06[9]
New York	0.03	2004	Heschong Mahone Group, Inc.

[7] 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,* prepared for Duke Energy Carolinas. [not available online]

[8] Energy Efficiency Task Force Report to the Clean and Diversified Energy Advisory Committee of the Western Governor's 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.org/wga/initiatives/cdeac/Energy%20Efficiency-full.pdf.

[9] Available at http://www.psc.state.mt.us/eDocs/

			2005[10]
MA IOUs	0.038	2002	Gene Fry 2003[11]
California	0.03	n/a	ACEEE 20004[12]
Connecticut	0.023	n/a	ACEEE 20004
New Jersey	0.03	n/a	ACEEE 20004
Vermont	0.03	n/a	ACEEE 20004

- *Efficiency Measure Lifetime*: 13 years on average,
- *Displaced Emissions, Electricity*: 237 tons of CO_2-equivalent emissions per billion British thermal units (tCO_2e/Bbtu), average 2008-2020, based on North Carolina analysis by CCS. Energy efficiency measures are assumed to displace generation from existing facilities in the short-term and to contribute to postponing the construction of new conventional power plants in Displaced Emissions in the long-term.

Key Uncertainties

The source of funding to implement the DSM program envisioned here is uncertain.

Additional Benefits and Costs

- Savings to consumers and business on energy bills. Benefits to low-income households by reducing utility costs.
- Electricity system benefits: reduced peak demand, reduced capital and operating costs, improved utilization and performance of electricity system.
- Reduced the risk of power shortages.
- Reduced pollutants from emissions, improved health from fewer pollutants and particulates, and reduced water use for cooling.
- "Green-collar" employment expansion and economic development.
- Reduced dependence on imported fuel sources.
- Reduced energy price increases and volatility.

[10] Heschong Mahone Group, Inc. (June 2005), *New York Energy $mart[SM] 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

[11] Gene Fry, "Massachusetts Electric Utility Energy Efficiency Database," Massachusetts Department of Telecommunications and Energy, 2003 edition. [not available online]

[12] 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.

Feasibility Issues

None noted.

Status of Group Approval

Pending – [until CECAC moves to final agreement at Meeting #5 or #6]

Level of Group Support

TBD – [blank until CECAC Meeting #5 or #6]

Barriers to Consensus

TBD – [blank until final vote by the CECAC]

RCI-2. Demand-Side Management/Energy Efficiency Programs, Funds, or Goals for Natural Gas, Propane, and Fuel Oil

Policy Description

This option focuses on increasing investment in DSM programs for natural gas, propane, fuel oil, and other combustion fuels. The goals may be accomplished through programs run by utilities or others, energy efficiency funds, and/or energy efficiency goals. These strategies are typically termed DSM activities, and may be designed to work in tandem with other strategies recommended by the CECAC that can also encourage efficiency gains. In particular, this policy should be designed to complement option RCI-1.

This policy option also considers efficiency gains to be achieved through fuel neutrality, which refers to encouraging fuel switching where it results in reduced GHG emissions, lower energy use (measured in Btu's), economic savings, or some other metric. Common examples include switching from electric-resistance hot-water heaters to on-demand gas hot-water heaters for residential use, or switching from diesel-powered airport service equipment to electric or hybrid equipment. It is also worth noting that some natural gas and other fuels are used for on-site generation at industrial and some large commercial facilities; therefore, energy efficiency measures normally associated with electricity use will be of benefit to reducing nonelectric fuel use.

National and state-level studies for nonelectric-sector energy efficiency provide incomplete guidance for setting an appropriate goal for energy efficiency. The most commonly mentioned benchmarks are similar to the one set out in the National Action Plan for Energy Efficiency: "Well-designed energy efficiency programs are delivering annual energy savings on the order of 1 percent of electricity and natural gas sales."[13]

To implement expanded DSM programs, South Carolina could revise existing statutes to clarify support for utility investments in cost-effective energy efficiency at the levels indicated above. It could also go further and add a value for CO_2 emissions to cost-effectiveness evaluations for energy efficiency. South Carolina also may need to clarify how municipal, cooperative, and state agency utilities will be held accountable for expected results.

This policy would take a two-pronged approach to increasing DSM in the state: implementing specific goals and incentives for household (residential) DSM, and conducting consumer outreach on the value inherent in performance contracting and energy management programs for commercial, industrial, and institutional entities.

[13] Diane Munns and Jim Rogers. (July 2006), *National Action Plan for Energy Efficiency,* p. ES-4, U.S. Environmental Protection Agency and U.S. Department of Energy. See http://www.epa.gov/cleanrgy/documents/napee/napee_exsum.pdf.

Policy Design

Goals: Energy efficiency programs to reduce natural gas use, adjusted for growth, by 1% per year by 2015 and sustain annual savings through 2020. Similar goals should be set for other fuels, although they may need to be modified by the Public Utility Commission due to the smaller number of affected parties who may have special circumstances.

Timing: Legislative and Public Utility Commission action in 2008, initial target of 0.25% in 2009, gradually increasing to 1% in 2015, and then sustained through 2020.

Parties Involved: All natural gas utilities (public and private) and customers (all sectors), industrial facilities, large commercial facilities, and regulators.

Other: The TWG recommends that this policy implement specific goals and incentives for household (residential) DSM, as well as an educational awareness campaign showing the value inherent in performance contracting and energy management programs for commercial, industrial, and institutional entities.

Implementation Mechanisms

Among the measures that implementing agencies would be expected to take to achieve the goals in this policy option are:

- Subsidized energy audits for homeowners, businesses, industries, consumer education, and energy end-use surveys.
- Utility surveys and upgraded maintenance programs to prevent and repair leaks in natural gas pipelines.
- Incentives for specific technologies, potentially including water heating, motors, pumps, boilers, air conditioning, water use reduction, and ground-source heat pumps, among others. At facilities with on-site electric generation, lighting, plug loads, networked personal computer management, power supplies, customer-side transformers, and other electric equipment.
- Economic as well as conservation impact evaluation of incentive programs.
- Energy efficiency reinvestment funds.
- Complementary policies, such as appliance recycling/pickup programs.

See also RCI-1.

Related Policies/Programs in Place

See RCI-1.

Type(s) of GHG Reductions

Reduction in GHG emissions (largely CO_2) from avoided on-site fuel combustion.

Estimated GHG Reductions and Net Costs or Cost Savings

Table 4. Estimated GHG reductions and net costs or cost savings from RCI-2

Option No.	GHG Reductions (MMtCO2e)			Gross Cost (Million $)	Gross Benefits (Million $)	Net Present Value 2009–2020 (Million $)	Cost-Effectiveness ($/tCO2e)
	2012	2020	Total 2009–2020				
RCI – 2	0.1	0.7	3.7	$96	–$352	–$256	–$70

Data Sources:

- *Cost of Saved Fuels and Measure Lifetime:*
  - U.S. DOE, Office of Energy Efficiency and Renewable Energy (2007, “Industrial Assessment Centers (IAC) Database.” Available at: http://www.iac.rutgers.edu/database/.
  - Suzanne Tegen and Howard Geller (2006), Natural Gas Demand-Side Management Programs: A National Survey, Boulder, CO: Southwest Energy Efficiency Project. Available at: www.swenergy.org.
  - Diane Munns and Jim Rogers. (July 2006), *National Action Plan for Energy Efficiency,* p. ES-4, U.S. Environmental Protection Agency (EPA) and U.S. DOE. Available at: http://www.epa.gov/cleanrgy/documents/napee/napee_exsum.pdf.
  - Martin Kushler, Dan York, and Patti White (January 2005), *Examining the Potential for Energy Efficiency To Help Address the Natural Gas Crisis in the Midwest*, Washington, DC: American Council for an Energy Efficient Economy. Available at: http://www.aceee.org/pubs/u051.htm.
  - SWEEP (January 2006), Natural Gas Demand-Side Management Programs: A National Survey, Southwest Energy Efficiency Project, available at www.swenergy.org.
- *Avoided Cost of Fuels:*
  - U.S. DOE EIA, Office of Energy Statistics (April 2007), *Assumptions to the Annual Energy Outlook 2007*. Electricity Market Module. DOE/EIA-0554(2007). Available at: http://www.eia.doe.gov/oiaf/aeo/assumption/electricity.html.

Quantification Methods:

- Project energy savings based on the stated fuel savings target (a 1% per year reduction in electricity use by 2015, sustained through 2020). Annual consumption will be adjusted each year based on the previous year’s DSM impacts.
- Estimate the total cost of fuel savings based on available data on the cost of saved fuels.
- Estimate the GHG emission reductions through the electric energy efficiency measures.

Key Assumptions:

- *Discount Rate*: 5% real.
  Discount rates for oil and propane conservation programs could be different from the one used for natural gas programs because, unlike natural gas programs, oil and propane programs are likely to be operated by an entity other than a utility.

- *Avoided Cost of Fuels:*
  - Natural gas (delivered): $7,898/Bbtu (2006$). (The natural gas avoided cost was projected using (1) the average South Carolina city gate price of natural gas in 2006 and (2) the trend in projected natural gas prices in the *Annual Energy Outlook 2007* (AEO2007) for the Southeast region).[14]
  - Propane: TBD.
  - Fuel oil: TBD.

- *Cost of Saved Natural Gas:* Natural gas savings per dollar of program investment is 72,700 million cubic feet per year per million dollars, based on the average cost of a number of gas DSM programs reported in SWEEP (2006). The RCI TWG will estimate the cost of saved natural gas per million Btu (MMBtu) based on (1) the natural gas savings per program investment above, (2) a 13-year average measure lifetime, and (3) a real discount rate of 5%.

- *Cost of Saved Fuel Oil and Cost of Saved Propane*: for residential and commercial uses, assumed to be the same as the cost of saved natural gas in terms of $/MMBtu. For the industrial sector, data available at DOE's IAC database might be useful.[15]

- *Efficiency Measure Lifetime:* 13 years on average. (Measure life typically ranges from 10 to 15 years. Note EPA and DOE 2006 and ACEEE 2005 assume 12-year average program life.)[16]

- *Displaced Emission factors (Natural Gas, Propane, Fuel Oil):* U.S. EPA (2003), *Inventory of U.S. Greenhouse Gas Emissions and Sinks*, Appendix A. http://epa.gov/climatechange/emissions/downloads06/03CR.pdf

Key Uncertainties

The source of funding to implement the DSM program envisioned here is uncertain.

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[14] U.S. DOE, EIA (February 2006), *Annual Energy Outlook 2007: With Projections to 2030,* IDOE/EIA-0383(2007). See http://tonto.eia.doe.gov/ftproot/forecasting/0383(2007).pdf.

[15] U.S. DOE, Office of Energy Efficiency and Renewable Energy (2007, "Industrial Assessment Centers (IAC) Database." Available at: http://www.iac.rutgers.edu/database/.

[16] Diane Munns and Jim Rogers. (July 2006), *National Action Plan for Energy Efficiency,* p. ES-4, U.S. Environmental Protection Agency (EPA) and U.S. DOE, available at: http://www.epa.gov/cleanrgy/documents/napee/napee_exsum.pdf.; Martin Kushler, Dan York, and Patti White (January 2005), *Examining the Potential for Energy Efficiency To Help Address the Natural Gas Crisis in the Midwest*, Washington, DC: American Council for an Energy Efficient Economy (ACEEE), available at: http://www.aceee.org/pubs/u051.htm.

Additional Benefits and Costs

- Indoor comfort and air quality improvements, with related improvements in health and productivity.
- Savings to consumers and business on energy bills. Benefits to low income households from reduced utility costs.
- Reduced natural gas price increases and volatility: small changes in demand can have large effects on the price of natural gas. Replacing inefficient oil and gas boilers with efficient ones can reduce demand and affect the price of natural gas.
- Reduced risk of power shortages.
- Green collar employment expansion and economic development.
- Reduced dependence on imported fuel sources.
- Reduced energy price increases and volatility.

Feasibility Issues

None noted.

Status of Group Approval

Pending – [until CECAC moves to final agreement at Meeting #5 or #6]

Level of Group Support

TBD – [blank until CECAC Meeting #5 or #6]

Barriers to Consensus

TBD – [blank until final vote by the CECAC]

RCI-3. Incentives and Regulatory Reform To Promote Implementation of Renewable Energy Systems, Including Solar Hot Water (Residential, Commercial, and Industrial)

Policy Description

This policy promotes the use of renewable energy systems sited at residences and commercial and industrial facilities. Under RCI-3, consumers would be encouraged to switch from using fossil fuels to using solar energy for water-heating applications. (Incentives for distributed renewable energy generation are considered in ES-8.)

Potential elements of this option include:

- Programs targeted at specific customer sectors (residential, commercial, industrial), or specific markets within sectors.
- Tax credits and/or utility or other incentives to lower the first cost of distributed energy systems to users. South Carolina currently offers a tax credit of 25% of the installation cost for residential or business purchase of solar heating and cooling systems. (Amounts over the annual tax credit limit of $3,500 can be rolled over to subsequent years.)
- Supporting measures, including training and certification of installers and contractors.

Policy Design

Goals:

- 10% of all South Carolina homes will have solar hot water installations by 2020.
- 10% of all suitable business facilities in South Carolina will have solar hot water installations by 2020. A portion of these installations will also have solar cooling systems.

Timing: Beginning in 2009, 1% per year of all South Carolina homes and business facilities will have solar hot water installed.

Parties Involved: Residential, commercial, and industrial sectors; state regulatory authorities; utilities.

Implementation Mechanisms

Tax credits for installation of solar hot-water systems and adsorption chillers on commercial or residential buildings will be increased to 35% of the installation cost. Systems must be designed to meet minimum performance requirements to qualify for the tax credit.

Related Policies/Programs in Place

South Carolina offers tax incentives for residential/business purchase of solar heating and cooling systems – tax credit of 25% of installation cost - $3,500 annual tax credit limit (amounts over the cap can be rolled over to subsequent years)

The Mid-Carolina Electric Cooperative, Inc., H_2O Advantage® water heating program.

Type(s) of GHG Reductions

Reduction in GHG emissions (largely CO_2) from avoided electricity production or on-site fuel combustion.

Estimated GHG Reductions and Net Costs or Cost Savings

Table 4. Estimated GHG reductions and net costs or cost savings from RCI-3

Option No.	GHG Reductions ($MMtCO_2e$)			Gross Cost (Million $)	Gross Benefits (Million $)	Net Present Value 2009–2020 (Million $)	Cost-Effectiveness ($/t$CO_2$e)
	2012	2020	Total 2009–2020				
RCI – 3	TBD	TBD	TBD	TBD	TBD	TBD	TBD

Data Sources:

- *Cost of and Performance Solar Hot Water and Cooling Systems:*
  - Personal communication with Michael Shore, FLS Energy. (http://www.flsenergy.com/)
  - Personal communication with Mitch Perkins of the SC Energy Office, based on information provided by Erika Hartwig, South Carolina Solar Council (http://scsolarcouncil.johnstondesigngroup.com/).
  - Personal communication with David Wallace, Appalachian Energy (http://www.appalachianenergy.com).
- *Solar Hot Water Potential:*
  - Bernadette Del Chiaro and Timothy Telleen-Lawton, Environment California (April 2007), *Solar Hot Water Heating: How California Can Reduce Its Dependence on Natural Gas,* Environment California Research and Policy Center. Available at: http://www.environmentcalifornia.org/uploads/at/56/at563bKwmfrtJI6fKl9U_w/Solar-Water-Heating.pdf.
  - P. Denholm (March 2007), *The Technical Potential of Solar Water Heating to Reduce Fossil Fuel Use and Greenhouse Gas Emissions in the United States,* Technical Report NREL/TP-640-41157, prepared under task no. SH07/9001, Golden, CO: U.S. DOE, National Renewable Energy Laboratory. Available at: http://www.nrel.gov/docs/fy07osti/41157.pdf.
- *Fraction of Fuel Consumption for Water Heating Applications:*
  - AEO2007—U.S. DOE, EIA (February 2006), *Annual Energy Outlook 2007: With Projections to 2030.* IDOE/EIA-0383, available at: http://tonto.eia.doe.gov/ftproot/forecasting/0383(2007).pdf.

- 2002 MECS—U.S. DOE, EIA, "2002 Manufacturing Energy Consumption Survey and Data Quality: Survey Design, Implementation, and Estimates." See http://www.eia.doe.gov/emeu/mecs/mecs2002/methodology_02/meth_02.html.

Quantification Methods:

- Project heat output from solar hot-water systems through 2020 based on the stated penetration target. Total hot-water energy consumption in the South Atlantic region was taken as a percentage of total energy consumed in the region, broken down by fuel type. These percentages were then applied to the South Carolina total energy consumption projections from AEO2007, giving estimates for water heating energy projections to 2020. To estimate the heat output of solar hot-water systems under this policy, the annual hot-water requirement per South Carolina household was multiplied by the number of households needed to satisfy the policy's goal (ramped in) and the fraction of a user's hot-water requirement that could be met with a solar hot-water system.
- Project solar cooling output through 2020 based on the stated penetration target. Solar cooling output was estimated by taking the solar hot-water energy output estimates and multiplying by a typical chiller efficiency to determine the cooling output. Typical chiller efficiencies are 70% (1 Btu of heat input will yield 0.7 Btu of cooling).
- Estimate the benefit of solar hot water systems in terms of avoided fuel and electricity use for water heating. The same percentage of each fuel used for hot water in the South Atlantic data from the AEO2007 was applied to South Carolina, varying by sector, yielding estimates for avoided energy by fuel type (electricity, natural gas, distillate oil, etc).
- Estimate the benefit of solar cooling systems in terms of avoided fuel and electricity use. Avoided costs of solar cooling were based on the estimates of cooling produced (in Btus) from the solar cooling systems, multiplied by the breakdown of avoided cooling energy consumption by fuel type (typically 95% electricity).
- Estimate GHG emission reductions from avoided fuel and electricity use. Avoided emissions were estimated based on the avoided fuel use (in Btus) multiplied by the forecasted emission factors.

Key Assumptions:

- *Cost of Solar Hot-Water System:* $6,000 - $8,000 for residential systems (assumed capacity of 80–100 gallons per day, 2 panels), to be determined for commercial and industrial systems. The costs of residential solar hot-water systems are presented in Table 5.

Table 5. Costs of residential solar hot-water systems

Solar Hot Water Financial Information *design life: 30 years*					
Panels	Tank Capacity (gallons)	Hot Water Output (gallons per day)	Turnkey Price ($)	Cost After Tax Credits ($)	Return on Investment
two 4' x 8'	80	80	7,790	4,390	18.9%
two 4' x 10'	120	100	8,290	4,890	20.9%
three 4' x 8'	120	120	8,890	5,490	22.6%

Source: Michael Shore. “Residential Solar Energy Electric and Hot Water,” FLS Energy.

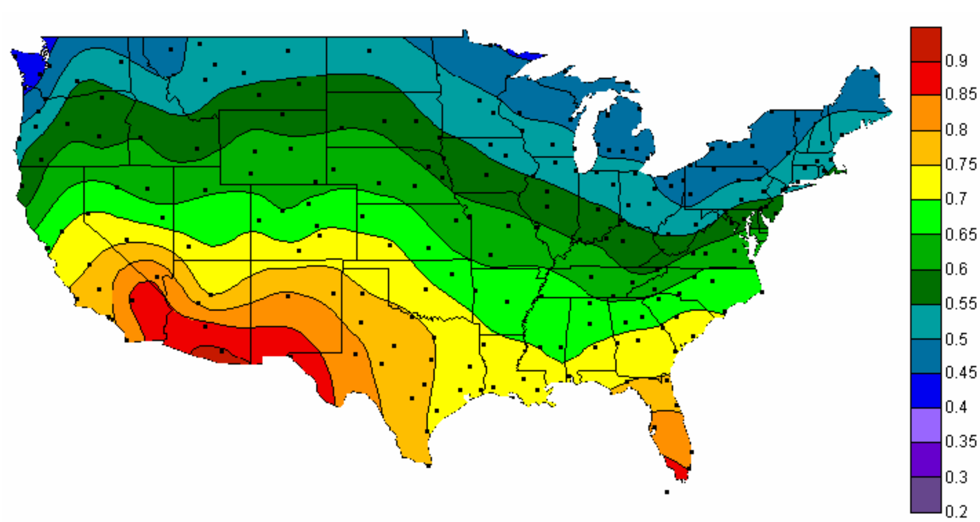
- *Tax Credits for Installation of Solar Hot Water Systems:* 30% federal credit. (State tax credits and rebates are also available but will not affect the net present value of the policy.)
- *Cost of Solar Cooling System:* $8,000 per ton of cooling, from David Wallace, Appalachian Energy. According to Mr. Wallace, solar cooling is only cost-effective in commercial and industrial applications. Thus, the TWG modeled this technology only for the commercial and industrial sectors.
- *Chiller Efficiency:* 65% from David Wallace, Appalachian Energy.
- *Chiller Backup Fuel Cost:* 2.5 cents per ton, from David Wallace , Appalachian Energy.
- *Fraction of Hot Water Needs Provided by Solar Hot-Water Units per Household:* Average of values of base-system solar and lower-cost system solar from the 2007 National Renewable Energy Laboratory (NREL) for the South Atlantic region, As shown in Table 6, below. This fraction is assumed to increase by 10% by 2020.
    - Residential: 60% (in 2009) to 70% (in 2020)
    - Commercial: 60% to 70% (placeholder)
    - Industrial: 60% to 70% (placeholder)

Table 6. Average of values of base-system solar and lower-cost system solar

Region	Representative City	Base System Solar Fraction (%)	Lower-Cost System Solar Fraction (%)
New England	Boston, MA	50	45
Mid-Atlantic	Harrisburg, PA	50	45
East No. Central	Chicago, IL	50	45
West No. Central	Des Moines, IA	55	45
South Atlantic	Raleigh, NC	65	55
East So. Central	Birmingham, AL	65	55
West So. Central	Little Rock, AR	65	60
Mountain	Denver, CO	65	60
Pacific (w/o CA)	Eugene, OR	50	45
New York	Albany	50	40
California	Sacramento	70	60
Texas	Fort Worth	75	65
Florida	Tampa	75	70
U.S. Weighted Avg.		**62**	**54**

Source: P. Denholm (March 2007), *The Technical Potential of Solar Water Heating to Reduce Fossil Fuel Use and Greenhouse Gas Emissions in the United States,* Technical Report NREL/TP-640-41157, Golden, CO: U.S. DOE, National Renewable Energy Laboratory. Available at: http://www.nrel.gov/docs/fy07osti/41157.pdf.

Figure 1. Simulated solar fraction using a "base" (current technology) residential solar water heating system



Source: P. Denholm (March 2007), *The Technical Potential of Solar Water Heating to Reduce Fossil Fuel Use and Greenhouse Gas Emissions in the United States,* Technical Report NREL/TP-640-41157, Golden, CO: U.S. DOE, National Renewable Energy Laboratory. Available at: http://www.nrel.gov/docs/fy07osti/41157.pdf.

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According to NREL 2007, "The actual solar fraction of a solar hot water system depends on the quality of the solar resource, the technical characteristics of the individual system, and water-use patterns. Figure [above] provides the results of a simulation of a "base" residential

SWH system in 215 locations in the United States. This base system represents current technology, using a selective surface collector and glycol as the heat transfer fluid."[17]

- *Fraction of Fuel in Water Heating in Absence of Program:* The fraction of fuel consumption for water heating applications is based on regional data provided by EIA. The fuel data in AEO2007 for the residential and commercial sector are for the South Atlantic region were obtained from Erin Boedecker at EIA. The data for the industrial sector is for South Census region in the 2002 Manufacturing Energy Consumption Survey[18] and obtained from Crawford Honeycutt at EIA. As a placeholder assumption, the fuel fraction for the industrial sector is assumed to be half of the fuel use for heating, ventilation, and air conditioning (HVAC) applications. Table 7 presents assumptions regarding residential and commercial energy consumption for water heating.

Table 7. Assumptions for residential and commercial energy consumption for water heating

Fuel Type	Residential		Commercial	
	% in Water Heating	% in Total Sector Consumption	% in Water Heating	% in Total Sector Consumption
Natural Gas	41%	5.3%	53%	4.54%
Electricity	56%	7.2%	44%	3.73%
Distillate Fuel Oil	1%	0.1%	3%	0.22%
Liquefied Petroleum Gas LPG)	2%	0.3%		
Solar	0%	0.0%		
Total Water Heater	100%	12.9%	100%	8.49%
Total Consumption		**100%**		

Table 8. Industrial HVAC (in trillion Btu)

Fuel Type	% in HVAC	% in Total	% of Hot-Water Heating in Total
Natural gas	45%	2.0%	0.99%
Electricity	52%	2.3%	1.15%
Distillate fuel oil	0%	0.0%	0.01%
LPG	1%	0.0%	0.02%

[17] Source: P. Denholm (March 2007), *The Technical Potential of Solar Water Heating to Reduce Fossil Fuel Use and Greenhouse Gas Emissions in the United States,* Technical Report NREL/TP-640-41157, p. 6, Golden, CO: U.S. DOE, National Renewable Energy Laboratory. Available at: http://www.nrel.gov/docs/fy07osti/41157.pdf.

[18] U.S. DOE, EIA, "2002 Manufacturing Energy Consumption Survey and Data Quality: Survey Design, Implementation, and Estimates." See http://www.eia.doe.gov/emeu/mecs/mecs2002/methodology_02/meth_02.html.

Solar	0%	0.0%	0.00%
Kerosene	0%	0.0%	0.00%
Geothermal	0%	0.0%	0.00%
Wood	0%	0.0%	0.00%
Coal	2%	0.1%	0.04%
Total HVAC	**100%**	**4.4%**	**2.2%**

- *Avoided Cost of Fuels for Water Heating, Such as Natural Gas and Oil:* Same assumptions as used for RCI-2.
- *Emission Factors and Discount Rate*: Same assumptions as used for RCI-1 and RCI-2.

Key Uncertainties

TBD – [as needed and approved by the TWGs]

Additional Benefits and Costs

- Savings to consumers and business on energy bills. Benefits to low income households from reduced utility costs.
- Electricity system benefits: reduced peak demand, reduced capital and operating costs, improved utilization and performance of electricity system.
- Reduced natural gas price increases and volatility: small changes in demand can have large effects on the price of natural gas. Replacing inefficient gas hot-water heaters can reduce demand and affect the price of natural gas.
- Reduced risk of power shortages.
- Reduced pollutants from emissions, improved health from fewer pollutants and particulates, and reduced water use for cooling.
- Green collar employment expansion and economic development.
- Reduced dependence on imported fuel sources.
- Reduced energy price increases and volatility.

Feasibility Issues

None noted.

Status of Group Approval

Pending – [until CECAC moves to final agreement at Meeting #5 or #6]

Level of Group Support

TBD – [blank until CECAC Meeting #5 or #6]

Barriers to Consensus

TBD – [blank until final vote by the CECAC]

RCI-4. Energy Management Training/Training of Building Operators

Policy Description

In many facilities, utility bills can be significantly decreased through more efficient equipment and building operation. Administrative and technical training can inform and encourage energy managers, school officials, building operators, and others responsible for facility energy efficiency to utilize methods for minimizing unnecessary energy waste. This policy would increase education and demonstrate the benefits of energy-efficient building operation through government demonstration of efficient equipment and building operations and energy service contracting.

Specifically, this policy involves developing, implementing, and requiring a statewide Energy Conservation Education and Training Program for energy managers and facility operators to learn techniques for improving the efficiency of their steam, process heat, pumping, compressed air, motors, and other systems. Successful completion of this training would be required for energy managers and facility operators in all sectors (residential, commercial, industrial, and institutional) by a licensing requirement. Continuing education credits would be required annually. Classes would be conducted at the state's Technical College Facilities. South Carolina was the first state in America to provide a Technical College System with a campus within 28 miles of every residence.

Energy management training would include instruction in and demonstration of successful energy management programs throughout the state, including Winthrop University and government projects (e.g., undertaken under RCI-7) as models.

This policy could draw on or expand the South Carolina Energy Office's preparation classes for Energy Manager certification and other related training.

Policy Design

Goals: Starting in 2018, require energy managers and facility operators in all sectors to obtain certification for successful completion of the training program.

Timing: See above.

Parties Involved: State and local entities, private energy managers, and facility operators throughout the state.

Other: Not applicable.

Implementation Mechanisms

The South Carolina Energy Office would develop the requirements for licensing and maintain a database of licensed professionals. Course curricula would be developed by the Energy Office, but would include instruction in and demonstration of successful energy management programs throughout the state. Classes would be available at the state's Technical College Facilities.

Successful completion of this training would be required for energy managers and facility operators in all sectors (residential, commercial, industrial, and institutional) by a licensing requirement. Energy managers and facility operators would have two years to attain the license. Companies can outsource energy management, energy planning, and facility operations, or they can retain licensed staff to oversee operations.

Related Policies/Programs in Place

The South Carolina Energy Office holds a preparation class for Energy Manager certification and other related training.

Type(s) of GHG Reductions

Reduction in GHG emissions (largely CO_2) from avoided electricity production or on-site fuel combustion.

Estimated GHG Reductions and Net Costs or Cost Savings

The potential for GHG reductions varies to such an extent that this option will not be quantified. While GHG reductions are difficult to directly attribute to this policy option, it acts as a supporting action for other quantified options, such as RCI-6 and RCI-7.

For comparison purposes, North Carolina's Utility Savings Initiative for State Facilities provides electric and water utility bill audits, energy-use benchmarking, facility audits and tune-ups, energy management training sessions, and technical workshops. As part of the Utility Savings Institute, the North Carolina State Energy Office provided training to over 1,320 course participants between June 2002 and September 2003.[19] The program's activities are estimated to have resulted in more than $30 million in avoided utility costs since its inception in 2002.[20]

In 2004, Winthrop University of South Carolina entered into a contract with Ameresco Energy Services Company at an overall project cost of $5,247,000. The resulting plan is projected to produce annual energy savings of over $673,800. This energy savings plan was awarded Energy Project of the Year by the Association of South Carolina Energy Managers in 2004 and the Duke Energy Power Partner Award in 2006.[21]

Data Sources: Not applicable.

Quantification Methods: Not applicable.

[19] Larry Shirley. "State Facilities Utility Savings Initiative." Presentation from North Carolina State Energy Office, 2003 NASEO Annual Meeting, Austin, TX, September 16, 2003. See http://www.energync.net/programs/docs/usi.ppt.

[20] National Association of State Energy Officials (Winter 2007), *State Energy Program and Activity Update*, pp. 87–88. See http://www.naseo.org/sep/updates/2007_SEP_Updates.pdf, accessed February 7, 2008.

[21] Ayeola G. Elias, ed. *FYI: The News Bulletin for the Winthrop University Community*, Office of University Relations, Winthrop University, October 20, 2004 (http://www.winthrop.edu/news/releases/archivereleases/fall2004/energyplan.htm); Monica Bennett, ed. *Winthrop Magazine*. Office of University Relations, Winthrop University, Spring 2007, p.18. (http://www.winthrop.edu/news/winthropmagazine/Spring07%20Mag.pdf).

Key Assumptions: Not applicable.

Key Uncertainties

None noted.

Additional Benefits and Costs

None noted.

Feasibility Issues

None noted.

Status of Group Approval

Pending – [until CECAC moves to final agreement at Meeting #5 or #6]

Level of Group Support

TBD – [blank until CECAC Meeting #5 or #6]

Barriers to Consensus

TBD – [blank until final vote by the CECAC]

RCI-5. Incentives, Resources, and Regulatory Reform To Promote Energy Recycling, Including Combined Heat and Power

Policy Description

Combined heat and power (CHP) refers to any system that simultaneously or sequentially generates electric energy and utilizes the thermal energy that is normally wasted. CHP is sometimes called "recycled energy" because the same energy is used twice. The recovered thermal energy can be used for industrial process steam, space heating, hot water, air conditioning, water cooling, product drying, or nearly any other thermal energy need in the residential, commercial, and industrial sector. The end result is significantly increased efficiency over generating electric and thermal energy separately. In fact, many CHP systems are capable of an overall efficiency of over 80%—double that of conventional systems. Another significant advantage is the reduced transmission and distribution (T&D) losses associated with centralized power generation.

There is a number of existing CHP installations in South Carolina, primarily at large manufacturing facilities. According to one study, South Carolina has the potential to install an additional 4,497 MW of commercial (1,243 MW) and industrial (3,254 MW) CHP, considering technical potential only.[22] While it is unlikely that all technically feasible installations would be economically or operationally practical, this estimate is conservative in that it assumes systems are sized to meet thermal loads with no power exports, it does not consider economic growth for target markets, and it does not consider the potential for upgrades of existing CHP systems. In the absence of a market potential study, these data suggest a very large unrealized potential for CHP in South Carolina.

Energy recycling, including CHP, is challenged by several noneconomic factors:

- When excess electricity is produced (either overall or only at certain times), this excess electricity should be sold onto the electrical grid. There may be resistance or legitimate concerns regarding these sales. In the absence of decoupling, these sales represent an evident loss of expected revenue for utilities.
- To the extent that energy recycling results in increased fuel consumption (which may be economically and environmentally efficient), it may nevertheless lengthen the time required to obtain air pollution permits or trigger a higher level of scrutiny. So-called performance permitting can address this concern, but may nevertheless increase permitting complexity.
- The addition of energy recycling of any type to a facility adds design and operational complexity. Although the adjustments may be modest, the requirement for new expertise and different operating skills may be a barrier, particularly to firms that are already facing challenges in attracting talent.

[22] Bruce Hedman, "CHP Market Review," Energy and Environmental Analysis, Southeast Planning Session Presentation, July 6, 2005. [not available online]

- Regulatory and environmental permitting complexity or uncertainty is associated with use of innovative processes and "alternative fuels."

Additional installations of new CHP systems and continued operation or expansion of existing systems by residential, commercial, institutional, and industrial energy consumers could be encouraged through a combination of regulatory changes and incentive programs. Potential elements of this option include:

- Promotion of education and information transfer related to the use of CHP in residential, commercial, and industrial applications.
- Promotion of industrial (and large commercial facility) cooperation in sharing energy needs/utilization of waste energy.
- Creation and expansion of markets for, and incentives designed to promote implementation of, CHP units in capacities suitable for residential, commercial, and industrial users.
- Provision of tax benefits, attractive financing arrangements, and other incentives to promote CHP technologies.
- Consideration and adoption by state regulatory authorities of rate designs (possibly incorporating into the rate design a value for offset CO_2 emissions) and policies (including net metering policies), coupled with the necessary metering technology, that promote reduction in GHG emissions by encouraging consumers to install combined heat (and or cooling) and power systems that offer the opportunity to improve the overall efficiency of fuel use. This includes reviewing existing net-metering policies and establishing clear, consistent interconnection standards.
- Consideration of "fast track" or streamlined environmental permitting mechanisms for all recycled energy projects, including CHP installations.

Policy Design

Goals: Installation of 40% of the additional CHP and waste heat recovery technical potential in South Carolina by 2020, while maintaining the existing baseline.

Timing: Beginning with 100 MW installed in 2011, increasing gradually to achieve the 50% goal by 2020.

Parties Involved: Large residential, commercial, industrial, and institutional buildings.

Implementation Mechanisms

Implement the Western Governors' Association's recommendations to states to promote CHP implementation (modified here):

- Initiate a thorough review by the South Carolina Public Service Commission of policies affecting CHP.
- Adopt recently enacted Federal Energy Regulatory Commission standards for interconnection agreements.

- Seek CHP solutions to T&D-constrained areas.
- Undertake a review of electricity rates, including standby rates, to make sure they are not discriminatory toward CHP. Incorporate policies that will appropriately promote CHP in state utility Least-Cost Planning and Integrated Resources Plans.
- Consider adding CHP to DSM and other energy efficiency programs.
- Consider decoupling or other mechanisms to remove utility disincentives for CHP.
- Adopt simplified, streamlined, and consistent permitting for CHP systems. Offer state-funded training and technical assistance programs for local code officials.
- Ensure that renewable portfolio standards, environmental portfolio standards, advanced energy portfolio standards, and other renewable energy laws include the full range of renewable CHP options, including waste-heat recovery and spent pulping liquor.
- Call on DOE's CHP Regional Application Centers for assistance with policy, programs, and analysis.
- Wherever possible, adopt consistent, region-wide policies, as recommended by the Western Governors' Association.

Related Policies/Programs in Place

South Carolina has several CHP facilities powered by waste (Eastover and Charleston), wood (Georgetown, Florence, and Charleston), and biomass (Spartanburg).

Type(s) of GHG Reductions

Improved energy use efficiency associated with expanded use of CHP, avoiding GHG emissions (largely CO_2) from electricity production or on-site fuel combustion.

Estimated GHG Reductions and Net Costs or Cost Savings

Table 8. Estimated GHG reductions and net costs of or cost savings from RCI-5

Option No.	GHG Reductions ($MMtCO_2e$)			Gross Cost (Million $)	Gross Benefits (Million $)	Net Present Value 2009–2020 (Million $)	Cost-Effectiveness ($/t$CO_2$e)
	2012	2020	Total 2009–2020				
RCI – 5	1.0	8.2	39.5	$3,528	–$3,779	–$251	–$6

Data Sources:

- *CHP Technical Potential:*
  - Bruce Hedman, "CHP Market Review," Energy and Environmental Analysis, Southeast Planning Session Presentation, July 6, 2005. [not available online]

   - WGA 2006—Western Governors Association (January 2006), *Clean and Diversified Energy Initiative: Combined Heat and Power White Paper*. Available at: http://www.westgov.org/wga/initiatives/cdeac/CHP-full.pdf.
   - Energy and Environmental Analysis, Inc. (May 2003), *Market Potential for Advanced Thermally Activated BCHP in Five National Account Sectors*, Oak Ridge, TN: U.S. DOE, Oak Ridge National Laboratory. Available at: http://www.eere.energy.gov/de/pdfs/bchp_market_potential.pdf.
   - Resource Dynamics Corporation (August 2004), *Combined Heat and Power Market Penetration for Opportunity Fuels*, prepared for U.S. DOE. (http://www.eere.energy.gov/de/chp/chp_applications/information_resources.html#publications)

- *CHP Economic Potential:*
   - Energy and Environmental Analysis, Inc. (April 2004), *Project Summary Report: Assessment of Large Combined Heat and Power Market*, Oak Ridge, TN: U.S. DOE, Oak Ridge National Laboratory. Available at: http://www.eea-inc.com/dgchp_reports/ORNLMIPDCHPProjectSummaryReport.pdf.
   - Electric Power Research Institute (July 2005), *Assessment of California CHP Market and Policy Options for Increased Penetration*, Draft Consultant Report, CEC-500-2--5-060-D, prepared for California Energy Commission, Public Interest Energy Research Program. Available at: http://www.energy.ca.gov/2005publications/CEC-500-2005-060/CEC-500-2005-060-D.PDF.
   - Energy and Environmental Analysis, Inc. (2004), Combined Heat and Power in the Pacific Northwest: Market Assessment: Task 1-Final Report, submitted to Oak Ridge National Laboratory, August 2004 (http://www.chpcenternw.org/NwChpDocs/Chp_Market-Assessment_In_PNW_EEA_08_2004.pdf).
   - Energy and Environmental Analysis, Inc. (October 2003), *Natural Gas Impacts of Increased CHP, submitted to U.S. Combined Heat and Power Association*. Available at: http://www.uschpa.org/CHP_GasOct03.pdf.
   - Eastern Connecticut State University, Institute for Sustainable Energy (March 15, 2004), *Distributed Generation Market Potential: 2004 Update/Connecticut and Southwest Connecticut*. Available at: http://www.easternct.edu/depts/sustainenergy/publication/reports/Report 3-04 Final (3-15).pdf.

- *Cost and Performance of CHP and Distributed Generation (DG):*
   - WGA 2006—Western Governors Association (January 2006), *Clean and Diversified Energy Initiative: Combined Heat and Power White Paper*. Available at: http://www.westgov.org/wga/initiatives/cdeac/CHP-full.pdf.
   - Navigant Consulting (2006), "Energy Cost Savings Module for Customer-Sited DG," prepared for the Massachusetts DG Collaborative. Available at:

  http://masstech.org/renewableenergy/public_policy/DG/EnergyCostSavingsModule-Jan202006.zip.
  - 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.
- *Avoided Cost of Biomass:* GDS Associates, Inc., and La Capra Associates, Inc. (September 12, 2007), "Analysis of Renewable Energy Potential in South Carolina: Renewable Resource Potential—Final Report," prepared for Central Electric Power Cooperative, Inc. Available at: http://www.ecsc.org/newsroom/RenewablesStudy.ppt.
- *Avoided Cost of Coal:* AEO2007.
- *Avoided Cost of Oil (Distillate):*
  - AEO2007.
  - Historical oil prices from U.S. DOE, EIA, available at: http://tonto.eia.doe.gov/dnav/pet/pet_pri_wfr_dcus_SNC_w.htm.
- *Fraction of Fuel Consumption for Heating Applications:*
  - AEO2007.
  - U.S. DOE, EIA, "2002 Manufacturing Energy Consumption Survey and Data Quality: Survey Design, Implementation, and Estimates." See http://www.eia.doe.gov/emeu/mecs/mecs2002/methodology_02/meth_02.html.

Quantification Methods:

- Investigate the technical and market potential of CHP in South Carolina.
- Project CHP installations in MW by fuel type.
- Estimate electricity production and heat output from the new CHP systems.
- Estimate the amount of fuels used for space and water heating that could be displaced by the heat output from CHP.
- Estimate the cost of CHP systems.
- Estimate the .GHG emissions reduction

Key Assumptions:

- *CHP technical Potential in South Carolina*: 4,497 MW (1,243 MW in the commercial sector and 3,254 MW in the industrial sector).
- *CHP Market Potential in South Carolina*: 50% of the technical potential for the market potential is higher than in other states, for which studies show the market or economic potential of CHP to be roughly 30% of the technical potential.

  The CHP market potential takes into account many factors influencing the economics and feasibility of CHP, including customer payback period, electricity price, natural gas price, standby rates, customer awareness and interest in CHP, availability of a streamlined permitting process, capital availability, and natural gas availability. CHP economic potential studies often conduct a scenario analysis, which includes a business-as-usual scenario and another (advanced) scenario with favorable policies for CHP implementation. The 30% figure is based on CHP studies for advanced scenarios.

- *Annual Growth in CHP Potential*: 1.34%, based on growth in electricity use in the commercial and industrial sectors.
- *Share of New CHP Systems by Fuel Type:*
  - *Biomass:* 15% in 2009, increasing to 20% by 2020.
  - *Natural Gas:* 85% in 2009, decreasing to 80% by 2020.
  - *Coal:* 0%, all years.
- *Economic Life of CHP and Distributed Generation Measures:* 20 years.
- *Financing Cost:* 5.5% interest rate and 7.9% capital recovery factor.
- *Capital Costs for CHP ($/kW):* Capital costs for CHP are incremental to the cost of regular space- and water-heating systems because CHP systems are assumed to replace space- or water-heating systems or both. The costs of regular space- and water-heating systems are assumed to be around $1,500. Incremental costs for natural gas CHP systems are assumed to be $1,300 and to decrease to $1,040 by 2020, and the incremental costs for biomass CHP systems (including wood and biomass) is assumed to be $2,000 and decrease to $1,400 by 2020. The cost reduction the study period is around 20%, based on EIA's DG cost projection in AEO2007. The capital costs in 2010 are close to the weighted-average capital cost of equivalent DG systems in "Self-Generation Incentive Program Data" by the San Diego Regional Energy Office. (http://www.sdreo.org/ContentPage.asp?ContentID=279&SectionID=276&SectionTarget=35)
- *Fraction of Thermal Energy Displaced by CHP Heat Output, by Fuel:* The fraction of fuel consumption for heating applications is based on regional data provided by EIA. The fuel data for the commercial sector are for the South Atlantic region in AEO2007 and were obtained from Erin Boedecker at EIA. The data for the industrial sector are for South Census region in the 2002 Manufacturing Energy Consumption Survey and obtained from Crawford Honeycutt at EIA. The fuel fraction data for the industrial sector is for HVAC applications. (Published data from the EIA Commercial Buildings Energy Consumption Survey (CBECS) and the Manufacturing Energy Consumption Survey (MECS) do not differentiate between heating and cooling applications. Further, the industrial fuel fraction data include industrial heat processing.)
  - Natural gas—75%.
  - Biomass—0%.
  - Coal—6%.
  - Electricity—16%.

  - Oil—3%.
- *Usable Co-Generated Heat Output as a Fraction of Fuel Energy Input:* 40% (placeholder assumption).
- *Net Efficiency of Displaced Boiler/Heater Thermal Energy by Fuel:*
  - Natural gas—85% (placeholder assumption).
  - Biomass—80% (placeholder assumption).
  - Electricity—92% (placeholder assumption).
  - Oil—80% (placeholder assumption)
- *Estimated Average Non-Fuel Operating. and Maintenance Costs by System Type ($/MWh):*
  - Natural gas—$10.00.
  - Biomass—$20.00.
  - Source: O&M costs for natural gas systems are based on GRI and NREL 2003. O&M for other fuels are assumed to be higher than natural gas; $20/MWh for biomass is a placeholder assumption.
- *Avoided Fuel Cost*
  - Electricity—See RCI-1.
  - Natural gas—See RCI-2.
  - Biomass—$2.89 per MMBtu (based on GDS and La Capra 2007).
  - Coal—$3.6 per MMBtu—the present value levelized cost of industrial coal between 2009 and 2020. Coal prices were projected using (1) the average industrial-use coal price in 2006 and (2) the projected trend in coal prices in AEO2007.
  - Oil—$13.27 per MMBtu—the average levelized cost of commercial and industrial distillate oil prices between 2009 and 2020. Oil prices were projected using (1) the average wholesale heating oil price of $2.140 per gallon for the 2007 heating season for North Carolina and (2) the projected trend in coal prices in AEO2007.
- *Avoided Emissions Factors:*
  - Electricity—See RCI-1.
  - Natural gas—See RCI-2.
  - Biomass—0.0013 metric tonnes (t) CO_2e/Bbtu (from the South Carolina Inventory and Forecast)
  - Coal—96.7 tCO_2e/Bbtu.
  - Oil —5.2 tCO_2e/Bbtu.
- *Discount Rate and Emissions Factors:* Same assumptions as used for RCI-1 and RCI-2

Key Uncertainties

While the TWG has set allocations among different CHP systems, the technology composition of currently installed systems is unknown. The performance and financial characteristics assumed are also subject to a wide range of uncertainty.

For example, it is uncertain how much CHP will be fueled by natural gas versus biomass. The assumption here is that 80%–85% of CHP is fueled by natural gas, and the rest is fueled by biomass. This fraction is consistent with the historical trend of CHP installations in South Carolina for the past several years. However, given the concern about natural gas price increases, the fraction of natural gas-fired CHP applications could be lower and the fraction of biomass CHP would be higher than predicted here. The implications of this change are that this policy option would result in more emission savings and would be less expensive because (1) biomass has little or no emissions and (2) the impact of high natural gas prices on the overall economics of CHP is likely to be higher than the impact of higher capital cost investment in biomass CHP applications.

Additional Benefits and Costs

- Reduced electricity price increases and volatility.
- Reduced natural gas price increases and volatility: small changes in demand can have large effects on the price of natural gas. Displacing inefficient oil and gas boilers with CHP (even if all CHP runs on gas) can reduce demand and affect the price of natural gas.
- Savings to consumers and business on energy bills.
- Electricity system benefits: reduced peak demand, reduced capital and operating costs, improved utilization and performance of electricity system.
- Green collar employment expansion and economic development.
- Reduced dependence on imported fuel sources.

Feasibility Issues

None noted.

Status of Group Approval

Pending – [until CECAC moves to final agreement at Meeting #5 or #6]

Level of Group Support

TBD – [blank until CECAC Meeting #5 or #6]

Barriers to Consensus

TBD – [blank until final vote by the CECAC]

RCI-6. Incentives and Policies for Improving Building Efficiency, Including Building Energy Codes

Policy Description

Almost half of all U.S. GHG emissions annually are associated with the operation of residential, commercial, and industrial buildings along with the embodied energy of building materials.[23] Improving the energy efficiency of state and/or local buildings—for example, by strengthening building energy codes—will have a considerable immediate and ongoing impact in reducing building-sector GHG emissions.

South Carolina law requires statewide use of the most up-to-date building codes, as defined by the International Energy Conservation Code (IECC). The IECC specifies minimum energy efficiency requirements for new buildings or for existing buildings undergoing a major renovation. South Carolina's local governments adopt and enforce the building codes.

Manufactured housing is exempt from South Carolina's building energy code. Instead, manufactured homes are subject to standards established by U.S. Department of Housing and Urban Development (HUD). A significant percentage of South Carolinians reside in manufactured housing.

To ensure that South Carolina's buildings, including manufactured homes, maximize the cost-effective potential for energy efficiency and minimize GHG emissions, the following policy prescriptions are recommended:

- Improve statewide enforcement of both existing and new building codes at all levels.
- As appropriate, modify codes to remove obstacles to renewable energy use, daylighting, and non-conventional energy-efficient building materials in buildings where applicable.
- Update South Carolina energy codes regularly. A 3-year cycle could be timed to coincide with release of national model codes. Local adoption of new statewide codes should occur within 6 months of statewide code adoption. (RCI-8, including education of building inspectors and other building professionals, is a supporting policy.)
- Task the South Carolina Building Codes Council with considering advanced codes (i.e., beyond IECC) as appropriate for the state (e.g., California Title 24).[24]
- Require manufactured housing and manufactured nonresidential buildings used in South Carolina to meet Energy Star certification standards after 2015.

[23] U.S. DOE, EIA, U.S. Energy Consumption by Sector. See http://www.architecture2030.org/building_sector/index.html.

[24] Note that research would be required to identify which portions of the California Title 24 codes are most applicable and appropriate for South Carolina.

- Provide state support for low-interest financing for the incremental cost of Energy Star-certified manufactured housing.
- Lobby for more stringent codes for manufactured housing at the federal level.

Policy Design

Goals:

- Adopt the 2006 IECC by 100% of South Carolina's municipalities by 2008.
- Fully enforce the 2006 IECC in all South Carolina municipalities by 2009.
- Achieve 25%–75% market penetration for Energy Star-labeled manufactured homes for new manufactured homes by 2010.

Timing: As noted above.

Parties Involved: As noted above.

Implementation Mechanisms

- *High-Performance Building Codes for Energy and Efficiency*—These codes specify minimum energy efficiency requirements for new buildings or for existing buildings undergoing a major renovation and/or additions. The minimums specified should be updated regularly, e.g. on a 3-year cycle.
- *Review of Existing Building and Trade Codes*—The state should undertake a comprehensive review of existing state and local building and trade codes to determine where increased energy efficiency can be achieved.
- *Education, Training, Certification and Technical Assistance*—Education, training and certification is expected to be a major component of improving building and trade codes. It will be necessary to develop enhanced state-mandated training, education, and certification for code officials, builders, and tradesmen. Education and outreach are important to help consumers and constituents understand the benefits of and cost savings from implementing these programs. Funding should be set aside for training and education of building inspectors.
- *Statewide Code and Inspections Program*—Understanding the importance of local government adoption and control over code enforcement, a minimum standard should be established statewide for related codes, permitting, and inspection.
- *Utility Involvement and Assistance*—The state should consider using utility resources to help implement energy codes. This can include energy audits, reviewing and promoting energy codes, interconnection rules, and tariffs and connection charges that encourage the construction and rehabilitation of buildings that incorporate energy efficiency.
- *Permitting and Fee Advantages*— To encourage building retrofit, the state provide programs that speed the permit approval process and reduce the permit and impact fees related to construction, This could include reduced building permit fees, water and sewer fees, and impact fees.

- *Rewards Programs*— The state should develop systems and programs that reward "beyond code" energy efficiency and emission reduction improvements, including "green mortgages," additional floor area ratio and/or zoning density for construction that meets or exceeds energy efficiency programs, or tax incentives. It should also work with financial institutions to develop loan tools for these programs, including nontraditional, off-grid, low- and carbon-neutral energy sources.
- *Compliance Flexibility*—Codes could allow permittees to utilize a combination of increased energy efficiency, switching to low- and no-carbon-based fuels for previously carbon-based end uses, off-site purchases of grid-supplied "green power," and/or installing on-site, off-grid, power-generating equipment.
- *Incentives To Promote Energy Star-Manufactured Homes*—The Manufactured Housing Research Alliance is currently using direct incentives for home retailers to promote Energy Star-manufactured homes.[25] The incentives are $400 for gas-heated homes and $700–$750 for electrically heated homes; the higher rebate for electrically heated homes is to help cover part of the incremental cost of the heat pump that is required for those homes. The Alliance has not administered programs that offer low-interest financing.

Related Policies/Programs in Place

Senator Jim Ritchie (R-Spartanburg) introduced a bill in 2007 (now passed) that would provide tax incentives and faster permitting for private developers to meet the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) silver standard.

A partnership of the South Carolina Energy Office, local homebuilder associations, and Southface Energy Institute is piloting an EarthCraft house program for Charleston and Greenville through which over 100 EarthCraft homes have been built.

International Code Council and IECC standards apply in South Carolina.

Manufactured homes that meet Santee Cooper's Good Cents Manufactured Homes criteria qualify for their Good Cents rate.[26]

Type(s) of GHG Reductions

Reduction in GHG emissions (largely CO_2) from avoided electricity production or on-site fuel combustion.

Estimated GHG Reductions and Net Costs or Cost Savings

This analysis consists of two components: energy savings from IECC 2006 adoption and enforcement, and energy savings from increased penetration of Energy Star-manufactured

[25] Per an e-mail from Gwynne Koch, Manufactured Housing Research Alliance.

[26] More information can be found at: https://www.santeecooper.com/portal/page/portal/SanteeCooper/MyHome/ResidentialGoodCents/Good Cents Manufactured Homes.

homes. As a result, the data sources, quantification methods, and key assumptions will be specified separately for each component.

Table 9. Estimated GHG reductions and net costs or cost savings from RCI-6

	GHG Reductions ($MMtCO_2e$)			Gross Costs (Million $)	Gross Benefits (Million $)	Net Present Value 2009–2020 (Million $)	Cost-Effectiveness ($/tCO_2e$)
	2012	2020	Total 2009–2020				
RCI–6 Total	0.9	2.4	16.6	TBD	–$875	TBD	TBD
Residential IECC 2006	0.8	2.2	14.8	TBD	–$785	TBD	TBD
Commercial IECC 2006	0.1	0.2	1.3	TBD	–$69	TBD	TBD
Residential Energy Star-Manufactured Homes	0.0	0.1	0.4	$9	–$21	–$12	–$27.6

Data Sources:

For IECC 2006 Adoption and Enforcement:

Benefits:

- Building Codes Assistance Project (BCAP), "Code Status Detail," available at: http://www.bcap-energy.org/code_status.php?STATE_AB=SC.
- U.S. DOE, Office of Energy Efficiency and Renewable Energy, "South Carolina Additional State Info," available at: http://www.energycodes.gov/implement/state_codes/state_stat_more.php?state_AB=SC.
- R.G. Lucas (January 2007), *Analysis of Energy Saving Impacts of New Residential Energy Codes for the Gulf Coast*, PNNL 16265, prepared for U.S. DOE, Pacific Northwest National Laboratory. Accessed January 2, 2008, at: http://www.energycodes.gov/pdf/pnnl16265.pdf.
- M.A. Halverson, 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.
- Building Codes Assistance Project (BCAP), personal communications with Aleisha Khan.

Costs:

- World Business Council for Sustainable Development (October 2007), "Energy Efficiency in Buildings: Business Realities and Opportunities—Summary Report," Figure 22: "Costing Green: A Comprehensive Cost Database and Budgeting Methodology," p. 31. Available at: http://www.wbcsd.org/DocRoot/UZxMnH1c1poU0uEhAm4P/EEB_Facts_Trends.pdf.
- RSMeans Construction Bookstore, QuickCost Estimator, http://www.rsmeans.com/calculator/index.asp (accessed January 6, 2008).

For Increased Penetration of Energy Star-Manufactured Homes:

Benefits:

- U.S. Census Bureau. *2006 American Community Survey: South Carolina Selected Housing Characteristics*. Accessed December 17, 2007, at: http://factfinder.census.gov/servlet/ADPTable?_bm=y&-geo_id=04000US45&-qr_name=ACS_2006_EST_G00_DP4&-ds_name=ACS_2006_EST_G00_&-_lang=en&-_sse=on ().
- Manufactured Housing Research Alliance (January 2006), *Factory Built Housing Roadmap (Including Recommendations for Energy Research)*, U.S. Department of Housing and Urban Development. Accessed December 19, 2007 at: http://www.pathnet.org/sp.asp?id=18383.
- Institute for Building Technology and Safety, "Manufactured Home Shipments by State (1990–2006). Accessed December 27, 2007 at: http://www.manufacturedhousing.org/admin/template/subbrochures/390temp.pdf
- 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*. [not available online]
- Support via emails from and conversations with Gwynne Koch at the Manufactured Housing Research Alliance

Costs:

- U.S. Census Bureau, "Average Sales Price of New Manufactured Homes Placed for Residential Use: All Homes, Single-Section & Double-Section Homes (1990–2001, in dollars)." Accessed December 27, 2007, at: http://www.manufacturedhousing.org/admin/template/subbrochures/394temp.pdf.
- 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*. [not available online]
- Support via e-mails from and conversations with Gwynne Koch, Manufactured Housing Research Alliance.

Quantification Methods:

For IECC 2006 Adoption and Enforcement:

Benefits:

Compliance rates associated with adoption and full enforcement were estimated. Then, the percentage of new and renovated homes and buildings to be built to the 2006 IECC was determined, along with the incremental energy savings. After the energy savings were broken out by fuel type, the GHG emission reductions were calculated using emission factors for each fuel type. The avoided costs by fuel type were also calculated.

Costs:

Incremental construction cost percentages were multiplied by the average cost of South Carolina homes and office buildings to determine the incremental cost per building for different levels of energy savings associated with different programs.

For Increased Penetration of Energy Star-Manufactured Homes:

Benefits:

A ramp-in scenario was developed based on the market penetration goals and the current penetration of Energy Star-manufactured homes in the state. Then, the number of new manufactured homes to be built to the Energy Star standard instead of the federal HUD standard was determined, along with the incremental energy savings by these homes. After the energy savings were broken out by fuel type, the GHG emission reductions were calculated using emission factors for each fuel type. The avoided costs by fuel type were also calculated.

Costs:

The incremental cost of an Energy Star-manufactured home as compared with a manufactured home built to the federal HUD standard was multiplied by the total number of federal HUD homes that were replaced by Energy Star-manufactured homes to calculate the total incremental cost of this policy.

Key Assumptions:

For IECC 2006 Adoption and Enforcement:

For the residential sector, the state standard overrides the need for builders to follow the 2003 IECC, even though it is in place. Thus, we are assuming that all existing buildings need to be brought up to the current 2003 IECC code.

For the commercial sector, the 2003 IECC is in force. Thus, we are assuming that the existing buildings have been following codes to a greater extent than for the residential sector.

Benefits:

In 2009 (with adoption and partial enforcement), 60% of new and renovated buildings and homes achieve 2006 IECC and 40% continue to be built to 2003 IECC. In 2010 (with adoption and full enforcement), 80% of new and renovated buildings and homes achieve 2006 IECC.

Table 10. Key assumptions for benefits from RCI-6

Assumption	Residential Sector	Commercial Sector	Notes
Number of New Homes/Buildings	663,719	14,274	Scaled from regional data using population
Ratio of New vs. Renovated Homes/Buildings	1.00	1.00	Placeholder assumption
Average Energy Use	0.0640 Bbtu/home/yr	0.00009 Bbtu/sq. ft./yr	Calculation of energy use divided by projected number of homes/buildings
Average Square Footage per Building	NA	11,829	Calculation of projected square footage of buildings divided by the projected number of buildings
Current Stock vs. New Stock Energy Savings	20%	16%	Calculated using Gulf Coast studies on building codes
Energy Savings for 2003 IECC to 2006 IECC	1%	5%	Placeholder assumptions; awaiting inputs from Aleisha Khan of BCAP
Proportion of Energy Savings by Fuel Type	79% Electricity 21% Natural Gas	77% Electricity 23% Natural Gas	Based on the breakout in the Inventory & Forecast

Assumption	Residential Sector	Commercial Sector	Notes
Emissions Factors, T&D Electricity Losses, Avoided Energy Costs (Delivered)	Same assumptions as used for RCI-1 and RCI-2		

Costs:

Table 11. Key assumptions for costs of RCI-6

Assumption	Residential Sector	Commercial Sector	Notes
Real Discount Rate	5%		Placeholder assumption
Capital Recovery Factor for Levelization	6.20% Interest Rate: 5.0% Period: 30 yrs	6.52% Interest Rate: 5.5% Period: 30 yrs	Calculated assumption
Average Construction Cost of a Home/Building	TBD	TBD	Using a cost estimator and a range of South Carolina-specific zip codes
Incremental Costs From Building Code Improvements	2006 IECC: TBD	2006 IECC: TBD	To be developed once energy reductions are determined

For Increased Penetration of Energy Star Manufactured Homes:

Benefits:

- Current Market Penetration in South Carolina: 0.19%.
- Market Penetration Ramp-In: See Table 12.

Table 12. Market penetration ramp-in for TCI-6

Year	Target
2009	10%
2010	25%
2011	30%
2012	35%
2013	40%
2014	45%
2015	50%
2016	55%
2017	60%
2018	65%
2019	70%
2020	75%

- Energy Use of Manufactured Homes Built to Federal HUD Standards: 0.079 billion Btu/home/yr.

- Energy Savings for an Energy Star Manufactured Home: 35%.
- Number of Manufactured Homes in South Carolina in 2006: 378,366.
- Projected Annual Growth in Manufactured Home Sales: 2,700 per yr.
- Proportion of Energy Use by Fuel Type in Manufactured Homes:
  - Electricity: 76%.
  - Natural Gas: 15%.
  - LPG: 9%
- Avoided Energy Costs by Fuel Type:
  - Electricity, Natural Gas: Same assumptions as used for RCI-1 and RCI-2.
  - LPG: $12,300/Bbtu (2005$) (NC price).
- Emissions Factors by Fuel Type:
  - Electricity, Natural Gas: Same assumptions as used for RCI-1 and RCI-2.
  - LPG: 62 tCO_2e/Bbtu.

Costs:

- Real Discount Rate, T&D Electricity Losses: Same assumptions as used for RCI-1 and RCI-2.
- Capital Recovery Factor for Levelization: 6.76%.
  - Interest Rate: 5%.
  - Period: 25 yrs.
- Average Sales Price of a Manufactured Home in South Carolina: $54,300/home (2004$).
- Incremental Cost for an Energy Star-Manufactured Home: $2,600 /home (2006$).

Key Uncertainties

Assumptions for which little supporting data were available include:

- The number of renovated homes and buildings;
- The building code compliance rate under partial and full enforcement; and
- The cost of building code implementation.

There is a need to define the threshold that would trigger the need for a building code permit.

Additional Benefits and Costs

- Resource conservation, including water: lower water demand leads to lower costs and reduced energy use for water production.
- Indoor comfort and air quality improvements, with related improvements in health and productivity.

- Savings to consumers and business on energy bills. Benefits to low-income households from reduced utility costs.
- Electricity system benefits: reduced peak demand, reduced capital and operating costs, improved utilization and performance of electricity system
- Reduced pollutants from emissions, improved health from fewer pollutants and particulates, and reduced water use for cooling.
- Employment expansion and economic development.
- Reduced dependence on imported fuel sources.
- Reduced energy price increases and volatility.

Feasibility Issues

Reaching 25% market penetration for Energy Star-manufactured homes over the course of a year may prove challenging, considering that there is little market penetration for these homes currently in the state.

Gwynne Koch at the Manufactured Housing Research Alliance stated, "Our target market penetration for Energy Star-manufactured homes in the areas of the country where we are currently administering utility-sponsored rebates depends on the amount and type of incentive being provided. However, these targets are currently less than 25% of new home shipments. As we discussed, a target of 25%–75% penetration within just a few years is an optimistic, albeit likely unrealistic, target."

Also, Ms. Koch noted, "There are no facilities/plants in South Carolina that are certified and that are producing Energy Star-manufactured homes. Any Energy Star HUD-code homes in South Carolina are being shipped into the state by out-of-state manufacturers." Supply constraints could impair the feasibility of this policy. However, this could also present an opportunity for economic development.

A 3-year cycle for building code updates could be challenging to implement for some jurisdictions with limited staff to keep up with frequent code changes. A greater number of cycles with less substantial updates may result in a loss of attentiveness by smaller counties. Fewer updates that each has more impact may be more feasible for smaller counties in particular.

Status of Group Approval

Pending – [until CECAC moves to final agreement at Meeting #5 or #6]

Level of Group Support

TBD – [blank until CECAC Meeting #5 or #6]

Barriers to Consensus

TBD – [blank until final vote by the CECAC]

RCI-7. Improved Design and Construction in New and Existing State and Local Government Buildings, "Government Lead by Example"

Policy Description

Government-led, or "lead by example," initiatives help state and local governments achieve substantial energy cost savings while promoting the adoption of clean energy technologies for significant GHC emission reductions in new and existing state and local government buildings. Elements of this policy include:

- A goal for green power purchasing by state and local facilities.
- Development and promotion of green procurement strategies, such as installing renewable energy systems for additional backup in emergency services buildings (e.g., police stations, fire stations, and National Guard facilities).
- Audits of energy performance and operations of state and other government buildings (in tandem with an audit program). Audit results could be used to target and prioritize investments in improving government building energy efficiency.
- Financial and technical assistance for implementation of energy-saving projects in existing buildings and facilities, and a requirement that all state and local facilities implement an energy management program.
- Expansion of A88 to include South Carolina school buildings.
- Implementation of design features to reduce energy use within state-funded and other government buildings, as well as in the surrounding community, through incorporation of proven planning guides and regulations.
- Improvement and review of efficiency goals over time, and development of flexibility in contracting arrangements to encourage integrated energy-efficient design and construction.
- Recommendations that the infrastructure for implementation (meters, bookkeeping systems, staff, etc.) be established as soon as possible.
- "Retained savings" policies whereby government agencies are able to retain funds saved by reducing energy bills for further energy efficiency/renewable energy investments or other uses.
- State bulk purchase of appliances and equipment with higher-than-standard energy efficiency for public facilities, e.g., Energy Star appliances.
- Requirement that energy efficiency be a criterion in procurement of energy-using equipment and systems, and in the improvement in the operation of buildings and other facilities.

Policy Design

Goals:

- Set a state goal that, by 2018, a minimum of 20% of electricity consumed by state and local facilities and schools should come from in-state renewable resources, as defined below. The renewable established portfolio standard would count toward this goal. This strategy would allow state agencies to "lead by example." It would also create an established market for green power generators.
- Provide state financial and technical assistance for implementation of energy-saving projects in existing buildings and facilities. Require that all state and local facilities implement an energy management program, which may include the use of contracts with ESCOs that guarantee savings. Seek to replicate the Winthrop University energy management program throughout the state.
- Procure and carry out a program to audit energy use and identify energy efficiency opportunities in state and local government buildings, similar to the energy software program in use by the South Carolina Energy Office. This energy audit program should have a goal of 15% audit rate per year over a 5-year period, and would cover existing buildings, buildings undergoing renovation, and buildings under design.
- Purchase in bulk for public facilities appliances and equipment with higher-than-standard energy efficiency for, such as Energy Star appliances. Require that energy efficiency be a criterion in procurement of energy-using equipment and systems, and in the improvement in the operation of buildings and other facilities.

Timing: Beginning in 2009.

Parties Involved: State government agencies, local governments, schools and universities, ESCOs.

Other: Definition of "green power": A renewable energy resource includes solar (roofing materials with built-in solar photovoltaic (PV) cells, solar PV panels erected on roofs, solar water-heating, and solar space-heating systems); wind; hydroelectric (less than 10 kW); geothermal; ocean current or wave energy; biomass resource, including agricultural waste, animal waste, wood waste, spent pulping liquors, combustible residues, combustible liquids, combustible gases, energy crops, or landfill methane; waste heat derived from a renewable energy resource and used to produce electricity; and hydrogen derived from a renewable energy resource.

Implementation Mechanisms

- The administering agency will establish a database of buildings and building attributes, including floor area, insulation level, energy-using equipment, and history of energy consumption, for all state and local government buildings and facilities. This baseline, or "carbon footprint," will be used to assess program success.
- State and local governments will be required to submit energy management plans to the administering agency every 5 years. Energy management plans should include targets for

energy use in the operation of buildings, potentially including a cap on state and local buildings' and facilities' energy use per square foot.

- State and local agencies will be required to conduct periodic reviews of building energy use over time.
- The database will track audits of energy performance and operations, information on energy management plans, and any ESCO contracts for these buildings and facilities. It will also track green power purchases or installation and performance of renewable energy systems.
- The administering agency will provide financial assistance (including information about federal grant opportunities) and technical assistance for implementation of energy-saving projects in existing buildings and facilities.
- The state Budget and Control Board will set up a fund and administer a program to purchase in bulk appliances and equipment with higher-than-standard energy efficiency for public facilities. It will also review contracts involving procurement of energy-using equipment and systems, or construction and renovation of buildings and other facilities, to ensure consideration of energy efficiency.

Related Policies/Programs in Place

State-funded buildings—either new construction or renovations—are required to meet the LEED silver standard for energy efficiency or “two globes” standard.

Type(s) of GHG Reductions

Reduction in GHG emissions (largely CO_2) from avoided electricity production or on-site fuel combustion.

Estimated GHG Reductions and Net Costs or Cost Savings

This analysis consists of two components: energy savings from energy audits and efficiency improvements and energy savings from renewable energy purchases. As a result, the data sources, quantification methods, and key assumptions will be specified separately for each component. Additionally, these two policies have been linked, such that the energy consumption reductions from the energy audits and efficiency improvements component are reflected in the baseline energy consumption used to determine the renewable energy purchase goals.

Table 13. Estimated GHG reductions and net costs or cost savings from RCI-7

Policy Strategies	GHG Reductions ($MMtCO_2e$)			Gross Costs (Million $)	Gross Benefits (Million $)	Net Present Value 2009–2020 (Million $)	Cost-Effectiveness ($/t$CO_2$e)
	2012	2020	Total 2009–2020				
RCI–7 Total	0.6	5.3	26.9	$790*	–$1,294	–$505*	–$18.8*
Energy Audits and Efficiency Improvements for Government Buildings	0.1	3.7	16.1	$15*	–$770	–$755*	–$46.9*
Energy Audits and Efficiency Improvements for Schools	0.0	0.5	2.2	$2*	–$107	–$105*	–$47.0*
Renewable Energy for Government Buildings	0.4	1.0	7.5	$682	–$368	$314	$41.6
Renewable Energy for Schools	0.1	0.1	1.0	$91	–$49	$42	$41.7

**Note: audits costs only; retrofit and efficiency improvement costs TBD.*

Data Sources:

Energy Audits and Efficiency Improvements

Benefits:

- Number and average size of state and local government buildings in the South Atlantic region: CBECS 2003—U.S. DOE, EIA, Office of Energy Statistics, "Commercial Buildings Energy Consumption Survey, Commercial Energy." Available at: http://www.eia.doe.gov/emeu/cbecs/.
- Average size of education buildings in the South Atlantic region: CBECS 2003.
- Number of public schools: South Carolina Department of Education, Division of School Enterprise Operations, Office of Research, *Quick Facts: Education in South Carolina*, p. 2, (accessed January 2, 2008):
  - 2003–2004 SY: http://ed.sc.gov/agency/offices/research/documents/44932_QuickFacts06.pdf
  - 2002–2003 SY: http://ed.sc.gov/agency/offices/research/documents/QuickFacts2005.pdf.
  - 2001–2002 SY: http://ed.sc.gov/agency/offices/research/documents/QuickFacts2004.pdf.
  - 2000–2001 SY: http://ed.sc.gov/agency/offices/research/documents/QuickFacts2003.pdf.

Costs:

- Estimated audit cost from Mitch Perkins of the RCI TWG.

Renewable Energy

Benefits:

- Number and average size of state and local government buildings in the South Atlantic region: CBECS 2003.
- Average size of education buildings in the South Atlantic region: CBECS 2003.

- Number of public schools: South Carolina Department of Education, Division of School Enterprise Operations, Office of Research, *Quick Facts: Education in South Carolina*, p. 2, (accessed January 2, 2008):
  - 2003–2004 SY: http://ed.sc.gov/agency/offices/research/documents/44932_QuickFacts06.pdf
  - 2002–2003 SY: http://ed.sc.gov/agency/offices/research/documents/QuickFacts2005.pdf.
  - 2001–2002 SY: http://ed.sc.gov/agency/offices/research/documents/QuickFacts2004.pdf.
  - 2000–2001 SY: http://ed.sc.gov/agency/offices/research/documents/QuickFacts2003.pdf.

Costs:

- Cost per kWh of renewable resources: See ES-1.

Quantification Methods:

Energy Audits and Efficiency Improvements

Benefits:

The audit rate was used to calculate the number of buildings that would receive an audit. Then, a percentage was used to estimate the number of buildings that are audited that would go on to make improvements and realize energy savings. The number of buildings that would realize energy savings was multiplied by an estimated average energy savings per square foot per building and by the average number of square feet per building. After the energy savings was broken out by fuel type, the GHG emission reductions were calculated using emission factors for each fuel type. The avoided costs by fuel type were also calculated.

Costs:

The average audit cost per building was multiplied by the number of audited buildings to arrive at the estimated costs associated with the audits.

Renewable Energy

Benefits:

A ramp-in to the renewable energy goal per building was developed. Then the current electricity use for the buildings involved was calculated. The renewable energy goal for each year was multiplied by the electricity use to determine the electricity that would need to be either generated on site or purchased via a green power purchase. The GHG emission reductions were calculated using the emission factor for electricity. The avoided cost was also calculated.

Costs:

Proportions for the renewable energy to be supplied on site vs. acquired from off-site resources were developed, and a cost per kWh was applied to each of these requirements.

Key Assumptions:

Energy Audits and Efficiency Improvements

Due to the difficulty in estimating implementation costs, these costs are not included in the cost estimates at this time.

Benefits: See Table 14.

Table 14. Key assumptions for benefits from energy audits and efficiency improvements

Assumption	Government Buildings	Schools	Notes
Number of Buildings	Existing: 9,002 New: 776 Total: 9,778	Existing: 1,205 New: 50 Total: 1,255	Government: Scaled from regional data using population Schools: Actual number of public schools provided by the state Division of School Enterprise Operations website Includes 2009–2013 only
Number of Audited Buildings	7,096	926	15% of the total number of buildings
% of Audited Buildings That Realize Energy Savings	80%		Placeholder assumption
Number of Buildings Undergoing Improvements	5,677	741	Calculated assumption
Average Energy Savings per Building	30%		Placeholder assumption
Average Square Footage per Building	26,453	28,103	Calculation of projected square footage of buildings divided by the projected number of buildings
Average Energy Use per Building	0.00008 Bbtu/sq. ft./yr		Calculation of energy use divided by projected number of square feet
Ratio of Energy Use in Commercial Buildings vs. Government & School Buildings	1.00	1.00	Placeholder assumption
Proportion of Energy Savings by Fuel Type	68% Electricity 32% Natural Gas		Based on the breakout in the Inventory & Forecast
T&D Electricity Loss, Avoided Cost of Electricity, Displaced Electricity Emissions Factor	See RCI-1.		
Avoided Natural Gas Costs, Displaced Natural Gas Emissions Factor	See RCI-2.		
Time Period From Audit to Completion of Renovations	3 years		

Costs: See Table 15.

Table 15. Key assumptions for costs of energy audits and efficiency improvements

Assumption	Government Buildings	Schools	Notes
Real Discount Rate	5%		
Capital Recovery Factor for	9.63%		Calculated assumption

Levelization	Interest Rate: 4.0% Period: 13 yrs	
Audit Cost per Building	$3,000	From Mitch Perkins

Renewable Energy

Ramp in of the goal: See Table 16.

Table 16. Assumed schedule for ramp-in of the RCI-7 renewable energy goal

Year	Target
2009	2%
2010	4%
2011	6%
2012	8%
2013	10%
2014	12%
2015	14%
2016	16%
2017	18%
2018	20%
2019	20%
2020	20%

Benefits: See Table 17.

Table 17. Key assumptions for benefits from renewable energy

Assumption	Government Buildings	Schools	Notes
Number of Buildings	Existing: 9,002 New: 1,978 Total: 10,979	Existing: 1,205 New: 120 Total: 1,325	Government: Scaled from regional data using population Schools: Actual number of public schools provided by the state Division of School Enterprise Operations website
Average Square Footage per Building	26,453	28,103	Calculation of projected square footage of buildings divided by the projected number of buildings
Avg. Energy Use for a Building, Ratio of Energy Use in Commercial Buildings vs. Government & School Buildings	Same assumption as used for Energy Audits.		
Proportion of Energy Savings by Fuel Type	68% Electricity 32% Natural Gas		Based on the breakout in the Inventory & Forecast
T&D Electricity Loss, Avoided Cost of Electricity, Displaced Electricity Emissions Factor	See RCI-1.		

Costs: See Table 18.

Table 18. Key assumptions for the costs of renewable energy

Assumption	Government Buildings	Schools	Notes
Real Discount Rate	Same assumption as used for Energy Audits		
Renewable Resource Solution	On-Site PV: 10% Green Energy Purchases: 90%		Green energy purchases include biomass co-firing, direct-fire biomass, landfill gas, and small hydro
Levelized Renewable Resource Cost	On-Site PV: $0.27/kWh Green Energy Purchases: $0.08/kWh		From ES-1 TWG analysis

Key Uncertainties

Assumptions for which little supporting data were available include:

- The percentage of existing and new buildings that are audited that will go on to make improvements and realize energy savings through efficiency measures;
- The percentage of energy savings possible on average through efficiency improvements as identified in the audit;
- The ratio between average commercial building energy use and government and school building energy use;
- The implementation costs associated with the recommendations from the audits; and
- The portion of the renewable energy needs that will be met with on-site PV solutions vs. green power purchasing.

Additional Benefits and Costs

- With any lead-by-example policy, the intent is that state employees will become interested in implementing the types of energy-saving measures they are exposed to at work in their own commercial buildings and/or residential homes. Another way that this initiative can spread is through word of mouth to the employees' friends and family. (This policy analysis did not include a quantification of this additional benefit.)
- Indoor comfort and air quality improvements, with related improvements in health and productivity.
- Savings on energy bills.
- Electricity system benefits: reduced peak demand, reduced capital and operating costs, improved utilization and performance of electricity system.
- Reduced risk of power shortages.

- Reduced pollutants from emissions, improved health from fewer pollutants and particulates, and reduced water use for cooling.
- Green collar employment expansion and economic development.
- Reduced dependence on imported fuel sources.
- Reduced energy price increases and volatility.

Feasibility Issues

This policy will require the state to provide resources.

Status of Group Approval

Pending – [until CECAC moves to final agreement at Meeting #5 or #6]

Level of Group Support

TBD – [blank until CECAC Meeting #5 or #6]

Barriers to Consensus

TBD – [blank until final vote by the CECAC]

RCI-8. Participation in Voluntary Industry–Government Partnerships (Including Incentives)

Policy Description

This mitigation option aims to create a voluntary program in which businesses, government, and industry become partners in reducing the emission of process gases that have high GWPs. The program would provide technical assistance, networking, best practices exchange, and rewards and recognition.

There are existing federal programs that encourage partnerships among businesses, industry, and government entities. EPA's Climate Leaders is an industry-government partnership that works with companies to develop long-term comprehensive climate change strategies. Partners set a corporate-wide GHG reduction goal and inventory their emissions to measure progress. South Carolina's program may be based on this model or in partnership with this program.

It should be recognized that, as a part of a voluntary partnership to reduce GHG emissions, verification of emission reductions is a key element. *The Climate Registry* is collaboration among states, provinces, and tribes aimed at developing and managing a common GHG emission reporting system with high integrity that is capable of supporting various GHG emission reporting and reduction policies for its member states and tribes and reporting entities. It can provide an accurate, complete, consistent, transparent, and verified set of GHG emissions data from reporting entities, supported by an auditable accounting and verification infrastructure.

Policy Design

Goals:

- Partner with industrial and other large users of energy (and/or of process gases that are GHGs) to encourage them to set emission reduction targets to return to 2000-level emissions by 2012 and 10% below 2000-level emissions by 2020, or to meet or exceed state goals. Approach the largest emitters to get the most significant reductions through the partnerships.
- Establish a technical assistance and networking program by 2009. This may be accomplished through already-established programs and should be administered by state agencies.
- Establish a reward and recognition program to include tax incentives by 2009. This may be accomplished through already-established programs and/or other CECAC TWG recommendations.

Timing: See above.

Parties Involved:

- Large Industrial firms and other major energy consumers or users of high-GWP process gases are the focus of this policy. The largest emitters should be approached first.

- State agencies: The South Carolina Energy Office and the South Carolina Department of Health and Environmental Control can also help manage the program, including coordinate reporting, auditing, and compliance.
- Utilities: May be involved in technical assistance or regulatory mandate in fuel switching.
- Regulators: May "level the playing field" between fuel options and to provide incentives for fuel switching where applicable.

Other: A clear definition of "green power" is a necessity. (See also ES-6.)

Implementation Mechanisms

- *Voluntary and or Negotiated Agreements*—Program participants would engage in voluntary agreements with the administering state agency to reduce use of electricity and oil or emissions of process-related GHGs.
- *Technical Assistance and Networking*—The administering state agency would provide information and assistance to participants with setting targets and determining individual measures that would be needed to meet targets. The program would include individualized technical assistance, as well as more generic literature on best practices or software tools to look for process improvement and other emission-reduction opportunities. A pilot facility may be used to demonstrate specific process changes or emission-reduction technologies.
- *Reporting and Registry*—Some sort of reporting, and possibly monitoring and evaluation (including establishment of baseline emissions), will be required to determine the degree to which targets have been met. Active participants may choose to be listed on a statewide registry and receive recognition for emission reductions.
- *Fuel Switching*—Where applicable, fuel switching may be used as a means of emission reduction. This recommendation may be implemented through a combination of financial and other incentives, public–private partnerships and agreements, provision of information and technical assistance, and other methods.
- *Process Change/Optimization*—Manufacturing processes may be improved so as to reduce energy use and/or release of GHG process gasses. The impacts and costs of process changes are highly process-specific.
- *Funding Mechanisms and or Incentives*—Tax incentives could be used as a monetary reward for participating in the program, subject to monitoring and verification of emission reductions.
- *Supporting Activities*—The program administrator may support core activities by assisting with the development of markets for alternative fuels, and engaging in technology transfer for ongoing research and development on biomass supplies, supply infrastructure, and industrial end-use equipment for using alternative fuels (see also ES-2).
- *Codes and Standards*—Adjustments to solid waste and air quality regulations may be necessary to encourage alternative renewable fuels in some applications.

Related Policies/Programs in Place

- *The Climate Registry* (http://www.theclimateregistry.org/).

- EPA Climate Leaders (http://www.epa.gov/climateleaders/index.html) (Web site indicates no representatives from South Carolina).
- The South Carolina Environmental Excellence Program (SCEEP) administered by Department of Health and Environmental Control, encourages and publicizes waste reduction and energy conservation efforts. This program provides reward and recognition as well as networking and idea exchange for entities that prevent pollution, conserve energy and other resources, and strive for continuous environmental improvement. (http://www.scdhec.net/eqc/admin/html/sceep.html) The Web site shows 30 members to date, including Alcoa-Mt. Holly, Associated Fuel Pump Systems (AFCO), BMW Manufacturing Corp., Bridgestone/Firestone South Carolina Company, Charleston Air Force Base, Charleston Commissioners of Public Works, Circle Environmental, DAA Draexlmaier Automotive of America LLC, Dayco Products, Inc., Eastman Chemical Company (formerly Voridian), Georgia-Pacific Resins, Inc., INA USA Corporation (5 facilities), Interlake Material Handling Solutions, International Paper (Eastover & Georgetown Mills), KEMET Electronics Corp. (Mauldin, Fountain Inn, & Simpsonville Plants), Kimberly-Clark, Beech Island Mill, Lang-Mekra, N.A., Michelin Earthmover Manufacturing, Michelin Spartanburg Manufacturing, National Beverage Screen Printers, Inc., Progress Energy—Energy Delivery Carolinas Southern Region, Santee Cooper Regional Water System, Springs Industries (12 facilities), Square D Company (Columbia & Seneca), U.S. Naval Weapons Station—Charleston, and Weyerhaeuser Co.—Marlboro Paper Mill.
- EPA's National Environmental Performance Track program (http://www.epa.gov/perftrac/program/index.htm).
- The Carbon Disclosure Project (http://www.cdproject.net) (Web site shows 5 members representing South Carolina, including Duke Energy Corporation, Embarq Corporation, MeadWestVaco, Progress Energy, Inc., and Synovus Financial Corp.).
- EIA Voluntary Reporting of Greenhouse Gases Program (http://www.eia.doe.gov/oiaf/1605/frntvrgg.html).

Type(s) of GHG Reductions

To the extent that voluntary emission reduction efforts target nonenergy emissions, GHG impacts will vary on a case-by-case basis. Potential impacts include:

- Reductions in emissions of hydrofluorocarbons and SF6 if industries using these gases participate.
- CO_2 reduction from avoided electricity production and avoided on-site fuel combustion. For fuel switching from electricity to gas or biomass fuels, the reduction in carbon emissions from avoided electricity production, less any emissions from additional on-site fuel combustion.

Estimated GHG Reductions and Net Costs or Cost Savings

Table 19. Estimated GHG reductions and net costs or cost savings from RCI-8

Policy No.	GHG Reductions ($MMtCO_2e$)			Gross Costs (Million $)	Gross Benefits (Million $)	Net Present Value 2009–2020 (Million $)	Cost-Effectiveness ($/t$CO_2$e)
	2012	2020	Total 2009-2020				
RCI-8 Total	0.0	0.0	0.1	N/A	N/A	N/A	N/A

Data Sources:

Research has not turned up any cost data for reduction programs involving industrial users. Thus, the results have been produced using little actual data and were produced using a scenario modeling approach.

Quantification Methods:

Benefits:

A portion of emissions was identified that voluntary measures could reduce. Then, emissions goals relative to 2000 per year were applied to a portion of emissions for the entire industrial sector.

Costs:

Not quantified.

Key Assumptions:

Table 20 presents the assumed ramp-in for the goals of this policy.

Table 20. Assumed ramp-in for achieving the goals of RCI-8

Year	Target
2009	8.0%
2010	5.3%
2011	3.1%
2012	0.0%
2013	–1.3%
2014	–2.5%
2015	–3.8%
2016	–5.0%
2017	–6.3%
2018	–7.5%
2019	–8.8%
2020	–10.0%

Industrial Sector Emissions: 81,338,693 tCO_2e between 2000 and 2020.

Percentage of Total Industrial Sector Emissions That Will Be Subjected to the Reduction Goal: 5%.

Key Uncertainties

It is unknown whether these reductions are attainable, given that there are no available data from existing programs to provide support for these estimates.

Additional Benefits and Costs

- Support of local businesses and stimulation of economic development.
- For efficiency measures, reduced consumer energy bills, reduced energy price increases and volatility, and improved utilization of the electricity system.
- Potentially reduced local air pollution impacts (from switching from electricity to on-site fuels combustion, or from gas to other fuels).
- Participation in this program at the state level could help build participation in other programs, thus resulting in additional indirect emission reductions.

Feasibility Issues

- The voluntary nature of this program may present a challenge in attracting participants with resources available to fund measures with high emission reduction potential.
- The major benefits of this type of program for participants are associated with reputation and networking. Businesses that perceive that consumers will respond positively to "branding" will be more likely to invest their time and money in voluntary measures. Community buy-in and word-of-mouth promotion will greatly facilitate the success of the program.

Status of Group Approval

Pending – [until CECAC moves to final agreement at Meeting #5 or #6]

Level of Group Support

TBD – [blank until CECAC Meeting #5 or #6]

Barriers to Consensus

TBD – [blank until final vote by the CECAC]

RCI-9. Incentives and Policies for Improving Appliance Efficiency, Including Appliance Standards

Policy Description

Appliance efficiency standards reduce the market cost of energy efficiency improvements by incorporating technological advances into base appliance models, thereby creating economies of scale. Appliance efficiency standards can be implemented at the state level for appliances not covered by federal standards, or standards can be jointly developed by multiple states.

There are existing federal standards for 17 residential products and 11 pieces of commercial equipment. Laws require the DOE to set minimum appliance efficiency standards that are technologically feasible and economically justified. However, state standards can play a role for many appliances not covered by federal standards.

Energy Star is a joint program of EPA and DOE, designed to promote energy-efficient products in the marketplace. Energy Star products and appliances exceed the energy efficiency levels mandated by minimum federal and state standards.

To ensure that appliances purchased in South Carolina maximize the cost-effective potential for energy efficiency and minimize GHG emissions, the following policy prescriptions should be considered:

- Improve appliance standards for appliances not regulated by federal standards.
- Lobby for more stringent appliance standards at the federal level. Require the preferential procurement of Energy Star products if available (equipment, appliance, or technology) if state funds are involved (state purchasing contracts, state grants or loans, etc.).
- Provide South Carolina state sales tax exemptions, whether temporary or permanent, for Energy Star-certified products.
- Provide South Carolina income tax credits to reduce the incremental cost of Energy Star appliances relative to standard appliances.

Policy Design

Goals:

- Set state minimum efficiency standards for appliances not covered by federal standards, as recommended by Appliance Standards Awareness Program,[27] by 2009.

[27] See http://www.standardsasap.org/documents/a062_sc.pdf. The analysis recommends standards for the following products: bottle-type water dispensers, commercial boilers, commercial hot-food-holding containers, compact audio products, DVD players and recorders, liquid immersion distribution transformers, medium-voltage dry-type distribution transformers, metal halide lamp fixtures, pool heaters, portable electric spas, residential furnaces and boilers, residential pool pumps, single-voltage external AC-to-DC power supplies, state-regulated incandescent reflector lamps, and walk-in refrigerators and freezers.

- Achieve 100% market penetration of Energy Star appliances in purchase transactions in which state funds are involved (state purchasing contracts, state grants or loans, etc.) by 2010.
- Achieve doubling of market penetration of Energy Star appliances in purchases made in the residential, commercial, and industrial sectors, where applicable, up to 100%, by 2015.

Timing: As noted above.

Parties Involved: As noted above.

Implementation Mechanisms

Appliance standards can be promulgated by legislation or developed administratively.

Appliances covered by the Appliance Standards Awareness Project (ASAP) are updated annually to incorporate the effects of new state and federal appliance standards. Review and adoption of updated ASAP-recommended state-level appliance standards should be undertaken periodically (e.g., every 3 years or as new federal standards are enacted).

The state should work with manufacturers and consider impacts on manufacturers when setting new standards.

Related Policies/Programs in Place

Energy Independence and Security Act of 2007—This federal law establishes new minimum efficiency standards for several appliance types, including five that are also recommended by the ASAP: residential boilers, state-regulated incandescent reflector lamps, single-voltage external AC-to-DC power supplies, metal halide lamp fixtures, and walk-in refrigerators and freezers. These appliances are not included in the quantification below.

Type(s) of GHG Reductions

Reduction in GHG emissions (largely CO_2) from avoided electricity production or on-site fuel combustion.

Estimated GHG Reductions and Net Costs or Cost Savings

Table 21. Estimated GHG reductions and net costs of or cost savings from RCI-9

Option No.	GHG Reductions ($MMtCO_2e$)			Gross Cost (Million $)	Gross Benefits (Million $)	Net Present Value 2009–2020 (Million $)	Cost-Effectiveness ($/tCO_2e$)
	2012	2020	Total 2009–2020				
RCI-9 Total	0.3	0.9	5.6	$178	–$268	–$90	–$16
ASAP Standards	0.0	0.2	1.0	$18	–$49	–$31	–$31
State Purchases	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Energy Star	0.2	0.8	4.6	$165	–$218	–$54	–$12

Data Sources:

- *Current Federal Appliance Standards*
  - U.S. Congress. House. *Energy Independence and Security Act of 2007*. H.R.6. 110th Cong., 1st sess.
- *Current Appliance Sales*
  - Association of Home Appliance Manufacturers, "Distributor Sales by State—2006," available at: http://www.aham.org/ht/d/ProductDetails/sku/BDSTATE/from/5256/pid/.
  - Bill McNary, Appliance Sales Data: 2006 Sales Data – National, State, and Regional. Energy Star, Resources for Appliance Manufacturers and Retailers, May 2007, at http://www.energystar.gov/ia/partners/manuf_res/2006FullYear.xls.
  - Summit Blue Consulting LLC (November 12, 2007), "Report to Baltimore Gas and Electric: Demand-Side Management Program: Measure Impact and Cost-Effectiveness," submitted to Honeywell Utility Solutions. http://webapp.psc.state.md.us/Intranet/Maillog/content.cfm?filepath=C:\Casenum\Admin%20Filings\60000-109999\108886%5C122807ConservationFilingFinal.pdf.
- *Efficiency Standards for Appliances*
  - Steven Nadel, Andrew deLaski, Maggie Eldridge, and Jim Kleisch (March 2006). *Leading the Way: Continued Opportunities for New State Appliance and Equipment Efficiency Standards*, Report Number ASAP-6/ACEEE-A062, ASAP and ACEEE. Available at: http://www.aceee.org/pubs/a062.htm.
  - Steven Nadel, Andrew deLaski, Maggie Eldridge, and Jim Kleisch. Energy Efficiency Standards Benefits—2006 Model Bill: South Carolina, ASAP and ACEEE. Accessed December 7, 2007, at: http://www.standardsasap.org/documents/a062_sc.pdf.

Quantification Methods:

- To quantify the state minimum efficiency standards for appliances not covered by federal standards:
  - Projected electricity and natural gas savings are taken from the 2006 ASAP data for South Carolina.
  - These annual energy savings are adjusted to fit the analysis period, per ramp rate of appliances and target implementation year.
  - The appropriate GHG emission factors, energy prices, and discount rate are applied.
- The purchase of Energy Star appliances in state-funded transactions is not calculated due to insufficient data.
- For quantification of the energy savings associated with residential, commercial, and industrial sector appliance purchases, historic quantities and types of purchases are used to forecast future quantities and types of purchases. The annual energy savings detailed in the Summit Blue report (noted above) are applied to the predicted future purchases and adjusted for discount rate, energy prices, and associated GHG reductions.

Key Assumptions:

- Of the appliances ASAP has recommended for minimum state standards, some are already subject to minimum standards in other states, suggesting that product development and manufacturing lead times are short. This analysis assumes that all of the appliances subject to minimum standards can be brought to market by the end of 2009, except commercial boilers, distribution transformers, pool heaters, and residential furnace fans, which are assumed to be available as of 2010, 2010, 2013, and 2014, respectively.
- Costs and savings from efficiency improvement via standards are similar in South Carolina to those indicated in the ASAP/ACEEE March 2006 report.
- Cost of financing: See Table 22.

Table 22. Key assumptions regarding the cost of financing for RCI-9

Sector	Interest rate	Asset life	Capital Recovery Factor
Commercial	6%	13	10.40%
Residential	5%	13	10.40%
Industrial	6%	13	10.14%
Commercial Government	4%	13	9.63%

- The actual annual energy savings associated with the Energy Star appliances purchased with state funds and in the residential, commercial, and industrial sectors are consistent with the energy savings cited by the 2007 Summit Blue report.
- Due to the limited information available about Energy Star market penetration levels, analysis of appliances for the residential, commercial, and industrial sectors is limited to the following major energy users: room air conditioners, dishwashers, clothes washers, and refrigerators. These four appliances are primarily residential appliances.
- Percent of Energy Star-qualified appliance retail sales in South Carolina in 2006 according to Energy Star:
    - Room air conditioners—43.89%.
    - Dishwashers—89.49%.
    - Clothes washers—26.16%.
    - Refrigerators—21.09%.
- Number of appliances distributed in South Carolina in 2006 according to the Association of Home Appliance Manufacturers:
    - Room air conditioners—67,186.
    - Dishwashers—77,969.
    - Clothes washers—116,889.
    - Refrigerators—102,325.

Key Uncertainties

It is unknown the degree to which other states in the region will join South Carolina in setting higher-than-federal standards so as to increase the effectiveness and practical application of standards.

Incremental costs and energy savings information for Energy Star appliances are taken from a Maryland-specific study. Actual costs and savings may be slightly different for South Carolina.

Additional Benefits and Costs

- Reduced water use for some appliance upgrades: lower water demand leads to lower costs and reduced energy use for water production. In the City of Annapolis, water utility and sewer pumps account for around 23% of energy use and 30% of CO_2e emissions.
- Indoor comfort and air quality improvements, with related improvements in health and productivity.
- Savings to consumers and business on energy bills. Benefits to low-income households from reduced utility costs.
- Electricity system benefits: reduced peak demand, reduced capital and operating costs, improved utilization and performance of electricity system.
- Reduced pollutants from emissions, improved health from fewer pollutants and particulates, and reduced water use for cooling.
- Reduced dependence on imported fuel sources.
- Reduced energy price increases and volatility.

Feasibility Issues

Feasibility enhanced by ongoing efforts in nearby states, such as North Carolina, and at the federal level.

Status of Group Approval

Pending – [until CECAC moves to final agreement at meeting #5 or #6]

Level of Group Support

TBD – [blank until CECAC meeting #5 or #6]

Barriers to Consensus

TBD – [blank until final vote by the CECAC]