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"SOLVENT MASS BALANCE" APPROACH FOR ESTIMATING VOC EMISSIONS FROM ELEVEN NONPOINT SOLVENT SOURCE CATEGORIES

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Abstract

Updated solvent usage data for the year 2002 has been developed for the EPA's Emission Inventory Group for eleven (11) nonpoint source categories that are common to many volatile organic compound (VOC) emission inventories. These categories are: Architectural Surface Coating, Automobile Refinishing, Consumer and Commercial Products, Dry Cleaning, Graphic Arts, Industrial Adhesive and Sealants, Industrial Coating Operations, Pesticide Application, Process Solvents (and other operations), Surface Cleaning (degreasing), and Traffic Paints. The methodology for developing the estimates uses a material mass balance approach that begins with national solvent production and consumption estimates for a category derived from sales and other market data, and accounts for point source contributions using facility estimates submitted to the EPA. National solvent utilization is allocated to states and counties using population and business activity data, as appropriate for the category. This approach to estimating solvent consumption and emissions will be used in the National Emission Inventory (NEI) as the new EPA "Solvent Mass Balance" method for estimating VOC emissions from these sources. The resulting nonpoint source VOC estimates for the 11 categories represent improved emission estimates for a sizeable portion of the overall VOC inventory. This paper describes the new material "Solvent Mass Balance" methodology and compares the new EPA estimates to existing 1999 NEI estimates and 2002 State-submitted estimates for the nonpoint solvent source categories.

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1.0 Introduction and Purpose

The U.S. Environmental Protection Agency's (EPA's) Emission Inventory Group (EIG) compiles the National Air Pollutant Emissions Inventory (NEI), which contains criteria and toxics emissions estimates for a number of source categories. The EIG has an ongoing effort to improve the methods and data resources used to generate emission estimates in the NEI. Some significant nonpoint source categories in the NEI are the solvent usage categories (e.g., architectural coatings, dry cleaning, graphic arts, pesticide use, etc.). Due to process changes and introduction of new technology, the national solvent consumption patterns have changed over time.

Recommended methods for state/local agencies to use in calculating specific nonpoint solvent emissions may be found in the Emissions Inventory Improvement Program (EIIP) nonpoint volume http://www.epa.gov/ttn/chief/eiip/techreport/volume03. Many of the EIIP nonpoint solvent estimating methods and emission factors are based on allocating national solvent consumption data to state and local areas. Other methodologies that have been used in the past are based on *per capita* or employment (in various SIC codes) emission factors.

A "Solvent Mass Balance" methodology for estimating emissions from nonpoint solvent source categories has been developed that uses a material balance approach that begins with total solvent production or sales for a category and accounts for point source contributions, emissions controls, waste management practices, and recycling. This work was done under numerous work assignments under EPA contracts over the last 10 years, with the most recent assignments under Contract No's 68D98046 and 68D0264. The contract officer's representative for the current work assignment is Mr. Dennis Beauregard of the U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina (D205-01).

This paper describes the procedures used to acquire the solvent utilization data used in the "Solvent Mass Balance" approach and to estimate nonpoint solvent source category emissions for 1999 and 2002. Generally, this paper describes how:

- National solvent utilization data was obtained from available marketing reports, distributed into specific solvent emission process activity classifications, and entered into an electronic database as tons per year (tpy) VOC consumed (emissions);

- The VOC solvent emission process data were "grown" to 1999 and 2002, as needed;

- Spatial surrogates were chosen to allocate the VOC estimates to the county level. In this step, the national solvent utilization data were also allocated to North American Industrial Classification System (NAICS) codes that are descriptive of the solvent emission process and to point and nonpoint source SCCs;

- Applicable national regulatory programs and effect of controls were determined and integrated into the VOC estimates;

- The EPA's 1999 and 2002 National Emission Inventories (NEI) for criteria air pollutants were used to represent the point source portion of the VOC emissions estimates for the inventory year, and were subtracted to obtain the nonpoint solvent source category emission estimates; and

- The "Solvent Mass Balance" estimates for 1999 and 2002 were compared against the existing NEI and state-submitted estimates for 2002 (submitted by June 2004).

2.0 Determining Solvent Utilization

The initial steps in the "Solvent Mass Balance" emissions estimation procedure divided the 11 nonpoint solvent source categories into two groups because of the availability and specificity of solvent utilization data. One group consists of four paint and coating (P&C) nonpoint solvent source categories and the other group consists of seven nonpaint (NP) nonpoint solvent source categories. Table 1 shows these two groups.

The solvent utilization data for the source categories were taken from The Freedonia Group's solvent market research reports[1,2,3] in units of million pounds of solvent for the years 1997, 1998, or 2002, as needed for the inventory year. Discussion of how the solvent consumption data were projected to 1999 and 2002 can be found in Section 4 below.

In the Freedonia reports, the solvent data were presented first by chemical group (hydrocarbons, esters, ethers, etc.), then by specific chemical, and then by solvent utilization category. The chemical specificity of the Freedonia solvent consumption data was retained as much as possible in the "Solvent Mass Balance" methodology. Consequently, chemical-specific data are available for six of the seven NP nonpoint solvent source categories: Consumer and Commercial Products, Dry Cleaning, Industrial Adhesive and Sealants, Pesticide Application, Process Solvents, Surface Cleaning. The various solvent chemicals included in the Freedonia data are listed in Table 2. For the seventh NP solvent source category, Graphic Arts, updated

total solvent consumption for the source category was available from a recent Freedonia report.[2] these data, however, did not include a breakdown of solvent by chemical.

In the “Solvent Mass Balance” procedure, the Freedonia solvent data were matched to each solvent nonpoint source category, as possible. In most cases, the Freedonia solvent market categories matched a specific solvent nonpoint source category. The solvent markets where the initial solvent utilization, i.e., purchases, were thought to occur, were examined to ensure that the solvent utilization was allocated to the processes where emissions activity is expected to occur. The solvent VOC utilization was then assumed to be equal to uncontrolled VOC emissions.

In some cases, the solvent utilization process data category in Freedonia for a particular solvent was called “Other.” For these “Other” cases, the background Freedonia information was consulted to determine if the solvent utilization could be assumed to predominantly correspond to one or more of the nonpoint solvent source categories. In most cases for a particular solvent, only a small amount of solvent utilization was noted in Freedonia for the “Other” category as compared to the specific end uses listed in Freedonia.

For the nonpoint solvent source categories of "Pesticide Application" and "Process Solvents," most of the solvent utilization was considered to be a part of the "Other" category designated by Freedonia for the individual solvents, based on the Freedonia descriptions of the processes included in the "Other" category. Table 3 shows specific solvent chemicals in the Freedonia data that are distributed to "other" end uses, and allocated to the "Pesticides" and "Process Solvents" nonpoint solvent source categories. In the Consumer and Commercial Products nonpoint source solvent category, the only antifreeze and deicer solvent data from Freedonia used in the”Solvent Mass Balance” estimate was for methanol, since the other solvent compounds were assumed to be recycled and/or to not volatilize.

Only total P&C solvent consumption was available in Freedonia. For three of the four P&C nonpoint solvent source categories (Automobile Refinishing, Industrial Coating Operations, and Traffic Paints), the fraction of the total P&C solvent consumed by the individual P&C source categories was estimated from a National Paint and Coating Association (NP&CA) report on solvent use[4] as follows: Automobile Refinishing, 0.030; Industrial Coating Operations, 0.291; and Traffic Paints, 0.022. To estimate solvent use for these three P&C source categories, the solvent fraction was multiplied by the total Freedonia P&C solvent consumption to obtain an estimate of solvent consumption for each of the three solvent source categories. For the Architectural Surface Coating nonpoint source solvent category, the solvent consumed in 1997 and 2002 was listed separately in a 2003 Freedonia report.[2]

Table 4 shows the solvent consumption estimated for 1998 for the 11 nonpoint solvent source categories using data from the marketing reports described above.

3.0 Background National Market Solvent Consumption Information

The analysis of the solvent market descriptions is a first step to understanding where the solvent data originates that results in nonpoint solvent consumption and emissions estimates. In general, the universe of potential solvent users and emitters falls into three groups as follows:

(1) Manufacturers that buy and use the solvent as a surface coating to produce/manufacture their products, are included in the Freedonia or NP&CA "market," but do not emit much solvent. These end-uses may be described by NAICS manufacturing codes and are not considered a description of where the emission activity occurs.

(2) Manufacturers that buy and use the solvent to produce/ manufacture their products, are included in the Freedonia or NP&CA "market," and do emit some solvent. These end-uses may be described by NAICS codes for both manufacturing and nonmanufacturing solvent emitting activities. Many of these NAICS industrial operations are characterized as point source solvent emission activities.

(3) Nonpoint source (nonmanufacturing) end-users who do not buy the solvent directly, are usually not identified in the Freedonia or NP&CA "market," but do emit solvent. The one exception is dry cleaners, an industrial/commercial operation that purchases solvent directly, is noted as a Freedonia "market," and also represents end-use solvent emissions.

Some manufacturing categories and market descriptions are industries that use surface coatings to produce their products. For instance, there is no separate manufacturing category for painting new car bodies, just for manufacturing the new car bodies. The car body manufacturers use a lot of paint to produce their product, and process emissions are clearly characterized methodologically as a point source activity, rather than a nonpoint source activity. This same reasoning applies to flatwood manufacturing/coating, paper manufacturing/coating, etc.

Similarly, the people that produce Architectural Surface Coating paints are paint manufacturers that are the "markets" for the solvents, as reported by Freedonia. The place where most of the Architectural Surface Coating solvents get emitted is within commercial operations, and is used for spatial allocation. For Architectural Surface Coating, these are the paint "users." In this case, the paint users are not the "markets" that utilize or buy the solvents as reported in Freedonia and the NP&CA reports.

A detailed analysis of the solvent market descriptions and the NAICS codes assigned to these markets is included in the documentation for this project which can be found at http://www.epa.gov/ttn/chief/net/2002inventory.html#nonpoint.

4.0 Growth Projections

As explained above, data on solvent consumption were not available for all of the nonpoint solvent source categories for the target inventory years of 1999 and 2002. Therefore, in many cases, it was necessary to project or "grow" the solvent consumption data to 1999 and 2002. As discussed in the section above, the underlying solvent consumption data were derived from national estimates taken from Freedonia reports.[1,2,3] Therefore, the solvent growth estimates were also derived from data in the Freedonia reports, since these data were expected to be the most compatible with the underlying solvent consumption data. The EPA is updating their Economic Growth Analysis System (EGAS) model which will include more specific growth rate data than that used previously. The EGAS model is expected to eventually be one of the more consistent tools for purposes of projecting growth into future years.

In the procedure used to "grow" the solvent consumption data from 1997 or 1998, solvent consumption estimates were obtained from Freedonia reports for future years 2002 [2,3] or 2003[1] and an annual growth rate was calculated assuming proportional growth during the period. Solvent consumption in the target years was then obtained by multiplying the base year by the annual growth rate (expressed as a fraction) and the number of years between the base year and the target year. For example, to estimate growth from 1999 to 2002, the annual growth rate (percentage divided by 100) was multiplied by a factor of three and then multiplied by consumption data for 1999.

Since chemical-specific solvent data was obtained for six of the seven NP solvent source categories from the 2000 Freedonia report,[1] the detail in this report was retained as much as possible by growing the data for 1998 to 1999 using the growth estimates in the Freedonia reports. For the Architectural Surface Coating, Automobile Refinishing, Industrial Coating Operations, Traffic Paints, and Graphics Arts solvent source categories, data for 2002 were used directly without the use of growth rates.

Table 5 shows the annual growth rates (in percent) and the Freedonia industry market categories used to calculate these growth rates for the nonpoint solvent source categories, referenced to the Freedonia reports where the growth projections were taken. The trend toward negative growth rates, i.e., less use of solvent for the 2002 growth rates is expected due to the trend toward lower rates of solvent consumption as water-based and other environmentally friendly products have been developed. The slowing in negative growth rates is also expected for some industries where the effect of promulgated and expected EPA regulations occurred in the late 1990's.

Table 4 above also shows the projected solvent consumption estimates for 1999 and 2002 for the nonpoint solvent source categories, using the growth rates in Table 5 and the procedures described above.

5.0 Effect of National and Local Regulations on the Solvent Mass Balance Estimates

5.1 Effect of National Rules

The national regulations considered applicable to emissions estimates for the nonpoint solvent source categories are the NESHAP rules. The nonpoint source solvent process categories (and subcategories) found to have applicable NESHAP rules were Degreasing and Dry Cleaning. However, the controls required for these NESHAP are nondestructive and, therefore, have the effect of reducing solvent demand. This reduced demand will be reflected in the national solvent consumption data used in the "solvent mass balance" approach and does not need to be otherwise incorporated into the emission estimating procedures.

There also are three national VOC rules (Clean Air Act Section 183(e)) that effect the nonpoint solvent source categories: Architectural Coatings, Automobile Refinish Coatings , and Consumer Products. However, the regulated entity in these rules is the manufacturer, distributor or importer. The users are not the regulated entity, and are only affected by the rule in terms of their material choices and material costs. These VOC rules serve to reduce the amount of solvent in the coatings purchased at the national (and state and county) level. The effect of these national VOC rules on the amount of solvent used at the county level will already be incorporated into national-level solvent use data and need not be addressed for emissions estimates made using the "solvent mass balance" approach.

5.2 Effect of State and Local Rules

Another step in estimating state/county nonpoint source emissions from solvent use in a "solvent mass balance" approach, is accounting for state and/or local (S/L) regulations. Because some regulations are only applicable to specific states or localities (i.e., counties), the effect of these regulations need to be addressed by the state/local agencies preparing the emissions estimates. Control estimates should be updated annually to account for any changes, such as increases in rule effectiveness and, perhaps, rule penetration. The S/L regulations could affect the amount and/or distribution of solvents used in the respective local areas. However, add-on control measures for the solvent nonpoint source categories are not likely to result in destructive control devices.

6.0 Spatial Allocation Procedure

Spatial allocation of the U.S. solvent utilization to the county level was performed using either employment, by NAICS code, or population as a spatial surrogate. State and county Federal Information Processing Standard (FIPS) codes were used to identify each state/county in the spatial allocation step.

In the current analysis, population was used as the surrogate for one of the 11 nonpoint solvent source categories and employment was used as the surrogate for eight of the nonpoint solvent source categories. For two of the nonpoint solvent source categories, a combination of

both population and employment were used. The spatial surrogates used for the nonpoint solvent source categories are shown in Table 6.

Employment was used for those nonpoint solvent source categories where employment was determined to be a better surrogate measure of activity than population and, therefore, directly related to where the emissions occur for these solvent utilization processes. Table 6 includes a list of the NAICS codes chosen for the nonpoint solvent source categories where employment is used as a spatial surrogate.

For those nonpoint solvent source categories where employment was used as a spatial surrogate, information was obtained from U.S. Department of Commerce, Census Bureau's 1997 "County Business Patterns" to derive a SAF equal to the proportion that the total (mid-March) employees in each NAICS code in the county were out of the total U.S. (mid-March) employees for the SIC/NAICS code. Solvent utilization was then allocated to the county level by multiplying the U.S. total solvent utilization by the county SAF for the NAICS codes in the nonpoint solvent source category.

The choice of NAICS code for each source category was made based on the end use descriptions of the solvent utilization category in the market literature and the NAICS code description that best describes where the solvent emission producing activities are expected to occur. Some of the NAICS employment surrogates listed in Table 6 may be more oriented toward point source emission activities, for example, all manufacturing NAICS codes in Table 6, such as NAICS 3221 (Paper Mills) and NAICS 32311 (Printing). In the point source subtraction step of this "Solvent Mass Balance" estimating procedure, the emissions related to these point source activities are subtracted leaving only the nonpoint source activity.

For the nonpoint solvent source categories where more than one NAICS code was assigned to represent different end-use activities within the category, the solvent utilization data were apportioned to each NAICS code based on financial information from the 1992 Department of Commerce's Bureau of Economic Analysis (BEA) "Benchmark Input/Output Accounts" tables[5] for each industry. There were no more recent data available at the time of this study. The BEA data were considered a good source of information on the relative use of solvents (based on costs), whereas the Freedonia and Census data were considered a better source for the total quantity of solvent consumed. Therefore, the BEA data were used to distribute the total solvent utilization data amongst the industries known to use the solvents, i.e., among the NAICS codes assigned to each solvent nonpoint source category.

Where population was used as a spatial surrogate, the solvent utilization data were allocated using the proportion that the county's population was out of the total U.S. population for the target years (1999 and 2002). This proportion is called the spatial allocation factor (SAF). County solvent use for these nonpoint solvent source categories was obtained by multiplying the total U.S. solvent utilization for the solvent nonpoint source category by the SAF. For the Consumer and Commercial Products solvent nonpoint source category, because the use of these

products is ubiquitous in the general population rather than connected to specific industrial sectors, population counts were used as the only surrogate to represent where the emissions occur.

For the Pesticide Application solvent nonpoint source category, only half of the solvent was apportioned using population (with the 1:1 ratio an approximation of the distribution), since the solvent use in this category was thought to be partly explained by population but also partly a function of employment trends (by NAICS code). For the Architectural Surface Coating solvent nonpoint source category, a 60:40 split between employment by painting contractors (NAICS 23521) and the population was used to apportion the solvent use in this category between commercial use and home owner use based on information obtained during development of the Architectural Coating National Rule.[6]

7.0 Assignment of Solvent Consumption to Source Classification Code (SCC)

Point and nonpoint SCCs are used to further characterize each of the 11 nonpoint solvent source categories as emission processes. Table 7 lists the primary point-to-nonpoint SCC correspondence, and includes descriptions of the nonpoint SCCs. The complete point-to-nonpoint SCC correspondence can be found in the documentation for the project, at http://www.epa.gov/ttn/chief/net/2002inventory.html#nonpoint, and includes descriptions of the point SCCs. In some cases, chemical-specific (sub-level) SCCs were used to characterize the solvent data where available by specific chemical. The purpose of retaining the chemical detail available is to provide information that may help to correlate estimation methods for total VOC and specific HAP emissions in the future as the need arises.

After the spatial allocation and SCC assignment steps, the amount of solvent used at the county level was summed back up to the national level as a check to ensure that the total solvent allocated equaled the original amount of national market solvent utilized.

8.0 Point Source Subtraction Step

Since the national solvent utilization data corresponds to both point and nonpoint solvent emissions sources, it was necessary to subtract the point source component to obtain the nonpoint solvent emissions. The NEI was used as a reference to determine the point source component of uncontrolled solvent VOC emissions. The NEI contains estimates of point source process emissions including some control information. Note that the spatial allocation procedure allocating the solvent consumption to the county level was performed before the point source component was subtracted. One reason for this step was that the point source control efficiencies for a process may vary on the county level. There were also other reasons for performing the point source subtraction at this point in the calculations that will become apparent in the discussion below.

8.1 Matching Point SCC to Nonpoint SCC

The point source VOC emissions estimates in the NEI are organized by point SCCs The national solvent utilization data were characterized in terms of nonpoint SCCs To estimate the amount of point source VOC consumption to subtract out of the total county VOC consumption, the point SCC from the point source inventory must be first matched with an appropriate nonpoint SCC for the same solvent process. The point-to-nonpoint SCC correlations for the solvent source categories used in this step are shown in Table 7.

8.2 Identification of Point-only and Nonpoint-only Source Categories and SCCs

To enhance the accuracy of the point source subtraction step, the solvent source categories, their SCCs, and the corresponding NEI point source emissions estimates were examined to determine if any solvent source category or SCC can be identified exclusively as a "point source only" or "nonpoint source only" source category or SCC.

First it was determined which solvent source categories were expected to have no point source component. For these source categories, the solvent consumption was directly allocated to the nonpoint SCCs, spatially allocated to counties, and was not included in the point source subtraction step. The five solvent source categories identified in Table 7 as having no applicable point SCCs are as follows: Architectural Surface Coatings, Automobile Refinishing, Consumer and Commercial Products, Pesticide Application, and Traffic Paints.

Next, the solvent source categories were examined to see which were expected to have some very clear and distinguishable solvent consumption associated with a "point source only" activity (expressed as a point SCC) without a nonpoint source counterpart. Some potential examples include: the portions of the industrial coating source category with the SCCs for automobile original equipment manufacturing (OEM), ship and boat building, and major household appliance manufacturing; and the portion of the graphic arts source category with publication, and product and packaging rotogravure SCCs. If these source category/SCC combinations and their respective solvent emissions were expected to be from point sources only, the national solvent VOC consumption allocated to these SCCs would then be allocated to point source activities only and thereby excluded from the nonpoint source portion in the point source subtraction procedure. For the current analysis, there did not appear to be sufficient information available that could identify an SCC as exclusively a point source prior to examination of the NEI inventory, since it was possible that there could be some nonpoint sources for all the SCCs.

Finally, for the remaining solvent source categories and SCCs, where exclusive point or nonpoint activity could not be identified from the solvent source category and/or SCC descriptions alone, the point source inventory was examined in all geographic regions to determine if further "point source only" SCCs could be identified for SCCs in specific counties. In this procedure, the NEI was examined to determine SCCs where there were only a few facilities with less than 70 to 100 tpy emissions, where 100 tpy is the traditional regulatory point

source cut off value. A range of values to as low as 70 tpy was examined so as to include areas where point sources voluntarily reduce their emissions below the regulatory cut off.

Upon examination of the inventory, only one point and nonpoint SCC combination, automobile original equipment surface coating (SCC 402016: Surface Coating Operations, Automobiles and Light Trucks; and nonpoint SCC 2401070000, Surface Coating, Motor Vehicles (SIC 371)) fit the criteria as likely to be exclusively point sources. Therefore, this point and nonpoint SCC combination was eliminated from the nonpoint SCC list before the point source subtraction step.

8.3 Calculating Uncontrolled Point Source Emissions/solvent Consumption

The point source VOC data in the NEI include some process control information in the form of controlled emissions. For VOC annual emissions where specific controls were indicated in the NEI and/or a control efficiency (CE) was provided, the VOC emissions were assumed controlled. Uncontrolled point source VOC emissions must be determined from the controlled point source VOC emissions and the reported VOC control efficiencies in the NEI. Uncontrolled VOC emissions were then considered equal to solvent consumption.

8.4 Direct Use of Point Source Estimates as Uncontrolled Emissions

For point source VOC emissions in the point source component of the NEI with no control devices indicated, the point source VOC emissions were assumed to be uncontrolled and were subtracted directly from total consumption in the point source subtraction step. If point source VOC estimates are found with annual throughputs reported for an SCC that designates the pure solvent, e.g., toluene, and the throughput can be converted to tons, the resulting throughput could be used directly to represent uncontrolled emissions for the point source subtraction step. This can be done regardless of whether control devices or control efficiencies are reported. However, unless the throughput data are in units that are solvent-specific, e.g., gallons of toluene, the reported throughput is likely to be in terms of a process material that can not be easily identified in terms of the amount of solvent VOC, such as “gallons of raw material.” This latter situation was found to be the case in a number of SCCs examined in the NEI. And because the number these SCCs were numerous, this procedure was not performed in the current analysis.

8.5 Back-calculation of Uncontrolled Emissions from Controlled Emissions for Point Sources

For point source data with control devices, the control devices were identified as either destructive or nondestructive by examining the primary control code in the point source inventory. The destructive controls destroy the VOC via the destructive control techniques such as of evaporation and combustion, rather than those devices such as cooling coils and chillers that do not utilize destructive control processes. If the point source VOC control devices were not destructive, the solvent was assumed to be used at some other point in the process,

contributing to the overall solvent consumption at the source. In this case, the controlled VOC emissions were treated as uncontrolled VOC emissions in the point source subtraction step, as were the VOC emissions from solvent sources without control devices.

For the point source VOC emissions with destructive control devices, the reported CE value was used to back-calculate the uncontrolled emissions for use in the point source subtraction step. For point source VOC emissions in the NEI where control devices were reported but no CE value was provided, the VOC emissions were assumed to be controlled. Because there was no CE to use, a conservative CE of 70 percent was applied for all these instances to back out uncontrolled point source VOC emissions for use in the point source subtraction step.

For point source VOC control devices that are destructive, the control efficiency factor for each point source, *I* (CEF_i), was calculated as below:[a]

$$CEF_i = 1/(1 - (eff/100))$$

where,

CEF_i	=	Control efficiency factor for each point source, *I*
eff	=	VOC control efficiency from the NEI point source inventory (percent)

Uncontrolled point source VOC emissions (in tons) were obtained by multiplying the point source controlled VOC emissions by the CEF_i. The results were the uncontrolled individual point source VOC emissions.

8.6 Thinning and Oven Processes

Point source estimates with SCCs associated with "thinning" or "oven" codes were distributed to nonpoint SCCs according to the groupings shown in Table 8. These groups represent all the processes that are involved with either thinning process emissions or oven process emissions. The point source NEI emission estimates were allocated to nonpoint SCCs by summing up the controlled emissions for all point source SCCs associated with either the thinning or oven group shown in Table 8, and allocating a portion of this total to each within the group. The portion of the total point source emissions (within an SCC) that should be correlated to any one SCC is equal to the proportion that the solvent consumption associated with each SCC represents out of the total national solvent consumption for the group.

[a] Rule effectiveness was not included in these calculations because of the expected high variability of its applicability in the NEI.

For example, for the "thinning" group with 12 nonpoint SCC's, each SCC listed was assigned 1/12 or 0.083 of the nonpoint solvent consumption, so each SCC was also assigned 0.083 of the total aggregate of the point source VOC emissions for all 30 point source SCCs found for the "thinning" group. This procedure is shown mathematically below.

$$VOC_{Pt-SCC} = (VOC_{TCA-i} / \sum_{i=1}^{group} VOC_{TCA-i}) * VOC_{Pt-SCC}$$

where,

$VOC_{Pt-ASSC-I}$	=	County point source VOC controlled emissions correlated to nonpoint SCCs, *I*, in the group;
VOC_{TCA-I}	=	"Total county solvent consumption in nonpoint SCCs (target year) in tons" estimates for each "Nonpoint SCC," *I*, in the group "thinning" or "ovens" (see Table 8).
VOC_{Pt-SCC}	=	Total county controlled point source VOC emissions from the point source portion of the NEI for all the SCCs in the group (see Table 7).

The resultant $VOC_{Pt-ASCC-I}$ for nonpoint SCCs within the same group ("thinning" or "ovens") are the total controlled county point source VOC emissions correlated to both point and nonpoint SCCs.

8.7 Final Point Source Subtraction Step

The total county uncontrolled point source VOC emissions for all point sources/stacks in the county with the same SCC were then obtained by summing the uncontrolled individual point source VOC emissions, determined as described above, for all point sources in the county with the same SCC. Since VOC consumption is assumed equal to (uncontrolled) VOC emissions, the total uncontrolled county point source VOC emissions by SCC were then equal to the total county point source VOC consumption for all SCCs. The total county point source VOC consumption by SCC in the NEI was then subtracted from the total county VOC consumption by SCC to produce the total county nonpoint VOC consumption by SCC.

Note that in this last step, where the county point source VOC consumption by SCC was subtracted out of the total point plus nonpoint county VOC consumption by SCC, if the results were negative a zero was assigned to that nonpoint SCC in that county. The "zero-ing" of data can be done on the state or county level, with the recognition that the point source estimate is then not mass balanced. Although this step can make a large difference in the values for point source consumption estimated from the "Solvent Mass Balance" method as compared to the point source inventory, the impact this zero-ing step has on the resultant "Solvent Mass Balance" nonpoint estimate is usually not significant. The results of the zero-ing step were also examined

before the nonpoint consumption estimates were considered final to ascertain that the amount and/or extent of zero-ing was consistent with the magnitude of the nonpoint inventory and the overlap between the point and nonpoint inventories.

Also, due to the potential misassignment of point to nonpoint SCCs and/or point source NEI emission estimates, the effect of zero-ing would cause a different value for the national nonpoint VOC consumption to be obtained if an estimate of total national point source VOC consumption was subtracted from the total national VOC consumption. Consequently, the total national point VOC consumption should not be obtained by summing the county point VOC consumption, due to the reasons described above.

9.0 "Solvent Mass Balance" VOC Estimates for 1999 and 2002 and Comparisons to Existing 1999 NEI and 2002 State-submitted Estimates

The "Solvent Mass Balance" technique was used to estimate VOC for the 11 nonpoint solvent source categories for 1999 and 2002. The "Solvent Mass Balance" estimates were then compared to the existing 1999 NEI estimates for these same source categories and also the 2002 estimates submitted by 36 states and the District of Columbia (hereafter referred to as the "37 states").

9.1 "Solvent Mass Balance" VOC Estimates for 1999 and 2002

The solvent consumption and VOC emissions for 1999 and 2002, respectively, estimated using the "Solvent Mass Balance" method are shown in Tables 9 and 10 for the 11 solvent nonpoint source categories. For 1999, solvent consumption for the 11 solvent nonpoint source categories is estimated to be 3.7 million tons, the solvent point source emissions subtracted are 0.24 million tons, leaving a total nonpoint solvent VOC emissions estimate for 1999 of 3.5 million tons. For 2002, solvent consumption is estimated to be 3.6 million tons, the solvent point source emissions subtracted are 0.25 million tons, leaving a total nonpoint solvent VOC emissions estimate for 2002 of 3.4 million tons. These estimates show a slight decrease (100,000 tons) of total solvent use from 1999 to 2002 for the 11 nonpoint source categories. Among the 11 solvent nonpoint source categories, the majority of the source categories also show a slight decrease from 1999 to 2002 in the "Solvent Mass Balance" estimate, with only one source category increasing slightly. Overall, no significant changes are evident in the estimated emissions for any of the solvent nonpoint source categories from 1999 to 2002. Figure 1 shows the distribution of the 3.6 million tons of solvent VOC consumption for 2002 among the 11 nonpoint solvent source categories as estimated using the "Solvent Mass Balance" method. The highest solvent consumption was in the source categories of Consumer and Commercial Products (27.8 percent), Process Solvents (20.0 percent), Architectural Surface Coating (11.7 percent), and Industrial Solvents (10.8 percent). The lowest categories were: Dry Cleaning (0.6 percent), Traffic Paints (0.8 percent), and Automobile Refinishing (1.1 percent).

9.2 Comparison of the "Solvent Mass Balance" to the Existing NEI 1999 Estimates

The "Solvent Mass Balance" VOC estimates for 1999 for the 11 solvent nonpoint source categories are compared to the existing 1999 NEI estimates in Table 11. The total "Solvent Mass Balance" estimate, at 3.5 million tons, is approximately 20 percent higher than the NEI estimate of 2.8 million tons for the 11 solvent nonpoint source categories. These 11 solvent source categories are significant on the national level, since they comprised approximately almost a quarter (23 percent) of the VOC emissions in the NEI in 1999.[7]

For eight out of the 11 source categories (Architectural Surface Coating, Consumer and Commercial Products, Dry Cleaning, Graphic Arts, Industrial Adhesive and Sealants, Pesticide Application, Process Solvents, and Surface Cleaning), the "Solvent Mass Balance" estimate for 1999 is higher. For the other three source categories (Automobile Refinishing, Industrial Coating Operations, and Traffic Paints), the NEI estimates are higher.

9.3 Comparison of the 2002 "Solvent Mass Balance" to the State-submitted Estimates

Of the 37 states that submitted emissions estimates for 2002, emissions were not estimated for all of the source categories. The number of solvent nonpoint source categories addressed by each of the 37 states ranged from one source category to nine, with an average of six solvent nonpoint source categories. In terms of the individual solvent source categories, the number of states that submitted estimates for 2002 ranged from a low of five (for Dry Cleaning) to a high of 31 (for Industrial Coating Operations).[b]

Table 12 shows that the submitted emissions estimates by the 37 states for selected nonpoint solvent source categories is 1.5 million tons, whereas the new EPA emissions estimated by the "Solvent Mass Balance" procedure for the same 37 states for the same source categories are more than 1.8 million tons. The ratio of this "Solvent Mass Balance" estimate to the state-submitted estimates is 1.2, which is the same ratio as the existing 1999 NEI and the "Solvent Mass Balance" estimate for 1999 (shown above in Table 11).

Table 12 also shows the total 2002 emissions estimates submitted by the 37 states for each solvent nonpoint source category. Table 12 shows the VOC emissions estimated by the "Solvent Mass Balance" procedure for the 14 states that did not submit estimates and then, by summation, the total VOC emissions estimated for each solvent nonpoint source category with the "Solvent Mass Balance" procedure. The "Solvent Mass Balance" solvent nonpoint source VOC emissions estimates for the states that did not submit emissions estimates are almost half

[b] The estimates submitted by Washington state for Architectural Coatings were erroneously omitted in this analysis.

(at 1.5 million tons, or 45 percent) of the total "Solvent Mass Balance" VOC estimate for 2002, at 3.4 million tons.

9.3.1 Ranked Solvent Emissions Estimates for 2002--Tables 13 and 14 show the emissions estimates for the 11 solvent nonpoint source categories ranked by either the ratio of the two emissions estimates (Table 13) or by their difference in emissions (Table 14).

The ratios shown in Table 13 are likely to reflect the similarities and differences between the emission estimating methodologies used by the states as compared to the "Solvent Mass Balance" procedure. High ratios are likely a reflection of large differences between the state and the "Solvent Mass Balance" methodologies. On the other hand, differences in the VOC emissions estimates between the state-submitted estimates and "Solvent Mass Balance," as shown in Table 14, reflect the relative impact that the two estimates have on the total VOC inventory estimate for the solvent nonpoint source categories, regardless of the differences in ratios. For example, the highest ratio difference in emissions estimates between the "Solvent Mass Balance" and the state-submitted estimates shown in Table 13 is for the Dry Cleaning solvent nonpoint source category with a ratio of 10. However, the difference in the emission estimates is only 1,457 tons, which is only 0.1 percent of the total state-submitted estimates and 0.04 percent of the total VOC estimate for the solvent nonpoint source categories. This example shows that the methodology used by the states and the "Solvent Mass Balance" for Dry Cleaning is likely to be very different, but the impact that this difference has on the total solvent inventory is very small.

In terms of the ratios between the two emissions estimates, the state-submitted estimates are the highest in the assessment of the Automobile Refinishing solvent nonpoint source category, where the ratio is 3.4. The"Solvent Mass Balance" estimate is highest, in terms of ratio to the state-submitted estimates, in the assessment of the Dry Cleaning nonpoint source category, where the ratio is 10.

The state-submitted estimates for Industrial Coating, shown in Table 14, have the highest emissions difference from the "Solvent Mass Balance," at 330,567 tons, which is more than 20 percent of the total state-submitted estimates for the solvent nonpoint source categories. The "Solvent Mass Balance" estimate for Consumer and Commercial Products nonpoint source category has the highest emissions difference, at 373,238 tons, which is more than 20 percent of the overall "Solvent Mass Balance" estimate for the states that submitted estimates.

Overall, the states submitted higher emissions estimates than the "Solvent Mass Balance" for the solvent nonpoint source categories of Automobile Refinishing, Industrial Coating, Pesticide Application, Surface Cleaning, and Traffic Paints. The "Solvent Mass Balance" procedure has a higher emissions estimate than the states for the source categories of Architectural Surface Coatings, Consumer and Commercial Products, Dry Cleaning, Graphic Arts, Industrial Adhesives and Sealants, and Process Solvents. Figure 2 illustrates this emission estimate

difference between the 2002 state-submitted estimates and the "Solvent Mass Balance" estimates for each of the 11 solvent nonpoint source categories.

These comparisons show that although the "Solvent Mass Balance" estimate differs from the state-submitted estimates on a source category basis, the differences have a balancing effect so that the difference in the overall estimate submitted by the states as compared to the "Solvent Mass Balance" is within 20 percent. This points to the possibility that the "Solvent Mass Balance" estimate may be correctly estimating total solvent use, but that the differences between the state-submitted estimates and the "Solvent Mass Balance" estimates are in the assignment of solvent use among the solvent nonpoint source categories.

9.3.2 Comparison by Individual State and Source Category Emissions Estimates--To further scrutinize the potential differences between the state-submitted estimates and "Solvent Mass Balance" VOC emissions estimates for the 11 solvent nonpoint source categories, a comparison was made on an individual source category and state basis. There are 214 total individual source category emissions estimates from the 37 states for the 11 nonpoint source categories. An analysis of the individual source category estimates showed that on a ratio basis, out of the 112 total estimates where the "Solvent Mass Balance" is higher than the state-submitted estimates, there are 41 estimates (37 percent) that are significantly higher, where ratios greater than eight were arbitrarily chosen to be significant. These 41 ratios ranged from 8 to 2,480 (the high for Process Solvents in TN). Of these 41 source category estimates where the "Solvent Mass Balance" is significantly higher, the following is the breakdown among the source categories, with the total number of state-submitted estimates in parentheses: Consumer and Commercial Products (12), Process Solvents (8), Graphic Arts (6), Dry Cleaning (5), Industrial Coating (3), Pesticide Application (2), Architectural Surface Coatings (2), Industrial Adhesives and Sealants (1), Automobile Refinishing (1), and Surface Cleaning (1).

On a ratio basis, there are 102 total source category estimates where the state-submitted estimates are higher, with five estimates (5 percent) significantly higher, where ratios greater than eight were arbitrarily chosen to be significant. These five ratios where the state-submitted estimates are higher ranged from 8 to 12 (the high for Automobile Refinishing in OR). Of these five source category estimates, the following is the breakdown among the source categories, with the total number of state-submitted estimates in parentheses: Automobile Refinishing (3) and Pesticide Application (2).

On the basis of differences in emissions estimates, out of the 112 total estimates where the "Solvent Mass Balance" is higher than the state-submitted estimates, there are 29 estimates (26 percent) that are significantly higher, where an emissions difference greater than 10,000 tpy was arbitrarily chosen to be significant. These 29 emissions estimates range from 10,000 to 92,000 (the high for Consumer and Commercial Products in CA). Of these 29 source category estimates where the "Solvent Mass Balance" is higher, the following is the breakdown among the source categories, with the total number of state-submitted estimates in parentheses: Consumer

and Commercial Products (11), Graphic Arts (9), Process Solvents (6), Industrial Coating (2), and Architectural Surface Coatings (1).

On the basis of differences in emissions estimates, out of the 102 total estimates where the state-submitted estimates are higher, there are 17 estimates (17 percent) that are significantly higher, where an emissions difference greater than 10,000 tpy was arbitrarily chosen to be significant. These 17 emissions estimates range from 10,000 to 43,000 (the high for Industrial Coating in GA). Of these 17 source category estimates where the state-submitted estimates are higher, the following is the breakdown among the source categories, with the total number of state-submitted estimates in parentheses: Industrial Coating (14), Consumer and Commercial Products (1), Pesticide Application (1), and Automobile Refinishing (1).

9.3.3 Comparison by Total State Nonpoint Solvent Emissions Estimates--The state-submitted estimates were also compared to the "Solvent Mass Balance" estimates on a total state emissions estimate basis in terms of the ratio of the estimates of the two approaches as well as their emissions difference, as above. On a ratio basis, when the "Solvent Mass Balance" emissions estimate is higher, Tennessee, Washington, and Nevada has the highest ratio differences of 107, 18, and 15 respectively. The next highest state emissions estimate has a ratio of approximately five. When compared on a ratio basis where the state-submitted emissions estimate is higher, Kansas has the highest ratio difference with a ratio of approximately nine. The next highest state has a ratio of approximately two.

On the basis of emissions differences, when the "Solvent Mass Balance" emissions estimate is higher than the state-submitted estimate, California, Texas, and Tennessee have the highest emissions differences, at approximately 234,000, 110,000, and 45,000 tpy, respectively. The next highest state has an estimated emissions difference of approximately 29,000 tpy. When compared on the basis of emissions differences, when the state-submitted emissions estimate is higher, Georgia and Florida have the highest emissions difference at approximately 45,000 and 36,000 tpy, respectively. The next highest state has an emissions difference ratio of approximately 29,000 tpy.

To further analyze the differences in the emissions estimates for the states, Tables 15 and 16 break down the differences in emissions for the highest states into the key nonpoint source categories that drive the differences in the emissions estimates. Table 15 shows the three states (CA, TX, TN) where the "Solvent Mass Balance" estimates are significantly higher than the state-submitted estimates (greater than 45,000 tpy) and also shows the nonpoint source categories that contribute to the difference. For California, the Consumer and Commercial Products nonpoint source category have the highest difference between the two estimates, with a more than 90,000 tpy difference in emissions. For Texas, the Consumer and Commercial Products nonpoint source category also has the highest difference, with an approximately 70,000 tpy emissions difference in this state. For Tennessee, the Process Solvents source category has the highest emissions difference at 23,000 tpy.

Table 16 shows the two states (FL, GA) where the state-submitted estimates are significantly higher than the "Solvent Mass Balance" (greater than 36,000 tpy) and the source categories that contributed to the difference. For Florida, the Industrial Coating nonpoint source category has the highest difference between the two estimates, with an approximately 40,000 tpy difference in emissions. For Georgia, the Industrial Coating source category also has the highest difference, with more than 40,000 tpy emissions difference.

10.0 References

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4. Paint and Coatings '2000': Review and Forecast. Prepared by Kline and Company, Inc., for the National Paint and Coating Association, Washington, DC. 1995.

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7. Tooly, R, D.L. Jones, W. Battye, and J.S. Fudge. "Update of Area Source Solvent Emissions and Methods." EPA/A&WMA Emission Inventory Conference, May 1 - 3, 2001. Denver, Colorado. May 2001.

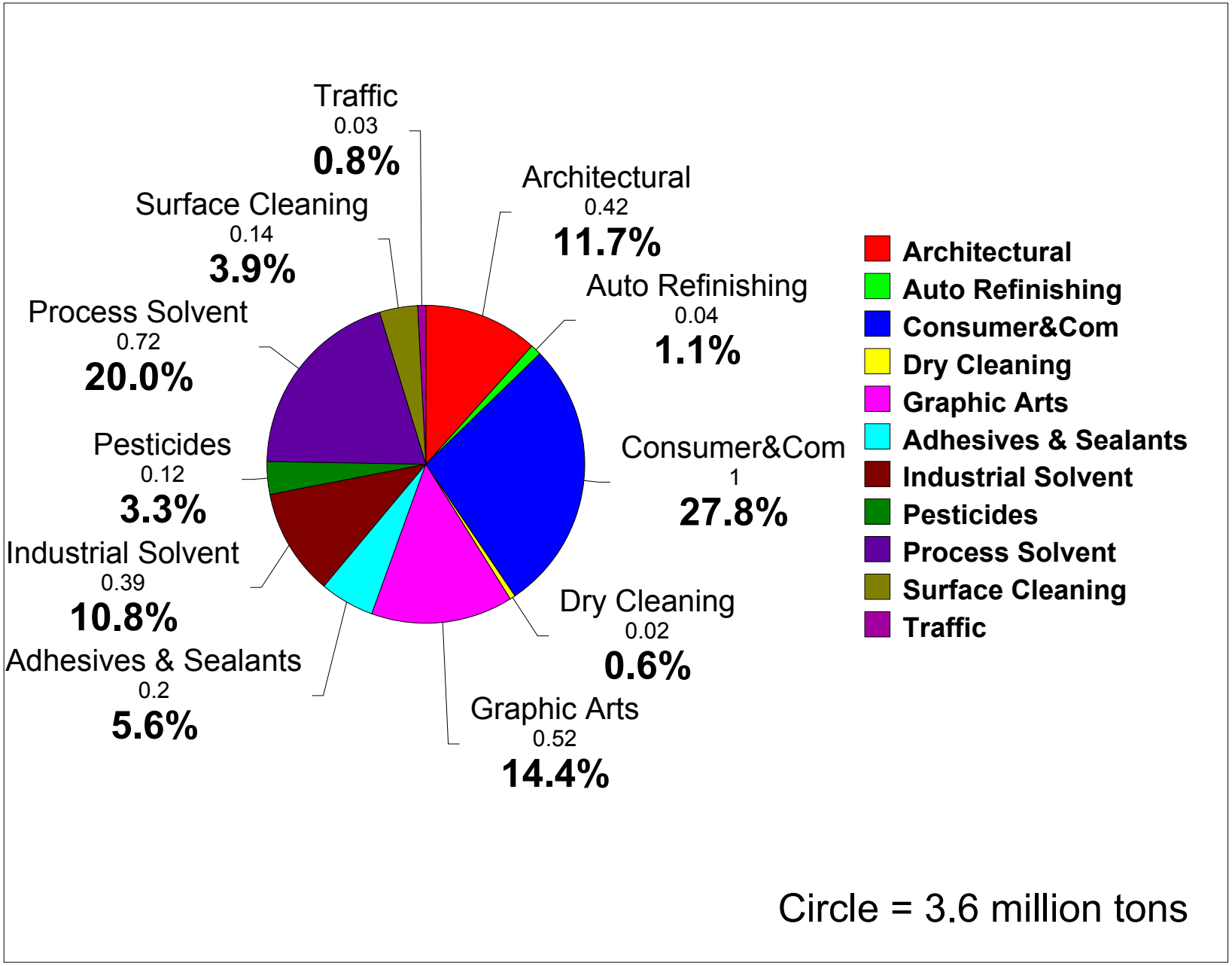

Figure 1. Breakdown of Solvent Consumption for 2002 for the 11 Nonpoint Solvent Source Categories using the "Solvent Mass Balance" Approach.

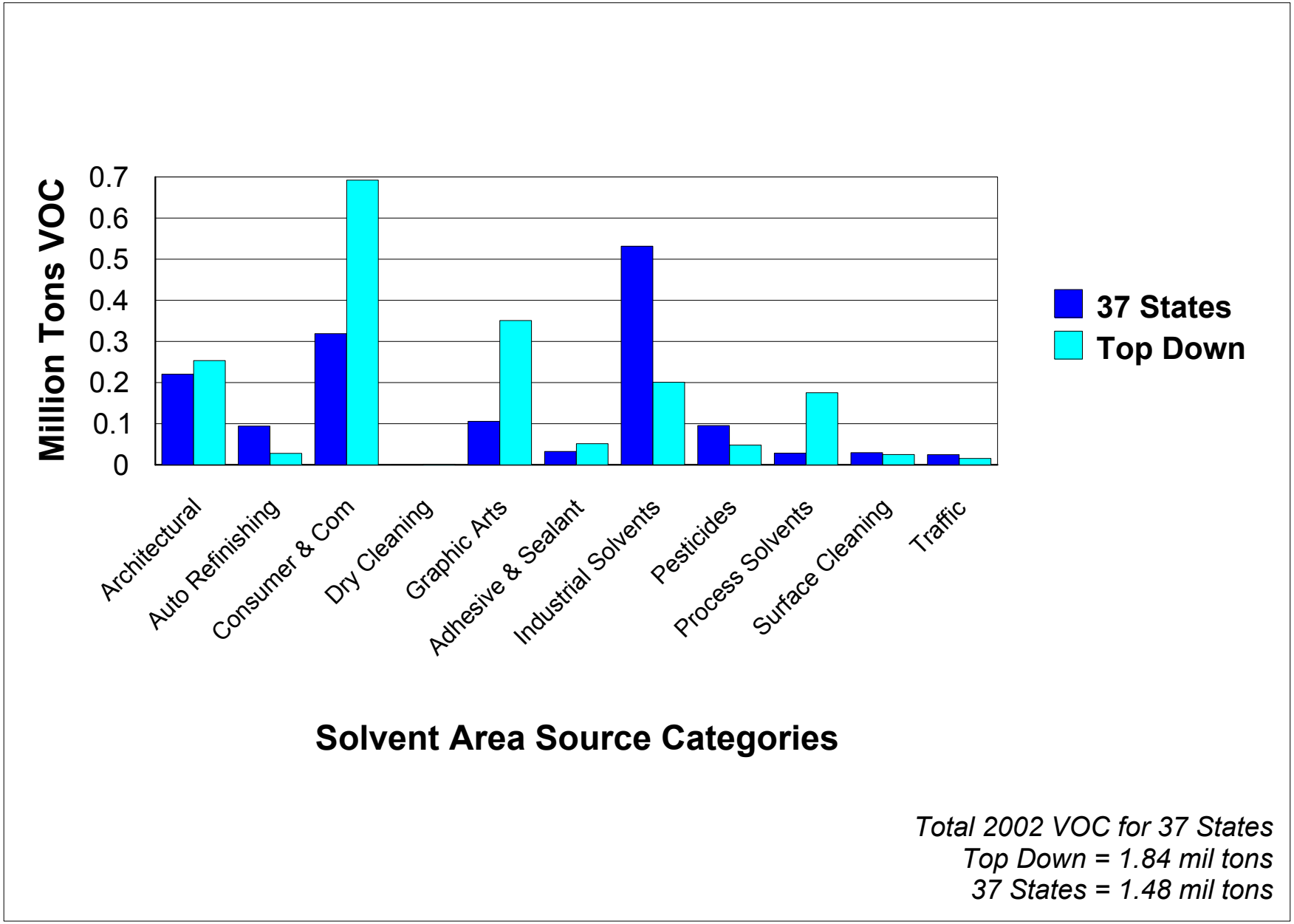

Figure 2. Comparison of the 37 State-submitted Estimates for 2002 to the "Solvent Mass Balance" Estimates for these States for the 11 Nonpoint Solvent Source Categories.

Table 1. Nonpoint Solvent Source Category Groups

Nonpoint Solvent Source Category	
Paint and Coating	**Non-Paint**
Architectural Surface Coating	Consumer and Commercial Products[a]
Automobile Refinishing	Dry Cleaning
Industrial Coating Operations	Graphic Arts
Traffic Paints	Industrial Adhesive and Sealants
	Pesticide Application
	Process Solvents (and other operations)
	Surface Cleaning (degreasing)

[a] This category is defined to include nonindustrial consumer and commercial products (personal care and household products).

Table 2. Solvents Included in the Freedonia Reports.

Solvent	HAP	VOC
Acetone	No	No
Alcohol Solvents, other	No	Yes
Benzene	Yes	Yes
Butanediol Derivatives	No	Yes
Butyl Acetate	No	Yes
Chlorinated Solvents, other	Yes	Yes
D-Limonene Solvents	No	Yes
E-Series Ether Solvents	No	Yes
Ester Solvents	No	Yes
Ethyl Acetate	No	Yes
Ether Solvents	No	Yes
Ethyl Alcohol	No	Yes
Ethylene Glycol	Yes	Yes
Ethylene Oxide Solvents, other	Yes	Yes
Furfural Solvents	No	Yes
Hydrocarbon Solvents	No	Yes
Isopropyl Alcohol	No	Yes
Ketone Solvents, other	No	Yes
Methyl Alcohol	Yes	Yes
Methyl Ethyl Ketone	Yes	Yes
Methyl Isobutyl Ketone	Yes	Yes
Methylene Chloride	Yes	No
Special Naphthas	No	Yes
Perchloroethylene	Yes	No
Pinene Solvents	No	Yes
Propyl Acetate	No	Yes
Propyl Alcohol	No	Yes
Propylene Glycol Solvents	Yes	Yes
Propylene Oxide-Derived Solvents, other	Yes	Yes
Solvents, other	No	Yes
Tetrahydrofuran Solvents	No	Yes
Toluene	Yes	Yes
Trichloroethane	Yes	Yes
Trichloroethylene	Yes	Yes
Xylene	Yes	Yes

Note: Freedonia solvents are from Reference 1.

Table 3. Allocation of Freedonia "Other" Data to the "Pesticides" and "Process Solvents" Nonpoint Solvent Source Categories

"Other" Freedonia Chemical Data Assignments	
"Pesticides"	**"Process Solvents"**
Benzene	Acetone
Benzene Derivatives	Benzene
Ethyl Acetate	Benzene Derivatives
Hydrocarbon Solvents	Butyl Acetate
Other Solvents	E-Series Ether Solvents
Special Naphthas	Ester Solvents
	Ethyl Acetate
	Ether Solvents
	Ethyl Alcohol
	Ethylene Glycol
	Furfural solvents
	Hydrocarbon Solvents
	Isopropyl Alcohol
	Methyl Alcohol
	Methyl Ethyl Ketone
	Methyl Isobutyl Ketone
	Methylene Chloride
	Other Alcohol Solvents
	Other Chlorinated Solvents
	Other Ethylene Oxide Solvents
	Other Ketone Solvents
	Other Propylene Oxide-Derived Solvents
	Other Solvents
	Perchloroethylene
	Pinene Solvents
	Propyl Acetate
	Propylene Glycol Solvents
	Special Naphthas
	Tetrahydrofuran Solvents
	Toluene
	Trichloroethane
	Trichloroehylene
	Xylene

Table 4. National Solvent Utilization for the Nonpoint Solvent Source Categories

	Estimated VOC Consumed (million tons)		
Nonpoint Solvent Source Categories	**1998**	**1999[e]**	**2002[e]**
Architectural Surface Coating[a]	0.46	0.45	0.42
Automobile Refinishing[b]	0.04	0.04	0.04
Consumer and Commercial Products[c]	1.0	1.0	0.98
Dry Cleaning[c]	0.02	0.02	0.02
Graphic Arts[d]	0.49	0.50	0.52
Industrial Adhesive and Sealants[c]	0.22	0.22	0.22
Industrial Coating Operations[b]	0.42	0.41	0.38
Pesticide Application[c]	0.13	0.13	0.13
Process Solvents[c]	0.74	0.74	0.73
Surface Cleaning[c]	0.15	0.15	0.15
Traffic Paints[b]	0.03	0.03	0.03
Total	3.7	3.7	3.6

[a] 1998 data were estimated from Freedonia reports from 2003 and 2004 (References 2 and 3).

[b] 1998 data were estimated from a 2003 Freedonia report (Reference 3) and a 1995 NP&CA report (Reference 4).

[c] 1998 data were obtained from a 2000 Freedonia (Reference 1).

[d] 1998 data were estimated from 2003 Freedonia (Reference 2).

[e] Projected using solvent consumption data from 1997 to 2002 from Freedonia reports (References 1, 2, 3) and, as needed, growth factors developed from the consumption data.

Table 5. Estimated Annual Growth Rates (As Percentages) for the Solvent Nonpoint Source Categories

Nonpoint Solvent Source Category	Industry Source Category Used for Projection Years 1999 and 2002	Estimated Annual Growth (percent)	
		To 1999	To 2002
Architectural Surface Coating	Architectural Surface Coating and Paint and Coating Solvents (1999 & 2002) [b, c]	-2.2[d]	- -[g]
Automobile Refinishing, Industrial Coating Operations, Traffic Paints	Paints and Coatings Solvents (1999 & 2002)[c]	-2.6[d]	- -[g]
Consumer and Commercial Products	Consumer Products (1999)[a] Other (2002)[b]	0.33[e]	-0.61[f]
Dry Cleaning	Hydrocarbon Solvents (1999)[a] Other (2002)[b]	-12.5[e]	-0.61[f]
Graphic Arts	Printing Inks (1999 & 2002)[b]	1.3[d]	- -[g]
Industrial Adhesive and Sealants	Adhesives (1999)[b] Other (2002)[?]	-1.5[e]	-0.61[f]
Pesticide Application	Carrier Solvents/Other Solvent Markets (1999)[a] Other (2002)[b]	0.18[e]	-0.61[f]
Process Solvents	Process Solvents/Other Manufacturing(1999)[a] Other (2002)[b]	1.15[e]	-0.61[f]
Surface Cleaning	Cold Cleaning (1999)[a] Cleaning Products (2002)[b]	-1.4[e]	-0.71[f]

[a] Using consumption data from a 2000 Freedonia report (Reference 1).

[b] Using consumption data from a 2003 Freedonia report (Reference 2).

[c] Using consumption data from a 2004 Freedonia report (Reference 3).

[d] For 1999: As calculated from the total solvent consumption reported for 1997 and 2002 from Reference 2 and/or 3, assuming an equal fraction of growth for each year in the five-year interval.

[e] For 1999: As calculated from the total solvent consumption reported for 1998 and projected data for 2003 from Reference 1, assuming an equal fraction of growth for each year in the five-year interval.

(continued)

Table 5. (Continued)

[f] For 2002: As calculated from the total solvent consumption estimated for 1999 as above, and then projected from 1999 to 2002 using projected data for 2002 from Reference 2, assuming an equal fraction of growth for each year in the reported interval. This procedure was used to retain the chemical-specific detail in the 1999 estimates obtained from Reference 1.

[g] Since data for 2002 were available for these nonpoint solvent source categories in References 2 and/or 3, no growth factors were needed for the 2002 estimates.

Table 6. Spatial Allocation Surrogates Used in the "Solvent Mass Balance" Approach

Nonpoint Solvent Source Category	Spatial Allocation Surrogate Used [a]	
	Employment by NAICS Code	Population
Architectural Surface Coating	Painting and Wall Covering Contractors 23521 (60%)[b]	Population (40%)[b]
Automobile Refinishing	Couriers and Messengers 492; Auto Equipment Rental and Leasing 5321; Auto Repair and Maintenance 8111	
Consumer and Commercial Products		Population (100%)
Dry Cleaning	Dry Cleaners: Coin-op 81231; Services 81232; Linen and Uniform 81233	
Graphic Arts	Paperboard Container 3222; Printing 32311	
Industrial Adhesive and Sealants	Wood Products 3212; Paperboard 32221; Paper Bag, Treated Paper 32222; Sanitary Paper 322291; Printing 32311; Plastics and Rubber 326; Motor Vehicle Body 336211; Building Materials/Supplies 4441; Auto Repair and Maintenance 8111.	
Industrial Coating Operations	Logging 1133; Wood Mft 321xx; Pulp&Paper 322x; Chemical Mft 325; Plastics and Rubber 326; Pottery, Plumbing Mft 32711; Glass 327212; Concrete 32739; Metal 332xx; Computer&Electron. Mft 334xx; Electr. Equip. Mft 335xx; Transp. Equip. Mft 336xx; Furniture Mft 337xx, Misc Mft 339xx; Couriers 492; Cables 5132; Telecomm. 5133; Auto Rental 5321; Auto Repair 8111; Electronic Repair 811x	
Pesticide Application	Crop Production 111 (50%)[c]	Population (50%)[c]
Process Solvents	Chem Mft 325; Computer & Electron. Mft 334	
Surface Cleaning	Metal 331,332; Machinery 333; Computers 334; Electrical 335; Transportation 336; Furniture 337; Misc Mft 339; Auto Parts 441; Transp. 483, 484, 485, 488; Auto Repair 8111; Electronic Repair 8112	
Traffic Paints	Highway and Street Construction 23411	

[a] A more detailed list can be fond in the appendix to the report prepared for this project at: http://www.epa.gov/ttn/chief/net/2002inventory.html#nonpoint .

[b] A 60/40 split between employment data (by NAICS) and population was used to allocate the solvent use.

[C] One-half of the solvent use was allocated by employment data (by NAICS) and one-half allocated by population.

Table 7. Assignment of Point and Nonpoint SCCs to National Solvent Utilization Data for the Solvent Nonpoint Source Categories

Nonpoint Solvent Source Category	Nonpoint SCC	Point SCC[a]	Nonpoint SCC Descriptor (3)	Nonpoint SCC Descriptor (7)
Architectural surface coatings	2401001	None	Surface Coating	Architectural Coatings
Automobile refinishing	2401000	None	Surface Coating	Auto Refinishing: SIC 7532
Consumer and commercial products	2460200	None	Miscellaneous Non-industrial: Consumer and Commercial	All Household Products
	2460000		Miscellaneous Non-industrial: Consumer and Commercial	All Products/Processes
	2460100		Miscellaneous Non-industrial: Consumer and Commercial	All Personal Care Products
	2460400		Miscellaneous Non-industrial: Consumer and Commercial	All Automotive Aftermarket Products
Dry cleaning	2420020	401001	Dry Cleaning	Coin-operated Cleaners
Graphic arts	2425000	305037, 330001, 402011,402040, 405002,405003, 405004,405008	Graphic Arts	All Processes
Industrial adhesives and sealants	2440020	402007	Miscellaneous Industrial	Adhesive (Industrial) Application
Industrial coating[a]	2401010	402001	Surface Coating	Textile Products: SIC 22
	2401015	402002	Surface Coating	Factory Finished Wood: SIC 2426 thru 242
	2401020	402003	Surface Coating	Wood Furniture: SIC 25
	2401025	402004	Surface Coating	Metal Furniture: SIC 25
	2401030	402005	Surface Coating	Paper: SIC 26
	2401040	402006	Surface Coating	Metal Cans: SIC 341
	2401050	402008	Surface Coating	Miscellaneous Finished Metals: SIC 34 - (341 + 3498)
	2401055	402009	Surface Coating	Machinery and Equipment: SIC 35
	2401060	402888	Surface Coating	Large Appliances: SIC 363
	2401065	402999	Surface Coating	Electronic and Other Electrical: SIC 36 - 363
	2401070	402008	Surface Coating	Motor Vehicles: SIC 371
	2401080	402041	Surface Coating	Marine: SIC 373
	2401090	402042	Surface Coating	Miscellaneous Mft.
	2401100	402043	Surface Coating	Industrial Maintenance Coatings
	2401200	402044	Surface Coating	Other Special Purpose Coatings
	2401990	402045	Surface Coating	All Surface Coating Categories
		402046		
		402047		
Pesticide application	2461850	None	Miscellaneous Non-industrial: Commercial	Pesticide Application: Agricultural
	2465800		Miscellaneous Non-industrial: Consumer	Pesticide Application
Process solvents	2301030	490999	Chemical Manufacturing: SIC 28	Process Emissions from Pharmaceutical Manufacturing
	2430000		Rubber/Plastics	All Processes
	2440000	302019,401005	Miscellaneous Industrial	All Processes

Table 7. (Continued)

Nonpoint Solvent Source Category	Nonpoint SCC	Point SCC[a]	Nonpoint SCC Descriptor (3)	Nonpoint SCC Descriptor (7)
		490001,490999 641310,644300 644310,645200 646320		
Surface cleaning	2415100	401002	Degreasing	All Industries: Open Top Degreasing
	2415125	401002	Degreasing	Industrial Machinery and Equipment (SIC 35): Open Top Degreasing
	2415300	401002,401003	Degreasing	All Industries: Cold Cleaning
	2415130	401002	Degreasing	Electronic and Other Elec. (SIC 36): Open Top Degreasing
Traffic paints	2401008	None	Surface Coating	Traffic Markings

[a] For this category, each of the 16 nonpoint SCCs are combined with each of the 18 point SCCs, for a total of 288 unique nonpoint-point SCC combinations.

Table 8. Thinning and Oven SCC Group Assignments

Group Name	Nonpoint SCCs in Group	Point SCCs in Group
Thinning	2401015, 2401020, 2401025, 2401030, 2401050, 2401055, 2401060, 2401065, 2401070, 2401090, 2401100, 2401200	40200913, 40200914, 40200915, 40200916, 40200917, 40200918, 40200919, 40200920, 40200921, 40200922, 40200923, 40200924, 40200925, 40200926, 40200927, 40200928, 40200929, 40200930, 40200931, 40200998, 40288824, 40290011, 40290012, 40290013, 40290023, 40299995, 40299996, 40299997, 40299998, 40299999
Ovens	2401015, 2401020, 2401025, 2401030, 2401050, 2401055, 2401060, 2401070,2401090	40200801, 40200802, 40200803, 40200810, 40200855, 40200856, 40200861, 40200870, 40200872, 40200898, 40200899

Table 9. 1999 National Solvent Utilization for the Solvent Nonpoint Source Categories

Solvent Nonpoint Source Categories	Estimated VOC Consumed (million tons)		
	All Sources[a]	Point Sources[b]	Nonpoint Sources[c]
Architectural Surface Coating	0.45	0.0	0.45
Automobile Refinishing	0.04	0.0	0.04
Consumer and Commercial Products	1.0	0.0	1.00
Dry Cleaning	0.02	0.0	0.02
Graphic Arts	0.50	0.07	0.43
Industrial Adhesive and Sealants	0.22	0.01	0.21
Industrial Coating Operations	0.41	0.14	0.27
Pesticide Application	0.13	0.00	0.13
Process Solvents	0.74	0.01	0.73
Surface Cleaning	0.15	0.01	0.14
Traffic Paints	0.03	0.0	0.03
Total	**3.7**	**0.24**	**3.5**

[a] Solvent consumption data were obtained and/or estimated from market reports, References 1, 2, 3, and 4.

[b] Estimated from the 1999 NEI point source controlled emissions and control efficiency estimates.

[c] By subtraction of the VOC consumed by "Point Sources" from "All Sources," in the third and second columns of this table, respectively.

Table 10. 2002 National Solvent Utilization for the Solvent Nonpoint Source Categories

Solvent Nonpoint Source Categories	Estimated VOC Consumed (million tons)		
	All Sources[a]	Point Sources[b]	Nonpoint Sources[c]
Architectural Surface Coating	0.42	0.0	0.42
Automobile Refinishing	0.04	0.0	0.04
Consumer and Commercial Products	1.00	0.0	1.00
Dry Cleaning	0.02	0.0	0.02
Graphic Arts	0.52	0.09	0.43
Industrial Adhesive and Sealants	0.20	0.02	0.19
Industrial Coating Operations	0.39	0.12	0.28
Pesticide Application	0.12	0.00	0.12
Process Solvents	0.72	0.02	0.70
Surface Cleaning	0.14	0.01	0.13
Traffic Paints	0.03	0.0	0.03
Total	**3.60**	**0.25**	**3.35**

[a] Solvent consumption data were obtained and/or estimated from market reports, References 1, 2, 3, and 4.
[b] Estimated from the 2002 NEI point source inventory controlled emissions and control efficiency estimates.
[c] By subtraction of the VOC consumed by "Point Sources" from "All Sources," in the third and second columns of this table, respectively.

Table 11. Comparison of the Existing 1999 NEI to the 1999 "Solvent Mass Balance" Estimates

Solvent Nonpoint Source Category	1999 VOC Estimate (10^6 tons per year)		Difference NEI - MB	Ratio When Higher	
	Existing NEI	Mass Balance		Existing NEI	Mass Balance
Architectural Surface Coating	0.43	0.45	(0.02)	--	1.0
Automobile Refinishing	0.11	0.04	0.07	2.8	--
Consumer and Commercial Products	0.79	1.00	(0.21)	--	1.3
Dry Cleaning	0.01	0.02	(0.01)	--	2.0
Graphic Arts	0.17	0.43	(0.26)	--	2.5
Industrial Adhesive and Sealants	0.14	0.21	(0.07)	--	1.5
Industrial Coating Operations	0.83	0.27	0.56	3.1	--
Pesticide Application	0.08	0.13	(0.05)	--	1.6
Process Solvents	0.07	0.73	(0.66)	--	10.4
Surface Cleaning	0.06	0.14	(0.08)	--	2.3
Traffic Paints	0.08	0.03	0.05	2.7	--
Totals	**2.8**	**3.5**	**(0.68)**	**0.80**	**1.2**

Table 12. Comparison of the 2002 State-submitted Estimates to the "Solvent Mass Balance" Estimates: All States

No. States	Solvent Nonpoint Source Category	2002 VOC Estimate (tons per year)		Difference State - MB	Ratio When Higher	
		State	Mass Balance		State	Mass Balance
24	Architectural Surface Coatings	220,615	253,465	(32,850)	--	1.1
27	Architectural Surface Coatings	No Data	170,535	--	--	--
51	Total - Architectural Surface Coatings	220,615	424,000	(203,385)	--	--
29	Automobile Refinishing	94,386	27,882	66,504	3.4	--
22	Automobile Refinishing	No Data	10,618	--	--	--
51	Total - Automobile Refinishing	94,386	38,500	55,886	--	--
27	Consumer and Commercial Products	319,180	692,418	(373,238)	--	2.2
24	Consumer and Commercial Products	No Data	306,816	--	--	--
51	Total - Consumer and Commercial Products	319,180	999,234	(680,054)	--	--
5	Dry Cleaning	162	1,619	(1,457)	--	10.0
46	Dry Cleaning	No Data	14,687	--	--	--
51	Total - Dry Cleaning	162	16,306	(16,144)	--	--
30	Graphic Arts	105,776	351,017	(245,241)	--	3.3
21	Graphic Arts	No Data	80,433	--	--	--
51	Total - Graphic Arts	105,776	431,449	(325,674)	--	--
10	Industrial Adhesives and Sealants	32,676	51,476	(18,800)	--	1.6
41	Industrial Adhesives and Sealants	No Data	135,541	--	--	--
51	Total - Industrial Adhesives and Sealants	32,676	187,017	(154,341)	--	--
31	Industrial Coating	531,642	201,066	330,576	2.6	--
20	Industrial Coating	No Data	76,773	--	--	--
51	Total - Industrial Coating	531,642	277,839	253,803	--	--
12	Pesticide Application	95,431	48,134	47,297	2.0	--
39	Pesticide Application	No Data	76,780	--	--	--
51	Total - Pesticide Application	95,431	124,914	(29,484)	--	--
10	Process Solvents	28,627	175,380	(146,753)	--	6.1
41	Process Solvents	No Data	525,164	--	--	--
51	Total - Process Solvents	28,627	700,545	(671,917)	--	--
7	Surface Cleaning	29,604	25,274	4,330	1.2	--
44	Surface Cleaning	No Data	102,362	--	--	--
51	Total - Surface Cleaning	29,604	127,636	(98,032)	--	--
29	Traffic Paints	24,795	15,758	9,037	1.6	--
22	Traffic Paints	No Data	12,542	--	--	--
51	Total - Traffic Paints	24,795	28,300	(3,505)	--	--
Overall Totals		**1,482,894**	**3,355,742**	--	--	2.3
Total - State-submitted Estimates		**1,482,894**	**1,843,489**		**0.80**	**1.2**

Table 13. Comparison of the 2002 State-submitted Estimates to the "Solvent Mass Balance" Estimates: Ranking by Ratio

No. States	Solvent Nonpoint Source Category	2002 VOC Estimate (tons per year) State	2002 VOC Estimate (tons per year) Mass Balance	Difference State - MB	Ratio When Higher State	Ratio When Higher Mass Balance
Higher Ratio - State-submitted Estimate						
29	***Automobile Refinishing***	94,386	27,882	66,504	***3.4***	
31	Industrial Coating	531,642	201,066	330,576	2.6	
12	Pesticide Application	95,431	48,134	47,297	2.0	
29	Traffic Paints	24,795	15,758	9,037	1.6	
7	Surface Cleaning	29,604	25,274	4,330	1.2	
Higher Ratio - "Solvent Mass Balance"						
5	***Dry Cleaning***	162	1,619	(1,457)		***10.0***
10	Process Solvents	28,627	175,380	(146,753)		6.1
30	Graphic Arts	105,776	351,017	(245,241)		3.3
27	Consumer and Commercial Products	319,180	692,418	(373,238)		2.2
10	Industrial Adhesives and Sealants	32,676	51,476	(18,800)		1.6
24	Architectural Surface Coatings	220,615	253,465	(32,850)		1.1
Total - State-submitted Estimates Only		**1,482,894**	**1,843,489**		**0.80**	**1.2**

Table 14. Comparison of 2002 State-submitted Estimates to the "Solvent Mass Balance" Estimates: Ranked by Emissions

No. States	Solvent Nonpoint Source Category	2002 VOC Estimate (tons per year)		Difference State - MB	Ratio When Higher	
		State	Mass Balance		State	Mass Balance
Higher State-submitted Estimate						
31	***Industrial Coating***	531,642	201,066	***330,576***	2.6	
12	Pesticide Application	95,431	48,134	47,297	2.0	
29	Automobile Refinishing	94,386	27,882	66,504	3.4	
7	Surface Cleaning	29,604	25,274	4,330	1.2	
29	Traffic Paints	24,795	15,758	9,037	1.6	
Higher "Solvent Mass Balance" Estimate						
27	***Consumer and Commercial Products***	319,180	692,418	***(373,238)***		2.2
30	Graphic Arts	105,776	351,017	(245,241)		3.3
10	Process Solvents	28,627	175,380	(146,753)		6.1
24	Architectural Surface Coatings	220,615	253,465	(32,850)		1.1
10	Industrial Adhesives and Sealants	32,676	51,476	(18,800)		1.6
5	Dry Cleaning	162	1,619	(1,457)		10
Total - State-submitted Estimates Only		**1,482,894**	**1,843,489**		**0.80**	**1.2**

Table 15. States with Highest Estimated Emissions Difference--Higher "Solvent Mass Balance" Estimate: California, Texas, and Tennessee

State	Contributing Solvent Nonpoint Source Category	2002 VOC Estimate (tons per year)		Difference State - MB (tons)	Ratio When Higher	
		State	Mass Balance		State	Mass Balance
Higher "Solvent Mass Balance" Estimate						
CA	**Consumer and Commercial Products**	11,428	103,122	**(91,694)**	--	9.0
CA	Architectural Surface Coatings	6,775	57,504	(50,729)	--	8.5
CA	Graphic Arts	3,967	46,776	(42,809)	--	11.8
CA	Process solvents	21,567	54,973	(33,405)	--	2.5
CA	Industrial Coating	7,309	21,539	(14,231)	--	2.9
CA	Industrial Adhesives and Sealants	7,216	16,796	(9,580)	--	2.3
CA	*Subtotal - Contributing source categories*	58,262	300,710	(242,449)	--	5.2
CA	*Total for State*	98,774	332,709	(233,935)	--	3.4
TX	**Consumer and Commercial Products**	11,909	81,215	**(69,306)**	--	6.8
TX	Graphic Arts	1,329	24,416	(23,086)	--	18.4
TX	Industrial Coating	1,293	14,625	(13,333)	--	11.3
TX	*Subtotal - Contributing Source Categories*	14,531	120,256	(105,726)	--	18.4
TX	*Total for State*	49,926	160,035	(110,109)	--	11.3
TN	**Process Solvents**	9	22,560	**(22,551)**	--	2,480
TN	Graphic Arts	149	8,105	(7,955)	--	54
TN	Industrial Coating	126	6,934	(6,809)	--	55
TN	Industrial Adhesives and Sealants	4	3,675	(3,671)	--	903
TN	Surface Cleaning	5	3,451	(3,446)	--	632
TN	Traffic Paints	133	819	(686)	--	6
TN	*Subtotal - Contributing Source Categories*	427	45,544	(45,117)	--	107
TN	*Total for State*	427	45,544	(45,117)	--	107

Note: These states submitted emissions estimates higher than the "Solvent Mass Balance" for other source categories, as follows:

California: Automobile Refinishing, Pesticide Application, and Surface Cleaning, for a total of 40,512 tpy state estimate vs. 31,999 "Solvent Mass Balance" estimate for these source categories.

Texas: Architectural Surface Coatings and Pesticide Application, for a total state estimate of 35,395 tpy vs. 39,778 tpy "Solvent Mass Balance" estimate for these source categories.

Table 16. States with Highest Emissions Difference--Higher State-submitted Estimates: Florida and Georgia

State	Contributing Solvent Nonpoint Source Category	2002 VOC Estimate (tons per year)		Difference State - MB (tons)	Ratio When Higher	
		State	Mass Balance		State	Mass Balance
Higher State-submitted Estimate						
FL	**Industrial Coating**	48,842	9,617	**39,225**	5.1	--
FL	Consumer and Commercial Products	59,682	43,697	15,985	1.4	--
FL	Traffic Paints	3,197	1,853	1,344	1.7	--
FL	Automobile Refinishing	3,171	2,099	1,072	1.5	--
FL	*Subtotal - Contributing Source Categories*	111,720	55,167	56,554	2.0	--
FL	*Total for State*	131,958	95,614	36,344	1.4	--
GA	**Industrial Coating**	53,447	10,902	**42,544**	4.9	--
GA	Automobile Refinishing	7,777	1,053	6,724	7.4	--
GA	*Subtotal - Contributing Source Categories*	61,224	11,956	49,268	5.1	--
GA	*Total for State*	86,029	41,137	44,892	2.1	--

Note: These states had higher "Solvent Mass Balance" emissions estimates than the state-submitted estimates for other source categories, as follows:

Florida: Dry Cleaning, Graphic Arts, and Industrial Adhesives and Sealants, for a total of 17,067 tpy state-submitted estimate vs. 38,349 tpy "Solvent Mass Balance" estimate for these source categories.

Georgia: Consumer and Commercial Products: 24,805 tpy state-submitted estimate vs. 29,181 tpy "Solvent Mass Balance" estimate for this source category.