

Chris A. Minnucci GHG Reporting and Verification Protocol Expert

Education

- 1979, BS, Mining Engineering, Pennsylvania State University

Experience

Science Applications International Corporation (SAIC), March 1983–Present

Program Manager

- For the U.S. EPA, 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.
- Currently, he is managing SAIC's project to prepare both The Climate Registry's (TCR) General Reporting Protocol and Verification Protocol. As a part of this effort, he developed a thorough, detailed knowledge of all of TCR's reporting requirements, and used this knowledge to prepare numerous examples of the application of these requirements to various industry sectors, including the electricity sector.
- For EPA, currently developing the draft 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. The performance thresholds and baselines are being developed based on an analysis of a mine-level database of coal mine methane emissions and mining methods.
- Also for EPA, he is supporting the development of inventory guidance for the Climate Leader's program.
- For the DOE's NETL, currently developing a set of MACs for GHG mitigation technologies, including carbon capture and storage and SECA fuel cells. The MACs are being developed by executing the National Energy Modeling System (NEMS) under alternative carbon tax levels, with and without each mitigation technology. In addition, will develop a MAC for the entire portfolio of mitigation technologies.
- For NETL, reviewed methods for comparing cost of adaptation options with cost of mitigation; developed a method to assess the impact of future climate change on the U.S. energy sector; and prepared a paper on the critical, generalized effects of climate change on the energy sector.
- For Maryland, applied a detailed energy and economy-wide model to the assessment of potential emission reductions resulting from more than 20 policies and programs under the state's consideration. The programs and policies covered most of the energy supply and demand sectors, including the electricity, coal mining, residential, industrial, and transportation sectors.
- For the U.S. Department of Transportation (DOT), assessed the feasibility of using NEMS as an overarching framework for a linked system of models designed to address the effect of GHG emissions on options in the transportation sector. As a part of this study, conducted an assessment of DOT's modeling user needs. This user-needs assessment included in-depth interviews of key users, as well as a comprehensive review and analysis of model documentation and modeling studies. Investigated potential solutions to the challenge of developing a modeling system, and assessed each option in terms of technical feasibility, advantages and disadvantages, and resource requirements.
- Participated in the development of Form EIA-1605 for the voluntary reporting of GHG emissions and emission reductions. EIA was responsible for developing the survey forms under Section 1605(b) of the Energy Policy Act of 1992. Designed and developed those sections of the form (and accompanying instructions) addressing GHG emissions and emission reductions in the electric utility sector.
- Led a task to analyze the variation in the ratio of carbon content to heat content for U.S. coal. The analysis results established the statistical significance of the relationship between the carbon/heat content ratio and the explanatory variables, including coal rank and geographic region. Based on these findings, developed detailed CO₂ emission factors by coal rank and state, and used the factors to estimate national and state-

level CO₂ emissions from coal-burning power plants in 1980, 1985, and 1990. In 1994, EIA published results of the study.

- Managed SAIC's Energy Modeling and Forecasting (EMF) practice, including an annual budget of approximately \$1.3 million, and a staff of nine comprising econometricians, OR analysts, engineers, and computer scientists. Representative projects within the EMF practice include a project to develop a Canadian energy market model for Natural Resources Canada (NRCan) to support Canada's assessment of GHG reduction policies and programs. EMF staff members are also responsible for the operation, maintenance, and improvement of models for U.S. federal government agencies such as the Energy Information Administration (EIA) and National Energy Technology Laboratory (NETL). The EMF practice also deployed models to estimate the benefits from DOE's fossil energy R&D programs.
- For NETL, assessed proposed methodologies for analyzing Clean Development Mechanism (CDM) projects. The assessments addressed advantages and disadvantages of each methodology with respect to determining additionality and the estimation of project emission reductions.
- Conducted coal utility- and electric utility-related data analysis and modeling studies for the EIA. Led the effort to design, develop, and implement the Coal Production Submodule (CPS) for EIA modeling system. The CPS is an econometric model used to generate coal supply curves by coal supply region and coal type, and it is a critical component of the modeling system that has been used since 1994 to develop EIA's annual energy market forecasts. Designed and developed a coal cleaning model for incorporation into the Coal Market Module. For more than 10 years, also worked on data input development and model enhancement of the Resource Allocation and Mine Costing model, an engineering/economic model that preceded the CPS.
- Was a principal author of the EIA analysis report Longwall Mining. This report provides a comprehensive description and analysis of longwall coal mining as it is practiced in the United States, including a discussion of methane emissions and methane recovery efforts, and other environmental issues.
- Developed, for the EPA, estimates of current and potential SO₂ emission reductions attainable through coal cleaning. Developed a database characterizing more than 38,000 distinct U.S. coal reserve blocks by their raw coal quality and SO₂ reduction potential under alternative physical coal cleaning scenarios.
- Conducted a telephone survey of more than 100 active coal-cleaning plants to obtain detailed plant operating and performance data, for a coal-cleaning study performed for EIA. Designed the survey form and selected the sample of cleaning plants.
- Participated in an analysis of energy markets in the Caspian region, for Unocal Corp. The main objective of this project was to assess the timing of the re-establishment of downstream oil markets in the region. Served as a principal author of the final report. Participated in a detailed assessment of energy markets in the Levant (also for Unocal).

Synergic Resources Corporation, June 1979–March 1983

Mine Systems Analyst

- Participated in developing reserve-related data inputs for the RAMC model. Collected reserve-related data from Mine MSHA district offices and from state mine reclamation offices.
- Conducted a detailed validation study of the data collected on Form FERC-423, as part of a subcontract to Oak Ridge National Laboratory. Performed on-site data quality audits at approximately one-third of a sample of 40 electric utilities. Developed the reporting standards used in the data error assessments and for recommending improvements in the Form FERC-423 reporting instructions.
- Participated in a project to quantify the causes of the post-1969 decline in coal mine productivity for the U.S. DOE. This project involved regression analysis of factors hypothesized to have affected mining productivity during the 1970s. Collected detailed geological, operating, equipment, and employment data from approximately 30 operating coal mines, through on-site visits to each mine.

Relevant Training and Awards

- Engineer-in-Training certificate (Pennsylvania)

Publications and Presentations

- “Analysis of the Relationship Between the Heat and Carbon Content of U.S. Coals,” Final Task Report prepared for EIA, Washington, D.C., September 1992.
- “Coal Production Submodule Component Design Report,” Energy Information Administration, Washington, D.C., May 1992.
- “Development of RAMC Longwall Model Mines,” Final Summary Report prepared for EIA, Washington, D.C., March 1991.
- “Assessment of Physical Coal Cleaning Practices for Sulfur Removal,” U.S. Environmental Protection Agency, EPA-600/7-90-013, Washington D.C., June 1990.
- “Data Requirements Review for Designing and Costing Longwall Model Mines,” Final Report prepared for EIA, Washington D.C., January 1990.
- “Enhancement of Short-Term Coal Supply Modeling Capabilities,” Final Report prepared for EIA, Washington D.C., March 1989.
- “Development of a Revised Methodology to Estimate the Distribution of the Demonstrated Reserve Base (DRB) by Quality,” Final Report prepared for EIA, Washington, D.C., August 1988.
- “Development of a Database Characterizing U.S. Coal Reserves by Their Sulfur Reduction Potential Through Physical Coal Cleaning,” Paper presented by C. Minnucci at the 80th Annual Meeting of the Air Pollution Control Association, Washington D.C., June 1987.
- “Coal Preparation,” Final Report prepared for EIA, Washington, D.C., June 1984.
- “RAMC Surface Mining Cost Equations Development,” Energy Information Administration, DOE/EIA-0433, Washington D.C., September 1983.
- “Industrial Engineering: What You Can Do Now to Increase Productivity.” Coal Mining and Processing, Vol. 18, Nos. 1 and 2, p. 38 and 66, respectively, Washington, D.C., January and February 1981.

Education

- 1978, B.S., Petroleum Engineering, Stanford University

Experience

Science Applications International Corporation (SAIC), July 2005–Present

Manager, Climate Change Services

- Led SAIC's work to develop CCAR's first GHG offset protocol for the capture of methane from manure management projects. He provides strategic advice on emissions reduction measures to the Port of Long Beach in California, leads SAIC's work for the San Diego Foundation's regional *Focus 2050* study on the future implications of climate change, and works with the California Energy Commission (CEC) to improve California's metrics for tracking conventional and alternative transportation fuels use to better determine full fuel cycle GHG emissions.
- Mr. Messner also has an extensive background in carbon capture and storage policy. His work with Carbon Capture and Storage issues includes his role as a co-author of the report "Carbon Capture and Storage Projects - Overcoming Legal and Regulatory Barriers" for the US DOE (June 8, 2006) and his role as the lead author for the study "A Briefing on Enhanced Oil Recovery – EOR Projects for CO₂ Offsets" for the US EPA (December 6, 2005). He was also a speaker on CCS issues at the recent (April 2006) California Climate Action Registry Annual Conference.
- Manages a task for the Sacramento Municipal Utility District (SMUD) to develop a Climate Change Strategic Plan in which he recommended to high-level decision makers an approach to respond to the physical, regulatory, and societal demands of climate change in California and identified the best GHG emission reduction opportunities for SMUD to meet its expected GHG reduction commitments under AB32. Development of the SMUD Plan required coordination among technical experts and chapter authors.
- Served as Lead Author for a study of potential mitigation measures that can be undertaken by California refineries to respond to anticipated legislation restricting CO₂ emissions. This study was performed for Environmental Defense, a large non-profit organization. Mr. Messner helps develop GHG offset project methodologies for EPA including for end uses of landfill and agricultural digester gas, commercial and industrial boilers, energy efficiency improvements, and cement kiln improvements.
- Mr. Messner is currently engaged with the EPA's Global Programs Division in establishing consistent methodologies and boundaries for the evaluation of GHG emission reduction projects in many industrial sectors including oil & gas, power, transportation, cement, steel, and forestry. This work has involved performance thresholds development, industry and sectoral practice reviews, and working closely with US EPA to restructure the methodology formats into more user-friendly formats.
- In 2005, Mr. Messner was the Project Manager for a comprehensive GHG internal emission reduction and emission trading strategy study for Hellenic Petroleum, a Greek oil refining company. The study helped Hellenic shape their future GHG emission reduction and emission trading strategies, along with their carbon price forecasting methods. He has also advised them on the types of internal reduction and external JI and CDM projects that are best suited the company's technological expertise, location, and management capabilities.

Atkins, August 2002–June 2005

Head of Climate Change and Emission Trading Services

- Mr. Messner was Project Manager for 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. Talisman required assistance in developing comprehensive metering and reporting

plans to satisfy the EU ETS monitoring and reporting requirements as well as the DTT's new offshore flare reporting and measurement guidelines. As a separate task, Talisman asked Mr. Messner to evaluate the potential for a domestic JI project for a large offshore wind farm they are planning to install. Mr. Messner conducted a feasibility study for this based on the UK Government's current and expected future positions on what type of carbon reduction projects will be eligible for domestic JI.

- A global car manufacturer (Toyota) required an evaluation of issues associated with their Central European manufacturing plants as they relate to the EU ETS. Mr. Messner led this review for Atkins. The key tasks performed were: 1) Evaluation of which parts of the manufacturing processes were included and which were excluded from the ETS on a country by country basis; 2) Assistance with developing accurate base year CO₂ inventories to obtain a fair allocation; 3) Assistance with negotiating allocation levels which should also reflect planned growth in the industry sector.
- Mr. Messner led several GHG related projects in the steel industry. Commercial Metals Corporation operates several steel scrap mini-mills in Central Europe and Mr. Messner led an Atkins project to first perform a detailed assessment of their GHG inventory methodology and recommend improvements to ensure all material GHG emissions were included. The study then reviewed the accuracies and uncertainties in the methodologies and noted deficiencies as compared to the Monitoring and Reporting requirements specified in the EU ETS regulations. For Mittal Steel, who operate three large integrated steel plants in Poland, Mr. Messner led an Atkins study to review their GHG inventory methodologies and recommend improvements. His work with Mittal involved developing a negotiation strategy to ensure that the steel plants were given fair CO₂ allocations consistent with the EU ETS guidelines on industry sector allocations.

Amerada Hess Corporation, October 1994–May 2002

Upstream Environmental Coordinator, January 2002–May 2002

Environmental Manager, November 1998–January 2002

Regional Environmental Coordinator, October 1994 – October 1998

- While at Amerada Hess in New York City, Mr. Messner led the company's efforts to develop their first corporate GHG inventory which included a strategy for curbing GHG emissions from the entire Corporation, focused on overseas (North Africa, West Africa, SE Asia) GHG reduction strategies. Wrote the Corporation's annual EH&S report.
- While at Amerada Hess in London, Mr. Messner was responsible for the implementation of the E&P Company's environmental and safety improvement programs in the UK and some 13 International countries of operation. These countries included many countries with current interests in developing CDM projects. For over two years, he chaired the UK offshore industry's carbon trading effort known as the Flare Consent Trading Scheme. This program was implemented in January 2001 and has been successful to date.
- Other highlights of this assignment include:
 - Development of Environmental Management Systems for Denmark, Brazil, Vietnam, and Azerbaijan operations.
 - Due diligence HSE assessments for acquisitions of E&P operations in Algeria and Azerbaijan.
 - Baseline Environmental Assessments and impact analyses in many sensitive environments, including Brazil, Gabon, Azerbaijan, Kazakhstan, and Malaysia.
- Responsible, as regional environmental coordinator, for carrying out environmental compliance efforts in Amerada Hess' Southeast E&P region – including the States of Texas, Louisiana, Mississippi, and Alabama.

Shell Western E&P, Inc., August 1986–September 1994

Senior Environmental Engineer

- Here Mr. Messner carried out environmental compliance efforts for Shell throughout their California E&P operations, primarily in the coastal areas of San Luis Obispo, Santa Barbara, Los Angeles, and Huntington Beach.

- Key accomplishments included:
 - Managed EIR/EIA and land use approval process for two large energy projects in coastal areas of California (San Luis Obispo, Huntington Beach)
 - Very involved with founding and early implementation of RECLAIM emission trading program. Executed large emission trades for Shell, selling over \$3 million in credits in early trading.

Aminol USA/ Phillips Petroleum, April 1981–July 1986

Staff Petroleum Engineer

Chevron USA, July 1978–March 1981

Production Engineer

Publications and Presentations

- June 2000; *Emission Trading in the UK*; Sydney, Australia; Third Annual Emission Trading Forum
- March 2001; *Challenging projects in the North Sea – high CO2 and H2S*; Aberdeen, UK; Institute of Petroleum/PESGB Conference on Environmental Issues
- September 2001; *Flare Consent Trading in the UK*; London, UK; Carbon Finance 2001 Conference
- September 2001; *Environmental and Social Responsibility – making it work in Azerbaijan*; Moscow, Russia; Rockefeller Foundation Conference – Leadership in Environment and Development
- February 2002; *Amerada Hess position on CO2 emissions trading*; Amsterdam, NL; Eye-on-energy conference on trading markets
- October 2002; *Flare Consent CO2 Trading – Lessons learned*; St. Andrews, UK Annual NEL Gas Measurement Conference
- July 2003; *J1 in Central and Eastern Europe*; London, UK; Carbon Credits in Project Finance Conference
- September 2003; *EU Emission Trading Scheme Allocations in Poland – Technical Issues*; Clifford Chance/Atkins Conference on ETS issues in Poland; Warsaw, Poland
- March 2004; *Russia, J1, and Kyoto*; Carbon Finance Conference; London, UK
- September 2004; *EU ETS Monitoring and Reporting issues – Proper Environmental Accounting for CO2*; Clifford Chance/Ernst & Young/Atkins conference; Warsaw, Poland
- February 2005; *EU ETS strategies – How compliance leads into better strategic management of CO2*; SMI conference on Carbon Trading; London, UK
- July 2005; *EU ETS compliance issues, allocation issues, and Carbon Price trends*; Carbon Finance conference; Brussels, Belgium
- November 2005; *GHG Project Development – International and Domestic Market Experiences*; Emissions Marketing Association Annual Meeting; San Francisco, CA
- March 2006; *Early Action Credits: Lessons Learned and Future Forecasts*; Air & Waste Management Association Conference on Climate Change and Clean Energy; San Francisco, CA
- April 2006; *Latest International Trends and Issues concerning CCS – Sequestration Workshop*; California Climate Action Registry Annual Conference; Dana Point, CA

Education

- 1992, M.A., International Relations, Yale University
- 1986, B.A., Portuguese, University of Iowa
- 1986, B.A., Journalism Mass Communication, University of Iowa

Experience

Science Applications International Corporation (SAIC), February 1996–Present

Senior Energy Analyst, February 2006-Present

Climate Change Specialist/Database and Web Manager, April 1998-February 2006

Communications Specialist, February 1996-April 1998

- In support of the U.S. Department of Energy's (DOE's) Office of Electricity Delivery and Energy Reliability OE, Infrastructure Security and Energy Restoration (ISER) Division, Ms. Gehlin is developing a database application that allows for analysis of energy infrastructure data published by that office in the daily Energy Assurance Daily publication. This user-friendly application enables intuitive data entry, and provides both ad-hoc and pre-designed data output options.
- Led SAIC's support of OE in the development of the Energy Sector's Sector-Specific Plan, in support of the Department of Homeland Security's National Infrastructure Protection Plan. She maintained a database of contacts; communicated with industry and government partners; handled inputs of stakeholder comments and the DOE adjudication process, which involved repeated communication with the reviewers; provided logistical support as needed, met difficult requests in a timely fashion; and assisted client by reminding him of even the small issues until they were each resolved to his satisfaction. Ms. Gehlin added considerable substantive value to the writing process by coordinating SAIC staff and industry partner writing contributions.
- Ms Gehlin supported DOE's Office of Policy and International Affairs in the development of revised Guidelines for the Voluntary Reporting of Greenhouse Gases Program. In addition to technical and editorial support, she developed a database application to collect and analyze public comments received during the development process, and to track adjudication of those comments.
- Managed the database of publicly available greenhouse gas emissions and reductions data provided to the U.S. Energy Information Administration's (EIA) Voluntary Reporting of Greenhouse Gases Program, established by the Energy Policy Act of 1992. She supported the data needs of EIA clients, EIA customers, and SAIC colleagues, designing queries and preparing reports summarizing the data from 1672 distinct reports and 13,245 individual emission reduction or sequestration projects. She provided all data needed for the annual preparation of *Voluntary Reporting of Greenhouse Gases*, DOE/EIA-0608, and carefully edited the full report, each year from the 1996 through the 2002 data report to ensure accuracy of all data published. Ms Gehlin also reviewed over 290 individual reports, encompassing over 1,800 distinct projects, for accuracy and consistency with reporting guidelines. She managed EIA's greenhouse gases web site. She assisted with annual update of U.S. state-average electricity emissions factors for carbon dioxide, methane and nitrous oxide used by DOE. Ms. Gehlin provided software and program support for users of the Communications Center, and tested new versions of the reporting software.
- On contract to USAID, Ms. Gehlin assisted the Government of Mexico establish a uniform methodology for the estimation of greenhouse gas reductions from the implementation of energy efficiency and renewable energy projects. She served as technical lead on USAID task to estimate carbon dioxide coefficients for reduction of the Mexican electric usage.
- Ms. Gehlin supported the U.S. Energy Information Administration's (EIA) Voluntary Reporting of Greenhouse Gases Program, heading operations of the national communications center. She improved and maintained a distribution system for published products and a system for receipt and processing of reporting forms. She maintained Microsoft Access databases of contacts, requests, and materials

distributed; modified the databases as needed. Ms. Gehlin maintained and updated the program's HTML and FTP web sites, and created and maintained a new first-level EIA web site, linking to EIA's various environmental publications and data. She provided software and program support for users of the Communications Center, and reviewed greenhouse gas emission and emission reduction reports submitted to the Program.

CET Academic Programs, April 1995–January 1996

Operations Officer

- In this short-term position with an international educational and tour company, ensured smooth functioning of the China study department during a period of staff transition and departmental growth. Developed and implemented a tracking system that improved communications between the central and field offices and that ensured follow-up on all issues. Handled student applications and inquiries, prepared and distributed mailings, and maintained a mailing list and participant database. Calmly and professionally handled student concerns and crises as needed. Also served as liaison with other departments in the parent organization.

Children International, February 1993–August 1994

International Program Coordinator

- Served as principal liaison between the central office of this international development organization and 19 field offices. Collaborated in conceptualizing and establishing program priorities, approving and monitoring project budgets. Traveled to international sites to review project progress and to ensure proper delivery of program benefits to sponsored children, reporting findings to central office executives. Compiled and summarized statistical project data, providing feedback and global analysis to project staff and to upper management. Also organized and facilitated project staff visits to Kansas City and to regional conferences.

U.S. Department of State, June 1991–August 1991

Intern, Office of Korean Affairs

- Researched and prepared background papers for internal and external use. Facilitated contacts and communication within the State Department, with Korean and U.S. Embassy personnel and the general public. Assisted in preparation for State visit of Korean President, Mr. Roh Tae Woo to the White House.

Publications

- *National Infrastructure Protection Plan, Energy Sector-Specific Plan*, Department of Energy 2006, editor
- *Inquiry into August 2003 Gasoline Price Spike*, SR/O&G/2003, 2004, editor
- *The Global Liquefied Natural Gas Market: Status and Outlook*, DOE/EIA-0637, 2003, editor
- *2003 California Gasoline Price Study*, SR/O&G/2003, 2003, editor
- *Preparations for Meeting New York and Connecticut MTBE Bans*, SR/O&G/2003, 2002, editor
- *Voluntary Reporting of Greenhouse Gases*, DOE/EIA-0608, annually 1996-2002, editor
- *Reducing Greenhouse Gas Emissions from Natural Gas Vehicle Projects: A Primer*, National Energy Technology Laboratory, 2001, Co-author and editor

Foreign Languages

- Fluent in Spanish (conversation, reading, writing)
- Excellent working knowledge of Portuguese (conversation, reading, writing)

Education

- 2007, M.A., International Business, Florida International University (FIU)
Dissertation thesis: Research on factors driving the price of carbon credits from CDM-JI projects for phase II of the Kyoto Protocol.
- 2004, MBA, Instituto de Empresas (IE)
- 2000, B.S, Chemical Engineering, Universidad Metropolitana

Experience

Science Applications International Corporation (SAIC), July 2008–Present

Analyst, Climate Change Services

- Provides technical and policy support to clients and works with management staff in modeling and projecting carbon emissions; conducting market and risk analyses for energy supply and end-use technologies; identifying performance measures for government programs; evaluating public policy options; writing technical reports; and preparing briefing packages to ensure environmental policy compliance with pertinent federal, state and local environmental regulations.
- Serves as technical support and workshop coordinator on a task for the Sacramento Municipal Utility District (SMUD) to assist in the development of RFP and evaluation of GHG offset project proposals.
- Served as an author of the Climate Change Related Impacts in the San Diego Region by 2050 report for the California Climate Change Center.

Florida International University (FIU), February 2006–May 2008

Consultant/Energy Researcher, Applied Research Center, September 2007- May 2008

Conducted research for report on Energy Integration with Latin America for the US Department of Energy.

Project Manager, Executive & Professional Education Department., School of Business, January 2007-September 2007

Managed budget in department offering non-degree training for U.S. and international executives with annual sales of \$1.5M. Develop structure and key elements of business programs offered in Latin America. Establish and manage partnerships in Colombia, Brazil, and El Salvador.

Program Manager, Executive & Professional Education Department., School of Business, February 2006-December 2006

Supervised Program Coordinator and Program Assistant while working in registration on data input, preparation of welcome packages, sending registration e-mails, and payment processing. Updated faculty on course scheduling, managed room availability, prepared yearly calendar. Hired vendors and consultants for office. Prepared program budget. Worked on part-time basis while pursuing studies in the evening.

Operational and Financial Highlights:

- Conducted research to develop Human Resources certification programs (GPHR-PHR). Established relationship with Human Resources Certification Institute, installed programs, and obtained faculty.
- Slashed 8 unprofitable programs, resulting in significant savings to marketing budget.
- Drafted 300 questions to develop Project Management Review Program, facilitating student preparation for certification examinations.

Schlumberger, February 2001–June 2003

Field Engineer, Surface Well Testing Services

- Supervised 5 staff while performing physical job involving complex technology, helping clients to locate, evaluate, and produce oil and gas reservoirs most efficiently. Executed assignments in remote towns and offshore locations with long hours and extreme conditions. Managed data acquisition department,

equipment operation and maintenance, troubleshooting, and technical procedures. Designed an Invoice Management and Inventory Control System, resulting in \$250K savings.

Empresas Polar C.A., January 2000–October 2000

Chemical Engineer Intern

- Optimized waste-water treatment process through efforts in pilot plant. Designed and developed tests to determine operating parameters.

Education

- 1979, M.S., Statistics, University of Wisconsin - Madison
- 1977, B.S., Statistics, Princeton University

Experience

ENVIRON International Corporation, December 1994 - Present

Alison K. 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, IPAMS, and CENRAP, 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's project experience includes the following:

- Currently directing the development of a Phase III oil and gas area source inventory for the Rocky Mountain States jointly for the Independent Petroleum Association of Mountain States (IPAMS) and the Western Regional Air Partnership (WRAP). This inventory represents a significant improvement over past inventories and aims to develop detailed emissions inventories for all criteria pollutants for all major oil and gas production basins in the Rocky Mountain states for all major oil and gas source categories. The work relies on developing equipment, activity and emissions factors data from a direct industry survey effort, and developing detailed historical, current and future year production data based on state records of oil and gas production and well counts.
- Currently directing the CENRAP oil and gas area sources emissions inventory improvement project to develop a new set of input data for CENRAP states to use in updating their base year and future year emissions inventories for oil and gas area sources. This work consists of researching and developing methodologies to conduct consistent basin-level emissions estimates for the top oil and gas area source categories, and to develop a database of input data to be used in these emissions estimates, including engine populations, emissions factors, activity data and information on venting and flashing sources. The work also includes a significant database analysis of each state's oil and gas production statistics and activity, including estimating active well counts, oil production, condensate production, gas production and spud counts on the basin level.
- Directed the development of emissions inventories of oil and gas sources in the western states for current and future years, for use in regional air quality modeling for WRAP. The inventory included significant emissions sources not previously evaluated, and covers both state and state and tribal lands. Sources covered included drill rig engines, gas compressor engines, coalbed methane pump engines, dehydrators and condensate tanks. Specific activities in the preparation of this inventory included surveys of state and tribal oil and gas permitting agencies and production companies, development of emission factors, extensive data collection and analysis, reconciliation with oil and gas point source inventories, and the

development of growth factors for emissions projections based on production forecasts from a variety of sources. The project also included the development of “white papers” on control options for oil and gas sources, and the development of controlled emissions scenarios for western states with significant oil and gas operations.

- Directed the development of a detailed area source emission inventory of ozone precursors in San Juan and Rio Arriba Counties for year 2002, for the New Mexico Environment Department. The inventory will include biogenic (naturally occurring) and area (non-permitted point and non-point) sources of oxides of nitrogen (NO_x) and volatile organic compounds (VOC). The focus of the project is on emissions related to oil and gas production, which are the dominant source in the two counties. ENVIRON is working with the New Mexico Oil and Gas Association to survey producers to obtain activity data and equipment specifications needed for developing accurate emissions estimates.
- Led the development of emission inventories for 8-hour ozone State Implementation Plans (SIP) modeling in several areas. These include area, point, and link-level on-road emission inventories for the Clark County (Las Vegas) nonattainment area, and link-level emission inventories for 25 transportation networks covering nonattainment areas in the Upper Midwest states. The detailed link-level emission inventories are being developed using ENVIRON’s CONCEPT Motor Vehicle Emissions Model, updated transportation demand modeling, and EPA’s MOBILE6 model.
- Directed an evaluation of on-road and off-road mobile source control strategies for 8-hour ozone nonattainment areas in the Upper Midwest. Work included evaluating the on-road and off-road inventories evaluations to determine the largest contributors; evaluating a range of control measures for their potential costs, emissions reduction, and cost-effectiveness; and assisting the air quality planning agencies in modeling the effects of these control strategies in future years.
- Directed the development of comprehensive and detailed county-level emission inventories for all on-road and off-road mobile sources for 14 Western States for the Western Regional Air Partnership (WRAP) for base and multiple future years, for use in regional visibility modeling. This project is an update of previous work that ENVIRON performed for the WRAP. In this project, mobile source emissions for a new base year are being developed with the latest EPA and CARB emission factor models, and an extensive survey is being conducted of all Western transportation and air quality planning agencies to get the most up-to-date model inputs and activity data. These emission inventories will be used in regional haze modeling for the WRAP being performed by ENVIRON and others.
- Directed the development of an open source database tool for generating link-level emission inventories using transportation modeling results from a wide variety of transportation demand models (TDM) in use by transportation planning agencies. The output from this tool is link activity data in a common format that will then be input to the CONCEPT emissions processing model.
- Directed the development of the on-road and off-road emissions estimation and processing modules for the CONCEPT emissions model. CONCEPT is a new open source emissions processing model that will create speciated and temporally and spatially allocated emissions for all source categories to be input to air quality models such as ENVIRON’s CAMx model and EPA’s CMAQ model.
- Directed the development of current and historical emission inventories for the Wyoming Department of Environmental Quality for assessing PSD NO₂ increment consumption within Class I and Class II areas from NO_x sources in Wyoming. Of particular interest was the impact from growth in oil and gas exploration and production in the vicinity of the Bridger/Fitzpatrick Wilderness Area. ENVIRON estimated historical (1986/1987) and current (2002) NO_x emissions for oil and gas-related emissions, stationary source emissions, area source emissions, and on- and off-road mobile source emissions. Under

a separate contract, ENVIRON also modeling the annual average NO₂ concentrations using the ISCST and CALPUFF dispersion models.

- Led the development of comprehensive and detailed year 2002 area, off-road, and on-road county-level emissions inventories for multiple states for submission to EPA to comply with the Consolidated Emissions Reporting Rule. Pollutants included are VOC, CO, NO_x, PM_{10/2.5}, SO_x, NH₃, and hazardous air pollutants. Emissions for all off-road sources were estimated – traditional off-road equipment (construction, agricultural, lawn and garden, etc.), aircraft, locomotives, and commercial marine.
- Directed studies to assess the existing on-road and off-road mobile source emission inventories in the Houston-Galveston Area and Dallas-Fort Worth area; to review and assess the Carl Moyer and Sacramento Emergency Clean Air Transportation Programs for the assessment of the Texas Emission Reduction Plan (TERP) and local control programs in the Houston and Dallas-Ft. Worth nonattainment areas for reducing heavy-duty diesel NO_x emissions; and to develop an action plan to achieve appropriate emission reductions, including recommendations on TERP program improvements or enhancements, control measures, and a time line for implementation.
- Led a project on the characterization of emissions sources near Class I visibility areas in the Western U.S., for the Western Regional Air Partnership (WRAP). Detailed maps were prepared that portray land use and emissions sources in a GIS environment; these maps and estimates of emissions in buffer zones around the Class I areas are available in a user-friendly format on the WRAP web page.
- Directed a large project for developing comprehensive and detailed county-level emission inventories for all on-road and off-road mobile sources for 13 Western States. EPA emission factor models were revised to include more recent test data for visibility-related pollutants, and the methodology for estimating emissions from reentrained road dust was also revised. Inventories are being used in regional haze modeling being performed by ENVIRON and other modelers for the Western Regional Air Partnership (WRAP).
- Directed an evaluation study of the EPA MOBILE6 on-road emission factor model. Multiple data sources were used to assess model accuracy: emission factors from several tunnel studies across the country, ratios of species in emission inventories prepared using MOBILE6 with corresponding ratios in ambient monitoring data, chassis dynamometer data for heavy-duty vehicles, and remote sensing data.
- Provided technical guidance in several studies on the development of surveys and analysis of survey data to derive improved local estimates of non-road equipment activity. Projects include construction equipment surveys in the Northeast for the Northeast States for Coordinated Air Use Management (NESCAUM), off-road heavy-duty diesel equipment surveys in the Atlanta area, and construction and lawn and garden equipment surveys in the Phoenix area.
- Directed a team of engineers and computer scientists on the development of a national off-road mobile source emissions model for EPA's Office of Transportation and Air Quality (OTAQ). The model estimates both engine/equipment population and emissions for off-road mobile equipment categories for all fuel types. The model consists of three components: a graphical user interface, a Fortran emissions calculation program, and an ACCESS-based reporting utility. The model has been released by EPA in draft form on the OTAQ web page and is being used in generating off-road emissions for the National Emissions Inventory (NEI), State Implementation Plans, and other emission inventory efforts.
- Directed all emission inventory and air quality modeling work for development of a PM₁₀ Maintenance Plan (SIP) for Northern Ada County, Idaho. Detailed "bottom up" emission inventories were developed

for all emissions sources for current and future years; receptor modeling was conducted using locally derived source profiles, and episodic and annual air quality modeling was performed for base and multiple future years. ENVIRON prepared the Maintenance SIP for the Idaho Department of Environmental Quality that was submitted to EPA.

- Directed a large multi-year umbrella contract covering a broad variety of tasks related to emission inventory improvement for the Texas Natural Resources Conservation Commission (TNRCC). Major projects included improvements to EPA default 1999 county-level emission inventories, and detailed NO_x, VOC, CO, SO₂, and PM emission inventories for all counties in Texas for all years in the period 1990-2010.
- Directed numerous mobile source emission inventory development projects for use in air quality modeling. For example, directed development of detailed off-road and area source emission inventories for the Little Rock, AK area; and detailed off-road and link-level on-road emission inventories for all counties in Oklahoma.
- Evaluated expected impacts of ozone and particulate matter NAAQS revisions on transportation planning for the NAS/NRC National Cooperative Highway Research Program. Evaluation included a review of potential control technologies for further reductions (beyond current Federal programs) in on-road light-duty and heavy-duty vehicle emissions.
- Directed a project on the impacts of biodiesel fuels in heavy-duty diesel vehicles on emissions, air quality, and human health. All available biodiesel test data were analyzed, and emissions impacts were incorporated into the latest mobile source emission factor models from EPA and CARB. The air quality and health effects evaluation included ozone, carbon monoxide, and particulate matter in several cities.
- Directed beta testing of MOBILE6-DRAFT for EPA's Office of Transportation and Air Quality by comparing nonattainment area emission inventories generated with MOBILE6-DRAFT and MOBILE5b. Converted State Implementation Plan (SIP) MOBILE5 input files to MOBILE6-DRAFT input files and provided emission estimates without current and planned control programs to compare the results of the two models.
- Reviewed available technical documents and databases used in the development of EPA's new MOBILE6 emission factor model and California's new EMFAC2000 model. The reviews encompassed exhaust and evaporative emission factors for all classes of vehicles, emission factor adjustments (e.g., for effects of state Inspection and Maintenance programs), and activity data used to derive composite fleet average emission rates.
- Evaluated on-road and off-road mobile source control measures for the Dallas-Ft. Worth ozone nonattainment area. A comprehensive listing of potential control programs was developed, and the emissions and cost implications of each control measure were evaluated. Control strategy packages for inclusion in the overall State of Texas State Implementation Plan revision were developed to achieve the needed reductions, and assistance was provided to the Texas Natural Resources conservation Commission (TNRCC) in photochemical modeling to assess air quality impacts of proposed control strategies.
- Directed an evaluation of the contribution of heavy-duty diesel truck NO_x emissions to the total NO_x inventory in the Eastern United States. This included review of heavy-duty truck activity data, a review of heavy-duty vehicle emission factors in EPA's MOBILE model, and analysis of the air quality contribution of heavy-duty truck NO_x emissions.

- Directed a statistical and engineering evaluation of exhaust and evaporative emissions factors for all vehicle classes in EMFAC7G, the mobile source emission factor model developed by the California Air Resources Board (CARB). The project included computer simulations to estimate uncertainties in estimated emissions based on uncertainties in underlying model databases, assumptions, and statistical analyses.
- Directed an evaluation of heavy-duty vehicle emission factors in the CARB EMFAC7G and EPA MOBILE5 emission factor models, and development of FORTRAN code for adding deterioration rates for particulate matter emissions as a function of vehicle mileage or age, for EPA's next version of the on-road mobile source particulate matter emission model (PART5).
- Directed a project in which ENVIRON staff provided a broad variety of technical services related to developing an approvable particulate matter (PM10) SIP and a carbon monoxide (CO) Maintenance Plan for the nonattainment areas in Jackson County, Oregon (Rogue Valley). Tasks included development of detailed mobile source emission inventories and other emission inventory components, design and execution of local roadway sampling for fugitive dust, critical review of PM air quality modeling, and facilitation of the public involvement process, and coordination of the SIP revision process with regulatory agencies as well as local industry and interest groups.
- Assembled and analyzed a database of chemical composition of exhaust emissions from all categories of mobile source emissions (on-road and off-road gasoline and diesel) and chemical composition of gasoline and diesel fuels. The database includes thousands of individual test results from dozens of test programs in and outside North America.
- Analyzed an extensive database of vehicle emissions to determine the effects of a fuel additive on regulated pollutants. Performed air quality modeling to assess the effects of changes in the vehicle emissions on ambient ozone in an urban corridor.
- Directed a multidisciplinary team of engineers, statisticians, and air quality modelers in a multi-million dollar project to assess the effects of reformulated and alternative fuels on light-duty vehicle emissions and urban air quality for the U.S. Auto/Oil Air Quality Improvement Research Program, a consortium of three domestic automobile manufacturers and fourteen petroleum companies.
- Analyzed a complex database of real-world exhaust and evaporative emissions and compared the real-world emissions to predictions of the MOBILE and EMFAC mobile source emission factor models. Developed revisions to the models so that they would more closely reflect the observed real-world emissions.
- Directed numerous studies of the air quality benefits derived from alternative mobile source emission control programs. For example, analyzed the air quality benefits of the adoption of the California Low Emitting Vehicle Program in the Northeast.
- Analyzed tailpipe emissions measured via remote sensing and compared the measurements to predictions of the MOBILE and EMFAC emission factor models. Compared the contribution of high-emitting vehicles between the remotely sensed measurements and the model predictions.
- Directed an analysis of in-use driving patterns for light-duty automobiles and compared the real-world driving patterns to the EPA Federal Test Procedure (FTP).
- Directed projects on the development of alternative driving cycles for light-duty vehicles and for heavy-duty trucks for both public and private sector clients.

- Directed several projects on the evaluation and sensitivity of different versions of the MOBILE and EMFAC regulatory computer models for estimating motor vehicle emissions factors.
- Directed numerous projects of the analysis of local, state, regional, and national emissions and air quality trends in criteria pollutants. For example, directed projects on the comparison and correlation of trends in ozone precursor emissions and ozone air quality for the New York City metropolitan region and for the South Coast Air Basin.

ENVIRON International Corporation, December 1994 - Present

Prior to joining ENVIRON, Ms. Pollack was a Corporate Officer and Business Unit Manager for Systems Applications International, a division of ICF Kaiser International (ICFKI), one of the world's largest engineering, construction, and consulting services companies. Developed and managed all technical and business aspects of air quality consulting services related to mobile source emissions and also environmental data analysis and statistics.

Professional Affiliations

- National Academy of Sciences Committee to Review EPA's Mobile Source Emissions Factor Model (MOBILE)
- National Academy of Sciences Committee on Effectiveness of Vehicle Emission Inspection and Maintenance Programs
- National Academy of Sciences Committee on State Practices in Setting Mobile Source Emissions Standards
- Air and Waste Management Association

Selected Recent Publications and Presentations

- Nopmongkol, U., J. Grant, A. Pollack, G. Yarwood, E. Knipping, M. Duvall, C. Clark. 2007. "Impacts of Plug-in Hybrid Electric Vehicles on Regional Haze and PM." Poster presented at American Association for Aerosol Research (AAAR) 26th Annual Conference, Grant Sierra Resort, Reno, NV. September.
- Mansell, G., J. Lester, A. Pollack. 2007. "Studies of Emissions from Anthropogenic and Natural Dust Sources in the Western United States". In publication: EM, A&WMA's Magazine for Environmental Managers. September.
- Bar-Ilan, A., R. Freisen, A.K. Pollack, A. Hoats. 2007. "An Updated Emissions Inventory of Oil and Gas Area Sources in the Western Region." Presented at the 16th International Emission Inventory Conference, *"Emission Inventories: Integration, Analysis, Communication."* May.
- Pollack, A.K. 2006. "Mobile Source Emissions: Issues and Uncertainties." Presented at the Electric Power Research Institute (EPRI) Air Quality Advisory Group. March.
- Pollack, A.K., D.S. Eisinger, D.A. Niemeier, T. Stoeckenius, T.P. Kear, M. J. Brady, J. Long. 2006. "Collecting Drivin Data to Support Mobile Source Emissions Estimation." *Journal of Transportation Engineering.* November.

- Yarwood, G., J. Russell, A. Pollack. 2006. "Modeling Weekday/Weekend Ozone Differences in the Los Angeles Region for 1997." Presented at the 99th AWMA Annual Conference, New Orleans, LA. June.
- Pollack, A.K. 2006. "CONCEPT MV Model for Estimating Link-Level Mobile Source Emissions." Presented at the CRC 2006 Mobile Source Air Toxics Workshop, Phoenix, AZ. October.
- Pollack, A.K., S. Shepard, J. Haasbeek, M. Janssen. 2006. "Development of Link-Level Mobile Source Emission Inventories." Presented at Emissions Inventory Conference, New Orleans, LA. May.
- Russell, J., A.K. Pollack, G. Yarwood. 2006. "An Emission Inventory of Non-point Oil and Gas Emissions Sources in the Western Region." Presented at the 15th International Emissions Inventory Conference, New Orleans, LA. May.
- Pollack, A.K., D.S. Eisinger, D.A. Niemeier, T.E. Stoeckenius, T.P. Kear, M. J. Brady, J. Long. 2006. "Collecting Driving Data to Support Mobile Source Emission Estimation." Accepted for Publication in Journal of Transportation Engineering, May 17.
- Pollack, A.K., (with members of the National Academy of Sciences Committee on State Practices in Setting Mobile Source Emissions Standards). 2006 "State and Federal Standards for Mobile-Source Emissions." National Research Council. March.
- Pollack, A.K., S. Shepard, J. Haasbeek. 2005. "Development of Link-Level Mobile Source Emission Inventories." Presented at the International Emissions Inventory Conference, Las Vegas, NV April.
- Pollack, A.K., j. Haasbeek, C. Loomis, J. G. Wilkinson. 2005. "ConCEPT – Consolidated Community Emissions Processing Tool. An Open-Source Tool for the Emissions Modeling Community." Presented at the International Emissions Inventory Conference, Las Vegas, NV April.
- Pollack, A.K., C. Lindhjem, L.M. Chan. 2004. "Applying Humidity and Temperature Corrections to On and Off-road Mobile Source Emissions." Presented at the Emission Inventory Conference Clearwater, FL June.
- Pollack, A.K., D.S. Eisinger, D.A. Niemeier, T. Stoeckenius, T. Kear, M. Brady, J. Long. 2004. "Collecting Driving Data to Support Mobile Source Emissions Estimation". to be published by Journal of Transportation Engineering; the American Society of Civil Engineers. May.
- Pollack, A.K., C.E., Lindhjem, R., Slot, R. Sawyer. 2004. "Review of MOVES Draft Design." Presented at 14TH CRC On-Road Vehicle Emissions Workshop, San Diego, CA. March.
- Pollack, A.K. 2003. "Emissions Characterization Near Western Class I Visibility Area". Presented at the International Emissions Inventory Conference, San Diego, CA. April.
- Pollack, A.K. 2003. "MOBILE6 Validation Study Results". Presented at the International Emissions Inventory Conference, San Diego, CA. April.
- Pollack, A.K., G.M. McGaughey, N.R. Desai, D.T. Allen, R.L. Seila, W.A. Lonneman, M.P. Fraser, R.A. Harley, J.M. Ivy, J.H. Price. 2003. "Analysis of Motor Vehicle Emissions in a Houston Tunnel during the Texas Air Quality Study 2000." Atmospheric Environment. March 18.
- Pollack, A.K. 2002. "MOBILE6 Validation Studies." Presented at the EPA Mobile Source Present and Future Models Workshop, November 7.

- Pollack, A.K. 2002. "WRAP Mobile Source Emission Inventories." Presented at the WRAP Technical Review Workshop, Denver, CO. July 9.
- Pollack, A.K. 2002. "WRAP Fugitive Road Dust Emission Inventory Improvements." Presented at the WRAP Technical Review Workshop, Denver, CO. July 10.
- Pollack, A.K. (with members of the National Academy of Sciences Committee on Effectiveness of Vehicle Emission Inspection and Maintenance Programs). 2001. "Evaluating Vehicle Emissions Inspection and Maintenance Programs." National Research Council. July.
- Pollack, A.K. 2000. "MOBILE5/6 and PART5 Emission Factor Models Used to Estimate Mobile Source Air Toxics." Invited presentation at Mobile Sources Technical Review Subcommittee Air Toxics Workgroup." October.
- Pollack, A.K. (with members of the National Academy of Sciences Committee to Review EPA's Mobile Source Emission Factor Model). 2000. "Modeling Mobile-Source Emissions." National Academy of Sciences. National Academy Press, Washington, D.C.
- Pollack, A.K. 2000. "Diesel NOx and PM Emissions Estimates: Predictions of Emission Inventory Models and Diesel's Share." Presented at Massachusetts Institute of Technology, symposium – "The Future of Diesel: Scientific Issues." July.
- Pollack, A.K. 1999. "Use of Models to Estimate General Population Exposures to Diesel Particulate Matter." Invited presentation Health Effects Institute (HEI) Diesel Workshop, Stone Mountain, Georgia. March.
- Pollack, A.K., R. Wilcox. 1998. "EPA's New NONROAD Mobile Emissions Model". Presented at the Air & Waste Management Association workshop, Emissions Inventory: Living in a Global Environment, New Orleans, LA. December.
- Pollack, A.K. 1998. "Uncertainty in Emission Factors in the California Emissions Model." Presented at the Air & Waste Management Association workshop, Emissions Inventory: Living in a Global Environment, New Orleans, LA. December.
- Pollack, A.K., D. Calkins and J. Heiken. 1998. "Successful Public Participation in Air Quality Planning for Oregon's Rogue Valley". 98-RA96A.06 Presented at the 91st Annual Meeting and Exhibition of the Air & Waste Management Association, San Diego, CA. June.
- Pollack, A.K., G. Yarwood, J. Heiken and C. Tran. 1998. "Investigation of Emission Factors in the California EMFAC7G Model." Presented at the Eighth Annual CRC On-Road Vehicle Emissions Workshop, San Diego, California. April.
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- Pollack, A.K., G. Yarwood. 1997. "The Contribution of On-Road Vehicles to Ozone in the Eastern United States". Presented at the Seventh Annual CRC On-Road Vehicle Emissions Workshop, San Diego, California. April.
- Pollack, A.K., A.M. Dunker, R.E. Morris, C.H. Schleyer, and G. Yarwood. 1996. Photochemical Modeling of the Impact of Fuels and Vehicles on Urban Ozone Using Auto/Oil Program Data. *Environmental Science and Technology*, 30(3): 787-801.
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- Pollack, A.K., C. H. Schleyer, A.M. Dunker, J.L. Fieber, and J.P. Cohen. 1995. Comparison of Real-World Emissions to MOBILE5a/EMFAC7F Predictions -- Auto/Oil Air Quality Improvement Research Program. Presented at the Fifth CRC On-Road Vehicle Emissions Workshop, San Diego, California. April.

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- Emery, C.A., G. Mansell, G. Yarwood, A. Pollack. 2008. "Modeling Hazardous Air Pollutants in Phoenix." Prepared for Arizona Department of Air Quality, Phoenix, AZ. February.
- Jimenez, M., S. Shepard, J. Grant, A.K. Pollack. 2008. "EPA On-Road Modeling: SEMCOG Network Emission Inventory Development Using Concept MV." Prepared for Karen Wesson; EPA/EMAD, Durham, N.C. January.
- Jimenez, M., S. Shepard, J. Grant, A.K. Pollack, R. Parikh. 2007. "LADCO On-Road Emission Inventory Development using Concept MV." Prepared for LADCO, Rosemont, IL. December.
- Pollack, A., A. Bar-Ilan, R. Friesen, A. Hoats. 2007. "Wrap Area Source Emissions Inventory Protections and Control Strategy Evaluation Phase II." Prepared for Western Governor's Association, Denver, CO. September.
- Pollack, A., U. Nopmongkol, J. Grant, G. Yarwood, E. Knipping, M. Duvall, N. Kumar, S. Bloomberg, A. Smith, D. Katz L. Tonachel. 2007. "Environmental Assessment of Plug-In Hybrid Electric Vehicles. Volume 2: United States Air Quality Analysis Based on AEO-2006 Assumptions for 2030." Prepared for Electric Power Research Institute, Palo Alto, CA. June.
- Pollack, A.K., S. Shepard, J. Russell, J. Grant. 2007. "Clark County On-Road Mobile Source Emissions." Prepared for Clark County Department of Air Quality Management, Las Vegas, NV. May.
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- Pollack, A.K., L. Chan, P. Chandraker, J. Grant, C. Lindhjem, S. Rao, J. Russell, C. Tran. 2006. "WRAP Mobile Source Emission Inventories Update." Prepared for Western Governors' Association, Denver, CO. May.
- Pollack, A.K., J. Russell, S. Rao, G. Mansell, J. Scarborough. 2006. "Wyoming 2002 Emission Inventory: Mobile and Area Source Emissions." Prepared for Wyoming Department of Environmental Quality, Cheyenne, WY. Rev. April.
- Pollack, A.K., J. Russell. 2005. "Oil and Gas Emission Inventories for the Western States." Prepared for Western Governors' Association. Denver, CO. December.
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- Pollack, A.K., C. Tran, J. Russell, P. Chandraker, S. Rao. 2004. "Arizona 2002 Emission Inventory." Prepared for Arizona Department of Environmental Quality, Phoenix, AZ. June.
- Pollack, A.K., G. Mansell, M. Masonjones, S. Coulter-Burke, S. Lau, P. Chandraker. 2004. "Characterization of Emission Sources Near Class I Areas in the WRAP Region." Prepared for Western Governors' Association, Denver, CO. June.
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- Pollack, A.K., C. Tran, P. Chandraker, M. Wolf, P. Fields. 2004. "Arkansas 2002 Emission Inventory." Prepared for Arkansas Department of Environmental Quality, Little Rock AR. May.
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- Pollack, A.K., C. Lindhjem, R. Friesen, B. Sylte, D. Calkins, T. McGuire, D. Baldwin. 2003. "Potential Control Measures for Reducing Visibility-Related Pollutants in Maricopa County." Prepared for Arizona Department of Environmental Quality. December.
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- Pollack, A.K., C. Tran, G. Yarwood, B. Koo, P. Chandraker, C. Tana. 2003. "Effect of Hotsoak and Diurnal Emissions Spatial Allocation Methodology on Predicted Ozone Levels." Prepared for Houston Advanced Research Center. August.
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- Pollack, A.K., T. Stoeckenius, C. Tran, T. Wenzel, J. Schwartz, V. McConnell. 2003. "Performance Audit of the Colorado Automobile Inspection and Readjustment (AIR) Program." Prepared for Office of the State of Colorado State Auditor. June.
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- Pollack, A.K., R. Morris, M. Green, J. Watson, H. Kuhns, P. Fields, M. Wolf. 2002. "A Scoping Study for Haze in the CENRAP Region." Prepared for Central Regional Air Planning Association (CENRAP). December.
- Pollack, A.K, C. Tran, P. Chandraker. 2002. "Development of Mobile Source Emission Inventories For Oklahoma." Prepared for Oklahoma Department Of Environmental Quality. October.
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- Pollack, A.K., D. Souten, R. Morris, G. Mansell, Ph.D., B. Joy, C. Anderson, D. Calkins, G. Hawthorne, R. Sawyer, Ph.D., R. Chi, C. Tran, C. Emery, and E. Tai. 2002. "Transportation Effects of The 1997 Changes To The National Ambient Air Quality Standards." NCHRP 25-17. Prepared for the National Cooperative Highway Research Program, Transportation Research Board, National Research Council. September.

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- Pollack, A.K., J.P. Cohen. 1991. General Linear Models Approach to Estimating National Air Quality Trends Assuming Different Regional Trends. Prepared for U.S. EPA, Research Triangle Park, North Carolina.

Education

- 2004, M Ph.D., Mechanical Engineering, University of California, Berkeley
- 2002, M.S., Mechanical Engineering University of California, Berkeley
- 1996, B.A., Cum Laude, Physics, Harvard University, Cambridge, MA

Experience

ENVIRON International Corporation

Dr. Amnon Bar-Ilan is a Manager at ENVIRON. 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. Prior to joining ENVIRON, Dr. Bar-Ilan's performed post-doctoral research at the University of California, Berkeley, where he focused on understanding and manipulating nanoparticle dynamics to develop power generation devices using nanoparticle catalysts. Dr. Bar-Ilan also has experience in emissions testing and analysis. While a consultant at the University of California, Berkeley he led an emissions testing project for evaluating alternative fuels and other controls on marine diesel engines, and as a consultant for Arthur D. Little, Inc. he participated in a number of emissions reduction projects for residential and commercial combustion devices. Dr. Bar-Ilan's current projects at ENVIRON include developing testing protocols for evaluating the effects on emissions of using bio-diesel fuel in diesel electric generators, evaluating emissions reductions and cost-effectiveness of a broad range of on-road and off-road mobile source control measures for a multi-state region, review and estimation of mobile source emission inventories, and estimation of emissions inventories and evaluation of control strategies for oil and gas exploration and production activities in the continental U.S.

Dr. Bar-Ilan's project experience includes the following:

- Currently leading the IPAMS/WRAP Phase III oil and gas inventory project to develop a refined emissions inventory of all criteria pollutants of the oil and gas industry in the western states. Work includes the development of highly detailed source category-specific surveys and direct communication with industry representatives to obtain and consolidate data on equipment, activity and emissions factors for well-field operations. Currently working to develop improved methodologies for estimating basin-wide emissions from various oil and gas source categories, and to develop methodologies for refining future year emissions projections based on incorporating production projections and petroleum production decline analysis. The work also includes significant database analysis of oil and gas production on a basin level and developing historical and current data on well counts and drilling activity in several major oil and gas basins.
- Currently leading the CENRAP oil and gas area sources emissions inventory improvement project to develop a new set of input data for CENRAP states to use in updating their base year and future year emissions inventories for oil and gas area sources. This work consists of researching and developing methodologies to conduct consistent basin-level emissions estimates for the top oil and gas area source categories, and to develop a database of input data to be used in these emissions estimates, including engine populations, emissions factors, activity data and information on venting and flashing sources. The work also includes a significant database analysis of each state's oil and gas production statistics and activity, including estimating active well counts, oil production, condensate production, gas production and spud counts on the basin level.
- Currently assisting in estimating emissions and providing technical guidance on the development of base year, and base case future year oil and gas emissions for the Four Corners Air Quality Task Force as part

of the Four Corners regional air quality modeling and oil and gas control scenario assessment. Work includes refining NMED/WRAP Phase II emissions estimates for the Four Corners region, including oil and gas point and area sources in Colorado and New Mexico, and analyzing potential control technologies and their feasibility for various oil and gas source categories, as well as recommending penetration rates to develop a controlled future year emissions scenario.

- Developed a region-wide emissions inventory for current and future years of oil and gas area sources in the western U.S. for the Western Regional Air Partnership (WRAP). This analysis consisted of developing inventory methodologies and estimation tools to address these largely un-inventoried sources. In addition, developed white papers to describe potential control strategies for these sources. Sources covered included drilling rigs, compressor engines, heaters, venting and fugitive emissions, tanks and pneumatic devices. Emissions were estimated on a county level for the western U.S., including emissions from tribal and nontribal land, and were used to support regional haze modeling by WRAP for states' regional haze SIPs.
- Developed a testing protocol and provided support for an ongoing research effort to measure emissions of NO_x from stationary backup electrical generators fueled by biodiesel. The work included developing a testing methodology for testing NO_x with a portable analyzer, support in the development of an in-situ testing facility for a stationary backup generator, review and analysis of emissions data and an analysis of biodiesel chemical formulation and its impacts on emissions of criteria pollutants.
- Analyzed emissions from a potential railroad project for generating an air quality impact section of an environmental impact report. The analysis consisted of detailed emissions estimates from the construction and operation of the railroad yard, including on-road, off-road and locomotive source categories. Controls measures, their effectiveness and emissions reduction potentials were also analyzed.
- Analyzed potential emissions control measures for locomotives operating in the Los Angeles Basin for the Southern California Association of Governments. Emissions controls included fleet modernization, retrofit and operational emissions reduction strategies. The analysis consisted of estimating potential emissions reductions, cost and cost-effectiveness of each measure in the L.A. Basin. A series of white papers describing this analysis was developed.
- Assessed control strategies for on-road and off-road diesel-powered mobile sources in the Great Lakes region of the U.S. for the Lake Michigan Air Director's Consortium (LADCO). The work consisted of identifying control strategies for these sources, assessing the emissions reduction potential of these sources, the cost and cost-effectiveness of these sources and development of state-by-state and region-wide controls scenarios to predict emissions reduction potential and costs from a variety of control strategy combinations.
- Assessed and ranked control strategies for the Texas Emissions Reduction Program (TERP) for on-road, off-road, locomotive and commercial marine sources in Texas. Developed a ranking system to address the emissions reduction potential, cost, cost-effectiveness, technical feasibility and public acceptance criteria for an extensive list of potential control measures. Identified the most favorable control measures, and developed white papers to describe these measures in detail.

University of California, Berkeley 2000–2005,

Consultant

- Investigated bio-diesel as a low-emissions fuel alternative for marine diesel applications for a ferry fleet operating in the San Francisco Bay. Study recognized by the Maritime Administration of the United States Department of Transportation (MARAD)

- Advised the San Francisco Water Transit Authority on a near- and long-term technology strategy for meeting marine diesel emissions targets
- Conducted experimental and numerical analyses of accidental fires in support of several litigation and forensic analysis projects

University of California, Berkeley 2004–2005,

Industrial Technology and Research Institute Post-Doctoral Fellow

- Conducted theoretical, numerical investigation of a fluidized bed catalytic nanoparticle reactor, including computational fluid dynamics modeling of a cyclone reactor and electric field-nanoparticle interaction using a granular flow model for nanoparticles

University of California, Berkeley 1999–2004

Doctoral Student Researcher

- Designed and built experimental apparatus to investigate the mechanisms of transition from smoldering to flaming combustion of porous materials for space applications
- Designed and developed a high-speed ultrasonic imaging system for porous combustible materials, including C-based software development for control and statistical analysis
- Performed experimental investigation of smoldering combustion in low gravity and normal gravity.

Arthur D. Little, Inc., Cambridge, MA 1997–1999

Research Analyst

- Conducted C- and FORTRAN-based numerical modeling of thermal stress failure in glass paneling for gas-fired hearth products including experimental verification; final report issued as ANSI Z.29 standard.
- Conducted experimental study of pollutant product formation from surface combustion in a radiant gas burner.
- Designed and conducted testing on two-stage burner for low-NO_x emissions from a residential gas-fired furnace.

Publications and Presentations

Bar-Ilan, A., R. Freisen, A.K Pollack, A. Hoats 2007. “An Updated Emissions Inventory of Oil and Gas Area Sources in the Western Region.” Presented at the 16th International Emission Inventory Conference, "Emission Inventories: Integration, Analysis, Communication." May.

Selected Reports

Bar-Ilan, A., C. Chandler-Nogales, C. Lindhjem. 2007. “Massachusetts Diesel PM Emissions Reduction: Retrofit Technical Feasibility Analysis.” Prepared for NESCAUM, Boston, MA. October.

Bar-Ilan, A., R. Friesen, A. Pollack, A. Hoats. 2007. “Wrap Area Source Emissions Inventory Protections and Control Strategy Evaluation Phase II.” Prepared for Western Governor’s Association , Denver, CO. September.

Yarwood, G., J. Johnson, A. Bar-Ilan, L. Chan. 2007. “Dallas-Fort Worth Ozone Impact Assessment of Biodiesel Use in the State of Texas.” Prepared for Houston Advanced Research Center, The Woodlands, TX. April.

Chan, L. M., A. Bar-Ilan, J. Grant, R. Parikh, A. Pollack. 2007. “Evaluation of Candidate Mobile Source Control Measures for LADCO States in 2009 and 2012.” Prepared for Lake Michigan Air Directors Consortium, Des Plaines, IL. March.

Chan, L.M., J. Grant, A. Bar-Ilan, C. Lindhjem, A. Pollack. 2006. "On-Road and Non-Road Emission Reductions from TERP in 2007, 2009 and 2012 in the Houston-Galveston Brazoria and Dallas Fort-Worth Areas." Prepared for Houston Advanced Research Center, The Woodlands, TX. December.

Education

- 1971, M.S. Engineering, California State University, Sacramento
- 1966, B.S. Mechanical Engineering, California State University, Sacramento

Experience**ENVIRON International Corporation, June 2006 - Present**

- Project Manager for an emissions inventory of oil and gas operations in the Uinta Basin of Utah. The Uinta Basin emissions inventory is part of an overall effort that is focused on creating a comprehensive criteria pollutant emissions inventory for all activities associated with oil and gas field operations in the basins throughout the study region for year 2006 as well as future projection years; that includes all point and area sources related to the oil and gas industry. Oil and gas companies were surveyed for 25 sources of emissions which represented 71% of well ownership in the basin, 82% of gas production in the basin, and 78% of oil production in the basin.
- Project Manager for an emissions inventory projection of oil and gas operations and a control strategy evaluation for emissions from drilling rigs, compressor engines and other associated operations in the Western Region of the U.S. The control strategy evaluation included the cost and cost-effectiveness of retrofitting existing oil and gas equipment with emission control technologies for oxides of nitrogen, particulate matter, volatile organic compounds and sulfur oxides.
- Project manager for Analysis of Converting North Slope Gas Turbines to Operate on Hydrogen, Alaska Department of Environmental Conservation. This project focused on current research on the use of H₂ and H₂-blended fuels for heavy-duty gas turbine applications such as those operating on the North Slope, regardless of the process used to produce H₂. Hydrogen production can include production from renewable energy sources (solar or wind), but the most realistic and near-term methods will be H₂ derived from conventional fossil fuels by conversion processes that also include carbon dioxide (CO₂) sequestration (Chiesa et al., 2005). For this reason, the State of Alaska is interested in the state of technology for using H₂ as a gas turbine fuel. In addition to reducing greenhouse gas emissions, the state of Alaska is interested in reducing NO_x emissions.
- Project Manager for assessment of the effectiveness of an emissions control system for gas compressor engines in Northeast Texas. Assessment included managing the emissions testing of several gas compressor engines used in gas production operations. The project succeeded in retrofitting several gas compressor engines with controls that achieved greater than 90 percent reductions in NO_x emissions.
- Project Manager for development of emissions inventory for oil and gas related operations in the Western Region of the United States. The work refined emissions estimates for gas compressors, drill rigs, as well as updated emissions for a number of other NO_x and VOC sources associated with oil and gas production, including flaring and venting, heaters, fugitives, pneumatics and storage tanks.

California Air Resources Board, January 2001 to June 2006

- Executive Director of the California Stationary Fuel Cell Collaborative (CaSFCC), a collaboration of government agencies, fuel cell companies, utilities, universities, environmental groups and other non-government organizations dedicated to promoting the use of fuel cell technology in distributed generation and other stationary applications to help bring clean, reliable and sustainable power to all Californians.
- Participated in several initiatives that are targeted as strategies for the reduction of GHG emissions through advancing technologies such as fuel cells, increasing efficiencies, using renewable fuels and using combined cooling, heat and power (CCHP) to further increase generation efficiencies.
- Specific initiatives included the Hydrogen Highway Network Initiative and the Governor's Green Buildings initiative. Represented not only the Fuel Cell Collaborative but the office of the Secretary,

CalEPA regarding the benefits and impacts of the stationary source sector in the development of the Blueprint plan for Governor Schwarzenegger. Also represented the Fuel Cell Collaborative as a member of the Rollout Strategy Topic Team and the Governor's Advisory Board.

- Participated on the Governors Green Action Team (GAT) and made several presentations and interacted with the GAT, which is charged to implement the California's Green Buildings initiative
- Developed a Strategic Plan codified tasks, processes, goals, responsibilities and resources required to commercialize fuel cells in California. This plan included a situation assessment, an assessment of the energy landscape, an assessment of the status of the technology, and a roadmap for commercialization and short term priorities for the California Stationary Fuel Cell Collaborative.
- Interacted with CalEPA staff responsible for implementing AB 32 and AB 1368. This included members of the Air Resources Boards Research Division and the Executive Office responsible for implementing the program. In addition to these agencies, worked with several utilities including the Sacramento Municipal Utility District, the Los Angeles Department of Water and Power, Southern California Edison, Pacific Gas and Electric and Semptra Energy.
- Quantified the impacts on GHG and recommended specific strategies including the advancement of building efficiencies measures, the use clean distributed generation to replace grid-based generation including the use of high temperature fuel cells and the use of alternative fuels. This work includes an evaluation of the cost of using these technologies.

Sierra Nevada Air Quality Group, January 2001 to June 2006

- Evaluation of Available Control Technologies for Oxides of Nitrogen from Point Sources in Ellis County, Texas. Work focused on detailed analysis of five large cement plants. Work identified available NOx control methods and technology, the equipment and controls currently in place and the technical feasibility of applying additional NOx controls.
- Evaluation of ozone precursor strategies for the state of Texas, which included a technical assessment of emissions and stringency of regulation in the eight "upwind" states, identified through modeling as having an air quality impact in East Texas. Major point sources of NOx control methods and applicable regulations in the eight states. Based on existing published cost information for control equipment, a cost comparison of these regulations to control technologies was made.
- Screening, Ranking and Evaluation of Stationary and Area Source Control Measures in Sacramento, including a more detailed evaluation of approximately 20 measures that had survived the screening phase. Evaluations showed baseline and future emissions by county, potential emission reductions, cost-effectiveness, implementation schedules, and other relevant information.
- VOC and NOx Control Strategy Evaluation for 8-hour Ozone SIP for Dallas-Fort Worth Nonattainment Area. Work included quantitative evaluations of the emissions benefit, cost/benefit ratio and refined analysis of the technical and administrative feasibility of area and point source control measures for most significant control measures.
- Evaluation of Potential Control Measures for Reducing Visibility-Related Pollutants in Maricopa County, including an evaluation of potential control measures that reduce emissions of oxides of nitrogen (NOx), sulfur oxides (SOx) and fine particulate matter (PM2.5) from point, area and mobile sources. The study determined the existing level of controls for each identified category, the range of available technologies or strategies that could result in additional reductions and the costs/cost-effectiveness of the selected technologies or strategies.
- Assisted several public interest groups in evaluating the development of air quality mitigation measures for expansion of the Port of Los Angeles. The work involved detailed assessment of the cost, feasibility, and overall viability of applying advanced vehicle control technologies, cleaner conventional fuels, and alternative fuels to cargo-handling equipment, locomotives, on-road trucks, tugs, ferries and harbor vessels as well as commercial cargo vessels.
- Evaluated California's handling of the energy crisis-affected emissions and air quality control programs in the state. The purpose was to provide a clear, comprehensive picture of what really happened to California air quality, and what the impacts of the emergency policies were on air quality.

- Developed methodologies, gathered data and estimated total organic gas (TOG) and reactive organic gas (ROG) emissions for the five oil and gas emission inventory categories in the San Joaquin Valley Unified Air Quality Management District, including tank cleaning and venting, oil production flashing losses and oil pipeline pumping stations which were not reflected in the District's inventory.
- Evaluated thirty-seven (37) prohibitory rules in the San Joaquin Valley to forecast future year emission reductions consistent with the California Air Resources Board's new emissions inventory database (CEFS). Rules were reviewed to update the percent control (also referred to as the control efficiency) and to determine the portion of the emissions inventory process code affected by each rule (rule penetration). Compliance rates were also updated where information was available; however, the primary focus was to update the percent control and rule penetration for each of the rules.

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| California Air Resources Board, February 1971 to June 1996 |
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Prior to Mr. Friesen's work as a consultant, he was the Assistant Chief of the California Air Resources Board's Stationary Source Division. In that capacity Mr. Friesen was responsible for the development and review of air quality control regulations for all stationary sources in California.

Mr. Friesen is a registered Mechanical Engineer in California and is certified as a Qualified Environmental Professional (QEP) by the Institute of Professional Environmental Practice.

Publications and Presentations

Bar-Ilan, A., R. Friesen, A.K Pollack, A.Hoats. 2007. "An Updated Emissions Inventory of Oil and Gas Area Sources in the Western Region." Presented at the 16th International Emission Inventory Conference, "Emission Inventories: Integration, Analysis, Communication." May.

Friesen, R. 2006. "California Hydrogen and Fuel Cell Programs." Presented to the New Mexico Hydrogen Business Council, Santa Fe, N.M. February 24.

Friesen, R. 2004. "Fuel Cell Technologies and Stationary Applications, Lisbon Portugal." November 15.

Friesen, R. 2004. "California and Canada Hydrogen and Fuel Cell Technology Partnering Mission." Sacramento, CA. March 23.

Friesen, R. 2003. "Global Fuel Cell & Hydrogen Demonstration Organizations Communications." Presented at the Summit Meeting, Sacramento, CA. November 13.

Friesen, R. 2003. "Evaluation of Emission Reductions in Maricopa County". Presented to the Arizona Department of Environmental Quality, Cap and Trade Committee. June 9.

Selected Reports

Bar-Ilan, Amnon, R. Friesen, A. Pollack, A. Hoats. 2007. "WRAP Area Source Emissions Inventory Projection and Control Strategy Evaluation. Prepared for Western Governor's Association. September.

Friesen, R.L.Chan. 2006. "Registration/Permitting Requirement Review and Summary of Stationary Diesel Generators in Texas." Prepared for Houston Advanced Research Center. December.

Friesen, R., J. Russell, C. Lindhjem, G. Yarwood. 2006. "2006 Update on a Pilot Project to Assess the Effectiveness of an Emission control System for Gas Compressor Engines in Northeast Texas." Prepared for NETAC, Kilgore, TX. October.

- Pollack, A.K., J. Russell, J. Grant, R. Friesen, P. Fields, M. Wolf. 2006. "Ozone Precursors Emission Inventory for San Juan and Rio Arriba Counties, New Mexico." Prepared for New Mexico Environment Department, Santa Fe, NM. August.
- Friesen, R. 2006. "Analysis of Converting North Slope Gas Turbines to Operate on Hydrogen." Prepared for Alaska Department of Environmental Conservation. July.
- Friesen, R. 2004. "Evaluation of Potential Control Technologies for Oxides of Nitrogen from Point Sources in Ellis County, Texas."
- Friesen, R. 2003. "Potential Control Measures for Reducing Visibility-Related Pollutants in Maricopa County, Arizona."
- Friesen, R. 2003. "Potential Control Measures for Reducing Visibility-Related Pollutants in Maricopa County, Arizona."
- Friesen, R. 2003. "Control Measure Development for Sacramento Metropolitan AQMD SIP Update."
- Friesen, R. 2002. "Strategic Plan, California Stationary Fuel Cell Collaborative." April.
- Friesen, R. 2002. "Development of Air Quality Mitigation Measures for Expansion of Port of Los Angeles."
- Friesen, R. 2000. "Emission Inventory Improvements for Selected Petroleum Production and Transportation Sources in the San Joaquin Valley."
- Friesen, R. 1993. "Control Technology Guidelines for Fugitive Emissions of Volatile Organic Compounds from Oil and Gas Production and Processing Facilities, Refineries, Chemical Plants and Pipeline Transfers." Prepared for California Air Resources Board. December.
- Friesen, R. 1992. "Control Technology Guidelines for Oxides of Nitrogen from Stationary Gas Turbines." Prepared for California Air Resources Board. May.
- Friesen, R. 1991. "Control Technology Guidelines for Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters." Prepared for California Air Resources Board." July.