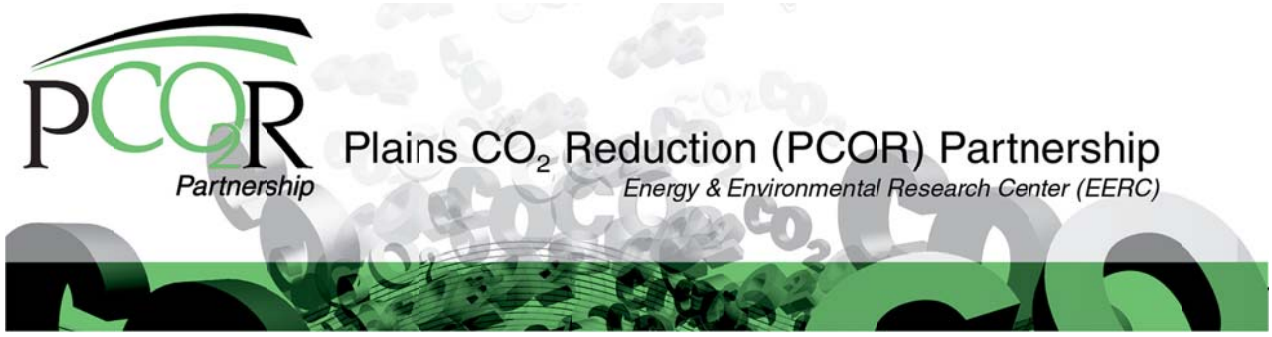


# REVIEW OF SOURCE ATTRIBUTES

**Plains $CO_2$ Reduction Partnership Phase III**
**Task 1 – Deliverable D1**

*Prepared for*:

Andrea M. Dunn

National Energy Technology Laboratory
U.S. Department of Energy
3610 Collins Ferry Road
PO Box 880, MS P03D
Morgantown, WV 26507-0880

DOE Cooperative Agreement No. DE-FC26-05NT42592

*Prepared by*:

Melanie D. Jensen
Kyle A. Glazewski
Wesley D. Peck
Charles D. Gorecki
Edward N. Steadman
John A. Harju

Energy & Environmental Research Center
University of North Dakota
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

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Approved

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## NOMENCLATURE AND ABBREVIATIONS

| | |
|---|---|
| $CH_4$ | methane |
| $CO_2$ | carbon dioxide |
| $CO_2eq$ | carbon dioxide equivalent |
| DOE | U.S. Department of Energy |
| DSS | Decision Support System |
| EPA | U.S. Environmental Protection Agency |
| HFC | hydrofluorocarbon |
| HFC-23 | fluoroform |
| $N_2O$ | nitrous oxide |
| NATCARB | National Carbon Sequestration Database and Geographic Information System |
| $NO_x$ | nitrogen oxides |
| PCOR | Plains $CO_2$ Reduction |
| PFC | perfluorocarbon |
| PFC-116 | hexafluoroethane |
| PFC-14 | tetrafluoromethane |
| $SF_6$ | sulfur hexafluoride |
| $SO_2$ | sulfur dioxide |

**REVIEW OF SOURCE ATTRIBUTES**

## EXECUTIVE SUMMARY

The Plains $CO_2$ Reduction (PCOR) Partnership maintains a database of regional sources of carbon dioxide ($CO_2$) emissions and evaluates it on an annual basis. The database is an important part of assessing potential $CO_2$ capture–transportation–storage scenarios that could reduce greenhouse gas emissions in the PCOR Partnership region. The emission measurements compiled in this database are typically acquired through online databases of the U.S. Environmental Protection Agency and Environment Canada. The updated database shows that there are 911 significant (greater than 13,600 metric tons or 15,000 short tons) $CO_2$ emission sources that emit 562 million tonnes (619 million short tons) on an annual basis.

# REVIEW OF SOURCE ATTRIBUTES

## INTRODUCTION

The Plains $CO_2$ Reduction (PCOR) Partnership maintains a database of significant regional point sources of carbon dioxide ($CO_2$). The database is a key in the development of $CO_2$ capture–transportation–storage scenarios that have the potential to reduce greenhouse gas emissions in the PCOR Partnership region. To maintain a reasonably current status, the data set undergoes an annual review during which new or missing sources are identified and added, $CO_2$ emission rates are updated, and facility locations are verified. This report summarizes the data review that took place between August 1, 2013, and September 15, 2014.

## APPROACH

Actual emission measurements are used whenever possible, but measured data are not always available for each of the sources. In cases where measured data are unavailable, emissions are estimated using the methodologies developed for the U.S. Department of Energy (DOE) National Energy Technology Laboratory by the DOE Regional Carbon Sequestration Partnerships Capture and Transportation Working Group (Capture and Transportation Working Group of the DOE Regional Carbon Sequestration Partnerships, 2010). Web searches are used to acquire updated information regarding fuel type, heat content, and usage rate and/or product slate and quantities; these values are used to estimate $CO_2$ emission rates for specific sources.

Four primary data sets were used to update the PCOR Partnership $CO_2$ emission database:

- The Environment Canada Reported Facility Greenhouse Gas Data (Environment Canada, 2014a), an online greenhouse gas search engine, provides the annual emissions of $CO_2$, $CH_4$ (methane), $N_2O$ (nitrous oxide), $SF_6$ (sulfur hexafluoride), PFCs (perfluorocarbons), HFCs (hydrofluorocarbons), and other greenhouse gases for point sources from all sectors. The Canadian point sources in the PCOR Partnership database were updated using 2012 data (the most current data). The search engine can be accessed at www.ec.gc.ca/pdb/ghg/onlineData/dataSearch_e.cfm.

- Emission data for criteria pollutants such as $SO_2$ (sulfur dioxide) and $NO_x$ (nitrogen oxides) can be found at the online Environment Canada National Pollutant Release Inventory Online Data Search engine (Environment Canada, 2014b). The Canadian point sources in the PCOR Partnership database were updated using 2012 data (the most

current data). The search engine can be accessed at www.ec.gc.ca/pdb/websol/querysite/query_e.cfm.

- The U.S. Environmental Protection Agency (EPA) Air Markets Program Data online emission search engine (U.S. Environmental Protection Agency, 2014a) provides $CO_2$, $SO_2$, and $NO_x$ emission data for electric utilities and larger industrial heat/power plants. The PCOR Partnership database was updated using facility data from 2013 so as to incorporate the most current data for these plants. This search engine can be accessed at http://ampd.epa.gov/ampd/.

- EPA's Greenhouse Gas Reporting Program Data for Calendar Year 2012 (U.S. Environmental Protection Agency, 2014b) is a searchable site that contains $CO_2$, $N_2O$, $CH_4$, PFC-14 (tetrafluoromethane), PFC-116 (hexafluoroethane), and HFC-23 (fluoroform) emission data reported from large facilities in nine industry groups: power plants, landfills, metal manufacturing, mineral production, petroleum refineries, pulp and paper manufacturing, chemical manufacturing, government and commercial facilities, and other industrial facilities. The Greenhouse Gas Reporting Program Data can be accessed at http://ghgdata.epa.gov/ghgp/main.do.

The emission data obtained from the EPA Greenhouse Gas Reporting Program are relatively easily incorporated into the PCOR Partnership data set with the exception of the ethanol plants. The PCOR Partnership tracks combustion- and process-related $CO_2$ emissions separately for potential carbon utilization purposes. The EPA site breaks down the emissions as either combustion-related or biogenic $CO_2$, which includes $CO_2$ that is formed by either combustion or decomposition of a biomass source. In other words, biogenic $CO_2$ includes both $CO_2$ that is fermentation process-related as well as the result of combusting biomass, making it difficult to determine the amount of $CO_2$ produced by processes other than combustion.

The EPA searchable database presents a second challenge in that it is difficult to determine the total $CO_2$ emissions as opposed to the total $CO_2$ equivalent ($CO_2eq$) emissions for some of the source types. One example of this is sugar-processing facilities with their inherent lime production. This is not true for all source types.

A final note about the use of the EPA database: the power plants are listed as producing $CO_2$ from both "stationary combustion" and "electricity generation." These values must be summed to produce the total $CO_2$ emissions at such sites of the demonstration project and provide basic information about the effort.

Because nearly all of the searchable databases, as well as NATCARB, list $CO_2$ and $CO_2eq$ data in tonnes (i.e., metric tons) rather than short tons, the PCOR Partnership $CO_2$ data set was converted from short tons to tonnes this year.

## RESULTS

As of September 15, 2014, the updated PCOR Partnership database contains 911 sources that produce an estimated 562 million tonnes (619 million short tons) of $CO_2$ annually. This compares to the 2013 values of 898 sources producing an estimated 568 million short tons of $CO_2$ each year. The breakdown of the $CO_2$ emissions by broad source category is presented in Table 1. The breakdown of the $CO_2$eq emissions by broad source category is given in Table 2, while Table 3 shows the types and $CO_2$eq of the other greenhouse gases emitted by the $CO_2$ sources tracked in the PCOR Partnership data set.

Occasionally, the name of a source is found to have changed in an emission data set. The PCOR Partnership database was modified to reflect the name change of five sources since July 31, 2013.

Sources that no longer exist or that were found to be duplicate entries in the database were eliminated. There were a total of 26 such point sources in the PCOR Partnership database.

Figure 1 shows the locations of 39 new facilities that were found to be missing from the data set and were, therefore, added to it.

Because the units were changed from short tons to tonnes, updated $CO_2$ emission information was found or estimated for all of the 911 sources. All of the various EPA and Environment Canada identifiers were added to the dataset.

**Table 1. Summary of $CO_2$ from Point Sources Found Within the PCOR Partnership Region as of September 15, 2014**

| Category | Count | Total $CO_2$, tonnes | % of Sources | % of Emissions |
|---|---|---|---|---|
| Agricultural and Agriculture-Related Processing | 68 | 8,162,577 | 7.5 | 1.5 |
| Electricity Generation | 196 | 327,480,947 | 21.5 | 58.3 |
| Chemical and Fuel Production | 40 | 21,017,398 | 4.4 | 3.7 |
| Ethanol Manufacture | 125 | 40,995,821 | 13.7 | 7.3 |
| Cement/Clinker Production | 22 | 27,522,099 | 2.4 | 4.9 |
| Industrial | 47 | 9,554,029 | 5.2 | 1.7 |
| Small-Scale Heat and Power | 35 | 3,598,010 | 3.8 | 0.6 |
| Manufacturing | 45 | 3,954,843 | 4.9 | 0.7 |
| Petroleum- and Natural Gas-Related | 265 | 106,753,954 | 29.1 | 19.0 |
| Paper and Wood Products | 45 | 11,651,927 | 4.9 | 2.1 |
| Waste Processing | 23 | 1,471,982 | 2.5 | 0.3 |
| **Total** | **911** | **562,163,588** | **100.0** | **100.0** |

**Table 2. Summary of $CO_2$-Equivalent Emissions from Point Sources Found Within the PCOR Partnership Region as of September 15, 2014**

| Category | Count | Total $CO_2$eq, tonnes | % of Sources | % of Emissions |
|---|---|---|---|---|
| Agricultural and Agriculture-Related Processing | 68 | 9,000,589 | 7.5 | 1.6 |
| Electricity Generation | 196 | 329,627,368 | 21.5 | 57.4 |
| Chemical and Fuel Production | 40 | 22,262,021 | 4.4 | 3.9 |
| Ethanol Manufacture | 125 | 41,409,740 | 13.7 | 7.2 |
| Cement/Clinker Production | 22 | 27,561,479 | 2.4 | 4.8 |
| Industrial | 47 | 10,009,563 | 5.2 | 1.7 |
| Small-Scale Heat and Power | 35 | 3,627,168 | 3.8 | 0.6 |
| Manufacturing | 45 | 4,208,459 | 4.9 | 0.7 |
| Petroleum- and Natural Gas-Related | 265 | 111,831,281 | 29.1 | 19.5 |
| Paper and Wood Products | 45 | 12,118,473 | 4.9 | 2.1 |
| Waste Processing | 23 | 2,640,876 | 2.5 | 0.5 |
| **Total** | **911** | **574,297,017** | **100.0** | **100.0** |

**Table 3. Summary of Greenhouse Gases Emitted by $CO_2$ Sources in the PCOR Partnership Region**

| Greenhouse Gas | $CO_2$ Equivalent Value | Number of Sources | Quantity, tonnes $CO_2$eq |
|---|---|---|---|
| $CH_4$ | 21 | 827 | 8,193,740 |
| $N_2O$ | 310 | 822 | 3,717,139 |
| $SF_6$ | 23,900 | 7 | 647 |
| HFC | 140 to 11,700 | 7 | 10,313 |
| PFC | 6500 to 9200 | 3 | 211,590 |

When available, the $CO_2$eq emissions due to $CH_4$, $N_2O$, HFCs, PFCs, and/or $SF_6$ were incorporated into the PCOR Partnership database. This information was found for as many as 827 (depending on the greenhouse gas) of the 911 sources and is summarized in Table 3. Roughly 91% of the large $CO_2$ point sources in the PCOR Partnership region emit other greenhouse gases in addition to $CO_2$.

The process of moving this latest data set to the PCOR Partnership Decision Support System (DSS) is currently under way. When the process is complete, the updated emission data will be reflected via the online geographic information systems on the PCOR Partnership DSS and DOE's national portal.

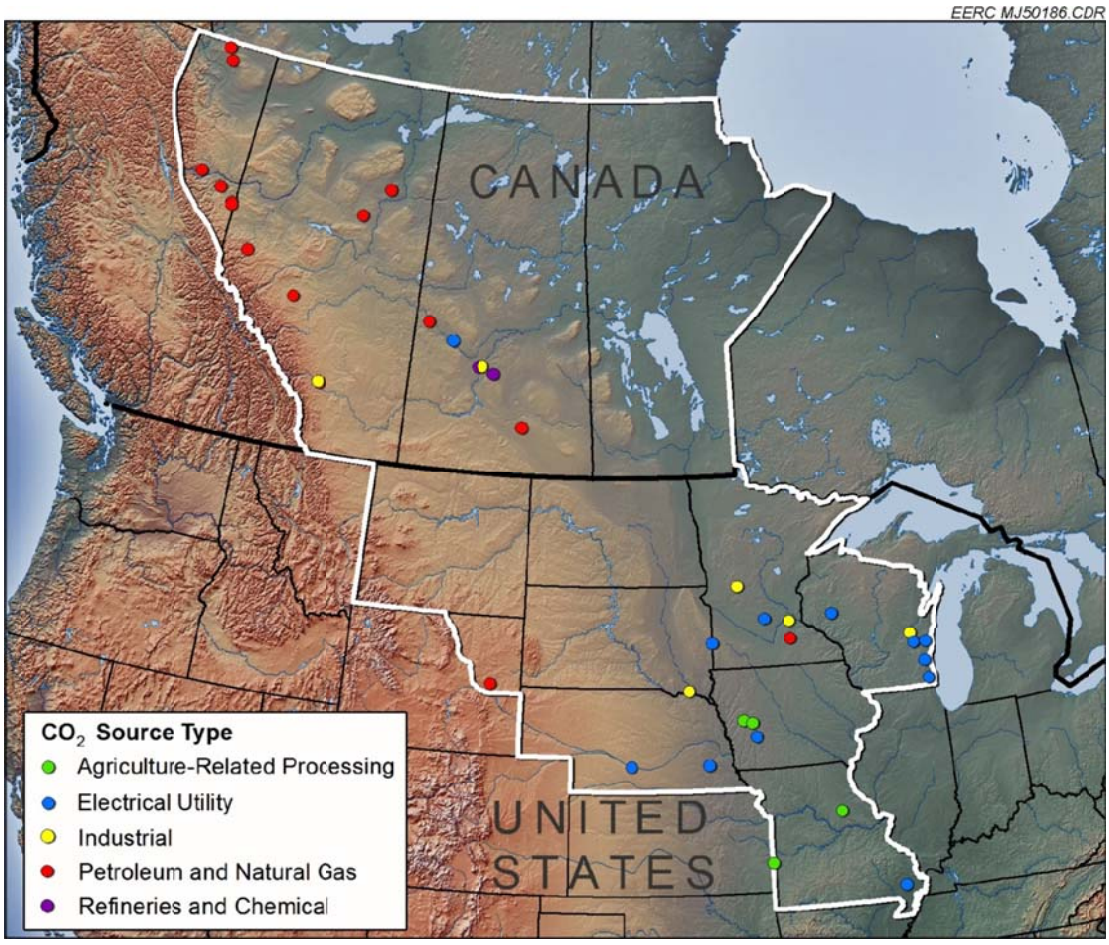


Figure 1. Location of the new facilities identified during this database update.

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