South Carolina Climate, Energy & Commerce Advisory Committee

Energy Supply (ES)
Technical Work Group Meeting #4
August 14, 2007

Office of the Governor

The Center for Climate Strategies

Agenda

- Call to order and roll call
- Review and approval of prior call summary
- Proposed date & time for TWG meetings
- Review of CECAC process
- Discussion of next steps for TWG
- Agenda items for next meeting
- Review and discussion of balloting results
- Address Questions on Inventory and Forecast
- Public Input and Announcements

Proposed TWG Meeting Schedule

CECAC Meetings	ES TWG Meetings
CECAC #2, 27-Jun (Wednesday)	25-Jul (Wednesday) 1:00 – 4:00 PM
	16-Aug (Thursday) 3:30 – 5:00 PM
CECAC #3, 22 Aug (Wednesday)	20-Sept (Thursday) 1:00 – 4:00 PM *in-person*
	11-Oct (Thursday) 3:30 – 5:00 PM
CECAC #4, 24 Oct. (Wednesday)	15-Nov (Thursday) 3:30 – 5:00 PM
	16-Jan (Wednesday) 3:30 – 5:00 PM
CECAC # 5, 31 Jan. (Thursday)	14-Feb (Thursday) 3:30 – 5:00 PM
	27-Mar (Thursday) 3:30 – 5:00 PM
CECAC # 6, April 28 (Monday)	
Final CECAC Report June 30	

Stepwise Planning Process

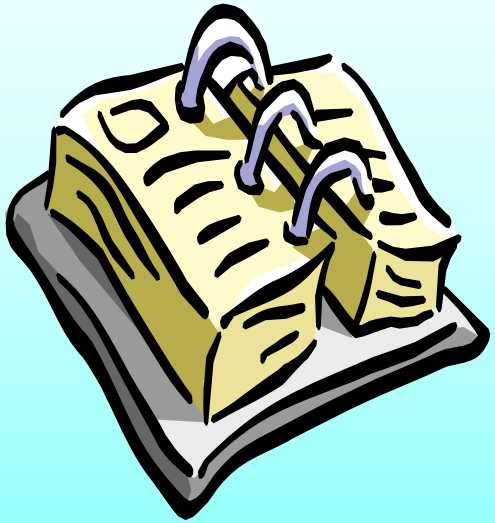
1. Develop inventory and forecast of emissions
2. Identify a full range of possible actions
3. Identify initial priorities for analysis
4. Develop straw proposals
5. Quantify GHG reductions and costs/savings
6. Evaluate externalities, feasibility issues
7. Develop alternatives to address barriers
8. Aggregate results
9. Iterate to final agreements
10. Finalize and report recommendations

TWG Next Steps

- Today:
  - Review and discuss results of balloting to identify priority policy options from catalog
  - Assign volunteers and a lead for each of the policy options
- After this meeting:
  - Develop Straw Proposals: first two sections of the policy options template

Next TWG Meeting

- Proposed Date and Time
  - Thursday, September 20, 1:00 – 4:00 PM
  - In-person, Room 252 of the Brown Building, at the corner of Pendleton and Sumter, behind the South Carolina State House in Columbia, SC
- Agenda:
  - Review CECAC input on list of priorities
  - Discuss details and continue to develop straw proposals
  - Continue to review the South Carolina emissions inventory and projections and any TWG recommendations for revision



Policy Design Proposals

- TWGs recommend priorities for SC to the CECAC
- CECAC identifies about 50 draft potential priority options for further development
- TWGs refine policy descriptions and develop initial policy option designs (“straw proposals”)
  - Timing
  - Goals
  - Coverage
- CCS quantifies and presents for review
- CECAC revisits list of potential priorities, as needed

Policy Option Template

- Policy Description (Concept)
- Policy Design (Goals, Timing, Coverage)
- Implementation Methods
- Related Programs and Policies (BAU)
- Estimated GHG Savings and Costs Per MMTCO2e
  - Data Sources, Methods and Assumptions
  - Key Uncertainties
- Additional (non-GHG) Benefits and Costs, as Needed
- Feasibility Issues, if Needed
- Status of Group Approval
- Level of Group Support
- Barriers to Consensus, if any

Example from Colorado: ES-2 Mandated Portfolio Standards

- Policy Description
  - A renewable portfolio standard (RPS) is a requirement that utilities must supply a certain percentage of electricity from an eligible renewable energy source(s). For example, an RPS of 5% would mean that for every 100 kWh that a utility supplies, 5 kWh must be generated from renewable resources. About 20 states currently have an RPS, including Colorado. Colorado's current RPS requires investor-owned utilities to provide 20% renewable energy by 2020 and other load serving entities to provide 10%, also by 2020. In Montana and some other states, utilities can also meet their RPS (or EPS) by purchasing certificates from eligible energy projects, typically referred to as Renewable Energy Certificates (RECs).
- Policy Design
  - Goals: 30% of total energy to come from renewables; no more than 85% of this from "big wind."
  - Timing: by 2020
  - Parties Involved: All retail electric suppliers, including municipally owned and co-ops

Example from Colorado (cont.)

- Implementation Mechanisms
  - Mandate applicable to all IOUs, munis and coops
- Related Policies/Programs in Place
  - The existing RPS in Colorado requires 20% renewables for IOUs and 10% renewables for cooperatives and municipal utilities (with +40,000 customers) by 2020. IOUs must meet 4% of their annual target with solar, half of which must be located on-site at customers' facilities
  - In-state renewable resources receive favorable treatment. Each kWh from eligible in-state renewable projects receives 125% credit for RPS-compliance purposes. Certain community-based projects can receive 150% credit under cooperatives and eligible municipal utilities, and solar projects online by 2015 receive 300% credit.
  - Utilities are entitled to recover prudent cost of complying RPS through retail rates. Utilities may comply with the RPS by purchasing RECs.

Example from Colorado (cont.)

- Data Sources, Methods and Assumptions
  - Black and Veatch; research performed for the U.S. Department of Energy, National Renewable Energy Laboratory and American Wind Energy Association.
  - Colorado Springs Utilities, unpublished research on biomass fuel and technology costs in Colorado.
  - KEMA 2006. Colorado DSM Market Potential Assessment, Mar 2006.
  - National Renewable Energy Laboratory, Comparison of Cost-Based U.S. Operational Impact Studies.
  - US EIA, Annual Energy Outlook 2007, Assumptions to the AEO, Electricy Market Module.
  - Wiser and Bolinger, Report Summary, Annual Report on U.S. Windpower Installation, Cost and Performance Trends, 2006, U.S. Department of Energy May 2007.
  - Wiser, et. al., Letting the Sun Shine on Solar Costs: An Empirical Investigation of Photovoltaic Cost Trends in California, LBL, January, 2006, LBNL-59282.

Example from Colorado (cont.)

Type(s) of GHG Reductions

- Reductions come from reduced fossil-fueled generation relative to the reference case.

Quantification Methods

- Developed cost assumptions for each of the eligible renewable technologies over the study period.
- Calculated the amount of new renewable energy needed in 2020, and interpolated the growth of each technology from current levels to 2020 levels.
- Balanced supply and demand in each year by backing off coal- and gas-fired generation in a ratio of 75% coal and 25% gas. We first backed off any fossil generation added in that year, and when new generation reached zero, we began backing off generation from existing fossil units.
- Calculated GHG reductions.
- Calculated the cost of the RPS by calculating total costs for each technology in each year. The total cost of the new renewable energy was then summed for each year and compared to the total avoided cost, calculated with an avoided cost figure of $56 per MWh (from Xcel's 2006 DSM market assessment) throughout the study period.

Example from Colorado (cont.)

- Key assumptions
  - Mix of renewable technologies meeting the RPS
    - 2007 mix is based on projected 2007 generation from existing renewable facilities, and the RPS is assumed to take effect in 2008.
    - 10% of existing hydro generation is eligible to meet the RPS.
  - Type of generation backed off by new renewable generation and avoided cost
  - Cost of renewable technologies
    - The production tax credit is assumed to be extended through 2020

	2010	2015	2020	Relevant Sources
Wind	50	45	45	Wiser and Bolinger; Black and Veatch
Solar PV	576	409	409	Synapse; Wiser, et. al.
Solar Thermal	254	243	243	Synapse; EIA
Small Hydro	---	105	105	PWG assumption.
Biomass Co-firing	20	20	20	Colorado Springs; Synapse
Other Biomass	67	67	65	Colorado Springs; Synapse
Geothermal	---	78	74	Scaled up from EIA; Black and Veatch

Example from Colorado (cont.): Estimated GHG Savings and Costs per MtCO2e

`Year	**2010**	**2015**	**2020**	**2007-2020**
GHG Reductions ($MMTCO_2e$)	2	5	8	58
% Reductions in Elec. Prod. Emissions	4.6%	10%	17%	9%
Cost ($/MtCO_2e$)	$22	$132	$291	$865 (2007 NPV)

Note also that costs shown include only the projected costs of the renewable energy and avoided cost of displaced generation; we have not included any administrative costs.

Example from Colorado (cont.)

- Feasibility Issues
  - Current RPS requirement for munis and coops is lower than IOUs—10% by 2020. This policy would be especially burdensome for these entities.
  - Cost allocation
- Additional Benefits and Costs
- Status of Group Approval
- Level of Group Support
- Barriers to Consensus

- Key Uncertainties
  - In terms of cost, the costs assumed for wind energy and the avoided cost have the largest impact on estimated RPS costs.
  - What fuels are backed off as new renewable generation is added to the system. This study assumed that both new plant additions are deferred and existing plants are utilized less in the ratio of 75% coal and 25% gas. In reality, each new resource type will affect the system differently, based on its pattern of generation, and the dynamics differ significantly in the short run and the long run. Hourly dispatch modeling would be necessary to shed more light on these dynamics.

Review of Balloting Results

Please refer to Balloting Results posted on website prior to the call.

SC GHG emissions inventory and forecast

Inventory Approach

- Standard US EPA and UN methodologies, guidelines, and tools
- Emphasis on transparency, consistency, and significance
- Preference for South Carolina or regional data, where available
- Consumption and production-basis emissions from electricity generation
  - Very simplified approach used for initial analysis

Projection Approach

- Reference case assumes no major changes from business-as-usual (BAU)
  - Includes approved policies and actions to the extent possible
- Growth assumptions from existing sources
  - State population and employment forecasts
  - US Census and Bureau of Labor & Statistics
  - US Energy Information Administration

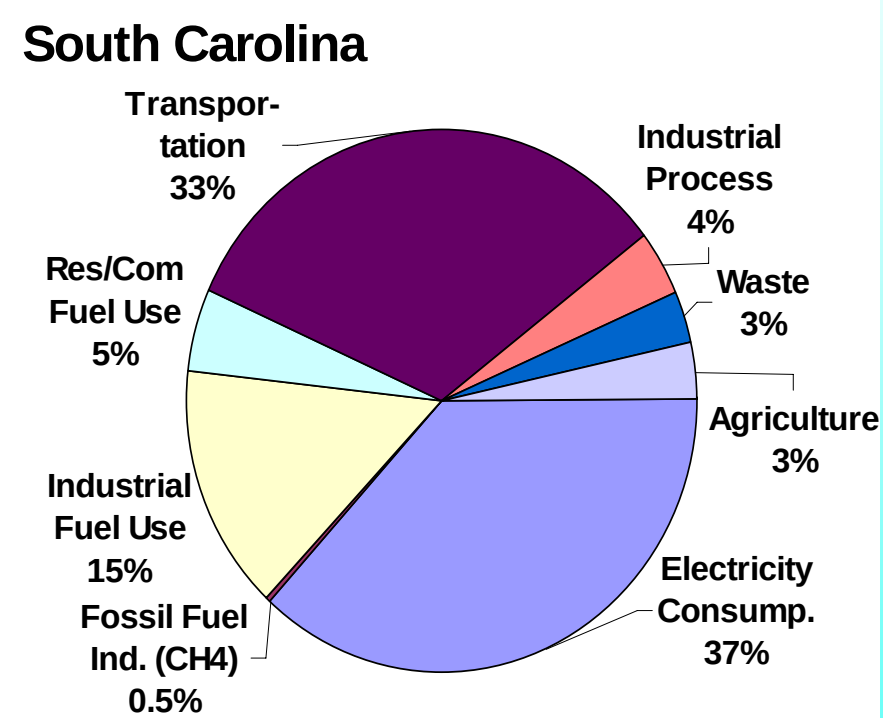
Coverage

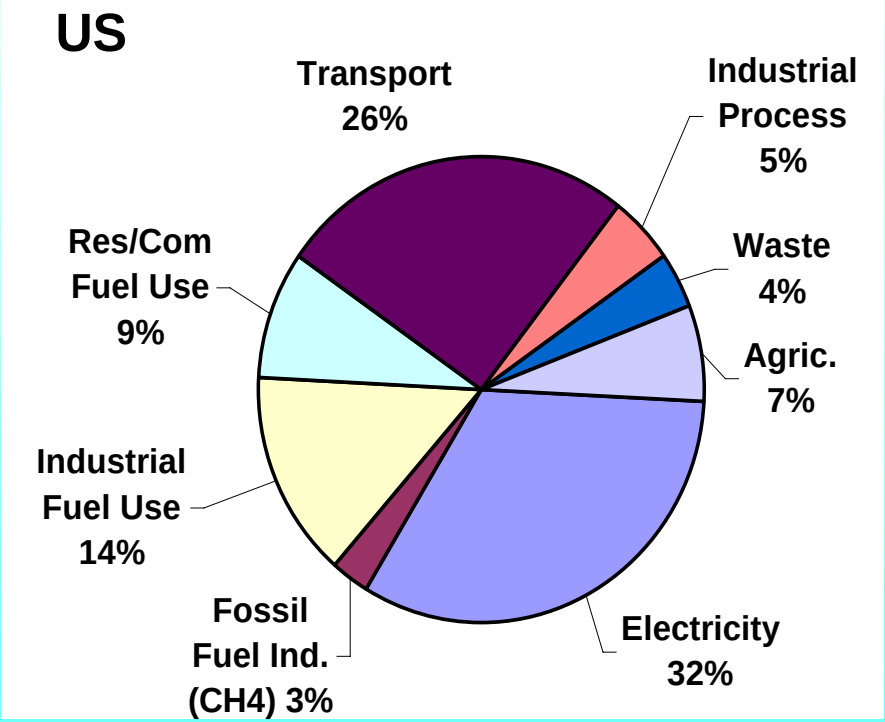
- Six gases per USEPA and UNFCCC guidelines
  - Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O, Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs), Sulfur Hexafluoride (SF_6)
- All major emitting sectors
  - Electricity Supply & Demand (Consumption Based)
  - Residential, Commercial, Industrial (RCI) Fuel Use
  - Industrial Non-Fuel Use Processes
  - Transportation (onroad and nonroad)
  - Natural gas pipeline transmission & distribution
  - Agriculture, Forestry, and Waste
- Emissions expressed as CO_2 equivalent
  - 100-year global warming potentials
    - CO_2 = 1; CH_4 = 21; N_2O = 310; HFC-23 = 11,700; SF6 = 23,900

Key Points

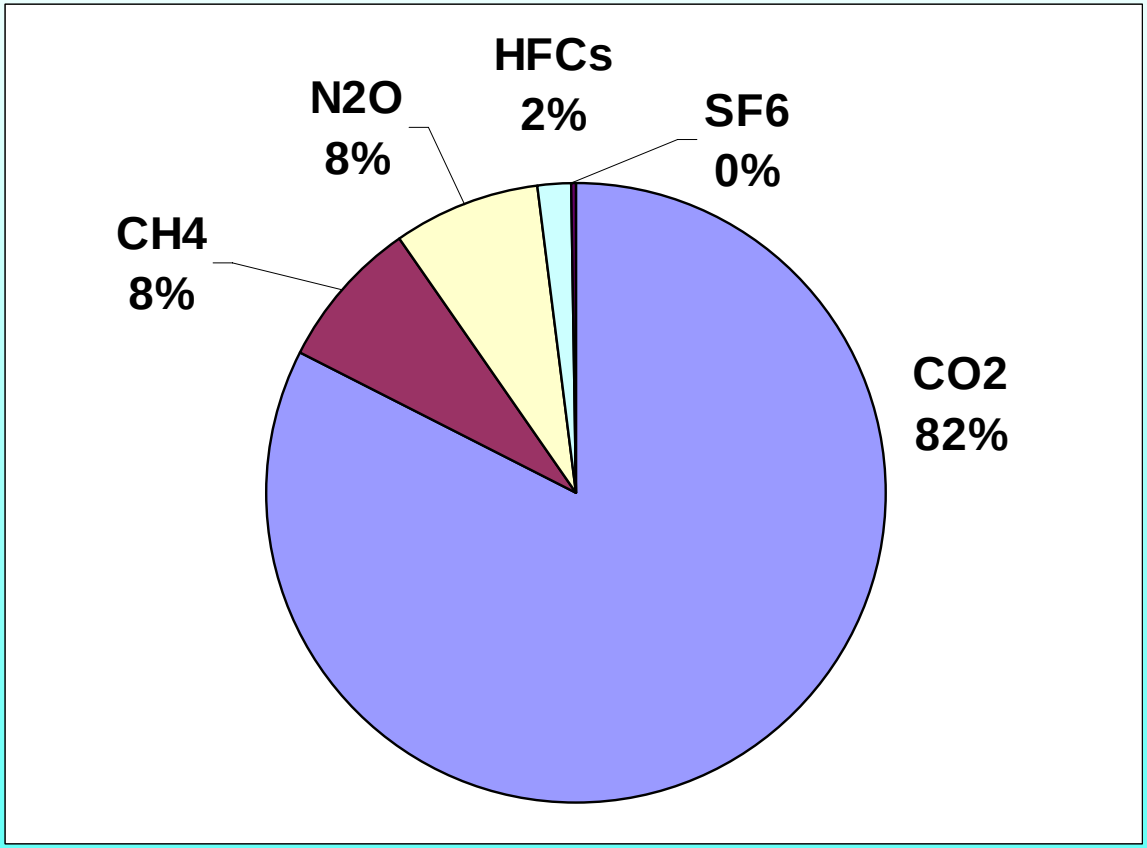
- Preliminary draft for CECAC and TWG review and revision, as needed
- Helpful for diagnosis of GHG emissions, but not a baseline for modeling or compliance for individual options
- Consumption and Production methods
- Net and Gross methods

South Carolina & US Gross Emissions By Sector, Year 2000

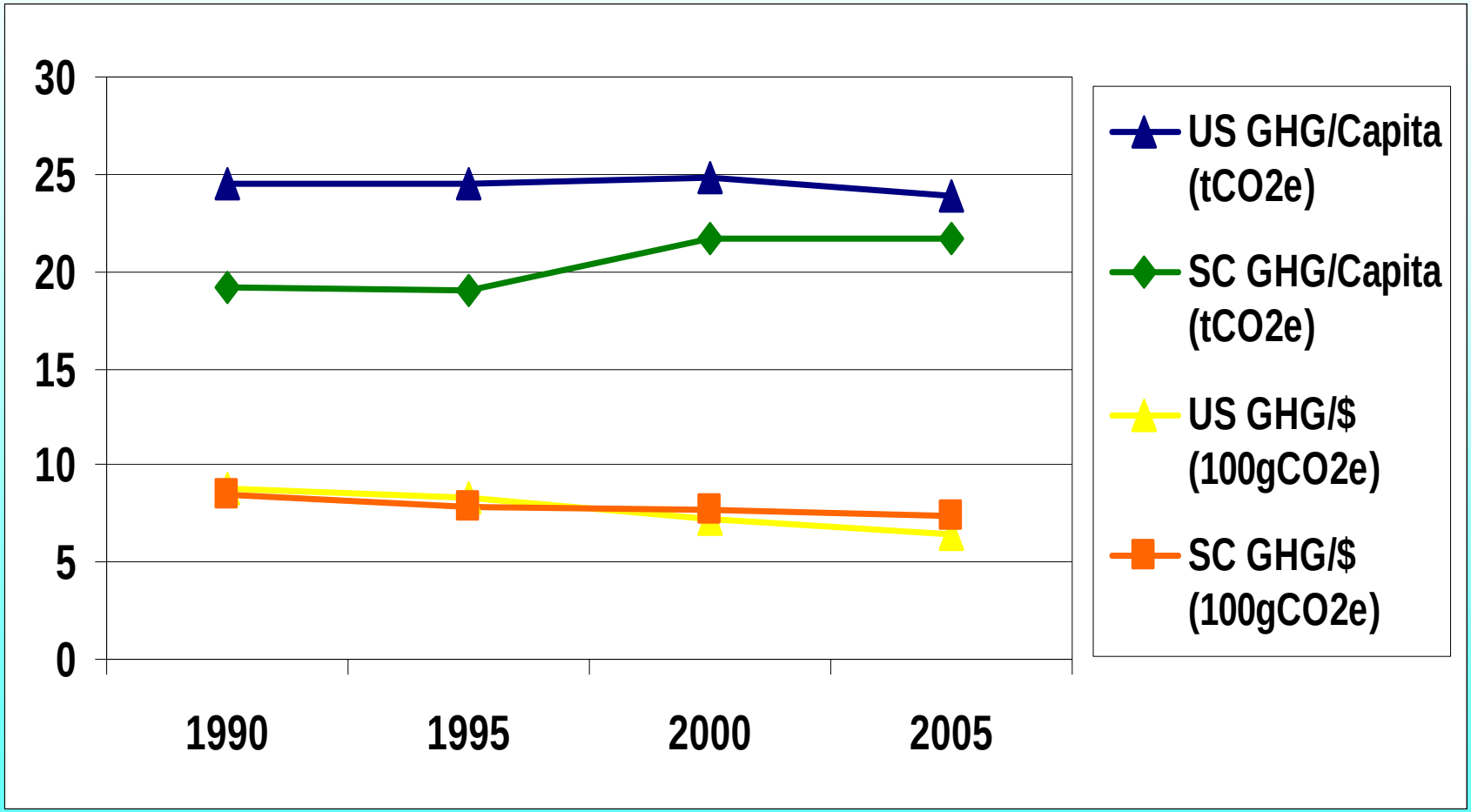




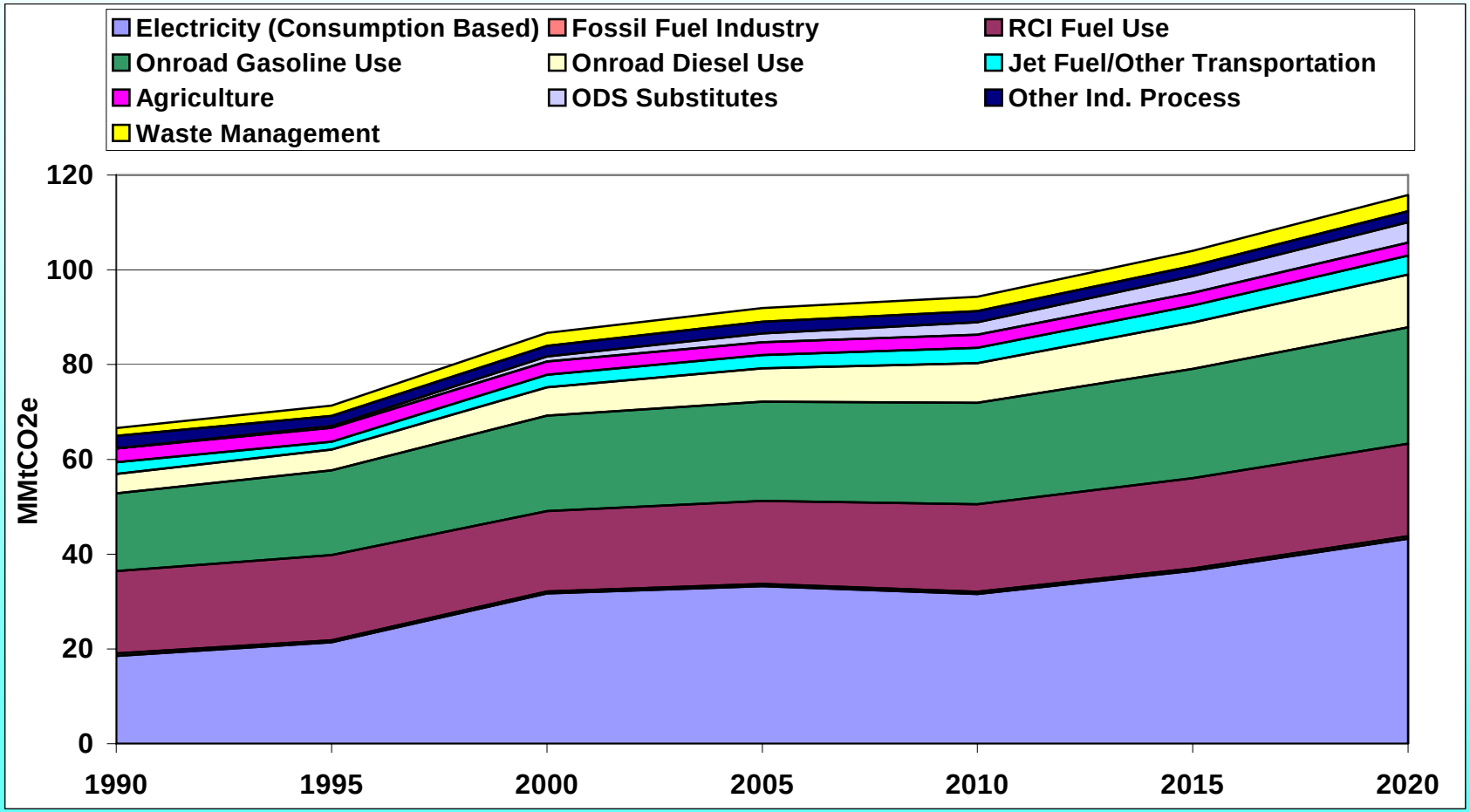
South Carolina Gross Emissions By GHG, Year 2000 ($MMtCO_2e$ Based)



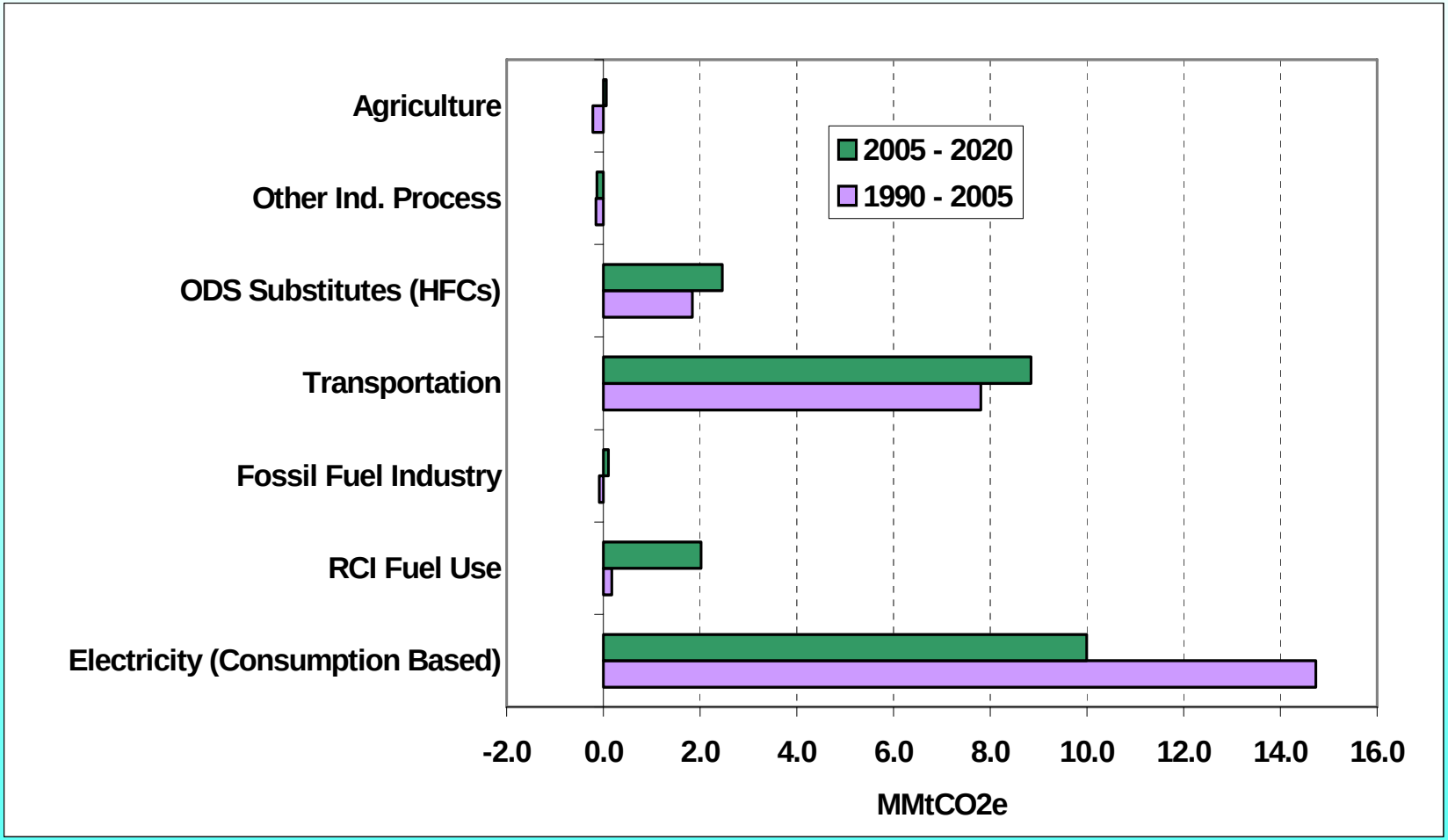
Per Capita and GSP/GDP Gross GHG Emissions, 1990-2005



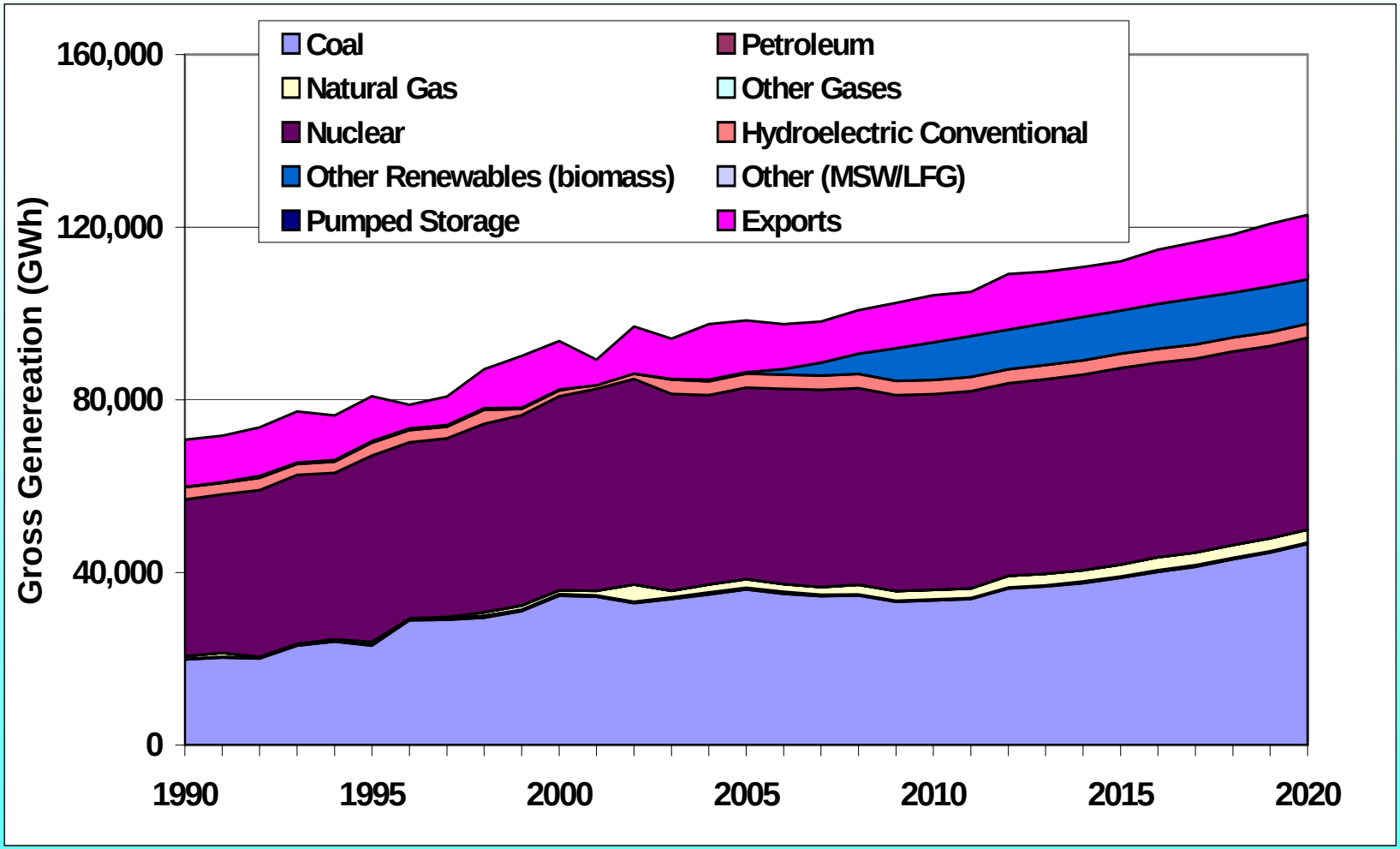
South Carolina Gross GHG Emissions By Sector, 1990-2020



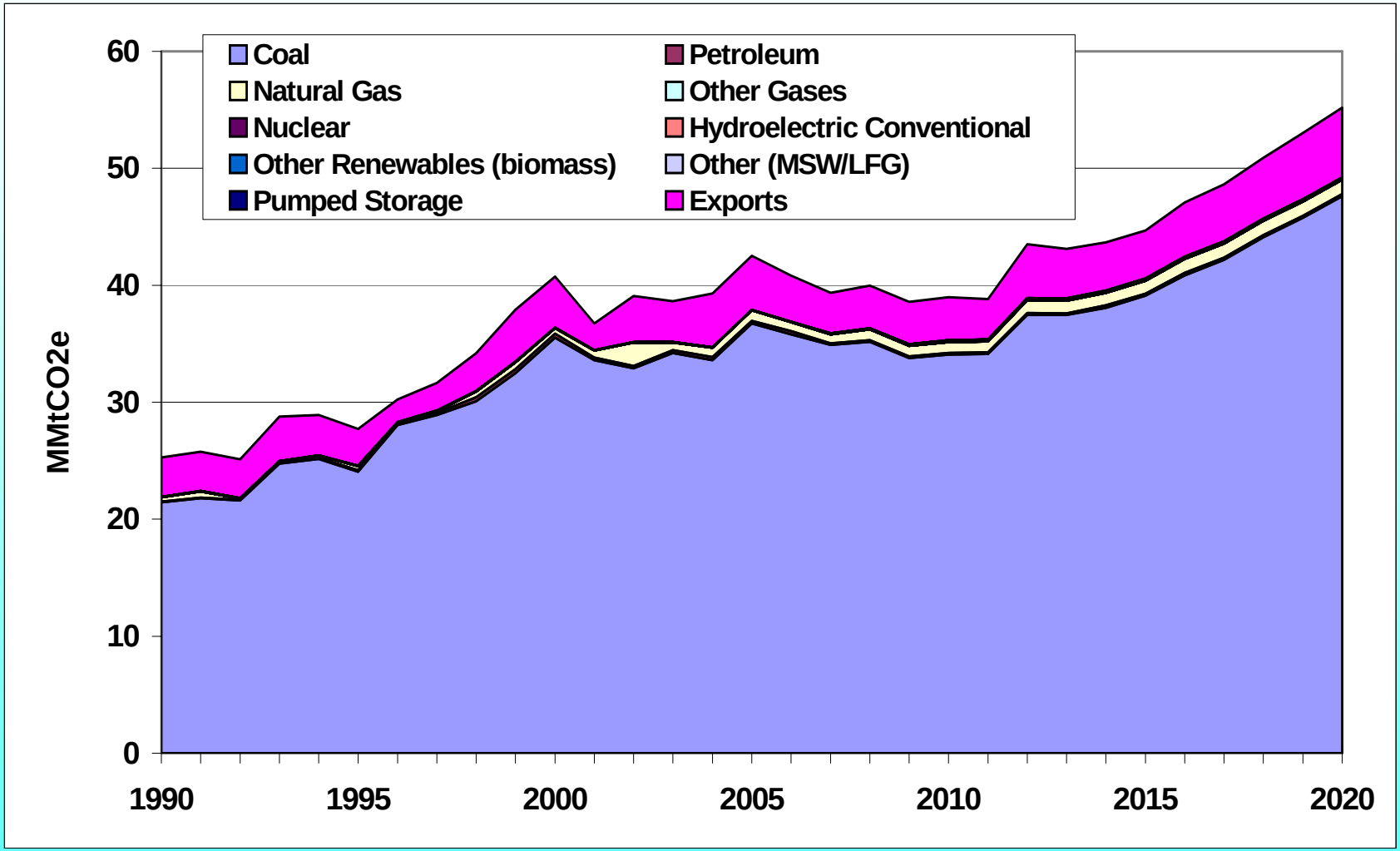
South Carolina Gross Emissions Growth
(MMtCO2e Basis)



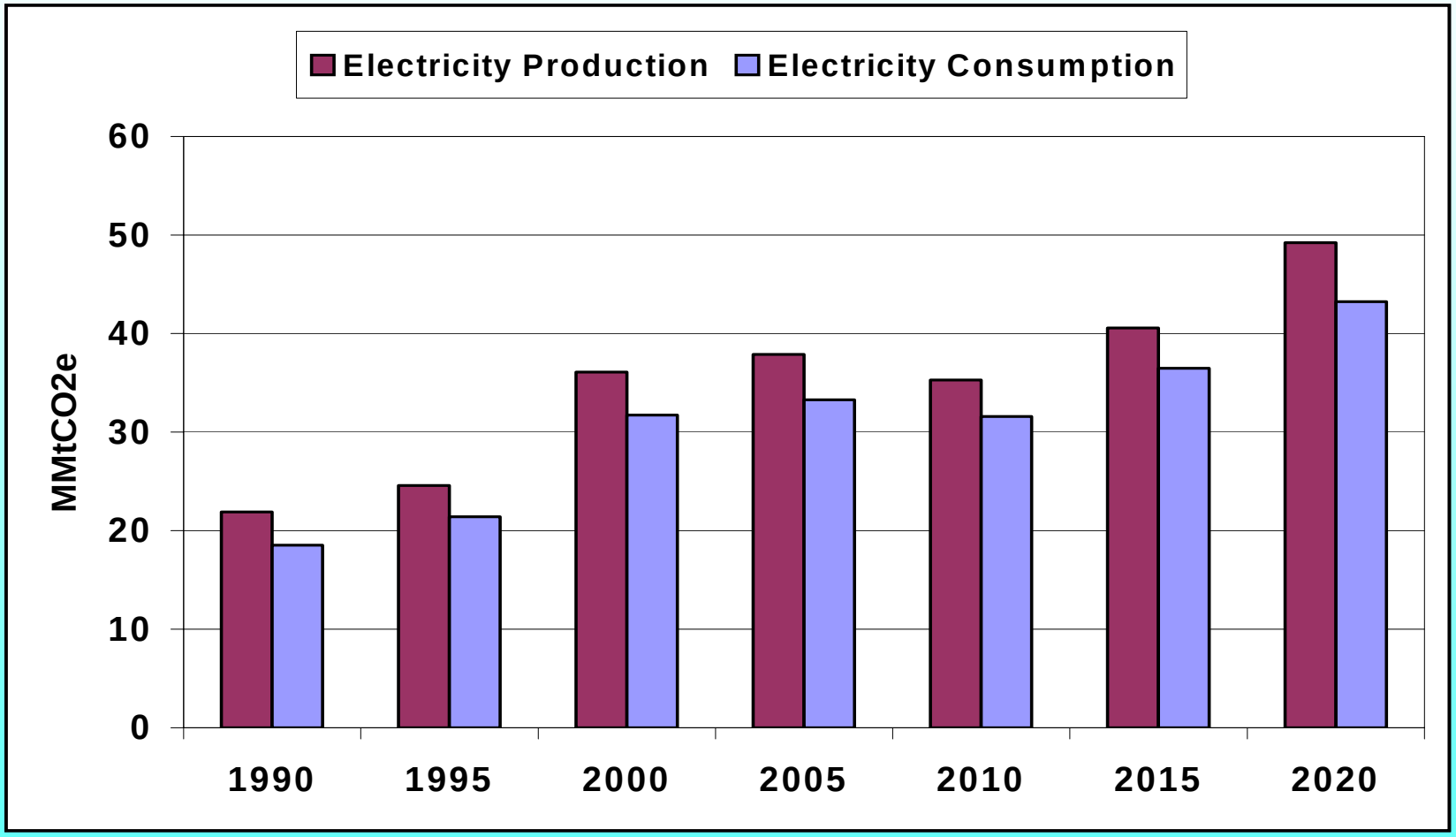
Electricity – Gross Generation



Electricity - Emissions



Electricity - Emissions



Electricity

- Data Sources
  - Historical –
    - Generation and fuel consumption for 1990-2003
      - 906/920 Monthly Time Series data (EIA)
    - Monthly Cost and Quality of Fuels for Electric Plants (EIA) – coal-type data
  - Forecast –
    - South Carolina Energy Office modeling
      - Projected electricity sales
    - Annual Energy Outlook 2007 for Southeastern Electric Reliability Council (SERC) region (EIA)
      - Projected trends in combustion efficiency improvement and transmission & distribution losses for 2004-2020

Electricity

- Methodology
  - Key Inputs:
    - Coal quality used in SC power stations
    - Gross annual primary energy consumption by SC power stations by fuel type
    - Gross annual generation to meet SC demand
  - Multiply gross annual primary energy consumption by SC power stations by CO2e emission factors
  - Assign the portion of CO2e emissions not associated with SC demand to exports

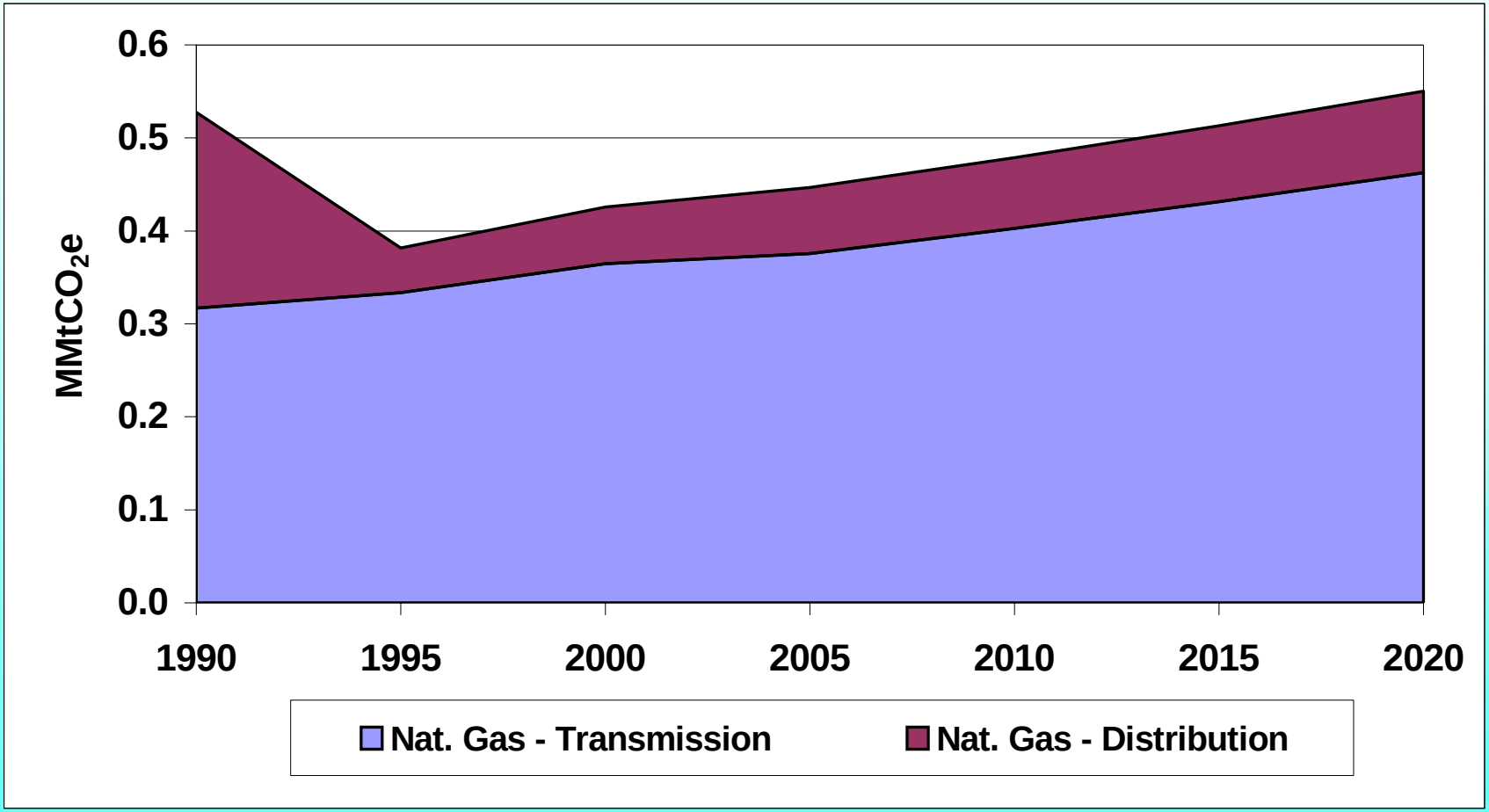
Electricity – Key Assumptions

Key Assumptions	2003	2020	Average Annual Growth / Change (%)
SC electricity demand (GWh)	77,054	102,200	1.68%
SC Gross generation (GWh)	94,125	122,843	1.58%
SC utility sales to meet SC demand (GWh)	84,927	107,961	1.42%
Gross generation exports to SERC (GWh)	9,198	14,882	2.87%
Power plant heat rate (btu/kWh)			
Coal	9,789	9,650	-0.08%
Petroleum	7,205	7,224	0.01%
Natural Gas	7,619	6,776	-0.69%
Other Gases	0	0	0.00%
Nuclear	10,392	10,392	0.00%
Hydroelectric Conventional	10,320	10,320	0.00%
Other Renewables (biomass)	10,500	10,500	0.00%
Other (MSW/LFG)	10,500	10,500	0.00%
Pumped Storage	10,320	10,320	0.00%
Losses (%)			
From on-site usage	0.35%	0.79%	5.48%
From T&D and on-site usage	9.27%	5.34%	-3.62%

Electricity

- Key Uncertainties
  - Top-down approach
    - Assumes SC electric systems evolve consistently with the surrounding Southeastern Electric Reliability Council (SERC) region
    - Does not capture all state-specific system characteristics
  - Source of electricity imports and exports
  - Coal quality over time
    - Coal quality for 2003 assumed for forecast period

Natural Gas Transmission and Distribution



Natural Gas Transmission and Distribution

- Data sources
  - Historic (2000-2005)
    - Miles of transmission and distribution pipeline
      - Pipeline and Hazardous Materials Safety Administration / Office of Pipeline Safety
    - Compressor stations – EPA defaults
  - Forecast
    - Annual growth rates from total NG consumption in SC
      - EIA Natural Gas Navigator
- Methods
  - Based on EPA SGIT
  - Activity x emission factors

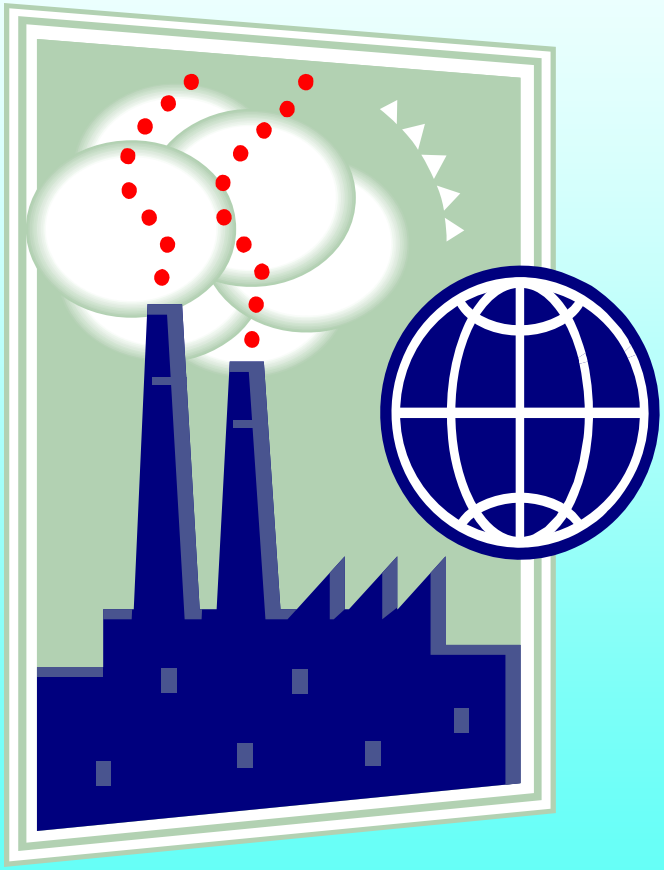
Natural Gas Transmission and Distribution

- Key Assumptions
  - Growth Rates for Transmission & Distribution
    - 1.4% annual for 2006-2020
  - EPA defaults for compressor stations?
- Key Uncertainties
  - Growth in emissions from transmission and distribution pipelines and compressor stations

Black Carbon

- One of two carbonaceous aerosol species – BC and Organic Carbon (OC)
- Also known as light absorbing carbon (LAC) and elemental carbon (EC)
- Absorbs solar energy and warms the troposphere (like GHG's)

Sources of Black Carbon



- Fossil Fuel Combustion
- Biomass Combustion
- Other (Minor) Sources

Black Carbon Emissions

- 2002
  - 7.0 MMtCO2e
  - Primary Contributors:
    - nonroad diesel (35%)
    - onroad diesel (28%)
    - electricity generated using coal (17%)
    - aircraft (5%)
    - rail (4%)
- 2018
  - Nonroad diesel drops from 2.5 to 0.8 MMtCO2e
  - Onroad diesel drops from 2.0 to 0.3 MMtCO2e

Public Input, Announcements