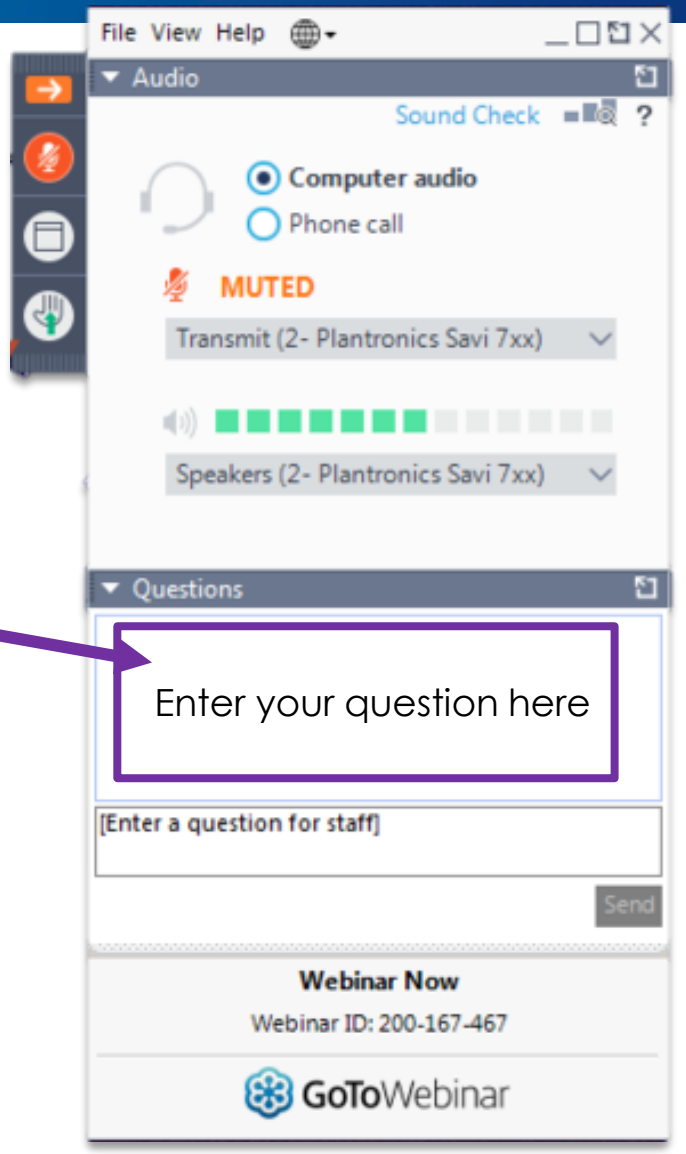
Data-Driven Decision Making for Cost-Effective Methane Emission Mitigation

July 24, 2019

Tips

- All participants (except speaker) are in listen-only mode
- Questions submitted during the webinar will be reviewed at the end of the webinar
  - Type a question here
- If you are experiencing technical difficulties, please let us know using the Questions pane on the right side
- A copy of today's presentation will be available on EPA's website



Agenda

- Welcome and Opening Remarks
- Data-Driven Decision Making Kinder Morgan Natural Gas Pipeline Business Unit
  - Jim Tangeman, Kinder Morgan
- Case Study - Strengthen Reporting Assurance with Business Intelligence Tool
  - Dan McDermott, Huco Consulting
  - Dave Cox, PE, FirmoGraphs
- Questions
- Upcoming Events

Data-Driven Decision Making Kinder Morgan Natural Gas Pipeline Business Unit

EPA Natural Gas STAR and Methane Challenge Programs

July 24, 2019

Jim Tangeman, Kinder Morgan EHS Manager
Natural Gas Pipelines Business Unit

Kinder Morgan: Leader in Energy Infrastructure

Experienced operator with unparalleled footprint built over decades

Note: Mileage and volumes are company-wide per 2019 budget.

Largest natural gas transmission network

- ~70,000 miles of natural gas pipelines
- Connected to every important U.S. natural gas resource play and key demand centers
- Move ~40% of natural gas consumed in the U.S.

Largest independent transporter of refined products

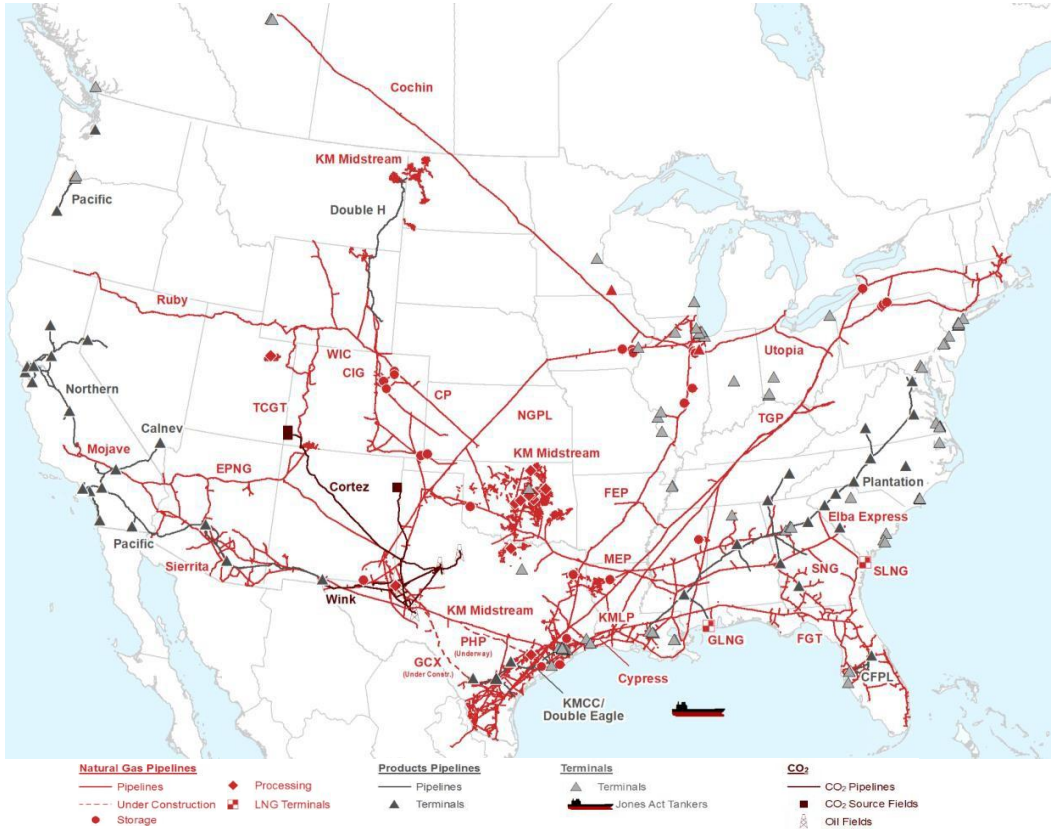
- Transport ~1.7 mmbbld of refined products
- ~6,900 miles of refined products pipelines
- ~5,800 miles of other liquids pipelines (crude and natural gas liquids)

Largest independent terminal operator

- 157 terminals

Largest transporter of CO_2

- Transport ~1.2 Bcfd of CO_2



Kinder Morgan – Commitment to Reduction of Methane

Kinder Morgan Commitment to Reduction of Methane Emissions

Kinder Morgan became one of the Founding Members of the Environmental Protection Agency's Natural Gas STAR Methane Challenge (ONE Future Option) Program in 2016 through our participation in the ONE Future Coalition industry group. By doing so, we are recognized as leaders in our industry in reducing methane emissions using smart performance-based approaches. Kinder Morgan believes it is important to be part of the solution toward reducing emissions of methane and other greenhouse gasses through industry-leading efforts in safely and efficiently delivering natural gas to consumers.

As a Methane Challenge Partner company, Kinder Morgan has committed our natural gas transmission and storage facilities to implement activities and technologies, and transparently report systematic and comprehensive actions to reduce methane emissions. This commitment will be met through a company policy made effective under **O&M Procedure 1229 – Methane Emissions, Reporting, and Reductions**.

Kinder Morgan – Decades of Commitment to Methane Reductions

- Charter Partner of EPA's Natural Gas STAR Program: 1993 to present
  - Many innovative technologies and practices resulted from the program
- A Founding Member of the ONE Future Coalition in 2014
- A Charter Partner of EPA's Natural Gas STAR Methane Challenge Program – ONE Future Option in 2016
  - KM committed to a methane emission intensity target of 0.31% across our transmission and storage operations by 2025.
  - First reporting year of 2017, KM achieved a methane emission intensity of 0.04%
  - **Additional years of methane emission reductions and methane emission intensities need to be collected to better understand the trends and targets.**
  - **Continuous Improvement: ONE Future's methane management approach aligns with Kinder Morgan's Operations Management Systems (OMS) philosophy.**

Kinder Morgan – Methane Reduction Programs Timeline (2015 to present)

- 2015: As part of ONE Future, began collaborating with USEPA on their Methane Challenge program to include a ONE Future option
- 2016: USEPA finalized the Methane Challenge-ONE Future option in August
- January 1, 2017: Official start date of Kinder Morgan's commitments under Methane Challenge
- 2017: Rollout of Methane Challenge tools and tracking systems to be used by stakeholders within Kinder Morgan: leak survey and repair spreadsheets, leak tracking database, gas loss minimization form (next few slides)
- 2017: Updating emission reporting tools for tracking and reporting methane reductions
- 2018: Finalize and rollout internal policy and procedure implementing program
- 2018 to present: Continue collaboration with EPA and Other Agencies

Kinder Morgan – Work Flow & Responsible Parties

Kinder Morgan's GHG group sends out list of facilities to be surveyed & measured during first quarter of each year.

Kinder Morgan assigned Technicians or Contractors perform the annual leak surveys & measurements at the affected facilities. Technicians enter the results in the respective spreadsheet tools (see upcoming slides)

For surveys & measurements performed by Kinder Morgan assigned Technicians upload all survey & measurement results into KM Leak Database from the spreadsheet tools (see upcoming slides).

Kinder Morgan's GHG Group collects all the leak data from the KM Leak Database and other KM databases to generate annual GHG Reports to EPA, ONE Future report, EPA's Natural Gas STAR Report, EPA's Methane Challenge Report, and Corporate ESG Report

Kinder Morgan – Program Implementation

- **Key Evaluation Questions**
  - Can this program be implemented using internal or external resources or a combination of both?
  - Business case: What is the estimated cost, where will the funds come from, what is the ROI, and intangible co-benefits?
  - **How will it be successfully implemented internally?**
  - Who are the internal stakeholders that will have responsibilities under this program?
  - How will the data needed for this program be collected and where will it reside?
  - **What will we do with this data after it is collected? Calculating emissions, determining emission reductions, reporting, and other analysis TBD**

- **Key Program Elements**
  - Kinder Morgan Internal Procedures
  - Determining affected facilities
  - Facility leak surveys & measurement data
  - Leak repairs & confirmation data
  - Determining internal responsible parties
  - Universal and **easy to use tools** to track and collect the data
  - Centralized data repository tool
  - Calculation and reporting tools

Kinder Morgan – Data Collection & Management Tools

- **Kinder Morgan Operation & Maintenance (O&M) Procedures: O&M 1229 Methane Emissions Reporting and Reductions**
- **Kinder Morgan ONE Future-Methane Challenge intranet website available to all Kinder Morgan employees and Kinder Morgan contractors**
- **Spreadsheets & Other materials posted on intranet website for stakeholders**
  - Annual list of facilities needing surveys & measurements
  - GHG survey spreadsheet
  - Leak repair list spreadsheet
  - Other spreadsheets
  - Training materials
  - Link to O&M 1229
  - Link to Kinder Morgan Equipment Leaks and Repairs Dashboard
  - Kinder Morgan methane commitment documents
- **Kinder Morgan Leak Database (MS Access and SQL)**
- **Kinder Morgan Equipment Leaks and Repairs Dashboard**
- **Sharepoint and Network Server**
- **OpsInfo Environmental Management System & Emission Reporting**

"Your recent Amazon purchases, Tweet score and location history makes you 23.5% welcome here."

Kinder Morgan – O&M Procedure 1229

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	No.	O&M 1229
	Title:	Methane Emissions Reporting and Reductions
O&M PROCEDURE	Revised:	2018-07-01

Table of Contents

1. Applicability

1.1. Facility Type

Gas Pipeline Facility:

- ☐ Gas Treatment
- ☐ Offshore Gathering
- ☐ Regulated Onshore Gathering – Type A
- ☐ Regulated Onshore Gathering – Type B
- ☒ Transmission

Storage Facility:

- ☒ Underground Natural Gas Storage

This procedure applies to all Company Transmission and Storage Operations.

1.2. Additions and Exceptions

Gas pipeline facilities, including pipe and appurtenances, and underground natural gas storage facilities covered by these procedures are subject to PHMSA regulations, and may be subject to additional regulations of other governing bodies (e.g., EPA, FERC, OSHA, Intrastate Regulated - AL PSC, LA DNR, OCC, TRRC, UT PSC, etc.).

The applicability of O&M Procedures to specific Company business entities is delineated in P0005 – Introduction to Company Standards

Kinder Morgan – Annual Survey Spreadsheet

KINDER MORGAN

KINDER MORGAN INC.

GHG Leak Survey & Measurement Report for 40 CFR 98, Subpart W and ONE Future Program

Version 4.0, November 2018

Description of Color Coding	
	Fields Requiring Entry
	Fields Not Requiring Entry; Auto-populated
	Information Only
	Optional Measurements or Data

Division #	0
Station Name	0
Station Number	#N/A
Entity	#N/A
Day 1 Date (mm/dd/yyyy)	1/1/2018

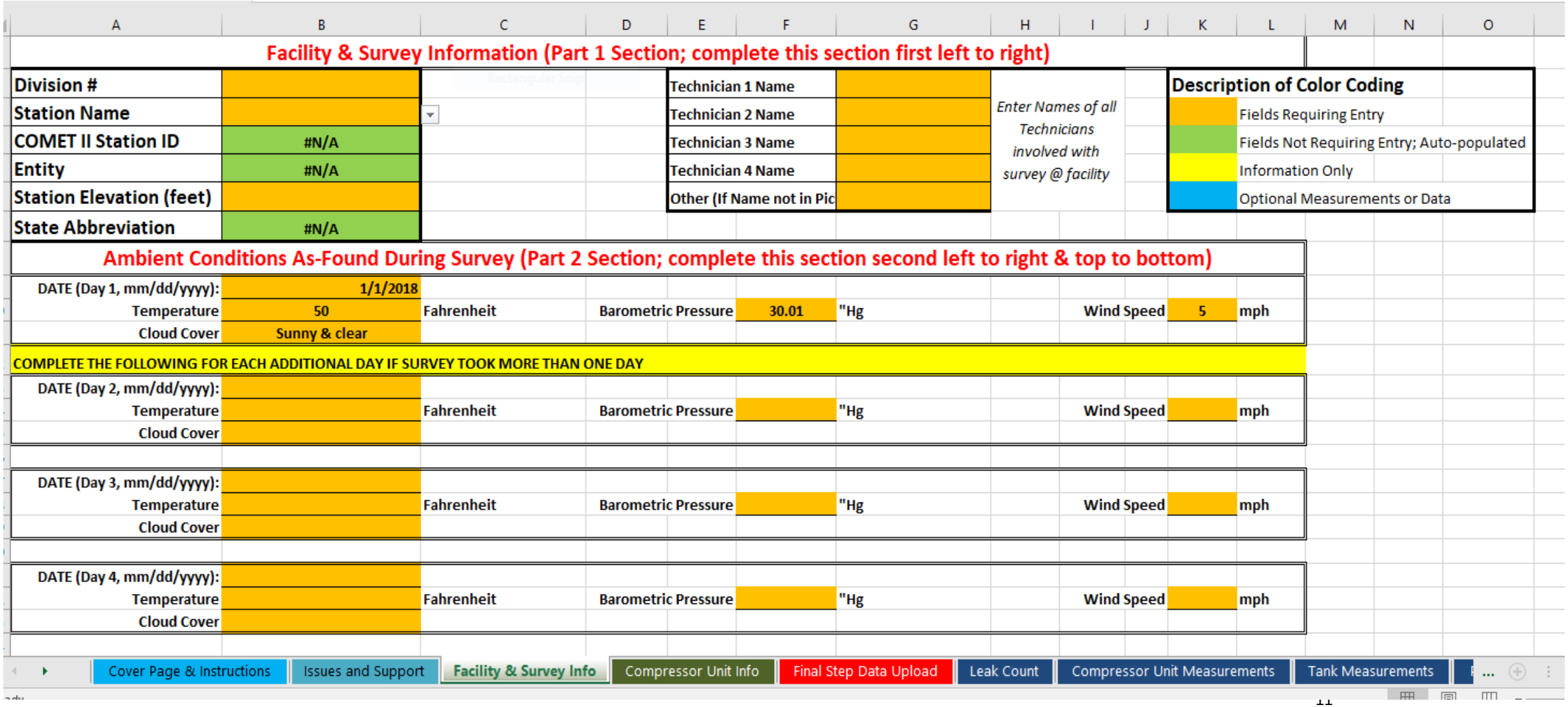
FIRST STEP: In order for this spreadsheet to work, you must configure/install Microsoft Access 2010 or 2016 on your computer. You will only need to do this once. Follow the steps below to complete this:

a	Go to the start menu of your PC and and type Access into the search bar
b	Click on Microsoft Access 2010 or 2016
c	Your PC will automatically complete configuring Access for your PC. This will take approximately 5 minutes
d	When complete, an access file will open on your computer. Close the file by clicking the X button in the top right
e	You can now run the program in the spreadsheet. Continue to the steps below

Instructions Completing the Report Tabs

Cover Page & Instructions | Issues and Support | Facility & Survey Info | Compressor Unit Info | Final Step Data Upload | Leak Count | Compressor Unit Measurements | Tank Measurements

Kinder Morgan – Annual Survey Spreadsheet
Facility Info.



Facility & Survey Information (Part 1 Section; complete this section first left to right)

Division #	
Station Name	
COMET II Station ID	#N/A
Entity	#N/A
Station Elevation (feet)	
State Abbreviation	#N/A

Technician 1 Name	
Technician 2 Name	
Technician 3 Name	
Technician 4 Name	
Other (If Name not in Pic	

Enter Names of all Technicians involved with survey @ facility

Description of Color Coding	
	Fields Requiring Entry
	Fields Not Requiring Entry; Auto-populated
	Information Only
	Optional Measurements or Data

Ambient Conditions As-Found During Survey (Part 2 Section; complete this section second left to right & top to bottom)

DATE (Day 1, mm/dd/yyyy):	1/1/2018							
Temperature	50	Fahrenheit	Barometric Pressure	30.01	"Hg	Wind Speed	5	mph
Cloud Cover	Sunny & clear							

COMPLETE THE FOLLOWING FOR EACH ADDITIONAL DAY IF SURVEY TOOK MORE THAN ONE DAY

DATE (Day 2, mm/dd/yyyy):								
Temperature		Fahrenheit	Barometric Pressure		"Hg	Wind Speed		mph
Cloud Cover								
DATE (Day 3, mm/dd/yyyy):								
Temperature		Fahrenheit	Barometric Pressure		"Hg	Wind Speed		mph
Cloud Cover								
DATE (Day 4, mm/dd/yyyy):								
Temperature		Fahrenheit	Barometric Pressure		"Hg	Wind Speed		mph
Cloud Cover								

Cover Page & Instructions | Issues and Support | Facility & Survey Info | Compressor Unit Info | Final Step Data Upload | Leak Count | Compressor Unit Measurements | Tank Measurements

Kinder Morgan – Leak Repair List Spreadsheet

	A	B	C	D	E	F	G	H	I	J	K
1	Select Facility Name				Get Leak Data from Database		Upload Repair Data				
2											
3	Select Repair Status		All								
4											
5	Entity	Division	Station Name	Leak Number Tag	Technician(s) who Identified the Leak	Leak Identification Date	Leak Description	Component Type	Component Category	Observed Severity	Technicians Comments
6											
7											
8											
9											

	D	K	L	M	N	O	P	Q	R
			Requires Input from Operations						
			Auto-Populated. No Input Needed			THIS IS THE INITIAL REPAIR DEADLINE			IF REPAIR IS MADE, YOU MUST ENTER YOUR NAME IN THE COLUMN BELOW
	Leak Number Tag	Technicians Comments	Leak Repair Status	Leak Repair Date	Leak Confirm Method/Device	Date of Next Scheduled Station Shutdown	Delay of Repair Reason (complete only if repair was not repaired at next scheduled shutdown in column O)	Repair Not to Exceed Date	Operations Person Name

Kinder Morgan – Leak Database

KINDER MORGAN

Leak Report

ID	Division	Auto Assign Leak Number	LeakIDTag	Leak Identification Date	Leak ID Year	Temp(F)	Pressure(Hg	WindSpeed(	CloudCover	Leak Description
2	2	CIG-2541042787-1	1001	2/21/2017	2017	34	30.06	5	Partly Cloudy	FCV-3 ESD Blow down
3	2	CIG-2541042787-2	1002	2/21/2017	2017	34	30.06	5	Partly Cloudy	V-4 scrubber sight glass valve.
4	2	CIG-2541042787-3	1003	2/21/2017	2017	34	30.06	5	Partly Cloudy	Domestic fuel gas neter 2 in. pipe
5	2	CIG-2541042787-4	1004	2/21/2017	2017	34	30.06	5	Partly Cloudy	V-27 Fisher 2732 regulator.
6	2	CIG-2541042787-5	1005	2/21/2017	2017	34	30.06	5	Partly Cloudy	Domestic fuel supply pot.
7	2	CIG-2541042787-6	1006	2/21/2017	2017	34	30.06	5	Partly Cloudy	CG-2 main fuel shut off valve sten
9	2	CIG-2546042786-1	1001	2/20/2017	2017	63	29.95	10	0	CG- 4 unloader vent
10	2	CIG-2546042786-2	1002	2/20/2017	2017	63	29.95	10	0	CG-4 Oil Sump vent
11	2	CIG-2546042786-3	1003	2/20/2017	2017	63	29.95	10	0	CG-4 compressor crank case breatl
12	2	CIG-2546042786-4	1004	2/20/2017	2017	63	29.95	10	0	CG- 2 Prelube filter 1 in. Piping thr
13	2	CIG-2546042786-5	1005	2/20/2017	2017	63	29.95	10	0	CG-1 #1 compressor 1/4 in. comp. h

Leak Report

Component Type	Component Category	Observed Se	Default Leak	Estimated Le	Direct Meas	Direct Measurement Device	Video ID	Leak Repair Da
OEL (Sub. W & OF)	Non-compressor	Low (0.01 to 1.(			0.03	High Flow Sampler	1448, 1449	2/20/2018
Valve (Sub. W & OF)	Non-compressor	Low (0.01 to 1.(	1				1444, 1454	
Connector (Sub. W & OF)	Non-compressor	Low (0.01 to 1.(	1				1450, 1451	2/20/2018
Connector (Sub. W & OF)	Non-compressor	Low (0.01 to 1.(	1				1437, 1438	2/20/2018
Connector (Sub. W & OF)	Non-compressor	Low (0.01 to 1.(	1				1452, 1453	
Valve (Sub. W & OF)	Compressor	Low (0.01 to 1.(	1				1455, 1456	2/20/2018
OEL (Sub. W & OF)	Compressor	Low (0.01 to 1.(			0.31	High Flow Sampler	1412, 1413	2/19/2018
OEL (Sub. W & OF)	Compressor	Moderate (1.01			4.17	High Flow Sampler	1414, 1415	2/19/2018
Connector (Sub. W & OF)	Compressor	Moderate (1.01	5				1423, 1424	2/19/2018
Connector (Sub. W & OF)	Non-compressor	Low (0.01 to 1.(	1				1422	2/19/2018
Other/Non-EPA see description (OF Only)	Compressor	Low (0.01 to 1.(	1				1420, 1421	2/19/2018
Connector (Sub. W & OF)	Non-compressor	Low (0.01 to 1.(	1					
Connector (Sub. W & OF)	Non-compressor	Low (0.01 to 1.(	1					

Kinder Morgan – Data, Data, Data

Kinder Morgan – Current Activities and Reductions

- ONE Future-Methane Challenge Commitments include:
  - Leak detection & repair at T&S stations (Phase-In 2017 to 2021)
  - Reduction of Transmission Pipeline Blowdown volumes
    - Pipeline pump downs and compression sleeves
  - Other technologies & work practices on case-by-case basis

- Year 1: 2017 Methane Reductions (volume)*
  - Vol. Leak Detection & Repair = 176,511 thousand cubic feet (MCF)
  - Reduction of Transmission Pipeline BDs = 3,115,817 MCF

- Year 1: 2017 Methane Reductions (mass)*
  - Vol. Leak Detection & Repair = **3,389 MT CH4 (84,725 MT CO2e)**
  - Reduction of Trans. Pipeline BDs = **59,823 MT CH4 (1,495,592 MT CO2e)**

- Year 2: 2018 Methane Reductions (Pending)

*Includes the annual methane reductions associated with Kinder Morgan's Methane Challenge commitments in 2017. Does not include the additional EPA Natural Gas STAR recurring reductions reported to EPA separately for 2017.

Kinder Morgan – Leak Dashboard

Kinder Morgan
Natural Gas Pipelines

ONE Future-Methane Challenge Leak Tracking Dashboard

Equipment Leaks

This page includes leak data for all piping and equipment components at the surveyed stations and it also identifies whether a component has been repaired or not repaired. These are the component types covered under the leak repair program described in Section 3.3.7 of O&M 1229

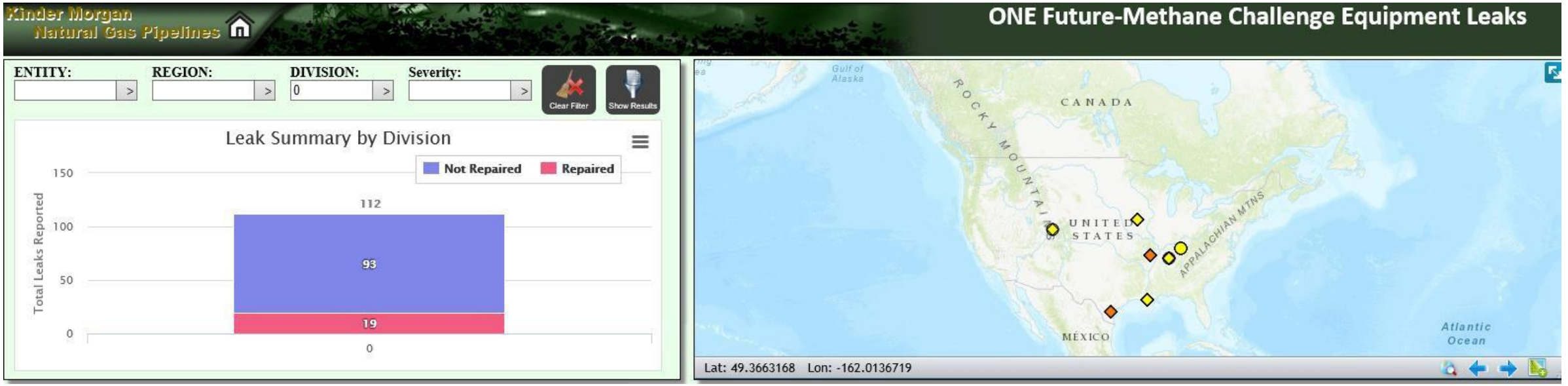
Compressor Leaks

This page includes leak survey and measurement data for the compressor sources at the surveyed stations. These compressor source categories include reciprocating compressor rod packings, centrifugal compressor wet seals, centrifugal compressor dry seals, unit blowdown valves, and unit isolation valves. These compressor sources are not covered under the leak repair program of O&M 1229, but this information is provided for Operations personnel to use in their decision-making about whether a repair or replacement might be warranted.

Tank Leaks

This page includes leak survey and measurement data for the tank leaks found at the surveyed stations. These tank leak sources might include thief hatches, tank vents, tank valves and other types of leak points associated with atmospheric tanks containing some type of hydrocarbon that is connected either upstream or downstream of a pressurized natural gas line. These tank leak sources are not covered under the leak repair program of O&M 1229, but this information is provided for Operations personnel to use in their decision-making about whether a repair or replacement might be warranted.

Kinder Morgan – Leak Dashboard (sample data only)



Previous 1 2 3 4 5 ... 12 Next Search:

Leak Identification Date	Leak Description	Component Type	Observed Severity	Leak Repair Status	Leak Confirm Method Device	Delay of Repair Reason	Repair Deadline
4/8/2019	Main fuel regulator tubing line fitting	Non-EPA: Connector (OF Only)	Low (0.01 to 1.00 cfm)	Repaired	OGI (FIIR or OpGal)		4/8/2021
4/23/2019	Fisher dump valve on fuel gas filter	Non-EPA: Valve (OF Only)	Low (0.01 to 1.00 cfm)	Not Repaired	NA		4/23/2021
4/23/2019	Unit 379 flange on the discharge pipe #48	Non-EPA: Connector (OF Only)	Low (0.01 to 1.00 cfm)	Not Repaired	NA		4/23/2021
4/23/2019	Unit 367 discharge isolation valve 1 nipple	Non-EPA: Connector (OF Only)	Low (0.01 to 1.00 cfm)	Not Repaired	NA		4/23/2021
4/25/2019	1 ball valve on the fuel regulator and meter, it is the 1 blowdown valve.	Non-EPA: OEL (OF Only)	Low (0.01 to 1.00 cfm)	Not Repaired	NA		4/25/2021
3/6/2019	Underground Main line valve stem control next to A3/D3 main line valve	Non-EPA: Valve (OF Only)	Low (0.01 to 1.00 cfm)	Not Repaired			3/6/2021

Kinder Morgan – Elements for Successful Implementation from a Data Perspective

- Tools available to the front-line stakeholders (i.e., Operations and Technicians).
  - User-friendly spreadsheets and databases accessible across the assets
  - When possible, make use of systems already in place that are familiar with stakeholders
- Company-wide internal procedures
- Proper training and guidance
- Third year of program: continues to evolve
- Continuous Improvement: always seek opportunities to make improvements
  - Continue communicating the program up and down the chain of command
  - Improvements with data collection & management tools
  - Get feedback from internal stakeholders/customers
  - Prioritization of leaks and repair activities
  - Implement lessons learned
  - Analyze and communicate data collected, identify trends, inform future decision-making, identify other opportunities to reduce

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Case Study - Strengthen Reporting Assurance with Business Intelligence Tool

Dan McDermott, Huco Consulting

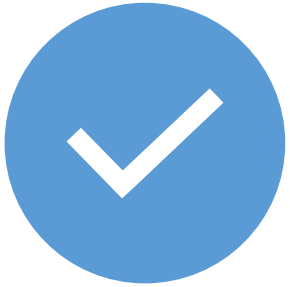
Dave Cox, PE, FirmoGraphs

Takeaway Points

KM has implemented data collection procedures to achieve beyond-compliance improvements. The outlook is great so far, as evidenced by the One Future leak survey activities.

Huco has worked with KM and other customers to apply business intelligence tools and techniques to strengthen reporting assurance.

FirmoGraphs supports Huco leveraging public data sources inside of the BI tools.



Substantial benchmarking opportunities exist.

What are Business Intelligence (BI) Tools?

- Software for data analysis and visualization
- 100s of them available
- 4 named as leaders in the Gartner, Inc Magic Quadrant
- Free versions and free training available online
- Today, working with Qlik Sense™

Why Use BI?

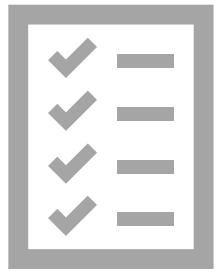
- Identify issues early, before submitting public reports
- Find trends otherwise invisible in spreadsheets
  - Single values, e.g., fuel use
  - Averages
  - Calculated results, e.g., fuel x emission factor
- Make observations to improve operations
- Detect suspicious-looking changes
  - 10x difference this year compared to last
  - Difference in ratios, e.g., production to emissions

Get Ready to Explore

Pick a tool

Do basic training

Learn by doing



Prepare your data

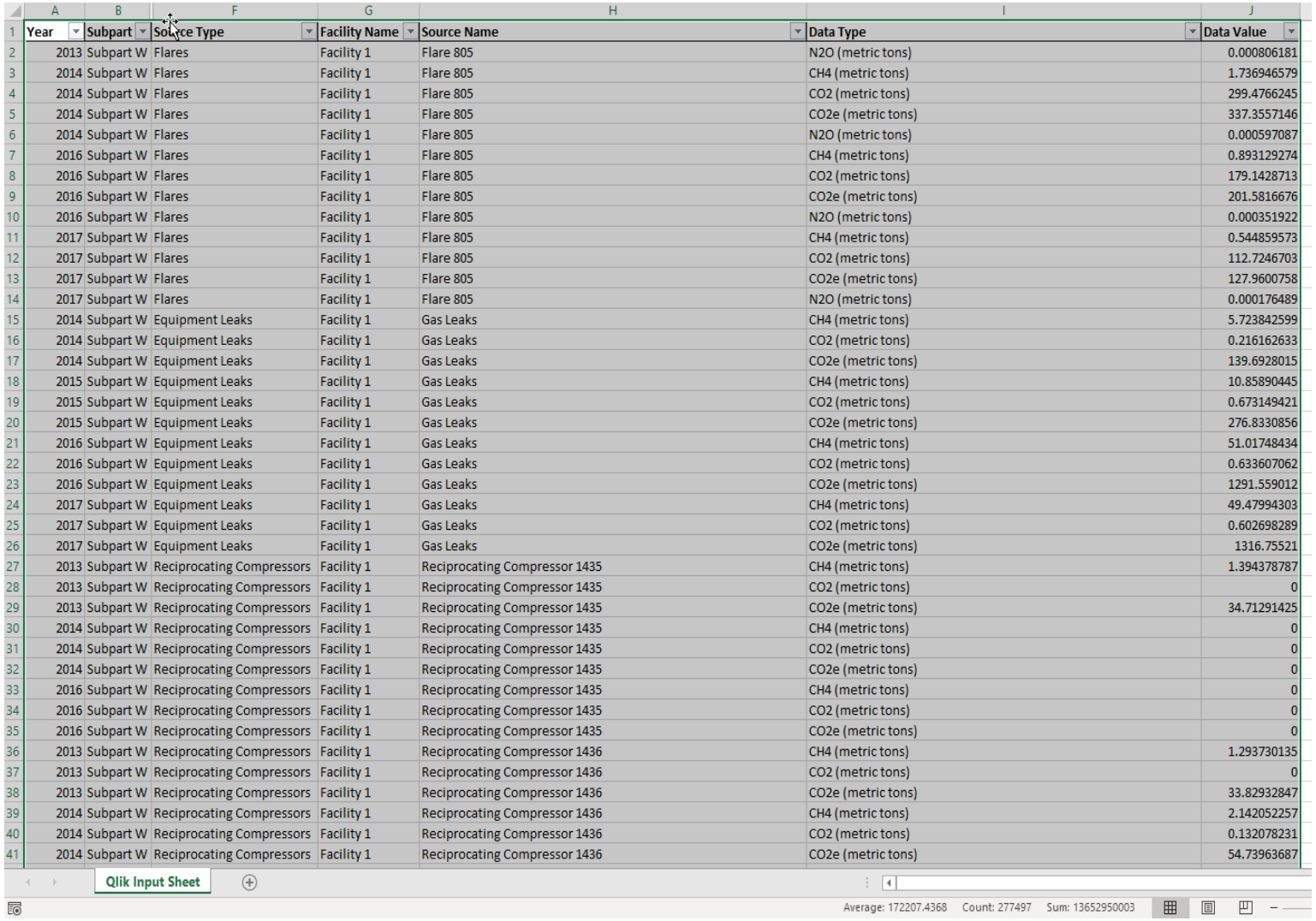
Needs to be structured

Does not need to be perfect

Visualization helps with Data QA

Starting Point

- All data captured in Excel Spreadsheet
- 277497 data points
- Very difficult to extrapolate trends in data.
- Very difficult to validate that data is accurate.



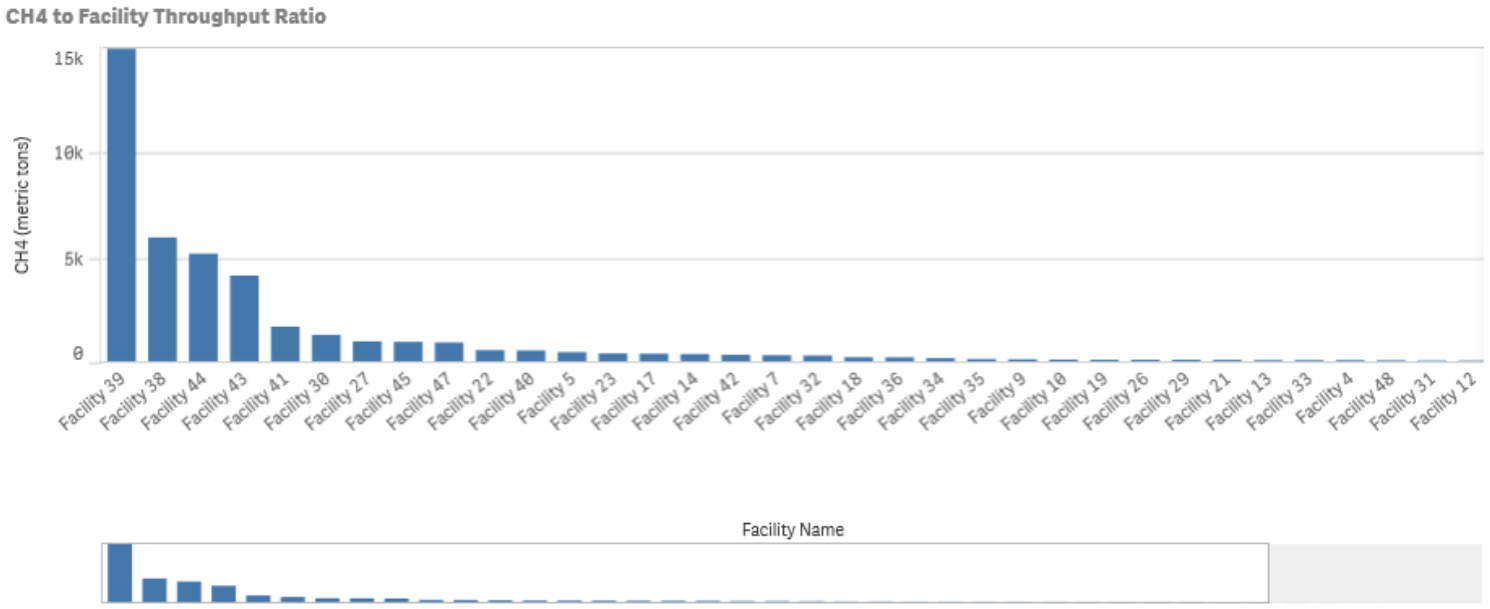
	A	B	F	G	H	I	J
1	Year	Subpart	Source Type	Facility Name	Source Name	Data Type	Data Value
2	2013	Subpart W	Flares	Facility 1	Flare 805	N2O (metric tons)	0.000806181
3	2014	Subpart W	Flares	Facility 1	Flare 805	CH4 (metric tons)	1.736946579
4	2014	Subpart W	Flares	Facility 1	Flare 805	CO2 (metric tons)	299.4766245
5	2014	Subpart W	Flares	Facility 1	Flare 805	CO2e (metric tons)	337.3557146
6	2014	Subpart W	Flares	Facility 1	Flare 805	N2O (metric tons)	0.000597087
7	2016	Subpart W	Flares	Facility 1	Flare 805	CH4 (metric tons)	0.893129274
8	2016	Subpart W	Flares	Facility 1	Flare 805	CO2 (metric tons)	179.1428713
9	2016	Subpart W	Flares	Facility 1	Flare 805	CO2e (metric tons)	201.5816676
10	2016	Subpart W	Flares	Facility 1	Flare 805	N2O (metric tons)	0.000351922
11	2017	Subpart W	Flares	Facility 1	Flare 805	CH4 (metric tons)	0.544859573
12	2017	Subpart W	Flares	Facility 1	Flare 805	CO2 (metric tons)	112.7246703
13	2017	Subpart W	Flares	Facility 1	Flare 805	CO2e (metric tons)	127.9600758
14	2017	Subpart W	Flares	Facility 1	Flare 805	N2O (metric tons)	0.000176489
15	2014	Subpart W	Equipment Leaks	Facility 1	Gas Leaks	CH4 (metric tons)	5.723842599
16	2014	Subpart W	Equipment Leaks	Facility 1	Gas Leaks	CO2 (metric tons)	0.216162633
17	2014	Subpart W	Equipment Leaks	Facility 1	Gas Leaks	CO2e (metric tons)	139.6928015
18	2015	Subpart W	Equipment Leaks	Facility 1	Gas Leaks	CH4 (metric tons)	10.85890445
19	2015	Subpart W	Equipment Leaks	Facility 1	Gas Leaks	CO2 (metric tons)	0.673149421
20	2015	Subpart W	Equipment Leaks	Facility 1	Gas Leaks	CO2e (metric tons)	276.8330856
21	2016	Subpart W	Equipment Leaks	Facility 1	Gas Leaks	CH4 (metric tons)	51.01748434
22	2016	Subpart W	Equipment Leaks	Facility 1	Gas Leaks	CO2 (metric tons)	0.633607062
23	2016	Subpart W	Equipment Leaks	Facility 1	Gas Leaks	CO2e (metric tons)	1291.559012
24	2017	Subpart W	Equipment Leaks	Facility 1	Gas Leaks	CH4 (metric tons)	49.47994303
25	2017	Subpart W	Equipment Leaks	Facility 1	Gas Leaks	CO2 (metric tons)	0.602698289
26	2017	Subpart W	Equipment Leaks	Facility 1	Gas Leaks	CO2e (metric tons)	1316.75521
27	2013	Subpart W	Reciprocating Compressors	Facility 1	Reciprocating Compressor 1435	CH4 (metric tons)	1.394378787
28	2013	Subpart W	Reciprocating Compressors	Facility 1	Reciprocating Compressor 1435	CO2 (metric tons)	0
29	2013	Subpart W	Reciprocating Compressors	Facility 1	Reciprocating Compressor 1435	CO2e (metric tons)	34.71291425
30	2014	Subpart W	Reciprocating Compressors	Facility 1	Reciprocating Compressor 1435	CH4 (metric tons)	0
31	2014	Subpart W	Reciprocating Compressors	Facility 1	Reciprocating Compressor 1435	CO2 (metric tons)	0
32	2014	Subpart W	Reciprocating Compressors	Facility 1	Reciprocating Compressor 1435	CO2e (metric tons)	0
33	2016	Subpart W	Reciprocating Compressors	Facility 1	Reciprocating Compressor 1435	CH4 (metric tons)	0
34	2016	Subpart W	Reciprocating Compressors	Facility 1	Reciprocating Compressor 1435	CO2 (metric tons)	0
35	2016	Subpart W	Reciprocating Compressors	Facility 1	Reciprocating Compressor 1435	CO2e (metric tons)	0
36	2013	Subpart W	Reciprocating Compressors	Facility 1	Reciprocating Compressor 1436	CH4 (metric tons)	1.293730135
37	2013	Subpart W	Reciprocating Compressors	Facility 1	Reciprocating Compressor 1436	CO2 (metric tons)	0
38	2013	Subpart W	Reciprocating Compressors	Facility 1	Reciprocating Compressor 1436	CO2e (metric tons)	33.82932847
39	2014	Subpart W	Reciprocating Compressors	Facility 1	Reciprocating Compressor 1436	CH4 (metric tons)	2.142052257
40	2014	Subpart W	Reciprocating Compressors	Facility 1	Reciprocating Compressor 1436	CO2 (metric tons)	0.132078231
41	2014	Subpart W	Reciprocating Compressors	Facility 1	Reciprocating Compressor 1436	CO2e (metric tons)	54.73963687

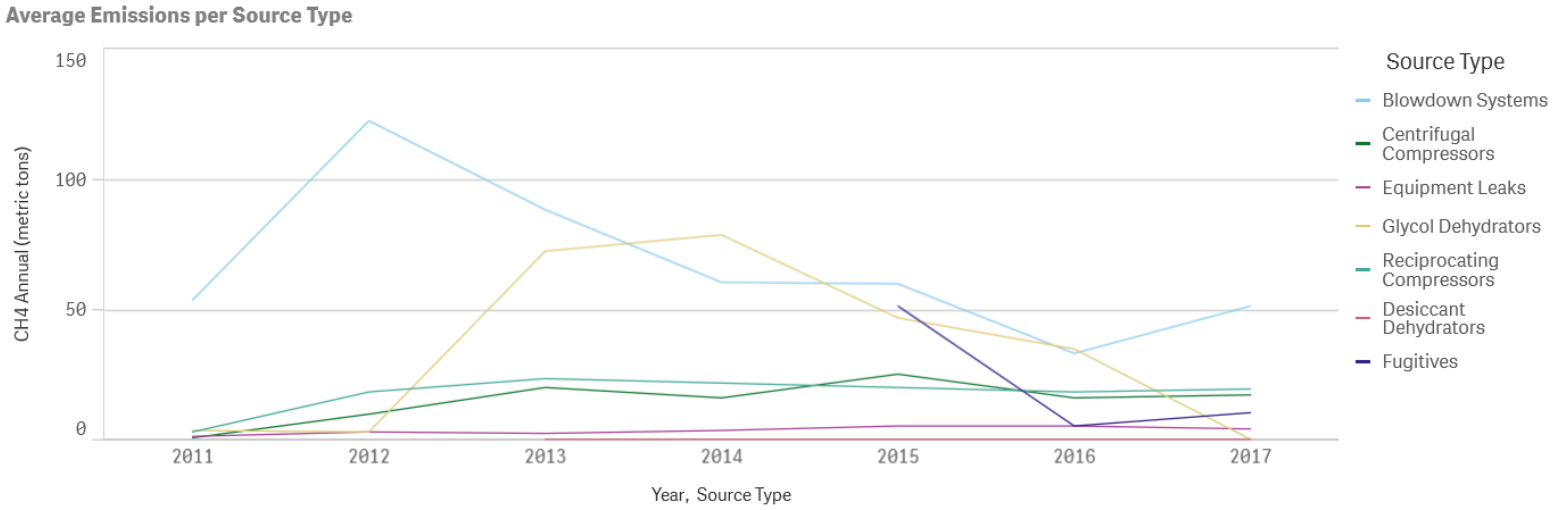
Qlik Input Sheet

Average: 172207.4368 Count: 277497 Sum: 13652950003

Methane Emissions

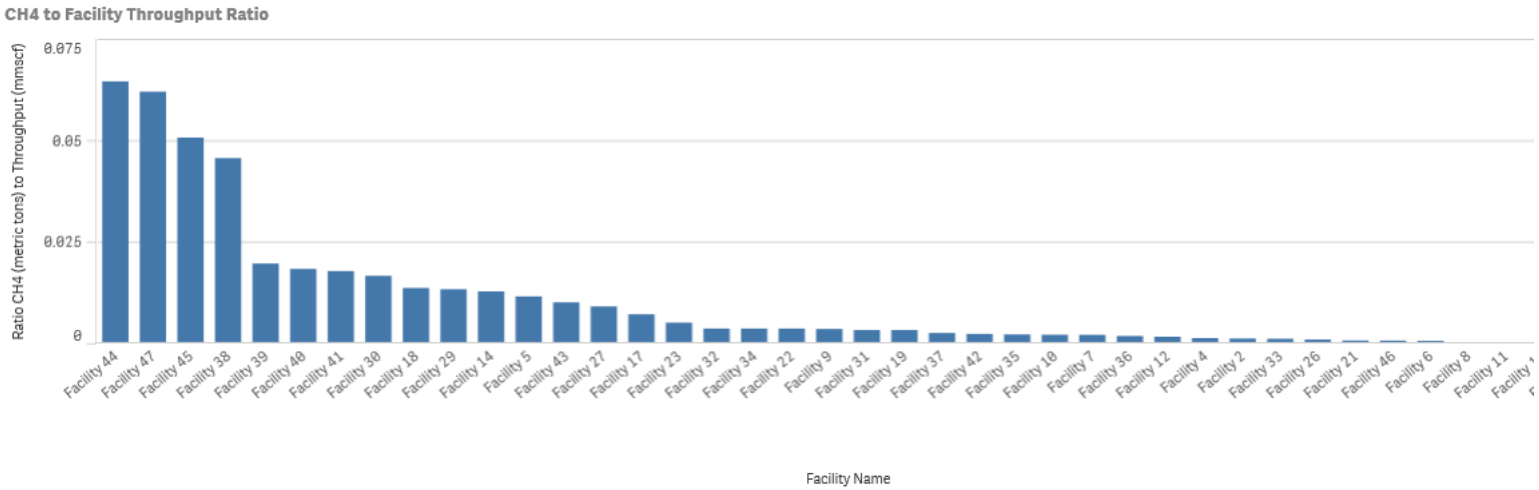
- Review Methane Emissions per facility for single reporting year.
- Review how methane emissions for certain source types changed over a variety of years
- Note that larger facilities are going to have larger emissions.





Methane Emission to Facility Throughput Ratio

- Normalize CH4 as a product of overall facility throughput.
- Ability to review how all facilities are performing and associated emissions from each source type.



Facility CH4 by Source Type

Facility Name	Source Type	CH4 (metric tons)
Totals		**40479.032626439**
Facility 39	Fugitives	10619.070597773
Facility 38	Fugitives	5137.1002334539
Facility 43	Centrifugal Compressors	3405.1472590465
Facility 44	Fugitives	3319.1540696461
Facility 39	Centrifugal Compressors	1718.9012935693
Facility 44	Centrifugal Compressors	1697.84634049
Facility 39	Blowdown Systems	1617.7705177822
Facility 41	Fugitives	1471.3194194474
Facility 45	Fugitives	830.04353698662
Facility 47	Fugitives	778.16916443903
Facility 39	Combustion	628.04932700107
Facility 27	Flares	615.66172875624
Facility 30	Flares	564.86750789711
Facility 22	Flares	478.40268393681

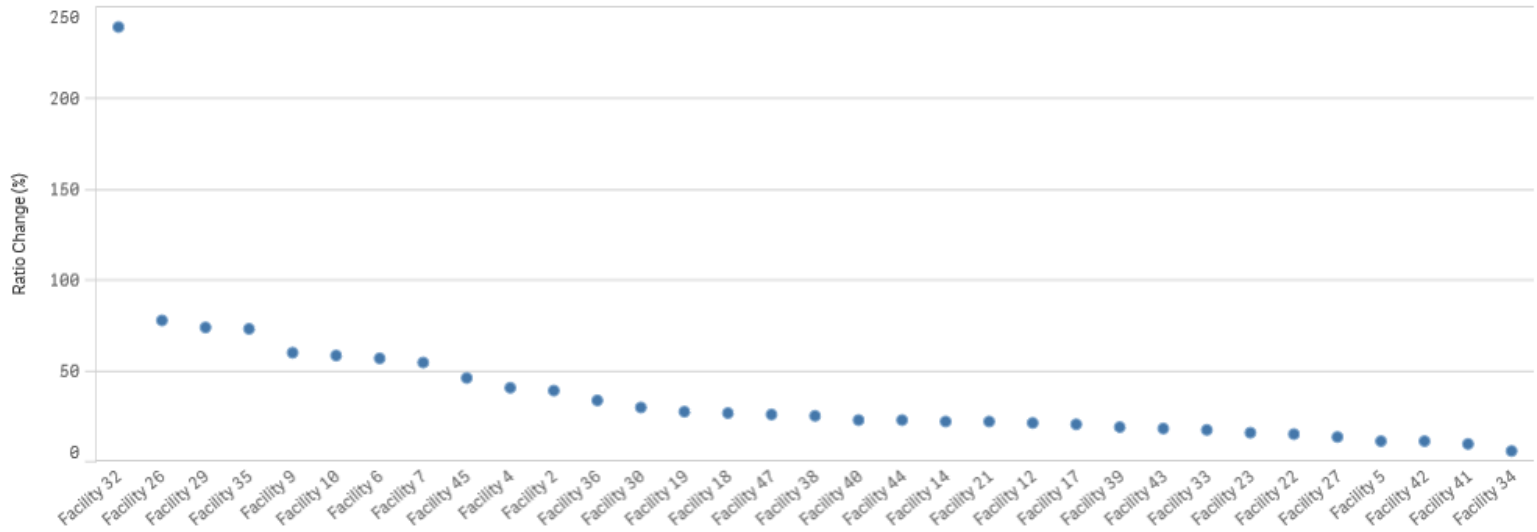
Facility Throughput

Facility Name	Throughput (mscf)
Totals	**3246180132.0696**
Facility 39	767511098.65002
Facility 43	415881821.10608
Facility 22	158880400.7056
Facility 21	156730864.56782
Facility 42	152097556.24137
Facility 38	129755347.21854
Facility 36	123508292.50757
Facility 27	107570405.6801
Facility 26	106639096.28298
Facility 41	94032546.452792
Facility 32	80824986.719448
Facility 44	79611032.922166
Facility 23	77254511.55402
Facility 30	76595019.518523

Data Validation – Change in Throughput Ratio

- Review changes in CH4 to throughput ratio between reporting years.
- Identify any outliers and investigate further

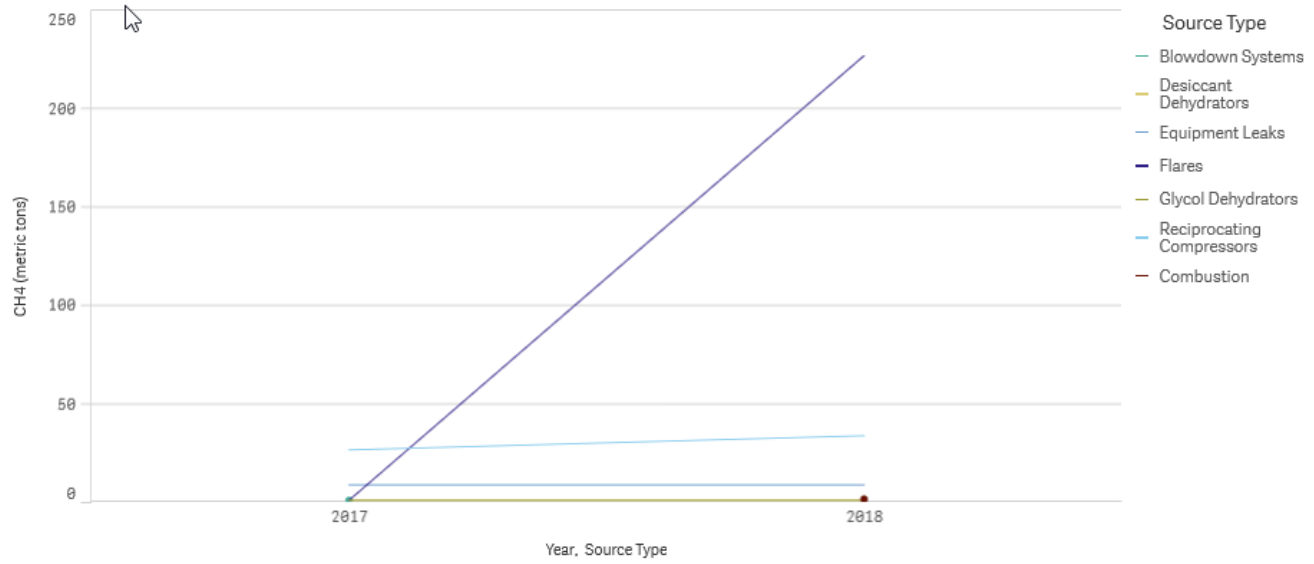
Change in Facility CH4/Throughput Ratio Between Current and Previous Year



Facility CH4, Throughput, and Change Data for Current and Previous Year

Facility Name	Ratio Change (%)	CH4, Prev Year (metric tons)	CH4, Curr Year (metric tons)	Throughput, Prev Year (mscf)	Throughput, Curr Year (mscf)
Totals	-	**40,542**	**40,287**	**2,841,549,035**	**3,246,180,132**
Facility 32	238.25	34	268	35,066,864	80,824,98
Facility 26	76.07	226	65	89,207,277	106,639,09
Facility 29	72.09	620	65	13,255,301	5,016,52
Facility 35	71.40	325	101	49,411,304	53,660,80
Facility 9	58.07	143	91	18,589,699	28,112,83
Facility 10	57.08	54	79	47,067,867	43,899,56
Facility 6	55.43	39	19	60,921,740	68,124,97
Facility 7	53.35	261	132	68,378,625	74,177,22
Facility 45	44.64	854	924	24,413,553	18,258,17
Facility 4	39.04	86	49	54,011,107	50,396,00
Facility 2	37.25	20	23	31,795,109	26,255,08
Facility 36	31.77	292	183	134,425,583	123,508,29
Facility 30	28.60	1,643	1,256	71,558,865	76,595,02
Facility 19	25.63	80	68	20,035,689	23,027,18

CH4 Emissions by Source Type



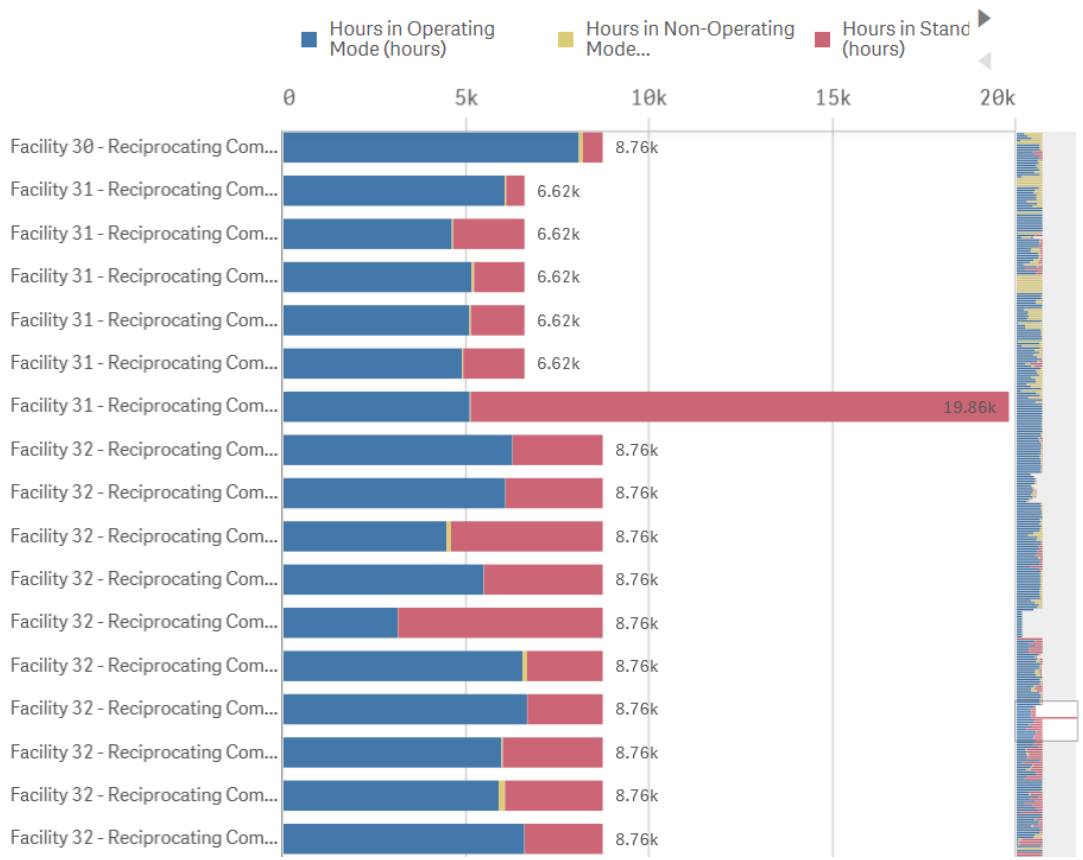
Facility CH4 by Source Type

Facility Name	Source Type	Year	CH4 (metric tons)
Totals			**303.64002089902**
Facility 32	Blowdown Systems	2017	0
Facility 32	Combustion	2018	0.7141495298263
Facility 32	Desiccant Dehydrators	2017	0
Facility 32	Desiccant Dehydrators	2018	0.003937470313534
Facility 32	Equipment Leaks	2017	7.9666698012042
Facility 32	Equipment Leaks	2018	8.2578788118015
Facility 32	Flares	2017	0.4813414716941
Facility 32	Flares	2018	226.59620290164
Facility 32	Glycol Dehydrators	2017	0.12840371611405
Facility 32	Glycol Dehydrators	2018	0.1664531294981
Facility 32	Reciprocating Compressors	2017	25.861648061293
Facility 32	Reciprocating Compressors	2018	33.46333600564

Data Validation – Change in Throughput Ratio

- Filter to outlier.
- Review other visualizations to determine where outlier can be found.
- Investigate further.

Hours for Current Year



Hours of operation will only be displayed when the total hours operated in all 3 modes exceeded the number of hours in a year for the current reporting year.

Hours Exceedances by Mode for Current Year

Only displays compressors where hours in all modes exceeded hours in year.

Facility Name	Source Name	Hours in All Modes (hours)	Hours in Operating Mode (hours)	Hours in Non-Operating Mode (hours)	Hours in Standby Mode (hours)
Facility 31	Reciprocating Compressor 1730	19,855.00	5,129	25	14,70
Facility 30	Reciprocating Compressor 1723	8,818.00	7,992	525	30
Facility 23	Reciprocating Compressor 1621	8,762.00	8,432	330	
Facility 36	Reciprocating Compressor 1781	8,760.00	7,970	300	49

Table will only display compressors that were measured within a mode where an operator had indicated 0 operating hours for that mode during the current reporting year. Filter down to facility if needed.

Measurement Mode Mismatches for Current Year

Only displays compressors that did not operate in a mode they were measured in.

Facility Name	Source Name	Operating Mode Measurement Check	Non-Operating Mode Measurement Check	Standby Mode Measurement Check
Totals		**0**	**0**	**0**

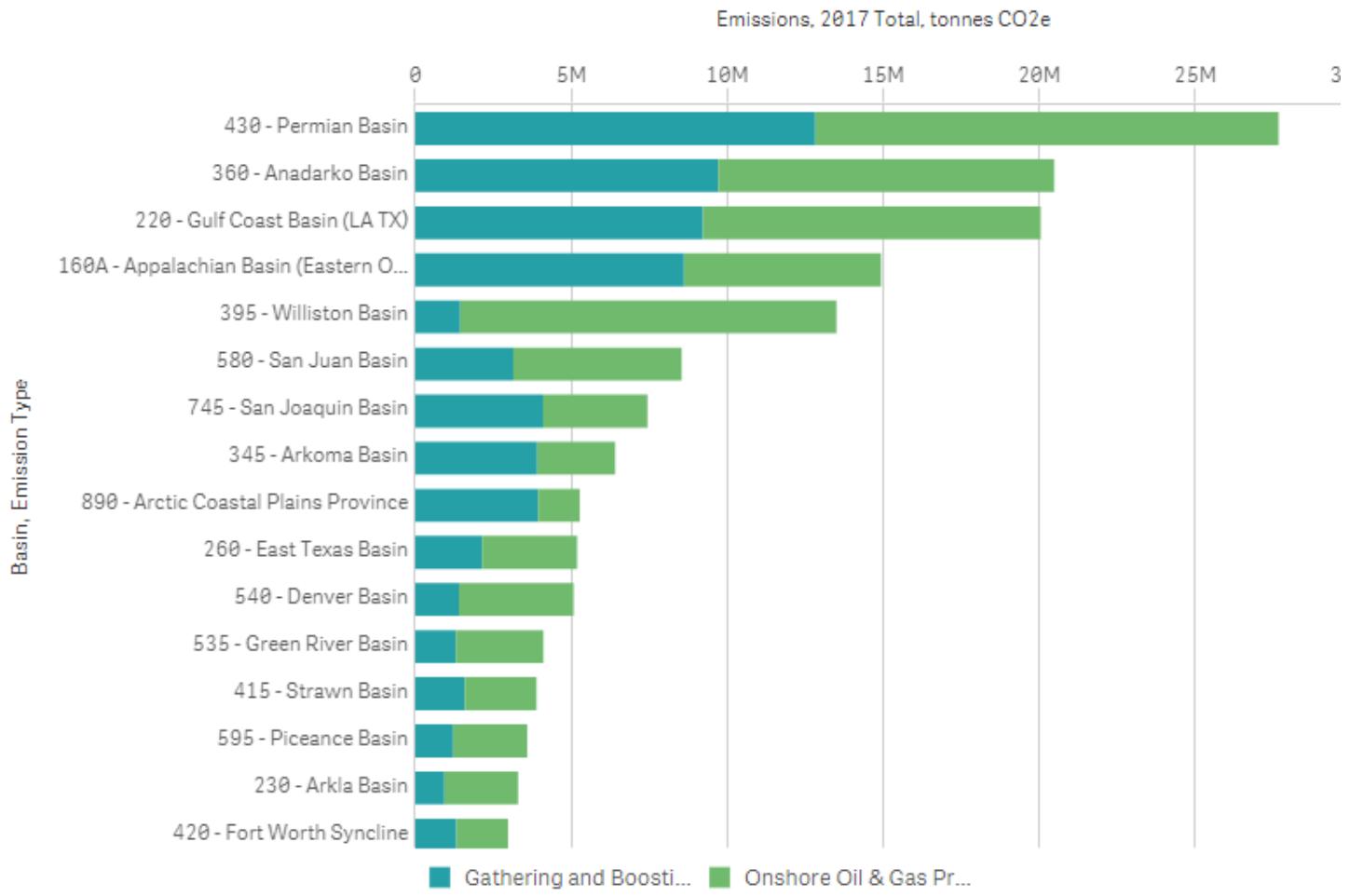
Data – Compressor Hours

- Compressor hours of operation for all modes greater than total hours in year.
- Processing and Transmission rely on these hours for emission calculations.
- Data can be validated within Excel files, but BI tool allows quick identification of data outliers and address issues prior to submittal.

Benchmarking Opportunities

- Utilize flight publicly available data to benchmark emissions
- Production, Gathering, and Boosting
- Data available by operator, facility, and gas emitted

Table: Onshore and Gas Gathering Emissions by Basin, Gas



Conclusions

BI software is inexpensive and powerful

Data exploration is fun

Insights are valuable beyond compliance to drive operational improvement

Questions

Upcoming Events

2019 Renewable Natural Gas Workshop

Save the Date!

Sept 24, 2019
Reno, NV

Photo Credit: Ken Lund, CC BY-SA 2.0

2019 Natural Gas STAR & Methane Challenge Workshop

Save the Date!

Nov 4-6, 2019
Pittsburgh, PA

Photo Credit: Ron Reiring, CC BY 2.0

EPA Methane Challenge & Natural Gas STAR Programs

Contact us:
GasSTAR@epa.gov

Natural Gas STAR Website:
www.epa.gov/natural-gas-star-program