Pipe Replacement Prioritization

WHITE PAPER

Utilities worldwide are using Picarro's Asset Management Solution to further improve the choices they make regarding capital pipe replacement projects informed by traditional risk models. The Picarro solution combines data analytics with a vehicle-based methane emissions data collection platform to assist with capital replacement decisions. This leads to significant O&M cost savings through avoided leak repair by prioritizing replacements of pipelines with high leak densities. When this data is combined with traditional risk (DIMP) models, such benefits are maximized. Additional benefits of optimized capital project prioritization include accelerated risk reduction, emissions reduction and reduction in odor calls.

Emissions Quantification Analytics & Leak Density Estimation

Picarro's advanced leak detection technology can be used for more than simply detecting and identifying leaks in a compliance survey application. The solution has its greatest economic benefit when used in applications where locating specific leaks is not the goal. In the latter, using methane data collected along pipelines, Picarro's analytics estimate leak density (leaks per mile or area) and measure the actual, aggregated methane emissions (flow rate) along pipe segments or areas rather than identifying individual leaks. In a pipeline replacement application, significant O&M cost avoidance can be realized by identifying pipe segments with the highest leak densities and prioritizing them for capital replacement, as shown in Figure 1. Additional applications of these analytics enable better-informed risk reduction programs and targeted emissions reduction programs. As is described in the examples that follow, the Picarro solution can significantly improve pipe replacement decisions based on historical risk models.

Figure 1. Emissions Quantification and Leak Density Estimation concept. If two pipelines incur similar replacement capital expense, but only one can be replaced in a given year, significant future O&M expense can be avoided by using capital dollars to replace the most leak-dense section. Traditional models can benefit from the addition of methane data to improve their performance in maximizing this capital efficiency.

Figure 2. Pipe sections prioritized by Picarro's Emissions Quantification Analytics where thick lines show the highest leak density of pipe segments. Leak density is calculated by analytics that process Picarro's methane emissions measurements along each section.

Application Example: Adjusting Individual Pipe Replacement Project Prioritization

A Picarro customer in the U.S. had 2217 pipeline replacement projects (400 miles of pipeline) identified by a traditional risk model for replacement in 2019. Picarro methane measurements and analytics indicated that 40% of these projects that were planned for replacement actually had no measurable emissions (no leaks). By reprioritizing the 2019 projects using Picarro's solution, and only replacing high-priority projects in 2019 (projects with the highest estimated leak density from Picarro's measurements), two times more leaks could be removed by pipe replacement, saving O&M for each avoided leak repair. In this example, the same amount of pipe is replaced annually, only the choice of 2019 projects changes – projects scheduled for both 2019 and 2020 were measured by the Picarro system and then reprioritized – some from 2020 would be pulled into 2019, while others originally in 2019 would be pushed out if they had no emissions (i.e. no predicted leaks). Again, these areas were measured in a mode whereby the Picarro system does not locate or indicate individual leaks – it simply aggregates the methane measurements over the pipeline section and makes a *prediction* of leak density along that pipe segment based on the emissions measurements.

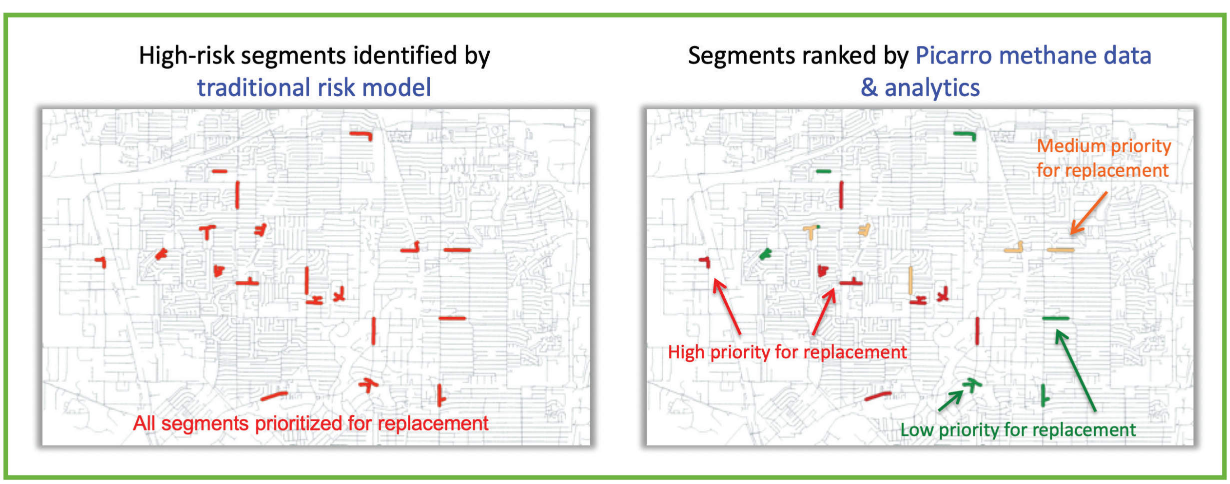

Figure 3. Example of reprioritization of individual pipeline replacement projects using Picarro's measurement and Emissions Quantification Analytics.

Application Example: Reducing Risk, Emissions & Odor Calls via Capital Project Reprioritization

In another example, PSE&G, New Jersey's largest utility, used the Picarro system in 2018 to assist in prioritizing their low-pressure cast iron pipe replacement priorities in the second phase of their Gas System Modernization Program (GSMPII). In this program, PSE&G calculated a hazard index from their traditional risk (DIMP) model to determine which 1-square-mile grids would be prioritized for replacement. Picarro then collected methane emissions data on 44 of these grids (280 miles of main) and the grids were further prioritized. Grids having emissions of 4.5 Liters per minute per mile or more were accelerated in priority for replacement in 2019 – in this case, six grids were accelerated based on Picarro's methane data.

Methane emissions data used as an additional prioritization metric is useful in situations like this when the hazard index of grids is relatively equal – the methane data in this case allowed PSE&G to accelerate their methane emissions reductions since these grids, if retired sooner than the "as is" plan, account for 41% of the methane loss in only 16% of the grids measured. There is also a safety benefit to removing these high-emitting leaks: there is less chance of non-hazardous leaks getting worse. PSE&G also anticipates fewer potential customer odor calls.

Application Example: Maximizing Leak Removal via Capital Replacement Reprioritization

PG&E and Picarro worked together on a project to understand the degree to which risk models with and without methane data would correctly predict risk. A comparison was made between PG&E's current DIMP model and a Combined model that uses Picarro methane data on top of the DIMP model. In an example (see Figure 4) of 4000 miles of distribution main where the 1% highest risk map tiles are identified and the number of below-ground leaks in those tiles is totaled, the DIMP model identifies 60 leaks in the top 1% whereas the combined model identifies 165 leaks in the top 1%. Tiles that the DIMP model predicts as high risk in some cases have no leaks, and vice versa. The Combined DIMP + Methane model does a better job of predicting where leaks will be located. More granular models enhanced with methane data offer a tremendous opportunity for improving capital efficiency of pipe replacement projects. In this comparison it was also shown that a model using only Picarro's methane data analytics outperforms the DIMP model but is not as good as a model that combines the two.

This illustration shows how the number of leaks remediated through capital pipe replacement can be maximized, leading to maximized O&M cost avoidance in future years since these leaks, removed by pipe replacement, would never be found by leak survey or customer calls.

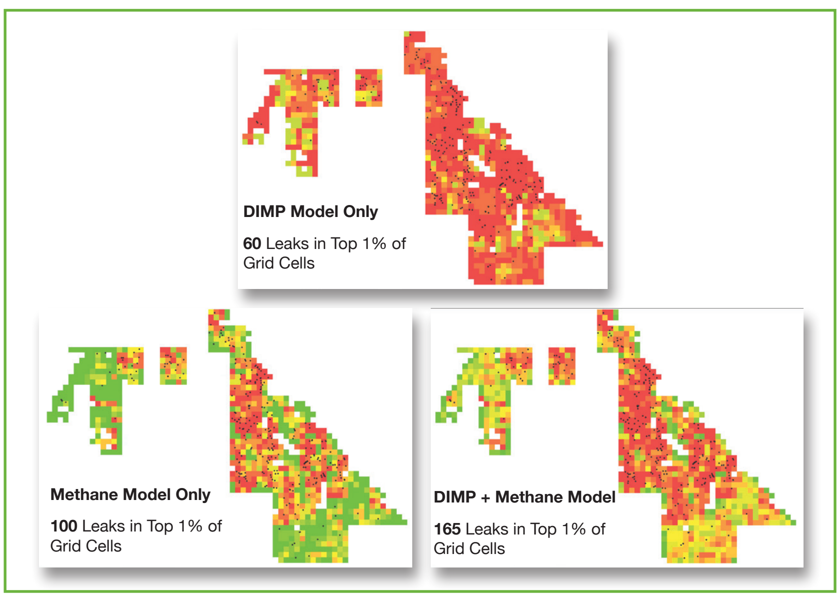

Figure 4. Subset of 4000-mile dataset. Example maps showing the performance of the DIMP and Combined models. Risk per map tile is indicated by color (red=high risk) and leaks found during subsequent compliance survey are indicated by black dots.

Construction Optimization Example: Application of Combined Model

Given the empirical results described above, a hypothetical scenario can be modeled wherein methane emissions data is collected by Picarro on the 10% riskiest areas identified by the DIMP model at a hypothetical utility. The methane data is then used to augment the DIMP model to define the top 1% for replacement. If it is assumed that the number of leaks removed by better identification of pipe replacement projects increases by 2.75x (as it did in the actual PG&E example, using the combined DIMP plus methane model), this logic can be applied to the hypothetical large utility with 70,000 miles of main: 1838 additional leaks are removed by capital dollars via pipe replacement. These leaks would incur O&M expense to repair if they were found by leak survey or odor calls, so removing them using capital pipe replacement funds represents a future O&M savings. Assuming a typical O&M repair cost of $4,000 per below-ground leak, this results in $7.4M of O&M cost avoidance of future O&M expense, as shown in Table 1.

Importantly, it is not necessary to measure all 70,000 miles to realize this annual benefit; emissions data only needs to be collected on 10% (7000 miles) of the infrastructure. One Picarro system can cover approximately 3500 pipeline miles annually.

	Top 1% by DIMP Model	Top 1% by DIMP + Methane Model	Difference
Number of Leaks	1050	2888	+ 1838
O&M Avoidance	$4.2M	$11.6M	+$7.4M

Table 1. Leak and implied construction costs avoided for DIMP and combined models.

LIT CODE: AB05-V1.0-190515
3105 Patrick Henry Drive Santa Clara, CA 95054 | 408-962-3900 | sales@picarro.com | picarro.com