CLIMATE ACTION RESERVE

Summary of Coal Mine Methane Gas Quality Analysis
October 20, 2009

Background
Upon completion of the original version of this report in May 2009, the Reserve provided the report to the members of its CMM workgroup for review. Although workgroup members were generally supportive of some aspects of the standards (e.g., the treatment of VAM and non-pipeline MC projects), many members took issue with the quantitative thresholds established for MDC and pipeline MC projects. In general, the workgroup expressed the concern that these thresholds would act as disincentives to new projects, and to the expansion of existing projects, involving the capture and sale of CMM to pipelines. More specifically, the workgroup felt that a number of factors critically important to the economics of pipeline projects were not addressed by the proposed standards. Of the various factors proposed, one in particular seemed to generate the most support amongst the group—namely, the quality of the CMM (including the percentages of gas contaminants as well as the percentage of methane comprising the gas).

Although both the Reserve and SAIC recognized the potential importance of gas quality as a determinant of pipeline project economics, the data needed to perform an analysis of common practice with respect to gas quality is not available from any public sources. SAIC therefore used well type as a rough proxy of gas quality in the analyses performed for the original version of this report. Our hypothesis was that pipeline projects would be uncommon at mines relying exclusively on gob wells, because lower quality gob gas would not meet pipeline specifications without either blending with higher quality gas (which would not be possible at mines lacking pre-mining wells) or processing of the gob gas to remove contaminants (which would be prohibitively expensive). However, while our data analysis indicated that pipeline projects are more prevalent at mines with pre-mine wells than at mines relying exclusively on gob wells, it is *not* uncommon at the latter mines. In fact, three of the seven "gob-drainage only" mines with methane drainage rates $\geq$0.25 billion cubic feet capture and sell the methane (42.9 percent).

In short, while we recognized, and agreed with, the CMM workgroup's recommendation to consider common practice with respect to gas quality, we lacked the data to properly analyze this important factor. However, as a result of the discussions concerning gas quality between Reserve staff and the workgroup, three members of the workgroup agreed to provide gas quality data for their existing operations. These three members represent three coal companies that combined operate approximately half of the twenty-six longwall mines included in our analysis of MC projects.

Data Collection
Based on the workgroup members' willingness to provide the needed gas quality data, SAIC developed a data request template defining, and providing a consistent reporting format, for the data to be provided by the coal companies. In addition to some general information on each mine (company and mine identifiers, mine location, drainage borehole types used, project start dates, type(s) of upgrading technology used, etc.), the data request template includes a request for the following five CMM quality parameters:

- Average methane content (percent);
- Average nitrogen content (percent);
- Average oxygen content (percent);
- Average carbon dioxide content (percent); and
- Average hydrogen sulfide content (percent).

The above-listed parameters were selected in consultation with the three coal company workgroup members. In each case a weighted average content was requested for the 2000 through 2008 time period (similar to the 2000-07 time period used for our original analysis, but with the addition of the most recent year believed to be available from the workgroup). In addition, separate quality data were requested for each of the three drainage borehole types and, within each borehole type, for CMM collected for sale to pipelines and for CMM either vented or captured for non-pipeline uses (e.g., electricity generation). In addition to the quality data, the quantity of CMM (in million cubic feet) drained by borehole type, and captured for pipeline use or for non-pipeline use (including venting) was also requested for the 2000-08 time period. Finally, data on the quantity of gas upgraded (2000-08) was requested for each borehole type.

Thus the requested data was designed to enable comparison of common practice with respect to gas quality not only across mines, but also across drainage borehole types and end uses within each mine. The hypothesis underlying this data request, and the data analysis documented in the next section, is that the quantity of CMM captured and sold to pipelines is dependent on the quality of the gas—especially the gas' methane, nitrogen, and oxygen contents.

Analysis of the Collected Data
Data were received for a total of twelve mines. All twelve of the mines are located in the eastern U.S.; none are in the Midwest or West. For seven of these mines, detailed data on the quantity and quality of the gas drained by each borehole type was provided for the years 2000 through 2006; an additional two mines provided detailed data for the years 2004 through 2008. For two mines, less detailed data (including methane content, but not nitrogen, oxygen, carbon dioxide and hydrogen sulfide contents) was provided for the years 2004 through 2008. Quantity, but no quality, data was provided for the remaining mine. Thus our sample size for methane content data includes eleven mines, but the sample size is smaller (nine mines) for the contaminant data.

Table 14 shows the distribution of the mines by drainage system type, along with an indication as to which mines upgrade their gas prior to sale. All of the twelve mines use gob wells. Six of the twelve mines use horizontal pre-mining wells (which will be referred to, in the remainder of this chapter, as in-mine pre-mining wells). Of these six mines, five also utilize vertical pre-mining wells (which will be referred to hereafter as surface pre-mining wells). Finally, one mine uses both gob and surface pre-mining wells, but not in-mine pre-mining wells.

Table 14 - Distribution of the Sample Mines by Drainage System Type

Type of Drainage System	Total Number of Mines	Number of Mines that Upgrade
Gob Only	5	1
Gob & Pre-Mining	7	5
Total	12	6

Table 14 indicates that, within this sample of twelve mines, upgrading is *not* an uncommon practice. It is in fact the norm at mines with multiple drainage system types, although it is more unusual at mines that employ gob drainage exclusively. However, these general conclusions mask certain key differences in the utilization of upgrading by drainage system type. As Table 15 indicates, most of the gas drained from gob and in-mine pre-mining wells at the twelve mines in our sample was upgraded and sold. In sharp contrast, although nearly all of the gas (98.9 percent) drained via surface pre-mining was collected and sold to pipelines almost none of this gas was upgraded. Clearly the vast majority of the surface pre-mining gas meets pipeline specifications without any need for processing indicating that gas quality is generally not an impediment to pipeline sales for surface pre-mining gas. For this reason, our analysis will focus primarily on the quality of the gas drained via gob and in-mine pre-mining wells.

Table 15 - Percent Sales and Percent Upgraded by Gas Type

Type of Gas	Percent of Gas Sold to Pipelines	Percent of Gas Upgraded	Percent of Gas Sold without Upgrading
Gob Gas	79.2	79.2	0.0
In-Mine Pre-Mine Gas	96.8	85.5	11.3
Surface Pre-Mine Gas	98.9	1.9	97.0

Although Table 15 indicates that a portion of the in-mine pre-mining gas was sold without upgrading (11.3 percent), most of this gas (85.5 percent) had to be upgraded prior to sale. Furthermore, *all* of the gob gas sold to pipelines was first upgraded. Yet it is important to note that, while the raw gob and in-mine gas generally did not meet pipeline specifications, the mines were nonetheless able to upgrade this gas, presumably overcoming any financial barriers. The need to upgrade this gas was not a financial impediment to the collection and sale of *most* of this gas. In fact, approximately four-fifths of the gob gas, and an even higher percentage of the in-mine pre-mining gas, were upgraded.

Nonetheless, it is important to consider the question of why the remaining gas was not upgraded. Was the raw quality of this unsold gas significantly lower than that of the gas sent to upgrading facilities? If the answer to this question is "yes", it may indicate that upgrading is technically or economically feasible only for gas meeting a certain minimum quality level. Below this threshold level, upgrading/pipeline sales projects may not be feasible without the incentive provided by emission reduction credits.

Therefore, the analysis that follows focuses on the question of whether or not the data exhibit significant differences in the various quality parameters between the gob/in-mine gas that was upgraded and sold and the gob/in-mine gas that was vented or used on-site. To facilitate our analysis, we will consider this question first by comparing gas quality for the mines that do *not* recover, upgrade and sell their gob/in-mine gas with those that do. Then, we will turn to an in-depth analysis of the latter mines, to consider the question of why these latter mines upgrade only a portion of their gob/in-mine gas.

Comparison of Mines that Upgrade vs. Those that Do Not
As Table 14 indicates, six of the twelve mines upgrade their gob/in-mine gas, while six do not. One of the latter six mines did not provide any quality data, and is therefore excluded from this analysis. Two of the six non-upgrading mines provided only methane content data, while the remaining three mines provided data on both methane content and contaminants content. Since the sample sizes for the quality data thus differ by parameter, we will begin with an analysis of the contaminant data for the smaller (nine-mine) sample, and then broaden the analysis to the eleven mines that provided methane content data. It should be noted that although the contaminant analysis covers only nine mines, these mines actually provide fourteen separate observations for each contaminant, because three of the mines provide quality data for both gob gas and in-mine pre-mining gas.

Contaminant Data Analysis
Figures 30, 31 and 32 are frequency distributions of the data observations for nitrogen content, oxygen content, and carbon dioxide content, respectively (all nine mines reported that their gas had a hydrogen sulfide content of zero or nearly zero, so this fourth contaminant is not included in our analysis).

Turning first to Figure 30, we note that gas with an average nitrogen content of up to 25 percent is being upgraded. In fact, ten of the thirteen gas quality observations falling in the 0 to 25 percent range are for gas that is being upgraded, indicating that it is common practice to upgrade gas with a nitrogen content of 25 percent or less. However, none of the gas currently being upgraded has average nitrogen content greater than 25 percent, suggesting that upgrading may not be feasible for the gas shown in Figure 30 with nitrogen content of 35 to 45 percent.

Figure 31 reveals a pattern similar to Figure 30. From this figure, we can see that upgrading is common practice for gases with an average oxygen content of 3 percent or less, but above 3 percent there are two gases that are not being upgraded. In the case of carbon dioxide (Figure 32), upgrading is common even for gases with average carbon dioxide contents in excess of 5 percent, suggesting that levels of this contaminant are not acting as a constraint on the use of upgrading.

Figure 30 - Histogram of Average Nitrogen Content Data for Gob and In-Mine Gas

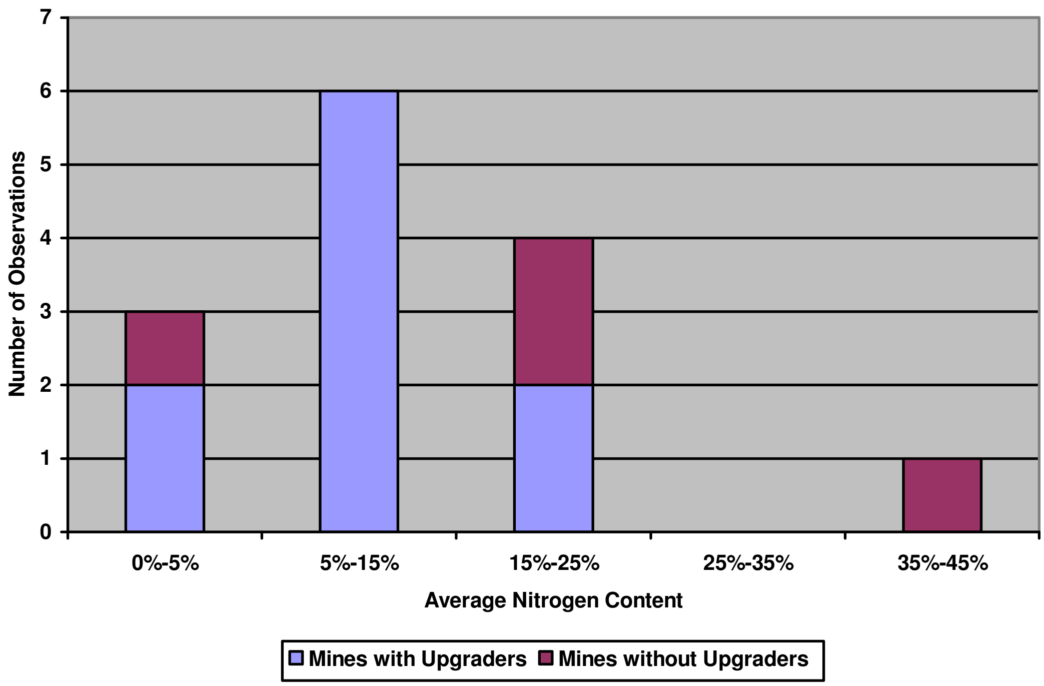


Figure 31 - Histogram of Average Oxygen Content Data for Gob and In-Mine Gas

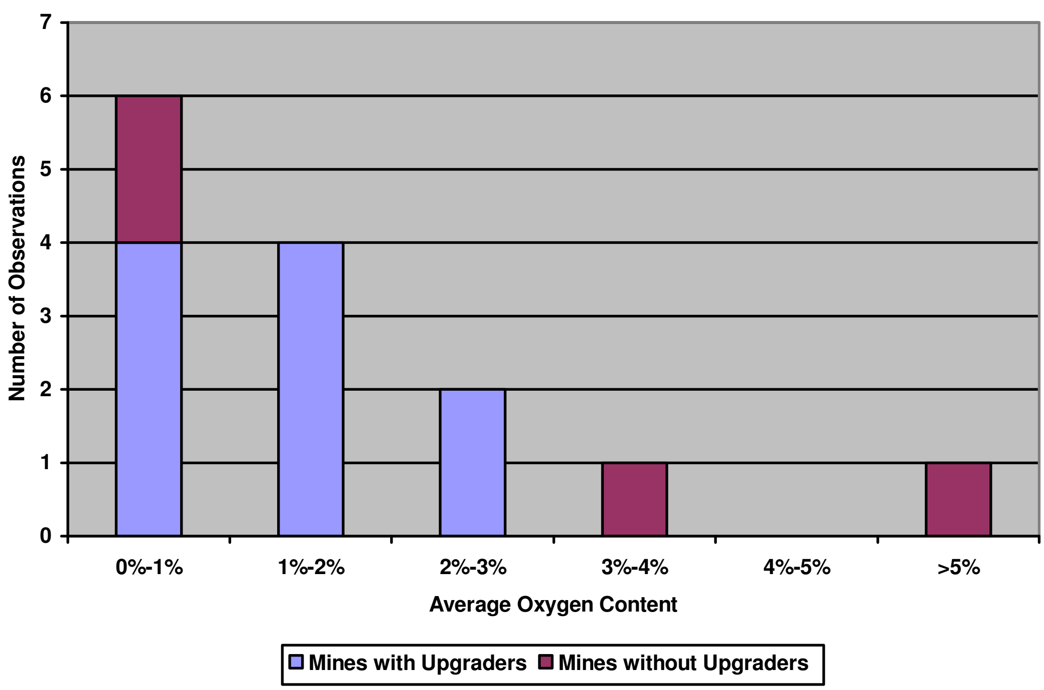
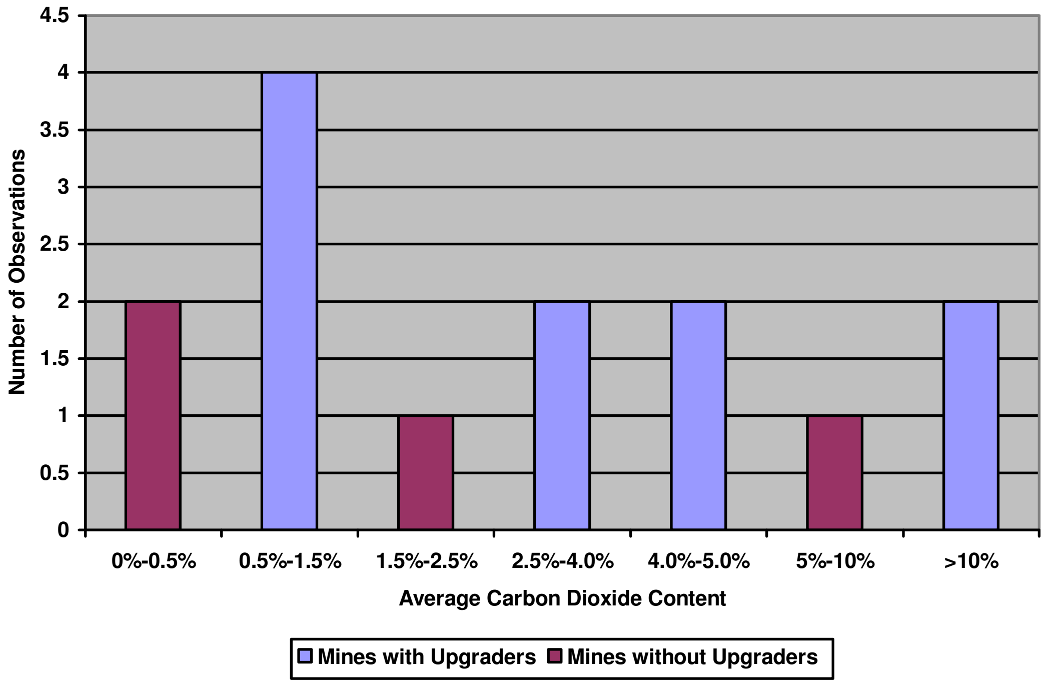


Figure 32 - Histogram of Average Carbon Dioxide Content Data for Gob and In-Mine Gas



Of the three mines represented in Figures 30 through 32 that do *not* upgrade their gas, two had average oxygen contents in excess of 3 percent, and one of these two also had an average nitrogen content in excess of 35 percent. It is possible that removal of the contaminants in the gas produced by these two mines is not economically feasible, due to the high oxygen and (in one case) nitrogen content of the gas. However, it is important to consider whether or not other explanations besides gas quality might exist for the decision to vent and use the gas produced at these mines on site.

One obvious alternative explanation is provided by the gas quantity data. Based on the data provided, the low gas drainage quantities, rather than the high contaminant levels may better explain why these mines are not upgrading and selling their gas. Quite simply, the mines might not be producing enough gas to justify the expense of a gas upgrading facility. There are significant reasons to prefer this quantity-based explanation over an explanation based on gas contaminant concentrations:

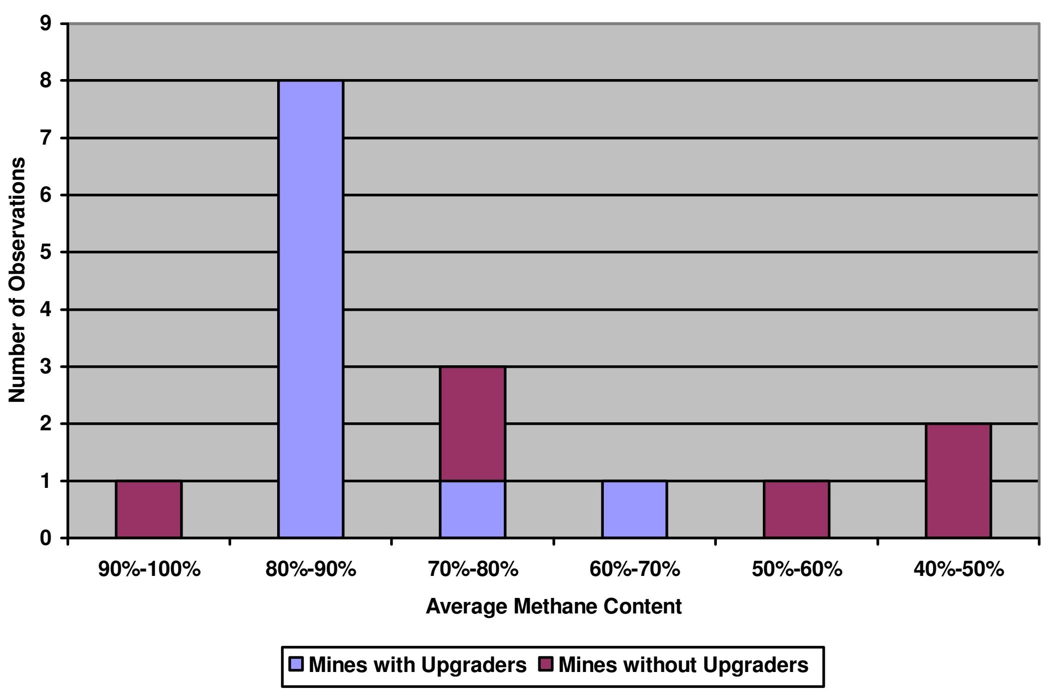
- The analysis underlying the quantity-based explanation is significantly more robust than the gas quality analysis provided in Figures 30 through 32 above. For one, the quantity analysis is based on data for nearly the entire population of mines with drainage systems. In contrast, the gas quality analysis is based on a non-random sample of only nine mines, representing approximately one-third of the entire population (and none of the mines in the Midwest or West).

- High contaminant concentrations can only explain the decision to vent/use on-site the gas at a few of the mines. Low gas production levels can explain this decision for all of the mines.

For the above reasons we do not recommend the development of contaminant-level common practice standards based on the data presented in Figures 30 through 32. However, it still remains to be seen whether a comparison of the *methane content* data for the mines with vs. the mines without upgrading facilities will support a new gas quality threshold.

Methane Content Analysis
Figure 33 is a frequency distribution of the data observations for methane content. As the figure shows, most of the gas that was upgraded in the 2000-08 time period had an average methane content falling in the 80 to 90 percent range. That said, upgrading of gas with average methane content in the 60 to 80 percent range was not uncommon; half of the methane content observations falling in this range were for gas that was upgraded.

Figure 33 - Histogram of Average Methane Content Data for Gob and In-Mine Gas



However, below a methane content of 60 percent none of the gas was upgraded. Furthermore, unlike the case with the contaminant analyses shown in Figures 30 through 32, there are multiple observations available at this tail end of the frequency distribution to support the establishment of a threshold value for methane content. Equally important, two of the three mines with methane content averages below 60 percent produced gas in quantities similar to the gas production levels at mines that use upgrading.

Based on these considerations, it is believed that a threshold value for gas methane content, below which pipeline sales projects could be considered additional, should be established as part of the coal mine methane common practice standards. In the next section we will set forth specific recommendations for a quantitative methane threshold. First, however, it is important to complete our data analysis. Specifically, while we have now completed our analysis of gas quality differences between mines that do and mines that do not upgrade their gas, we must still address a second issue: namely, why do mines *with* upgrading facilities upgrade only a portion of their gob and in-mine pre-mining gas? By comparing the quality of the gas upgraded at these mines with the quality of the gas that is not upgraded, we can determine whether or not gas quality might explain the upgrade decision. This comparative analysis is undertaken in the following subsection.

In-Depth Analysis of Quality Data for Mines that Upgrade Their Gas
In this subsection a detailed analysis of the quality of the gas sold versus vented/used on-site at the samples mines that upgrade their gas is provided. To facilitate this analysis, we have broken the mines down into three separate groups:

- A group that upgrades gob gas exclusively;
- A group that upgrades both gob and in-mine pre-mining gas; and
- A group that upgrades gas from all three borehole types.

We begin with an analysis of the mines that limit upgrading to gob gas.

Analysis of Mines that Upgrade and Sell Gob Gas Exclusively
The data indicate that, for each mine that upgrades and sells only a portion of its gob gas, the quality of the gob gas vented was identical, in every respect, to the quality of the gob gas upgraded and sold. In other words, at each mine, reported methane contents, nitrogen contents, oxygen contents, carbon dioxide contents, and hydrogen sulfide contents were the same for the gas vented as for the gas upgraded and sold. It therefore does not appear that differences in gas quality can explain the decision to upgrade only a portion of the gob gas at these mines. Perhaps the current capacity of the gas upgrading plant is a limiting factor, or perhaps some of the mine's gob wells are located too far from the plant to enable a cost-effective extension of the gas gathering system to these wells. Regardless of the mines' reasons for capturing some but not all of the gob gas, the available data suggest that gas quality is not an explanatory factor for these mines.

Analysis of Mines that Upgrade and Sell Gob Gas and In-Mine Pre-Mining Gas
These mines utilize all three drainage system types. The mines upgrade and/or sell most of the gas from all three borehole types. However, the gob gas and in-mine pre-mine gas captured for sale is upgraded; the surface pre-mining gas is sold without upgrading.

These mines upgraded and sold the majority of the gas produced from their gob wells and in-mine pre-mining wells, as well as selling almost all of the gas produced by their surface pre-mining wells (no upgrade necessary).

As was the case for the "gob-only" mines, the data shows that the quality of the vented gas is identical, in all respects, to the quality of the gas that was upgraded and/or sold. However, while this identical relationship holds true for each type of gas (gob, in-mine pre mine, and surface pre-mine) that was both sold and vented/used, the gas quality data differs *across* borehole types. Specifically, there are slight differences in gas quality between the gob and in-mine pre-mining gas, and significant differences between these two gases and the surface pre-mining gas.

As in the case for the "gob-only" mines, it does not appear that differences in gas quality would explain the mines' decision to vent some of the gob (and surface pre-mining) gas, and upgrade the remainder. Once again, gas quality is the same, at least on average, for the vented and the upgraded gob gas. However, the situation for these mines is complicated by the use of blending as well as upgrading to meet pipeline specs. Blending of the gas from different borehole types was not an option at the "gob-only" mines considered above, because these mines captured gob gas exclusively. However, at the mines with all three drainage systems, blending was used during the 2000-06 period. Presumably these mines are blending their gob gas with their in-mine pre-mining gas prior to upgrading; this would have the effect of raising the quality of the blended, upgraded gas above the quality of the gob gas that is vented/used. It is also possible that some of the gob gas, and the in-mine pre-mining gas, is being blended with the surface pre-mining gas and sold without any upgrading, although SAIC communications with the two mines indicate that such blending is not in fact taking place.[1]

Given the blending of gob and in-mine pre-mining gas prior to upgrading, it is important to consider the effects of this blending on gas quality. Assuming that all gob gas and in-mine gas was blended prior to upgrading, SAIC computed weighted average quality values for the blended gas based on the quality data and the reported quantities of gas sold. This analysis found that there is no discernible difference in the quality of the vented gob gas versus the blended gas at these mines. These results reflect the fact that the quantity of gas produced by the in-mine pre-mining drainage systems at the mines was much smaller than the quantity produced by the gob wells. This leads us to conclude that differences in the quality of the sold versus the vented gas do not explain the decision to vent a portion of the gas at these mines.

There is one other possibility that *might* explain the decision to vent/use on-site a portion of the gob gas. Specifically, it is possible that the upgraders at the mines do *not* upgrade to pipeline specs, but by blending the upgraded gob/in-mine gas with the raw surface pre-mining gas a final product meeting pipeline requirements is achieved. In this case, there could be a limit to the amount of upgraded gob/in-mine gas that can be mixed with the surface pre-mining gas; above this limit the quality of the final blended product would not meet the pipeline specs. However, while this is possible it must be noted that the quality of the blended gob/in-mine gas is significantly higher than that of the gob gas at the "gob-only" mines in all respects except one

[1] The original data received from the mines showed differences in the quantities of gas being sold versus the quantities being upgraded (with the former quantities larger than the latter), suggesting the possibility that some of the gas was being sold without being upgraded. However, in response to an SAIC e-mail questioning whether some of the gas was being sold without upgrading, the mines indicated that the difference was instead due to the reporting of gas quantities prior to upgrading for gas amounts sold and gas quantities after upgrading for amounts upgraded. In other words, the gas sales quantities include gas removed during the upgrading process, while the gas upgraded quantities exclude this removed gas. Based on this communicated information we believe that *all* of the gob and in-mine pre-mining gas is in fact being upgraded prior to sale.

(oxygen content), and a significant amount of the latter gas is *fully* upgraded to pipeline specs without any reliance on blending. If full upgrading to pipeline specs of a lower-quality gas is possible at the "gob-only" mines, it is presumably possible at the "gob/in-mine pre-mining" mines as well. This explanation cannot be entirely ruled out on this basis. However, it should be considered in conjunction with other possible explanations. Part of the reason a portion of the gas might not be sold is simply that it is being used on-site for another purpose. Furthermore, not only was a relatively small percentage of the low-quality gob gas not sold, but a small percentage of the very high-quality surface pre-mining gas was likewise not sold. Gas quality cannot explain the decision to vent, or use on-site, the latter gas, since the data indicate that the quality of this gas is identical to the quality of the surface pre-mining gas that is sold directly to pipelines without any upgrading. Clearly there are other reasons, besides gas quality, that explain the decision to vent, or use on site, a portion of the gas at this mine.

Analysis of Mines that Upgrade and Sell Gas from All Three Drainage System Types
Finally, the third group of mines upgraded and sold gas from all three drainage system types. The data show that since the installation of the upgrader facilities, these mines have upgraded 100 percent of the gas from all three borehole types. Therefore neither gas quality, nor for that matter any other factor, has constrained the upgrading of gas at these mines. Clearly if 100 percent of the gas has been upgraded, the quality of the gas at these mines has not in any way limited the application of upgrading.

Comparative Analysis across the Three Mine Groupings
Thus far we have analyzed the three groups of mines with upgraders independently of one another. However, if we compare the percentages of gas upgraded across the three sets we will find marked differences in these percentages. Could gas quality possibly explain these differences? Why are the "gob-only" mines capturing a much lower percentage of their gob gas than the other mines? Could gas quality explain these differences?

Measured in terms of methane and nitrogen content, the gob gas at the "gob-only" mines is of lower quality than the gob gas at all of the other mines. Specifically, at the "gob only" mines, average methane content is lower and average nitrogen content is higher. In the case of oxygen and carbon dioxide, the results are more mixed.

However, while the gob gas quality appears to be lower at the "gob only" mines, at least with respect to methane and nitrogen content, it is not clear that this would explain the observed differences in the percentages of gob gas upgraded and sold across the different mine groupings. Again, as discussed above the quality of the gob gas that is upgraded and sold at the "gob only" mines is *identical* to the quality of the gob gas vented. If *none* of the gob gas at the "gob only" mines was being upgraded, it might be surmised that the lower quality of the gas at these two mines, *vis a vis* the other mines with upgraders, was an obstacle to the application of upgrading at the former mines. However, given that some of the gob gas drained at the gob-only mines was upgraded, upgrading of this lower quality gas is clearly feasible. Furthermore, given that there is no difference between the quality of the gas upgraded at the "gob only" mines and the gas vented at these same mines, we are once again led to conclude that gas quality cannot explain the decision to upgrade some but not all of the gas.

Can the Mines Distinguish Quality of the Upgraded Gas Versus the Vented Gas?

Based on our analysis of both the three individual groups of mines, and our comparative analysis across the three groups, we are led to conclude that gas quality is not a likely explanation of the decision to upgrade or vent gas at operations with upgrading facilities. This conclusion is based largely on two key points gleaned from the data:

- At some of the sample mines with upgrading facilities, 100 percent of the gas is being upgraded; and
- At the other mines, the average quality of the gas being upgraded and sold is identical in every respect to the quality of the gas being vented/used on-site.

Clearly, gas quality is not an impediment to the upgrading of the gas if all of the gas can be upgraded, as is the case at the first group of mines above. Furthermore, gas quality cannot explain the upgrade/vent decision if there are no differences in the quality of the gas being upgraded versus the quality being vented.

However, are there in fact no differences in average gas quality at the mines that upgrade only a portion of their gas? Or, alternatively, do these mines lack the data necessary to distinguish the quality of their upgraded gas from their vented gas? The fact that the data indicates absolutely no differences whatsoever in five different parameters (methane content, nitrogen content, oxygen content, carbon dioxide content, and hydrogen sulfide content) leads us to suspect at least the possibility that these mines were unable to distinguish the quality of their non-upgraded gas from their upgraded gas.

However, even if the observed lack of a distinction in the quality of the gas reflects a lack of information rather than the actual equivalence of upgraded and non-upgraded gas, it is not clear that this should effect our conclusions. If the mines are unable to distinguish the quality of the gas being upgraded versus the gas being vented or used on-site, then it is unlikely that gas quality is the basis for their decision to upgrade only a portion of the gas. A lack of data on the quality of the non-upgraded gas would indicate that gas quality is not a determinant of the upgrade/vent decision.

In any event, if the mines cannot in fact distinguish the quality of the gas being upgraded from the quality of the gas being vented or used on-site, then the data needed to address the question of whether or not the quality of these two gases differ is not available, and there exists no basis for establishing gas quality as a determinant of upgrading. In short, we must assume that the lack of a distinction in gas quality exhibited by the data reflects reality, in order to be able to analyze the data. Without this assumption no analysis is possible.

Recommended Quality-Based Common Practice Standard
Based on the preceding analyses, we can now address the following questions:

- Are there significant differences between the upgraded and the vented gas at mines that currently upgrade a portion of their gas; and

- Are there significant differences between the quality of the gas at mines that do *not* upgrade their gas versus mines that *do* upgrade?

The answer to the first question above appears to be "no." However, as we have seen, our comparison of the gas quality data at the mines that do not have gas upgrading facilities with the quality data at the mines that do utilize such facilities indicates a significant difference in the average methane content of the two groups. Specifically, as shown in Figure 33, none of the mines producing gas with average methane content below 60 percent upgrade the gas. However, to be conservative, we would recommend that a common practice threshold be established at 55 percent, rather than 60 percent, methane. Such a threshold would be applied *only* to MC pipeline sales projects that exceed the previously recommended quantity threshold of 0.25 billion cubic feet per year of gas. Thus under this recommendation, MC pipeline sales projects at mines that drain more than 0.25 billion cubic feet per year from their boreholes would be given a second opportunity to qualify for emission reduction credits, based on methane content. Specifically, such projects would be deemed to qualify if upgrading of the gas is required to meet pipeline specifications, and if the average methane content of the gas entering the upgrader facility is 55 percent or less. Projects that can meet pipeline specifications *without* any upgrading of the gas (e.g., by blending ≤55 percent methane gas with higher quality gas) should not be qualified under this recommended standard. We recommend that methane content be measured according to the procedures adopted in EPA's Mandatory Reporting Rule (once those procedures have been finalized).

In addition, SAIC recommends adding one caveat to the acceptance of MC pipeline sales projects with average methane content of ≤55 percent. If a project takes place at a mine that is already upgrading a portion of its gas; if the average methane content of the gas upgraded in the past is ≤55 percent (as measured in accordance with EPA's Mandatory Reporting Rule); *and* if the mine has *not* received emission reduction credits from the Reserve for the portion of the gas upgraded in the past, the new project should *not* be qualified on the basis of its methane content (regardless of how low the methane content might be). In this case, conclusive evidence would exist that upgrading of low-quality (≤55 percent methane) gas at the hypothetical mine is not only possible without the incentive emission reduction credits, but has in fact already been done. Such evidence would outweigh the analyses presented in this chapter. We believe it is necessary to add this caveat to the application of the methane content standard given that the mine sample upon which this standard is based is both small and non-random. Given the limitations of the sample data, it is important to err on the conservative side in qualifying projects based on this data.