Appendix H
Energy Supply Sector
Policy Recommendations

Summary List of Policy Recommendations

Policy No.*	Policy	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	Efficiency and Renewable Portfolio Standard and Statement of Support for Nuclear Energy	1.9	12.6	66.5	$689	$10	Super Majority (Three objections)
ES-1a	Energy Efficiency: 5% of energy met with energy efficiency resources by 2020	0.8	4.2	22.4	–$586	–$26	
ES-1b	Renewables: 5% of energy served by new renewable resources by 2020	1.1	3.8	25.3	489	$19	
ES-1c	Nuclear: 6% of energy served by new nuclear resources by 2020	0.0	4.6	18.9	$786	$42	
ES-2	Technology Research and Development, Including State Funding	*Not quantified*					Unanimous
ES-3	Renewable Energy Financing, Tax Incentives, Loans	0.4	0.9	7.1	$591	$84	Unanimous
ES-4	Regulatory Model To Equalize Utility Earnings on Energy Efficiency With Earnings on Traditional Power Supply	*Not quantified*					Super Majority (One objection)
ES-5	Nuclear Fuel Reprocessing	*Not quantified*					Unanimous
ES-6	Green Power Purchases and Marketing, 1% Participation by 2012	0.2	0.2	1.7	$46	$27	Unanimous
ES-7	Attract Renewable Energy Technology Businesses to South Carolina	*Not quantified*					Unanimous
ES-8	Distributed Renewable Energy Incentives and/or Barrier Removal (Including Interconnection Rules)	0.05	0.1	0.8	$42	$50	Unanimous
	Sector Total After Adjusting for Overlaps	**0.3**	**3.0**	**22.5**	**$1,201**	**$53**	
	Reductions From Recent Actions	**0.0**	**0.0**	**0.0**	**0**	**0**	
	Sector Total Plus Recent Actions	**0.3**	**3.0**	**22.5**	**$1,201**	**$53**	

GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $/$tCO_2e$ = dollars per metric ton of carbon dioxide equivalent.

All costs are reported in 2005 U.S. dollars, net present value as of January 1, 2009. Negative values in the Net Present Value and the Cost-Effectiveness columns represent net cost savings associated with the recommendations. Totals in some columns may not add to the totals shown due to rounding.

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

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 policies, the incentives for utility-scale renewable energy projects in ES-3 are assumed to be redundant with the renewable energy mandate in ES-1; however, the distributed energy incentives in ES-3 are found to be larger than the impact of ES-8 and ES-8 is found to have no incremental impact over ES-3. These distributed renewable energy incentives, as well as voluntary green power initiatives (ES-6) are assumed to be incremental, and not to overlap with ES-1. Further, the energy efficiency component of ES-1 is assumed to overlap with the energy efficiency policy under RCI-1, and the goals for the nuclear and renewables components of ES-1 are reduced to reflect energy savings under RCI-1.

Several Energy Supply policies rely on biomass feedstock to replace fossil-based electricity generation. Similarly, a number of AFW policies also rely on the use of biomass for both electricity production and other energy-related uses. Specifically, the biomass generation benefits in ES policies 1, 3, and 6 are found to overlap with AFW policies 2, 5, and 9. The fundamental limit that creates an overlap among these policies is the limited availability of biomass feedstock in South Carolina.

To accommodate this limit, the cumulative impact analysis for the ES sector does not include any of the electricity generation from woody biomass, swine waste, or poultry litter resulting from ES policies, and the impact of landfill gas generation has been reduced by 18%. Either this generation is already accounted for in AFW policies, or else the feedstock is used for another purpose that has a similar or greater impact in mitigating GHG emissions in the state.

ES-1. Efficiency and Renewable Portfolio Standard and Statement of Support for New Nuclear Energy

Policy Description

This policy recommends that the state develop energy portfolio standards, including renewable technologies and energy efficiency, and adopt a statement of policy supporting development of new 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 demands for electricity in South Carolina are met without causing undue economic harm to its citizens.
- Protect and enhance the quality of the environment in South Carolina through increased use of renewable, energy efficiency, nuclear, and/or other low-greenhouse-gas (GHG)-emitting sources of energy.
- Encourage the development, construction, and operation of clean energy resources at sites in South Carolina that have the greatest economic potential.

Policy Design

Goals:

Each public or private utility generating electricity in South Carolina for sale within the state will meet at least 5% of its South Carolina retail customers' electricity needs by 2020 through energy efficiency and demand response program implementation. The state, in developing its energy efficiency and demand response policy, will minimize the cost impacts to customers, while ensuring cost recovery for utilities. The policy will allow the industrial class of customers to opt out of the energy efficiency programs if such customers have similar programs in place achieving similar goals.

Each public or private utility generating electricity in South Carolina for sale within the state will meet at least 5% of its retail customers' electricity needs by 2020 from renewable energy placed into service after December 31, 2003. These needs may be met with renewable energy placed on the utility's retail distribution system. The state, in developing this renewable policy, will minimize the cost impacts to retail customers, while ensuring cost recovery for utilities. This renewable energy requirement may be met either through physical generation with in-state renewable energy resources, or through the purchase of Renewable Energy Credits (RECs) from in-state or out-of-state sources.

It is the declared policy of South Carolina that the development of new nuclear energy is an important part of the state's future energy needs due to the reliability of nuclear energy and the substantial reduction of GHG emissions resulting from nuclear energy. Therefore, the state will produce by 2020 at least 6% of the total electricity generated in South Carolina with new nuclear energy put into service after January 1, 2008.

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

Implementation Mechanisms

- The General Assembly should consider amendments to the South Carolina Energy Efficiency Act, Chapter 52 of Title 48 of the South Carolina Code of Laws, to enact renewable energy and energy efficiency portfolio standards, and to adopt policies and goals supporting the development of new nuclear energy.
- Renewable requirements may only be met with resources brought on line no earlier than January 2004, subject to geographic restrictions similar to those adopted by North Carolina for its Renewable Energy and Energy Efficiency Portfolio Standard.
- Renewable resources are assumed to be brought on line in merit order—i.e., starting with the lowest-cost available resources on a levelized dollar per megawatt-hour ($/MWh) basis.
- Provision should be made to address or exempt the inclusion of the Piedmont Municipal Power Agency and other small utilities relying primarily on hydropower. Piedmont currently generates over 90% of its power from nuclear and renewable resources.
- Caps or limitations should be considered on the amount of renewable energy to be generated from woody biomass in order to avoid inappropriate interference with forest product markets. No limitation should be placed on closed-loop woody biomass, such as planting short-rotation woody fiber crops as a dedicated source for biomass fuel.
- Consumers should be protected from excessive cost impacts from this policy—e.g., by limiting the cost per MWh, the rate impact, or the total impact of ratepayers' bills. These cost-protection measures can apply to one or more components of this policy (i.e., renewable energy, energy efficiency, or nuclear resources), in aggregate or individually.
- Provisions should be made for utilities to recover all costs of demand-side management/energy efficiency and renewable energy through an annual recovery clause consistent with policy ES-4 (Regulatory Model To Equalize Utility Earnings on Energy Efficiency With Earnings on Traditional Power Supply).

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

Table H-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	4.2	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	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
Residential & commercial 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	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		

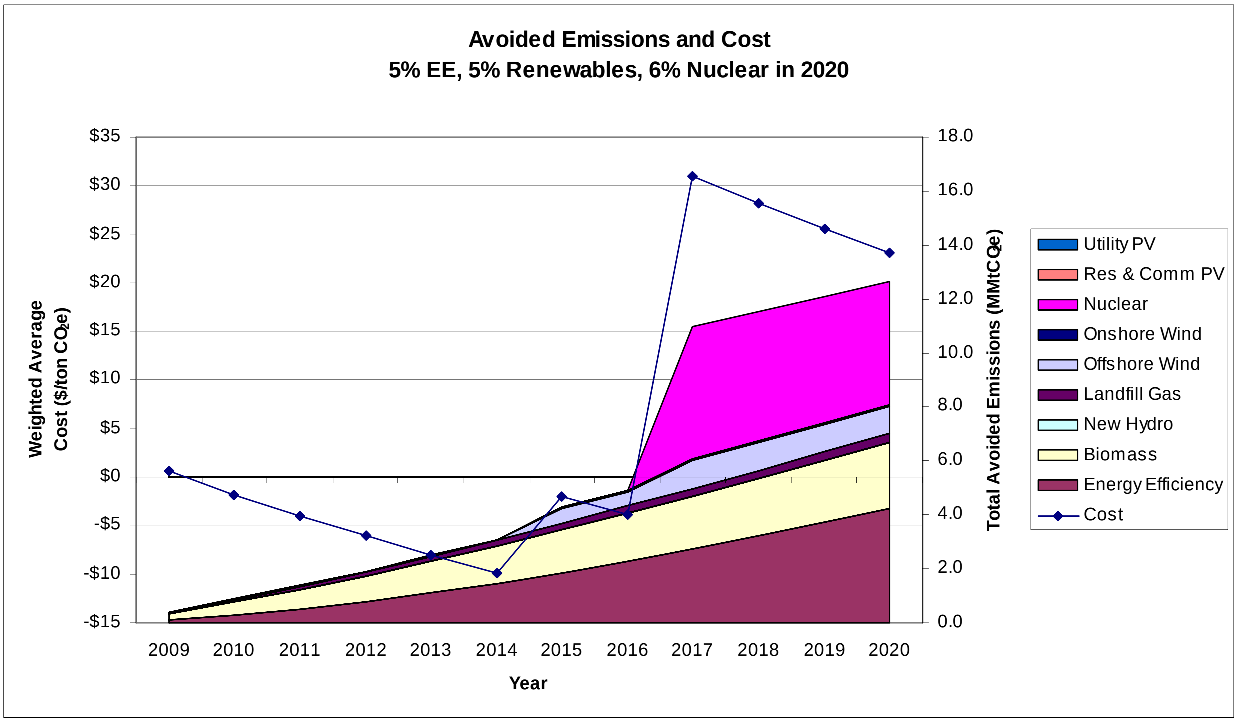
GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; kWh = kilowatt-hour; $\$/tCO_2e$ = dollars per ton of carbon dioxide equivalent; MW = megawatt; PV = photovoltaic; SC = South Carolina.

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
Residential and Commercial 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	1,000 MW in 2017

Figure H-1 shows the annual avoided emissions by component in million metric tons of carbon dioxide equivalent ($MMtCO_2e$) (right vertical axis) and the total annual cost in dollars per metric ton of carbon dioxide equivalent ($\$/tCO_2e$) (left vertical axis) for the aggregate scenario.

Figure H-1. Annual avoided emissions by component and total annual cost



EE= energy efficiency; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $\$/tCO_2e$ = dollars per ton of carbon dioxide equivalent.

Data Sources:

Cost of Power Plants

- 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.
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- 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.
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- Thomas N. Hansen, "The Promise of Utility Scale Solar Photovoltaic (PV) Distributed Generation." Presented at POWER-GEN International 2003, December 10, 2003. Tucson Electric Power 2003. Available at: http://www.greenwatts.com/docs/HansenPGDec2003.pdf.
- Data on fuel cell costs: GRI and NREL 2003—Gas Research Institute and National Renewable Energy Laboratory, Gas-Fired Distributed Energy Resource Technology Characterizations: Bringing You a Prosperous Future Where Energy Is Clean, Abundant, Reliable, and Affordable. U.S. DOE, Office of Energy Efficiency and Renewable Energy, 2003. Available at: www.eea-inc.com/dgchp_reports/TechCharNREL.pdf.

Cost of Energy Efficiency Measures

- GDS Associates, Inc., *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.
- GDS Associates, Inc., "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, *Duke Energy Carolinas DSM Action Plan: South Carolina Draft Report,* July 24, 2007.

Experience in Other States

- Martin Kushler, Dan York, and Patti White, *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, April 2004. Available at: http://www.aceee.org/pubs/u041.htm.
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Renewable Energy Potential

- 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.
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- 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.

Avoided Cost of Electricity

- 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 "Preliminary Avoided Costs To Be Used For Purchases From Small Power Producers," received by e-mail from Henry Barton of SCANA Corporation. (Not available online.)

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

The avoided cost of electricity at the generator bus in South Carolina is $55.75 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 the 2007 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; and
  - 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 per kilowatt-hour ($/kWh) basis, as well as dollar per metric ton of carbon dioxide equivalent ($/t$CO_2$e) avoided.
- Pre-2015 eligible resources are assumed to receive a production tax credit (PTC) throughout the period. The federal investment tax credit (ITC) for solar is assumed to be 30% until 2012, decreasing to 15% by 2020.
- Biomass co-firing projects receive a PTC of 1 cent/kWh, and other biomass projects receive a PTC of 1.5 cents/kWh.
- The economic and operational assumptions for renewable energy resources used in the analysis are summarized in Table H-2; the economic parameters used for new nuclear power plants are summarized in Table H-3.

Table H-2. Economic and operational assumptions 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; kW = kilowatt; kWh = kilowatt-hour; MW = megawatt; MWh = megawatt-hour; O&M = operation and maintenance; PV = photovoltaic.

Source: 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.

Note: Capital costs for landfill gas, biomass, and hydropower are reduced over time following U.S. Department of Energy (DOE), Energy Information Administration (EIA) 2007 trends analysis in AEO 2007. Fuel cell capital costs are assumed to decrease consistent with GRI and NREL 2003. The capital cost for PV is a TWG assumption. No cost decrease is assumed for wind and nuclear technologies.

Notes:

1. The fuel cost range for landfill gas projects is assumed to be $0.50–$1.50/MMBtu [2006$]).

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 H-3. Summary of 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 cost	$12.5	$/MWh	Moody's
Fixed O&M cost	$110	$/kW-yr	Morris et al.
Fuel	$15	$/MWh	Morris et al.

O&M = operation and maintenance; kWh = kilowatt-hour; kW-yr = kilowatt-year; MWH = megawatt-hour

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

Cost of Energy Efficiency Measures or Saved Electricity

The cost of saved energy is assumed to be $0.03/kWh, following Residential, Commercial, and Industrial (RCI) Technical Work Group (TWG) analysis of policy RCI-1.

For other states, see Table H-4.

Table H-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	Energy Efficiency Task Force 2006[1]
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. 2004
Connecticut	0.023	N/A	Kushler et al. 2004
New Jersey	0.03	N/A	Kushler et al. 2004
Vermont	0.03	N/A	Kushler et al. 2004

IOUs = investor-owned utilities; $/kWh = dollars per kilowatt-hour; N/A = not applicable; PSC = Public Service Commission.

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

Zero-or Low-Carbon Resource Supply Curve

The levelized cost of electricity (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 emission energy sources (including energy efficiency.) The financial model parameters are as shown in Table H-5.

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

Table H-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	Economic Life	CRF	Source
Landfill gas ICE (> 5 MW)	$58	83%	$1,701	$97.2	$11.7	$9.5	8.5%	0%	20	9.7%	GDS 2007
Landfill gas ICE (< 5 MW)	$67	83%	$2,430	$97.2	$11.7	$9.5	8.5%	0%	20	9.7%	GDS 2007
Biomass (co-fire Blending)**	$15	73%	$73	$11.7	$4.9	$7.7	8.5%	0%	20	9.7%	GDS 2007
Biomass (co-fire Retrofit)**	$18	73%	$224	$11.7	$4.9	$7.7	8.5%	0%	20	9.7%	GDS 2007
Biomass (stoker)	$91	85%	$2,624	$72.9	$9.7	$37.6	8.5%	0%	20	9.7%	GDS 2007
Biomass (fluidized bed)	$98	85%	$2,915	$72.9	$9.7	$39.9	8.5%	0%	20	9.7%	GDS 2007
Anaerobic Digester (swine waste)	$98	75%	$3,887	$262.4	$0.0		8.5%	0%	20	9.7%	GDS 2007
Wind (onshore)	$94	27%	$1,749	$43.7	$1.9		8.5%	0%	20	9.7%	GDS 2007
Wind (offshore)	$122	33%	$2,721	$77.7	$1.9		8.5%	0%	20	9.7%	GDS 2007
Hydro Power (conventional)	$71	30%	$1,944	$11.7	$2.9		8.5%	0%	30	8.6%	GDS 2007
Hydro Power (small hydro)	$107	30%	$2,915	$19.4	$4.9		8.5%	0%	30	8.6%	GDS 2007
Hydro Power (low head)	$168	28%	$3,887	$48.6	$9.7		8.5%	0%	30	8.6%	GDS 2007
Nuclear power	$109	90%	$5,700	$110.0	$18.0	$15.0	8.5%		30	8.6%	Keystone, Moody's
Solar PV (utility scale)	$192	20%	$3,887	$14.6			8.5%	15%	20	9.7%	GDS 2007
Solar PV (commercial)	$292	20%	$5,831	$29.2			8.5%	15%	20	9.7%	GDS 2007
Solar PV (residential)	$395	20%	$7,775	$48.6			8.5%	15%	20	9.7%	GDS 2007
Small scale wind	$185	25%	$3,637	$50.0			8.5%		20	9.7%	CA SGIP; Synapse 2005
Small biomass	$101	90%	$3,500		$20.0	37.6	8.5%		20	9.7%	CA SGIP & Synapse 2005
Solar PV (res. & comm.)	$411	20%	$8,568	$11.48			8.5%	15%	20	9.7%	CA SGIP; WRA 2004.
Solar PV (utility scale)	$240	20%	$5,000		$4.0		8.5%	15%	20	9.7%	Tucson Electric Power 2003.

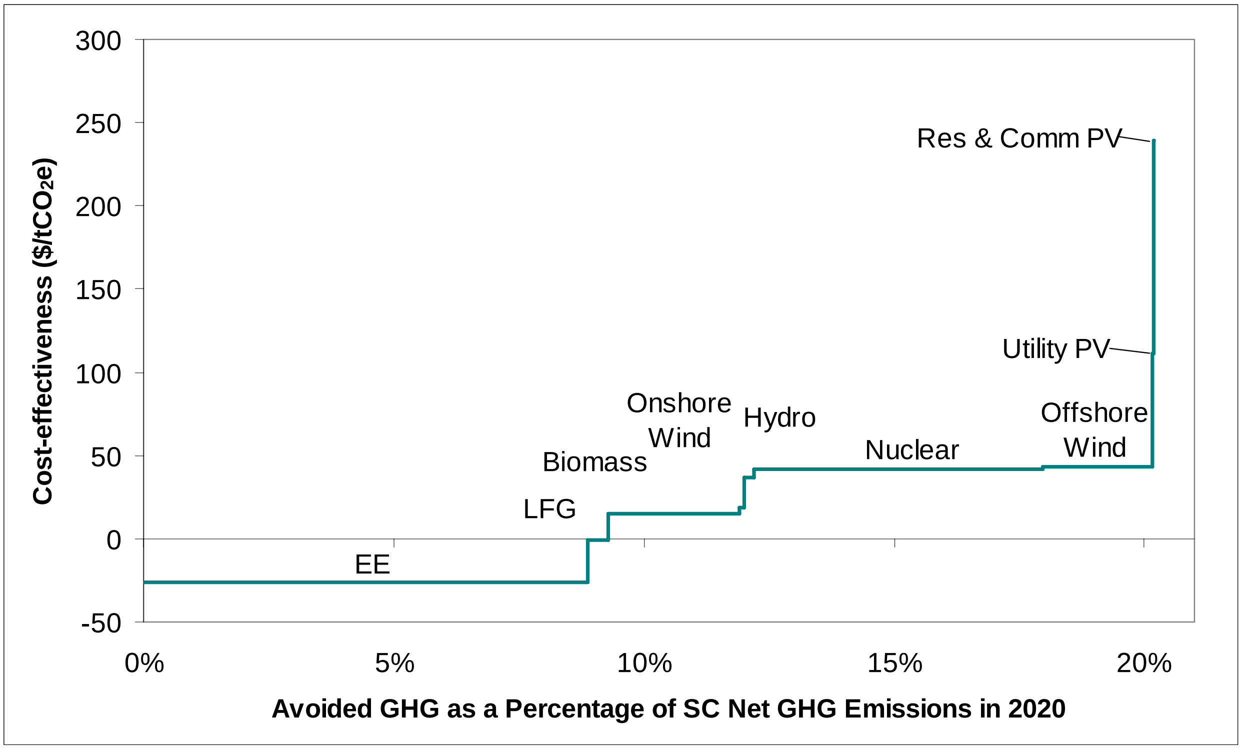
LCOE = levelized cost of electricity; O&M = operations and maintenance; PV = photovoltaic; res. & comm. = residential and commercial; WACC = weighted-average cost of capital; CRF = capital recovery factor; CA SGIP = California Self-Generation Incentive Program; kW = kilowatt; MWh = megawatt-hour.

*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 do not have avoided energy costs associated with this resource.

Figure H-2 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 H-2. Supply curve of low- and no-carbon resources in South Carolina



$/tCO$_2$e = dollars per metric ton of carbon dioxide equivalent; EE = energy efficiency; GHG = greenhouse gas; LFG = landfill gas; res & comm = residential and commercial; PV = photovoltaic; SC = South Carolina.

Key Uncertainties

- Resource potential and cost for renewable resources.
- Nuclear costs and feasibility in 2020 timeframe.
- Avoided Cost of Electricity (Delivered): $55.75/MWh (2005$), a sales-weighted average for the state based on Duke Energy, Progress Energy, and South Carolina Electric & Gas avoided cost calculations. Avoided costs of electricity may not reflect the full costs of new generation planned in South Carolina. Future avoided costs are likely to be higher than they are today, which would improve the economic benefits of this policy.
- In the interest of advancing the recommended policies, the members are accepting the best available numbers as being reasonable, although individual members may disagree with certain assumptions.

Additional Benefits and Costs

Economic benefits of technology development in state, employment benefits.

Clean air benefits of nonfossil resources.

Nuclear waste management costs, risks.

Feasibility Issues

Resource potentials and economics.

Nuclear feasibility in 2020 timeframe.

Status of Group Approval

Complete.

Level of Support

Supermajority (three objections).

Barriers to Consensus

- *Objection 1*—Nuclear energy represents 50% of South Carolina's electricity production, while renewable energy is just getting started. A policy supporting development of new nuclear power should be a stand-alone policy, and should not be mixed with renewables.
- *Objection 2*—Objects to structuring these components as mandates, as opposed to strong targets.
- *Objection 3*—Prefers a strong mandate, but the fixed-goal nuclear costs are too high.

ES-2. Technology Research and Development, Including State Funding

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, and 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 of 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 South Carolinians.
- 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 the Policy Design section.

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

- The 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 bioenergy 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, *Energy Research at DOE: Was It Worth It? Energy Efficiency and Fossil Energy Research 1978 to 2000*, Washington D.C: National Academies Press, 2001. 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*).[2]
- Additional benefits of reduced dependence on foreign oil and improved environmental conditions can be realized.

Feasibility Issues

None noted.

Status of Group Approval

Complete.

Level of Support

Unanimous.

Barriers to Consensus

Not applicable.

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

ES-3. Renewable Energy Financing, Tax Incentives, Loans

Policy Description

This policy concerns financial incentives to encourage investment in the full range of renewable energy resources by helping to 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.

Goal #1—Remove legislative caps on current tax incentives for renewable fuel use.

Goal #2—Expand the existing 25% income tax credit for solar and biomass equipment to include micro-hydro and small wind. Offer tax credits of $3,500/kW-equivalent for small solar PV, micro-hydro, and small wind up to 50 kW.

Goal #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 or state renewable energy standard. This would be a modification of the current 1 cent/kWh state incentive payment for biomass energy.

Goal #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 timely recovery of all costs through an annual rider, 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

Goal #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 on line between 2009 and 2015; loans are available for projects brought on line 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 Energy Supply (ES) TWG members were divided on whether this policy should apply to conversion of municipal solid waste to energy.

Implementation Mechanisms

- The legislative caps on current tax incentives can be removed by legislative action, with no additional cost to the state beyond that anticipated when the incentives were passed in 2006 and 2007.
- Expansion of the existing income tax credits for renewables to include micro-hydro and small wind would be achieved through legislation. This would have no net cost to the state, because it represents, in effect, forgiveness of tax obligations that would not otherwise exist without the incentives.
- Per-kilowatt incentive payments for power production from solar, micro-hydro, and small wind would be achieved through legislation, with costs borne by the state's General Fund.
- Feed-in tariffs and an accompanying cost recovery rider would be achieved through legislative mandate. The resulting subsidy would ultimately be paid for by ratepayers who are customers of electricity suppliers.
- Low-interest loans for feasible and desirable biomass generation would be achieved through legislative appropriations.
- 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 (SCEO), at http://www.energy.sc.gov/index.aspx?m=1&t=67.

Existing state clean energy incentives include

- The existing 25% income tax credit for solar and biomass equipment, and
- A 1 cent/kWh state incentive payment for biomass energy, with $100,000 per taxpayer per year limit.

Type(s) of GHG Reductions

Avoided emissions associated with reduced fossil fuel generation.

Estimated GHG Reductions and Net Costs or Cost Savings

Table H-6 presents the quantification results for the components of policy ES-3.

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

Policy #	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-3 [Goal #2]	0.06	0.14	1.04	$200	–$51	$149	$143
ES-3 [Goal #4]	0.30	0.79	6.01	$742	–$290	$451	$75
ES-3 [Total]	0.36	0.93	7.06	$942	–$342	$600	$85

GHG = greenhouse gas; MMtCO2e = million metric tons of carbon dioxide equivalent; $/tCO2e = dollars per metric ton of carbon dioxide equivalent.

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, "Statewide Self-Generation Incentive Program Data & Reports," updated January 8 2007. Available at: http://www.energycenter.org/ContentPage.asp?ContentID=279&SectionID=276&SectionTarget=35.
- GRI and NREL 2003—Gas Research Institute and 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*. U.S. DOE, Office of Energy Efficiency and Renewable Energy, 2003.Available at: www.eea-inc.com/dgchp_reports/TechCharNREL.pdf.
- Navigant Consulting, "Energy Cost Savings Module for Customer-Sited DG," prepared for the Massachusetts DG Collaborative, 2006. Available at: http://masstech.org/renewableenergy/public_policy/DG/EnergyCostSavingsModule-Jan202006.zip.
- Synapse Energy Economics and Zapotec Energy, *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., August 2005. 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 Center for Sustainable Energy California 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

- Estimate the amount of state money to be spent on renewable subsidies based on experience in other states.
- 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).
- Determine the potential biomass generation that meets environmental performance standards.
- Determine the type and amount of renewable energy imported to South Carolina from an area directly connected to the South Carolina grid.
- Estimate energy production from new renewable resources.
- Apply financial incentives, as noted above, to each renewable energy resource.
- Estimate the aggregate cost of renewable energy production and displaced emissions following ES-1.

Goal #3

This goal has not been quantified.

Goal #4

- Establish the 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.)
- Estimate a schedule for bringing on line new renewable resources of each type, subject to available subsidies as indicated above.
- 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.
- Determine annual output and total payment at each rate-recovery level.

Goal #5
This goal has not been quantified.

Key Assumptions:
Table H-7 presents the total South Carolina state budget assumptions 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.

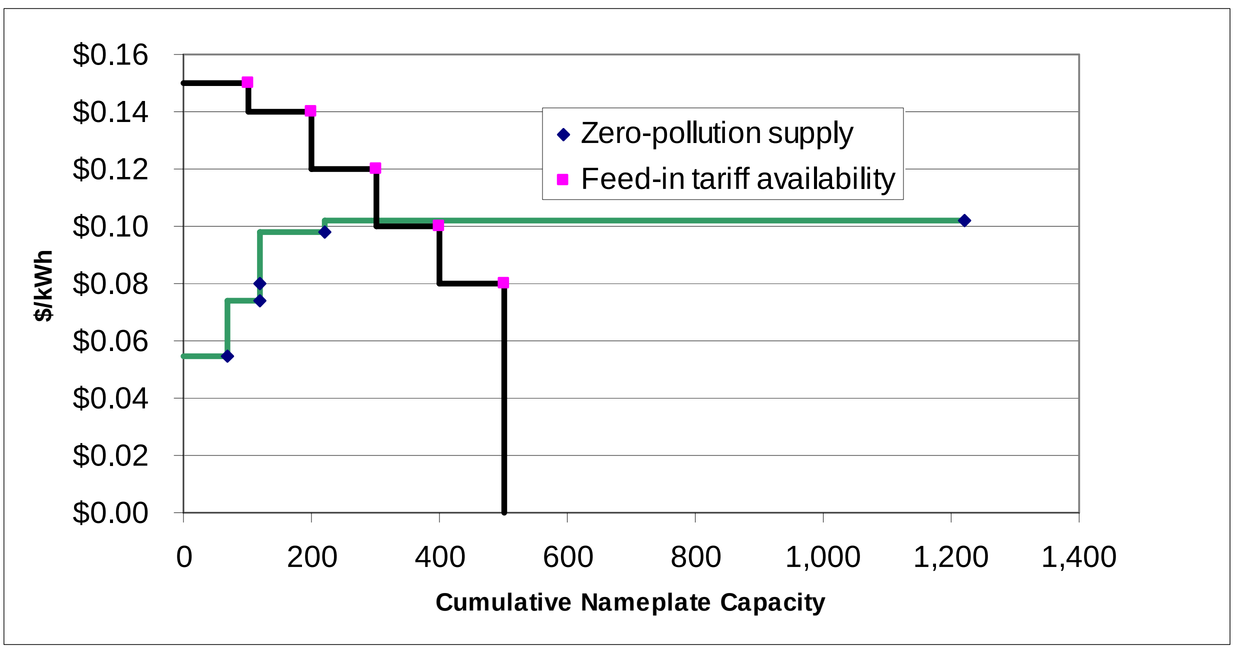
Table H-7. South Carolina budget assumptions for renewable energy

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; N/A = not applicable.

For feed-in tariff (Goal #4), the supply and demand (i.e., rate recovery level) curves are shown in Figure H-3, below.

Figure H-3. Proposed feed-in tariff vs. levelized cost curve for target resources



$/kWh = dollars per kilowatt-hour.

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 onshore wind power, 100 MW of new hydropower, and 80 MW of offshore 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

- Avoided Cost of Electricity (Delivered): $55.75/MWh (2005$), a sales-weighted average for the state based on Duke Energy, Progress Energy, and South Carolina Electric & Gas avoided cost calculations. Avoided costs of electricity may not reflect the full costs of new generation planned in South Carolina. Future avoided costs are likely to be higher than they are today, which would improve the economic benefits of this policy.
- Available resources for renewable energy incentives in South Carolina.
- Costs and resource potential for renewable energy sources.

Additional Benefits and Costs

Economic development and job creation benefits.

Feasibility Issues

Availability of biomass feedstock and competition with other uses for this resource.

Status of Group Approval

Complete.

Level of Support

Unanimous.

Barriers to Consensus

Not applicable.

ES-4. Regulatory Model To Equalize Utility Earnings on Energy Efficiency With Earnings on Traditional Power Supply

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 DG renewable energy.

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 may face profit losses for EE and renewable 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 renewable 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 RCI 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 ES 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 (SCPSC) to implement a 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 CECAC 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:

- Create 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 SCPSC to 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, *Duke Energy Carolinas DSM Action Plan: South Carolina Draft Report,* July 24, 2007.
- GDS Associates, Inc. *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 "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, 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, *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, April 2004. 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. *New York Energy $mart^{SM} Program Cost-Effectiveness Assessment*, prepared for New York State Energy Research and Development Authority, June 2005. Available at: http://www.getenergysmart.org/.
- Energy Efficiency Task Force, *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, January 2006. 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.," updated September 21, 2007. Accessed on October 1, 2007, at: http://www.ecsc.org/newsroom/EfficiencyStudy.ppt.
- Forefront Economics, Inc., H. Gil Peach & Associates, LLC, and PA Consulting Group, *Duke Energy Carolinas DSM Action Plan: South Carolina Draft Report,* July 24, 2007.

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 "Preliminary Avoided Costs To Be Used For Purchases From Small Power Producers," received by e-mail from Henry Barton of SCANA Corporation, 2008. (Not available online.)

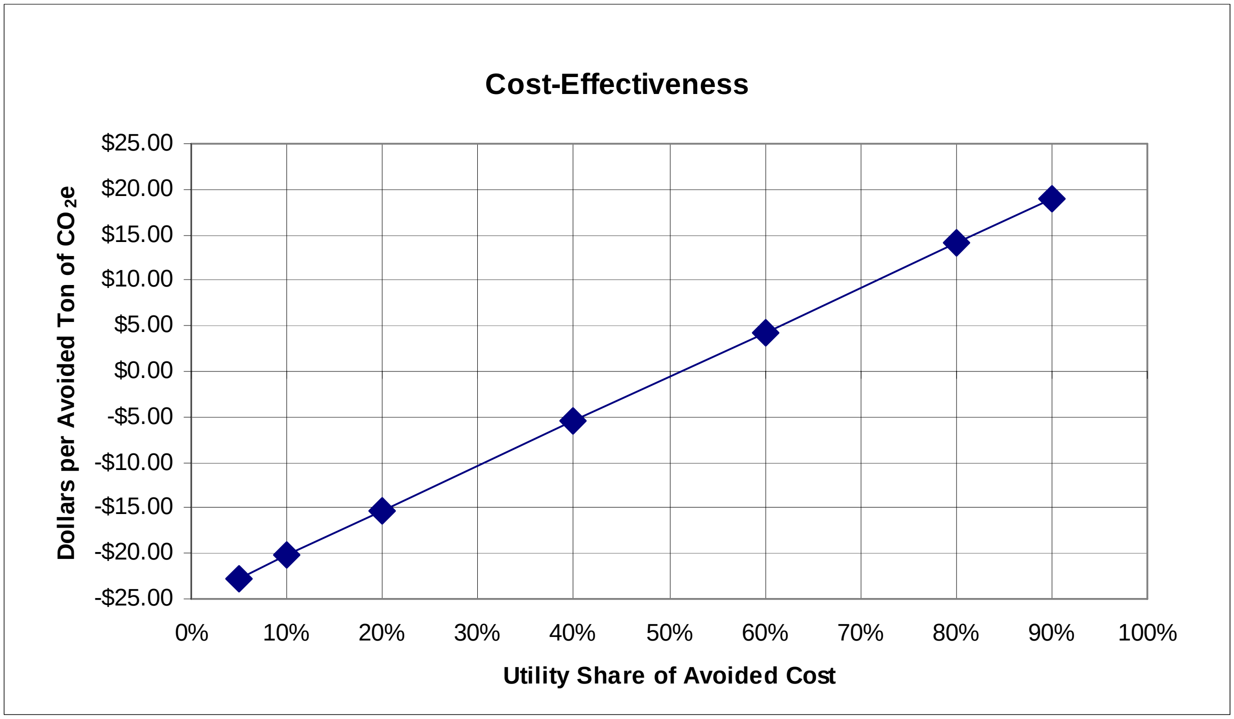
Quantification Methods:

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 H-4 shows the impact of varying utility shares of avoided cost 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 for ratepayers.

Figure H-4. Impact of varying utility shares on ratepayer cost



CO_2e = carbon dioxide equivalent.

Key Uncertainties

- Formula for sharing avoided costs.
- Nature and costs of avoided new resources.
- What revenues would have been in the absence of EE and DG activities is difficult to establish or calculate.

Additional Benefits and Costs

Facilitates development of demand management resources.

Feasibility Issues

None noted.

Status of Group Approval

Complete.

Level of Support

Super Majority (one objection).

Barriers to Consensus

Because it is difficult to know what level of energy savings would be achieved without the additional incentives recommended in this policy, South Carolina could be footing a higher energy bill without any incremental benefit.

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. However, a number of technical, economic, environmental, and other hurdles must be evaluated and overcome before nuclear waste reprocessing is a viable alternative for South Carolina.

Compared to other states, South Carolina bears an inordinate burden for the environmental and health risks associated with the disposal of nuclear reprocessing waste. The state currently has a significant amount of nuclear waste for which there is no designated disposal site. South Carolina's support for in-state nuclear reprocessing should be contingent on the shipment of the waste out-of-state to an operating facility that is actively receiving nuclear waste for long-term disposal.

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, economically, and environmentally feasible.

Policy Design

Goals:

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

- If this evaluation shows that reprocessing and recycling of spent nuclear fuel are 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 the policy goals, above.

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 *The Future of Nuclear Power: An Interdisciplinary MIT Study*, ISBN: 0-615-12420-8, Cambridge, MA, 2003. Available at: http://web.mit.edu/nuclearpower/.
- Catherine Morris et al., *Nuclear Power Joint Fact-Finding*, The Keystone Center, June 2007. Available at: http://www.keystone.org/spp/documents/FinalReport_NJFF6_12_2007(1).pdf.
- AEO 2007—U.S. DOE, EIA "Assumptions to the Annual Energy Outlook 2007," Electricity Market Module, 2007. Available at: http://www.eia.doe.gov/oiaf/aeo/assumption/index.html.
- Institute for Policy Studies, Friends of the Earth USA, and Government Accountability Project, *Radioactive Wastes and the Global Nuclear Energy Partnership*, 2007. Available at: www.whistleblower.org/doc/2007/gnepFINAL.pdf.
- MRW & Associates, Inc., *Nuclear Power in California: 2007 Status Report*, prepared for the California Energy Commission, October 2007. Available at: http://www.hks.harvard.edu/hepg/Nuclear_Power_CA_2007.pdf.
- David. Schlissel, Robert Alvarez, and Peter Bradford, *Risky Appropriations: Gambling US Energy Policy on the Global Nuclear Energy Partnership,* sponsored by Friends of the Earth

USA, Government Accountability Project, Institute for Policy Studies, and Southern Alliance for Clean Energy, January 2008. Available at: http://www.synapse-energy.com/Downloads/SynapseReport.2008-01.GRACE.GNEP-Nuclear-Policy.06-067.pdf

Quantification Methods:

This policy will not be analyzed quantitatively.

Key Assumptions:

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

- The Boston Consulting Group, *Economic Assessment of Used Nuclear Fuel Management in the United States,* prepared for AREVA, July 2006. Available at: http://www.bcg.com/impact_expertise/publications/files/Economic_Assessment_Used_Nuclear_Fuel_Mgmt_US_Jul2006.pdf.
- Matthew Bunn, John P. Holdren, Steve Fetter, Bob van der Zwaan, "The Economics of Reprocessing Versus Direct Disposal of Spent Nuclear Fuel," *Nuclear Technology Journal* June 2005;150:209–230. Available at: http://belfercenter.ksg.harvard.edu/publication/806/economics_of_reprocessing_versus_direct_disposal_of_spent_nuclear_fuel.html?breadcrumb=%2Fexperts%2F13%2Fhui_zhang.
- Steve Fetter "Economic Aspects of Nuclear Fuel Reprocessing," testimony before the U.S. House of Representatives Subcommittee on Energy of the Committee on Science, July 2005. Available at: http://gop.science.house.gov/hearings/energy05/july 12/fetter.pdf.
- National Research Council, Committee on Separations Technology and Transmutation Systems, *Nuclear Wastes: Technologies for Separations and Transmutation,* Washington, DC: National Academy Press, 1996, p. 113. Available at: http://books.nap.edu/catalog.php?record_id=4912.
- Frank N. von Hippel, "Reprocessing: Why We Can and Should Wait," presentation at the Forum on the Nuclear Fuel Cycle, Washington, DC, Russell Senate Office Building, November 16, 2005. Available at: http://www.nuclearfoundation.org/documents/VonHippel16November2005.pdf.

The costs of nuclear reprocessing are often expressed in dollar per kilogram ($/kg) of uranium processed. Table H-8 compares the cost of reprocessing from the sources indicated above to the cost of storing uranium in interim spent fuel storage.

Table H-8. Estimated cost of nuclear reprocessing in comparison to interim spent-fuel storage

Project	Cost per Kilogram of Uranium	Source
Interim spent-fuel storage	$100–$300	Bunn et al. 2005
THORP (UK) and UP3 (France) reprocessing projects	$1,000–$1,500	Bunn et al. 2005, p. 213
THORP with different financing costs	$1,350–3,100	Bunn et al. 2005, p. 213
Generic future reprocessing project	$1,080 –$2,800	National Research Council 1996, p. 116
Generic future reprocessing project	$2,000	Fetter 2005, p. 2
Generic future reprocessing project	$500–$2,000	Bunn et al. 2005, p. 222
Generic future reprocessing project	$630	Boston Consulting Group 2006
Generic future reprocessing project	$1,000–$2,000	von Hippel 2005

Table H-9 presents estimated capital costs for existing reprocessing plants in the 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 interest costs during the construction, with the exception of the 2005 cost estimate for Rokkashomura. The cost of this plant has been inflated more than three times the original estimate due to many factors, including delays in the construction schedule and increasingly stringent environmental and safety regulations.

Table H-9. Estimated capital costs for contemporary reprocessing plants

Project	Annual Throughput (milligrams per year)	Capital Cost (million 2006$)	Source
THORP (UK)	900	$7,245	National Research Council 1996
UP3 - La Hague (France)	800	$8,999	National Research Council 1996
UP3 - La Hague and Melox (France)	n/a	$17,800	Boston Consulting Group 2006
Generic U.S. facility based on UP3	2,268 (2,500 ton)	$16,200	Boston Consulting Group 2006
Rokkashomura (Japan)	800	$8,769 (in 1996)	National Research Council 1996
Rokkashomura (Japan)	800	$18,567 (in 2005)	Fetter 2005

UK = United Kingdom.

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

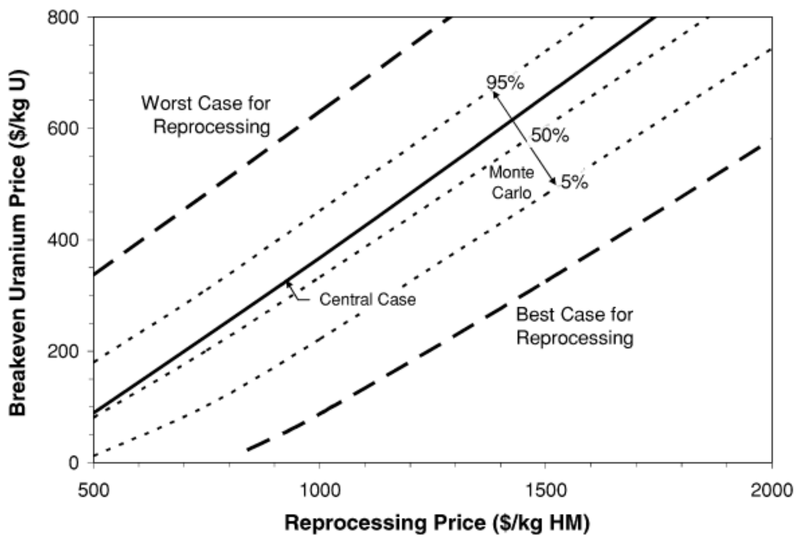
Reprocessing also entails significant annual operating costs. Table H-10 presents operating cost estimates by The Boston Consulting Group (2006) and the Nuclear Research Council (1996).

Table H-10. Operating cost estimates

Project	Annual Throughput (milligrams per year)	Annual Operating Cost (million $)	Source
Generic U.S. facility based on UP3	2,268 (2,500 tons)	$900 (in 2006$)	Boston Consulting Group 2007
Generic U.S. facility	900	$374 (in 1992$)	NRC 1996

Finally, Bunn et al. (2005) analyzed the break-even uranium price to make reprocessing technologies competitive with a conventional interim spent-fuel storage technology. Figure H-5 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 H-5 shows to what extent uranium prices have to increase to make reprocessing technologies competitive with the fuel storage technologies. For example, assuming the cost of fuel processing is $1,000/kg of uranium, the price of uranium has to increase to over $350/kg in the study's Central Case (or Reference Case). In comparison, the current price of uranium is around $30–$40/kg.[3]

Figure H-5. Break-even uranium price as a function of reprocessing price, for various sets of assumptions about other fuel cycle prices and parameters



$/kg U = dollars per kilogram of uranium; $/kg HM = dollars per kilogram of heavy metal.

Key Uncertainties

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

[3] U.S. Department of Energy, Energy Information Administration. "Uranium Purchased by Owners and Operators of U.S. Civilian Nuclear Power Reactors." May 16, 2007. Available at: http://www.eia.doe.gov/cneaf/nuclear/umar/summarytable1.html

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

Feasibility Issues

- While 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

Complete.

Level of Support

Unanimous.

Barriers to Consensus

Not applicable.

ES-6. Green Power Purchases and Marketing, 1% Participation by 2012

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, SCEO, Duke Energy Carolinas, Progress Energy Carolinas, and South Carolina Electric & Gas (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 SCEO.

Policy Design

Goal #1

- Educate consumers about the power (fuel) sources and emissions associated with the electricity they use.

Goal #2

- Establish a Voluntary Green Power Utility Program.

Timing (#1 and #2): Operational by April 2008; 1%–5% participation of retail customers by 2012.

Parties Involved (#1 and #2): South Carolina Office of Regulatory Staff, SCEO, Duke Energy Carolinas, Progress Energy Carolinas, SCE&G, Santee Cooper, Lockhart Power Company, and SCPSC.

Other (#1 and #2): 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.
- Supplement the activities of voluntary green power programs in South Carolina (PaCE and Santee Cooper Green Power) by providing marketing and renewable resource development assistance through state-funded green power initiatives coordinated by SCEO.

Timing (#3): Fully implemented by 2012.

Parties Involved (#3): SCEO, Duke Energy Carolinas, Progress Energy Carolinas, SCE&G, Santee Cooper, Lockhart Power Company, SCPSC, and PaCE.

Implementation Mechanisms

Table H-11 presents demand- and supply-side recommendations for implementing this policy.

Table H-11. 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 incentives 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 incentives through reward and recognition for the top generators of green power.

R&D = research and development.

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.
- PaCE.
- North Carolina Power.

Type(s) of GHG Reductions

Decreased emissions associated with reduced fossil generation.

Estimated GHG Reductions and Net Costs or Cost Savings

Table H-12 presents the estimated GHG reductions and net costs of or savings from this policy.

Table H-12. 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

GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $/$tCO_2e$ = dollars per metric ton of carbon dioxide equivalent.

Data Sources:

- "Santee Cooper Fingertip Facts," January 1, 2006–December 31, 2006, p. 24. Available at: https://www.santeecooper.com/portal/page/portal/SanteeCooper/AboutUs/CorporatePublications/2006_Fingertip_Facts.pdf.
- Lori Bird and Marshall Kaiser *Trends in Utility Green Pricing Programs*, NREL/TP-640-40777, U.S. DOE, NREL, October 2006. 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 on 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., "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.
- La Capra Associates, Inc., GDS Associates, Inc., and Sustainable Energy Advantage, LLC, *Analysis of a Renewable Portfolio Standard for the State of North Carolina*, prepared for the North Carolina Utilities Commission, December 2006, Available at: http://www.ncuc.commerce.state.nc.us/rps/NC RPS Report 12-06.pdf.
- L. Stoddard, J. Abiecunas, and R. O'Connell, *Economic, Energy, and Environmental Benefits of Concentrating Solar Power in California*, NREL/SR-550-39291, U.S. DOE, NREL, May 2005–April 2006. Available at: http://www.nrel.gov/csp/pdfs/39291.pdf.
- AEO 2007—U.S. DOE, EIA, "Assumptions to the Annual Energy Outlook 2007," Electricity Market Module, 2007. Available at: http://www.eia.doe.gov/oiaf/aeo/assumption/index.html.

- Ryan Wiser and Mark Bolinger, *Annual Report on U.S. Windpower Installation, Cost, and Performance Trends: 2006,* U.S. DOE, Lawrence Berkeley National Laboratory, May 2007. Available at: http://www.nrel.gov/docs/fy07osti/41435.pdf.
- Ryan Wiser, Mark Bolinger, Peter Cappers, and Robert Margolis, *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, January 2006. 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 and its 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 H-13 presents the assumed average purchases of renewable energy per residential customer (kWh/year). The average purchase of renewable energy per residential customer is assumed to grow at the same rate as in Table H-13 (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 purchase about 2,400 kWh/yr of green power. The average purchase of renewable energy per commercial and industrial customer (kWh/yr) is assumed to be 30% of their total consumption.

Table H-13. Average purchases of renewable energy per residential customer

% of Customers	2001 (kW/yr)	2002 (kW/yr)	2003 (kW/yr)	2004 (kW/yr)	2005 (kW/yr)	2006 (kW/yr)
100%	2,400	2,900	3,400	4,000	4,200	4,400

kW/yr = kilowatts per year.

Source: Bird and Kaiser 2006, p. 10.

- Table H-14 presents the number of customers, broken down by sector, and total purchases for Santee Cooper's Green Power Program in 2006. 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, and is assumed to remain constant after 2012.

Table H-14. Number of customers involved in the Santee Cooper Green Power Program in 2006

Types of Customers	Number of Customers
Residential customers	1,527
Commercial customers	283
Industrial customers	1
Customers reached through cooperatives and municipalities	2,519
Green Power Sales (MWh)	15,984

MWh = megawatt = hour.

- The projected number of retail electricity customers in South Carolina by sector.
- The projected retail electricity sales in South Carolina.
- The emissions factor associated with avoided fossil fuel generation and renewables.
- 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.
- For the purposes of the cumulative analysis, this policy is assumed to have incremental emissions reduction benefits beyond the portfolio standard (ES-1).

Key Uncertainties

- Avoided Cost of Electricity (Delivered): $55.75/MWh (2005$), represents a sales-weighted average for the state based on Duke Energy, Progress Energy, and South Carolina Electric & Gas avoided cost calculations. Avoided costs of electricity may not reflect the full costs of new generation planned in South Carolina. Future avoided costs are likely to be higher than they are today, which would improve the economic benefits of this policy.
- Participation rates in voluntary programs are uncertain.

Additional Benefits and Costs

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

Feasibility Issues

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

Status of Group Approval

Complete.

Level of Support

Unanimous.

Barriers to Consensus

Not applicable.

ES-7. Attract Renewable Energy Technology Businesses to South Carolina

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, roadways, transportation hubs identified and targeted
- Trained workforce—quantify and develop
- Increased incentives for projects utilizing in-state manufactured equipment
- Cost of living—positive part of promotion
- International presence—positive attraction
- Good location for manufacturing engineers
- Job training plan
- R&D plan

Market-generating policies/incentives (overlap with other ES policies):

- 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 in government-owned facilities

Related Policies/Programs in Place

None identified.

Type(s) of GHG Reductions

Not applicable.

Estimated GHG Reductions and Net Costs or Cost Savings

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

Key Uncertainties

Not applicable.

Additional Benefits and Costs

- Facilitates and supports other renewable energy programs
- Employment and economic benefits to state.

Feasibility Issues

None identified.

Status of Group Approval

Complete.

Level of Support

Unanimous.

Barriers to Consensus

Not applicable.

ES-8. Distributed Renewable Energy Incentives and/or Barrier Removal (Including Interconnection Rules)

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 to 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 costs of fossil fuel technologies.

Some of these barriers have been or are being addressed through recent or current 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 nonwoody energy crops, wood wastes, and agricultural waste; methane from animal waste; and geothermal.

Goal: Three MW/yr 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.

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.
- State regulatory authorities could encourage distributed renewable generation through the development of a Clean Energy Standard Offer Program, which would provide long-term rate stability for qualifying distributed renewable generation.
- 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

- Utility net metering tariffs.
- SCPSC approval of interconnection rules.
- Ongoing SCPSC proceedings in this area.
- Santee Cooper net metering effective 2007.

Type(s) of GHG Reductions

Avoided emissions associated with fossil generation.

Estimated GHG Reductions and Net Costs or Cost Savings

For purposes of analysis, we assume that 3 MW of new distributed resources are built per year, allocated as described below under the Assumptions section. The quantitative analysis results are presented in Table H-15.

Table H-15. Estimated GHG reductions and net costs of or cost savings from ES-8

Policy No.	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-8	0.05	0.11	0.81	$80	–$39	$41	$51

GHG = greenhouse gas; $MMtCO_2e$ = million metric tons of carbon dioxide equivalent; $/$tCO_2e$ = dollars per metric ton of carbon dioxide equivalent.

Data Sources:

Renewable Energy Potential:

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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:
Table H-16 presents the assumptions regarding the distributed resources.

Table H-16. Assumptions regarding distributed resources

Resource	Share in Policy Analysis	Capacity Factor	2008–2010	2011–2015	2016–2020
Biomass	30%	80%	$86	$87	$96
Fuel Cells	10%	75%	$94	$87	$85
Photovoltaic	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: See ES-1.

Discount Rate: See ES-1.

Key Uncertainties

- Avoided Cost of Electricity (Delivered): $55.75/MWh (2005$), a sales-weighted average for the state based on Duke Energy, Progress Energy, and SCE&G avoided cost calculations. Avoided costs of electricity may not reflect the full costs of new generation planned in South Carolina. Future avoided costs are likely to be higher than they are today, which would improve the economic benefits of this policy.
- Availability and feasibility of net metering on a statewide basis pursuant to filed tariffs.
- Availability and cost of targeted resources.

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 resources, owner benefits could include

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

For the public, benefits could include

- Reduced air pollution;
- Increased renewable energy awareness;
- Increased energy security/reliability;
- Technological innovation; and
- 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; and
- 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; and
- 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?

Status of Group Approval

Complete.

Level of Support

Unanimous.

Barriers to Consensus

Not applicable.