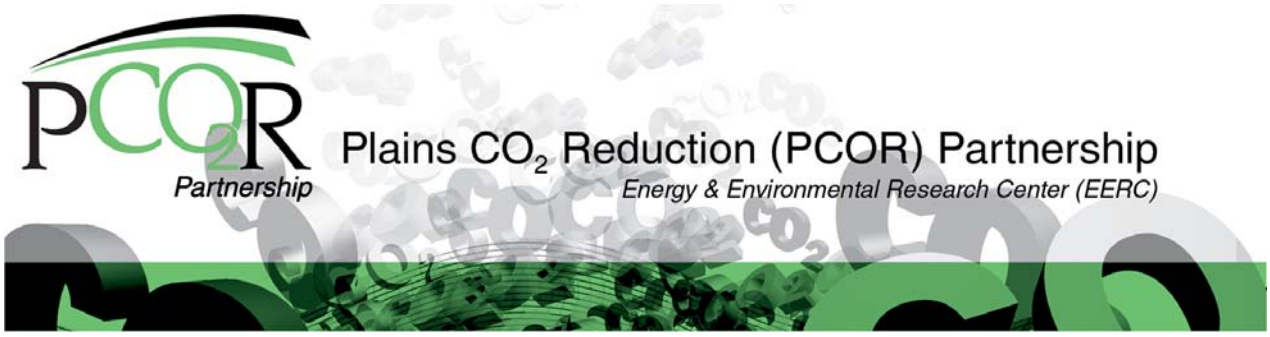

REVIEW OF SOURCE ATTRIBUTES

Plains CO_2 Reduction Partnership Phase III
Task 1 – Deliverable D1

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EERC DISCLAIMER

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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
RCSPs	Regional Carbon Sequestration Partnerships
SF_6	sulfur hexafluoride
SO_2	sulfur dioxide

REVIEW OF SOURCE ATTRIBUTES

EXECUTIVE SUMMARY

The Plains CO_2 Reduction (PCOR) Partnership, led by the Energy & Environmental Research Center at the University of North Dakota, 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 394 significant (greater than 100,000 metric tons) CO_2 emission sources that emit 483 million tonnes on an annual basis.

REVIEW OF SOURCE ATTRIBUTES

INTRODUCTION

The Plains CO_2 Reduction (PCOR) Partnership, led by the Energy & Environmental Research Center at the University of North Dakota, 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 September 8, 2015, and August 16, 2016.

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' (RCSPs') 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 data sets were used to update the PCOR Partnership's CO_2 emission database:

- The Environment Canada Reported Facility Greenhouse Gas Data (Environment Canada, 2016), 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 2014 data (the most current data). The search engine can be accessed at www.ec.gc.ca/pdb/ghg/onlineData/dataSearch_e.cfm.

- The U.S. Environmental Protection Agency (EPA) Air Markets Program Data online emission search engine (U.S. Environmental Protection Agency, 2016a) provides CO_2, SO_2 (sulfur dioxide), and NO_x emission data for electric utilities and larger industrial heat/power plants. The PCOR Partnership database was updated using facility data from

2015 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 2014 (U.S. Environmental Protection Agency, 2016b) 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 EPA searchable database presents a 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.

The threshold for inclusion of the sources into the PCOR Partnership data has been set to 100,000 tonnes/yr. The threshold was chosen for several reasons:

- 100,000 tonnes/yr is generally thought to be the minimum emission level that would be useful to a commercial end user.

- The cost to capture and transport CO_2 from a system producing a smaller CO_2 stream than this would likely be prohibitively expensive.

- The other RCSPs have generally reported their CO_2 data for sources that produce at least 100,000 tonnes CO_2/yr. This threshold puts the PCOR Partnership data set on the same basis as the other RCSP data sets within NATCARB (National Carbon Sequestration Database and Geographic Information System).

RESULTS

As of August 16, 2016, the updated PCOR Partnership database contains 394 sources that produce an estimated 483 million tonnes of CO_2 annually. The breakdown of the CO_2 emissions by broad source category is presented in Table 1. The breakdown of the CO_2eq emissions by broad source category is given in Table 2, while Table 3 shows the types and CO_2eq of the other greenhouse gases emitted by the CO_2 sources tracked in the PCOR Partnership data set.

Figure 1 shows the locations of 13 new facilities that were found to be missing from the data set and were, therefore, added to it.

When available, the CO_2eq emissions due to CH_4, N_2O, HFCs, PFCs, and/or SF_6 are incorporated into the PCOR Partnership database. This information was found for as many as 302 (depending on the greenhouse gas) of the 394 sources and is summarized in Table 3. Roughly 76% 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.

Table 1. Summary of CO_2 from Point Sources Found Within the PCOR Partnership Region as of August 16, 2016

Category	Count	Total CO_2, tonnes	% of Sources	% of Emissions
Agricultural and Agriculture-Related Processing	20	6,224,049	5.1	1.3
Electricity Generation	131	319,122,996	33.2	66.1
Chemical and Fuel Production	23	14,990,659	5.8	3.1
Ethanol Manufacture	53	20,228,451	13.5	4.2
Cement/Clinker Production	21	18,067,045	5.3	3.7
Industrial	21	9,774,422	5.3	2.0
Small-Scale Heat and Power	11	2,528,177	2.8	0.5
Manufacturing	8	1,601,065	2.0	0.3
Petroleum- and Natural Gas-Related	84	80,459,325	21.3	16.7
Paper and Wood Products	19	9,144,660	4.8	1.9
Waste Processing	3	581,859	0.8	0.1
Total	**394**	**482,722,706**	**100.0**	**100.0**

Table 2. Summary of CO_2-Equivalent Emissions from Point Sources Found Within the PCOR Partnership Region as of August 16, 2016

Category	Count	Total CO_2eq, tonnes	% of Sources	% of Emissions
Agricultural and Agriculture-Related Processing	20	6,882,711	5.1	1.4
Electricity Generation	131	319,641,971	33.2	65.3
Chemical and Fuel Production	23	16,112,038	5.8	3.3
Ethanol Manufacture	53	20,300,518	13.5	4.1
Cement/Clinker Production	21	18,130,670	5.3	3.7
Industrial	21	10,011,143	5.3	2.0
Small-Scale Heat and Power	11	2,542,637	2.8	0.5
Manufacturing	8	1,878,536	2.0	0.4
Petroleum- and Natural Gas-Related	84	83,690,428	21.3	17.1
Paper and Wood Products	19	9,492,614	4.8	1.9
Waste Processing	3	591,713	0.8	0.1
Total	**394**	**489,274,981**	**100.0**	**100.0**

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

Greenhouse Gas	CO_2 Equivalent Value	Number of Sources	Quantity, tonnes CO_2eq
CH_4	21	302	3,945,291
N_2O	310	302	2,212,845
SF_6	23,900	5	1,728
HFC	140 to 11,700	6	3,645
PFC	6500 to 9200	2	273,927

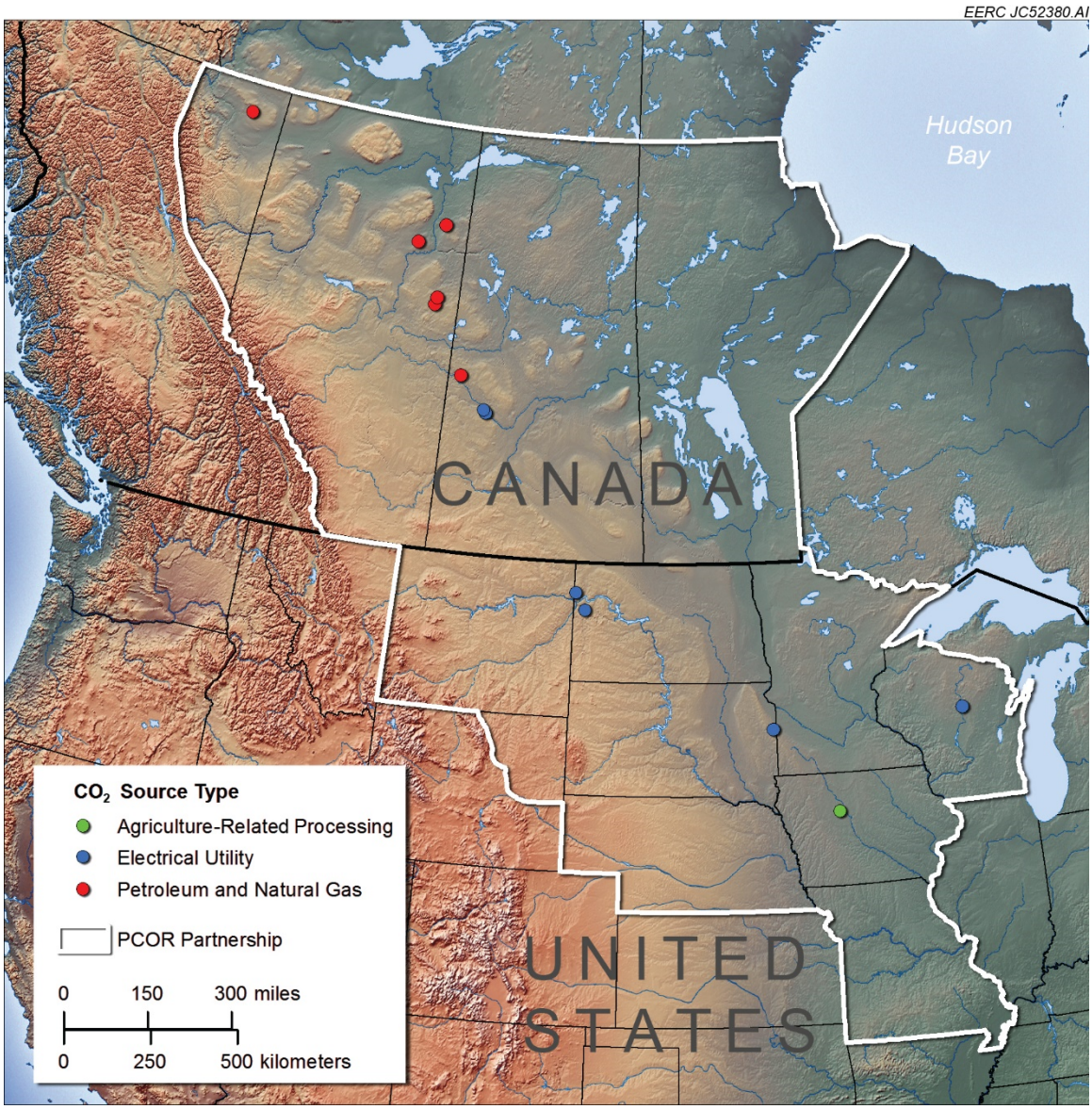

Figure 1. Location of the new facilities identified during this database update.

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