

**LA PLATA COUNTY DRAFT  
EMISSIONS INVENTORY REVISIONS REPORT**

**CEAP Colorado's Energy Economy Strong**



**CEAP Colorado Resilient to Climate Change**

**DISTRIBUTED FOR PUBLIC REVIEW AND COMMENT**

Latest Revision Date: June 28, 2009

## Contents

1. Overview.....	1
1.1 Background .....	1
1.2 Decision to Revise La Plata Baseline Inventory Report .....	1
2. Methodology, Analysis, and Results .....	1
2.1 General Approach .....	1
2.2 Future Trends .....	2
2.3 Analysis of Segments and Results .....	2
2.3.1 Segment A – Direct Emissions of Methane and CO2 From Gas Industry .....	2
2.3.2 Segment B – Emissions from Industrial Energy Use (Natural Gas Industry) .....	3
2.3.3 Segment C – Emissions from Other Activities .....	4
2.3.4 Segment D – Emissions from Methane Seeps at the Fruitland Outcrop.....	5
3. Conclusions and Next Steps.....	5

## Table

Table 1. La Plata County 2005 GHG Emissions Estimates Comparisons .....	7
---	---

## **1. Overview**

This Emissions Inventory Revisions Report provides—to the fullest extent possible considering availability of resources—comprehensive, accurate and useful estimates of: (1) recent historical (2005) and (2) projected future (2020) greenhouse gas (GHG) emissions for La Plata County. It also recommends update frequency and an inventory maintenance process.

### **1.1 Background**

A Green House Gas Emissions Study was commissioned by La Plata County to provide baseline data to 4CORE, which in turn was charged with facilitating the development of a Climate and Energy Action Plan (CEAP) for La Plata County in furtherance of the County’s participation in the Mayor’s Climate Protection Agreement.

In early 2008, the Brendle Group, Inc. submitted the *Baseline Greenhouse Gas Emission Profile and Forecast Report*, also referred to as “The Brendle Report,” to La Plata County. After the La Plata Energy Council (LPEC) reviewed the report it voiced concerns about the data sources used to establish the emissions baseline for oil and gas operations in La Plata County. As a result, the County’s Planning Department recommended that Appendix B data not be used.

### **1.2 Decision to Revise La Plata Baseline Inventory Report**

After on-going collaborative discussions between the oil and gas industry representatives and 4CORE, the decision was made to have the CEAP Emissions Inventory Work Group research and prepare a comprehensive emissions inventory to replace Appendix B of the April 3, 2008 *Brendle Report*. The Emissions Inventory work group was also asked to establish frequency guidelines for updating baseline information and a process for inventory maintenance. This report replaces Appendix B.

## **2. Methodology, Analysis, and Results**

References to Segments A, B, and C in this report refer to the category labels given each Segment in the Brendle Report. The work group kept this nomenclature to provide continuity between these revisions and the original report.

### **2.1 General Approach**

The Emissions Inventory Work Group did not revise the April 3, 2008 La Plata County “Baseline Greenhouse Gas Emission Profile and Forecast” (aka the “Brendle Report”) for Segment C emissions (residential, commercial, transportation and other source categories) except to add estimated emissions from residential and commercial propane use which were not included in the Brendle report due to lack of data. However, because there were questions about Brendle’s results for emissions from the natural gas industry, most of the work group’s effort was directed at improving the estimates for the natural gas industry – Segment A (direct emissions of methane and venting of entrained CO<sub>2</sub>) and Segment B (industrial energy use). This primarily involved collecting and evaluating local data provided by the natural gas industry in La Plata County.

The work group also added a category (“Segment D”) to address emissions from methane seeps at the Fruitland Outcrop.

Note: All emissions reported here are “short” tons. While it is more typical to report emissions in metric tonnes, Brendle reported their results in short tons. Since the work group is building on and comparing to Brendle’s results, the revisions presented here are in short tons. One short ton = 0.907 metric tonnes.

## 2.2 Future Trends

The CEAP Emissions Inventory work group was unable to produce quantitative estimates of projected future emissions (2020) given the time, resources, and data available. However, the revised estimates for each category presented below include a section with comments on future trends. In many cases, the work group identified issues with respect to the assumptions about future emissions made in the Brendle report that suggest their conclusions about significant decreases in some source categories and significant increases in other source categories may be overstated.

## 2.3 Analysis of Segments and Results

The Brendle Report categorized emissions in 3 segments. The work group developed revised estimates for 2005 as described and presented below. We also added a fourth segment to address emissions of methane at the outcrop.

### 2.3.1 Segment A – Direct Emissions of Methane and CO<sub>2</sub> From Gas Industry

#### a. Direct Emissions of Methane

The Brendle report applied a significant portion (1.2 million tons CO<sub>2</sub> equivalent) of the overall industry segment of the GHG emissions inventory to the direct venting of methane from unidentified sources. This would include venting from fugitive sources, such as leaks, and venting from production equipment and direct venting during initial well completion. Direct emissions of methane occur during routine maintenance activities and during upset conditions. It is very difficult to quantify these types of emissions because there is currently no industry accepted technique for doing so. Additionally, these sources of GHG emissions are dispersed and are often very small as individual sources. These sources are not gauged or metered in any way making quantification that much more difficult. Also, industry practices for drilling and completing individual wells may have been different for different producers and the use of emissions controls for such sources, whether technical or behavioral, are not well documented. The industry wide use of no bleed and low bleed pneumatically actuated controllers and green or reduced venting completion procedures as of 2005 is unknown. The use of technical and behavioral control measures to reduce fugitive emissions is currently not regulated. Currently these reduction and control measures are being applied by industry to a varying extent. Accordingly, industry representatives did not revise the Brendle estimate for direct vented methane emissions.

The GHG reporting protocol being developed by the Western Regional Air Partnership (WRAP), which will be available in late 2009 should help provide methods by which these emissions can be quantified. Also, US EPA has proposed a mandatory GHG reporting rule which will require companies to report emissions from these sources beginning in 2010 (with the first data available in 2011).

As a point of reference, the work group made the following calculation with respect to Brendle's estimate of direct emissions of methane.

1,282,168 tons CO<sub>2</sub>e from direct emissions of methane / 21 tons CO<sub>2</sub>e per ton methane = 61,056 tons methane per year.

47,100 scf methane / ton methane<sup>1</sup> x 61,056 tonnes methane per year = 2.88 Bcf of direct methane emissions per year based on Brendle's estimate of emissions

---

<sup>1</sup> Density of CH<sub>4</sub> = 0.68 Kg/m<sup>3</sup> \* 1 m<sup>3</sup>/35.3 ft<sup>3</sup> \* 1 tonne/1000 kg = 1.93 x 10<sup>-5</sup> tonnes/ft<sup>3</sup>.  
Then, 1/x = 51,912 ft<sup>3</sup>/tonne \* 1 tonne/1.1023 tons = 47,100 ft<sup>3</sup> CH<sub>4</sub>/ton

With total 2006 gas production in LPC equaling 437 Bcf per year, this amount of direct methane emissions equates to about 0.66% of total production.

**Future Trend of Direct Methane Emissions:** Direct methane emissions can be expected to decrease along with decreases in production. More work is needed to estimate the magnitude of expected decrease in direct methane emissions relative to decreasing production. This would also require an estimate of future production, which is dependent on a variety of factors that are difficult to predict (e.g., future price of natural gas, number of new wells, timing of new wells, rate of decline from existing wells, etc.).

#### **b. Venting of Entrained CO<sub>2</sub>**

CO<sub>2</sub> that occurs naturally in gas produced in La Plata County is stripped from the gas stream at 4 plants in the county and vented to the atmosphere. By determining the % of CO<sub>2</sub> in the gas as it enters and leaves the plants, and knowing the volume of gas flowing through each plant, a straightforward calculation was performed to estimate CO<sub>2</sub> emissions from this source category. Three of the four companies performing these operations in La Plata County provided the data needed to estimate 2005 emissions. Volumes and CO<sub>2</sub> concentrations were extrapolated for the fourth plant in an effort to make this portion of the inventory as accurate as possible.

Brendle estimated 1,008,330 tons per year from venting of entrained CO<sub>2</sub>. Based on local data provided by the natural gas industry in LaPlata County, the revised estimate for 2005 is 1,073,640 tons per year, a difference of +6.5% from the Brendle estimate. The Brendle estimate was based on an assumption of total volume of gas produced in the county in 2005 and assumed a CO<sub>2</sub> concentration in the gas stream of 17%. Operators that provided data to the inventory found that the gas produced in La Plata County varies in CO<sub>2</sub> concentration across the basin but all measured streams were less than the 17% reported by Brendle.

**Future Trend from Venting of Entrained CO<sub>2</sub>:** Future emissions from venting of entrained CO<sub>2</sub> will depend on changes in gas production in the county between now and 2020 and changes in CO<sub>2</sub> content. While production is expected to continue its decline, CO<sub>2</sub> content is likely to increase due to the fact that the coal seam preferentially releases methane as compared to CO<sub>2</sub>. This means that as the methane in the field is drawn down, the coal seam will start to release more CO<sub>2</sub>, which will be vented. While the work group has not estimated future emissions from this category, Brendle's assumption that there will be a large reduction in emissions from venting of entrained CO<sub>2</sub> is probably overstated.

### **2.3.2 Segment B – Emissions from Industrial Energy Use (Natural Gas Industry)**

This category includes natural gas and electricity consumed in field and plant operations. The natural gas industry has provided local data on natural gas use for 2005 to replace the estimates made in the Brendle report. The industry representatives on the work group determined that the Brendle data on industry use of electricity did not need revision at this time due to those emissions being accurately captured by the full Residential, Commercial and Industrial electrical consumption values that are reported in the Brendle Report. These values were based on data that was provided by La Plata Electric Association (LPEA) to the Brendle group.

#### **a. Natural Gas Consumption by Natural Gas Industry in La Plata County**

Industry members of the work group were concerned with the industry associated GHG emissions from combustion of natural gas within the County. The Brendle report had little access to actual combustion data in the preparation of the report. In response to this concern, industry related combustion emissions were also addressed in the review.

Industry Representatives looked closely at their inventory of natural gas combustion sources (i.e., compressors, internal combustion engines and heaters). Two separate techniques were used to determine the theoretical CO<sub>2</sub> equivalent emissions from combustion sources. The correlation between the two methods demonstrated that they were statistically identical. This confirmed that using the California Climate Registry Emission Factor and total horsepower ratings results in similar predicted CO<sub>2</sub> emissions as using a detailed gas analysis and the fuel consumption rating on each combustion device. Approximately sixty percent of the natural gas production in La County was represented using these two methodologies. The work group used these reported combustion values to directly extrapolate upward to account for 100% of natural gas production within the County. The extrapolation assumes that all the other producers use similar compressors and heaters to those that provided data to the review. Industry members feel that this process is defensible in that more than 50% of the county production is represented by actual data and not an assumption. Review efforts by industry members resulted in an increase of GHG emissions associated with combustion of natural gas. This change will be reflected in the overall industry associated emissions inventory.

The revised estimate for emissions from industry combustion of natural gas in its operations is approximately 1,917,000 tons CO<sub>2</sub>e for 2005.

**Future Trend in Emissions from Energy Use by Natural Gas Industry:** Brendle predicted a 61.5% decline in these emissions between 2005 and 2020 based on expected decreases in production. However, due to the fact that the natural gas industry will have to add compression to extract the remaining gas as the field declines, emissions from this category are unlikely to decrease significantly between now and 2020.

### 2.3.3 Segment C – Emissions from Other Activities

The main sources of Segment C are transportation and commercial energy use.

The work group briefly reviewed the Clean Air and Climate Protection (CACP) software and other methods used by Brendle to estimate Segment C emissions. However, the work group did not have the time or resources to revise the Brendle estimates for this category. In general, the work group believes that Brendle's Segment C estimates for 2005 are adequate for the CEAP's current purpose. The work group did address one deficiency in Brendle's estimates for this category, which is that it lacked any estimate of emissions from propane use.

#### **Propane:**

While exact numbers on La Plata County usage of propane remain uncertain, the work group received some data on 2005 propane production in the county (about 31.6 million gallons) and estimates that about 40% of this production is used in the county (about 13 million gallons). So:

12.67 lb CO<sub>2</sub>/gal propane burned x 13 million gallons = 82,350 tons CO<sub>2</sub>e  
(see: <http://www.eia.doe.gov/oiaf/1605/coefficients.html>)

**Future Trend in Emissions from transportation, residential, and commercial energy use:** Updates and refinements to Brendle's estimates for 2020 are needed, including: 1) incorporation of recent state and federal regulations that will effect emissions (i.e., Colorado Renewable Portfolio Standard and stricter

federal standards for fuel economy); 2) incorporation of local efforts to improve conservation and energy efficiency; and 3) evaluation of future emissions scenarios based on expected future regulation, such as federal cap-and-trade. The EIWG believes that the growth rates for La Plata County of 3.5% used by Brendle (based on State Demographer's data) overstated growth based on current trends and Brendle's subsequent estimate of a 54% increase in emissions from this segment between 2005 and 2020 is overstated. This led to a reevaluation of Brendle's assumption. In sum, based on data from the Region 9 Economic Development District and the State of Colorado Ozone Non-Attainment Report, EIWG concluded that a 2.4% growth rate is more realistic.

### 2.3.4 Segment D – Emissions from Methane Seeps at the Fruitland Outcrop

These data are not included in the Brendle Report, but they represent a significant contribution to GHG emissions in the county. The work group believes they should be included in the La Plata County GHG inventory.

The following data were obtained from the 2007 Outcrop Monitoring Report prepared by LT Environmental (LTE) for the Colorado Oil and Gas Conservation Commission.

- *LTE Report - Sec 4.4 page 4.6 :*

If the total methane flux value (1,005 MCFD) for areas which LTE did not map is added to the 6,120 MCFD of methane estimated over the mapped portions of the project area, the result is 7,125 MCFD. Therefore, the estimated total methane flux over the Kf outcrop in La Plata County north of the SUIT line is 7,125 MCFD.

- $7,125 \text{ MCFD} \times 365 = 2.6 \text{ Bcf / yr}$  of Methane emitted from the outcrop
- $2.6 \text{ Bcf/yr} \times 1 \text{ ton CH}_4 / .0000471 \text{ Bcf} = 55,200 \text{ tons CH}_4 \times 21 \text{ CO}_2\text{e/CH}_4 = \underline{1.16 \text{ million tons CO}_2\text{e per year from methane emitted at the outcrop}}$

- *LTE Report - Section 4.5 page 4.6*

Based on LTE's calculations, the total carbon dioxide flux from the seep areas mapped along Kf outcrop north of the SUIT line is 1,055 MCFD (0.385 Bcf/yr) of CO<sub>2</sub> emitted from the outcrop.

- $\text{CO}_2 \text{ density} = 1.98 \text{ Kg/m}^3 \times 1 \text{ m}^3 / 35.3 \text{ ft}^3 \times 1 \text{ tonne} / 1000 \text{ Kg} = 5.6 \times 10^{-5} \text{ tonnes/ft}^3$
- Then  $1/x = 17,830 \text{ ft}^3/\text{tonne}$ .
- So  $0.385 \text{ Bcf/yr CO}_2 / 17,830 \text{ ft}^3 / \text{tonne} = 21,590 \text{ tonnes / year}$  or 23,800 short tons CO<sub>2</sub>e per year from CO<sub>2</sub> emitted at the outcrop.

### **Total for Segment D = 1.183 million tons per year**

**Future Trend in Emissions at the Outcrop:** Emissions from the outcrop are expected to decrease over time as gas is removed through production, but the work group did not attempt to estimate future emissions from this source. As more data is released, it can be added as amendment to this report, and this accumulated data can be used to establish trends at the outcrop.

## 3. Conclusions and Next Steps

With the inclusion of local data provided by the natural gas industry, the accuracy of the inventory estimates has improved for the categories addressed. We recognize a degree of uncertainty still surrounds these corrected values and an estimated uncertainty of  $\pm 15\%$  is still reasonable. The highest individual sector uncertainty resides in the "vented Methane" sector which industry did not address.

New Environmental Protection Agency (EPA) regulations are currently proposed for GHG emissions and industry will be required in 2011 to report GHG emissions for calendar year 2010. The drafted EPA - GHG Reporting regulation will allow for much more accuracy in reporting GHG emissions from larger emissions sources. It may also include an approved method for quantifying fugitive emissions allowing for greater accuracy in overall nation-wide emissions inventories. The WRAP may also release fugitive reporting guidelines later this year. The venting of methane will decline with the evolution of “green” completions and the use of “low-bleed” pneumatic devices. Accordingly, the inventory methodology for this sector is expected to evolve. Industry will be engaged and even consumed in a detailed inventory of GHG emissions beginning in 2010 and sees no need to revise or update the County inventory in subsequent years. The EPA - GHG report should serve as the Industry emissions inventory from this point forward. Updates to the other source categories (Segment C) should be undertaken in the next few years as better information on state and federal regulations, activity and growth data, and emission estimation methods become available – including data from the 2010 census.

**Table 1. La Plata County 2005 GHG Emissions Estimates Comparisons**

<b>Item Description</b>	<b>Brendle Report</b>	<b>Notes</b>	<b>Revised Estimates</b>	<b>Notes</b>
<b>Segment A - Natural Gas Industry Direct Emissions</b>	<b>2,479,051</b>	Segment A Total	<b>2,544,361</b>	Segment A Total
Direct emissions of methane	1,282,168		1,282,168	No Change
Venting of entrained CO2	1,008,330		1,073,640	Per Industry
Other combustion (mostly transportation)	188,553	App B includes in combustion	188,553	No Change
<b>Segment B - Natural Gas Industry Energy Use</b>	<b>1,206,777</b>	Segment B Total	<b>2,472,033</b>	Segment B Total
natural gas burned in operations	638,000	Brendle pg 10	1,916,533	Per Industry
electricity consumed	555,500	Brendle pg 9	555,500	No Change
<b>Segment C - All other activities</b>	<b>1,333,645</b>	Segment C Total	<b>1,415,995</b>	Segment C Total
other sources	114,133	Coal mining & non-road vehicles	114,133	No Change
land use changes	111,241		111,241	No Change
transportation	411,481		411,481	No Change
waste	63,094		63,094	No Change
commercial energy	304,655	mostly electricity	304,655	No Change
Residential energy (no propane)	324,624	mostly electricity	324,624	No Change
other energy	4,417		4,417	No Change
propane		not included	82,350	Work Group Est.
<b>Segment D - Emissions at the Outcrop</b>		not included	<b>1,183,000</b>	Per LTE Report
<b>Total</b>	<b>5,019,473</b>		<b>7,615,389</b>	