
G. ALEX STEGE

Education

M.A. – Geography (Geomorphology), University of California, Los Angeles, 1996
B.S. – Geology, Tufts University, 1981

Professional Affiliations

Solid Waste Association of North America (SWANA). Currently serves as the chairman of SWANA's Generation and Modeling Committee.

Professional Experience

Alex Stege provides SCS with expertise in evaluating landfill gas (LFG) to energy and landfill methane emission reduction projects based on the application of LFG models to project LFG recovery. For nearly 20 years, Mr. Stege has supported the U.S. EPA's Landfill Methane Outreach Program (LMOP), World Bank, International Finance Corporation, landfill owners, municipalities, and LFG project developers in assessing the feasibility and performance of LFG utilization projects. Mr. Stege leads SCS's LFG modeling practice, which is based on the scientific application of actual flow and site data to develop an empirically calibrated LFG recovery model. Mr. Stege prepares or reviews domestic and international LFG modeling/ due diligence studies for SCS offices throughout the U.S. He also provides training in LFG modeling to SCS staff at annual meetings, and is responsible for the ongoing development of SCS's domestic and international LFG models. SCS has the most advanced LFG modeling practice in the industry because Alex Stege has developed a model calibration procedure, applied SCS's collection system design and operations expertise and its vast database of LFG flow and site data, and created an empirically-based model which accounts for the effects of collection system coverage/efficiency, site conditions, waste moisture, and waste composition on LFG recovery.

Mr. Stege has been selected to give presentations on the application of LFG models to evaluate landfill methane generation and recovery at conferences hosted by the following organizations: LMOP (numerous conferences); the Global Methane Initiative (GMI) Partnership [Expos in Beijing (2008), Delhi (2010), and Vancouver (2013)]; the Solid Waste Association of North America (SWANA); the Environmental Research and Education Foundation (EREF); the Global Waste Management Symposium; and the International Solid Waste Association (ISWA). Mr. Stege was the author of LMOP/GMI LFG models for Central and Eastern Europe (2014), Colombia (2010), Ukraine (2009), Mexico (Version 1 [2003] and Version 2 [2009]), and Central America (2007), and has provided training on the use of these models. Alex Stege has served as the Chairman of SWANA's Generation and Modeling Committee for the past 10 years.

Domestic Project Assignments

Mr. Stege has developed LFG recovery projections to support LFG system design, existing LFG project assessments, and LFG-to-energy project feasibility and financing for hundreds of landfills throughout the U.S. Many of the models and reports projected LFG recovery under

various landfill management scenarios, including: non-MSW disposal, organics diversion, bioreactor development, leachate recirculation, and geocomposite final cover installation. Mr. Stege has provided training on LFG modeling to clients as well as SCS staff, and has led discussions of SCS Engineers' modeling methodology at meetings with project developer clients and their investors.

Some of Mr. Stege's domestic energy developer clients for which he prepared LFG recovery projection models and reports include the following:

- AER Montauk
- AES Carbon Holdings
- Ameresco
- Biomass Development, Inc.
- Blue Source
- Cambrian Energy
- Clean Energy Fuels
- DTE Biomass
- Ecogas/Pacific Natural Energy
- Energy Developments, Inc. (EDI)
- Element Markets
- Fortistar Methane Group
- Gas Recovery Systems (GRS)
- INGENCO
- Methane Power, Inc.
- NEO Corporation/Minnesota Methane
- Northland Power
- Pepco Energy Services
- Reliant Energy
- U.S. Energy Biogas (formerly Zapco)
- Viridis Energy

Landfill owners and other non-developer clients that Mr. Stege has completed large and/or multiple LFG modeling assignments for include the following:

- Republic Services
- Waste Management
- WCA Waste Corporation of America
- City of Vancouver, British Columbia.
- Salt River Project, Arizona (included bioreactor modeling).
- Anne Arundel County, Maryland
- San Bernardino County, California
- Outagamie County, WI (included leachate recirculation and geomembrane covers)

International Project Assignments

Mr. Stege's international LFG project assignments have included preparation of pre-feasibility studies, due-diligence reports, and Project Design Documents (PDDs) for Clean Development Mechanism (CDM) GHG emission reduction and methane utilization projects throughout the world. Project clients have included EPA's LMOP, the World Bank, International Finance Corporation (IFC), Ameresco, Natsource, AES, and others, including many international LFG project developer clients. This work has involved preparing LFG models to evaluate methane recovery and achievable certified emission reductions (CERs) for well over one-hundred landfills in developing countries, including sites in Latin America, Asia, Africa, and Australia. A summary of this international project work is provided below.

LMOP/GMI Assignments. Mr. Stege has been providing assistance to U.S. EPA's LMOP in their efforts to promote LFG utilization internationally, and has been the primary author of country-specific LFG models and multiple reports for LMOP, including pre-feasibility studies and assessment reports. These projects are summarized below. Mr. Stege also has prepared numerous LFG models for other LMOP assignments for sites throughout the world.

- **Central-Eastern Europe LFG Model.** Mr. Stege was the author of the Central-Eastern Europe LFG Model and the model user's manual, which was released in 2014. He has presented on the Central-Eastern Europe LFG Model at the Global Waste Management Symposium in June 2014 and provided training on the model via a webinar in December 2014.
- **International Best Practices Guide Chapter on Landfill Gas Modeling.** Mr. Stege was the primary author of Chapter 6, "Landfill Gas Modeling" in GMI's "International Best Practices Guide for LFGE Projects – 2012".
- **Colombia LFG Model.** Mr. Stege was the author of LMOP's Colombia LFG Model and the model user's manual, which was released in September 2010. He presented the Colombia LFG Model at workshops in September 2010 in Medellin, Colombia and in December 2011 in Bogota, Colombia.
- **Ukraine LFG Model.** Mr. Stege was the author of LMOP's Ukraine LFG Model and the model user's manual, which was released in 2009. He presented the Ukraine LFG Model at a workshop in October 2009 in Kiev, Ukraine.
- **Mexico LFG Model.** Mr. Stege was the author of LMOP's Mexico LFG Model and the model user's manual, versions 1 and 2 (version 2 was released in 2009). He presented the new version of the Mexico LFG Model and provided training on model use at a workshop in March 2009 in Guadalajara, Mexico.
- **Central America LFG Model.** Mr. Stege developed an LFG model for the 7 Central American countries, prepared the model users' manual, and conducted model training at workshop in San Salvador, El Salvador in March 2007 where the model was publicly released.
- **Site Assessments and Pre-feasibility Studies in Latin America.** Mr. Stege prepared the LFG models and was the primary author of project assessment reports and prefeasibility studies for many landfills throughout Latin America, including sites in Argentina

(Buenos Aires, Neuquen, Bahia Blanca), Brazil (Contagem, Gericino, Santana do Paraíso, Uberaba), Colombia (Bogota, Medellin, Cali, Cartagena), Mexico (Mexico City, Cancun, Ensenada, Nuevo Laredo), Chile (El Molle, Colihues).

- **GMI Workshops, Site Assessments, and Pre-Feasibility Studies in India.** Mr. Stege has traveled to India several times as part of an SCS-LMOP team, where he has conducted site visits to landfills, and given presentations on assessing LFG project potential at landfills in India and other developing countries. Mr. Stege has prepared LFG model projections for numerous India sites and been the primary author of pre-feasibility studies and assessment reports for landfills in Mumbai (2), Delhi, Ahmedabad, Pune, Lucknow, Hyderabad, Agra, and Kolkatta (in progress).
- **Site Assessments and Pre-feasibility Studies in Eastern Europe (Serbia, Turkey, Ukraine, and Russia).** Mr. Stege was the primary author of LFG project prefeasibility studies for the Vinca Landfill in Belgrade Serbia, and three sites in the Istanbul Turkey region (Sakarya and two sites in Canakkale). Mr. Stege prepared LFG models for numerous sites in Ukraine and Russia and was a contributing author of project pre-feasibility studies and assessment reports for landfills in Ukraine and Russia.
- **El Trebol Landfill (Guatemala) Pre-feasibility Study.** Mr. Stege prepared the LFG modeling and was the primary author of the El Trebol Landfill Pre-Feasibility Study. Mr. Stege presented the results of the pre-feasibility study at an LMOP/USAID workshop in Guatemala City in October 2005.
- **World Bank/LMOP Thailand LFG Modeling Study.** Mr. Stege evaluated data on Thailand's disposal sites and developed LFG generation and recovery projections for 56 sites. Mr. Stege co-hosted a 3-hour World Bank workshop on LFG development training in Bangkok in April 2004 and presented the results of the modeling work.
- **International Finance Corporation (IFC)/Due Diligence Reports.** Mr. Stege was the project lead and primary author of a technical due diligence assessment of proposed LFG-to-energy projects at five landfills in the Sao Paulo Brazil area. He evaluated prepared LFG models for each landfill under alternative scenarios based on an evaluation of landfill design, waste disposal rates and composition, site operations, collection system design and operations, estimated collection efficiencies, and actual historical recovery rates. The due diligence assessments included a review of project costs, evaluating project risks, and developing LFG-to-electricity facility installation and expansion schedules based on projected methane fuel availability.
- **City of Vancouver, Canada.** Mr. Stege developed a multi-phase LFG generation and recovery model for the Vancouver Landfill that evaluated LFG generation, recovery, and emissions from each disposal area (phase) of the landfill, using separate model calculations for each phase and for each waste category (MSW, demolition waste, and "demo-hog" waste). The model was calibrated to actual LFG flow data while accounting for estimated collection efficiency by landfill phase. Mr. Stege also was the primary author of the LFG Assessment Report which presented the results of the LFG model, as well as sections of the LFG Management Facilities Design Plan which summarized the LFG Assessment Report findings.

- **LFG Modeling of Brazil's Landfills (various clients).** Mr. Stege prepared LFG models and conducted the analyses of potential LFG recovery and CERs from many existing and proposed LFG projects in Sao Paulo, Rio de Janeiro, Adrianopolis, and Sao Joao.
- **Project Design Document (PDD) – Los Laureles Landfill Gas Project, Guadalajara, Mexico.** Mr. Stege was the primary author of the PDD, which is the project planning document required to implement a greenhouse gas emission reduction project to obtain carbon credits under the Clean Development Mechanism (CDM). The work involved following the CDM protocol for evaluating the “additionality” of the LFG-to-energy project (whether the project will create emission reductions that are additional to what would have occurred without the benefit of carbon credits), estimating the amount of emission reductions to be produced by the project, and developing a monitoring plan for demonstrating achievement of emission reductions.
- **Project Design Document (PDD) and CDM Support – Coyula Landfill Gas Project, Guadalajara, Mexico.** Mr. Stege was the primary author of the PDD, including following the CDM protocol for evaluating the “additionality” of the LFG-to-energy project, estimating the amount of emission reductions to be produced by the project, and developing a monitoring plan for demonstrating achievement of emission reductions. The project is now registered under the United Nations Framework Convention on Climate Change.
- **AES Carbon Holdings, LLC (AES)/Nejapa Landfill, El Salvador – Due Diligence Evaluation and LFG Modeling.** Mr. Stege provided critical due diligence support for the Nejapa LFG project, including the evaluation of site conditions and gas collection system performance, and the development of LFG recovery projections for various existing and future phases of the landfill. Mr. Stege also prepared dozens of LFG model runs for the client to use in economic analyses, and performed a sensitivity analysis of the impacts of varying assumptions and future scenarios on projected CERs.
- **CAF and Panama City/Cerro Patacon, Panama Pre-Feasibility Study and Pump Test Evaluation Report.** Mr. Stege prepared the LFG model and analysis of potential CERs from the proposed project, performed the financial analysis and evaluation of environmental impacts, and was one of the primary authors of the pre-feasibility study. Mr. Stege also was the primary author of a report describing the pump test performed at the landfill, analyzing the field data, and presenting a revised LFG generation model accounting for the pump test results and the proposed LFG development schedule.
- **World Bank/Study of CDM LFG Project Shortfall.** Mr. Stege was the primary author of a study for the World Bank involving a comparison of methane recovery rates forecast in PDDs to actual recovery rates provided in monitoring reports. The study examined the extent of under-performance of international LFG projects and performed modeling analysis to evaluate model error and other reasons for not achieving CERs projected in the PDDs. Mr. Stege has continuously updated this study with new data and given presentations on the updated results at EPA, M2M, and SWANA conferences in Beijing, China (October 2007), Washington, D.C. (January 2008 and 2009), Houston, TX (March 2008), Singapore (November 2008), and Delhi, India (March 2010).

- **Confidential Client / Due Diligence Assessments and LFG Modeling Studies of Proposed LFG Projects for Four Landfills in Colombia.** Mr. Stege prepared the LFG models, contributed to the writing of assessment reports for two sites, and wrote the LFG modeling studies for two sites.
- **Confidential Client / Due Diligence Assessment of Proposed LFG Project for a Landfill in Mexico.** Mr. Stege prepared the LFG models and was a primary author of the due diligence report.
- **World Bank/Latin America Pre-Feasibility Reports.** Mr. Stege was a key member of the SCS team that worked on the 2004-2005 pre-feasibility studies for 10 landfills in Latin America. Mr. Stege prepared the LFG models and report sections on model results, and helped prepare many of the other sections of the reports, including the financial analyses and environmental impacts evaluations.
- **International Finance Corporation (IFC)/Due Diligence Report.** The IFC project was conducted during the fall of 2004 and involved a technical and financial appraisal of, and due diligence on, a proposed LFG-to-energy project being constructed at the Villa Dominico Landfill in Buenos Aires, Argentina. Mr. Stege was the lead investigator evaluating the proposed LFG collection and flare system to determine whether it would be capable of reducing greenhouse gas emissions by the amounts estimated by the project developers. Mr. Stege was the primary author of the report providing the results of the project evaluation.
- **Other Due Diligence Assignments/Pre-Feasibility Studies.** Mr. Stege has performed or assisted with many studies of proposed LFG projects at landfills throughout the world for other clients not listed above. The assignments involved preparing evaluations of completed pump tests, the proposed LFG collection and flaring systems, the project's capability of delivering the amount of CERs cited in the PDD, project additionality, the adequacy of the PDDs' monitoring methodologies, and evaluations of health, safety, and environmental issues.
- **Other International LFG Modeling.** Mr. Stege has developed numerous LFG models for other clients in support of assessments of the LFG recovery potential at landfills in Latin America, Korea, New Zealand, Australia, Africa, and Israel.

Conference Presentations

EREF Regional Summit, Austin TX, November 13, 2014. "Correlating Landfill Gas Modeling to Practice and Policy"

Global Waste Management Symposium, Orlando FL, June 23, 2014. "Central-Eastern Europe GMI Landfill Gas Model."

SWANA's 37th Annual Landfill Gas Symposium, Monterey, CA. March 27, 2014. "The Effects of Organic Waste Diversion on LFG Generation and Recovery from U.S. Landfills."

SWANA's 36st Annual Landfill Gas Symposium, Las Vegas, NV. March 18-21, 2013.
"Estimated 100-Year Collection Efficiency for U.S. Landfills."

Global Waste Management Symposium, October 1, 2012. "Evaluating the Historical Performance of Landfill Gas Projects Developed Under the CDM."

Solid Waste Association of North America (SWANA) Northwest Chapter Conference, April 19, 2012. "Evaluating the Impacts of Organic Waste Diversion in the Pacific Northwest on LFG Recovery."

14th Annual LMOP Conference and Project Expo, January 2011. "Introducing a New Landfill Gas Model for Colombia."

Methane to Markets Partnership Expo: Delhi, India, March 2-5, 2010. "Steps Towards Initiating LFG Utilization Projects in Developing Countries – Planning Process, LFG Models, and Managing Project Expectations."

13th Annual LMOP Conference and Project Expo, January 2010. "LMOP's New LFG Models for Mexico and Ukraine – Tools for LFG Project Screening and Assessment."

ISWA/WMRAS World Conference 2008. Singapore, Nov. 3-6. "Methane Emission Reductions Achieved by Landfill Gas Projects in Developing Countries".

SWANA's 31st Annual Landfill Gas Symposium, Houston, Texas. March 10-13, 2008.
"Overestimation of emission reductions from Landfill Gas Projects in Developing Countries."

11th Annual LMOP Conference and Project Expo, January 2008. "Overestimation of Landfill Gas Recovery – Implications and Recommendations for Better Modeling Practices."

Methane to Markets Partnership Expo: Beijing China, Oct. 30 – Nov. 1, 2007. "Evaluation of Landfill Gas Models Using Monitored Recovery from Projects in Latin America, China, and Eastern Europe."