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Energy Supply Technical Work Group

Summary List of Recommended Priority Policy Options for Analysis

Option No.	Policy Option	GHG Reductions ($MMtCO_2e$)			Net Present Value 2008–2020 (Million $)[1]	Cost-Effective-ness ($\$/tCO_2e$)[1]	Level of Support
		2012	2020	Total 2008–2020			
ES-1	Energy Portfolio Standard	1.9	12.7	66.5	689	$10.4	
ES-1a: Energy Efficiency	*5% of baseline energy met with energy efficiency by 2020*	*0.8*	*4.3*	*22.4*	*-$586*	*-$26*	
ES-1b: Renewables	*5% of baseline energy served by new renewable resources by 2020*	*1.1*	*3.8*	*25.3*	*489*	*$19*	
ES-1c: Nuclear	*6% of baseline energy served by new renewable resources by 2020*	*0.0*	*4.6*	*18.9*	*$786*	*$42*	
ES-2	Technology research and development, including state funding	*Not quantified*					Complete
ES-3	Renewable energy financing, tax incentives, loans	0.36	0.93	7.06	$600	$85	Pending
ES-4	Regulatory model to equalize utility earnings on energy efficiency with earnings on traditional power supply	*Not quantified*					Pending
ES-5	Nuclear fuel reprocessing	*Not quantified*					Pending
ES-6	Green power purchases and marketing, 1% participation by 2012	0.2	0.2	1.7	$46	$27	Complete
ES-7	Attract renewable energy technology businesses to South Carolina	*Not quantified*					Complete
ES-8	Distributed renewable energy incentives and/or barrier removal (Including Interconnection Rules)	0.05	0.11	0.81	$41	$51	Pending
	Sector Total After Adjusting for Overlaps	1.3	6.2	41.8	1,320	$32	
	Reductions From Recent Actions	0.0	0.0	0.0	0	0	
	Sector Total Plus Recent Actions	1.3	6.2	41.8	1,320	$32	

GHG = greenhouse gas; $MM\$/tCO_2e$ = million dollars per ton of carbon dioxide equivalent; MW = megawatt; PV = photovoltaic.

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

[1]All costs are reported in 2005 U.S. dollars, net present value as of January 1, 2009.

General definition: For the purposes of the policies discussed here, and unless otherwise noted, "renewable energy" is defined as follows: A renewable energy resource includes solar; wind; small hydroelectric geothermal; ocean current or wave energy; biomass resources, including agricultural waste, animal waste, wood waste, spent pulping liquors, combustible residues, combustible liquids, combustible gases, energy crops, and landfill methane; waste heat derived from a renewable energy resource and used to produce electricity; and hydrogen derived from a renewable energy resource.

For the combined impact of all ES options, the nuclear portion of ES-1 is assumed to be an overlap with ES-5; also incentives for utility-scale renewable energy projects in ES-3 are assumed to overlap with the renewable energy mandate in ES-1. Distributed renewable energy and voluntary green power initiatives are assumed to be incremental, and not to overlap with ES-1. Finally, the energy efficiency component of ES-1 is assumed to overlap with the energy efficiency policy under RCI, RCI-1.

ES-1. Study the Energy Options for Portfolio Standards

Policy Description

This option recommends that the state undertake a thorough study of energy options for portfolio standards, including renewable technologies, energy efficiency, and nuclear power.

Energy efficiency includes applications that provide measurable, verifiable, long-term savings to the retail customer compared to current technology in use, including (but not limited to) appliances; lighting; heating, ventilation, and air conditioning; building envelope; and efficient motors.

The portfolio standard will consider the following implementation parameters:

- Ensure that the short-term and long-term demand for electricity in South Carolina is met without causing undue economic harm to its citizens.
- Protect and enhance the quality of the environment in South Carolina through increased use of renewables, energy efficiency, nuclear, and/or other low-greenhouse-gas (GHG)-emitting sources.
- Encourage the development, construction, and operation of clean energy resources at sites in South Carolina that have the greatest economic potential.

Policy Design

Goals: The following scenario is considered for analysis purposes:

- 5% energy efficiency, 5% renewable energy, and 6% new nuclear on a MWh basis relative to projected load. These components will be considered individually as well as collectively as a composite portfolio option.

See "Key Assumptions" for additional detail on interpretation of goals for analytical purposes.

Implementation Mechanisms

Renewable requirements may only be met with in-state resources brought on line no earlier than January 2004.

Renewable resources are assumed to be brought on-line in merit order—i.e., starting with the lowest-cost available resources on a levelized $/MWh basis.

Do we want some language about separability—i.e., components of this policy can be considered individually as well as combined into a single portfolio?

Related Policies/Programs in Place

South Carolina Energy Efficiency Act, Title 48, Chapter 52.

Type(s) of GHG Reductions

Avoided emissions associated with reduced fossil-fired electricity generation.

Estimated GHG Reductions and Net Costs or Cost Savings

Table 1 presents the estimated GHG emission reductions and the net costs or savings from implementing each component of this policy option.

Table 1. Estimated GHG reductions and net costs of or savings from ES-1

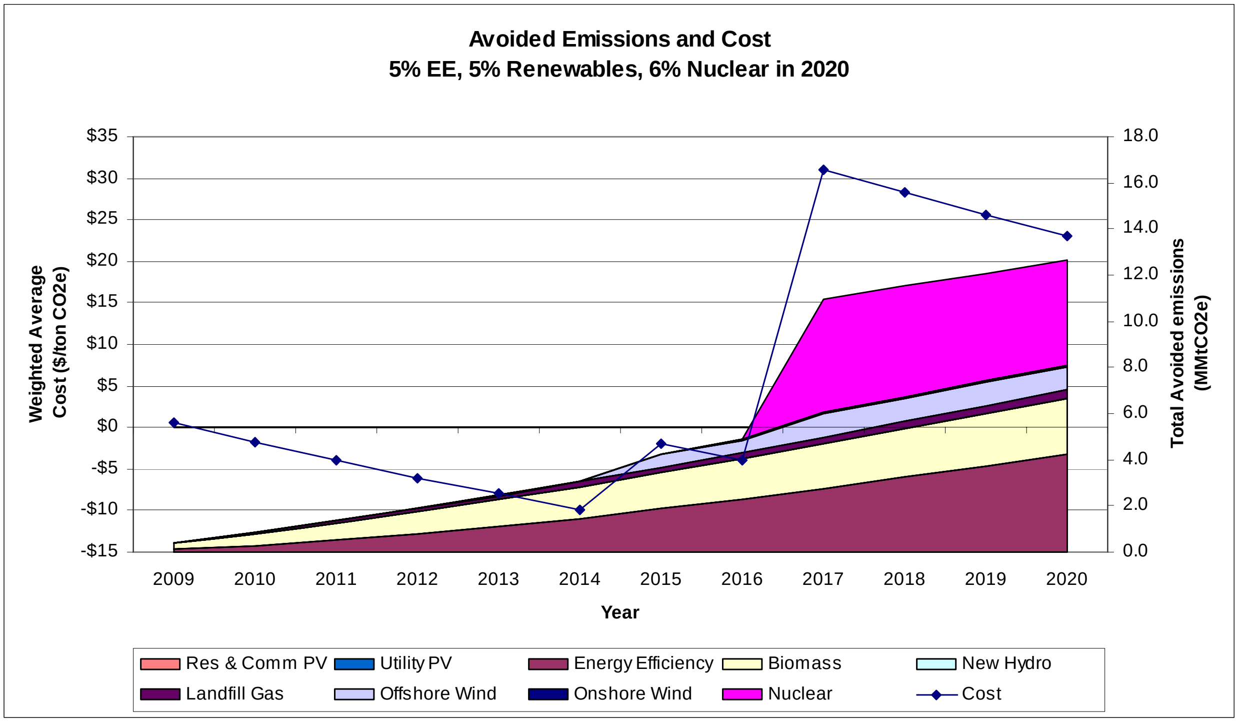
Scenario	GHG Reductions ($MMtCO_2e$)			Gross Cost (Million $)	Gross Benefits (Million $)	Net Present Value 2009–2020 (Million $)	Cost-Effective-ness ($/tCO_2e$)	Net per kWh Produced in 2020 (cents/ kWh)	Net rate impact per SC kWh in 2020 (cents/ kWh)
	2012	2020	Total 2009–2020						
Energy Efficiency	0.8	4.3	22.4	$513	$(1,099)	$(586)	$(26.2)		
Biomass	1.0	2.4	17.0	$1,116	$(857)	$259	$15.2	2.1	0.065
New Hydro	0.0	0.0	0.0	$-	$-	$-	$36.6	4.4	0.000
Landfill Gas	0.1	0.4	2.5	$126	$(128)	$(2)	$(0.7)	0.2	0.001
Res & Comm PV	0.0	0.0	0.0	0.0	0.0	0.0	239.0	26.7	0.000
Utility PV	0.0	0.0	0.0	$-	$-	$-	$111.2	2.0	0.000
Offshore Wind	0.0	1.0	5.1	$465	$(244)	$221	$43.3	5.5	0.070
Onshore Wind	0.0	0.1	0.6	$40	$(29)	$11	$18.4	2.6	0.003
Nuclear	0.0	4.6	18.9	$1,675	$(889)	$786	$41.6	5.1	0.306
Aggregate Portfolio	**1.9**	**12.7**	**66.5**	**3,936**	**-3,247**	**689**	**$ 10.4**		

GHG = greenhouse gas; kWh = kilowatt-hour; MM$/$tCO_2e$ = million dollars per ton of carbon dioxide equivalent; PV = photovoltaic; SC = South Carolina.

Constituent scenarios are defined as follows:

Energy Efficiency	1% demand reduction per year by 2015, 1.5%/year by 2020
Biomass	491 MW by 2020
New Hydro	100 MW by 2020
Landfill Gas	70 MW by 2020
Res & Comm PV	5 MW by 2020
Utility PV	10 MW by 2020
Offshore Wind	500 MW in 2015, 500 MW in 2017
Onshore Wind	50 MW by 2020
Nuclear	1000 MW in 2017

The following graph shows the annual avoided emissions by component (right vertical axis) and the total annual cost in $/$MMtCO_2e$ (left vertical axis) for the aggregate scenario:



Data Sources:

Cost of Power Plants:

- 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.
- La Capra Associates, Inc., GDS Associates, Inc., and Sustainable Energy Advantage LLC (December 2006), *Analysis of a Renewable Portfolio Standard for the State of 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.
- National Renewable Energy Laboratory, National Wind Technology Center (November 19, 2007), "Wind Integration Impacts: Results of Detailed Simulation Studies and Operational Practice in the U.S.," (presents data on wind integration costs). Available at: http://www.neo.ne.gov/renew/wind-working-group/ milligan_wind-integration-nppd.ppt.
- Stoddard, L., J. Abiecunas, and R. O'Connell (May 2005–April 2006), *Economic, Energy, and Environmental Benefits of Concentrating Solar Power in California*, NREL/SR-550-39291, U.S. Department of Energy (DOE), National Renewable Energy Laboratory. Available at: http://www.nrel.gov/csp/pdfs/39291.pdf.
- U.S. DOE, Energy Information Administration (EIA) (2007), "Assumptions to the Annual Energy Outlook 2007," Electricity Market Module. Available at: http://www.eia.doe.gov/oiaf/aeo/assumption/index.html.

- Moody's Investors Service, October 2007. "New Nuclear Generation in the United States: Keeping Options Open vs. Addressing An Inevitable Necessity."
- Catherine Morris et al. (June 2007), *Nuclear Power Joint Fact-Finding*, The Keystone Center. Available at: http://www.keystone.org/spp/documents/FinalReport_NJFF6_12_2007(1).pdf.
- Ryan Wiser and Mark Bolinger (May 2007), *Annual Report on U.S. Windpower Installation, Cost, and Performance Trends: 2006,* U.S. DOE, Lawrence Berkeley National Laboratory. Available at: http://www.nrel.gov/docs/fy07osti/41435.pdf.
- Ryan Wiser, Mark Bolinger, Peter Cappers, and Robert Margolis (January 2006), *Letting the Sun Shine on Solar Costs: An Empirical Investigation of Photovoltaic Cost Trends in California*, LBNL-59282, U.S. DOE, Lawrence Berkeley National Laboratory. Available at: http://eetd.lbl.gov/ea/EMP/reports/59282.pdf.
- Tucson Electric Power 2003. The Promise of Utility Scale Solar Photovoltaic (PV) Distributed Generation.

Cost of Energy Efficiency Measures:

- GDS Associates, Inc. (December 2006), *A Study of the Feasibility of Energy Efficiency as an Eligible Resource as Part of a Renewable Portfolio Standard for the State of North Carolina, Report for the North Carolina Utilities Commission*. Available at: http://www.ncuc.commerce.state.nc.us/reps/NCRPSEnergyEfficiencyReport12-06.pdf.
- GDS Associates, Inc. (2007) "Electric Energy Efficiency: Potential Study for Central Electric Power Cooperative, Inc.: Final Report," updated September 21, 2007. Available at: www.ecsc.org/newsroom/EfficiencyStudy.ppt.
- Forefront Economics, Inc., H. Gil Peach & Associates LLC, and PA Consulting Group (July 24, 2007), *Duke Energy Carolinas DSM Action Plan: South Carolina Draft Report*.

Experience in Other States:

- 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.
- 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.getenergysmart.org/.
- Bill Prindle (September 28, 2007), "Energy Efficiency: The First Fuel in the Race for Clean and Secure Energy," presentation at the NAPEE Southeast Energy Efficiency Workshop on American Council for an Energy-Efficient Economy. Available at: http://www.epa.gov/solar/pdf/southeast_28sep07/prindle_new_napee_presentation_atlanta_9_28_07.pdf.

- 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.

Renewable Energy Potential:

- 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.
- South Carolina Energy Office (April 9, 2007 rev.), *Biomass Energy Potential in South Carolina: A Conspectus of Relevant Information*—Final Report, and Southeast Biomass State and Regional Partnership. Available at: http://www.energy.sc.gov/publications/Biomass Conspectus 4-10-07.pdf.
- Robert A. Harris, et al., *Final Report to the South Carolina Forestry Commission on Potential for Biomass Energy Development in South Carolina*, U.S. Department of Agriculture, U.S. Forest Service and South Carolina Forestry Commission. Available at: http://www.state.sc.us/forest/prod1004.pdf.

Quantification Methods:

- Determine the resource mix consistent with the policy goal and least-cost renewables ramped in over each year through 2020.
- Determine the costs of each resource and the aggregate cost each year based on the resource mix
- Estimate the annualized costs, avoided electricity costs, and avoided emission benefits of the policy.

Key Assumptions:

Basis of analyzed composite portfolio structure:

- The 5% energy efficiency, 5% renewable energy, 6% new nuclear clean energy portfolio supports investment in energy efficiency and renewable energy while considering and balancing the cost impacts to electricity customers and the requirement to provide South Carolina citizens with safe, reliable, cost effective electricity

Avoided costs—Avoided cost of electricity at the generator bus in South Carolina is $58 per megawatt-hour (MWh).

Operational and Economic Resource Parameters:

- For purposes of analysis only, we assume the following renewable resource potentials:
  - 100 megawatts (MW) of small hydro;
  - 50 MW of onshore wind;
  - 1,000 MW of offshore wind (two 500-MW projects installed in 2015 and 2017, respectively);

  - Biomass total potential based on "practical potential" from GDA/La Capra study, split evenly between co-firing and direct firing, or a total of 491 MW statewide by 2020;
  - 15 MW of photovoltaic (PV) potential by 2020;
  - Efficiency and nuclear resource components were assumed not to be constrained by resource availability.
- For the percentage-based renewable energy goals, resources are included in increasing order by resource cost.
- Costs to be analyzed on a dollar ($)/kWh basis, as well as metric ton of carbon dioxide-equivalent ($/t$CO_2$e) avoided.
- Pre-2015 eligible resources assumed to receive a production tax credit (PTC) throughout the period. Availability of the investment tax credit (ITC) for solar TBD,
- Biomass co-firing projects receive a PTC of 1 cent/kWh, and other biomass projects receive a PTC of 1.5 cents/kWh.

A summary of economic and operational assumptions for renewable energy resources used in the analysis is shown in Table 2; economic parameters used for new nuclear power plants are shown in Table 3.

Table 2. Summary economic parameters for renewable energy resources

Renewable Technologies	Typical Size (MW)	Capacity Factors	Average Installed Cost (2006$/kW)	High Installed Cost (2006$/kW)	Fixed O&M (2006 $/kW)	Variable O&M (2006$/ MWh)	Heat Rate (Btu/kWh)
Landfill Gas ICE (> 5 MW)[1]	5–10	80%–85%	$1,750	$2,000	$100	$12	9,500
Landfill Gas ICE (< 5 MW)[1]	1–5	80%–85%	$2,500	$3,000	$100	$12	9,500
Biomass (Co-Fire Blending)[2,3,5]	5% of host capacity	70%–75%	$75	$100	$12	$5	12,000
Biomass (Co-Fire Retrofit)[2,4,5]	15%– 20% of host capacity	70%–75%	$230	$300	$12	$5	12,000
Biomass (Stoker)[5]	25	80%–90%	$2,700	$2,970	$75	$10	13,000
Biomass (Fluidized Bed)[5]	25	80%–90%	$3,000	$3,300	$75	$10	13,800
Anaerobic Digester (Swine Waste)	0.1	70%–80%	$4,000	$6,000	$270	$0	14,000
Wind (Onshore)	25–50	25%–28%	$1,800	$2,000	$45	$2	
Wind (Offshore)	50–400	30–35%	$2,800	$3,300	$80	$2	
Hydropower (Conventional)	1–50	25%–35%	$2,000	$3,500	$12	$3	
Hydropower (Small Hydro)	1–30*	25%-35%	$3,000	$4,000	$20	$5	
Hydropower (Low Head)	< 1*	20%–35%	$4,000	$5,000	$50	$10	
Solar PV (Utility Scale)	1–10	19%–21%	$4,000	$5,000	$15		
Solar PV (Commercial)	0.025–0.050	19%–21%	$6,000	$8,000	$30		
Solar PV (Residential)	0.002	19%–21%	$8,000	$10,000	$50		

Btu = British thermal unit; ICE = internal combustion engine; MW = megawatt; O&M = operation and maintenance; PV = photovoltaic.

Source: 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.

Note: Capital costs for renewables and nuclear are reduced over time following U.S. DOE EIA 2007 trends analysis. No cost decrease is assumed for wind technology.

Notes:

[1] The fuel cost range for landfill gas projects is assumed to be $0.50–$1.50 per million British thermal unit (MMBtu) [2006$]).

[2] Co-firing costs are calculated as incremental costs of avoiding coal consumption for generation ($2.25/MMBtu [2006$] coal cost assumed). No additional avoided costs are assumed for this resource.

[3] Blending refers to retrofitting coal plants with the ability to blend some biomass (up to 5% of fuel consumption of site) with coal fuel.

[4] Retrofit refers to greater capital improvements needed to accommodate higher levels of biomass co-firing (15%–20% of fuel consumption of site) with coal.

[5] The biomass fuel cost range is assumed to be $1.88–$3.90/MMBtu (2006$).

* The size of hydro facilities is measured in MWh, based on annual average flow, rather than nameplate capacity.

Table 3. Summary economic parameters for nuclear resources

Nuclear Power Cost Assumptions			
Parameter	Value	Units	Source
Installed cost	5,700	$/kW	Moody's
Capacity Factor	90%		Moody's
"To-Go" Costs*	5.5	$/MWh	Moody's

Variable O&M	12.5	$/MWh	Moody's
Fixed O&M cost	110	$/kW-yr	Morris et al.
Fuel	15	$/MWh	Morris et al

*Incremental capital costs, administrative and general costs, insurance costs, and other fees.

Cost of Energy Efficiency Measures or Saved Electricity

- Cost of saved energy assumed to be $0.30/kWh, following RCI-1 analysis.

- For other states, see Table 4.

Table 4. Cost of energy efficiency measures or saved electricity for other states

State/Utility	CSE ($kWh)	Program Year	Source
Western Utilities	0.025	1978-2004	WGA 2006
Northwest Energy	0.02	2006	Montana PSC Docket No.: D2005.5.88 07/12/06
New York	0.03	2004	Heschong Mahone Group, Inc. 2005
Massachusetts IOUs	0.038	2002	Fry 2003
California	0.03	n/a	Kushler et al., 20004
Connecticut	0.023	n/a	Kushler et al., 20004
New Jersey	0.03	n/a	Kushler et al., 20004
Vermont	0.03	n/a	Kushler et al., 20004

IOUs = investor-owned utilities; n/a = not applicable; WGA = Western Governors' Association..

Efficiency Measure Lifetime/Amortization Period: 13 years on average, no attrition during lifetime.

Zero-or low-carbon resource supply curve

The levelized cost (LCOE, measured in lifetime $/MWh) of each resource can be calculated using a financial model, leading to a supply curve for reducing carbon emissions by displacing conventional generation with zero- or low-carbon emissions energy sources (including energy efficiency.) The financial model parameters are as shown in Table 5.

Table 5. Financial model parameters and costs for energy resources

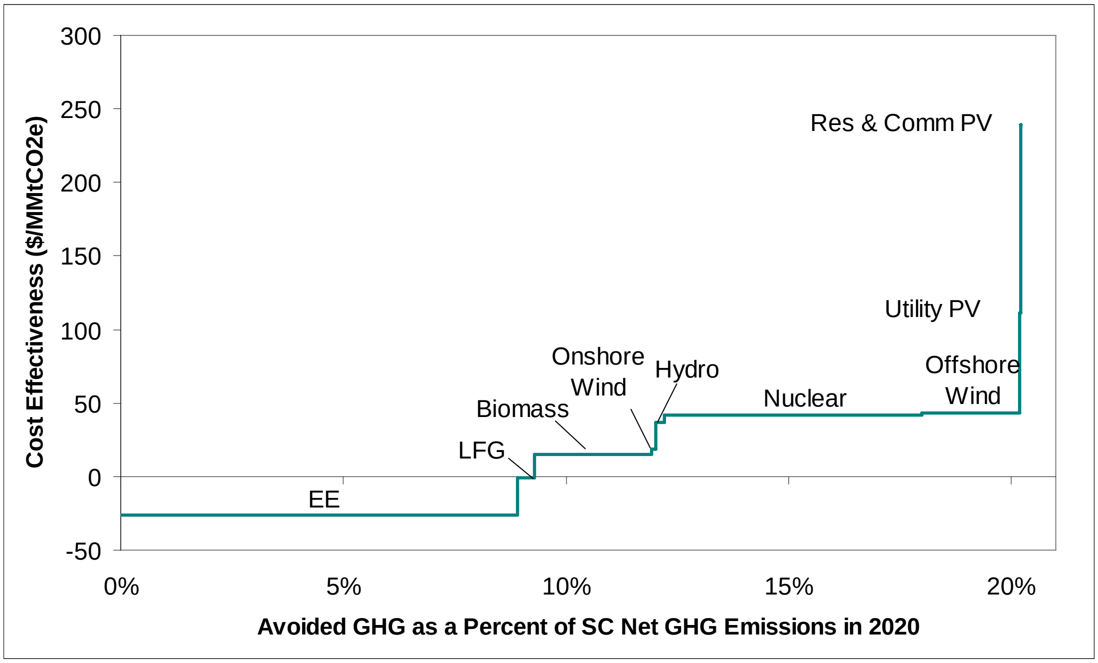
Renewable Technologies	LCOE (2005$/ MWh)	Average Capacity factor	Installed Cost (2005$/kW)	Fixed O&M (2005$/kW/yr)	Variable O&M (2005$/ MWh)	Fuel Cost (2005$/ MWh)	WACC*	Tax Credit	Econ-omic Life	CRF
Landfill Gas ICE (>5 MW)	$58	83%	$1,701	$97.2	$11.7	$9.5	8.5%	0%	20	
Landfill Gas ICE (<5 MW)	$67	83%	$2,430	$97.2	$11.7	$9.5	8.5%	0%	20	
Biomass (Co-fire Blending)**	$15	73%	$73	$11.7	$4.9	$7.7	8.5%	0%	20	

Biomass (Co-fire Retrofit)**	$18	73%	$224	$11.7	$4.9	$7.7	8.5%	0%	20
Biomass (Stoker)	$91	85%	$2,624	$72.9	$9.7	$37.6	8.5%	0%	20
Biomass (Fluidized Bed)	$98	85%	$2,915	$72.9	$9.7	$39.9	8.5%	0%	20
Anaerobic Digester (Swine Waste)	$98	75%	$3,887	$262.4	$0.0		8.5%	0%	20
Wind (On-Shore)	$94	27%	$1,749	$43.7	$1.9		8.5%	0%	20
Wind (Off-Shore)	$122	33%	$2,721	$77.7	$1.9		8.5%	0%	20
Hydro Power (Conventional)	$71	30%	$1,944	$11.7	$2.9		8.5%	0%	30
Hydro Power (Small Hydro)	$107	30%	$2,915	$19.4	$4.9		8.5%	0%	30
Hydro Power (Low Head)	$168	28%	$3,887	$48.6	$9.7		8.5%	0%	30
Nuclear Power	$109	90%	$5,700	$110.0	$18.0	$15.0	8.5%		30
Solar PV (Utility Scale)	$192	20%	$3,887	$14.6			8.5%	15%	20
Solar PV (Commercial)	$292	20%	$5,831	$29.2			8.5%	15%	20
Solar PV (Residential)	$395	20%	$7,775	$48.6			8.5%	15%	20
Small Scale Wind	$185	25%	$3,637	$50			8.5%		20
Small Biomass	$101	90%	$3,500		$20	37.6	8.5%		20
Solar PV (RE&COM)	$411	20%	$8,568	11.48			8.5%	15%	20
Solar PV (Utility Scale)	$240	20%	$5,000		4		8.5%	15%	20

*WACC assumption based on TWG consensus.
**Note that biomass co firing costs are assumed to be incremental to the cost of coal generation, and thus does not have avoided energy costs associated with this resrource.

Figure 1 presents a supply curve of all of the available low-carbon and no-carbon resources considered in the ES-1 analysis. The quantity on the horizontal axis is the percentage of projected net South Carolina GHG emissions in 2020 avoided by full implementation of each resource.

Figure 1. Supply curve of low- and no-carbon resources in South Carolina



Key Uncertainties

- Resource potential and cost for renewable resources
- Nuclear costs and feasibility in 2020 timeframe

Additional Benefits and Costs

- Economic benefits of technology development in state, employment benefits
- Clean air benefits of non-fossil resources
- Nuclear waste management costs, risks

Feasibility Issues

- Resource potentials and economics
- Nuclear feasibility in 2020 timeframe

Status of Group Approval

Pending

Level of Group Support

TBD – [blank until CECAC Meeting #6]

Barriers to Consensus

TBD – [blank until final vote by the CECAC]

ES-2. Technology Research and Development

Policy Description

A number of energy technology research and development (R&D) programs are already underway at organizations and academic facilities throughout South Carolina. R&D funding can be targeted toward a particular technology or group of technologies as part of a state initiative to build or expand an industry or core technical competency around that technology in the state, and/or to set the stage for adoption of the technology for use in the state. (For example, part of the South Carolina Hydrogen and Fuel Cell Alliance's mission is to help develop and deploy hydrogen technologies in the state.) R&D funding can also be made available to any renewable or other advanced technology (including nuclear) through an open bidding procedure (i.e., driven by bids received, rather than by a focused strategy to develop a particular technology). Funding can also be provided for demonstration projects to help commercialize technologies that have already been developed, but that are not yet in widespread use. Finally, funding can be targeted to increase collaboration among existing institutions in the state for R&D.

Policy Design

- Establish an energy technology roadmap for South Carolina to focus on efforts that have the greatest potential for achieving reduced GHG emissions, economic development opportunities, national security, and energy independence for the state. Include in the process the South Carolina Department of Commerce, economic development organizations, utilities, as well as state technology providers.
- Support and provide funding opportunities and incentives for developing and implementing new technologies for GHG reduction that encourage collaborations among R&D, government, academic, and commercial sectors.

Goals:

- Complete a detailed evaluation study for offshore wind energy potential in South Carolina.
- Provide additional state funding of $20 million for R&D initiatives in clean energy.
- Establish hydrogen infrastructures that are accessible to a majority of the population of South Carolina.
- Complete a least one high-visibility R&D demonstration to showcase alternative energies.
- Create a technology advisor position in the Governor's office.

Timing: Not applicable

Parties Involved: As noted under "Policy Design"

Implementation Mechanisms

- H. 3146—The Hydrogen Infrastructure Act identifies a potential $5 million for energy technology R&D in 2008 (proposed $15 million total over 5 years) for in-state projects. (This has passed but has not been funded.)
- H. 3649—South Carolina Renewable Energy Infrastructure Development Fund.
- Small Business Innovation Research/Tech Transfer Phase I Matching Grant Programs.
- South Carolina Research Authority (SCRA) SC Launch! Program—$200,000 per entity is available for entrepreneur assistance.
- State-funded R&D infrastructure.
- State-funded South Carolina Centers of Economic Excellence Endowed Professorship Program.

Related Policies/Programs in Place

- University of South Carolina's National Science Foundation Center for Fuel Cells and Clean Coal Center of Excellence.
- Energy research conducted at the Savannah River National Laboratory and Center for Hydrogen Research.
- Clemson University's Restoration Institute's research in bio-energy and wind.
- Clemson's University's International Center for Automotive Research automotive system integration and materials science program.
- The Greater Columbia Fuel Cell Challenge—creating a plan to make the region a center for fuel cell use.
- SCRA's clean energy initiatives programs.
- Nonprofit organizations that promote researchers, entrepreneurs, and businesses preparing for the emerging technologies in energy—e.g., EngenuitySC, Concurrent Technologies, New Carolina, FuelCellSouth.
- State-supported organizations that encourage R&D—e.g., South Carolina Biotechnology Incubation Program, South Carolina Hydrogen and Fuel Cell Alliance, South Carolina Biomass Council, South Carolina Institute for Energy Research.

Type(s) of GHG Reductions

Nonquantifiable due to the uncertainty of selected research endeavors.

Estimated GHG Reductions and Net Costs or Cost Savings

Nonquantifiable due to the uncertainty of selected research endeavors.

Data Sources:

Committee on Benefits of DOE R&D on Energy Efficiency and Fossil Energy (2001), *Energy Research at DOE: Was It Worth It? Energy Efficiency and Fossil Energy Research 1978 to 2000*, Washington D.C: National Academies Press. Available at: http://www.nap.edu/openbook.php?isbn=0309074487.

Quantification Methods:

This policy will not be analyzed quantitatively.

Key Assumptions: Not applicable.

Key Uncertainties

Not applicable.

Additional Benefits and Costs

- Job creation within South Carolina from utilizing enhanced R&D to build an energy industry is an additional benefit. The state is poised through its strength in hydrogen research to become a national leader in the hydrogen economy. By 2020, it is estimated hydrogen could have potential for more than 40,000 jobs in South Carolina and $10 billion in capital investments.
- With its strong nuclear industry, South Carolina has the potential to capitalize on the emerging renaissance, by establishing itself as a hub for nuclear expertise and training. The state is also in a position to benefit from the R&D focus on nuclear production of hydrogen (as was recommended in the National Research Council's *Review of DOE's Nuclear Energy Research and Development Program.*[1]
- Additional benefits of reduced dependence on foreign oil and improved environmental conditions can be realized.

Feasibility Issues

TBD

Status of Group Approval

Complete

Level of Group Support

Unanimous

Barriers to Consensus

None

[1] National Research Council, Board on Energy and Environmental Systems (October 2007), *Review of DOE's Nuclear Energy Research and Development Program,* Washington, DC: National Academies Press. See http://books.nap.edu/openbook.php?record_id=11998&page=24.

ES-3. Renewable Energy Financing

Policy Description

This policy option concerns financial incentives to encourage investment in the full range of renewable energy resources. The intent of these financial incentives will be to help overcome barriers for renewable energy development. Institutional and market barriers include price distortions, inadequate information, institutional barriers to grid interconnection, high transaction costs because of small projects, and high financing costs because of lender unfamiliarity and perceived risk. These can be overcome through a suite of financial and regulatory redresses, as well as through information and public education campaigns.

Financial obstacles can also be addressed through property tax exemptions, exclusions, and credits; personal income tax credits or deductions to cover the expense of purchasing and installing renewable energy equipment; loan programs to aid in financing the purchase of renewable energy equipment; and grant programs designed for R&D or to help a project achieve commercialization.

Policy Design

Goals: The initial evaluation should include several different types of financial incentives to represent the range of opportunities.

1. Remove legislative caps on current tax incentives for renewable fuel use.
2. Offer tax credits or other incentives of $3,500 per kW-equivalent for small solar PV, micro-hydro, and small wind up to 50 kW of grid-connected generation.
3. Provide a subsidy to renewable energy generators of 1 cent/kWh for electricity generated from a renewable resource, unless that electricity is used to meet a federal, state, or voluntary renewable energy standard.
4. Establish feed-in tariffs for large-scale, zero-pollution renewable generation projects, providing a guaranteed price for electricity or the market rate (if higher) by guaranteeing rate base recovery, as follows:
   - first 100 MW—15 cents/kWh
   - second 100 MW—14 cents/kWh
   - third 100 MW—12 cents/kWh
   - fourth 100 MW—10 cents/kWh
   - fifth 100 MW—8 cents/kWh
5. Offer low-interest loans for feasible and desirable biomass generation that meets exemplary environmental performance standards, with partial loan forgiveness for equipment that fails to perform to standard.

Timing: Tax credits and subsidies are available from 2009 through 2025; feed-in tariffs are guaranteed for the lifetime of a project, up to 25 years, for projects brought online between 2009 and 2015; loans are available for projects brought online between 2009 and 2015.

Parties Involved: All power producers operating qualifying facilities for incentives other than tax credits, which would be available to any grid-connected customer.

Other: The ES TWG members were divided on whether this policy should apply to conversion of municipal solid waste to energy.

Implementation Mechanisms

Incentives are to be provided and funded by the state through ……..?

Financial incentives should be structured in such a way as to promote feasible and desirable renewable energy development and to minimize distortions to any existing markets involving renewable energy, or renewable energy feedstocks (e.g., biomass).

Related Policies/Programs in Place

See the list of current and pending legislation posted by the South Carolina Energy Office, at http://www.energy.sc.gov/index.aspx?m=1&t=67.

Type(s) of GHG Reductions

TBD – [CCS to list GHG reductions with input / approval from TWG]

Estimated GHG Reductions and Net Costs or Cost Savings

Table 6. Quantification results for components of policy ES-3

Option #	GHG Reductions (MMtCO2e)			Gross Cost (Million $)	Gross Benefits (Million $)	Net Present Value 2009–2020 (Million $)	E
	2012	2020	Total 2009-2020				
ES – 3 [Goal #2]	0.06	0.14	1.04	$200	-$51	$149	
ES – 3 [Goal #4]	0.30	0.79	6.01	$742	-$290	$451	
ES – 3 [Total]	0.36	0.93	7.06	$942	-$342	$600	

Data Sources:

Renewable Energy Potential: See ES-1.

Cost of Renewable Energy: See ES-1 for utility-scale costs.

General Distributed Generation Cost and Performance Data:

- Center for Sustainable Energy California (2007), "Statewide Self-Generation Incentive Program Data & Reports" (updated January 8 2007, 2.3 MB XLS). Available at: http://www.energycenter.org/ContentPage.asp?ContentID=279&SectionID=276&SectionTarget=35.
- 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.
- 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.
- Synapse Energy Economics and Zapotec Energy (August 2005), *Feasibility Study of Alternative Energy and Advanced Energy Efficiency Technologies for Low-Income Housing in Massachusetts*, prepared for The Low-Income Energy Affordability Network, Action for Boston Community Development, and Action Inc. Available at: http://www.synapse-energy.com/cgi-bin/synapseProjects.pl?ClientName=+&ClientType=Other+Public+Interest+Group&Topic=Energy+Efficiency+%26+Load+Response&Year=+&submit=Submit.
- Distributed PV/small hydro costs are based on GDS Associates, Inc., and La Capra Associates, Inc. "Analysis of Renewable Energy Potential in South Carolina: Renewable Resource Potential—Final Report." Prepared for Central Electric Power Cooperative, Inc. September 12, 2007. Available at: http://www.ecsc.org/newsroom/RenewablesStudy.ppt.
- .Costs for biomass and distributed wind are from the above-noted California Self-Generation Incentive Program database and Synapse/Zapotec study.

Quantification Methods:

Goal #1

This is considered an enabling goal for other incentive programs and is not specifically quantified.

Goal #2

1) Estimate the amount of state money to be spent on renewable subsidies based on experience in other states
2) Establish targets (or assumptions) for the type and the amount of renewables installed through 2020, including the size of renewables (i.e., small systems up to 50 kW and larger systems).
3) Determine the potential biomass generation that meets environmental performance standards.
4) Determine the type and amount of renewable energy imported to South Carolina from an area directly connected to the South Carolina grid.

5) Estimate energy production from new renewable resources.
6) Apply financial incentives, as noted above, to each renewable energy resource.
7) Estimate the aggregate cost of renewable energy production and displaced emissions following ES-1.

Goal #3

This goal has not been quantified.

Goal #4

1) Establish total potential and cost for "large-scale, zero pollution" renewable generation projects, including landfill gas, wind, solar, and hydropower. (For purposes of this analysis, biomass is NOT considered a "zero pollution" resource.)
2) Estimate schedule for bringing on line new renewable resources of each type, subject to available subsidies as indicated above
3) Assume construction of renewables on this schedule, using the next available rate-recovery level, assuming the levelized cost of the resource does not exceed the available rate-recovery level..
4) Determine annual output and total payment at each rate recovery level.

Goal #5

This goal has not been quantified.

Key Assumptions:

Table 7 presents the total South Carolina state budget for incentives scaled from the California budget by total utility revenues in 2006. The allocation percentages are based on assumptions made by Center for Climate Strategy (CCS) analysts. These data are used in the analysis of Goal #2.

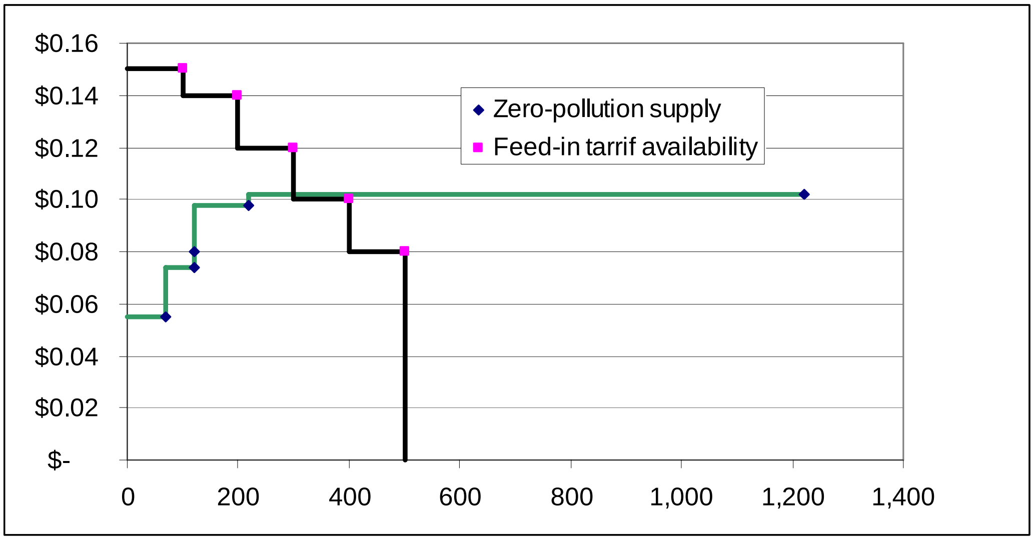
Table 7. South Carolina budget assumptions for renewable energy

Resource	Allocation	Budget ($Million)	kW/year in budget
Biomass	35%	$13.3	n/a
PV	35%	$13.3	3,793
Hydro	20%	$7.6	2,168
Wind	10%	$3.8	1,084
Total		**$37.9**	**7,045**

kW = kilowatt; PV = photovoltaic

For feed-in tariff (Goal #4), the supply and demand (i.e., rate recovery level) curves are shown in the Figure 2, below:

Figure 2. Proposed feed-in tarrif vs. levelized cost curve for target resources



Based on the intersection of these curves, a total of 200 MW of renewable resources will participate in this program. This includes 70 MW of landfill gas, 50 MW of on-shore wind power, 100 MY of new hydropower, and 80 MW of off-shore wind. The total payment on a per-kWh basis depends on the capacity factor of each of these resources, as described in ES-1.

Avoided Costs: See ES-1.

Displaced Emissions: See ES-1.

Cost of Renewable Energy Systems: See ES-1 for most of renewables.

Other state processes may provide a basis for establishing assumptions for analysis.

Key Uncertainties

- Available resources for renewable energy incentives in South Carolina
- Costs and resource potential for renewable energy sources

Additional Benefits and Costs

TBD – [as needed and approved by the TWGs]

Feasibility Issues

See comments below.

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]

ES-4. Return on Investments in Energy Efficiency

Policy Description

Utilities generate a predictable long-term earnings stream from investments in new supply resources that are needed to meet customer demand. Energy efficiency (EE) and distributed-generation (DG) renewable energy not only reduce sales, they also reduce the predictable earnings stream that Wall Street expects for the future earnings of the utility. This policy is designed to ensure that alternative methods of meeting customer demand provide the opportunity for an equivalent earnings stream to achieve investment parity.

Under traditional rate making, costs incurred by utilities, including a return on investment, are recovered through the sales of electricity. Because EE and DG renewable energy sources can decrease the volume of electricity sales, traditional cost-recovery mechanisms have created a financial disincentive to utility support for EE and renewables.

In the short run (between rate cases), lost sales due to EE programs reduce revenue by the full tariffed rate, thereby undermining the utility's recovery of costs. When this net lost revenue is taken into account, utilities may be unable to recover costs and face profit losses for EE and DG measures.

The goal of this policy is to implement a regulatory model that equalizes the incentive for utilities to invest in cost-effective EE and DG with the incentive to invest in new supply resources. By equalizing utility earnings on demand-side management (DSM) and EE programs with earnings on traditional power supply, utilities will consider investment in EE in parity with investment in new conventional capacity.

This strategy is intended to be coupled with EE strategies being evaluated in the Residential, Commercial, and Industrial TWG to achieve actual reductions in energy demand and GHG emissions.

Policy Design

Goals: The contemplated regulatory model would provide for the following:

- *Timely Recovery of Costs*—Provide utilities timely recovery of all costs associated with the implementation of DSM and EE programs. Depending on each utility's proposed plan, this should include the recovery of program costs and lost margins, as well as any incentives. These costs would be recovered through an annual DSM/EE adjustment clause and rider.
- *Recovery of Lost Revenues*—Include lost revenues experienced by the utility as a result of the implementation of DSM/EE programs in the costs recovered through the annual DSM/EE rider.
- *Financial Incentives*—Allow utilities to earn a financial incentive for the implementation of DSM/EE programs. Incentives may include sharing of savings achieved by the DSM/EE programs, or could be based on the capitalization of a percentage of avoided costs achieved by the programs. The TWG has not determined what the structure or magnitude of this incentive payment should be.

Because parity in returns does not in itself guarantee any particular level of investment, equalization of revenues as a policy may be evaluated in a comparative framework. Assuming that all cost-effective EE is implemented, the cost and the level of EE achieved with and without equalization of utility revenues should be compared. The benefit of this policy would be its marginal contribution to the availability of cost-effective EE.

Timing: The regulatory model could be implemented in 2008 and fully available in 2009.

Parties Involved: South Carolina Public Service Commission to implement rule, if necessary, affecting all investor-owned utilities.

Other:

This proposal contains some elements that are consistent with the conventional notion of "decoupling," which is designed to remove utility disincentives for pursuing EE by ensuring recovery of utility costs, regardless of the level of sales (i.e., utilities will not be penalized for effectively reducing their own sales.) It also has some features in common with Duke's proposed "Save-A-Watt" program, in that the avoided cost of energy would be shared between the utility and the ratepayer. The current proposal goes beyond the concept of decoupling by:

- Ensuring that utilities' total *earnings* will not be adversely affected by pursuing EE efficiency instead of generation investments, and
- Providing an incentive payment for utilities, based on avoided cost, to promote additional investment in EE and load reduction.

The TWG has not endorsed any particular formula for sharing of avoided cost benefits between the utility and consumers.

Implementation Mechanisms

In general, this policy contemplates that whatever state policies are selected to achieve EE, they would include a provision for timely recovery of costs and appropriate financial incentives. Furthermore, there should be consideration of an opt-out provision for large commercial and industrial customers that can have the internal capacity to finance and implement EE measures and can demonstrate that they have previously implemented conservation measures that are comparable to what the utility offers..

The following elements are central to the current proposal:

- Provide a financial structure that provides comparability for investments in end-use technologies that are cost-effective and reduce energy consumption or demand with investments in new supply-side generation for utilities. This structure may include decoupling, cost recovery, cost recovery capitalization, and lost revenues, and may also include utility incentives, such as shared savings or a percentage of avoided cost of generation.
- Require that the Public Service Commission establish rates and charges that ensure that the electric or gas utility's earnings, after implementation of cost-effective DSM/EE measures, are at least as high as the earnings would have been if the DSM/EE measures had not been implemented, without allowing for excessive, imprudent, or unreasonable returns.

Related Policies/Programs in Place

None identified.

Type(s) of GHG Reductions

To the extent that this policy leads to increased energy efficiency and reduced fossil fuel generation, it will lead to decreased emissions of CO_2.

Estimated GHG Reductions and Net Costs or Cost Savings

Data Sources:

- *Cost of Energy Efficiency Measures:*
  - Forefront Economics, Inc., H. Gil Peach & Associates LLC, and PA Consulting Group, (July 24, 2007), *Duke Energy Carolinas DSM Action Plan: South Carolina Draft Report,* prepared for Duke Energy Carolinas.
  - GDS Associates, Inc. (December 2006), *A Study of the Feasibility of Energy Efficiency as an Eligible Resource as Part of a Renewable Portfolio Standard for the State of North Carolina*, Report for the North Carolina Utilities Commission. Available at: http://www.ncuc.commerce.state.nc.us/reps/NCRPSEnergyEfficiencyReport12-06.pdf.
- *Experience in Other States on Cost of Energy Efficiency:*
  - Bill Prindle (September 28, 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. 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.
  - 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.getenergysmart.org/.
  - Energy Efficiency Task Force (January 2006), *The Potential for More Efficient Electricity Use in the Western United States*, Report to the Clean and Diversified Energy Advisory Committee of the Western Governor's Association, Denver, CO: Western Governors' Association. Available at: http://www.westgov.org/wga/initiatives/cdeac/Energy%20Efficiency-full.pdf.
- *Energy Efficiency Potential:*

- GDS Associates, Inc. (2007), "Electric Energy Efficiency Potential Study for Central Electric Cooperative, Inc." Retrieved 10/1/07 from http://www.ecsc.org/newsroom/EfficiencyStudy.ppt.
- Forefront Economics, Inc., H. Gil Peach & Associates LLC, and PA Consulting Group (July 24, 2007), *Duke Energy Carolinas DSM Action Plan: South Carolina Draft Report,* prepared for Duke Energy Carolinas.

- *Avoided Cost of Electricity (Delivered):*
  - Duke Energy Carolinas LLC (July 27, 2007), 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)." Available at: http://dms.psc.sc.gov/matters/matters.cfc?Method=MatterDetail&MatterID=187531.
  - Progress Energy (November 29, 2007), 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." Available at: http://dms.psc.sc.gov/attachments/8D4605A3-D0C6-1E0B-7E9AFC3D3422E8A0.pdf.

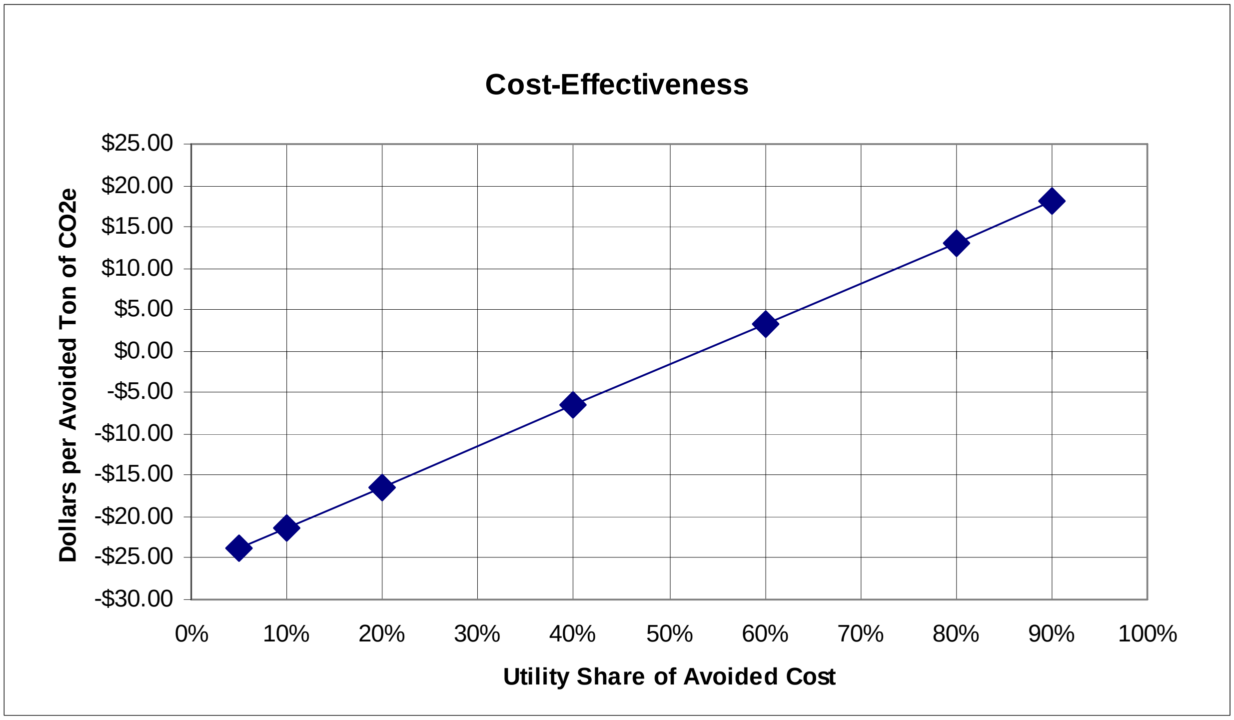
Quantification Methods:

This policy will not be analyzed quantitatively. Some quantitative details for informational purposes are provided below, based on energy efficiency costs and savings in policy RCI-1.

Key Assumptions:

Figure 2 shows the impact of varying utility share of avoided cost benefits on the ultimate cost savings for ratepayers. Below a utility share of approximately 55%, the policy has a net savings for ratepayers; above this level, it has a net cost on ratepayers.

Figure 2. Impact of varying utility shares on ratepayer cost savings:



Key Uncertainties

- Formula for sharing of avoided costs
- Nature & costs of avoided new resources

Additional Benefits and Costs

- Facilitate development of demand management resources

Feasibility Issues

TBD – [as needed and approved by the TWGs]

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]

ES-5. Nuclear Fuel Reprocessing

Policy Description

Nuclear power currently provides about 20% of U.S. electricity supply, and accounts for approximately 50% of the electricity produced in South Carolina. South Carolina currently has seven nuclear reactors, making it the state with the third highest total nuclear generating capacity. During operation, nuclear plants generate no GHG emissions, although there are GHG emissions associated with the mining, enrichment, and transport of nuclear fuel and the construction and decommissioning of plants.

Electricity demand is increasing each year in South Carolina. Estimates are that it would take approximately 10 years to design, permit, and construct a new nuclear plant, making rapid action in this area imperative if expanded nuclear power generation is to play a role in mitigating GHG emissions in the near future. Recently enacted federal energy legislation includes financial incentives for new nuclear plants, in an effort to jump-start the nuclear power industry, potentially reducing the cost for ratepayers within the state for new nuclear facilities.

Reprocessing spent nuclear fuel could significantly reduce the volume of high-level radioactive waste. Through reprocessing, the recovered uranium and plutonium can be recycled into new fuel. Recycling involves the re-enrichment of the recovered uranium for use in light-water-reactor fuel assemblies and the conversion of the recovered plutonium into mixed-oxide fuel assemblies, which also can be used in light-water nuclear reactors. This approach offers the benefits of significantly reducing the inventories of commercial spent nuclear fuel and plutonium, as well as reducing the total volume of waste requiring geologic disposal. Recycling technologies have evolved significantly since the United States abandoned commercial recycling in the 1970s, and can now be deployed in a manner consistent with U.S. and international safety and nonproliferation standards.

The focus of this policy should be to recommend state legislative and regulatory actions that would address the nuclear waste disposal issue by supporting the reprocessing and recycling of nuclear fuel, should this turn out to be technically and economically feasible.

Policy Design

Goals: The goals of this policy are:

(1) Evaluate the economic, environmental, waste reduction, national energy security, and other implications of nuclear waste reprocessing-recycling in South Carolina.

(2) If reprocessing and recycling of spent nuclear fuel are shown to be cost effective and viable for South Carolina, expeditiously implement applicable regulatory and legislative actions to support the construction of such facilities.

Timing: This policy would become effective immediately upon approval by the South Carolina General Assembly.

Parties Involved: Electric utilities, environmental advocacy groups, state legislators, county government, economic development leaders, manufacturer-business advocacy groups, and energy user/energy ratepayer advocacy groups.

Implementation Mechanisms

As enumerated under policy goals.

Related Policies/Programs in Place

- Savannah River National Laboratory, which is partnered with the Economic Development Partnership of Aiken and Edgefield counties, and EnergySolutions will each receive a part of the $10 million in Global Nuclear Energy Partnership grants to allow for detailed studies of the proposed nuclear waste recycling plants.
- Savannah River National Laboratory is applying for the nuclear recycling program.

Type(s) of GHG Reductions

Avoided emissions associated with reduced fossil generation output to the extent that this policy facilitates expanded use of nuclear energy generation.

Estimated GHG Reductions and Net Costs or Cost Savings

Data Sources:

- Massachusetts Institute of Technology (2003), *The Future of Nuclear Power: An Interdisciplinary MIT Study*, ISBN: 0-615-12420-8. Available at: http://web.mit.edu/nuclearpower/.
- Catherine Morris et al. (June 2007), *Nuclear Power Joint Fact-Finding*, The Keystone Center. Available at: http://www.keystone.org/spp/documents/FinalReport_NJFF6_12_2007(1).pdf.
- U.S. DOE, EIA (2007), "Assumptions to the Annual Energy Outlook 2007," Electricity Market Module. Available at: http://www.eia.doe.gov/oiaf/aeo/assumption/index.html.
- Other data sources on benefits & risks of reprocessing, as provided by CCS and members of the public?

Quantification Methods:

This policy will not be analyzed quantitatively.

Key Assumptions:

A number of studies are available on the cost of nuclear fuel reprocessing, including the following:

- Boston Consulting Group (2006), Economic Assessment Of Used Nuclear Fuel Management In The United States
- Matthew Bunn, John P. Holdren, Steve Fetter, Bob van Der Zwaan (2005), "The Economics of Reprocessing Versus Direct Disposal of Spent Nuclear Fuel" in Newclear Technology Journal,

Vol. 150, June 2005: Harvard University's John F. Kennedy School of Government and University of Maryland's School of Public Policy

- Steve Fetter (2005), Economic Aspect of Nuclear Fuel Reprocessing: testimony of Steve Fetter for the Subcommittee on Energy of the Committee on Science in the U.S. House of Representatives, July 2005.
- National Research Council (1996), Technologies for Separations and Transmutation, page 113: National Academy Press
- Frank N. von Hippel 2005. "Reprocessing: Why we can and should wait", presentation at the Forum on the Nuclear Fuel Cycle at Russel Senate Office Building Room 385, Nov 16, 2005

Costs of nuclear reprocessing is often expressed in $ per kilogram uranium processed. Table 8 compares the cost of reprocessing from the sources indicated above to the cost of storing uranium in interim spent fuel storage.

Table 8. Estimated Cost of Nuclear Reprocessing in Comparison to Interim Spent-fuel Storage ($ per kg of Uranium)

Project	Cost per kg uranium	Source
Interim spent-fuel storage	$100 to $300	Matthew Bunn, et al. 2005
THORP (UK) and UP3 (France) reprocessing projects	$1,000 to $1,500	Referenced in Matthew Bunn, et al. 2005, page213
THORP with different financing costs	$1,350 to 3,100	Matthew Bunn, et al. 2005, page213
Generic future reprocessing project	$1,080 to $2,800	NRC 1996, page 116
Generic future reprocessing project	$2,000	Steve Fetter 2005, page 2
Generic future reprocessing project	$500 to $2,000	Matthew Bunn, et al. 2005, page 222
Generic future reprocessing project	$630	Boston Consulting Group 2006
Generic future reprocessing project	$1,000 to $2,000	Frank N. von Hippel 2005

Table 9 presents estimated capital costs for existing reprocessing plants in United Kingdom, France, and Japan as well as for a generic facility for the United States. Note that the costs do not include finance costs such as interests during the construction, with the exception of the cost estimate of Rokkashomura in 2006. The cost of this plant has been inflated more than 3 times from the original estimate due to many factors including delays in the construction schedule, and increasingly stringent environmental and safety regulations.

Table 9. Estimated Capital Costs for Contemporary Reprocessing Plants

Project	Annual throughput (Mg/yr)	Capital cost $million (2006$)	Source
THORP (UK)	900	7,245	NRC 1996
UP3- La Hague (France)	800	8,999	NRC 1996
UP3- La Hague and Melox (France)	n/a	17,800	Boston Consulting Group 2006
Generic US facility based on UP3	2,268 (2,500 ton)	16,200	Boston Consulting Group 2006
Rokkashomura (Japan)	800	8,769 (in 1996)	NRC 1996
Rokkashomura (Japan)	800	18,567 (in 2005)	Steve Fetter 2005

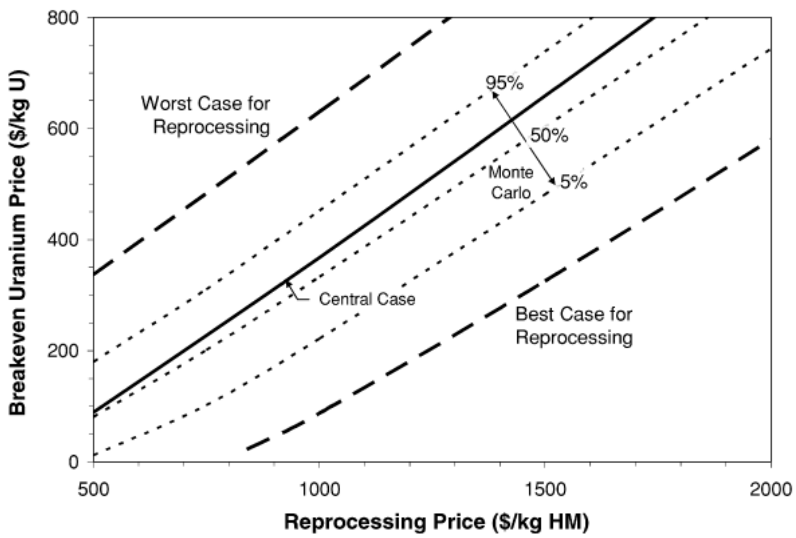
Note: financing costs, including interest during construction, are not included except $18 billion ($2005) of Rokkashomura project. Also note the original reported numbers are converted to $2006 value.

Reprocessing also entails significant annual operating costs. The table below presents operating cost estimates by Boston Consulting Group (2006) and the Nuclear Research Council (1996)

Project	Annual throughput (Mg/yr)	Annual operating cost $million	Source
Generic US facility based on UP3	2268 (2500 ton)	900 (in 2006$)	Boston Consulting Group 2007
Generic US facility	900	374 (in 1992$)	NRC 1996

Finally, Matthew Bunn, et al. (2005) analyzed the breakeven uranium price to make reprocessing technologies competitive to a conventional interim spent-fuel storage technology. Figure 3 shows the relationship between uranium price and fuel processing cost to establish the break-even cost relative to interim spent-fuel storage. In other words, Figure 3 shows to what extent uranium prices have to increase in order to make reprocessing technologies competitive to the fuel storage technologies. For example, assuming the cost of fuel processing is $1000 per kg of uranium, the price of uranium has to increase over $350 per kg in the study's Central Case (or Reference Case). In comparison, the current price of uranium is around $30 to $40 per kg.[2]

Figure 3. Breakeven Uranium Price as a Function of Reprocessing Price, for Various Sets of Assumptions About Other Fuel Cycle Prices and Parameters



Key Uncertainties

- Cost and feasibility of nuclear fuel reprocessing
- Availability of reactors that can use reprocessed (MOX) fuel

Additional Benefits and Costs

- Additional nuclear plants and reprocessing facilities would generate significant employment benefits during construction, and provide several long-term jobs, creating economic activity in the region and supporting the tax base.

[2] http://www.eia.doe.gov/cneaf/nuclear/umar/summarytable1.html

- Waste management, storage, proliferation, and health risks associated with radioactive and acidic materials should be considered.

Feasibility Issues

- Reprocessing of nuclear fuel may decrease certain high-level waste streams, concern has been raised that it could significantly increase other waste streams, including waste that is both radioactive and highly acidic
- Reprocessing has also been found to be uneconomic in all current implementations.
- Decreasing the waste stream would require a sufficient number of nuclear facilities that could use the reprocessed fuel as feedstock, of which there are currently none in the United States.

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]

ES-6. Green Power Purchases and Marketing

Policy Description

This policy would establish a voluntary program offering a green power option to consumers throughout the state. The green power purchases are comprised of a variety of consumer-driven strategies to increase the production and delivery of low-GHG power sources.

Palmetto Clean Energy (PaCE) is an independent, nonprofit organization established in August 2007. It consists of representatives from the South Carolina Office of Regulatory Staff, South Carolina Energy Office, Duke Energy Carolinas, Progress Energy Carolinas, and SCE&G. PaCE is a renewable energy program designed to encourage the development of renewable energy resources that improve the environment through reduced GHG emissions. Consumers can elect to fund green power purchases by South Carolina investor-owned electrical utilities.

Contributions to the program help provide financial incentives for generators of electricity from renewable sources. To supplement the activities of voluntary green power programs in South Carolina (PaCE and Santee Cooper Green Power), this policy provides support for marketing green power to consumers and for the developers of renewable generation through state-funded green power initiatives coordinated by the South Carolina Energy Office.

The relationship between this policy and a renewable portfolio standard needs to be determined by the CECAC.

Policy Design

Goals #1: Educate consumers about the power (fuel) sources and emissions associated with the electricity they use.

Goals #2: Establish a Voluntary Green Power Utility Program.

Timing: Operational by April 2008; 1%–5% participation of retail customers by 2012.

Parties Involved: South Carolina Office of Regulatory Staff, South Carolina Energy Office, Duke Energy Carolinas, Progress Energy Carolinas, SCE&G, Santee Cooper, Lockhart Power Company, and the Public Service Commission of South Carolina.

Other: Definition of "green power"—A renewable energy resource includes solar (roofing materials with built-in solar 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, and landfill methane; waste heat derived from a renewable energy resource and used to produce electricity; or hydrogen derived from a renewable energy resource.

Goal #3: Sponsor green power initiatives.

To supplement the activities of voluntary green power programs in South Carolina (PaCE and Santee Cooper Green Power), this policy also provides marketing and renewable resource development assistance through state-funded green power initiatives coordinated by the South Carolina Energy Office.

Timing: Fully implemented by 2012.

Parties Involved: South Carolina Energy Office, Duke Energy Carolinas, Progress Energy Carolinas, SCE&G, Santee Cooper, Lockhart Power Company, the Public Service Commission of South Carolina, and PaCE.

Other: [As needed]

Implementation Mechanisms

Table 10 presents demand- and supply-side recommendations for implementing this policy option.

Table 10. Demand- and supply-side recommendations for implementing ES-6

Demand-Side Recommendations	Supply-Side Recommendations
• Provide consumer education programs and green power promotional materials. • Provide incentives for new or expanding businesses to purchase power through voluntary green power programs. • Provide tax credits for companies purchasing power through voluntary green power programs. • Provide incentives for homebuilders to include 1 year of green energy through PaCE with the purchase of new homes • Provide assistance and participation in consumer and business marketing programs. • Provide Web-based technical assistance to consumers. (See Maine Public Utilities Commission program.) • Provide incentive through reward and recognition for Industry to purchase power through voluntary green power programs.	• Provide support for R&D on new and developing renewable energy technologies. • Provide support for feasibility studies of various renewable energy technologies. • Provide a mechanism for long-term contract guarantees for renewable energy producers. • Provide support for renewable energy development projects, thereby leading to more options and sales tools. • Provide low- or no-interest loans for qualified developers of renewable energy projects. • Provide incentive through reward and recognition for the top generators of green power.

Related Policies/Programs in Place

- Green Power program through Santee Cooper (landfill methane—five sites), expanding into solar. Eighteen electric co-ops also participate in the green power program through Santee Cooper.
- Palmetto Clean Energy (PaCE).
- North Carolina Power.

Type(s) of GHG Reductions

TBD – [CCS to list GHG reductions with input / approval from TWG]

Estimated GHG Reductions and Net Costs or Cost Savings

Table 11 presents the estimated GHG reductions and net costs of or savings from this policy option.

Table 11. Estimated GHG reductions and net costs of or savings from ES-6

ES-6 Options	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				
ES-6 @ 1%	0.2	0.2	1.7	$46	–$0	$46	$27
ES-6 @ 5%	0.8	0.8	8.3	$223	–$0	$223	$27

Data Sources:

- "Santee Cooper Fingertip Facts," Jan. 1, 2006–Dec. 31, 2006, page 24. Available at: https://www.santeecooper.com/portal/page/portal/SanteeCooper/AboutUs/CorporatePublications/2006_Fingertip_Facts.pdf.
- Lori Bird and Marshall Kaiser (October 2006), *Trends in Utility Green Pricing Programs*, NREL/TP-640-40777, U.S. DOE, National Renewable Energy Laboratory. Available at: http://www.nrel.gov/docs/fy07osti/40777.pdf.
- U.S. DOE, Office of Energy Efficiency and Renewable Energy, "Can I Buy Green Power in My State?" Accessed December 6, 2007, at: http://www.eere.energy.gov/greenpower/buying/buying_power.shtml?state=SC&print.
- 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.
- La Capra Associates, Inc., GDS Associates, Inc., and Sustainable Energy Advantage LLC (December 2006), *Analysis of a Renewable Portfolio Standard for the State of 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.
- Stoddard, L., J. Abiecunas, and R. O'Connell (May 2005–April 2006), *Economic, Energy, and Environmental Benefits of Concentrating Solar Power in California*, NREL/SR-550-39291, U.S. DOE, National Renewable Energy Laboratory. Available at: http://www.nrel.gov/csp/pdfs/39291.pdf.
- U.S. DOE, EIA (2007), "Assumptions to the Annual Energy Outlook 2007," Electricity Market Module. Available at: http://www.eia.doe.gov/oiaf/aeo/assumption/index.html.

- Ryan Wiser and Mark Bolinger (May 2007), *Annual Report on U.S. Windpower Installation, Cost, and Performance Trends: 2006,* U.S. DOE, Lawrence Berkeley National Laboratory. Available at: http://www.nrel.gov/docs/fy07osti/41435.pdf.
- Ryan Wiser, Mark Bolinger, Peter Cappers, and Robert Margolis (January 2006), *Letting the Sun Shine on Solar Costs: An Empirical Investigation of Photovoltaic Cost Trends in California*, LBNL-59282, U.S. DOE, Lawrence Berkeley National Laboratory. Available at: http://eetd.lbl.gov/ea/EMP/reports/59282.pdf.

Quantification Methods:

- Identify a resource mix of renewable energy in conjunction with ES-1 that will be developed under this policy option and costs.
- Estimate ramp-in to meet the program participation goal for low-participation and high-participation scenarios.
- Estimate the average amount of green power purchases per participant and the number of participants per year.
- Estimate the costs of the green power purchasing program to customers.
- Estimate the costs of energy production from renewable energy sources following ES-1.
- Estimate the GHG emission reductions associated with the green power program.

Key Assumptions:

Amount of Green Power Purchased by Each Customer:

- Table 12 presents the assumed average purchases of renewable energy per residential customer (kWh/year).

Table 12. Average purchases of renewable energy per residential customer (kWh/yr)

% of Customers	2001	2002	2003	2004	2005	2006
100%	2,400	2,900	3,400	4,000	4,200	4,400

Source: Bird and Kaiser 2006, p. 10.

- The average purchase of renewable energy per residential customer is assumed to grow at the same rate indicated by in Table 12, above (but starting in 2009), until customers are purchasing a maximum of 30% of their total consumed electricity as green power.
- This ramp-in rate is consistent with current green power purchasing in South Carolina. According to an employee for the Santee Cooper Green Power Program, customers currently purchased about 2,400 kWh/year of green power.
- The average purchase of renewable energy per commercial and industrial customer (kWh/year) is assumed to be 30% of their total consumption.
- Table 13 presents the umber of customers, broken down by sector, and total purchases for Santee Cooper's Green Power Program in 2006:

Table 13. Number of customers involved in the Santee Cooper Green Power Program in 2006

Number of customers in the Santee Cooper Green Power Program in 2006	
Number of Residential Customers	1,527
Number of Commercial Customers	283
Number of Industrial Customers	1
Customers Reached Through Cooperatives and Municipalities	2,519
Green Power Sales (MWh)	**15,984**

- The current level of participation in green power programs in South Carolina is assumed to be approximately the total number of customers in the 2006 Santee Cooper Green Power Program, divided by the total number of 2006 retail electricity customers in South Carolina.
- The participation rate is assumed to steadily increase between 2009 and 2012.
- The participation rate is assumed to be constant after it reaches the goal in 2012.
- The projected number of retail electricity customers in South Carolina by sector.
- The projected retail electricity sales in South Carolina.
- The emissions associated with avoided fossil fuel generation and renewables (see ES-1).
- The average premium for green power purchases is 3 cents/kWh based on the following existing programs:
  - Santee Cooper (3 cents/kWh): Primarily uses landfill gas.
  - North Carolina Power (4 cents/kWh): Uses a mix of solar, wind, landfill gas, and biomass. For purchases of more than 10 MWh per month, the premium is 2.5 cents/kWh, with a different mix of renewables, including small hydroelectric and clean wood waste.
  - The national average premium, as reported in Bird and Kaiser 2006 (2.6 cents/kWh).
- The premium is assumed to cover program costs as well as the incremental costs of green power.
- The avoided GHG emissions associated with landfill gas do not include methane, since it is assumed that the landfill gas would otherwise be flared.

Key Uncertainties

TBD – [as needed and approved by the TWGs]

Additional Benefits and Costs

Would help to provide local employment and grow renewable energy use.

Feasibility Issues

- Interaction with other options to promote renewable energy needs to be taken into account.
- Third-party verification may be necessary and would add incrementally to program cost,

Status of Group Approval

Complete

Level of Group Support

Unanimous

Barriers to Consensus

None identified

ES-7. Renewable Energy Technology Businesses

Policy Description

Renewable energy has recently developed into an immediate and long-term growth industry. South Carolina can capitalize on this economic potential by working to attract companies that specialize in this industry. Incentives to attract renewable energy businesses should be designed to create South Carolina as a partner in the renewable energy market. The goal of this policy is to create a strong local market for renewables in South Carolina and for the state to become a vocal advocate of these energy solutions. Luring these types of businesses has become a primary economic target for many states, so competition will be tough.

The CECAC accepted this policy priority for analysis in order to capture a comprehensive range of options for attracting renewable energy technology businesses to South Carolina.

Policy Design

Goals:

- South Carolina has an internationally respected renewable energy business cluster, making it an obvious destination point for company facilities.
- South Carolina is a top-five U.S. state (per capita) for new renewable energy installations per year.
- South Carolina ranks as a leader in higher education and technical education for R&D and implementation of renewable technologies.

Timing:

- January 2009: State legislators are educated on the magnitude of the economic potential for renewable energy technologies in South Carolina.
- July 2009: Incentives are in place for promoting widespread adoption of renewable energy in South Carolina.
- December 2009: A plan is in place for luring businesses to South Carolina (includes an information packet, materials, policies, marketing, etc.).
- October 2010: Programs are in place at universities, colleges, and technical schools for renewable energy R&D, training, and education.
- January 2010: A renewable energy cluster in place with two to five businesses signed on.
- 2012: South Carolina cracks the top-five list of states with new renewable energy installations.

Parties Involved: State and local governments, community and business leaders, citizens, education facilities, students, and visitors.

Implementation Mechanisms

Elements of this policy could include the following policies and incentives:

- Incentives for business operations:
  - Tax credits
  - Low-cost financing
  - Business energy tax credit
  - Alternative Energy Product Manufacturers Tax Credit (as in New Mexico)
- Policies for promoting locations in South Carolina:
  - Recruitment marketing plan (for developing a state renewable cluster)
  - Infrastructure improvement assistance
  - Workforce and wage level availability
  - Reliable and reasonably priced power
  - Mothballed plants and analyzed or potential sites
  - Railways, roadway, transportation hubs identified and targeted
  - Trained workforce—quantify and develop
  - Increased incentives for projects utilizing in-state manufactured equipment
  - Cost of living in South Carolina—positive part of promotion
  - International presence in South Carolina—positive attraction
  - South Carolina is good location for manufacturing engineers
  - Job training plan
  - R&D plan
- Market-generating policies/incentives (overlap with other ES options):
  - Renewable energy feed-in production incentive
  - Energy efficiency and renewable energy bond program
  - Sales and tax abatement on capital equipment
  - Statewide net metering
  - Statewide interconnection standards
  - Renewable portfolio standard
  - Tax credits
- Other policies and incentives:
  - Educating legislators on the potential of renewable technologies (world/state economic potential analysis)
  - Implementation of renewable technologies on government owned facilities

Related Policies/Programs in Place

None identified.

Type(s) of GHG Reductions

TBD – [CCS to list GHG reductions with input/approval from TWG]

Estimated GHG Reductions and Net Costs or Cost Savings

The costs and benefits associated with this policy will not be quantified.

Data Sources: [TBD by CCS on TWG approval]

Quantification Methods: [e.g., Full life-cycle analysis with supply/demand equilibrium adjustments on TWG approval]

Key Assumptions: [TBD, as needed on TWG approval]

Key Uncertainties

TBD – [as needed and approved by the TWGs]

Additional Benefits and Costs

TBD – [as needed and approved by the TWGs]

Feasibility Issues

TBD – [as needed and approved by the TWGs]

Status of Group Approval

Complete

Level of Group Support

Unanimous

Barriers to Consensus

None identified

ES-8. Distributed Renewable Energy

Policy Description

Distributed generation refers to the production of electricity at or near the sites of consumption. Distributed renewable energy is energy specifically generated by naturally replenishing resources. The production of renewable energy results in few or no GHG emissions. Institutional and market barriers to distributed renewable energy include:

- Inadequate information;
- Institutional barriers to grid interconnection;
- Community barriers (e.g., local covenants and restrictions);
- Limited availability of qualified contractors;
- High transaction costs;
- High financing costs (e.g., due lender unfamiliarity and perceived risk);
- Interconnection rules (e.g., standby fees, exit fees);
- Ownership of renewable energy credits (RECs);
- Pricing of net generation; and
- Failure of the market to value the public benefits of renewable technologies and the social cost of fossil fuel technologies.

These barriers can be overcome through a suite of financial and regulatory redresses, as well as through information and public education campaigns.

The goal of this policy is to identify all renewable energy sources that could lead to possible distributed generation options for residences and commercial and industrial facilities, as well as the uncertainties and risks associated with greater adoption of these resources. In addition, this policy should identify and examine current and potential barriers impeding current and potential participants. Finally, it should provide specific incentives or policies that would eliminate or limit barriers and expand distributed generation in South Carolina.

Policy Design

Definition: Distributed renewables include solar PV and solar thermal; wind power; micro-hydropower (< 20 MW); fuel cells using renewable fuels; biomass, including non-woody energy crops, wood wastes, and agricultural waste; methane from animal waste; and geothermal.

Goal:

- 3 MW/year of new distributed renewable generation (this numerical goal is for analytical purposes only, and does not carry the TWG's endorsement of the "best" number).

Timing: Three MW of new distributed renewable generation annually from 2009 through 2020.

Parties Involved: Any industrial, commercial, or residential entity operating qualifying distributed renewable energy systems, whether directly connected to the South Carolina grid or otherwise could participate.

Other:

Implementation Mechanisms

Elements of this policy could include the following policies and incentives:

- Adoption of Interstate Renewable Energy Council Model Interconnection Standards and Procedures for Small Generator Facilities Statewide.
- Adoption of Interstate Renewable Energy Council Model Net-Metering Rules Statewide.
- Uniform permitting standards for large/industrial distributed renewable generation.
- State licensing and/or training for distributed renewable generation installers and contractors.
- Consideration of adoption by state regulatory authorities of rate designs (possibly incorporating into the rate design a value for offsetting CO_2 emissions), coupled with the necessary metering technology, that promote reduction in GHG emissions by encouraging consumers to install renewable distributed generation systems.
- Financial incentives, including:
    - Expand/increase existing corporate tax credits to include all qualifying distributed renewable energy systems.
    - Expand/increase existing personal tax credits to include all qualifying distributed renewable energy systems.
    - Expand the state rebate program for solar thermal installations on EarthCraft homes to all qualifying distributed renewable energy systems and all homes.
    - Institute a sales tax exemption for distributed renewable energy systems
    - Institute a property tax exemption for distributed renewable energy systems.
    - Set distributed renewable energy procurement standards for the state government.
    - Provide grants and incentive programs for schools and higher education institutions unable to benefit from state and federal tax incentives.

Related Policies/Programs in Place

None identified.

Type(s) of GHG Reductions

TBD – [CCS to list GHG reductions with input / approval from TWG]

Estimated GHG Reductions and Net Costs or Cost Savings

For purposes of analysis, we assume that three MW of new distributed resources are built per year allocated as described below under “Assumptions”. The quantitative analysis results are as follows:

Option #	GHG Reductions (MMtCO2e)			Gross Cost (Million $)	Gross Benefits (Million $)	Net Present Value 2009–2020 (Million $)	E
	2012	2020	Total 2009-2020				
ES – 8	0.05	0.11	0.81	$80	-$39	$41	

Data Sources:

Renewable Energy Potential:

- 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.
- South Carolina Energy Office and Southeast Biomass State and Regional Partnership (April 9, 2007 rev.), *Biomass Energy Potential in South Carolina: A Conspectus of Relevant Information—Final Report.* Available at: http://www.energy.sc.gov/publications/Biomass Conspectus 4-10-07.pdf.
- Robert A. Harris, et al., *Final Report to the South Carolina Forestry Commission on Potential for Biomass Energy Development in South Carolina*, U.S. Department of Agriculture, U.S. Forest Service and South Carolina Forestry Commission. Available at: http://www.state.sc.us/forest/prod1004.pdf.
- U.S. DOE, EIA (2005), "Renewable Energy Potential in the South Atlantic Division." Available at: http://www.eia.doe.gov/emeu/reps/rpmap/rp_so-atl.pdf.
- J.R.V. Flora and Cyrus Riahi-Nezhad (August 2006), *Availability of Poultry Manure as a Potential Bio-Fuel Feedstock for Energy Production*, submitted to the South Carolina Energy Office. Available at: http://www.scbiomass.org/Publications/Poultry Litter Final Report.pdf.

Cost of Renewable Energy:

- 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.
- La Capra Associates, Inc., GDS Associates, Inc., and Sustainable Energy Advantage, LLC (December 2006), *Analysis of a Renewable Portfolio Standard for the State of 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.
- Natural Resources Canada (2004), *Microhydropower Systems: A Buyers Guide*. Available at: http://www.oregon.gov/ENERGY/RENEW/Hydro/docs/MicroHydroGuide.pdf.
- National Renewable Energy Laboratory, National Wind Technology Center (November 19, 2007), "Wind Integration Impacts: Results of Detailed Simulation Studies and Operational

Practice in the U.S." (data on wind integration costs) . Available at: http://www.neo.ne.gov/renew/wind-working-group/ milligan_wind-integration-nppd.ppt.

- U.S. DOE, EIA (2007), "Assumptions to the Annual Energy Outlook 2007," Electricity Market Module. Available at: http://www.eia.doe.gov/oiaf/aeo/assumption/index.html.
- Ryan Wiser and Mark Bolinger (May 2007), *Annual Report on U.S. Windpower Installation, Cost, and Performance Trends: 2006,* U.S. DOE, Lawrence Berkeley National Laboratory. Available at: http://www.nrel.gov/docs/fy07osti/41435.pdf.
- Ryan Wiser, Mark Bolinger, Peter Cappers, and Robert Margolis (January 2006), *Letting the Sun Shine on Solar Costs: An Empirical Investigation of Photovoltaic Cost Trends in California*, LBNL-59282, U.S. DOE, Lawrence Berkeley National Laboratory. Available at: http://eetd.lbl.gov/ea/EMP/reports/59282.pdf.

General DG Cost and Performance Data:

- Center for Sustainable Energy California (2007), "Statewide Self-Generation Incentive Program Data & Reports," updated January 8, 2008, (2.3 MB XLS). Available at: http://www.energycenter.org/ContentPage.asp?ContentID=279&SectionID=276&SectionTarget=35.
- GRI and NREL—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.
- 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.
- Synapse Energy Economics and Zapotec Energy (August 2005), *Feasibility Study of Alternative Energy and Advanced Energy Efficiency Technologies for Low-Income Housing in Massachusetts*, prepared for The Low-Income Energy Affordability Network, Action for Boston Community Development, and Action Inc. Available at: http://www.synapse-energy.com/cgi-bin/synapseProjects.pl?ClientName=+&ClientType=Other+Public+Interest+Group&Topic=Energy+Efficiency+%26+Load+Response&Year=+&submit=Submit.

Quantification Methods:

- Identify distributed renewable energy potential in South Carolina, and define the resource mix.
- Project energy production from new renewable energy-based distributed generation development through 2020.
- Estimate the cost of energy production from the distributed generation development.
- Estimate the benefits of the above as in the avoided costs of electricity.
- Estimate GHG emission reductions from the distributed generation development.

Key Assumptions:

The distributed resources were assumed to be distributed as follows:

Resource	Share in Policy Analysis	Capacity Factor	Levelized Cost		
			2008-2010	2011-2015	2016-2020
Biomass	30%	80%	**$86**	**$87**	**$96**
Fuel Cells	10%	75%	**$94**	**$87**	**$85**
PV	30%	20%	**$344**	**$331**	**$310**
Hydro	20%	30%	**$98**	**$99**	**$105**
Wind	10%	25%	**$178**	**$178**	**$168**

Solar hot water analyzed as part of RCI-3

Capital and O&M Costs of Renewable Energy Technologies: See ES-1.

Emission Factors: ????

Discount Rate: ????

Key Uncertainties

TBD – [as needed and approved by the TWGs]

Additional Benefits and Costs

Benefits of distributed renewable energy accrue to owners of the resource, the public, utilities, and the economy. In particular, for distributed renewable energy resource, owner benefits could include:

- Reduced utility costs
- Revenue from net generation
- Stabilized costs on the portion of utility replaced renewably
- Revenue from selling RECs

For the public, benefits could include:

- Reduced air pollution
- Increased renewable energy awareness
- Increased energy security/reliability
- Technological innovation
- Reduced export of South Carolina energy dollars

For utilities, benefits could include:

- Reduced peak demand and associated expenses
- Reduced system load (e.g., transmission)
- Avoided cost of new transmission and generation
- Reduced transmission and distribution losses
- Expanded resource investment opportunities

For the economy, benefits could include:

- Expanded renewable energy markets (including service business opportunities, South Carolina employment opportunities, and a new marketplace where renewable energy manufacturing businesses will want to locate)
- Increased disposable income for consumers
- Reduced export of South Carolina energy fuel dollars

Feasibility Issues

Uncertainties and risks associated with distributed renewable generation and their increased adoption also exist. Can increased adoption of distributed renewable generation lead to increased costs for utilities? How will owners of distributed generation resources interface with wholesale electricity markets? How reliable will distributed renewable resources be? What will the future capital investment requirements be? How long will federal and other incentives for distributed renewable generation last? How will grid-connected distributed renewable energy affect system reliability? Also uncertain is the status of the CECAC's approval.

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]