IPAMS/WRAP JOINT ROCKY MOUNTAIN
PHASE III OIL AND GAS EMISSIONS INVENTORY PROJECT
(JULY 28, 2008)

The Western Regional Air Partnership (WRAP) and the Independent Petroleum Association of Mountain States (IPAMS) are co-sponsoring the development of a region-wide emissions inventory from oil and gas (O&G) exploration and production in the Intermountain West. This represents a Phase III inventory effort for O&G sources, building on two previous WRAP sponsored regional O&G inventories and considering the major geologic basins of O&G activity in the region.

Background

In 2002, more than 5.6 trillion cubic feet of natural gas and 1.15 billion barrels of crude oil were drawn from oil and gas wells in the 14 western states. In 2005, those numbers were 6.4 trillion cubic feet of natural gas and 1.1 billion barrels of crude oil. To support this activity, the oil and gas industry employs a large fleet of various exploration and production equipment that operates throughout the western regional U.S., concentrated in the Intermountain states of New Mexico, Utah, Colorado, Wyoming, Montana and North Dakota. This equipment contributes to emissions of NOx, VOC and other pollutants in the region.

Beginning in 2005, the WRAP initiated a series of projects to develop a regionally consistent emissions inventory of oil and gas exploration and production activities for all of the western U.S. states. The first of these projects, the Phase I inventory, completed in 2005, represented the first regional oil and gas emissions inventory for the western U.S. This was followed by the Phase II inventory, which focused on improving emissions estimates of drilling rigs and compressors from those in the Phase I work. Both the Phase I and Phase II inventories were focused on estimating oil and gas NOx and SOx emissions for regional haze modeling purposes. Final reports of the Phase I and Phase II inventories are available on the WRAP web page at http://www.wrapair.org/forums/ssjf/documents/eictts/oilgas.html.

In addition to these two WRAP-sponsored regional inventories, other work has been done to estimate emissions in other geographic sub-regions of the western U.S. The New Mexico Environment Department (NMED) sponsored a detailed, bottom-up emissions inventory of oil and gas activity in San Juan and Rio Arriba Counties in northwest New Mexico. The Wyoming Department of Environmental Quality (WYDEQ) developed a state-wide oil and gas emissions inventory for Wyoming. Various U.S. Bureau of Land Management (BLM) Regional Management Plans (RMPs) have estimated oil and gas emissions in areas covered by the RMPs throughout the Rocky Mountain States.

WRAP and the oil and gas industry have recognized that all of these previous studies have had serious limitations in scope, accuracy or methodology, and thus have jointly sponsored the development of a new Phase III inventory which is described here.

Why A Phase III Project?

The previous studies – the WRAP Phase I and II emissions inventories, and various regionally-specific emissions inventories – all had some limitations in their scopes. The Phase I and Phase II inventories were focused on estimating NOx and SOx emissions for WRAP's regional haze analysis and planning purposes. Thus they did not focus on all major oil and gas source categories, particularly the major VOC source categories. Some pollutants, such as PM and VOC, were not specifically addressed in these studies. The WRAP Phase I did attempt to estimate some VOC and miscellaneous source category emissions, but used only the available data at the time which was then generalized to the regional inventory. This lack of regionally-specific data for the major oil and gas basins across the region was a serious limitation of the Phase I study, as oil and gas activity varies greatly from basin to basin. Further, these inventories did not account for well production declines, technological advances, new regulations, and other measures that may result in lower emissions. The Phase II work added surveys of producers in each Basin, and attempted to develop regionally-specific estimates of NOx emissions, but only for drilling rigs and wellhead compressor engines. Finally, both of these inventories relied on oil and gas production statistics that were derived from state oil and gas conservation commission (OGCC) databases, and did not have the involvement of a broad base of companies operating across the Intermountain West. Although significant work was done to analyze these databases and extract the necessary information, these databases often contain inaccuracies and inconsistencies which were unavoidably incorporated into the analyses.

The new Phase III work attempts to improve on the methodologies of the previous regional inventories, and address some of the limitations discussed above. In an effort to obtain the most accurate, and regionally-specific information on equipment, activity, emissions factors, and controls, the Phase III work relies heavily on direct cooperation and data from a broad range of oil and gas production companies operating in the Intermountain West. The Phase III project uses comprehensive activity surveys of producers in each Basin, and employs a technical integrator to assist producers with completing surveys and answering questions. In order to incorporate emissions from permitted sources, the Phase III methodology also relies upon close cooperation and communication with the various state environmental agencies to obtain and analyze these permits. The oil and gas production statistics used in this analysis are obtained from a commercially-available database maintained by the IHS Corporation (the "IHS database"). IHS has developed a highly accurate oil and gas production statistics database, derived from each state's OGCC data, with significant effort undertaken to clean up these statistics and improve their accuracy.

General Features of the Phase III Inventory

Temporal and Geographic Scope

The Phase III inventory compiles emissions data for the baseline year of 2006, the latest year for which oil and gas production statistics were available at the outset of the project. The Phase III inventory also considers two additional future years for emissions projections: (1) a mid-term projection year of 2012 (2010 for the Denver-Julesburg Basin in Colorado); and (2) a far future year of 2018.

The region covered in the Phase III work includes all of the major basins of significant oil and gas activity in New Mexico, Utah, Colorado, Wyoming, Montana and North Dakota:

- Denver-Julesburg Basin
- Uinta Basin
- San Juan Basin (North and South)
- Piceance Basin
- Southwest Wyoming Basin (Green River Basin)
- Powder River Basin
- Paradox Basin
- Williston Basin
- Wind River Basin
- Big Horn Basin
- North-Central Montana Basin (Great Plains Basin)

Figure 1 below shows a map of all of the basins covered in the Phase III work.

Figure 1. Basin boundaries for all basins included in the Phase III study.

Pollutants Covered

The Phase III analysis includes estimates of all criteria pollutants:

- NOx
- SOx
- VOC
- PM
- CO

Phase III Baseline Emissions Inventory Methodology

The baseline 2006 inventory for each basin is developed by combining data on permitted sources from states' permit databases, and data on unpermitted sources obtained from direct industry surveys. The IHS database is used to determine oil and gas production statistics, which are used to combine these two groups of source categories to generate a complete basin-wide emissions inventory. Below is a description of the methodology for generating baseline emissions.

IHS Database Analysis

The IHS database is used to extract baseline 2006 oil and gas production statistics for each basin in the study region. The statistics include:

- Oil, gas and condensate production by well type (oil, gas or CBM), by county and by company in the basin;
- Well counts by well type (oil, gas or CBM), by company and by county in the basin;
- Spud counts by company and by county in the basin

From this production data the top companies in the basin are determined by ownership of oil production, gas production, condensate production, well counts, and spud counts. IPAMS sends surveys to these major operators, as well as to a broad range of other companies operating in the basin. The requirements for this study in generating baseline emissions are that the companies participating in each basin inventory represent a minimum of 60% of ownership of these parameters.

Permitted Sources (State and/or Federal Permits)

Permitted sources in most states typically include large point sources such as gas processing plants, large central compressor stations, and some lateral compressor stations. However, in Colorado and Wyoming for example, there are more stringent emissions thresholds for permitting, and therefore more extensive permitted sources data are available on a wider range of source categories.

To estimate emissions from these permitted sources for each basin, the state permitting threshold is analyzed to determine the number and types of sources that would be covered under permitting. The permitted sources emissions data are requested from each state environmental agency, and/or the U.S. EPA, as appropriate. The permits often indicate a not-to-exceed (NTE) permitted emissions level, rather than actual emissions. In this case the permit data are provided to the company owning the source (if this company is participating in the inventory development) and the company is given the opportunity to modify the data to show actual emissions. Any modifications to the emissions reported in the permits must include documentation to justify the change. All permitted sources emissions are then summarized on a county level for the basin.

Unpermitted Sources

The unpermitted sources considered in this analysis include the following:

- Lateral/wellhead compressor engines
- Drilling rigs
- Workover rigs/frac rigs
- CBM pump engines
- Salt-water disposal engines
- Artificial lift engines (pumpjacks)
- Vapor recovery unit (VRU) compressor engines
- Miscellaneous gas-fired engines
- Oil well heaters
- Gas well heaters
- Miscellaneous gas-fired heaters or boilers
- Flaring
- Oil well tanks – breathing losses, gas venting, flashing emissions
- Gas well tanks – breathing losses, gas venting, flashing emissions
- Pneumatic devices
- Oil well fugitive emissions
- Gas well fugitive emissions
- Gas well completions
- Venting
- Blowdowns
- Dehydrators
- Amine units
- Gas well truck loading
- Oil well truck loading
- Pipeline/compressor station fugitive emissions
- Landfarms
- Water treatment/water injection facilities

As mentioned above, in Colorado and Wyoming, some of the equipment in these source categories may be covered by Air Quality permits due to those states' low permitting thresholds.

To estimate emissions from these unpermitted sources, detailed spreadsheet-based surveys are sent to the participating companies for each basin. These surveys request information on typical equipment types, counts, configurations, annual activity levels, controls, and emissions factors.

Depending on the nature of the data provided by the companies, the IHS database production statistics are used in conjunction with the survey response to estimate each participating company's emissions of all relevant pollutants for each of the unpermitted source categories. These are combined and represent the emissions total from participating companies. Because these companies do not represent 100% of production activities in each basin, the IHS database is used to scale up the combined company emissions to generate basin-wide emissions. Each source category is scaled up by the appropriate production parameter.

Phase III Future Year Emissions Inventory Methodology

Mid-Term Emissions Projections

Mid-term emissions projections will be developed for 2012 for most basins. Projections for the Denver-Julesburg (D-J) Basin have been developed for 2010 for conformance with the requirements of the Denver area ozone State Implementation Plan (SIP) process.

Mid-term projections are conducted by generating historical data on key operating parameters: oil production, gas production, condensate production, well counts and spud counts for each county in each basin. The historical data are analyzed and a best-fit curve is fit to each parameter's historic data and projected forward. Projections are either linear, 2nd order polynomial or exponential as appropriate. These projections then predict levels of activity of each of these parameters in the mid-term future year (2010 or 2012). The participating companies also provide input and guidance to the projections in order to insure that the projections are consistent with the overall activity trends in each basin, and with the companies' planned activities.

The ratio of the parameter (e.g. gas production) in 2012 to that in 2006 is taken to be the parameter's scaling factor. Scaling factors are generated for each parameter by county for each basin, and then applied as appropriate to each source category to scale its emissions from the baseline year to the mid-term year. The emissions are then adjusted to reflect any "on-the-books" regulations that would affect any oil and gas source categories – Federal nonroad engine regulations as well as any promulgated state controls.

Far Future Year Emissions Projections

A methodology for estimating far future year emissions has not yet been developed for this Phase III work. However, it is expected that the methodology will estimate emissions for 2018, and that the methodology will be similar to that used in the WRAP Phase I and Phase II inventories. In those inventories, the methodology called for generating scaling factors based on

activity projections derived from BLM Resource Management Plans (RMP's), and Environmental Impact Statements (EIS) that cover particular sub-regions of the study region. The Phase III work will attempt to expand on this methodology by including all draft and final RMPs and EIS within the study region. For regions not covered by an RMP or EIS, the Energy Information Administration's (EIA) Annual Energy Outlook will be used to determine future production levels for purposes of generating scaling factors.

Documentation and Emissions Spreadsheets

Detailed technical reports will be prepared on each basin's baseline, mid-term and far future year emissions, along with summary spreadsheets providing the quantitative emissions data for each basin. The documentation for each basin will be posted on the WRAP SSJF Oil and Gas Working Group web page as it becomes available. As of mid-July 2008, 2006 base year and 2010 mid-term projections documentation for the Denver-Julesberg Basin is posted on the web page.

WRAP Stakeholder Presentations

Presentations will be given to the WRAP SSJF Oil and Gas Working Group to summarize the findings of the inventory analysis, and to receive WRAP stakeholder input on the methodology and results.

Project Schedule

Table 1 shows the overall project schedule. It should be noted that this schedule is in draft form and will be updated as project tasks are completed.

Table 1. Overall project schedule for completion of emissions estimates for all basins.

December 2007 – June 2008	• Complete D-J Basin baseline 2006 emissions • Complete D-J Basin mid-term 2012 projections • Complete draft Uinta Basin baseline 2006 emissions • Begin Uinta Basin mid-term 2012projections • Begin Piceance Basin baseline 2006 emissions
July 2008	• Complete Uinta Basin mid-term 2012 projections • Complete Piceance Basin baseline 2006 emissions • Begin Piceance Basin mid-term 2012 projections • Begin San Juan Basin (North) baseline 2006 and mid-term 2012 projections • Begin San Juan Basin (South) baseline 2006 emissions
August 2008	• Complete Piceance Basin mid-term 2012 projections • Complete San Juan Basin (North) baseline 2006 and mid-term 2012 projections • Begin all Wyoming basins baseline 2006 emissions • San Juan Basin (South) surveys to producers
September 2008	• Complete San Juan Basin (South) baseline 2006 emissions • Begin San Juan Basin (South) mid-term 2012 projections • Wyoming basins surveys to producers • Continue work on all Wyoming basins baseline 2006 emissions
October 2008	• Complete San Juan Basin (South) mid-term 2012 emissions • Continue work on all Wyoming basins baseline 2006 emissions
November 2008	• Complete all Wyoming basins baseline 2006 emissions • Begin work on all Wyoming basins mid-term 2012 projections • Begin work on all Montana basins and Paradox Basin baseline 2006 emissions
January 2009	• Complete all Wyoming basins mid-term 2012 projections • Williston, Great Plains and Paradox Basin surveys to producers
February 2009	• Begin work on Williston, Great Plains and Paradox Basin midterm 2012 projections • Complete Williston, Great Plains and Paradox Basin baseline 2006 emissions
March 2009	• Complete Williston, Great Plains and Paradox Basin midterm 2012 projections • Begin work on far future year projections for all basins
April 2009	• Continue work on far future year projections for all basins
May 2009	• Complete work on far future year projections for all basins
June 2009	• Final project report • WRAP PRP18 modeling • Phase III emissions files for future modeling available at WRAP Regional Modeling Center (http://pah.cert.ucr.edu/aqm/308/)