



NARUC

Winter Committee Meetings

Staff Subcommittee On Gas





U.S. DEPARTMENT OF
ENERGY

Methane Emissions and Efforts to Reduce Them

2017 NARUC Winter Committee Meetings

Joint session of the Gas Staff Subcommittee and the ERE Staff Subcommittee

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James Bradbury

Senior Policy Adviser

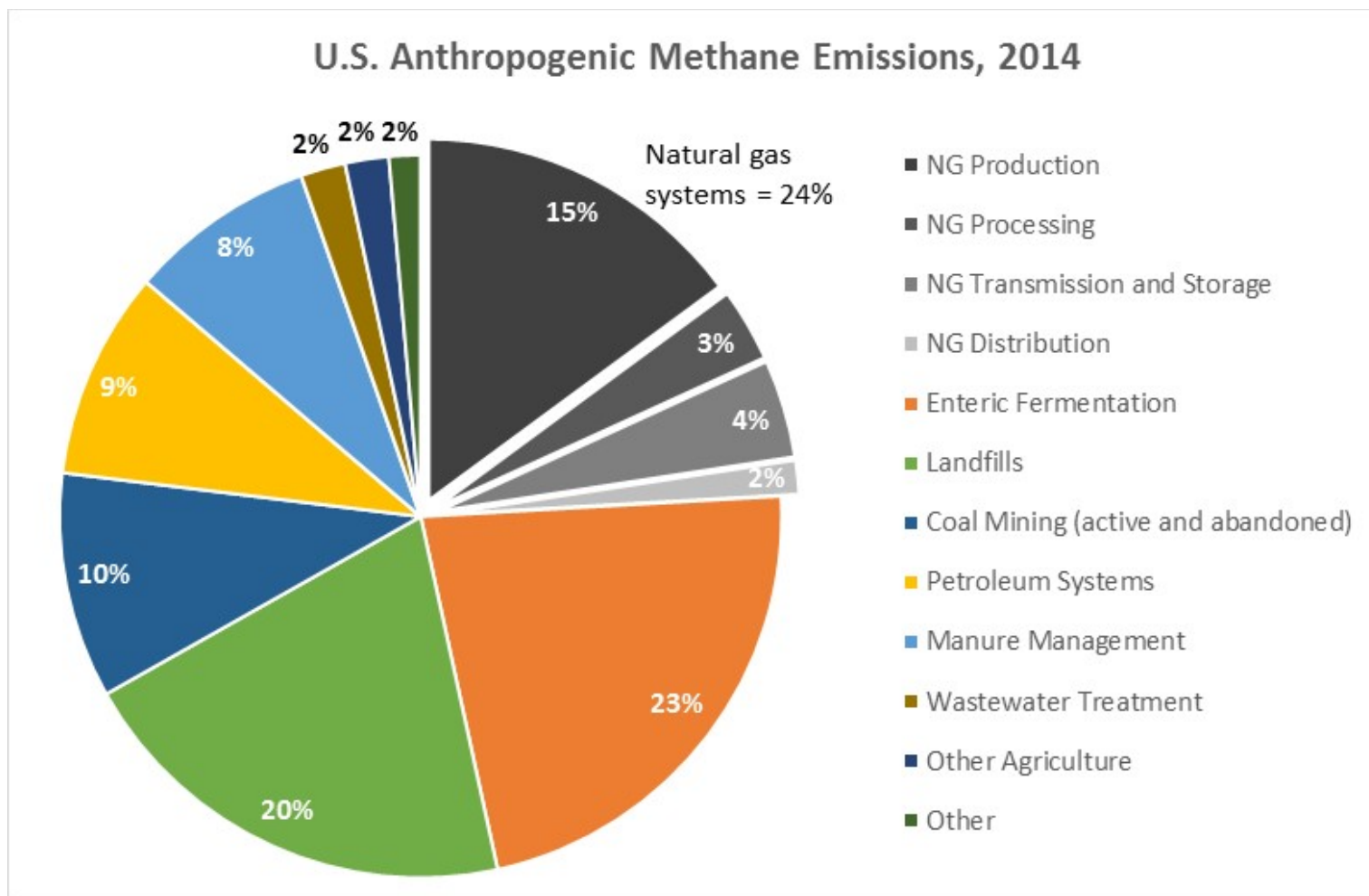
Office of Energy Policy and Systems Analysis

U.S. Department of Energy

Presentation Outline

- **Characteristics of methane emissions from the oil and natural gas sectors**
- **Opportunities and ongoing efforts to identify leaks and reduce emissions**
- **DOE programs and initiatives**
- **Final thoughts and resources**

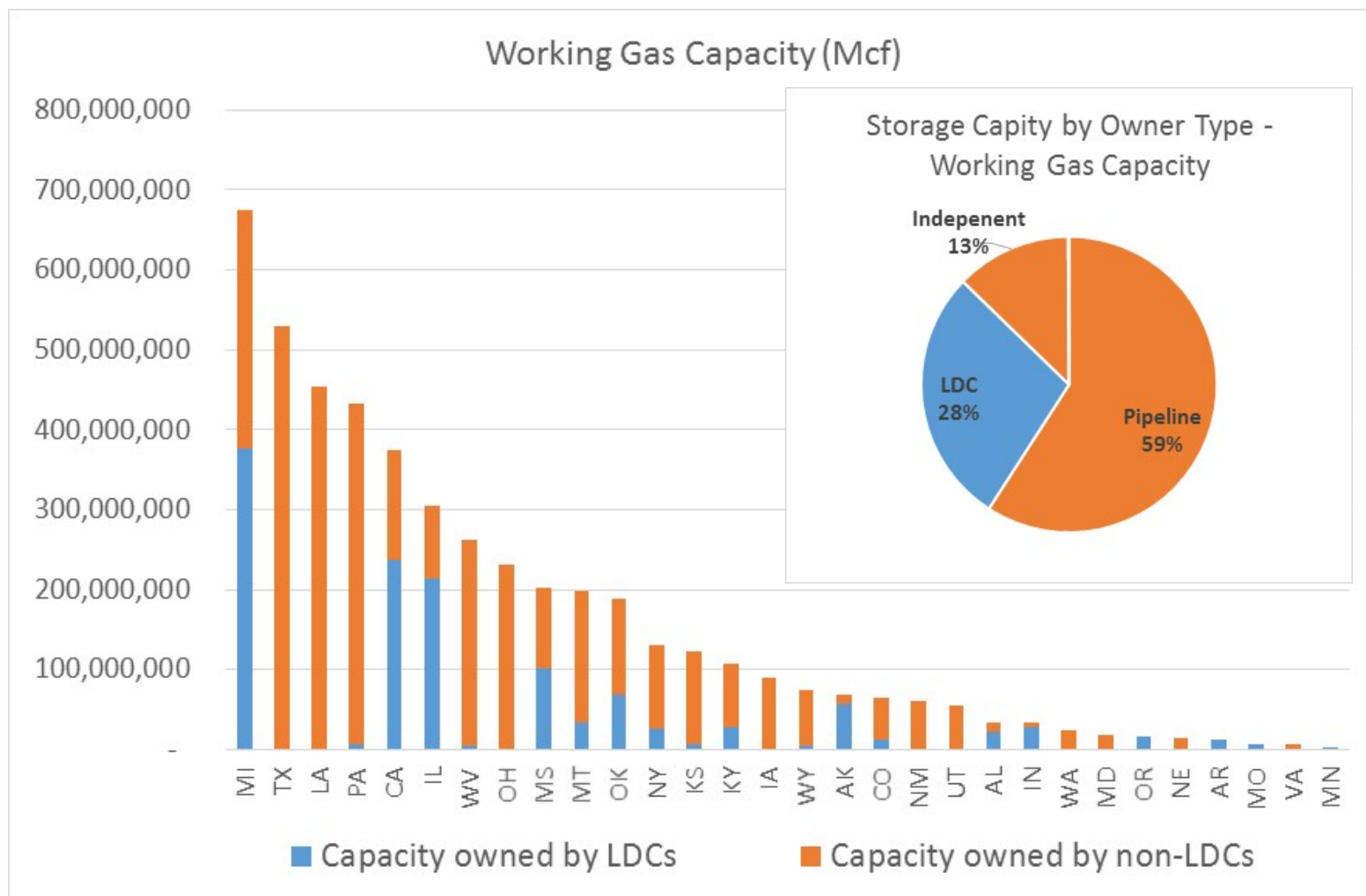
The Latest Estimates of U.S. Methane Emissions



Methane represents roughly 10% of all U.S. anthropogenic GHG emissions.

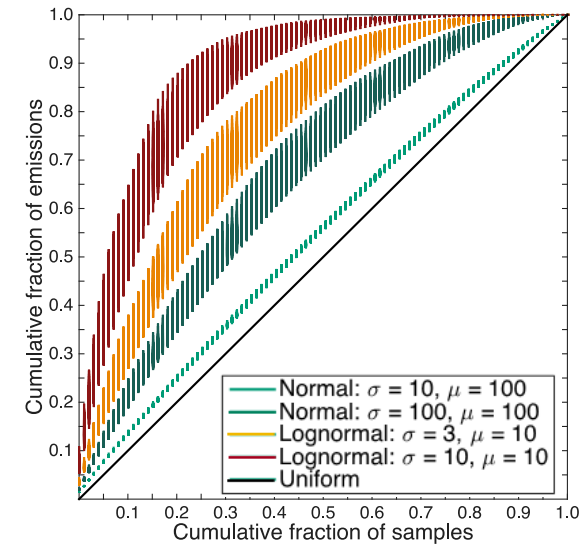
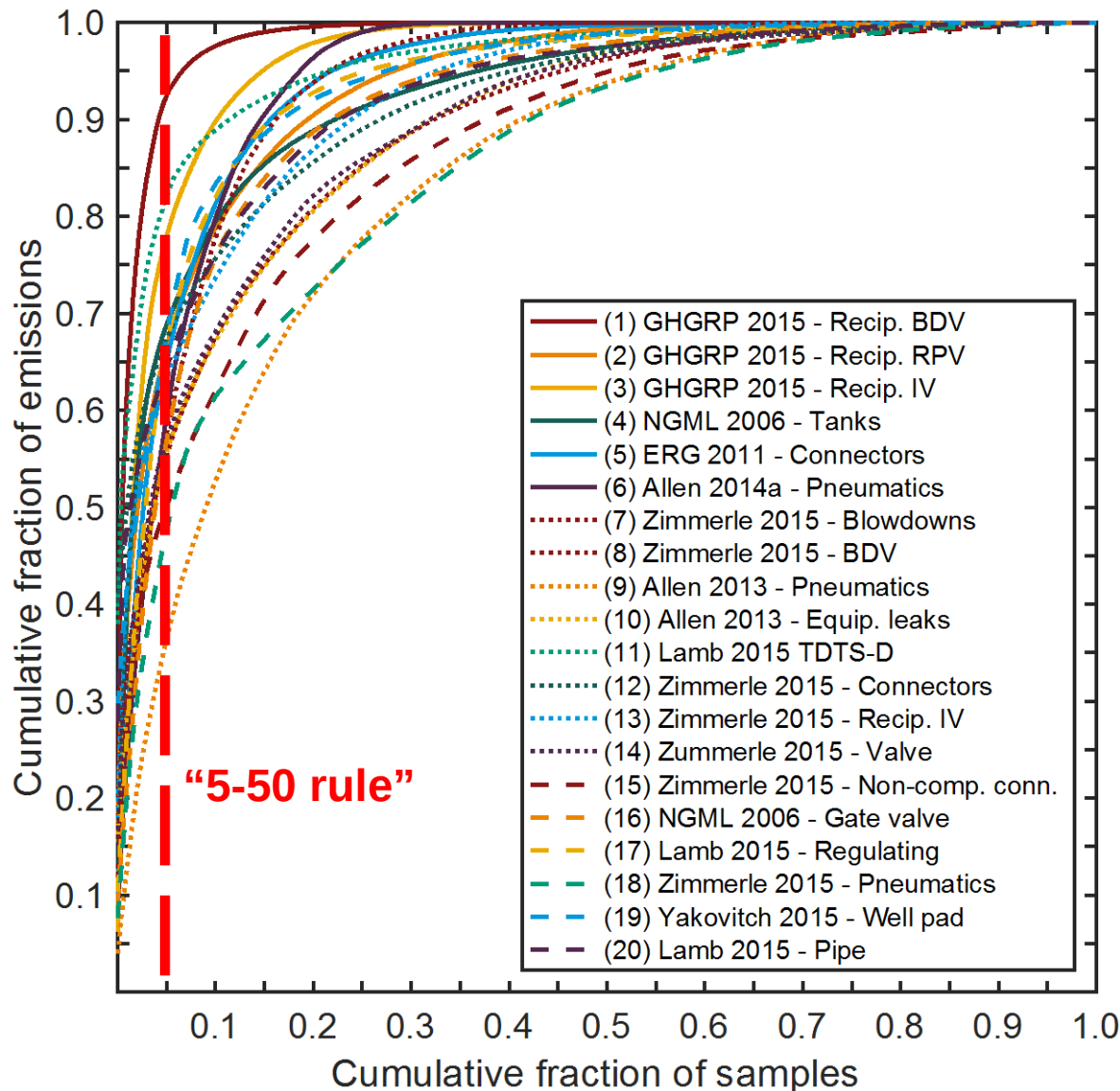
Local Distribution Companies Own More Than Distribution Facilities:

Storage Capacity by State and Owner Type



LDC-owned storage facilities are operated in 22 (out of 30) different states

Fat Tails Analysis - Grouping Results by Single Studies

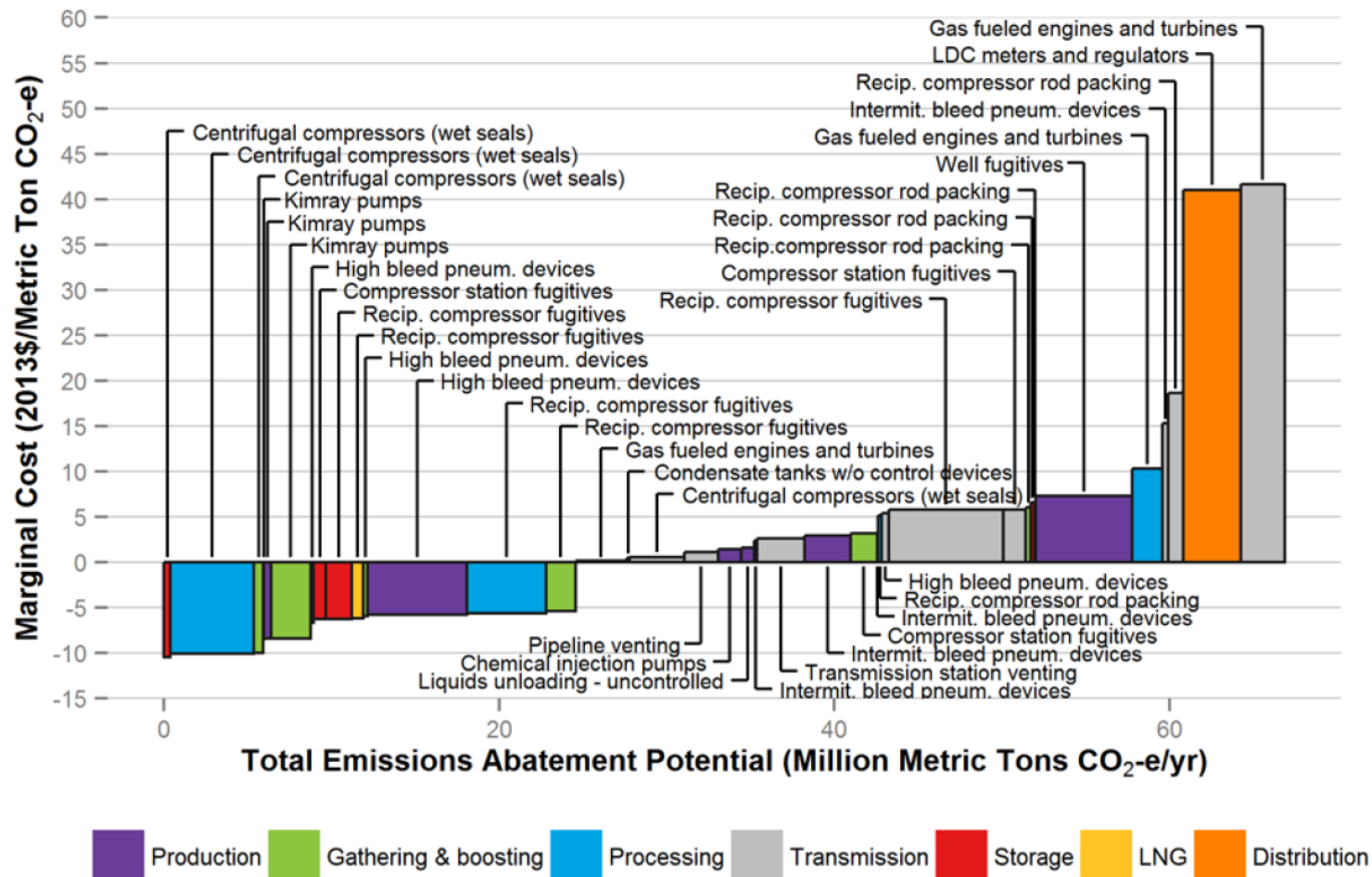


Source:

A.R. Brandt, G.A. Heath, and D. Cooley,
2016. "Methane Leaks from Natural Gas
Systems Follow Extreme Distributions."
Environ. Sci. Technol., 2016, 50 (22), pp
12512–12520

COST EFFECTIVE EMISSIONS ABATEMENT OPPORTUNITIES THROUGHOUT THE NATURAL GAS SUPPLY CHAIN

Figure: Natural gas marginal abatement costs by source and supply chain segment (for partial revenue scenario) in 2018.

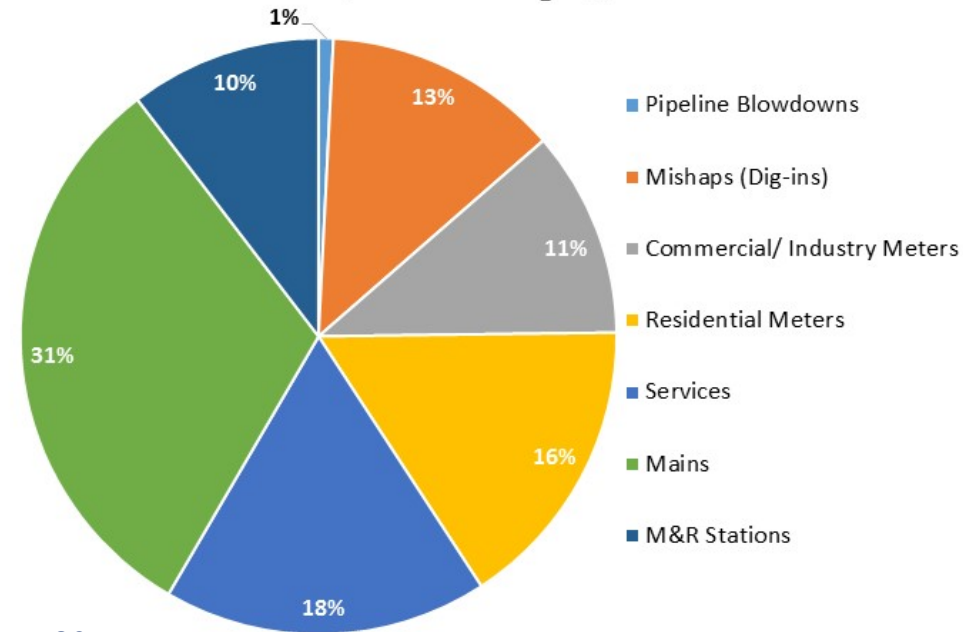


NOTE: Over 80% of these emissions sources are from existing facilities.

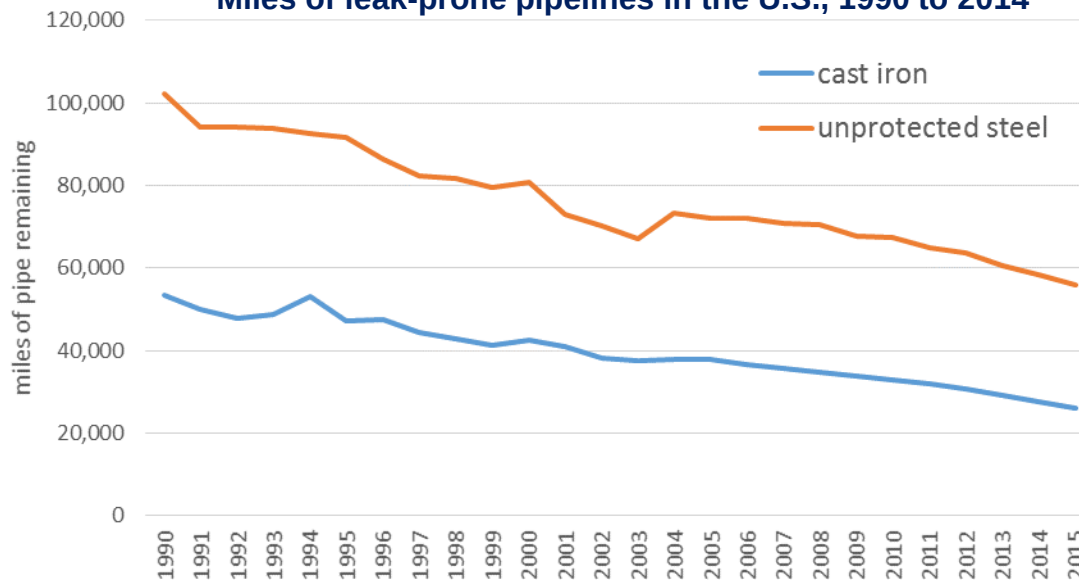
EMISSIONS FROM THE DISTRIBUTION SEGMENT ARE DECLINING

Aging pipelines made of leak-prone materials represent the largest source of emissions from U.S. NG distribution infrastructure

Methane Emissions from NG Distribution (11.1 MMT CO₂ Eq.)



Miles of leak-prone pipelines in the U.S., 1990 to 2014



40 States (plus the District of Columbia) have specific rate structures for accelerating pipeline replacement

DOE's Natural Gas Modernization Initiative

- **ARPA-E** announced \$38M in funding for 11 new projects developing low-cost methane sensing for the oil and gas sector (Dec., 2014).
 - MONITOR projects begins field test site demonstrations in the second quarter of 2017.
- **Office of Fossil Energy** announced \$13M funding awards for their Methane Emissions Mitigation and Methane Emissions Quantification (September 2016)
- **Office of Energy Policy and Systems Analysis** sponsors policy-relevant research, supporting efforts to improve updates to EPA's GHGI
- **FERC** issued a Policy Statement on cost recovery for midstream natural gas infrastructure upgrades (April, 2015). Policy now in effect (October, 2015)
- **DOE-NARUC partnership** for technical assistance was announced (Feb, 2016)

Final Thoughts

- DOE is funding projects that will help to address some known limitations and gaps in the U.S. Inventory of methane emissions
- Most methane leaks from natural gas systems are from a small number of sources (the “5-50 rule”)
- The time-dimension characteristics of emissions remains a significant area of uncertainty
- More direct measurements of methane emissions can help to reduce uncertainties and “bridge the gap” between top-down and bottom-up measurement studies
- Stakeholders have proposed many options for the federal government to help improve methane emissions quantification and mitigation (e.g., low-cost tools for companies to more quickly identify leaks)

RESOURCES

- U.S. Department of Energy, 2017. *"Natural Gas Infrastructure Modernization Programs at Local Distribution Companies: Key Issues and Considerations."* Report by the Office of Energy Policy and Systems Analysis, 78 pg. <https://energy.gov/epsa/downloads/natural-gas-infrastructure-modernization-programs-local-distribution-companies-key>
- Christopher T. Clavin, Leslie S. Abrahams, Alexis M. W. McKittrick, 2017. Research Strategies for Detection and Measurement of Oil and Gas Sector Methane Emissions. Science and Technology Policy Institute. IDA Paper P-8315, 69 pgs. <https://www.ida.org/idamedia/Corporate/Files/Publications/STPIPubs/2017/P-8315.ashx>
- A.R. Brandt, G.A. Heath, and D. Cooley, 2016. "Methane Leaks from Natural Gas Systems Follow Extreme Distributions." *Environ. Sci. Technol.*, 2016, 50 (22), pp 12512–12520. <http://pubs.acs.org/doi/abs/10.1021/acs.est.6b04303>
- U.S. Department of Energy and Pipeline and Hazardous Materials Safety Administration , 2016. "Ensuring Safe and Reliable Underground Natural Gas Storage; Final Report of the Interagency Task Force on Natural Gas Storage Safety." Report, 92 pgs. <https://www.energy.gov/articles/federal-task-force-issues-recommendations-increase-safety-and-reliability-us-natural-gas>
- Heath, G., E. Warner, D. Steinberg, and A. Brandt, 2015. *"Estimating U.S. Methane Emissions from the Natural Gas Supply Chain: Approaches, Uncertainties, Current Estimates, and Future Studies."* Joint Institute for Strategic Energy Analysis. Technical Report NREL/TP-6A50-62820. <http://www.nrel.gov/docs/fy16osti/62820.pdf>
- Paranhos, E., T.G. Kozak, W. Boyd, J. Bradbury, D.C. Steinberg, D.J. Arent, 2015. *"Controlling Methane Emissions in the Natural Gas Sector: A Review of Federal & State Regulatory Frameworks Governing Production, Processing, Transmission, and Distribution."* Joint Institute for Strategic Energy Analysis, Technical Report NREL/TP-6A50-63416. <http://www.energy.gov/epsa/downloads/controlling-methane-emissions-natural-gas-sector-review-federal-state-regulatory>
- Warner, E., D. Steinberg, E. Hodson, and G. Heath, 2015. *"Potential Cost-Effective Opportunities for Methane Emission Abatement."* Joint Institute for Strategic Energy Analysis. Technical Report NREL/TP-6A50-62818. <http://www.nrel.gov/docs/fy16osti/62818.pdf>

Questions?

Contact:

James Bradbury

James.bradbury@hq.doe.gov

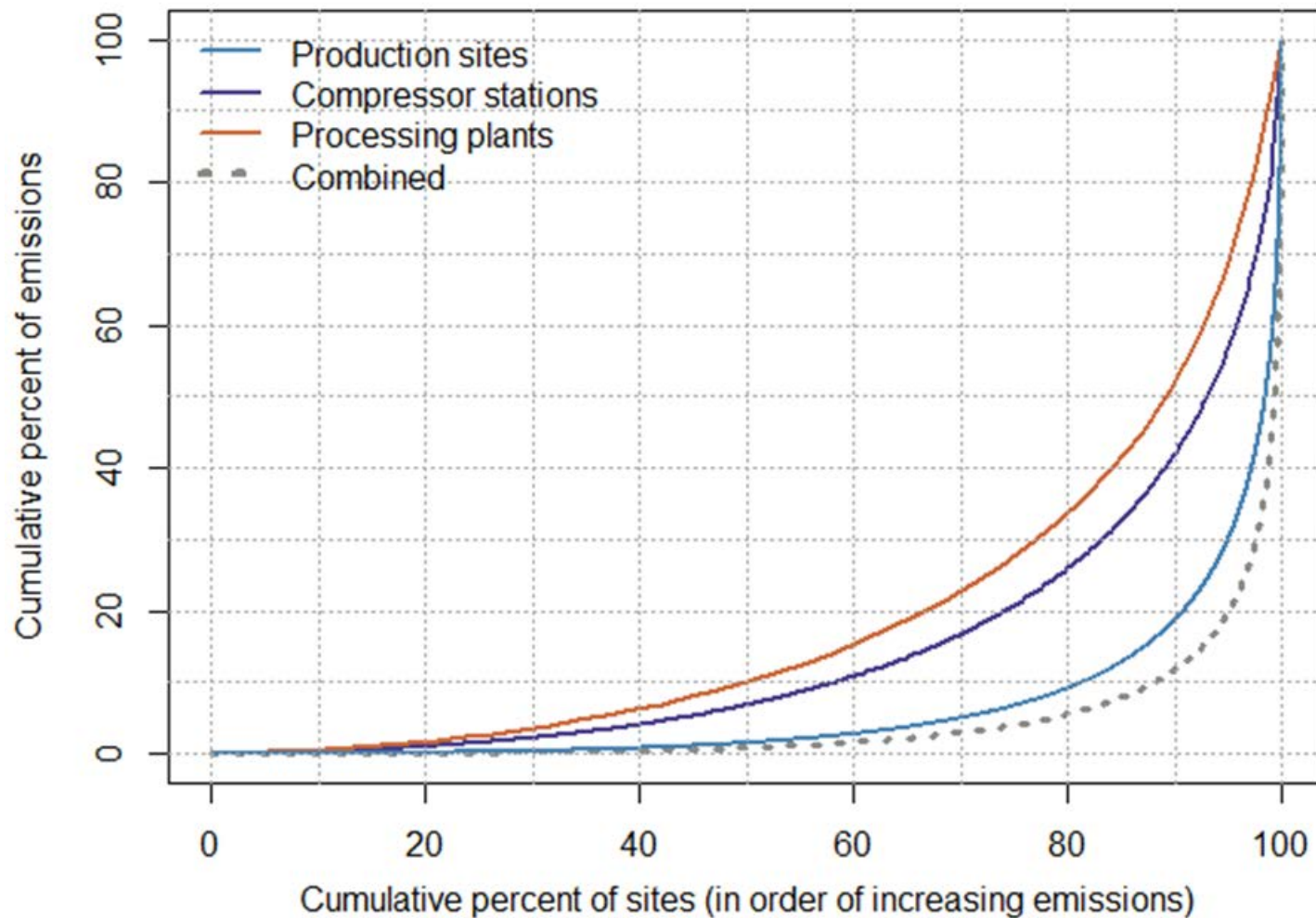
**Office of Energy Policy and Systems Analysis
U.S. Department of Energy**

Super-emitters in Natural Gas Infrastructure

Implications to Distribution Utility Leak Abatement Programs

NARUC 2017 Winter Meeting – Joint Session of Staff Subcommittees on Energy Resources and the Environment, and Gas

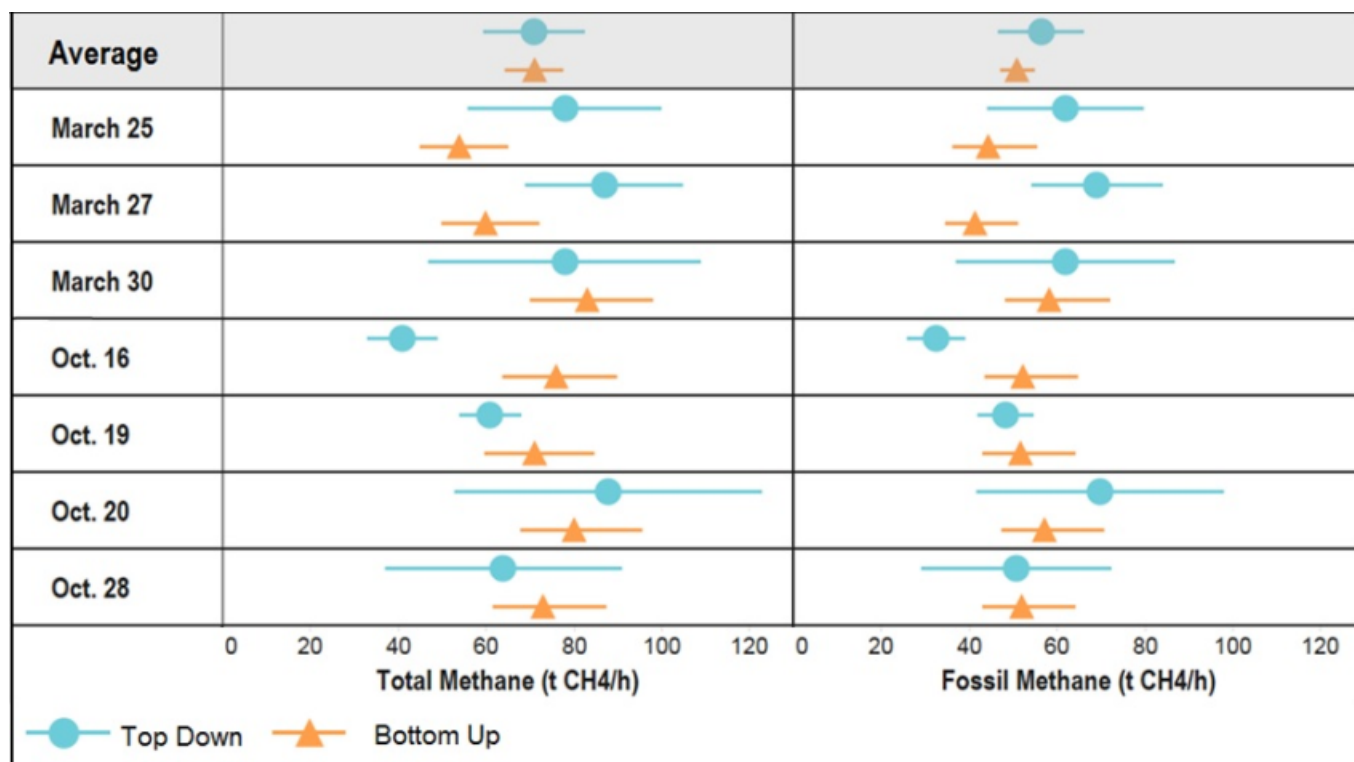
N. Jonathan Peress



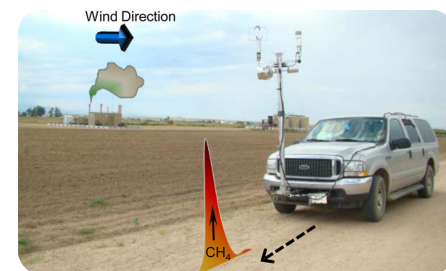
[Source: Zavala-Araiza et al, PNAS 2015]

1% of sites → 44% of emissions

10% of sites → 80% of emissions



[Source: Zavala-Araiza et al, PNAS 2015]



Component-level emissions

By design

Unintended

Site-level emissions

Higher

($>26 \text{ kg CH}_4 \text{ h}^{-1}$)

- Flashing
- Liquid Unloadings

(Site-level) Super-emitters

Lower

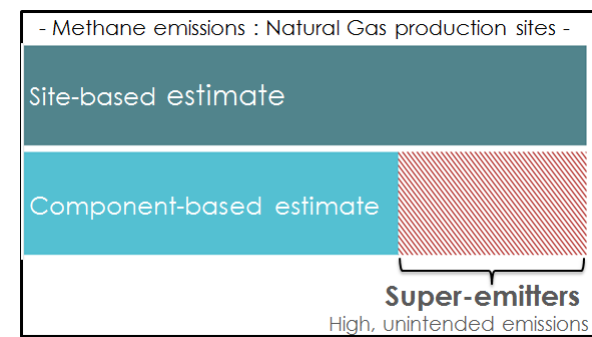
($\leq 26 \text{ kg CH}_4 \text{ h}^{-1}$)

- Pneumatic controllers
- Chemical injection pumps
- Compressors
- Dehydrators
- Flashing

- Pneumatic controllers
- Equipment Leaks

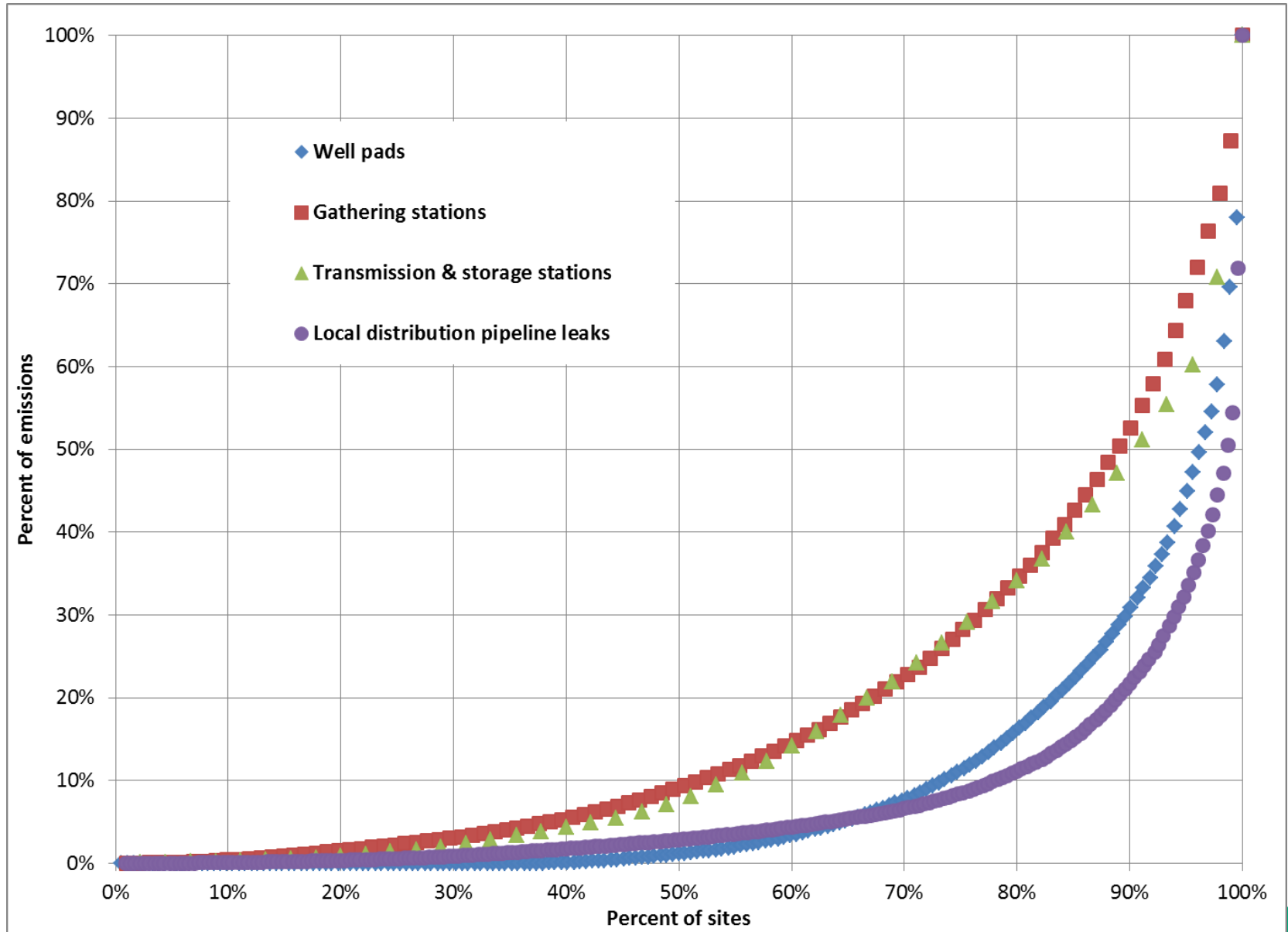
[Source: Zavala-Araiza et al, 2017]

Summary



- Our component-based emission estimate is significantly lower than an independent site-based estimate.
- Component-based estimates do not produce enough high-emitting sites (*condensate flashing, liquids unloadings are not enough*).
- The inability of routine operating conditions to explain high-emitting sites **reveals the existence of super-emitters: sites with abnormal process conditions.**
- Frequent or even continuous site-level monitoring of emissions or process conditions will most likely be required to address emissions from these sites.

Distribution Segment: Small fraction of sites and components contributes the majority of emissions



Top-down Discrepancy for Distribution Emissions - Boston Pipeline Study

- Harvard, Boston and Duke universities with Aerodyne Research, Atmospheric and Environmental Research University
- Published in **Proceedings of the National Academy of Sciences**
- **Tower-based quantitative technique** for use in the urban environment.
- **Findings:** Boston's methane emissions are more than two times higher than inventory data suggests, with a yearly **average loss rate between 2.1 and 3.3- percent.**



Cause: The quantity of super-emitters in the distribution segment is **significantly underestimated** in some studies, data and pending studies will show.

New Generation of Sensors and Methods

- PG&E, Centerpoint Energy, EDF UNU analysis finds 3 to 5 times more leaks than traditional (e.g., FI)

The results of 14 Customer Field Trials

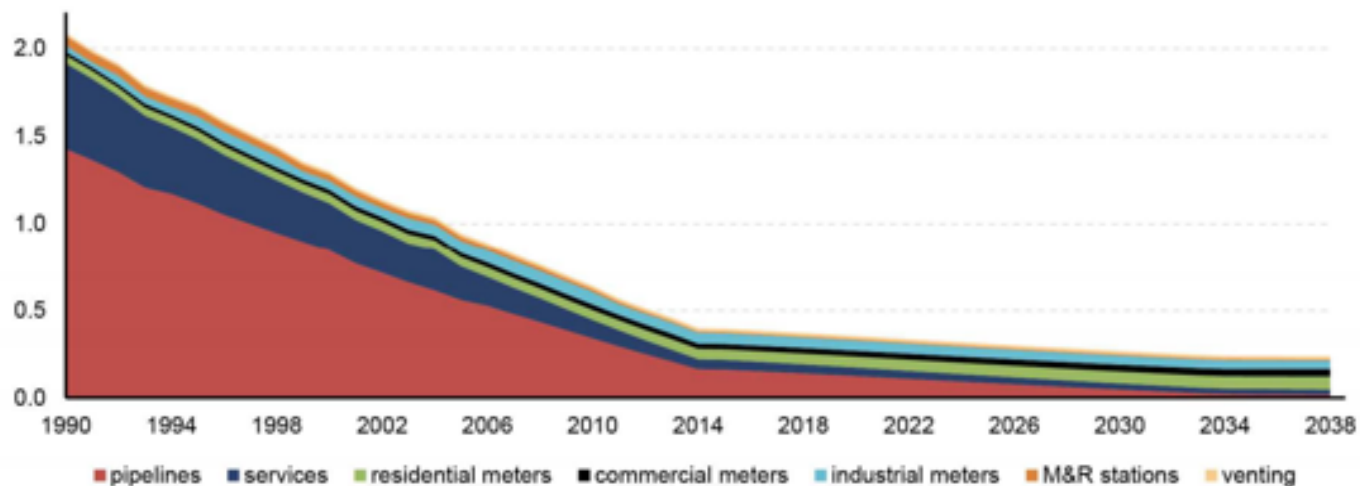
PICARRO

- 3x more hazardous leaks found: Picarro (93%) Traditional (31%)
- 3x more gradeable leaks founds: Picarro (90%) Traditional (31%)
- Geographic FOV coverage: 92% for mains and 87% for services

State Initiatives – CA and MA

- Technologies to find leaks
- Technologies to quantify the amount of methane leaked from individual leaks
- Technologies to quantify the system leak rates

Figure 1. Historical and Projected Emissions (MMtCO₂e) from Leaks in the Natural Gas Distribution System.¹¹

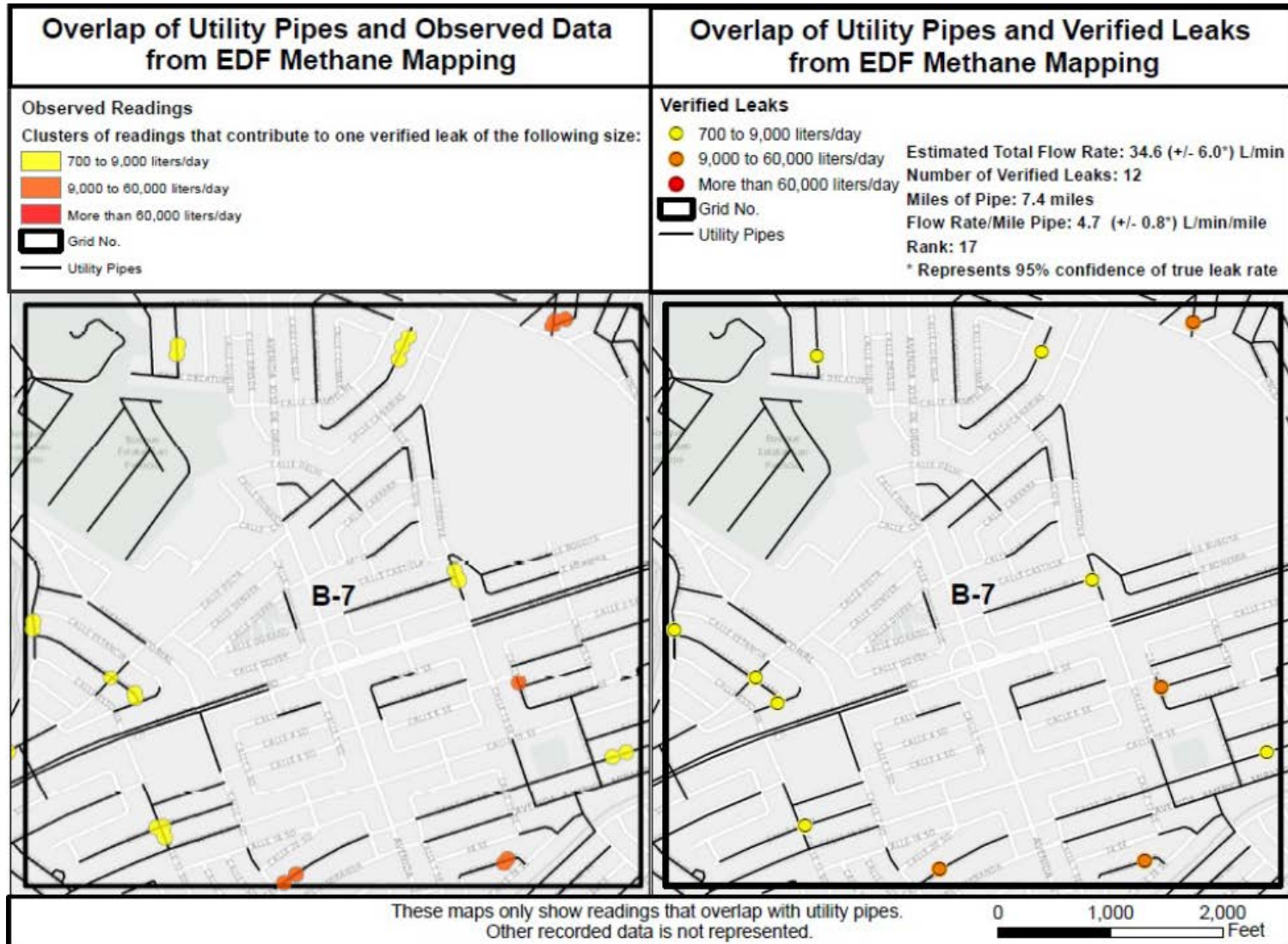


Source: MassDEP (2015).

Commission Orders – NY and NJ

- Use of advanced leak detection technologies to quantify leak flow volume, identify super-emitters **and Grade 1 hazardous leaks**
- Leak size used to prioritize main replacement – after safety
- Incentives for maximizes leak reductions in the course of safety programs
- **States that do not require advanced sensors and data analytics are spending too much customer \$\$ to maintain and enhance safety**
 - Even worse, safety can be compromised.

Example of leak attribution with infrastructure (randomized data)

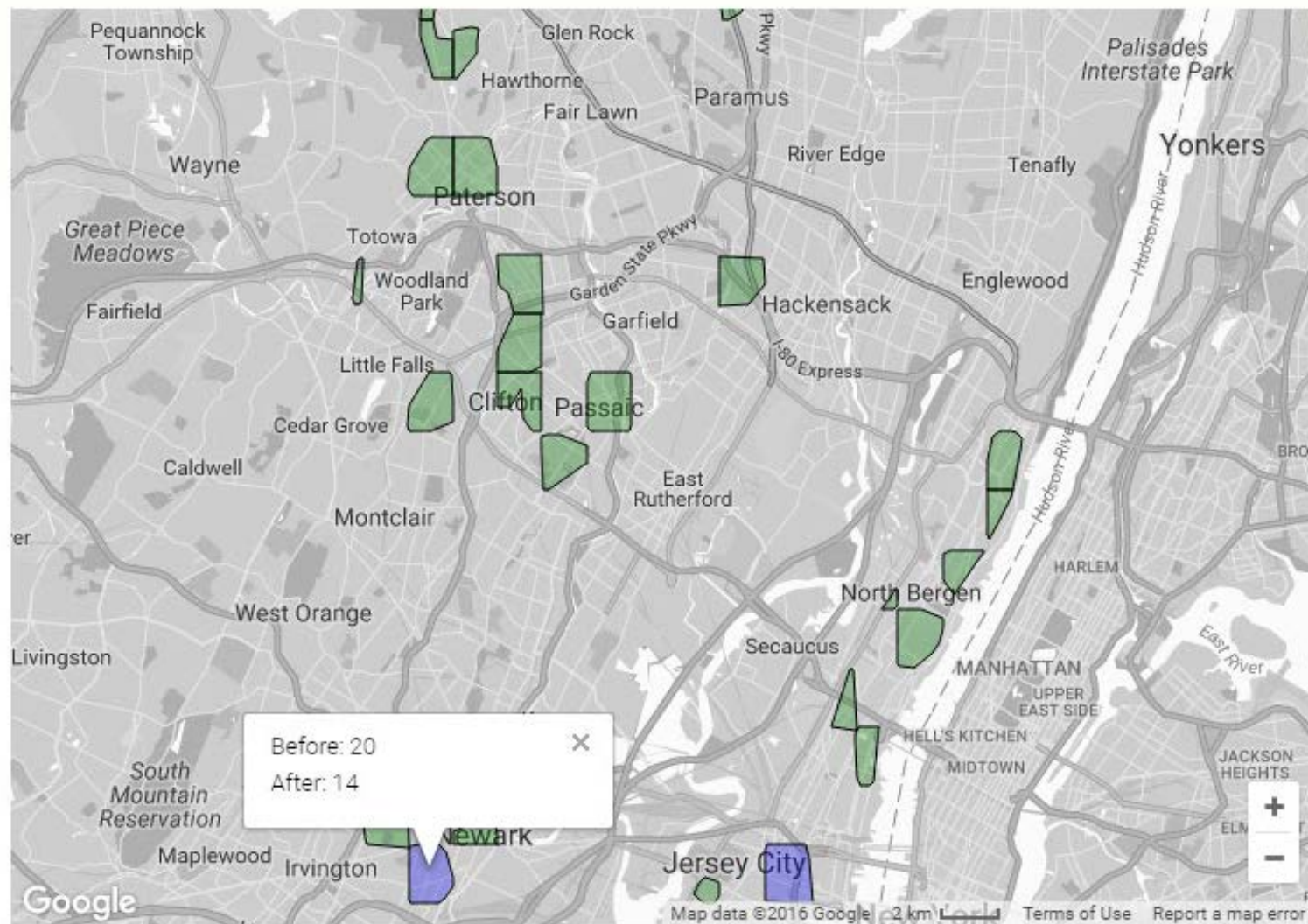


Example of ranking procedure

Grid	No. Verified Leaks in Grid	Total Estimated Flow Rate (L/min)	Rank By Total Estimated Flow Rate
B-5	22	183.3	1
B-8	24	166.8	2
D-8	26	163.9	3
C-1	13	142.3	4
A-1	10	142.0	5
H-6	19	102.9	6
A-2	17	98.7	7
G-1	6	93.0	8
A-7	13	90.6	9
H-2	10	88.5	10
B-3	8	88.4	11
F-3	11	66.6	12
H-4	5	60.6	13
F-2	16	55.5	14
B-2	12	45.5	15
B-7	12	34.6	16
A-4	6	30.2	17
F-6	4	27.8	18
D-5	8	24.2	19
D-6	0	0.0	20

New Jersey Grid Map

Map: Impact of flow rate on pipeline repair priority



This effort draws on a pioneering collaboration among PSE&G, EDF, and its partners, Google Earth Outreach and

[Explore New Jersey leak data](#)



Results and Benefits

- Readings showed an average of 1 leak per mile of gas line within grid areas where flow rate was quantified.
- The three grids that PSE&G prioritized based on leak flow rate accounted for over 40% of the emissions, but represented only 9% of the gas line miles where flow rate was quantified.
- Using leak flow rate for prioritization allowed PSE&G to achieve an 84% reduction in methane emissions by replacing one-third fewer miles of gas line than that needed to achieve the same results under business-as-usual scenario.
- The high cost of pipe replacement underscores the need to explore efficient methods for prioritizing replacement efforts that co-optimize safety, ratepayer, and environmental benefits.
- This data and prioritization scheme allowed PSE&G to correlate expenditures to leak reductions.

**NARUC 2017 Winter Meeting
Washington D.C.**

**Gas Staff Subcommittee
*"The Unknown Fugitive"***

AGA Member Perspective

**Tal Centers, Jr.
VP Safety & Gas System Integrity
*CenterPoint Energy***

February 12, 2017



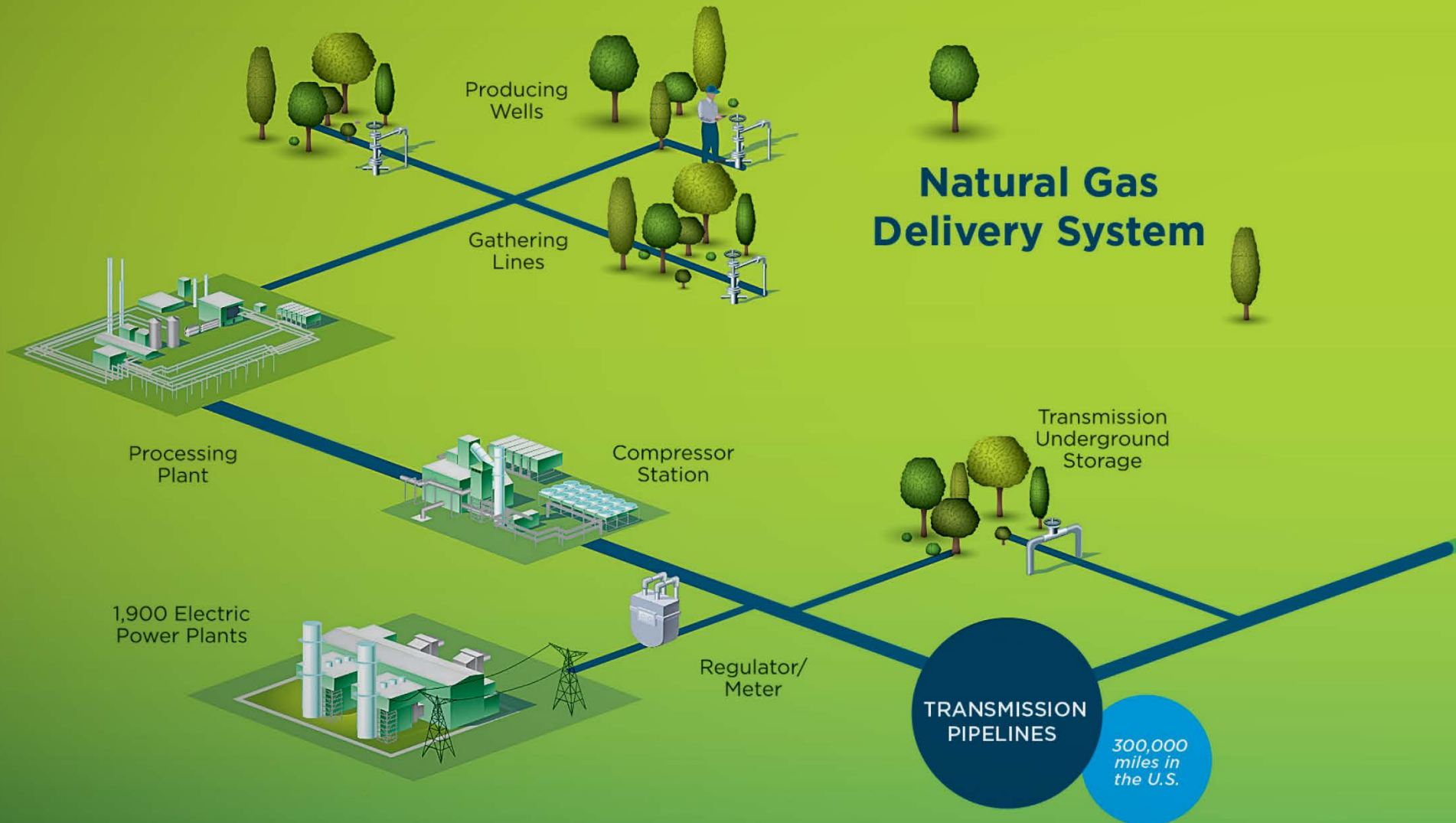
Industry and Regulatory Actions Supporting Emissions Reductions

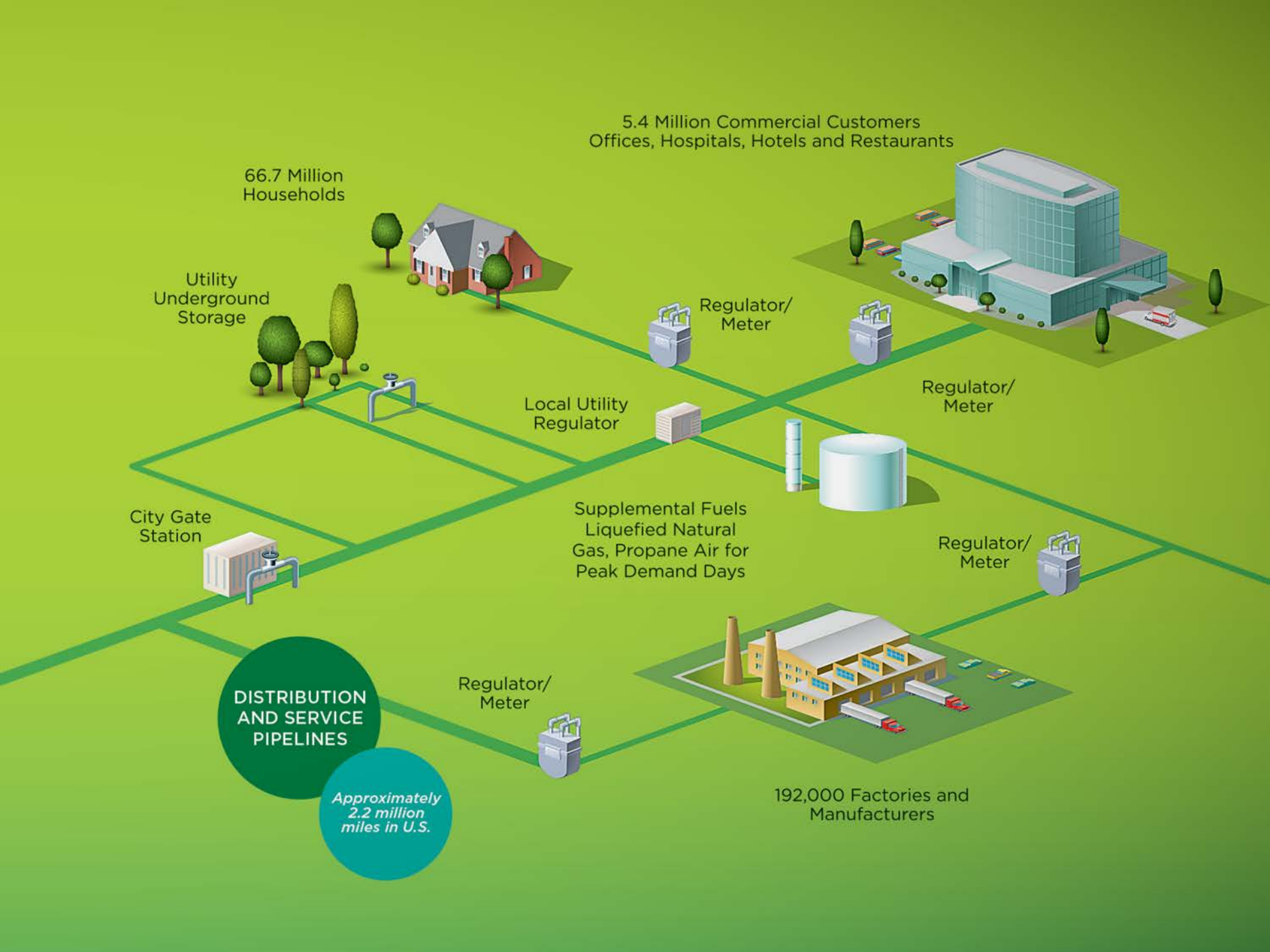
Focus must be on:

- **Safety**
- **Reliability**
- **Prudency – value added to customers, shareholders, and communities**
- **and, Proactive Solutions**

Natural Gas

Getting It to Homes, Businesses and to Work for America





Primary Areas of Industry Response

- **Regulatory Process and Construct**
- **Emissions within the value chain**
- **Emissions Reduction at the point of consumption**

Regulatory Process and Construct

- **Efficient and innovative recovery mechanisms**
- **Accurate reporting and monitoring**
- **Partnering with agencies**
 - **EPA Methane Challenge Program**
 - **Recommended Best Practices Approach**

Emissions Within the Value Chain

- **Innovation in Technology**
 - **Advanced Leak Detection**
 - **EFV**
 - **Remote shut off**
- **Risk Based Solutions**
 - **Infrastructure replacement**
 - **PSMS – RP 1173**
 - **Risk Based Leak Survey**
- **Participation in Industry Emissions Studies**
 - **EDF / Universities / AGA**

Emissions Reduction at the Point of Consumption

- **Energy Efficiency Program Expenditures (2014)**
 - **Commercial Programs...\$203 million**
 - **Residential Programs...\$495 million**
 - **Multi-Family...\$73 million**
 - **Low Income...\$54 million**
 - **Other...\$97 million**
 - **TOTAL...1.3 billion**
- **New Technology**
 - **Smart Homes**
 - **More Efficient Appliances**
 - **In home methane detection**
 - **Pipe inspection devices**

Public Education

AGA and natural gas utilities have participated in a number of studies to better understand methane emissions from natural gas utilities and the value chain.

- For example, 13 local gas distribution companies participated in a study of distribution methane emissions, the largest measurement exercise of utility systems since the 1990s.
- The study, published in 2015, found that distribution system emissions were 36-70% less than previous EPA estimates, a result of investments into infrastructure modernization and improvements in leak detection and maintenance activities.

Summary of Emissions Mitigation Benefits

- **Reduced System Risks**
 - **Lower leakage**
 - **Improved Safety**
- **Increased understanding of factors contributing to emissions**
- **Reduced emissions at the point of consumption**



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