North Carolina Department of Environment and Natural Resources

Division of Air Quality

Integration of GHGs into NC DAQ's Air Emissions Reporting Online (AERO) as a tool for State Planning

2012 Annual International Emission Inventory Conference

August 13-16, 2012

Background

- June 2002, NCGA enacted SB1078 known as 'Clean Smokestacks Act' requiring certain coal-fired facilities to reduce NO_x and SO_2.
- NC DAQ incorporated GHGs in its web-based emission inventory reporting system, AERO and requested that facilities voluntarily report GHGs for CY2007.
- In 2008, NC DAQ initiated a rule revision to modify its emission inventory rule to require reporting of GHGs from TV facilities.
- October 2009, EPA promulgated the Mandatory Reporting Rule for GHGs.
- As a result, NC Environmental Management Commission took no further action on the emission inventory rule revision.

Voluntarily Reporting GHGs to NC DAQ

- NC DAQ had developed an integrated, web-based application called Integrated Build Environment for Application Management (IBEAM) to track emissions inventory data, permits, compliance status and other necessary air program records.
- IBEAM module, Air Emissions Reporting Online (AERO), is an external module used by permitted facilities to submit emission inventory data.
- IBEAM module, Emissions Data (ED), is an internal module used by NC DAQ staff for review and quality assurance, among other functions, of emission inventory data.

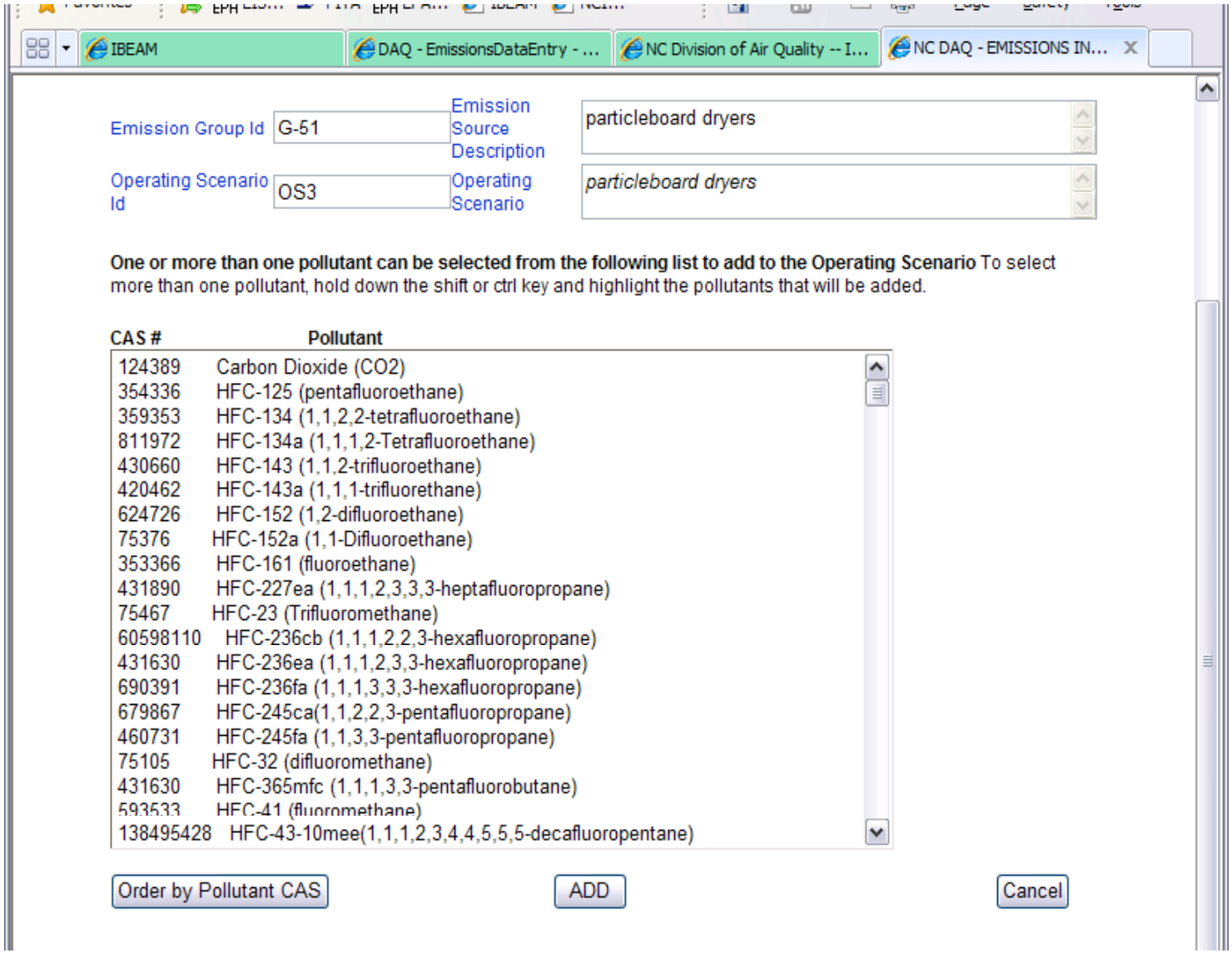
Voluntarily Reporting GHGs to NC DAQ (cont.)

- Emission Inventory User Group (EIUG) and IT established business rules to:
  1. Identify which GHGs to collect
  2. Include GHGs at the top of the pollutant list when adding pollutants to the emissions reported
  3. Show how GHG emissions would be totaled and reported
  4. Identify where GHG emissions would be displayed and on system pages and reports
- EIUG and Planning Section decided which GHGs to include in the IBEAM system. This list has not been changed since the MRR was promulgated.
- EIUG elected to request that GHG emissions be reported in short tons, consistent with reporting of criteria air pollutants.

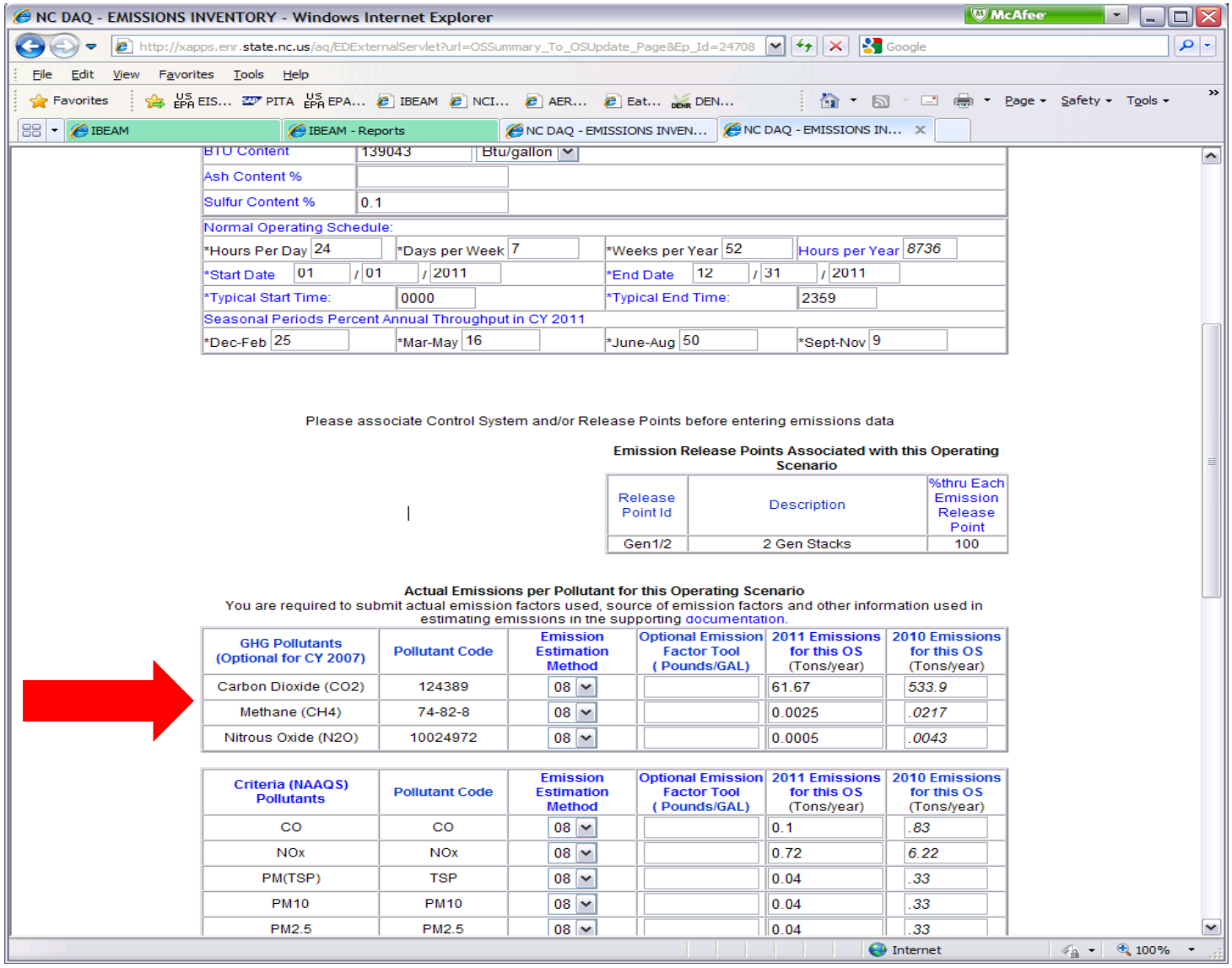
List of GHGs added to NC DAQ IBEAM system

Pollutant Code (CAS)	Pollutant
124389	Carbon Dioxide (CO_2)
74828	Methane (CH_4)
10024972	Nitrous Oxide (N_2O)
2551624	Sulfur Hexafluoride (SF_6)
354336	HFC-125 (pentafluoroethane)
359353	HFC-134 (1,1,2,2-tetrafluoroethane)
811972	HFC-134a (1,1,1,2-Tetrafluoroethane)
430660	HFC-143 (1,1,2-trifluoroethane)
420462	HFC-143a (1,1,1-trifluorethane)
624726	HFC-152 (1,2-difluoroethane)
75376	HFC-152a (1,1-Difluoroethane)
353366	HFC-161 (fluoroethane)
431890	HFC-227ea (1,1,1,2,3,3,3-heptafluoropropane)
75467	HFC-23 (Trifluoromethane)
60598110	HFC-236cb (1,1,1,2,2,3-hexafluoropropane)
431630	HFC-236ea (1,1,1,2,3,3-hexafluoropropane)
690391	HFC-236fa (1,1,1,3,3,3-hexafluoropropane)
679867	HFC-245ca(1,1,2,2,3-pentafluoropropane)
460731	HFC-245fa (1,1,3,3-pentafluoropropane)
75105	HFC-32 (difluoromethane)
408586	HFC-365mfc (1,1,1,3,3-pentafluorobutane)
593533	HFC-41 (fluoromethane)
138495428	HFC-43-10mee(1,1,1,2,3,4,4,5,5,5-decafluoropentane)
355259	Perfluorobutane (decafluorobutane)
115253	Perfluorocyclobutane (octafluorocyclobutane)
76164	Perfluoroethane (hexafluoroethane)
355420	Perfluorohexane (tetradecafluorohexane)
75730	Perfluoromethane (tetrafluoromethane)
678262	Perfluoropentane (dodecafluoropentane)
76197	Perfluoropropane (octafluoropropane)

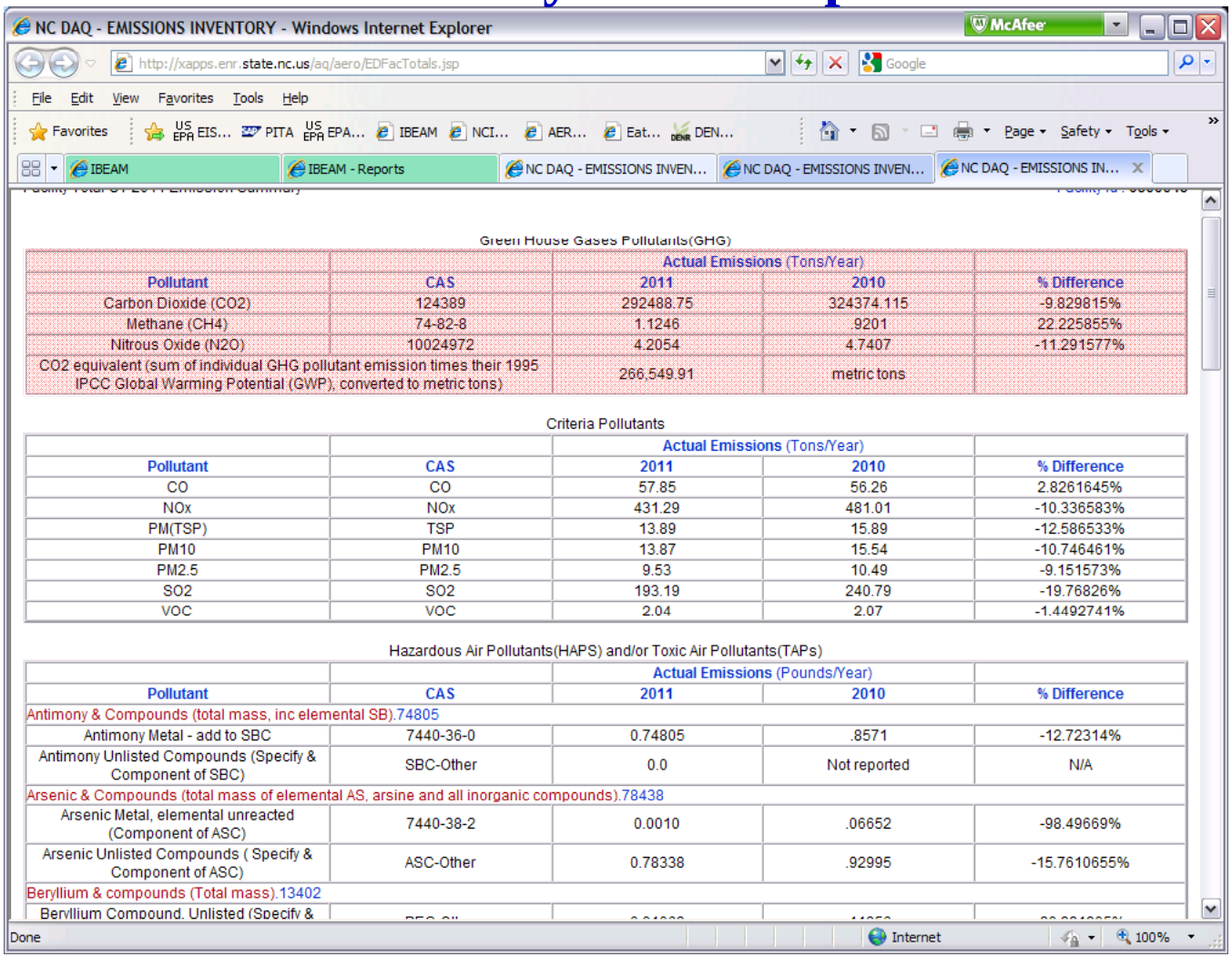
Screenshot of AERO Pollutant list for addition



Once the GHG(s) are selected for reporting, they are listed at the top of the list in the main AERO emissions screen.



GHG emissions are requested to be reported in short tons. Total GHG emissions in metric tons CO_2e is calculated and reported in the Facility Totals Report.



NC DAQ - EMISSIONS INVENTORY - Windows Internet Explorer

http://xapps.enr.state.nc.us/aq/aero/EDFacTotals.jsp

Green House Gases Pollutants(GHG)

		Actual Emissions (Tons/Year)		
Pollutant	CAS	2011	2010	% Difference
Carbon Dioxide (CO2)	124389	292488.75	324374.115	-9.829815%
Methane (CH4)	74-82-8	1.1246	.9201	22.225855%
Nitrous Oxide (N2O)	10024972	4.2054	4.7407	-11.291577%
CO2 equivalent (sum of individual GHG pollutant emission times their 1995 IPCC Global Warming Potential (GWP), converted to metric tons)		266,549.91	metric tons	

Criteria Pollutants

		Actual Emissions (Tons/Year)		
Pollutant	CAS	2011	2010	% Difference
CO	CO	57.85	56.26	2.8261645%
NOx	NOx	431.29	481.01	-10.336583%
PM(TSP)	TSP	13.89	15.89	-12.586533%
PM10	PM10	13.87	15.54	-10.746461%
PM2.5	PM2.5	9.53	10.49	-9.151573%
SO2	SO2	193.19	240.79	-19.76826%
VOC	VOC	2.04	2.07	-1.4492741%

Hazardous Air Pollutants(HAPS) and/or Toxic Air Pollutants(TAPs)

		Actual Emissions (Pounds/Year)		
Pollutant	CAS	2011	2010	% Difference
Antimony & Compounds (total mass, inc elemental SB).74805				
Antimony Metal - add to SBC	7440-36-0	0.74805	.8571	-12.72314%
Antimony Unlisted Compounds (Specify & Component of SBC)	SBC-Other	0.0	Not reported	N/A
Arsenic & Compounds (total mass of elemental AS, arsine and all inorganic compounds).78438				
Arsenic Metal, elemental unreacted (Component of ASC)	7440-38-2	0.0010	.06652	-98.49669%
Arsenic Unlisted Compounds (Specify & Component of ASC)	ASC-Other	0.78338	.92995	-15.7610655%
Beryllium & compounds (Total mass).13402				
Beryllium Compound, Unlisted (Specify &				

Other Technical Assistance Provided

- NC DAQ developed and provided online written GHG reporting guidelines for various industry types and source categories.
- NC DAQ modified existing emission calculation spreadsheets, incorporating the MRR calculation strategies, that are routinely used by facilities to calculate emissions to include GHGs in the output.
- NC DAQ organized and executed technical workshops at industry trade association conferences and in-house training sessions to assist facilities with voluntarily reporting GHG emissions.

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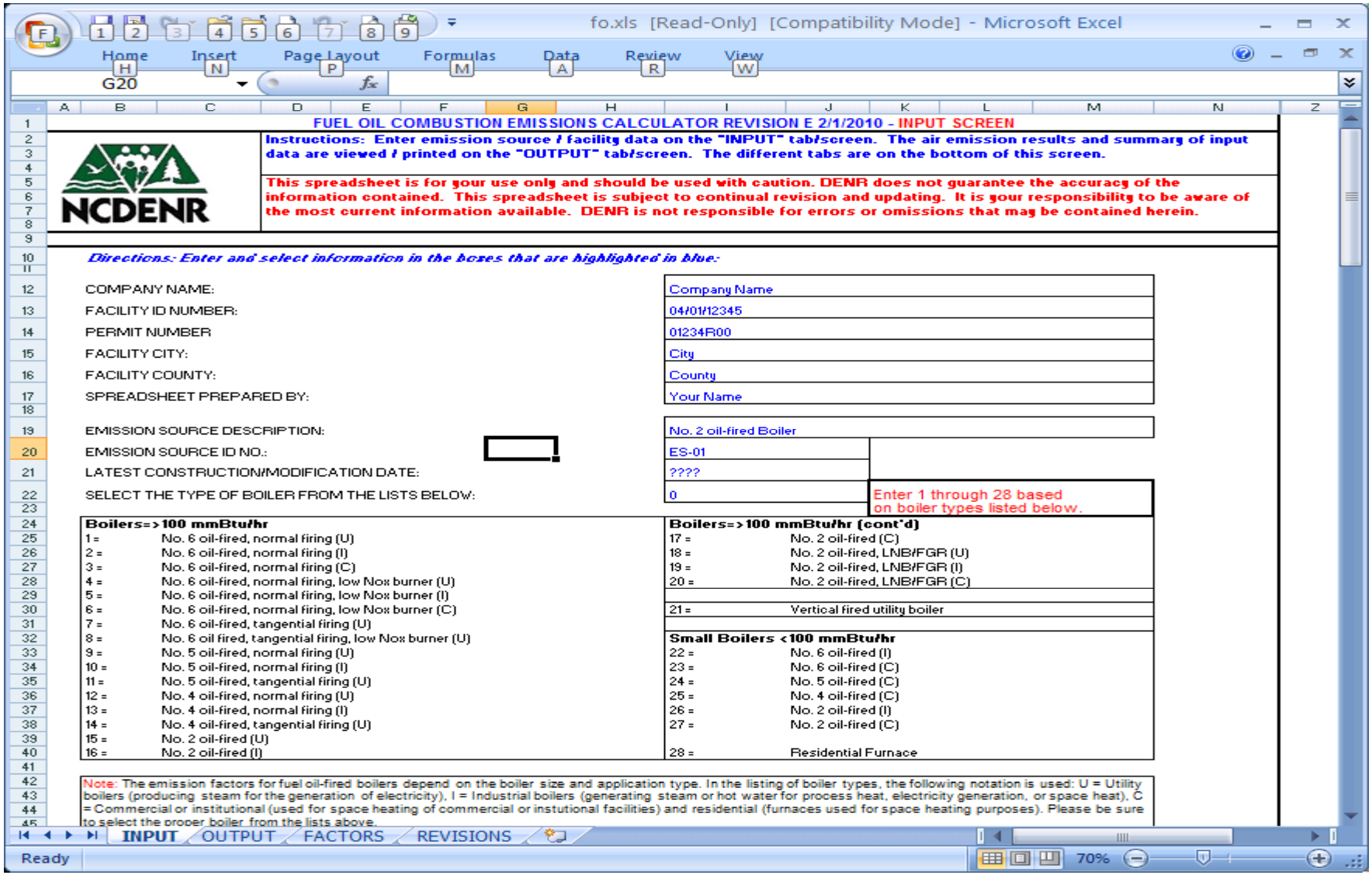
Emission Calculation Spreadsheet - Input



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G20

FUEL OIL COMBUSTION EMISSIONS CALCULATOR REVISION E 2/1/2010 - INPUT SCREEN

NCDENR

Instructions: Enter emission source / facility data on the "INPUT" tab/screen. The air emission results and summary of input data are viewed / printed on the "OUTPUT" tab/screen. The different tabs are on the bottom of this screen.

This spreadsheet is for your use only and should be used with caution. DENR does not guarantee the accuracy of the information contained. This spreadsheet is subject to continual revision and updating. It is your responsibility to be aware of the most current information available. DENR is not responsible for errors or omissions that may be contained herein.

Directions: Enter and select information in the boxes that are highlighted in blue.

COMPANY NAME:	Company Name
FACILITY ID NUMBER:	04/01/12345
PERMIT NUMBER	01234R00
FACILITY CITY:	City
FACILITY COUNTY:	County
SPREADSHEET PREPARED BY:	Your Name
EMISSION SOURCE DESCRIPTION:	No. 2 oil-fired Boiler
EMISSION SOURCE ID NO.:	ES-01
LATEST CONSTRUCTION/MODIFICATION DATE:	????
SELECT THE TYPE OF BOILER FROM THE LISTS BELOW:	0

Enter 1 through 28 based on boiler types listed below.

Boilers=>100 mmBtu/hr	
1 =	No. 6 oil-fired, normal firing (U)
2 =	No. 6 oil-fired, normal firing (I)
3 =	No. 6 oil-fired, normal firing (C)
4 =	No. 6 oil-fired, normal firing, low Nox burner (U)
5 =	No. 6 oil-fired, normal firing, low Nox burner (I)
6 =	No. 6 oil-fired, normal firing, low Nox burner (C)
7 =	No. 6 oil-fired, tangential firing (U)
8 =	No. 6 oil fired, tangential firing, low Nox burner (U)
9 =	No. 5 oil-fired, normal firing (U)
10 =	No. 5 oil-fired, normal firing (I)
11 =	No. 5 oil-fired, tangential firing (U)
12 =	No. 4 oil-fired, normal firing (U)
13 =	No. 4 oil-fired, normal firing (I)
14 =	No. 4 oil-fired, tangential firing (U)
15 =	No. 2 oil-fired (U)
16 =	No. 2 oil-fired (I)

Boilers=>100 mmBtu/hr (cont'd)	
17 =	No. 2 oil-fired (C)
18 =	No. 2 oil-fired, LNB/FGR (U)
19 =	No. 2 oil-fired, LNB/FGR (I)
20 =	No. 2 oil-fired, LNB/FGR (C)
21 =	Vertical fired utility boiler
Small Boilers <100 mmBtu/hr	
22 =	No. 6 oil-fired (I)
23 =	No. 6 oil-fired (C)
24 =	No. 5 oil-fired (C)
25 =	No. 4 oil-fired (C)
26 =	No. 2 oil-fired (I)
27 =	No. 2 oil-fired (C)
28 =	Residential Furnace

Note: The emission factors for fuel oil-fired boilers depend on the boiler size and application type. In the listing of boiler types, the following notation is used: U = Utility boilers (producing steam for the generation of electricity), I = Industrial boilers (generating steam or hot water for process heat, electricity generation, or space heat), C = Commercial or institutional (used for space heating of commercial or institutional facilities) and residential (furnaces used for space heating purposes). Please be sure to select the proper boiler from the lists above.

INPUT OUTPUT FACTORS REVISIONS

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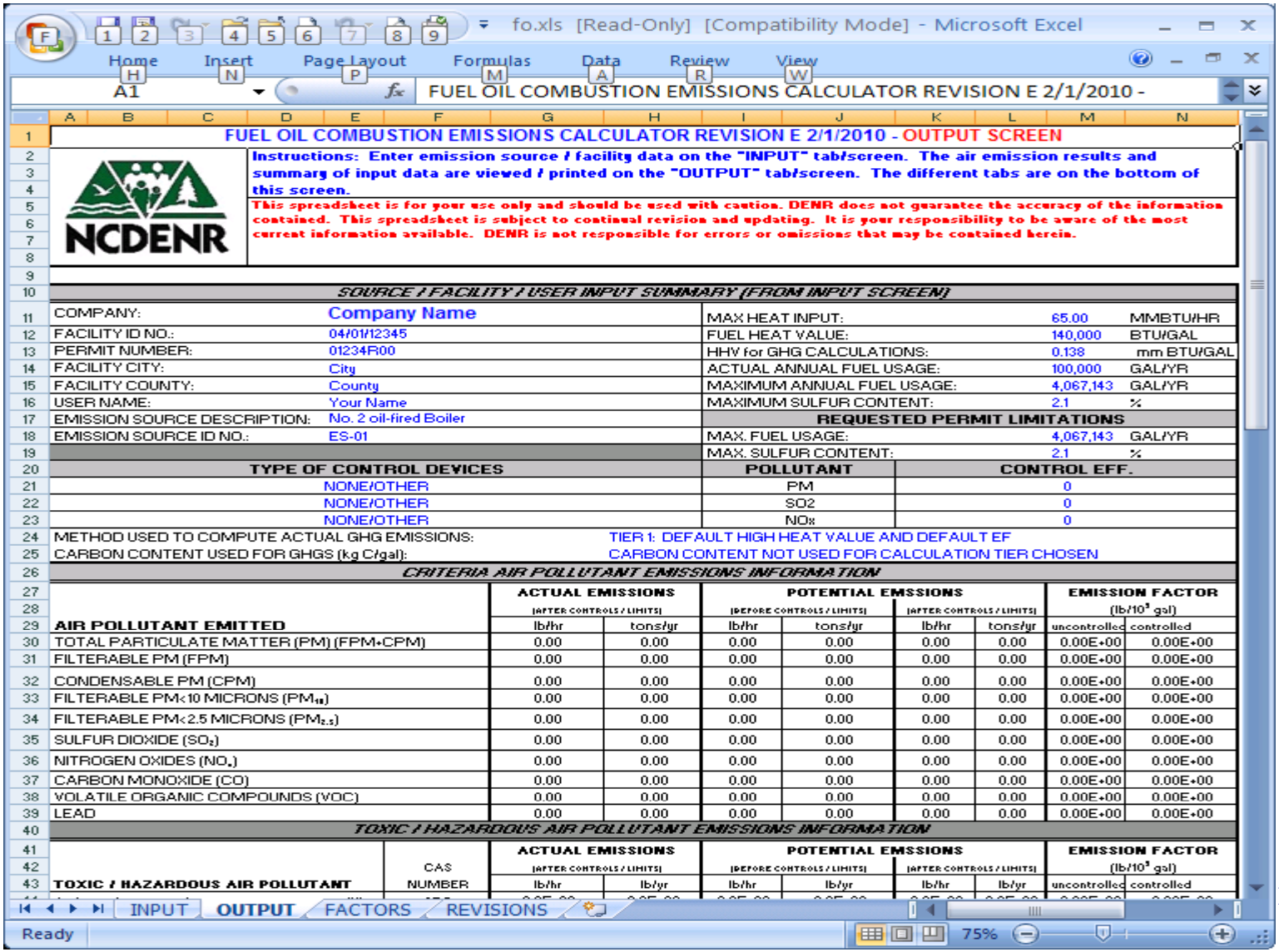
Emission Calculation Spreadsheet - Output



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Home Insert Page Layout Formulas Data Review View

A1 FUEL OIL COMBUSTION EMISSIONS CALCULATOR REVISION E 2/1/2010 -

FUEL OIL COMBUSTION EMISSIONS CALCULATOR REVISION E 2/1/2010 - OUTPUT SCREEN

NCDENR

Instructions: Enter emission source / facility data on the "INPUT" tab/screen. The air emission results and summary of input data are viewed / printed on the "OUTPUT" tab/screen. The different tabs are on the bottom of this screen.

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SOURCE / FACILITY / USER INPUT SUMMARY (FROM INPUT SCREEN)

COMPANY:	Company Name	MAX HEAT INPUT:	65.00	MMBTU/HR
FACILITY ID NO.:	04/01/12345	FUEL HEAT VALUE:	140,000	BTU/GAL
PERMIT NUMBER:	01234R00	HHV for GHG CALCULATIONS:	0.138	mm BTU/GAL
FACILITY CITY:	City	ACTUAL ANNUAL FUEL USAGE:	100,000	GAL/YR
FACILITY COUNTY:	County	MAXIMUM ANNUAL FUEL USAGE:	4,067,143	GAL/YR
USER NAME:	Your Name	MAXIMUM SULFUR CONTENT:	2.1	%
EMISSION SOURCE DESCRIPTION:	No. 2 oil-fired Boiler	**REQUESTED PERMIT LIMITATIONS**		
EMISSION SOURCE ID NO.:	ES-01	MAX. FUEL USAGE:	4,067,143	GAL/YR
		MAX. SULFUR CONTENT:	2.1	%

TYPE OF CONTROL DEVICES	POLLUTANT	CONTROL EFF.
NONE/OTHER	PM	0
NONE/OTHER	SO2	0
NONE/OTHER	NOx	0

METHOD USED TO COMPUTE ACTUAL GHG EMISSIONS: TIER 1: DEFAULT HIGH HEAT VALUE AND DEFAULT EF

CARBON CONTENT USED FOR GHGS (kg C/gal): CARBON CONTENT NOT USED FOR CALCULATION TIER CHOSEN

CRITERIA AIR POLLUTANT EMISSIONS INFORMATION

	ACTUAL EMISSIONS (AFTER CONTROLS / LIMITS)		POTENTIAL EMSSIONS (BEFORE CONTROLS / LIMITS)		POTENTIAL EMSSIONS (AFTER CONTROLS / LIMITS)		EMISSION FACTOR (lb/10^3 gal)	
AIR POLLUTANT EMITTED	lb/hr	tons/yr	lb/hr	tons/yr	lb/hr	tons/yr	uncontrolled	controlled
TOTAL PARTICULATE MATTER (PM) (FPM+CPM)	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00
FILTERABLE PM (FPM)	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00
CONDENSABLE PM (CPM)	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00
FILTERABLE PM<10 MICRONS (PM_{10})	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00
FILTERABLE PM<2.5 MICRONS ($PM_{2.5}$)	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00
SULFUR DIOXIDE (SO_2)	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00
NITROGEN OXIDES (NO_x)	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00
CARBON MONOXIDE (CO)	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00
VOLATILE ORGANIC COMPOUNDS (VOC)	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00
LEAD	0.00	0.00	0.00	0.00	0.00	0.00	0.00E+00	0.00E+00

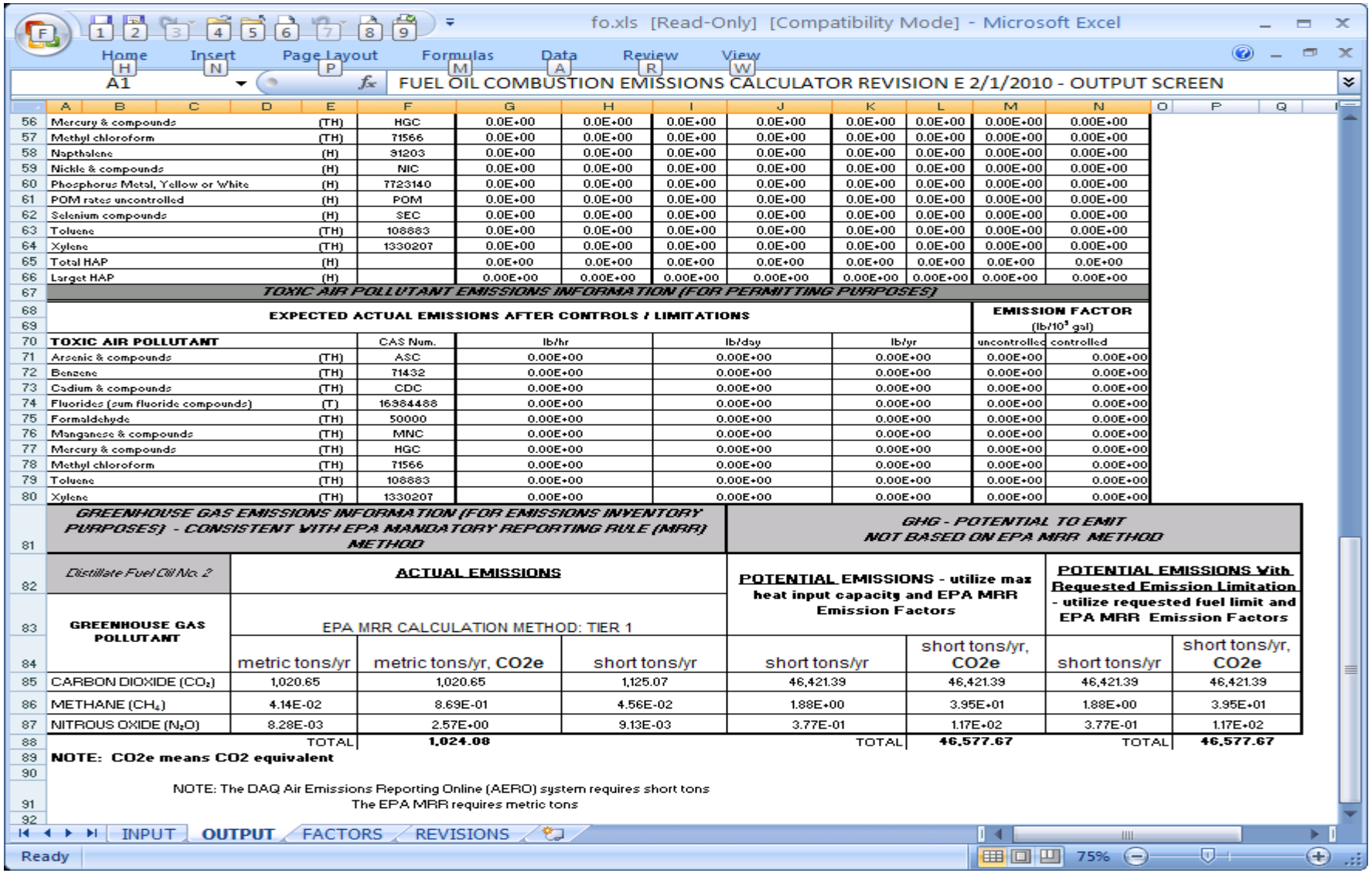
TOXIC / HAZARDOUS AIR POLLUTANT EMISSIONS INFORMATION

	CAS NUMBER	ACTUAL EMISSIONS (AFTER CONTROLS / LIMITS)		POTENTIAL EMSSIONS (BEFORE CONTROLS / LIMITS)		POTENTIAL EMSSIONS (AFTER CONTROLS / LIMITS)		EMISSION FACTOR (lb/10^3 gal)	
TOXIC / HAZARDOUS AIR POLLUTANT		lb/hr	lb/yr	lb/hr	lb/yr	lb/hr	lb/yr	uncontrolled	controlled

INPUT OUTPUT FACTORS REVISIONS

Ready 75%

Emission Calculation Spreadsheet – Output (cont.)



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A1: FUEL OIL COMBUSTION EMISSIONS CALCULATOR REVISION E 2/1/2010 - OUTPUT SCREEN

56	Mercury & compounds	(TH)	HGC	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.00E+00	0.00E+00	
57	Methyl chloroform	(TH)	71566	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.00E+00	0.00E+00	
58	Napthalene	(H)	91203	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.00E+00	0.00E+00	
59	Nickle & compounds	(H)	NIC	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.00E+00	0.00E+00	
60	Phosphorus Metal, Yellow or White	(H)	7723140	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.00E+00	0.00E+00	
61	POM rates uncontrolled	(H)	POM	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.00E+00	0.00E+00	
62	Selenium compounds	(H)	SEC	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.00E+00	0.00E+00	
63	Toluene	(TH)	108883	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.00E+00	0.00E+00	
64	Xylene	(TH)	1330207	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.00E+00	0.00E+00	
65	Total HAP	(H)		0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	
66	Larget HAP	(H)		0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	

TOXIC AIR POLLUTANT EMISSIONS INFORMATION (FOR PERMITTING PURPOSES)

	EXPECTED ACTUAL EMISSIONS AFTER CONTROLS / LIMITATIONS					EMISSION FACTOR ($lb/10^3$ gal)	
70	**TOXIC AIR POLLUTANT**	CAS Num.	lb/hr	lb/day	lb/yr	uncontrolled	controlled
71	Arsenic & compounds (TH)	ASC	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
72	Benzene (TH)	71432	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
73	Cadium & compounds (TH)	CDC	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
74	Fluorides (sum fluoride compounds) (T)	16984488	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
75	Formaldehyde (TH)	50000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
76	Manganese & compounds (TH)	MNC	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
77	Mercury & compounds (TH)	HGC	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
78	Methyl chloroform (TH)	71566	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
79	Toluene (TH)	108883	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
80	Xylene (TH)	1330207	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

GREENHOUSE GAS EMISSIONS INFORMATION (FOR EMISSIONS INVENTORY PURPOSES) - CONSISTENT WITH EPA MANDATORY REPORTING RULE (MRR) METHOD

GHG - POTENTIAL TO EMIT NOT BASED ON EPA MRR METHOD

	Distillate Fuel Oil No. 2	**ACTUAL EMISSIONS**			**POTENTIAL EMISSIONS - utilize max heat input capacity and EPA MRR Emission Factors**		**POTENTIAL EMISSIONS With Requested Emission Limitation - utilize requested fuel limit and EPA MRR Emission Factors**	
83	**GREENHOUSE GAS POLLUTANT**	EPA MRR CALCULATION METHOD: TIER 1						
84		metric tons/yr	metric tons/yr, CO2e	short tons/yr	short tons/yr	short tons/yr, CO2e	short tons/yr	short tons/yr, CO2e
85	CARBON DIOXIDE (CO_2)	1,020.65	1,020.65	1,125.07	46,421.39	46,421.39	46,421.39	46,421.39
86	METHANE (CH_4)	4.14E-02	8.69E-01	4.56E-02	1.88E+00	3.95E+01	1.88E+00	3.95E+01
87	NITROUS OXIDE (N_2O)	8.28E-03	2.57E+00	9.13E-03	3.77E-01	1.17E+02	3.77E-01	1.17E+02
88		TOTAL	**1,024.08**		TOTAL	**46,577.67**	TOTAL	**46,577.67**

NOTE: CO2e means CO2 equivalent

NOTE: The DAQ Air Emissions Reporting Online (AERO) system requires short tons
The EPA MRR requires metric tons

INPUT | OUTPUT | FACTORS | REVISIONS

Ready 75%

Summary of Voluntarily Reported GHG Data

- NC DAQ has collected voluntarily reported GHG data since CY2007.
- The number of facilities voluntarily reporting GHG emissions has increased from 47 (2007) to 163 (2010).
- Data fluctuations can be attributed to several factors.

Calendar year	Carbon dioxide, CO_2	Methane, CH_4	Nitrous Oxide, N_2O	Sulfur Hexafluoride, SF_6	HFC	PFC	Total in CO_2e,
	metric tons/yr (number of reporting facilities)						
2007 (47)	4,087,529 (43)	2,323 (33)	245 (30)	0.01 (1)	1,537 (7)	0.01 (1)	6,077,283
2008 (150)	6,593,619 (147)	11,422 (128)	583 (115)	0	7.63 (11)	0.04 (1)	7,752,994
2009 (144)	4,035,736 (139)	9,516 (121)	416 (109)	0	8.06 (8)	0	4,443,108
2010 (163)	4,060,446 (159)	6,456 (135)	2,119 (125)	0	8.56 (5)	0	4,935,438

Integration of Voluntary and Mandatory Reported GHG Data

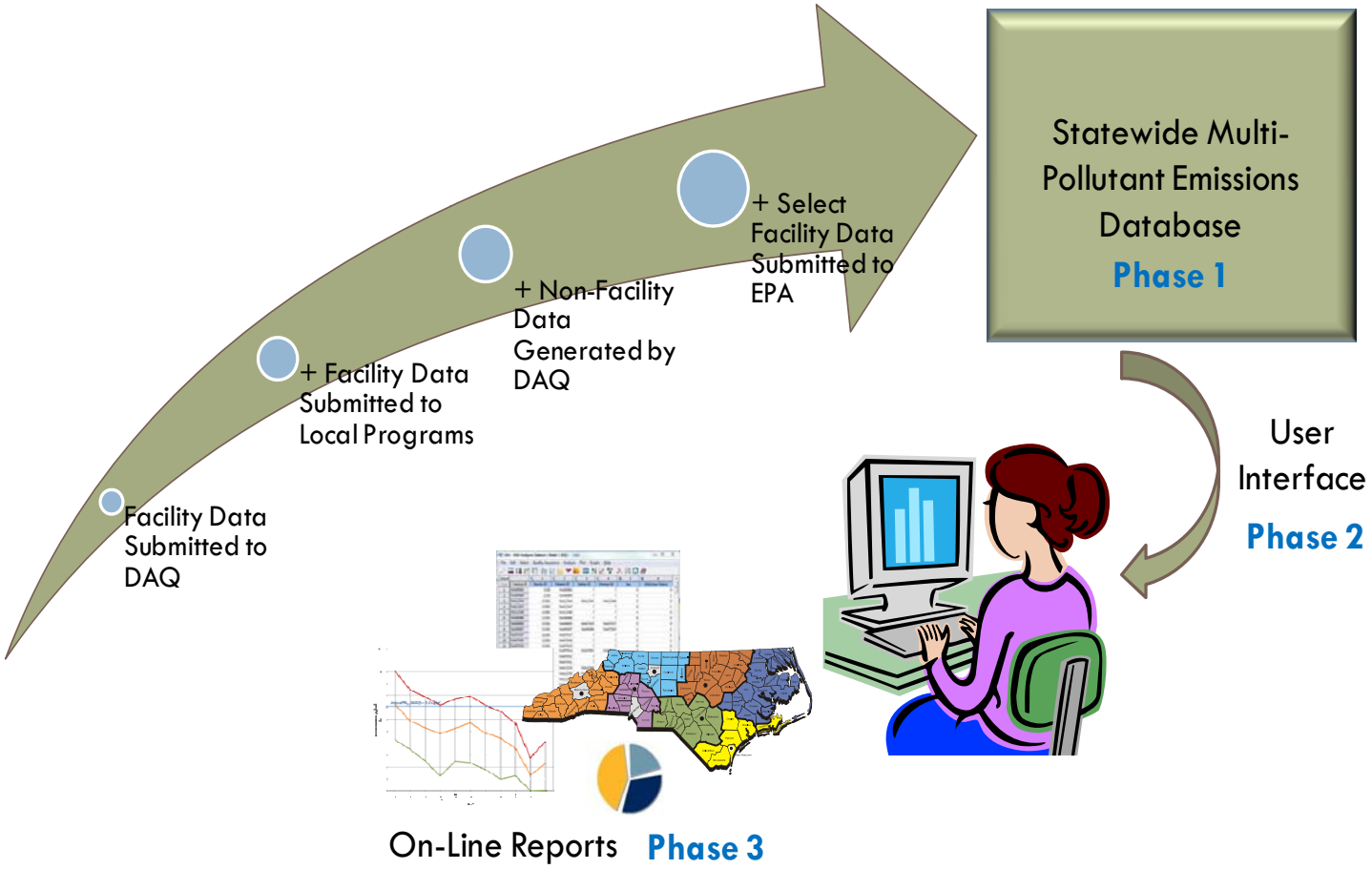
- NC DAQ set out to create a multi-pollutant database incorporating NC DAQ emission inventory data including the voluntarily reported GHG emissions, MRR GHG data as well as 3 local programs emission inventory data, non-point, mobile on-road and mobile non-road emissions data.
- Major Challenges encountered
  - Lack of one facility identifier used across multiple databases
  - Level of reporting differed; Voluntarily Reported GHG data-source specific, MRR GHG data-Facility-wide
  - Different units of measure used for GHG emissions in MRR and Voluntarily Reported Database
  - CAS numbers for GHG emissions were not identified in MRR GHG database

Summary of Voluntarily Reported and MRR GHG Emissions Data

	Voluntary	Mandatory	NC Total
Total GHGs (metric tons CO2e)	2,549,524	81,487,435	84,036,959
No. of Reporting Facilities	206*	132	338
* Facilities that operated in CY 2010 but may have reported in CY2010 or most recent year .			

Note: If a facility reported GHGs voluntarily to NC DAQ and to the MRR, only the MRR GHG data for that facility was used in the combined database. This is why the voluntary reported total is lower on this slide versus the previous slide of voluntarily reported GHG data.

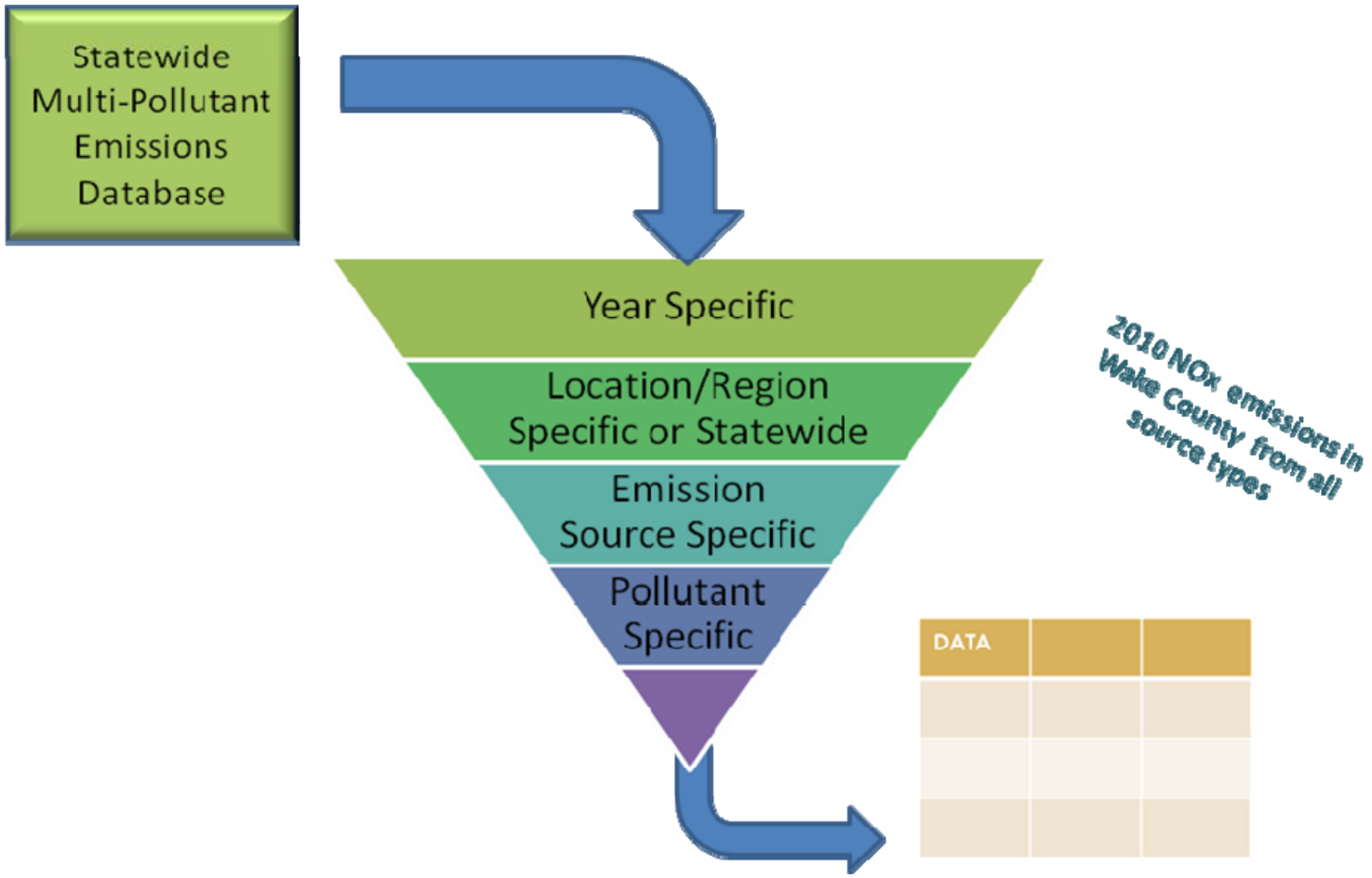
The Concept for the State-wide Multi-Pollutant Database



Phases of Developing a State-wide Multi-pollutant Emissions Database

- Phase 1– Create aggregated emissions database.
  - Step 1. Combine NC DAQ, NC's 3 Local Programs and MRR into a single point source database
  - Step 2. Add Non-point, mobile on-road and mobile non-road emissions data into the point source database
- Phase 2 – Create an internal user interface which allows the user to generate unique queries and data subsets.
- Phase 3 – Integrate the user interface with NC DAQ's IBEAM system, allow access through web page for data downloads, complete dataset or subsets, and add geographical mapping capabilities.

User Interface Concept



Conclusions

- Integration of multiple databases would have been infinitely easier if only one facility/site identifier was used across EPA databases.
- Combining MRR and voluntarily reported GHG emissions data would have been much easier if MRR publicly available data included CAS numbers.
- Formats of data and reported pollutants vary between point sources and other sectors as well as between NC DAQ and local programs. However, now that queries are written this issue should be lessened in future years.
- A statewide multi-pollutant database will be a valuable asset for NC DAQ when responding to legislative analysis and requests, for SIP planning, rules review, forecasting and emissions modeling.

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