

Draft Work Plan

**STATIONARY SOURCES JOINT FORUM: EMISSION INVENTORY
AND CONTROL TECHNOLOGY TECHNICAL SUPPORT**

Oil and Gas Emissions Projections to 2018



Prepared for

Western Governors' Association
1515 Cleveland Place, Suite 200
Denver, CO 80202

Prepared by

James Russell
Alison Pollack
ENVIRON International Corporation
101 Rowland Way, Suite 220
Novato, CA 94945-5010



July 18, 2005

Introduction

With the completed an emissions inventory of oil and gas sources completed for the base year 2002, the next step is to project the emissions from this industry to the year 2018. While preparing the base year inventory, we have gathered information that will be useful in developing projections. At this point, we have sufficient information to elaborate a plan for how projections will be addressed. Oil and gas emissions projections for the WRAP states will be based on projections of oil and gas production from several sources. Projected emissions will be controlled to the degree suggested by upcoming State and Federal regulations.

Production Growth Factors

The preferred source of production projections is the Bureau of Land Management (BLM). The BLM periodically prepares Resource Management Plans (RMP) for the lands and mineral resources under its stewardship. RMP for oil and gas production areas typically include an estimate of reasonable foreseeable oil and gas development. The future development is usually estimated as a number of new oil, gas and possibly CBM wells anticipated over the next 10 or 20 years. Table 1 provides a brief summary of some of the reasonable foreseeable development (RFO) scenarios that have been reviewed.

Table 1. Projection information obtained from BLM Resource Management Plans.

Document	Date Prepared	Projected Well Development
Northern San Juan Basin Coal Bed Methane Project	Jun-04	Proposed Action: 296 new CBM wells. 40 year project life.
EIS for proposed Amendment of the PR and Billings Resource Management Plans (Montana)	Jan-03	RFD Scenario: Restricted Development Scenario: 675 exploration wells, 250 production wells. Expanded Development Scenario: 10,000-26,000 wells drilled.
Wyoming PRB Final EIS	Jan-03	RFD Scenario: Moderate Scenario: (future drilling) 81,000 total CBM wells, 50,000 by 2010.
BLM Colorado Evaluation of Impact of Oil and Gas Leasing Development	Jan-91	Projected Oil & Gas Wells: Wildcat wells: 625 wells. Development wells: 1339 wells. Wells to be developed over 20 year planning period beginning in 1989
White River Resource Area RMP EIS	Jun-96	Drilling Forecast: 20 year plan. Wildcat drilling: 264 total wells. Development drilling: 836 total wells
RMP EIS for Mineral Leasing and Development in Sierra and Otero Counties	Dec-03	20 year projection for Oil & Gas development: Frontier Wildcat wells: 39. Appraisal gas wells: 12. Gas development wells: 30. Oil development wells: 60.
Dakota Prairie Grasslands O&G Leasing	Jun-03	RFD Scenario: 660 total wells drilled over the next 10 years. 600 traditional wells. On average 75% of traditional wells are productive. 60 CBM wells. All CBM wells are predicted to be producers.
Farmington Proposed Resource Management Plan and Final Environmental Impact Statement	Mar-03	RFD Scenario: Total new wells predicted is 16,615 over 20 years.
Desolation Flats Natural Gas Field Development Project: Sweetwater and Carbon Counties, Wyoming	May-04	Air Quality Analysis predicts 45 new wells per year beginning in 2004, up to a project total 385 wells.
Draft Vernal Resource Management Plan, Utah	May-05	Anticipated 2,055 new oil wells, 4,345 new gas wells and 130 new CBM wells drilled during the 15 year planning period.
Jack Morrow Hills Coordinated Activity Plan, Wyoming	Jul-04	205 conventional oil and gas wells drilled by 2021; 107 expected to be productive. 50 CBM wells drilled; all expected to be productive.
Pinedale	Anticipated 2006	Unconstrained development scenario anticipates 9,800 additional wells drilled from 2004 to 2024.

As shown in Table 1, we have obtained a number of RMPs covering a large portion of the WRAP production areas. Figure 1 shows the approximate area covered by these resource management plans. Despite the broad combined coverage of these plans, there are some significant production areas for which management plans could not be located. In addition, some of the plans that we have obtained are over a decade old and are due for an update. The process of obtaining RMPs and other information from the BLM has been somewhat hindered by the non-functionality of the BLM website in recent months. However, with the assistance of the BLM field offices, we believe we have obtained all the applicable RMP that are available at this time.

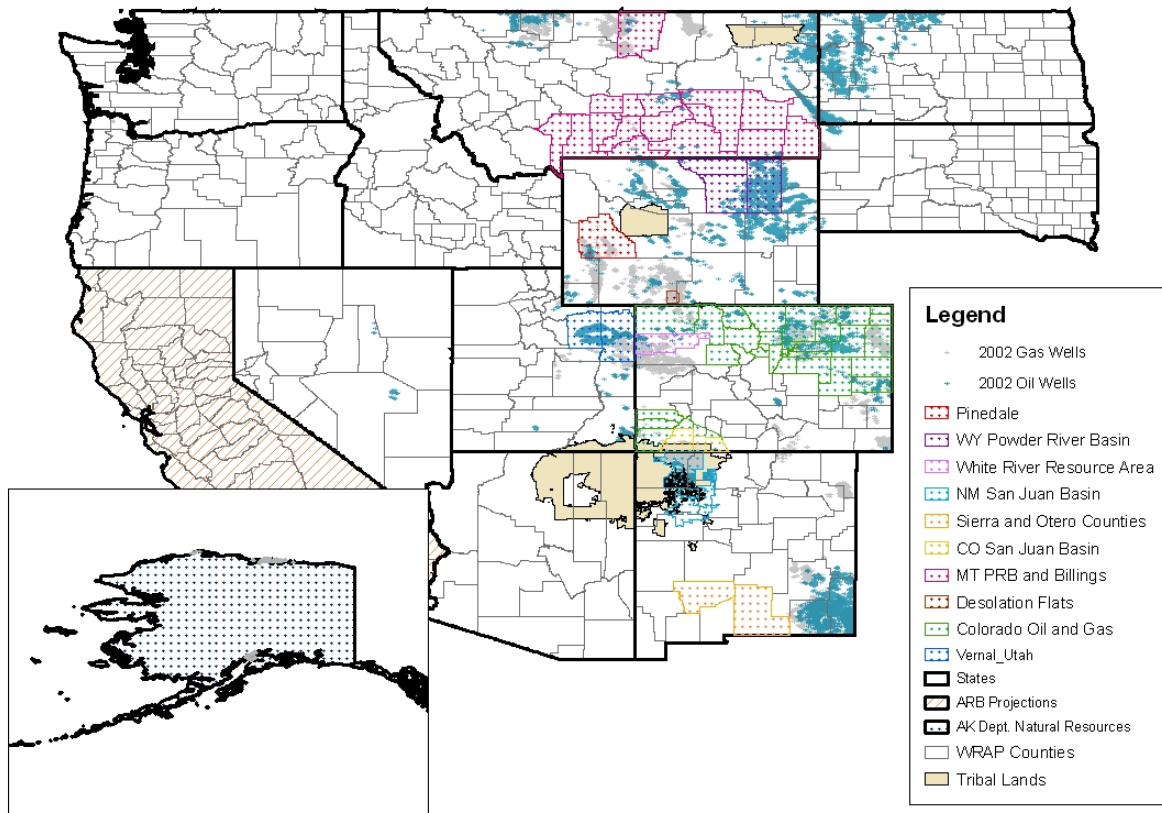


Figure 1. Coverage of resource management plans for use in projecting emissions.

For some areas where it was not possible to obtain recent local development forecasts from the BLM, other sources of local data have been identified. For example, the Alaska Department of Natural Resources (<http://www.dog.dnr.state.ak.us/>) prepares 20-year production forecasts that will be used in this effort. Other local sources of data are summarized in Table 2. For remaining areas, where no local information is available, regional production forecasts published by the Energy Information Administration (<http://www.eia.doe.gov/>) will be used.

Table 2. Projection information provided by State OGCs.

State	Information	Action
Alaska	Department of Revenue (DOR) and Department of Natural Resources (DNR) prepare 20 year projections	Obtain projections from DOR and DNR and use as preferred information source for projections
Arizona	Production expected to be constant. No new wells anticipated in the next 3-5 years.	Ensure projection method provides results consistent with this information
Colorado	Provided actual, estimated and planned new wells for 2003, 2004 and 2005	Estimate 2018 production/wells using 2005 information as base year
North Dakota	North Dakota Office of Management and Budget prepares production estimates for 2 years. 2007 estimated oil production of 110,000 barrels per day.	Estimate 2018 production/wells using 2007 information as the base year

The EIA has published projection forecasts out to 2025. For production areas where EIA forecasts are the only source of data identified, separate oil and gas growth factors have been calculated as the 2018 regional production forecast by the EIA divided by 2002 regional production reported by the EIA. There are three EIA growth regions in which some portion of emissions in that region will be projected using EIA data. Those regions are the Rocky Mountain Region, the Southwest Region and the West Coast Region. Growth factors developed for those regions based on the EIA's production forecasts are shown in Table 3. The delineation of those regions is shown in Figure 2.

Table 3. 2002 to 2018 oil and gas growth factors based on EIA forecasts.

Region	Oil Production	Gas Production
Rocky Mountain	1.334	1.458
Southwest	0.866	1.354
West Coast	0.601	0.568

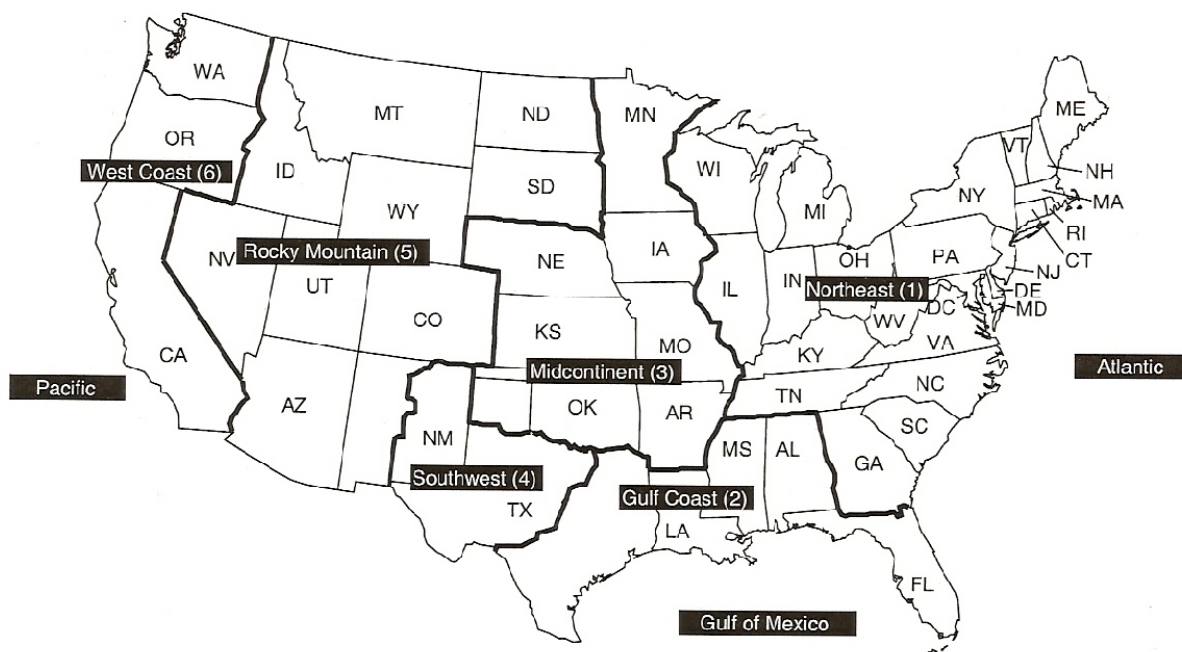


Figure 2. EIA production forecasting regions.

Projections to 2018 based on the BLM resource management plans or other local data will be made using growth factors derived from the proposed future development and the actual 2002 activity. In order to estimate the future number of wells, both the number of wells installed and the number of wells plugged and abandoned must be estimated. The RMPs do not generally include estimates of the number of wells that will be plugged and abandoned in future years. The historical plugging and abandoning of wells is, however, available from the OGCs. Thus, lacking other projections of future well abandonment, we will use OGC data to estimate the number of wells plugged and abandoned annually in areas such as the Powder River Basin, the San Juan Basin, etc. We will then develop an estimate of the future number of wells in a production area based on the number of existing wells in 2002, the number of new wells anticipated by the RMP and the estimated number of wells that will be abandoned. The calculation of a growth factor will thus be accomplished as shown in Calculation 1.

Calculation 1: Determination of CBM, oil and gas well growth factor based on BLM RMP

$$G = \frac{(W_{02} + W_f - W_p)}{W_{02}}$$

where:

- G = the 2002 to 2018 growth factor
- W₀₂ = the wells (oil/gas/CBM) active in 2002
- W_f = the wells (oil/gas/CBM) forecast to be added by 2018
- W_p = the wells (oil/gas/CBM) estimated to be plugged and abandoned by 2018

Because gas production at all well types drives compressor emissions, none of the three growth factors developed for oil wells, gas wells or CBM wells is alone representative of growth in compression. Compressor engine emissions must be projected based on the total growth in gas

production. Thus a growth factor for total gas production will be developed as shown in Calculation 2.

Calculation 2: Derivation of a gas production growth factor based on BLM RMP

$$G_{gas} = \frac{\sum_i (W_{02,i} + W_{f,i} - W_{p,i}) * P_i}{\sum_i P_i * W_{02,i}}$$

where:

i refers to the three well types: oil, gas and CBM

G_{gas} = the 2002 to 2018 growth factor

P_i = the average 2002 production of an oil/gas/CBM well

$W_{02,i}$ = the oil/gas/CBM wells active in 2002

$W_{f,i}$ = the oil/gas/CBM wells forecast to be added by 2018

$W_{p,i}$ = the oil/gas/CBM wells estimated to be plugged and abandoned by 2018

In areas with coverage by a RMP, we will also estimate a separate growth factor for drill rig activity as the number of wells drilled per year suggested by the development scenario divided by the number of wells drilled in the same area in 2002. A growth factor for drilling in areas where EIA forecasts will be used has been determined based on the total predicted growth in well drilling in the lower 48 states. Regional drilling growth was not available. 27.25 thousand wells are anticipated to be drilled in the lower 48 states in 2018, versus 25.45 thousand wells drilled in 2002. This yields a drill rig activity growth factor of 1.071.

A total of eight types of growth factors will be used to project 2018 oil and gas emissions; three have been developed from EIA forecasts, and six based on local production projections are under development. A summary of these eight growth factors is presented in Table 4. How emissions in the year 2018 will be estimated using these growth factors is discussed in the next section.

Table 4. Projection growth factors.

ID	Data Source	Growth Factor	Derivation
G1	EIA	Gas production	2018 estimated gas production for the region divided by 2002 gas production for the region (Table 3)
G2	EIA	Oil production	2018 estimated oil production for the region divided by 2002 gas production for the region (Table 3)
G3	EIA	Well drilling	2018 estimated wells drilled in the lower 48 divided by 2002 wells drilled in the lower 48
G4	Local	Gas wells	2018 estimated gas wells in the planning area divided by 2002 gas wells in the planning area (Calculation 1)
G5	Local	Oil wells	2018 estimated oil wells in the planning area divided by 2002 oil wells in the planning area (Calculation 1)
G6	Local	CBM wells	2018 estimated CBM wells in the planning area divided by 2002 CBM wells in the planning area (Calculation 1)
G7	Local	Gas production	2018 estimated total gas production in the planning area divided by total 2002 gas production in the planning area (Calculation 2).
G8	Local	Well drilling	Number of wells drilled per year suggested by the development forecast divided by the number of wells drilled in 2002

2018 Emissions Estimates

County level, process-specific emissions estimates will be made for 2018 by applying growth factors to the 2002 emissions and then adjusting the estimates to incorporate future year controls. As growth factors are being developed for production areas rather than counties, it will be necessary to intersect the production areas with the WRAP counties to determine which growth factor will be applied in each county. In some counties it will be necessary to apply BLM-based growth factors to a fraction of the wells in the county and EIA-based growth factors to the remaining wells. The general formula that will be used to estimate 2018 emissions for the process-specific emissions estimates is presented in Calculation 3. Which of the eight growth factors will be applied to each of the emissions sources is stipulated in Tables 5 and 6.

Calculation 3. General formula for projecting process-specific emissions estimates

$$E_{18} = G * E_{02}$$

where:

E_{18} = the emissions from a process in 2018

G = the growth factor for the process, as indicated in Tables 5 and 6

E_{02} = the emissions from a process in 2002

Table 5. Growth factor to be used for each source in areas where local plans are used.

Source	Growth Factor*
Compressor Engines	Local Gas Production (ID = G7)
CBM Pump Engines	Emissions grown based on CBM well growth factor (ID = G6)
Oil Well - Minor NOx & VOC sources	Emissions grown based on oil well growth factor (ID = G5)
Gas Well - Minor NOx & VOC sources	Emissions grown based on gas well growth factor (ID = G4)
Drill Rigs	Emissions grown based on growth in number of wells drilled annually (ID = G8)

* IDs correspond to those assigned in Table 4

Table 6. Growth factor to be used for each source in areas where EIA data is used.

Source	Growth Factor*
Compressor Engines	Emissions grown based on gas production growth factor (ID = G1)
CBM Pump Engines	Emissions grown based on gas production growth factor (ID = G1)
Oil Well - Minor NOx & VOC sources	Emissions grown based on oil production growth factor (ID = G2)
Gas Well - Minor NOx & VOC sources	Emissions grown based on gas production growth factor (ID = G1)
Drill Rigs	Emissions grown based on growth in wells drilled (ID = G3)

* IDs correspond to those assigned in Table 4

Future Year Emission Controls

Simply estimating future year emissions based on future production would neglect the substantial impact that the implementation of new controls will have on future emissions. Both State and Federal emissions control estimates will be incorporated into the projections for 2018. A

summary of the controls that have been identified and actions that will be taken to incorporate them into the 2018 projections is provided in Table 7.

Table 7. Projection information provided by State DEQ.

State	Future Controls	Action
All	NONROAD diesel engine performance standards (US EPA)	Use phase-in and emissions standards information from EPA's NONROAD model to adjust drill rig engine emissions for future performance standards
Colorado ¹	<ul style="list-style-type: none"> • 2004, control for glycol dehydrators requiring units in the nonattainment area with greater than 15 tpy VOC emission to achieve 90% control. • 2006 new control of large engines in the Denver-Joulsborough Basin NA Area • 2006, new control on condensate tanks requiring VOC emissions in nonattainment area reduced by 47.5% during the VOC season and 38% during off season 	<p>The following will be used as inputs to the procedure used to project point sources:</p> <ul style="list-style-type: none"> • Determine fraction of dehydrators in nonattainment area and for 2004 and beyond apply 90% control to that fraction. • Select engines with greater than 500 hp and apply 90% control for 2006 and beyond. • Reduce annual VOC emissions from condensate tanks by 43% for 2006 and beyond.
Montana	2006, allow producers to include controls in their potential to emit estimates so that they can stay under 25 tpy and thus not be permitted. DEQ regulation will probably be introduced to require controlling PTE to 25 tpy	Cap total increase of any one pollutant due to the addition of one well at 25 tpy after 2006.
Utah	Controls are under development with EPA Region 8	Obtain control estimates from EPA Region 8 if available and apply

¹In Colorado, due to the low point source inventory threshold, these control adjustments must be made in the point source inventory

All of the expected future year controls reported in the survey of State environmental departments are indicated in Table 7. If any State agencies or stakeholders elect to provide additional information on future year controls, we will incorporate that information into the projections.