



Methane to Markets

Directed Inspection & Maintenance with Remote Sensing

U.S. Environmental Protection Agency

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Agenda

- Methane Losses
- Methane Recovery
- Directed Inspection and Maintenance (DI&M)
- Infrared Leak Detection
- Partner Experience
- Discussion

Potential Methane Losses

- Fugitive emissions from natural gas systems worldwide are estimated to be 40 billion cubic meter per year
 - Estimate half a billion cubic meters fugitive emissions in China
- In excess of \$100¹ million worth of methane emissions per year for China



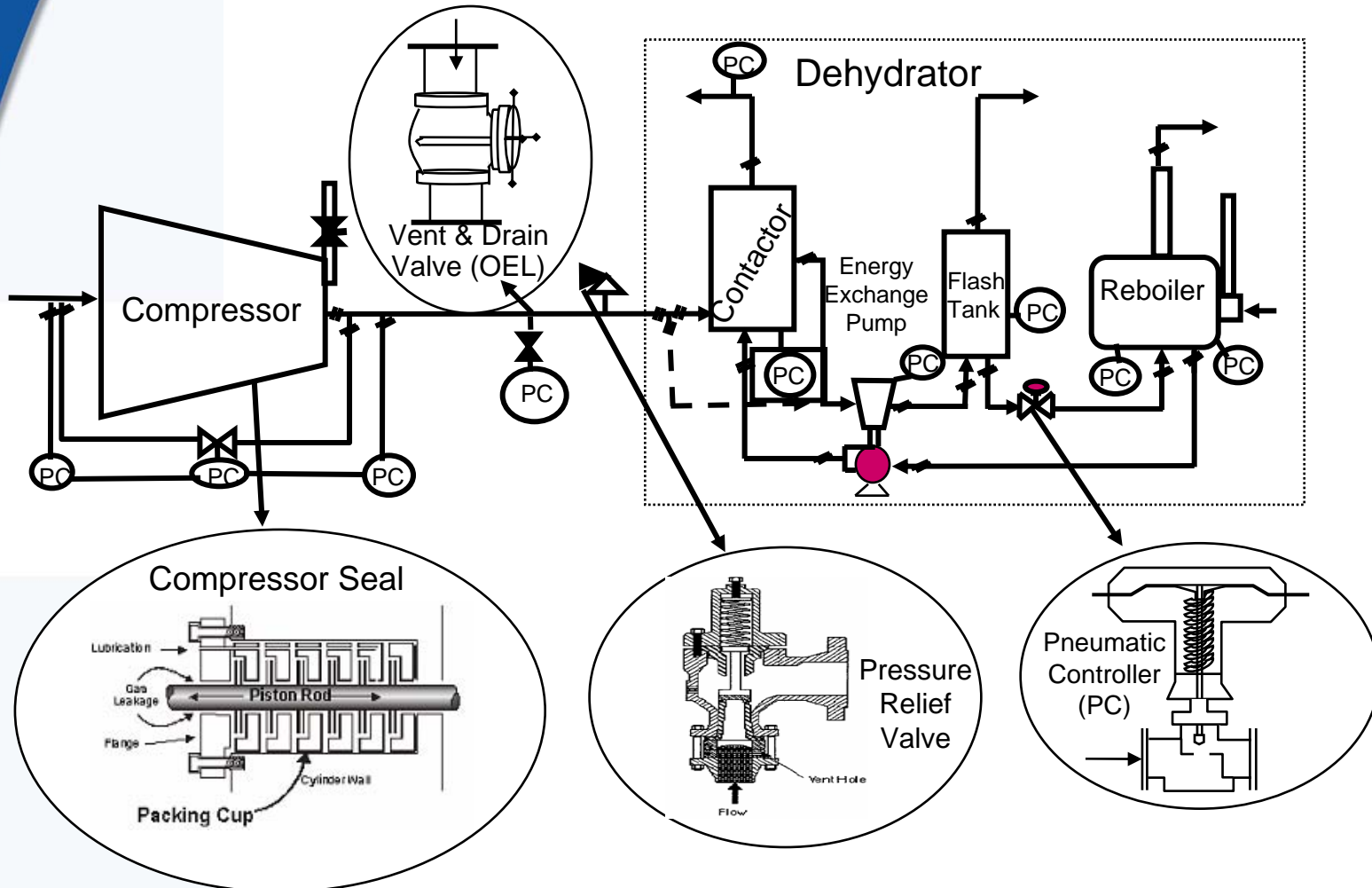
Source: Newfield

¹ Value of natural gas at \$0.25/cubic meter (m³)

What is the Problem?

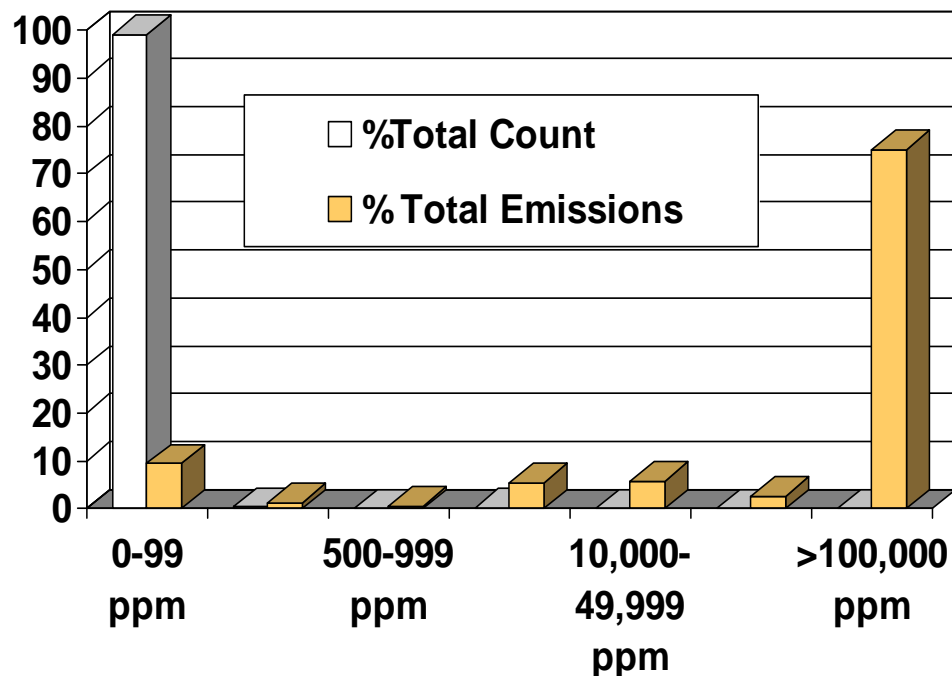
- Gas leaks are invisible, odorless, and go unnoticed
- Natural Gas STAR Partners find that valves, connectors, compressor seals, and open-ended lines (OELs) are major methane emission sources
 - Fugitive methane emissions depend on operating practices, equipment age, and maintenance

What are the Sources of Emissions?



Component Contribution

- American Petroleum Institute (API) study showed that 92% of reducible emissions come from only ~ 0.13% of components
- Leaks occur randomly
- Few significant repeat leakers found



Source: API Publication 310
ppm = parts per million by volume

Methane Recovery

- Fugitive losses can be dramatically reduced by implementing a directed inspection and maintenance program
 - This is a program to identify and fix leaks that are cost-effective to repair
 - Survey cost will pay out in the first year
 - Provides valuable data on leak sources with information of where to look



Source: Targa Resources

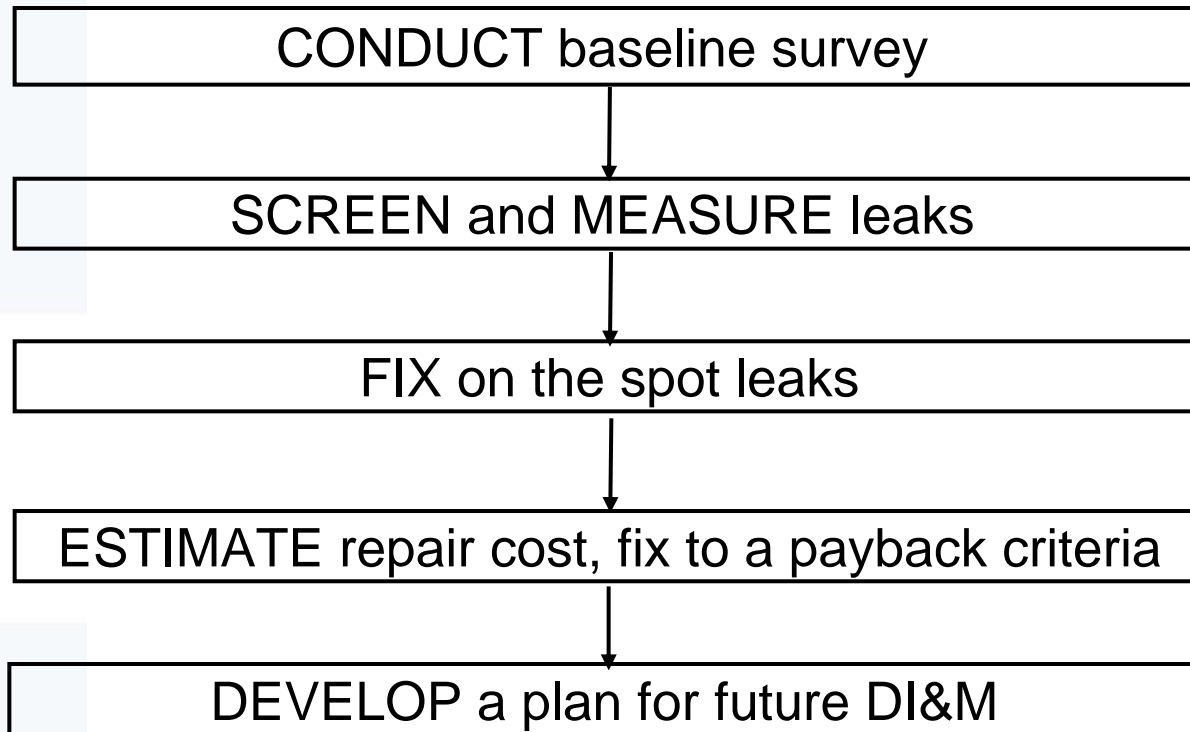
What is Directed Inspection and Maintenance?

- **Directed Inspection and Maintenance (DI&M)**
 - Cost-effective practice, by definition
 - Find and fix significant leaks
 - Choice of leak detection technologies
 - Strictly tailored to company's needs



Source: Targa Resources

How Do You Implement DI&M?



Screening and Measurement

Summary of Screening and Measurement Techniques		
Instrument/ Technique	Effectiveness	Approximate Capital Cost
Soap Solution	★ ★	\$
Electronic Gas Detector	★	\$\$
Acoustic Detector/ Ultrasound Detector	★ ★	\$\$\$
Toxic or Organic Vapor Analyzer	★	\$\$\$
Bagging	★	\$\$\$
High Volume Sampler	★ ★ ★	\$\$\$
Rotameter	★ ★	\$\$
Infrared Leak Detection	★ ★ ★	\$\$\$

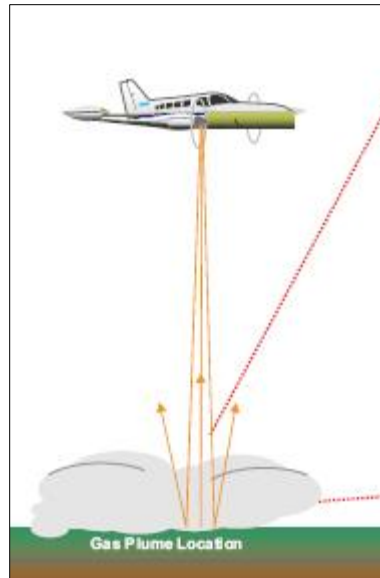
Source: EPA's Lessons Learned

* - Least effective at screening/measurement \$ - Smallest cost

*** - Most effective at screening/measurement \$\$\$ - Largest cost

DI&M by Infrared Leak Detection

- Real-time detection of methane leaks
 - Quicker identification & repair of leaks
 - Screen hundreds of components an hour
 - Screen inaccessible areas simply by viewing them
 - Aerial surveillance of flow lines



Infrared Methane Leak Detection

- Video recording of fugitive leaks detected by various infrared devices



- More video available from FLIR Systems:
www.flirthermography.com/smartLDAR

DI&M - Lessons Learned

- A successful, cost-effective DI&M program requires measurement of the leaks
- Infrared remote leak detection has made finding leaks quicker and easier than ever
- A high volume sampler is an effective tool for quantifying leaks and identifying cost-effective repairs
- Open-ended lines, compressor seals, blowdowns, engine-starters, and pressure relief valves represent <3% of components but >60% of methane emissions



Source: Chevron

Industry Experience – Targa Resources (formerly Dynegy)

- Surveyed components in two processing plants: 23,169 components
- Identified leaking components: 857 (about 3.6%)
- Repaired components: 80% to 90% of the identified leaking components
- Annual methane emissions reductions: 5,600 million cubic meter per year
- Annual savings: \$1,386,000/year (at \$0.25/cubic meter)



Source: Targa Resources

Discussion

- Industry experience applying these technologies and practices
- Limitations on application of these technologies and practices
- Actual costs and benefits