Area Source Industrial Fuel Combustion in Austin-Round Rock Metropolitan Statistical Area for 2006

FINAL REPORT, Task 3.4a, Phase II Rider 8 Work Plan

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Introduction

Based on a review of the existing emissions inventory and the documentation for estimating the area source industrial fuel combustion, the Capital Area Council of Governments (CAPCOG) decided to develop new estimates of emissions of nitrogen oxides (NO_X), volatile organic compounds (VOC), and carbon monoxide (CO) from this source category using the 2006 Manufacturing Energy Consumption Survey (MECS) in combination with employment data from the County Business Patterns (CBP) and databases provided by the Capital Area Metropolitan Planning Organization (CAMPO).

Table 1: Summary of Typical Ozone Season Weekday Emissions in Austin MSA in 2006 (tons per day)

Fuel	SCC	NO_X	VOC	CO
Distillate Fuel Oil	2102004000	0.08070	0.00081	0.02018
Residual Fuel Oil	2102005000	0.30006	0.00153	0.02728
Natural Gas	2102006000	1.04110	0.05726	0.87452
LPG	2102007000	0.02968	0.00100	0.01528
TOTAL		1.45153	0.06060	0.93726

Geographic Scope

This study includes the five counties included in the Austin-Round Rock Metropolitan Statistical Area (Austin MSA):

- Bastrop County,
- Caldwell County,
- Hays County,
- Travis County, and
- Williamson County.

Time Period Covered

CAPCOG developed estimates for 2006 because that year included the base case ozone episode CAPCOG is currently using to perform photochemical modeling. It also coincides precisely with the year the MECS was last completed.

Source Classification Codes (SCCs) Covered

CAPCOG included four source classification codes in this study, as listed below:

Table 2: Source Classification Codes

SCC Code	Description
2102004000	Industrial Fuel Combustion: Distillate Oil: Boilers/IC Engines.
2102005000	Industrial Fuel Combustion: Residual Oil
2102006000	Natural Gas: Boilers/IC Engines
2102007000	Industrial Fuel Combustion: Liquefied Petroleum Gas (LPG)

Although there are SCCs for area source kerosene and coal combustion, less than 9,000 gallons of kerosene total were consumed by "industrial" customers in 2006 in Texas, according to the Energy Information Administration (EIA) (http://www.eia.gov/dnav/pet/pet_cons_821kera_dcu_STX_a.htm), and given the reporting threshold of 25 tons per year of nitrogen oxides (NO_X) within the 5-county MSA,

it is highly unlikely that industrial sources using coal would not be reporting to the point source database.

CAPCOG also did not separate the fuel combustion categories into boilers and internal combustion engines. The rationale for keeping these aggregated together can be found later in the report in the discussion of activity adjustments.

Comparison to Texas Commission on Environmental Quality (TCEQ) Estimates

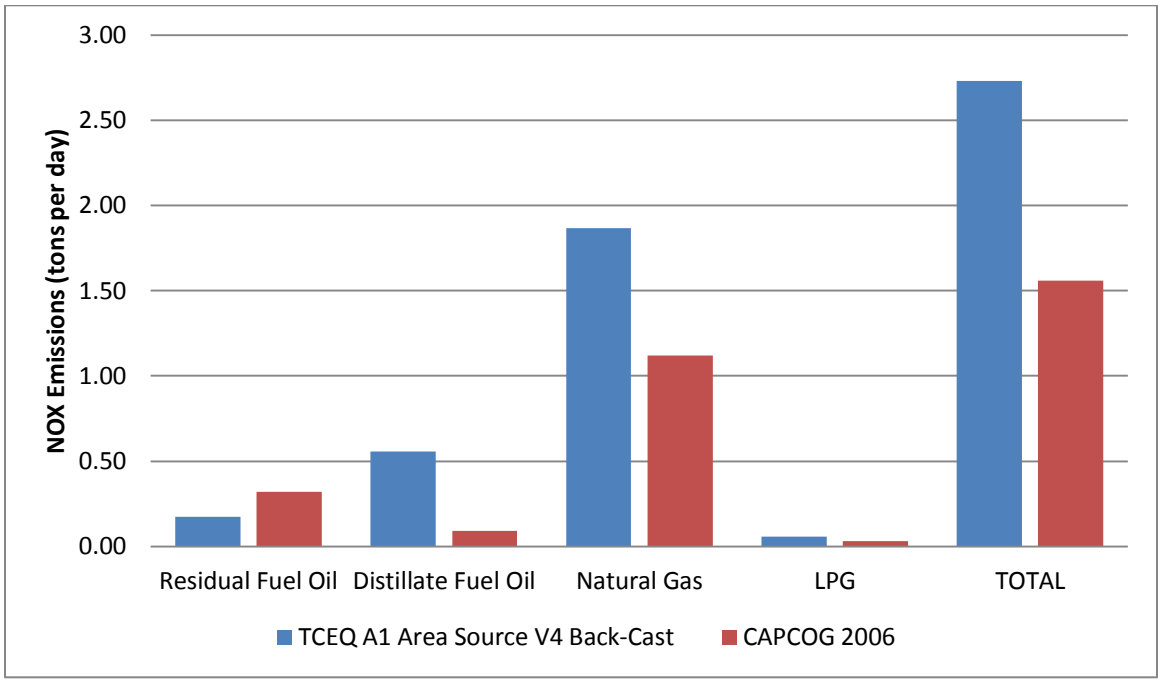
The most recent emissions estimate for area source industrial fuel combustion comes from TCEQ's A1 2008 Area Source V4-2008 inventory. The table below provides the estimates by county:

Table 3: 2008 Area Source Industrial Fuel Combustion Emissions (tons per day)

Source	NOX	VOC	CO
Distillate Fuel Oil	0.6372	0.0060	0.1599
Residual Fuel Oil	0.1501	0.0010	0.0127
Natural Gas	1.9014	0.1046	1.5972
LPG	0.0460	0.0010	0.00115
TOTAL	2.7347	0.1125	1.7812

CAPCOG's estimates are significantly lower than TCEQ's estimates for this category. The figure below compares CAPCOG's estimate with a back-cast of TCEQ's 2008 estimate in the A1 2008 Area Source V4-2008 inventory. The back-cast growth rates used were from the latest Economic Growth Analysis System (EGAS) growth figures in TCEQ's Texas Air Emissions Repository (TxAER).

Figure 1: Comparison of CAPCOG and TCEQ Estimates of NO_X Emissions



Based on discussions with TCEQ staff, these inventories were based on a methodology developed by Pechan (now Transystems) for EPA. (E.H. Pechan & Associates, Inc., 2009) This methodology involved the following steps:

- Use state-level natural gas consumption estimates for energy consumed by industrial customers from Energy Information Administration's State Energy Data System data for residual fuel oil, natural gas, and liquefied petroleum gas, and from the Fuel Oil and Kerosene Sales report for distillate fuel oil,
- Subtract non-road consumption of fuels from agriculture, logging, mining, and construction source categories using the National Mobile Inventory Model for 2006,
- Subtract non-fuel (feedstock) uses by US Census Region (Northeast, South, Midwest, West) from state fuel consumption totals based on the Manufacturing Energy Consumption Survey,
- Subtract point source emissions from the state total, and
- Allocate state totals to each county based on that county's fraction of the state's employees in the manufacturing sector (North American Industry Classification System (NAICS) Codes 31-33).

The table below summarizes the assumptions Pechan made regarding the percentages of each fuel used in stationary sources and the percentages of stationary source use that is consumed as a fuel rather than a feedstock for Texas.

Table 4: Pechan Assumptions on Stationary Source Use and Portion used as Fuel

Fuel	Stationary Source Use	Used as Fuel
LPG	91%	2%
Industrial No. 1 Distillate	60%	91%
Industrial No. 2 Distillate	100%	91%
Industrial Diesel	15%	91%

Fuel	Stationary Source Use	Used as Fuel
Industrial No. 4 Distillate	100%	91%
Farm-Other Distillate	100%	91%
Off-Highway-Distillate	5%	91%
Residual Oil	100%	85%
Natural Gas	100%	75%

The primary difference between CAPCOG's estimate and TCEQ's estimate is the use of industry-specific fuel consumption factors in combination with industry-specific employment data for each of the 5 counties in the Austin MSA. The existing estimates assume an equal fuel consumption rate per employee for all types of manufacturing industries, but data from the MECS indicates that different industry types have widely different fuel consumption rates. For instance, oil refineries consume 12,597 Million British Thermal Units (MMBTU) per employee, while semiconductor manufacturers consume only about 133 MMBTU per employee. Since the industrial mix in the Austin area typically requires less fuel combustion than many of the other industries in the state, the existing methodology over-allocated activity to this region.

CAPCOG Methodology

CAPCOG's methodology bears some similarities to Pechan's approach for the 2008 NEI, and a refined approach developed by Pechan for the Central Regional Air Planning Association that accounts for the energy-intensity of various industrial sectors (energy consumed per employee) to modify the county-level allocations (E.H. Pechan & Associates, Inc., March 2009). CAPCOG's approach is based strictly on the 2006 Manufacturing Energy Consumption Survey, County Business Patterns data, and raw data on the number of employees at each establishment within the 5-county MSA according to its NAICS code, which was obtained from the CAMPO. The raw data from CAMPO comes from a confidential database containing the number of employees, locations, and NAICS codes for every employer in the 5-county region for September 2005 and September 2007.

CAPCOG's method involves the following steps:

- Calculate NAICS-specific fuel consumption factors (fuel consumed per employee) using the 2006 MECS and the 2006 CBP Data,
- Multiply the fuel consumption factors by the number of employees within that NAICS code in each county, and
- Subtract the estimated number of employees working at sources that reported to the 2006 TCEQ point source emissions inventory from the county totals.

Under the State Energy Data Systems (SEDS) data, which were the basis for the TCEQ estimates, the "Industrial Sector" is defined as "an energy-consuming sector that consists of all facilities and equipment used for producing, processing, or assembling goods." The NAICS Codes includes in this sector are:

- 31-33: Manufacturing
- 11: Agriculture, Forestry, Fishing, and Hunting
- 21: Mining, Including Oil and Gas Extraction
- 23: Construction

One of the limitations of the SEDS estimates is that it includes energy consumption for all uses, not just fuel combustion. Moreover, since the "industrial" sector includes the construction, mining, and farm sectors, the estimates for energy consumption are likely to include substantial quantities of diesel used for non-road equipment. The table below compares the nation-wide SEDS consumption estimates in 2006 to the estimates from the MECS.

Table 5: Comparison of SEDS to MECS Data

Energy Source	SEDS	MECS-All Uses	MECS-Fuel Only
LPG	593.714 million barrels	664 million barrels	21 million barrels
Residual Fuel Oil	38.057 million barrels	50 million barrels	40 million barrels
Distillate Fuel Oil	216.799 million barrels	25 million barrels	22 million barrels
Natural Gas	7,668.522 billion cubic feet	5,744 billion cubic feet	5,357 billion cubic feet

The MECS data show higher consumption from just the manufacturing sector in 2006 for both Liquified Petroleum Gas (LPG) and Residual Fuel Oil. It should therefore be safe to assume that all emissions for area source LPG and residual fuel oil combustion should be accounted for in the MECS Fuel Consumption data.

For Distillate Fuel Oil, the SEDS data includes all diesel consumption from non-road equipment in the construction, agriculture, and mining sectors. Data from the Energy Information Administration (EIA)'s Adjusted Distillate Fuel Oil and Kerosene Sales by End Use (http://www.eia.gov/dnav/pet/pet_cons_821usea_dcu_nus_a.htm) further breaks down industrial use into farm and construction categories. This data indicates that in 2006, 68% of the distillate consumed in the "industrial" sector was consumed in the construction sector (57 million barrels) or as diesel in the agricultural sector (90 million barrels). Only 1 million barrels of other distillate was used in the agricultural sector. Since in this table, "industrial" now only includes manufacturing and mining, it is possible to compare these figures to the MECS to get a clearer picture of the difference. The Distillate Fuel Oil and Kerosene Sales by End Use shows 53 million barrels of diesel consumed in the "industrial" sector and 11 million barrels of other distillate for a total of 64 million, which is much closer to the MECS total. Since this sector would still include non-road equipment used in the mining sector, though, it still would be better to use the MECS data.

Since the MECS provides data for some NAICS codes on more detailed levels than the 3-digit level, it is possible to develop aggregate fuel consumption rates within higher-level NAICS codes by subtracting out the lower-level fuel consumption and employment data for the lower-level NAICS codes. For example, to calculate the natural gas consumption rate for businesses within NAICS Code 334 (Computer and Electronic Products) other than those in NAICS Code 334413 (Semiconductors and Related Devices), you would need to perform the following calculation:

> Fuel Consumed in code 334 – Fuel Consumed in code 334413 = Other Fuel Consumed in code 334
>
> - 44 billion cubic feet – 18 billion cubic feet = **26 billion cubic feet** (26,000 million cubic feet (MMCF))

Employees in code 334 – Employees in code 334413 = Other Employees in code 334

- 1,057,485 - 143,368 = **914,117 employees**

Other Fuel Consumed in code 334/Other Employees in code 334 =

- **0.0284 MMCF/employee**

A comprehensive listing of the final consumption factors calculated for each NAICS code combination using these calculations is provided in an appendix to this report.

CAPCOG's methodology assumes that all fuel is burned in an external combustion device. The rationale for this will be described in the "Activity Adjustments for End Use of Fuel" section of this report. For this report, CAPCOG also assumed that the national-level fuel consumption data from the MECS was representative of industries in the Austin region at all scales of employment. There is some evidence in other parts of the MECS (table 6-4) that indicate that the energy consumption rate per employee is higher as the size of an establishment grows. However, the data are not separated into different fuel types so it isn't possible to analyze fuel combustion from electricity usage independently.

County-Level Employment Data

CAPCOG used the employment data for each NAICS code in manufacturing from the 2006 County Business Patterns data for Bastrop, Caldwell, Hays, Travis, and Williamson Counties as the basis for the fuel consumption activity within the MSA. CAPCOG used the actual number of employees where available for a given NAICS code. The employment figures were totaled at each NAICS level for which the MECS provided data.

Where the exact number of employees was not disclosed, but the range was provided, CAPCOG calculated the minimum number of employees within that NAICS code based on the number of establishments within the employment ranges provided:

- 1-4 employees,
- 5-9 employees,
- 10-19 employees,
- 20-49 employees,
- 50-99 employees,
- 100-249 employees,
- 250-499 employees,
- 500-999 employees, and
- 1,000 or more employees.

By using the minimum employment for NAICS codes where the total was not disclosed, CAPCOG avoided the possibility of having negative values for the number of employees within the "not elsewhere classified" categories. It also avoided the problem of how to deal with establishments with 1,000 or more employees, for which a midpoint would not be available.

For example, for NAICS Code 3254 (Pharmaceutical and Medicine Manufacturing), Travis County has:

- 3 establishments with 1-4 employees,
- 1 establishment with 250-499 employees, and
- 1 establishment with 1,000 or more employees.

Therefore, the minimum number of employees in NAICS Code 3254 would be:

3*1 + 1*250 + 1*1,000 = **1,253**

CAPCOG then subtracted these estimates from higher-level totals to obtain an estimate of the total not elsewhere classified. For example, Travis County had:

- 1,730 employees in Chemical Manufacturing (NAICS Code 325) of whom,
  - at least 5 were in Industrial Gases Manufacturing (325120),
  - at least 60 were in Other Basic Inorganic Chemicals Manufacturing (325188),
  - at least 1,253 were in Pharmaceutical and Medicines (3254), and
  - at least 101 were in Photographic Film, Paper, Plate, and Chemicals (325992).

That leaves at least 311 Chemical Manufacturing employees not elsewhere classified, so they are assigned to the category "325 NEC." These "NEC" total are then multiplied by a fuel consumption factor based on nation-wide employment totals and the fuel consumption totals, as described later in this report.

For one specific NAICS Code (331), this procedure does not work for Travis County because the lower-level NAICS codes listed in the MECS make up the entire higher-level code. In this case, the 49 "NEC" employees are allocated to each lower-level NAICS code in proportion to the minimum number of employees listed:

- at least 6 employees in 331111 (4%),
- at least 50 employees in 3312 (34%),
- at least 40 employees in 3314 (27%), and
- at least 51 employees in 3315 "NEC" (35%).

Point Source Adjustments to County-Level Employment Figures

CAPCOG adjusted the number of employees within certain NAICS Codes in each county based on sources with Industrial SIC codes that reported to TCEQ's Point Source Emissions Inventory in 2006 within the region. The number of employees for each facility was calculated by averaging the number of employees reported at each facility in the September 2005 and September 2007 databases provided by CAMPO. The number of employees was then subtracted from the number of employees within each industrial classification in the appropriate county. The table below lists the point sources that CAPCOG performed these adjustments for.

Table 6: Point Source Subtractions

Registration Number	Facility	NAICS Code	County
RN100225846	Acme Brick Company	327121	Bastrop
RN100212034	Hanson Brick Elgin Facility	327121	Bastrop
RN102597846	Texas Lehigh Cement Company	327310	Hays
RN100211945	Parkview Metal Products	332116	Hays
RN100214337	Austin White Lime Company	327410	Travis

Registration Number	Facility	NAICS Code	County
RN100843747	Freescale-Ed Bluestein Site	334413	Travis
RN102752763	Freescale-Oak Hill Site	334413	Travis
RN100518026	Samsung	334413	Travis
RN100723741	Spansion	334413	Travis
RN102776994	Ironhorse Austin Hot Mix	324121	Travis
RN100216746	Austin Counter Tops	326191	Travis
RN100728179	Durcon Laboratory Tops	339111	Williamson
RN104321021	Burrows Manufacturing	337110	Williamson
RN100215193	Aquatic Industries	326191	Williamson

Other Adjustments to County-Level Employment Figures

Upon examination of the databases, and in consultation with Brett Davis of Zephyr Environmental, CAPCOG identified a number of businesses that are listed as manufacturers that CAPCOG knows were not engaged in manufacturing within this region in 2006. These are all businesses listed as Computer and Electronics Product manufacturers, but their Austin facilities are actually research or design facilities. These facilities include:

- 3M,
- IBM,
- AMD,
- Silicon Laboratories,
- Cirrus Logic, and
- Texas Instruments.

The employees from these establishments were subtracted from the Travis County totals for NAICS Codes 334413 and 334 (other than 334413).

Fuel Consumption Factors by NAICS Code

CAPCOG calculated the fuel consumption factors for all of the NAICS codes listed in the Manufacturing Energy Consumption Survey, which in some cases go down to the 6-digit level. The quantity of fuel consumed for each NAICS Code came from Table 3.2 (Energy Consumption as a Fuel by Manufacturing Industry and Region-Trillion BTU) of the EIA's MECS (http://www.eia.gov/emeu/mecs/mecs2006/excel/Table3_1.xls).

For cases in which the data were not listed, such as if the value was less than 0.5 or the relative standard error was greater than 50%, CAPCOG assigned a zero to that value. Where data for a 3-digit code was available at more detailed levels, CAPCOG calculated a "not otherwise classified" version of the 3-digit code. Below is an example for the NAICS Code 311-Food. The "gas" column represents the total quantity of natural gas consumed in that sector in 2006 in trillion BTU; the "rate" column represents the fuel consumption rate in MMBTU/employee.

Table 7: Example Calculation of "Not Elsewhere Classified" Fuel Consumption Rates (MMBTU/Employee)

NAICS	Description	Gas	US Employees	Rate
311	Food	635	1,458,738	435.31
3112	Grain and Oilseed Milling	118	53,724	2,196.41
311221	Wet Corn Milling	52	8,875	5,859.15
31131	Sugar Manufacturing	18	14,414	1,471.60
3114	Fruit and Vegetable Preserving and Specialty Food	126	130,253	766.75
3115	Dairy Product	83	503,800	637.22
3116	Animal Slaughtering and Processing	145	592,217	287.81
3112 NEC*	3112 minus 311221	66	44,849	1,471.60
311 NEC*	311 minus 3112, 31131, 3114, 3115, 3116	145	592,217	244.84

Performing these more detailed calculations enables more industry-specific information to be used. This also enables for a fuller accounting of the fuel consumption, including-in aggregate-the data that was withheld due to either the value being below 0.5 or the relative standard error being greater than 50%.

Using this procedure leaves some fuel unaccounted for, as can be seen in the table below.

Table 8: Unaccounted for U.S. Fuel Consumption from MECS Calculations (MMBTU)

Item	Residual Fuel Oil	Distillate Fuel Oil	Natural Gas	LPG
Total Accounted For	245	126	5,508	79
Total Unaccounted For	6	3	4	0
TOTAL	251	129	5,512	0

Since subtracting the employees in the same fashion results in zero unaccounted-for US employees, it is not possible to use the same technique to estimate the fuel consumption rates for unaccounted-for fuel. Instead, CAPCOG calculated the sum total of fuel consumed in each NAICS code for which the Austin MSA had employees and then divided that figure by the total number of “accounted-for” employees. CAPCOG then multiplied the unaccounted for employees within each county by the aggregate accounted-for fuel consumption rates. The rates used for the “NEC” employees were the following:

Table 9: Fuel Consumption Rates for Employees Not Elsewhere Classified (MMBTU/employees)

Category	Residual Fuel Oil	Distillate Fuel Oil	Natural Gas	LPG
31-33 NEC	12.83	12.17	168.73	3.95

A complete listing of fuel consumption rates is provided in an Appendix to this report.

Activity Estimates by County

Annual activity levels were estimated by multiplying the fuel consumption rate for each NAICS Code (including the “NEC” categories developed using the procedure stated above) by the number of employees estimated within each NAICS Code in each County and then summing the NAICS Code

County-level subtotals up to the County level. This provides the following estimates of fuel consumed in each county in 2006, in MMBTU:

Table 10: Total Area Source Industrial Fuel Consumption by County in 2006 (MMBTU)

County	Residual Fuel Oil	Distillate Fuel Oil	Natural Gas	LPG
Bastrop	20,231	19,853	270,804	4,094
Caldwell	2,070	3,896	82,771	1,667
Hays	171,889	110,953	870,440	14,599
Travis	218,988	175,440	3,315,932	83,391
Williamson	10,667	84,481	1,033,424	25,210
TOTAL	423,846	402,015	5,573,372	130,349

Activity Adjustments For End Use of Fuel

Since the MECS includes energy consumed by manufacturing establishments for all end uses, including non-road equipment, the county-level activity levels need to be adjusted to account for this use. Table 5.2 in the MECS includes data on the end uses of each fuel type consumed in the manufacturing sector, which can be used to calculate the total percentages of fuels that are consumed for on-site non-road equipment. This activity was subtracted from the activity totals in order to obtain the fuel consumed for stationary equipment. Therefore, CAPCOG reduced the activity in each county by the following percentages:

Table 11: Non-Road Mobile Source Subtractions to Activity Levels

Category	Residual	Distillate	Natural Gas	LPG
"On-Site Transportation"	0.00%	27.13%	0.05%	25.32%

After subtracting this fuel from the activity levels, the adjusted county-level fuel consumption totals for 2006 are the following:

Table 12: Stationary Equipment Area Source Industrial Fuel Consumption by County in 2006 (MMBTU)

County	Residual Fuel Oil	Distillate Fuel Oil	Natural Gas	LPG
Bastrop	20,231	19,853	270,657	4,094
Caldwell	2,070	2,839	82,725	1,245
Hays	171,889	80,850	869,967	10,903
Travis	218,988	127,840	3,314,128	62,279
Williamson	10,667	61,560	1,032,862	18,828
TOTAL	423,846	292,942	5,570,338	97,349

Unfortunately, it is not possible to use the other end uses listed in Table 5-2 to directly estimate the extent to which the fuel consumed at these industrial establishments may be used in different types of combustion devices.

Nationally, the break-down in fuel consumption by end use is as follows:

Table 13: Fuel Consumption by End Use (MMBTU)

End Use	Residual Oil	Distillate Oil	Natural Gas	LPG
Indirect Uses-Boiler Fuel	133	23	2,119	8
Conventional Boiler Use	71	17	1,281	8
CHP and/or Cogeneration Process	62	6	838	1
Direct Uses-Total Process	62	52	2,788	39
Process Heating	59	19	2,487	32
Process Cooling and Refrigeration	<0.5	1	32	<0.5
Machine Drive	2	24	129	2
Electro-Chemical Processes	0	0	0	0
Other Process Use	RSE>50%	8	140	5
Direct Uses-Total Nonprocess	6	50	438	27
Facility HVAC	4	4	378	5
Facility Lighting	0	0	0	0
Other Facility Support	1	<0.5	30	<0.5
Onsite Transportation	0	35	3	20
Conventional Electricity Generation	<0.5	4	19	<0.5
Other Nonprocess Use	<0.5	6	8	1
End Use Not Reported	49	4	168	5
TOTAL FUEL CONSUMPTION	251	129	5,512	79

In some of these cases, internal combustion devices such as turbines or engines may be used, but it is not possible to know exactly how much to attribute to such devices. Based on the percentages used for indirect uses as a boiler fuel and direct uses for process heating, it is safe to assume that at a minimum, 76% of residual fuel oil, 45% of distillate fuel oil, 84% of natural gas, and 68% of LPG consumed by stationary equipment is used for external combustion sources. Without more information, it isn't possible to estimate how much of the remaining fuel is used in engines or turbines.

The only other information available that might indicate the extent to which local industries use different types of combustion sources is the point source emissions database. For local sources that fall under the 100 ton per year (tpy) threshold to be considered a "major" source under the Clean Air Act but which report to the point source database, the vast majority of NO_X emissions come from external combustion sources.

Table 14: Pounds Per Day of NO_X emissions From Natural Gas Combustion Sources Selected Point Facilities

Facility	External Combustion	Internal Combustion
Samsung	17.05	0.00
Freescale-Ed Bluestein	16.07	0.00
Freescale-Oak Hill	36.82	9.51
Spansion	79.83	3.80
Acme Brick Company	158.33	0.00
Hanson Brick Company	41.69	0.00

Since the emission factors for turbines and engines are significantly higher than for external combustion sources, the actual quantities of fuel going to internal combustion sources would be much less than even the ratio of NO_X emissions would indicate. It seems reasonable for estimation purposes to assume that 100% of the industrial fuel combustion at area sources is in external combustion devices. Future survey work may shed more light on the extent of fuel use in other types of devices. In particular, fuel use for categories such as machine drive, process cooling, facility HVAC, and conventional electricity generation may be employing turbines or internal combustion engines.

Emissions Estimates

Emission Factors

CAPCOG used the emission factors for NO_X, VOC, and CO from AP-42, Fifth Edition, Volume I, Chapter 1: External Combustion Sources (U.S. Environmental Protection Agency, July 1998). CAPCOG assumed uncontrolled combustion in boilers smaller than 100 MMBTU/hour for all fuels. For LPG, CAPCOG used the Bureau of Mines assumption of 60 percent butane and 40% propane (as described by EIA here: http://www.eia.gov/state/seds/sep_use/notes/use_b.pdf) to estimate a weighted average for NO_X emissions, and assumed that the VOC and CO rate for LPG was the same as natural gas on a heat basis, as described in a footnote to Table 1.5-1.

Table 15: Emission Rates

SCC	Fuel	NO_X	VOC	CO	Units	Basis
2102005000	Residual Oil	55	0.28	5	Lbs/10^3 gallons	AP-42 Tables 1.3-2, 1.3-3
2102004000	Distillate Oil	20	0.2	5	Lbs/10^3 gallons	AP-42 Tables 1.3-2, 1.3-3
2102006000	Natural Gas	100	5.5	84	Lbs/MMCF	AP-42 Tables 1.4-2, 1.4-3
2102007000	LPG	14.2	0.48	7.31	Lbs/10^3 gallons	AP-42 Table 1.5-1

CAPCOG then converted the emission rates from pounds of emissions per physical unit to pounds of emissions per MMBTU, using the ratios available in the MECS, as shown below:

Table 16: Fuel Heat Content & Emission Rate Conversion Factor

Fuel	Energy Consumed	Physical Units Consumed	Heat Content	Adjustment Factor
Residual Oil	251 trillion BTU	40 million barrels	149 MMBTU/gallon	0.00669
Distillate Oil	129 trillion BTU	22 million barrels	140 MMBTU/gallon	0.00716
Natural Gas	5,512 trillion BTU	5,357 billion CF	1,029 MMBTU/MMCF	0.000972
LPG	79 trillion BTU	21 million barrels	90 MMBTU/gallon	0.0112

CAPCOG then multiplied the emission rates by the adjustment factors above to get emission rates on a heat input basis, as shown below.

Table 17: Emission Rates for NO_X, VOC, and CO (pounds per MMBTU of heat input)

SCC	Fuel	NO_X	VOC	CO
2102005000	Residual Oil	0.368	0.00187	0.0345

SCC	Fuel	NO_X	VOC	CO
2102004000	Distillate Oil	0.143	0.00143	0.0358
2102006000	Natural Gas	0.0972	0.00535	0.0816
2102007000	LPG	0.0335	0.00535	0.0816

Emissions Estimates by County

Annual Emissions

CAPCOG multiplied the estimated annual fuel consumption by stationary equipment at industrial area sources by the emission factors listed above to calculate the estimated annual emissions. The tables below show the annual totals for each fuel by county.

Table 18: Residual Oil Activity & Emissions by County, 2006

County	Activity (MMBTU)	NO_X (tons)	VOC (tons)	CO (tons)
Bastrop	20,231	3.72	0.02	0.34
Caldwell	2,070	0.38	0.00	0.03
Hays	171,889	31.64	0.16	2.88
Travis	218,988	40.31	0.21	3.66
Williamson	10,667	1.96	0.01	0.18
TOTAL	423,846	78.01	0.40	7.09

Table 19: Distillate Oil Activity & Emissions by County, 2006

County	Activity (MMBTU)	NO_X (tons)	VOC (tons)	CO (tons)
Bastrop	19,853	1.42	0.01	0.36
Caldwell	2,839	0.20	0.00	0.05
Hays	80,850	5.79	0.06	1.45
Travis	127,840	9.16	0.09	2.29
Williamson	61,560	4.41	0.04	1.10
TOTAL	292,942	20.98	0.21	5.25

Table 20: Natural Gas Activity & Emissions by County, 2006

County	Activity (MMBTU)	NO_X (tons)	VOC (tons)	CO (tons)
Bastrop	270,657	13.15	0.72	11.05
Caldwell	82,725	4.02	0.22	3.38
Hays	869,967	42.28	2.33	35.51
Travis	3,314,128	161.05	8.86	135.28
Williamson	1,032,862	50.19	2.76	42.16
TOTAL	5,570,338	270.68	14.89	227.38

Table 21: LPG Activity & Emissions by County, 2006

County	Activity (MMBTU)	NO_X (tons)	VOC (tons)	CO (tons)
Bastrop	4,094	0.32	0.01	0.17

County	Activity (MMBTU)	NO_X (tons)	VOC (tons)	CO (tons)
Caldwell	1,245	0.10	0.00	0.05
Hays	10,903	0.86	0.03	0.45
Travis	62,279	4.94	0.17	2.54
Williamson	18,828	1.49	0.05	0.77
TOTAL	97,349	7.72	0.26	3.97

Seasonal Allocation

There appears to be no discernible seasonality of industrial fuel combustion, based on the monthly industrial natural gas combustion figures available through the Energy Information Administration (see http://www.eia.gov/dnav/ng/hist/n3035tx2m.htm). The month-to-month fluctuation in Texas industrial fuel combustion varied by no more than + 2% and -5% of the annual average in 2006. There is no indication that local industrial activity varies by season, so CAPCOG applied no seasonal adjustment to the emissions.

Weekday/Weekend Allocations

CAPCOG assumed that all industrial activity in this SCC occurred on weekdays. There were 260 weekdays in 2006, so CAPCOG allocated the annual emissions evenly to each of 260 work days during 2006.

Conclusion and Recommendations

Using the EIA's MECS in conjunction with US and county-level employment data, the point source emissions inventory for the region, and expert consultation, CAPCOG developed an updated estimate of area source industrial fuel combustion activity and emissions for the region for 2006. Since these estimates account for the wide variability in fuel combustion by industry type and the specific industrial establishments within the MSA, CAPCOG is confident that this inventory more accurately accounts for emissions from this sector than the existing estimates. Since the 2010 MECS will be released shortly, CAPCOG recommends that TCEQ use those figures in conjunction with 2011 employment data to estimate emissions from this sector for the 2011 periodic inventory.

Future work on this source category could include the following:

- Matching records from the Texas Department of Licensing and Regulation's Boiler Safety database with individual records from CAMPO's employment data base for 2005 and 2007 to determine the location and sizes of specific boilers,
- Surveying industrial facilities within the region to determine the extent of these fuels, including the use of turbines, backup generators, and other internal combustion devices,
- Determining whether any pollution controls are used on these combustion devices.

One challenge for this category is that given the wide variation in fuel combustion rates per employee, without having a comprehensive survey in which all sources are required to report, such as the MECS, it would be very questionable to assume that a sample of survey respondents would be representative of those who did not respond. Given these challenges, CAPCOG believes that the MECS and employment data provide the best basis for estimating area source fuel combustion activity and emissions within the region.

Appendix A: Fuel Consumption Rates by NAICS Code

Table 22: Fuel Consumption Rate by NAICS Code (MMBTU per employee)

NAICS	Description	Residual Oil	Distillate Oil	Natural Gas	LPG	Directly Used?
311	Food	17.82	10.97	435.31	2.06	No
3112	Grain and Oilseed Milling	37.23	18.61	2196.41	0.00	No
311221	Wet Corn Milling	0.00	0.00	5859.15	0.00	Yes
3112 minus 311221		44.59	22.30	1471.60	0.00	Yes
31131	Sugar Manufacturing	624.39	69.38	1248.79	0.00	Yes
3114	Fruit and Vegetable Preserving and Specialty Food	12.17	6.09	766.75	6.09	Yes
3115	Dairy Product	7.68	7.68	637.22	0.00	Yes
3116	Animal Slaughtering and Processing	5.95	9.92	287.81	1.98	Yes
311 minus 3112, 31131, 3114, 3115, 3116		15.20	11.82	244.84	1.69	Yes
312	Beverage and Tobacco Products	19.34	6.45	264.36	6.45	No
3121	Beverages	14.90	7.45	283.15	7.45	Yes
3122	Tobacco	47.88	0.00	143.63	0.00	Yes
313	Textile Mills	10.65	0.00	346.18	0.00	Yes
314	Textile Product Mills	0.00	0.00	295.66	6.43	Yes
315	Apparel	0.00	0.00	32.37	0.00	Yes
316	Leather and Allied Products	0.00	0.00	25.91	0.00	Yes
321	Wood Products	6.94	26.02	149.17	8.67	No
321113	Sawmills	0.00	76.43	114.65	0.00	Yes
3212	Veneer, Plywood, and Engineered Woods	0.00	8.03	361.53	24.10	Yes
3219	Other Wood Products	0.00	14.99	83.95	3.00	Yes

NAICS	Description	Residual Oil	Distillate Oil	Natural Gas	LPG	Directly Used?
321 minus 321113, 3212, 3219		289.50	72.37	72.37	72.37	Yes
322	Paper	206.15	29.45	1073.78	11.33	No
322110	Pulp Mills	1487.69	540.98	1758.18	0.00	Yes
322121	Paper Mills, except Newsprint	533.24	22.69	1974.11	11.35	Yes
322122	Newsprint Mills	362.25	0.00	1449.01	0.00	Yes
322130	Paperboard Mills	769.23	159.15	3766.58	0.00	Yes
322 minus 322110, 322121, 322122, 322130		6.61	3.30	452.63	13.22	Yes
323	Printing and Related Support	0.00	0.00	60.84	1.56	Yes
324	Petroleum and Coal Products	563.12	242.73	8242.96	281.56	No
324110	Petroleum Refineries	830	128	12,597	447	Yes
324199	Other Petroleum and Coal Products	0	0	1,104	0	Yes
324 minus 324110, 324199		159	452	1,514	27	Yes
325	Chemicals	28.57	11.18	1731.54	8.69	No
325110	Petrochemicals	607.31	121.46	13360.86	0.00	Yes
325120	Industrial Gases	0.00	0.00	1143.32	0.00	Yes
325181	Alkalies and Chlorine	0.00	0.00	16019.34	0.00	Yes
325182	Carbon Black	0.00	0.00	7166.12	0.00	Yes
325188	Other Basic Inorganic Chemicals	221.73	24.64	1330.41	0.00	Yes
325192	Cyclic Crudes and Intermediates	342.58	0.00	5481.33	0.00	Yes
325193	Ethyl Alcohol	0.00	0.00	19239.79	0.00	Yes
325199	Other Basic Organic Chemicals	28.69	28.69	4389.43	0.00	Yes
325211	Plastics Materials and Resins	0.00	16.42	5466.90	98.50	Yes
325212	Synthetic Rubber	0.00	0.00	3041.29	0.00	Yes
325222	Noncellulosic Organic Fibers	194.06	0.00	2199.37	0.00	Yes

NAICS	Description	Residual Oil	Distillate Oil	Natural Gas	LPG	Directly Used?
325311	Nitrogenous Fertilizers	0.00	0.00	32708.97	0.00	Yes
325312	Phosphatic Fertilizers	0.00	162.84	1791.24	0.00	Yes
3254	Pharmaceuticals and Medicines	4.00	4.00	184.19	0.00	No
325412	Pharmaceutical Preparation	6.13	6.13	189.95	0.00	Yes
3254 minus 325412		0.00	0.00	173.32	0.00	Yes
325992	Photographic Film, Paper, Plate, and Chemicals	0.00	0.00	232.74	0.00	Yes
325 minus 325110, 325120, 325181, 325182, 325188, 325192, 325193, 325199, 325211, 325212, 325222, 325311, 325312, 3254, 325992		7.03	7.03	425.32	3.52	Yes
326	Plastics and Rubber Products	9.99	3.33	140.98	5.55	Yes
327	Nonmetallic Mineral Products	6.22	62.18	951.38	10.36	No
327211	Flat Glass	90.88	0.00	4725.98	0.00	Yes
327212	Other Pressed and Blown Glass and Glassware	0.00	0.00	0.00	0.00	Yes
327213	Glass Containers	0.00	0.00	3474.15	0.00	Yes
327215	Glass Products from Purchased Glass	0.00	0.00	922.90	0.00	Yes
327310	Cements	56.69	170.08	1133.85	0.00	Yes
327410	Lime	0.00	237.19	1185.96	0.00	Yes
327420	Gypsum	0.00	72.89	5539.76	0.00	Yes
327993	Mineral Wool	0.00	0.00	1767.06	0.00	Yes
327 minus 327211, 327212, 327213, 327215, 327310, 327410, 327420, 327993		3.07	76.86	522.63	15.37	Yes

NAICS	Description	Residual Oil	Distillate Oil	Natural Gas	LPG	Directly Used?
331	Primary Metals	42.23	13.34	1300.25	8.89	No
331111	Iron and Steel Mills	174.97	27.63	3002.06	0.00	Yes
331112	Electrometallurgical Ferroalloy Products	0.00	0.00	454.96	0.00	Yes
3312	Steel Products from Purchased Steel	0.00	0.00	552.38	0.00	Yes
3313	Alumina and Aluminum	0.00	15.29	1774.05	15.29	No
331314	Secondary Smelting and Alloying of Aluminum	0.00	0.00	2438.69	0.00	Yes
331315	Aluminum Sheet, Plate and Foils	0.00	0.00	2049.75	0.00	Yes
331316	Aluminum Extruded Products	0.00	0.00	626.08	36.83	Yes
3313 minus 331314, 331315, 331316		0.00	78.11	3436.96	0.00	Yes
3314	Nonferrous Metals, except Aluminum	0.00	16.78	721.36	16.78	Yes
3315	Foundries	0.00	5.99	430.99	5.99	No
331511	Iron Foundries	0.00	16.89	405.34	0.00	Yes
331521	Aluminum Die-Casting Foundries	0.00	0.00	630.57	0.00	Yes
331524	Aluminum Foundries, except Die-Casting	0.00	0.00	489.37	0.00	Yes
3315 minus 331511, 331521, 331524		0.00	0.00	347.85	17.39	Yes
332	Fabricated Metal Products	0.00	1.28	153.48	2.56	Yes
333	Machinery	0.00	1.78	74.56	2.66	Yes
334	Computer and Electronic Products	0	1	43	0	No
334413	Semiconductors and Related Devices	0	0	133	0	Yes
334 minus 334413		0	1	28	0	Yes
335	Electrical Equip., Appliances, and Components	0	0	98	2	Yes
336	Transportation Equipment	4.31	1.85	153.46	2.47	No
336111	Automobiles	0.00	0.00	279.16	0.00	Yes
336112	Light Trucks and Utility Vehicles	0.00	0.00	240.81	0.00	Yes
3364	Aerospace Product and Parts	7.54	2.51	75.39	0.00	No
336411	Aircraft	0.00	0.00	48.93	0.00	Yes

NAICS	Description	Residual Oil	Distillate Oil	Natural Gas	LPG	Directly Used?
3364 minus 336411		12.80	4.27	93.85	0.00	Yes
336 minus 336111, 336112, 3364		3.83	1.91	165.46	3.83	Yes
337	Furniture and Related Products	0.00	0.00	31.29	1.84	Yes
339	Miscellaneous	0.00	0.00	36.44	1.46	Yes
31-33	Total	18.41	9.46	404.35	5.80	No
Unaccounted For		12.83	12.17	168.73	3.95	Yes