

**COMMONWEALTH OF VIRGINIA
DEPARTMENT OF ENVIRONMENTAL QUALITY
AIR AND RENEWABLE ENERGY DIVISION**

**Ad Hoc Work Group Concerning Methane Leakage from Natural Gas
Infrastructure**

The first part of this document consists of the minutes for the fourth meeting for the Ad Hoc Work Group Concerning Methane Leakage from Natural Gas Infrastructure (Rev. A19).

The second part of this document consists of the October 3, 2019, Final Activity Report for this work group (begins on page 16 of the document).

**COMMONWEALTH OF VIRGINIA
DEPARTMENT OF ENVIRONMENTAL QUALITY**

**METHANE LEAKAGE FROM NATURAL GAS INFRASTRUCTURE
REVISION A19**

AD HOC WORK GROUP, FOURTH MEETING MINUTES

**THIRD FLOOR CONFERENCE ROOM
1111 EAST MAIN STREET, RICHMOND, VIRGINIA
August 13, 2019**

Members Present:

Braven Beaty, The Nature Conservancy
James Bradbury, Georgetown Climate
Jeff Bennett for Andres Clarens, UVA
Will Cleveland, SELC

Jon Lawson for Kevin Elkins, Coronado
Michael Hahn for Richard Lutz, Transco
Shepelle Watkins-White, VNG

Members Absent:

Joshua Ball, CNX
Lisa S. Beal, Dominion

Andrew Williams, EDF

Staff:

Michael G. Dowd, Air Division
Tamera Thompson, Air Division

Irina Calos, Communications
Karen Sabasteanski, Regulatory Affairs

The meeting began at approximately 10:05 a.m.

Meeting Purpose: This ad hoc work group has been established to advise and assist DEQ in the development of a framework for limiting methane leakage from natural gas infrastructure. This group will support DEQ in its collection and evaluation of data to inform the regulation development process. The agenda (Attachment A) follows.

Welcome and Introductions: Ms. Sabasteanski welcomed the group. Members introduced themselves individually. Ms. Calos reviewed several themes that have emerged over the past meetings and items of general agreement identified during the third meeting, and reiterated the Governor's charge to the group (Attachment B).

Group Discussion: Ms. Sabasteanski reviewed the three sectors involved in the natural gas industry (see the last slide of Attachment B). Based on previous group discussion, the current meeting focused on transmission, including associated equipment and compressor stations. Although the remaining sectors--production and distribution--still need to be considered and evaluated in the future, they are a lower priority at this time due to the state of current controls, inventories, and resources. In particular, control of methane emissions from wellheads requires greater analysis of inventory and control technologies than currently available.

The group discussed, in greater detail, the areas of general agreement that were identified during the third meeting as they relate to transmission (see Slide 9 of Attachment B). In particular, leak detection and repair (LDAR) programs were discussed in the context of Subparts OOOO and OOOOa of 40 CFR Part 60¹. Blowdowns were also discussed in detail; they are not subject to Subparts OOOO or OOOOa, and the nature of the activity may call for a flexible best management practice approach. Reporting and recordkeeping issues were also discussed, as were various methane control approaches taken by different states.

Ms. Thompson reiterated the Governor's charge to DEQ, and asked the group to consider the path forward. She and Mr. Dowd reminded the group that the goal was to recommend specific areas to consider in more detail to DEQ management. Based on further discussion, it appeared that most of the group did not object to the following list, which has been identified by DEQ as a starting point for potential future consideration:

1. Develop Virginia-specific inventory of methane emissions (coordinate existing efforts, leverage recordkeeping and reporting)
2. Subparts OOOO and OOOOa
 - LDAR and other compliance options
 - the appropriateness of applying certain requirements for new sources to existing sources
 - recordkeeping and reporting (quarterly or annual); frequency and vehicle (e.g., routine emissions statements)
 - alternative compliance options
3. Blowdowns
 - different types
 - different facilities
4. DEQ resources
5. Accessibility of information (coordinate what is already readily available)

DEQ will take these issues into consideration when developing its report to the administration.

Some of the group members also showed interest in potentially exploring the inclusion of new sources not yet regulated or proposed in Virginia (such as new LNG infrastructure) beyond current federal standards.

Once the group agreed that areas of focus have been properly identified, they agreed that no further meetings of the group were necessary at this time. The group was reminded that should a regulatory action be initiated, that there would likely be an opportunity to participate in a formal Regulatory Advisory Panel.

¹ Subpart OOOO, Crude Oil and Natural Gas Production, Transmission and Distribution for which Construction, Modification or Reconstruction Commenced after August 23, 2011, and on or before September 18, 2015, and Subpart OOOOa, Crude Oil and Natural Gas Facilities for which Construction, Modification, or Reconstruction Commenced after September 18, 2015, are federal New Source Performance Standards (NSPSs) that do not apply to existing sources.

Wrap-up/Next Steps: Ms. Sabasteanski concluded the meeting. The meeting adjourned at approximately 2:00 p.m.

REG\DEVA19-AH04-4-minutes

**COMMONWEALTH OF VIRGINIA
DEPARTMENT OF ENVIRONMENTAL QUALITY**

**METHANE LEAKAGE FROM NATURAL GAS INFRASTRUCTURE
AD HOC WORK GROUP**

DRAFT AGENDA, FOURTH MEETING

August 13, 2019

10:00 – 10:05	WELCOME
10:05 – 11:30	GROUP DISCUSSION: STRUCTURING RECOMENDATIONS; MOVING FORWARD
11:30 – 12:30	LUNCH BREAK (on your own)
12:30 – 2:45	GROUP DISCUSSION, CONTINUED
2:45	WRAP UP/NEXT STEPS



Methane Ad Hoc Workgroup

Fourth Meeting

Air and renewable Energy Division
Virginia Department of Environmental Quality
August 13, 2019

Things we've heard...

- Emissions are already effectively controlled.
- Not all facilities are improving emissions through available voluntary measures.

Things we've heard...

- Facilities need more incentives for voluntary measures.
- Regulations ensure emission reductions are made.

Things we've heard...

- Regulation is a disincentive to innovation.
- Regulation can be structured to reward compliance.

Things we've heard...

- Regulation will create expense with little benefit.
- Expenses are worth the long-term benefits.

Things we've heard...

- Emissions may be less than expected, and not enough Virginia data is available.
- Additional reporting will assure certainty and establish better data.

Things we've heard...

- Other source types produce more methane, so the focus should be elsewhere.
- Significant reductions are still achievable.

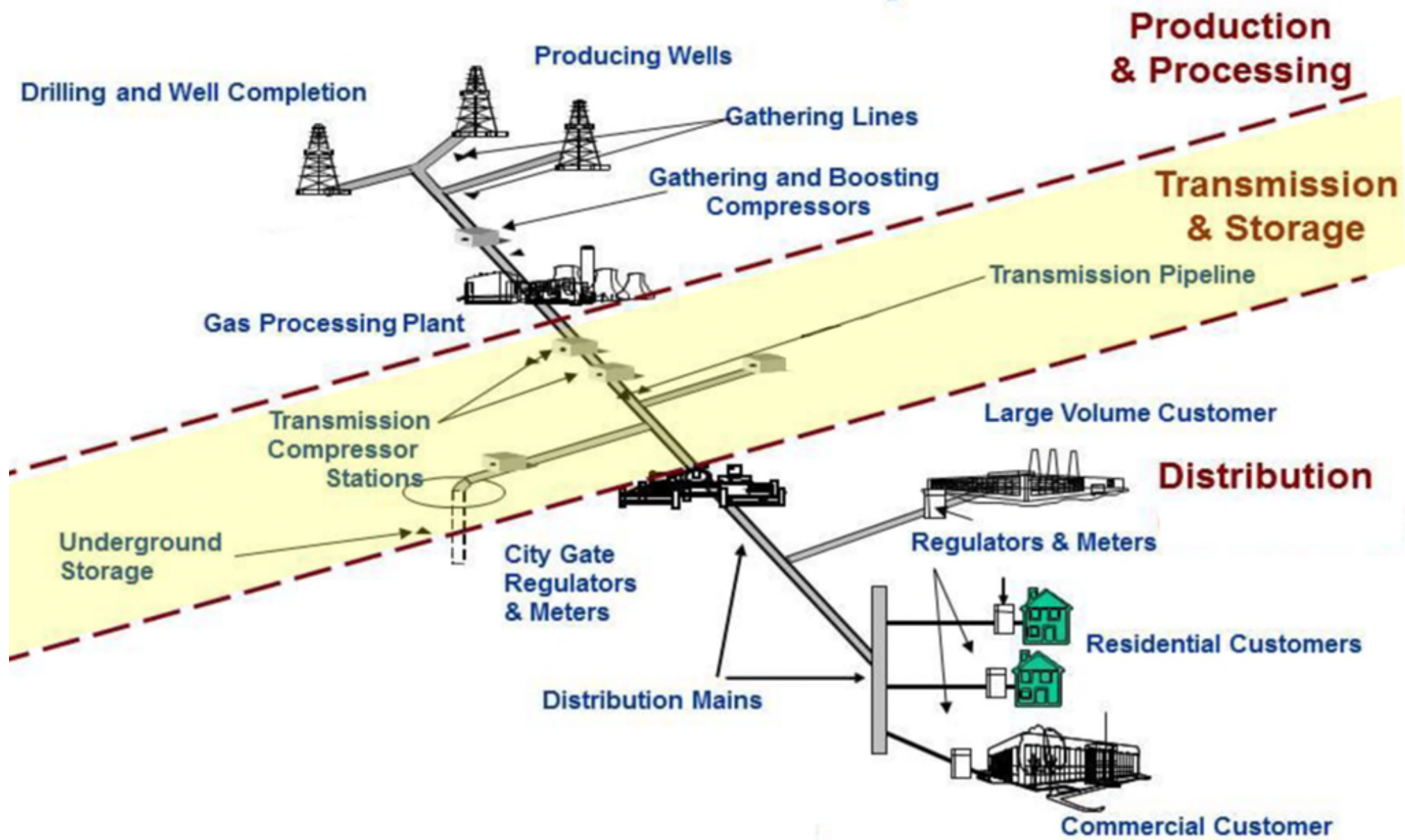
Why we are here

- *Develop a framework for limiting methane leakage from natural gas infrastructure and landfills.*

Natural gas has significant potential as a bridge fuel to help us reduce carbon pollution that drives climate change while we transition to solar, wind, and other clean energy sources. The relative climate benefits of natural gas compared to other fossil fuels are well documented, but we only realize those benefits if we prevent natural gas from leaking into the atmosphere before it is burned. For that reason, and due to inaction at the federal level, Virginia must take action to limit methane pollution within its borders. The Virginia Department of Environmental Quality (DEQ) will lead this effort, and will establish a workgroup of environmental, academic and business stakeholders within the next 120 days to support DEQ in its collection and evaluation of data to inform the regulation development process.

General points of agreement/further evaluation

- LDCs should be lower priority.
- Reporting is important.
- LDAR should be a component of recordkeeping.
- OOOO and OOOOa could be a good starting point.
- Alternative compliance should be considered.
- BMPs are useful on a case to case basis.
- Specific technological controls need to be identified.
- Cost-effectiveness should be considered.
- Periodic review of technologies should be considered.



**COMMONWEALTH OF VIRGINIA
DEPARTMENT OF ENVIRONMENTAL QUALITY
AIR AND RENEWABLE ENERGY DIVISION**

**Ad Hoc Work Group Concerning Methane Leakage from Natural Gas
Infrastructure**

The October 3, 2019, Final Activity Report for the Ad Hoc Work Group Concerning Methane Leakage from Natural Gas Infrastructure (Rev. A19) follows.

**COMMONWEALTH OF VIRGINIA
DEPARTMENT OF ENVIRONMENTAL QUALITY
AIR AND RENEWABLE ENERGY DIVISION**

INTRA AGENCY MEMORANDUM

TO: File

FROM: Karen G. Sabasteanski, Office of Regulatory Affairs

SUBJECT: Final Activity Report - Ad Hoc Work Group Concerning Methane Leakage from Natural Gas Infrastructure (Rev. A19)

DATE: October 3, 2019

INTRODUCTION

Pursuant to an announcement by Governor Northam, the Department of Environmental Quality (DEQ) established an ad hoc work group of stakeholders to develop a framework for limiting methane leakage from natural gas infrastructure. The purpose of the group was to support DEQ in its collection and evaluation of data to inform the regulation development process. A list of members is included as Enclosure 1.

DEQ coordinated and facilitated the discussions of this group in an effort to find common ground and recommendations that could be considered by the department. Meetings of the group were held at the DEQ central office building, 1111 East Main Street, Richmond, Virginia on the following dates:

- March 25, 2019 from 9:00 a.m. to 3:00 p.m.
- May 29, 2019 from 9:00 a.m. to 3:00 p.m.
- June 26, 2019 from 9:00 a.m. to 3:00 p.m.
- August 13, 2019 from 9:00 a.m. to 3:00 p.m.

Meeting minutes are found in Enclosure 2.

At the time of this report, no further meetings have been planned; however, at a later date DEQ may evaluate whether additional meetings are needed.

PROCEDURES

This group is a public body under the Freedom of Information Act (FOIA), and must comply with FOIA requirements for conducting state business in the open and the availability of public records. Members were advised of FOIA requirements, including the need for members to circulate information to the group via staff. All materials

circulated among the group are available on the web page established for the group at <https://www.deq.virginia.gov/Programs/Air/GreenhouseGases/LimitingMethaneLeakagefromNaturalGasInfrastructure.aspx>.

The group was formed to advise the department on approaches to regulating methane leaks from the identified entities, including informing the department on programs that are currently in place and being utilized by the industry. The group's activities consisted mainly of informal discussions and presentations from various groups related to the topics being discussed. The group is an advisory body to the department and, as such, the department is not obligated to accept any recommendation.

The group was polled from time to time by the facilitator in order to determine if general agreement existed on a particular issue, or to better define specific areas of agreement or disagreement. "General agreement" was the result of the group overall in favor of a subject, with some members expressing reservations or outstanding questions.

RECOMMENDATIONS/UNRESOLVED ISSUES

Below is a summary of the results of the work of the group.

A. It appeared that most of the group did not object to the following list, which has been identified by DEQ as a starting point for potential future consideration:

1. Develop Virginia-specific inventory of methane emissions (coordinate existing efforts, leverage recordkeeping and reporting)
2. Subparts OOOO and OOOOa of 40 CFR Part 60¹
 - Leak detection and repair (LDAR) and other compliance options
 - the appropriateness of applying certain requirements for new sources to existing sources
 - recordkeeping and reporting (quarterly or annual); frequency and vehicle (e.g., routine emissions statements)
 - alternative compliance options
3. Blowdowns
 - different types
 - different facilities
4. DEQ resources
5. Accessibility of information (coordinate what is already readily available)

B. The following general areas of agreement were put forth by group members as meriting further discussion and exploration:

¹ Subpart OOOO, Crude Oil and Natural Gas Production, Transmission and Distribution for which Construction, Modification or Reconstruction Commenced after August 23, 2011, and on or before September 18, 2015, and Subpart OOOOa, Crude Oil and Natural Gas Facilities for which Construction, Modification, or Reconstruction Commenced after September 18, 2015, are federal New Source Performance Standards (NSPSs) that do not apply to existing sources.

1. Given the relatively small percentage of contribution of methane emissions to the overall inventory and jurisdictional limitations, LDCs should be a relatively low priority.²

2. Reporting is important, particularly using certified data, in order to further develop the inventory and demonstrate compliance.³

3. Recordkeeping - LDAR protocols should be a component. Details have already been worked out or can be amended, and this can be a baseline. However, an LDAR schedule needs to be equipment-specific.

4. Subparts OOOO and OOOOa of 40 CFR Part 60 could be the starting point for a program. Existing facilities are not covered by these federal New Source Performance Standards, but they could be a model and work with the current greenhouse gas (GHG) reporting and focused inspection used by existing sources.

5. Alternative compliance scenarios should be considered; i.e., sources should have the flexibility to use new technologies and controls.

6. Best management practices (BMPs) are useful on a case by case basis, recognizing different choices available to different sources.

7. Specific technological controls need to be identified in the context of what is being controlled, i.e., what is best by equipment/blowdown events.

8. Control cost effectiveness should be considered.

9. A periodic review of available technologies (innovations, improvements) should be considered.

TEMPLATES\PROPOSED\RP08
REG\DEVA\A19-AH05

Enclosures

cc: Director, Air and Renewable Energy Division

² One group member noted that at the fourth and final meeting, it was observed that production still needs to be considered and evaluated in the future; however, it is a lower priority at this time due to the state of current controls, inventories, and resources. In particular, control of methane emissions from wellheads requires greater analysis of inventory and control technologies.

³ One group member noted that there was interest shown in improving access to data via the SCC website so that users can more readily obtain public information.

**ENCLOSURE 1
LIST OF MEMBERS**

<p>Joshua Ball Operations Superintendent, Virginia Operations, CNX 128 Glenwood St, Cedar Bluff, VA 24609 (276) 596-5018 – W; (330) 771-7348 – M JoshBall@cnx.com</p>
<p>Braven Beaty, The Nature Conservancy 146 East Main St., Abingdon, VA 24210 Phone: (276) 676-2209 office; 276-608-6508 mobile bbeaty@tnc.org</p>
<p>Lisa S. Beal Environmental Projects Advisor, Dominion Energy 5000 Dominion Blvd, Glen Allen, VA 23060 (O) - (804) 273-4608; (M) - (804)489-4046; Tie 8- 730-4608 Lisa.S.Beal@dominionenergy.com</p>
<p>James Bradbury Mitigation Program Director Georgetown Climate Center Hall of States, Suite 422, 444 N. Capitol St, Washington DC 20001 (202) 661-6566 james.bradbury@georgetown.edu</p>
<p>Andres Clarens Associate Director, University of Virginia Environmental Resilience Institute P (office) 434-924-7966 W (lab) faculty.virginia.edu/clarens W (eri) eri.virginia.edu</p>
<p>Will Cleveland Staff Attorney, Southern Environmental Law Center 201 West Main Street, Suite 14, Charlottesville, Virginia 22902 434.218.7388 wccleveland@selcva.org</p>
<p>Kevin Elkins Senior Project Engineer, Coronado Global Resources/Buchanan Minerals Oakwood, VA kevin.elkins@coronadous.com</p>
<p>Richard Lutz Environmental Specialist, Transco, Williams Atlantic – Gulf Operating Area 345 Greenbrier Dr, Charlottesville, VA 22901 Richard.C.Lutz@williams.com</p>
<p>Shepelle Watkins-White Director, Government & Community Affairs, Virginia Natural Gas 544 S. Independence Blvd, Virginia Beach, Virginia 23435 757.374.9833 shwatkin@southernco.com</p>
<p>Andrew Williams Director, Legislative and Regulatory Affairs, Environmental Defense Fund 1875 Connecticut Ave, NW, Suite 600 Washington, DC 20009 (202) 572-3252 (o) (918) 408-4429 (c) Awilliams@edf.org</p>

**ENCLOSURE 2
MEETING MINUTES**

COMMONWEALTH OF VIRGINIA
DEPARTMENT OF ENVIRONMENTAL QUALITY

METHANE LEAKAGE FROM NATURAL GAS INFRASTRUCTURE
REVISION A19

AD HOC WORK GROUP, FIRST MEETING MINUTES

THIRD FLOOR CONFERENCE ROOM
1111 EAST MAIN STREET, RICHMOND, VIRGINIA
MARCH 25, 2019

Members Present:

Joshua Ball, CNX
Braven Beaty, The Nature Conservancy
Lisa S. Beal, Dominion
James Bradbury, Georgetown Climate
Andres Clarens, UVA

Will Cleveland, SELC
Kevin Elkins, Coranado Global
Richard Lutz, Transco
Shepelle Watkins-White
Andrew Williams, EDF

Staff:

Department of Environmental Quality

David K. Paylor, Director
Ann M. Regn, Public Information
Karen Sabasteanski, Regulatory Affairs

Dept. of Mines, Minerals and Energy

Al Christopher

Michael G. Dowd, Air Division
Tamera Thompson, Air Division
Tom Ballou, Air Division

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Michael Skeffington

The meeting began at approximately 10:05 a.m.

Meeting Purpose: This ad hoc work group has been established to advise and assist DEQ in the development of a framework for limiting methane leakage from natural gas infrastructure. This group will support DEQ in its collection and evaluation of data to inform the regulation development process. The agenda (Attachment A) and a copy of the staff presentation (Attachment B) follow.

Welcome and Introductions: Mr. Paylor made a number of introductory remarks, noting that this is important work and a priority for the Governor. Mr. Dowd welcomed the group. Members introduced themselves individually.

FOIA Requirements: Ms. Sabasteanski discussed Virginia Freedom of Information Act (FOIA) requirements as they pertain to this group's meetings (see Attachment C).

Issues Overview: Mr. Dowd provided a broad overview of issues to be considered by the group. In broad terms, the department is looking for information and approaches for dealing with all elements associated with natural gas production, transmission, storage

and distribution, including compressor stations, appurtenances and associated equipment, and pipelines, including wellfield, inter- and intra-state pipelines. Ms. Thompson summarized department's concerns, including how to best address new and existing facilities: what are the emissions, and how to identify and address problems. Mr. Ballou provided a summary of methane emissions in Virginia by industrial sector (see Attachment D).

Work Plan/Group Discussion: The group discussed opportunities and challenges associated with their organizations' natural gas transmission experiences. The group's concerns were summarized under two broad topics: the emissions inventory, addressed as actual emissions and existing programs for addressing emissions, and regulatory options, including achievable emission reduction targets, mitigation options, and alternative compliance options. Some needs for additional information to be provided by DEQ and group members were identified.

Wrap-up/Next Steps: Ms. Regn concluded the meeting. Future meetings will be scheduled at a later date.

The meeting adjourned at approximately 3:00 p.m.

Attachments
REG\DEVA\A19-AH04-1-minutes

**COMMONWEALTH OF VIRGINIA
DEPARTMENT OF ENVIRONMENTAL QUALITY**

**METHANE LEAKAGE FROM NATURAL GAS INFRASTRUCTURE
AD HOC WORK GROUP**

DRAFT AGENDA FIRST MEETING

Monday, March 25, 2019

10:00 – 10:30	WELCOME/INTRODUCTIONS
10:30 – 10:40	FOIA REQUIREMENTS
10:40 – 11:00	ISSUES OVERVIEW
11:00 – 12:00	WORK PLAN/GROUP DISCUSSION
12:00 – 1:00	LUNCH BREAK (on your own)
1:00 – 2:45	WORK PLAN/GROUP DISCUSSION
2:45	WRAP UP/NEXT STEPS

Northam Administration Takes New Steps to Fight Climate Change, Ocean Acidification

RICHMOND—Governor Ralph Northam this week announced a series of actions to help Virginia better address the impacts of carbon pollution from fossil fuels. Governor Northam has directed the Virginia Department of Environmental Quality to identify ways to improve environmental protection in the Commonwealth.

*Develop a framework for limiting methane leakage from **natural gas infrastructure** & landfills*

Natural gas has significant potential as a bridge fuel to help us reduce carbon pollution that drives climate change while we transition to solar, wind, and other clean energy sources. The relative climate benefits of natural gas compared to other fossil fuels are well documented, but we only realize those benefits if we *prevent natural gas from leaking into the atmosphere before it is burned*. For that reason, and due to inaction at the federal level, Virginia must take action to limit methane pollution within its borders. **DEQ will lead this effort, and will establish a workgroup to support DEQ in its *collection and evaluation of data* to inform the regulation development process.**



METHANE LEAKAGE FROM NATURAL GAS INFRASTRUCTURE AD HOC WORK GROUP

Monday, March 25, 2019

10:00 – 10:30	Welcome/Introductions
10:30 – 10:40	FOIA Requirements
10:40 – 11:00	Issues Overview
11:00 – 12:00	Work Plan/Group Discussion
12:00 – 1:00	Lunch Break (On Your Own)
1:00 – 2:45	Work Plan/Group Discussion
2:45	Wrap Up/Next Steps

Stakeholder Discussion

- Turn off all electronic devices
- Be courteous; speak one at a time
- There is no public comment/open forum during this meeting
- Minutes and notes are being taken today
- To avoid confusion — after the meeting please speak for yourself not for the ad hoc group

FREEDOM OF INFORMATION ACT (FOIA)

The Virginia Freedom of Information Act (FOIA) ensures ready access to public records and free entry to meetings where the business of the people is being conducted. It is to be liberally construed to promote an increased awareness of governmental activities and afford every opportunity to citizens to witness the operations of government. It is largely a procedural act setting forth the procedures that a public body must follow in conducting an open meeting and convening in a closed meeting and guiding a user as to how to make or respond to a FOIA request for public records.

THINGS TO REMEMBER

The good news is that DEQ as the coordinator for the group will be the custodian of the records of the group and ensure that compliance with meeting notice requirements of FOIA.

When responding to an email, never hit reply to all.

One on one email, discussion and meetings are not a meeting under FOIA. More than 2 members of the body gathering to discuss the business of the group is a meeting under FOIA and must be noticed.

Any material you would like the group to receive should be sent to DEQ for distribution.

Questions on meetings contact Cindy M. Berndt; cindy.berndt@deq.virginia.gov; 804-698-4378
Questions on records contact DEQ FOIA Officer, Diana Adams, deqfoias@deq.virginia.gov, 540-574-7886, and/or review the DEQ FOIA Policy available on the web at
<http://www.deq.virginia.gov/ConnectWithDEQ/FreedomofInformationAct.aspx>

WHAT IS A MEETING UNDER FOIA? A "meeting" is defined as "meetings including work sessions, when sitting physically, or through telephonic or video equipment pursuant to § 2.2-3708 or 2.2-3708.1, as a body or entity, or as an informal assemblage of (i) as many as three members or (ii) a quorum, if less than three, of the constituent membership, wherever held, with or without minutes being taken, whether or not votes are cast, of any public body" where the business of the public body is being discussed or transacted.

MAY A PUBLIC BODY CONDUCT A MEETING BY CONFERENCE CALL OR OTHER ELECTRONIC METHOD? State public bodies may conduct such meetings under specified circumstances. Special conditions and requirements apply before electronic methods may be utilized.

IF IT IS A MEETING, WHAT DOES FOIA REQUIRE?

1. Notice of the meeting must be given at least three working days prior to the meeting; must contain the date, time, and location of the meeting; and if a state public body includes at least one member appointed by the Governor, the notice must also indicate whether or not public comment will be received at the meeting and, if so, the approximate point during the meeting when public comment will be received.
2. The meeting must be open to the public; and
3. Minutes of the meeting must be taken and preserved.

WHERE TO POST THE NOTICE? FOIA requires that all public bodies post notice of the meeting on their own websites and on the Commonwealth Calendar website.

MAY THE PUBLIC OR MEDIA RECORD THE MEETING? Yes. Any person may photograph, film, record, or otherwise reproduce any portion of a meeting required to be open, but may not interfere with the proceedings.

WHEN MUST AGENDA MATERIALS BE AVAILABLE TO THE PUBLIC/MEDIA? At least one copy of all agenda packets and, unless exempt, all materials furnished to members of a public body for a meeting must be made available for public inspection at the same time the packets or materials are furnished to the members of the public body.

MUST ALL VOTES OF A PUBLIC BODY TAKE PLACE IN AN OPEN MEETING? Yes. Any and all votes taken to authorize the transaction of any public business must be taken and recorded in an open meeting. A public body may not vote by secret or written ballot.

IS IT A FOIA VIOLATION TO POLL MEMBERS OF A PUBLIC BODY? No, nothing in FOIA prohibits separately contacting the membership, or any part thereof, of any public body for the purpose of ascertaining a member's position with respect to the transaction of public business. Such contact may be done in person, by telephone, or by electronic communication, provided the contact is done on a one-on-one basis.

EMAIL & MEETINGS: The use of email can blur the line between correspondence and a meeting under FOIA. Email is similar to traditional paper correspondence in many ways and is a written form of communication that is by definition a record under FOIA. However, from a practical perspective, email is often used as a substitute for a phone call and can be used to communicate quickly with multiple people at once, making it more akin to a meeting.

The use of email by public officials is clearly allowed by FOIA. One member of a public body may individually email other members, even if the email relates to public business. Questions arise based on the manner in which a recipient responds to an email addressed to three or more members of a public body. If a recipient chooses "reply to all," then three or more members of a public body will see not only the initial email, but also another member's response. Other members could then, in turn, respond to the email or the ensuing responses. In the end, three or more members of a public body could have used the chain of email to discuss, and possibly reach a conclusion about, a matter relating to the transaction of public business.

Based on the possibility of email being more akin to a meeting and on recent court decisions, keep in mind the following tips:

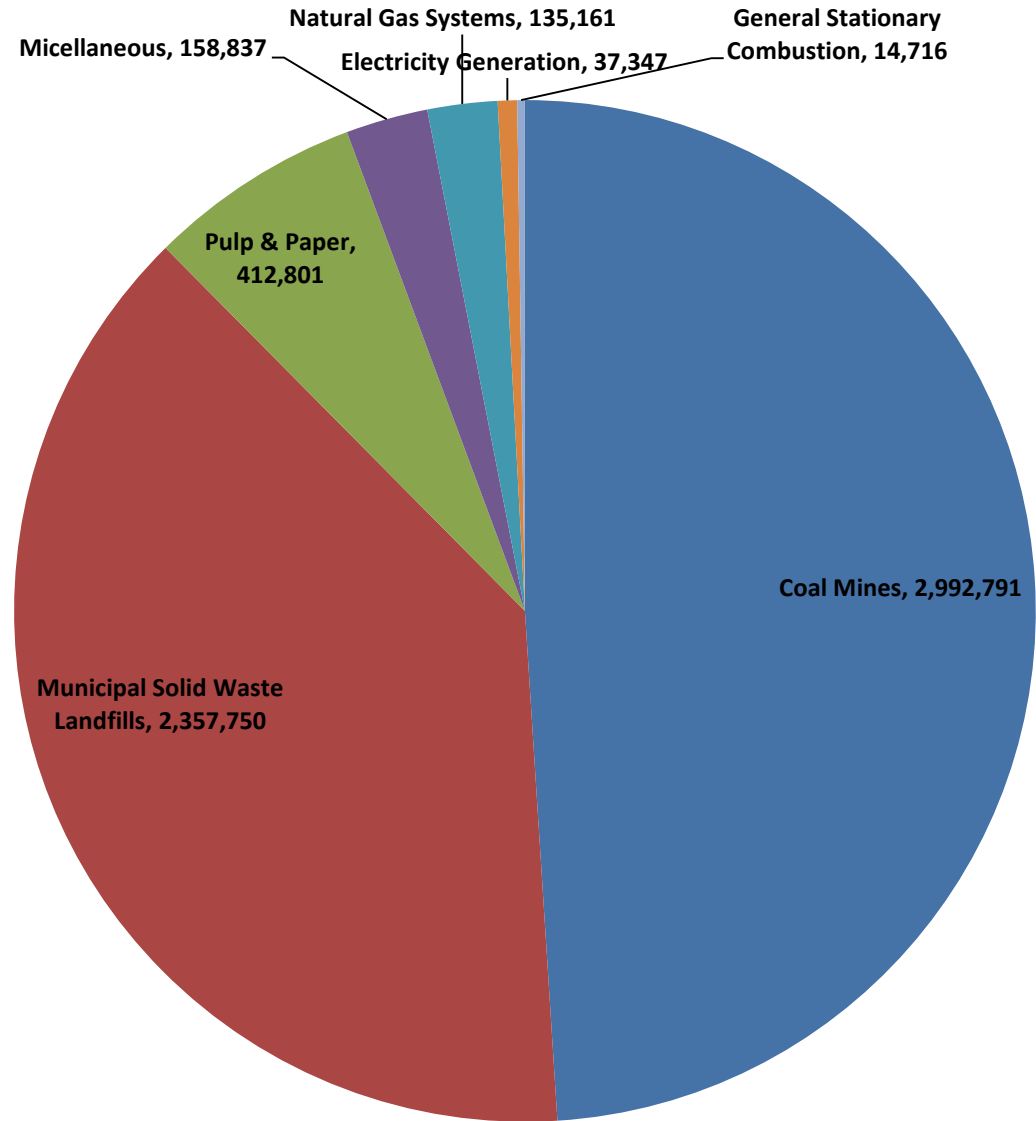
1. Remember the underlying principle of the open meeting provisions of FOIA: the public has the right to witness the operations of government. If you question whether your email communication might lead to the deliberation of public business by three or more members of a public body in real time (i.e., has an element of simultaneity), then you may be better served by saving that communication for a public meeting.
2. If you receive an email sent to three or more recipients who are members of the same public body, and you wish to respond, choose "respond to sender" instead of "respond to all." One-on-one communications are clearly allowed under FOIA, and this will avoid an email discussion among three or more members.

WHAT IS A PUBLIC RECORD UNDER FOIA? A "public record" is any writing or recording, in any format, prepared or owned by, or in the possession of a public body or its officers, employees or agents in the transaction of public business. For example, public records may be in the form of handwritten notes, typewritten documents, electronic files, audio or video recordings, photographs, or any other written or recorded media.

WHO MAY REQUEST RECORDS UNDER FOIA? Citizens of the Commonwealth; Representatives of newspapers and magazines with circulation in the Commonwealth; and Representatives of radio and television stations broadcasting in or into the Commonwealth.

HOW LONG DOES A PUBLIC BODY HAVE TO RESPOND TO A REQUEST? A public body must respond to a request within five working days of receipt of the request, with some exceptions.

VA Methane Emissions 2017 (CO2E)



COMMONWEALTH OF VIRGINIA
DEPARTMENT OF ENVIRONMENTAL QUALITY

METHANE LEAKAGE FROM NATURAL GAS INFRASTRUCTURE
REVISION A19

AD HOC WORK GROUP, SECOND MEETING MINUTES

THIRD FLOOR CONFERENCE ROOM
1111 EAST MAIN STREET, RICHMOND, VIRGINIA
MAY 29, 2019

Members Present:

Joshua Ball, CNX	Emily Wyche for Will Cleveland, SELC
Braven Beaty, The Nature Conservancy	Kevin Elkins, Coronado Global
Lisa S. Beal, Dominion	Richard Lutz, Transco
James Bradbury, Georgetown Climate	Shepelle Watkins-White, VA Natural Gas
Andres Clarens, UVA	Andrew Williams, EDF

Guest Speakers:

James McCarthy, IES	David Lyon, EDF
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Staff:

Department of Environmental Quality

Michael G. Dowd, Air Division	Ann M. Regn, Communications
Tamera Thompson, Air Division	Karen Sabastanski, Regulatory Affairs
Tom Ballou, Air Division	

Dept. of Mines, Minerals and Energy

Michael Skiffington, Policy and Planning

The meeting began at approximately 10:05 a.m.

Meeting Purpose: This ad hoc work group has been established to advise and assist DEQ in the development of a framework for limiting methane leakage from natural gas infrastructure. This group will support DEQ in its collection and evaluation of data to inform the regulation development process. The agenda (Attachment A) and a copy of the staff presentation (Attachment B) follow.

Welcome and Introductions: Mr. Dowd welcomed the group. Members introduced themselves individually. Ms. Regn reviewed meeting rules and summarized the agenda.

Issues Overview: Mr. Dowd briefly reviewed the overarching issues that the group is considering, including needs identified at the previous meeting. Mr. Ballou discussed the summary of Virginia methane emissions based on EPA data, and indicated that staff is in the process of establishing an emissions inventory for methane in Virginia. There is

a lot of debate about the level of methane coming from natural gas infrastructure, and staff are in the process of working out approaches for addressing this.

Presentations: Mr. McCarthy from Innovative Environmental Solutions (IES) provided detailed information on methane emissions and sources from natural gas infrastructure, including natural gas and energy use throughout the U.S. and Virginia, historical and current inventories, and an overview of methane mitigation strategies (Attachment C).

Mr. Lyon from the Environmental Defense Fund (EDF) along with Mr. Williams presented information on EDF's methane synthesis study for the quantification of methane emissions from the U.S. oil and gas supply chain (Attachment D), and discussed the associated implications of its findings for Virginia. The assessment was a collaborative project with input from technical and academic organizations, and essentially established that site measurements revealed higher emissions levels than inventories.

Each presentation was followed by group questions and discussion.

Work Plan/Group Discussion: The group discussed the types of and need for additional data, opportunities to anticipate and prevent situations that contribute to emissions, and current "triage" approaches for identifying and correcting leaks. Mr. Dowd reiterated that the department's goal is to find the most flexible and cost-effective approach while achieving real reductions in methane emissions, as well as identifying the specific sectors and processes where the "most bang for the buck" can be obtained.

Mr. Lyon and Mr. Williams agreed to locate and share additional emissions data. Ms. Sabasteanski reminded the group to be mindful of FOIA: inter-member contacts are limited to one-on-one, and two members may directly contact staff.

Ms. Thompson requested that the group plan on identifying specific, easily identified and implemented control opportunities ("low-hanging fruit") that should be considered as a starting point for any program that may come out of this process.

Wrap-up/Next Steps: Ms. Regn concluded the meeting. The next meeting is scheduled for June 26, 2019.

The meeting adjourned at approximately 3:15 p.m.

Attachments
REG\DEVA19-AH04-2-minutes

COMMONWEALTH OF VIRGINIA
DEPARTMENT OF ENVIRONMENTAL QUALITY

METHANE LEAKAGE FROM NATURAL GAS INFRASTRUCTURE
AD HOC WORK GROUP

DRAFT AGENDA, SECOND MEETING

May 29, 2019

10:00 – 10:10	WELCOME
10:10 – 10:30	ISSUES OVERVIEW
10:30 – 11:30	PRESENTATION: industry overview, GHG inventories, lessons learned (James McCarthy, IES)
11:30 - 12:30	LUNCH BREAK (on your own)
12:30 - 1:30	PRESENTATION: sectors and emissions (Andrew Williams and David Lyon, EDF)
1:30 – 2:45	GROUP DISCUSSION
2:45	WRAP UP/NEXT STEPS



ATTACHMENT B

Methane Leakage from Natural Gas Infrastructure Ad Hoc Work Group

Second Meeting

DEQ Air and Renewable Energy Division

May 29, 2019

Agenda

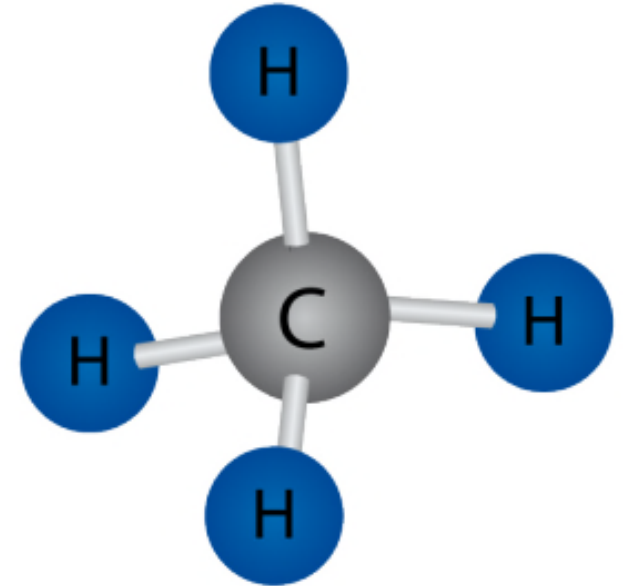
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|-------------------------|--|
| 10:00 a.m. – 10:10 a.m. | Welcome |
| 10:10 a.m. – 10:30 a.m. | Issues overview |
| 10:30 a.m. – 11:30 a.m. | Presentation – Jim McCarthy, IES |
| 11:30 a.m. – 12:30 p.m. | Lunch – on your own |
| 12:30 p.m. – 1:30 p.m. | Presentation – Andrew Williams & David Lyon, EDF |
| 1:30 p.m. – 2:45 p.m. | Group discussion |
| 2:45 p.m. | Wrap up and next steps |

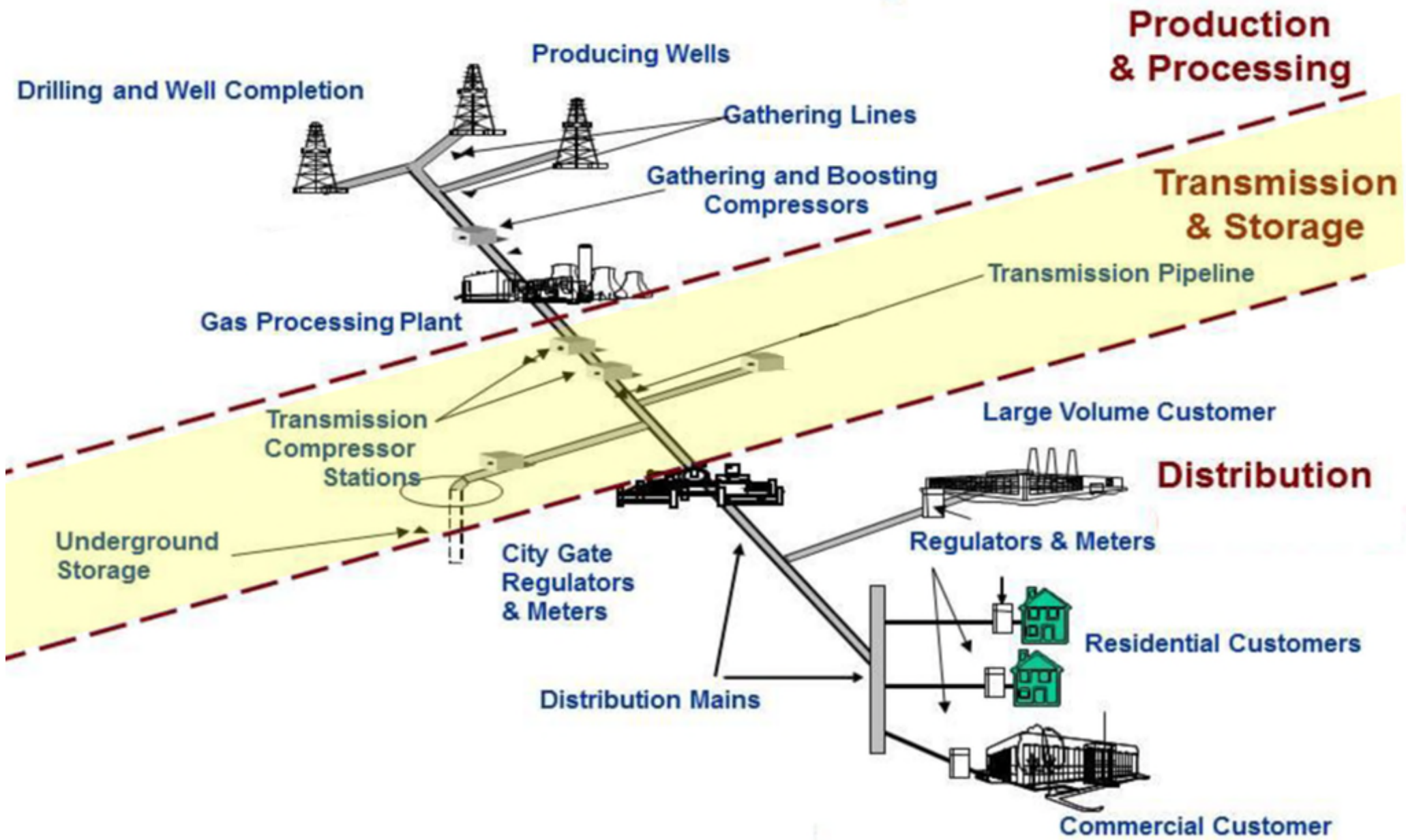
Stakeholder Discussion

- Turn off all electronic devices
- Be courteous; speak one at a time
- There is no public comment/open forum during this meeting
- Minutes and notes are being taken today
- To avoid confusion — after the meeting please speak for yourself not for the ad hoc group

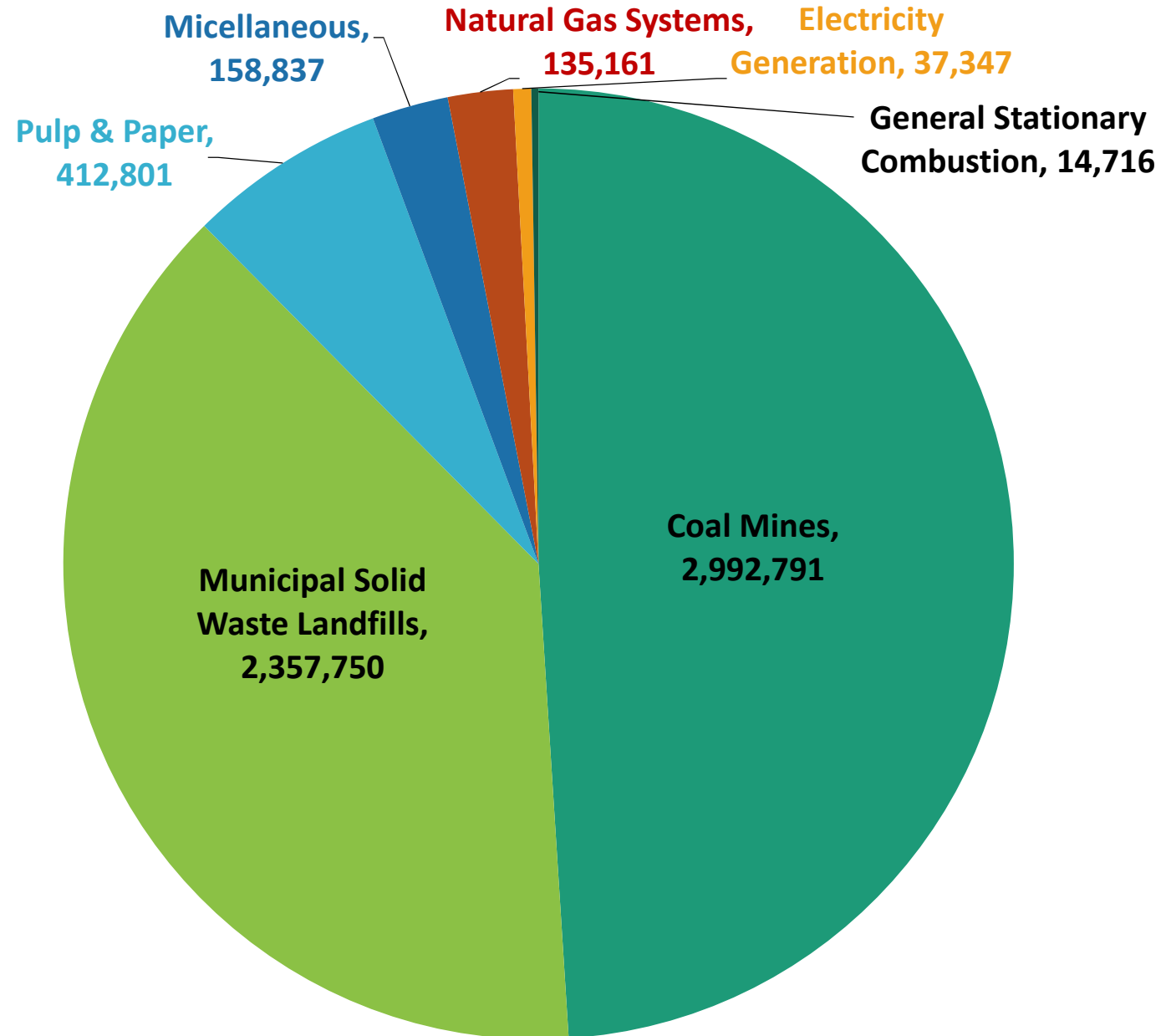
Overview

- Second most prevalent greenhouse gas emitted in the U.S.
 - About 10% of U.S. greenhouse gas emissions
- Per unit, at least 25x more potent at trapping heat in the atmosphere than CO₂ over 100 years; 72x more potent over 20 years

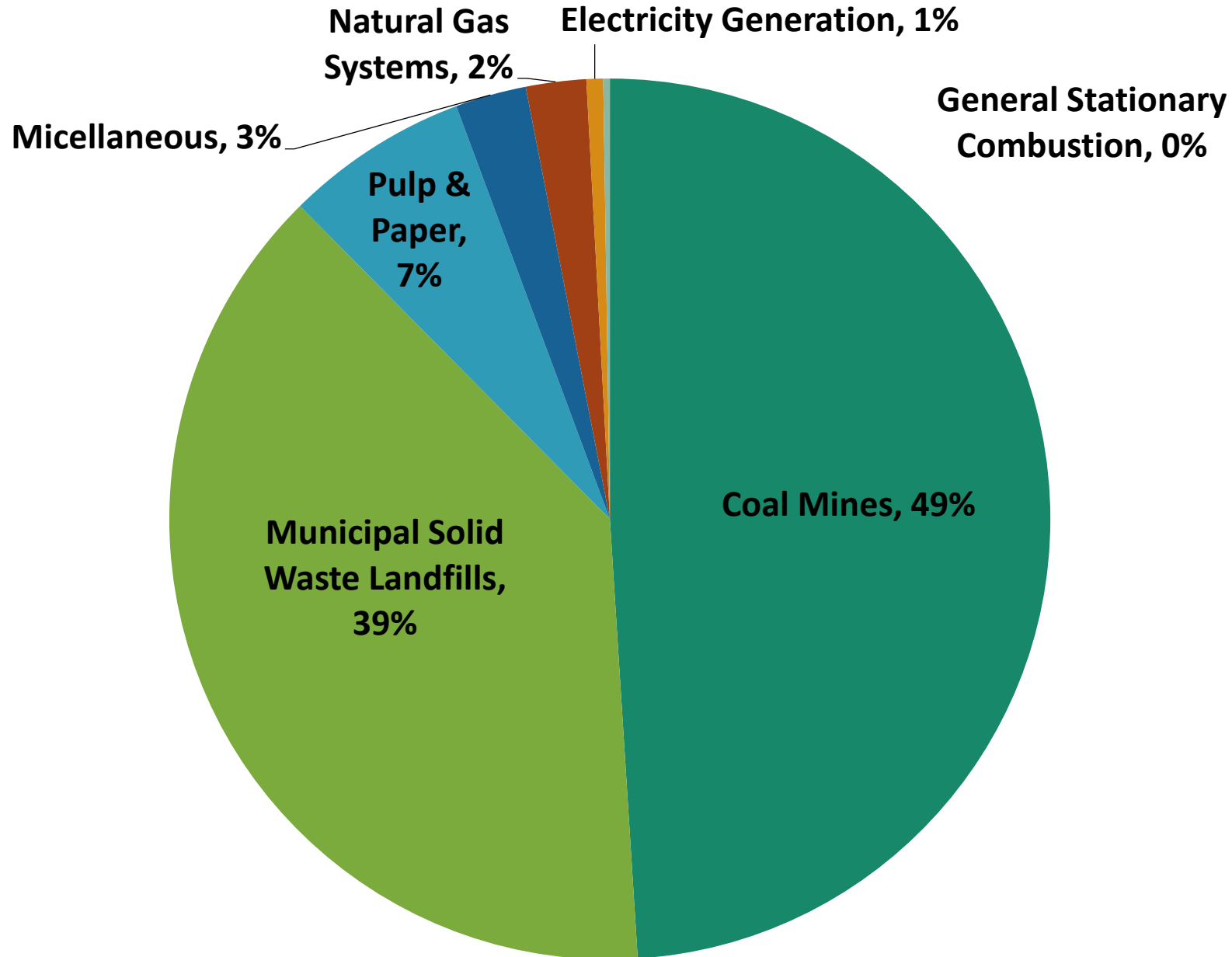




Virginia Methane Emissions (2017; CO2E)

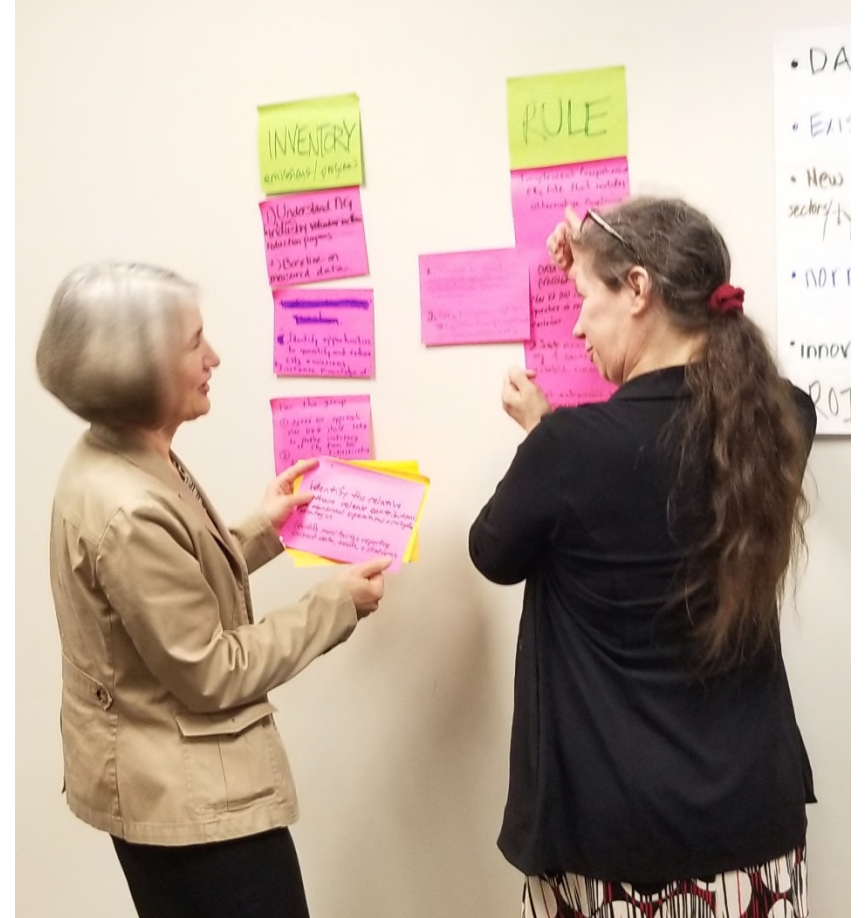


Virginia Methane Emissions (2017; CO2E)



Needs identified

- Data: baseline emission factors
- Existing controls & programs
- New vs. existing structures/sources
- Normal vs. abnormal operations
- Innovation/alternative compliance
- Cost effective measures



Agenda

- | | |
|-------------------------|--|
| 10:00 a.m. – 10:10 a.m. | Welcome |
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| 2:45 p.m. | Wrap up and next steps |

Review of Methane Emissions and Sources from Natural Gas Operations

Virginia Department of Environmental Quality
Methane Leakage from Natural Gas Infrastructure
Ad Hoc Workgroup Meeting

Presented by:

Jim McCarthy, Innovative Environmental Solutions, Inc.



Richmond, VA

May 29, 2019

Agenda

- **Natural gas and U.S. energy use; VA implications**
- **Methane emission estimates from natural gas operations**
 - » **VA estimates from EPA GHG Reporting Program (GHGRP)**
 - » **Background on historical / other data sources**
- **Methane emission sources for transmission & storage (T&S) and distribution**
- **Overview of methane mitigation strategies for T&S and distribution**
 - » **Insights from GHGRP data**
 - » **EPA programs / regulations:**
 - **NSPS (Subpart OOOOa) for compressor stations**
 - **EPA Natural Gas STAR – e.g., Methane Challenge BMPs**

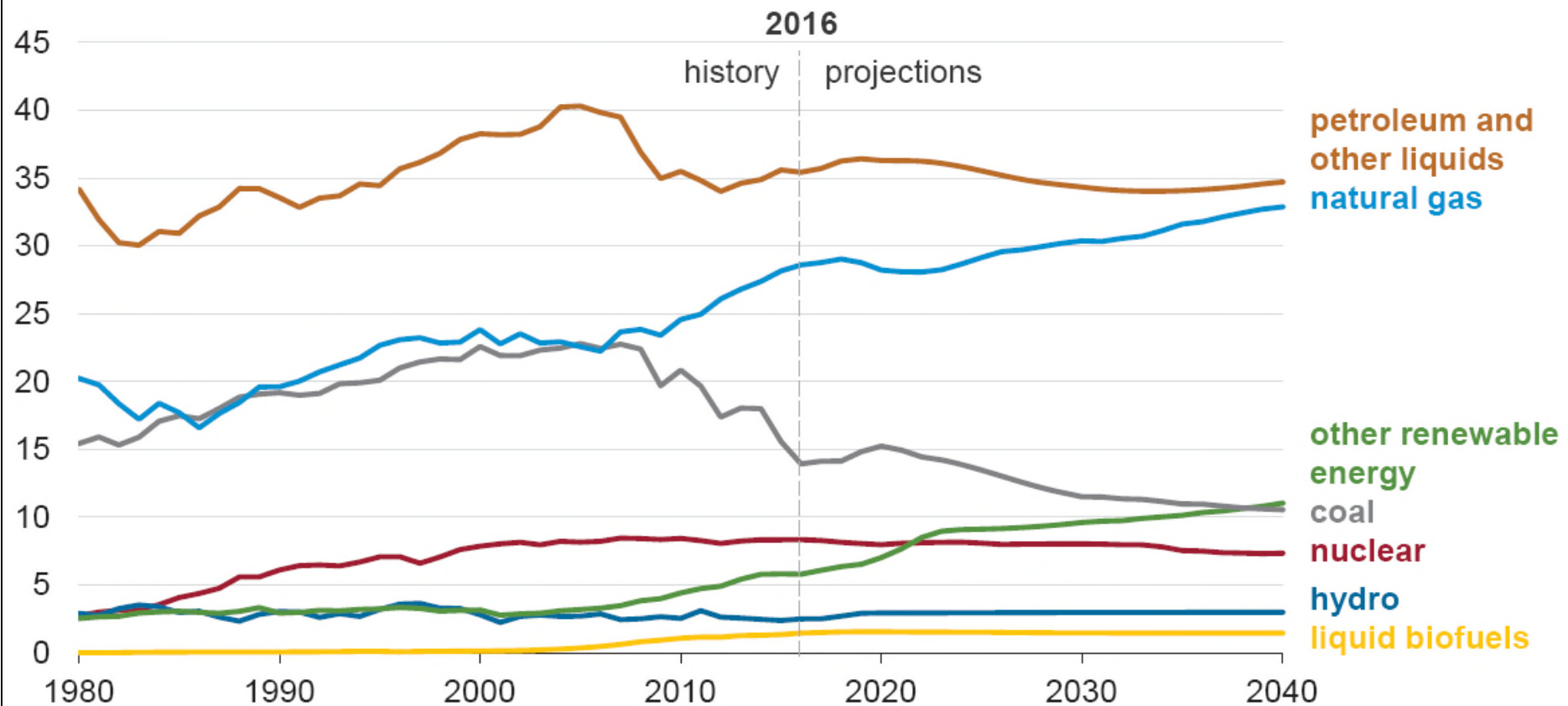
Presentation Highlights

- **Natural gas use in U.S. and VA is growing and growth is projected to continue (e.g., supplant coal)**
 - » Although gas use has grown, methane emissions from natural gas systems have decreased
- **There are relatively few natural gas facilities in VA, so methane emissions are relatively small from natural gas operations (Distribution systems, ~ 20 transmission compressor stations)**
- **Improved understanding of CH₄ sources & emissions in recent years – e.g., from GHGRP data, other studies**
 - » Sources and emissions by natural gas segment; GHGRP data is providing insight into emission priorities
- **Voluntary efforts (e.g., Natural Gas STAR) and regulations have identified methane mitigation options**
- **For leak emissions, a few large leaks contribute most emissions**
 - » Technology advances (e.g., leak quantification) may be imminent
 - » Convergence of emissions understanding and technology provide opportunities for smarter alternatives to reduce methane

DOE EIA – U.S. Energy Consumption

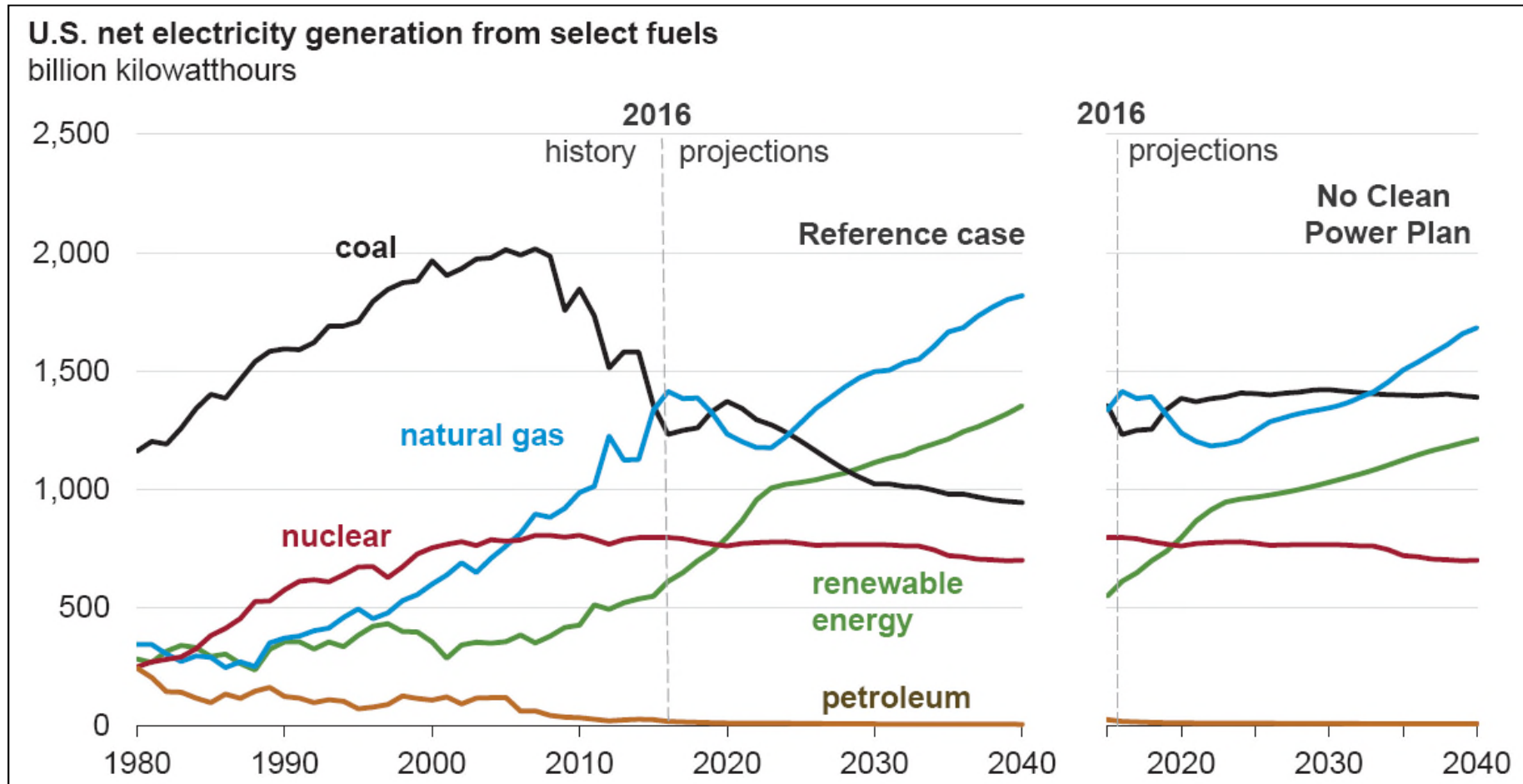
- DOE EIA projections – all uses (transportation, electricity, etc.)

Energy consumption (Reference case)
quadrillion British thermal units



DOE EIA – U.S. Electricity Generation

- DOE EIA projections for 2016 provided with and without Clean Power Plan
- 2017 VA electricity: 11.9% coal, 49.2% gas, 33.8% nuclear



VA Natural Gas Facts

- 1.3 million natural gas customers (1.2 million residential)
- Consumed ~552 BCF of natural gas in 2015 (~570 trillion Btu) with was 2.2% of U.S. consumption (AGA state gas facts)
 - » 14% residential
 - » 12% commercial
 - » 57% electric power generation
 - » 17% industrial / other
- VA natural gas market share for all electricity generation
 - » <https://www.eia.gov/electricity/data/state/> (Sept 2018 update)
 - » 49.2% in 2017 (11.9% coal, 33.8% nuclear, 1.3% solar/biomass)
 - 72% growth in VA electric generation from 1990 to 2017
 - » 23.3% in 2010 (34.9% coal, 36.4% nuclear , 1.1% solar/biomass)
 - » 6.0% in 2000 (51.5% coal, 36.7% nuclear , 0.6% biomass)
 - » 2.2% in 1990 (45.5% coal, 45.3% nuclear, 1.2% biomass)

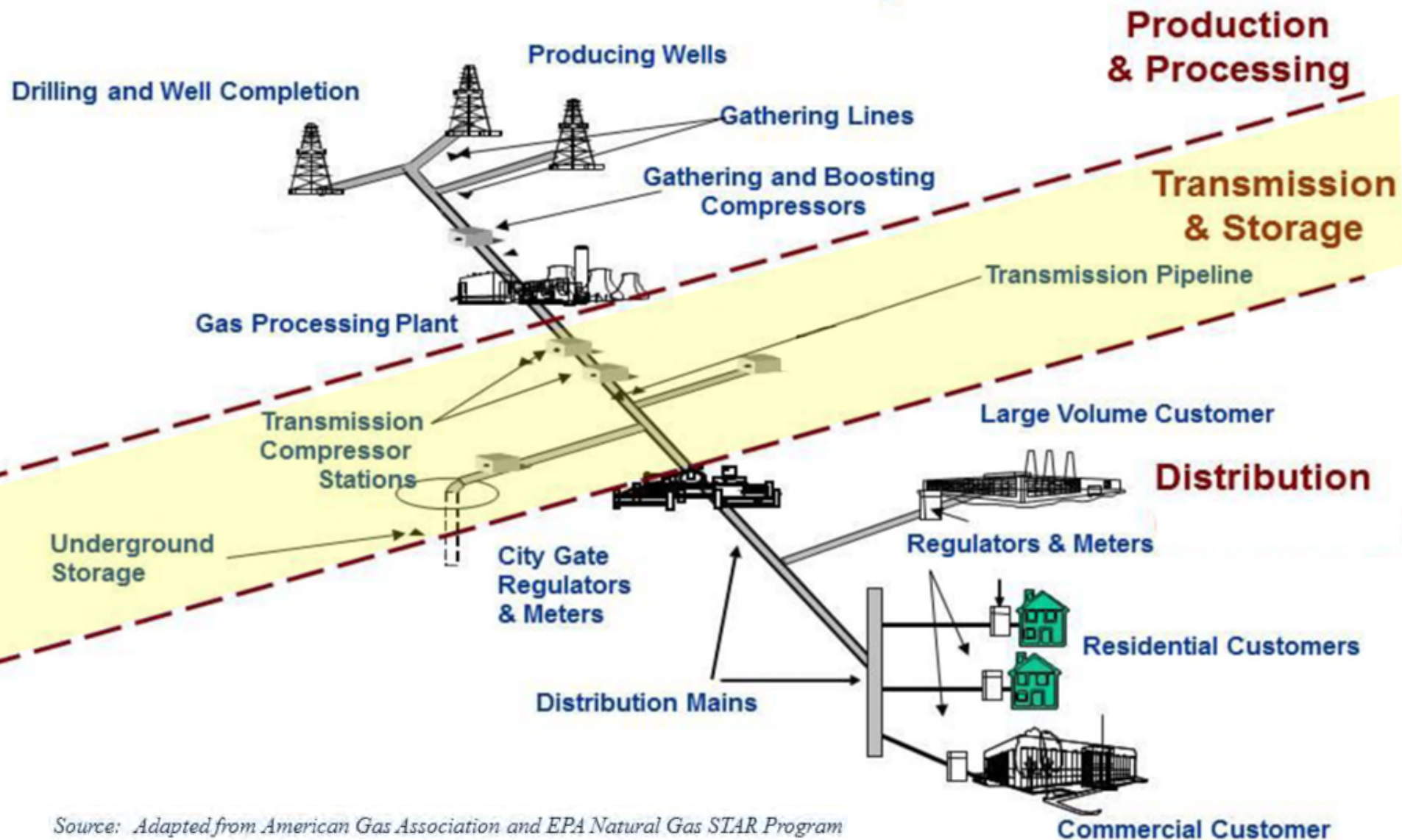
Natural Gas Operations: Methane Emissions Background

- Pipeline natural gas is typically 90 – 96% methane
 - » Balance is mainly ethane
 - » Relatively low VOC content
- Historical estimates of natural gas industry methane emissions (e.g., EPA annual GHG inventory (GHGi), estimation protocols) primarily based on 1996 EPA-GRI report
 - » For over 20 years, minimal new methane data was added
 - » EPA GHGRP, other new studies include new measurement data for T&S operations
- Voluntary Natural Gas STAR program demonstrated reductions – mitigation identified by industry operators
 - » STAR supplemented with Methane Challenge in 2016
 - » Mandatory rules now evolving at federal and state levels

Federal Programs: Chronology

- EPA-GRI report (15 vols) on NG industry methane emissions in 1996
- Annual U.S. GHGi has been prepared since 1997
 - » Time series of emissions by industry segment to 1990
- EPA Natural Gas STAR program: Voluntary reductions from natural gas systems since mid-1990s
 - » EPA introduced supplemental Methane Challenge program in 2016
- GHG Reporting Rule (GHGRP) since 2010 (combustion) and 2011 (add Subpart W methane leaks and vented emissions)
 - » Intent: Provide information to inform policy
 - » Most industries use emission factors or engineering estimates; T&S requires measurement of several key sources
- NSPS (Subpart OOOO) in 2012 affected oil and gas operations upstream of transmission: VOC rule with methane co-benefits
- Add methane to NSPS: Subpart OOOOa in June 2016 adds T&S

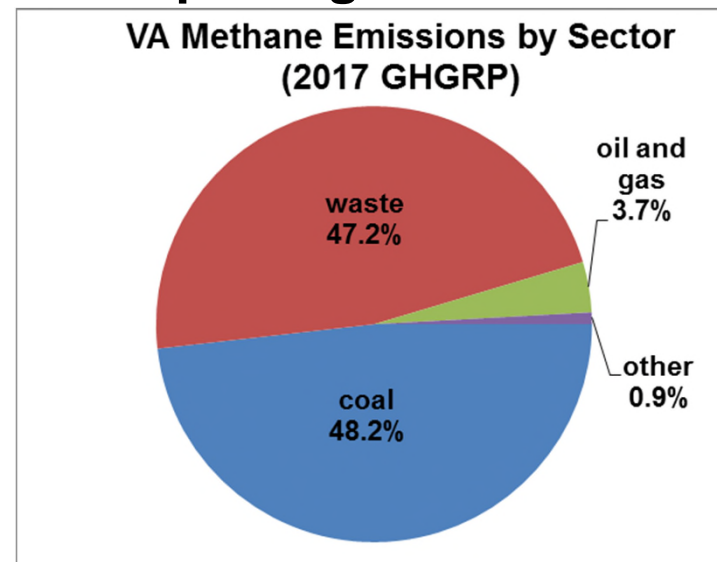
Natural Gas Operations: Industry Segments



Source: Adapted from American Gas Association and EPA Natural Gas STAR Program

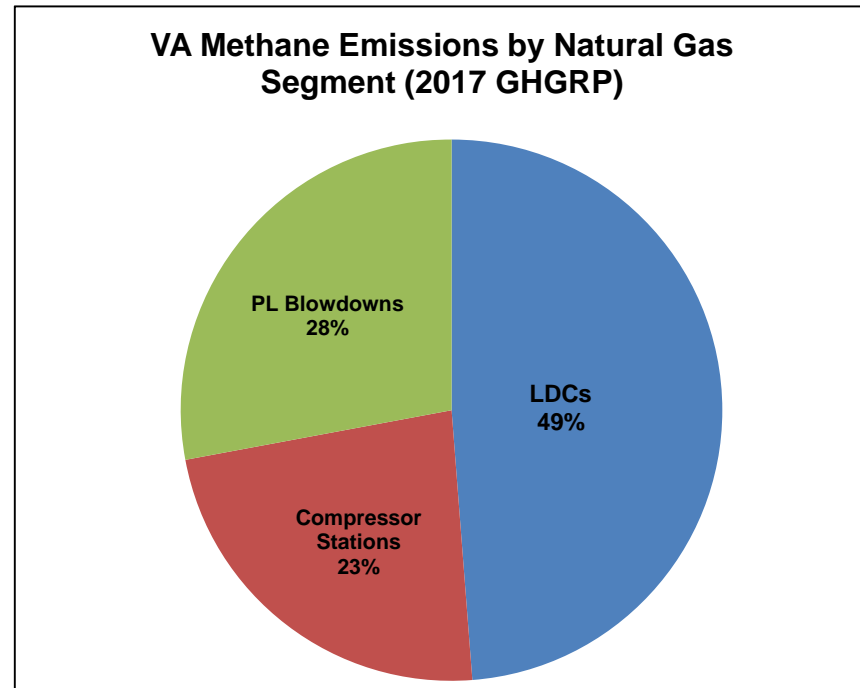
VA Methane Emissions and Natural Gas Operations

- Natural gas sector in VA (and thus emissions) is primarily comprised of transmission and storage (T&S), and distribution
 - » Minimal production (115 BCF in 2017, 0.3% of U.S. production)
- Approximately 20 T&S facilities in VA; EPA GHGRP (2017 data) includes 4 compressor stations, 4 LDCs
 - » Other compressor stations are smaller and/or low use so emissions did not exceed 25,000 metric ton reporting threshold
- Methane emissions are ~14% of VA GHG inventory (2017 GHGRP)
 - » 6 MM mt CO₂e CH₄ of 44 MM mt total
 - » VA methane mainly from coal and waste (landfills); 3.7% from gas ops
 - » In comparison, nationwide CH₄ ~10% of total; oil & gas is ~24% of methane



VA Methane Emissions by Natural Gas Segment

- Natural gas segment 2017 methane emissions in VA ~232,000 metric tons CO₂e
 - » Roughly half of emissions from LDCs and half from T&S
 - » LDCs have typically not been regulated – reductions primarily from replacing gas mains – e.g., see Methane Challenge Best Management Practices (BMPs)
 - » Additional discussion follows on T&S emission sources and mitigation approaches

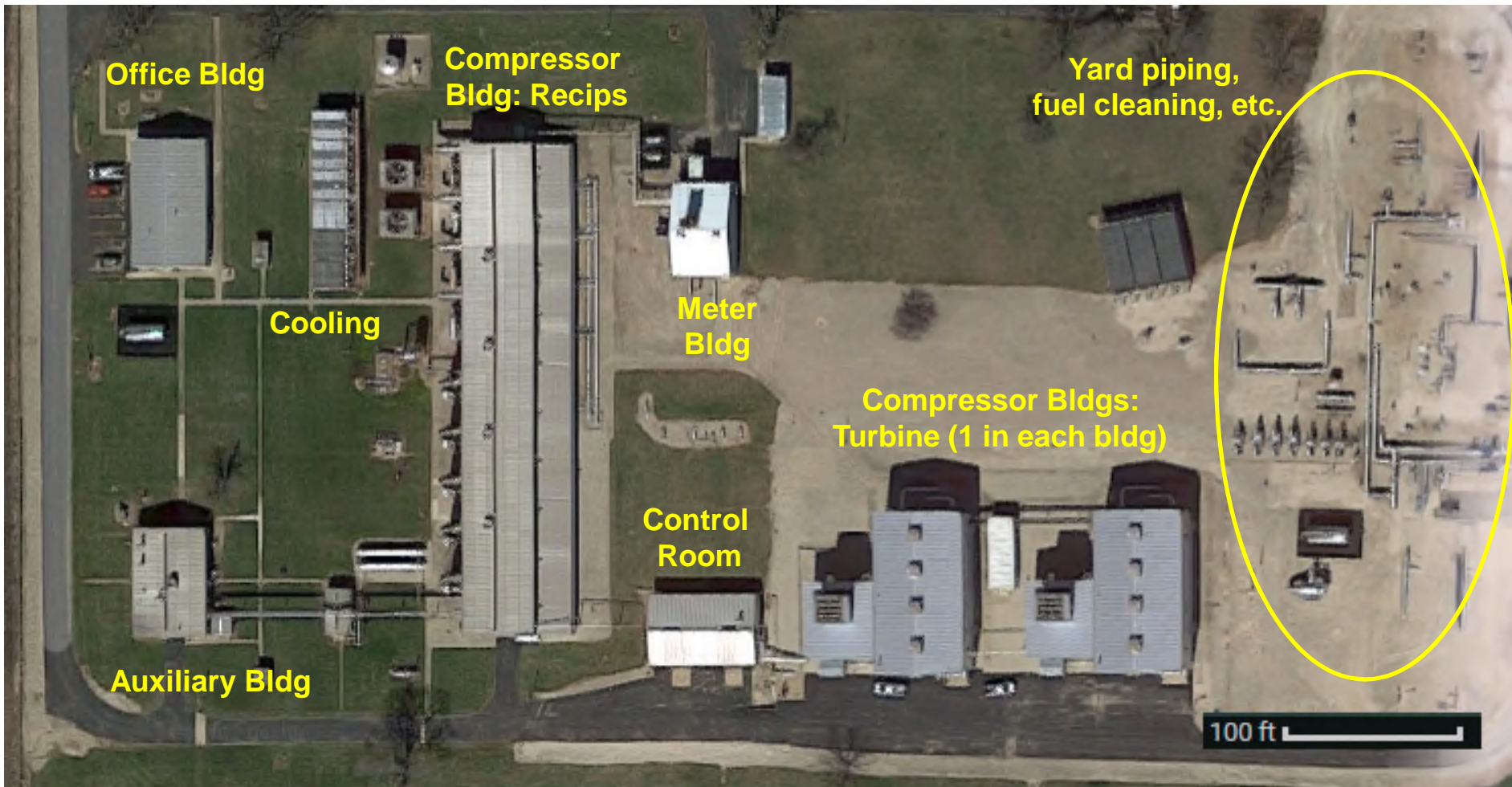


U.S. EPA GHG Reporting Program: Primary Methane Emission Sources

- **Onshore production segment reports 16 methane sources**
 - » Well-related venting (completions, recompletions, etc.)
 - » Initial processing (e.g., remove H₂O) and compression at well
 - » Storage tanks, pneumatic devices, leaks
- **Gathering and boosting segment reports 10 sources**
 - » Pneumatics, processing, blowdowns, compressors, leaks
- **Processing segment reports 6 sources**
 - » Processing, compressors, blowdowns, leaks
- **Transmission compressor stations report 6 sources**
 - » Pneumatics, blowdowns, compressors, leaks (details upcoming)
 - » Underground storage facilities report 4 of the 6
 - » Pipeline blowdown reporting added in 2016
- **Distribution – 6 sources (leaks from mains, services, M&R)**

Transmission Compressor Station

- Overhead view of example compressor station (Recips & Turbines)



Subpart W Methane Emission Sources

- **GHGRP: Reporting is required for six methane emission sources for “onshore natural gas transmission compression” sector (*four of six apply to underground storage facilities*):**
 - (1) Reciprocating compressor venting^A*
 - (2) Centrifugal compressor venting^A*
 - (3) Transmission storage tanks (leaking valve)^A*
 - (4) Blowdown vent stacks*
 - (5) Natural gas pneumatic device venting*
 - (6) Equipment leaks from valves, connectors, open ended lines, pressure relief valves and meters^B*

^A Subpart W requires direct measurement of emissions for T&S

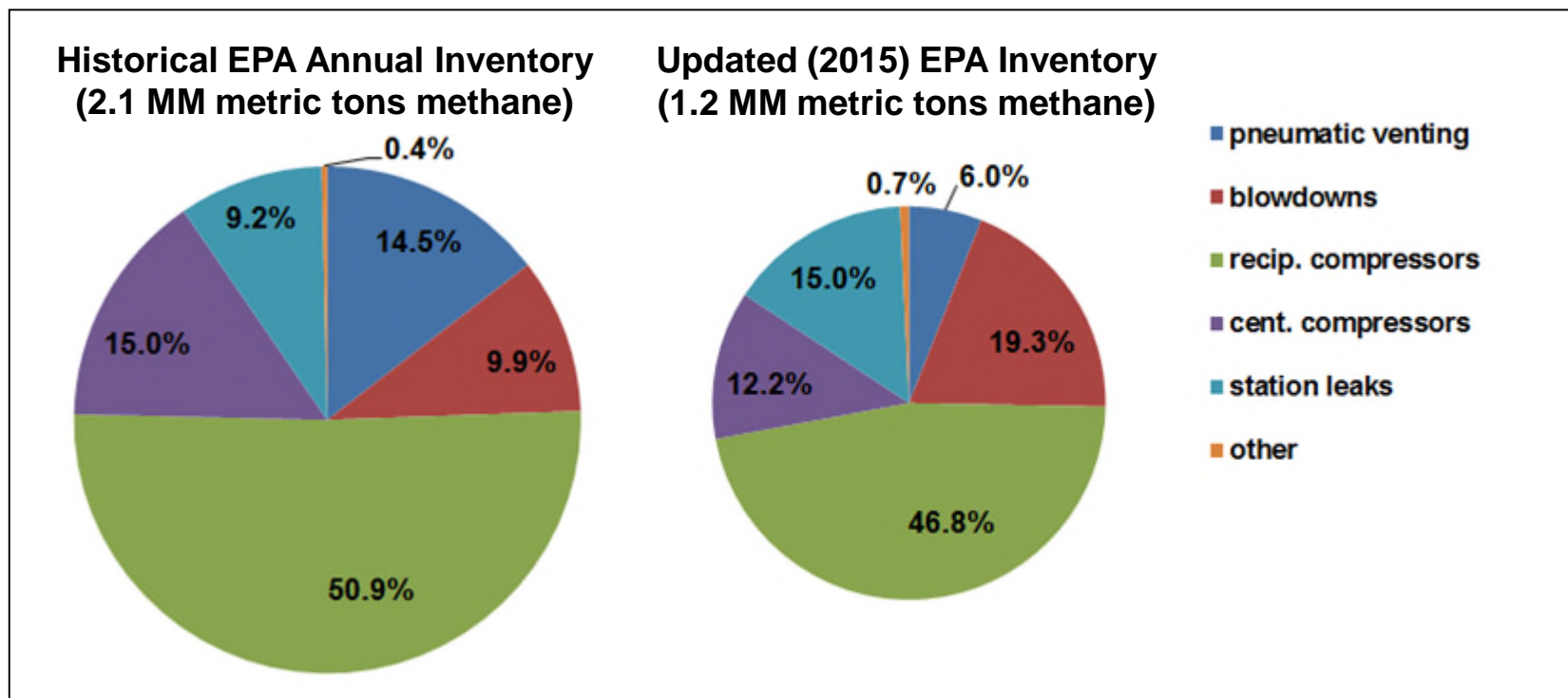
^B Subpart W requires Leak Survey for T&S segments; emission estimates based on leak counts & “leaker” emission factors
- **Transmission pipeline blowdown reporting added in 2016**

Subpart W Estimation Methods for Natural Gas Transmission

Emission Source	Monitoring Method / Data	Emission Quantification Method
Natural Gas Pneumatic Devices: Low (≤ 6 scfh), High (>6 scfh) or intermittent bleed devices	Component Count for (1) Low Bleed, (2) High Bleed and (3) Intermittent Bleed Devices	Population EF (scfh) x device count x 8,760 hr/yr (three emission factors)
Blowdown Vent Stacks	Engineering Estimation (calculation)	Volume calculation; track by event type
Condensate Tanks (leaking dump valve)	Leak Detection & <u>Direct Flow Measurement</u>	For leaks; <u>Measured emission rate</u> x operating hours
Centrifugal Compressors: Blowdown Valve Leaks, Unit Isolation Valve Leaks, and Wet Seal Oil Degassing Vent	<u>Direct Measurement</u> of Vented Gas Emissions in TWO Modes: Operating and Not operating – depressurized	<u>Measured emission rate</u> (or Emission Factor if mode not measured) x operating hrs (by operating mode)
Reciprocating Compressors: Rod Packing Leakage, Blowdown Valve Leaks, and Unit Isolation Valve Leaks	<u>Direct Measurement</u> of Vented Gas Emissions THREE Operating Modes: -Operating, Standby pressurized, Not operating – depressurized	<u>Measured emission rate</u> (or Emission Factor if mode not measured) x operating hrs (by operating mode)
Equipment Leaks (other)	Leak Survey to identify & count leaking components OR Component count (population – for storage wellheads)	Leaking components count x Leaker EF x operating hours OR, Population by component type x EF (storage wellheads)

T&S Compressor Station Methane Emissions from Leaks and Vents

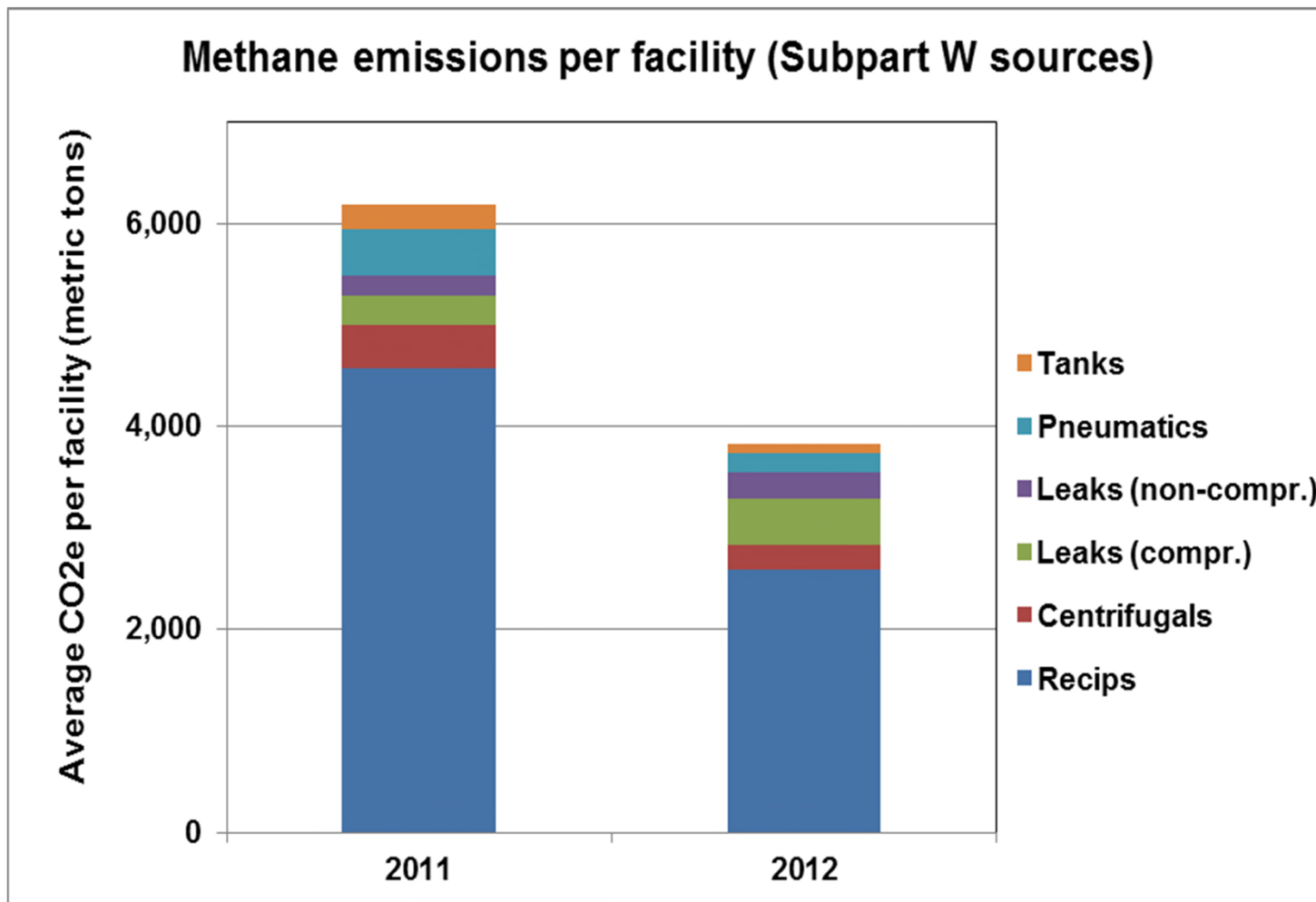
- EPA updated GHGi methods in 2016 – T&S CH₄ emissions *decreased* using more recent data (e.g., emissions factors from EDF-Industry study)
 - » The updated estimates did *not* incorporate Subpart W data
- Relative % of station emissions from leaks & vents by source type:
 - » Compressor leaks and rod packing are the primary source



T & S Methane Emissions: Subpart W Implications

- For many years, estimates in EPA annual GHGi were primarily based on data from mid-1990s EPA/GRI study
 - » Updates in 2016 report (for 2014 inventory) integrated some results from EDF-Industry study (~45 T&S facilities)
 - » Compressor emissions are a key source
 - » Compressor “emission factor” (EF) includes leaks from blowdown valves, isolation valves, rod packing (reciprocating compressor) and seals (centrifugal compressor)
 - These emissions are *measured* for Subpart W of GHGRP
 - EDF-Industry study provided EF updates for compressors
 - Subpart W compressor measurement data provides the opportunity for further review and update of compressor EFs
 - A Pipeline Research Council International (PRCI) report (April 2018) compiled and analyzed Subpart W compressor measurements
- 2nd PRCI report in 2019 will present other Subpart W data

Station Emissions: Subpart W Results for Leaks and Pneumatic Controller Venting



- Bar charts from PRCI GHGRP data compilation

Initial Overview of Emissions Mitigation (and Subpart OOOOa Sources)

- **EPA National Inventory and Natural Gas STAR reports provided background for 2014 EPA “White Papers” on mitigation of methane from natural gas leaks and venting**
- **T&S sources and mitigation in Subpart OOOOa include:**
 - » **Reciprocating compressor rod packing (replacement every 26,000 operating hours or 36 months)**
 - » **Centrifugal compressors wet seals oil degassing vents (reduce VOC emissions)**
 - » **High bleed pneumatic devices (low / no bleed or air driven devices)**
 - » **Equipment leaks (LDAR)**
 - » **Storage tanks with VOC emissions >6 TPY (reduce VOC emissions)**

Subpart W Measurement / Survey Data

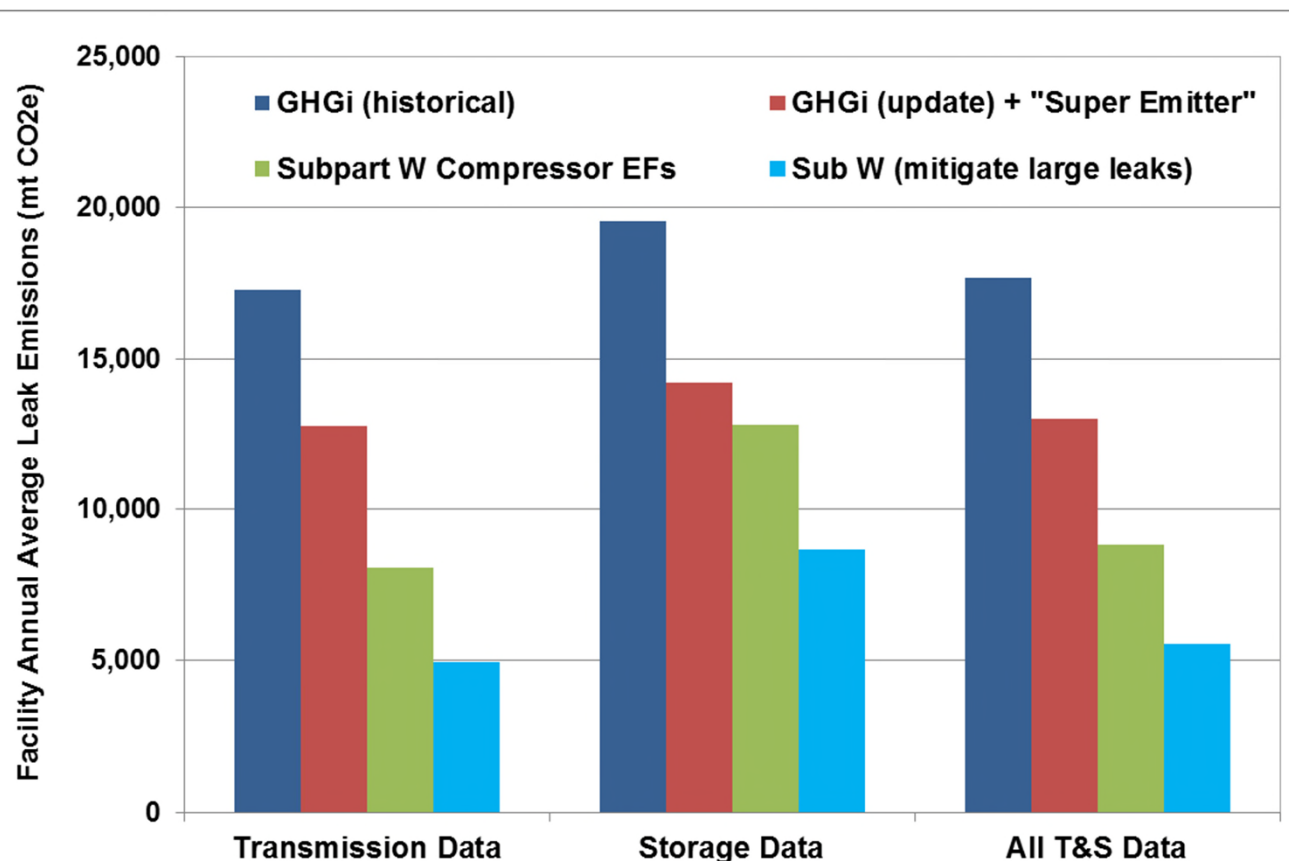
- **PRCI project compiled Subpart W data from members and developed report that presents compressor emission factors**
 - » **PRCI Report, “GHG Emission Factor (EF) Development for Natural Gas Compressors” (based on over 14,000 measurements)**
 - » **Report presents 2011–2016 data for different leak source – e.g., unit isolation valves, rod packing, wet seals, etc. and resulting implications for compressor EFs**
 - » **PRCI White Paper in Spring 2019 will include significant additional details on compressor EFs based on Subpart W data**
- **PRCI companion report will be available in Spring 2019 that presents other Subpart W data on facility leak surveys, pneumatics, facility and pipeline blowdowns**
- **These Subpart W results can be compared to historical data (e.g., facility emission estimates based on EPA GHGi)**

Updated Compressor EFs: Facility Level GHG Inventory Implications

- Emission factors can be used to assess the implications for “average” facility leak emissions based on EPA GHGi EFs versus

Subpart W-based Compressor EFs

- » Historical GHGi
- » Recent GHGi updates w/ EFs from industry-EDF study
- » Subpart W Compressor EFs
- » Subpart W Compressor EFs commensurate with mitigating larger compressor-related leaks (~3% of leaks)



Theme from Literature: Large Leaks are Responsible for Most Leak Emissions

- INGAA Foundation study summarized literature in response to influx of papers <http://www.ingaa.org/Foundation/Foundation-Reports/ComparativeMethaneStudies.aspx>

Study	Measurement Technique	% of Leak Sources Contribute to...	...% of emissions
Allen (2013)	Direct Measurement of Well Liquids Unloading	44 percent	90 percent
Alvarez (2012)	Analysis of Reported Emissions	10 percent	70 percent
Kang (2014)	Direct Measurement	16 percent	3 orders of magnitude larger than median flow rate
Subramanian (2015)	Direct measurement Site level and concurrent downwind tracer-flux (T&S)	10 percent	50 percent
Mitchell (2015)	Direct measurement at G&P site level; concurrent downwind tracer-flux	30 percent	80 percent
Clearstone (2002)*	Direct measurement w/ Hi-Flow™ sampler	Up to 10 leaks in each facility	36 – 65 percent
NGML, Clearstone, IES (2006)*	Direct measurement w/ Hi-Flow™ sampler and optical methods	0.6 percent	58 percent
Picard (2005)*	Sampling via various methods	Top 10 leaks	80 percent
Shorter (1997)*	Remote sampling via tracer methods	Top emitters	2 – 4 orders of magnitude larger than small emitters
Trefiak (2006)*	Optical measurement and Hi-Flow™	23 percent	77 percent

* Cited in Brandt (2014), which provided a synopsis of studies and data gaps

Technology Solutions – Status: Methane Monitoring or Measurement

- Technology continues to advance – e.g., leak *rate* algorithms may become available for optical gas imaging (OGI)
- DOE ARPA-E “MONITOR” program is developing and testing several low cost technologies
 - » e.g., lower cost OGI / IR technology and operating platforms such as miniature sensors and use on drones
 - » See <https://arpa-e.energy.gov/?q=arpa-e-programs/monitor>
- OGI / IR camera manufacturers are developing leak rate *quantification* capability using advanced computational algorithms from plume visual; commercial products anticipated
 - » Even qualitative binning into leak size ranges could support leak repair decisions
- While not yet feasible, flexibility to integrate new technologies is desired (e.g., streamlined path for alternative methods)

Pipeline Blowdown Mitigation

- Pipeline blowdown mitigation from “pump down” is a common practice, but application is limited
- Pipeline blowdown mitigation practices may include:
 - » Divert to low pressure line: Transfer gas to a parallel line
 - » In-Line compression: Operate downstream compression after upstream valve is closed
 - » Mobile compression: Use additional compressors to move gas or pull line down to lower pressure (e.g., incremental gain)
 - » Flaring: Rarely used
- Practice is limited by:
 - » Availability of parallel line
 - » Pressures of lines
 - » Economics (e.g., for mobile compression)

Summary and Conclusions

- **T&S and Distribution segment methane emissions are a relatively minor contributor to VA methane emissions**
 - » **And, some emissions sources are minor for T&S facilities**
 - » **Recent data, including Subpart W measurements, show T&S emissions are lower than historical levels**
- **EPA voluntary programs, NSPS, and state actions have focused on similar sources and mitigation approaches**
 - » **Voluntary reductions have occurred and will continue**
- **New data and technologies provide the opportunity for program evolution and efficiency gains**
 - » **Flexibility / access to alternative methods / technologies**
 - » **Addressing large leaks is key – and new technologies may facilitate development of improved approaches**

Questions and Discussion



Methane Synthesis Study: Quantifying CH₄ Emissions from the U.S. Oil and Gas Supply Chain

David Lyon
Scientist

EDF U.S. Oil and Gas Methane Studies

PRODUCTION

GATHERING/PROCESSING

TRANSMISSION/STORAGE

LOCAL DISTRIBUTION

TRUCKS AND STATIONS

**NOAA
Denver-Julesburg**

**NOAA Barnett
Coordinated Campaign**

12 campaign papers
Barnett synthesis
Barnett component

**UT Phase 1
UT Phase 2**
• Pneumatics
• Liquids Unloading
HARC/EPA

CSU Study
• Methods
• Measurements
• National Scale-up

CSU Study
• Measurements
• National Scale-up

**Methane Mapping
Boston Study
WSU Multi-City
Indianapolis**

WVU Study
• Measuring
• Modeling

Pilot Projects

Gap Filling

- Abandoned wells
- Helicopter IR Survey

Synthesis Projects

- NETL LCA
- **Synthesis**



EDF's Methane Research



Science

Studies employ independent experts and use multiple methods to measure methane emissions



Collaboration

More than 130 co-authors from 50 research institutions and 50 O/NG companies



Results

Published in peer-reviewed journals with publically available data

Cite as: R. A. Alvarez *et al.*, *Science*
10.1126/science.aar7204 (2018).

Assessment of methane emissions from the U.S. oil and gas supply chain

Ramón A. Alvarez^{1*}, Daniel Zavala-Araiza¹, David R. Lyon¹, David T. Allen², Zachary R. Barkley³, Adam R. Brandt⁴, Kenneth J. Davis³, Scott C. Herndon⁵, Daniel J. Jacob⁶, Anna Karion⁷, Eric A. Kort⁸, Brian K. Lamb⁹, Thomas Lauvaux³, Joannes D. Maasakkers⁶, Anthony J. Marchese¹⁰, Mark Omara¹, Stephen W. Pacala¹¹, Jeff Peischl^{12,13}, Allen L. Robinson¹⁴, Paul B. Shepson¹⁵, Colm Sweeney¹³, Amy Townsend-Small¹⁶, Steven C. Wofsy⁶, Steven P. Hamburg¹

¹Environmental Defense Fund, Austin, TX, USA. ²University of Texas at Austin, Austin, TX, USA. ³The Pennsylvania State University, University Park, PA, USA. ⁴Stanford University, Stanford, CA, USA. ⁵Aerodyne Research Inc., Billerica, MA, USA. ⁶Harvard University, Cambridge, MA, USA. ⁷National Institute of Standards and Technology, Gaithersburg, MD, USA. ⁸University of Michigan, Ann Arbor, MI, USA. ⁹Washington State University, Pullman, WA, USA. ¹⁰Colorado State University, Fort Collins, CO, USA. ¹¹Princeton University, Princeton, NJ, USA. ¹²University of Colorado, CIRES, Boulder, CO, USA. ¹³NOAA Earth System Research Laboratory, Boulder, CO, USA. ¹⁴Carnegie Mellon University, Pittsburgh, PA, USA. ¹⁵Purdue University, West Lafayette, IN, USA. ¹⁶University of Cincinnati, Cincinnati, OH, USA.

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Scope of Synthesis Study

- Quantify methane emissions from the U.S. oil and gas supply chain
- Integrates several recently published datasets
 - Production segment emissions based on site-level measurements from 6 U.S. basins
 - Emissions compared to aircraft-based estimates in 9 basins



Drilling &
Production



Gathering &
Processing



Transmission &
Storage



Local
Distribution



Regional
Research

Synthesis Collaborators

Aerodyne Research

Scott C Herndon

Carnegie Mellon University

Allen L. Robinson

Colorado State University

Anthony J. Marchese

EDF

Ramon A. Alvarez

David R. Lyon

Daniel Zavala–Araiza

Mark Omara

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Harvard University

Daniel J. Jacob

Joannes D. Maasackers

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Colm Sweeney

Pennsylvania State University

Zachary R. Barkley

Kenneth J. Davis

Thomas Lauvaux

Princeton University

Stephen W. Pacala

Purdue University

Paul B. Shepson

Stanford University

Adam R. Brandt

University of Cincinnati

Amy Townsend-Small

University of Michigan

Eric A. Kort

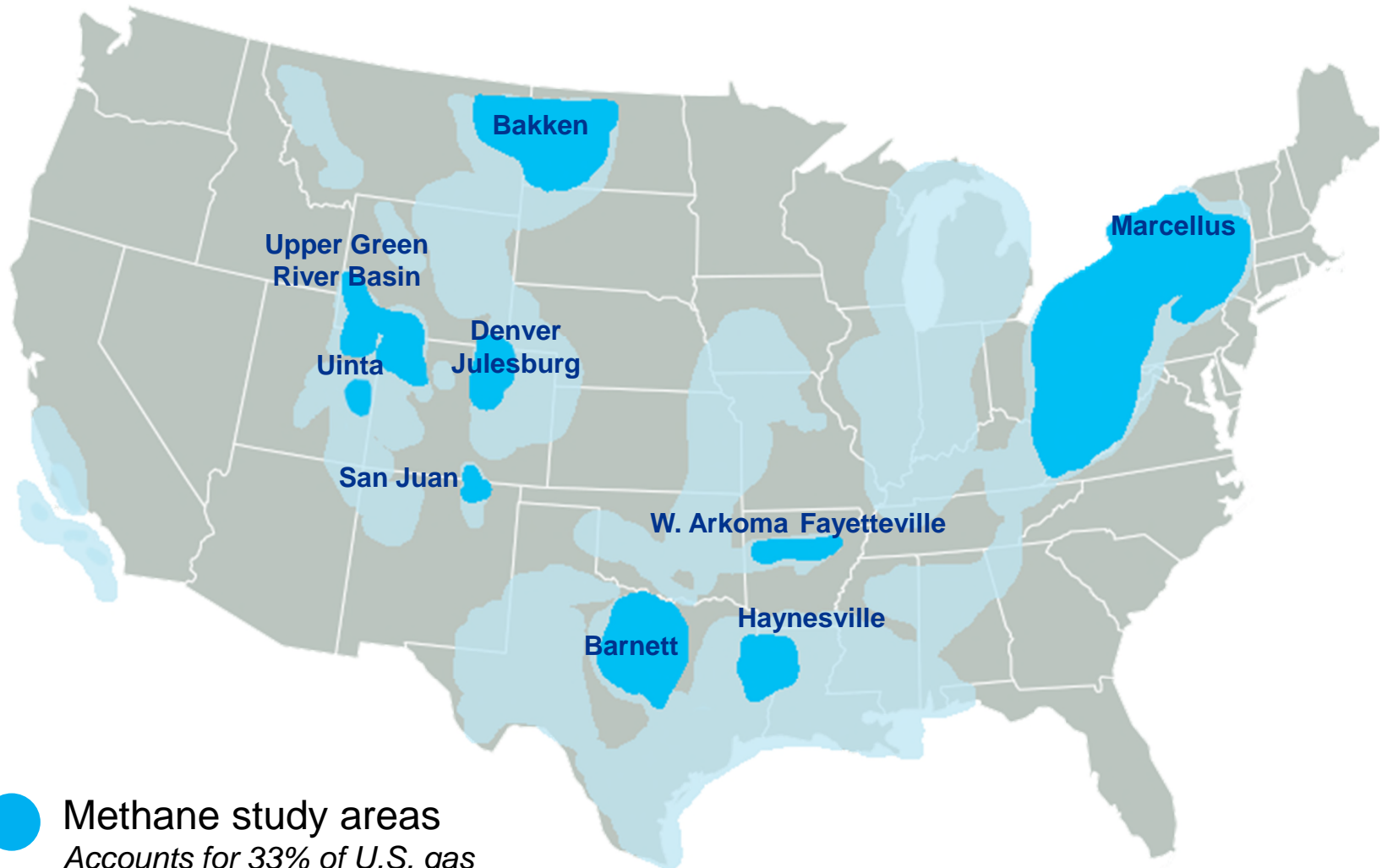
University of Texas

David T. Allen

Washington State University

Brian K. Lamb

Sources of Regional Synthesis Data



● Methane study areas
Accounts for 33% of U.S. gas production; 24% of oil production

Emissions Quantified at Different Spatial Scales



**Site-level
(primary approach)**



**Basin-level
(validation)**



**Component-level
(comparison)**



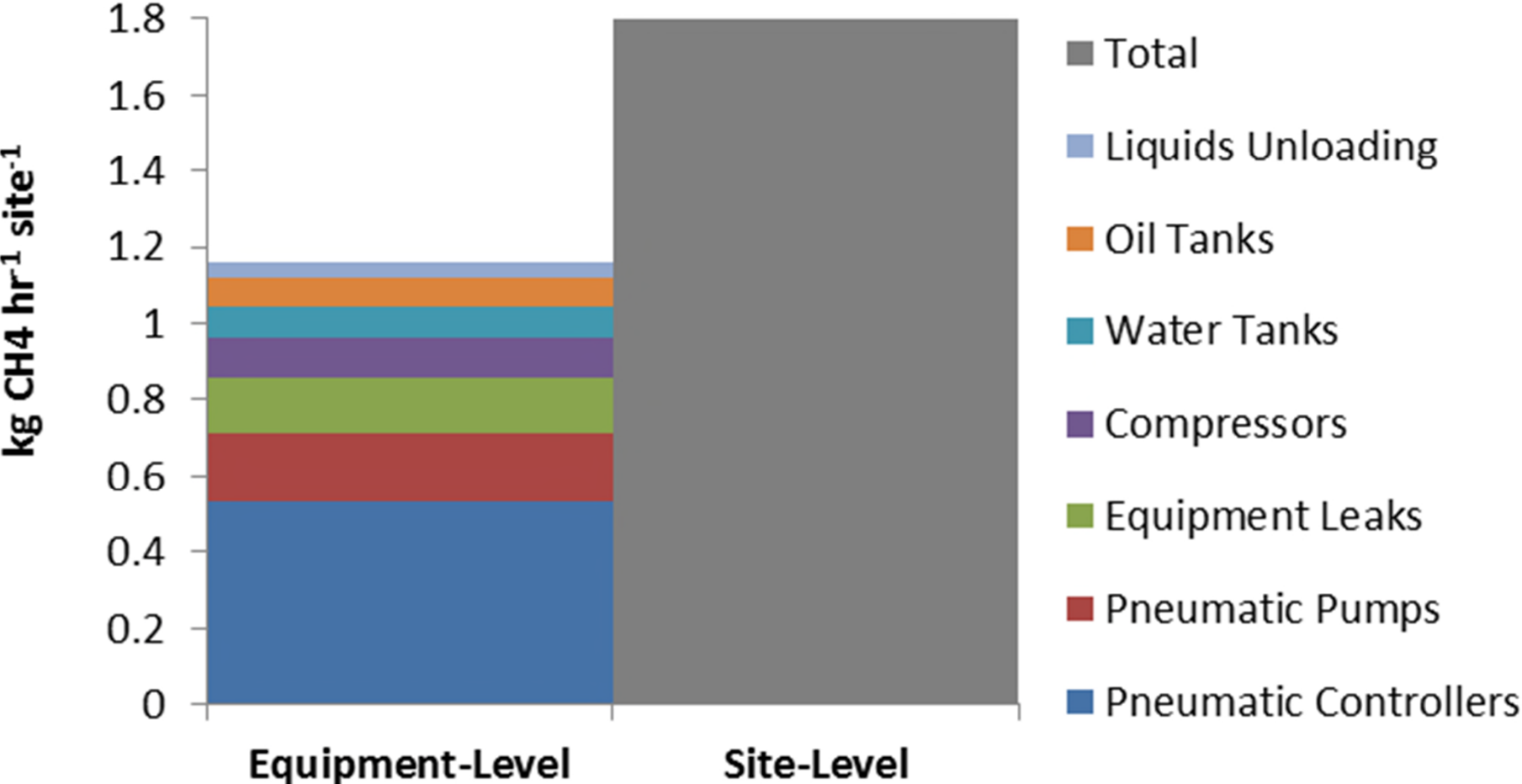
Comprehensive site measurements reveal higher emissions than inventories



Basin- and site-level quantification methods can find emissions that are overlooked by equipment-level measurements.

For example, site-level measurements find 50% more emissions in the Barnett Shale than estimated by traditional methods

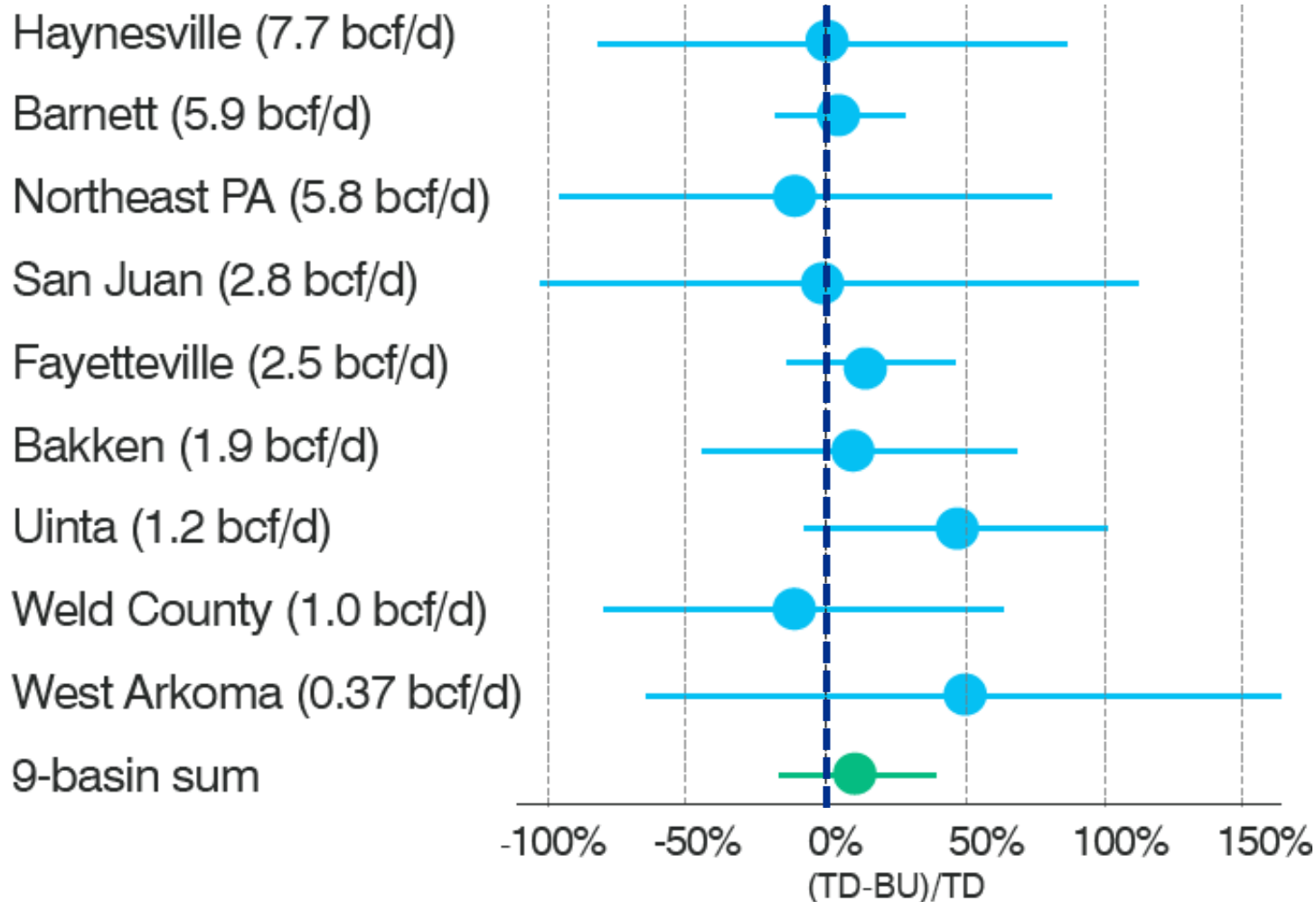
Barnett Shale Well Pads



Synthesis Methods

- Multiple, previously published datasets integrated to estimate 2015 U.S. O&G CH₄ emissions by segment
 - **Production:** >400 site-level measurements from 6 basins
 - Basins: Barnett, DJ, Fayetteville, Uintah, Upper Green River, Marcellus
 - Methods: Dual tracer, mobile flux plane, inverse Gaussian, OTM 33A
 - **Gathering & Processing:** Marchese et al 2015
 - **Transmission & Storage:** Zimmerle et al 2015
 - **Local distribution:** Lamb et al 2015
- Basin-level, site-based estimates validated with aerial mass balance data from 9 basins
 - Basins: Haynesville, Barnett, Marcellus, San Juan, Fayetteville, Bakken, Uintah, Weld, West Arkoma
- Synthesis estimate compared to U.S. EPA GHG Inventory and custom component-based inventory

Aircraft- and site-based emission estimates are statistically similar



U.S. O&G Supply Chain 2015 Methane Emissions

Drilling & Production



7.6 Tg
1.3%

3.5 Tg
0.6%

Gathering & Processing



3.3 Tg
0.6%

2.7 Tg
0.5%

Transmission & Storage



1.8 Tg
0.3%


1.4 Tg
0.2%

Local Distribution



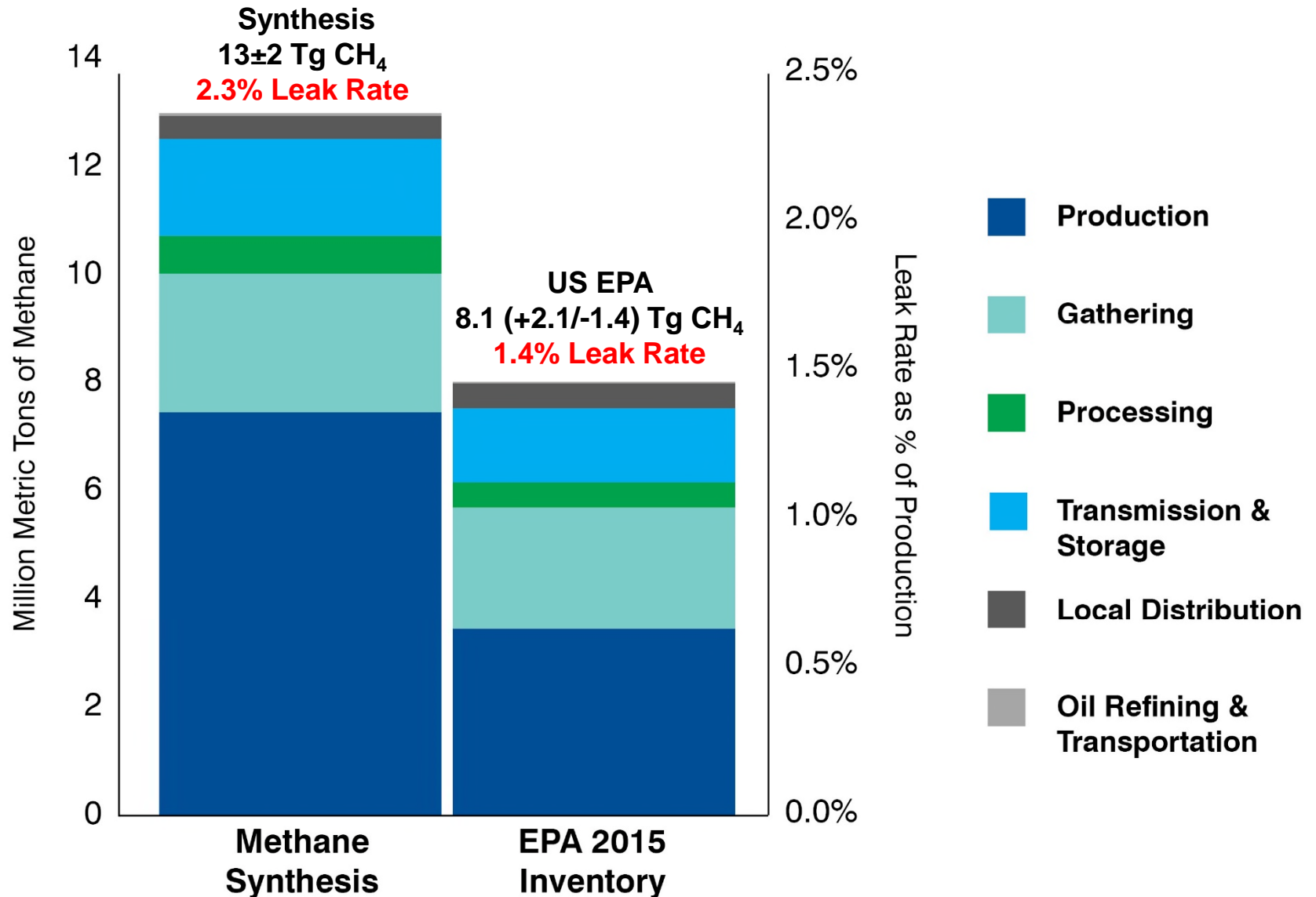
0.44 Tg
0.1%

0.44 Tg
0.1%

 Methane Synthesis
Alvarez et al 2018

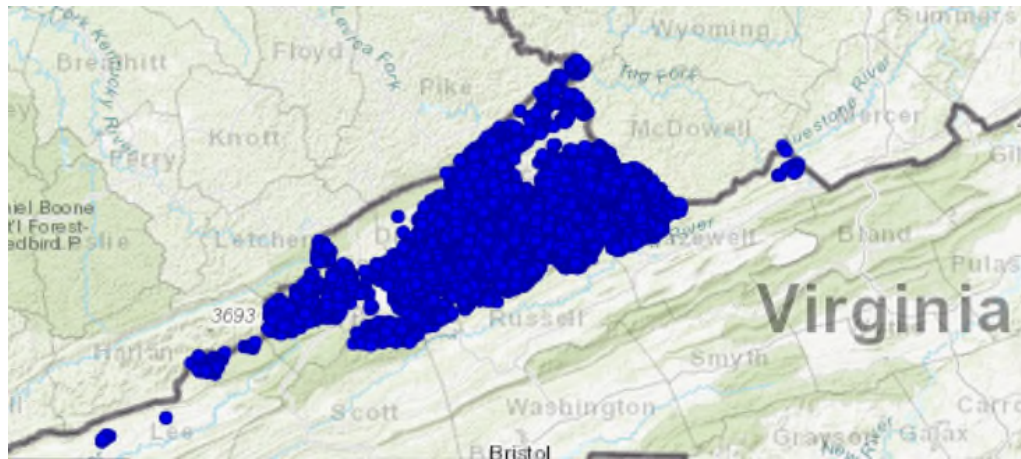
 2017 EPA GHG Inventory
(For year 2015)

O&G CH₄ emissions 60% higher than EPA GHGI



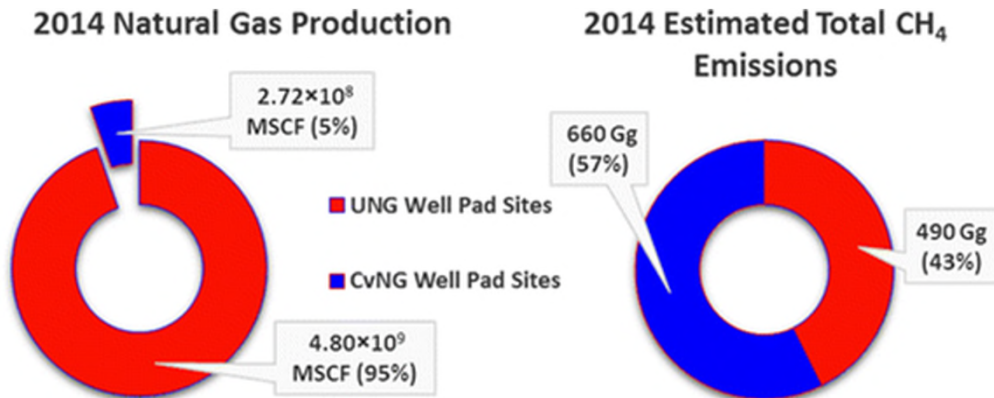
Implications for Virginia

- The state includes approximately:
 - 8,000 active O&G wells
 - 3,000 inactive/plugged wells
 - 25 compressor stations
 - 2 storage fields
- Active wells are almost exclusively marginal gas wells with 94% producing less than 15 barrel of oil equivalents per day.



Implications for Virginia

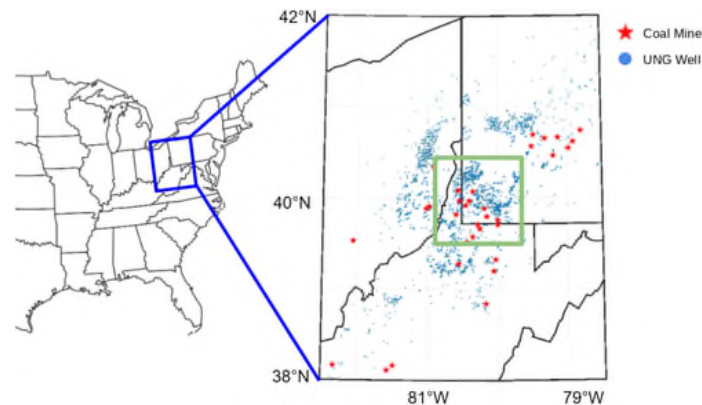
- Measurement data from the state are not available, but studies from a similar production area in southwest Pennsylvania provide insights.
- Marginal conventional wells have relatively low absolute emission rates but very high loss rates:
 - Mean emission factor = 0.8 kg CH₄/hr (7.8 tons per year)
 - Median loss rate = 11% gas production



<https://pubs.acs.org/doi/abs/10.1021/acs.est.5b05503>

Implications for Virginia

- Another study in SW PA used aircraft data to estimate emissions from O&G and coal mines.
 - Both coal and O&G were important methane sources.
 - EPA estimates were accurate for coal but 5X too low for O&G.
 - Production and gathering loss rate of $0.5 \pm 0.3\%$ is in agreement with other regional studies.



Preliminary Emission Estimates for Virginia wells and compressor stations

- 8,000 active wells * 7.8 TPY = 62,400 TPY CH₄
 - <https://pubs.acs.org/doi/abs/10.1021/acs.est.5b05503>
- 3,000 abandoned wells * 0.14 TPY = 400 TPY
 - <https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2015GL067623>
- 25 compressor stations * 739 TPY = 18,500 TPY
 - <https://pubs.acs.org/doi/abs/10.1021/acs.est.5b01669>

Summary

- **O&G CH₄ emissions are higher than estimated by official inventories like the EPA GHGI**
 - Upstream sources responsible for ~80% of total emissions
 - Site-based estimates validated with basin-level data
- **Abnormal conditions cause large emissions often excluded from traditional inventories**
 - Avoidable issues such as malfunctions, human error, and poor site design can lead to very high emission rates
 - Abnormal conditions account for about 50% of production segment and 33% of total supply chain emissions
- **Regulatory and voluntary actions can reduce emissions**
 - Effective monitoring to quickly detect high emissions
 - Root cause analysis and better site design to minimize the recurrence of abnormal conditions
 - Improved reporting to more accurately understand emissions

Additional Slides



Alternative, source-based estimate is substantially lower than site-based estimate. This traditional approach underestimates emissions by failing to account for uncategorized abnormal emissions.

Industry Segment	Source Category	2015 U.S. Emissions (Gg CH ₄ yr ⁻¹)		
		GHGI	This work (source-based)	This work (site-based)
O/NG Production	Pneumatic Controllers	1,800	1,100 (1,100 - 1,200)	7,200 (5,600 - 9,100)
	Equipment Leaks* \$	360	620 (570 - 670)	
	Liquids Unloading	210	170 (170 - 200)	
	Pneumatic Pumps*	210	190 (180 - 200)	
	Oil & Condensate Tanks	100	100 (97 - 120)	
	Produced Water Tanks	40	360 (340 - 380)	
	Fuel combustion	240	98 (91 - 210)	
	Associated gas flaring and venting	150	71 (69 - 86)	
	Other production sources*	40	60 (58 - 68)	
	Routine Operations Subtotal	3,100	2,800 (2,700 - 2,900)	
	Completions + Workovers	100	86 (80 - 120)	
	Abandoned and Orphaned Wells	NA	61 (59 - 360)	
	Onshore Production Subtotal	3,200	2,900 (2,900 - 3,300)	7,300 (5,700 - 9,300)
	Offshore Platforms	300	300 (240 - 380)	
Production Total	3,500	3,200 (3,100 - 3,600)	7,600 (6,000 - 9,600)	
Natural Gas Gathering	Gathering Stations	2,000	2,100 (2,100 - 2,200)	
	Gathering Episodic Events	200	170 (7 - 750)	
	Gathering Pipelines	160	310 (300 - 330)	
	Gathering Total	2,300	2,600 (2,400 - 3,200)	
Natural Gas Processing	Processing Plants	410	680 (610 - 880)	
	Routine Maintenance	36	36 (29 - 46)	
	Processing Total	450	720 (650 - 920)	
Transmission and Storage (T/S)	T/S Stations	1,100	1,100 (860 - 1,400)	
	T/S Uncategorized/Superemitters	NA	440 (350 - 570)	
	Transmission Pipelines	220	220 (180 - 290)	
	LNG Storage and Import Terminals	70	67 (54 - 87)	
	T/S Total	1,300	1,800 (1,600 - 2,100)	
Local Distribution	All sources through customer meters	440	440 (220 - 950)	
Petroleum Midstream	Oil Transportation + Refining	34	34 (26 - 84)	
Total U.S. Oil and Gas Supply Chain		8,100 (6,800 - 10,000)	8,800 (8,400 - 9,700)	13,000 (12,000 - 15,000)

Over 30% of emissions are from very marginal (<10 Mcf/d) sites responsible for <1% of U.S. gas production.

Table S4. Distribution of the activity data of U.S. oil and natural gas wells in 2015. The last row shows the percent of emissions from production sites calculated with the model described in this section. The production cohorts in this table were selected based on breakpoints evident in the dataset of production site emission measurements (Fig. S2 and Section S1.9), and 0.68 Mcf/d is the minimum production of the sampled population. The measurement dataset predominantly contains sites with gas production within the bolded gas production cohorts.

Natural Gas Production Cohorts (Mcf d ⁻¹)	% of US 2015 Activity Data by Gas Production Cohort				
	0	>0–0.68	0.68–10	10–5,000	>5,000
Sites*	15% (0%)	7.6% (8.9%)	29% (34%)	48% (57%)	0.38% (0.45%)
Wells	19%	5.1%	20%	53%	3.3%
Gas Production	0%	0.015%	0.84%	59%	40%
Oil Production	7.3%	0.49%	3.0%	74%	15%
Emissions*	6.4% (0%)	5.1% (5.5%)	20% (21%)	64% (68%)	4.8% (5.1%)

*The main value includes oil wells with zero reported gas production; the value in parentheses excludes them.

**COMMONWEALTH OF VIRGINIA
DEPARTMENT OF ENVIRONMENTAL QUALITY**

**METHANE LEAKAGE FROM NATURAL GAS INFRASTRUCTURE
REVISION A19**

AD HOC WORK GROUP, THIRD MEETING MINUTES

**THIRD FLOOR CONFERENCE ROOM
1111 EAST MAIN STREET, RICHMOND, VIRGINIA
June 26, 2019**

Members Present:

Joshua Ball, CNX	Will Cleveland, SELC
Braven Beaty, The Nature Conservancy	Kevin Elkins, Coronado Global
Lisa S. Beal, Dominion	Richard Lutz, Transco
James Bradbury, Georgetown Climate	Tyler Lake for Shepelle Watkins-White, VNG
Jonah Fogel for Andres Clarens, UVA	Andrew Williams, EDF

Guest Speakers:

Joshua Shodeinde, MDE	Stephen Holcomb, Columbia Gas
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Staff:

Department of Environmental Quality

Michael G. Dowd, Air Division	Irina Calos, Communications
Tamera Thompson, Air Division	Karen Sabasteanski, Regulatory Affairs
Tom Ballou, Air Division	

Dept. of Mines, Minerals and Energy

Michael Skiffington, Policy and Planning

The meeting began at approximately 10:05 a.m.

Meeting Purpose: This ad hoc work group has been established to advise and assist DEQ in the development of a framework for limiting methane leakage from natural gas infrastructure. This group will support DEQ in its collection and evaluation of data to inform the regulation development process. The agenda (Attachment A) follows.

Welcome and Introductions: Ms. Sabasteanski welcomed the group. Members introduced themselves individually.

Presentations: Mr. Shodeinde, Regulatory Compliance Engineer with the Maryland Department of the Environment (MDE), Air and Radiation Administration, discussed the current status of the development of a regulation controlling methane emissions from natural gas compressor stations (Attachment B). Mr. Shodeinde indicated that the MDE stakeholder group was meeting on June 28, 2019 to consider draft proposed regulation (available on the MDE web site at

<https://mde.maryland.gov/programs/Regulations/air/Pages/ARMARegulationsStakeholders.aspx>); a final regulation is expected next year.

Mr. Holcomb, Team Leader, Environmental Policy, NiSource on behalf of Columbia Gas of Virginia, gave a presentation on local distribution centers (LDCs), including discussion of the Steps to Advance Virginia's Energy (SAVE) Plan and the amount of methane emissions being reduced in Virginia by natural gas distribution companies (Attachment C).

The presentations were followed by group questions and discussion.

Group Discussion: Rather than attempt to complete the work sheets previously distributed by Ms. Sabasteanski (Attachment D), the group entered into a general discussion, beginning with whether methane should be addressed by the three primary sectors (production and processing, transmission and storage, and distribution). The group also discussed general means of control including best management practices (BMPs) and leak detection and repair (LDAR) programs, and whether they should be voluntary or mandatory.

The group did not attempt to reach formal consensus on any potential issues, i.e., there was no attempt to identify areas of complete agreement by all members. However, a number of areas of general agreement that merit further discussion and exploration were identified:

1. Given the relatively small percentage of contribution of methane emissions to the overall inventory and jurisdictional limitations, LDCs should be a relatively low priority.
2. Reporting is important, particularly using certified data, in order to further develop the inventory and demonstrate compliance. (Note there is currently some under-reporting due to varying applicability thresholds.)
3. Recordkeeping - LDAR protocols should be a component. Details have already been worked out or can be amended, and this can be a baseline. However, an LDAR schedule needs to be equipment-specific. For example, optical gas image (OGI) cameras may not be an option for existing/smaller sources due to cost.
4. Subparts OOOO and OOOOa of 40 CFR Part 60 could be the starting point for a program. Existing facilities are not covered by these federal New Source Performance Standards, but they could be a model and work with the current greenhouse gas (GHG) reporting and focused inspection used by existing sources.
5. Alternative compliance should be considered; i.e., sources should have the flexibility to use new technologies and controls.
6. BMPs are useful on a case by case basis, recognizing different choices available to different sources.

7. Specific technological controls need to be identified in the context of what is being controlled, i.e., what is best by equipment/blowdown events.

8. Control cost effectiveness should be considered.

9. A periodic review of available technologies (innovations, improvements) should be considered.

Wrap-up/Next Steps: Ms. Sabasteanski concluded the meeting. The next meeting is scheduled for August 13, 2019.

The meeting adjourned at approximately 3:00 p.m.

Attachments
REG\DEV\A19-AH04-3-minutes

**COMMONWEALTH OF VIRGINIA
DEPARTMENT OF ENVIRONMENTAL QUALITY**

**METHANE LEAKAGE FROM NATURAL GAS INFRASTRUCTURE
AD HOC WORK GROUP**

DRAFT AGENDA, THIRD MEETING

June 26, 2019

10:00 – 10:05	WELCOME
10:05 – 10:15	ISSUES OVERVIEW
10:15 – 10:45	PRESENTATION: Maryland's regulatory process and status (Joshua Shodeinde, MDE)
10:45 - 11:00	PRESENTATION: LDCs (Stephen Holcomb, Columbia Gas)
11:00 – 11:30	GROUP DISCUSSION
11:30 – 12:30	LUNCH BREAK (on your own)
12:30 – 2:45	GROUP DISCUSSION
2:45	WRAP UP/NEXT STEPS



Maryland
Department of
the Environment

Minimizing Methane Emissions from the Natural Gas Industry



Joshua Shodeinde, Maryland Department of the Environment (MDE)
VA DEQ Ad Hoc Work Group Meeting
June 26, 2019



Maryland Commission on Climate Change

- In 2007, The Maryland Commission on Climate Change (MCCC) was established by Executive Order
 - MCCC was codified into law in 2015
- Basic charge of the MCCC:
 - Provide recommendations on how to reduce GHG emissions and adapt to the impacts of climate change



Greenhouse Gas Reduction Act (GGRA)

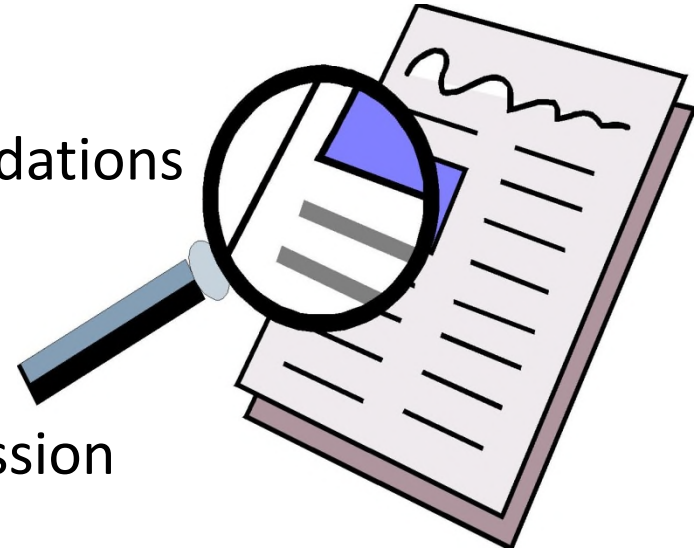
- Originally adopted in 2009
- Required that Maryland develop and implement a plan to reduce greenhouse gas (GHG) emissions by 25% by 2020
- The law also requires that the plan support a healthy economy and create new jobs
- Refreshed by the General Assembly in 2016 to add an additional goal for 2030
 - 40 % GHG reduction by 2030
 - Same focus on the economy and jobs





MCCC Recommendations

- On November 15, 2016 the MCCC issued its annual report
- The report included over forty recommendations on mitigation, adaptation and education, communication and outreach
- One was specific to in-state methane emission reductions:
 - *“... the MCCC supports MDE’s efforts to reduce methane emissions from landfills, natural gas infrastructure (e.g. compressor stations and underground storage), and waste water treatment plants, and recommends further research into additional sources such as agriculture and fuel production/transport”.*





US Climate Alliance

- Maryland joined the U.S. Climate Alliance (USCA) on January 10, 2018
 - Originally, an alliance of 12 states ... now 24 states
- Basic mission: to meet the goals of the Paris Climate Agreement, aiming to reduce GHG emissions by at least 26-28 percent below 2005 levels by 2025
- One working group is focused on short-lived climate pollutants.





MDE Actions

PHASE 1

Production

Ban on hydraulic fracturing



Phase 2

Transmission and Storage

Currently drafting regulations



Phase 3

Distribution

Under review



MD Transmission Sector Sources

- Three compressor stations
 - Dominion, Myersville
 - TransCanada, Rutledge
 - Williams Transco, Ellicott City
- One underground storage facility
 - Spectra Texas Eastern, Accident
- One import and liquefaction/export facility
 - Dominion, Cove Point





Stakeholder Meetings

MEETING 1 – June 29, 2017

Overview of the Natural Gas Industry



MEETING 2 – July 10, 2018

Regulatory and Voluntary Concepts - General



MEETING 3 – March 8, 2019

Regulatory and Voluntary Concepts - Specifics



FRIDAY'S MEETING – June 28, 2019

Summary and Discussion of “Discussion Draft” of Regulation



Stakeholder Comments/Concerns

Industry

Establish regulatory framework that allows for flexibility

Consider requirements that will not cause more emissions

Community Groups

Concerned about methane emissions/leakage surrounding facilities

Require facilities to keep communities informed during blowdown events

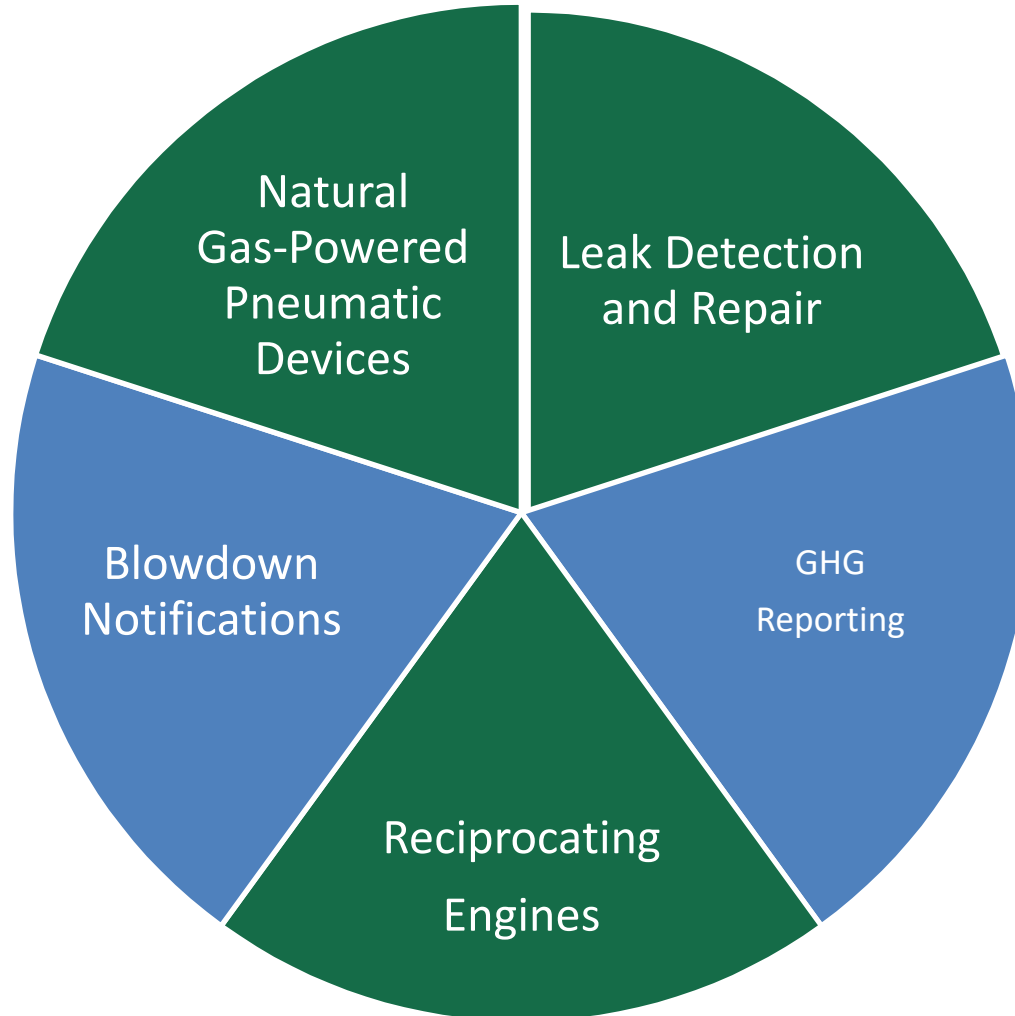
Environmental Advocacy

Maryland should focus on emissions from entire natural gas value chain

Encourage methane recovery

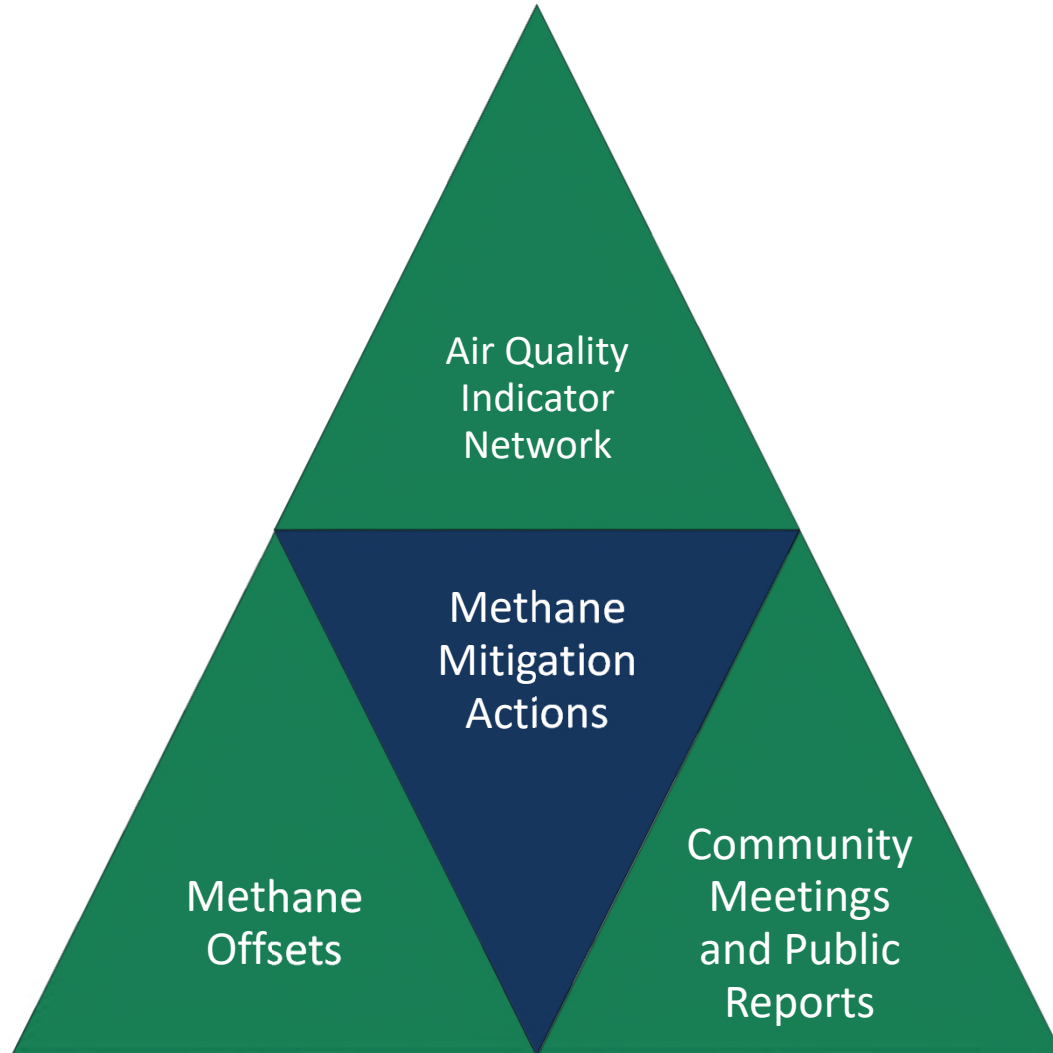


Part I: Regulatory Requirements (Under Consideration)





Part II: Voluntary (Under Consideration)





Summary

- MCCC, GGRA, and USCA are driving forces to MDE actions
 - Also interest from surrounding communities
- MDE intends to evaluate and address methane emissions across entire natural gas chain
 - Current focus is Transmission and Storage
- Contact Information:

Joshua Shodeinde

Joshua.Shodeinde@maryland.gov

410-537-3866

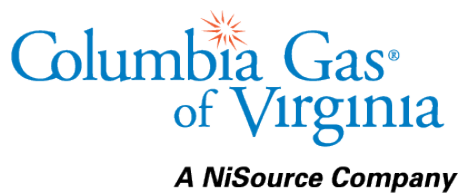
A bright sun is positioned in the upper right quadrant of the image, casting a strong glow and creating a lens flare effect. The sky is a deep, clear blue, and several large, fluffy white cumulus clouds are scattered across the scene, particularly on the left and right sides. The overall atmosphere is bright and clear.

QUESTIONS



Methane Emissions Reductions in Virginia By Natural Gas Distribution Companies

June 26, 2019



NiSource

Largest Natural Gas Distribution Companies in the Commonwealth



A NiSource Company

- Headquartered in Chester, Columbia Gas of Virginia provides natural gas service to more than 275,000 residential, commercial and industrial customers across a diverse footprint encompassing 22,000 square miles of Virginia, including 55 counties, 17 cities, and 20 towns. Columbia Gas of Virginia is one of the seven energy delivery companies of NiSource Inc., who together provide essential natural gas and electric service to nearly 4 million customers.



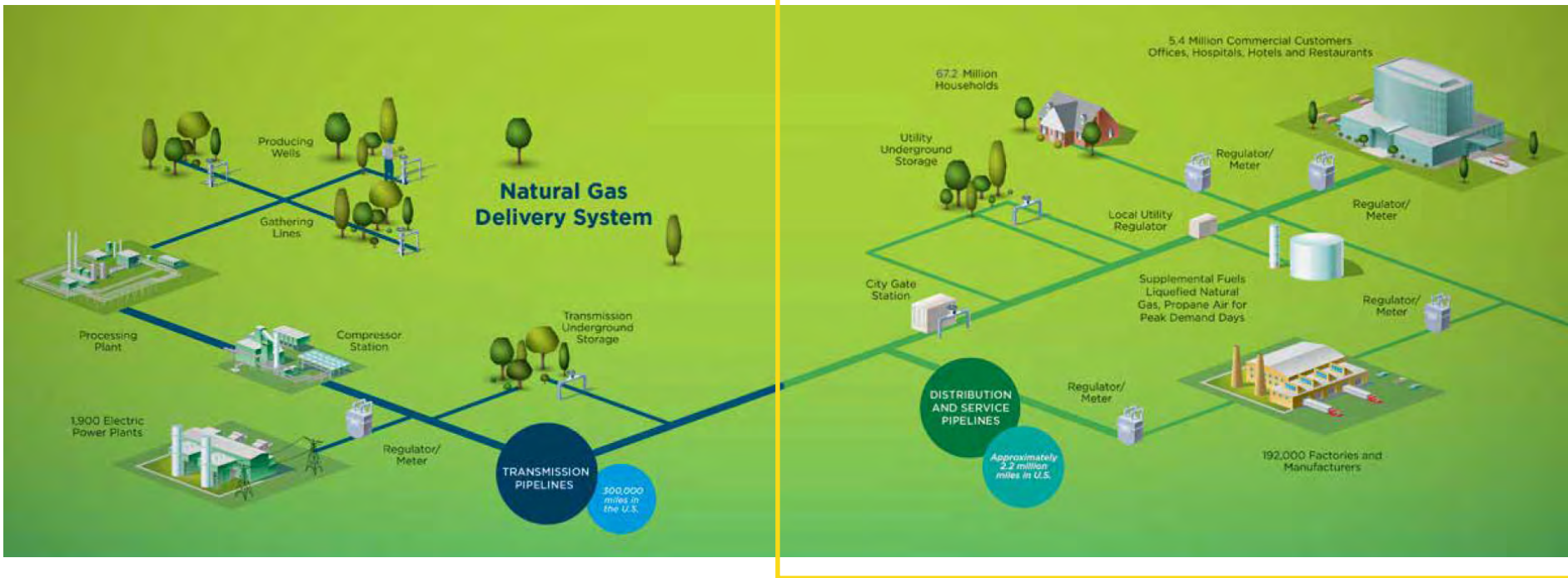
- With roots that stretch back to 1850, Virginia Natural Gas (VNG) serves approximately 299,000 residential, commercial and industrial customers in southeastern Virginia. VNG is owned by Southern Company Gas, a wholly-owned subsidiary of Southern Company. Southern Company serves nearly 9 million natural gas and electric customers.



A WGL Company

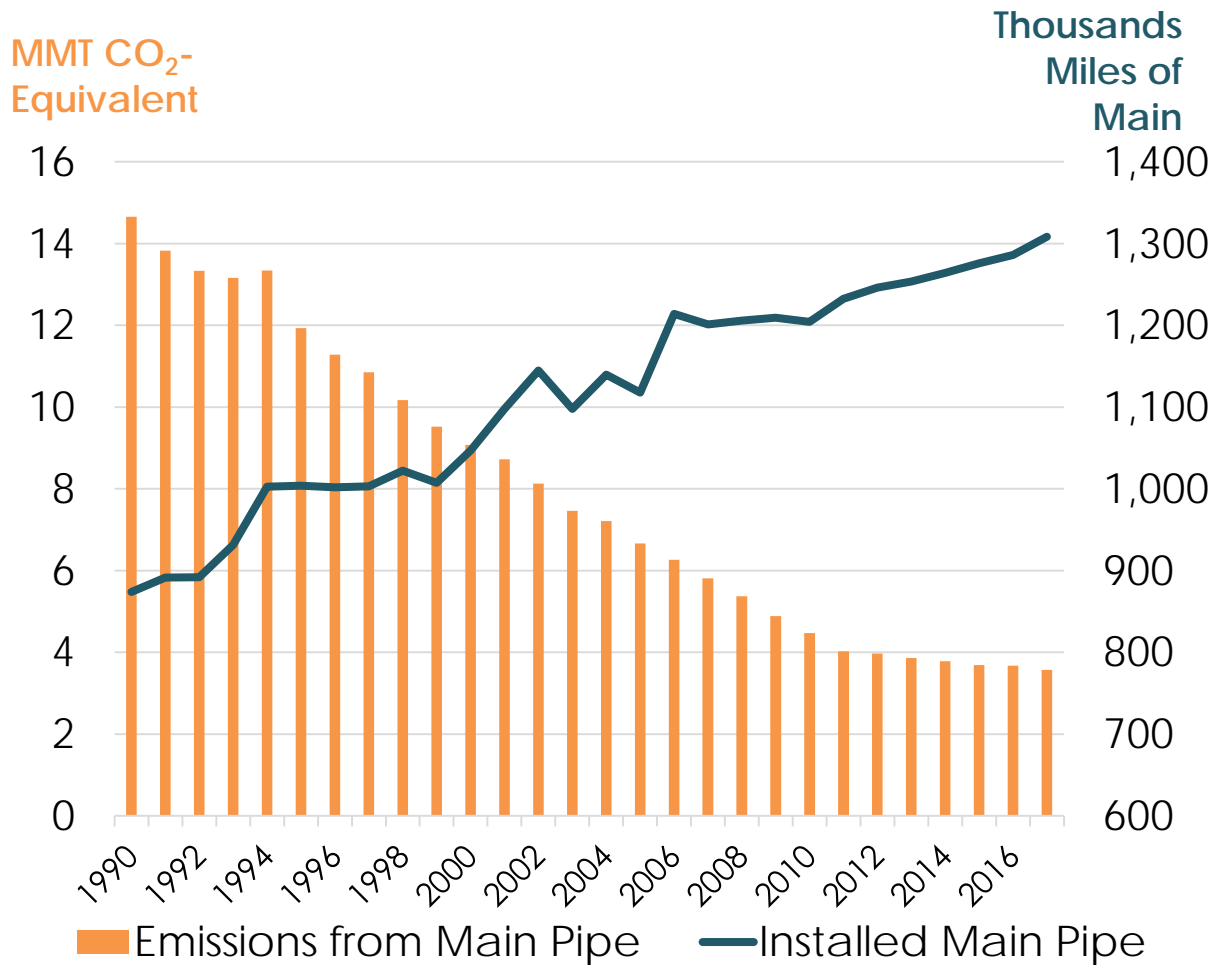
- Washington Gas Light Company is a regulated natural gas utility providing safe, reliable natural gas service to more than 1.1 million customers in the District of Columbia, Maryland and Virginia. A subsidiary of WGL Holdings, Inc., the company has been providing energy to residential, commercial and industrial customers for more than 170 years. Please see the Appendix for more information about the company.

Natural Gas Distribution Overview



Source: American Gas Association (AGA)

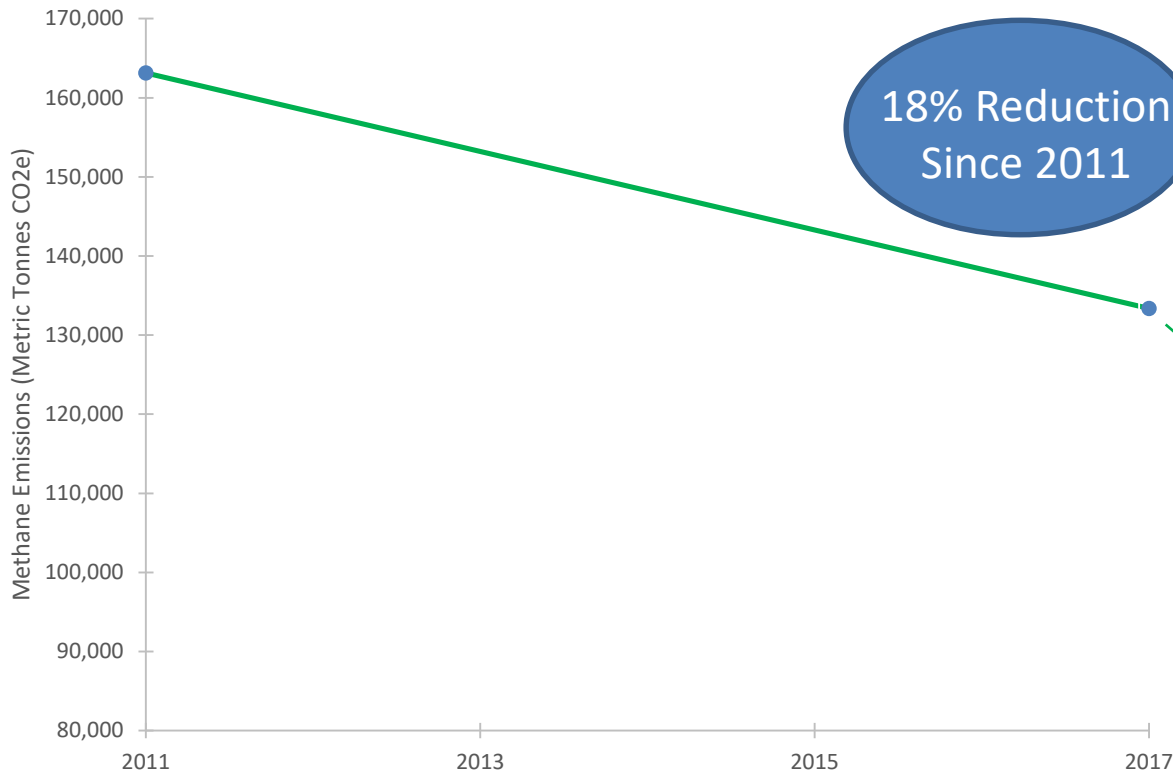
Pipe Replacement Lowers Emissions, Even With System Growth



Sources: EPA and AGA

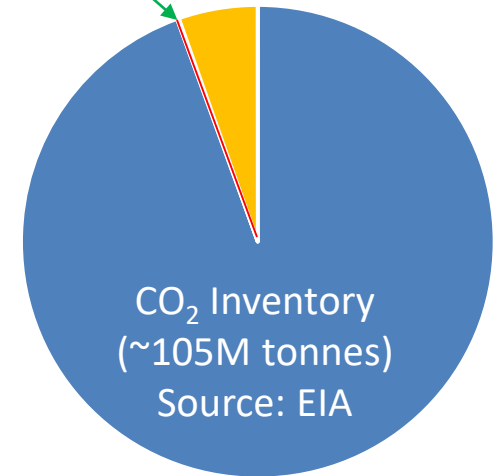
Activity Data and Emissions from EPA *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2017*

Natural Gas Distribution Companies in VA are Reducing Methane Emissions



LDC Methane Inventory
0.1% of VA GHG Inventory
(133,358 tonnes CO₂e)

Non-LDC Methane Inventory
(~6M tonnes CO₂e)
Source: EPA GHGRP



Source: EPA Flight Database – 2011 and 2017 Data from Columbia Gas of Virginia, Virginia Natural Gas, and Washington Gas Light Company

Virginia GHG Inventory

Steps to Advance Virginia's Energy (SAVE) Plan, Regulated by the SCC

Safety

Reliability

Methane Reductions

- In 2010, the General Assembly passed the SAVE Act, which allows for recovery of certain costs associated with infrastructure replacement projects
 - All projects must enhance safety or reliability, and reduce GHG emissions
 - Annual filings with the SCC publicly report the GHG emission reductions
- Columbia Gas has ramped up investment from \$5M to \$37M per year
 - The company eliminated cast iron pipe in 2015
 - Cathodically unprotected bare steel is being replaced with modern cathodically protected coated steel and plastic pipe
- Virginia Natural Gas has ramped up investment from \$17M to \$39M per year
- Washington Gas is investing an average of \$100M per year

Voluntary Partnerships to Reduce Methane Emissions

- We are founding members of EPA's Methane Challenge Program, a voluntary program to recognize companies that make specific and transparent commitments to reduce methane emissions
 - Washington Gas hosted the Excavation Damage Prevention Technology Transfer Workshop in May 2017
- Working collaboratively with EPA for nearly 30 years to support methane emissions reductions through EPA's Natural Gas STAR Program



Methane Reduction Targets



- 50% methane reduction from natural gas main and service lines by 2025, from a 2005 baseline
 - Columbia Gas of Virginia achieved a 22% reduction in 2018. NiSource is on track to achieve its 2025 target.



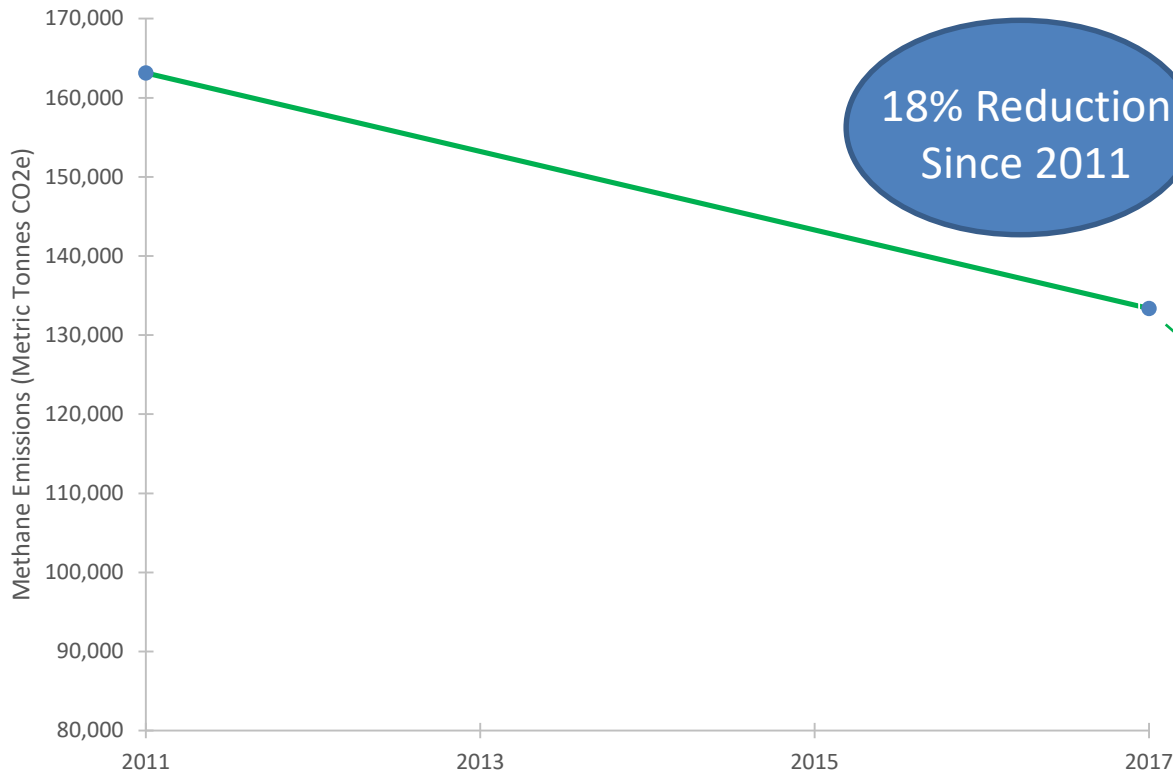
- Methane intensity (leak rate divided by throughput) of 0.22% by 2025



- In 2014, Washington Gas achieved a **20% reduction in the fugitive emission intensity** of their gas supply system compared to the 2008 baseline
- The company set a new target for 2025 – targeting a 38% reduction in the fugitive emission intensity

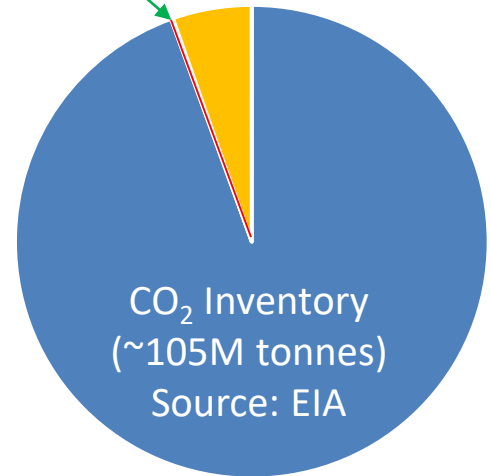
Questions and Discussion

(Slide #5 Has Been Copied Here for Review)



LDC Methane Inventory
0.1% of VA GHG Inventory
(133,358 tonnes CO₂e)

Non-LDC Methane Inventory
(~6M tonnes CO₂e)
Source: EPA GHGRP



Source: EPA Flight Database – 2011 and 2017 Data from Columbia Gas of Virginia, Virginia Natural Gas, and Washington Gas Light Company

Virginia GHG Inventory

Appendix

WASHINGTON GAS SAVE INFO

- Washington Gas(WG) has 9 distribution programs and 4 transmission programs that enhances the safety, improve reliability, and reduce GHG emissions under the VA SAVE program.
- WG is investing an average of **\$100M per year**
 - Note: VA PSC approved \$500M starting Jan 2018 - Dec 2022 with a cap not to exceed by 5%
- WG replaced **85 miles of main** and 31,563 services over the past 9 years.
- All of the WG's proposed replacements for SAVE reduce potential leaks, enhance safety (e.g., Excess Flow Valves, new marking technology, updated as-builting, moving inside meters outside, etc.) and improve reliability (e.g., uprating low pressure systems which can reduce water infiltration into pipelines causing outages, etc.) of the Company's distribution system.
- Replacements will be made using modern polyethylene (PE) pipe which has a historical leak rate of almost zero, excluding leaks related to excavation damages which are addressed in the Company's robust damage prevention program.

EXPERIENCED ENVIRONMENTAL STEWARDS

- Washington Gas has an established Emissions Committee that brings together various cross-functional disciplines to provide strategic planning, support, technical assessment, and policy oversight to ensure focus and direction of methane emission reduction programs and projects.
- In 2018, Washington Gas earned a top spot as **Utility Champion of the Environment** in a nationwide industry study of energy utilities conducted by Market Strategies International for Cogent Reports. Among the criteria for this award: dedication to environmentally friendly energy sources, providing effective tools and programs, helping customers conserve energy, supporting environmental causes, encouraging green initiatives for buildings and vehicles, and demonstrating progress in protecting the environment.
- In 2016, we reported substantial progress in reducing greenhouse gas (GHG) emissions, exceeding targeted expectations over a 2008 GHG baseline assessment. Afterwards, we established new long-range GHG goals and targets to achieve “carbon neutrality” for our fleet and facilities by 2025 while striving to reduce fugitive emissions from the gas we deliver by 38 percent. In addition, we added a third goal — to help WGL customers achieve reductions equivalent to the avoidance of 18 million tons of carbon dioxide emissions. Because of these and other initiatives, Washington Gas’ achievements were recognized in 2017 by the Maryland Green Registry’s Leadership Award.

Worksheet I: Applicability by Industry Segment

- 1. Where do we focus our resources, and why?
- 2. For each sector, where is the low-hanging fruit?

Production and processing
(wells, gathering, processing)

1. _____

2. _____

Transmission and storage
(pipeline, compressor stations, storage)

1. _____

2. _____

Distribution
(city gate, mains, customers)

1. _____

2. _____

Worksheet II: Potential Recommendations

Voluntary

Improve emission reductions and generate useful data with certainty:

1. _____

2. _____

3. _____

Assure voluntary measures are ongoing/assure continuity:

1. _____

2. _____

3. _____

Regulatory

Incentives:

1. Reward super compliance with reduced reporting

2. _____

3. _____

Other suggestions:

1. _____

2. _____

3. _____

Baseline requirements

1. _____

2. _____

Monitoring

1. _____

2. _____

Recordkeeping/reporting

1. _____

2. _____

**COMMONWEALTH OF VIRGINIA
DEPARTMENT OF ENVIRONMENTAL QUALITY**

**METHANE LEAKAGE FROM NATURAL GAS INFRASTRUCTURE
REVISION A19**

AD HOC WORK GROUP, FOURTH MEETING MINUTES

**THIRD FLOOR CONFERENCE ROOM
1111 EAST MAIN STREET, RICHMOND, VIRGINIA
August 13, 2019**

Members Present:

Braven Beaty, The Nature Conservancy
James Bradbury, Georgetown Climate
Jeff Bennett for Andres Clarens, UVA
Will Cleveland, SELC

Jon Lawson for Kevin Elkins, Coronado
Michael Hahn for Richard Lutz, Transco
Shepelle Watkins-White, VNG

Members Absent:

Joshua Ball, CNX
Lisa S. Beal, Dominion

Andrew Williams, EDF

Staff:

Michael G. Dowd, Air Division
Tamera Thompson, Air Division

Irina Calos, Communications
Karen Sabasteanski, Regulatory Affairs

The meeting began at approximately 10:05 a.m.

Meeting Purpose: This ad hoc work group has been established to advise and assist DEQ in the development of a framework for limiting methane leakage from natural gas infrastructure. This group will support DEQ in its collection and evaluation of data to inform the regulation development process. The agenda (Attachment A) follows.

Welcome and Introductions: Ms. Sabasteanski welcomed the group. Members introduced themselves individually. Ms. Calos reviewed several themes that have emerged over the past meetings and items of general agreement identified during the third meeting, and reiterated the Governor's charge to the group (Attachment B).

Group Discussion: Ms. Sabasteanski reviewed the three sectors involved in the natural gas industry (see the last slide of Attachment B). Based on previous group discussion, the current meeting focused on transmission, including associated equipment and compressor stations. Although the remaining sectors--production and distribution--still need to be considered and evaluated in the future, they are a lower priority at this time due to the state of current controls, inventories, and resources. In particular, control of methane emissions from wellheads requires greater analysis of inventory and control technologies than currently available.

The group discussed, in greater detail, the areas of general agreement that were identified during the third meeting as they relate to transmission (see Slide 9 of Attachment B). In particular, leak detection and repair (LDAR) programs were discussed in the context of Subparts OOOO and OOOOa of 40 CFR Part 60¹. Blowdowns were also discussed in detail; they are not subject to Subparts OOOO or OOOOa, and the nature of the activity may call for a flexible best management practice approach. Reporting and recordkeeping issues were also discussed, as were various methane control approaches taken by different states.

Ms. Thompson reiterated the Governor's charge to DEQ, and asked the group to consider the path forward. She and Mr. Dowd reminded the group that the goal was to recommend specific areas to consider in more detail to DEQ management. Based on further discussion, it appeared that most of the group did not object to the following list, which has been identified by DEQ as a starting point for potential future consideration:

1. Develop Virginia-specific inventory of methane emissions (coordinate existing efforts, leverage recordkeeping and reporting)
2. Subparts OOOO and OOOOa
 - LDAR and other compliance options
 - the appropriateness of applying certain requirements for new sources to existing sources
 - recordkeeping and reporting (quarterly or annual); frequency and vehicle (e.g., routine emissions statements)
 - alternative compliance options
3. Blowdowns
 - different types
 - different facilities
4. DEQ resources
5. Accessibility of information (coordinate what is already readily available)

DEQ will take these issues into consideration when developing its report to the administration.

Some of the group members also showed interest in potentially exploring the inclusion of new sources not yet regulated or proposed in Virginia (such as new LNG infrastructure) beyond current federal standards.

Once the group agreed that areas of focus have been properly identified, they agreed that no further meetings of the group were necessary at this time. The group was reminded that should a regulatory action be initiated, that there would likely be an opportunity to participate in a formal Regulatory Advisory Panel.

¹ Subpart OOOO, Crude Oil and Natural Gas Production, Transmission and Distribution for which Construction, Modification or Reconstruction Commenced after August 23, 2011, and on or before September 18, 2015, and Subpart OOOOa, Crude Oil and Natural Gas Facilities for which Construction, Modification, or Reconstruction Commenced after September 18, 2015, are federal New Source Performance Standards (NSPSs) that do not apply to existing sources.

Wrap-up/Next Steps: Ms. Sabasteanski concluded the meeting. The meeting adjourned at approximately 2:00 p.m.

REG\DEVA19-AH04-4-minutes

COMMONWEALTH OF VIRGINIA
DEPARTMENT OF ENVIRONMENTAL QUALITY

METHANE LEAKAGE FROM NATURAL GAS INFRASTRUCTURE
AD HOC WORK GROUP

DRAFT AGENDA, FOURTH MEETING

August 13, 2019

10:00 – 10:05	WELCOME
10:05 – 11:30	GROUP DISCUSSION: STRUCTURING RECOMENDATIONS; MOVING FORWARD
11:30 – 12:30	LUNCH BREAK (on your own)
12:30 – 2:45	GROUP DISCUSSION, CONTINUED
2:45	WRAP UP/NEXT STEPS



Methane Ad Hoc Workgroup

Fourth Meeting

Air and renewable Energy Division
Virginia Department of Environmental Quality
August 13, 2019

Things we've heard...

- Emissions are already effectively controlled.
- Not all facilities are improving emissions through available voluntary measures.

Things we've heard...

- Facilities need more incentives for voluntary measures.
- Regulations ensure emission reductions are made.

Things we've heard...

- Regulation is a disincentive to innovation.
- Regulation can be structured to reward compliance.

Things we've heard...

- Regulation will create expense with little benefit.
- Expenses are worth the long-term benefits.

Things we've heard...

- Emissions may be less than expected, and not enough Virginia data is available.
- Additional reporting will assure certainty and establish better data.

Things we've heard...

- Other source types produce more methane, so the focus should be elsewhere.
- Significant reductions are still achievable.

Why we are here

- *Develop a framework for limiting methane leakage from natural gas infrastructure and landfills.*

Natural gas has significant potential as a bridge fuel to help us reduce carbon pollution that drives climate change while we transition to solar, wind, and other clean energy sources. The relative climate benefits of natural gas compared to other fossil fuels are well documented, but we only realize those benefits if we prevent natural gas from leaking into the atmosphere before it is burned. For that reason, and due to inaction at the federal level, Virginia must take action to limit methane pollution within its borders. The Virginia Department of Environmental Quality (DEQ) will lead this effort, and will establish a workgroup of environmental, academic and business stakeholders within the next 120 days to support DEQ in its collection and evaluation of data to inform the regulation development process.

General points of agreement/further evaluation

- LDCs should be lower priority.
- Reporting is important.
- LDAR should be a component of recordkeeping.
- OOOO and OOOOa could be a good starting point.
- Alternative compliance should be considered.
- BMPs are useful on a case to case basis.
- Specific technological controls need to be identified.
- Cost-effectiveness should be considered.
- Periodic review of technologies should be considered.

