Synopsis of the ASIP $PM_{2.5}$ Sensitivity Study and SO_2/NO_X Equivalency Ratios

In 2006, Georgia Tech performed emission sensitivity studies to examine the impact of emission reductions on regional haze, 8-hour ozone, and annual $PM_{2.5}$ concentrations. This work was performed using model version CMAQv4.4SOAmods on the VISTAS 12 km modeling domain.

The model simulations examined two episodes, a summer episode (June 1 through July 10, 2002) and a winter episode (November 19 through December 19, 2002), and used the 2009 on the way (OTW) Base D VISTAS emissions inventory. Episode days were weighted using classification and regression tree (CART) analyses to create an assessment of $PM_{2.5}$ annual averages.

The simulations assumed 30% emission reductions from the ten VISTAS states (West Virginia, Virginia, Tennessee, South Carolina, North Carolina, Mississippi, Kentucky, Georgia, Florida, and Alabama) as well as three RPOs (MRPO, MANE-VU, CENRAP) for the following emissions categories:

- EGU point SO_2 emissions
- non-EGU point SO_2 emissions
- point NO_X emissions

Various other emission reduction scenarios such as boundary SO_2 and sulfate emissions, ground level NO_X emissions, ground level primary carbon emissions from a variety of regions and areas were also examined.

Annual $PM_{2.5}$ sensitivities to each scenario were calculated for a number of monitors, including an Arlington County monitor (Monitor ID 51-013-0020), a Washington D.C. monitor (Monitor ID 11-001-0043) and a Baltimore County monitor (Monitor ID 24-510-0040). The reduction in $PM_{2.5}$ seen at each monitor was normalized based on the amount of emission reductions for the pollutant targeted in that scenario, creating a ratio of reductions in concentration of $PM_{2.5}$ (ng/m^3) versus reduction in emissions (tons).

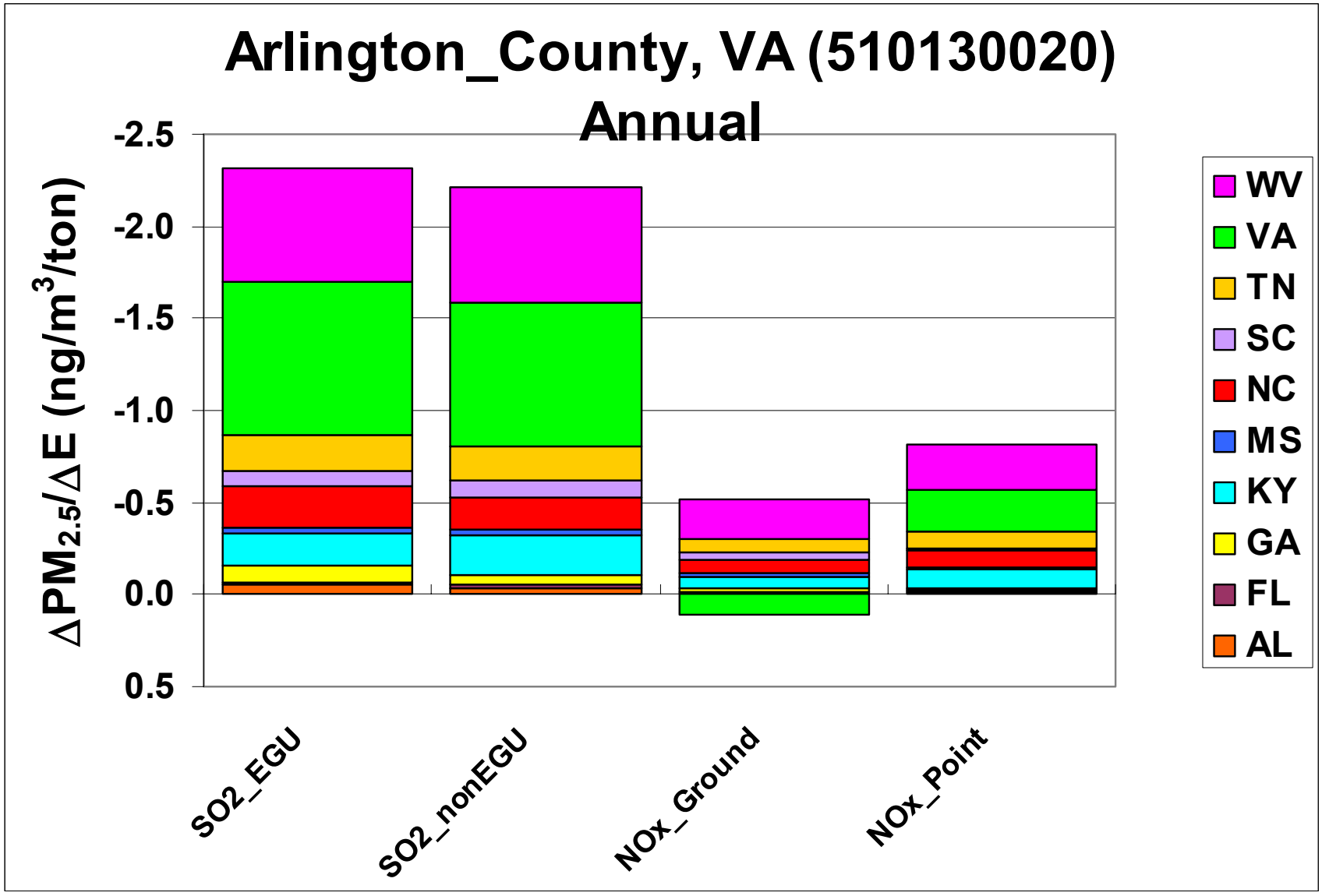
To create a conservative equivalency ratio between SO_2 and NO_X, the normalized annual sensitivities to a 30% reduction of EGU SO_2 emissions and a 30% reduction of point NO_X emissions in Virginia were reviewed. EGU SO_2 emissions are considered the appropriate sensitivity to use since nearly all the SO_2 reductions achieved between 2009 and 2010 are the result of the Clean Air Interstate rules implemented by DC and Virginia as well as the Healthy Air Act implemented by Maryland.

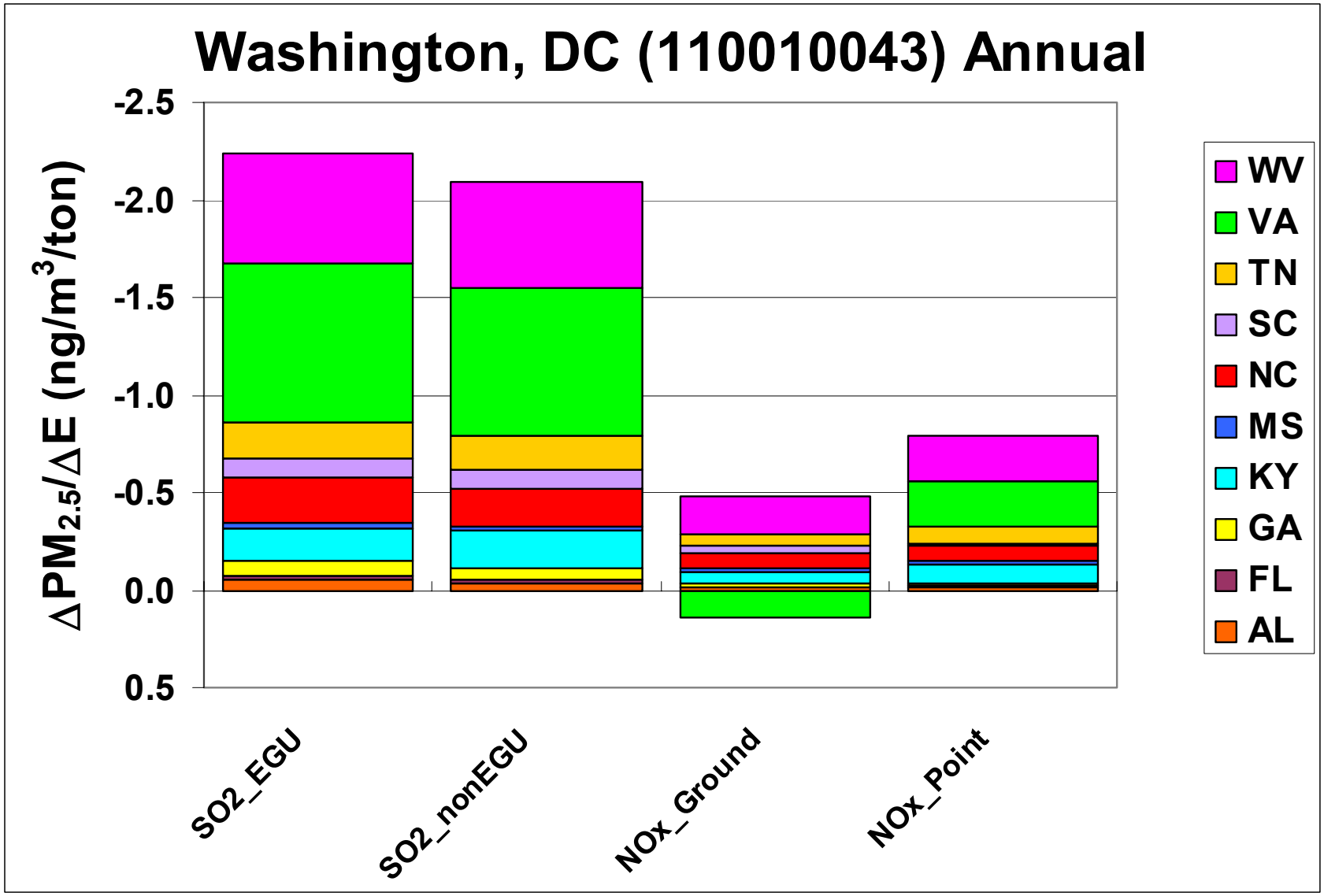
Monitor	$\Delta PM_{2.5}/\Delta E$ (ng/m^3 per ton)		Ratio of normalized EGU SO_2 response to Point NO_X response
	VA EGU SO_2 Emissions	VA Point NO_X Emissions	
Arlington 51-013-0020	-0.833	-0.234	3.6
D.C. 11-001-0043	-0.820	-0.225	3.6
Baltimore County 24-510-0040	-0.680	-0.205	3.3

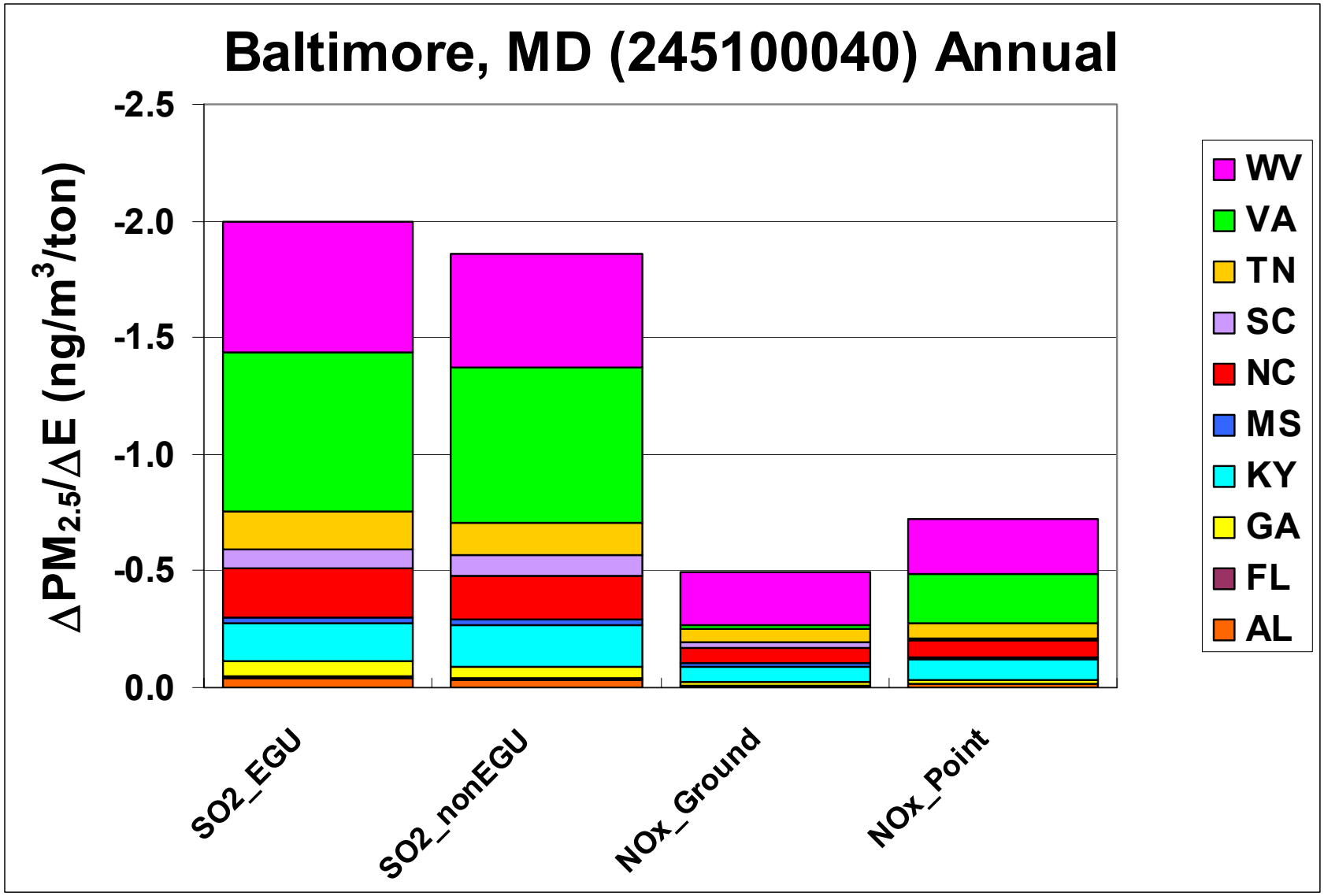
Based on this information, one ton of EGU SO_2 emissions from Virginia reduces the $PM_{2.5}$ concentration at these monitoring sites about the same amount as 3.3 to 3.6 tons of NO_X point source emission reductions.

Graphical representations for each of these monitor's responses on a CART-weighted annual average for $PM_{2.5}$ follow. Data and charts for all sensitivities may be found at the following URL: .

http://www.ce.gatech.edu/research/vistas/xcel/2009_D1/


Arlington_County, VA (510130020)
Annual
ΔPM2.5/ΔE (ng/m3/ton)
-2.5
-2.0
-1.5
-1.0
-0.5
0.0
0.5
SO2_EGU
SO2_nonEGU
NOx_Ground
NOx_Point
WV
VA
TN
SC
NC
MS
KY
GA
FL
AL


Washington, DC (110010043) Annual
ΔPM2.5/ΔE (ng/m3/ton)
-2.5
-2.0
-1.5
-1.0
-0.5
0.0
0.5
SO2_EGU
SO2_nonEGU
NOx_Ground
NOx_Point
WV
VA
TN
SC
NC
MS
KY
GA
FL
AL


Baltimore, MD (245100040) Annual
ΔPM2.5/ΔE (ng/m3/ton)
-2.5
-2.0
-1.5
-1.0
-0.5
0.0
SO2_EGU
SO2_nonEGU
NOx_Ground
NOx_Point
WV
VA
TN
SC
NC
MS
KY
GA
FL
AL