Santee Cooper
Overview

Mission Statement

The mission of Santee Cooper is to be the state's leading resource for improving the quality of life for the people of South Carolina.

Jefferies Generating Station

Moncks Corner, SC

- **Hydro, Oil, and Coal**
- **526 total MWs**

Grainger Generating Station

Conway, SC

- **Coal, 1967**
- **Santee Cooper & Central partner**
- **170 MWs**

Winyah Generating Station

Georgetown, SC

- **Coal**
- **Four units**
  - 1975
  - 1977
  - 1980
  - 1981
- **1,155 MWs**

Cross Generating Station

Cross, SC

- **Coal**
- **Four units:**
  - 1983
  - 1995
  - 2007
  - 2008
- **2,400 MWs**

V. C. Summer Station

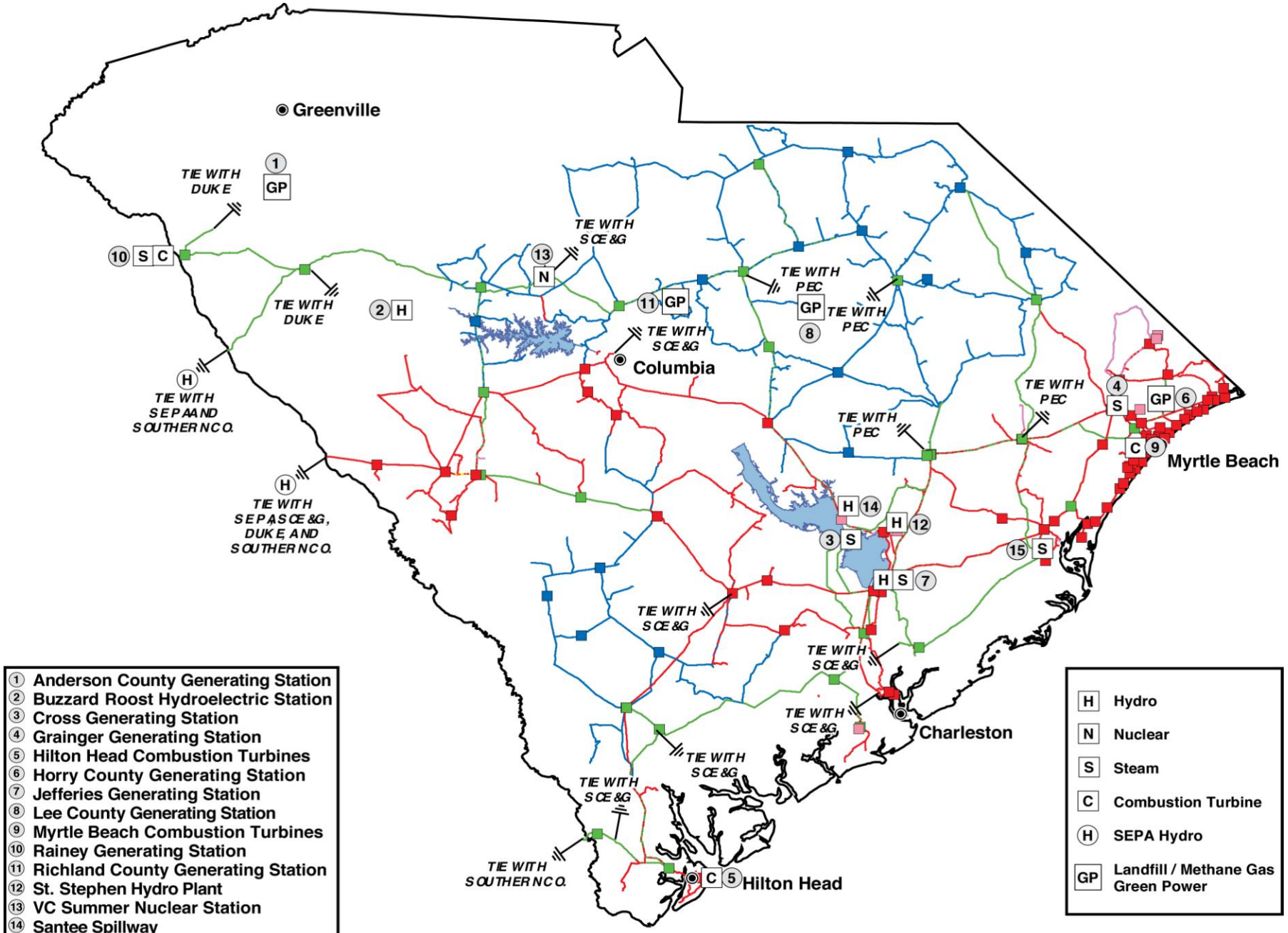
Jenkinsville, SC

- **Nuclear**
- **Shared ownership with SCE&G**
- **Operational in 1983**
- **318 MWs**
  (954 total MWs)

Rainey Generating Station

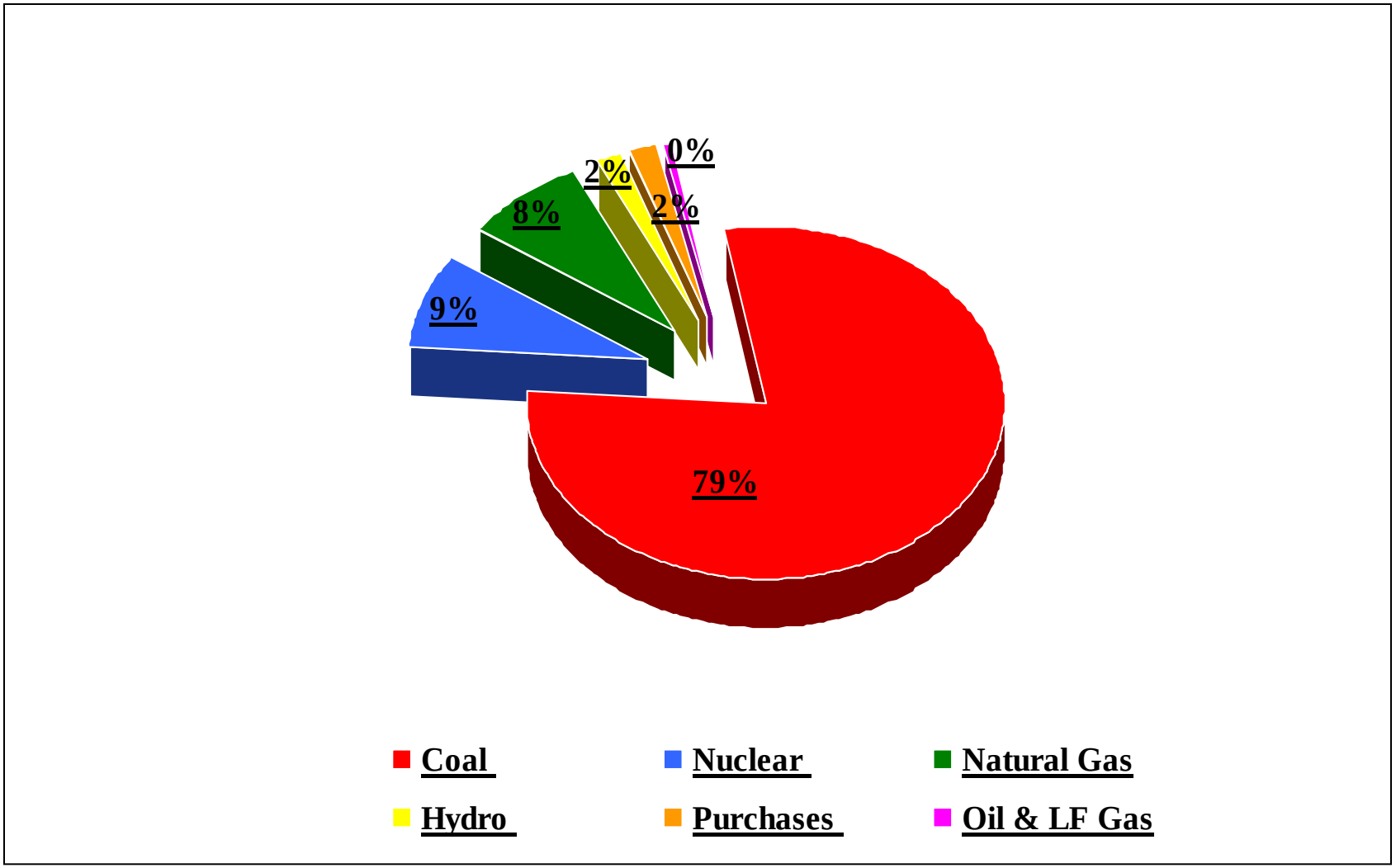
Iva, SC

- **Natural gas**
- **Six units:**
  - 2002
  - 2004
- **961 MWs**



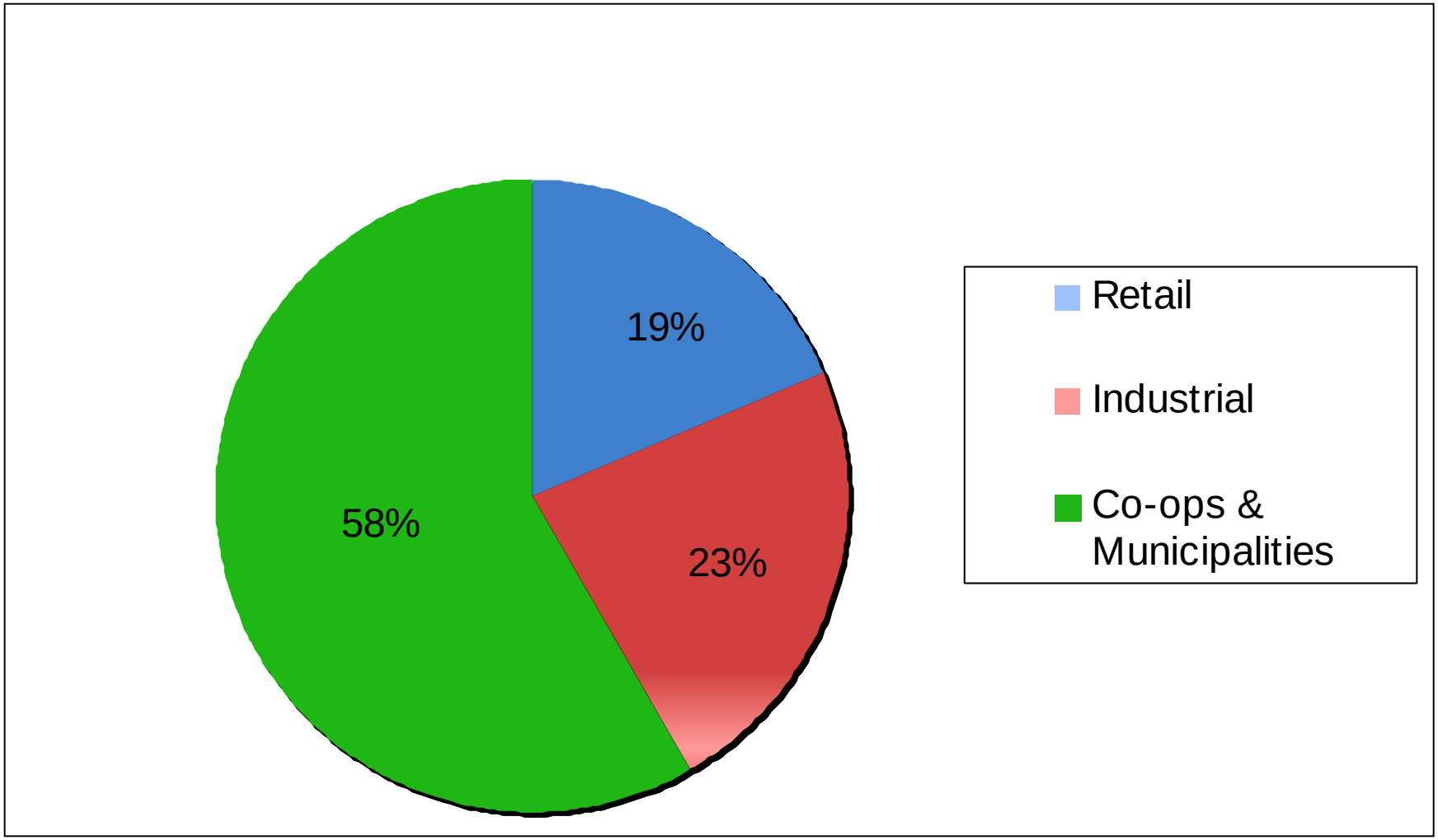
GENERATING STATIONS AND TRANSMISSIONS LINES

Generation by Fuel Type 2009

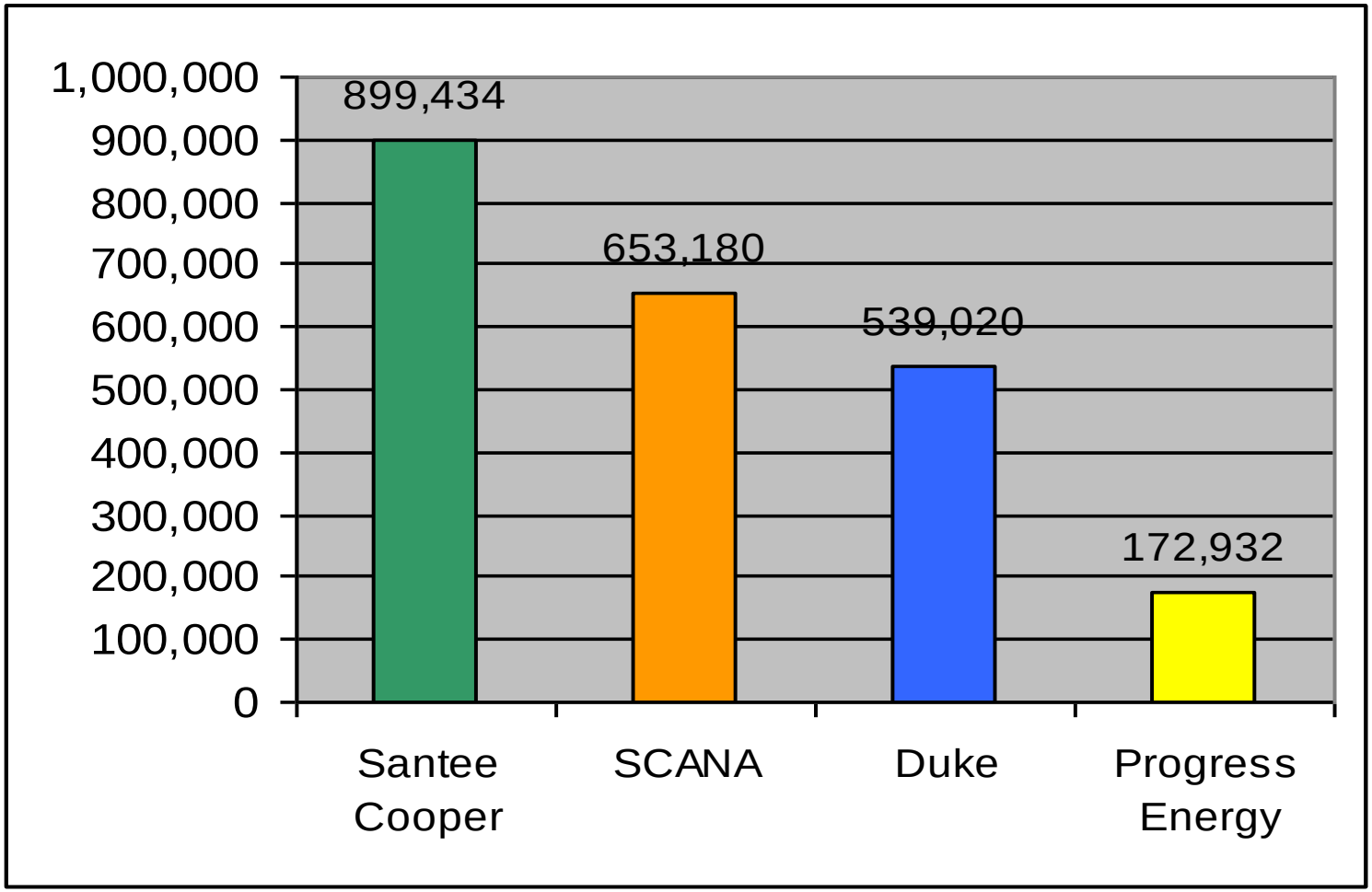


January–December Actuals

Salesof Electricity by Customer Class

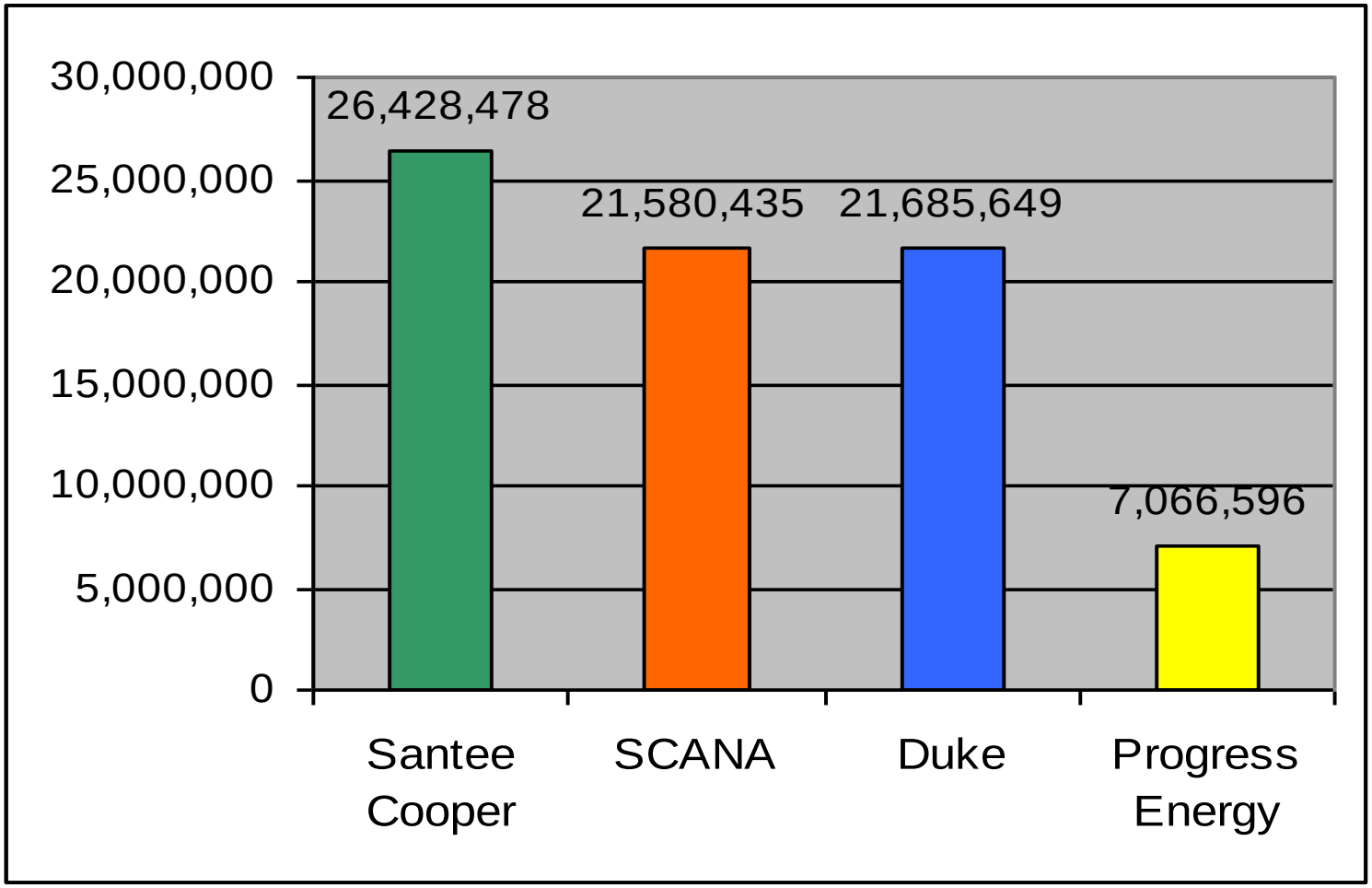


Total Customers Served in South Carolina



December 2009

Megawatt-hour Sales in South Carolina



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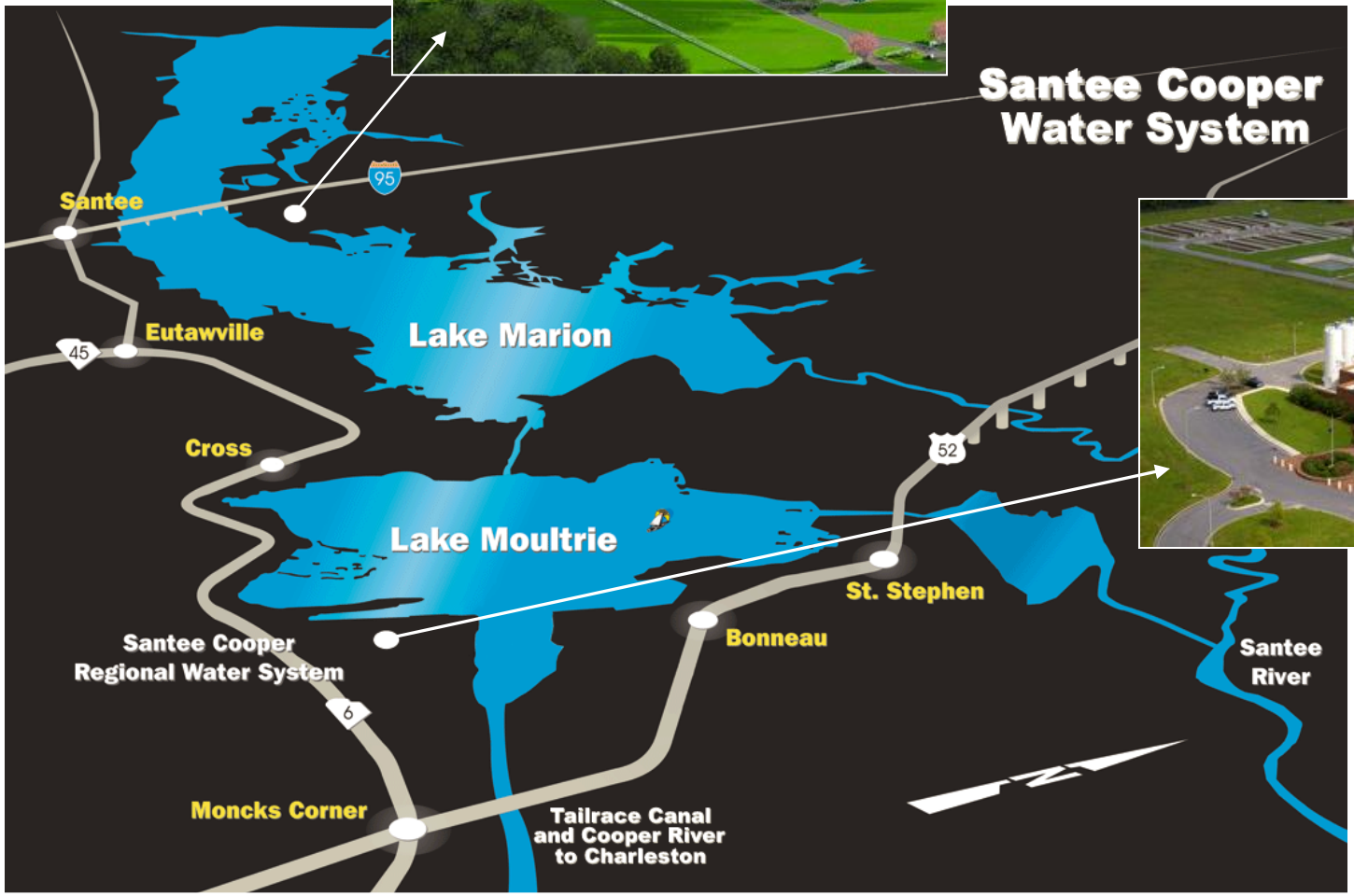

Water Systems

Santee Cooper Regional Water System

- Commercial Operation Began Oct. 1994
- Current Capacity: 30 MGD
- Members:
  - *Goose Creek*
  - *Berkeley County WSA*
  - *Moncks Corner PWC*
  - *Summerville CPW*

Lake Marion Regional Water System

- Commercial Operation Began May 2008
- Current Capacity: 8 MGD
- Members:
  - *Counties of Berkeley, Dorchester, Clarendon, Calhoun, Orangeburg and Sumter*
  - *Town of Santee*
  - *City of Sumter*

Supports public recreation with parks, landings, boat ramps and historical interpretive facilities.

Shoreline:	450 miles
Lake Surface:	160,481 acres
Islands:	2,660 acres
Dams and dikes:	41 miles
Marinas:	44
Public Boat Landings:	29
Commercial Leased Areas:	56
Gratis Leased Areas:	34
Public Parks & Recreation Areas:	6
Residential Leases:	2,400
Navigation Lock:	180’ X 60’X 75’

GreenPower

- **18 Solar Schools YTD**
- **6 Landfill Methane Gas stations:**
  - *Anderson Regional Landfill*
    3 megawatts
  - *Horry Solid Waste Authority*
    3 megawatts
  - *Lee County Landfill*
    10 megawatts
  - *Richland County Generating Station*
    5 megawatts
  - *Georgetown County Landfill*
    1 megawatt
  - *Berkeley County Landfill*
    3 megawatts (under construction – online Fall 2010)
- **GreenPower Partners**

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Overview of Santee Cooper's Use of PEPSE Modeling in the Past Year

By

Leif M. E. Svensen III, P.E.

Santee Cooper

Uses of PEPSE® @ Santee Cooper

- Weekly
- Test Reports
- Special Studies

Weekly Uses

- Weekly heat rates

- Help to explain changes in curves
  - –Use trends W3 CBO Flow
  - –Comparison of two data sets Cross #2 HR Comparisons-100602.xls
  - –Review operational changes
- Use PEPSE® to Quantify the changes
  - –Common Uses
    - Condenser Pressure
    - Sprays
    - Temperatures

Testing and Test Studies

- Test data reduction
  - Corrected data
  - Check instruments
- Test studies
  - N2 leakage evaluation
- Enthalpy Drop Testing
- Cycle Isolation Checks

Links:

C3n2.MDL 100302c3tb.OUT W4Apr10a.xls

Batch Mode Run

c:\pepse\pep386 pause YES m:\testcrew\c3\testdata\091208tb.prn

Special Studies

- These are requests for special modeling using PEPSE
  - Recently the following have been completed
    - Condenser re-tube /new material
    - External steam supply to High Pressure feedwater heater extraction
    - Boiler economizer plugged tube study
    - Cost of leaking heater by-pass valve

Boiler Economizer Plugged Tube Study

- Economizer 48 of 558 tubes plugged
- Ran combined turbine/boiler models
  - One for the base case
  - Second for the economizer plugged case
  - Kept fuel and steam flow constant
- Heat rate increased
- Boiler efficiency decreased
- Output decreased

Boiler Economizer Plugged Tube Study

- Turbine models (C1DES08.MDL,C1DES10.MDL)
  - Setup SOP 11 in the turbine model
  - Set the desired steam flow (input component)
- Boiler model Base (C1blr08.MDL)
  - Set fuel flow (in this case 443,200 lbs/hr)
  - Allowed the back pass damper to balance SH/RH temps
- Boiler model Economizer change (C1blrEc.MDL)
  - Same as above plus “plugged” tubes
    - » Removed the tubes from economizer changed the NTPR count (no of tube rows perpendicular to gas path)

Special Studies

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Boiler Economizer Plugged Tube Study

- Results
  - » Output change at full load -2.44 MW
  - » Heat rate change 15 Btu/kWhr
  - » Boiler efficiency change -0.2%
  - » Estimated cost $500,000 per year (C1-Economiser-Study-RonW-070706.pdf)

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Condenser Re-tube /New Material

- Turbine model (W1HEI9a.MDL)
- Used HEI type condenser
- Condenser tube
  - Cu-Ni 90-10 (Design Condenser Specification)
  - Sea-Cure ®
  - Titanium

Special Studies

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Condenser Re-tube /New Material

- Tube wall thicknesses
  - Cu-Ni 20 BWG
  - Sea-Cure®
    - » 22 BWG and 24 BWG
  - Titanium
    - » 22 BWG and 24 BWG
- Circulating water flows (all at design temp of 79°F)
  - 20 BWG 195,600 GPM
  - 22 BWG 203,377 GPM
  - 24 BWG 204,360 GPM

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Condenser Re-tube /New Material

- Ran different cleanliness factors for study
  - 50% and 85% for the Cu-Ni
    - » 50% current
    - » 85% would be with ball cleaning system
  - 60% and 90% for the Sea-cure®
    - » 60% without ball cleaning system
    - » 90% with ball cleaning system
  - 60% and 90% for the Titanium
    - » 60% without ball cleaning system
    - » 90% with ball cleaning system

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Condenser Re-tube /New Material

- Results
  - Ti
  - 22 BWG
  - Ball cleaning system (90% CF)
  - 75% capacity factor
  - Heat rate improvement over current system 145 Btu/kWhr
  - Output improvement 5.7 MW
  - Estimated savings $800,000 per year

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Feedwater heater by-pass valve leak

- Determine the cost of a leaking feedwater heater by-pass valve
- Unit has 3 HP heaters one a HARP heater
- By-pass valve by-passes the lower two HP heaters (#5 & #6)
- Leak mixes before the HARP heater (#7)
- Had outlet temperature of #6 heater and inlet of #7

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Feedwater Heater By-pass Valve Leak

- Have data around the heaters
  - » Inlet temperature to #7 after mixing
  - » Outlet temperature from #6 before mixing
  - » Temperature for the inlet to #5 heater
- Using this data and PEPSE® I was able to determine the leakage rate

Special Studies

PEPSE® Modeling (Feedwater heater by-pass valve leak)

- Added a splitter before the #5 heater (J3Bypassleak.MDL)
- Mixer before the #7 heater
- Control for leakage runs
  - » Controlled to the inlet temperature to #7 heater that was occurring at full load
  - » Set max flow to 700,000 lbs/hr
  - » Set min flow to 1 lbs/hr
  - » Relaxation factor to 0.95

Special Studies

Results (Feedwater heater by-pass valve leak)

- Feedwater flow before leak 1,200,000 lbs/hr
- By-pass flow about 522,000 lbs/hr
- Heat rate change 50 Btu/kWhr
- Output put change less that 60 kW
- Estimated annual value for heat rate change $94,000
  - » This cost is low due to the capacity factor currently lower than 30%

Special Studies

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External Steam Supply to High Pressure Feedwater Heater Extraction

- Outside steam supply to the steam side highest pressure heater
- Conditions 655°F
- Up to 680 psia
- Max flow around 250,000 lbs/hr

Special Studies

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External Steam Supply to High Pressure Feedwater Heater Extraction

- PEPSE® Modeling (C1stm10.MDL)
  - » Added splitter to condensate line outlet of condenser
  - » Added heat exchanger
  - » Added mixer to the extraction steam line going to top heater
  - » Operation to control the flow to be about 60 % of heater extraction flow

Special Studies

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External Steam Supply to High Pressure Feedwater Heater Extraction

- Results
  - » 340 Btu/kWhr heat rate improvement
  - » 25,000 kW output improvement
  - » These assume that all of the external heating is not part of the heat rate envelope (Free heating for steam)

Questions