

Technical and Cost Proposal

Technical Support and Greenhouse Gas Protocol Preparation for the Oil & Gas Exploration and Production and Gas Processing Greenhouse Gas Accounting Protocol Project

Prepared for:
**Western Governors' Association
Western Regional Air Partnership**

October 7, 2008

Submitted by:
**Science Applications International Corporation and ENVIRON International
Corporation**



1.0 STATEMENT OF QUALIFICATIONS

Science Applications International Corporation (SAIC) is pleased to submit this proposal to the Western Governors' Association (WGA) Western Regional Air Partnership (WRAP) for technical support and greenhouse gas (GHG) protocol preparation for the oil & gas (O&G) exploration and production (E&P) and gas processing sector. For more than a decade SAIC has been at the forefront of state, Federal and international GHG accounting and mitigation efforts. We supported the development of the California Registry's General Reporting and Certification Protocols, as well as The Climate Registry's (TCR) General Reporting Protocols and General Verification Protocols. Steve Messner, the proposed Project Manager, is a petroleum engineer with over 20 years of experience in various E&P environmental management positions. He combines a detailed understanding of the emission sources and relevant estimation methodologies for the O&G E&P sector with extensive experience in the preparation of GHG estimation protocols for both entity-level inventories and a wide array of offset project types. Mr. Messner's team includes Chris Minnucci, who led SAIC's efforts to support The Climate

Registry's (TCR) preparation of its *General Reporting Protocol* (GRP) and *General Verification Protocol* (GVP), and who is intimately familiar not only with the TCR's accounting and reporting rules themselves but with the discussions and rationales underlying these rules. Our technical firepower, our expert understanding of GHG Protocols for a wide variety of U.S. and international emissions programs, our ability to organize and communicate complex GHG accounting issues and concepts in an easy-to-understand, user-friendly manner, and our ability to complete projects on time regardless of any challenges posed by the schedule, are reflected in these remarks commending our work on both the TCR and the earlier California Climate Action Registry's General Reporting and Certification Protocols:

I am indebted to SAIC for your help in the development of both the California Climate Action Registry and The Climate Registry protocols. You have provided the right technical expertise, met very aggressive schedules, and shown valuable insight into state-of-the-art reporting protocols around the world. It is a pleasure to work with SAIC. – Jill Gravender, The Climate Registry

SAIC is especially pleased to be teaming with ENVIRON International Corporation (ENVIRON). ENVIRON has extensive experience in emission inventory development, including the estimation of comprehensive "bottom-up" emission inventories for oil and gas and all other source categories, development of emission inventory modeling procedures and guidance documents, development of emission factor models, emission inventory evaluation for regional and urban-scale air quality studies, and development and peer review of emissions estimation and emissions processing computer models.

Of particular interest to this RFP, ENVIRON is currently leading a wide-scale oil and gas point and area source inventory for the Rocky Mountain states under contract to the Independent Petroleum Association of Mountain States (IPAMS) and the Western Regional Air Partnership (WRAP). This work was developed by cooperating closely with oil and gas industry representatives, WRAP, state and tribal representatives and other stakeholders. The work involves a detailed, industry-wide survey effort in which ENVIRON is collecting highly-detailed activity, equipment, configuration, and emissions factor data to be used as inputs into highly spatially-resolved emissions inventories across the Rocky Mountain States. In addition, this work has involved gathering and extensive analysis of detailed production statistics data for this region, on a well-by-well basis. This is to date the most detailed inventory of emissions from oil and gas activity in this region.

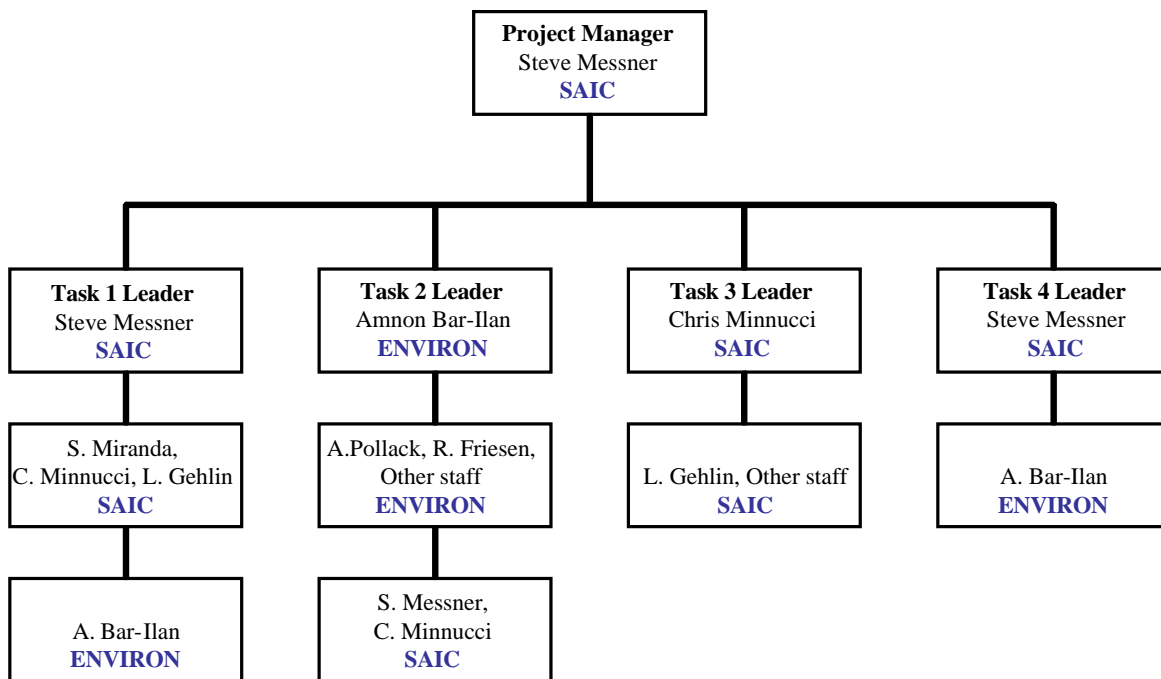
Exceptional Offerings of the SAIC/ENVIRON Team

- ✓ Proven Project Manager combining petroleum engineering background with extensive experience developing GHG protocols and estimation methodologies
- ✓ ENVIRON brings to the Team unparalleled expertise and experience in estimating emissions from a vast array of O&G E&P sources
- ✓ SAIC supported the preparation of The Climate Registry's General Reporting and Verification Protocols, as well as the California Climate Action Registry's General Reporting and Certification Protocols
- ✓ Direct experience on O&G E&P-related projects for WRAP, the States of Wyoming and New Mexico, and the Independent Petroleum Association of Mountain States (IPAMS)

ENVIRON has also recently completed the development of detailed and greatly expanded area source oil and gas emission inventories for Western States for WRAP as part of the “Phase II” oil and gas area source inventory for this region. Prior to that effort, ENVIRON prepared an oil and gas emission inventory for all counties in Wyoming and two counties in New Mexico. In addition, ENVIRON has completed fully detailed bottom-up area source emission inventories for all counties in Wyoming, and for Clark County in Nevada. ENVIRON’s studies for Wyoming, New Mexico and the WRAP represent the first comprehensive emission inventories for these sources in the Western Region. ENVIRON’s work in developing oil and gas emissions inventories is described below and will serve as the basis for providing technical support to the preparation of a comprehensive GHG reporting protocol for oil and gas activities.

The WRAP Phase III work involves regular communication with most major companies in the oil and gas industry; with state regulators of most western states in which there is significant oil and gas activity; with federal regulators such as EPA and the Bureau of Land Management; with representative of tribal groups across the western regional U.S.; with citizen’s groups and environmental groups; and with the WRAP and WGA itself. ENVIRON will draw on this extensive experience with many of the major stakeholders involved in this effort to ensure a successful project.

Management Plan. The unique combination of SAIC’s protocol development team with ENVIRON’s oil and gas emission inventory experts will provide WRAP with unparalleled assurance that the protocols developed in this project will be both comprehensive and accurate. The upstream oil & gas sector is a very challenging one. It has a wide variety of combustion, fugitive, and venting emissions sources that not been comprehensively covered in any mandatory reporting framework to date. The SAIC/ENVIRON Team came together with a mutual recognition that this challenging sector can best be addressed through a combination of skills with oil and gas emission sources and in translating this emission source expertise into an effective reporting protocol framework. The SAIC/ENVIRON Team has held several conference discussions on the most streamlined and effective project management approach, which is summarized graphically below.



Key Personnel. As noted above, this project will be managed by Steve Messner. Mr. Messner will be supported by key staff members Chris Minnucci, Laura Gehlin (SAIC), as well as Amnon Bar-Ilan, Ron Friesen, and Alison Pollack (ENVIRON). Dr. Bar-Ilan will serve as lead for ENVIRON’s team. Table 1 summarizes the experience,

capabilities and qualifications offered by each of the SAIC/ENVIRON Team members. Biographies of the team members, along with their responsibilities on the project and their availabilities, follow the table. Resumes for all (key and non-key) team members are provided in the appendix.

Table 1. Qualifications of SAIC/ENVIRON Team Personnel

Needed Qualifications	Steve Messner	Amnon Bar-Ilan	Chris Minnucci	Laura Gehlin	Sandra Miranda	Ron Friesen	Alison Pollack
Detailed understanding of O&G E&P/gas processing activities, technologies, and emission sources	X	X			X	X	X
Detailed understanding of GHG accounting methodologies, data and emission factors for O&G E&P/gas processing sector	X	X				X	X
Experience in preparing emissions inventories for the O&G E&P sector	X	X				X	X
Detailed Understanding of TCR's GRP & GVP	X		X				
Experience in preparing GHG Inventory Protocols	X		X	X			

Steve Messner (SAIC), Project Manager – Mr. Messner will serve as Project Manager, responsible for leading the efforts of both the SAIC and ENVIRON team members. He will also serve as the main point of contact for the Steering Committee, the TWG and PAG, and WGA staff, and will attend all project meetings and conference calls. Mr. Messner's location on the west coast will enable him to attend the meetings called for in the project schedule without incurring excessive travel costs. Mr. Messner's availability for the project is 35% through December 2008 and 40% in 2009.

Mr. Messner is a well-known figure in the field of GHG accounting and project methodologies and is the Western Region Manager of Climate Change Services for SAIC's Climate Change team. He is now engaged with work on GHG project methodologies for the U.S. EPA, including methodologies for end uses of landfill gas and agricultural digester gas, commercial and industrial boilers, energy efficiency improvements, sulfur hexafluoride emissions from power industry equipment, and cement kiln improvements. He was the Project Manager and lead author for a 2007 project that developed the methodology for the California Climate Action Registry's first GHG offset protocol for the end use of methane from manure management. He is also the Project Manager for a current California Energy Commission project to improve the State's data tracking and metrics for conventional and alternative transportation fuel use to better determine greenhouse emission reductions. During his time as the Head of Climate Change and Emissions Services for Atkins in the UK, Mr. Messner was the Project Manager for the EU Emission Trading Scheme (ETS) accounting, data tracking, and compliance for Talisman Energy UK for eleven large offshore oil & gas platforms and two onshore processing facilities. Mr. Messner holds a B.S. in Petroleum Engineering from Stanford University.

Amnon Bar-Ilan (ENVIRON), O&G Emissions Expert – Dr. Bar-Ilan will serve as the project leader for ENVIRON's technical work on the project. He will be the point of contact for ENVIRON for the Steering Committee, the TWG and PAG and WGA staff for all issues related to the technical aspects of oil and gas GHG emissions estimates and methodologies. Dr. Bar-Ilan will attend all project meetings and conference calls and will be available to attend any other meetings called for in the project schedule. Mr. Bar-Ilan's availability for the

project is 50%.

Dr. Bar-Ilan is a manager located in ENVIRON's Novato office. Dr. Bar-Ilan is a mechanical engineer with a background in fundamental combustion studies; his doctoral research focused on understanding smoldering combustion mechanisms and emissions. Since joining ENVIRON Dr. Bar-Ilan has been involved in developing both the WRAP Phase II and the IPAMS/WRAP Phase III emissions estimates, leading the technical analysis, reporting and presentation for this work. As part of the Phase III work, Dr. Bar-Ilan has developed the highly detailed methodologies for estimating basin-level emissions of criteria pollutants from most oil and gas source categories across the development areas of the western regional U.S. He has also been involved in several oil and gas air quality modeling projects as an emissions expert, including the Four Corners Air Quality Task Force. He is currently working on developing a detailed methodology report for estimating oil and gas emissions in the central states for CENRAP, including updating the input data used by CENRAP to generate these inventories. He has worked on several projects to develop controls analysis and control scenarios for on-road mobile sources, non-road sources, and stationary sources, including an extensive controls analysis for the oil and gas industry as part of the WRAP Phase II work. His work has included estimating greenhouse gas emissions from a variety of sources, including the energy and oil and gas industries. Dr. Bar-Ilan holds a B.A. degree in Physics from Harvard University and Master's and Doctorate degrees in Mechanical Engineering from the University of California, Berkeley.

Alison Pollack (ENVIRON), Emissions Inventory Expert – Ms. Pollack will serve as the principal in charge of ENVIRON's technical work on the project, and will be responsible for overall review of ENVIRON's work products relating to the technical aspects of GHG emissions methodologies and estimates.

Ms. Pollack, a Principal at ENVIRON International Corporation, has been an air quality consultant for more than 25 years. She has extensive technical and managerial experience in the development of emission inventories and control strategies for air quality planning. Ms. Pollack is nationally recognized for her expertise in emissions analysis and modeling, and has served on three National Academy of Sciences Committees related to emissions and controls. Ms. Pollack has directed and/or served as Principal Investigator on a large number of emission inventory and modeling studies for both public and private sector clients. Ms. Pollack has directed all of ENVIRON's oil and gas emission inventory projects: for the Wyoming DEQ, NMED, WRAP, and IPAMS, as well as the emission inventory tasks for all oil and gas-related modeling projects, including the Four Corners Air Quality Task Force. Ms. Pollack has led numerous emission inventory efforts for mobile, area, and point source emissions, both for submission to EPA under the Consolidated Emissions Reporting Rule (CERR) and for use in SIP modeling. Ms. Pollack has degrees in Statistics from Princeton University and the University of Madison-Wisconsin.

Ronald A. Friesen (ENVIRON), O&G Emissions Expert – Ron Friesen will be part of ENVIRON's technical team, working on reviewing and developing detailed emissions GHG estimation methodologies for O&G sources for the protocol. Mr. Friesen will also work closely with SAIC on developing the protocol and integrating the technical methodology and reporting/verification segments of the protocol. He will also attend all project meetings and conference calls.

Mr. Friesen, a Manager with ENVIRON, has 31 years of experience in air quality planning and management in government and the private sector. Mr. Friesen has developed stationary source, area source, mobile source and transportation control measures, developed and updated point source and area source emission inventories, prepared emission forecasts, conducted cost-effectiveness studies of control measures, monitored plan implementation and prepared environmental impact reports. Mr. Friesen has a very good knowledge of emissions inventory methods for both area and point sources. Mr. Friesen has directly relevant experience in developing emissions inventories. Most recently, Mr. Friesen was involved in the development of emissions from oil and gas sources in the Western United States. Mr. Friesen was a co-author of the Ozone Precursors Emissions Inventory for San Juan and Rio Arriba Counties, New Mexico as well as Phase II WRAP Area Source Emissions Inventory Projections and Control Strategy Evaluation. Currently, Mr. Friesen is working on the WRAP Phase III Oil and Gas Emissions Inventory. Mr. Friesen has experience in developing emissions inventories for a wide variety of sources including the development of methodologies and an emissions inventory for oil production fugitives, oil pipeline pumping station

fugitives, oil production flashing losses, oil and gas storage tank cleaning and venting and oil production tanks. Mr. Friesen holds a Master of Science Degree in Mechanical Engineering from California State University in Sacramento is a registered Mechanical Engineer in California and Oregon and is certified as a Qualified Environmental Professional (QEP) by the Institute of Professional Environmental Practice.

Chris Minnucci (SAIC), TCR Protocol Expert – Mr. Minnucci will serve as technical lead on the Task 3 effort to prepare the protocol, including working with the Project Manager to assign the writing of specific sections of the protocol to individual team members, organizing the team's comment response efforts and ensuring that each comment is addressed and documented, editing each draft of the document, and formatting the protocol along the lines of the existing TCR protocols. In addition, Mr. Minnucci will provide technical support on Task 1, particularly with respect to addressing reporting boundary and other reporting issues in the Background and Scoping Paper. Mr. Minnucci will be available 20 percent of the time during October and November 2008, and 40 percent during January through June 2009.

Mr. Minnucci was the technical lead on SAIC's project to prepare both the Climate Registry's GRP and GVP. His other recent efforts include work for the U.S. EPA, where he is developing a greenhouse gas offsets performance standard, or accounting methodology, for greenhouse gas offset projects designed to capture and use coal mine methane. This performance standard will distinguish four types of coal mine methane projects; and it will define project boundaries, performance thresholds, and emission baselines for each project type. Mr. Minnucci was part of the original team involved in the development of the 1605(b) Voluntary Reporting on Greenhouse Gas Emissions Program. Mr. Minnucci has a B.S. in Mining Engineering from Pennsylvania State University. Mr. Minnucci will attend all meetings and conference calls related to the Task 3 protocol preparation effort.

Laura Gehlin (SAIC), Technical Editor – Ms. Gehlin will serve as the team's technical editor throughout the project. She will be responsible for editing the draft and final versions of the Task 1 Background and Scoping paper and the Task 2 Technical Review paper. In addition, she will support Mr. Messner and Mr. Minnucci on Task 3. Specifically, she will prepare the team's documentation of comments and comment responses, and she will assist in addressing comments, editing each draft of the protocol, and formatting the document.

Ms. Gehlin has 12 years of experience in energy and environmental analysis. During this time, she has developed extensive and diverse organizational, editing, communications, and data management skills, as well as specific expertise handling and addressing public comments on high profile documents. Her efforts include management of several databases and program websites for the U.S. Department of Energy (DOE) Energy Information Administration's (EIA) Voluntary Reporting of Greenhouse Gases Program. For this program, she also developed an application to collect, analyze, and track adjudication of public comments received during the development of the revised guidelines. In addition, Ms. Gehlin provides professional editing services to a wide variety of clients and colleagues and has edited several technical publications on the subject of energy and greenhouse gases. For example, she ensured the accuracy of all data published in the annual preparation of *Voluntary Reporting of Greenhouse Gases*, DOE/EIA-0608 from 1996 to 2002 and reviewed over 290 individual reports submitted to the program to determine their accuracy and consistency with regard to the reporting guidelines. Ms. Gehlin holds an M.A. in International Relations from Yale University and a B.A. in Portuguese and Journalism Mass Communication from the University of Iowa.

Sandra Miranda (SAIC), Literature Review Specialist – Sandra Miranda (SAIC), Literature Review Specialist – Mrs. Miranda will serve as a literature reviewer and technical support specialist throughout the project. She will research the different aspects of the O&G E&P sector and will compile and analyze the information. She has 3 years of prior experience in O&G E&P operations. During her time in SAIC she has served as an author of the Climate Change Related Impacts in the San Diego Region by 2050 report for the California Climate Change Center. Ms. Miranda has conducted research on a variety of energy and climate change-related topics, including research on carbon credit prices for CDM-JI projects for the Finance, Economics and Urban Department of the World Bank. She has performed program and operational analysis for multi-billion dollar corporations and has achieved significant corporate savings through creativity and initiative. She is a Chemical Engineer, MBA qualified.

2.0 PROPOSED WORK PLAN

Our proposed approach to each of the four tasks comprising the project is described below.

Task 1: Background and Scoping Paper. As our first task, the SAIC/ENVIRON Team will prepare draft and final versions of a paper that will provide background information on the O&G E&P sector and its emissions sources, and that will examine in detail the various relevant accounting methodologies and address various reporting and verification issues. The overall objective of the paper will be to provide the WGA's Project Steering Committee, the Technical Workgroup, and the Protocol Advisory Group (PAG) with a detailed, comprehensive analysis of the technical issues surrounding the estimation, reporting, and verification of GHG emissions in the O&G E&P sector, and that discusses the options (including pros and cons) and presents the team's recommendations for addressing each of these issues. To meet this objective, the SAIC/ENVIRON Team will be able to draw not only on the relevant literature, but on our own experiences grappling with these issues in the course of our work to estimate E&P emissions for a wide variety of clients. We are thoroughly familiar with the O&G E&P sector, its GHG sources, and the challenges involved in quantifying these emissions sources, and in fact we have made our own contributions towards improving emissions quantification methods for the sector.

Mr. Messner (SAIC) was one of the expert reviewers for the late 2005-early 2006 California Energy Commission (CEC) and CCAR project that reviewed IPIECA's *Petroleum Industry Guidelines for Reporting Greenhouse Gas Emissions* and API's *Compendium of Greenhouse Gas Emissions Estimation Methodologies for the Oil and Gas Industry* and evaluated their consistency with the CCAR's General Reporting and Certification Protocols developed by SAIC. This experience reinforced our belief that this is a challenging sector from a technical standpoint and can have deep rooted disagreements over quantification approaches. In addition, ENVIRON is currently involved in a large-scale inventory development project for WRAP/IPAMS to develop the most highly detailed oil and gas exploration and production emissions for all major basins in the Rocky Mountain States. As part of this work, ENVIRON has been authoring methodologies for estimating emissions from critical oil and gas source categories, and has developed an extensive database of information on oil and gas emissions source categories, their ranked contributions to emissions from this industry, and has gained a keen understanding of the issues related to company-level inventory data and the development of regional inventories. In the central states region, ENVIRON is preparing a scoping paper that provides detailed criteria pollutant methodologies and input data to CENRAP, WRAP's sister organization. This CENRAP scoping paper is very similar in scope to the work to be conducted in Task 1 and ENVIRON will bring this experience to bear on this proposed work.

The background and scoping paper will:

- *Provide overviews of the O&G E&P and gas processing sectors in North America and within the jurisdictions of the Western Climate Initiative.* Under the minimum scope effort, the overviews will address all land-based and off-shore based O&G E&P, gas processing operations, and collection systems delivering oil and gas products to processing and refining facilities, with the exception of oil sands and oil shale operations; under the expanded scope oil sands and oil shale will be addressed as well. The SAIC/ENVIRON Team is thoroughly familiar with the relevant literature and information sources on these sectors, and will therefore be able to summarize the relevant information from these sources in a highly efficient manner. For example, because we have served as one of the Energy Information Administration's (EIA) main support contractors for 20 years, SAIC is thoroughly familiar with EIA's data surveys and databases related to O&G E&P, as well as EIA's sector analytical reports and Annual Energy Outlooks (AEO). In fact, SAIC has been a contributor to many of the analytical reports, and we have been responsible for the development, operation, and maintenance of the oil and gas forecasting modules of the National Energy Modeling System (NEMS) used to produce the AEOs since NEMS' inception in the early 1990s. In addition, SAIC led the effort to convert the NEMS model to a Canadian energy model (MAPLE-C) for Natural Resources Canada, and as a part of this effort we developed a new NEMS submodule to represent Canadian oil sands. (Chris Minnucci of the SAIC/ENVIRON Team was manager of SAIC's NEMS modeling team for the period 2001-06, and he led the effort to develop MAPLE-C.) We believe it

is important that the overview address not only the sectors' current economics, operations, and technologies, but that it looks forward to new developments in all these areas, particularly as these developments may affect the types and relative magnitudes of the sectors' emission sources going forward. The insights we have obtained into potential future developments in the O&G sectors, both as a result of our modeling work and our extensive experience working for O&G clients on their emissions inventories, will enable us to bring a forward-looking perspective to the overviews. This forward-looking perspective will in turn help us ensure that the protocol not only responds to current needs and priorities but anticipates future priorities/requirements as well.

- *Provide a comprehensive catalogue, including a description and prioritization, of emissions of the six Kyoto GHGs by source from oil and gas field operations and gas processing plants, including direct and indirect (Scope 1 and 2) emissions, and combustion, fugitive, vented, mobile source, and stationary source emissions.* This catalogue will provide a comprehensive identification of all land-based and off-shore sources except oil sands and oil shale sources; however, the latter two sets of sources will be included in the catalogue under the expanded scope effort. This catalogue of sources will be developed by the SAIC/ENVIRON Team and will draw from ENVIRON's work in developing the emissions inventories for the WRAP for these source categories in the comprehensive Phase III emissions inventory effort. An example of the inventory methodology and results for the Phase III work is provided as a sample work product included with this proposal. Through that work ENVIRON has already created a detailed list of direct GHG source categories for consideration in all E&P activities, as well as in gas gathering and transmission (midstream) activities. These include sources related to drilling and workovers of wells; combustion source categories related to production such as compressor engines, pumpjacks, flares, dehydrator-, amine unit-, and tank-heaters and boilers as well as other miscellaneous engines; venting sources such as completion venting, well blowdowns, and compressor engine start-ups and shut-downs; fugitive sources such as flashing and working/breathing losses from stock tanks, pneumatic devices, wellhead fugitive losses, pipeline fugitive losses, and compressor station/gas plant fugitive losses. In the process of developing the scope of work for the Phase III project, ENVIRON has identified the prioritization of these direct source categories with respect to criteria pollutant emissions. As part of this task the SAIC/ENVIRON Team will extend this prioritization and ranking to GHG emissions from these sources using the detailed basin-level data acquired as part of the work which includes key information on gas speciation that can be used to accurately assess the methane and CO₂ emissions from venting and fugitive sources. In addition to this, the SAIC/ENVIRON Team will use its knowledge of detailed O&G operations to expand the source category catalogue and rankings to include indirect sources such as transportation of goods/materials and energy generation. The SAIC/ENVIRON Team will work closely with industry to ensure that the catalogue of indirect sources has identified all aspects of conventional oil and gas E&P and gathering/transmission activities. The following is a list of oil and gas GHG sources that include exploration & production activities, gathering/transmission, gas processing, mobile sources, and electricity/heat imports. The list is not intended to be comprehensive, but includes the following source categories:

Gas well tanks – flashing and working & breathing losses	Compressor start-ups and shutdowns	Salt-water disposal (SWD) engines
Oil well tanks – flashing and working & breathing losses	Miscellaneous gas-fired heaters or boilers	Artificial lift engines (pumpjacks)
Gas well truck loading	Dehydrators	Frac pumps
Oil well truck loading	Amine units	Gas turbines
Pneumatic devices	Completion venting	Large compressor engines
Gas well fugitives	Well blowdowns	Miscellaneous engines
Oil well fugitives	Compressor blowdowns	Flares
Gas Pipeline fugitives	Pipeline blowdowns	Incinerators
Oil pipeline fugitives	Boilers/steam generators	Heavy-duty trucks
Land farms	Oil well heaters	Medium-duty trucks
Water treatment facilities	Gas well heaters	Light-duty trucks

(evaporative ponds)		
Chemical injection pumps	Lateral/wellhead compressor engines	Passenger vehicles
Well testing	Drill rigs	Planes/helicopters
Exploratory drilling	Workover rigs	Supply boats/barges
Gas processing plant fugitives	CBM pump engines	Electricity imports
Vapor recovery unit (VRU) engines	Process heat/steam imports	

As part of the expanded scope effort, the SAIC/ENVIRON Team will include oil sands and oil shale sources. To catalogue these direct and indirect sources, the SAIC/ENVIRON Team will rely on its contacts with oil and gas companies involved in this type of development and on a literature review to identify studies that have examined oil shale and oil sands source categories, such as those conducted in the Province of Alberta in Canada. The work product will be separate ranked lists of direct and indirect source categories from oil shale and oil sands activities respectively. Special consideration will be given to the indirect sources, particularly those related to mining and power generation as they are expected to be higher indirect source categories for this activity. A fuller discussion of the expanded scope effort for oil sands and oil shales is provided below after the Task 4 discussion.

- Provide an examination of current GHG accounting methodologies, data and emissions factors. Based on published literature, the SAIC/ENVIRON Team will describe current best practice emissions estimation methods for these emission sources, and the origin of these methods.* The minimum scope effort will address estimation methods for all sources *except* those unique to oil sands and oil shale; under the expanded scope estimation methods for these latter sources will be addressed as well. ENVIRON’s detailed database of information on E&P and transmission/gathering source categories provide the SAIC/ENVIRON Team with a unique resource of information on key input data from which the team can create a very detailed examination of GHG methodologies and data to be used to ultimately derive highly-accurate GHG emissions factors. ENVIRON has developed, and in some cases authored, the methodologies used to develop inventories of criteria pollutant emissions from a wide range of E&P and transmission/gathering source categories on the county and basin level for all of the Rocky Mountain States that are being used now by WRAP and other RPO’s in regional haze modeling. In parallel, the SAIC/ENVIRON Team will review available literature to determine if methodologies are available for estimation of GHG emissions from other source categories that are not included in the scope of the Phase III work. This literature review will include the API Compendium, EPA documentation such as AP-42, and methods developed by state and other regulatory agencies in oil and gas inventory work as well as methodologies developed by industry for their internal GHG inventories. For the expanded scope, this will include reviewing all available information on oil sands and oil shale development, including oil sands activity in Alberta Province, Canada, and planned oil shale activities in the continental U.S. by some of the major oil and gas companies. With regards to the input data and emissions factors, ENVIRON has developed a large database of equipment, activity, usage, configurations, emissions factors, gas and oil chemical composition analyses, and other key input data that will be used to estimate emissions factors of all GHGs. This database is unique in its level of detail and geographic and source category resolution including detailed speciation data, which can be used to inform company-level GHG accounting.

ENVIRON has also developed a number of techniques by which regional variations in a single company’s production activities can be accounted for in an estimate of company-wide GHG emissions. ENVIRON’s experience in development of oil and gas criteria pollutant inventories on the basin level has shown that local variations in production activity and the gas, oil or condensate produced can greatly affect both the emissions from individual source categories, and the ranking of top source categories. This is particularly true for venting and fugitive source categories if the local region has particularly high or low methane content of produced gas, but this effect is also observed in the variation of oil or condensate production from region to region. The local region may be as small as an individual oil or gas formation, or field, or basin. A number of averaging methodologies can be employed to derive representative information for the

field, formation or basin level to determine the appropriate geographic unit by which to account for GHG emissions from particular source categories.

It is expected that this portion of the scoping paper will provide a comprehensive methodology description and recommended input data and factors to use in estimating GHG emissions from the source categories identified, presented as a data matrix for all source categories. ENVIRON is currently engaged in preparing just such a scoping report for CENRAP (including GHGs) and the team will draw upon ENVIRON's experience in the CENRAP project in the preparation of the scoping paper.

- *Address reporting boundary considerations within the sector (as they relate to TCR boundary requirements), including an overview ownership arrangements, joint ventures, and co-located facilities; control versus equity share reporting; lease and service contract arrangements; options for installation/facility definitions; and potential geographic boundary considerations.* The minimum scope effort will address reporting boundary issues for all operations *except* oil sands and oil shale; under the expanded scope issues unique to these latter sources will be addressed as well. Effective performance of this subtask will require a contractor that combines a thorough knowledge of the various ownership, control, leasing, and contractual arrangements found in the O&G E&P sector with an intimate understanding of the TCR's reporting rules regarding geographic boundaries, organizational boundaries, operational boundaries, and the definition of a "facility." The SAIC/ENVIRON Team brings this combination of industry expertise and protocol understanding together. We are thoroughly familiar with the relevant information sources for the E&P sector, including, e.g., the IPIECA Guidelines, the TIAX summary of the IPIECA Guidelines, EIA's Financial Reporting System (FRS), and the U.S. Environmental Protection Agency's (EPA) criteria emissions reporting system

Using this unique combination of industry expertise and intimate familiarity with the TCR protocols, the SAIC/ENVIRON Team will first develop a comprehensive identification of the various parent/subsidiary, ownership, control, leasing, and contracting arrangements that apply within the sector, as well as jurisdictional and facility-definition issues related to the physical layouts and geographic locations of sector operations. Then, based on an analysis of how the TCR protocols would apply to each of the various legal arrangements and location issues thus identified, the SAIC/ENVIRON Team will identify those specific types of arrangements and issues which do not lend themselves to a simple, clear-cut application of the TCR rules, and that therefore may be deserving of their own treatment in the O&G protocol. The proper procedures for applying the TCR's general protocols to these more challenging situations will be addressed in depth in the Background and Scoping Paper. Specific examples, drawn from our "real-world" experience, will be developed to help clarify these procedures. Situations that tend to be challenging from a reporting boundary definition perspective, and that will therefore likely need to be addressed in the paper (and the protocol itself) include, e.g., responsibilities for the reporting of emissions associated with leased equipment and outsourced activities under the control and equity share consolidation methods, as well as the assignment of these emissions to the different Scopes (1, 2 and 3). Furthermore, geographic boundary issues will likely need to be addressed in the case of offshore operations, while the definition of what constitutes a "facility" presents unique challenges for the O&G E&P sector. With respect to the latter issue, it is important to note that the TCR's GRP allows the aggregation of emissions by facility type, rather than individual facility, for certain special categories of facilities including oil and gas wells as well as pipelines. Emissions from these facility types can be aggregated to the state, province or territory level (and in some limited situations to the national or even continental levels). In addition, geographic boundary considerations must be taken into account when addressing a single company's or entity's operations over regions with very diverse production characteristics, such as mixes of gas and oil/condensate production, and variations in gas methane and carbon dioxide content as it affects venting and fugitive source categories.

- *Address other GHG emissions reporting considerations, including carbon dioxide equivalence, small source considerations, efficiency metrics, and other optional reporting allowed under the TCR (e.g., reporting of Scope 3 emissions, additional emissions beyond the six Kyoto GHGs, historical reporting and*

transitional reporting). As the TCR's support contractor for the preparation of the GRP, SAIC is thoroughly familiar with the TCR's various reporting options, as well as its rules and requirements concerning, e.g., establishing and updating base year data, use of "simplified estimation methods" for small emission sources (defined as any combination of sources that, in aggregate, account for 5 percent or less of an entity's total emissions). Once again, as in the prior bullet item the SAIC/ENVIRON Team's combination of industry expertise and protocol knowledge will enable us to identify and address potential situations in the O&G E&P sector that pose special challenges for the application of the TCR protocols. For the expanded scope effort, these special challenges will include those related specifically to oil sands and oil shale operations as well as other O&G E&P and gas processing operations. The development of efficiency metrics, such as intensity ratios that measure emissions per unit of physical activity or economic output, represents one such challenge. To address this challenge, SAIC will be able to draw on its experience as EIA's support contractor in the development of the new 1605(b) reporting system—a system specifically designed to collect GHG emissions intensity data. In the case of the O&G E&P sector the SAIC/ENVIRON Team will develop recommendations for efficiency metrics taking into account the following possibilities: average emissions intensity in terms of GHG emissions per unit of hydrocarbon produced; variation of emission intensities by type of production operation (e.g. primary recovery, thermally enhanced, waterflood, etc); variations of emissions and emission intensities with maturity of the producing field; changes in emissions and emission intensities with the API gravity of the oil produced and with different oil producing geological formations; share of direct and indirect emissions (e.g. emissions coming from purchased electricity or other sources of energy such as steam); how upstream emissions are apportioned between exploration, production and transportation activities, etc.

- *Address verification issues specific to the O&G sources.* This is another task that the SAIC/ENVIRON Team is particularly well suited to perform. In addition to SAIC's past work with general verification protocol development, Steve Messner from SAIC is currently on TCR's Verification Oversight Panel which was formed to input on Registry's verification and accreditation programs to ensure they are appropriate, effective, and efficient and advise TCR on new verification and accreditation issues as they arise. Verification in upstream oil & gas operations poses special challenges that will be highlighted in the scoping paper in order to develop a sector specific verification protocol for oil & gas operations. Although the larger pieces of combustion equipment will be similar, from a verification standpoint, to other industries, E&P operations can have a wide distribution of small combustion devices and flares that may not be equipped with metering with the accuracies typically associated with larger devices. In many cases, metering may be entirely absent and other parameters are tracked to make a fuel use determination. This issue will be explored further in Task 2, but it will be important to keep in mind the verifier's perspective during the Task 2 analysis. In addition, E&P operations are often associated with a number of process and non-routing venting and blowdown events that are typically recorded in a non-standardized manner – often relying on field operator log books and estimates of rates and duration of venting. A verifier without a good background in E&P operations may not recognize the difference between well-kept logs with good estimates of venting information versus poorly kept records. We will explain these issues, as they will affect the form of the final O&G verification protocol and the specific guidance that will be developed here.
- *Develop outlines of the Task 2 and 3 products.* Finally, the Task 1 Background and Scoping Paper will provide annotated outlines of the Task 2 technical review paper and the Task 3 draft protocol. We anticipate that the Task 2 paper will be organized along the lines of the emission source types identified in Task 1 (including oil sands and oil shale sources if the expanded scope is in effect), perhaps as prioritized in the Task 1 paper. The Task 3 protocol organization will be modeled on the organization of the TCR's General Reporting Protocol.

The draft version of the paper will be modified to address comments, in consultation with the TWG and Steering Committee.

Task 2: Technical Review of High-Tier Emissions Quantification Methods. In task 2 the SAIC/ENVIRON

Team will technical review paper that addresses methodologies and emissions quantification methods for “high-tier” source categories identified in Task 1. The purpose of this technical review is to provide a comprehensive recommendation for methodologies to estimate GHG emissions from these source categories that are likely to be top contributors to the GHG inventories from this industry.

The technical review will:

- *Prioritize sources for mandatory reporting, considering the magnitude of known or projected emissions.* In this task the SAIC/ENVIRON Team will identify the high-tier sources likely to be major contributors to the GHG inventories from oil and gas exploration and production, field gathering/transmission of oil and gas products to processing and refining facilities, and gas processing activities. In order to do this, the team will analyze the variations in the production, transmission/gathering and processing activities on a regional basis to determine the most appropriate geographic unit by which to create the ranking of high-tier sources for various entities, as discussed in Task 1. There is expected to be significant variation in the ranking lists depending on the region under consideration, and thus some quantification of emissions would be needed to determine the high-tier source category ranked list on the basis of the most appropriate geographic unit. The team proposes to do some emissions quantification using the very detailed criteria pollutant inventories developed by ENVIRON as part of the Phase III work (and provided as a sample work product included with this proposal). These inventories can be easily expanded on to include CO₂ and CH₄ emissions from combustion sources such as compressor engines and drilling rigs. The inventories have also developed very detailed databases of information on regional gas and oil/condensate compositions that can be expanded upon to include quantification of direct vented or fugitive CH₄ or CO₂ emissions from these activities. In addition, for sources not considered as part of ENVIRON’s past work on oil and gas inventories, such as mobile source emissions, and indirect sources such as goods transport and electricity usage, the team will use activity information compiled as part of the Phase III work, other existing emissions inventories and other literature review to rank these sources and include them in the high-tier categories as appropriate. This quantification – for both those sources considered in Phase III and other sources – will not be as detailed as the type of inventory development work done by ENVIRON in the past, but will be sufficiently quantitative to allow for ranking of the various high-tier categories. The end result of this quantification is the identification of the high-tier sources on the basis of the most appropriate geographic unit, whether within the boundaries of a large region or on the basis of an individual company’s operations.
- *Evaluate existing GHG accounting strategies and available data and emission factors. Discuss limitations inherent in currently available accounting methodologies, emission factors and data, focusing on the largest GHG sources.* For this portion of the technical review the team will review literature, including the work conducted by ENVIRON, to determine the most appropriate methodologies for accounting for GHG emissions from these high-tier source categories. In addition, under this task the team will attempt to identify the most appropriate input data to use for these methodologies, including emissions factor and activity data. The methodology literature will be reviewed with several key criteria to help determine what the limitations of these methodologies are. These criteria include:
 - What was the activity data used and how was the activity data derived?
 - Are the methodologies based on “bottom-up” or “top-down” inventory methods?
 - What geographic considerations were included in the determination of these methodologies? Do the methodologies have the ability to account for variations in production activities and the product itself (e.g. chemical composition and dry vs. wet gas) over some geographic domains?
 - What surrogates are used in the methodologies to scale the emissions from individual sources to company-wide, entity-wide, or region-wide GHG emissions? Are other surrogates available which would more accurately represent these emissions?

The SAIC/ENVIRON Team will document the results of this review, including identifying deficiencies in the methodologies from applying the criteria described above, and others, to the existing methodologies

from the full range of high-tier source categories considered.

- *Identify current methodological deficiencies for these high-priority sources; propose and discuss high-tier alternative sampling and/or analytical methodologies designed to address these deficiencies and improve emissions data quality.* The SAIC/ENVIRON Team will conduct a thorough review of those methodologies already published in studies and literature to estimate emissions from the high-tier source categories identified as part of this task. As described above, various criteria will be used to evaluate these methodologies and their input data to determine whether there are deficiencies in the methodologies. Based on the criteria above, any deficiencies identified will be documented, and the team will develop solutions to address these based on extensive experience in estimating oil and gas emissions and activity. For example some methodologies for estimating total wellhead compression GHG emissions rely on scaling individual engine emissions by gas production as a scaling surrogate. However, ENVIRON's past work in oil and gas inventory development indicates that it may be more appropriate to use well counts for determining regional or company-wide wellhead compression emissions. Gas production as a surrogate may understate the fractional usage of wellhead compression, particularly for fields that are in decline. For each deficiency identified in the methodology review for the high-tier sources, the team will present in the technical review a recommendation for addressing the deficiency and improving the methodology if an alternative methodology can be found or developed. Addressing deficiencies may require acquisition of additional data, such as gas and oil/condensate composition analyses, venting rates, or leak detection from pipelines. The technical review will recommend where such additional sampling would be needed to greatly improve the input data to a high-tier source GHG emissions calculation methodology. In addition the technical review will discuss issues of averaging this sampling data, the domains over which the sampling data is averaged, and the degree to which the sampling data is representative of the operations in a particular geographic domain.

A draft version of the technical review will be provided to the TWG and Steering Committee for review. The SAIC/ENVIRON Team will work with the TWG and Steering Committee to address any comments or further considerations before finalizing the review.

Task 3: Protocol Draft and Preparation. Using the information and analyses presented in the Task 1 and 2 deliverables, along with guidance from the TWG, the SAIC/ENVIRON Team will prepare a comprehensive reporting and verification protocol for the O&G E&P and gas processing sector. This protocol will be designed to complement and supplement the TCR's GRP and GVP, by providing comprehensive guidance sufficient to address the reporting and verification of GHG emissions from all major O&G E&P and natural gas processing operations within Canada, the United States, and Mexico. In addition to emission estimation methods for all sources, the protocol will address key entity GHG accounting concepts (e.g., organizational and operational boundaries), to the extent that unique or particularly challenging situations within the sector (as identified in Task 1) will require explanation of how the TCR's general reporting protocols would apply to these situations. To facilitate the use of the new protocol in conjunction with TCR's existing protocols, the team plans to model the organization and format of the O&G protocol on the existing documents (with two separate main sections—one for reporting and one for verification—as opposed to two separate volumes). Up to four sequential drafts of the protocol will be prepared, as well as one final version; each draft will address comments received from the TWG, the Steering Committee, the public, and/or the TCR Board on the prior draft. The assumptions, methods, and uncertainties underlying the protocol will be thoroughly documented. Under the expanded scope, the protocol will include accounting rules and estimation procedures for emissions sources unique to oil sands and oil shale, as well as the necessary rules and procedures to cover all other O&G E&P/gas processing emission sources.

It is critically important that the protocol provides a clear, unambiguous, thorough, and precise understanding of the reporting rules and estimation methodologies to the reporter. SAIC has extensive experience in the preparation of protocols designed to explain complicated emission reporting concepts and rules in easy-to-understand language. This experience includes not only our preparation of the CCAR and TCR general reporting and verification protocols and the Form EIA-1605 guidelines and instructions, but standardized baseline and project emission quantification protocols for power generation projects and compressed natural gas (CNG) vehicles (for the National

Energy Technology Laboratory), for manure management projects (for CCAR), for industrial and commercial boilers, transportation fuel switching, landfill methane, coal mine methane, iron and steel efficiency improvements, transit bus conversion to hybrids, cement production, sulfur hexafluoride emission reduction projects, and terrestrial carbon sequestration (for the Environmental Protection Agency's Climate Leaders program). Furthermore, SAIC's and ENVIRON's work for commercial clients has provided us with the opportunity to understand emissions quantification and reporting from the standpoint of the audience for our protocols. This commercial experience has provided us with insight into the GHG accounting concepts and estimation methods that present particular challenges to the reporter, and the best ways for explaining these concepts and methods in a clear, comprehensible manner.

One of the lessons we have learned during our long experience explaining GHG reporting rules and estimation methods in written documents is that different readers respond to different explanatory approaches. For those who tend to think visually, a good, accurate graphical depiction of a concept is often clearer than a text description. For others, a few concrete examples help to clarify an abstract rule. Therefore SAIC uses figures and examples extensively in the protocols it writes (see, e.g., our use of examples and graphics in the TCR GRP). We plan to follow the same "road-tested" approach in preparing the O&G protocol.

In addition to the protocol itself, the SAIC/ENVIRON Team will prepare a separate document summarizing all comments received on each draft of the protocol, and the response to each of these comments. SAIC has extensive experience organizing responses to comments received from multiple committees and the public. As just one example, TCR received over 1000 comments on the first publicly-released draft of the GRP. SAIC was able to help TCR evaluate and address these comments within a two-month time frame.

Task 4: Technical Meeting Review Support. Under Task 4, the SAIC/ENVIRON Team will support the TWG and PAG in preparing, and participating in, all TWG, PAG, and public meetings. Close communication between the TWG and the SAIC/ENVIRON Team will be essential to the success of the project. In particular, careful listening will be required of the team during meetings as the TWG and PAG deliberate on the issues. The SAIC project manager and key team members will represent the team at all meetings, and will work with the TWG and PAG leaders both prior to and during meetings to help facilitate productive discussions. In particular, SAIC's recent experience participating in the conference calls by TCR's Protocol Workgroup and Programs and Protocol Committee, and supporting TCR staff in the preparation of presentation materials for these conference calls, has illustrated to us the importance of providing concrete options with supporting pros and cons to help inform and guide committee deliberations on complex GHG accounting and estimation issues.

In addition to participating in TWG, PAG and public meetings, under Task 4 the SAIC/ENVIRON Team will prepare monthly project status reports. In addition to summarizing labor-hours spent and deliverables provided during the month, these status reports will also summarize:

- Project activities during the month;
- Planned activities for the next month;
- Problems/Issues – a discussion of problems or difficulties either anticipated or encountered; and
- Funds – as applicable, total funds expended during the month, cumulative total to date, outstanding commitments, and percentage of approved funds spent to date.

Under problems/and issues, SAIC will also offer proposed solutions. Finally, each Monthly Status Report will include a lessons learned section.

Project Schedule and Deliverables. SAIC confirms the project schedule as delineated in Section 3.2 of the RFP. It is understood and accepted that the precise dates for meetings and deadlines for deliverables will be determined upon contract award and will depend on the actual start date upon contract signature.

It should be noted that the schedule is quite aggressive. It will be challenging even for our project team with the combination of O&G E&P emissions estimation expertise and protocol development experience. By virtue of our extensive experience in both of these areas, the SAIC/ENVIRON Team will be fully ready to “hit the ground running” on Day One of the project and meet the schedule. SAIC has met similarly aggressive schedules, most recently on our project supporting TCR in the preparation of the GRP and GVP. The schedule for that project was at least as aggressive, if not more, than the schedule outlined in Section 3.2 of the RFP. To meet TCR’s schedule, SAIC completed a 100-plus page first draft of the GRP within 3 weeks of contract award, we addressed over 1000 public comments on the GRP, we prepared over five separate versions of the GRP, and over five separate versions of the GVP, and we completed final versions of both documents within eight months of project initiation. The SAIC/ENVIRON Team is also aware that this industry sector is complex as well as being very detail oriented on issues characterizing emissions. Detailed and extensive comments are the norm in this sector, not the exception. This fact could potentially result in an adjustment to the time schedule, although that would be fully discussed with the TWG and PAG at the time.

SAIC proposes to provide the following deliverables and services for WRAP:

1. Draft Task 1 Background and Scoping Paper
2. Final Task 1 Background and Scoping Paper, including separate documentation of analysis and response to comments on the draft paper
3. Draft Task 2 Technical Review of High-Tier Emissions Quantification Methods Paper
4. Final Task 2 Technical Review of High-Tier Emissions Quantification Methods Paper, including separate documentation of analysis and response to comments on the draft paper
5. Three or Four Drafts of the Task 3 Protocol (depending on WGA’s needs), including separate documentation of analysis and response to comments on each prior draft. For budgeting purposes, we have assumed 4 drafts total.
6. Final Task 3 Protocol, including separate documentation and response to all comments on the final draft Protocol
7. Participation in all TWG and public meetings called for in the project schedule provided in Section 3.2 of the RFP

Expanded Scope. Should the project scope be expanded to include oil sands and oil shale, it will be necessary to consider additional emissions sources beyond those associated with conventional oil and gas resources. This follows from the fact that oil sands and oil shale extraction techniques differ from conventional drilling and, furthermore, upgrading of the recovered oil is generally required prior to the refining process.

Commercial oil sands operations are currently limited to Alberta, although it should be noted that oil sands deposits also occur in eastern Utah. Two basic types of recovery methods are currently utilized in Alberta: *in situ* and mining. The *in situ* method is used to recover oil sands deposits that are too deep to be economically recoverable via mining. Although *in situ* recovery involves the drilling of wells, it also requires underground heating because the bitumen is too viscous to be pumped from the ground in its natural state. Steam injection is currently the favored heating method in Alberta, although solvent injection and firefloods (in which oxygen is injected and part of the resource burned to produce heat) are alternative approaches. Emissions associated with steam injection include those resulting from the fuel consumed to generate the steam, as well as those from the energy used to pump the water from its source(s) and the oil sands/water mixture from the ground. Emission estimation methodologies that have been developed for stationary combustion sources will be applicable to many of these sources.

The second oil sands recovery method in use in Alberta is open pit mining, in which any material overlying the bitumen is drilled, blasted and removed by shovels, so that the underlying tar sands can be loaded into off-road trucks for transportation to the extraction plant. Key emissions sources for tar sands mines include shovels, trucks, front-end loaders, bulldozers, etc. Most of this equipment runs on diesel fuel, but some (e.g., shovels) are electrically-powered. Estimation methods that have been developed for mobile combustion sources will be

applicable to the former, while methods developed for electricity generation and use will need to be applied to the latter.

Oil shale, unlike oil sands, has not been exploited on a significant commercial scale to date; currently there is only one small oil shale demonstration project in operation, in Colorado. However, development and testing of the potential techniques for producing oil shale goes back to the 1970s. The basic process, retorting, involves heating the shale to release the oil. Retorting can occur either *in situ*, where the oil shale is heated in place and the released oil is then extracted; or on the surface, after the shale has been mined and transported to a retort facility. In addition to surface mining techniques such as the open pit mining method used to produce oil sands, underground room and pillar mining may be applicable to deeper-lying oil shale deposits. Again, diesel mining equipment, as well as the power plants used to generate electricity for electrically-powered equipment, will represent significant emissions sources for oil shale mines, while the fuel used in the retorting process to heat the shale (either above or below ground) will be an additional significant emissions source.

3.0 BUDGET

- ATTACHMENT 1: Proposer Cost Submittal Sheet**
- ATTACHMENT 2: Budget Proposal for Basic Scope of Work**
- ATTACHMENT 3: Budget Proposal for Expanded Scope of Work**

4.0 RELATED EXPERIENCE STATEMENT

The SAIC/ENVIRON Team has successfully performed projects that cover the range of issues and require the kinds of services outlined in the RFP.

- ATTACHMENT 4: Representative Projects**

5.0 SAMPLE WORK PRODUCTS

- ATTACHMENT 5: SAIC - The Climate Registry General Reporting Protocol**
- ATTACHMENT 6: ENVIRON – Development of Baseline Emissions from Oil and Gas Activity in the Denver-Julesburg Basin**

6.0 RESUMES

- ATTACHMENT 7: Resumes**