Methane Leakage Overview

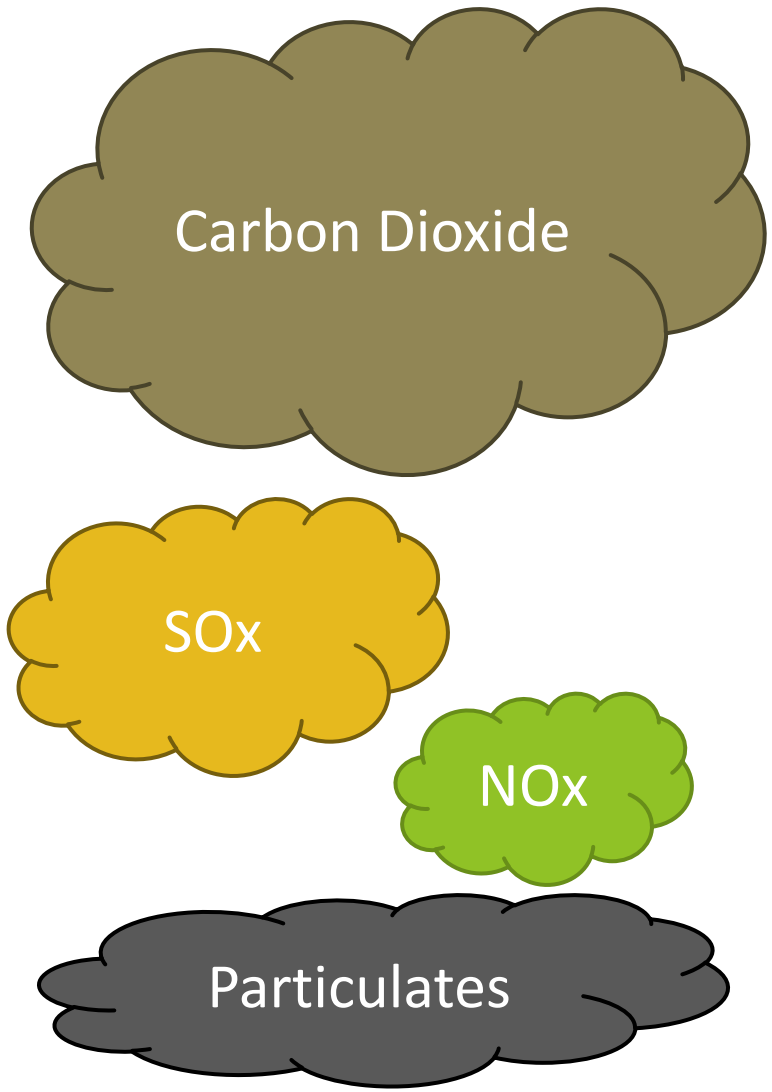
DNV GL

C/CAG Resource Management and Climate Protection Committee

June 17, 2020

Coal

$(C_{240}H_{90}O_4NS)$



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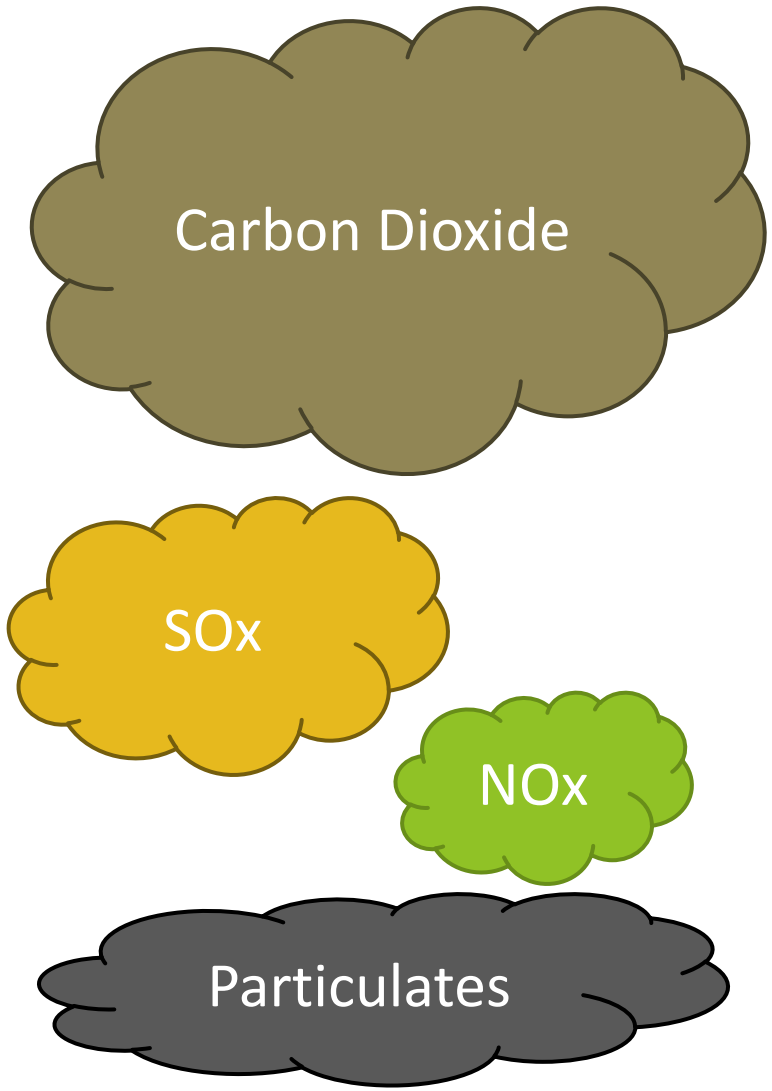
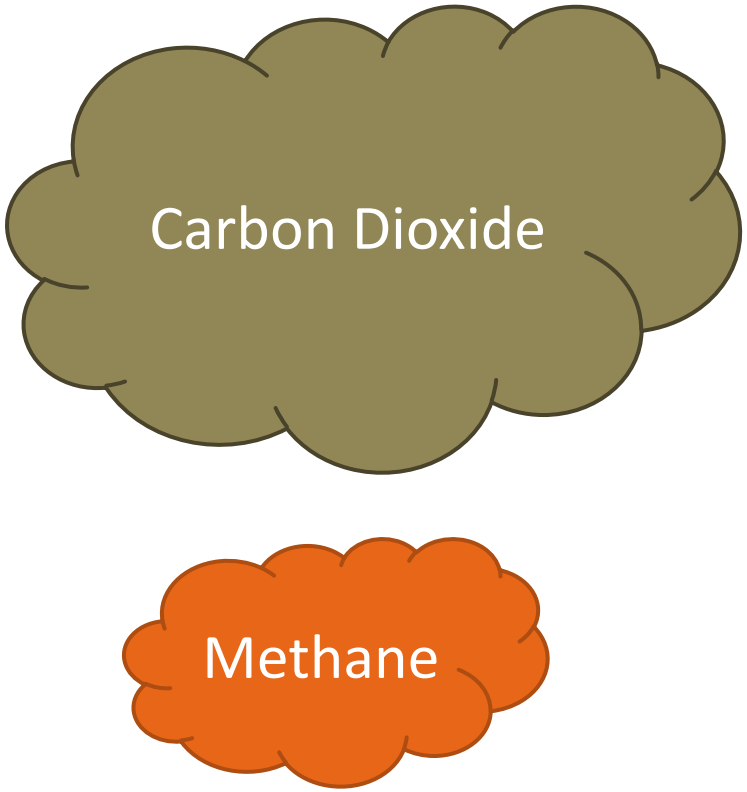


Natural Gas

(CH4)



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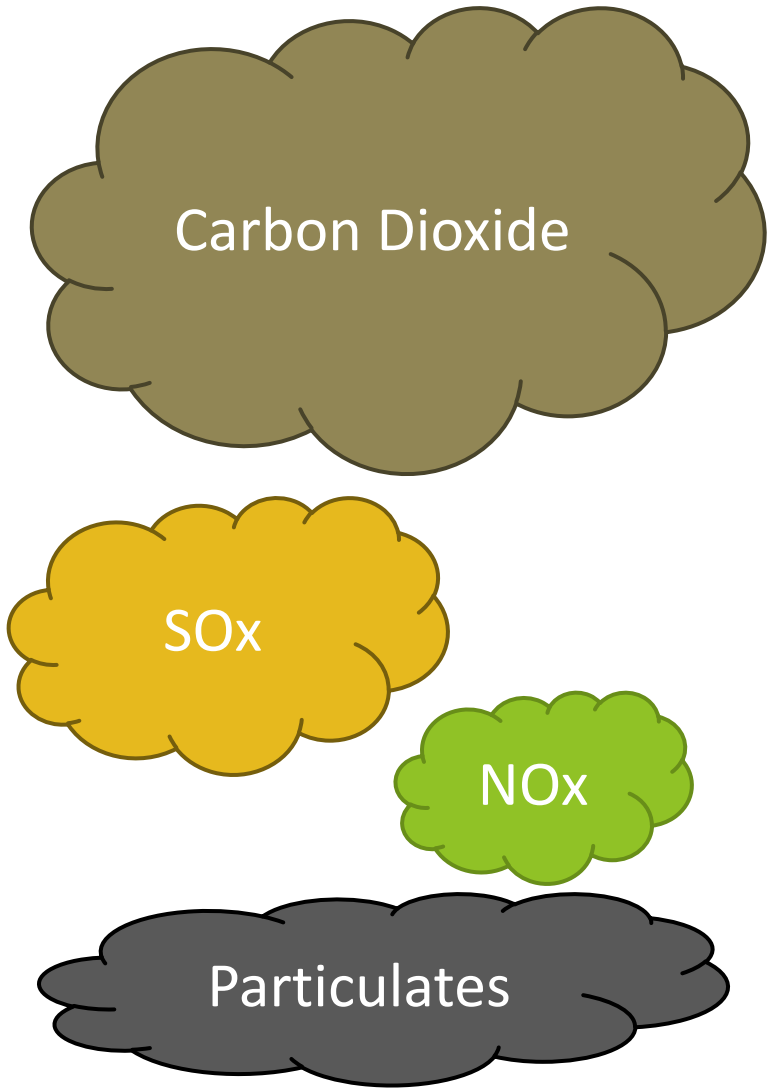

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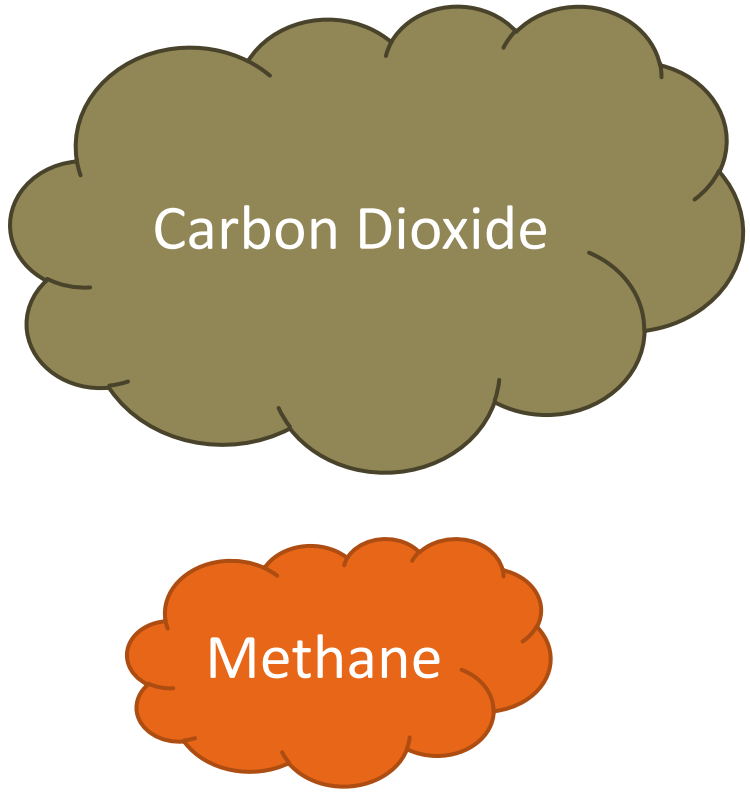


Electricity Powered by Solar, Wind, Hydro

(O_2)

Methane Leakage

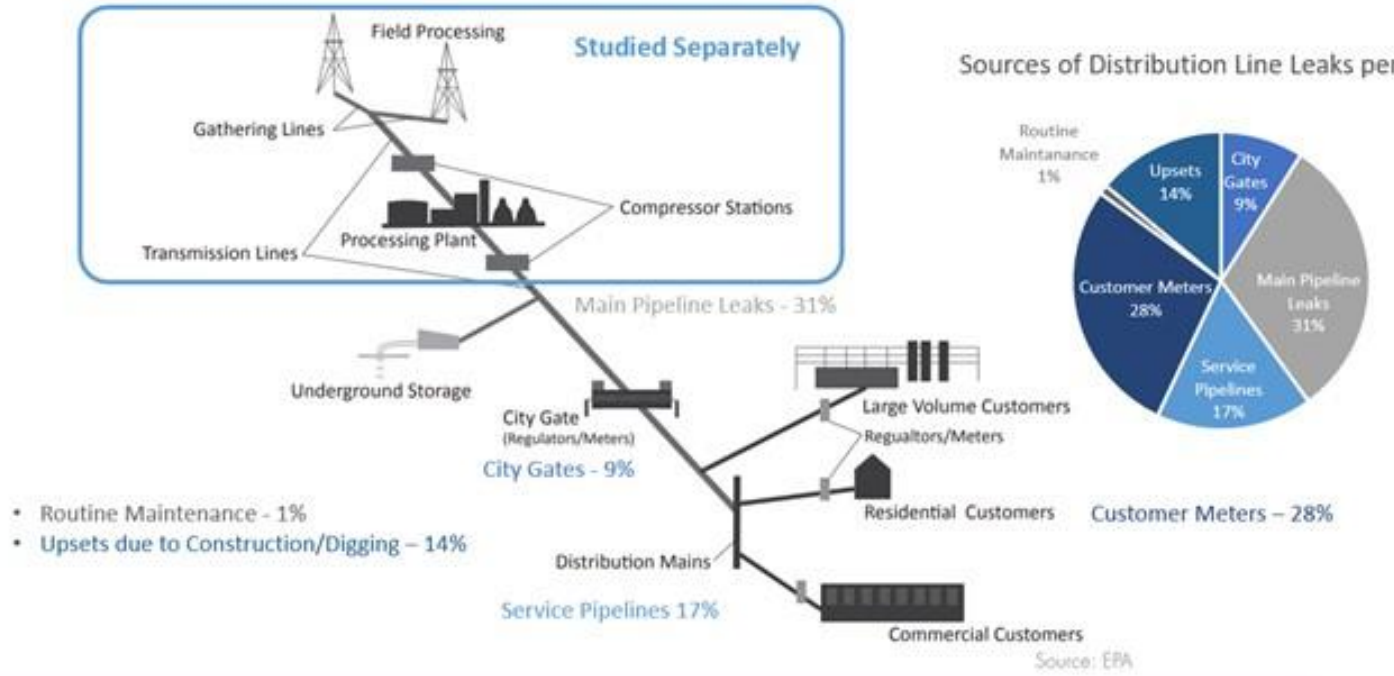
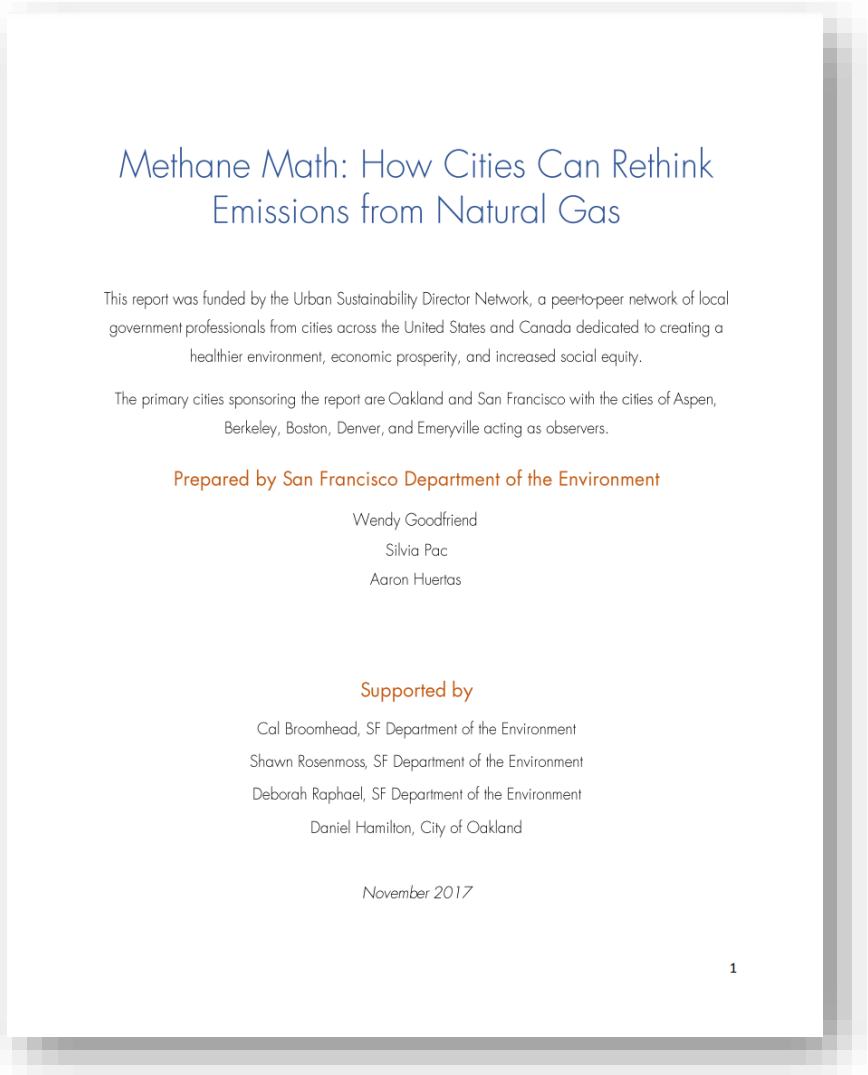


Table 3: Sources of Distribution Line Leaks per USGHGI		
Distribution Segment	**Description**	**Percentage**
Metering & Regulating Stations	Custody transfer stations and pressure regulator stations (City Gates)	9%
Main Pipeline Leaks	Distribution pipelines usually 2" to 24" diameter that transport gas from long-distance transmission lines to local service lines	31%
Service Pipeline Leaks	Distribution pipelines usually under 2" diameter that transport gas from mains to end user	17%
Customer Meters	Connection point from service lines to natural gas end use	28%
Routine Maintenance	Maintenance procedures such as venting and pressure releases	1%
Upsets	Leaks due to digging/construction impacts	14%

How Much Leakage Is There?



Methane Math: How Cities Can Rethink Emissions from Natural Gas

This report was funded by the Urban Sustainability Director Network, a peer-to-peer network of local government professionals from cities across the United States and Canada dedicated to creating a healthier environment, economic prosperity, and increased social equity.

The primary cities sponsoring the report are Oakland and San Francisco with the cities of Aspen, Berkeley, Boston, Denver, and Emeryville acting as observers.

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November 2017

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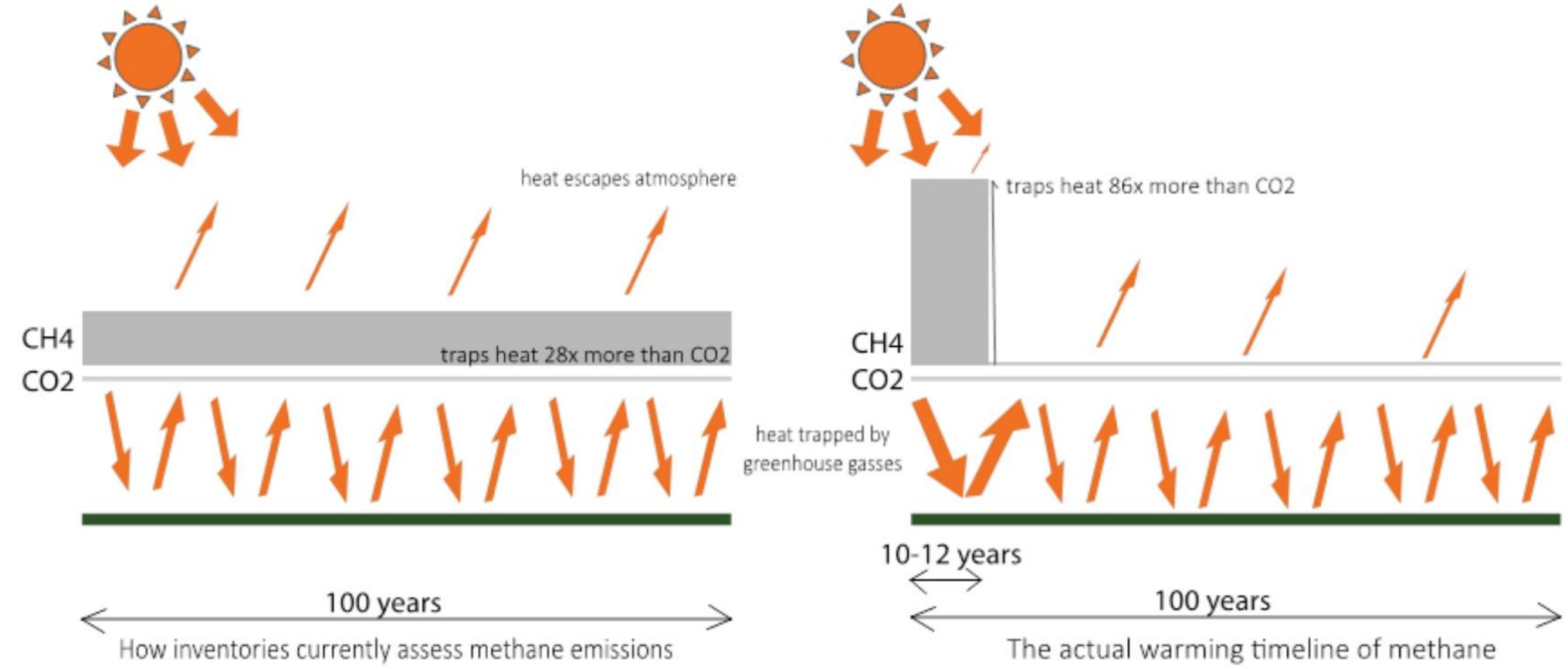
TABLE 1: LITERATURE REVIEW ON METHANE LEAKS FROM NATURAL GAS SYSTEMS

Study	Percent Leak	Min Leak	Max Leak	Production Type	Analysis Type	Year
EPA GHGI*[i]	1.37%	1.11%	1.78%	All production	Bottom-Up	2014
Brandt*[ii]	2.35%	1.96%	2.75%	All production	Top-Down	2014
Miller*[iii]	3.57%	2.74%	4.40%	All production	Top-Down	2013
Caulton et al[iv]	7.00%	2.30%	11.70%	All production	Lit Review	2014
Burnham[v]	2.75%	0.97%	5.47%	Conventional	Lit Review	2011
Howarth[vi]	3.80%	1.70%	6.00%	Conventional	Lit Review	2011
Burnham[vii]	2.01%	0.71%	5.23%	Shale	Lit Review	2011
Howarth[viii]	5.80%	3.60%	7.90%	Shale	Lit Review	2011
Howarth[ix]	12.00%	4.30%*	19.70%*	Shale	Lit Review	2015
Averages	*4.52%*	*2.15%*	*7.21%*			

**Additional data points were estimated by the San Francisco Department of the Environment*

Global Warming Potential (GWP) & Some Light Chemistry

FIGURE 1: SHORT-TERM POWER OF METHANE



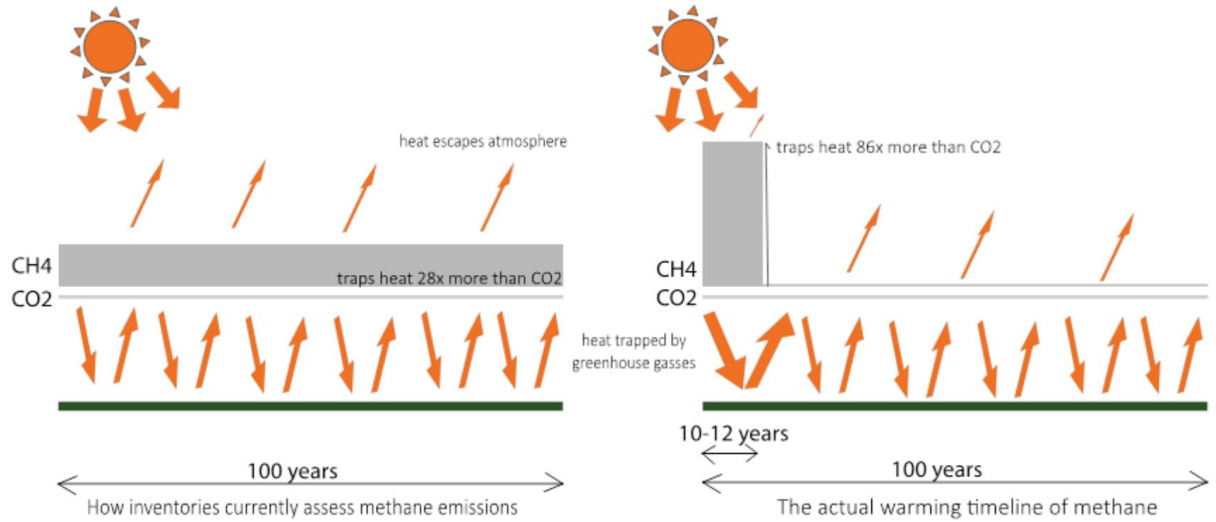
Global Warming Potential (GWP) & Some Light Chemistry

Global Warming Potential (GWP) of
Leake

Methane over 10

Methane over 2

FIGURE 1: SHORT-TERM POWER OF METHANE



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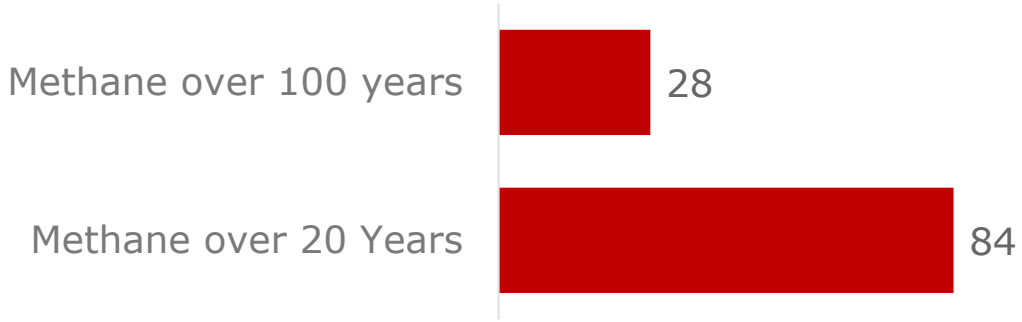
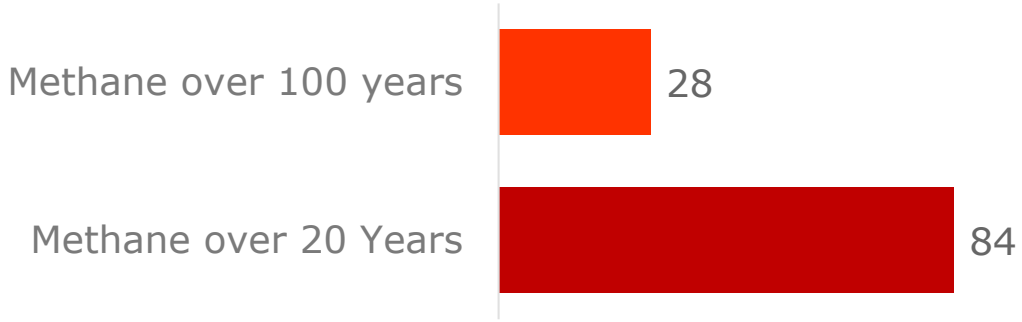


$$CH_4 + 2O_2 = CO_2 + 2H_2O$$

Molar Mass CH4	16.04 g mol−1
Molar Mass CO2	44.01 g mol−1

Global Warming Potential (GWP) & Some Light Chemistry



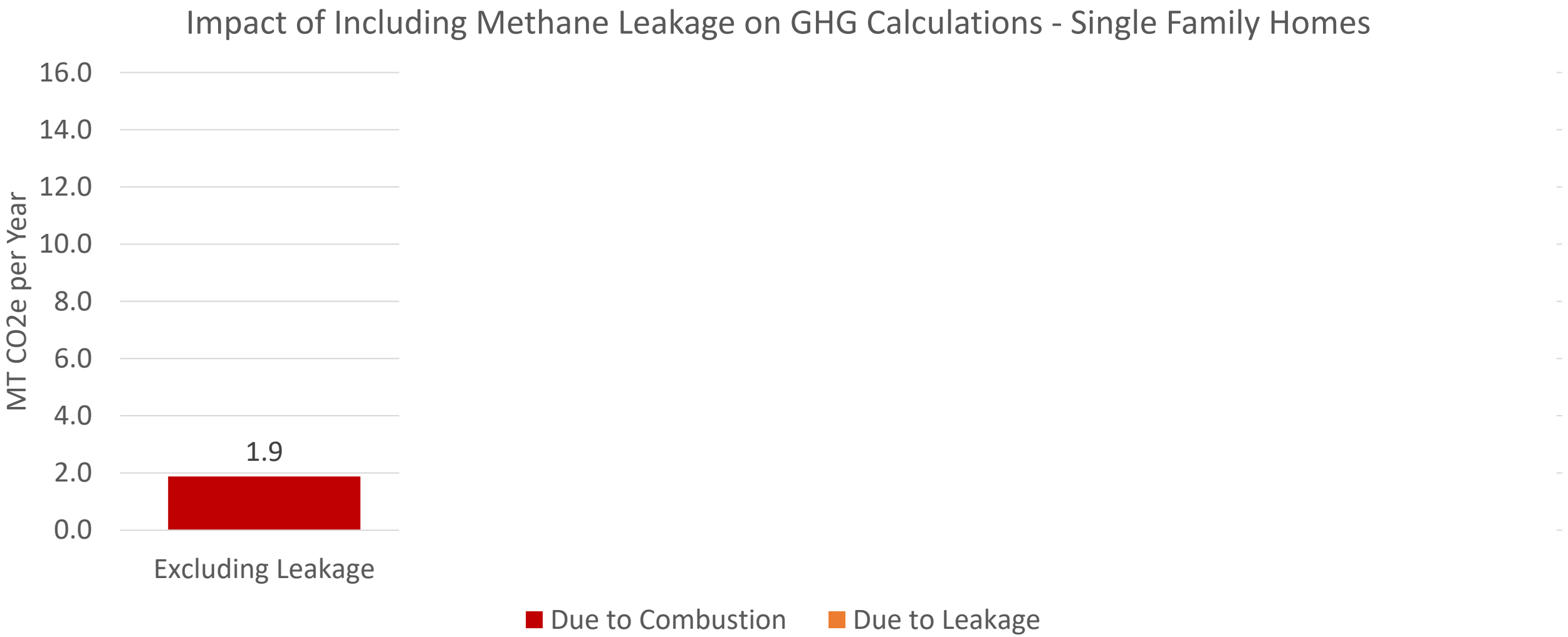
$$CH_4 + 2O_2 = CO_2 + 2H_2O$$

Molar Mass CH4	16.04 g mol−1
Molar Mass CO2	44.01 g mol−1

28 (GWP_{20} of Methane) x (16.04/44.01) = 10.2 worse to leak a therm than burn a therm

84 (GWP_{20} of Methane) x (16.04/44.01) = 30.6 worse to leak a therm than burn a therm

Gas May Be Worse Than Coal



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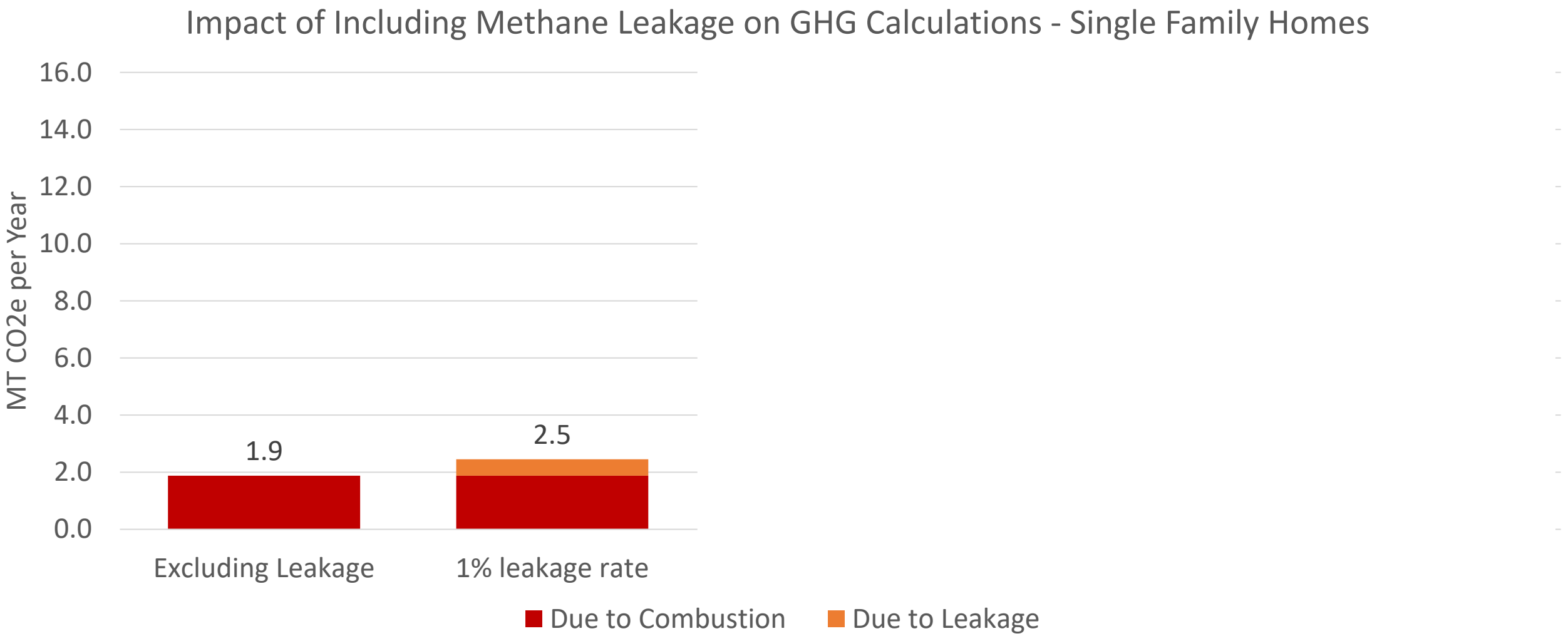

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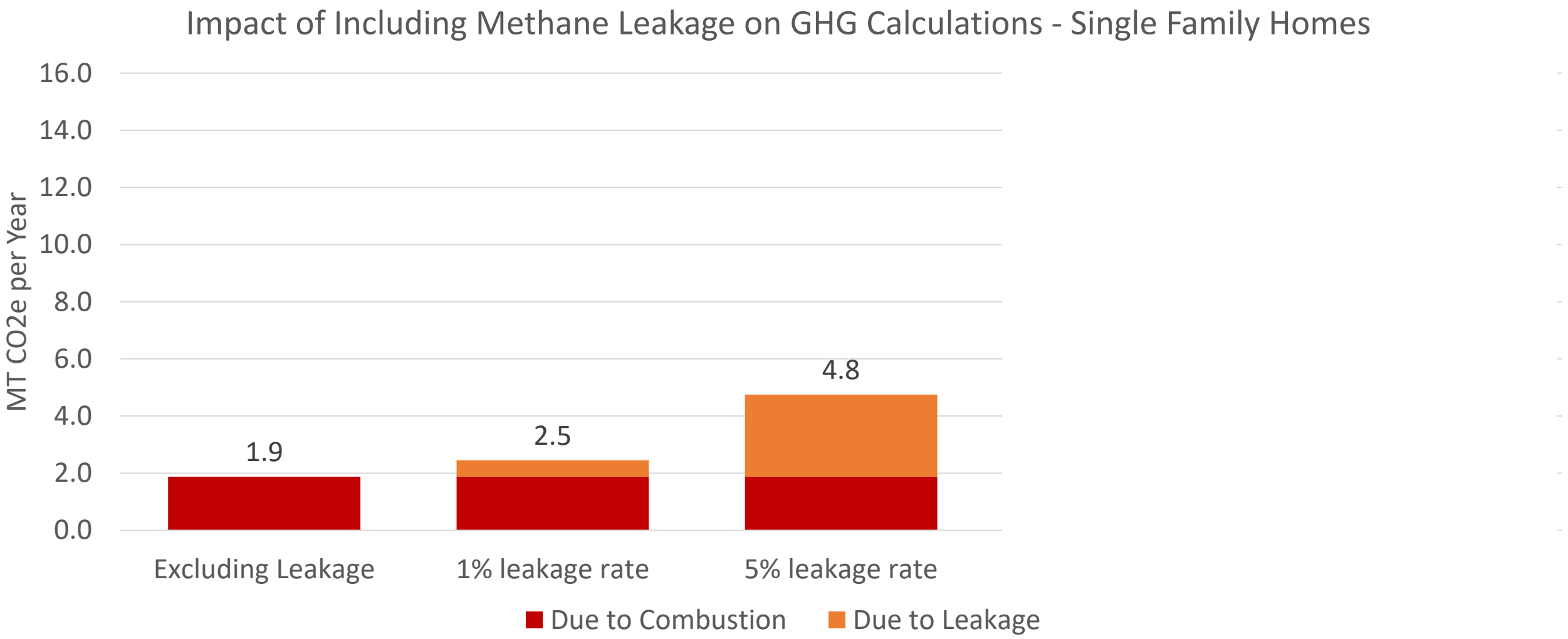

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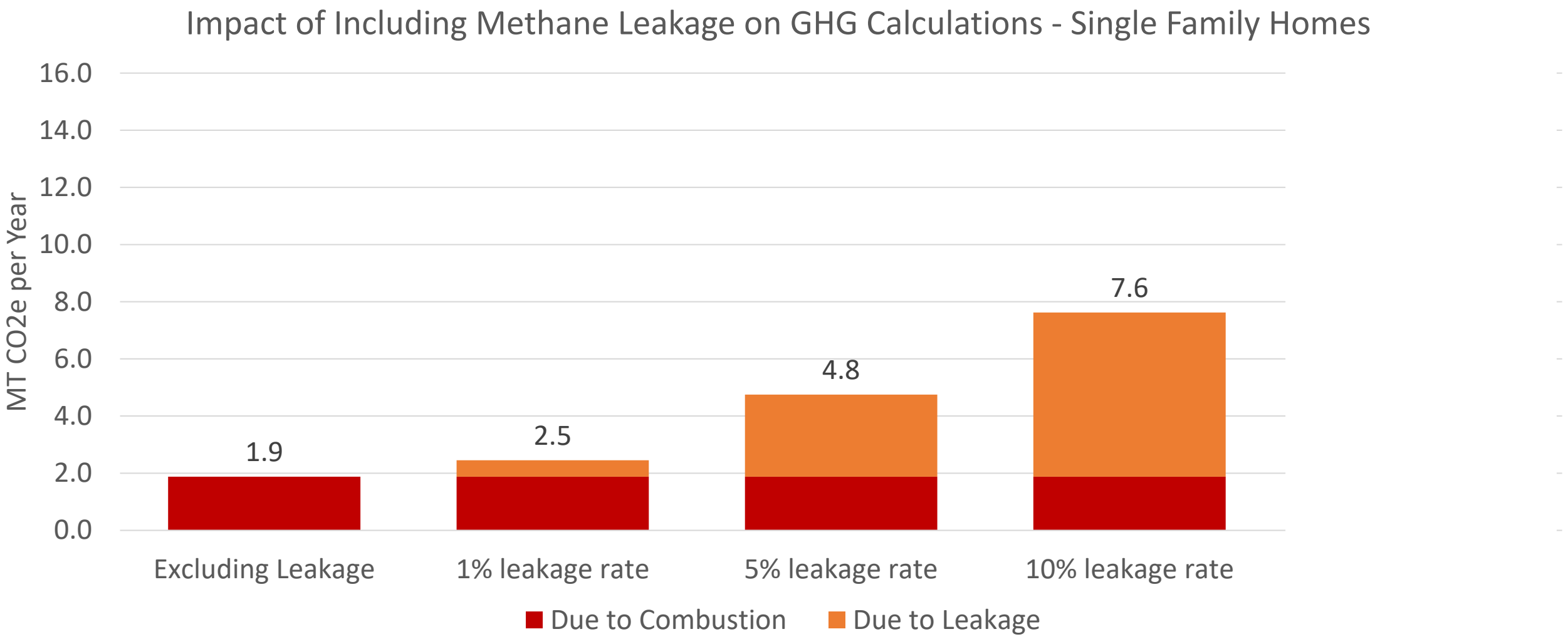

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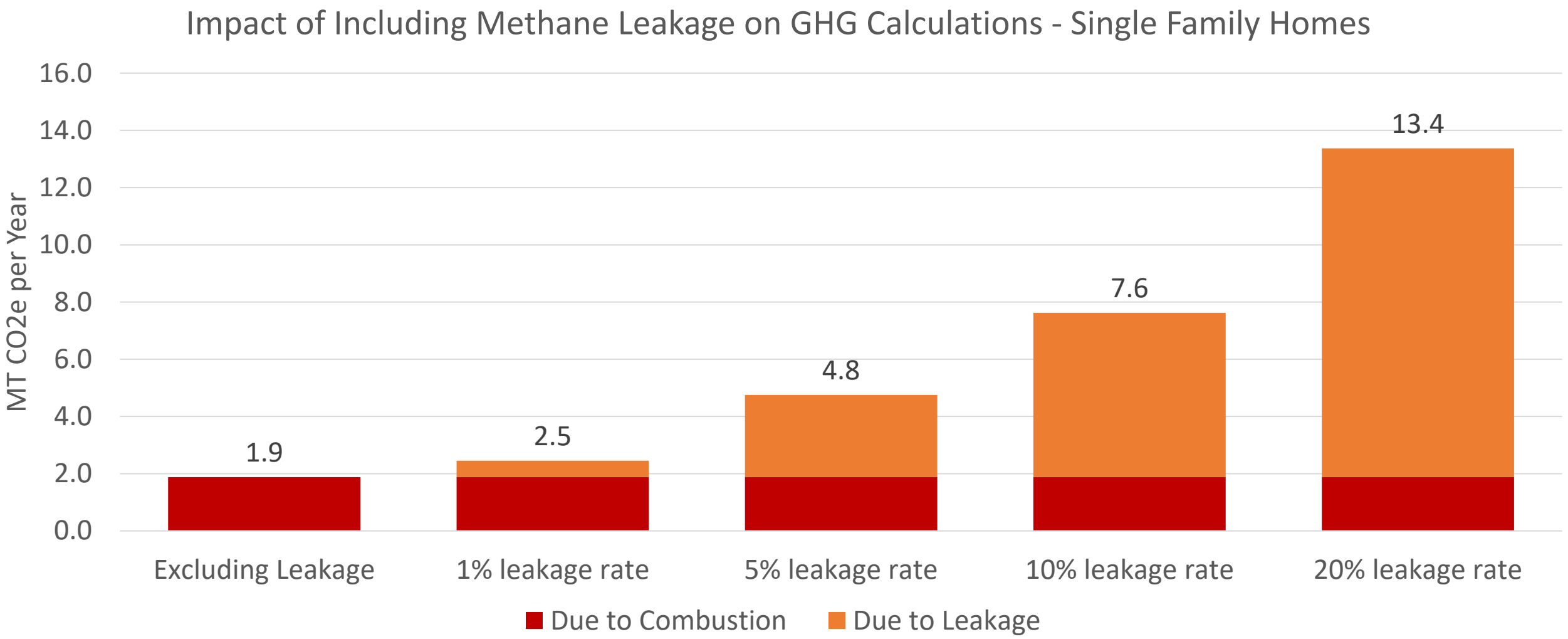
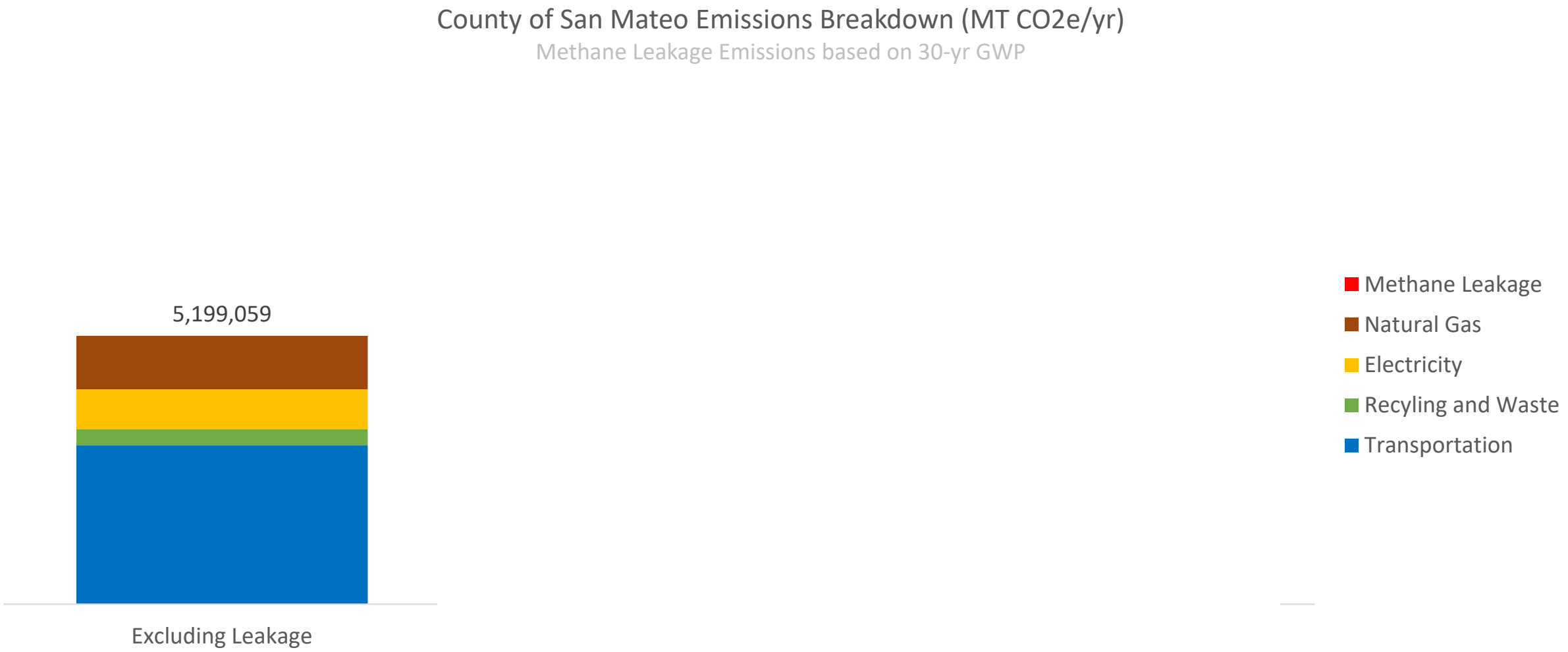


Community Emissions Example



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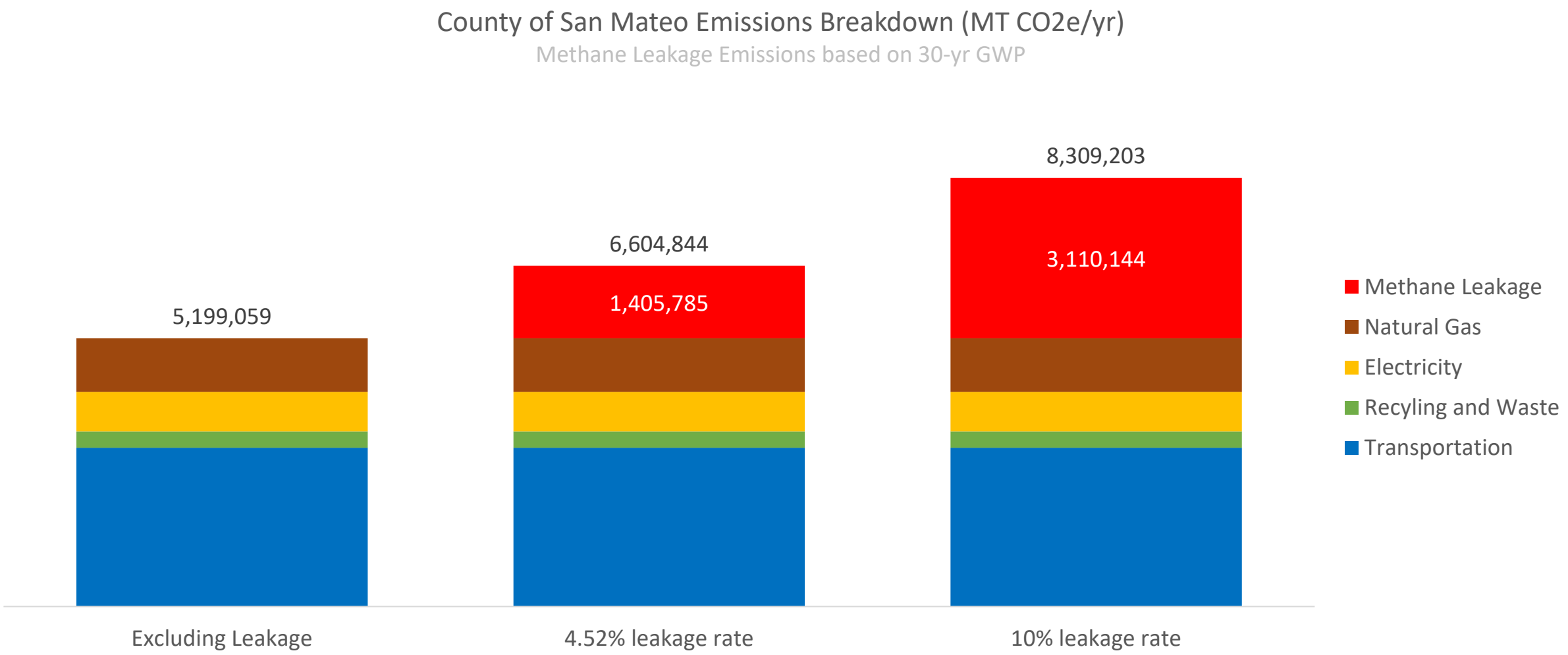

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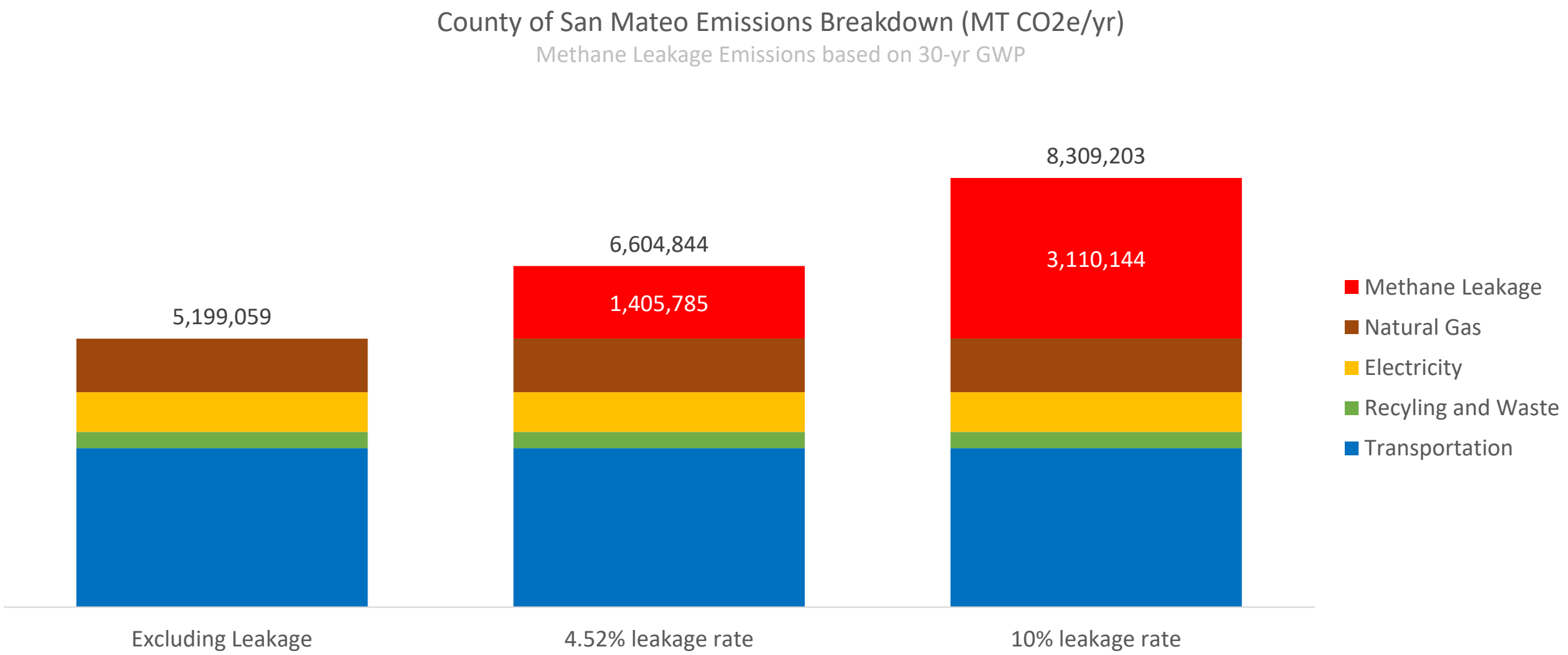
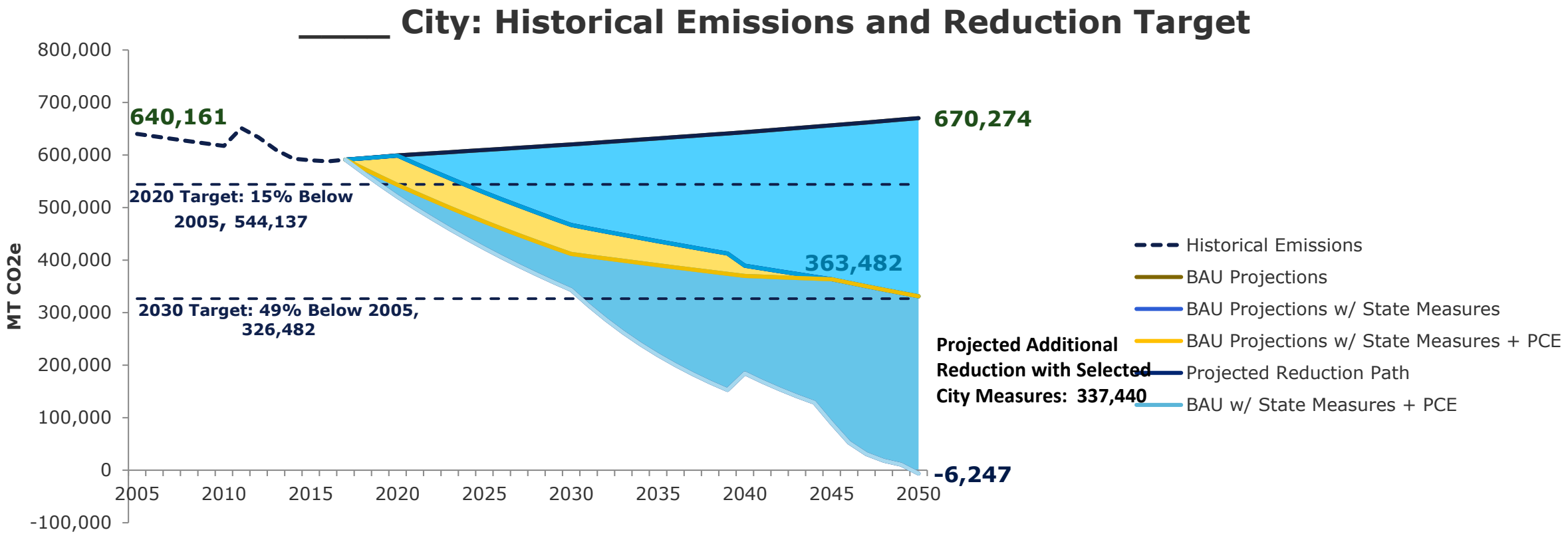


25% Increase

60% Increase

Emissions Planning



Questions?

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DNV GL – Energy

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