2023

ANNUAL REPORT

ON CALENDAR YEAR 2022 METHANE INTENSITIES

Working together to reduce methane emissions across the natural gas value chain

ONE
OUR NATION'S ENERGY FUTURE

DUKE ENERGY


KINDER MORGAN


DUKE ENERGY

SOUTHERN COMPANY GAS

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Letter from the Executive Director

ONE Future is pleased to present its sixth Annual Methane Intensity Report, highlighting the success of more than 50 member companies in reducing methane emissions and our collaborative approach to continuous improvement.

The data underscores that our science-based, performance-focused approach is successful in helping our members prevent, find, and fix methane emissions in a cost-effective manner, demonstrating that we don't have to choose between tackling climate change and providing the affordable natural gas Americans rely on every day.

The coalition has surpassed its 2025 target of 1% methane intensity for all six years of reporting ahead of schedule. In 2022, our members achieved a collective methane intensity of 0.421%, a 10% decrease from 2021 results. Our goal is not only to continue to drive down methane emissions, but to measure emissions more precisely than ever before. That's why we are investing in advanced detection, monitoring, and measurement technologies and practices to continue contributing to global emissions reductions goals.

Over the past year, we've been reminded of the global importance of American natural gas as our industry stepped up to the plate to help meet Europe's energy needs. Our member companies are providing affordable, reliable, and cleaner energy around the world. Our innovation will help accelerate the energy transition and advance a lower-emissions future. Our 2023 study of member company activity shows that our material gains in emissions reductions have come from deployment of advanced leak detection technologies such as aerial and satellite based spectrometry and Light Detection and Ranging (LiDAR), ultrasonic listening devices, and compressor vent line alarms to enhance detection and measurement.

We continue to advocate for and invest in research to improve emissions management technology and practices by partnering with the academic and scientific community.

As part of our commitment to increased transparency and accuracy of measurement practices, the coalition and its members continue to substantially invest in GTI Energy's Veritas Initiative[1], a standardized, science-based, technology-neutral, measurement-informed approach to calculating and reporting methane emissions. In the latter half of 2023, several member companies conducted demonstration projects to test newly released protocols[2], aimed at improving consistency and credibility in emissions measurement and calculations.

As an extension of our mission, we awarded five $10,000 scholarships again this year to the next generation of innovators and leaders who will contribute to the sustainable development of the natural gas industry. Alongside these scholarships, we announced our annual ONE Future Awards recipients, organizations who have made material contributions to emissions reduction in the natural gas industry.

In closing, it's an honor to serve a coalition of companies whose culture demonstrates that they are committed to ensuring the future of natural gas as a long-term affordable and sustainable fuel source by reducing methane emissions intensity and enhancing measurement and reporting. I look forward to continued partnership and all that we will continue to achieve in the coming year as an industry.

Sincerely,

Jim Kibler

Overview

KINDER MORGAN

Our Nation's Energy Future (ONE Future) is a coalition of over 50 natural gas companies working to voluntarily reduce methane (CH4) emissions across the natural gas value chain. This industry-leading coalition spans five segments of the value chain: oil and natural gas production, natural gas gathering and boosting, natural gas processing, natural gas transmission and storage, and natural gas distribution.

Through shared best practices and groundbreaking technologies, the coalition's member companies are driving down emissions and advancing the innovation and cutting-edge technologies needed to progress a net zero future, all while delivering the affordable, reliable, and secure energy the U.S. and the world needs.

Mission

ONE Future's mission is to ensure that natural gas is a long-term sustainable fuel in a net zero future by reducing member companies' ratio of methane emissions to natural gas produced (methane intensity) to 1.0% or less by 2025.

We're working toward that goal by demonstrating that the natural gas industry can minimize methane emissions while increasing production to meet increasing demand for affordable, reliable, and cleaner energy. This progress is critical for ensuring natural gas can play an important, foundational role in the energy transition for decades to come.

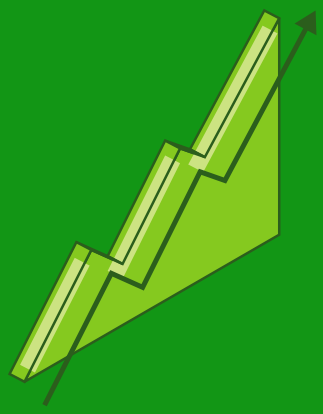
That's why the coalition is focused on supporting the nation's energy needs and climate goals by accelerating action to reduce emissions through sharing best practices and advancing new technologies. This includes identifying policy and technical solutions that support continuous improvement in the management of methane emissions associated with the production, processing, transmission, and distribution of natural gas.

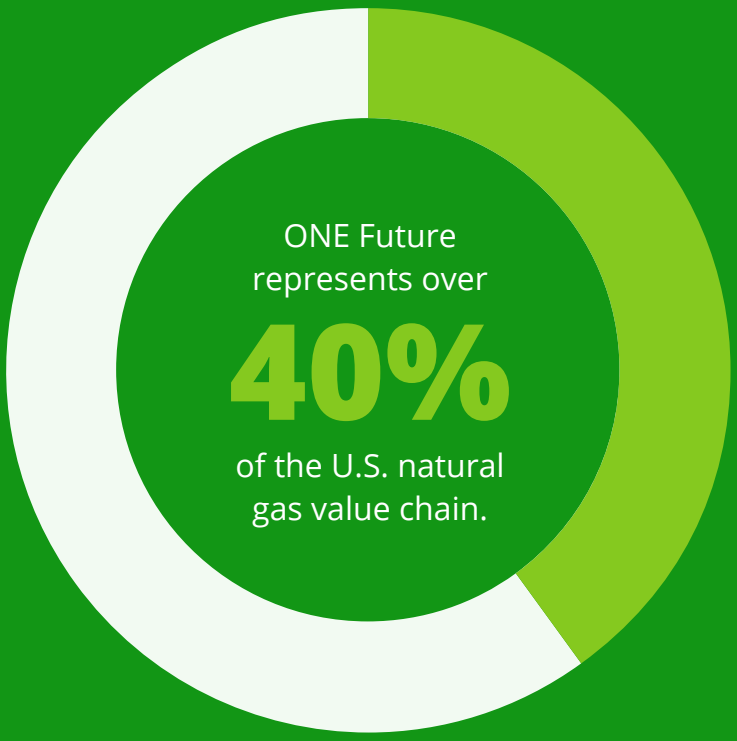
ONE Future's approach is science-based and goal-oriented, but flexible in that member companies can choose how they cost-effectively and efficiently achieve their methane intensity goal for their particular assets – whether that is by deploying an innovative technology, modifying a work practice, implementing best practices, or in some cases replacing or retrofitting methane emitting pipe or equipment. What is important is that each company demonstrates progress toward the target, which in turn allows the members, as a collective, to achieve ONE Future's overall emissions intensity target of 1.0% or less by 2025.

More information on the history behind the 1% target can be found on page 14.

SOUTHERN COMPANY GAS

Growth and Impact



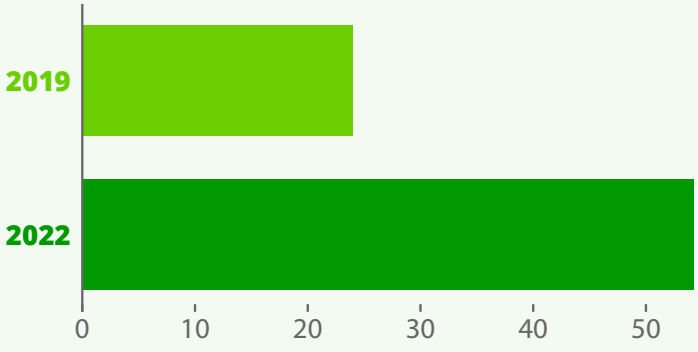


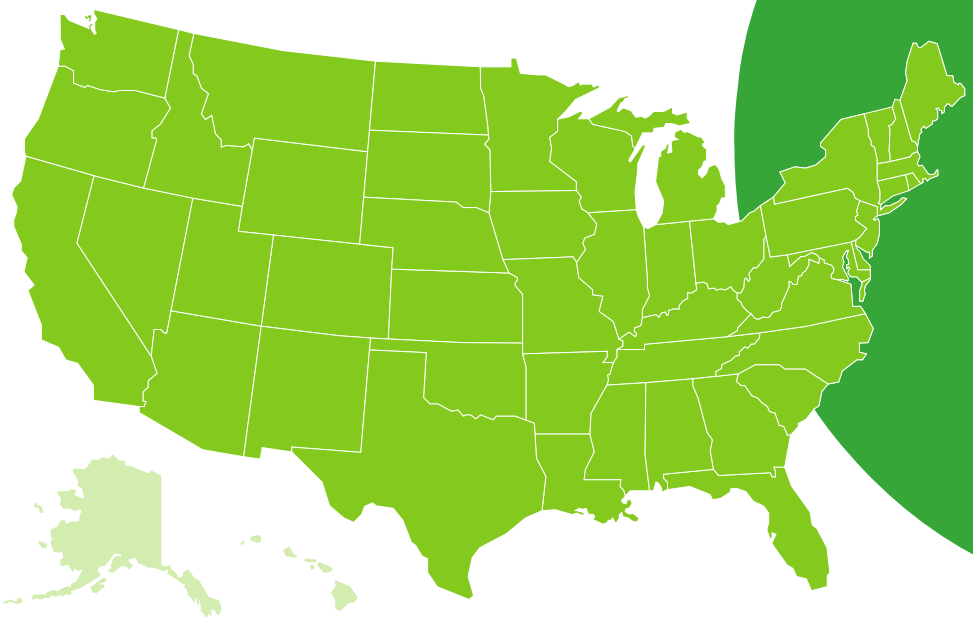
ENGAGING STAKEHOLDERS

The coalition continues to actively engage with key industry stakeholders, through activities such as conversations with the Department of Energy and the Environmental Protection Agency or participation in panels at events such as NYC Climate Week and GTI Energy's CH4 Connections.

METHANE INTENSITY REPORTS

The number of member companies that report their methane intensities to ONE Future has more than doubled since 2019.





OPERATIONS

As of 2022, ONE Future member companies operate in 25 out of the 38 production basins[3] and have operations in 48 out of the 50 states.

EXPANDING INTO LIQUEFIED NATURAL GAS (LNG)

For 2023, ONE Future has given membership the option of cataloging LNG export/import reductions to evaluate how it works. This comes at a time when Russia's invasion into Ukraine has remapped global energy supply and positioned the U.S. as a top exporter of LNG.
Recent geopolitical turmoil and volatility in global energy markets serve as a stark reminder of the importance of U.S. LNG in supporting global energy security, reducing reliance on foreign energy sources, and accelerating global action on climate change by transitioning countries away from coal to cleaner fuels.

Member Companies

Report Highlights

54 COMPANIES

reported their methane intensities in 2022.

BY THE NUMBERS

In 2022, ONE Future member companies achieved a collective methane intensity of 0.421%.

Overall methane intensity decreased by 10% year over year while the number of ONE Future members that reported increased by 2%.

5 SEGMENTS OF THE VALUE CHAIN

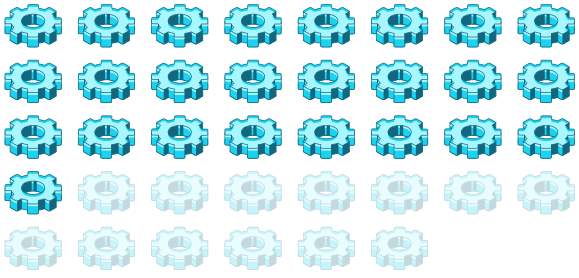
were represented in methane emissions reporting in 2022.

ONE FUTURE SURPASSES GOAL FOR THE SIXTH YEAR IN A ROW.

REPORTED METHANE INTENSITY **2025 GOAL: 1%** **2022 REPORT: 0.421%**

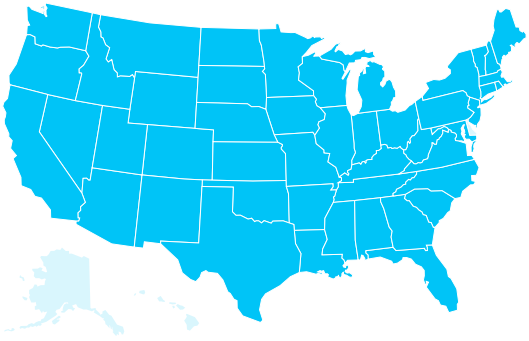
As of 2022, ONE Future member companies operate in

25 OUT OF THE 38 PRODUCTION BASINS.



As of 2022, ONE Future member companies

HAVE OPERATIONS IN 48 OUT OF THE 50 STATES.



Executive Summary

2022 METHANE INTENSITY RESULTS

This marks ONE Future's sixth year of reporting methane intensity, and based on 2022 methane emissions and throughput, ONE Future's methane intensity is 0.421%. The 2022 ONE Future methane intensity decreased year-over-year (compared to the 2021 methane intensity of 0.470%, noted in Appendix A), while member companies reporting increased from 53 to 54. The results from 2017 through 2022 demonstrate that ONE Future continues to be significantly below the 2025 target of a 1.0% methane intensity, and that natural gas continues to be a vital and viable resource as we move towards a cleaner energy future while providing customers with a reliable and affordable energy source.

PROGRESS AT A GLANCE

Even as the coalition grows, the methane intensity from ONE Future members continues to remain well below the 1.0% goal set for 2025, reflecting the constant progress of the industry.

Despite reaching our goal well ahead of schedule, we strive for continuous improvement – through shared best practices and innovative technologies – to ensure that natural gas remains a long-term sustainable fuel source. These results further underscore that we do not have to choose between reducing emissions and providing access to the affordable natural gas Americans rely on every day. We can achieve both through continued progress and technological advancements.

Driving Down Emissions

HISTORY

When the ONE Future coalition was formed in 2014, most ONE Future member companies had already been investing and implementing methane emissions reduction technologies and work-practices for several decades.

Today, the coalition is comprised of over 50 of the largest natural gas production, gathering & boosting, processing, transmission & storage and distribution companies in the U.S. and represents more than 40% of the U.S. natural gas value chain.

THE ONE FUTURE PROTOCOL

The coalition developed the ONE Future Protocol[4] to enable companies across different segments of the natural gas value chain to calculate, report, and track methane intensity goal progress and to benchmark performance consistently, transparently, and verifiably. This protocol defines methane intensity calculation techniques and how annual results will be compared to the coalition's collective goals.

The ONE Future Protocol describes how we track company methane emissions reduction progress by calculating emission intensities at the national, segment, and member levels. ONE Future uses national gas production rates that are published annually by the U.S. Department of Energy's Energy Information Administration (DOE EIA). Additionally, the protocol follows a combination of the EPA's Greenhouse Gas Reporting Program (GHGRP), EPA's annual Greenhouse Gas Inventory (GHGI), and other representative methodologies as outlined in the protocol document.

Segment-specific methane intensity targets are identified in the ONE Future Protocol to allow member companies to benchmark progress and facilitate comparisons toward methane intensity goals within each segment. These segment methane intensity targets have been scaled to the national level to track progress toward ONE Future's overall methane intensity goal.

ONE Future reviews its target periodically as the coalition gains a better understanding of the methane intensity data collected each year and the areas that need continued improvement.

HOW WE ARE GETTING THERE

To reach our emissions reduction goals, the ONE Future coalition is committed to continuous improvement through shared best practices and groundbreaking technologies. Through 83 unique methane abatement activities across segments, our member companies are leading the way in driving down emissions across the natural gas value chain. Select abatement activities implemented by some of the members are highlighted below, with a full list available in Appendix B.

Implementing various Optical Gas Imaging (OGI) leak survey and **leak detection and repair** (LDAR) programs

Installing ultrasonic listening devices and Lower Explosive Limit (LEL) detectors within gas units, programmed to **shut in the wellpad if gas is detected**

Performing **aerial leak surveys** to identify methane slip due to combustion

Increasing the length of pressurized holds on compressor drivers to **reduce the frequency of compressor unit blowdowns**

Implementing company requirement to have adequate takeaway capacity at wellpads to **prevent venting or flaring** of associated (or stranded) gas

Scaling **satellite methane leak detection** pilot to an entire state in 2023

Performing periodic maintenance on flare burner and blower (air-assisted) to **improve flare efficiency** and **minimize methane slip** due to combustion

Installing **solar power** for chemical injection pumps

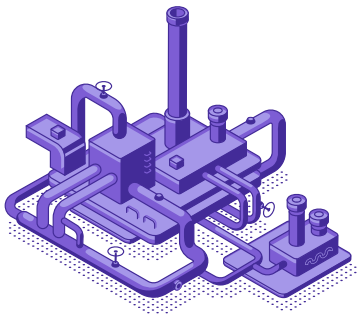
Performing **regular preventative maintenance** and burner tip maintenance on combustion units and flares

Installing **"line break" valves** to prevent a significant loss of gas to the atmosphere

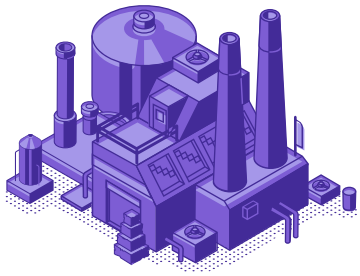
In the interest of continuous improvement and enhanced measurement, 14 member companies provided stack test data this year. A full summary of the data collected can be found in Appendix C.

Overview of Segments

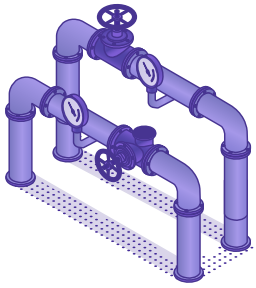
Production



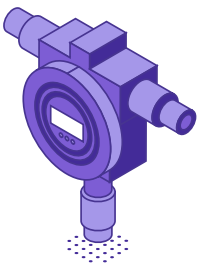
Gathering & Boosting



Processing



Transmission & Storage



Distribution

In 2022, 54 member companies reported their emissions. There were decreases in methane intensities for four segments (Production, Gathering & Boosting, Transmission & Storage, and Distribution) and only a slight increase in methane intensity for one segment (Processing), resulting in an overall decrease in the ONE Future value chain methane intensity. The chart below summarizes this data by segment.

Segment	2021 Methane Intensity	2022 Methane Intensity	Percent Change in Methane Intensity	2025 Methane Intensity Goal	Beating Goal By:
Production	0.152%	0.133%	-12.2%	0.283%	53.0%
Gathering & Boosting	0.080%	0.077%	-4.9%	0.080%	3.8%
Processing	0.027%	0.028%	1.7%	0.111%	74.8%
Transmission & Storage	0.097%	0.088%	-9.0%	0.301%	70.8%
Distribution	0.113%	0.095%	-16.0%	0.225%	57.8%
ONE Future Value Chain	0.470%	0.421%	-10.4%	1.000%	57.9%

METHODOLOGY UPDATES FOR THIS YEAR

All Segments: For the combustion exhaust methane emissions, ONE Future members were allowed the option to submit measured methane stack test data for engines/turbines that were tested in their respective fleet. For member companies that tested only a portion of their engines/turbines, ONE Future used the methane stack test data to calculate methane emissions from engines/turbines that were tested at least once in 2022. For those engines/turbines not tested by the member company in 2022, fuel usage and AP-42 emission factors[6] were used to calculate the emissions for the non-tested engines/turbines.

Transmission & Storage and Distribution: For Calendar Year(CY) 2022, underground natural gas storage and LNG storage facilities were included with either the Transmission & Storage segment or the Distribution segment. In previous years, all underground and LNG storage assets were included solely in the Transmission & Storage segment as a default based on the typical function of these storage facilities to provide peak shaving capacity when needed. It was decided this year by ONE Future member companies to separate these facilities based on the segment in which they are physically located and operated rather than place them all in the Transmission & Storage segment which is more in line with their peak shaving functional purpose.

Production

GETTY IMAGES

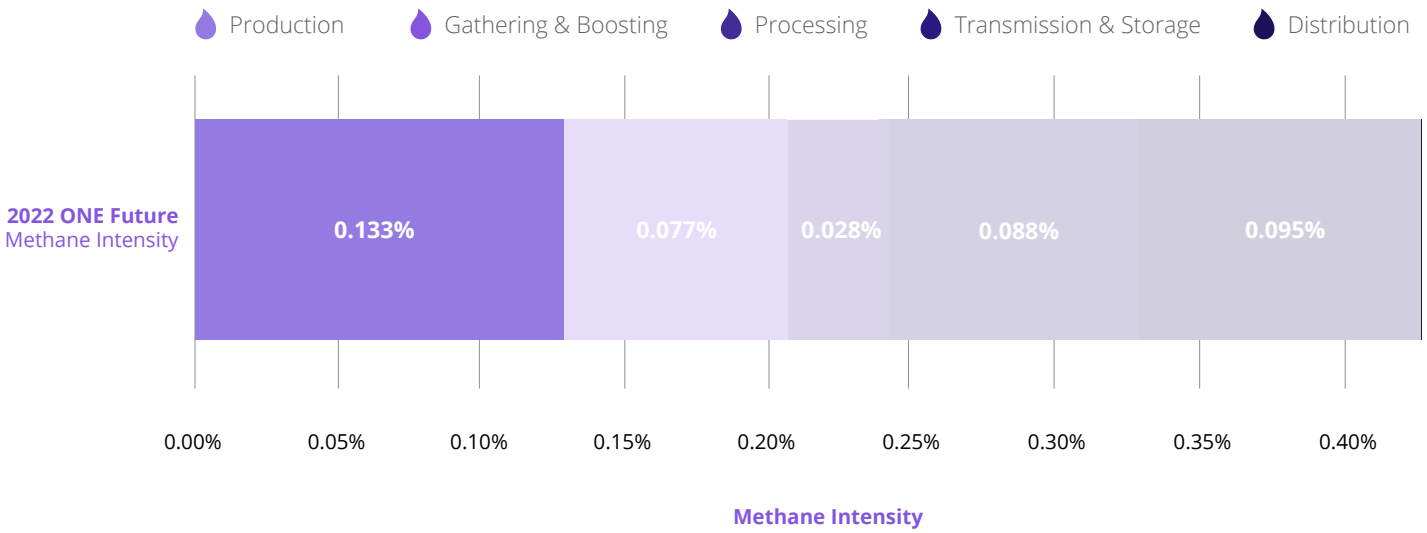
OVERVIEW

The production segment consists of the exploration of natural gas, wells producing natural gas, and production equipment located at the well site. Because wells often co-produce natural gas and crude/ condensate, the ONE Future Protocol provides an approach that allocates the total methane emissions associated with only natural gas.

ONE Future members represent 23% of the national gas produced in the U.S. in CY2022.

2022 SEGMENT RESULTS:

METHANE INTENSITY OF 0.133% VS. GOAL OF 0.283% BEATING GOAL BY 53%



Gathering and Boosting

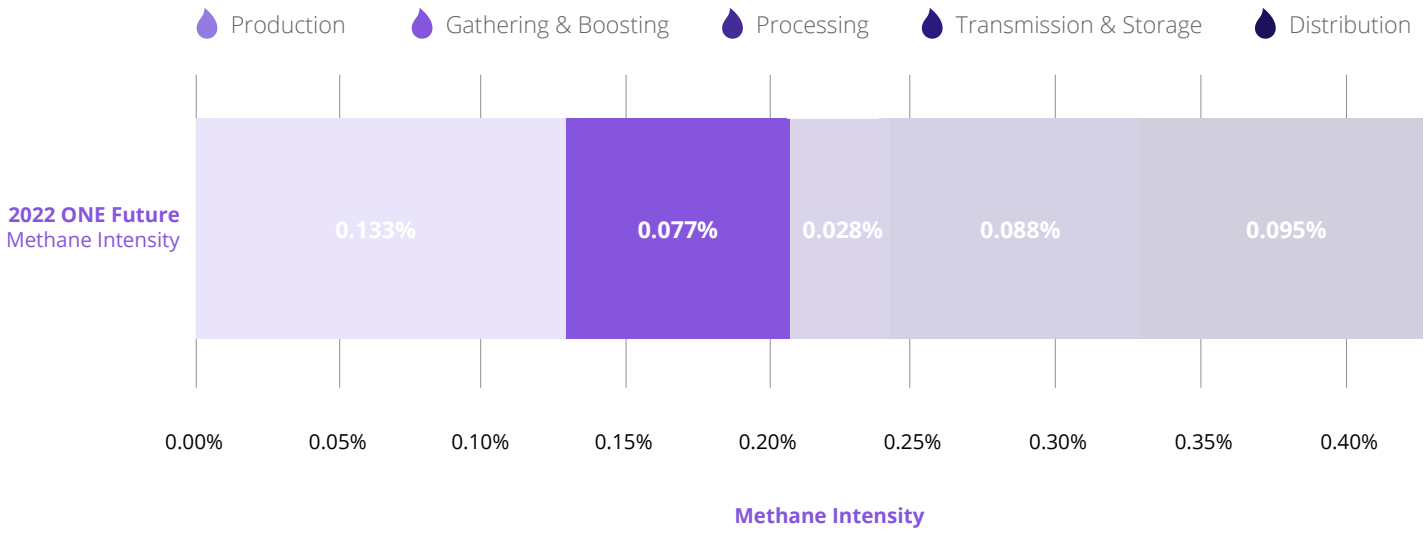
OVERVIEW

The gathering and boosting (G&B) segment includes pipelines and other equipment used to gather natural gas from production facilities, treat the gas as needed through dehydration or acid gas removal, and compress the gas to transport it to a natural gas processing facility, a natural gas transmission pipeline, or to a natural gas distribution pipeline. Methane emissions from combustion, equipment leaks, and natural gas-operated pneumatic controllers are the three largest emissions sources that gathering and boosting companies are working to further reduce.

ONE Future members represent 48% of the national gas gathered in the U.S. in CY2022.

2022 SEGMENT RESULTS:

METHANE INTENSITY OF 0.077% VS. GOAL OF 0.080% BEATING GOAL BY 3.8%



Processing

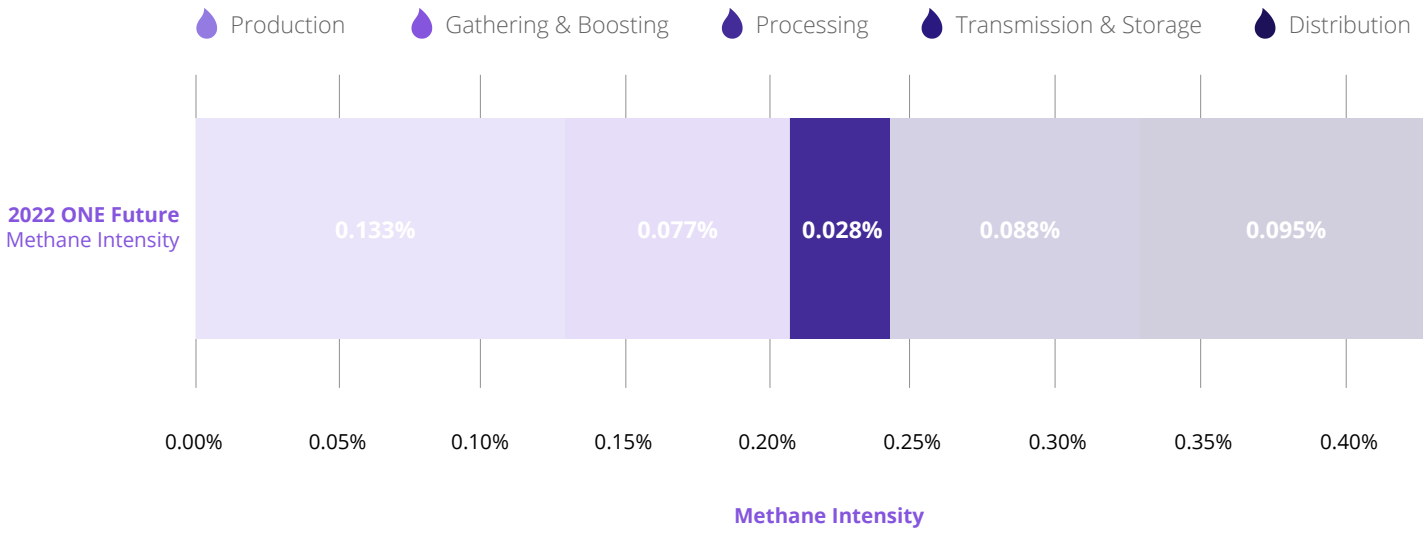
OVERVIEW

The processing segment consists of gas processing plants where hydrocarbons and fluids in produced natural gas are separated to produce natural gas that meets pipeline specifications. Equipment associated with the gas processing segment includes the equipment inside a gas processing plant, such as absorption units or cryogenic expanders, fractionators, dehydrators, acid gas removal units, and compressors. Engine exhaust from uncombusted natural gas is the largest source of methane emissions that the processing segment is tackling.

ONE Future members represent 31% of the gas processed in the U.S. in CY2022.

2022 SEGMENT RESULTS:

METHANE INTENSITY OF 0.028% VS. GOAL OF 0.111% BEATING GOAL BY 74.8%



Transmission and Storage

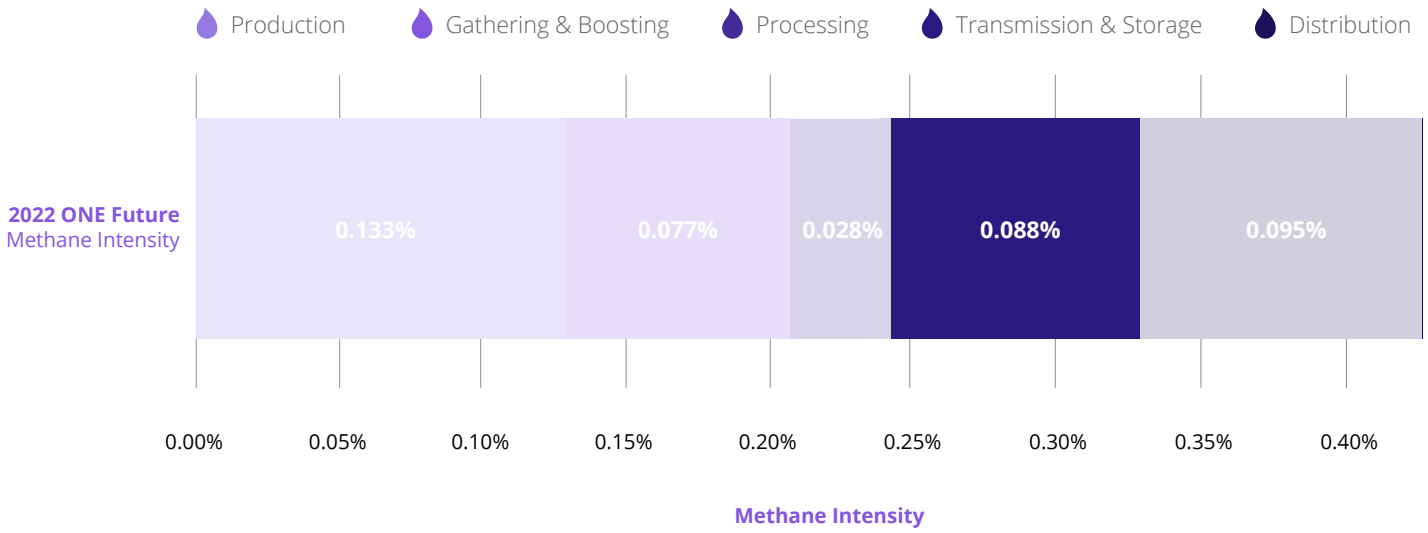
OVERVIEW

The transmission and storage (T&S) segment includes high-pressure, large-diameter pipelines that transport natural gas from G&B and processing to natural gas distribution systems or large-volume consumers such as power plants. EPA combines T&S into one segment since transmission companies own and operate many of the storage facilities. Natural gas compression is a significant operation for the T&S segment – therefore emissions from compressors, components designed to vent gas, and compressor exhaust play a more prominent role in methane emissions.

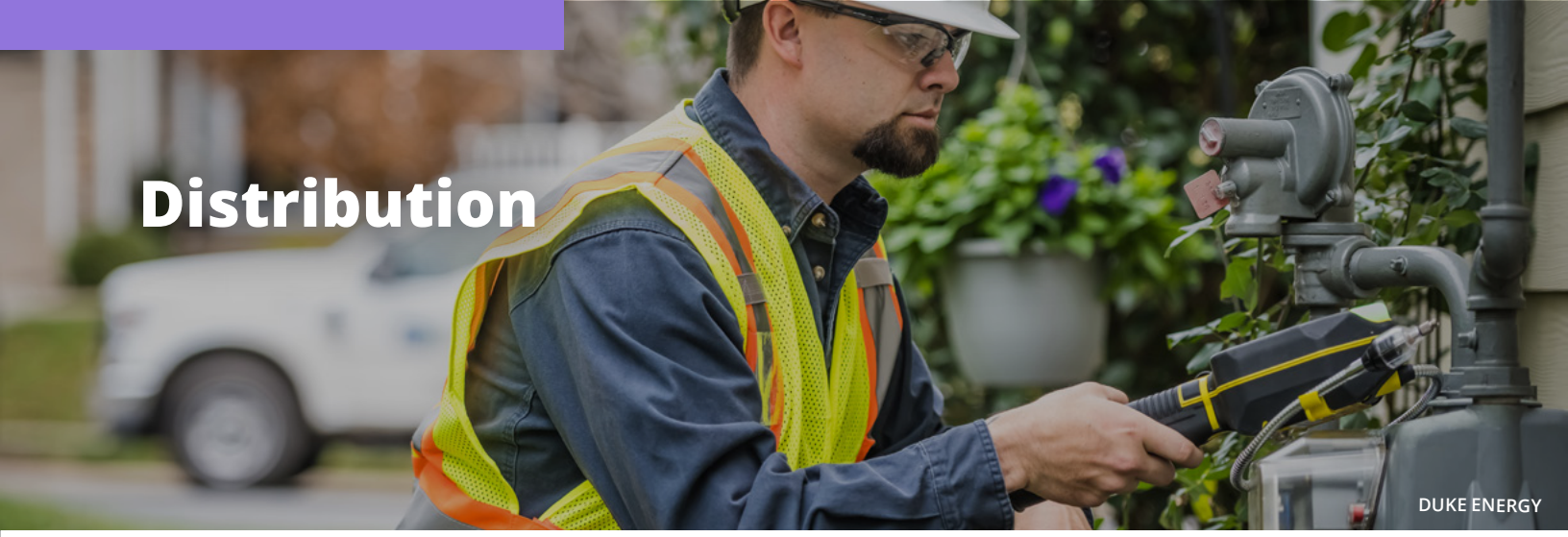
ONE Future members account for 61% of total transmission pipeline miles in the U.S. in CY2022.

2022 SEGMENT RESULTS:

METHANE INTENSITY OF 0.088% VS. GOAL OF 0.301% BEATING GOAL BY 70.8%



Distribution


DUKE ENERGY

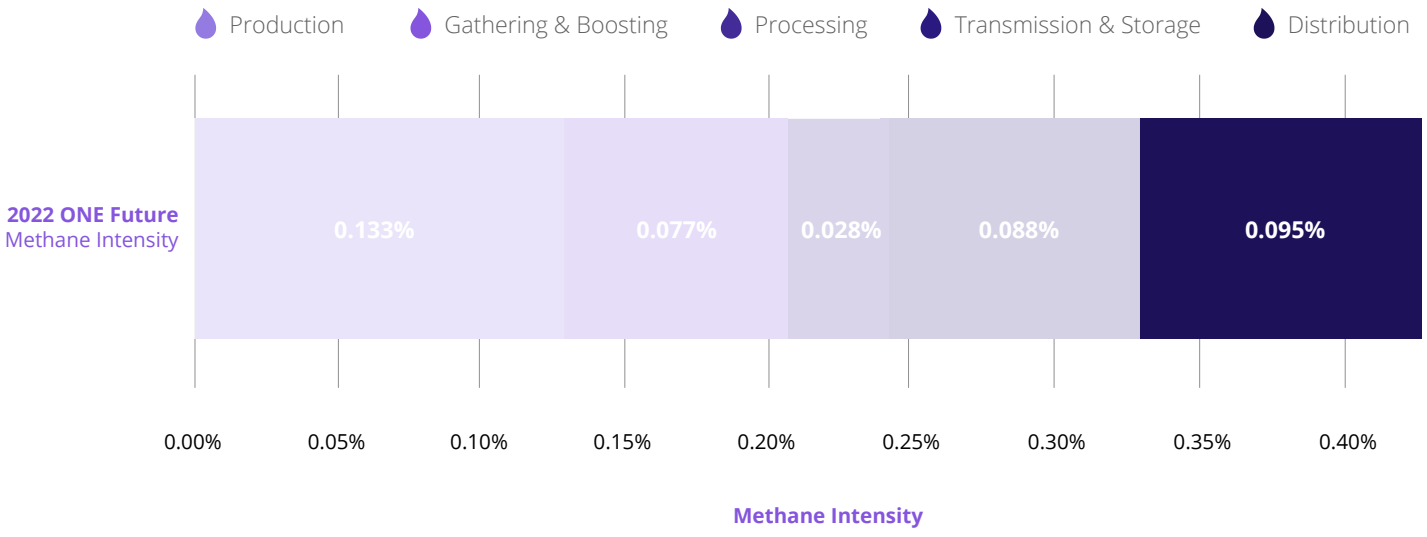
OVERVIEW

The distribution segment covers natural gas pipelines that take high-pressure gas from transmission systems and gathering systems, reduce the pressure, and distribute the gas through primarily underground service lines to users. This segment includes natural gas mains and services, metering and pressure regulating stations, customer meters, as well as associated underground storage and LNG storage assets.

ONE Future members account for 42% of gas delivered to end users in the U.S. in CY2022.
ONE Future members represent 45% of miles of mains in the U.S. in CY2022.

2022 SEGMENT RESULTS:

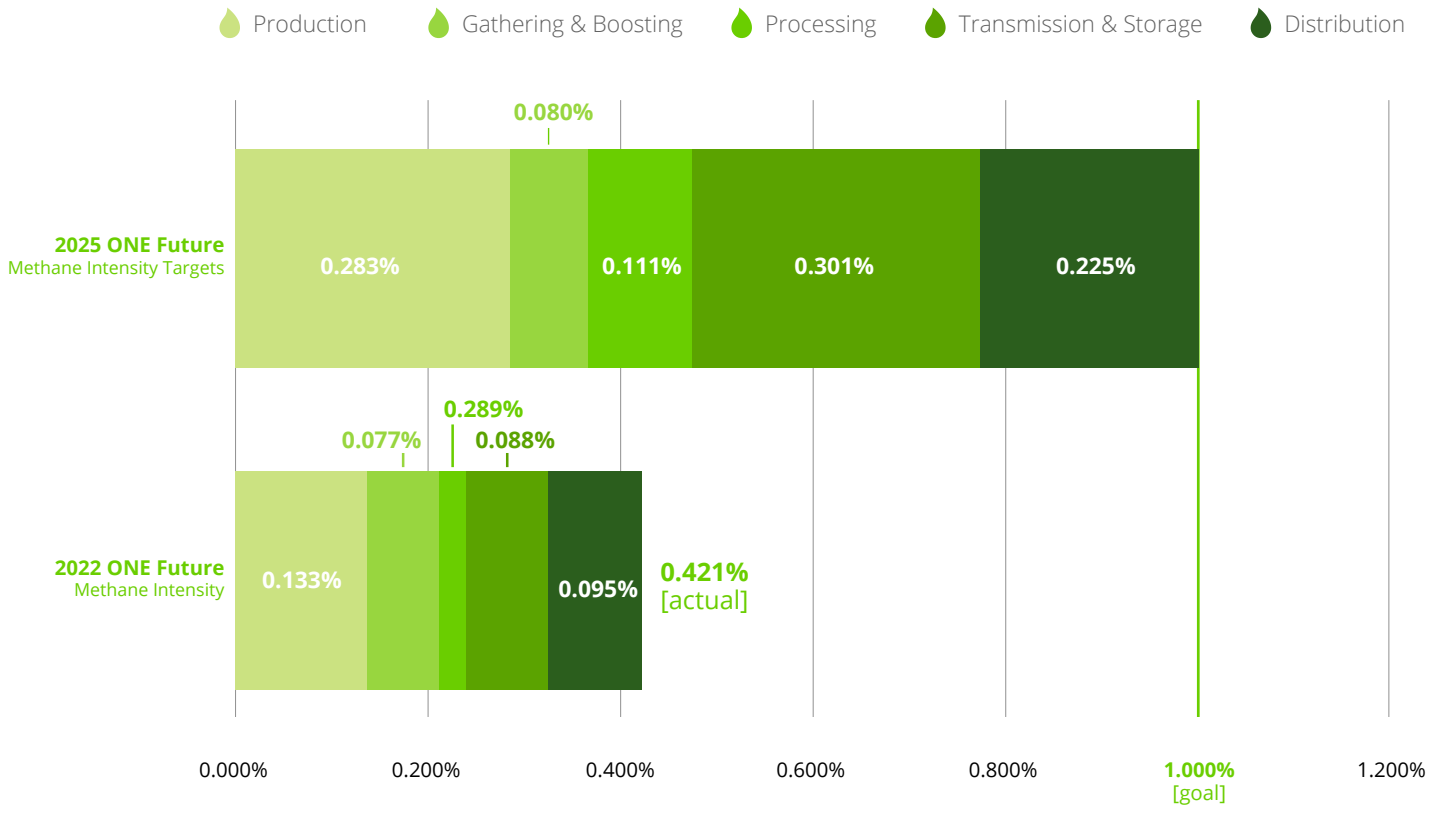
METHANE INTENSITY OF 0.095% VS. GOAL OF 0.225% BEATING GOAL BY 57.8%



Conclusions

ONE Future has surpassed its 2025 target of 1.0% methane intensity for the sixth year in a row, ahead of schedule. In 2022, our members achieved a collective methane intensity of 0.421%, a 10% decrease from the prior year, while the number of ONE Future members that reported increased by 2%.

The coalition's goal is not only to continue to drive down methane emissions, but to measure emissions more precisely than ever before by investing in advanced detection, monitoring, and measurement technologies and practices to continue contributing to global emissions reductions goals. We encourage other natural gas companies to join us in our mission to continue reducing the methane intensity of the natural gas value chain.



The above graph illustrates ONE Future's 2022 cumulative methane intensity of 0.421% by segment versus ONE Future's 2025 cumulative target of 1.0%.

Year-to-year segment changes and comparisons for 2022 are described below.

PRODUCTION

There was an overall net decrease of one member company reporting in the production segment. Acquisition and divestiture of assets also impacted the overall segment methane intensity. Additionally, three of the 19 companies reporting in the production segment provided measured engine stack test data, which had an influence on this segment's intensity. Production from member companies increased by 0.16% from CY2021 to CY2022.

GATHERING & BOOSTING

There was an overall net increase of two companies reporting in this segment along with acquisition and divestiture of assets that impacted the overall segment methane intensity. Additionally, eight of the 23 companies reporting in this segment provided measured engine stack test data, which had a significant influence on this segment's intensity. Gas gathered by member companies increased by 16.35% from CY2021 to CY2022.

PROCESSING

There was an overall net decrease of one company reporting in this segment along with acquisition and divestiture of assets that impacted the overall segment methane intensity. Additionally, three of the 12 companies reporting in this segment provided measured engine stack test data, which had an influence on this segment's intensity. Gas processed by member companies increased by 23.21% from CY2021 to CY2022.

TRANSMISSION & STORAGE

There was no overall net change in the number of reporting companies. However, there was a change to some of the companies reporting in this segment. This along with acquisition and divestiture of assets impacted the overall segment methane intensity. Additionally, four of the 25 companies reporting in this segment provided measured engine stack test data, which had a small influence on this segment's intensity. Also, some storage assets that had been reported in this segment in past years have now been reported in the Distribution segment this year due to the updated methodology, which had an impact on lowering this segment's methane intensity. Gas transmitted (based on transmission pipeline miles) increased 3.92%.

DISTRIBUTION

There was an overall net decrease of two companies reporting in this segment along with acquisition and divestiture of assets that impacted the overall segment methane intensity. Additionally, due to the updated methodology, there were some storage stations that were included in this segment for CY2022 that had not been included in past years. Natural gas deliveries to customers by member companies decreased by 9.77%.

> While ONE Future's 2022 data demonstrates strong progress, the coalition is focused on the future and is committed to raising the bar even higher through further collaboration across the industry, engagement with policymakers and investment in advanced detection, monitoring and measurement technologies to track and eliminate more emissions than ever before.

Footnotes and References

1. GTI Energy Veritas home page accessible via the following link: veritas.gti.energy/
2. GTI Energy Veritas Protocols accessible via the following link: veritas.gti.energy/protocols
3. American Association of Petroleum Geologists (AAPG) Geologic Note: AAPG–CSD Geologic Provinces Code Map: AAPG Bulletin, Prepared by Richard F. Meyer, Laure G. Wallace, and Fred J. Wagner, Jr., Volume 75, Number 10 (October 1991) (incorporated by reference in USEPA's GHGRP, see § 98.7).
   The total production basin count is based upon the number of U.S. Basins with production and emissions reported to the USEPA under the GHGRP.
4. ONE Future Methane Intensity Protocol 2022 accessible via the following link: onefuture.us/resources/protocols/. *ONE Future reserves the right to update the contents of the ONE Future Protocol at any time to maintain alignment with EPA definitions and methodologies and reflect EPA's most current GHG emissions data.*
5. EPA's Greenhouse Gas Reporting Program (GHGRP): epa.gov/ghgreporting
6. EPA's AP-42 Emission Factor database for Reciprocating Engines can be found here: AP-42, Vol. I, 3:2 Natural Gas-fired Reciprocating Engines (epa.gov) and EPA's AP-42 Emission Factor database for Stationary Gas Turbines can be found here: AP-42, Vol. I, 3.1: Stationary Gas Turbines (epa.gov)
7. EPA (2023) Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2021. U.S. Environmental Protection Agency, EPA 430-R-23-002: epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2021
8. IEA's Golden Rules for a Golden Age of Gas: iea.org/reports/golden-rules-for-a-golden-age-of-gas
9. U.S. Natural Gas Gross Withdrawals and Production (eia.gov): eia.gov/dnav/ng/ng_prod_sum_dc_NUS_MMCF_m.htm
10. EPA's Natural Gas STAR Methane Challenge (ONE Future option program): epa.gov/sites/default/files/2016-08/documents/methanechallenge_one_future_supp_tech_info.pdf

Appendix A

Revisions to CY2021 Transmission & Storage (T&S) Segment and ONE Future value chain methane intensities:

There were data discrepancies identified in June 2023 associated with the CY2021 methane emissions and throughput data for two member companies reporting in the T&S segment. These discrepancies were identified as the under-reporting of methane emissions for the first T&S company and the under-reporting of methane emissions and over-reporting of mileage-based throughput for the second T&S company. After correcting these discrepancies, the methane intensity for the T&S segment for CY2021 increased from 0.089% to 0.097% and the overall ONE Future methane intensity for CY2021 also increased from 0.462% to 0.470%.

Revisions to CY2017 to CY2020 Gathering & Boosting (G&B) Segment and ONE Future value chain methane intensities:

There were discrepancies identified in January 2023 for the CY2017 to CY2020 methane emissions, throughput, and percent methane composition for a member company reporting in the G&B segment. These discrepancies resulted in an increase in the CY2017 to CY2020 G&B segment methane intensities and an increase in ONE Future value chain methane intensity for CY2017 to CY2020.

The current and updated intensities are summarized in the table below.

Segment	CY2017 CH4 Intensity	CY2018 CH4 Intensity	CY2019 CH4 Intensity	CY2020 CH4 Intensity
Original G&B Segment Intensity	0.093%	0.028%	0.033%	0.042%
Updated G&B Segment Intensity	0.111%	0.031%	0.037%	0.045%
Original ONE Future Value Chain Intensity	0.552%	0.326%	0.334%	0.400%
Updated ONE Future Value Chain Intensity	0.570%	0.329%	0.338%	0.403%

Appendix B

Methane Abatement Activities from ONE Future Member Companies

PRODUCTION

- Company requirement to have adequate takeaway capacity at wellpads to prevent venting or flaring of associated (or stranded) gas. All natural gas produced is sent directly to pipeline.
- Implementation of various Optical Gas Imaging (OGI) leak survey and leak detection and repair (LDAR) programs: Quarterly, biannual, or annual leak surveys across assets. The companies implementing LDAR programs are performing them either under a voluntary or regulatory program or a combination of both programs.
- Quarterly aerial leak surveys and repairs across all unconventional wellpads and annual across all conventional wells. Desktop review of work orders and site data followed by field investigation of each emission event >10 kg/hr (intermittent and persistent).
- Implementing large pilot of continuous monitoring system with multiple technologies for detection
- Wellpad pressure testing is conducted with an onsite Optical Gas Imaging team member to find emission sources prior to the start of production.
- Wellpads are investigated daily or weekly for leaks using Audio, Visual and Olfactory (AVO) checks.
- New wells are monitored with a density meter. If the density meter notes gas going to the tank the well is shut-in to perform a field investigation and possible maintenance of the dump valves associated with those tanks.
- Install ultrasonic listening devices and Lower Explosive Limit (LEL) detectors within gas units. They are programmed to shut in the well pad if gas is detected.
- Equip all well tenders with CH4 detection monitors that are checked weekly to ensure there are no leaks.
- Best management and operational practices integrated across construction and production sites with the goal of minimizing venting and flaring.
- Best management and operational practices that limit number of compressor and vessel blowdowns to atmosphere only when needed.
- Use of portable compression equipment to capture and recompress the gas blowdown from compressors and other vessels transferring the gas to a pipeline downstream of the isolated equipment or pipeline segment.
- Installation of instrument air to replace gas starters on compressor drivers.
- Automated plunger lifts are installed and monitored by a central control center to minimize liquids unloading emissions.
- Tubing is installed either during initial construction or within 3 years of acquisition to support the installation of plunger lifts and minimize liquids unloading emissions.
- Pneumatic controllers/actuators: replacing existing gas driven pneumatic controllers/ actuators with electric, solar, nitrogen or instrument air devices and implemented plans to design all new wellpads without any gas driven pneumatic controllers/actuators.
- Installing solar power for chemical injection pumps.
- Using glycol energy exchange pneumatic pumps resulting in minimal levels of CH4 released.

- Implementation of reduced emission completions during well completions and hydraulic fracturing.
- State regulatory agency regulates/limits venting from well unloading (down to ~400 total unloads/month from ~1200/month in 2021) - mostly all on plunger lifts.
- Routing of vented gas from pneumatic controller/actuator to combustor/separator pilot fuel when it is not feasible to have a portable compressor to capture and recompress the small amount of gas vented from pneumatic controllers/actuators.
- Began utilizing emission control devices (ECDs) to lower completions emissions.
- Changed the facility design to perform bulk test separation vs. having separator units on every well.
- Installed compressors on wells to enhance gas lift and/or boosting to minimize emissions from liquids unloading.
- Glycol Dehydration units: all flash off-gas is captured and sent back to station inlet or controlled via VRU or combustion device (flare or enclosed combustor), all regen off-gas routed to BTEX condenser/sump and routed to combustion device for control.

GATHERING & BOOSTING

- Implementation of various Optical Gas Imaging (OGI) leak survey and leak detection and repair (LDAR) programs: Quarterly, biannual, or annual leak surveys across assets. The companies implementing LDAR programs are performing them either under a voluntary or regulatory program or a combination of both programs.
- Installation of instrument air to replace gas starters on compressor drivers.
- Pig launcher/receiver trap blowdowns: Some facilities utilize VRU/ECD/Flare to capture ~90% pig trap blowdown.
- Pig launcher/receiver trap blowdowns: Auto Launcher and larger barrel to receive multiple pigs before depressuring trap to atmosphere.
- Perform aerial leak surveys performed to identify methane slip due to combustion.
- Perform regular preventative maintenance and burner tip maintenance on combustion units and flares (tuning of the unit).
- Perform rod packing maintenance and replacement for all reciprocating compressor units regardless of whether they are subject to regulatory requirements.
- Implement best management and operational practices by minimizing the frequency of blowdowns to the extent possible thru scheduling and grouping of maintenance activities.
- Utilize vapor recovery units (VRUs), ECDs, or flares to combust or capture 90%+ of compressor or pipeline blowdowns.
- Gas control continuous monitoring of significant changes in gathering pipeline pressures to minimize chances of gathering pipeline unplanned events/mishaps outside of the control of the operator. If event were to occur, the company gas control personnel can take immediate actions to close valves and isolate the pipeline to minimize the gas vented until personnel can make the repair.
- Perform routine gathering pipeline walking leak surveys to minimize gathering pipeline unplanned events/mishaps outside of the control of the operator.
- Best management and operational practices to minimize pipeline segment length and gas volume needing to be blown down during gathering pipeline planned events.

- During gathering and transmission pipeline planned events, reduce the operating pressure on segment(s) of gathering and transmission pipelines as much as possible using portable compression and/or existing compression and route the gas downstream of the isolated segment being blown down.
- Glycol Dehydration units: all flash off-gas is captured and sent back to station inlet or controlled via VRU or combustion device (flare or enclosed combustor), all regen off-gas routed to BTEX condenser/sump and routed to combustion device for control.
- Utilize electric glycol pumps instead of energy exchange glycol pumps which do vent methane emissions.
- Perform periodic maintenance on flare burner and blower (air-assisted) to improve flare efficiency and minimize methane slip due to combustion.
- Pneumatic controllers/actuators: replacing existing gas driven pneumatic controllers/ actuators with instrument air devices at gathering compessor stations, gas processing plants, transmission & storage facilities, and distribution systems.
- Best management or operational practice by minimizing the operating frequency of gas driven pneumatic pumps.
- Facility engineering incorporates pressure cuts prior to routing liquids to tanks to minimize storage tank venting.
- Installation and maintenance of properly designed and weighted thief hatches on storage tanks to minimize frequency of venting from thief hatches.
- Performing annual methane slip stack testing of reciprocating engines and comparing to gas engine rating pro (GERP) curves to improve combustion efficiency and minimize methane slip.
- Increasing the length of pressurized holds on compressor drivers to reduce the frequency of compressor unit blowdowns.
- Implementation of emergency shutdown system procedures to more effectively isolate the station and close station block valves. This helps to manage and reduce the amount of gas blown down from the station if an emergency shutdown of the station occurs. During testing of the system, the blowdown valves/vents are capped to prevent blowdown to atmosphere.
- Installation of solar powered generator at a station instead of a natural-gas fired generator.

PROCESSING

- Implementation of various Optical Gas Imaging (OGI) leak survey and leak detection and repair (LDAR) programs: Quarterly, biannual, or annual leak surveys across assets. The companies implementing LDAR programs are performing them either under a voluntary or regulatory program or a combination of both programs.
- Perform aerial leak surveys performed to identify methane slip due to combustion.
- Perform regular preventative maintenance and burner tip maintenance on combustion units and flares (tuning of the unit).
- Utilize electric glycol pumps instead of energy exchange glycol pumps which do vent methane emissions.
- Pneumatic controllers/actuators: replacing existing gas driven pneumatic controllers/ actuators with instrument air devices at gathering compessor stations, gas processing plants, transmission & storage facilities, and distribution systems.
- Utilizing the acid gas removal (AGR) system to exclusively treat the ethane stream rather than the methane stream.

- Routing AGR system vents to emission control device such as combustor, flare or thermal oxidizer to reduce methane slip from combustion.
- Utilize nitrogen gas purge prior to evacuation of equipment/piping in order to reduce the gas volume blown down to atmosphere.
- During the repair of equipment leaks, nitrogen gas purge the locked out equipment or piping before opening the vent to atmosphere.
- Replacement of natural gas-fired compressor drivers with electric motor driven compressor drivers.
- Replacement of wet seal centrifugal compressors with dry seal centrifugal compressors when feasible.
- Route reciprocating compressor unit blowdowns to ECD, VRU, or flare to capture or combust the blowdown gas volumes rather than venting to atmosphere.
- Perform rod packing replacement on reciprocating compressors equal to or more frequently than required by regulation.
- Install molsieve dehydration units in lieu of glycol dehydration units and implement best management or operational practices to minimize molesieve bed changeouts to reduce frequency of venting during those changeouts.
- Vapor recovery unit on flare header to recover vent gas from process with the flare only used as backup in the event the VRU goes down.
- Route AGR vented gas to underground injection well.

TRANSMISSION & STORAGE

- Implementation of various Optical Gas Imaging (OGI) leak survey and leak detection and repair (LDAR) programs: Quarterly, biannual, or annual leak surveys across assets. The companies implementing LDAR programs are performing them either under a voluntary or regulatory program or a combination of both programs.
- Installation of instrument air to replace gas starters on compressor drivers.
- Pneumatic controllers/actuators: replacing existing gas driven pneumatic controllers/ actuators with instrument air devices at gathering compessor stations, gas processing plants, transmission & storage facilities, and distribution systems.
- Increasing the length of pressurized holds on compressor drivers to reduce the frequency of compressor unit blowdowns.
- Perform rod packing replacement on reciprocating compressors equal to or more frequently than required by regulation.
- Utilizing hot taps/Stopple® fittings during pipeline maintenance not requiring pipeline blowdowns to atmosphere.
- Recovery of compressor unit blowdowns (Compressor Unit BDR).
- Replace Bi-directional Orifice Meters with Ultrasonic Meters.
- Directed Inspection and Maintenance (DI&M) – Atmospheric Pressure Gas Loss (AGL) Inspections and repairs of leaks.
- Use of YALE Enclosures for Emergency Shut Down (ESD) Testing to prevent full station blowdowns.
- Capture and recompression of dry seal vented gas and compressor process vented gas.
- Installation of cathodically protected pipe.
- Installation of “line break” valves to prevent a significant loss of gas to the atmosphere.
- Reduce excessive compressor purging.
- Install compressor rod packing case purging systems.
- Perform valve maintenance.
- Reduce “methane slip” through combustion efficiency improvements.

- Use of pipeline wrap or steel sleeves during pipeline maintenance to reduce or eliminate pipeline blowdowns to atmosphere.
- Emergency Shut Down (ESD) blowdown to flare.
- Compressor Vent line alarms.
- Replacement of reciprocating engines with newer more efficient reciprocating engines resulting in lower methane slip from combustion.
- Implementation of valve maintenance best management practice under Methane Challenge program that includes unit isolation and blowdown valve maintenance.
- Installation of rod packing vent capture systems.

DISTRIBUTION

- Implementation of various Optical Gas Imaging (OGI) leak survey and leak detection and repair (LDAR) programs: Quarterly, biannual, or annual leak surveys across assets. The companies implementing LDAR programs are performing them either under a voluntary or regulatory program or a combination of both programs.
- Pneumatic controllers/actuators: replacing existing gas driven pneumatic controllers/ actuators with instrument air devices at gathering compressor stations, gas processing plants, transmission & storage facilities, and distribution systems.
- Cross compression for transmission/large pipes (major projects); piloting for distribution pipe.
- Satellite methane leak detection pilot scaled to an entire state in 2023.
- Creation of PAR (Pinpoint, Access & Repair) tool to ingest satellite data and advance leak remediation.
- Gas cloud imaging technology regulator stations, compressor station & LNG plant (Pilot).
- Leak surveys once every of 3 years instead of 5 years combined with goal for find it & fix it process (Q4 2023) - zero leak inventory.
- MSRP Replacement program for older metallic services under a 20 year program in one of the states with cost ~13 million a year.
- Advanced Mobile Leak Detection Units deployed around distribution system to identify leaks for repair.
- Capital based allocation largely based on leakage rate and type pipe in the system.

Appendix C

Stack Test Data

Segment	Number of Engines/ Turbines* for which Stack Test Data were Provided	Number of Engines/ Turbines for which Fuel Usage Data were Provided (Engines/ Turbines not stack tested)	Segment CH4 Intensity using Stack Test Data** (%)	Segment CH4 Intensity using Fuel Usage and AP-42 EFs (%)	Percent Difference
Production	287	254	0.0498%	0.0502%	-0.8%
Gathering & Boosting	830	401	0.0508%	0.0684%	-25.7%
Processing	94	39	0.0572%	0.0581%	-1.7%
Transmission & Storage	106	313	0.0860%	0.0839%	2.5%

*Turbine stack test data were provided by four companies for a total of 21 turbines.

**This column uses emissions calculated using a combination of engine stack test data for the engines tested and fuel usage and AP-42 emission factors for the engines not tested.

Note: This table only includes data for the 14 companies that provided stack test data and the CH4 intensities only include emissions and throughputs for these 14 companies *(The below numbers don't add up to 14 because four of the companies reported engine stack test data for two different segments).*

The following total number of companies reported engine stack test data in each segment:

- **Production**: 3
- **Gathering & Boosting:** 8
- **Processing:** 3
- **Transmission & Storage:** 4