2007 Kansas Greenhouse Gas Inventory
Instructions, FAQ's and Forms

Introduction

As you're likely well aware, global climate change and greenhouse gas emissions (GHG) have been a recent focus for many, including state governments. The Secretary of the Kansas Department of Health and Environment (KDHE) has recently made a commitment to engage various industries to establish goals for reducing carbon dioxide emissions. The KDHE is currently developing a greenhouse gas emissions (GHG) inventory for all sectors in the state. Kansas has also joined The Climate Registry and recently entered into the Midwestern Greenhouse Gas Reduction Accord. With the increased focus on GHG, the KDHE would like to ensure that decisions related to GHG are made and based on sound and accurate data. In order to achieve this goal, KDHE is requesting all permitted air sources emitting over 10,000 tons CO_2 equivalent emissions to submit a GHG inventory for the 2007 calendar year. Your source has been identified as a source potentially meeting these criteria.

Instructions

The inventory you submit should reflect the actual direct emissions of greenhouse gases emitted by process at your facility in the 2007 calendar year. Emissions should be calculated and reported, in tons, as CO_2 equivalents based on a 100 year time horizon.

We are requesting the following greenhouse gases be reported:

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O)
- Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs)
- Sulfur hexafluoride (SF_6)

The following 100 year global warming potential multipliers should be used when calculating CO_2 equivalent emissions:

GHG Name(s)	Formula	CAS Number	Multiplier
Carbon dioxide	CO_2	124-38-9	1
Methane	CH_4	74-82-8	21
Nitrous oxide	N_2O	10024-97-2	310
HFC-23; trifluoromethane	CHF_3	75-46-7	11,700
HFC-32; difluoroethane	CH_2F_2	75-10-5	650
HFC-125; pentafluoroethane	CHF_2-CF_3	354-33-6	2,800
HFC-134a; 1,1,1,2-tetrafluoroethane	CF_3-CH_2F	811-97-2	1,300
HFC-143a; 1,1,1-trifluoroethane	CF_3-CH_3	420-46-2	3,800
HFC-152a; 1,1-difluoroethane	CH_3-CHF_2	75-37-6	140
HFC-227ea; 1,1,1,2,3,3,3-heptafluoropropane	CF_3-CHF-CF_3	431-89-0	2,900
HFC-236fa; 1,1,1,3,3,3-hexafluoropropane	CF_3-CH_2-CF_3	690-39-1	6,300

HFC-4310mee; 1,1,1,2,2,3,4,5,5,5-decafluoropentane	CF_3-CHF-CHF-CF_2-CF_3	138495-42-8	1,300
Tetrafluoromethane; carbon tetrafluoride	CF_4	75-73-0	6,500
Hexafluoroethane, perfluoroethane	C_2F_6	76-16-4	9,200
Decafluorobutane; perfluorobutane	C_4F_{10}	355-25-9	7,000
Tetradecafluorohexane; perfluorohexane	C_6F_{14}	355-42-0	7,400
Sulfur hexafluoride	SF_6	2551-62-4	23,900

Source for global warming potential multipliers: http://www.epa.gov/nonco2/econ-inv/table.html

You should only consider direct emissions from the permitted facility. Emissions from any indirect sources such as vehicle transportation, offsite waste disposal, or electricity consumption should not be included as part of the inventory.

KDHE will not be collecting fees on GHG's. The Department is also not mandating the use of specific emissions factors; however, we request the factors and estimation methods used be appropriate for the individual process being reported. Again this is a request for information and not a regulatory requirement.

Emissions Estimation Methods

Emissions should be based on the best possible method and may vary between source categories. A general hierarchy of estimation methods is listed below in order of decreasing accuracy. Regardless of the method used to calculate emissions, supporting documentation that would allow KDHE to recreate your emissions calculations would be beneficial..

1. **Continuous emissions monitoring** — Continuous emissions monitoring (CEM) systems directly measure pollutant concentrations in the exhaust stack 24 hours a day. This is the most accurate method for determining emissions. Most likely used for: CO_2 emissions from utilities, ethanol plants, portland cement plants, large combustion units, or other units with CEMs.

2. **Stack test** — A stack test measures the concentration of pollutants in the exhaust stack during the test period. Test periods can vary from a couple of hours to an entire day. Stack test data can provide an accurate emission rate for many different processes and pollutants. Most likely used for: CO_2 emissions from combustion sources that have already been tested for particulate matter and other process-related CO_2 emissions from specific source categories.

3. **Material balance** — Material balance can only be used on specific types of emission units. Information must first be gathered on process rates, material used and material properties (usually from a material safety data sheet, or MSDS). By combining this information with the knowledge of the process, emission estimation can be made. Most likely used for: SF_6, HFC, and PFC emissions.

4. **Emission factors** — Emission factors are the basis for many calculations. Emission factors represent industry averages and show the relationship between emissions and a measure of production. Emission factors for select industries and processes, as well as reference sources for additional information, are provided in Appendix A. When using

an emission factor, you should use the most current version. Most likely used for: CO_2, CH_4, and N_2O emissions.

5. **Vendor-supplied factors** — Vendor-supplied factors may be used if a more preferred method is not available.

6. **Engineering estimation** — Engineering estimation is recommended if a more preferred method is not available. The KDHE realizes that some processes have no published guidance regarding the estimation of emissions.

We request all emissions be reported as CO_2 equivalent emissions. CO_2 equivalent emissions are calculated by multiplying the greenhouse gas pollutant times the 100 year global warming potential multiplier.

CO_2, N_2O, and CH_4 are all emitted from the combustion of fuels from stationary sources. CO_2 is formed from the oxidation of the fuel carbon, CH_4 is a product of incomplete combustion, and N_2O is formed by oxygen-nitrogen reactions. If no CEM or stack test data is available, emissions of these pollutants can be calculated by multiplying the amount of fossil fuel combusted by the applicable emission factor. The KDHE has provided appropriate emissions factors for stationary combustion sources in Appendix A.

Greenhouse gases are also emitted from non-combustion processes, such as from fermentation to produce ethanol, decomposition in landfills, etc. Appendix B contains factors and calculation methodologies associated with non-combustion processes.

Appendix C contains examples of calculating emissions for several sources.

The Department has established a *de minimus* reporting threshold of 10,000 tons CO_2 equivalent facility wide for this request. If your facility emits less than 10,000 tons CO_2 equivalent in calendar year 2007, we are not requesting these emissions. You may return the inventory form and indicate your calculated emissions were below the *de minimus* reporting threshold. If you're a source that has over 10,000 tons CO_2 equivalent we are requesting you report these emissions. If your emissions are over the recommended 10,000 ton *de minimus* and you did not receive inventory forms from us you may contact Will Stone and request the inventory packet. You may also download the inventory packet at http://www.kdheks.gov/bar.

Further information on emissions calculations can be found from the following websites:

- Emissions inventory improvement program (EIIP)
  http://www.epa.gov/ttn/chief/eiip/techreport

- WebFIRE — [Emission] factor information retrieval (FIRE) data system
  http://cfpub.epa.gov/oarweb/index.cfm?action=fire.main

- The climate registry general reporting protocol
  http://www.theclimateregistry.org/crdocuments.html

- KDHE emission inventory frequently asked questions
  http://www.kdheks.gov/emission/EmInfaq.html

Frequently asked questions:

1. ***Who is being surveyed?***

   Facilities with direct greenhouse gas emissions of 10,000 tons or more of carbon dioxide equivalent on a 100 year basis.

2. ***What gases are covered in this inventory?***

   Carbon dioxide (CO_2), Methane (CH_4), Nitrous oxide **(**N_2O), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs), Sulfur hexafluoride (SF_6).

3. ***Are there fees involved in the greenhouse gas inventory?***

   No

4. ***What are indirect emissions?***

   "Indirect Emissions" is a term used to describe emissions that result from an activity that do not directly cause emissions such as electricity use. Companies, cities or organizations often estimate their indirect emissions with their direct emissions of greenhouse gases to determine their total impact or "carbon footprint". The KDHE is only surveying direct emissions from our stationary sources.

5. ***What about other sources of Greenhouse Gases?***

   The KDHE is developing estimates for greenhouse gas emissions from all sources throughout the state including vehicle tailpipe emissions, home heating, animal waste, waste water treatment, electricity distribution, etc. This is a separate process from this emissions inventory survey.

6. ***Will these emissions be made public or reported to EPA?***

   The emissions will be public information, available on request. The Department does not intend on reporting these emissions to the EPA at this time. However, the December 18, 2007 Omnibus Federal Appropriations Bill requires that the EPA develop a rule requiring mandatory reporting of GHG emissions. When this rule takes affect the Department will likely be required to report GHG emissions to the EPA.

7. ***Will you require that I reduce my GHG emissions if I'm over 10,000 tons of actual emissions?***

   KDHE is encouraging voluntary reductions of greenhouse gas pollutants. There are no requirements associated with this request.

8. ***How does this inventory request differ from the GHG data being reported to The Climate Registry, and why can't KDHE just use the information from the registry if I join?***

There are three main reasons that we are requesting information separately from The Climate Registry:

A. The Climate Registry is asking for indirect emissions in addition to direct emissions. We are only concerned with direct emissions in our request.
B. The Climate Registry's aggregates data by corporate entities not by geography so companies with sources all over North America report their emissions to the Climate registry not by source ID or state.
C. The Climate Registry is not accepting data until this summer at the earliest and probably won't have any published until the end of 2008, whereas KDHE has determined that our stakeholders need data as soon as is reasonably possible.

9. I did not receive a GHG inventory packet but my GHG emissions are over the de minimus threshold of 10,000 tons for this request, am I required to report my GHG emissions?

This is a request, thus you are not required to report your emissions to KDHE. Should you choose to report, as we encourage you to do, you may call Will Stone at 785.296.6427 and request an inventory packet, or download it from http://www.kdheks.gov/bar.

10. How did the Department arrive at a 10,000 ton de minimus threshold for this request?

The Department's initial estimations of GHG emissions indicate that the majority of the GHG's from permitted sources come from a relative small number of emitters. The Department is attempting to capture an accurate estimate of emissions for the majority of emitters without unduly burdening small emitting sources with reporting. It is possible that the *de minimus* reporting threshold will change to accommodate an EPA mandatory reporting requirement when and if mandatory reporting takes affect.

11. Can I use the web-based emission inventory system to report GHG's?

The web system is not available for reporting GHG's.

12. What authority does KDHE have to require reporting of GHG emissions?

This is a request for information and is not a reporting requirement. Should the EPA implement a mandatory reporting requirement, KSA 65-3005(d) "Require access to records relating to emissions which cause or contribute to air pollution" would be the authority used for the reporting requirement.

Appendix A: Fossil Fuel Greenhouse Gas Emission Factors from AP-42

Fuel	Configuration	CO_2 EF	Units		CH_4 EF	Units		N_2O EF	Units	Source
Solid fuels										
Coal (high volatile bituminous)	PC-fired, dry bottom, tangentially fired	5,510	lb/ton		0.04	lb/ton		0.08	lb/ton	Tables 1.1-19, 1.1-20
Coal (subbituminous)	PC-fired, dry bottom, wall fired	4,810	lb/ton		0.04	lb/ton		0.03	lb/ton	Tables 1.1-19, 1.1-20
Coal (subbituminous)	PC-fired, dry bottom, tangentially fired	4,810	lb/ton		0.04	lb/ton		0.08	lb/ton	Tables 1.1-19, 1.1-20
Coal (subbituminous)	PC-fired, wet bottom	4,810	lb/ton		0.05	lb/ton		0.08	lb/ton	Tables 1.1-19, 1.1-20
Coal (subbituminous)	Cyclone furnaces	4,810	lb/ton		0.01	lb/ton		0.09	lb/ton	Tables 1.1-19, 1.1-20

Fuel	Configuration	CO_2 EF	Units	CH_4 EF	Units	N_2O EF	Units	Source
Liquid fuels								
Liquefied Petroleum Gas (LPG)	All boilers and furnaces	14,300	lb/Mgal	0.2	lb/Mgal	0.9	lb/Mgal	Table 1.5-1
Gasoline	Industrial engines	154	lb/MMBtu					Table 3.3-1
Gasoline	Industrial engines	1.08	lb/hp-hr					Table 3.3-1
No. 1 fuel oil (kerosene)	Utility boilers (all firing types)	21.5	lb/gal					Table 1.3-12
No. 2 fuel oil (diesel)	Utility boilers (all firing types)	22.3	lb/gal			0.00011	lb/gal	Tables 1.3-3, 1.3-8, 1.3-12
No. 2 fuel oil (diesel)	Industrial boilers	22.3	lb/gal	0.000052	lb/gal	0.00011	lb/gal	Tables 1.3-3, 1.3-8, 1.3-12
No. 2 fuel oil (diesel)	Commercial/Instit./Resid. boilers	22.3	lb/gal	0.000216	lb/gal	0.00011	lb/gal	Tables 1.3-3, 1.3-8, 1.3-12
No. 2 fuel oil (diesel)	Combustion turbines	157	lb/MMBtu					Table 3.1-2a
No. 2 fuel oil (diesel)	Industrial engines ≤ 600 hp	154	lb/MMBtu					Table 3.3-1
No. 2 fuel oil (diesel)	Industrial engines ≤ 600 hp	1.08	lb/hp-hr					Table 3.3-1
No. 2 fuel oil (diesel)	All engines > 600 hp	165.00	lb/MMBtu	0.0081	lb/MMBtu			Table 3.4-1
No. 2 fuel oil (diesel)	All engines > 600 hp	1.16	lb/hp-hr	0.000000514	lb/hp-hr			Table 3.4-1
No. 6 (residual) oil	Utility boilers (all firing types)	24.4	lb/gal	0.00028	lb/gal	0.00011	lb/gal	Tables 1.3-3, 1.3-8, 1.3-12
No. 6 (residual) oil	Industrial boilers	24.4	lb/gal	0.001	lb/gal	0.00011	lb/gal	Tables 1.3-3, 1.3-8, 1.3-12
No. 6 (residual) oil	Commercial/Instit./Resid. boilers	24.4	lb/gal	0.000475	lb/gal	0.00011	lb/gal	Tables 1.3-3, 1.3-8, 1.3-12
Waste oil	Small boilers and all burner types	22	lb/gal					Table 1.11-3

Fuel	Configuration	CO_2 EF	Units	CH_4 EF	Units	N_2O EF	Units	Source
Gaseous fuels								
Natural gas	All 2-stroke RICE	110	lb/MMBtu	1.45	lb/MMBtu			Table 3.2-1
Natural gas	4SLB RICE	110	lb/MMBtu	1.25	lb/MMBtu			Table 3.2-1
Natural gas	4SRB RICE	110	lb/MMBtu	0.23	lb/MMBtu			Table 3.2-1
Natural gas	Combustion turbine	110	lb/MMBtu	0.0086	lb/MMBtu	0.003	lb/MMBtu	Table 3.1-2a
Natural gas	All boilers and furnaces	120,000	lb/MMcf	2.3	lb/MMcf	2.2	lb/MMcf	Table 1.4-2
Natural gas	Hot mix asphalt plants	37	lb/ton product					Table 11.1-5
Natural gas	Brick dryer	71	lb/ton product	0.02	lb/ton product			Tables 11.3-3, 11.3-5
Natural gas	Brick kilns	400	lb/ton product	0.037	lb/ton product			Tables 11.3-3, 11.3-5
Mixed/other fuels								
Dual fuel (95% NG, 5% FO)	All engines	110	lb/MMBtu	0.6	lb/MMBtu			Table 3.4-1
Dual fuel (95% NG, 5% FO)	All engines	1	lb/hp-hr	0.00397	lb/hp-hr			Table 3.4-1
Process gas	Carbon black process vent gas			50	lb/ton			Table 6.1-2

Appendix B: GHG emission factors for non-combustion processes

Source Category/Fuel Type	GHG Emission Factors				CO_2e	Unit (annual basis)	Factor
	CO_2	CH_4	N_2O	SF_6	EF[1]		Source[2]
Non-Fuel Combustion Industrial Processes							
Ammonia manufacture	1.2				**1.20**	**tons/ton NH_3 produced**	1
Carbon black production (furnace process)	2.62	22.0			**464.6**	**lbs/ton carbon black produced**	2
Ceramics production (incl. brick mfg.)	0.149				**0.15**	**tons/ton bricks produced**	3
Electric transmission facilities (fugitive SF_6)				n/a		**[*Use mass balance*]**	4
Ethanol production (fermentation)	6.1					**lbs/gallon ethanol produced**	5
Glass production (incl. fiberglass mfg.)	0.20				**0.20**	**tons/ton glass produced**	2
Limestone use (flux, FGD use)	0.12				**0.12**	**tons CO_2/ton $CaCO_3$ used**	1
Nitric acid production			0.0080		**2.5**	**tons/ton HNO_3 produced**	1
Portland cement production	0.507				**0.51**	**tons/ton clinker produced**	1
Soda ash production	---					**[*No specific EF - need to test*]**	2
Steel production (electric arc)	9.68				**9.68**	**lbs/ton steel produced**	1

[1] Global warming potential multipliers for calculating CO_2 equivalent (CO_2e) are the following:

CO_2 = 1

Methane (CH_4) = 21

Nitrous oxide (N_2O) = 310

[2] Sources:

1 U.S. EPA, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2005*

2 IPCC (2006) *Revised 2006 IPCC Guidelines, Vol. 3 - The Refernce Manual*

3 EC Ref. Document (2007) *Reference Document on Best Available Techniques in the Ceramic Manufacturing Industry* , European Commission, August 2007

4 CARB (*see* http://www.arb.ca.gov/cc/ccei/presentations/PowerRegConcepts_June07_V2.pdf)

5 KDHE

Appendix C: Greenhouse Gas Example Forms

Source ID Number: _____

Air Emissions Source Operating Information*

Enter a unique unit identification (ID) number, which will be used to identify these specific emissions throughout the emissions calculation

Unit ID Number	Unit Description: Include model or serial number, horsepower, etc. as applicable. Please list EACH operating unit individually.
11	300 MW pulverized coal-fired Boiler, dry-botton, tangentially fired

Annual Operating Rate. Enter the applicable 8-digit Source Classification Code(s) (SCC) for this process or operation. In some cases, a Process ID number will be necessary as an additional identifier. Enter the annual operating rate and the units of measurement of the annual operating rate.

Process #	SCC	Annual Operating Rate	Process Description	Units of Measurement of Annual Operating Rate
1	10100212	1,500,000	coal combustion	tons of subbituminous coal combusted
2	10100604	100	natural gas combustion	million cubic feet of natural gas combusted
3	10100501	100	distillate combustion	1000 gallons of distillate oil combusted

*** This form is not necessary for units reported in the CAP or HAP emission inventory.**

Emission Factor Method Calculation Form

This worksheet is for Greenhouse Gas emissions using emission factors. If you are not using emission factors to calculate emissions, skip this

Enter the unit ID and process ID.

Unit #	11	Process ID #	1

For all pollutants that apply in column A, enter the source of the emission factor in column B and the emission factor in column C. Each emission factor should be in units of pounds per unit of measurement. Transfer the operating rate from worksheet 1 to column D. Multiply column C by column D to obtain uncontrolled emissions in units of pounds for each applicable pollutant; enter the emissions in column E. Divide emissions in pounds by 2,000 to obtain emissions in tons, and enter the result in column F. Multiply the carbon dioxide equivalent multiplier by the emissions in column F and enter the result in column H.

Column A	Column B	Column C	Column D	Column E E = C x D	Column F F = E/2,000	Column G	Column H H = F x G
Criteria Pollutant	**Emission Factor Origin (If use AP-42 list table number)**	**Emission Factor (lbs per unit of measurement)**	**Operating Rate (in units of measurement)**	**Emissions (lbs)**	**Emissions (tons)**	**Carbon Dioxide Equivalent Multiplier**	**Estimated Emissions (tons)**
CO_2	CEMS				2,900,000	1	2,900,000
CH_4	AP-42	0.04	1,500,000	60,000	30	21	630
N_2O	AP-42	0.08	1,500,000	120,000	60	310	18,600
HFC_S			1,500,000	0	0		0
PFC_S			1,500,000	0	0		0
SF_6			1,500,000	0	0	23,900	0

Material Balance Method Calculation Form

Enter the point ID, SCC ID and stack ID numbers from worksheet 1.

Unit #	1	Process ID Number	1

Enter the total quantity of pollutant that enters the process or operation (Q_added) in column B. Enter the total quantity of pollutant that becomes an integral part of the product (Q_consumed) in column C. In column D, enter the total quantity of the pollutant recovered for reuse (Q_recovered). Subtract Q_consumed and Q_recovered from Q_added to obtain the emissions in pounds, and enter the result in column E. Divide the emissions in pounds by 2,000 to obtain the emissions in tons, and enter in column F. Multiply the carbon dioxide equivalent multiplier by the emissions in column F and enter the result in column H.

Column A	Column B	Column C	Column D	Column E E = B - C - D	Column F F = E/2,000	Column G	Column H H = F x G
Criteria Pollutant	**Q_added (lbs)**	**Q_consumed (lbs)**	**Q_recovered (lbs)**	**Emissions (lbs)**	**Emissions (tons)**	**Carbon Dioxide Equivalent Multiplier**	**Estimated Emissions (tons)**
CO_2						1	
CH_4						21	
N_2O						310	
HFC_S							
HFCS							
SF_6	4000		1000	3,000.00	1.50	23,900	35,850.00

Emission Factor Method Calculation Form

This worksheet is for Greenhouse Gas emissions using emission factors. If you are not using emission factors to calculate emissions, skip this

Enter the unit ID and process ID.

Unit #	11	Process ID #	1

For all pollutants that apply in column A, enter the source of the emission factor in column B and the emission factor in column C. Each emission factor should be in units of pounds per unit of measurement. Transfer the operating rate from worksheet 1 to column D. Multiply column C by column D to obtain uncontrolled emissions in units of pounds for each applicable pollutant; enter the emissions in column E. Divide emissions in pounds by 2,000 to obtain emissions in tons, and enter the result in column F. Multiply the carbon dioxide equivalent multiplier by the emissions in column F and enter the result in column H.

Column A	Column B	Column C	Column D	Column E E = C x D	Column F F = E/2,000	Column G	Column H H = F x G
Criteria Pollutant	**Emission Factor Origin (If use AP-42 list table number)**	**Emission Factor (lbs per unit of measurement)**	**Operating Rate (in units of measurement)**	**Emissions (lbs)**	**Emissions (tons)**	**Carbon Dioxide Equivalent Multiplier**	**Estimated Emissions (tons)**
CO_2	KDHE Factor	6.1	118,000,000	719,800,000	359,900	1	359,900
CH_4				0	0	21	0
N_2O				0	0	310	0
HFC_S				0	0		0
PFC_S				0	0		0
SF_6				0	0	23,900	0