

**MEMORANDUM**

Date: March 10, 2010  
To: Jim Neumann, IEC  
From: Jim Wilson, Andy Bollman, Maureen Mullen  
Subject: Revised Section 812 Nonpoint Source PM<sub>2.5</sub> Emission Estimates  
Work Assignment 0-1, TD #3

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The Section 812 project team identified the need to refine the “without-CAAA” scenario emissions previously developed for the following nonpoint PM<sub>2.5</sub> emission source categories:

Category	2000 PM <sub>2.5</sub> Emissions (tons per year)		
	Without CAAA	With CAAA	Difference
1. Construction	1,134,719	237,780	896,939
2. Paved Roads	634,762	202,706	432,056
3. Unpaved Roads	1,103,413	835,152	268,261
4. Residential Wood Combustion	260,121	428,044	-167,924
5. Fuel Combustion Industrial/Coal/Other	3,584	154,045	-150,512

These are the nonpoint categories with the largest differences between the 2000 with- and without-CAAA scenario emission estimates. While the 2000 with-CAAA nonpoint source emission estimates are taken directly from the U.S. Environmental Protection Agency’s (EPA’s) 2002 nonpoint source National Emissions Inventory (NEI), the 2000 without-CAAA scenario nonpoint source emissions represent estimates projected from 1990 NEI emissions. Because of discrepancies in the emission estimation procedures for these categories, Pechan recalculated these categories’ 1990 and 2000 without-CAAA scenario emission estimates so that these categories’ estimates would rely on procedures comparable to those used in the 2002 NEI. In addition, Pechan developed revised 2010 and 2020 without-CAAA emission estimates for these categories by applying previously generated growth factors to the 2000 without-CAAA emissions. The balance of this memorandum describes how each category’s emissions were recalculated, and reports the updated with- and without-CAAA PM<sub>2.5</sub> emissions for each nonpoint source category.

**A. METHODS FOR RECALCULATING WITHOUT-CAAA EMISSIONS**

The following sections discuss the methods used for each of the five priority area source categories to recalculate the without-CAAA scenario emissions.

## 1. Construction

For the 2002 NEI, EPA developed emission estimates for three of the eight possible construction Source Classification Codes (SCCs). Emissions for other construction SCCs were supplied by local and/or state air quality agencies. Because of the minor contribution of these SCCs to total construction PM<sub>2.5</sub> emissions (~ 2.5 percent), Pechan calculated revised without-CAAA emission estimates for the state/local agency-supplied categories by applying year-specific uncontrolled/controlled emission ratios calculated from the emissions for the three categories for which EPA developed estimates.

Pechan computed revised without-CAAA emission estimates for the following specific SCCs, which are the three major components of construction emissions:

- 2311010000 – Residential Construction;
- 2311020000 – Nonresidential Construction; and
- 2311030000 – Road Construction.

First, Pechan recalculated the 2000 without-CAAA scenario emissions for each SCC by removing the 50 percent PM<sub>2.5</sub> emission reduction assumption that was applied to PM<sub>10</sub> nonattainment area counties in the 2002 NEI. This control efficiency represents the Best Available Control Measure (BACM) controls on fugitive dust construction activity for these counties. Because state/local agencies also supplied emission estimates to the 2002 NEI for these SCCs, directly relying on the resulting emission estimates would have led to without-CAAA emission estimates that are not directly comparable to the with-CAAA scenario emissions. Therefore, Pechan computed values representing the ratio of EPA method-derived uncontrolled 2002 PM<sub>2.5</sub> emissions to EPA method-derived 2002 controlled PM<sub>2.5</sub> emissions. These ratios were computed as 1.206 (Residential Construction), 1.136 (Nonresidential Construction), and 1.128 (Road Construction), and each value multiplied by the 2000 with-CAAA scenario emissions to yield the without-CAAA scenario 2000 emission estimates.

An analogous procedure was used to estimate 1990 emissions. For Residential and Nonresidential Construction, Pechan utilized EPA's 2002 NEI estimation procedure for each SCC, but replaced the 2002 emissions activity values (e.g., number of housing starts) with 1990 values and removed the 50 percent emission reduction assumption for PM<sub>10</sub> nonattainment area counties.<sup>1</sup> Pechan then computed values representing the ratio of EPA method-derived uncontrolled 1990 PM<sub>2.5</sub> emissions to EPA method-derived 2002 uncontrolled PM<sub>2.5</sub> emissions. These ratios were computed as 0.767 (Residential Construction) and 1.020 (Nonresidential Construction), and these values were applied to the 2000 without-CAAA emissions to yield 1990 emission estimates. For Road Construction, less detailed road construction expenditure data were available for 1990 than were used in developing emissions for EPA's 2002 NEI. Therefore, Pechan computed a ratio using more aggregate road construction expenditure data for each year, and this ratio was applied to the 2002 expenditures to estimate comparable 1990 expenditure data.<sup>2</sup> Using the same methods that were used to develop a 2002-specific

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<sup>1</sup>The NEI methods were only replicated at the national level. To follow them exactly would have required obtaining 1990-specific data for allocating activity/emissions to counties. In the interest of time, we relied on the 2002 allocation data to also represent 1990 allocations.

<sup>2</sup>In the 2002 NEI, it was possible to exclude resurfacing and minor bridge rehabilitation expenditures from the emissions activity data. The ratio of 1990 to 2002 total outlays was used to estimate 1990 expenditure data consistent the expenditure data used by EPA to develop road construction emissions for the 2002 NEI.

conversion factor, Pechan computed a 1990-specific factor for converting the 1990 construction expenditures to number of acres disturbed. Pechan also removed the 50 percent emission reduction assumption for PM<sub>10</sub> nonattainment area counties in calculating initial 1990 emission estimates for Road Construction. Pechan then computed the ratio of 1990 emissions to 2000 without-CAAA emissions (0.596) for application to the 2000 without-CAAA scenario emissions to yield estimates of 1990 emissions.

For 2010 and 2020, Pechan applied the growth factors that had previously been applied in preparing without-CAAA emission projections. These growth factors, which reflect regional output projections for the construction sector, were multiplied by the 2002 without-CAAA emission estimates that were computed in this effort, with the result representing estimates of national without-CAAA emissions in 2010 and 2020.

## **2. Paved Roads**

The previous 2000 without-CAAA estimates were based on growing 1990 paved road emissions to 2000, while the 2000 with-CAAA estimates were taken from the 2002 NEI. Paved road emissions in the 2002 NEI reflect a combination of EPA emission estimates and emission estimates submitted by state/local agencies. To keep consistency with the previous emissions modeling, no changes were made to any of the previous Section 812 with-CAAA emission estimates. Because it was not possible to replicate the mix of EPA and state/local agency emission estimation methods that comprise the 2002 NEI, it was necessary for Pechan to estimate without-CAAA emission estimates by applying ratios to the with-CAAA emission estimates.

Paved road emissions were recalculated as part of this effort to be consistent with the calculation methodology and inputs that EPA used for the 2002 NEI. The without-CAAA emissions were re-estimated using the same general data inputs as the EPA used in developing estimates for the 2002 NEI (i.e., paved road vehicle miles traveled and AP-42 emission factor equation). Because the 2000 with-CAAA emission estimates include the effects of paved road controls in PM nonattainment areas, it was necessary to remove the effects of these controls in calculating without-CAAA emissions. In the 2002 NEI, EPA applied a control efficiency of 79 percent to urban and rural roads in serious PM nonattainment areas, and urban roads in moderate PM nonattainment areas (this corresponds to vacuum sweeping on paved roads twice per month). Rule penetration values varied by road type and nonattainment area classification (serious or moderate).

Between the time that the 1990 and 2002 NEI's were prepared, EPA made substantial changes to the paved road emission factor equation (the 2002 NEI uses the current AP-42 emission factor equation). Therefore, in recalculating the 1990 paved road dust emissions, Pechan multiplied the recomputed 2002 without-CAAA paved road PM<sub>2.5</sub> emissions by the ratio of 1990 paved road vehicle miles traveled (VMT) to 2002 paved road VMT. The paved road VMT ratios were developed at the state and roadway type level of detail.

The 2000 without-CAAA fugitive road dust emissions from paved roads were projected to 2010 and 2020 using the same county-level population-based growth factors that were applied in the previous Section 812 projections. These factors were applied to the 2000 without-CAAA emissions to provide revised estimates of 2010 and 2020 without-CAAA emissions.

### **3. Unpaved Roads**

A review of the PM<sub>2.5</sub> emission estimates in the 2002 NEI indicates that EPA was responsible for developing estimates for only one of the three SCCs under which unpaved road emissions were reported. Emissions for other unpaved road SCCs were supplied by local and/or state air quality agencies. Because of the minor contribution of these SCCs to total unpaved road PM<sub>2.5</sub> emissions (~ 0.2 percent), Pechan calculated revised without-CAAA emission estimates for these two categories by applying year-specific uncontrolled/controlled emission ratios calculated from the emissions for the SCC for which EPA developed estimates (i.e., SCC 2294000000 – All Paved Roads/Total: Fugitives). The remainder of this section describes how Pechan recalculated the without-CAAA emissions for this SCC.

Because the 2002 NEI that forms the basis of the current 2000 with-CAAA unpaved road emissions represents a mixture of EPA and state/local agency data, it was not possible to replace the existing without-CAAA unpaved road emissions with updated values. Instead, Pechan calculated an updated without-CAAA emission value by first developing new with- and without-CAAA emission estimates for 2002, and then applying the resulting without- to with-CAAA emissions ratio to the 2002 NEI emissions that represent the 2000 with-CAAA scenario emissions.

Pechan used the same EPA data inputs, unpaved road VMT, and AP-42 emission factor equation that was used in the 2002 NEI in the updated emission calculations. However, without-CAAA emissions removed the unpaved road emission controls from the calculations. The EPA-developed unpaved road estimates in the 2002 NEI incorporated a control efficiency of 80 percent with a rule penetration rate of 75 percent for urban roads in serious PM nonattainment areas, a 50 percent control efficiency with 50 percent rule penetration rate for rural roads in serious PM nonattainment areas, and a 96 percent control efficiency with a 50 percent rule penetration for urban roads in moderate PM nonattainment areas. The ratio of newly calculated without- to with-CAAA emission estimates (1.01) was then applied to the existing national with-CAAA PM<sub>2.5</sub> emission estimate.

The 1990 NEI was the source for the original Section 812 1990 unpaved road emissions. To be consistent with the methods used to calculate unpaved road emissions in the 2002 NEI, the 1990 unpaved road dust emissions were recalculated by first computing 1990 unpaved road emissions using the same methods as the uncontrolled 2002 unpaved emissions, but with 1990 unpaved VMT data replacing 2002 unpaved VMT data (these data were developed at the state and roadway type level of detail). Next, Pechan summed the 1990 and 2002 emission estimates to the national level, and computed the ratio of 1990 to 2002 unpaved emissions. This ratio (1.007) was then applied to the newly calculated 2000 without-CAAA PM<sub>2.5</sub> emission estimate that was computed as described above.

The 2000 without-CAAA unpaved road emissions that were directly re-computed in this effort were projected to 2010 and 2020 using the same regional unpaved road VMT growth factors that were previously applied in calculating the 2010 and 2020 with-CAAA emission estimates.

### **4. Residential Wood Combustion**

As part of the original Section 812 effort, Pechan performed a sector-specific analysis of emissions activity and controls for all but 2 of the 12 residential wood combustion (RWC) source

category SCCs with emissions in the 2002 NEI.<sup>3</sup> Much of the information compiled from that work was applied in this effort. Because the two SCCs that were not previously analyzed accounted for a small percentage of total category 2002 with-CAAA PM<sub>2.5</sub> emissions (0.08 percent), and will not have any significant CAAA reductions, Pechan did not attempt to refine the without-CAAA emission estimates for these two SCCs.

The first step in recalculating the 2000-without CAAA RWC emissions for the remaining ten SCCs was to identify the emission reductions attributable to lower-emitting wood heating units resulting from EPA's wood heater New Source Performance Standard (NSPS). The 2002 NEI that forms the basis for the 2000 with-CAAA scenario emissions assumed the following proportions of total residential wood consumption: 92 percent in non-EPA certified units; 5.7 percent in EPA certified non-catalytic units; and 2.3 percent in EPA certified catalytic units. EPA's RWC forecast year proportions were calculated by adjusting the 2002 year proportions using an annual 2 percent RWC unit turnover rate computed from 1992-2005 data. This adjustment accounts for non-EPA certified units being replaced by NSPS compliant EPA-certified units. Therefore, by year 2020, it is assumed that 64.4 percent of residential wood consumption in woodstoves and fireplaces with inserts will occur in non-EPA certified units, 25.4 percent in EPA certified non-catalytic units, and 10.2 percent in EPA certified catalytic units.

For the four SCCs that represent heating units that meet EPA emission requirements, the ratio of non-CAAA to CAAA emissions was computed by dividing the 2002 NEI emission factor for conventional units by the 2002 NEI emission factor for EPA-certified units. Two SCCs are specific to non-EPA-certified units and therefore have no CAAA emission reductions (2104008001 and 2104008010). Two SCCs do not specify EPA certification status (2104008000-Total Fireplaces and Woodstoves and 2104008001-Total Fireplaces). For these SCCs, it was necessary to develop a 2002 weighted emission factor from the EPA-certified and non-EPA-certified unit emission factors. Each emission factor was weighted by the proportion of RWC that is estimated to have occurred in the particular type of unit (as noted above, the 2002 NEI provided this information). Each SCC's ratio of non-CAAA emissions to CAAA emissions was computed by dividing the emission factor for conventional units by the given weighted emission factor. The 2000 without-CAAA emissions were computed by multiplying the 2000 with-CAAA emissions by the appropriate adjustment ratio.

Pechan used the back-cast factors that were developed in the earlier Section 812 analysis to back-cast the 2000 with-CAAA emissions to 1990. These back-cast factors were computed based on SCC-level 2002 and 1990 residential wood consumption estimates. To calculate 1990 consumption, Pechan first calculated the ratio representing national 1990 residential wood consumption relative to 2002 consumption (1.85), and then multiplied this ratio by 2002 year regional residential renewable (wood) energy consumption. Next, Pechan applied values representing the estimated 1990 year proportions of total residential wood consumption attributable to each of the following unit types: woodstoves, fireplaces with inserts, and fireplaces without inserts. Next, we allocated the general unit-level consumption estimates to individual SCCs. For 1990, this step assumed that zero residential wood consumption would occur in EPA-certified units because 1992 was the first year of certification. Finally, we calculated the back-cast/forecast year growth factors by dividing estimated 1990 consumption by estimated 2002 year consumption.

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<sup>3</sup>These two SCCs were 2104009000-Residential/Firelog/Total: All Combustor Types, and 2199008000-Total Area Source Fuel Combustion/Wood/Total: All Boiler Types.

The final step was to apply the 2010 and 2020 growth factors from the previous Section 812 analysis to the 2000 without-CAAA emissions to yield estimates of 2010 and 2020 without-CAAA emissions.

## **5. Fuel Combustion Industrial/Coal/Other**

Pechan did not identify any CAAA emission controls that affect PM<sub>2.5</sub> emissions for this category. Therefore, Pechan set the without-CAAA emissions for 2000, 2010, and 2020 equal to the with-CAAA emissions for each year. For 1990, Pechan was unable to replicate the 2001 emission calculations that underlie the EPA developed industrial coal combustion estimates for the 2002 NEI<sup>4</sup> because the NEI methods reflect the effects of point source subtractions that eliminate double counting of emissions reported in EPA's point source inventory. Therefore, 1990 emissions were estimated by applying the ratio of 1990 to 2001 emissions activity for this category to the NEI emissions. The emissions activity for this category is the volume of non-coke plant coal consumed by the industrial sector.<sup>5</sup> Pechan calculated the national ratio of 1990 coal consumption to 2001 coal consumption (1.170), and then multiplied this ratio by the national emissions in 2000 to estimate 1990 emissions.

## **B. SUMMARY OF REVISED EMISSION REDUCTIONS ATTRIBUTABLE TO CAAA**

Table 1 displays the final with- and without-CAAA emissions for each of the source categories analyzed. Overall, the CAAA are estimated to reduce PM<sub>2.5</sub> emissions for these categories by approximately 4 percent, 9 percent, and 10 percent in 2000, 2010, and 2020, respectively.

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<sup>4</sup>The 2002 NEI industrial coal emissions were based on the most recent data available at the time, which was 2001.

<sup>5</sup>Because Pechan only recalculated bituminous/sub-bituminous coal combustion, and not anthracite coal combustion, it was also necessary to estimate the portion of total consumption from bituminous/sub-bituminous coal. Pechan implemented this adjustment by applying the 2001 year state-specific bituminous to total coal consumption ratios that were compiled for the 2002 NEI. The 2001 ratios were used because analogous 1990 data were not available.

**Table 1. Summary of Updated Section 812 Second Prospective PM<sub>2.5</sub> Emission Estimates for Five Nonpoint Source Categories (tons per year)**

Category	1990	2000		2010		2020	
		Without CAAA	With CAAA	Without CAAA	With CAAA	Without CAAA	With CAAA
Construction	200,082	270,473	237,780	327,378	252,815	355,450	312,317
Paved Roads	162,436	210,409	202,706	226,196	217,706	245,903	236,673
Unpaved Roads	849,408	843,503	835,152	793,147	786,853	720,534	716,237
Residential Wood Combustion	786,697	460,003	428,043	529,172	438,225	573,504	431,195
Fuel Comb. Industrial/Coal/Other	180,361	154,095	154,095	153,289	153,289	147,870	147,870
<b>Subtotal</b>	2,178,984	1,938,484	1,857,776	2,029,183	1,848,888	2,043,261	1,844,291
% Reduction			4.2%		8.9%		9.7%