CO_2 Stationary Source Emission Estimation Methodologies Summary

APPENDIX A

Prepared for

U.S. Department of Energy
National Energy Technology Laboratory
Carbon Sequestration Program

Prepared by

Capture and Transportation Working Group
of the DOE Regional Carbon Sequestration Partnerships

June 2010

Contents

Introduction

The following summarizes the calculations, emissions factors, and databases employed by the Regional Carbon Sequestration Partnerships (RCSPs) with respect to carbon dioxide (CO_2) stationary source emissions estimation methods. Tables of information are used to summarize the methodology. The CO_2 stationary sources include power plants, ethanol plants, petroleum and natural gas processing facilities, cement and lime plants, agricultural processing facilities, industrial facilities, iron and steel production facilities, and fertilizer producing facilities. Estimation methods include databases and emissions factors. Each table lists the databases and emissions factors utilized for the particular CO_2 source type. Not all databases or emissions factors were used by all of the RCSPs. The legend following each table contains the definitions of equation variables.

The documents used to identify each CO_2 stationary source, as well as the practical quantitative method (i.e., emission factors, continuous emissions-monitoring results, emission estimate equations, etc.) used to estimate CO_2 emissions from that source, are listed in the "CO_2 Emissions Methodology References" section of this report. These documents are organized by the reference numbers shown after the main text of each entry. The data sources to determine specific plant capacities, production outputs, or fuel usage data are listed by RCSP in the "Data References by Partnership and Industry" section of this report.

Approach

The approach to determine these methodologies was to identify significant CO_2 emission sources within each region, and then assess the availability of CO_2 emission data or to apply an estimate of the CO_2 emissions based upon sound scientific and engineering principles. In each RCSP, the emissions were grouped by emission source and a methodology was established for each emission source category; then the methodology was utilized to estimate the CO_2 emissions from each emission source category. To summarize these efforts, nine tables containing CO_2 emission estimation methodology and equations for the major CO_2 stationary source industries outlined in the third version of the *Carbon Sequestration Atlas of the United States and Canada (Atlas III)* were created. During the Characterization Phase (Phase I), each RCSP was responsible for developing greenhouse gas (GHG) emission inventories and stationary source surveys within their respective partnership boundary area. More than 4,365 stationary sources have been documented for the seven RCSPs.

Stationary sources fall under one of the nine industry types outlined in Atlas III. Table A-1 identifies the variety of stationary sources falling under any given industry type as identified in *Atlas III*.

Table A-1. CO_2 Stationary Sources by Industry Category

Industry type	CO_2 Stationary Sources Included
Electric Generating Plants	• Coal-, Oil-, and Natural Gas-Fired Power Plants • Limited Municipal Solid Waste
Ethanol Production Plants	• Ethanol Plants, Regardless of Feedstock Type
Agricultural Processing Facilities	• Sugar Production
Natural Gas Processing Facilities	• Natural Gas Processing Facilities
Industrial Facilities	• Aluminum Production Facilities • Soda Ash Production Facilities • Glass Manufacturing Facilities • Automobile Manufacturing Facilities • Compressor Stations • Iron Ore Processing Facilities • Paper and Pulp Mills
Iron and Steel Facilities	• Iron and Steel Producing Facilities
Cement and Lime Plants	• Lime Production Facilities • Cement Plants
Refineries and Chemical Facilities	• Petroleum Refinery Processing • Ethylene Production Facilities • Ethylene Oxide Production • Hydrogen Production Facilities
Fertilizer Production	• Ammonia Production

CO_2 Estimation Methodology

For any stationary source within a given industry type, the RCSPs employed CO_2 emissions estimate methodologies that are based on the most readily available representative data for that particular industry type within the respective partnership area. CO_2 emissions data provided by databases (for example, eGRID, IEA GHG, or NATCARB) were the first choice for all of the RCSPs, both for identifying major CO_2 stationary sources and for providing reliable emission estimations. Databases are considered to contain reliable and accurate data obtained from direct emissions measurements via continuous emissions monitoring (CEM) systems. One drawback of formal databases can be the delay between data collection and publication, but this does not present a significant problem for the RCSPs as the dates of information are clear. When databases were not available, stationary source facility production or fuel usage were coupled with CO_2 emissions factors to estimate annual CO_2 emissions from the production or fuel usage data. Emissions factors, fuel usage data, and facility production data were obtained from various databases, websites, and publications. Stationary source spatial location data (latitude and longitude) were determined from a variety of sources. Some databases (eGRID) contain latitude and longitude information for each stationary source. Where spatial location information was not available through an emissions database, other spatial location methods were utilized. These include the use of mapping tools (Google Earth, TerraServer, and USGS Digital Orthophoto Imagery) equipped with geospatially defined data, along with web-based databases (Travelpost) containing latitude and longitude information for various U.S. locations.

Table 1. Methodology for Estimating CO_2 Emissions from Electric Generating Plants

Methodology	Description
Database	The most current data were used where available. Actual emissions data were obtained from various databases even if not all sources had the same vintage data. These include: • EPA Clean Air Markets Division Facility Emissions Data (2010), where the average of the most recent five years of available data were selected and aggregated to the plant level, and the lowest values dropped to reduce the impacts of startup and maintenance anomalies.[1] • EPA eGRID Database (2004, 2008).[2] • EPA Acid Rain Program Emission Report for 2005 (2006).[3] • Commission for Environmental Cooperation Website (U.S. Plants).[4] • Commission for Environmental Cooperation Website (Canadian Plants) (2002).[5] • Website for Canadian Sources;[6] new plant data from EIA Table ES3; New and Planned U.S. Electric Generating Units by Operating Company, Plant and Month, 2007-2008.[7] • U.S. DOE – EIA Power Plant Database.[8]
Emissions Factors	Data were analyzed based on the IPCC (2006) GHGs methodology using fuel consumption, a fuel-specific carbon coefficient, and the fuel-related fraction of carbon oxidized, similar to the following equation.[9] CO_2 emissions were also calculated via combustion based on fuel type and usage data provided by the Transfer Technology Network (TTN) Database:[10] $M_{CO_2} = \frac{3.664 F_t C_{\%} D_F}{2000}$ (if liquid or gaseous fuel) $M_{CO_2} = 3.664 C_{\%} F_t$ (if solid fuel)
	For new natural gas-fired plants plants without CO_2 data, annual emissions were estimated by calculating megawatt hours from the plant capacity and 50% annual production for natural gas combined cycle or 20% for natural gas simple cycle. 1,100 lb of CO_2 per MWh was approximated based on examination of natural gas plants in the eGRID data to estimate emissions at new plants.[2] $M_{CO_2} = \frac{1100 P}{2000}$

Legend:

$C_{\%}$ = Carbon in the fuel (weight fraction; i.e., % ÷ 100) (Found in Appendix B of this report)
D_F = Fuel density (lb per gallon if liquid; lb per million scf if gas)
F_t = Fuel usage rate (depends on fuel type) (gallons per year if liquid; million scf per year if gas; tons per year if solid)
M_{CO2} = Total CO_2 emissions (tons per year)
P = Annual plant generation (MWh)

Notes: The Emissions & Generation Resource Integrated Database (eGRID) is a comprehensive inventory of environmental attributes of electric power systems and has been the most widely used source for gathering CO_2 stationary source emissions by the partnerships. The eGRID provides annual CO_2 emissions data reported from the Environmental Tracking System (Continuous Emissions Monitoring), rather than emissions factors based solely on production or heat input. In addition to emissions data, eGRID also provides facilities' latitude, longitude, primary fuel, annual heat input, and annual power generation.

Table 2. Methodology for Estimating CO_2 Emissions from Ethanol Plants

Methodology	Description
Database	Where available, actual emissions data were obtained from various databases. The most current data were used, even if not all sources had the same vintage data. These include: • e-GRID Spreadsheets[2] • NATCARB's Ethanol Plant Excel Worksheet (2006 data).[11] • Data cited from the Renewable Fuels Association [12,13] and contact with ethanol plant operators within certain partnership areas.
Emissions Factors	Process-related emissions:[14, 15,16, 17, 18] $M_{CO_2} = \frac{\sum(E_{g,f}\theta_{E,f})}{2000}$ Combustion emissions using natural gas: [14, 16, 19, 20] $M_{CO_2} = \frac{44 E_g \left(\frac{39{,}000\ BTU}{gal}\right)\left(\frac{lbmol}{359\ ft^3}\right)}{2000\left(\frac{1000\ BTU}{ft^3}\right)}$ Combustion emissions using coal:[6, 12] $M_{CO_2} = \frac{0.039 E_g \theta_{coal}}{2000}$
	CO_2 emissions based on fermentation (2.88 ktonne CO_2 per million gal. ethanol). Emissions factor converted to a lb CO_2 per gallon ethanol produced:[12, 21] $M_{CO_2} = \frac{6.34 E_{g,f}}{2000}$

Legend:

θ_{coal} = CO_2 emissions factor for coal combustion (lb CO_2 per million Btu)
$\theta_{E,f}$ = CO_2 emissions factor for ethanol production by feedstock (lb CO_2 per gal ethanol): corn = 6.31 lb CO_2 per gal ethanol (MGSC), 6.6 lb CO_2 per gal ethanol (PCOR), and 6.624 lb CO_2 per gal ethanol (WESTCARB); corn/wheat = 6.15 lb CO_2 per gal ethanol and beverage waste = 5.05 lb CO_2 per gal ethanol (MGSC)
E_g = Ethanol production (gal ethanol/year)
$E_{g,f}$ = Ethanol production by feedstock (i.e. corn, corn and/or wheat, beverage waste) (gal per year)
M_{CO2} = Total CO_2 emissions (tons per year)

Table 3. Methodology for Estimating CO_2 Emissions from Agricultural Processing Facilities

Methodology	Description
Emissions Factors	For facilities where fuel usage is known (obtained from EPA TTN Database):[1,2,6,22] $M_{CO_2} = \frac{3.664 F_t C_{\%} D_F}{2000}$ (if liquid or gaseous fuel) $M_{CO_2} = 3.664 C_{\%} F_t$ (if solid fuel) Sugar production CO_2 emissions from the calcination of limestone-dolomite:[1,2,22] $M_{CO_2} = 0.785 E_{\text{Lime}}$

Legend:
$C_{\%}$ = Carbon in the fuel (weight fraction) (Found in Appendix B of this report)
D_F = Fuel density (lb per gallon if liquid; lb per million scf if gas)
E_{Lime} = Lime production rate (tons per year)
F_t = Fuel usage rate (depends on fuel type) (gallons per year if liquid; million scf per year if gas; tons per year if solid)
M_{CO2} = Total CO_2 emissions (tons per year)

Table 4. Methodology for Estimating CO_2 Emissions from Natural Gas Processing Facilities

Methodology	Description
Emissions Factors	Petroleum or natural gas processing facilities CO_2 emissions based on fuel usage data and energy content: [23] $M_{CO_2} = \beta F_t \theta_{fuel}$
	Natural gas processing emissions based on production (20% CO_2 content):[7] $M_{CO_2} = 4{,}238 F_{CH_4}$
	Natural gas sweetening process emissions based on fuel combustion needed to provide heat to regenerate the amine sorbent: [1, 6, 22] $M_{CO_2} = \frac{44.01\ F_{CH_4}}{2000\left(\frac{379\ ft^3}{lbmol}\right)}$
	Emissions based upon recovery from natural gas with a 4% average inlet gas CO_2 concentration and 1% average outlet gas CO_2 concentration: [24,25] $M_{CO_2} = 608 E_{NG}$

Legend:
θ_{fuel} = CO_2 emissions factor based on heat input rate (tons CO_2 per million BTU)
E_{NG} = Natural gas processing rate (million scf per day)
F_{CH4} = Natural gas usage rate (standard cubic feet per year)
F_t = Fuel usage rate (depends on fuel type) (kgal per year = liquid; million scf per year = gas; tons per year = solid)
M_{CO2} = Total CO_2 emissions (tons per year)
β = Heat content of fuel used (million BTU per million scf [gas]; million BTU per ton [solid]; million BTU per kgal [liquid])

Table 5. Methodology for Estimating CO_2 Emissions from Industrial Facilities

Methodology	Description
Emissions Factors	Aluminum production emissions:[26, 27, 28, 29] $M_{CO_2} = E_A \theta_{A1, A2}$ Emissions from aluminum production (based on EPA AP-42 emissions factors):[30] $M_{CO_2} = \frac{3{,}080 E_A}{2000}$ Soda ash production combustion emissions were determined from fuel use data obtained from the U.S. EPA's NEI (1999) Database. Fuel use data were used with a default emissions factor for specific fuels to convert fuel consumed to metric tons of CO_2 produced.[31, 32] $M_{CO_2} = F_t \theta_f$ Soda ash production emissions were based on stoichiometric relationship between trona ($Na_3HCO_3(CO_3)_2 \cdot 2H_2O$) and soda ash ($Na_2CO_3$):[31,32,33] $M_{CO_2} = 0.09737\ E_T$ (based on Trona production) $M_{CO_2} = 0.1383\ E_{SA}$ (based on Soda ash production)
	Glass container manufacturing emissions:[34] $M_{CO_2} = 160.16\ E_g$ Flat glass manufacturing emissions:[34] $M_{CO_2} = 180.69\ E_g$ Pressed and brown glass manufacturing emissions:[34] $M_{CO_2} = 112.93\ E_g$ Compressor station emissions based on heat input of natural gas:[30] $M_{CO_2} = \frac{8760\, \beta_{NG} (110 F_{NG})}{2000}$ Compressor station emissions based on NO_X emissions (when heat input is not available):[30] $M_{CO_2} = \frac{110\, C_{NO_x}}{\theta_{NO_x}}$ Autos manufacturing emissions:[35, 36] $M_{CO_2} = \frac{8760\ F_L (110\, \beta_{NG} + 146\, \beta_{diesel} + 214\, \beta_{coal})}{2000}$
	Paper production and combustion emissions based on fuel burned:[1,6,22] $M_{CO_2} = \frac{3.664\, F_t C_{\%} D_F}{2000}$ (if liquid or gaseous fuel) $M_{CO_2} = 3.664\, C_{\%} F_t$ (if solid fuel) Iron ore processing emissions:[30] $M_{CO_2} = 0.0155\, E_{Fe}$

Legend:

$\theta_{A1,A2}$ = CO_2 emissions factor for aluminum production based on the reduction technology implemented (Prebaked (A1) = 1.6 tons CO_2 per ton Al; Søderberg (A2) = 1.7 tons CO_2 per ton Al)
θ_f = CO_2 emissions factor for fuel usage based on fuel type (tons CO_2 per ton fuel = solid; tons CO_2 per gallon fuel = liquid)
θ_{NOx} = NO_X emissions factor based on heat input (lb NO_X per million Btu)
$C_{\%}$ = Carbon in fuel (weight fraction) (Found in Appendix B of this report)
C_{NOx} = NO_X emissions rate (tons per year)
D_F = Fuel density (lb per gallon = liquid; lb per million scf = gas)
E_A = Aluminum production rate (tons per year)
E_C = Clinker manufacture production (tons per year)
E_{Fe} = Iron ore production (tons pellet per year)
E_g = Glass manufacturing production (tons per day)
E_{SA} = Soda ash production rate (tons per year)
E_T = Trona production rate (tons per year)
F_L = Autos manufacturing loading factor (use 0.8 when data not available)
F_{NG} = Compressor loading factor (use 0.6 when data not available)
F_t = Fuel usage rate (depends on fuel type) (gallons per year = liquid; million scf per year = gas; tons per year = solid)
M_{CO2} = Total CO_2 emissions (tons per year)
β_{coal} = Maximum coal heat input rate (million Btu per hr)
β_{diesel} = Maximum diesel fuel heat input rate (million Btu per hr)
β_{NG} = Maximum NG heat input rate (million Btu per hr)

Table 6. Methodology for Estimating CO_2 Emissions from Iron and Steel Facilities

Methodology	Description
Emissions Factors	Emissions from iron and steel manufacturing: [37, 38, 39] $M_{CO_2} = 3.3E_{\varepsilon} + 0.02(3.667E_{pig}) + 0.004(3.667E_{SS}) + \theta_{EAF}E_{EAF}$
	Iron and steel production emissions factors: [40] General steel production: $M_{CO_2} = 1.27\,E_S$ Use of an electric arc furnace: $M_{CO_2} = E_{EAF}\,\theta_{EAF}$

Legend:

θ_{EAF} = CO_2 emissions factors for electric arc furnace
(MGSC: 0.0044 tons CO_2 per ton EAF steel; SECARB: 0.14 tons CO_2 per ton EAF steel)
E_{EAF} = EAF steel production rate (tons per year)
E_{pig} = Pig iron production rate (tons per year)
E_S = Steel production rate (tons per year)
E_{SS} = Scrap steel consumption rate (tons per year)
E_{ε} = Coke usage (tons per year)
M_{CO2} = Total CO_2 emissions (tons per year)

Table 7. Methodology for Estimating CO_2 Emissions from Cement and Lime Plants

Methodology	Description
Database	Where available, CO_2 emissions taken from NATCARB Cement Database (2006).[24] Lime plants identified by USGS Mineral Industry Surveys. [41]
Emissions Factors	Process related emissions based on clinker production and estimated generation of cement kiln dust (CKD):[39, 42] $M_{CO_2} = (1 + C_{Dust})\,E_C\,\theta_C$ Combustion related emissions based on clinker production:[39, 42, 43] $M_{CO_2} = 0.463\,E_C$ Emissions from lime production:[39, 43, 44] $M_{CO_2} = 0.75\,E_{QL} + 0.87\,E_{DL}$
	Process emissions:[47] $M_{CO_2} = (1 + C_{Dust})\,E_C\,\theta_C$ Combustion emissions based on clinker production:[43,46,46b] $M_{CO_2} = 0.575\,E_C$ Lime (clinker) production emissions (from lime production reaction stoichiometry): $M_{CO_2} = 0.785\,E_C$
	Lime production combustion emissions:[23,32] $M_{CO_2} = \beta F_t \theta_{fuel}$ Lime production process emissions:[23,32] $M_{CO_2} = 0.75\,RE_{Lime}$
	CO_2 emissions from cement plants were generated based on cement produced, clinker content, amount of raw materials used and CO_2 emitted from combustion.[48] $M_{CO_2} = 0.9\,E_{CP}$

Legend:

θ_C = CO_2 emissions factor for clinker production
(MGSC: 0.507 ton CO_2 per tonne clinker; PCOR: 0.536 ton CO_2 per ton clinker)
θ_{fuel} = CO_2 emissions factor based on heat input rate (tons CO_2 per million BTU)
C_{Dust} = Fraction of cement kiln dust (Assume 2% if no other data is available)
E_C = Clinker production rate (tons per year)
E_{CP} = Cement production rate (tons per year)
E_{DL} = Dolomite lime production rate (tons per year)
E_{Lime} = Lime production rate (tons per year)
E_{QL} = Quicklime production rate (tons per year)
F_t = Fuel usage rate (depends on fuel type) (kgal per year = liquid; million scf per year = gas; tons per year = solid)
M_{CO2} = Total CO_2 emissions (tons per year)
R = content of CaO in lime produced (EPA estimates 0.95 for high calcium lime)
β = Heat content of fuel used
(million BTU per million scf [gas]; million BTU per ton [solid]; million BTU per kgal [liquid])

Table 8. Methodology for Estimating CO_2 Emissions from Refineries and Chemical Facilities

Methodology	Description
Emissions Factors	Refinery processing emissions based on plant production :[49] $M_{CO_2} = E_P \theta_P$
	The combustion CO_2 emission rate was estimated for each fuel within each Petroleum Administration for Defense District (PADD) by multiplying the fuel usage rate (unit volume per yr) for each PADD with the CO_2 emission coefficient (lb CO_2 per unit volume). The total CO_2 emission rate was determined by summing the CO_2 emission rates for all fuels. An emissions factor (tons CO_2 per barrel per calendar day) was then calculated for each of the PADDs by dividing the total CO_2 emission rate for the district by the refining capacity (barrels per calendar day) for the district. States in the PCOR Partnership region are represented in PADDs 2 and 4. The CO_2 emissions factors for PADDs 2 and 4 were estimated in 2008 to be 11.00 and 11.84 tons CO_2 per barrel per calendar day, respectively. (Note: These values must be recalculated each year when new refinery statistics are issued.) As an example, calculation of an emissions factor for a refinery in North Dakota, an emissions factor of 11.00 tons CO_2 per barrel per calendar day of the major product was used to calculate the total combustion-related emissions as follows: [1, 6, 20, 22] $M_{CO_2} = 11E_P$
	Refinery emissions rate: [40] $M_{CO_2} = E_P \theta_P$ Ethylene production emissions: [40] $M_{CO_2} = 2.43E_{et}$ Ethylene oxide production emissions: [40] $M_{CO_2} = 0.51E_O$
	An estimated emissions factor based on plant capacity was generated and emissions are estimated as follows: [50] $M_{CO_2} = 0.025(0.9E_P)$ CO_2 emissions for hydrogen (H_2) production were based on steam methane reforming (SMR) in which a hydrocarbon and water vapor are used to create H_2 and CO_2 as a byproduct governed by the following reaction: $CH_4 + 2H_2O = CO_2 + 4H_2$ This reaction implies that 0.25 volumes of CO_2 are produced per volume of H_2. Thus, emissions from hydrogen production are calculated as follows: [50,51] $M_{CO_2} = \frac{44.01(0.25\ E_H)}{2000\left(\frac{379\ ft^3}{lbmol}\right)}$

Legend:

θ_P = CO_2 emissions factor for petroleum refinery production (MGSC: 11.44 tons CO_2 per year per barrel per day petroleum; SECARB: 9.9 tons CO_2 per year per barrel per day of petroleum processed)
$C_{\%}$ = Carbon in fuel (weigh fraction) (Found in Appendix B of this report)
D_F = Fuel density (lb per gallon = liquid; lb per million scf = gas)
E_{et} = Ethylene production (tons per year)
E_H = H_2 production (scf per year)
E_O = Ethylene oxide production rate (tons per year)
E_P = Petroleum plant production rate (barrels per day)
F_{CH4} = Natural gas usage rate (standard cubic feet per year)
F_t = Fuel usage rate (depends on fuel type) (gallons per year = liquid; million scf per year = gas; tons per year = solid)
M_{CO2} = Total CO_2 emissions (tons per year)

Table 9. Methodology for Estimating CO_2 Emissions from Fertilizer Production

Methodology	Description
Emissions Factors	Ammonia production emissions: [39,52] $M_{CO_2} = E_{NH_3}(\theta_{NH_3} + \theta_{fuel})$
	Ammonia production emissions: [52,53] $M_{CO_2} = E_{NH_3}\theta_{NH_3}$

Legend:

E_{NH3} = Ammonia production (tons NH_3 per year)

θ_{NH3} = CO_2 process emissions factor for ammonia production (PCOR: 1.15 tons CO_2 per ton NH_3; MGSC: 1.2 tons CO_2 per ton NH_3; SECARB: 1.13 tons CO_2 per ton NH_3)

θ_{fuel} = CO_2 combustion emissions factor (0.5 tons CO_2 per ton NH_3)

M_{CO2} = Total CO_2 emissions (tons per year)

CO_2 Emissions Methodology References

1. U.S. Environmental Protection Agency, "Clean Air Markets – Data and Maps," http://camddataandmaps.epa.gov/gdm.

2. U.S. Environmental Protection Agency, "Emissions & Generation Resource Integrated Database" (eGRID) Version 2.1 http://www.epa.gov/cleanenergy/egrid/index.htm.

2a. U.S. Environmental Protection Agency, "Emissions & Generation Resource Integrated Database" (eGRID2007 Version 1.1) http://www.epa.gov/cleanenergy/egrid/index.htm.

3. U.S. Environmental Protection Agency, "2010 U.S. Greenhouse Gas Inventory Report." http://epa.gov/climatechange/emissions/usinventoryreport.html.

4. Commission for Environmental Cooperation (Database of individual power plants - U.S. Plants), http://www.cec.org/files/PDF/Pollutants/US_2002_metric_en.xls.

5. Commission for Environmental Cooperation Website (database of individual power plants - Canadian Plants). http://www.cec.org/files/PDF/Pollutants/Canada_2002_metric_en.xls.

6. Environment Canada. Information on Greenhouse Gas Sources and Sinks. 2007. http://www.ec.gc.ca/pdb/ghg/onlinedata/kdt_t3_e.cfm?year=2007.

7. Energy Information Administration, Refinery Capacity Data http://www.eia.doe.gov/pub/oil_gas/petroleum/data_publications/refinery_capacity_data/historical/2006/refcap06.xls.

8. U.S. Department of Energy, Energy Information Administration, "EIA 767 2005 Data Files: Annual Steam-Electric Plant Operations and Design Data," 2005, http://www.eia.doe.gov/cneaf/electricity/page/eia767.html.

9. Intergovernmental Panel on Climate Change, "2006 IPCC Guidelines for National Green house Gas Inventories," Prepared by the National Greenhouse Gas Inventories Programme, H.S Eggleston., L. Buendia, K. Miwa, T. Ngara, and K. Tanabe,eds, IGES, Japan, http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.htm.

10. U.S. Environmental Protection Agency, Technology Transfer Network Database. "Pollutants and Sources." http://www.epa.gov/ttn/atw/pollsour.html.

11. National Carbon Sequestration Database and Geographic Information System (NATCARB), "Ethanol Plants" (2006 data). http://www.natcarb.org.

12. Renewable Fuels Association, "Ethanol Biorefinery Locations." http://www.ethanolrfa.org/industry/locations.

13. Renewable Fuels Association, "Ethanol Industry Outlook 2006." http://www.ethanolrfa.org/objects/pdf/outlook/outlook_2006.pdf.

13b. Renewable Fuels Association, "Ethanol Industry Outlook 2010." http://www.ethanolrfa.org/page/-/rfa-association-site/img/content/outlook-2010.jpg.

14. Personal Communication with Ethanol Facilities in Phase I Regional Partnership Effort, Midwest Geological Carbon Sequestration Consortium Partnership, 2004.

15. Nebraska Energy Office, Table titled, "Fuel Ethanol Production Capacity by State and by Plant," Oct 2007. http://www.neo.ne.gov/statshtml/122.htm.

16. T. Aulich, Personal Communication. BBI International, July 2004.

17. Martin K. Dubois, Scott W. White, and Timothy Carr, "Co-Generation, Ethanol Production and CO_2 Enhanced Oil Recovery: Model for Environmentally and Economically Sound Linked Energy Systems," Kansas Geological Survey, University of Kansas, 2002, http://www.kgs.ku.edu/PRS/Poster/2002/2002-6/P2.

18. Aulich, T. 2004. Personal communication from Aulich. Director of the National Alternative Fuels Laboratory to M. Musich. EERC. May 2004.

19. B. Duff, Personal Communication, BBI International, 2004.

20. Energy Information Administration, "Voluntary Reporting of Greenhouse Gases Program: Fuel and Energy Sources Codes and Emission Coefficients," http://www.eia.doe.gov/oiaf/1605/coefficients.html.

21. H. Kheshgi and R. Prince, "Sequestration of Fermentation CO_2 from Ethanol Production," ExxonMobil Research and Engineering Company. July 2003. Energy (Oxford), 2005 (Vol. 30) (No. 10) 1865-1871.

22. U.S. Environmental Protection Agency, Technology Transfer Network Ozone Implementation, Areas (Emissions and Air Quality Data), Emissions Inventory Data. http://www.epa.gov/ttn/naaqs/ozone/areas.

23. U. S. Environmental Protection Agency, "Emissions Inventory Improvement Program," EIIP Document Series Volume VIII, Estimating Greenhouse Gas Emissions, 2006, http://www.epa.gov/ttn/chief/eiip/techreport/volume08/index.html.

24. NATCARB (2007), "General Information on CO_2 Source Data Available Through NATCARB," http://www.natcarb.org/Dbase/index.html.

25. C. N. Threlkeld, "Organic Geochemistry Database: Provisional Release," United States Geological Survey. http://energy.cr.usgs.gov/prov/og/data.htm.

26. The Greenhouse Gas Protocol, 2006, Greenhouse gas emissions monitoring and reporting by the aluminum industry: The Aluminum Sector Greenhouse Gas Protocol Addendum to the WRI/WBCSD Greenhouse gas protocol. http://www.ghgprotocol.org/templates/GHG5/layout.asp?type=p&MenuId=OTAx.

27. Plunkert, PA. 1998, Primary aluminum plants worldwide – 1998: USGS Mineral Industry Surveys, 159 pp. http://minerals.usgs.gov/minerals/pubs/commodity/aluminum/alplants1.pdf.

28. E. L. Bray, Personal Communication. United States Geological Survey, July 25, 2007.

29. Plunkert, Patricia A. "Aluminum," Mineral Yearbook, U.S. Geological Survey, 2005, http://minerals.usgs.gov/minerals/pubs/commodity/aluminum/alumimyb05.pdf.

30. U.S. Environmental Protection Agency, AP-42, Fifth Edition. http://www.epa.gov/ttn/chief/ap42/.

31. U.S. Environmental Protection Agency, "1999 National Emission Inventory Documentation and Data – Final Version 3.0," 2002, http://www.epa.gov/ttn/chief/net/1999inventory.html.

32. U. S. Environmental Protection Agency, "Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2005." 2007. http://www.epa.gov/climatechange/emissions/downloads06/07CR.pdf.

33. D. S. Kostick, "Soda Ash," USGS Minerals Yearbook 2005, http://minerals.usgs.gov/minerals/pubs/commodity/soda_ash/soda_myb05.pdf.

34. Office of Industrial Technologies, U.S. Department of Energy, "Energy and Environmental Profile of the U. S. Glass Industry," April 2002. http://www1.eere.energy.gov/industry/glass/pdfs/glass2002profile.pdf.

35. U.S. Environmental Protection Agency, Title V Air Permit Records, 2002-2006. http://www.epa.gov/air/oaqps/permits/index.html.

36. Tom Beer et. al., "Study of Life-cycle Emissions Analysis of Alternative Fuels for Heavy Vehicles: Final Report," EV45A/2/F3C, http://www.greenhouse.gov.au/transport/publications/lifecycle.html.

37. U.S. Environmental Protection Agency, "Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2004." 2-27-2006. http://www.epa.gov/EPA-AIR/2006/February/Day-27/a2734.htm.

38. Michael D. Fenton, "Iron and Steel Scrap," Minerals Yearbook, 2002. U.S. Geological Survey, 2003. http://minerals.er.usgs.gov/minerals/pubs/commodity/iron_&_steel_scrap/fescrmyb03.pdf.

39. Houghton, J., Meira Filbo, L., Lim, B., Treanton, K., Mamaty, I., Bonduki, Y., Griggs, D., and Callander, B. Intergovernmental Panel on Climate Change.
IPCC Guidelines for National Greenhouse Gas Inventories. 1996. IPCC/OECD/IEA, Paris, France.

40. International Energy Agency Greenhouse Gas Programme, Global IEA GHG CO_2 Emissions Database, http://www.co2captureandstorage.info/co2emissiondatabase/co2emissions.htm.

41. Miller, MM, Directory of lime plants in the United States in 2006. USGS Mineral Industry Surveys, 14 pp. 8-6-2007. http://minerals.usgs.gov/minerals/pubs/commodity/lime/limedir06.pdf.

42. Hendrik G. van Oss, "Cement," Minerals Yearbook, 2002. U.S. Geological Survey, 2004. http://minerals.usgs.gov/minerals/pubs/commodity/cement/cemenmyb04.pdf.

43. Lisa J. Hanle, Kamala R. Jayaraman, and Joshua S. Smith, "CO_2 Emissions Profile of the U.S. Cement Industry," U. S. Environmental Protection Agency. http://www.epa.gov/ttn/chief/conference/ei13/ghg/hanle.pdf.

44. Personal Communication with Carmeuse Lime's South Chicago Plant, Plains CO_2 Reduction Partnership, 2004.

45. U.S. Environmental Protection Agency, "Aerometric Information Retrieval System," http://www.epa.gov/enviro/html/airs/index.html.

46. U.S. Geological Survey, 2003, Minerals yearbook – Vol. 1 – metals and minerals, 2002: U.S. Department of the Interior.

46b. Worrell, E., and Galitsky, C., 2004, Energy efficiency improvement opportunities for cement making—an energy star guide for energy and plant managers: Environmental Technologies Division, Lawrence Berkley National Laboratory, LBNL-54036, http://www.energystar.gov/ia/business/industry/LBNL-54036.pdf (accessed 2007).

47. World Business Council for Sustainable Development, "The cement CO_2 protocol: CO_2 Accounting and Reporting Standard for the Cement Industry," June 2005, http://www.wbcsd.org/DocRoot/0fWZ2YrMg9EsNR3WCQrh/cement-tf1.pdf.

48. U. S. Environmental Protection Agency, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2005; Section 4. Industrial Processes (April 2007). USEPA #430-R-07-02. http://www.epa.gov/climatechange/emissions/downloads06/07Industrial.pdf.

49. Internal Communications in the CO_2 Capture Working Group. Combustion CO_2 Emission Calculations by the Plains CO_2 Reduction Partnership, October 2004.

50. John Nyboer and Rose Murphy of the Canadian Industry Energy End-use Data and Analysis Centre, Simon Fraser University, "A Review of Energy Consumption in Canadian Oil Refineries 1990, 1994 to 2002," Prepared for Canadian Petroleum Products Institute and Canadian Industry Program for Energy Conservation. January 2004. http://www.cieedac.sfu.ca/CIEEDACweb/pubarticles/Industry%20-%20Energy%20Supply/conventional%20refinery%2003.pdf.

51. Oil and Gas Journal Worldwide Gas Processing Survey (2006). http://www.ogj.com/resourcecenter/survey.cfm.

52. European Fertilizer Manufacturers Association, Environmental Data. http://www.efma.org/Publications/BAT%202000/Bat01/section06.asp.

53. J. Polo, Personal Communication. International Fertilizer Development Center (IDFC).

Appendix A

Data References by Partnership and Industry

Big Sky Regional Carbon Sequestration Partnership (BSCSP)

ELECTRIC GENERATING UNITS:

U.S. Environmental Protection Agency, "The Emissions and Generation Resource Integrated Database (eGRID2007 Version 1.1)," 2008, http://www.epa.gov/cleanenergy/egrid/index.htm.

U.S. Environmental Protection Agency, "1999 National Emission Inventory Documentation and Data – Final Version 3.0," 2002, http://www.epa.gov/ttn/chief/net/1999inventory.html.

ETHANOL PLANTS:

National Carbon Sequestration Database and Geographic Information System (NATCARB), "Ethanol Plants," 2007, http://www.natcarb.org.

Nebraska Energy Office, "Fuel Ethanol Production Capacity by State and by Plant," January 2010, http://www.neo.ne.gov/statshtml/122.htm.

PETROLEUM AND NATURAL GAS PROCESSING FACILITIES:

U.S. Environmental Protection Agency, "The Emissions and Generation Resource Integrated Database (eGRID2007 Version 1.1)," 2008, http://www.epa.gov/cleanenergy/egrid/index.htm.

U.S. Environmental Protection Agency, "1999 National Emission Inventory Documentation and Data – Final Version 3.0," 2002, http://www.epa.gov/ttn/chief/net/1999inventory.html.

U.S. Environmental Protection Agency, "NAAQS 1996 National Emissions Trends database", 1998, http://www.epa.gov/ttn/naaqs/ozone/areas/net.htm.

INDUSTRIAL FACILITIES:

Bray, Lee E., "2008 Minerals Yearbook: Aluminum," U.S. Geological Survey, 2009, http://minerals.usgs.gov/minerals/pubs/commodity/aluminum/myb1-2008-alumi.pdf .

Bray, Lee E., USGS Aluminum Commodities Expert, personal communication, 7/25/2007.

Kostick, DS., "Soda Ash: U.S. Geological Survey Minerals Yearbook 2008," 2010, http://minerals.usgs.gov/minerals/pubs/commodity/soda_ash/myb1-2008-sodaa.pdf .

U.S. Environmental Protection Agency, "The Emissions and Generation Resource Integrated Database (eGRID2007 Version 1.1)," 2008, http://www.epa.gov/cleanenergy/egrid/index.htm.

CEMENT AND LIME PLANTS:

Miller, MM., "Directory of lime plants in the United States in 2008: U.S. Geological Survey Mineral Industry Surveys," 2010, http://minerals.usgs.gov/minerals/pubs/commodity/lime/dir-2009-lime.pdf.

Miller, MM., Lime Specialist, US Geological Survey, personal communication, 07/25/2007.

U.S. Environmental Protection Agency, "1999 National Emission Inventory Documentation and Data – Final Version 3.0," 2002, http://www.epa.gov/ttn/chief/net/1999inventory.html.

Midwest Geologic Sequestration Consortium (MGSC)

ELECTRIC GENERATING UNITS:

U.S. Environmental Protection Agency, "Acid Rain Program Emission Report for Year of 2005," Greenhouse Gas Inventory Sector Analysis, 2006. http://epa.gov/climatechange/emissions/usinventoryreport.html.

U.S. Environmental Protection Agency, "Emissions & Generation Resource Integrated Database" (eGRID) Version 2.1 http://www.epa.gov/cleanenergy/egrid/index.htm.

U.S. Department of Energy, Energy Information Administration, "EIA 767 2004 Data Files: Annual Steam-Electric Plant Operations and Design Data," 2004, http://www.eia.doe.gov/cneaf/electricity/page/eia767.html.

ETHANOL PLANTS:

Nebraska Energy Office, Table titled, "Fuel Ethanol Production Capacity by State and by Plant," Oct 2007. http://www.neo.ne.gov/statshtml/122.htm.

Renewable Fuels Association, Ethanol Industry Outlook 2006. http://www.ethanolrfa.org/objects/pdf/outlook/outlook_2006.pdf.

INDUSTRIAL FACILITIES:

Office of Industrial Technologies, U.S. Department of Energy, "Energy and Environmental Profile of the U.S. Glass Industry," April 2002. http://www1.eere.energy.gov/industry/glass/pdfs/glass2002profile.pdf.

Tom Beer et. al., "Study of Life-cycle Emissions Analysis of Alternative Fuels for Heavy Vehicles: Final Report," EV45A/2/F3C, http://www.greenhouse.gov.au/transport/publications/lifecycle.html.

U.S. Environmental Protection Agency, AP-42, Fifth Edition. http://www.epa.gov/ttn/chief/ap42/.

U.S. Environmental Protection Agency, Title V Air Permit Records, 2002-2006. http://www.epa.gov/air/oaqps/permits/index.html.

U.S. Environmental Protection Agency, "1999 National Emission Inventory Documentation and Data – Final Version 3.0," 2002, http://www.epa.gov/ttn/chief/net/1999inventory.html.

Plunkert, Patricia A. "Aluminum," *Mineral Yearbook*, U.S. Geological Survey, 2005, http://minerals.usgs.gov/minerals/pubs/commodity/aluminum/alumimyb05.pdf.

IRON AND STEEL FACILITIES:

Michael D. Fenton, "Iron and Steel Scrap," *Minerals Yearbook,* 2002. U.S. Geological Survey, 2003. http://minerals.er.usgs.gov/minerals/pubs/commodity/iron_&_steel_scrap/fescrmyb03.pdf.

U.S. Environmental Protection Agency, "1999 National Emission Inventory Documentation and Data – Final Version 3.0," 2002, http://www.epa.gov/ttn/chief/net/1999inventory.html.

CEMENT AND LIME PLANTS:

Hendrik G. van Oss, "Cement," *Minerals Yearbook,* 2002. U.S. Geological Survey, 2004 http://minerals.usgs.gov/minerals/pubs/commodity/cement/cemenmyb04.pdf.

USEPA, Enforcement & Compliance History Online (ECHO). http://www.epa-echo.gov/echo/compliance_report_air.html.

Miller, MM., Directory of lime plants in the United States in 2006. USGS Mineral Industry Surveys, 14 pp. 8-6-2007. http://minerals.usgs.gov/minerals/pubs/commodity/lime/limedir06.pdf.

Personal Communication with Carmeuse Lime's South Chicago Plant, 2004.

REFINERIES/CHEMICAL FACILITIES:

U.S. Environmental Protection Agency, "1999 National Emission Inventory Documentation and Data – Final Version 3.0," 2002, http://www.epa.gov/ttn/chief/net/1999inventory.html.

U.S. DOE – EIA, Refinery Capacity Report Historical 2002, Accessed: 2003. http://www.eia.doe.gov/pub/oil_gas/petroleum/data_publications/refinery_capacity_data/historical/2002/refcap02.xls.

FERTILIZER PRODUCTION:

Deborah A. Kramer, "Nitrogen," *Minerals Yearbook*, 2002. U.S. Geological Survey, 2003. http://minerals.er.usgs.gov/minerals/pubs/commodity/nitrogen/nitromyb02.pdf.

Midwest Regional Carbon Sequestration Partnership (MRCSP)

ELECTRIC GENERATING UNITS:

U.S. Environmental Protection Agency, 2008, "Emissions & Generation Resource Integrated Database" (eGRID2007 Version 1.1) http://www.epa.gov/cleanenergy/egrid/index.htm.

U.S. Environmental Protection Agency, "Clean Air Markets – Data and Maps," 2010. http://camddataandmaps.epa.gov/gdm.

ETHANOL PLANTS:

H. Kheshgi. and R. Prince, "Sequestration of Fermentation CO_2 from Ethanol Production," ExxonMobil Research and Engineering Company. July 2003. Energy (Oxford), 2005 (Vol. 30) (No. 10) 1865-1871.

Personal Communication with Ethanol Facilities in Phase I Regional Partnership Effort, Midwest Regional Carbon Sequestration Partnership, 2004.

Renewable Fuels Association, Ethanol Industry Outlook 2010. http://www.ethanolrfa.org/page/-/rfa-association-site/img/content/outlook-2010.jpg.

PETROLEUM AND NATURAL GAS PROCESSING FACILITIES:

IEA Greenhouse Gas R&D Programme, 2006, "Updating the IEA GHG Global CO_2 Emissions Database: Developments Since 2002," IEA GHG Report 2006/7. International Energy Agency, Cheltenham, United Kingdom.

Oil and Gas Journal Worldwide Gas Processing Survey (2006). http://www.ogj.com/resourcecenter/survey.cfm.

IRON AND STEEL FACILITIES:

IEA Greenhouse Gas R&D Programme, 2006, "Updating the IEA GHG Global CO_2 Emissions Database: Developments Since 2002," IEA GHG Report 2006/7. International Energy Agency, Cheltenham, United Kingdom.

CEMENT AND LIME PLANTS:

IEA Greenhouse Gas R&D Programme, 2006, "Updating the IEA GHG Global CO_2 Emissions Database: Developments Since 2002," IEA GHG Report 2006/7. International Energy Agency, Cheltenham, United Kingdom.

World Business Council for Sustainable Development, "The cement CO_2 protocol: CO_2 Accounting and Reporting Standard for the Cement Industry," June 2005, http://www.wbcsd.org/DocRoot/0fWZ2YrMg9EsNR3WCQrh/cement-tf1.pdf.

REFINERIES/CHEMICAL FACILITIES:

Oil and Gas Journal Worldwide Refinery Survey (2006). http://www.ogj.com/resourcecenter/survey.cfm.

U.S. DOE – Energy Information Administration (June 2003) http://www.eia.doe.gov/oil_gas/petroleum/data_publications/refinery_capacity_data/refcapacity.html.

FERTILIZER PRODUCTION:

IEA Greenhouse Gas R&D Programme, 2006, "Updating the IEA GHG Global CO_2 Emissions Database: Developments Since 2002," IEA GHG Report 2006/7. International Energy Agency, Cheltenham, United Kingdom.

Plains CO_2 Reduction (PCOR) Partnership

ELECTRIC GENERATING UNITS:

Commission for Environmental Cooperation (Database of individual power plants - U.S. Plants), http://www.cec.org/files/PDF/Pollutants/US_2002_metric_en.xls.

Commission for Environmental Cooperation Website (database of individual power plants - Canadian Plants). http://www.cec.org/files/PDF/Pollutants/Canada_2002_metric_en.xls.

Environment Canada. Facility Greenhouse Gas Reporting http://www.ec.gc.ca/pdb/ghg/onlineData/dataSearch_e.cfm.

U.S. Environmental Protection Agency, "Clean Air Markets – Data and Maps," http://camddataandmaps.epa.gov/gdm.

U.S. Environmental Protection Agency, "eGRID2007 Version 1.1" http://www.epa.gov/cleanenergy/energy-resources/egrid/.

U.S. Environmental Protection Agency, Technology Transfer Network Ozone Implementation, Areas (Emissions and Air Quality Data), Emissions Inventory Data. http://www.epa.gov/ttn/naaqs/ozone/areas.

ETHANOL PLANTS:

U.S. Environmental Protection Agency, "Emissions & Generation Resource Integrated Database" (eGRID) Version 2.1 http://www.epa.gov/cleanenergy/egrid/index.htm.

Renewable Fuels Association, Ethanol Industry Outlook. http://www.ethanolrfa.org/pages/annual-industry-outlook.

AGRICULTURAL FACILITIES:

Environment Canada. Facility Greenhouse Gas Reporting http://www.ec.gc.ca/pdb/ghg/onlineData/dataSearch_e.cfm.

U.S. Environmental Protection Agency, "Aerometric Information Retrieval System," http://www.epa.gov/enviro/html/airs/index.html.

U.S. Environmental Protection Agency, "Clean Air Markets – Data and Maps," http://camddataandmaps.epa.gov/gdm.

U.S. Environmental Protection Agency, Technology Transfer Network Ozone Implementation, Areas (Emissions and Air Quality Data), Emissions Inventory Data. http://www.epa.gov/ttn/naaqs/ozone/areas.

NATURAL GAS PROCESSING FACILITIES:

DeBruin, R. et al. 2003. Carbon Dioxide (CO_2) Map of Wyoming; Open File Report 04-1.

Environment Canada. Facility Greenhouse Gas Reporting http://www.ec.gc.ca/pdb/ghg/onlineData/dataSearch_e.cfm.

U.S. Environmental Protection Agency, "Clean Air Markets – Data and Maps," http://camddataandmaps.epa.gov/gdm.

U.S. Environmental Protection Agency, Technology Transfer Network Ozone Implementation, Areas (Emissions and Air Quality Data), Emissions Inventory Data. http://www.epa.gov/ttn/naaqs/ozone/areas.

Oil and Gas Journal Worldwide Gas Processing Survey (2008). http://www.ogj.com/resourcecenter/survey.cfm.

INDUSTRIAL FACILITIES:

U.S. Environmental Protection Agency, AP-42, Fifth Edition. http://www.epa.gov/ttn/chief/ap42/.

Environment Canada. Facility Greenhouse Gas Reporting http://www.ec.gc.ca/pdb/ghg/onlineData/dataSearch_e.cfm.

U.S. Environmental Protection Agency, "Clean Air Markets – Data and Maps," http://camddataandmaps.epa.gov/gdm.

U.S. Environmental Protection Agency, Technology Transfer Network Ozone Implementation, Areas (Emissions and Air Quality Data), Emissions Inventory Data. http://www.epa.gov/ttn/naaqs/ozone/areas.

U.S. Environmental Protection Agency, Technology Transfer Network Ozone Implementation, Areas (Emissions and Air Quality Data), Emissions Inventory Data. http://www.epa.gov/ttn/naaqs/ozone/areas.

CEMENT AND LIME PLANTS:

Environment Canada. Facility Greenhouse Gas Reporting http://www.ec.gc.ca/pdb/ghg/onlineData/dataSearch_e.cfm.

Miller, MM., Directory of lime plants in the United States in 2006. USGS Mineral Industry Surveys, 14 pp. 8-6-2007. http://minerals.usgs.gov/minerals/pubs/commodity/lime/limedir06.pdf.

U.S. Environmental Protection Agency, "Aerometric Information Retrieval System," http://www.epa.gov/enviro/html/airs/index.html.

U.S. Environmental Protection Agency, "Clean Air Markets – Data and Maps," http://camddataandmaps.epa.gov/gdm.

U.S. Environmental Protection Agency, Technology Transfer Network Ozone Implementation, Areas (Emissions and Air Quality Data), Emissions Inventory Data. http://www.epa.gov/ttn/naaqs/ozone/areas.

World Business Council for Sustainable Development, "The cement CO_2 protocol: CO_2 Accounting and Reporting Standard for the Cement Industry," June 2005, http://www.wbcsd.org/DocRoot/0fWZ2YrMg9EsNR3WCQrh/cement-tf1.pdf.

REFINERIES/CHEMICAL FACILITIES:

U.S. Environmental Protection Agency, Technology Transfer Network Ozone Implementation, Areas (Emissions and Air Quality Data), Emissions Inventory Data. http://www.epa.gov/ttn/naaqs/ozone/areas.

U.S. Energy Information Administration Petroleum Supply Annual, Volume 1, Released June 29, 2009, available online at www.eia.doe.gov/oil_gas/petroleum/data_publications/petroleum_supply_annual/psa_volume1/psa_volume1.html.

U.S. Energy Information Administration Petroleum Supply Annual, Volume 2, Released June 29, 2009, available online at www.eia.doe.gov/oil_gas/petroleum/data_publications/petroleum_supply_annual/psa_volume2/psa_volume2.html.

FERTILIZER PRODUCTION:

European Fertilizer Manufacturers Association, 2000, Production of Ammonia, Booklet No. 1 of 8, Section 4 Environmental Data. http://www.efma.org/documents/file/bat/BAT%20Production%20of%20Ammonia.pdf.

Southeast Regional Carbon Sequestration Partnership (SECARB)

ELECTRIC GENERATING UNITS:

U.S. Environmental Protection Agency, "Emissions & Generation Resource Integrated Database" (eGRID) Version 2.1 http://www.epa.gov/cleanenergy/egrid/index.htm.

ETHANOL PLANTS:

National Carbon Sequestration Database and Geographic Information System (NATCARB), "Ethanol Plants" (2006 data). http://www.natcarb.org.

IRON AND STEEL FACILITIES:

International Energy Agency Greenhouse Gas Programme, Global IEA GHG CO_2 Emissions Database, http://www.co2captureandstorage.info/co2emissiondatabase/co2emissions.htm.

NATURAL GAS PROCESSING FACILITIES:

Oil and Gas Journal Worldwide Gas Processing Survey (2006). http://www.ogj.com/resourcecenter/survey.cfm.

USGS Organic Geochemistry Database (well CO_2 levels). http://energy.cr.usgs.gov/prov/og/.

REFINERIES/CHEMICAL FACILITIES:

U.S. DOE – Energy Information Administration (June 2003) http://www.eia.doe.gov/oil_gas/petroleum/data_publications/refinery_capacity_data/refcapacity.html.

Oil and Gas Journal Ethylene Report, International Survey of Ethylene from steam crackers, (April 23, 2001).

http://www.ogj.com/resourcecenter/survey.cfm.

FERTILIZER PRODUCTION:

International Fertilizer Development Report. "North American Fertilizer Capacity" June 2006, http://www.ifdc.org/PDF_Files/Complete.Pub.List2.pdf.

Southwest Regional Partnership on Carbon Sequestration (SWP)

ELECTRIC GENERATING UNITS:

U.S. Environmental Protection Agency, "Emissions & Generation Resource Integrated Database" (eGRID) Version 2.1 http://www.epa.gov/cleanenergy/egrid/index.htm.

CEMENT AND LIME PLANTS:

NATCARB (2007), "General Information on CO_2 Source Data Available Through NATCARB," http://www.natcarb.org/Dbase/index.html.

West Coast Regional Carbon Sequestration Partnership (WESTCARB)

ELECTRIC GENERATING UNITS:

U.S. Environmental Protection Agency, "Emissions & Generation Resource Integrated Database" (eGRID) Version 2.1 http://www.epa.gov/cleanenergy/egrid/index.htm.

U.S. Energy Information Administration data, "Existing Generating Units in the United States by State, Company and Plant, 2005" http://www.eia.doe.gov/cneaf/electricity/page/capacity/existingunits2005.xls.

ETHANOL PLANTS:

Renewable Fuels Association, "Ethanol Biorefinery Locations." http://www.ethanolrfa.org/industry/locations.

CEMENT AND LIME PLANTS:

http://www.epa.gov/climatechange/emissions/downloads06/07Industrial.pdf.

Plant Production (Arizona, Nevada, and Washington). http://minerals.usgs.gov/minerals/pubs/commodity/lime/limedir02.pdf.

Plant Production (California). http://www.arb.ca.gov.

Plant Production (Oregon). PCA data and data provided by Oregon Department of Environmental Quality (DEQ). http://deq12/deq/state/or.us.

REFINERIES/CHEMICAL FACILITIES:

California Air Resource Board Link: http://www.arb.ca.gov/homepage.htm.

Plant Production (Oregon). PCA data and data provided by Oregon Department of Environmental Quality (DEQ). http://deq12/deq/state/or.us/fp20/StartPage.aspx.

U.S. DOE – Energy Information Administration (June 2003) http://www.eia.doe.gov/oil_gas/petroleum/data_publications/refinery_capacity_data/refcapacity.html. http://www.eia.doe.gov/neic/rankings/refineries.htm.

Appendix B

Carbon Fraction of Various Fuels Used for Combustion

Fuel	%C, as received	Basic Fuel Units
Eastern Bituminous Coal[1]	72.7	tons
Subbituminous Coal[1]	50.6	tons
Lignite[1]	36.4	tons
Natural Gas[2]	74.9	million ft^3
Fuel Oil[3]	86.7	1000 gal
Municipal Solid Waste[4]	38.0	tons
Propane[2]	81.7	1000 gal
Biomass (wood and wood wastes)[4]	21.5	tons
Residual Oil[3]	86.9	1000 gal
Coke (derived from coal)[5]	86.0	tons
Gasoline[6]	85.5	1000 gal

Notes:

1. EERC Ultimate Analysis (Eastern Bituminous is a Pittsburgh No. 8 Seam, Powder River Basin subbituminous coal is a Cordero Rojo, and lignite is a Fort Union Lignite).
2. Direct Calculations (Natural Gas is CH_4 and Propane is $CH_3CH_2CH_3$).
3. www.ec.gc.ca/energ/fuels/reports/cnslt_rpts/fqp/tables1_e.htm.
4. www.trmiles.com/alkali/fulesc3.html.
5. www.rexresearch.com/coal/4chap/4chap.htm.
6. http://www.woodgas.com/proximat.htm.