San Joaquin Valley
Air Pollution Control District

APR 1930
Area Source Emissions Inventory Methodology Format

Approved By: [signature] David Warner, Director of Permit Services	Date: 4/14/14

The purpose of this policy is to provide a guide for preparation of an area source emissions inventory methodology document in a standardized format.

This document (Attachment A) insures that all data elements required for the input of an area source emissions inventory into the California Air Resources Board's CEIDARS database are collected. These data elements include:

- A complete description of the emissions source category for which emissions are estimated.
- A description of the activity data and emission factors or other methods used to estimate emissions.
- Sample calculations.
- Measures of the temporal and spatial distribution of the emissions.
- County level unreconciled emissions estimates for each affected pollutant and source.

The attached document has been structured in a way to provide transparency to stakeholders interested in understanding and reproducing the District's emissions estimates. The main sections and subsections include subject headings, written explanations, example statements, example calculations, and tables, as appropriate, that each clarify the intent of the section in which they appear. While most methodology documents will include all of the main sections represented, they may be modified as necessary on a case-by-case basis. The tables, equations and many of the discussions have been designed to, and can be copied, modified as appropriate, and used in actual methodology documents.

Attachment A

Area Source Emissions Inventory Methodology Format

San Joaquin Valley
AIR POLLUTION CONTROL DISTRICT

20XX Area Source Emissions Inventory Methodology
Title (Summary Category #, Name, and Sub Title if needed)
Example:
050 – INDUSTRIAL NATURAL GAS COMBUSTION

PLEASE NOTE THE FOLLOWING:

- **METHODOLOGY FILE NAMES SHOULD INCLUDE A DESCRIPTIVE NAME AND EMISSIONS YEAR i.e., GasolineMarketing2006.doc**
- **ALL ACRONYMS MUST BE DEFINED THE FIRST TIME THEY ARE USED IN THE TEXT.**
- **MAKE SURE TABLES ARE NUMBERED AND INCLUDE HEADERS AND COLUMN TITLES.**
- **FORMATTING**
    - **FONT = ARIAL; TITLE = 18 PT; SUBTITLE = 16 PT; SECTION HEADS = 14 PT; BODY TEXT = 12 PT; TABLES = 10 PT.**
    - **TABLE SHADING = 25% GRAY; CENTER TABLES HORIZ. ON PAGE.**
    - **MARGINS = 1" TOP/BOTTOM/LEFT/RIGHT; 0.5" HEADER/FOOTER.**

I. Purpose

This document describes the Area Source Methodology used to estimate emissions of **[LIST POLLUTANTS AND ABBREVIATIONS I.E.,** carbon monoxide (CO), nitrogen oxides (NO_x), fine particulate matter less than 10 microns (PM_{10}), volatile organic compounds (VOC), sulfur oxides (SO_x), ammonia (NH_3)**]** from **[SPECIFY THE AREA SOURCE CATEGORY AND SUB CATEGORY IF NEEDED]** combustion of natural gas by the industrial sector in the San Joaquin Valley Air Basin. An area source category is a collection of similar emission units within a geographic area (i.e., a County) that are small and numerous and may not have been inventoried as specific point, mobile, or biogenic sources. The California Air Resources Board (CARB) has grouped these individual sources with other like sources into area source categories. These source categories are grouped in such a way that they can be estimated collectively using one methodology.

II. Applicability

The emission calculations from this Area Source Methodology apply to sources that are identified by the following Category of Emission Source (CES) code(s) and Reconciliation Emission Inventory Code(s) (REIC):

Table 1. Emission inventory codes.

CES	REIC	Description
66787	050-040-0110-0000	Industrial Stationary - I.C. Engines - Natural Gas
47142	050-995-0110-0000	Industrial Natural Gas Combustion (Unspecified)

III. Point Source Reconciliation

[IF THERE ARE 5 COMBINATIONS OR LESS, USE THE FOLLOWING STATEMENT AND TABLE, ADD ROWS AS NECESSARY] Emissions from the area source inventory and point source inventory are reconciled against each other to prevent double counting. This is done using relationships created by the California Air Resources Board (CARB) between the area source REIC and the point sources' Standard Industry Classification (SIC) code and emissions process Source Category Code (SCC) combinations. The area sources in this methodology reconcile against processes in our point source inventory with the following SIC/SCC combinations :

Table 2. Point source reconciliation relationships for REIC XXX-XXX-XXXX-XXXX.

EIC	SIC	SCC	Point Source Type

[IF THERE ARE MORE THAN 5 COMBINATIONS, PUT THE TABLES IN AN APPENDIX AND USE THE FOLLOWING STATEMENT] Emissions from the area source inventory and point source inventory are reconciled against each other to prevent double counting. This is done using relationships created by the California Air Resources Board (CARB) between the area source REIC and the point sources' Standard Industry Classification (SIC) code and emissions process Source Category Code (SCC) combinations. The area sources in this methodology reconcile against processes in our point source inventory with the SIC/SCC combinations listed in Appendix A.

[IF THE AREA SOURCE DOES NOT RECONCILE WITH THE POINT SOURCE INVENTORY USE THE FOLLOWING STATEMENT] Emissions from the area source inventory and point source inventory are reconciled against each other to prevent double counting. This is done using relationships created by the California Air Resources Board (CARB) between the area source REIC and the point sources' Standard Industry Classification (SIC) code and emissions process Source Category Code (SCC) combinations. The area source(s) in this methodology are not represented within our point source inventory so reconciliation is not necessary.

[FOR POINT SOURCE ONLY SOURCE CATEGORIES] Emissions from the area source inventory and point source inventory are reconciled against each other to prevent double counting. This is done using relationships created by the California Air Resources Board (CARB) between the area source REIC and the point sources' Standard Industry Classification (SIC) code and emissions process Source Category Code (SCC) combinations. This source category consists of only point sources (no area source emissions). The SIC/SCC combinations in our point source inventory that reconcile to this source category are listed in Appendix A.

IV. Methodology Description

[BRIEF DESCRIPTION OF THE METHODOLOGY USED TO CALCULATE EMISSIONS FOR THE SOURCE CATEGORY. FOLLOWING IS AN EXAMPLE FOR INDUSTRIAL NATURAL GAS COMBUSTION:]

This area source methodology is a top down estimation of emissions from the combustion natural gas by the industrial sector in the San Joaquin Valley Air Pollution Control District. The industrial sector consumes natural gas for process uses (primarily heat), boiler fuel, space heat, electricity generation and feedstock. These end uses are divided into two categories: 1) stationary internal combustion engines - reciprocating engines and turbines, and 2) unspecified. The "unspecified" category includes external combustion sources such as heaters, boilers, and burners. The amount of natural gas delivered to industrial sources in each county within the District was obtained from the California Energy Commission (Gough, 2007). From this, the amount of natural gas reported to the District's point source inventory as consumed was subtracted. The difference between the amount of natural gas reported delivered and the amount reported consumed was considered the area source process rate. To estimate area source emissions, the area source process rate was assigned to end uses and then multiplied by emission factors.

V. Activity Data

[DESCRIBE AND PRESENT ACTIVITY DATA USED TO CALCULATE EMISSIONS. SUBSECTIONS MAY BE CREATED IF MULTIPLE CATEGORIES ARE INCLUDED AS PART OF THIS METHODOLOGY. IN GENERAL, ACTIVITY DATA SHOULD BE SUMMARIZED IN TABULAR FORMAT.]

Consumption. Total natural gas deliveries to the industrial sector for each county in the district in was obtained from the California Energy Commission (Gough, 2007) and is presented below. Industrial deliveries exclude companies whose primary function is to generate electricity or produce oil and gas as determined by their company SIC. Emissions from these industries are tabulated in other EICs. The District's point source inventory of industrial natural gas combustion processes was then reconciled against the amount of natural gas reported delivered to industrial sources within the District. The area source consumption was calculated as the difference between the industrial natural gas deliveries and the industrial consumption reported through the point source inventory (Table 2).

Table 3. 2006 industrial natural gas consumption (MMSCF).

County	Industrial Deliveries Reported by CEC	Industrial Point Source Consumption	Reconciled Area Source Consumption
Fresno			
Kern			
Kings			
Madera			
Merced			
San Joaquin			
Stanislaus			
Tulare			
Total			

Categorization. To categorize industrial natural gas end use, we used a 1994 report prepared by the Energy Information Administration (EIA) entitled "How Changing Energy Markets Affects Manufacturing." This study found divided industrial natural gas consumption into three main end use categories represented in Table 3 below.

Table 4. Industrial natural gas consumption categories.

REIC Category	Description	Combustion Process	Industrial Natural Gas Consumption
050-040-0110-0000	Industrial Stationary - I.C. Engines - Natural Gas	Turbines/Reciprocating Engines	6%
050-995-0110-0000	Industrial Natural Gas Combustion (Unspecified)	Heaters, Boilers, and Furnaces	84%
	Feedstock Non-combustion Processes	Natural Gas used in the synthesis of other products	10%

The Feedstock category does not involve natural gas combustion and will not be considered in this area source methodology.

VI. Emission Factors

[THIS SECTION SHOULD INCLUDE A DESCRIPTION OF THE EMISSION FACTORS SELECTED, THE EMISSION FACTORS FOR EACH CRITERIA POLLUTANT (IF APPROPRIATE), AND THE EQUIPMENT THEY ARE ASSOCIATED WITH; ALL DISPLAYED IN A TABLE. MAKE SURE ALL EMISSION FACTORS ARE REFERENCED COMPLETELY. IF AP-42 FACTORS ARE USED, REFERENCE THE SECTION AND DATE. FOLLOWING IS AN EXAMPLE FOR INDUSTRIAL NATURAL GAS COMBUSTION:].

CO, NOx, SOx, VOC and PM emission factors for reciprocating engines and "unspecified" industrial natural gas combustion were obtained from the EPA's AP-42 document (EPA, 1998 & 2000b). The SOx emission factor for all processes was obtained from San Joaquin Valley Air Pollution Control District Policy APR 1720.

For internal combustion (IC) engines, the NOx, VOC, CO, and PM10 emission factors were taken from AP-42, section 3.2, table 3.2-2 (EPA, 2000b). The NOx emission factor was used under the assumption that the IC engines are 4-stroke lean-burn engines operating at normal conditions which assumed to be less than 90% load. The Total Organic Gas (TOG) emission factor was speciated into a VOC emission factor using CARB's speciation profiles. The CO emission factor for IC engines is from the same table, however, the emission factor for a less than 90% load is used because it would lead to a higher, and therefore, more conservative estimate. The PM_{10} emission factor is also taken from the same table. In a effort to provide a more conservative estimate, the total PM (condensable) emission factor was speciated into PM_{10} emissions using CARB's speciation profiles.

For small boilers, the NOx, VOC, CO, and PM10 emission factors were taken from AP-42, section 1.4, tables 1.4-1 and 1.4-2 (EPA, 1998). The NOx and CO emission factors were taken under the assumption that these were small, uncontrolled boilers. The VOC emission factor is taken directly from AP-42 because it would be higher than the speciated TOC emission factor and therefore be a more conservative emission factor. The PM10 emission factor was obtained by applying the CARB speciation profile to the total PM emission factor.

Table 5. Industrial natural gas combustion emission factors.

Combustion process	Emissions (pounds per million cubic feet)				
	NO_x	CO	SO_x	VOC	PM_{10}
Reciprocating Engines	864	568	2.9	4.7	10.2
Unspecified	100	84	2.9	5.5	7.6

VII. Emissions Calculations

[IN THIS SECTION, CALCULATE EMISSIONS FOR A SINGLE POLLUTANT AND SOURCE. FIRST, LIST ALL OF THE ELEMENTS REQUIRED FOR THE CALCULATION. THEN, PRESENT STEP BY STEP CALCULATIONS SO THAT THE READER CAN UNDERSTAND HOW THE EMISSIONS IN THE EMISSIONS TABLES WERE DEVELOPED. THE RESULTS OF THE SAMPLE CALCULATION ANSWER SHOULD MATCH THAT PRESENTED IN THE EMISSONS TABLE AT THE END OF THE METHODOLOGY. FOLLOWING IS AN EXAMPLE FOR INDUSTRIAL NATURAL GAS COMBUSTION]

Industrial natural gas emissions are estimated using the amount of fuel consumed by the sector, the fraction of fuel attributed to the end use within the sector (reciprocating engines or unspecified), and emission factors. Following is sample calculation of NO_x emissions from the combustion of natural gas in unspecified industrial sources in Fresno County:

Given:

1. All non-permitted unspecified natural gas combustion devices within the District are uncontrolled small boilers.
2. The NO_x emission factor for unspecified industrial natural gas combustion is 100 pounds per million cubic feet of natural gas burned.
3. The reconciled area source consumption of natural gas by the industrial sector in Fresno County was 3,177 mmscf (million std. cubic feet) in 2006.
4. 84% of industrial end use was for unspecified sources.

Equation:

$$E_{pol, tpy} = FC_{mmscf} \; x \; EU_{pct} \; x \; EF \; x \; CF$$

Where,

E_{tpy} = *end use emissions of a given pollutant in tons per year;*

FC_{mmscf} = *fuel consumption in millions of standard cubic feet;*

EU_{pct} = *percentage end use (reciprocating engines or unspecified);*

EF = *emission factor in pounds of pollutant emitted per million standard cubic feet fuel consumed;*

CF = *conversion factor of one ton per 2,000 pounds.*

Calculate Emissons:

$$E_{NO_x, typ} = \frac{3,177 \; mmscf}{year} \; x \; 0.84 \; x \; \frac{100 \; lb \; NO_x}{mmscf} \; x \; \frac{1 \; ton}{2,000 \; lbs}$$

$$E_{NO_x, typ} = \frac{133.4 \; tons \; NO_x}{year}$$

VIII. Temporal Variation

[THIS SECTION SHOULD DISCUSS THE TEMPORAL VARIATION (OPERATIONAL SCHEDULE) FOR SOURCES DESCRIBED BY THIS METHODOLOGY, AND HOW THAT DATA WAS DETERMINED. FOLLOWING IS AN EXAMPLE FOR INDUSTRIAL NATURAL GAS COMBUSTION.].

A. Daily

CARB Code 24. 24 hours per day - uniform activity during the day.

[SELECT FROM THE FOLLOWING CODES, DELETE TABLE.]

CARB Code	Description
1	1 hour per day
2	2 hours per day
3	3 hours per day
4	4 hours per day
5	5 hours per day
6	6 hours per day
7	7 hours per day
8	8 hours per day - uniform activity from 8 a.m. to 4 p.m. (normal working shift)
9	9 hours per day
10	10 hours per day
11	11 hours per day
12	12 hours per day
13	13 hours per day
14	14 hours per day
15	15 hours per day
16	16 hours per day - uniform activity from 8 a.m. to midnight (2 working shifts)
17	17 hours per day
18	18 hours per day
19	19 hours per day
20	20 hours per day
21	21 hours per day
22	22 hours per day
23	23 hours per day
24	24 hours per day - uniform activity during the day
31	Major activity 5-9 p.m., average during day, minimal in early a.m.(gas stations)
33	Max activity 7-9 a.m. & 7-11 p.m.,ave during day, low at night (resident combst)
34	Activity 1 to 9 a.m.; no activity remainder of day (i.e. orchard heaters)
35	Max activity 7 a.m. to 1 a.m., remainder is low (i.e. commercial aircraft)
37	Activity during daylight hours; less chance in early morning and late evening
38	Activity during meal time hours (i.e. residential cooking)
50	Peak activity at 7 a.m. & 4 p.m.; average during day (on-road motor vehicles)

CARB Code	Description
51	Activity from 6 a.m. to 12 p.m. (petroleum dry cleaning in Sacramento)
52	Major activity from 6 a.m.-12 p.m., less from 12-7 p.m. (pesticides in ventura)
53	Activity from 7 a.m. to 12 p.m. (agricultural aircraft in Ventura)
54	Uniform activity from 7 a.m. to 9 p.m. (daytime biogenics)
55	Uniform activity from 9 p.m. to 7 a.m. (nightime biogenics)

B. Weekly

CARB Code 7. 7 days per week - uniform activity every day of the week

[SELECT FROM THE FOLLOWING CODES, DELETE TABLE.]

CARB Code	Description
1	1 day per week
2	2 days per week
3	3 days per week
4	4 days per week
5	5 days per week - uniform activity on week days; none on Saturday and Sunday
6	6 days per week - no activity on Sunday; uniform during the remaining 6 days
7	7 days per week - uniform activity every day of the week
20	Uniform activity on Saturday and Sunday; no activity the remainder of the week
21	Uniform activity on week days; twice as much activity on weekends
22	Uniform activity on week days; reduced activity on weekends
23	Uniform activity on week days; reduced on weekends (for on-road motor vehicles)

C. Monthly

[CALCULATE THE PERCENTAGE OF THE TOTAL ACTIVITY THAT OCCURS IN EACH MONTH. THE SUM OF ALL ACTIVITY MUST EQUAL 100%.]

Monthly activity in California is relatively uniform as illustrated by 2006 industrial natural gas consumption data from the U.S. Department of Energy's Energy Information Administration presented below:

Table 6. California industrial natural gas consumption.

Month (2006)	Natural Gas Consumption (million cubic feet)	Activity Level (% of annual)
January	60,043	8.20%
February	59,659	8.15%
March	61,924	8.46%
April	60,888	8.32%
May	58,174	7.95%
June	57,333	7.83%
July	59,573	8.14%
August	62,997	8.61%
September	64,032	8.75%
October	63,729	8.71%
November	60,995	8.33%
December	62,708	8.57%
Total	732,055	100.00%

IX. Spatial Variation

[THIS SECTION SHOULD DISCUSS THE SPATIAL VARIATION OF THE DATA COLLECTED FOR THIS METHODOLOGY AND ANY FACTORS THAT MAY EFFECT THE SPATIAL VARIATION IN THE FUTURE. CURRENT SPATIAL SURROGATES CAN BE FOUND IN THE AREA SOURCE DATABASE. THE FOLLOWING EXAMPLE IS FOR INDUSTRIAL NATURAL GAS COMBUSTION:]

Industrial natural gas deliveries in 2006 for each county in the SJVAPCD were provided by the California Energy Commission (e-mail communication from A. Gough on May 30, 2006) and were presented previously in Section V. Within each county, activity can be assigned to parcels zoned for industrial activity.

X. Growth Factor

Growth factors are developed by either the District's Strategies and Incentives Department or CARB for each EIC. These factors are used to estimate emissions in future years. The growth factors associated with this emissions category may be obtained from the District's Strategies and Incentives Department.

XI. Control Level

Control levels are developed by either the District's Strategies and Incentives Department or CARB for each EIC. Control levels are used to estimate emissions reductions in future years due to implementation of District rules. These control levels take into account the effect of control technology, compliance and exemptions at full implementation of the rules. Control levels associated with this emissions category may be obtained from the District's Strategies and Incentives Department.

XII. CARB Chemical Speciation

[THIS SECTION SHOULD DISCUSS THE CARB PROFILE(S) USED TO DESCRIBE THIS CATEGORY. FOLLOWING ARE EXAMPLES FOR INDUSTRIAL NATURAL GAS COMBUSTION ORGANIC GASSES AND PARTICULATE MATTER:]

CARB has developed organic gas profiles in order to calculate reactive organic gasses (ROG), volatile organic compounds (VOC) or total organic gas (TOG) given any one of the three values. For each speciation profile, the fraction of TOG that is ROG and VOC is given. The organic gas profile codes can also be used to lookup associated toxics. CARB's speciation profiles for industrial natural gas combustion processes are presented in the table below. Organic gas profile #719 is applied to REIC 050-040-0110-0000 (Industrial stationary IC engines, natural gas). Organic gas profile #3 is applied to REIC 050-995-0110-0000 (industrial natural gas combustion, unspecified).

Table 8. CARB organic gas speciation profiles for 050-040-0110-0000 and 050-995-0110-0000.

Profile Description	CARB Organic Gas Profile#	Fractions	
		ROG	VOC
Internal Combustion Engines - Reciprocating - Natural Gas	719	0.091428	0.091428
External Combustion Boiler - Natural Gas	3	0.422181	0.422181

CARB has developed particulate matter speciation profiles in order to calculate particulate matter (PM), particulate matter with a diameter less than or equal to 10 microns (PM_{10}) or particulate matter with a diameter less than or equal to 2.5 microns ($PM_{2.5}$) given any one of the three values. For each speciation profile, the fraction of PM that is PM_{10} and $PM_{2.5}$ is given. The particulate matter profile codes can also be used to lookup associated toxics. CARB's speciation profiles for industrial natural gas combustion processes are presented in the table below. Particulate matter profile #123 is applied to REIC 050-040-0110-0000 (Industrial stationary IC engines, natural gas). Particulate matter profile #120 is applied to REIC 050-995-0110-0000 (Industrial natural gas combustion, unspecified).

Table 9. CARB particulate matter speciation profiles for 050-040-0110-0000 and 050-995-0110-0000.

Profile Description	CARB PM Profile#	Fractions	
		PM_{10}	$PM_{2.5}$
Stationary I.C. Engine - Natural Gas	123	0.994	0.992
Gaseous Material Combustion	120	1	1

XIII. Assessment Of Methodology

[THIS SECTION SHOULD HAVE A BRIEF DISCUSSION OF WHAT IS AND IS NOT COVERED BY THIS METHODOLOGY AND WHETHER OR NOT THIS INCLUDES DATA FROM THE POINT SOURCE INVENTORY. THIS SECTION CAN ALSO BE USED TO COMMENT ON UNDERLYING ASSUMPTIONS USED BY THE METHODOLOGY, AS WELL AS WHETHER THE METHOD USED IS IDENTIFIED AS A PREFERRED OR ALTERNATE METHOD BY THE EPA-EIIP.]

This area source estimate relies on point source and total District consumption of natural gas to determine area source consumption. It is important that both inventories be accurate and complete.

Although all internal combustion engines less than 50 horsepower are assumed to be reciprocating engines, there are proposals for microturbines within the District in the future. However, these microturbines are not expected to make a significant impact on the area source estimation.

The manner by which the EIA broke down the natural gas usage in the manufacturing sector (EIA, 1994) is used as a surrogate for the assignment of industrial natural gas consumption to devices. This is based on a national study performed in 1994 and representing the manufacturing sector only. Future research or studies could lead to a more accurate and up-to-date depiction of the natural gas consumption in the industrial sector.

XIV. Emissions

[IN THIS SECTION, PRESENT THE AREA SOURCE EMISSIONS ESTIMATED BY THIS METHODOLOGY, THE POINT SOURCE EMISSIONS FROM OUR POINT SOURCE INVENTORY, THE TOTAL UNRECONCILED EMISSIONS FOR THE CATEGORY (POINT + AREA), AND LASTLY A TABLE SUMMARIZING THE CHANGE IN EMISSIONS]

Following is the 20XX area source emissions inventory for REIC XXX-XXX-XXXX-XXXX estimated by this methodology. Emissions are reported for each county in the District.

Table 10. Area source emissions for REIC ###-###-####-#### (20XX).

County	Emissions (tons/year)					
	NOx	CO	SOx	VOC(1)	PM_{10}	$PM_{2.5}$(2)
Fresno						N/A
Kern						N/A
Kings						N/A
Madera						N/A
Merced						N/A
San Joaquin						N/A
Stanislaus						N/A
Tulare						N/A
TOTAL						N/A

(1) The District only reports ROG to CARB. As noted in Section XII, ROG is the same as VOC.
(2) At this time, the District does not calculate $PM_{2.5}$ emissions. $PM_{2.5}$ emissions can be estimated using the speciation profiles found in Section XII.

Following is the 20XX point source emissions inventory for REIC XXX-XXX-XXXX-XXXX as reported to the District by our permit holders. Emissions are reported for each county in the District.

Table 11. Point source emissions for REIC ###-###-####-#### (20XX).

County	Emissions (tons/year)					
	NOx	CO	SOx	VOC(1)	PM_{10}	$PM_{2.5}$(2)
Fresno						N/A
Kern						N/A
Kings						N/A
Madera						N/A
Merced						N/A
San Joaquin						N/A
Stanislaus						N/A
Tulare						N/A
TOTAL						N/A

(1) The District only reports ROG to CARB. As noted in Section XII, ROG is the same as VOC.
(2) At this time, the District does not calculate $PM_{2.5}$ emissions. $PM_{2.5}$ emissions can be estimated using the speciation profiles found in Section XII.