

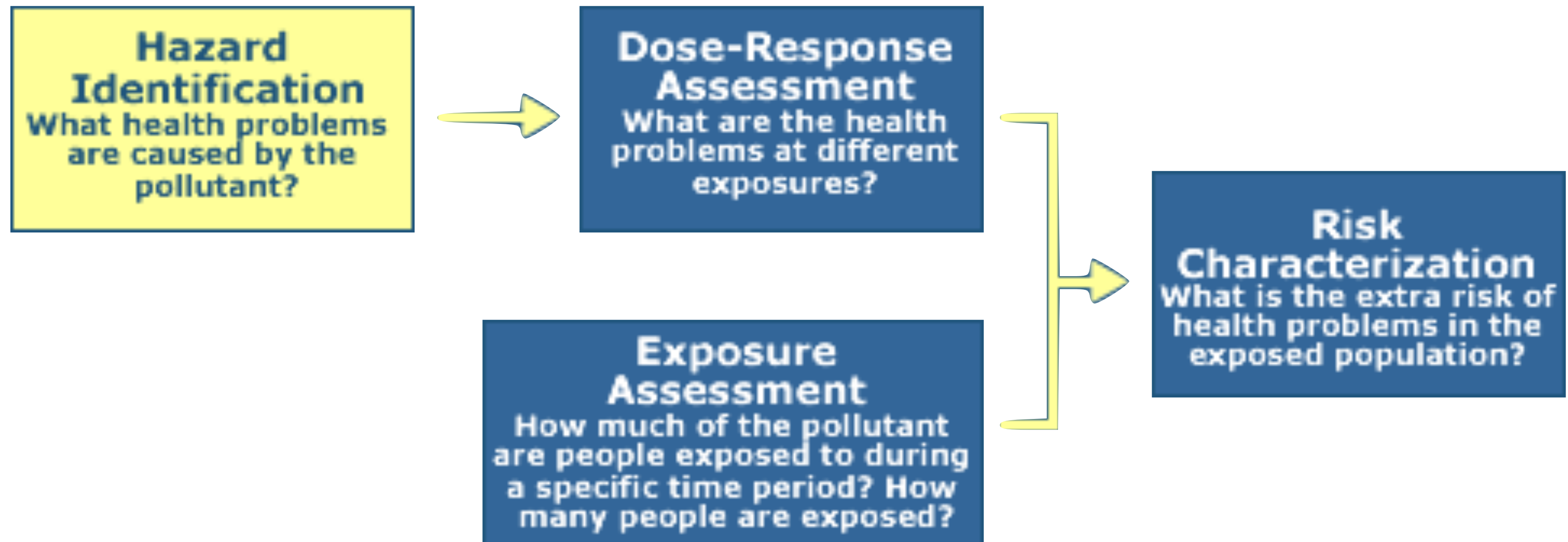
Health Impacts of Methane ("Natural") Gas Systems

Jonathan Buonocore, Sc.D.

January 30th, 2025

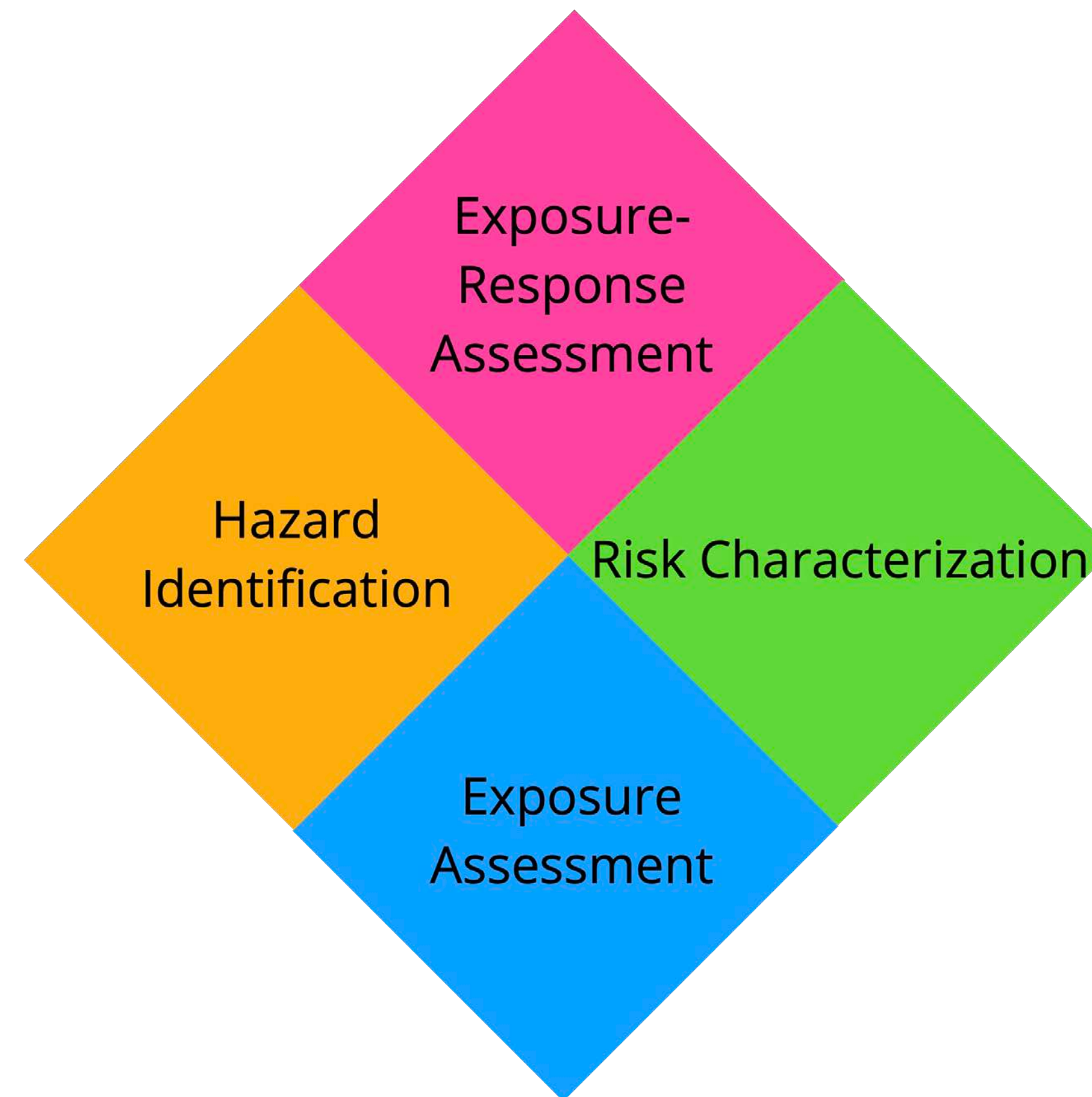
Risk Assessment Process

4 Step Risk Assessment Process



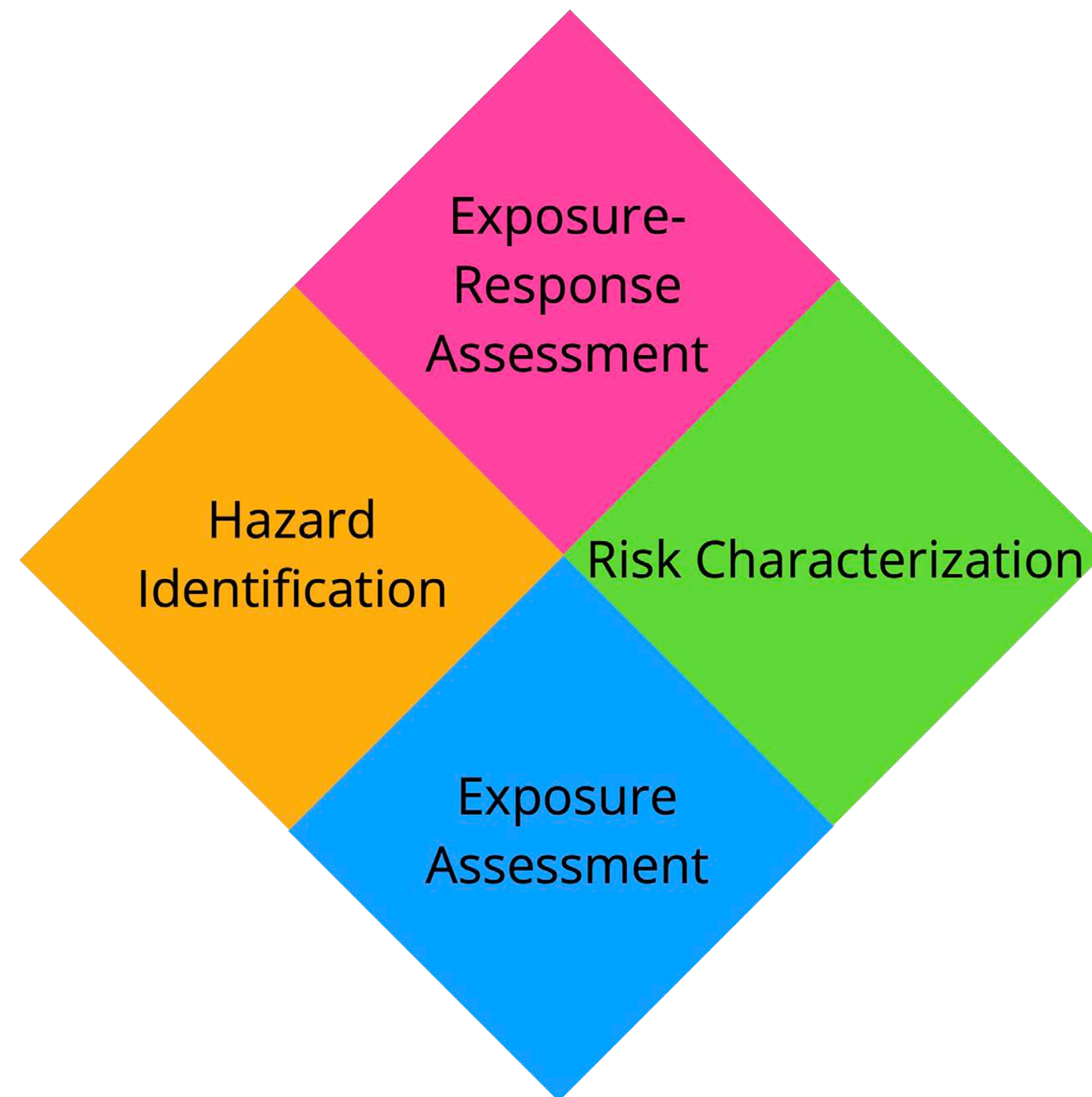
How we (and the U.S. EPA) think about environmental health risks

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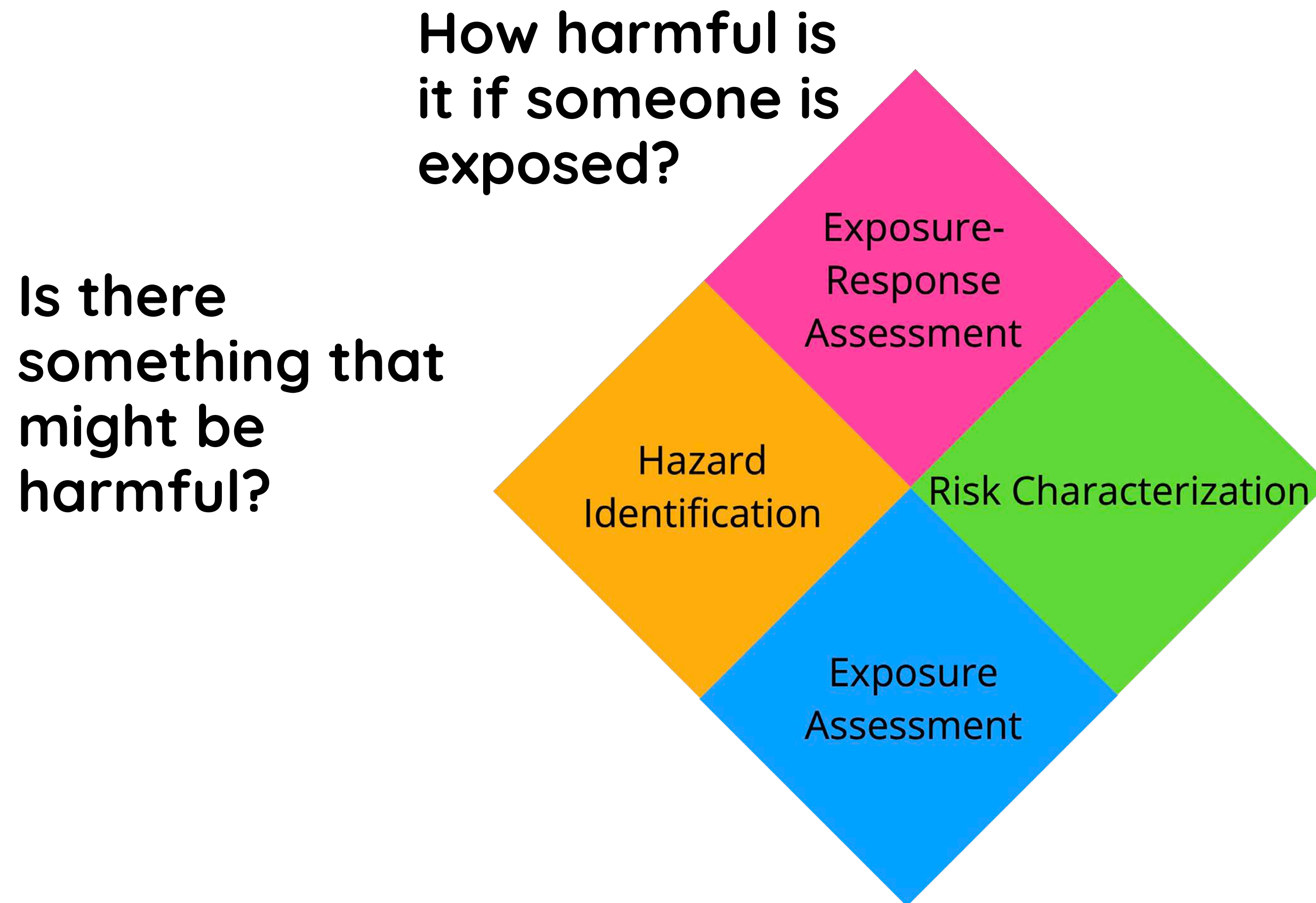


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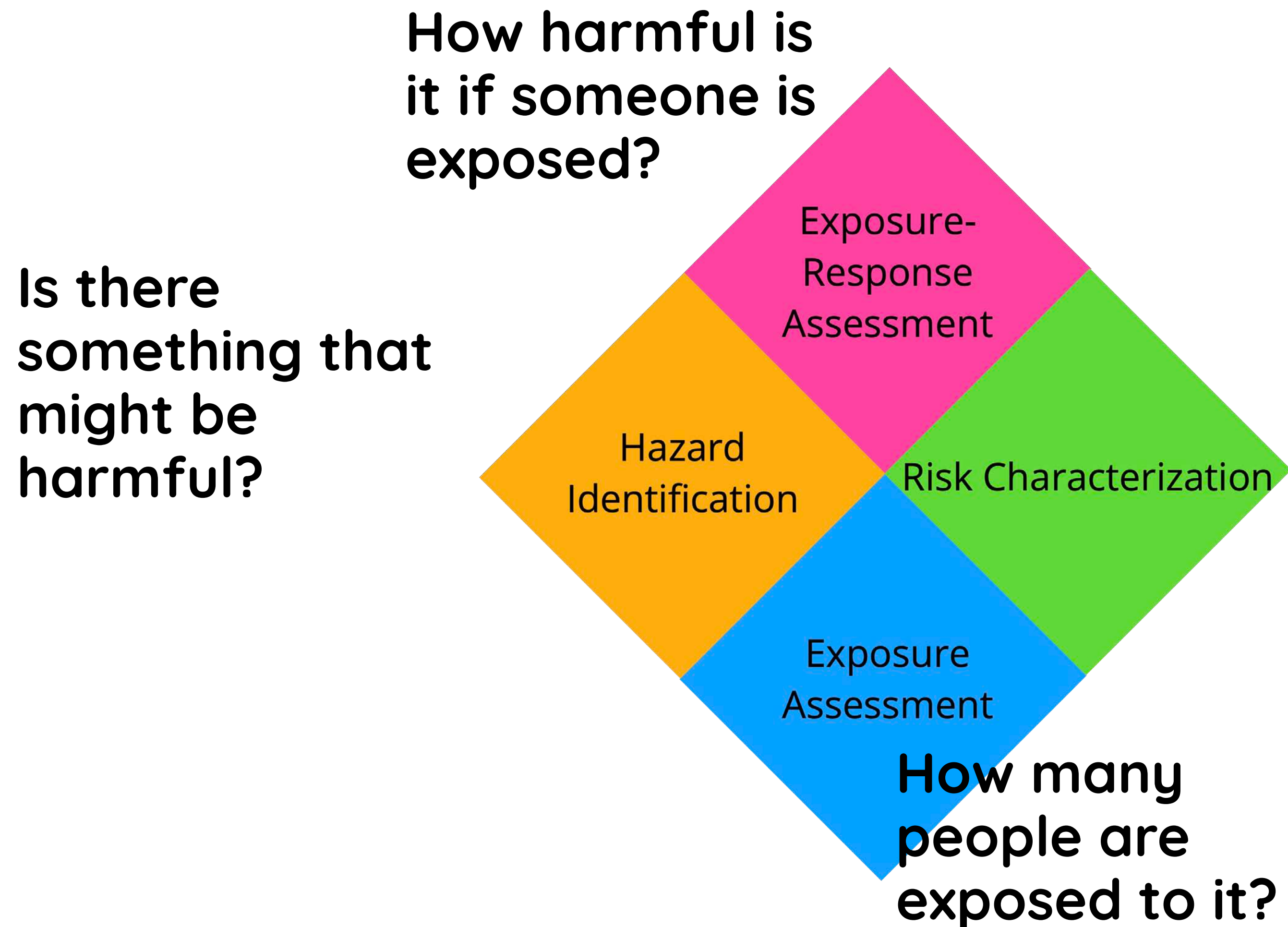
Is there
something that
might be
harmful?



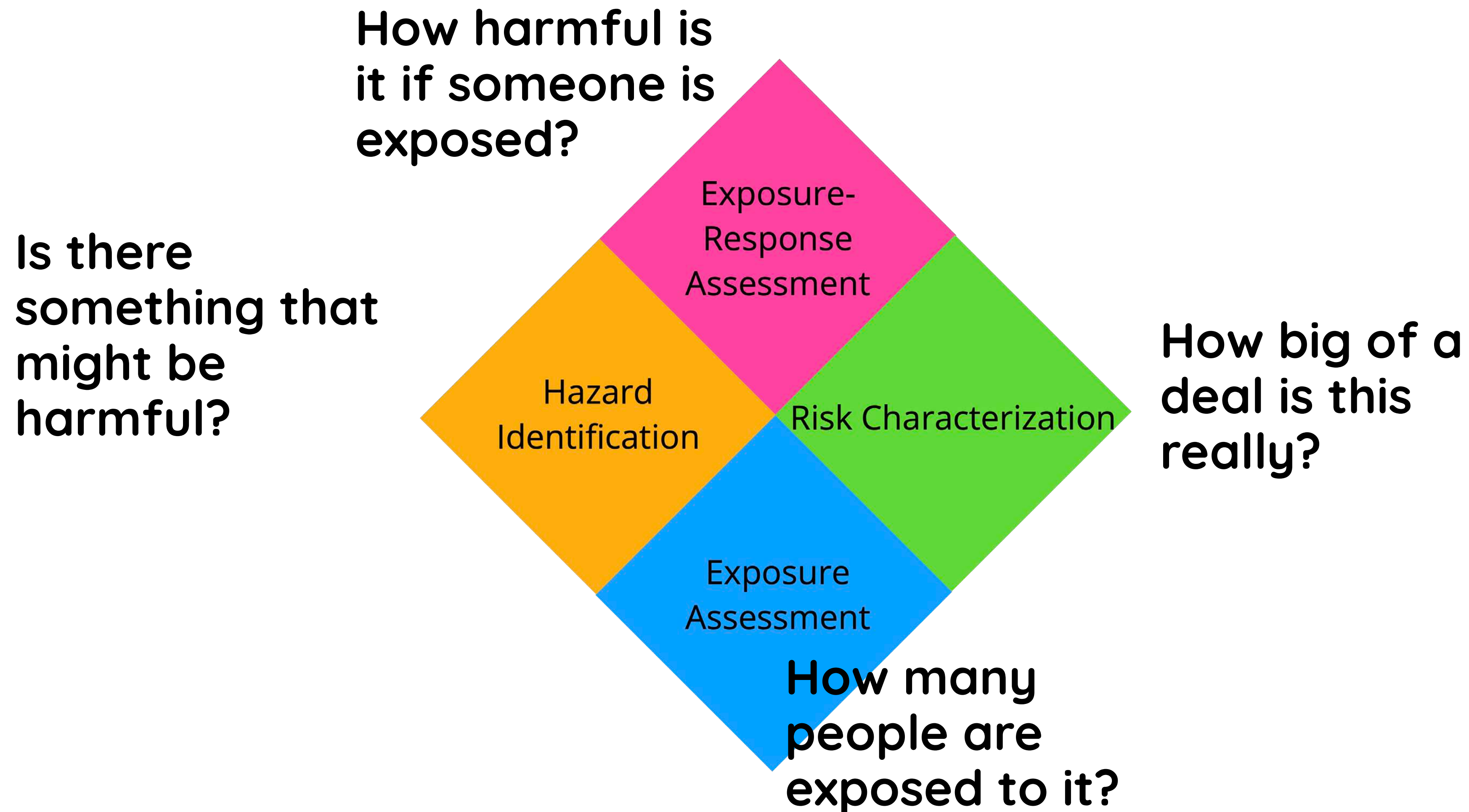
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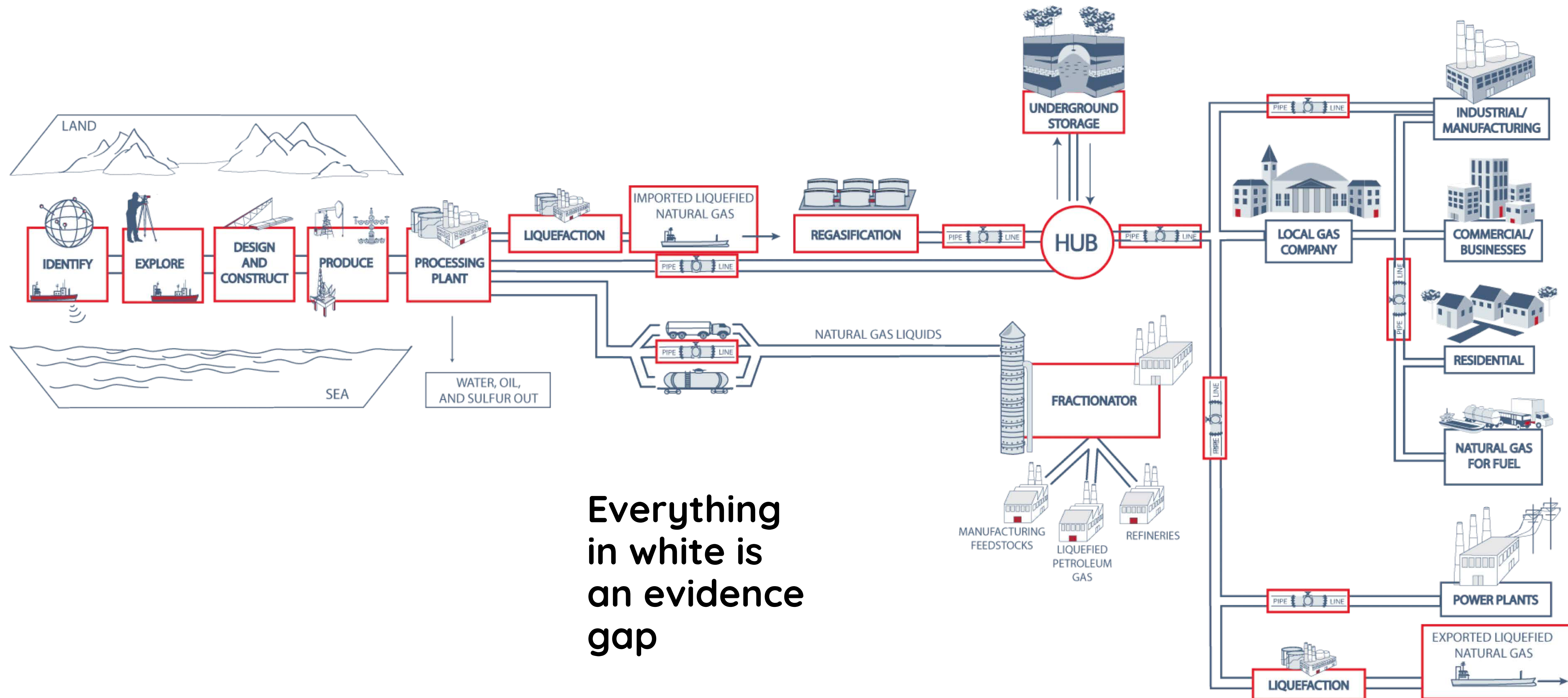
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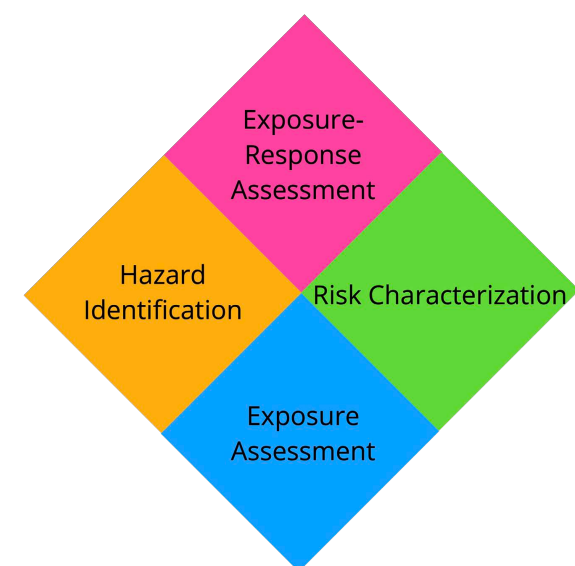
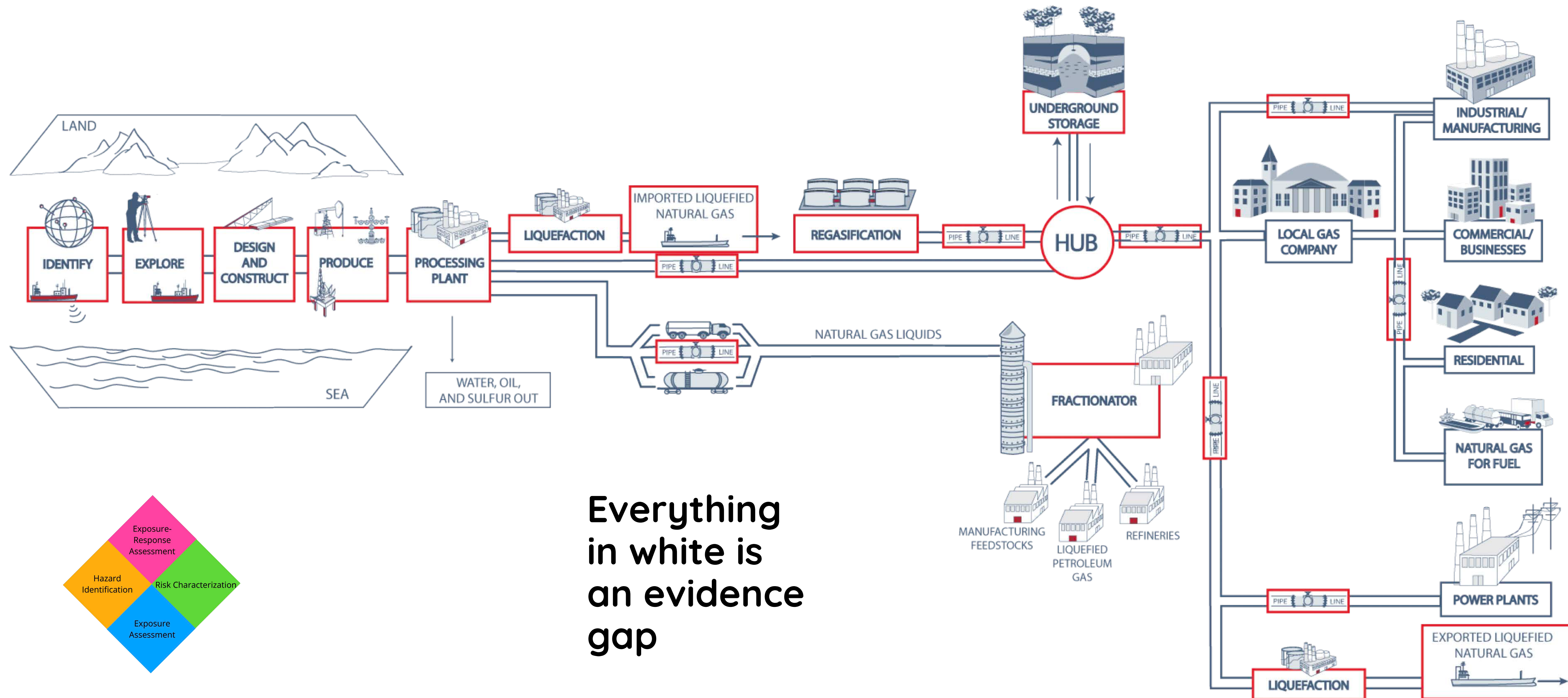
How we (and the U.S. EPA) think about environmental health risks



Life Cycle of Natural Gas

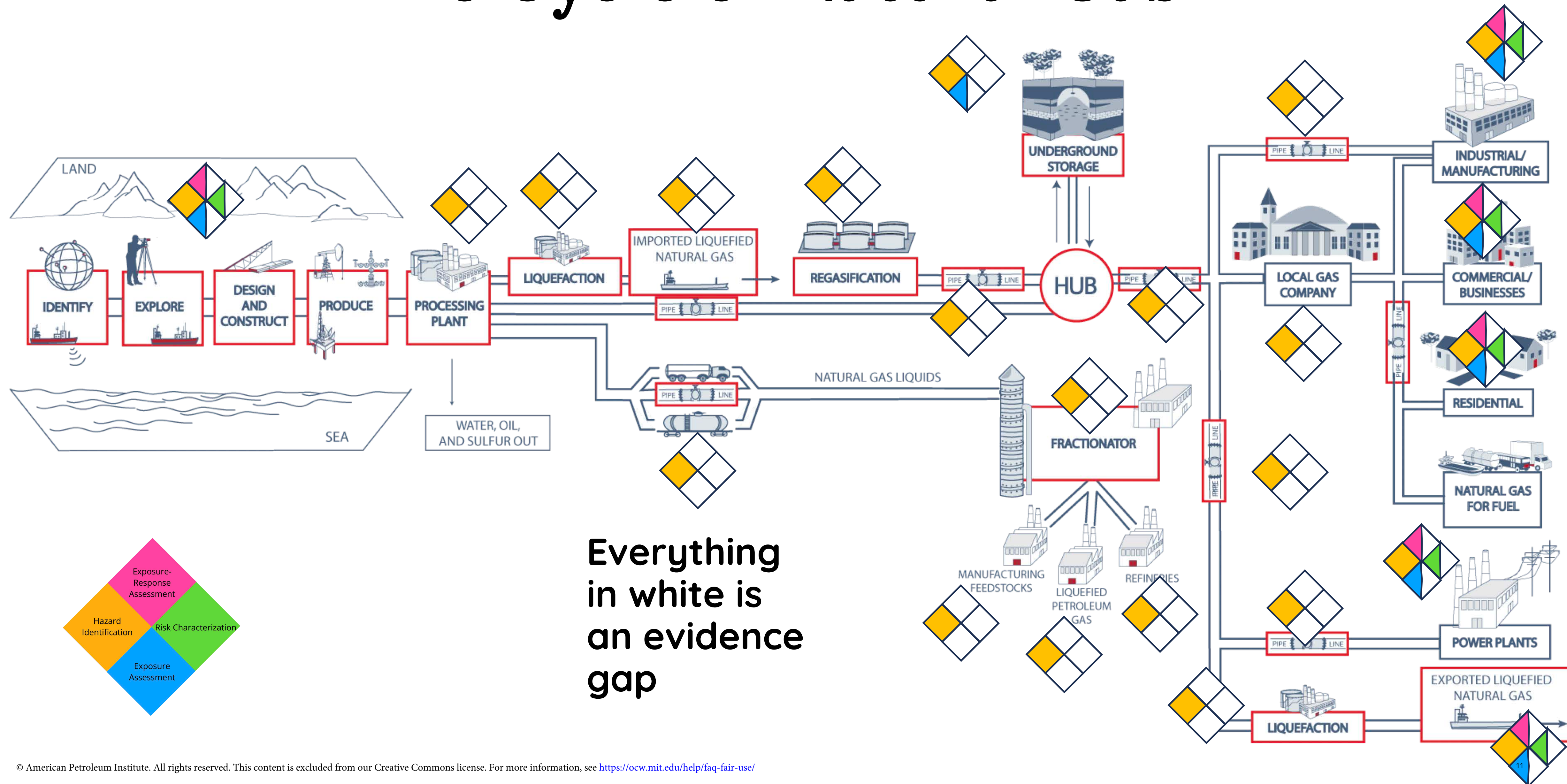


Life Cycle of Natural Gas

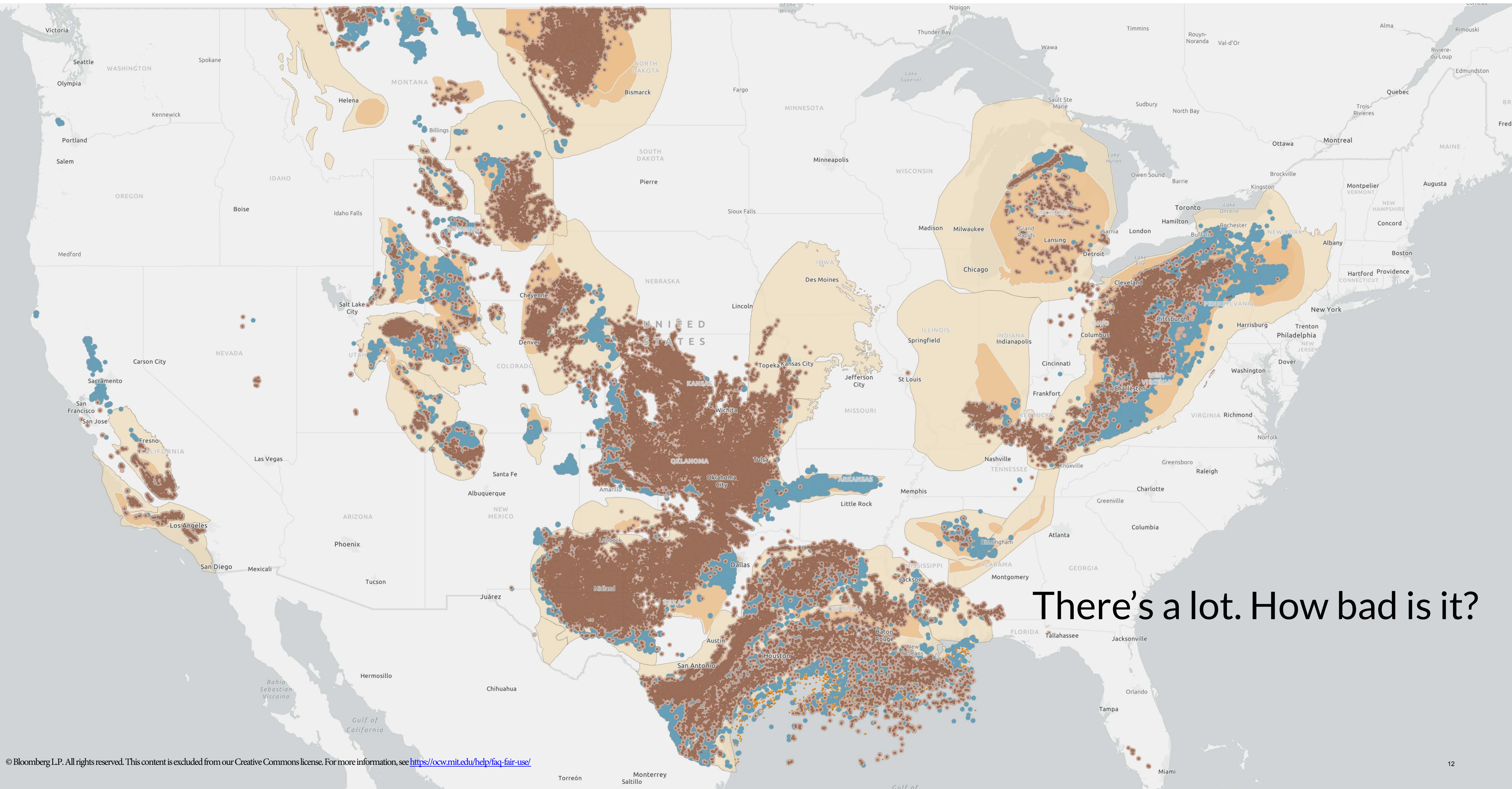


Everything
in white is
an evidence
gap

Life Cycle of Natural Gas



Oil & Gas Production in the U.S.

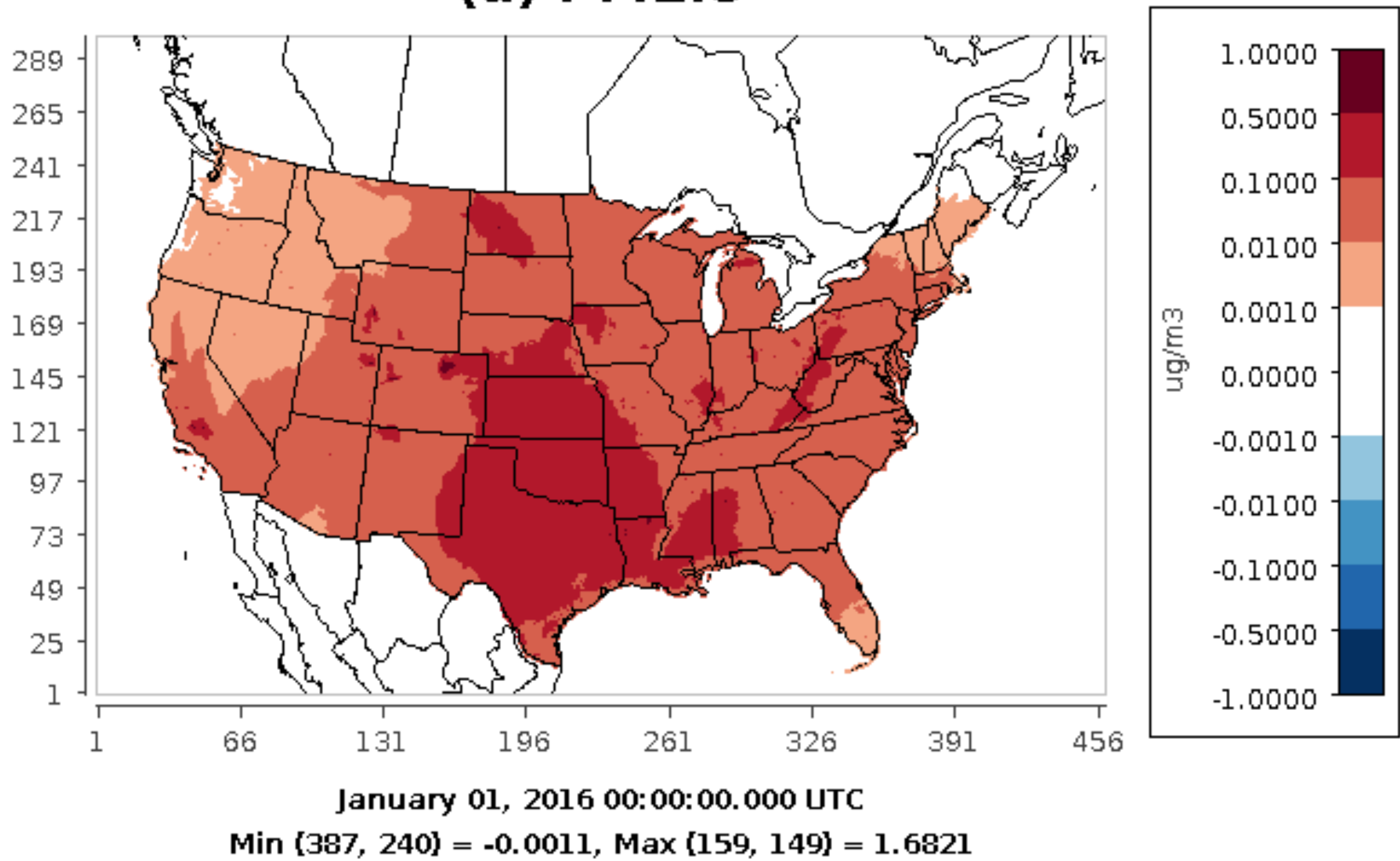


2016 Air Pollution from O&G Production

29 daily
exceedances, 1
annual

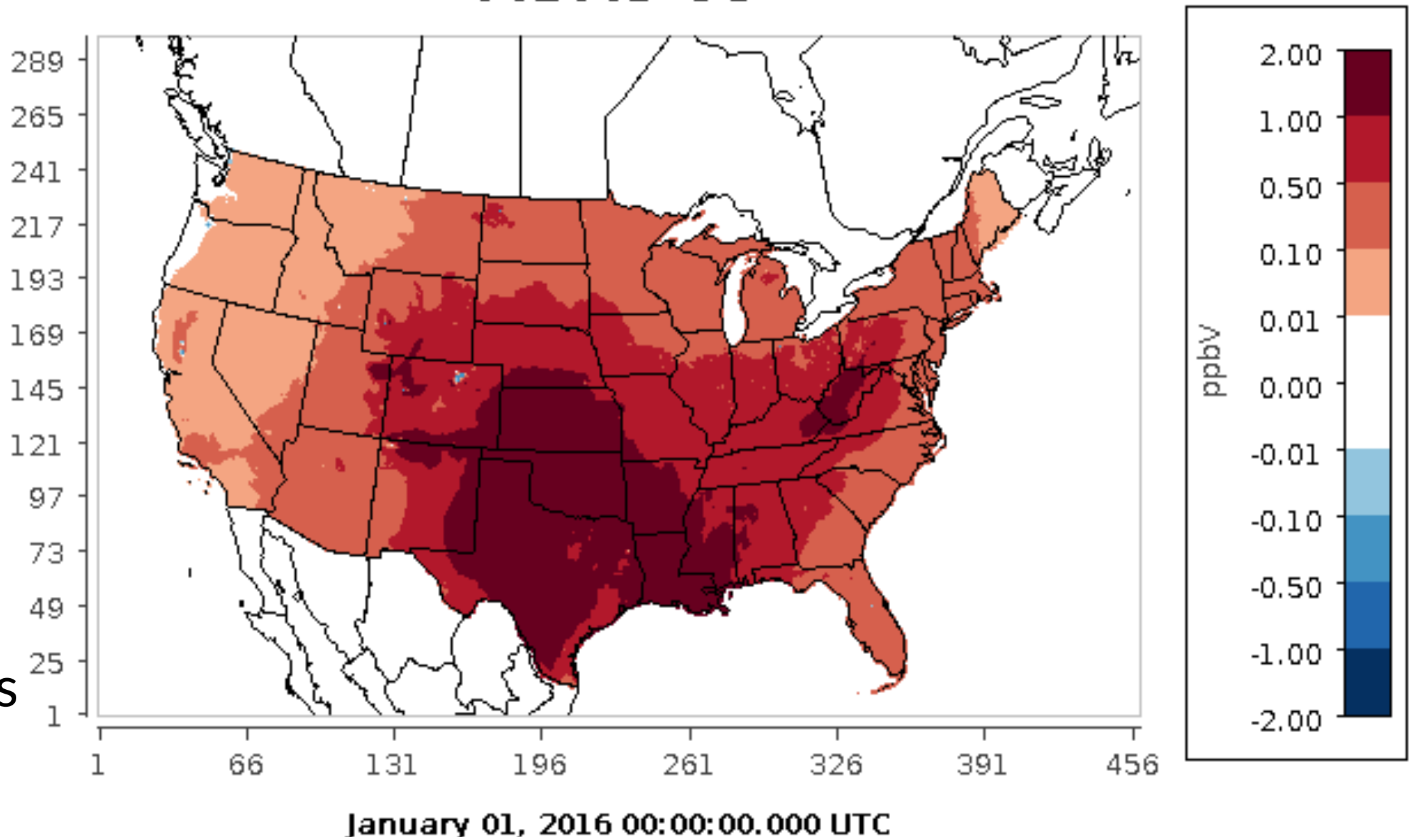
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(a) PM2.5

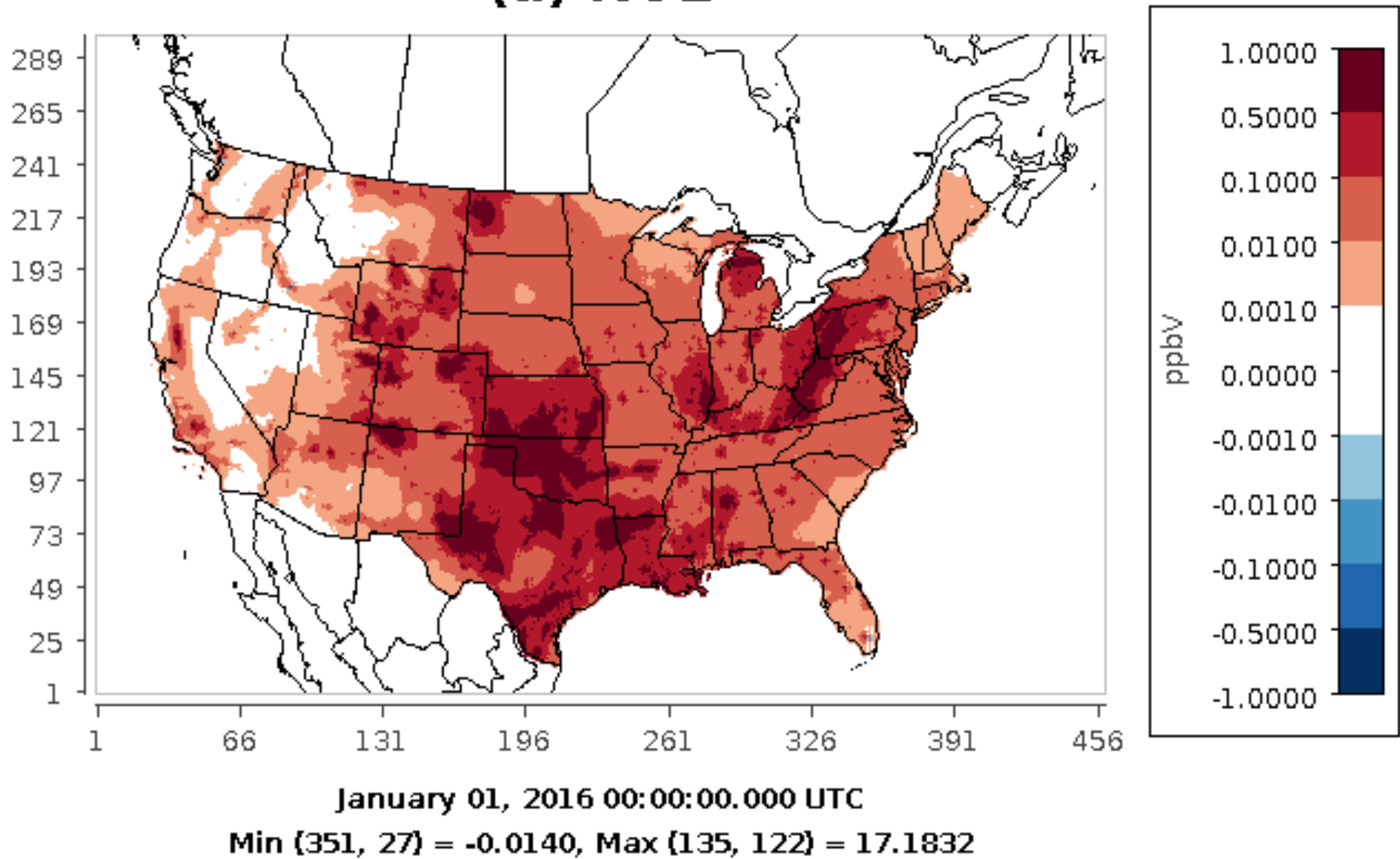


634
exceedances

MDA8 O3

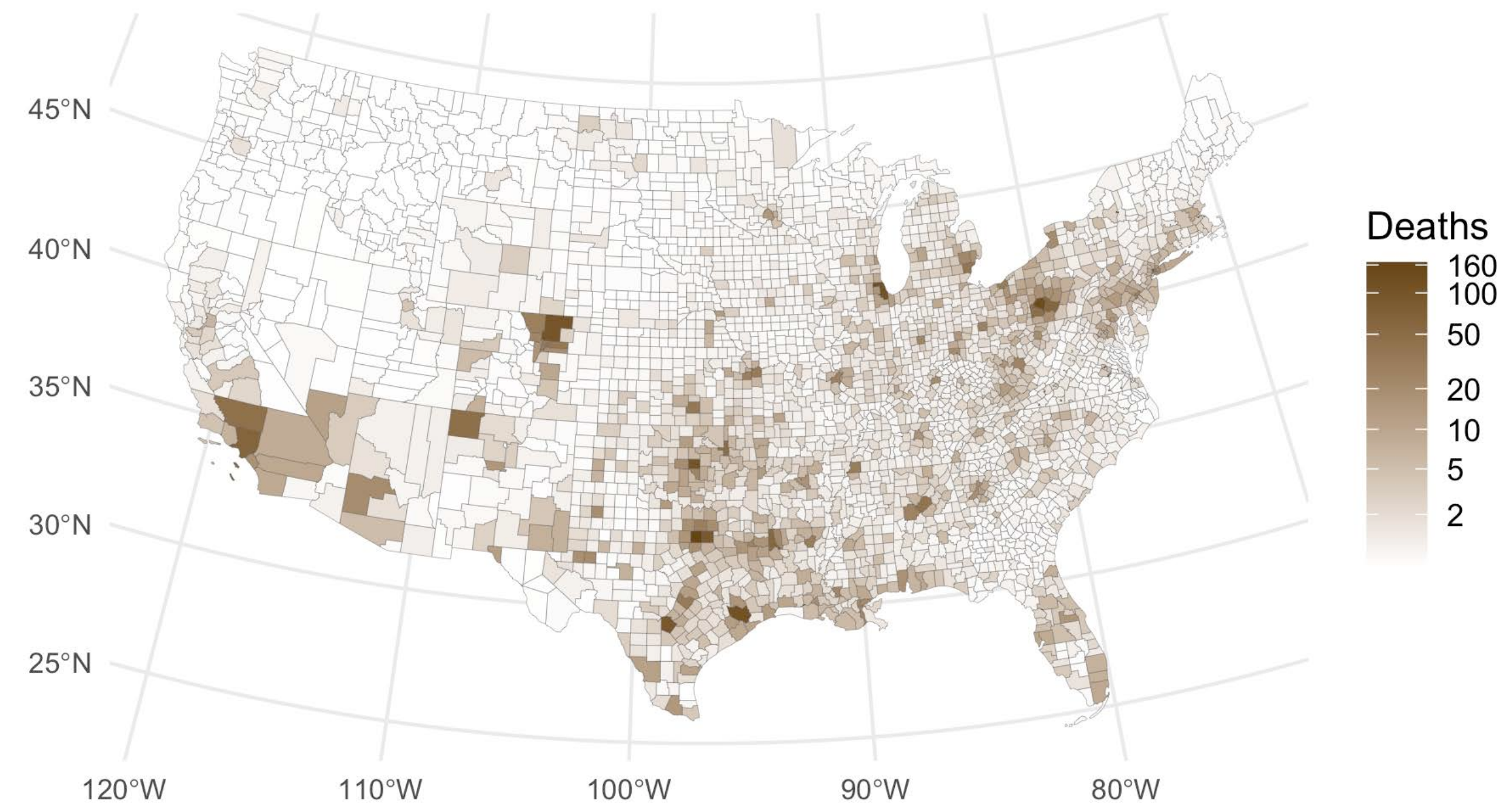


(a) NO2



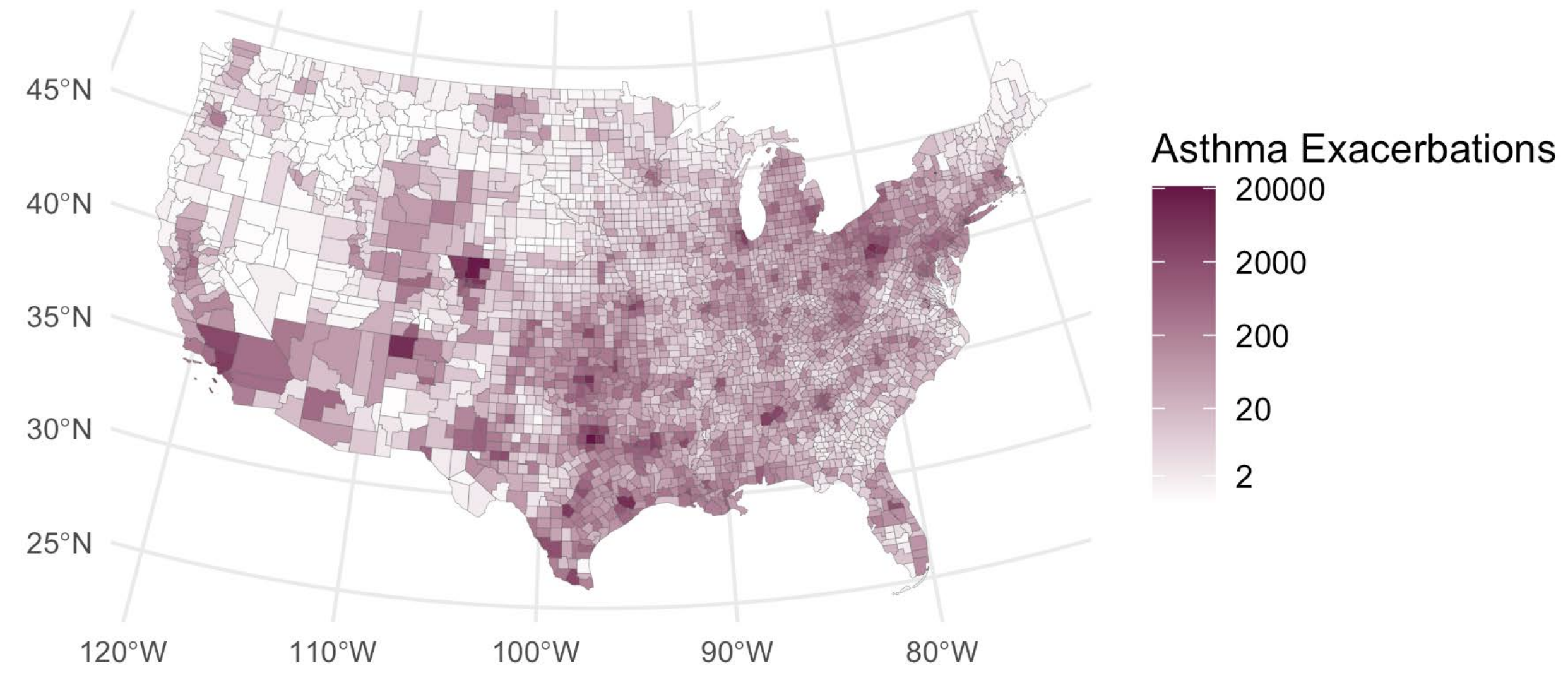
2016 Health Impacts

7,500 (4,500 - 12,000) Deaths

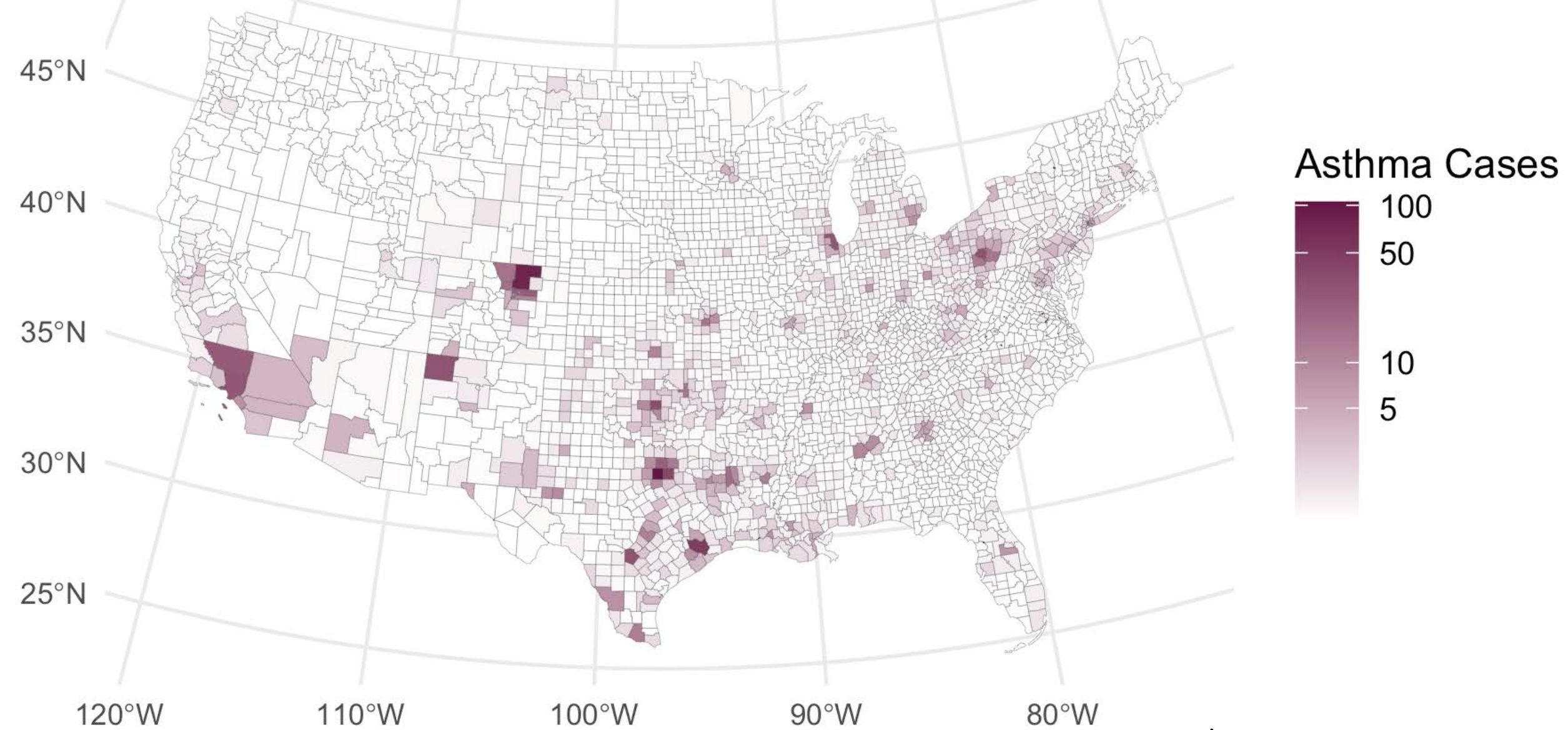


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410,000 (9,200 - 810,000) Asthma Exacerbations



2,200 (830 - 3,200) New Asthma Cases



2016 Baseline Health Impacts

Health Outcome	Pollutant	Case Count	Value
Deaths	All Three	7,500 (4,500 - 12,000)	\$77 billion (\$27 billion - \$170 billion)
Asthma Incidence	PM _{2.5} and NO ₂	2,200 (830 - 3,200)	\$130 million (\$20 million - \$300 million)
Asthma Hospitalizations	PM _{2.5} and NO ₂	53 (1.2 - 110)	\$970,000 (\$22,000 - \$1,900,000)
Asthma ED Visits	PM _{2.5} and NO ₂	530 (12 - 1,100)	\$240,000 (\$5,200 - \$500,000)
Asthma Exacerbations	PM _{2.5} and NO ₂	410,000 (9,200 - 810,000)	\$24 million (\$200,000 - \$80 million)
Respiratory Hospitalizations	PM _{2.5} and Ozone	1,500 (550 - 2,400)	\$44 million (\$16 million - \$72 million)
Heart Attacks	PM _{2.5} and NO ₂	270 (150 - 390)	\$19 million (\$11 million - \$27 million)
Grand Total			\$77 billion (\$27 billion - \$170 billion)

Gas stoves emit air pollution



- Benzene
- Other volatile organic compounds (VOCs)
- NO₂
- Methane

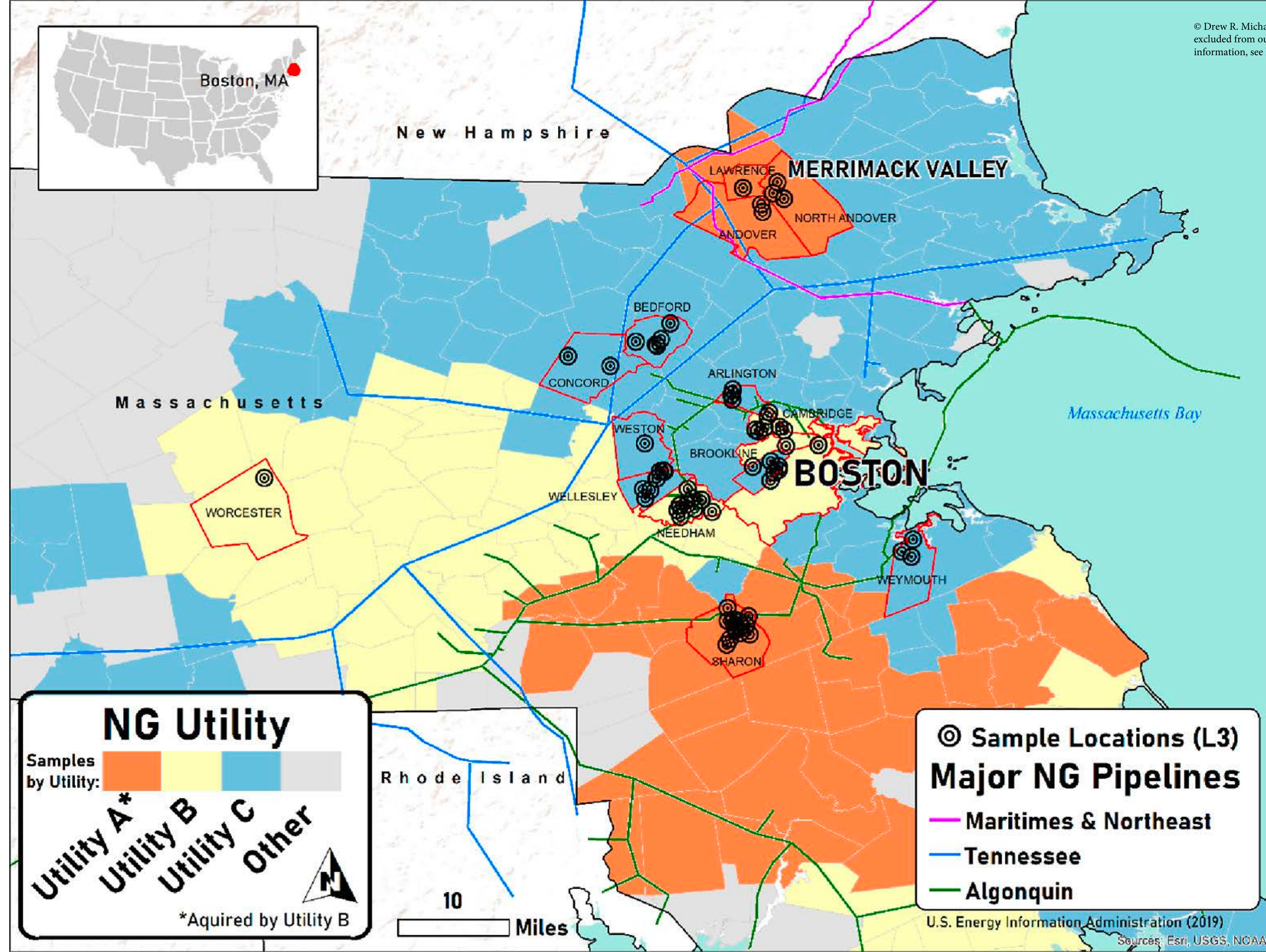


Table 1. Top 15 VOCs (Standard TO-15 Suite) with Statistical Measures and Confidence Intervals Derived from a 1000-Sample Bootstrap of Data from 234 Total Whole NG Samples^a

VOC [CAS] (units)	<i>n</i> (% detect)	Mean	SD	95% LCI	95% UCI
methane [74-82-8] (%) ^{b,d}	184 (79) ^c	101	1.0	99.2	103
ethane [74-04-0] (%) ^b	184 (79) ^c	2.07	0.05	1.98	2.17
hexane [110-54-3] (ppbv)	229 (98)	567	61	460	696
benzene [71-43-2] (ppbv)	223 (95)	165	16	136	195
toluene [108-88-3] (ppbv)	220 (94)	151	17	119	197
heptane [142-82-5] (ppbv)	219 (94)	267	26	220	324
cyclohexane [110-82-7] (ppbv)	208 (89)	215	20	176	254
<i>m,p</i> -xylene [108-38-3; 106-42-3] (ppbv)	175 (75)	58	7.2	44.9	73
ethanol [64-17-5] (ppbv)	153 (65)	126	18	92.4	164
<i>o</i> -Xylene [95-47-6] (ppbv)	148 (63)	17.5	2.4	13.1	22.4
ethylbenzene [100-41-4] (ppbv)	131 (56)	12.8	1.7	9.64	16.2
1,2,4-trimethylbenzene [95-63-6] (ppbv)	108 (46)	7.86	1.2	5.62	10.3
4-ethyltoluene [622-96-8] (ppbv)	95 (41)	6.02	0.88	4.35	7.68
1,3,5-trimethylbenzene [108-67-8] (ppbv)	66 (28)	3.04	0.51	2.08	4.06
acetone [67-64-1] (ppbv)	37 (16)	10.3	5.4	2.71	22.1
isopropylbenzene [98-82-8] (ppbv)	31 (13)	0.764	0.2	0.386	1.17
1,2-sichloroethane [107-06-2] (ppbv)	24 (10)	0.0652	0.039	0.0129	0.159

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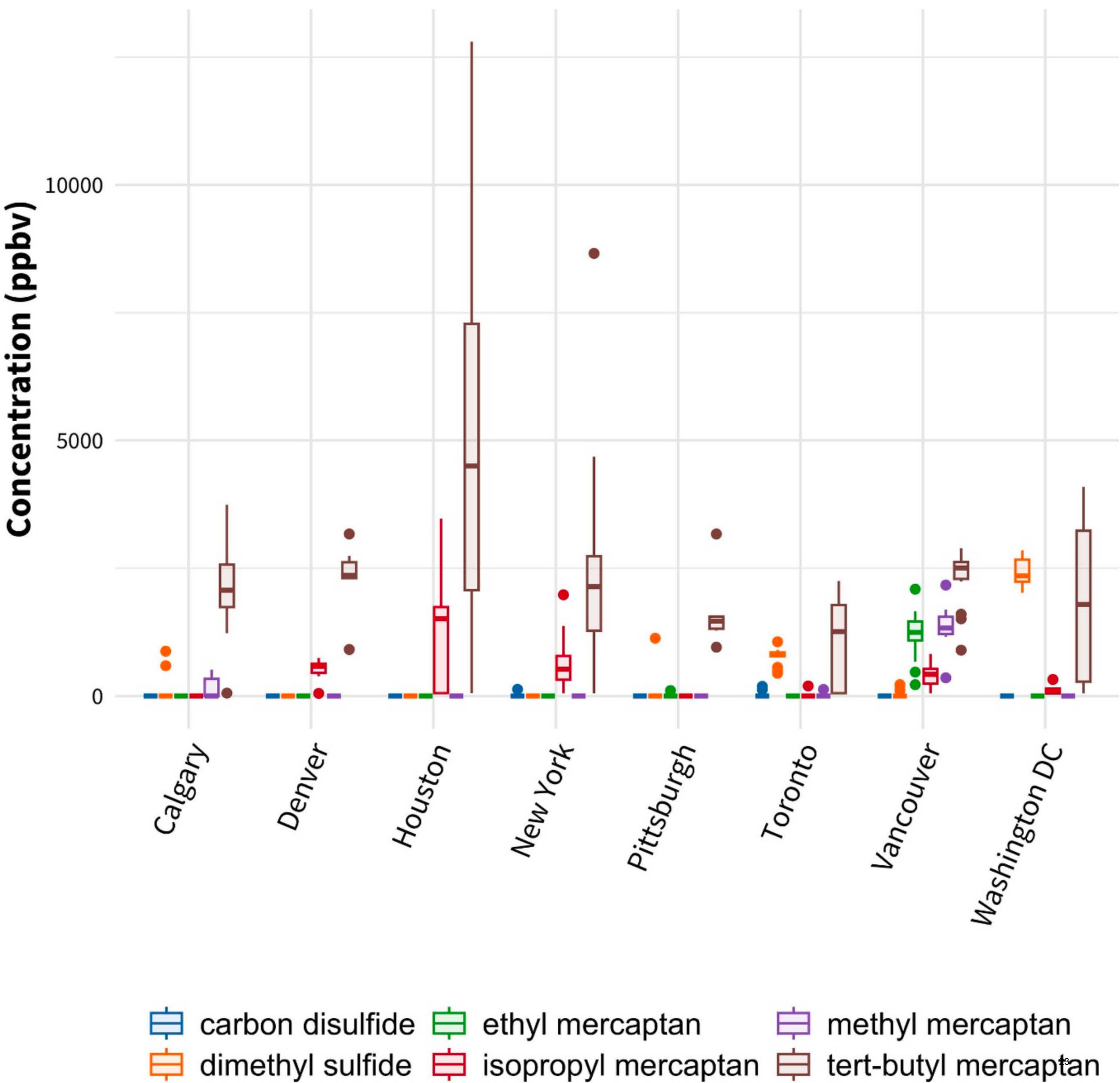
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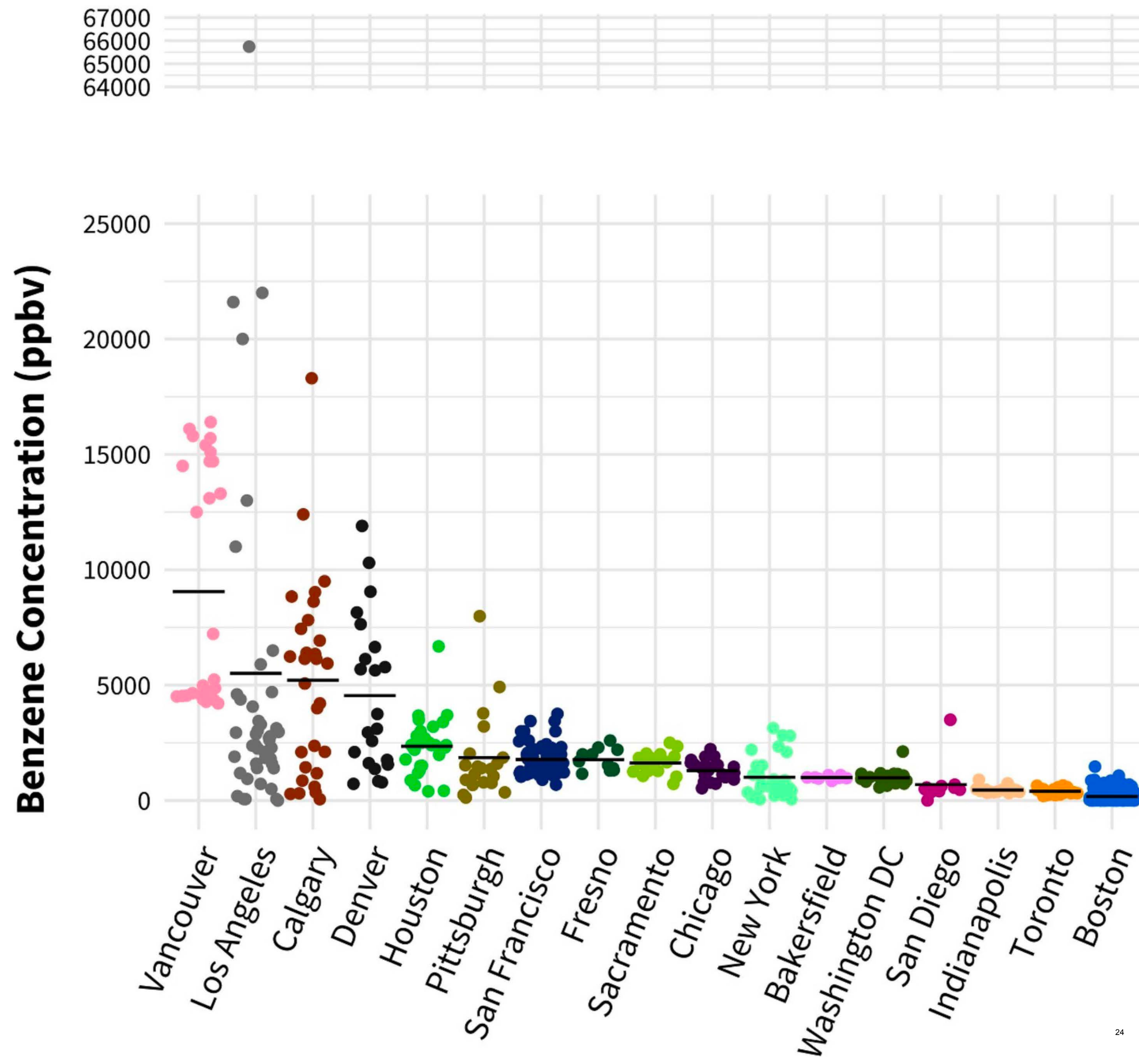
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Across North America

- High concentrations of odorant compounds

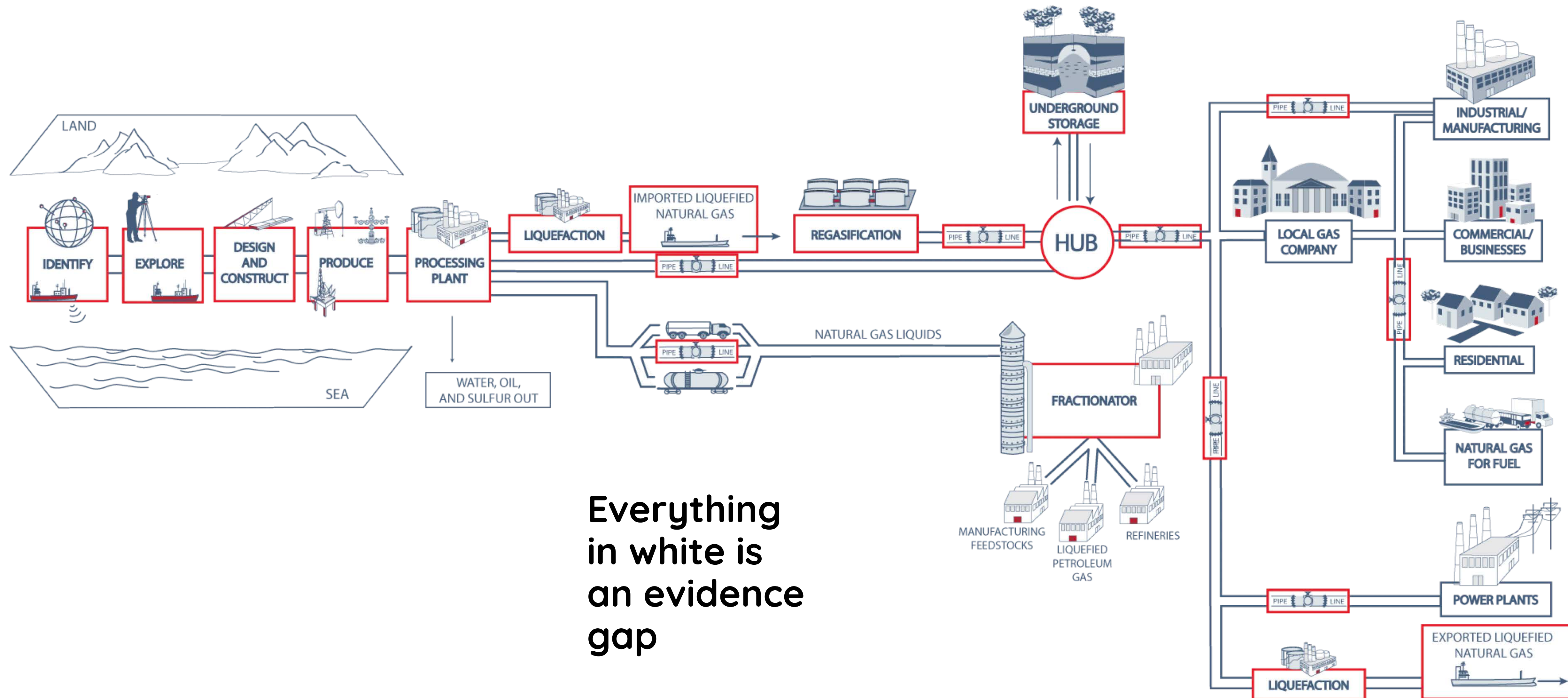


Benzene in gas across North America

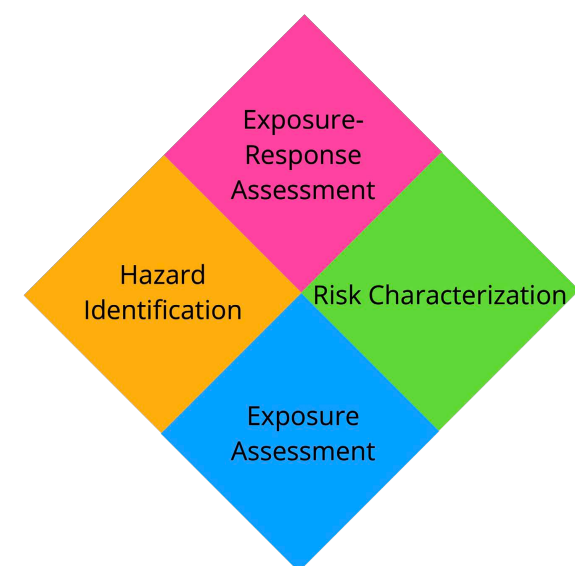
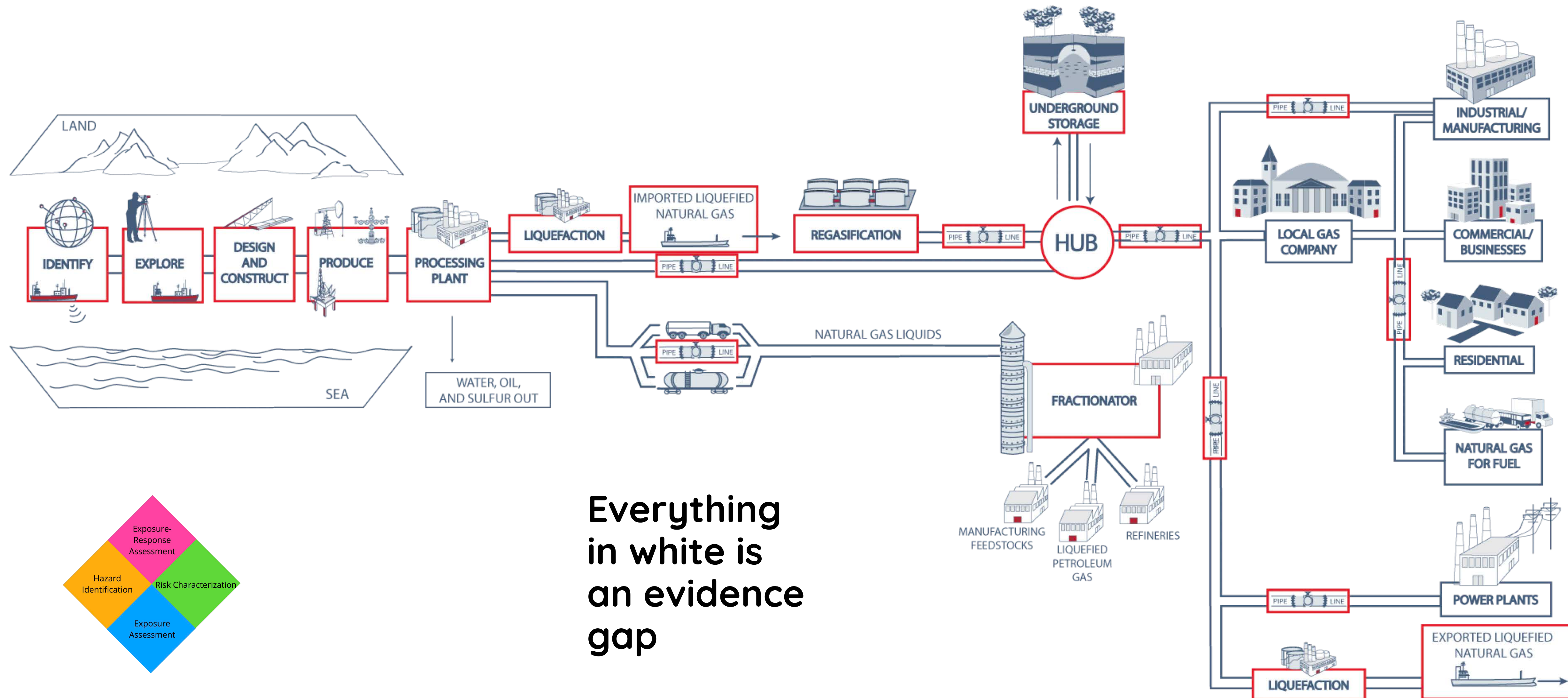


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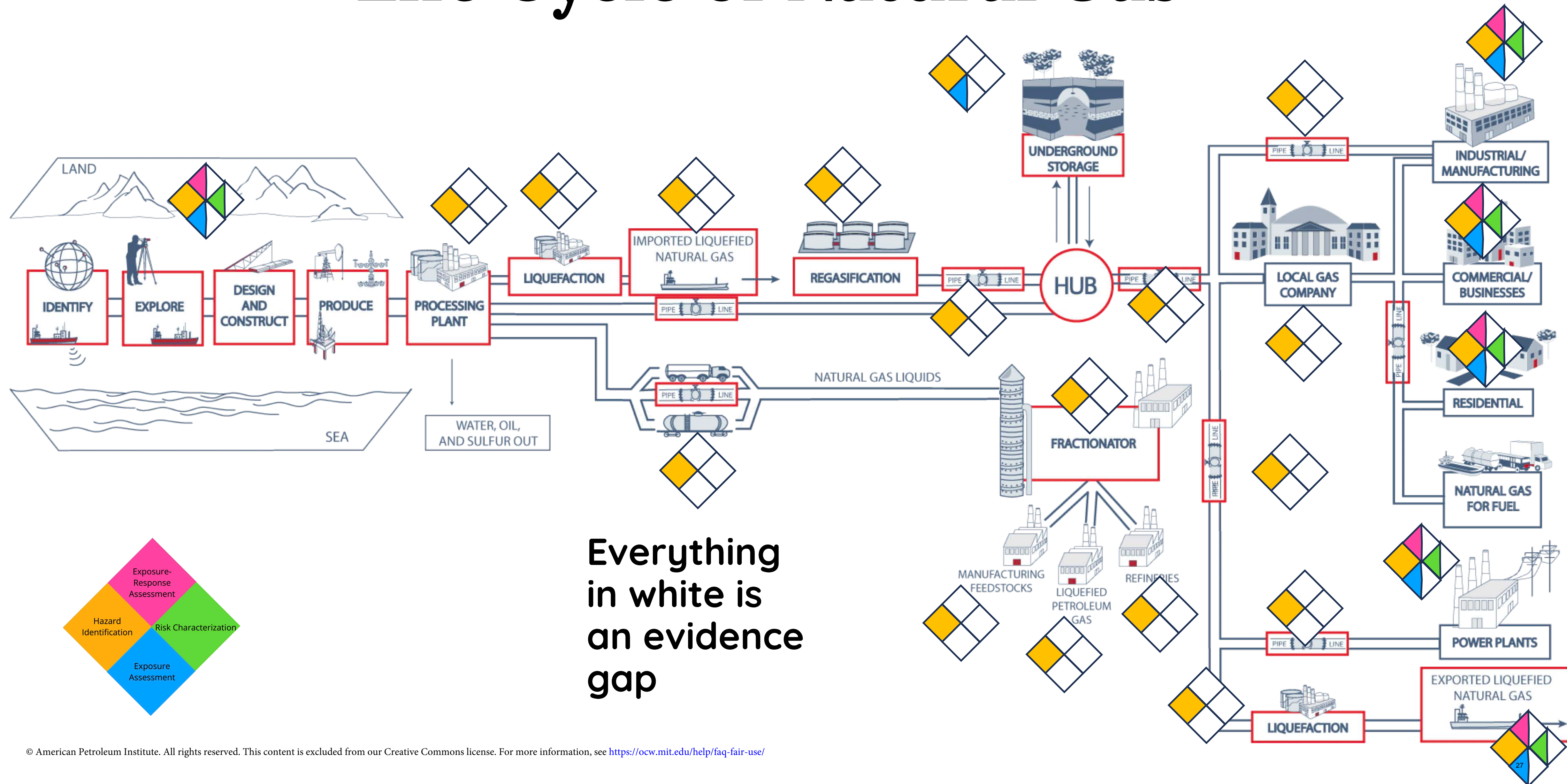
Life Cycle of Natural Gas



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