EXPLORING BASELINE DEVELOPMENT IN THE NATURAL GAS INDUSTRY: PROJECTS TO MITIGATE METHANE EMISSIONS

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ABSTRACT

A number of companies in the mid- and upstream natural gas industry have gained valuable experience in identifying opportunities for greenhouse gas (GHG) emissions reductions, and have undertaken activities to help achieve these reductions. One area drawing particular attention from companies is project-based greenhouse gas mitigation (GHG) activities.

A project-based activity includes any project undertaken with a view to reduce GHG emissions below an established baseline. Such reductions could translate into transferable emissions credits, or could be used to meet a voluntary or mandatory domestic reduction goal. Although significant opportunities exist to reduce GHG emissions in the natural gas industry, one of the greatest challenges many companies will encounter before these opportunities can be realized is determining the baseline.

This article will begin by discussing opportunities for project-based activities in the mid- and upstream natural gas industry to reduce methane (CH_4) emissions. Focusing on fugitive CH_4 emission reduction and flaring mitigation projects, this paper highlights issues investors may need to consider when developing baselines, including, baseline aggregation, project boundaries, baseline emissions units, data sets, data assumptions, and crediting lifetime. A primary goal of the article is to initiate the dialogue among potential project participants about how to develop credible, and creditable, baselines in the natural gas industry.

1.0 INTRODUCTION

Whether striving to meet a voluntary internal reduction goal or a national-level emissions target, companies are seeking innovative, cost-effective, ways to reduce GHG emissions. There are a number of options for reducing emissions, including fuel switching, the introduction of more energy efficient technologies, and carbon sequestration. These options answer the question of "what can be done", but entities are also interested in "how" these reductions can be achieved most cost-effectively.

Project-based activities are gaining increasing resonance as an option for cost-effectively reducing emissions. The natural gas industry has already engaged in a number of project-based activities, as illustrated in Table 1. One of the first challenges that all project participants must face before realizing emissions reductions is determining projected emissions levels under a business-as-usual (BAU) scenario, in other words, determining the baseline.

Table 1. Selected Methane Reduction Projects in the Natural Gas Industry

Project	Partners	Description
Chile Natural Gas Project: Capturing Fugitive Methane Emissions	Australia and Chile	Project utilizes nylon pipeline technology to reduce fugitive emissions from distribution system.
Atlantic Methanol Production Company Environmentally Responsible Gas Processing on Bioko Islands.	United States and Equatorial Guinea	Project entails building a methanol plant adjacent to the gas processing plant to utilize emissions that would have otherwise been flared.
RUSAGAS: Capturing Fugitive Gas Emissions from Compressor Stations	United States and Russian Federation	Project designed to seal leaking valves in two compressor stations in Russia's transmission and distribution systems.
Reduction of Leaks in Natural Gas Pipelines	United States and China	Project focuses on minimizing, and where possible, eliminating leaks from control valves. Project examines leak detection and maintenance programs.
Nigeria West African Gas Pipeline	Chevron Nigeria	Gas that was previously flared will be transported to Ghana and Benin to be used in power plants.

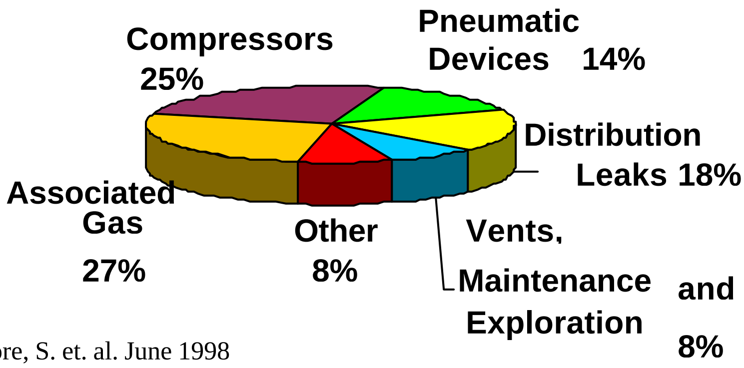
2.0 POTENTIAL FOR PROJECT-BASED ACTIVITIES TO REDUCE FUGITIVE METHANE EMISSIONS

Global CH_4 emissions from the oil and gas industry are estimated to be between 30 and 70 million metric tons per year (MMt/y) (IPCC, 1997) rising to approximately 78 MMt/y by 2025 (IEAGREEN, 1998). Studies suggest that natural gas is responsible for about 73% of these emissions. Global, regional and site-specific CH_4 emissions from the natural gas industry are rather uncertain as emissions are not systematically monitored and site-specific sources not well studied. Although this does not suggest that project-based activities cannot be undertaken, it may suggest that, at least initially, default emissions factor data may be necessary. This is explored further below.

2.1 FUGITIVE METHANE EMISSION REDUCTION PROJECTS

Fugitive CH_4 emissions may be reduced throughout the natural gas cycle, from the well to the burner tip. The most significant single point sources of emissions result from the flaring of associated gas, leakage from gas compression stations, and leakage from pneumatic devices (Figure 1). Together these sources account for approximately two-thirds of total CH_4 emissions from the industry. In addition, although individual leaks from gas transmission and distribution systems may seem relatively minor, collectively, leakage from these systems can be substantial.

Figure 1. CH_4 Emissions Sources in the Oil and Gas Industry



Source: Moore, S. et. al. June 1998

Potential project-based activities could target any of these emissions sources. For example, a project developer may elect to replace a single high-bleed pneumatic device with a low- or no-bleed pneumatic device, potentially realizing up to a 98% emissions reduction (U.S. EPA, 1998). Alternatively, a project may replace leaky valves at a number of compressor stations. For example, a project in Russia designed to replace 150 leaky valves at two compressor stations was projected to result in a reduction of 1.06 MMt CO2equivalent per year (see http://www.unfccc.int).

The potential return on investment for implementing these projects can be significant. In the example of Russia above, the project could generate about $3.8m per year if all otherwise leaked gas were sold on the market [2]. The revenues accruing from the sale of natural gas on the market, however, are just one component of the benefits of undertaking a project-based activity. In a world where carbon assumes a price, either because of voluntary or mandatory programs, CH_4 mitigation projects also can achieve a high rate of return because of the global warming potential of CH_4 (21 times that of CO_2). In other words, for every ton of CH_4 not emitted, credit equal to 21 tCO_2 can be acquired, and perhaps, sold on the market. In the example cited above, at $5.00/ tCO2, the project could bring in additional annual revenue of $5.3m.

2.2 FLARING MITIGATION/ELIMINATION PROJECTS

It is difficult to assess global emissions from the flaring of natural gas. A study undertaken by The World Bank estimates approximately 108 billion cubic meters of natural gas were flared in 2000, although this may be an underestimate due to the absence of data from some countries. Based on projected increases in oil production, and no action to mitigate flares, flaring is projected to increase by about 60% by 2020 (The World Bank, 2002).

There are, however, a number of opportunities to reduce both CH_4 and CO_2 emissions from flaring. One project-based option is capture and re-injection of the gas into a storage facility, for example an oil well for enhanced oil recovery, or salt caverns. The Sleipner Field in Norway, where approximately one million tons of CO_2 are annually separated from gas production and re-injected, is a prime example of a capture and re-injection project.

Another potentially creditable project-based activity might involve capturing otherwise flared gas for use in international or domestic markets. According to conclusions of the Global Gas Flaring Reduction Initiative, an effort led by The World Bank, international gas markets hold the greatest potential to utilize otherwise flared gas. For example, there are a number of flaring sites in the Middle East and Africa that could benefit from a project to convert currently flared gas to liquefied natural gas (LNG) to supply the Atlantic Basin.

According to The World Bank, although smaller in scope, domestic markets offer another outlet for otherwise flared gas. One potential project-based activity to service a domestic market might be conversion of otherwise flared gas to liquefied petroleum gas (LPG). Although LPG is a popular household fuel in many developing countries, there are low market penetration rates in countries that currently flare. Increased use of LPG in these countries could provide a market for consumption of this otherwise flared gas, offsetting the use of more carbon-intensive fuels.

3.0 PROJECT-BASED ACTIVITIES AND BASELINE DEVELOPMENT

A primary challenge developers will face in pursuing project-based activities is determining the baseline. Baselines are critical because they provide the basis against which any emissions reductions due to a project are calculated.

Project emissions reductions = Baseline emissions – Project emissions

There are a number of issues to consider in developing an environmentally credible and creditable emissions baseline, including baseline aggregation, project boundaries, baseline units, data requirements, and crediting lifetime. When considering how to address these issues, a balance should be sought between encouraging only projects achieving real emissions reductions (i.e., beyond BAU) and ensuring that developers have an incentive to undertake projects by keeping transaction costs at a minimum.

3.1 BASELINE AGGREGATION

The term “standardized baseline” is often used to refer to an emissions baseline that can be used for more than one project activity. There are two options for standardization, either a standardized *value* applicable to all projects can be developed or a standardized *approach.* Because of the different characteristics of gas infrastructure throughout the world (for example, age and maintenance history) as well as differences in combustion efficiency in the case of flaring, standardized *values* for CH_4 reduction projects are not recommended. This paper recommends use of a standardized *approach* to baseline development in other words, outlining the steps a project developer should take to develop a baseline, but allowing, where possible, for more site-specific data to be incorporated.

3.2 PROJECT BOUNDARIES

Project boundaries are important for baseline development because they delineate those emissions that should be accounted for by the project developer in both the baseline and project scenario. Although different existing programs have slightly different definitions of "project boundary", generally, project boundaries should include all GHG emissions that are considered significant and reasonably attributable to a project. The baseline should include all sources of emissions within the project boundary.

This paper does not recommend a definitive project boundary for fugitive CH_4 emission reduction projects because a project could conceivably include anything from a single pneumatic device to a pipeline spanning hundreds of kilometers, or both. For flaring mitigation projects, three main project boundaries are identified: (1) just the flare itself, (2) the extraction/production boundary or (3) the upstream flaring site and the downstream sector, in the case where otherwise flared gas is collected and used to displace more carbon-intensive energy use downstream.

Regardless of the boundary selected, project developers should explain and justify *why* a particular boundary has been selected. The developer should also ensure that all significant emissions are accounted for and that emissions accounted for in the baseline are also accounted for in the project scenario.

3.3 UNITS FOR BASELINE EMISSIONS

Identifying common baseline units for similar project activities contributes to transparency and comparability among different projects. This paper recommends that baselines be expressed on a "rate" basis (for example, tCO_2/unit of activity). However, not all CH_4 reduction projects can be expressed in the same units. Suggested baseline units for fugitive CH_4 emissions reduction projects are illustrated in Table 2.

Table 2. Possible Baseline Units of Measurement

Activity	Suggested Measurement	Baseline Unit
Production & Processing LNG Plants	% of throughput	TCO_2e/MMcm
Transmission Pipelines Distribution	M^3/km/yr	TCO_2e/km/yr
Compressor Stations	M^3/MW/yr	TCO_2e/MW/yr
Meter&Regulator Station	M^3/station/yr	TCO_2e/station/yr

Source: "Suggested Measurements" found in Altfeld *et.al.*, 2000.

For flaring reduction projects, baseline units are best expressed in terms of tCO2/MMcm (i.e., per unit of throughput). These rate-based units contribute to the environmental integrity of the baseline, because projects cannot generate credits for reductions in system activity, for example, because a pipeline segment is shut down resulting in decreased emissions.

3.4 HISTORICAL VERSUS PROJECTIONS DATA

Baseline analyses undertaken by the OECD/IEA have evaluated the advantages and disadvantages of developing baselines using either historical or projected data (OECD/IEA, 2000). Consistent with their conclusions, this paper recommends using most recent historical data for baseline development. Recent historical data is believed to be a better representation of what would have otherwise occurred than projections data which are inherently more subjective and open to possible gaming.

Implementing this recommendation for baseline development may not, however, be straightforward. Where a project is based on an existing facility (i.e., retrofit projects) the emissions from the existing facility can serve as the baseline. This assumes, as mentioned below, the existing facility would have been in operation for the project's full crediting lifetime. However, using most recent historical data for greenfield projects is not as straightforward, as there is no existing facility to approximate baseline emissions.

Theoretically, for greenfield projects developers could consider the emissions performance of existing facilities in the same geographic area (or another geographic area if it exhibits similar circumstances). However, for fugitive CH_4 reduction projects this could prove costly to a project developer as these data sets currently are not available. This could introduce significant costs to first movers. One option might be to consider default values for baseline development. This is discussed further below.

For greenfield flaring mitigation projects another problem arises. Although the emissions performance of similar facilities in a region could be used to calculate the baseline, perhaps in terms of average GHG emissions from flaring as a function of total associated gas produced, this may not truly reflect what would have happened in a BAU scenario. There are a number of factors that enter into a decision whether or not to flare (e.g., distance to market and quality of the gas). Thus, even considering "similar" facilities may not be reflective of BAU.

Considering this uncertainty around greenfield flaring projects, developers might be required to expend additional resources to "prove" why their project would not have occurred anyway. Alternatively, a program administrator might determine that this project type is not eligible for crediting. Additional research could prove useful to determine whether there is an objective means of determining eligibility for greenfield flaring reduction projects.

3.5 DATA ASSUMPTIONS AND AVAILABILITY

Although use of most recent data is desirable, it may not always be practical or cost-effective to assume that this data set can be collected, particularly in the short term. In these instances, assumptions may be made and default data used. This study examined five potential sources of default data for fugitive CH_4 emission reduction projects. The International Gas Union (IGU) (see Altfeld *et.al*, Sec. 2.3) and the Intergovernmental Panel on Climate

Change (see IPCC, 1997, Vol.3, Table 1-58 and IPCC, 2000, Table 2.16) provide potential default emissions factors for segments of the natural gas industry. It should be noted that these default values were originally defined for national-level emissions estimates and may not be reflective of individual project emissions levels. However, where baseline emissions are not clearly overestimated, these values may prove useful for baseline development.

The Canadian Association of Petroleum Producers (CAPP) developed another potentially useful source of data for baseline development. CAPP provides default CH_4 emissions factors for various technologies, such as valves, flanges and compressor seals in units of $kgCO_2e$/hr/fitting (CAPP, 2000). Knowing the number of fittings in the project boundary a developer could estimate baseline emissions. Alternatively, CAPP also provides default data for the number of fittings per technology. Thus, knowing the number of larger pieces of equipment (e.g., compressors, dehydrators, etc) a developer could deduce the average number of fittings within the project boundary, and then use the emissions factors outlined above to estimate baseline emissions.

Once default (or actual) emissions factors are known, baseline emissions can be determined by multiplying activity factor (e.g., kilometers of pipeline, number of compressors, etc) by an appropriate emissions factor.

3.6 CREDITING LIFETIME

Crediting lifetime, i.e., how long a project can generate credits, is closely related to investor certainty and the environmental credibility of a project. Crediting lifetimes of 7 and/or 10 years, as suggested in the international arena are appropriate for most fugitive CH_4 emission reduction and flaring mitigation projects. There may be certain projects where the 7/10-year option is not appropriate. For example, if a project proposes to collect flared gas, but the otherwise flared gas would have had to be captured anyway in five years due to upcoming legislation, the project might only earn credits for the first five years. After this time the project would be considered “business as usual”.

4.0 CONCLUSIONS

Companies may elect to undertake project-based activities for a number of reasons, including public recognition, to achieve internal voluntary reduction goals, as part of an emissions trading system, or to meet national commitments. One of the first stumbling blocks encountered by these companies will be development of a GHG emissions baseline against which similar project activities can be compared.

Although there are a number of challenges in trying to determine “what would have happened otherwise,” a key goal should be to maintain the environmental credibility of individual projects, while promoting a system that minimizes transaction costs and encourages certainty for the developer. *How* the issues discussed in this paper are addressed impacts the effectiveness of the system in achieving this environmental benefit. This paper has sought to initiate a dialogue. General recommendations for fugitive CH_4 emission reduction and flaring mitigation projects include:

- Development of standardized approaches to baseline development is possible and desirable.
- Project boundaries should include all emissions that are significant and reasonably attributable to a project. It is difficult to delineate specific boundaries for fugitive emissions projects because of the nature of the projects. Three main boundaries for flaring projects are the flare itself, the extraction/production boundary, and the upstream and downstream sector.
- Common units are important to enhance transparency and comparability between projects. Common units can be identified for these project types.
- Use of most recent historical data is recommended.
- Default values for baseline development may be appropriate, at least initially. Developers should justify the use of the selected default value(s) and be cognizant not to overestimate baseline emissions.
- The crediting lifetime options of 7/10 years are appropriate for *most* flaring reduction and fugitive emission reduction projects.

5.0 ENDNOTES

1. This article is taken from a larger paper written while on assignment at the International Energy Agency (IEA). For a copy of the paper contact: Hanle.Lisa@epa.gov. The views expressed in this paper are solely those of the author and do not reflect the official views of the IEA or the U.S. Government.
2. Assumes an average price of $53/1000m^3.
3. The author would like to thank Jonathan Pershing and Martina Bosi of the IEA for their continued assistance and insight during drafting of the paper.

6.0 REFERENCES

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