Methane Sources by Oil and Gas Market Segment

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About the Handbook

A ‘how-to’ action guide to empower legislators, ministries, regulators, and NOC officials to adopt and enforce legal instruments that will rapidly and effectivel reduce methane emissions from the oil an gas sector.

Available here:

https://cldp.doc.gov/methane-abatement-resources

Methane Abatement for Oil and Gas: Handbook for Policymakers

About the Handbook (Cont.)

- Sponsored by **U.S. Department of State, Bureau of Energy Resources.**
- Drafted over one week in an intense session with 13 expert co-authors.
- Co-written by authors representing:
  - Government (U.S., Sri Lanka, and Bangladesh)
  - NGOs
  - Multilaterals
  - Industry
  - Academia

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Methane Sources by Oil and Gas Segment

Overview

- The makeup of a country's industry can inform priority-setting among different mitigation options.
- Each of the three methane value chain segments (upstream; midstream; downstream) has unique equipment, components, and processes.
    - Example: flaring is much more common in upstream production activities than in mid-and downstream segments.

Case Study: Retrofitting Gas Distributions Systems (Bangladesh)

- In Bangladesh, the priorities are the midstream and downstream segments, as the country modernizes its decades-old gas distribution system.
- Bangladesh noticed many methane leaks in pipelines and undertook a project to replace and upgrade them, in order to maximize energy efficiency and cost savings downstream..
- This modernized network will be brought under the energy sector automation system, and the reduced leaks will advance climate goals, conserve resources, and improve local public safety and the environment.

Methane Sources by Oil and Gas Segment

Upstream

- Upstream segment consists of:
  - Oil and gas wells (both onshore and offshore);
  - Oil separation facilities;
  - Gas processing facilities; and
  - Gathering short distance pipelines between these facilities.
- The next two slides outline sources of upstream methane emissions, the primary abatement options to address them, and the potential trade-offs.

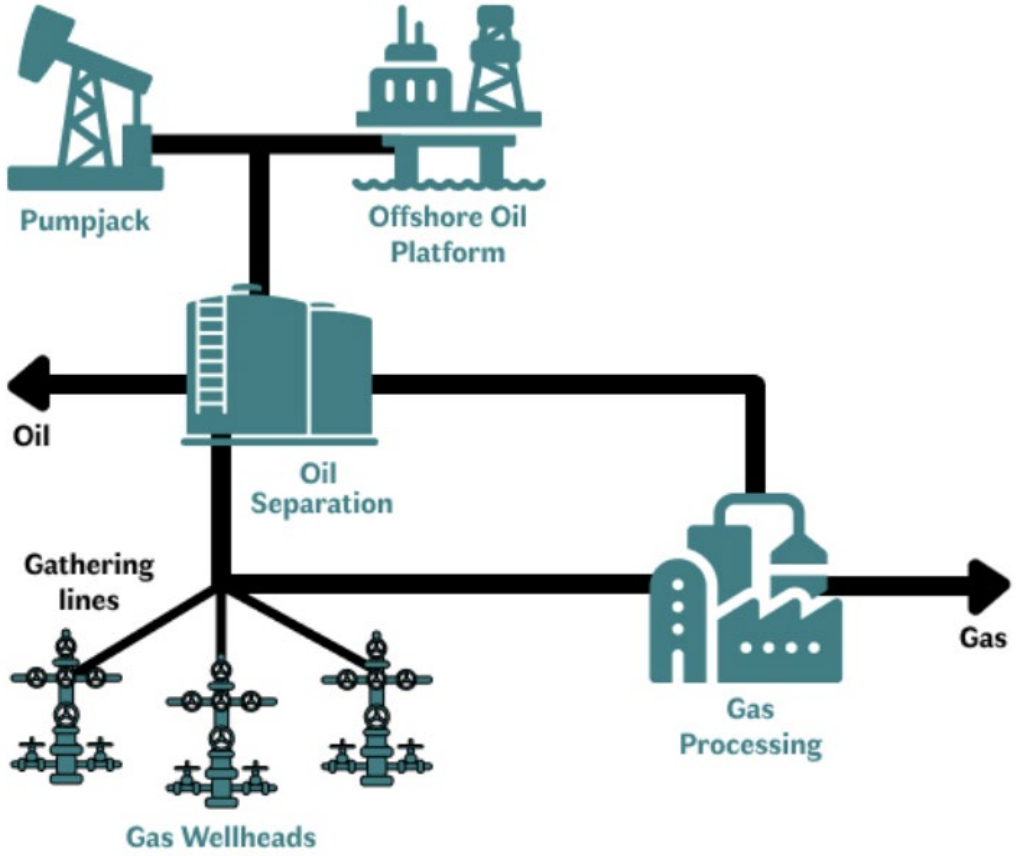


Figure 4.1: Illustration of upstream oil and gas infrastructure.

Methane Sources by Oil and Gas Segment

Selected Methane Emission Sources and Abatement Opportunities in Upstream Oil and Gas (1)

Pneumatic Controllers and Pumps: Devices that use pressurized natural gas for process control actions or pumping fluid when electricity is unavailable.

Abatement Option	Description	Considerations
High Bleed Retrofits or Replacements.[34]	Replace certain types of high-emitting controllers with options that vent less natural gas.	None identified.
Inspection of Intermittent Vent Controllers.[35]	Ensure intermittent vent controllers do not vent gas outside active actuation periods.	Requires the existence of an LDAR program for fugitive emissions.
Replacement with compressed air (can replace any / all high bleed, intermittent bleed, low bleed, and pumps).[36]	Replace pressurized natural gas with compressed air.	Requires access to or on-site generation of electricity, which may be achieved by on-site solar.

Manual Liquid Unloading: Temporary diverting of the well to a lower pressure location to remove accumulated water.

Abatement Option	Description	Considerations
On-site personnel during unloading operation.[37]	The operator remains on-site until unloading is completed and the well is returned to production.	None identified.

Methane Sources by Oil and Gas Segment

Selected Methane Emission Sources and Abatement Opportunities in Upstream Oil and Gas (2)

Hydrocarbon Storage Tanks: Gas emissions associated with pressure drop and liquid movement activities in storage tanks.

Abatement Option	Description	Considerations
Route to a control device like a flare.	Flare rather than vent gas.	Select situations where supplemental gas would be needed to combust vapors.
Route to a vapor recovery system.	Capture gas for sale or beneficial on-site use.	Some tank designs are not compatible with vapor recovery systems; inadequate design to handle emissions.

Centrifugal Compressor Wet Seals: Methane becomes entrained in oil-based (wet) seal systems that must be purged to maintain compressor function.

Abatement Option	Description	Considerations
Re-route gas.	Capture gas via vapor recovery or routing to the compressor suction.	Convert to a lower-emitting dry seal technology.
Convert to a lower-emitting dry seal technology.	Replace or design the seal system with lower-emitting technology.	Conversion of some older compressor designs is not feasible.

Methane Sources by Oil and Gas Segment

Midstream

- Midstream sector includes:
  - Transportation infrastructure, such as long-distance pipelines and associated compressor stations;
  - Liquefied natural gas facilities and tankers; and
  - Storage facilities.
- The next five slides outline sources of midstream methane emissions, the primary abatement options to address them, and the potential trade-offs.

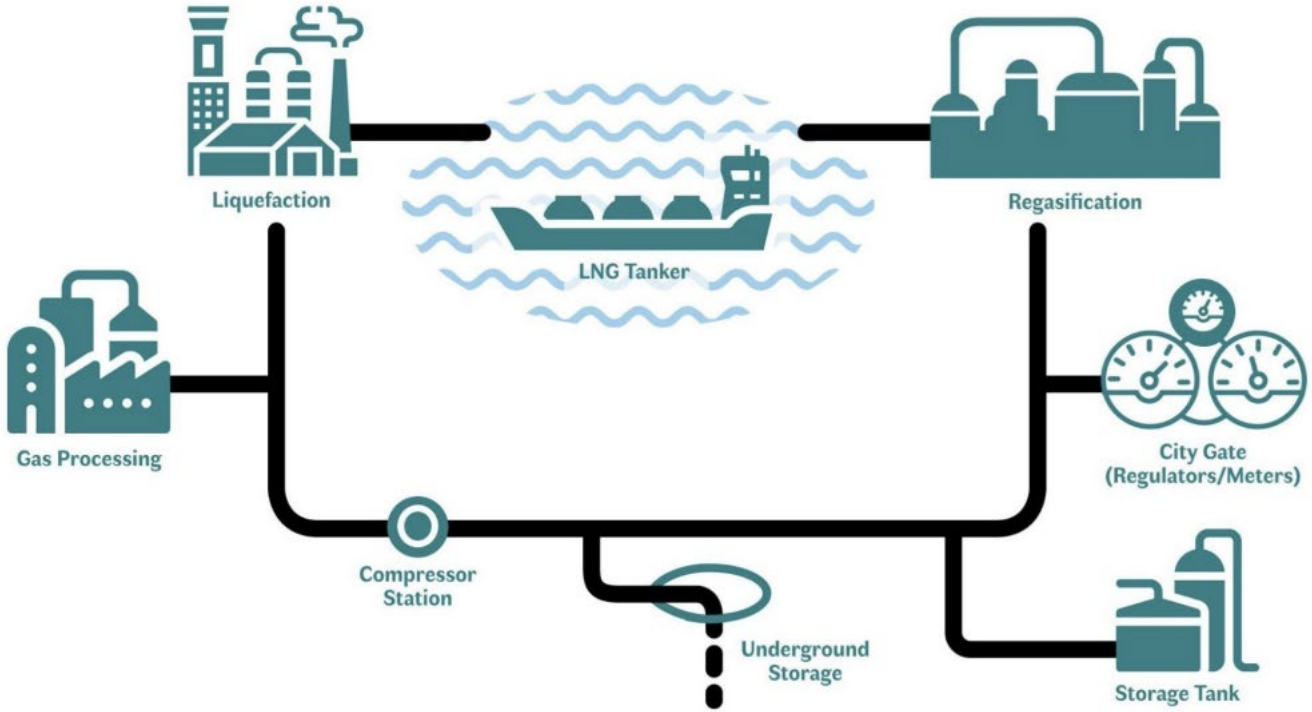


Figure 4.2: Illustration of midstream oil and gas infrastructure.

Methane Sources by Oil and Gas Segment

Selected Methane Emission Sources and Abatement Opportunities in Midstream Oil and Gas (1)

Pneumatic Devices: Devices that use pressurized natural gas for process control actions or pumping fluid when electricity is unavailable.

Abatement Option	Description	Considerations
High Bleed Retrofits or Replacements.[39]	Replace high-emitting controllers with those that vent less gas.	None identified.
Inspection of Intermittent Vent Controllers.[40]	Ensure intermittent vent controllers are not venting outside of active actuation periods.	Requires the existence of an LDAR program for fugitive emissions.
Replacement with compressed air (can replace any / all high bleed, intermittent bleed, low bleed, and pumps).[41]	Replace pressurized gas with compressed air.	Requires access to or on-site generation of electricity, which may be achieved by on-site solar.

Hydrocarbon Storage Tanks: Gas emissions associated with pressure drop and liquid movement activities in storage tanks.

Abatement Option	Description	Considerations
Route to a control device like a flare.	Flare, rather than vent, gas.	Select situations where supplemental gas would be needed to combust vapors.
Route to a vapor recovery system.	Capture gas for sale or on-site beneficial use.	Some older tank designs are not compatible with vapor recovery systems.

Methane Sources by Oil and Gas Segment

Selected Methane Emission Sources and Abatement Opportunities in Midstream Oil and Gas (2)

Reciprocating Compressors – Rod Packing Vent: Rod packing emissions typically do not occur around the rings but through the nose gasket around the packing case, between the packing cups, and between the rings and shaft. As the rings wear, or if the fit between the rod packing rings and the rod is too loose, more gas can escape.

Abatement Option	Description	Considerations
Re-route gas.	Capture gas via vapor recovery or routing to the compressor suction.	Convert to a lower-emitting dry seal technology.
Convert to a lower-emitting dry seal technology.	Replace or design the seal system with lower-emitting technology.	Conversion of some older compressor designs is not feasible.

Abatement Option	Description	Considerations
Capture, flare, or control vented gas.	Route packing vent to capture system for beneficial use or route to flare to achieve at least a 95 percent reduction in methane emissions.	Scheduling downtime as described above, potential space constraints, and possible disruptions with associated systems.
Conditions-based monitoring.	Use continuous monitoring or testing data to track emissions and develop a predictive maintenance program.	Start-up costs; Initial configuration of sensors and associated software; and learning curve for a new system.

Methane Sources by Oil and Gas Segment

Selected Methane Emission Sources and Abatement Opportunities in Midstream Oil and Gas (3)

Centrifugal Compressor Wet Seals: Methane becomes entrained in oil-based (wet) seal systems that must be purged to maintain compressor function.

Abatement Option	Description	Considerations
Route to a control device like a flare.	Flare rather than vent gas.	Select situations where supplemental gas would be needed to combust vapors.
Route to a vapor recovery system.	Capture gas for sale or beneficial on-site use.	Some tank designs are not compatible with vapor recovery systems; inadequate design to handle emissions.

Transmission Pipeline Blowdowns Between Compressor Stations: Blowdowns are the release of gas from a pipeline that causes a reduction in system pressure or a complete depressurization. They are typically required for maintenance.

Abatement Option	Description	Considerations
Capture vented gas.[44] .	Route gas to a compressor or capture system for beneficial use, route to flare, or leverage existing piping connections between high and low-pressure systems.[45]	Extensive planning and coordination with Gas Control to minimize downtime; some route opportunities may not be available due to safety concerns; hot tapping adds new infrastructure, increasing maintenance and leak points.

Methane Sources by Oil and Gas Segment

Selected Methane Emission Sources and Abatement Opportunities in Midstream Oil and Gas (4)

Compressor Station, Transmission Meter, and Regulator Stations on Above-Ground Facilities: Fugitive and vented gas areas associated with above-ground facilities.

Abatement Option	Description	Considerations
Periodic LDAR; re-design venting or emergency blowdown systems to simulate or re-direct gas back into the system during testing; install continuous monitoring.	Conduct routine inspection and maintenance programs or LDAR programs at defined intervals; install continuous monitoring at compressor stations; and incorporate the ability not to vent gas during safety testing of emergency blowdown systems.	Re-designs of emergency blowdown systems can be capital intensive and disrupt other operations; cost-effectiveness of continuous monitoring systems if the low risk of large emission events; integrating new infrastructure will have initial up-front costs and ongoing maintenance.

Engines or other on-site combustion devices (e.g., flares): Incomplete combustion allows methane to slip into flue gas in the atmosphere.

Abatement Option	Description	Considerations
Periodic Tune-up and Maintenance Programs; Process Monitoring and Control optimization systems.	Periodic maintenance programs to ensure the engine or combustion device is operating as designed and per specs; install monitoring and control systems for optimal combustion efficiency.	New skills to learn how to properly tune and maintain equipment for optimal combustion efficiency or learn new process monitoring and control systems.

Methane Sources by Oil and Gas Segment

Selected Methane Emission Sources and Abatement Opportunities in Midstream Oil and Gas (5)

Pipelines: Transmission pipelines can leak via integrity failures from corrosion and unintentional damages from weather events (e.g., landslides) or third-party (dig-ins).

Abatement Option	Description	Considerations
Pipeline Integrity Program; LDAR programs; Continuous Monitoring Systems.	Pipeline integrity programs with internal and external inspection; periodic LDAR surveys (aerial and walking); installing Continuous Monitoring along pipeline routes.	Integrity programs require diligence and expertise in evaluating and addressing identified threats with good data management tools; new training and skill may be required.

Methane Sources by Oil and Gas Segment

Downstream

- Downstream gas segment consists primarily of distribution networks designed to reach end consumers, whether residential, commercial, or industrial.
- The next two slides outline sources of downstream methane emissions, the primary abatement options to address them, and the potential trade-offs.

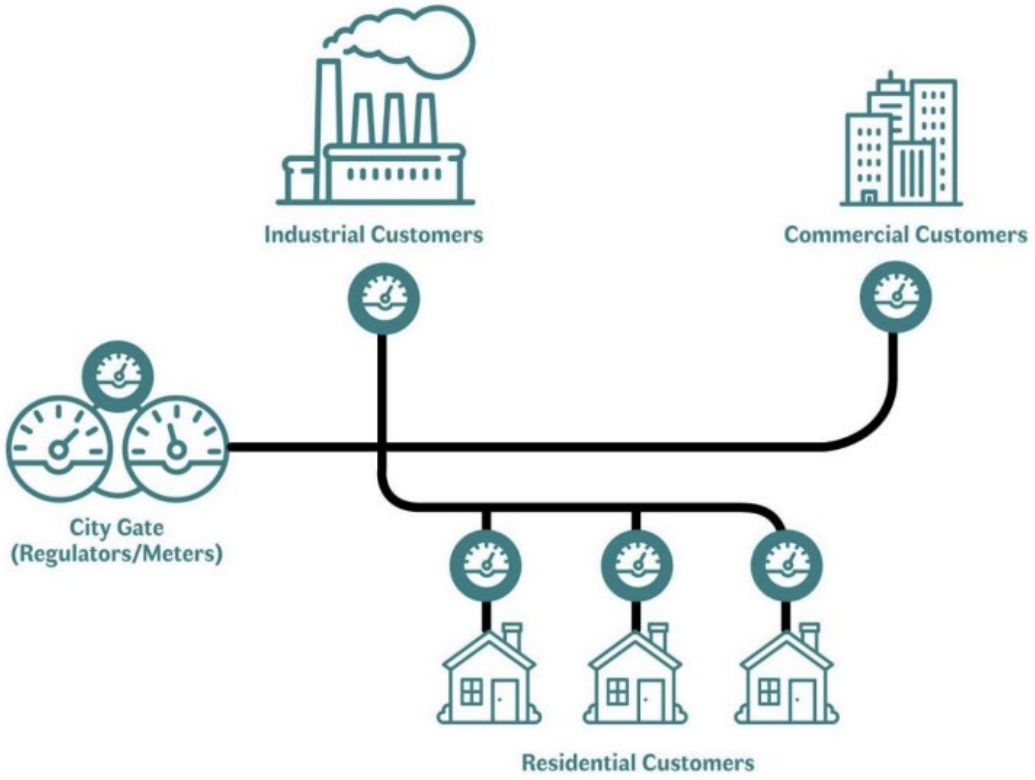


Figure 4.3: Illustration of downstream gas infrastructure.

Methane Sources by Oil and Gas Segment

Selected Methane Emission Sources and Abatement Opportunities in Downstream Oil and Gas (1)

Pipelines (mains and services): Distribution pipelines can leak via integrity failures (typically from corrosion of the steel at the joints for cast iron and cracking from non-state-of-the-art plastic materials) or inadvertent damages from third-party dig-ins.

Abatement Option	Description	Considerations
Damage Prevention Programs (e.g., Call Before You Dig 811).	These programs reduce the risk of pipeline ruptures from digging activities by maintaining an easily accessible system for developers to get information about the location of pipelines before they dig.	It may be difficult to obtain the GIS data of pipeline locations. Have to build the information database. Time and cost of building public awareness of the program.

Table 4.3: Selected methane abatement sources/opportunities in downstream gas.

Abatement Option	Description	Considerations
Pipeline Integrity Programs.	Distribution Integrity Management Programs to identify threats and monitor ongoing performance. Use aerial and mobile surveys and continuous point-sensing monitoring technologies. Prioritize repair on bigger leaks. Accelerate replacement of leak-prone pipe systems.	Rehabilitating and replacing pipelines can take years and require significant upfront capital. Demonstrating reductions will require alternatives to traditional emission factor methods — new methods to link emissions to actual leaks and their duration before repair. Developing cost-effectiveness or marginal abatement cost curves are critical to ensuring enhanced LDAR can be prioritized for maximum impact.
Enhanced LDAR Programs.	Enhanced LDAR programs increase surveys in poor-performing areas. Use decision tree analysis to find the bigger leaks.	Capital and operating costs. Developing cost-effectiveness or marginal abatement cost curves is critical to ensuring enhanced LDAR can be prioritized for maximum impact.

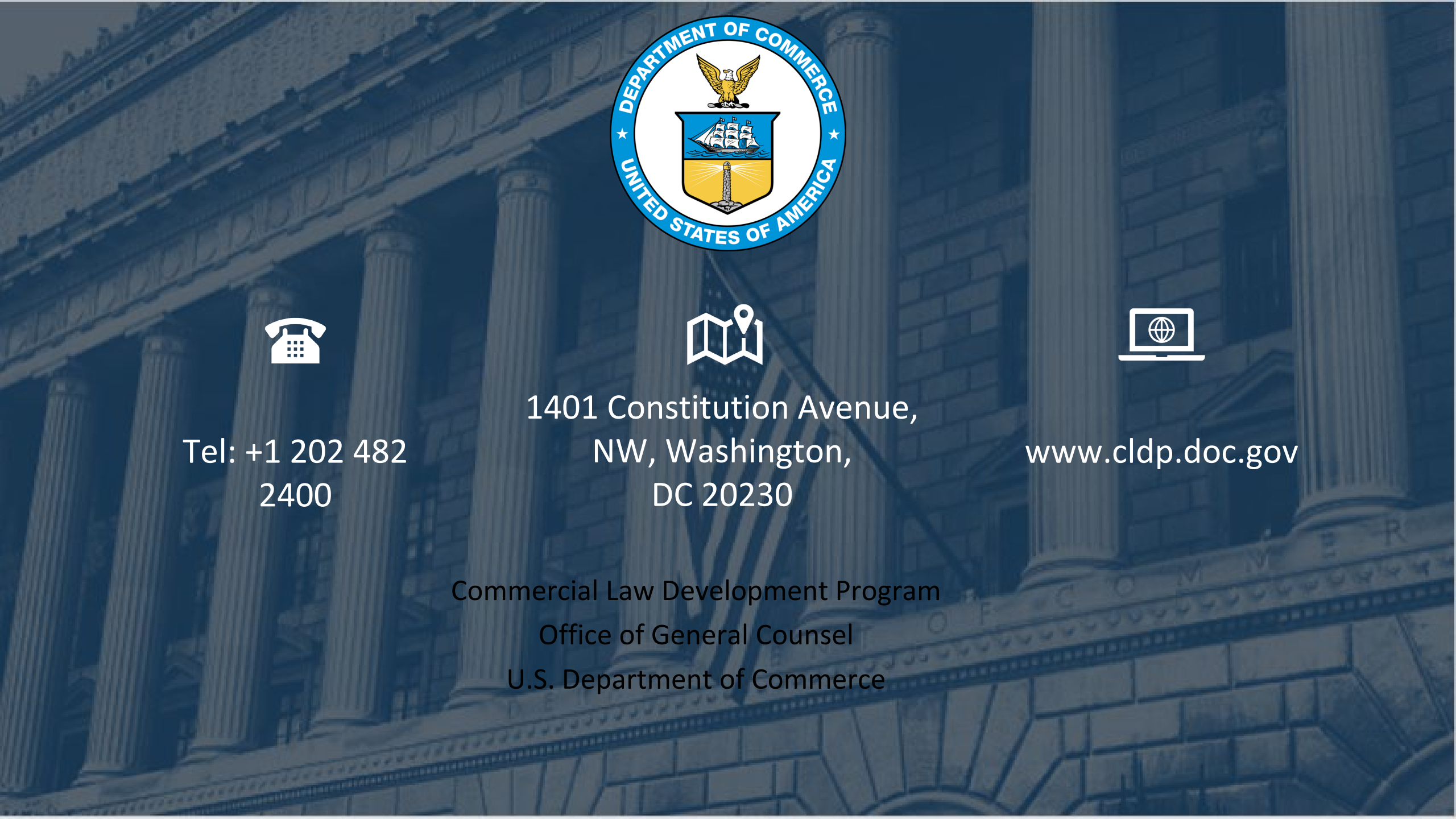
Methane Sources by Oil and Gas Segment

Selected Methane Emission Sources and Abatement Opportunities in Downstream Oil and Gas (2)

Customer Meters: Fugitive emissions from leaking components (e.g., loose-fitting) or venting from pressure regulators. Commercial/industrial meters may have pneumatic devices and a higher potential to emit because they operate at higher pressures than residential meters.

Abatement Option	Description	Considerations
Enhanced leak detection and accelerated repair.	Enhance leak detection through aerial and mobile surveys and installation of point sensing where data analytics can be used to find leaks. Accelerate or prioritize repair based on leaks from higher-pressure systems (if not safety-sensitive).	Funding and human capacity constraints. Similar to pipelines, a need exists to move from traditional emission factors to leaker-based factor methods to demonstrate reductions and to develop more accurate emission profiles.

Abatement Option	Description	Known Implementation Challenges
Installation of advanced meter networks.	Advanced meter networks can use data analytics on the customer side of the meter to find leaks through anomalies in hourly consumption rates.	Capital and operating costs. Training costs and integration into IT infrastructure.
Re-design of meter to reduce leak points.	Re-design of meters may involve changing from displacement to sonic meters for residential or eliminating leak points where possible.	Capital and operating costs.



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