Development of a County Level Portable Fuel Container (PFC) Emission Inventory for VISTAS Based on the U.S. EPA National PFC Inventory

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Background

- To come into compliance with air quality standards, in particular regional haze and ozone standards, State, local and regional air quality planning groups have looked increasingly at smaller more diffuse area sources for potential controls.
- This examination is driven largely by two factors:
  - The overall emission levels of the sources
  - Inability to institute more significant control levels on larger more easily controlled sources since many of these sources are already highly controlled

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Background – PFC Emissions and Control Programs

- Portable fuel containers (PFCs, or gas cans) are consumer products used to refuel a wide variety of gasoline-powered equipment.
- In 2001, California established an emissions control program for gas cans (revised in 2005). Since that time, some other states have adopted the California requirements or instituted similar control programs.
- The U.S. EPA is planning to propose standards to control VOCs as an ozone precursor and also to minimize exposure to VOC-based toxics such as benzene and toluene.
- PFCs are being evaluated for potential controls similar to the California program.
  - Single can is a relatively modest emission source; VOC emissions from estimated 80 million gas cans could be quite significant
  - Left uncontrolled, the evaporative emissions from a gas can are up to 60 times the VOC of a new Tier 2 vehicle evaporative control system.
- PFC emissions largely result from one of three areas:
  - evaporative emissions from unsealed or open containers;
  - permeation emissions from gasoline passing through the walls of the plastic containers;
  - evaporative emissions from gasoline spillage during use.

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Background - VISTAS Interest

- The Visibility Improvement State and Tribal Association of the Southeast (VISTAS) regional planning organization (RPO) is interested in emission sources that can contribute to regional haze and fine particulates
- VOC emissions = secondary organic aerosols (SOAs) which can contribute to regional haze and fine particulates
- Several of the N. VA counties/independent cities in VISTAS region are also part of the OTC which has a PFC control rule in effect (Rule 4-42)
- VISTAS was interested in developing county-level base and future year inventories for PFCs as part of their Base G modeling inventory update
  - PFCs were not included in modeling inventories used by VISTAS prior to Base G
- As a consequence, MACTEC (under contract with VISTAS) was tasked to prepare a county-level 2002 base year and 2009 and 2018 future year projection inventories for PFCs in the VISTAS region

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Methodology

- MACTEC's approach to creation of a county-level PFC inventory was:
  - Make the development as straightforward as possible
  - Produce an inventory that was tied to national estimates
  - Produce the inventory with minimal effort since the timeframe for development to make it into VISTAS Base G inventory was short
- MACTEC determined that there was no existing county-level inventory for PFCs that could be scaled or modified to provide what VISTAS needed
- National inventory (at State level) available from U.S. EPA
  - Published in a draft report entitled "Estimating Emissions Associated with Portable Fuel Containers (PFCs)"
- EPA inventory available for two years, 1990 and 2005

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Methodology – cont'd

- EPA used NONROAD2004 to estimate the seasonal (nonroad) consumption of gasoline by source classification code (SCC) for each state plus the District of Columbia
- Within NONROAD model, each SCC code has a unique usage (commercial versus residential), a unique ratio of the percent of fuel dispensed from PFCs (versus from fuel pumps), and a unique spillage rate (grams per gallon)
  - NONROAD2004 model, the spillage (from PFCs) is assumed to be a constant 17 grams for each refueling event
- Since the fuel tank capacity varies for different pieces of equipment, the spillage rate (in terms of grams per gallon of dispensed gasoline) also varies greatly
- By combining those two outputs of NONROAD2004, EPA was able to estimate (by State) the total quantity of gasoline supplied from PFCs as well as the total spillage from using the PFCs

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Methodology – cont'd

- VISTAS base year is 2002. Although both 1990 and 2002 were available, VISTAS decided to use the 2005 values as surrogates for 2002 and then perform the allocation to the county-level for the base year and projections.
- State-level emission estimates for 2005 were derived from Appendix Table B-2 of the PFC report and used as the starting point for developing 2002 county-level emissions estimates
  - State values for vapor displacement and spillage from refueling operations left out to avoid double counting refueling emissions in the non-road sector
- In Base G inventory VISTAS used NONROAD05 (NR05) model
- Prior inventory versions had refueling emissions (from vapor displacement and spillage) for on-road and non-road sources estimated separately and included in the area source component of the inventory
- Effective with the Base G inventory, refueling estimates were included in the on-road and non-road estimates made with the MOBILE and NONROAD models respectively.
- Thus to avoid double counting, MACTEC only used the State-level emission estimates from the following categories: vapor displacement and spillage from refilling the PFC at the pump, spillage during transport and permeation plus evaporation.

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State-level PFC Emissions for VISTAS States

State	Refilling PFC at Pump		Spillage During Transport	Refueling Equipment		Permeation Plus Evaporation
	Vapor Displacement	Spillage		Vapor Displacement	Spillage	
AL	192.7	15.9	482.8	192.7	944.9	4,685.2
FL	931.4	82.1	2,308.8	931.4	5,232.2	12,159.4
GA	356.8	34.0	986.9	356.8	2,088.3	5,229.9
KY	131.0	12.4	384.5	131.0	704.9	2,931.8
MS	89.4	8.2	262.5	89.4	460.9	2,552.4
NC	426.4	33.1	968.7	426.4	2,047.6	7,896.5
SC	185.2	16.2	471.6	185.2	1,029.0	3,114.2
TN	216.1	19.7	598.3	216.1	1,156.3	4,855.2
VA	337.3	29.9	864.4	337.3	1,937.0	5,046.7
WV	67.9	5.8	188.4	67.9	309.8	2,112.5

Shaded columns were not used in calculating emissions from PFCs since including these emissions could have resulted in double counting.

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Methodology – County-level allocation for 2002 Base year

- MACTEC had seasonal outputs from NR05 model runs for every county in the VISTAS region for 2002, 2009 and 2018
  - Included in these output files was the fuel usage by county, SCC and HP classification
- If linkage could be made between the fuel usage and the fraction of fuel handled by PFCs for each county/SCC/HP classification, then allocation of State-level emissions to county-level could be made using county fuel usage for engines utilizing PFCs for fueling
- The necessary linkage can be found in the NONROAD model SPILLAGE file
  - The SPILLAGE file, (normally found in the \nonroad\DATA\EMSFAC directory), contains information related to the method used to fuel each type of nonroad engine by SCC and horsepower classification.

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Spillage File example

```
SCC_code   Name                                Filled    TnkHp HPmn HPmx   Tech    Units
/EMSFAC/
2260001010 2-Str Offroad Motorcycles           CONTAINER HP       0 9999    ALL    GALLONS
2260001020 2-Str Snowmobiles                   PUMP      HP       1  175    ALL    GALLONS
2260001030 2-Str All Terrain Vehicles          CONTAINER HP       0 9999    ALL    GALLONS
2260001060 2-Str Specialty Vehicle Carts       CONTAINER HP       0    6    ALL    GALLONS
2260001060 2-Str Specialty Vehicle Carts       PUMP      HP       6   25    ALL    GALLONS
2260001060 2-Str Specialty Vehicle Carts       PUMP      HP      25   40    ALL    GALLONS
2260001060 2-Str Specialty Vehicle Carts       PUMP      HP      40  100    ALL    GALLONS
2260002006 2-Str Tampers/Rammers               PUMP      HP       3    6    ALL    GALLONS
2260002009 2-Str Plate Compactors              PUMP      HP       1    3    ALL    GALLONS
2260002021 2-Str Paving Equipment              PUMP      HP       1    3    ALL    GALLONS
2260002027 2-Str Signal Boards/Light Plants    PUMP      HP       1    3    ALL    GALLONS
2260002039 2-Str Concrete/Industrial Saws      PUMP      HP       1    3    ALL    GALLONS

2260002039 2-Str Concrete/Industrial Saws      PUMP      HP       3    6    ALL    GALLONS
```

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Methodology – County-level allocation for 2002 Base year (cont'd)

- All of the SCC and horsepower classes using containers were extracted from the SPILLAGE file and cross-referenced with the fuel usage by county for those SCC/horsepower combinations from the appropriate year model runs (2002, 2009 or 2018)
- Then the fuel usages by county from the NR05 runs prepared for VISTAS were summed for those SCCs by county
- The county level fuel use was then divided by the State total fuel use for the same SCCs to determine the fraction of total State fuel usage and that fraction was used to allocate the State-level emissions to each county.

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Emission Projections – 2009 and 2018

- In order to prepare the 2009 and 2018 emission projections MACTEC used the NR05 fuel use data for nonroad engines using fuel containers as fueling devices to create State-level growth factors
- The State-level growth factors were developed by determining ratios between the 2002 and projection year NR05 fuel usage
- That value was then applied at the State-level to project the 2005 emissions from the U.S. EPA report to the corresponding future year
- The future year State-level emissions were then apportioned to the county-level using the fraction of each county-level fuel usage from the projection year

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Results

- The results for 2002 clearly show that emissions are primarily centered around population centers and that the highest emissions (at both the State and county level) are found in areas with high temperatures and thus high evaporative emissions (FL in particular)
- Data for 2009 and 2018 show similar patterns but with slightly higher emissions overall

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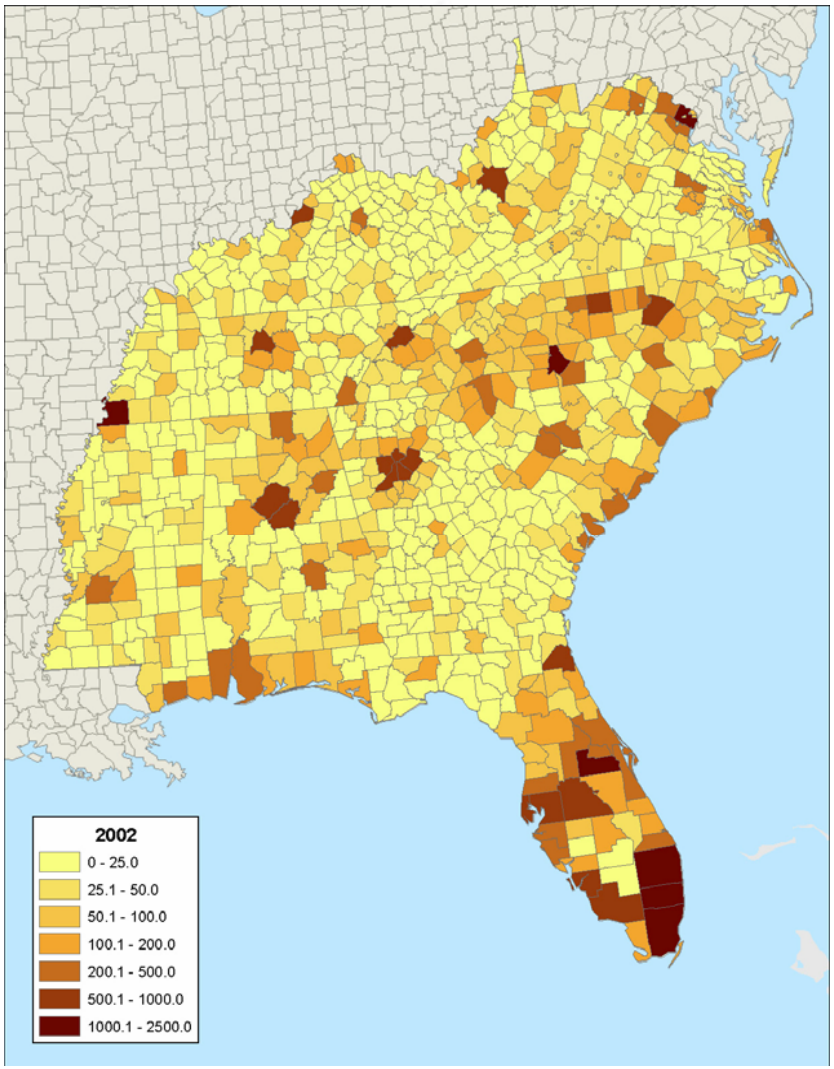
2002 Emissions



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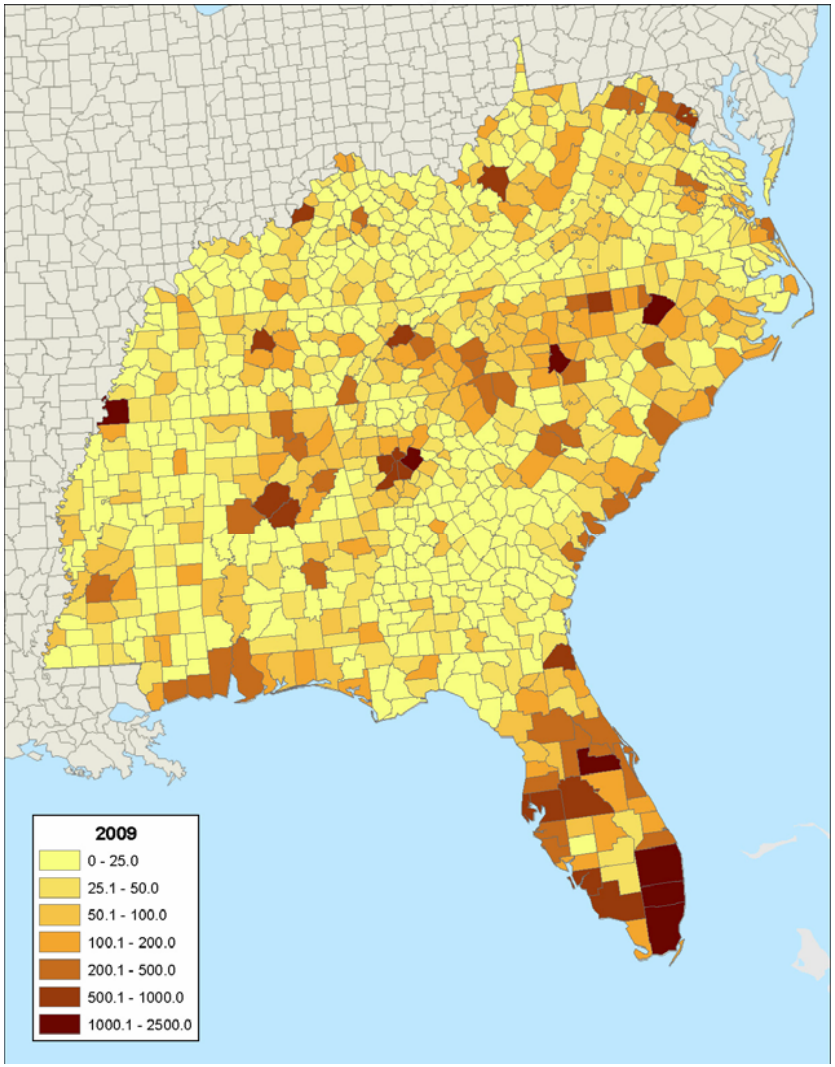
2009 Emissions



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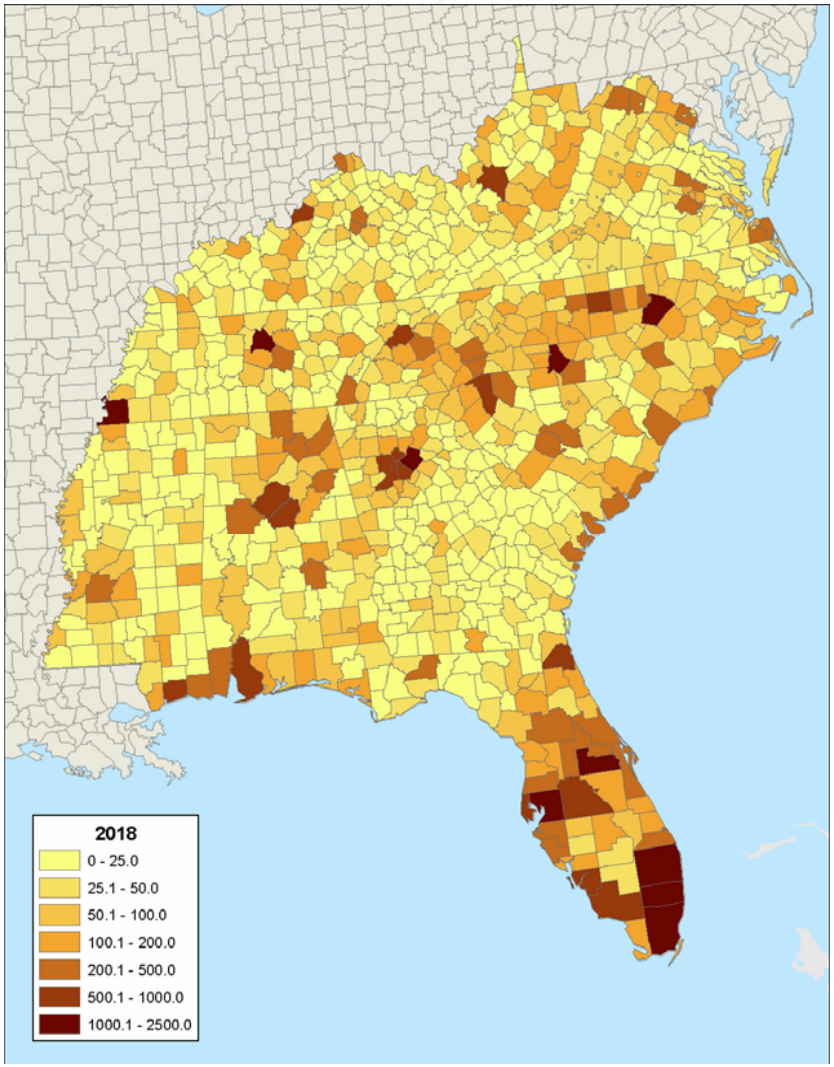
2018 Emissions



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Emissions by State

State	2002	2009	2018
AL	5,376.6	6,135.2	7,138.1
FL	15,481.7	16,319.5	18,932.0
GA	6,607.6	7,232.2	8,413.6
KY	3,459.7	4,021.4	4,678.7
MS	2,912.5	3,522.2	4,111.0
NC	9,324.7	10,184.1	11,815.0
SC	3,787.2	4,094.9	4,738.3
TN	5,689.3	6,430.5	7,471.9
VA	6,278.3	5,872.5	5,806.3
WV	2,374.6	2,946.5	3,442.7
Total	**61,292.2**	**66,759.0**	**76,547.6**

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