# Quantitative Gas Imager and Leak Rate Estimator

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Natural gas pipeline leakage poses safety hazards, contributes to greenhouse gas loads, and costs customers the price of lost gas [1]. The principal purpose of developing rapid and remote leak rate measurement techniques is to rank leaks based not only on the current practice of measuring local concentration (which can be very high for a small leak in a no wind condition), but also on measuring leak rate. No current leak survey tool directly images gas leak plumes quantitatively, much less quantifies emission rate, a technology gap that this sensor development addresses.

The technology under development, which we call "RMLD-QGI" (Quantitative Gas Imager), combines low-cost laser scanner, visible camera, and near-IR tunable diode laser absorption spectroscopy (TDLAS) gas detection to answer this need (see Figure 1). Leak detection by near-infrared backscatter Tunable Diode Laser Absorption Spectroscopy (b-TDLAS) is exemplified by the widely-deployed Remote Methane Leak Detector (RMLD™) developed by PSI and now produced and sold by PSI's exclusive licensee Heath Consultants Inc. [2]. The operator manually scans the laser beam across the area of interest, be it the surface above an underground pipeline or the region around a gas meter or pipe fitting. The RMLD continually measures the path-integrated methane concentration (in unit of ppm-m) along the line traversed by the laser beam between the operator and the surface illuminated by the laser.

With the RMLD-QGI, the operator also scans the area of interest with the sensor, but the laser beam is simultaneously rastered very quickly over the field of view. The scanned beam generates a map of the path-integrated methane at a 1Hz rate, which is then overlaid on a co-aligned visible camera output, placing the plume in the visible scene.

This new tool addresses the need for reliable, robust, low-cost sensors to detect, image, and quantify fugitive methane emissions, enabling operators to prioritize repairs. Figure 1 shows a prototype platform that demonstrated quantitative performance in the laboratory and municipal field tests of over 60 leaks. Based on measured signal-to-noise ratios, it can quantify emissions as small as 0.25 scfh in seconds.


Figure 1: (left) Concept rendering of the RMLD-QGI, (center, left) image of methane plume from a Hencken burner, (center, right) breadboard RMLD-QGI transceiver and electronics support van, and (right) first-ever image of fugitive emission from a residential gas leak.

**References:**

1. "America Pays for Gas Leaks", Report Prepared for Senator Edward J. Markey, July 2013.
2. Frish, M.B., Wainner, R.T., Stafford-Evans, J., Green, B.D., Allen, M.G., Chancey, S., Rutherford, J., Midgley, G., and Wehnert, P., "Standoff Sensing of Natural Gas Leaks: Evolution of the Remote Methane Leak Detector (RMLD)," Photonic Applications Systems Technologies (PHAST) Conference, Baltimore, MD (24-26 May 2004).