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 $)	Cost-Effective-ness ($\$/tCO_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)	1.4	7.2	39.3	–$1,031	–$26	Pending
RCI -2	Demand-Side Management/Energy Efficiency Programs, Funds, or Goals for Natural Gas, Propane, and Fuel Oil	0.2	0.8	4.5	–$379	–$85	Complete
RCI -3	Incentives and Regulatory Reform To Promote Implementation of Renewable Energy Systems, Including Solar Hot Water (Residential, Commercial, and Industrial)*	0.2	0.6	3.9	$162	$41	Pending
RCI -4	Energy Management Training/Training of Building Operators	*Not quantified*					Complete
RCI -5	Incentives, Resources, and Regulatory Reform To Promote Energy Recycling, Including Combined Heat and Power	1.0	8.2	39.5	–$332	–$8	Complete
RCI -6	Incentives and Policies for Improving Building Efficiency, Including Building Energy Codes	1.4	6.3	34.9	–$403	–$12	Complete
RCI -7	Improved Design and Construction in New and Existing State and Local Government Buildings, "Government Lead by Example"	0.4	4.7	22.8	–$743	–$33	Complete
RCI -8	Participation in Voluntary Industry-Government Partnerships (Including Incentives)	0.0	0.0	0.05	*Not quantified**		Pending
RCI -9	Incentives and Policies for Improving Appliance Efficiency, Including Appliance Standards	0.3	0.9	5.6	–$94	–$17	Complete
	Sector Total After Adjusting for Overlaps (excluding RCI-8)**	4.1	25.6	131.8	–$2,542	–$19	
	Reductions From Recent Actions	0.5	2.0	11.9	*Not quantified*		
	Sector Total Plus Recent Actions	4.5	27.6	143.7	–$2,542	–$19	

*Costs of RCI-8 have not been quantified, due to lack of publicly available data. Refer to discussion of Key Uncertainties under RCI-8 for more information.

** The benefits and costs of RCI policies overlap as follows: between residential and commercial new construction in RCI-1 and RCI–6; between residential and commercial new construction in RCI-2 and RCI–6; between RCI–7 and energy efficiency efforts in government and schools within RCI-1 and RCI-2; and between RCI-9 and parts of RCI-1, RCI-2, and RCI-7. Overlaps also occur between RCI-1 and the energy efficiency component of ES-1, and between the electricity load reductions from RCI policies in general and ES-1; adjustments for these overlaps are made in the

ES totals. Benefits and costs of renewable energy in RCI-7 overlap with ES renewable energy policies and are not included.

The numbering used to denote the above policy options is for reference purposes only; it does not reflect prioritization among these important policy options.

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

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[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 point 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.

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[5] GDS Associates, Inc. (2007), "Electric Energy Efficiency Potential Study for Central Electric Cooperative, Inc." Accessed October 1, 2007 at: 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, GDS Associates, and 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 (not available online); Bruce Hedman (2006), "CHP Market Review," Energy and Environmental Analysis, Southeast Planning Session Presentation, July 6, 2005.

Implementation Mechanisms

Energy Performance Contracts: Commercial, Industrial, and Institutional Sectors

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 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.

Goals and Incentives: All Sectors

This policy would also implement specific goals and incentives for DSM for all electricity consumers. Policy and administrative mechanisms that might be used to implement 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 these economy-wide goals 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

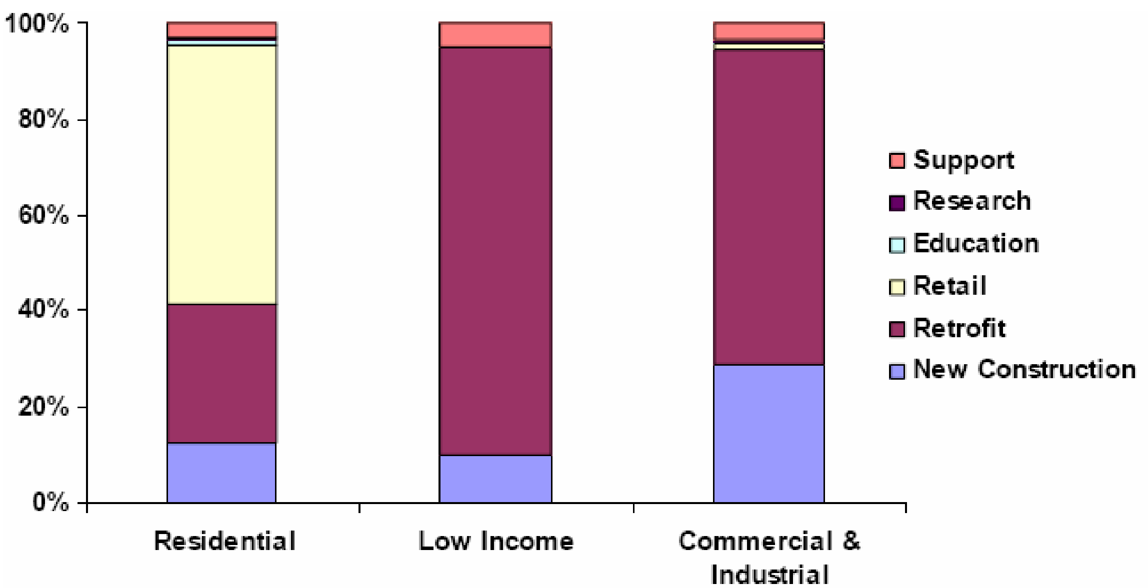
- Complimentary policies, such as appliance recycling/pick-up programs.

Types of Energy Efficiency Measures in a DSM Portfolio

The Massachusetts investor-owned utility (IOU) efficiency programs have achieved high energy savings from their portfolios. Although adjustment to this sample portfolio is appropriate for South Carolina (especially to the focus on lighting in Massachusetts), the Massachusetts portfolio could provide a starting point for designing efficiency programs for South Carolina.

Massachusetts IOU efficiency programs are classified under two major categories: productive and supportive. Programs under productive strategies include New Construction, Retrofit and Retail, which account for 95% of the all programs. Programs under supportive strategies include Program Support, Research and Education. As shown in Figure 1, residential programs focus on retail, encouraging customers to buy ENERGY STAR lights and other measures. Low income programs mainly target retrofit measures; these help residents of existing buildings to lower their energy bills by retrofitting old, inefficient measures in the buildings with new, efficient measures (e.g., lighting, refrigeration, HVAC measures). Finally, the Commercial & Industrial programs mainly focus on new construction and major renovation, which encourages investment in higher energy efficiency when buildings are being constructed or renovated.

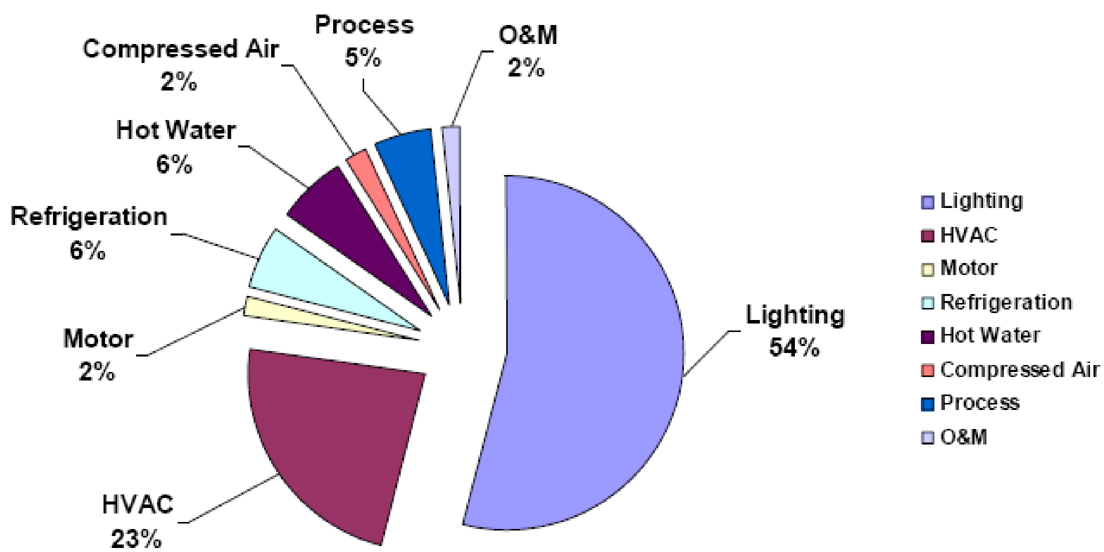
Figure 1. Percentage of expenditures for Massachusetts IOU energy efficiency measures by strategy and sector: 2003–2005



Source: Massachusetts Division of Energy Resources 2007.

While we do not have data for energy savings by end-use application, we do have economic benefits by end-use application, which is to some extent proportional to energy savings. As shown in Figure 2, the majority of the benefits are from lighting and HVAC measures.[7]

Figure 2. Share of benefits from Massachusetts IOU energy efficiency measures



Source: Massachusetts Division of Energy Resources 2007.

For purposes of comparison, GDS Associates, an engineering and consulting firm, conducted an electricity energy efficiency potential study for South Carolina's Central Electric Power Cooperative, Inc. (CEPCI). This study estimates technical potential for the residential sector by measure type and by assumed penetration of energy efficiency measures.[8] It should be noted that the focus of the GDS study is on potential, not on savings from historical performance of an energy efficiency portfolio (as is the case with the Massachusetts Division of Energy Resources report, the sources of information in Figures 1 and 2), and that in some cases the two studies define categories of efficiency measures differently.

Energy efficiency potential studies often estimate energy savings based cost supply curves for saved energy. The supply curves are composed of the cost of saved energy and the amount of energy savings for each measure "currently" available, and include/choose the least-cost resources first for portfolios of technical and economical potentials. This notion of an "increasing cost supply curve for saved energy" reflects a logical order of prioritization of opportunities. However, the actual portfolios of energy efficiency programs by leading utilities often tell a different story. Utility programs generally include a range of measures, ranging from zero (or

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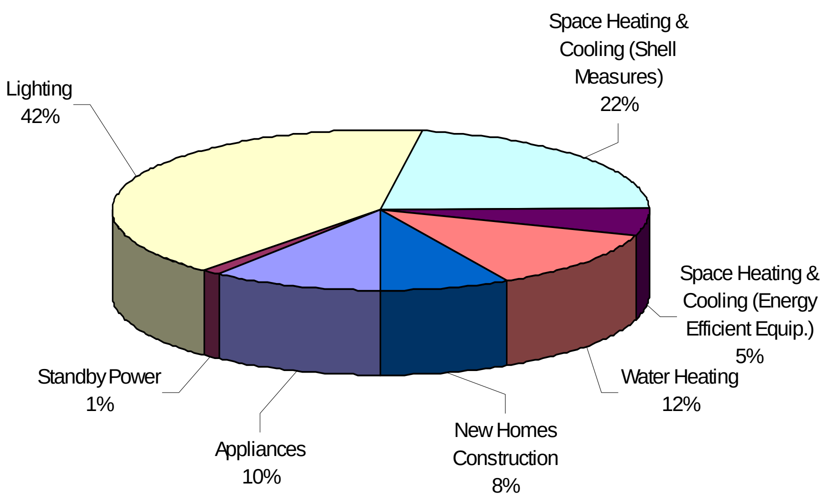
[7] Massachusetts Division of Energy Resources (April 2, 2007), *Massachusetts Saving Electricity: A Summary of the Performance of Electric Efficiency Programs Funded by Ratepayers Between 2003 and 2005*. Available at: http://www.mass.gov/Eoca/docs/doer/pub_info/ee03-05.pdf.

[8] GDS Associates, Inc. (2007), "Electric Energy Efficiency Potential Study for Central Electric Cooperative, Inc.: Final Report." Accessed October 1, 2007, at: http://www.ecsc.org/newsroom/EfficiencyStudy.ppt.

even negative) net cost per kWh saved up to (and in rare occasions exceeding) avoided costs. Often the portfolio includes some measures related to customer, retailer, and vendor education and market transformation that will not save any energy immediately, but could have a significant impact on the landscape of energy efficiency measures available in the long run. Given this background, we will present a brief summary of the potential study.

GDS presents three market penetration scenarios for achievable cost-effective energy efficiency potential in the residential sector: 20% penetration, equivalent to about 4% energy savings by 2017; 50% penetration, yielding about 11% energy savings by 2017; and 80% penetration, projected to save 21% by 2017. RCI-1 calls for approximately 6% reduction in load by 2017. For GDS's 20% penetration scenario shown in Figure 3, in which low-cost energy efficiency measures are adopted first, lighting measures comprise a smaller portion of energy-saving potential in a hypothetical portfolio (42%) than in Massachusetts (54%), whereas water heating is a greater portion (12% in GDS's 20% penetration scenario, versus 6% for Massachusetts).[9] As shown in Figure 4, lighting measures become even less prominent (34%), and hot water measures more prominent (16%), in the more aggressive 50% penetration scenario in the GDS study.

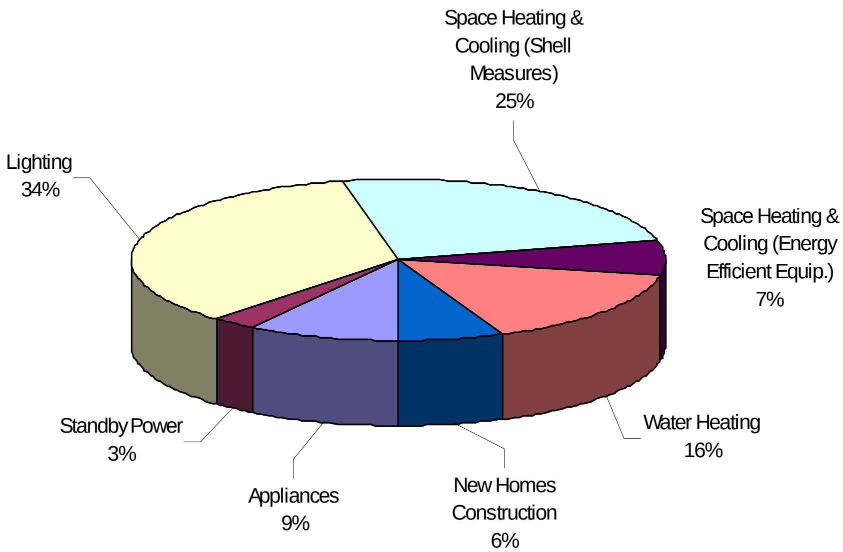
Figure 3. Residential sector end use savings as a percentage of total achievable cost-effective potential by measure type for the CEPCI service territory (20% penetration scenario)



Source: GDS Associates, Inc. 2007.

[9] Note that the Massachusetts report provides avoided costs. In reality, lighting savings accounts for the majority of the total energy savings.

Figure 4. Residential sector end use savings as a percentage of total achievable cost-effective potential by measure type for the CEPCI service territory (50% penetration scenario)



Source: GDS Associates, Inc. 2007.

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 Manufacturing Corp., 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 $)	Cost-Effectiveness ($/$tCO_2e$)
	2012	2020	Total 2009–2020				
RCI -1 Total	1.4	7.2	39.3	$903	–$1,934	–1,031	–$26

Data Sources:

- *Cost of Energy Efficiency Measures:*
  - 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 Governors' Association (January 2006), *The Potential for More Efficient Electricity Use in the Western United States*. Denver, CO: Western Governors' Association. Available at: http://www.westgov./wga/initiatives//%20Efficiency-full.pdf.
- *Energy Efficiency Potential:*

- GDS Associates, Inc. (2007), "Electric Energy Efficiency Potential Study for Central Electric Cooperative, Inc." Accessed October 1, 2007, at: 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 Carolinas LLC, 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. 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.
  - South Carolina Electric & Gas Company (2008), "Preliminary Avoided Costs To Be Used For Purchases From Small Power Producers," received by e-mail from Henry Barton of SCANA Corporation.

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). Adjust annual consumption 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):* $55.75 per megawatt-hour (MWh) (2005$), a sales weighted average for the state based on Duke Energy, Progress Energy, and South Carolina Electric & Gas avoided cost calculations. The actual implications of avoided electricity may be different for customers.
- *Transmission and Distribution (T&D) Electricity Losses:* 6% (consistent with the Energy Supply TWG assumptions).
- *Cost of Energy Efficiency Measures:*
  - For Duke Energy: 500 gigawatt-hours (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).[10]

- 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[11]
Northwest Energy	0.02	2006	Montana PSC Docket No.: D2005.5.88 07/12/06[12]
New York	0.03	2004	Heschong Mahone Group, Inc. 2005[13]
Massachusetts IOUs	0.038	2002	Gene Fry 2003[14]
California	0.03	n/a	ACEEE 20004[15]
Connecticut	0.023	n/a	ACEEE 20004
New Jersey	0.03	n/a	ACEEE 20004
Vermont	0.03	n/a	ACEEE 20004

[10] 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.)

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

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

[13] 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.

[14] Gene Fry, "Massachusetts Electric Utility Energy Efficiency Database," Massachusetts Department of Telecommunications and Energy, 2003 edition. (Not available online.)

[15] 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.

- *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 the Center for Climate Strategies (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 the long term.

Key Uncertainties

Avoided costs of electricity may not reflect the full costs of new generation planned in South Carolina. For example, nuclear power plant busbar costs are around or above $100/MWh, well above the avoided cost of $55.75/MWh assumed in this analysis. In addition, DSM has been shown to lower the wholesale price of electricity during some periods.[16, 17] Both of these factors may increase the value of DSM to the state.

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

Additional Benefits and Costs

- Savings to consumers and businesses on energy bills, which can have macroeconomic benefits. 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.

Feasibility Issues

None noted.

[16] Rick Hornby, Dr. Carl V. Swanson, Michael Drunsic, Dr. David E. White, Paul Chernick, Bruce Biewald, and Jennifer Kallay (January 2008). *Avoided Energy Supply Costs in New England: 2007 Final Report.* Prepared for Avoided-Energy-Supply-Component (AESC) Study Group. Available at: http://www.synapse-energy.com/Downloads/SynapseReport.2007-08.AESC.Avoided-Energy-Supply-Costs-2007.07-019.pdf.

[17] RLW Analytics, Neenan Associates (December 2005). *An Evaluation of the Performance of the Demand Response Programs Implemented by ISO-NE in 2005. Annual Demand Response Program Evaluation submitted to FERC.* Available at: http://www.iso-ne.com/regulatory/ferc/filings/2005/dec/er02-2330-__12-30-05.pdf.

Status of Group Approval

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

Level of Group Support

TBD – [blank until CECAC Meeting #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."[18]

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.

[18] 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. Available at: 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, an 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 ($MMtCO_2e$)			Gross Cost (Million $)	Gross Benefits (Million $)	Net Present Value 2009–2020 (Million $)	Cost-Effectiveness ($/t$CO_2$e)
	2012	2020	Total 2009–2020				
RCI-2 Total	**0.2**	**0.8**	**4.5**	**115**	**–$494**	**–$379**	**–$85**
Natural Gas	0.1	0.7	3.7	$96	–$352	–$256	–$70
Propane	0.0	0.0	0.3	$6	–$69	–$63	–$234
Fuel Oil	0.0	0.1	0.5	$14	–$83	–$70	–$134

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 (January 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:*
  - AEO012007—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.
  - U.S. DOE EIA, Petroleum Navigator, Weekly Heating Oil and Propane Prices. Available at: http://tonto.eia.doe.gov/dnav/pet/pet_pri_wfr_dcus_SNC_w.htm.

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). Adjust annual consumption 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): $7.68/MMBtu (2006$), the levelized cost of projected natural gas prices. 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.[19]
  - Propane: $24.53/MMbtu (2006$), the levelized cost of projected propane prices in AEO2007 for the South Atlantic Region. Data can be retrieved from: http://www.eia.doe.gov/oiaf/aeo/supplement/sup_t2t3.xls in Table 15.
  - Fuel oil: $13.17/MMBtu (2006$), the levelized cost of projected fuel oil prices based on EIA data. EIA provides weekly fuel oil price data for North Carolina (South Carolina data were not available). Weekly prices were averaged to estimate an annual price for wholesale heating oil of $2.140 per gallon and a residential price of $2.657 per gallon in the 2007 heating season. The 2007 prices were then projected to 2020 using the AEO2007 data for the South Atlantic Region. Weekly fuel oil prices can be obtained from: http://tonto.eia.doe.gov/dnav/pet/pet_pri_wfr_dcus_SNC_w.htm.
- *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 Tegen and Geller (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%.
- *Costs of Saved Fuel Oil and Propane*: For residential and commercial uses, these costs are 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.[20]
- *Efficiency Measure Lifetime:* 13 years on average. (Measure life typically ranges from 10 to 15 years. Note Kushler et al. (2006) and Munns and Rogers (2005) assume 12-year average program life.)[21]

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

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

- *Displaced Emission Factors (Natural Gas, Propane, Fuel Oil):* U.S. EPA (2003).[22]
- *Losses Associated With the Delivery of Natural Gas*: TBD.

Key Uncertainties

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

There are few data on the cost of saved propane and fuel oil. For this analysis, it was assumed that the costs of saved propane and fuel oil equal the $ per MMBtu saved for natural gas. To the extent that oil and propane appliances are similar to natural gas appliances, the costs will be similar among fuel-saving measures per MMbtu saved. While there are similar applications among all fuels (e.g., water heating, cooking), the similarities between specific appliances running on different fuels are less clear. On the other hand, given that there has not been any significant effort to promote efficient use of oil and propane, there may be more "low-hanging fruit" in energy efficiency measures for oil and propane than for gas.

DSM programs for propane and fuel oil would require communication with and coordination of a network of small distributors, unlike centralized natural gas utilities. Program costs (and the cost of saved energy per MMBtu) may vary accordingly.

Additional Benefits and Costs

- Indoor comfort and air quality improvements, with related improvements in health and productivity.
- Savings to consumers and businesses on energy bills, which can have macroeconomic benefits. 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.

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[21] 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.

[22] U.S. EPA (April 15, 2003), *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2001*, Appendix A. Available at: http://epa.gov/climatechange/emissions/downloads06/03CR.pdf.

Feasibility Issues

None noted.

Status of Group Approval

Complete.

Level of Group Support

Unanimous.

Barriers to Consensus

Not applicable.

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—a tax credit of 25% of installation cost, with a $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 5. 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 Total	**0.2**	**0.6**	**3.9**	**$393**	**–$231**	**$162**	**$41**
Residential SHW	0.1	0.5	2.9	$307	–$174	$133	$45
Commercial SHW	0.0	0.1	0.7	$60	–$39	$21	$31
Industrial SHW	0.0	0.0	0.3	$22	–$15	$7	$25
Commercial Cooling	0.0	0.0	0.1	$5	-$3	$2	$26
Industrial Cooling	TBD	TBD	TBD	TBD	TBD	TBD	TBD

Data Sources:

- *Cost and Performance of Solar Hot Water and Cooling Systems:*
  - Personal communication with Michael Shore, FLS Energy. (http://www.flsenergy.com/)
  - Personal communication with Mitch Perkins of the South Carolina Energy Office (SCEO), 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).
  - Personal communication with David Wach, Roche Carolina, Inc.

- *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.
  - Personal communication with Erin Boedecker at U.S. DOE EIA for residential and commercial data (e.g., fraction of fuel consumption for water-heating applications).
  - 2002 MECS—U.S. DOE, EIA, "2002 Manufacturing Energy Consumption Survey and Data Quality: Survey Design, Implementation, and Estimates," available at: http://www.eia.doe.gov/emeu/mecs/mecs2002/methodology_02/meth_02.html.

Quantification Methods:

Solar Hot Water:

- Project the number of households and commercial and industrial buildings that are going to install solar hot-water systems.
- Estimate the average water-heating energy consumption per household and business by fuel type.
- To estimate the heat output of solar hot-water systems under this policy, the annual hot-water requirements per South Carolina household and per commercial and industrial building were multiplied by the number of households or the number of buildings 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.

Solar Cooling:

- Project the number of commercial and industrial buildings that are going to install both solar hot-water and cooling systems. Customers who adopt solar cooling technology are assumed to already have a chilled water distribution system.
- Estimate the average cooling energy consumption per business by fuel type (mainly electricity) based on EIA data (i.e., AEO 2007, CBECS, and MECS)
- Estimate the total cooling energy consumption each year.
- Estimate the capacity (energy output) of solar cooling systems each year based on annual cooling energy consumption and the assumed average efficiency factor for standard cooling appliances (i.e., 3 coefficient of performance)
- Calculate the total and incremental capital cost of solar cooing systems relative to the capital cost of standard chiller technologies, after taking into account the federal investment tax credit.

Benefit Calculation for Solar Hot Water and Cooling:

- Apply solar fraction factors (e.g., 60% to 70%) to annual hot water needs by the customers who are going to install solar hot water systems and estimate avoided fuel and electricity use. The same percentage of each fuel used for hot water in the South Atlantic data from EIA data was applied to South Carolina, varying by sector, yielding estimates for avoided energy by fuel type (electricity, natural gas, distillate oil, etc).
- Apply solar fraction factors (e.g., 60% to 70%) to annual cooling energy consumption by the customers who are going to install solar hot water/cooling systems and estimate avoided fuel and electricity use, multiplied by the breakdown of avoided cooling energy consumption by fuel type (mostly 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:

For Solar Hot Water Systems:

- *Cost of Residential Solar Hot-Water System:* The cost data we found range from $5,000 to $9,000 per system. We decided to use $6,500 per average residential system, assuming an 80-gallon-per-day capacity based on data provided by the South Carolina Energy Office. We assume the cost of solar hot-water systems decreases by 20% between 2012 and 2020. (This cost reduction is based on AEO2007's assumption of a 23% cost reduction between 2004 and 2020 for the cost of solar hot-water heaters. See: http://www.eia.doe.gov/oiaf/aeo/assumption/index.html.) Details of the cost reduction are presented in the Table 6, below.

Table 6. Assumed decreases in the cost of solar hot-water systems

Year	Price
2008–2012	$6,500
2013	$6,338
2014	$6,175
2015	$6,013
2016	$5,850
2017	$5,688
2018	$5,525
2019	$5,363
2020	$5,200

- *Tax Credits for Installation of Solar Hot-Water Systems:* 30% federal credit until 2012, decreasing to 15% by 2020. (State tax credits and rebates are also available but will not affect the net present value of the policy.)
- *Cost of Commercial Solar Hot-Water System*: $41,722 per average size building. To estimate the average cost of commercial hot-water systems, the cost of a typical residential solar hot-water system was adjusted upward based on (1) commercial hot-water needs relative to

residential hot-water needs and (2) a 20% cost reduction due to economies of scale for materials and installation for commercial units relative to residential units. We also assume a 20% cost reduction between 2012 and 2020. The level of cost reduction is based on AEO2007's assumption of the cost of solar hot-water heaters.

- *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 for the South Atlantic region, as shown in Table 7, below. This fraction is assumed to increase by 10% by 2020.
  - Residential: 60% (in 2009) to 70% (in 2020).
  - Commercial: 70% (in 2009) to 80% (in 2020).
  - Industrial: 70% (in 2009) to 80% (in 2020).

Table 7. Average of values of base-system solar and lower-cost system solar

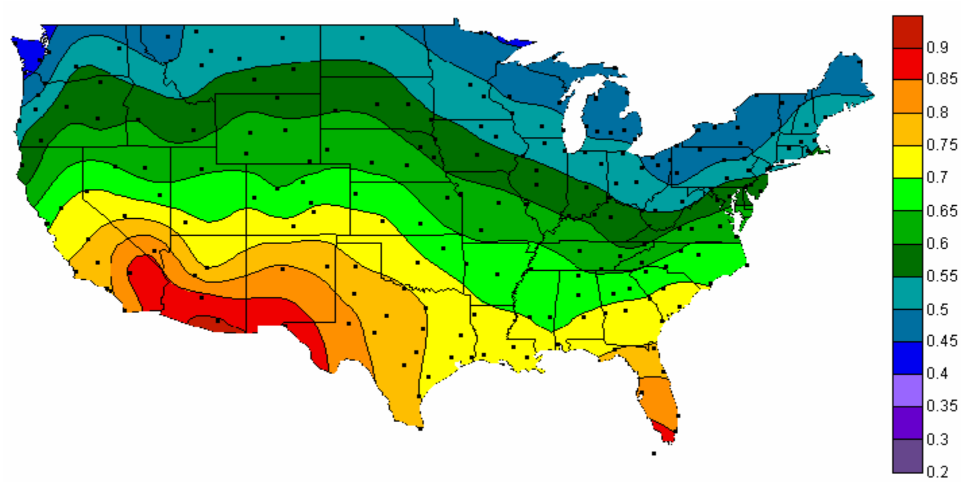
Region	Representative City	Base System Solar Fraction (%)	Lower-Cost System Solar Fraction (%)
New England	Boston, MA	50	45
Mid-Atlantic	Harrisburg, PA	50	45
East North Central	Chicago, IL	50	45
West North Central	Des Moines. IA	55	45
South Atlantic	Raleigh, NC	65	55
East South Central	Birmingham, AL	65	55
West South Central	Little Rock, AR	65	60
Mountain	Denver, CO	65	60
Pacific (w/o California)	Eugene, OR	50	45
New York	Albany, NY	50	40
California	Sacramento, CA	70	60
Texas	Fort Worth, TX	75	65
Florida	Tampa, FL	75	70
U.S. Weighted Average		**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.

According to Denholm 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 5 provides the results of a simulation of a "base" residential SWH [solar water-heating] 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."[23]

[23] 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.

Figure 5. 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.

- *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 in the South Atlantic region were obtained from Erin Boedecker at EIA. The data for the industrial sector are for the South Census region in the 2002 Manufacturing Energy Consumption Survey.[24] The fuel fraction for the industrial sector for hot water consumption is assumed to be 26% of the fuel use for heating, ventilation, and air conditioning (HVAC) applications based on commercial HVAC consumption data from AEO2007. Tables 8 and 9 present assumptions regarding residential, commercial, and industrial energy consumption.

Table 8. 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%	0%	0.0%

[24] 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%	0.0%
Total Water Heater	100%	12.9%	100%	8.49%
Total Consumption		**100%**		

Table 9. Assumptions for industrial energy consumption for HVAC and water heating

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%
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%**

- *Use of Electricity and Other (Non-Solar) Energy Sources per (Non-Solar) Household in Absence of Program*: The annual water-heating energy per household is about 4,800 kWh/yr.[25] Other fuel consumption is assumed to be about 22 MMBtu per household per year. This estimate is based on an average water heater efficiency of 93% for electricity and 70% for other fuels. The value in 2020 assumes a 5% reduction in water-heating energy use between 2012 and 2020, due to a reduction in the number of people per household, plus naturally occurring energy efficiency improvements.
- *Use of Electricity and Other (Non-Solar) Energy Sources per (Non-Solar) Commercial Building in Absence of Program*: The annual water-heating energy per commercial building was estimated by applying the fraction of the regional hot-water demand to the total commercial energy demand. The hot-water consumption per building is about 38,500 kWh in 2012. Other fuel consumption was estimated based on an average water heater efficiency of 93% for electricity and 70% for other fuels. The average natural gas consumption per commercial building is about 175 MMBtu in 2012
- *Capital Recovery Factor for Solar Hot-Water System*: 6% for the residential system (based on a 5% real interest rate and 30-year measure life) and 6.5% for the commercial and industrial systems (based on a 5.5% real interest rate and 30-year measure life).
- *Avoided Cost of Fuels for Water Heating, Such as Natural Gas and Oil:* Same assumptions as used for RCI-2.

[25] Forefront Economics Inc., H. Gil Peach & Associates LLC, and PA Consulting Group. Duke Energy Carolinas DSM Action Plan: South Carolina Draft Report. Prepared for Duke Energy Carolinas. July 24, 2007.

- *Emission Factors and Discount Rate*: Same assumptions as used for RCI-1 and RCI-2.

For Solar Cooling Systems:

- *Solar Cooling Adoption among SHW Applications*: 5% of the SHW policy goal each year.

Year	Percent of Buildings
2009	0.05%
2010	0.09%
2011	0.13%
2012	0.17%
2013	0.21%
2014	0.25%
2015	0.30%
2016	0.34%
2017	0.38%
2018	0.42%
2019	0.46%
2020	0.50%

- *Cost of Solar Cooling System and Regular Chiller System:* Solar cooling is only cost-effective in commercial and industrial applications. Thus, the TWG modeled this technology only for the commercial and industrial sectors.
    - Commercial & Industrial Solar Cooling System: $10,800 per ton of cooling capacity per hour, decreasing to $8,640 per ton of cooling by 2020. These costs cover the SHW and cooling system for buildings that already have a chilled water distribution system. We assumed a 20% cost reduction between 2012 and 2020, the same level of cost reduction assumed for solar hot water systems based on AEO2007's assumption. Current capital costs are based on information from David Wach, Roche Carolina, Inc.
    - Commercial & Industrial Conventional Chiller System: $6,000 per ton of cooling capacity per hour, decreasing to $5,400 per ton by 2020. Current capital costs are based on information from David Wach, Roche Carolina, Inc. Capital costs are assumed to decline by 10% by 2020.
- *Average Number of Buildings that adopt SHW/Cooling Technologies per Year:*
    - Commercial: 37
    - Industrial: 9
- *Fraction of Cooling Needs Provided by Solar Cooling Systems:*
    - Commercial & Industrial: 70% in 2010, increasing to 75% in 2020
- *Estimated Fraction of Cooling Energy Consumption in Absence of Program:*
    - Commercial: 9.8% of total commercial energy consumption

- Industrial: 3.9% of total industrial energy consumption, consistent with historic industrial fuel use for air conditioning (HVAC) applications and process cooling and refrigeration.

- *Fraction of Fuel in Cooling Energy Use in Absence of Program:* The fraction of fuel consumption for cooling applications is based on regional data provided by EIA. The fuel data in AEO2007 for the commercial sector in the South Atlantic region were obtained from Erin Boedecker at EIA. The data for the industrial sector are for the South Census region in the 2002 Manufacturing Energy Consumption Survey.[26] The fuel fraction for the industrial sector for building cooling is assumed to be 30% of the fuel use for heating, ventilation, and air conditioning (HVAC) applications based on commercial HVAC consumption data from AEO2007. In addition, the fraction of fuel use for industrial cooling is assumed to be equal to the fraction of fuel use for commercial cooling due to lack of this data. Table XX presents assumptions regarding commercial and industrial energy consumption.

Table XX. Fraction of Fuel in Cooling Energy Use in Absence of Solar Cooling

Fuel Type	Commercial		Industrial	
	% in Cooling Energy	% in Total Sector Consumption	% in Cooling Energy	% in Total Sector Consumption
Natural Gas	5%	0.52%	1%	19%
Electricity	95%	9.24%	3%	81%

- *Summer Cooling Load Hours:* 1500 hours for commercial & industrial applications
- *Capital Recovery Factor for Chiller*: 7.1% for the commercial and industrial systems (based on a 5.5% real interest rate and 25-year measure life).
- *Tax Credits for Installation of Solar Cooling Systems:* 30% federal credit until 2013, decreasing to 15% by 2020. (State tax credits and rebates are also available but will not affect the net present value of the policy.)
- *Avoided Cost of Fuels for Cooling, Such as Electricity, Natural Gas and Oil:* Same assumptions as used for RCI-1 and RCI-2.
- *Emission Factors and Discount Rate*: Same assumptions as used for RCI-1 and RCI-2.

Key Uncertainties

The cost of the solar cooling system is likely to vary from installation to installation, depending in part on whether a chilled water loop is present in the existing building infrastructure. Chilled water loops are thought to be common in large commercial and industrial facilities; however, the total number of buildings in South Carolina with existing systems is unknown.

The avoided fuel cost will have a large impact on the cost effectiveness of this policy.

[26] 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.

Avoided costs of electricity may not reflect the full costs of new generation planned in South Carolina. For example, nuclear power plant busbar costs are around or above $100/MWh, well above the avoided cost of $55.75/MWh assumed in this analysis. In addition, DSM has been shown to lower the wholesale price of electricity during some periods.[27,28] Both of these factors may increase the value of DSM to the state.

Additional Benefits and Costs

- Savings to consumers and businesses on energy bills, which can have macroeconomic benefits. 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 #6]

Level of Group Support

TBD – [blank until CECAC Meeting #6]

Barriers to Consensus

TBD – [blank until final vote by the CECAC]

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[27] Rick Hornby, Dr. Carl V. Swanson, Michael Drunsic, Dr. David E. White, Paul Chernick, Bruce Biewald, and Jennifer Kallay (January 2008). *Avoided Energy Supply Costs in New England: 2007 Final Report.* Prepared for Avoided-Energy-Supply-Component (AESC) Study Group. Available at: http://www.synapse-energy.com/Downloads/SynapseReport.2007-08.AESC.Avoided-Energy-Supply-Costs-2007.07-019.pdf.

[28] RLW Analytics, Neenan Associates (December 2005). *An Evaluation of the Performance of the Demand Response Programs Implemented by ISO-NE in 2005. Annual Demand Response Program Evaluation submitted to FERC.* Available at: http://www.iso-ne.com/regulatory/ferc/filings/2005/dec/er02-2330-__12-30-05.pdf

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 energy waste. This policy would increase education and demonstrate the benefits of energy-efficient building operations 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.[29]

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

SCEO would develop the requirements for licensing and maintain a database of licensed professionals. Course curricula would be developed by SCEO, 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.

[29] South Carolina was the first state in America to provide a Technical College System with a campus within 28 miles of every residence.

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 2 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

SCEO 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 Initiative, the North Carolina State Energy Office provided training to over 1,320 course participants between June 2002 and September 2003.[30] The program's activities are estimated to have resulted in more than $30 million in avoided utility costs since its inception in 2002.[31]

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.[32]

Data Sources: Not applicable.

Quantification Methods: Not applicable.

Key Assumptions: Not applicable.

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[30] Larry Shirley, "State Facilities Utility Savings Initiative." presented at the 2003 NASEO Annual Meeting, Austin, TX, September 16, 2003. Available at http://www.energync.net/programs/docs/usi.ppt.

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

[32] Ayeola G. Elias, ed., *FYI: The News Bulletin for the Winthrop University Community*, Office of University Relations, Winthrop University, October 20, 2004, available at: (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. Available at: (http://www.winthrop.edu/news/winthropmagazine/Spring07%20Mag.pdf).

Key Uncertainties

None noted.

Additional Benefits and Costs

None noted.

Feasibility Issues

None noted.

Status of Group Approval

Complete.

Level of Group Support

Unanimous.

Barriers to Consensus

Not applicable.

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.

South Carolina has a number of existing CHP installations in the state, primarily at large manufacturing facilities. According to one study, South Carolina has the potential to install an additional 4,497 megawatts (MW) of commercial (1,243 MW) and industrial (3,254 MW) CHP, considering technical potential only.[33] 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), it should be sold onto the electrical grid. There may be resistance or legitimate concerns regarding these excess electricity sales, because in the absence of decoupling, they 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.

[33] 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. Also, state regulatory authorities could encourage CHP through the development of a Clean Energy Standard Offer Program (CESOP), which would provide long-term rate stability for qualifying CHP generation.
- 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. Consider developing a Clean Energy Standard Offer Program to provide long-term rate stability for qualifying CHP generation. 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 10. 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 $)	Cost-Effectiveness ($/tCO_2e$)
	2012	2020	Total 2009–2020				
RCI-5 Total	**1.0**	**8.2**	**39.5**	**$3,459**	**–$3,791**	**–$332**	**–$8**

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 Office of Energy Efficiency and Renewable Energy. Available at: 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*, Oak Ridge, TN: Oak Ridge National Laboratory, August 2004. Available at: 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*, Falls Church, VA: 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." Available at: http://www.eia.doe.gov/emeu/mecs/mecs2002/methodology_02/meth_02.html.
  - Personal communication with Erin Boedecker at U.S. DOE EIA for residential and commercial data (e.g., fraction of fuel consumption for heating and cooling applications).

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*: Studies of CHP potential in other states show the market or economic potential of CHP to be 30%–40% 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 one or both types of systems. 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) are 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 provided by the California Center for Sustainable Energy.[34]
- *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

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[34] California Center for Sustainable Energy, "Self-Generation Incentive Program Data." Available at: http://www.sdreo.org/ContentPage.asp?ContentID=279&SectionID=276&SectionTarget=35.

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%.
- *Net Efficiency of Displaced Boiler/Heater Thermal Energy by Fuel:*
  - Natural gas—85%
  - Biomass—80%
  - Electricity—92%
  - Oil—80%
- *Estimated Average Non-Fuel Operating. and Maintenance Costs by System Type ($/MWh):*
  - Natural gas—$10/MWh.
  - Biomass—$20/MWh.
  - Source: Operation and maintenance (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.
- *Avoided Fuel Cost*
  - Electricity—See RCI-1.
  - Natural gas—See RCI-2.
  - Biomass—$2.89/MMBtu (based on GDS and La Capra 2007).
  - Coal—$3.6/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/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 $2.14 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.

Avoided costs of electricity may not reflect the full costs of new generation planned in South Carolina. For example, nuclear power plant busbar costs are around or above $100/MWh, well above the avoided cost of $55.75/MWh assumed in this analysis. In addition, DSM has been shown to lower the wholesale price of electricity during some periods.[35,36] Both of these factors may increase the value of DSM to the state.

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 businesses on energy bills, which can have macroeconomic benefits.
- 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.

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[35] Rick Hornby, Dr. Carl V. Swanson, Michael Drunsic, Dr. David E. White, Paul Chernick, Bruce Biewald, and Jennifer Kallay (January 2008). *Avoided Energy Supply Costs in New England: 2007 Final Report.* Prepared for Avoided-Energy-Supply-Component (AESC) Study Group. Available at: http://www.synapse-energy.com/Downloads/SynapseReport.2007-08.AESC.Avoided-Energy-Supply-Costs-2007.07-019.pdf.

[36] RLW Analytics, Neenan Associates (December 2005). *An Evaluation of the Performance of the Demand Response Programs Implemented by ISO-NE in 2005. Annual Demand Response Program Evaluation submitted to FERC.* Available at: http://www.iso-ne.com/regulatory/ferc/filings/2005/dec/er02-2330-__12-30-05.pdf

Feasibility Issues

None noted.

Status of Group Approval

Complete.

Level of Group Support

Unanimous.

Barriers to Consensus

Not applicable.

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.[37] 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 on 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 the 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 nonconventional energy-efficient building materials in buildings where applicable.
- Update South Carolina energy codes regularly. This update should be timed to coincide with release of national model codes every 3 years. 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).[38]
- Require manufactured housing and manufactured nonresidential buildings used in South Carolina to meet ENERGY STAR certification standards after 2015.

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

[38] 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:

- 100% of South Carolina's local governments adopt and fully enforce the 2006 IECC in 2009.
- 100% of South Carolina's local governments adopt and fully enforce the 2012 IECC in 2015.
- ENERGY STAR-labeled manufactured homes achieve 25% market penetration for new manufactured homes by 2010 and 75% by 2020.

Timing: As noted above.

Parties Involved: As noted above.

Implementation Mechanisms

- *Legislative Changes To Allow Adoption and Enforcement of Energy Efficient Building Codes*—Building codes and energy codes are adopted by the South Carolina Building Codes Council (SCBCC) for all municipalities. The 2006 editions of the International Residential Code (IRC), which covers one and two family dwellings and multiple single-family dwellings, and the International Building Code (IBC), which covers other residential construction (e.g. high rise condominiums, mixed use developments), will take effect in South Carolina on July 1, 2008. However, conflicts with state law have severely weakened the effectiveness of the building codes adopted by the SCBCC. Chapter 11 of the 2006 IRC, which includes residential energy efficiency requirements, has been superseded by an outdated1976 state law.[39] The 1976 legislation prescribed specific building envelope requirements for one- and two-family dwellings (indicated in red text, below), which would impede progress toward advanced energy efficiency measures as described in RCI-6. These specific requirements also put excessive demands on building code officials, who currently must know and enforce codes and standards from two different sources. The legislature can greatly facilitate adoption and enforcement of improved energy codes by striking Part C with its sub-parts from section 6-9-50 of the South Carolina Code of Laws:

  SECTION 6-9-50. Mandatory adoption of certain nationally recognized codes and standards; adoption by reference; residential buildings; accessibility of referenced code; three-story homes.

  (A) The council shall adopt by reference and amend only the latest editions of the following nationally recognized codes and the standards referenced in those codes for regulation of construction within this State: building, residential, gas, plumbing, mechanical, fire, and energy codes as promulgated, published, or made available by the International Code Council, Inc. and the National Electrical Code as published by the National Fire Protection Association. The appendices of the codes provided in this section may be adopted as needed, but the specific appendix or appendices must be referenced by name or letter designation at the time of adoption. However, the provisions of the codes referenced in this section which concern the qualification, removal, dismissal, duties, responsibilities of, and administrative procedures for all building officials, deputy

[39] South Carolina Code of Laws, Title 6, Chapter 9, enacted 1976.

building officials, chief inspectors, other inspectors, and assistants do not apply unless they have been adopted by the municipal or county governing body.

(B) The governing body of a county may not enforce that portion of a nationally recognized fire prevention code it has adopted which may regulate outdoor burning for forestry, wildlife, and agricultural purposes as regulated by the South Carolina Forestry Commission.

(C) A residential building is considered in compliance with the Building Envelope Requirements of the Energy Code if:

(1) it is built in compliance with prescriptive standards issued by the South Carolina Residential Builders Commission, in consultation with the State Energy Office, based on computer models of the Energy Code including, but not limited to, options developed by Pacific Northwest National Laboratories, or other nationally recognized laboratories which use the standards developed by Pacific Northwest National Laboratories, for South Carolina's climatic zones, or

(2) if double pane or single pane with storm windows are used for window glass and in the case of ceilings, exterior walls, floors with crawl space, and heating and air conditioning duct work, the determination of the minimum thermal resistance ratings (R-value) is:

(a) R-30 for ceilings, except for ceiling/roof combinations, which must be at least R-19;

(b) R-13 for exterior walls;

(c) R-19 for floors with crawl space;

(d) R-6, or the installed equivalent, for heating and air conditioning duct work not located in conditioned space.

(D) All referenced codes adopted by the council shall be accessible at no cost to the public through the Department of Labor, Licensing and Regulation's Internet web page as a "read only" document.

(E) Notwithstanding any provision of the referenced codes adopted by the council, a home with three floors of living space constructed on a raised foundation which is not used as living space is considered a three-story building for the purposes of issuing a building permit to a person licensed under Title 40, Chapters 11 and 59. Any person authorized in South Carolina to design and construct buildings up to three stories is authorized to design and construct buildings described by this section.

- *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., every 3 years.
- *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 educating 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, review and promotion of 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 should provide programs that speed the permit approval process and reduce the permit and impact fees related to construction. Advantages 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.[40] 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 these 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.

[40] Per an e-mail to Jennifer Kallay from Gwynne Koch, Manufactured Housing Research Alliance, dated Jan. 4, 2008.

Manufactured homes that meet Santee Cooper's Good Cents Manufactured Homes criteria qualify for Santee Cooper's Good Cents rate.[41]

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 new code adoption and enforcement, and energy savings from increased penetration of ENERGY STAR-manufactured homes. As a result, the data sources, quantification methods, and key assumptions will be specified separately for each component.

Table 11. Estimated GHG reductions and net costs or cost savings from RCI-6

RCI-6 Components	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	**1.4**	**6.3**	**34.9**	**$1,362**	**–$1,765**	**–$403**	**–$11.6**
Residential Building Codes	1.3	5.3	30.1	$1,267	–$1,528	–$261	–$8.7
Commercial Building Codes	0.1	0.9	4.3	$86	–$217	–$131	–$30.3
Residential ENERGY STAR-Manufactured Homes	0.0	0.1	0.4	$9	–$20	–$11	–$27.5

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, Richland, WA: U.S. DOE, Pacific Northwest National Laboratory. Accessed January 2, 2008, at: http://www.energycodes.gov/pdf/pnnl16265.pdf.

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

- 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.
- BCAP, personal communications with Aleisha Khan with Jennifer Kallay in January, 2008.

Costs:

- Greg Katz and Jon Braman. Greening Buildings and Communities: Costs and Benefits. Draft Findings on the Cost Premium, Energy and Water Savings by LEED Level. 2008.
- ICC Code Website. Building Valuation Data. Accessed March 13 , 2008, at: http://www.iccsafe.org/cs/techservices/.

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 e-mails from and conversations with Gwynne Koch at the Manufactured Housing Research Alliance with Jennifer Kallay in January 2008.

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 to 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 Building Code 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. For the commercial sector, the 2003 IECC is in force.
- This analysis assumes that improvements are incremental to a scenario where the status quo persists. The benefits and costs for new homes are derived from the fact that these homes are built to future building codes that are more stringent than current codes. The benefits and costs for renovated homes are derived in the same way; instead of being renovated to current codes, these homes will be renovated to more stringent codes.
- A new building is defined as any building that is built between 2009 and 2020. A renovated building is defined as any building that undergoes major renovations between 2009 and 2020.

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. In 2015, we assumed that code enforcement practices are in place and 80% of new and renovated buildings and home can achieve the 2012 IECC with the adoption of the code. Table 12 presents the key assumptions for the potential benefits from this policy option.

Table 12. 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	
Average Energy Use	0.0566 BBtu/home/yr	0.00008 BBtu/sq. ft./yr	Calculation of energy use divided by the projected number of homes/buildings
Average Square Footage per Building	1,700	11,829	Calculation of projected square footage of buildings divided by the projected number of buildings
Cumulative Energy Savings 2006 IECC 2012 IECC	vs. the 1976 Standard 32% 67%	vs. the 2003 IECC 8% 38%	From Aleisha Khan of BCAP
Proportion of Energy Savings by Fuel Type	76% Electricity 24% Natural Gas	75% Electricity 25% Natural Gas	Based on the breakout in the Inventory & Forecast
Emissions Factors, T&D Electricity Losses, Avoided Energy Costs (Delivered)	Same assumptions as used for RCI-1 and RCI-2		

Costs: Table 13 presents the key assumptions for the potential costs of this policy option.

Table 13. Key assumptions for costs of RCI-6

Assumption	Residential Sector	Commercial Sector	Notes
Real Discount Rate	5%		
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	$187,425	$1,546,610	Based on national estimates from the International Code Council (ICC)

Assumption	Residential Sector	Commercial Sector	Notes
Incremental Costs From Building Code Improvements	vs. the 1976 Standard	vs. the 2003 IECC	Based on incremental costs associated with LEED levels that achieve similar energy savings
2006 IECC	2%	0.5%	
2012 IECC	4%	2%	

For Increased Penetration of ENERGY STAR-Manufactured Homes:

Benefits:

- *Current Market Penetration in South Carolina*: 0.19%.
- *Market Penetration Ramp-In*: See Table 14.

Table 14. Market penetration ramp-in for RCI-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/yr.
- *Proportion of Energy Use by Fuel Type in Manufactured Homes*:
  - Electricity: 76%.
  - Natural Gas: 15%.
  - LPG: 9% (not modeled).
- *Avoided Energy Costs by Fuel Type*:
  - Electricity, Natural Gas: Same assumptions as used for RCI-1 and RCI-2.
- *Emissions Factors by Fuel Type*:

 - Electricity, Natural Gas: Same assumptions as used for RCI-1 and RCI-2.

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.

Additionally, the cost of new construction is based on national estimates. Region-specific estimates are not available but may be either higher or lower than these costs.

During the implementation stage, there will be a need to define the threshold that would trigger the need for a building code permit for new buildings, existing buildings undergoing major renovations and existing buildings undergoing minor renovations.

Avoided costs of electricity may not reflect the full costs of new generation planned in South Carolina. For example, nuclear power plant busbar costs are around or above $100/MWh, well above the avoided cost of $55.75/MWh assumed in this analysis. In addition, DSM has been shown to lower the wholesale price of electricity during some periods.[42,43] Both of these factors may increase the value of DSM to the state.

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.

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[42] Rick Hornby, Dr. Carl V. Swanson, Michael Drunsic, Dr. David E. White, Paul Chernick, Bruce Biewald, and Jennifer Kallay (January 2008). *Avoided Energy Supply Costs in New England: 2007 Final Report.* Prepared for Avoided-Energy-Supply-Component (AESC) Study Group. Available at: http://www.synapse-energy.com/Downloads/SynapseReport.2007-08.AESC.Avoided-Energy-Supply-Costs-2007.07-019.pdf.

[43] RLW Analytics, Neenan Associates (December 2005). *An Evaluation of the Performance of the Demand Response Programs Implemented by ISO-NE in 2005. Annual Demand Response Program Evaluation submitted to FERC.* Available at: http://www.iso-ne.com/regulatory/ferc/filings/2005/dec/er02-2330-__12-30-05.pdf

- Savings to consumers and businesses on energy bills, which can have macroeconomic benefits. 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 currently little market penetration for these homes 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.

Status of Group Approval

Complete.

Level of Group Support

Unanimous.

Barriers to Consensus

Not applicable.

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. (Any portion of electricity consumption that is procured or generated consistent with this RCI-7 goal and is in excess of the renewable energy requirement, as a percent of total load, under ES-1 would not count toward the portfolio standard in ES-1.) 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 SCEO. 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, 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 that 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 15. 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$CO_2e$)
	2012	2020	Total 2009–2020				
RCI-7 Total	**0.4**	**4.7**	**22.8**	**$344**	**–$1,088**	**–$743**	**–$33**
Energy Audits and Efficiency Improvements for Government Buildings	0.1	3.5	15.2	$20	–$723	–$702	–$46.1
Energy Audits and Efficiency Improvements for Schools	0.0	0.5	2.1	$3	–$101	–$98	–$46.2
Renewable Energy for Government Buildings	0.3	0.6	4.8	$248	–$233	$50	$10.4
Renewable Energy for Schools	0.1	0.1	0.6	$38	–$31	$7	$10.5

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:

- *Cost of Electric Efficiency Measures*: Same assumptions as used for RCI-1.
- *Cost of Saved Natural Gas:* Same assumptions as used for RCI-2.

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 costs of saved electricity and natural gas from DSM programs were multiplied by the saved electricity and natural gas. Then, a profit adder was included on top of these costs.

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 versus 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

- We are assuming that the ESCOs audit fees would be similar in nature and scope to DSM program management and administration costs and are therefore already included in the levelized cost of saved electricity and natural gas.
- As ESCO costs are paid with energy savings, payments would not be made back to the ESCO until savings are realized.
- Benefits: See Table 16.

Table 16. 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 Web site 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%		
Number of Buildings Undergoing Improvements	5,677	741	Calculated assumption
Average Energy Savings per Building	30%		
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	0.00007 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	
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 17.

Table 17. Key assumptions for costs of energy audits and efficiency improvements

Assumption	Government Buildings	Schools	Notes
Real Discount Rate	5%		
Levelized Cost of Saved Electricity	$8,792 per BBtu		Same assumption as used for RCI-1.
Levelized Cost of Saved Natural Gas	$2,143 per BBtu		Same assumption as used for RCI-2.
Profit Margin Adder	7%		

Renewable Energy

Ramp in of the goal: See Table 18.

Table 18. 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 19.

Table 19. Key assumptions for the 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 Web site

Assumption	Government Buildings	Schools	Notes
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 20.

Table 20. 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 ESCO costs including average profit margins; and
- The portion of the renewable energy needs that will be met with on-site PV solutions versus green power purchasing.

Avoided costs of electricity may not reflect the full costs of new generation planned in South Carolina. For example, nuclear power plant busbar costs are around or above $100/MWh, well above the avoided cost of $55.75/MWh assumed in this analysis. In addition, DSM has been shown to lower the wholesale price of electricity during some periods.[44,45] Both of these factors may increase the value of DSM to the state.

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 residences. 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, which can have macroeconomic benefits.
- 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

Complete.

Level of Group Support

Unanimous.

Barriers to Consensus

Not applicable.

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[44] Rick Hornby, Dr. Carl V. Swanson, Michael Drunsic, Dr. David E. White, Paul Chernick, Bruce Biewald, and Jennifer Kallay (January 2008). *Avoided Energy Supply Costs in New England: 2007 Final Report.* Prepared for Avoided-Energy-Supply-Component (AESC) Study Group. Available at: http://www.synapse-energy.com/Downloads/SynapseReport.2007-08.AESC.Avoided-Energy-Supply-Costs-2007.07-019.pdf.

[45] RLW Analytics, Neenan Associates (December 2005). *An Evaluation of the Performance of the Demand Response Programs Implemented by ISO-NE in 2005. Annual Demand Response Program Evaluation submitted to FERC.* Available at: http://www.iso-ne.com/regulatory/ferc/filings/2005/dec/er02-2330-__12-30-05.pdf

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 global warming potentials (GWP)s. 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 the state may join this partnership.

Verification of emission reductions is a key element of a voluntary partnership to reduce GHG emissions. *The Climate Registry* is a 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.
- SCEO and the SC DHEC can also help manage the program, including coordinate reporting, auditing, and compliance.

- Utilities may be involved in technical assistance or a 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 of 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, administered by SC DHEC, 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 sulfur hexafluoride 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 21. 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	0.05	Not Available			

Data Sources:

Research has turned up little data on voluntary energy reductions by industrial users. Thus, the results have been produced using a top-down scenario modeling approach rather than a bottom-up approach based on actual data inputs.

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

Table 22. 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 few 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 (which can have macroeconomic benefits), 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 fuel 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.
- Some of 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 #6]

Level of Group Support

TBD – [blank until CECAC Meeting #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 19 residential products and 19 pieces of commercial equipment, as well as 14 lighting standards. 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 (ASAP),[46] by 2009.

[46] 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 2006 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.

On November 19, 2007, the DOE updated the federal standard for residential gas furnaces to 80 - 81% Annual Fuel Utilization Efficiency (AFUE). This standard supersedes the potential savings level assumed by ASAP for residential gas furnaces in South Carolina.

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	–$271	–$94	–$17
ASAP Standards	0.0	0.2	1.0	$18	–$50	–$32	–$32
State Purchases	N/A	N/A	N/A	N/A	N/A	N/A	N/A
ENERGY STAR	0.2	0.8	4.6	$160	–$222	–$61	–$13

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:

- Energy savings are quantified for the following appliances, as recommended by ASAP: bottle-type water dispensers, commercial boilers, commercial hot food holding cabinets, compact audio products, DVD players and recorders, liquid-immersed distribution transformers, medium voltage dry-type distribution transformers, pool heaters, portable electric spas (hot tubs), residential furnace fans, and residential pool pumps.
- 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 electricity 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.
- Natural gas savings are not quantified for ENERGY STAR appliance purchases.

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%
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.
- Natural gas savings are not quantified for dishwashers and clothes washers with water heated by natural gas, due to a lack of consistent data on market share and gas savings.

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.

New federal standards may be enacted before 2020 that would minimize the projected energy savings from these appliances.

By December 31, 2013, the DOE must issue a new furnace fan electricity use standard to become effective at a later date. Depending on the standard requirements and effective date, this may supersede some of the projected electricity savings for furnace fans.

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.

There are many Energy Star appliances that are not analyzed due to a lack of available data. However, additional savings may be achieved by increasing the penetration of these appliances, in addition to the dishwashers, clothes washers, refrigerators, and room A/C units already quantified here.

The federal standards for dishwashers, clothes washers, and refrigerators were also updated in the Energy Independence and Security Act of 2007. As a result of the Act, the EPA must update its Energy Star standard for one or more of these appliances. However, it is currently unclear how the Energy Star efficiency levels will change as a result of this Act. Thus, savings for these three appliances may not be as high as shown here, depending on the updated Energy Star efficiency levels.

Avoided costs of electricity may not reflect the full costs of new generation planned in South Carolina. For example, nuclear power plant busbar costs are around or above $100/MWh, well above the avoided cost of $55.75/MWh assumed in this analysis. In addition, DSM has been shown to lower the wholesale price of electricity during some periods.[47,48] Both of these factors may increase the value of DSM to the state.

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, Maryland, 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 businesses on energy bills, which can have macroeconomic benefits. 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

Complete.

[47] Rick Hornby, Dr. Carl V. Swanson, Michael Drunsic, Dr. David E. White, Paul Chernick, Bruce Biewald, and Jennifer Kallay (January 2008). *Avoided Energy Supply Costs in New England: 2007 Final Report.* Prepared for Avoided-Energy-Supply-Component (AESC) Study Group. Available at: http://www.synapse-energy.com/Downloads/SynapseReport.2007-08.AESC.Avoided-Energy-Supply-Costs-2007.07-019.pdf.

[48] RLW Analytics, Neenan Associates (December 2005). *An Evaluation of the Performance of the Demand Response Programs Implemented by ISO-NE in 2005. Annual Demand Response Program Evaluation submitted to FERC.* Available at: http://www.iso-ne.com/regulatory/ferc/filings/2005/dec/er02-2330-__12-30-05.pdf

Level of Group Support

Unanimous.

Barriers to Consensus

Not applicable.