



Classification of Methane Emissions from Commercial and Industrial Natural Gas Customer Meter Sets

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Overall Project

- Improve the characterization of methane emissions from the natural gas distribution system
- Focus on:
 - emissions from industrial and commercial natural gas customer meter sets
 - differences between vintage and modern plastic pipelines
 - gather data to compare steel and cast iron pipelines with and without plastic liners
- Ultimately inform data used in the EPA Greenhouse Gas Inventory

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EIA Definitions

Commercial Sector

- An energy-consuming sector that consists of service-providing facilities and equipment of businesses
- Common uses of energy associated with this sector include space heating, water heating, air conditioning, lighting, refrigeration, cooking, and running a wide variety of other equipment

Industrial Sector

- An energy-consuming sector that consists of all facilities and equipment used for producing, processing, or assembling goods
- Overall energy use in this sector is largely for process heat and cooling and powering machinery, with lesser amounts used for facility heating, air conditioning, and lighting

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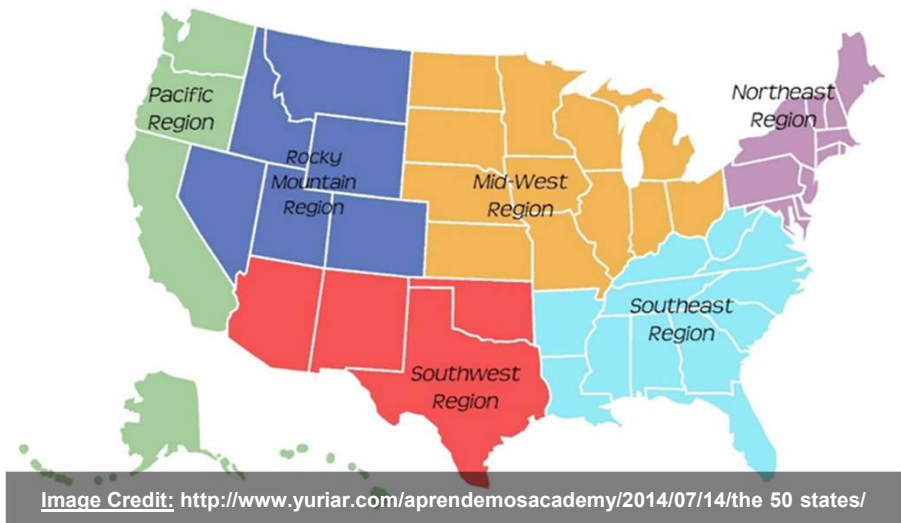


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Sampling Performed by Regions

- Roughly 5.6 million commercial/industrial meters nationwide according to EIA
- Sampling was broken down by region and weighted based on EIA estimates of industrial meters per region

Region	Meter Sets Sampled	Percent of Industrial Customers by Region (EIA 2015)	Percent of Samples by Region
Northeast	88	18.6%	16.8%
Southeast	20	10.1%	3.8%
Midwest	176	39.0%	33.7%
Rocky	21	4.9%	4.0%
Southwest	103	5.4%	19.7%
Pacific	115	22.0%	22.0%
Total	523	100.0%	100.0%



Information Categories

- Facility Type (initially seven types that were then separated into commercial and industrial)
- Region (six regions)
- Meter Type (3 main types)
- Company (11 companies)
- Individual Components (10 main categories plus “other”)

Information Categories



Background: <https://www.dresserengs.com/dresser-meters-instruments/dresser-meters>

Site Selection Methods



Industry partners in each region were asked to send lists of meters with addresses and meter type

One meter was randomly selected then other meter site visits were optimized for driving

Meter sets were classified by the largest meter at the site

Identification and Quantification methods

- Recorded number of components in main component categories
- Scanned all components with a combustible gas indicator
- Recorded concentration and component type for concentration indications at or above 100ppm
- Quantified emission rate for indications above 22,500 ppm (45% LEL)
- For a subset we quantified emission rates for all indications above 100 ppm
- Used enclosure method to quantify emission rate



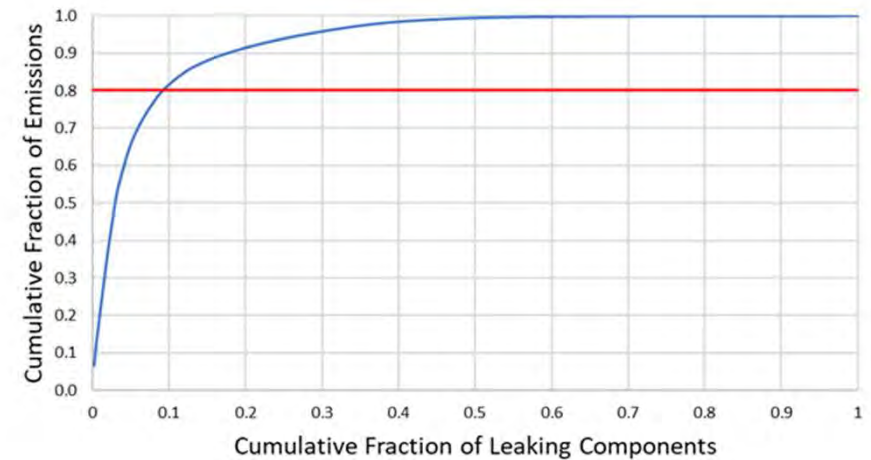
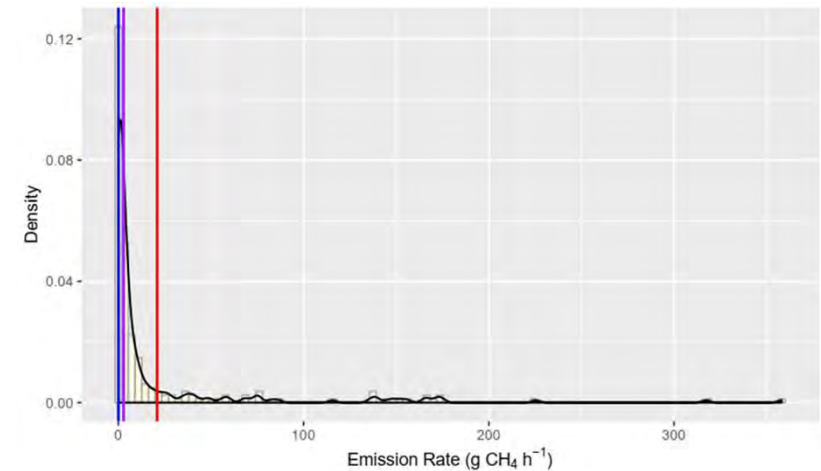
Components Scanned by Region

- 24,670 components scanned in the main categories logged at each meter set
- 43% of meter sets had a quantifiable emission based on study defined quantifiable limits

Region	Meter Sets	Emitting Meter Sets	Valve	Pneumatic Device	Regulator	Meter	Elbow	Tee	Coupling	Cap	Plug	Flange
Northeast	88	26	738	0	184	131	838	216	464	102	312	917
Southeast	20	19	287	0	33	21	72	30	188	32	138	415
Midwest	176	93	1874	0	380	204	1017	338	1055	91	1085	1623
Rocky	21	9	240	1	86	27	174	41	75	16	163	437
Southwest	103	41	1013	1	146	107	431	282	664	138	680	1056
Pacific	115	37	1633	1	370	122	729	403	584	45	1080	1140
Total	523	225	5785	3	1199	612	3261	1310	3030	424	3458	5588

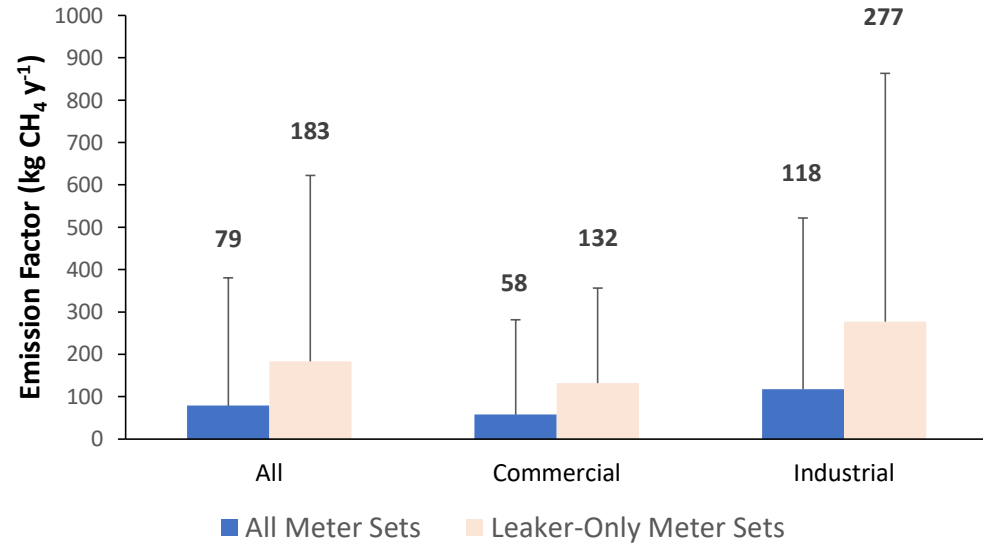
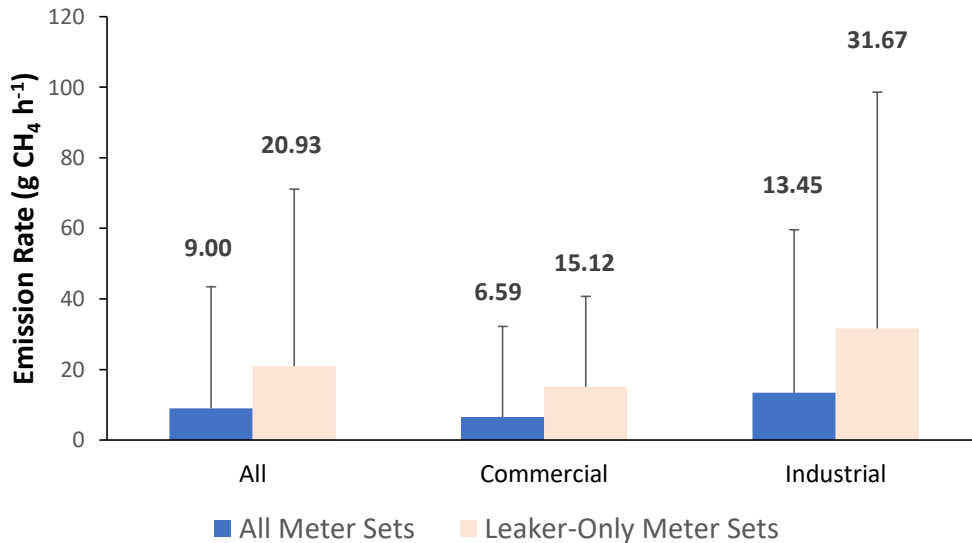
Highly Skewed/Fat-Tailed Emissions

- Quantified 458 individual component emissions at the 225 emitting meter sets
- Typical of natural gas sector, distribution of leak rates was highly skewed
- 80% percent of total emissions for the study came from 9% of individual component leaks



Meter Set Emissions – Commercial vs. Industrial

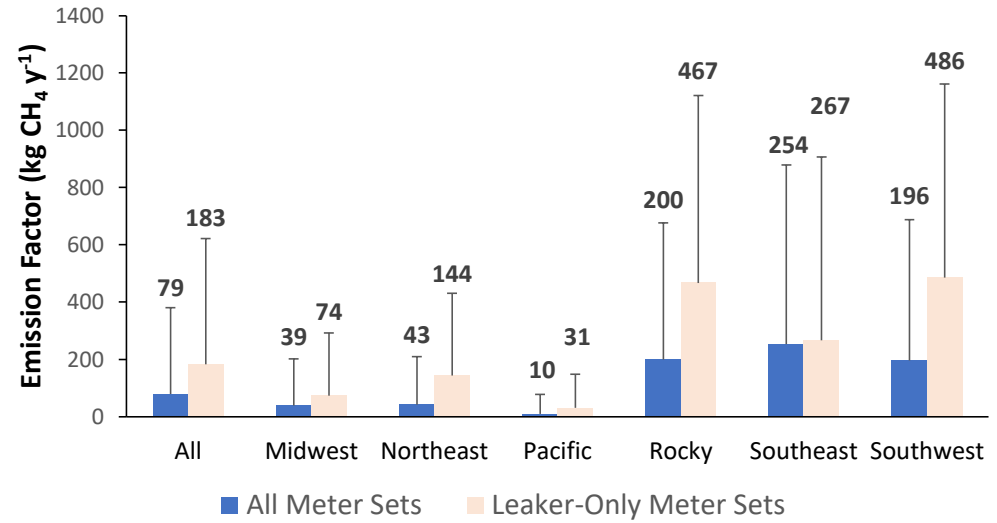
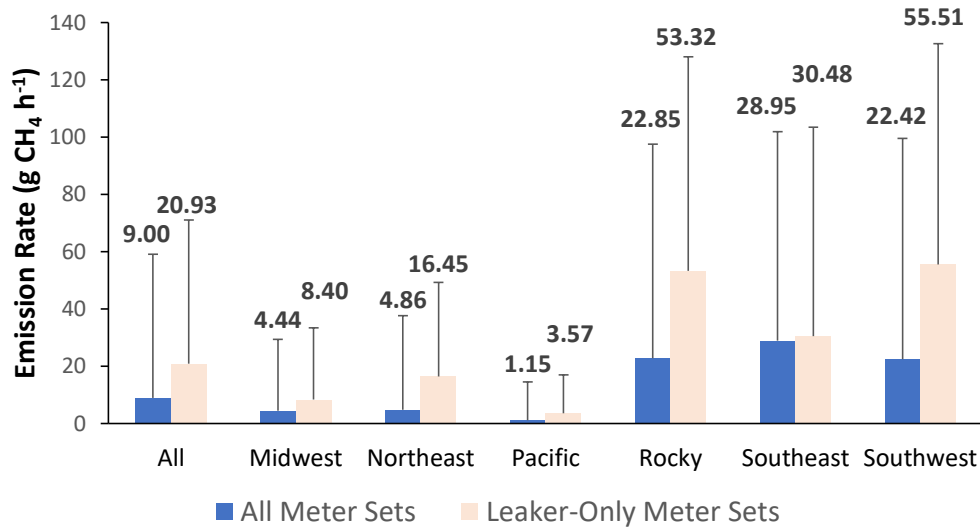
- Individual component emissions were summed to determine meter set emissions
- Industrial meter emissions were significantly larger across all data



Facility Type	Meter Sets Sampled	Meter Sets With a Leak Indication	Meter Sets with a Quantifiable Leak
Commercial Sector	337	278	146
Industrial Sector	186	161	79
Total	523	439	225

Meter Set Emissions - Region

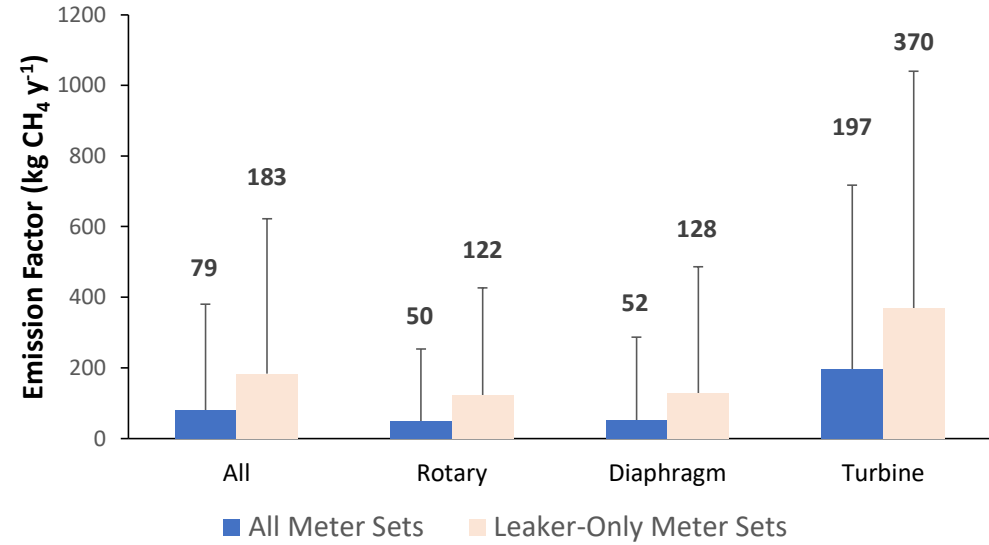
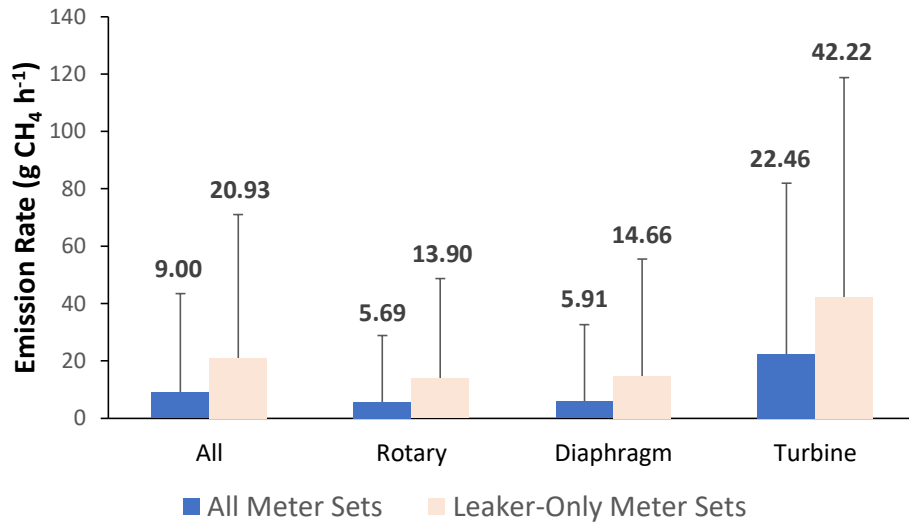
- For all data
 - Pacific and Midwest regions were statistically lower than NE, RO, SE, and SW



Region	Meter Sets Sampled	Meter Sets With a Leak Indication	Meter Sets with a Quantifiable Leak	Percent of Industrial Customers by Region (EIA 2015)	Percent of Samples by Region (this study)
Midwest (MW)	176	148	93	39.0%	33.7%
Northeast (NE)	88	74	26	18.6%	16.8%
Pacific (PA)	115	85	37	22.0%	22.0%
Rocky (RO)	21	20	9	4.9%	4.0%
Southeast (SE)	20	19	19	10.1%	3.8%
Southwest (SW)	103	93	41	5.4%	19.7%
Total	523	439	225	100.0%	100.0%

Meter Set Emissions – Meter Type

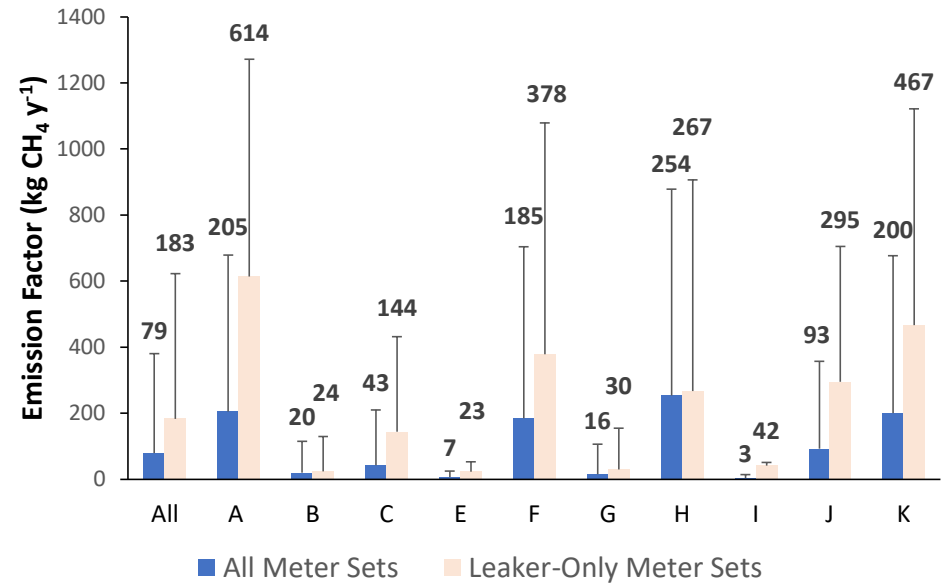
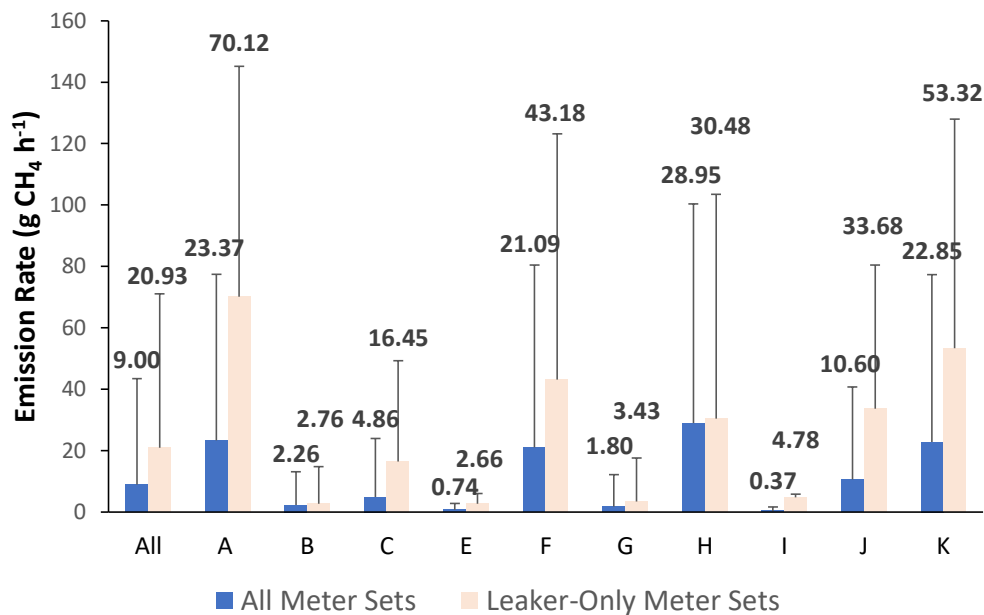
- Rotary and Diaphragm statistically lower than Turbine



Meter Set Type	Meter Sets Sampled	Meter Sets With a Leak Indication	Meter Sets with a Quantifiable Leak
Rotary	303	252	124
Diaphragm	119	95	48
Turbine	94	86	50
Ultrasonic	2	1	1
Orifice	2	2	1
Regulating Equipment	3	3	1
Total	523	439	225

Meter Set Emissions – Company

- Differences existed among companies



Company	Meter Sets Sampled	Meter Sets With a Leak Indication	Meter Sets with a Quantifiable Leak
A	60	51	20
B	78	69	64
C	88	74	26
D	1	1	0
E	43	34	12
F	43	42	21
G	63	37	33
H	20	19	19
I	52	48	4
J	54	44	17
K	21	20	9
Total	523	439	225

Meter Set Population Emission Factors

- Broken down first by commercial and industrial then by region
- 95% Confidence Intervals have been calculated (not in report)

	Commercial			Industrial		
	Mean	Standard Deviation	Total Sample Size	Mean	Standard Deviation	Total Sample Size
All	57.4	223.6	337	117.8	404.4	186
Midwest	28.4	145.5	99	52.3	183.2	77
Northeast	20.0	43.7	75	172.5	413.0	13
Pacific	4.0	9.5	63	17.4	100.1	52
Rocky	108.4	348.9	12	322.5	609.8	9
Southeast	139.3	292.0	5	291.7	707.1	15
Southwest	153.9	377.7	83	372.9	799.6	20

	Commercial				Industrial			
	Mean (kg meter ⁻¹ y ⁻¹)	Lower Confidence Interval	Upper Confidence Interval	Total Sample Size	Mean (kg meter ⁻¹ y ⁻¹)	Lower Confidence Interval	Upper Confidence Interval	Total Sample Size
All	57.4	35.3	82.5	337	117.8	64.8	179.8	186
Midwest	28.4	6.3	61.1	99	52.3	17.4	98.4	77
Northeast	20.0	11.1	30.4	75	172.5	20.9	416.1	13
Pacific	4.0	1.9	6.6	63	17.4	1.5	46.6	52
Rocky	108.4	1.9	312.9	12	322.5	10.4	769.2	9
Southeast	139.3	0.6	403.2	5	291.7	58.1	686.3	15
Southwest	153.9	80.0	241.1	83	372.9	83.9	765.3	20

Thank you

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