Since the Clean Air Act was enacted in 1970, EPA estimates that national emissions from the six primary pollutants has reduced 69%.

EPA estimates that:
- More than 200,000 early deaths have been annually prevented in the U.S.
- The number of asthmatic episodes—cases of acute bronchitis and hospitalization due to breathing problems—have been significantly reduced.

Clean Air Act calls for standards to be regularly monitored and reviewed every five years.
World Health Organization estimates 7 million deaths worldwide in 2012 caused by air pollution

American Lung Association: 2016 State of the Air

- Ozone Ratings
  - Oconee and Pickens: A
  - Greenville and Abbeville: B
  - Spartanburg and Anderson: C
  - Cherokee County: D

- Particle Matter Ratings
  - Spartanburg: A
  - Greenville: B
  - Others not classified
There are about 27,550 cases of Pediatric Asthma and 87,075 cases of Adult Asthma in the Upstate.

- ALA ranked Oconee and Pickens amongst the cleanest counties for Ozone.
- ALA ranked Spartanburg amongst the cleanest for the 24-hour PM$_{2.5}$.
The Birmingham, AL, case

- Lost over $5 billion of economic development and thousands of jobs after being designated as a non-attainment area
- It took them 30 years and millions of dollars before they finally reached attainment levels in 2012
Campaign started in 2012
Focus primarily on mobile sources for future emission reduction impacts
Identified two areas of focus: education/outreach and creating strategies for reducing emissions from onroad sources
Clean Air Upstate

Having clean air that allows all residents to safely enjoy outdoor activity is a crucial component of our quality of life. Learn how you can help promote Clean Air in Upstate South Carolina.

Check Out the Tip of the Week!

Plan errands to increase efficiency and reduce number of trips. Combine errands into one outing and group them by where they are located to reduce the amount of miles you travel. This saves gas and time, too.

For more tips, check out the Clean Air Upstate Tips page!

Air Quality Updates!

Air Alert Chart

Download the Upstate Air Alert Chart to learn more about Air Alert Levels and what you can do to help reduce emissions.

Air Quality Grants/B² Breathe Better Better Program

Currently, nearly 40 schools in the Upstate and more than 75 schools across South Carolina are participating in the DHEC Breathe Better No Idling program. Since 2013, Clean Air Upstate has provided grants to more than 30 schools in the Upstate to continue or start their Breathe Better program. We still have enough
Help Keep Our Air Clean

1. Walk or Bike to nearby locations
2. Cut grass in the evening to reduce emissions
3. Replace the air filter in your vehicle when due

Visit cleanairupstate.org
J. Dan Powell Electric Vehicle Charging Station Matching Grant Program

- $15,000 available for five matching grants of up to $3,000 each
- One grant available per recipient
- Eligible entities include local governments, non-profit organizations, libraries and community groups. For-profit businesses are not eligible for these grant funds.
- Grants funded by the Duke Energy Foundation
TIGER VIII Application

- Creating Circuits of Economic Success
- Joint Venture
  - City of Greenville (applying entity)
  - Greenville County
  - Greenville Transit Authority
- Transform the Greenlink transit system into a regional transportation network.
Eight (8) Zero-Emission Electric Buses
- Two (2) Charging Stations
- Seven (7) Supporting Circulator Buses
- Twenty-Nine (26) Multimodal Transit Stations
- Five B-Cycle Bike Share Stations
- Five (5)-mile Extension of the Swamp Rabbit Trail
  - Cleveland Park to CU-ICAR
- Seven (6) Pedestrian Bridges
- Six (6) Connection Trails
  - Focus on Low-Income Communities

Map is not to Scale
Funding Snapshot

- Total Project: $26,165,313
- TIGER Fund Request: $13,279,816
- Local Match: $12,885,497
  - 49.25% of Total
  - 97.03% vs Federal Ask
Air Quality Impacts

- South Carolina ground-level ozone is “improving” – SCDHEC
- EPA continues revising standards
- Upstate narrowly missed going “Non-Attainment”
Air Quality Impacts

- Improves Public Transportation
- Utilizes/Encourages use of Zero-Emission Transportation Alternatives
- Reduction of emissions by more than 348,695 lbs. annually (Argonne GREET Calculator, 2012)
- Advances shift in perceptions and culture for future development patterns and transportation decision-making.
- Improve physical activity, systemic changes towards better air quality.
Thank you!

- Questions?

- Keith Brockington, Transportation Planning Manager, GPATS and Greenville County
  - kbrockington@greenvillecounty.org
  - www.gpats.org
What we will be discussing today

• Recent developments in the Ozone NAAQS
• Ozone design values and number of exceedances trends
• 2016 Ozone data to date
• PM$_{2.5}$ trends
• Other criteria pollutant trends
The Ozone NAAQS

• The Clean Air Act establishes National Ambient Air Quality Standards (NAAQS) for six “criteria pollutants” including ozone.
• In general, ozone is formed by chemical reactions between NOx and VOCs in the presence of sunlight.
• A new Ozone NAAQS of 70 ppb was issued on October 1, 2015.
Nonattainment Area Designation Timetable

<table>
<thead>
<tr>
<th>Action</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Promulgation of Final Ozone Rule</td>
<td>10/1/2015</td>
</tr>
<tr>
<td>EPA Area Designations guidance*</td>
<td>2/1/2016</td>
</tr>
<tr>
<td>Area Designations due from States</td>
<td>10/1/2016</td>
</tr>
<tr>
<td>Area Designations Finalized</td>
<td>10/1/2017</td>
</tr>
<tr>
<td>If Designated Nonattainment, Transportation Conformity</td>
<td>10/1/2018</td>
</tr>
<tr>
<td>If classified Marginal, must attain by</td>
<td>10/1/2020</td>
</tr>
</tbody>
</table>

Finalized Ozone NAAQS Provisions

• Ozone season change
  - SC Ozone monitoring season has been expanded to cover the months March 1 – October 31 (starts one month earlier). This will be implemented starting ozone season 2017

• Data handling changes
  - No longer calculating 8-hour “rolling means” during the overnight hours to prevent double counting of exceedances at high elevation monitoring sites.

• Secondary standard
  - 70 ppb, maximum 8-hour average, same as Primary
2015 Ozone Design Values (ppm)

- Wolf Creek DV = 0.059
- Famoda Farm DV = 0.062
- Cowpens DV = 0.063
- York CMS DV = 0.059
- Chesterfield DV = 0.058
- Long Creek DV = 0.059
- Clemson CMS DV = 0.062
- Hillcrest DV = 0.064
- Sandhill Experimental Station DV = 0.062
- Pee Dee Experimental Station DV = 0.061
- Due West DV = 0.057
- Trenton DV = 0.054
- Parklane DV = 0.055
- Congaree Bluff DV = 0.055
- Jackson Middle School DV = 0.060
- Ashton DV = 0.054
- Cape Romain DV = 0.057
- Bushy Park Pump Station DV = 0.057

Legend:
- Ozone monitors
- County line

* Site has insufficient data for design value.
Ozone monitoring trends

• Based on the 2015 Ozone NAAQS there have been 2 exceedances since 2013 in the Upstate.
• Since 2005, there has been an ~27% decrease in average ozone design values for the Upstate (85 ppb in 1998 and 62 ppb in 2015).
Upstate Air Quality Advisory Committee Area Ozone Design Values 1998 - 2015

- 1997 NAAQS
- '2008 NAAQS'
- 2015 NAAQS

Sites:
- BIG CREEK
- CLEMSON
- COWPENS
- DUE WEST
- HILLCREST
- LONG CREEK
- NSFS#2
- WOLF CREEK

ppb vs Year from 1998 to 2015.
Upstate Air Quality Advisory Committee area ozone exceedances
2005 - 2015
Based on a NAAQS Standard of 70
Upstate Air Quality Advisory Committee area ozone exceedance
2005 - 2015
Based on a NAAQS Standard of 70
Counties at Risk of Exceedance (2015 DVs) – 70 ppb Ozone NAAQS
Exceedances in 2016 to date

• 4 exceedance days in the Upstate this year so far (based on preliminary data)
• 3 exceedances at North Spartanburg Fire Station
• 1 exceedance at Clemson, Hillcrest, Long Creek, and Wolf Creek
• Famoda Farm and Cowpens were shut down prior to the start of the ozone monitoring season
<table>
<thead>
<tr>
<th>Monitor Site</th>
<th>Number of Exceedances</th>
<th>Dates and values (MD8A ppb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Big Creek (Anderson)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Clemson (Pickens)</td>
<td>1</td>
<td>4/20/2016 (73)</td>
</tr>
<tr>
<td>Due West (Abbeville)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Hillcrest (Greenville)</td>
<td>1</td>
<td>6/10/2016 (73)</td>
</tr>
<tr>
<td>NSFS #2 (Spartanburg)</td>
<td>3</td>
<td>6/10/2016 (78); 5/25/2016 (77); 4/18/2016 (73)</td>
</tr>
<tr>
<td>Long Creek (Oconee)</td>
<td>1</td>
<td>4/20/2016 (72)</td>
</tr>
<tr>
<td>Wolf Creek (Pickens)</td>
<td>1</td>
<td>4/20/2016 (73)</td>
</tr>
</tbody>
</table>
If ozone season ended today
(data accessed 6/13/2016)

<table>
<thead>
<tr>
<th>Site Name</th>
<th>2014 4th High (ppb)</th>
<th>2015 4th High (ppb)</th>
<th>2016 4th High (ppb)</th>
<th>2016 Design Value (ppb)</th>
<th>Critical Value (ppb)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Big Creek</td>
<td>60</td>
<td>63</td>
<td>62</td>
<td>61</td>
<td>90</td>
</tr>
<tr>
<td>Clemson</td>
<td>62</td>
<td>64</td>
<td>67</td>
<td>64</td>
<td>87</td>
</tr>
<tr>
<td>Due West</td>
<td>60</td>
<td>55</td>
<td>60</td>
<td>58</td>
<td>98</td>
</tr>
<tr>
<td>Hillcrest</td>
<td>62</td>
<td>67</td>
<td>66</td>
<td>65</td>
<td>84</td>
</tr>
<tr>
<td>NSFS #2</td>
<td>65</td>
<td>67</td>
<td>70</td>
<td>67</td>
<td>81</td>
</tr>
<tr>
<td>Long Creek</td>
<td>64</td>
<td>60</td>
<td>65</td>
<td>63</td>
<td>89</td>
</tr>
<tr>
<td>Wolf Creek</td>
<td>58</td>
<td>63</td>
<td>63</td>
<td>61</td>
<td>92</td>
</tr>
</tbody>
</table>

*Critical value is the 4th high in 2016 needed to exceed the level of the Ozone NAAQS.
For information on ozone conditions

- DHEC’s daily ozone forecast (April 1 – September 30):


- Get forecasts by signing up for EnviroFlash: [http://www.enviroflash.info/](http://www.enviroflash.info/)
PM$_{2.5}$ Trends
Upstate Air Quality Advisory Committee area ozone exceedances PM$_{2.5}$ Quarterly Averages 2005 - 2014
Other pollutants
Upstate Air Quality Advisory Committee NO₂ 1-Hour Design Values 2010 - 2015

2010 NAAQS

Site Name

ESC
Upstate Air Quality Advisory Committee CO 1-hour Design Values 2011 - 2012

2011 NAAQS
QUESTIONS

Tommy Flynn
Air Data Analysis and Support Section, Bureau of Air Quality
flynntj@dhec.sc.gov
(803) 898-3251
Multi-Pollutant Risk-Analysis & Reduction Strategy for South Carolina

UPSTATE AIR QUALITY ADVISORY COMMITTEE MEETING

TUESDAY, JUNE 14, 2016
Background

• Collaborative effort between EPA, SC DHEC, and the local air coalition “Clean Air Upstate” (CAU) with participation from community and business leaders in ten SC upstate counties (*known as Ten at the Top (TATT)*) to develop and analyze a multi-pollutant, risk-based air quality management strategy.

• Goal was to identify and evaluate a local control strategy to reduce both ozone and PM2.5 precursor emissions as well as target emissions of air toxics of concern for communities to maximize both health benefits and air quality improvements.

• Local emission reduction measures for the Upstate that address multiple pollutants were identified by DHEC, EPA, and CAU/TATT.

• Started under the Advance program and focused on the upstate due to the impending 2015 ozone NAAQS and the local coalition’s commitment to air quality.
Project Details

• Control measures and their costs were identified.

• Air quality modeling was conducted to assess emission reduction effects on ozone, PM2.5, and other pollutants.

• Population risk exposure was assessed using the 2011 National Air Toxics Assessment (NATA) and Benefits Mapping and Analysis Program – Community Edition (BenMAP–CE).
Control Strategy Analysis

• Focused only on non-EGU point and area sources and did not include mobile sources.

• Maximum emissions reductions method was chosen to see what is potentially available in terms of controls and emissions reductions. Conducted a max controls CoST run “robust strategy.”

• Also included local CAU/TATT Strategies: 1) new gas stoves and gas logs and 2) open burning curtailment (both included in the CoST run). Anti-idling was also evaluated as a local control measure, but was analyzed by DHEC separately.
Control Measures

Area Sources

Low NOx Burner (1997 AQMD)
RACT to 25 tpy (Low NOx Burner)
Low NOx Burner
Water and Space Heaters
Curtailment Program, aka “Burn Ban”*
New gas stove or gas logs*
Control Technology Guidelines
LPV Relief Valve
Motor Vehicle Coating MACT
Process Modification
Reformulation (OTC Rule)
Reformulation (Phase II)
Reformulation-Process Modification
Reformulation-Process Modification (OTC Rule)
Solvent Utilization

Point Sources

Low Emission Combustion
Low NOx Burner
Selective Catalytic Reduction
Dry Injection / Fabric Filter System (DIFF)
Wet Scrubber
Add-on controls, work practices, and material reformulation/substitution
Permanent Total Enclosure (PTE)
Solvent Recovery System
Control Strategy Reductions

The breakdown for reductions by pollutant was:

- NOx: almost 1,600 tons reduced (of ~46,000)
- Primary PM2.5: about 200 tons reduced (of ~8,000)
- SO2: almost 800 tons reduced (of ~8,700)
- VOC: almost 3,000 tons reduced (of ~46,453)
Control Strategy Costs

• Total costs for this strategy was ~$20 million ($2011):
  • The breakdown for this cost by pollutant was:
    NOx at $2 million (10% of total cost)
    Primary PM2.5 at $2 million (10% of total cost)
    SO2 at $3 million (14% of total cost)
    VOC at $13 million (66% of total cost)
  • The breakdown by sector was:
    Non-EGU point sources: almost $8 million (40% of total cost)
    Non-point sources: $12 million (60% of total cost)

• The effectiveness of the NOx control measures varied widely based on the cost which ranged from ~$300-$13,000 per ton of emissions reductions.
Photochemical Modeling
The atmospheric chemistry behind the production of ozone is fairly complicated. In order to model the formation of ozone effectively, models must take into account all chemical and meteorological factors present in an expansive air shed.

Ozone is not emitted directly into the air, but is created by chemical reactions between NOx, and VOCs in the presence of sunlight.
Secondary PM2.5

Likewise for PM2.5
Results – PM2.5

Difference in Mean Annual PM2.5 Values
Results – PM2.5

<table>
<thead>
<tr>
<th>Monitor ID</th>
<th>date</th>
<th>Base DV</th>
<th>Future DV</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>450450015</td>
<td>Q4</td>
<td>10.44</td>
<td>9.944</td>
<td>4.8</td>
</tr>
<tr>
<td>450450015</td>
<td>Q1</td>
<td>10.15</td>
<td>9.701</td>
<td>4.4</td>
</tr>
<tr>
<td>450450015</td>
<td>Q2</td>
<td>11.04</td>
<td>10.96</td>
<td>0.7</td>
</tr>
<tr>
<td>450450015</td>
<td>Q3</td>
<td>11.98</td>
<td>11.96</td>
<td>0.2</td>
</tr>
<tr>
<td>450450015</td>
<td>Annual</td>
<td>10.9</td>
<td>10.64</td>
<td>1.9</td>
</tr>
<tr>
<td>450450009</td>
<td>Q4</td>
<td>9.929</td>
<td>9.5</td>
<td>4.3</td>
</tr>
<tr>
<td>450450009</td>
<td>Q1</td>
<td>9.551</td>
<td>9.199</td>
<td>3.7</td>
</tr>
<tr>
<td>450450009</td>
<td>Q2</td>
<td>11.12</td>
<td>11.04</td>
<td>0.7</td>
</tr>
<tr>
<td>450450009</td>
<td>Q3</td>
<td>11.84</td>
<td>11.83</td>
<td>0.4</td>
</tr>
<tr>
<td>450450009</td>
<td>Annual</td>
<td>10.6</td>
<td>10.39</td>
<td>2.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>crustal</th>
<th>Elemental carbon</th>
<th>nh4</th>
<th>Organic carbon</th>
<th>so4</th>
<th>no3</th>
<th>water</th>
<th>salt</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.999</td>
<td>0.9851</td>
<td>0.9972</td>
<td>0.9615</td>
<td>0.9982</td>
<td>0.9764</td>
<td>0.9985</td>
<td>0.9955</td>
</tr>
<tr>
<td>0.9991</td>
<td>0.9843</td>
<td>0.9971</td>
<td>0.9558</td>
<td>0.9982</td>
<td>0.9753</td>
<td>0.9986</td>
<td>0.9944</td>
</tr>
</tbody>
</table>

The biggest reductions occurred in the colder months in the organic carbon species. wood to natural gas control strategy likely had a lot to do with this temporal and species reduction profile.
Results – PM2.5
Results - Ozone

Max Difference in MDA8 Ozone Values
## Results - Ozone

<table>
<thead>
<tr>
<th>Monitor_ID</th>
<th>Monitor_Name</th>
<th>Base_DV</th>
<th>Future_DV</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>450010001</td>
<td>Due West</td>
<td>62</td>
<td>61.7</td>
<td>0.48</td>
</tr>
<tr>
<td>450070005</td>
<td>Big Creek</td>
<td>70</td>
<td>69.8</td>
<td>0.29</td>
</tr>
<tr>
<td>450210002</td>
<td>Cowpens</td>
<td>67.3</td>
<td>67.2</td>
<td>0.15</td>
</tr>
<tr>
<td>450450016</td>
<td>HillCrest</td>
<td>68</td>
<td>67.3</td>
<td>1.03</td>
</tr>
<tr>
<td>450451003</td>
<td>Famoda Farms</td>
<td>65.3</td>
<td>65.2</td>
<td>0.15</td>
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<tr>
<td>450730001</td>
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<td>64.5</td>
<td>64.4</td>
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<td>Clemson</td>
<td>69.7</td>
<td>69.5</td>
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<td>450770003</td>
<td>Wolf Creek</td>
<td>69</td>
<td>68.8</td>
<td>0.29</td>
</tr>
<tr>
<td>450830009</td>
<td>North Spartanburg</td>
<td>73.7</td>
<td>73.3</td>
<td>0.54</td>
</tr>
</tbody>
</table>
Upstate NOx Emissions by Source Category

- **mobile**: 64% 29630 tpy
- **nonroad mobile**: 13% 5950 tpy
- **area**: 8% 3595 tpy
- **rail**: 5% 2218 tpy
- **point**: 10% 4730 tpy

The image contains logos from DHHEC and EPA.
Mobile Source Impacts on Ozone
Mobile Source Impacts on Ozone

Region 1 Onroad Contributions
Mobile Source Impacts on Ozone
Final 2011 NATA
Expected % Cancer Risk Reductions - SC TATT
# Cost-Benefits Analysis

(Millions of 2010 Dollars)

<table>
<thead>
<tr>
<th>Total Air Quality Benefits</th>
<th>PM$_{2.5}$</th>
<th>Ozone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Air Quality Change in any TATT County$^1$</td>
<td>0.251 µg m$^{-3}$</td>
<td>0.106 ppb</td>
</tr>
<tr>
<td>Total Control Strategy Cost</td>
<td></td>
<td>$20$</td>
</tr>
<tr>
<td>Total Benefits of Avoided Mortality and Morbidity (PM: Krewski-Lepeule; Ozone: Bell-Levy)</td>
<td>$92-220$</td>
<td>$3.1-4.4$</td>
</tr>
<tr>
<td>Net Total Benefits</td>
<td></td>
<td>$82-210$</td>
</tr>
<tr>
<td>Benefit-Cost Ratio</td>
<td></td>
<td>4.1-10</td>
</tr>
</tbody>
</table>

$^1$The maximum change for PM$_{2.5}$ is expected at Greenville County, SC; the maximum change for ozone is expected at Spartanburg County, SC.
Avoided PM-Related Deaths

Lepeule et al. study for 25-99 year olds
# PM Benefits and Valuation Summary
(Millions of 2010 Dollars)

<table>
<thead>
<tr>
<th></th>
<th>TATT</th>
<th>South Carolina</th>
<th>Modeling Domain</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Population</strong></td>
<td>930,000</td>
<td>3,000,000</td>
<td>43,000,000</td>
</tr>
<tr>
<td><strong>PM Avoided Deaths</strong></td>
<td>10-23</td>
<td>11-24</td>
<td>16-36</td>
</tr>
<tr>
<td>(Krewski and Lepeule)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>PM Benefits</strong></td>
<td>$92-210</td>
<td>$97-220</td>
<td>$140-320</td>
</tr>
<tr>
<td>(Peters, 3% Discount)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ozone Avoided Deaths</strong></td>
<td>&lt;1</td>
<td>&lt;1</td>
<td>1.0</td>
</tr>
<tr>
<td>(Bell, 2004)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ozone Benefits</strong></td>
<td>$3.2</td>
<td>$4.3</td>
<td>$10</td>
</tr>
<tr>
<td>(Bell, 2004 + Morbidity)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total PM and Ozone Benefits</strong></td>
<td>$95 ($9.3-260)</td>
<td>$101 ($9.8-270)</td>
<td>$150 ($15-420)</td>
</tr>
</tbody>
</table>
Conclusions

• Improving air quality in areas already attaining the NAAQS can yield significant health and associated costs benefits.

• Mobile source reductions should be an area of focus for reduction strategies in the future in this area since mobile source emissions contribute significantly to NAAQS and air toxics levels.

• Reduction efforts to reduce precursors such as nitrogen oxides and other criteria pollutants can have a co-benefit in reducing risks from air toxics.

• Implementing local control strategies in an area with a mix of sources is an important component of successful air quality management programs. In light ever decreasing standards, we will rely on local governments and coalitions to pursue proactive transportation strategies that reduce pollutants...because creating nonattainment strategies will be difficult.