

ASTSWMO 2002 State Symposium on Fuel Oxygenates

“Prevalence of Oxygenates in Fuel and
at LUST Sties, State by State”

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Oxygenates State by State?

W-e-l-l not exactly.

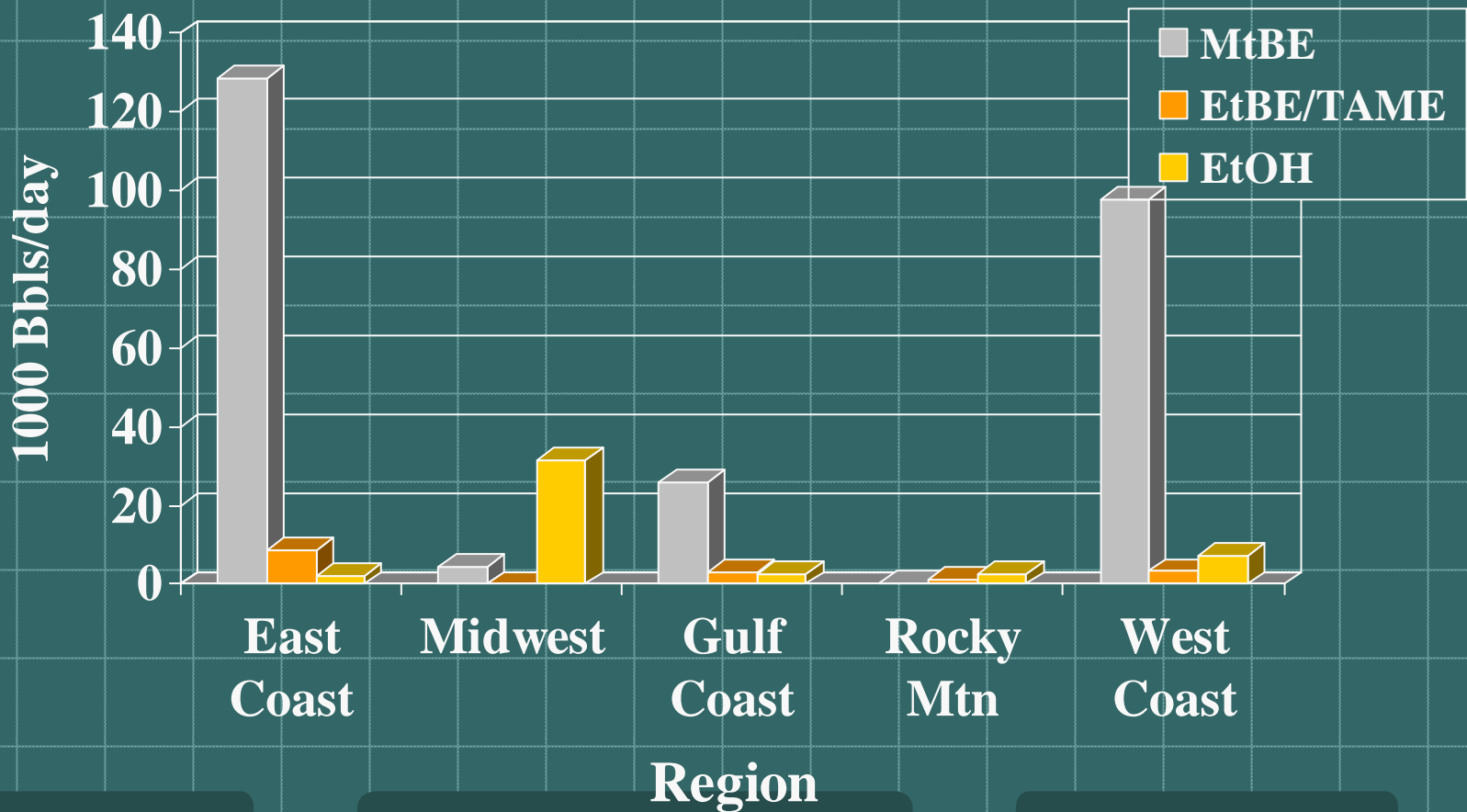


- ✧ 4 States for oxygenates in gasoline
- ✧ 5 States for oxygenates at LUST sites

What's in the Gasoline?

- ◆ Request sent out to all states via Stephen Crimando
- ◆ Responses from ME, VT, NY, KY, IA, VA, MN, KS, and DE

National Distribution of Oxygenates in RFG & Oxygenated Gasoline (1997)



Nationwide Use of Oxygenates in RFG

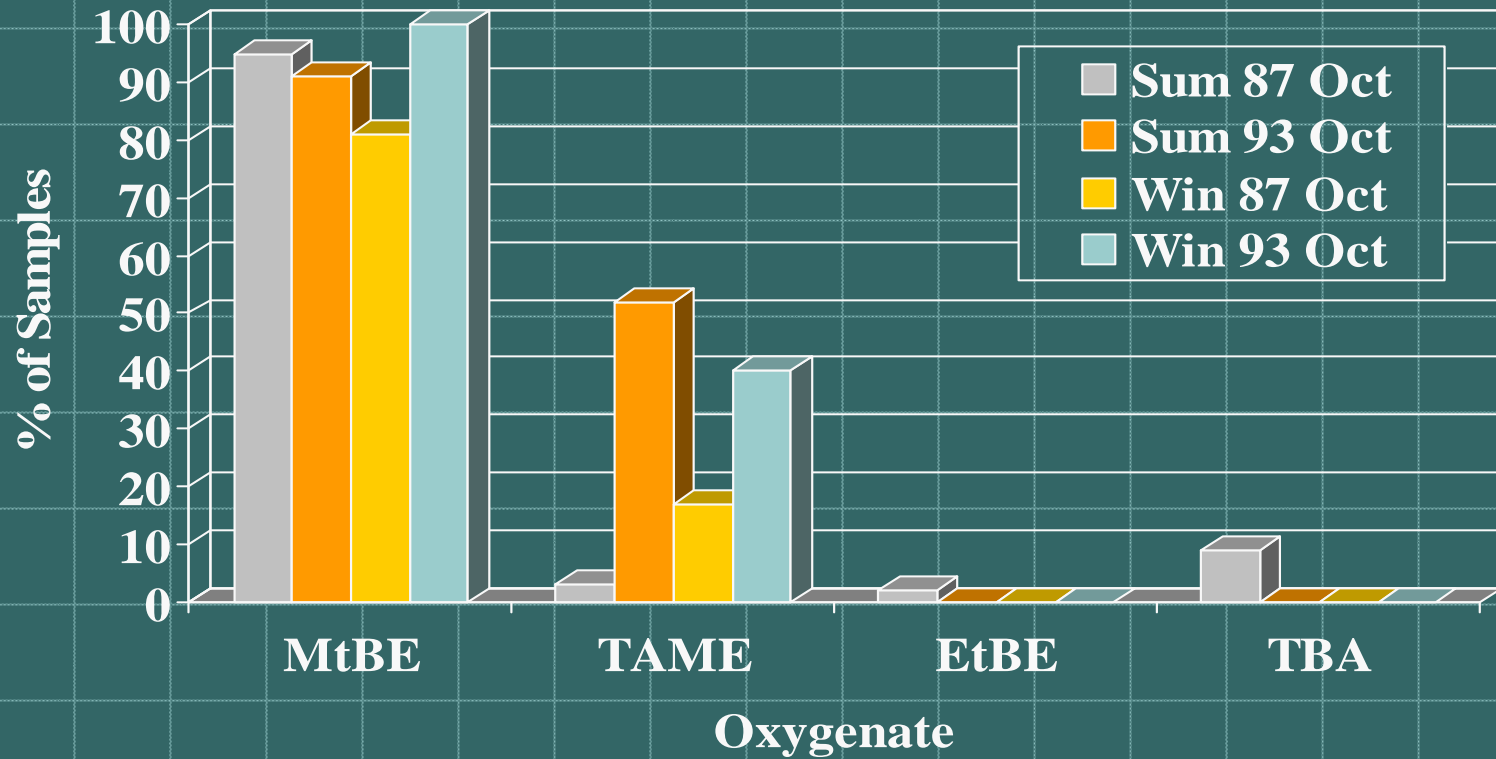
- ◆ 30% of all gasoline is RFG
- ◆ Required in parts of 11 states
- ◆ Parts of another 6 states chose to “Opt In”

Maine

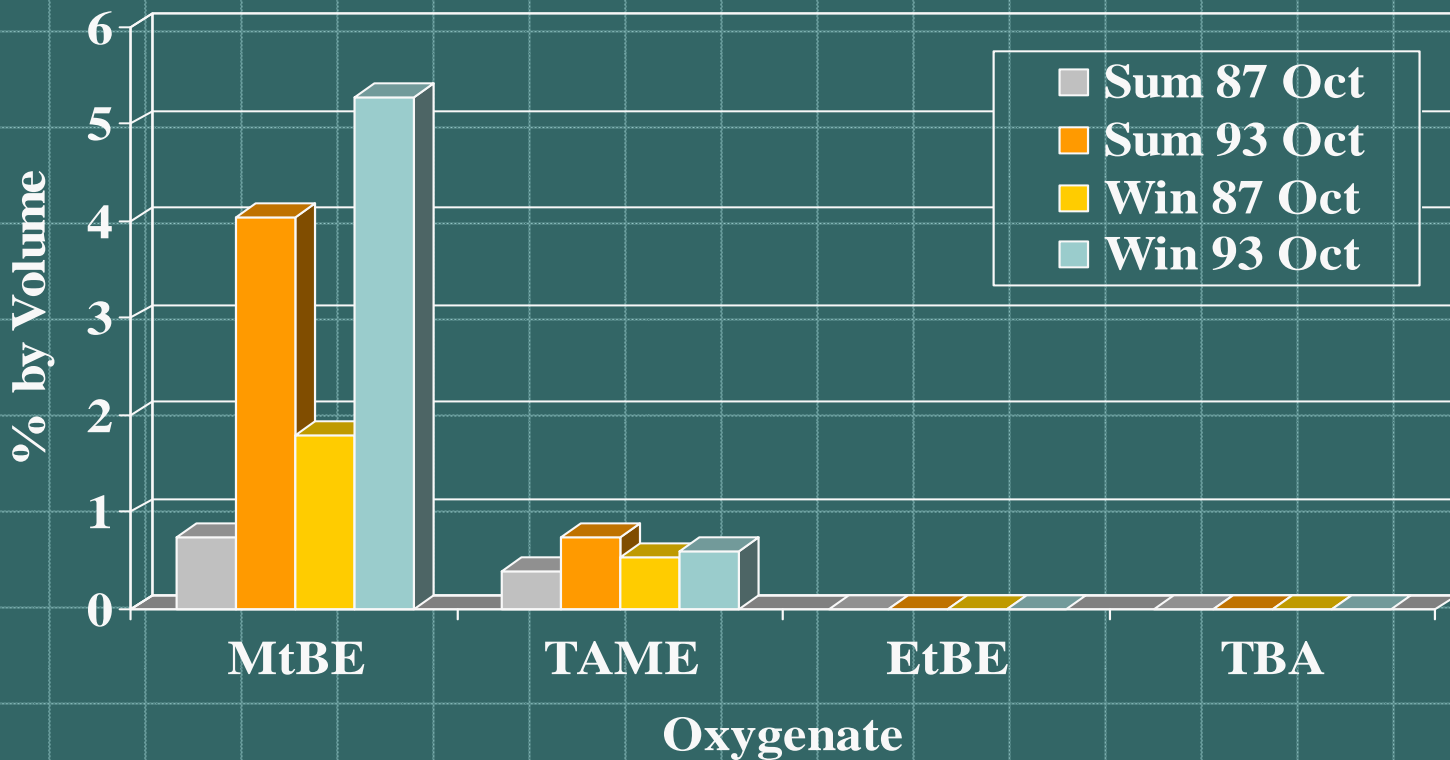
Gasoline Content Analysis

- ◆ All gasoline entering Portland harbor sampled
- ◆ Five refiners
 - ◆ Gulf
 - ◆ Exxon-Mobil
 - ◆ Motiva
 - ◆ Irving
 - ◆ Webber
- ◆ Shipments ranged from 4,000 to 242,000 bbls.
- ◆ Maine not an RFG state

Incidence of Oxygenates in Maine Gasoline (2002)



Volume of Oxygenates in Maine Gasoline (2002)



Maine Regular (87 Octane) Summer Blend (2002)

Oxygenate	Avg. %	Max. %	Min. %	% (No.) Samples
MtBE	0.74	2.58	0.08	95% (61)
EtBE	1.3	1.3	1.3	1.5% (1)
TAME	0.4	0.63	0.16	3% (2)
DIPE	Not	found	or	reported
TBA	1.3	3.39	0.2	9% (6)

64 samples total

Maine

Premium (93 Octane)

Summer Blend (2002)

Oxygenate	Avg. %	Max. %	Min. %	% (No.) Samples
MtBE	4.0	12.2	0.75	91% (21)
EtBE	Not	found	or	reported
TAME	0.75	2.1	0.1	52% (12)
DIPE	Not	found	or	reported
TBA	Not	found	or	reported

23 total samples

Maine

Regular (87 Octane)

Summer Blend

◆ Other oxygenates found

- ◆ Isobutanol 1.2% avg. / 3.6% max. vol., 8 samples
- ◆ N-butanol 0.15% avg. / 0.4% max. vol., 5 samples
- ◆ Methanol 1.5% avg. / 1.9% max. vol., 2 samples

Maine

Regular (87 Octane)

Winter Blend (2002)

Oxygenate	Avg. %	Max. %	Min. %	% (No.) Samples
MtBE	2.20	9.25	0.012	81% (39)
EtBE	Not	found	or	reported
TAME	0.4	0.63	0.16	17% (8)
DIPE	Not	found	or	reported
TBA	Not	found	or	reported

48 total samples



How Do Summer & Winter Blends Vary In Maine?

Octane	Avg. MtBE Summer	Avg. MtBE Winter	Avg. TAME Summer	Avg. TAME Winter
87	0.74%	1.79%	0.4%	0.53%
93	4.04%	5.28%	0.75%	0.59%

Do All Maine Refiners Have the Same MtBE Content?

- ◆ No!
- ◆ Exxon-Mobil
 - ◆ 0 – 2.4% regular
 - ◆ 2.5 – 6.2% premium
- ◆ Gulf
 - ◆ 0 – 0.5% regular
 - ◆ 0 – 11.7% premium
- ◆ Motiva
 - ◆ 0.1 – 2.6% regular
 - ◆ 0 – 3.0% premium

Vermont Premium (93 Octane) Fall, 2002 *DRAFT*

Oxygenate	Avg. %	Max. %	Min. %	% (No.) Samples
MtBE	5.4	7.7	3.9	100 (7)
EtBE	0.5	0.7	0.4	71 (5)
TAME	0.4	0.6	0.3	57 (4)
DIPE	Not	found		
TBA	0.2	0.2	0.2	57 (4)

7 samples total

Vermont Regular (87 Octane) Fall, 2002 *DRAFT*

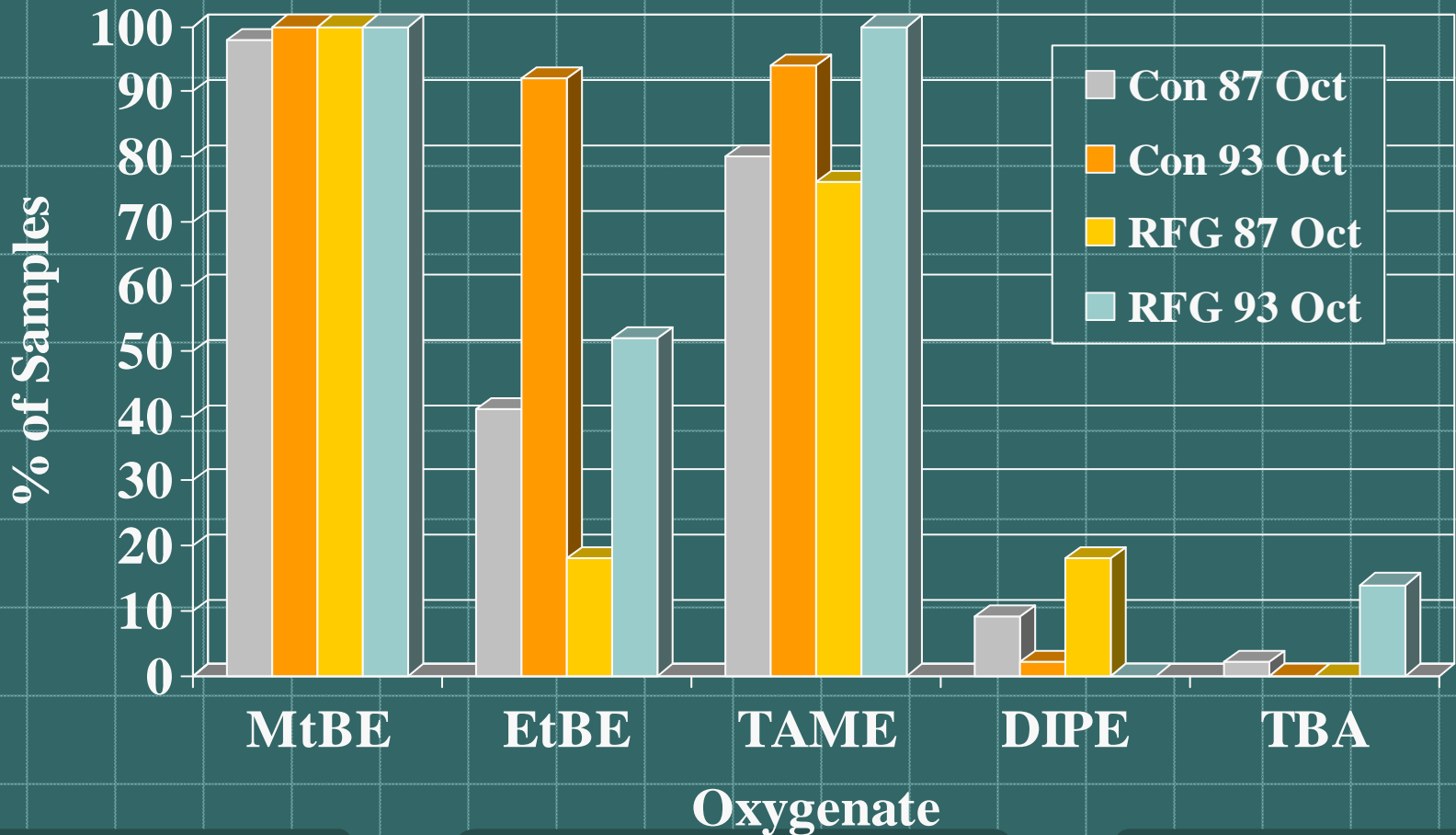
Oxygenate	Avg. %	Max. %	Min. %	% (No.) Samples
MtBE	1.3	3.0	0.4	87.5 (7)
EtBE	0.3	0.5	0.2	50 (4)
TAME	2.1	2.7	1.8	50 (4)
DIPE	Not	found		
TBA	0.3	0.4	0.2	37.5 (3)

8 samples total

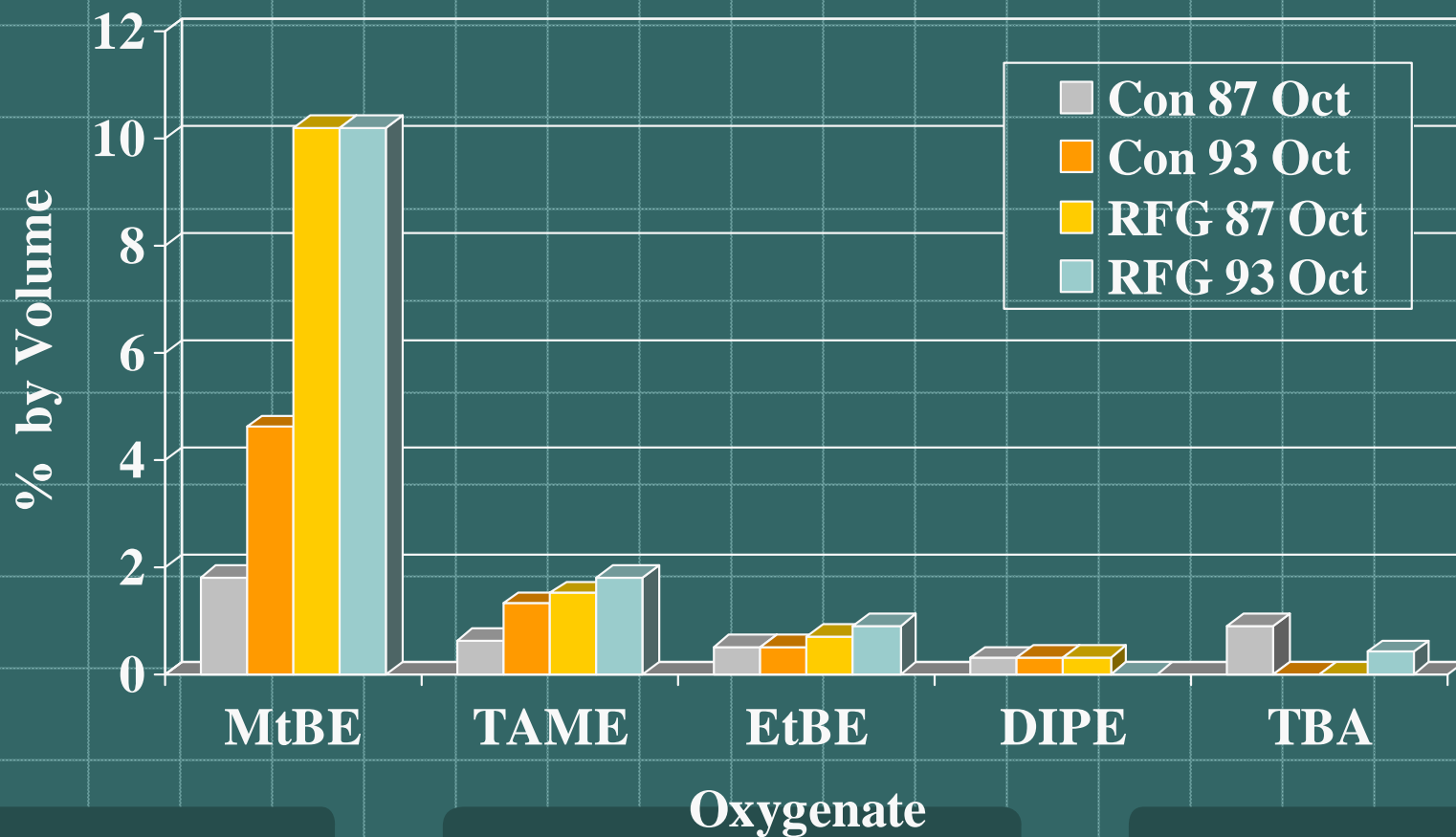
Use of RFG in N.H.

- ◆ NH "Opted In"
- ◆ 4 southern counties in RFG program
- ◆ 6 northern counties use conventional gas
- ◆ Reports of RFG distribution to other counties

Incidence of Oxygenates in NH Gasoline (2000 Study)



Volume of Oxygenates in NH Gasoline (2000)



N. H. Non-RFG Counties Regular (87 Octane)

Oxygenate	Avg %	Max %	Min%	% (No.) Samples
MtBE	1.8	12.1	0.3	100 (51)
TAME	0.6	1.4	0.3	80 (41)
EtBE	0.5	3.0	0.2	43 (22)
DIPE	0.28	0.5	0.2	10 (5)
TBA	0.9	0.9	0.9	2 (1)
% Oxygen	0.45	2.29	0.07	51

51 samples total

N.H. Non-RFG Counties Premium (93 Octane)

Oxygenate	Avg %	Max %	Min%	% (No.) Samples
MtBE	4.6	11.5	1.2	100 (52)
TAME	1.3	3.0	0.2	94 (49)
EtBE	0.5	0.8	0.2	92 (48)
DIPE	0.3	0.3	0.3	2 (1)
TBA	-	-	-	-
% Oxygen	1.13	2.47	0.33	52

52 samples total

N.H. RFG Counties Regular (87 Octane)

Oxygenate	Avg %	Max %	Min%	% (No.) Samples
MtBE	10.2	14	5.9	100 (17)
TAME	1.5	4.5	0.3	76 (13)
EtBE	0.7	0.7	0.6	18 (3)
DIPE	0.3	0.6	0.2	18 (3)
TBA	-	-	-	-
% Oxygen	2.08	2.66	1.81	17

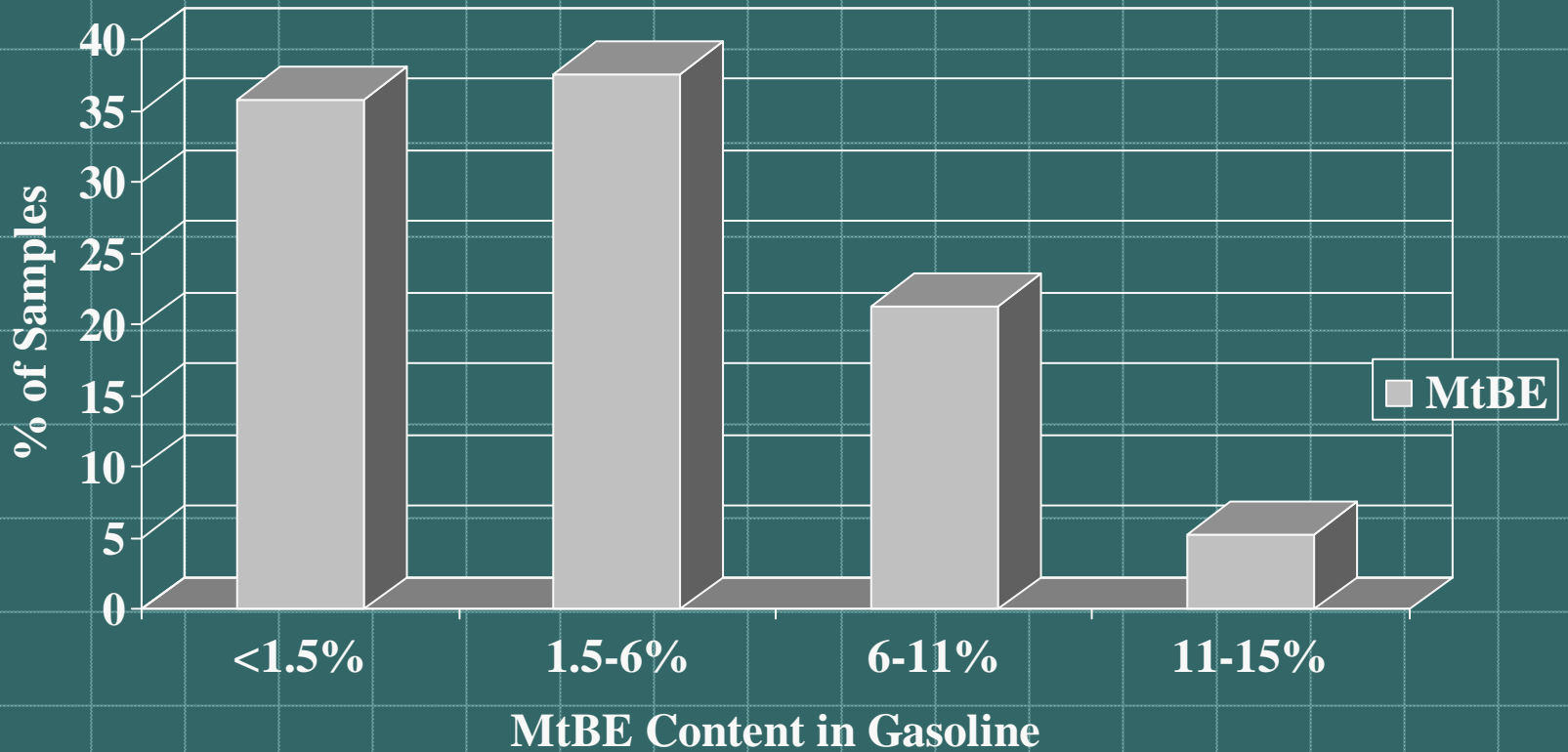
17 samples total

N.H. RFG Counties Premium (93 Octane)

Oxygenate	Avg %	Max %	Min%	% (No.) Samples
MtBE	10.2	12.4	3.9	100 (21)
TAME	1.8	5.5	0.2	100 (21)
EtBE	0.9	6.5	0.2	52 (11)
DIPE	-	-	-	-
TBA	0.4	0.7	0.2	14 (3)
% Oxygen	2.25	2.79	1.91	21

21 samples total

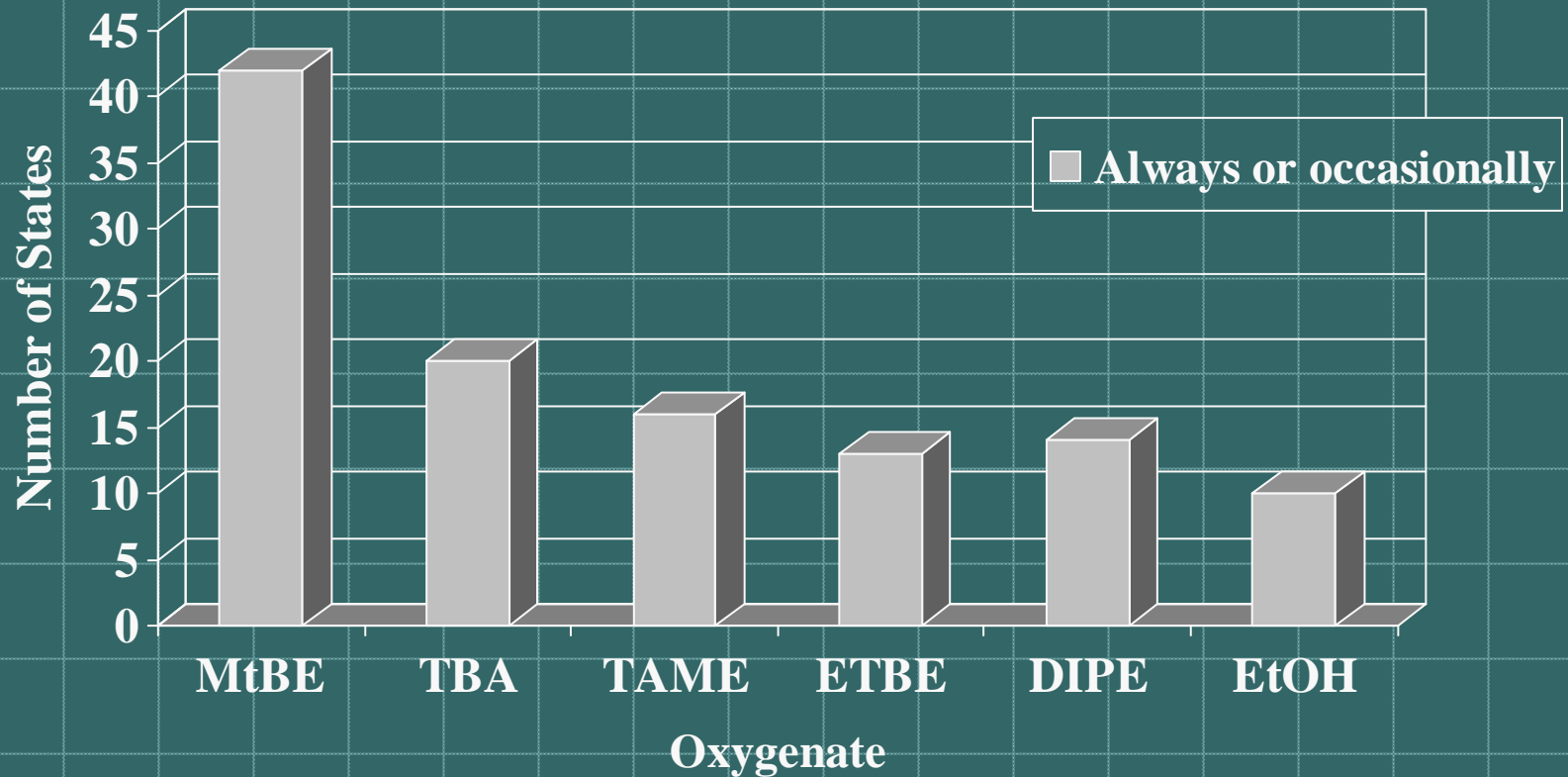
MtBE Content Of Gasoline In Kansas



1380 fuel samples

Prevalence of Oxygenates at LUST Sites

Who Analyzes for Oxygenates At Sites? NEIWPCC (2000 Survey)



Oxygenates in Groundwater at LUST Sites in NH

- ◆ MtBE present at nearly gasoline sites, often driving cleanup
- ◆ TAME second most prevalent ether ~ 1/10th MtBE conc.
- ◆ EtBE & DIPE appear occasionally, < 10ppb
- ◆ TBA present at most MtBE sites

NH Groundwater Samples (25 Sites)

◆ MtBE	18,300 ppb (avg.)* 3,700 ppb (med.)	25 sites
◆ TAME	1,700 ppb 160 ppb	19 sites
◆ TBA	11,900 ppb 4,300 ppb	13 sites

* Max. Conc. in MW at site

NH Groundwater Samples (25 Sites)

◆ EtBE	190 ppb	2 sites
	190 ppb	
◆ DIPE	5 ppb	4 sites
	4.6 ppb	

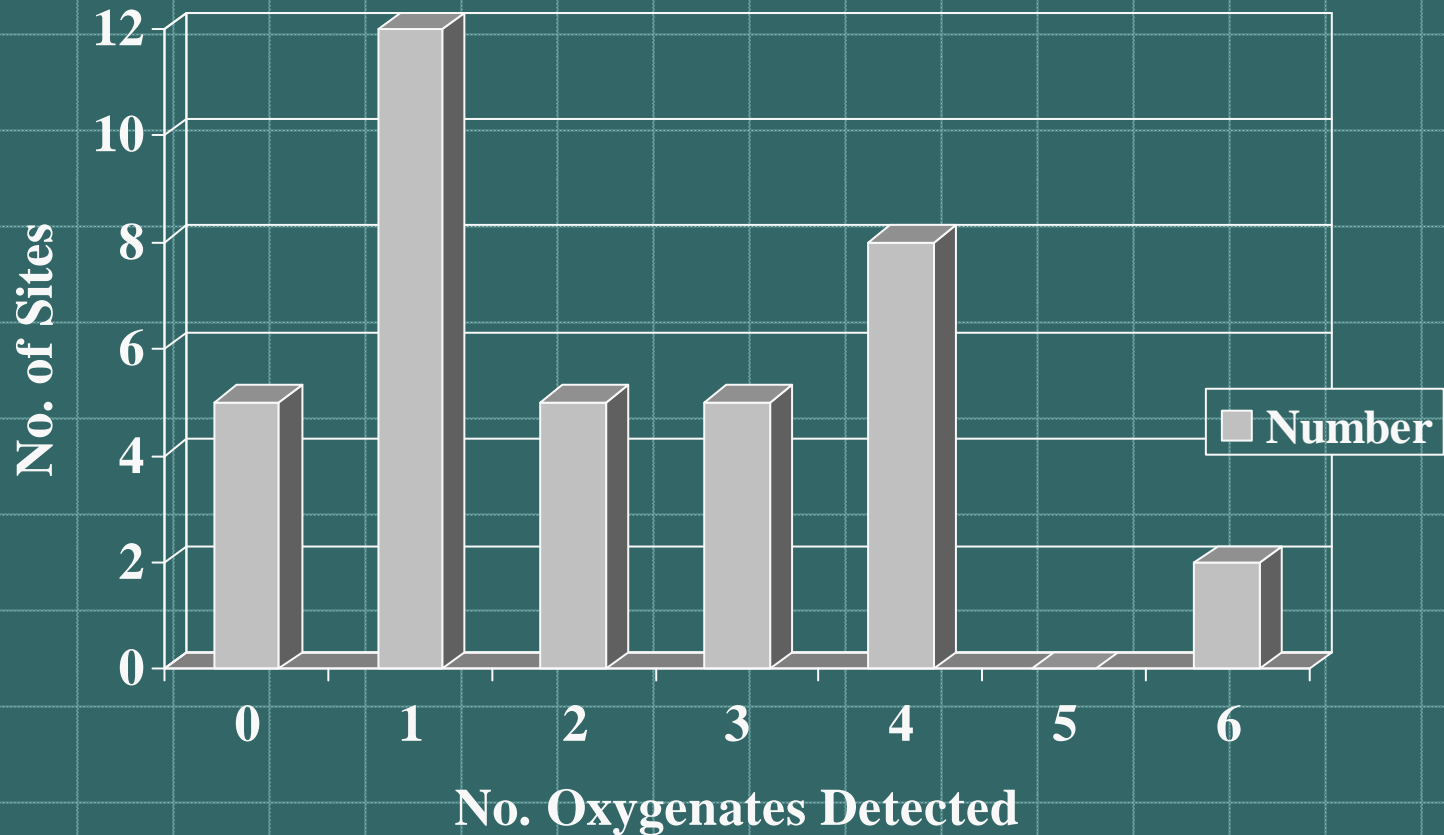
South Carolina Groundwater Samples (37 Sites)

Oxygenate	% Detections (# sites)	Highest Conc. $\mu\text{g/l}$	Average Conc. $\mu\text{g/l}$
MtBE	67 (24)	82,000	6,690
EtBE	6 (5)	60	42.5
TAME	28 (9)	1,760	257
DIPE	36 (14)	176	81.5

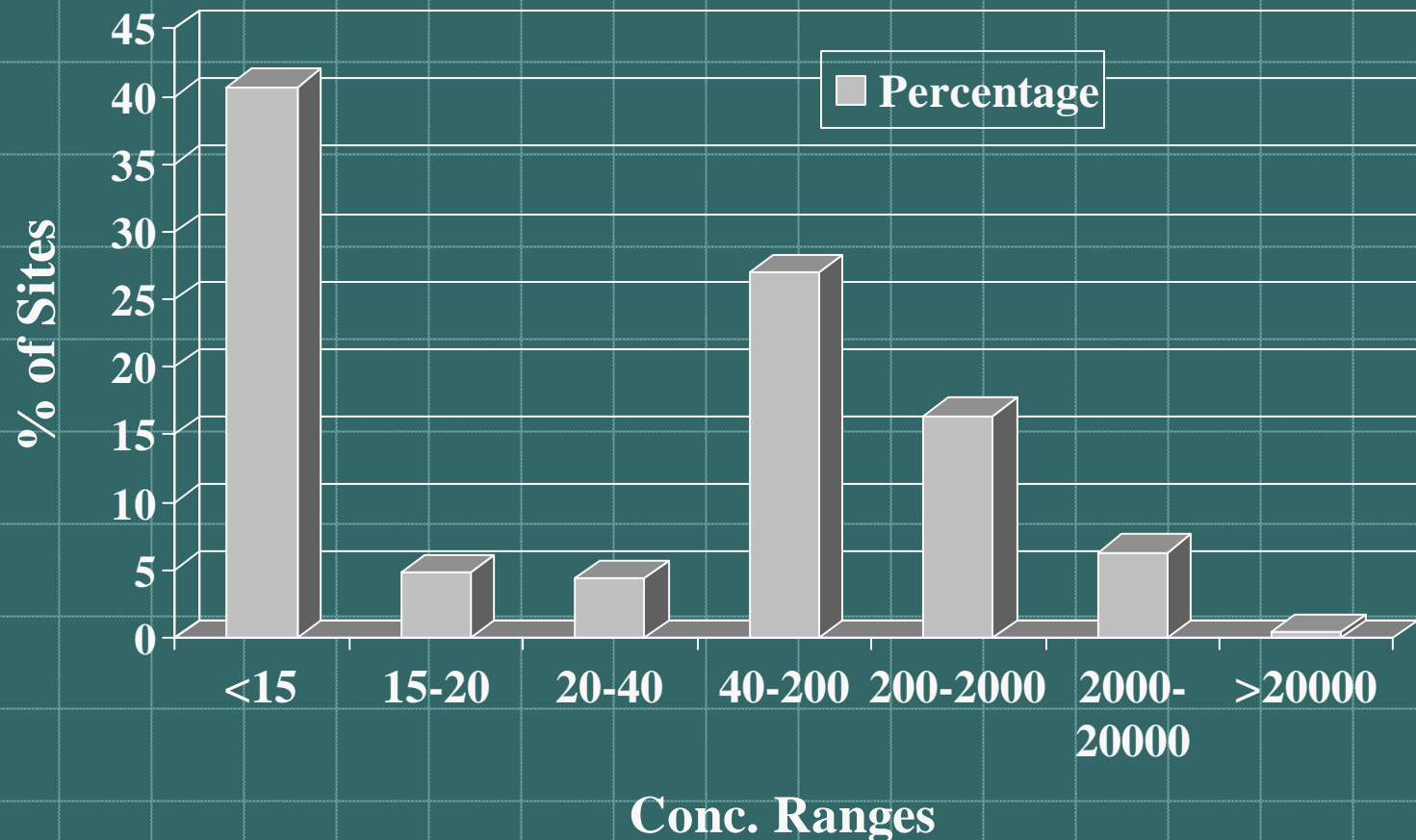
South Carolina Groundwater Samples (37 Sites)

Oxygenate	% Detections (# sites)	Highest Conc. $\mu\text{g/l}$	Average Conc. $\mu\text{g/l}$
EtBE	14 (5)	1,760	708
TBF	0 (0)	ND	ND
TBA	22 (8)	7,500	1,296
TAA	33 (13)	76,000	8,014
EtOH	14 (5)	9,800,000	1,962,000

South Carolina Groundwater Samples (37 sites)



MtBE Groundwater Maximums at Iowa LUST Sites (1999)

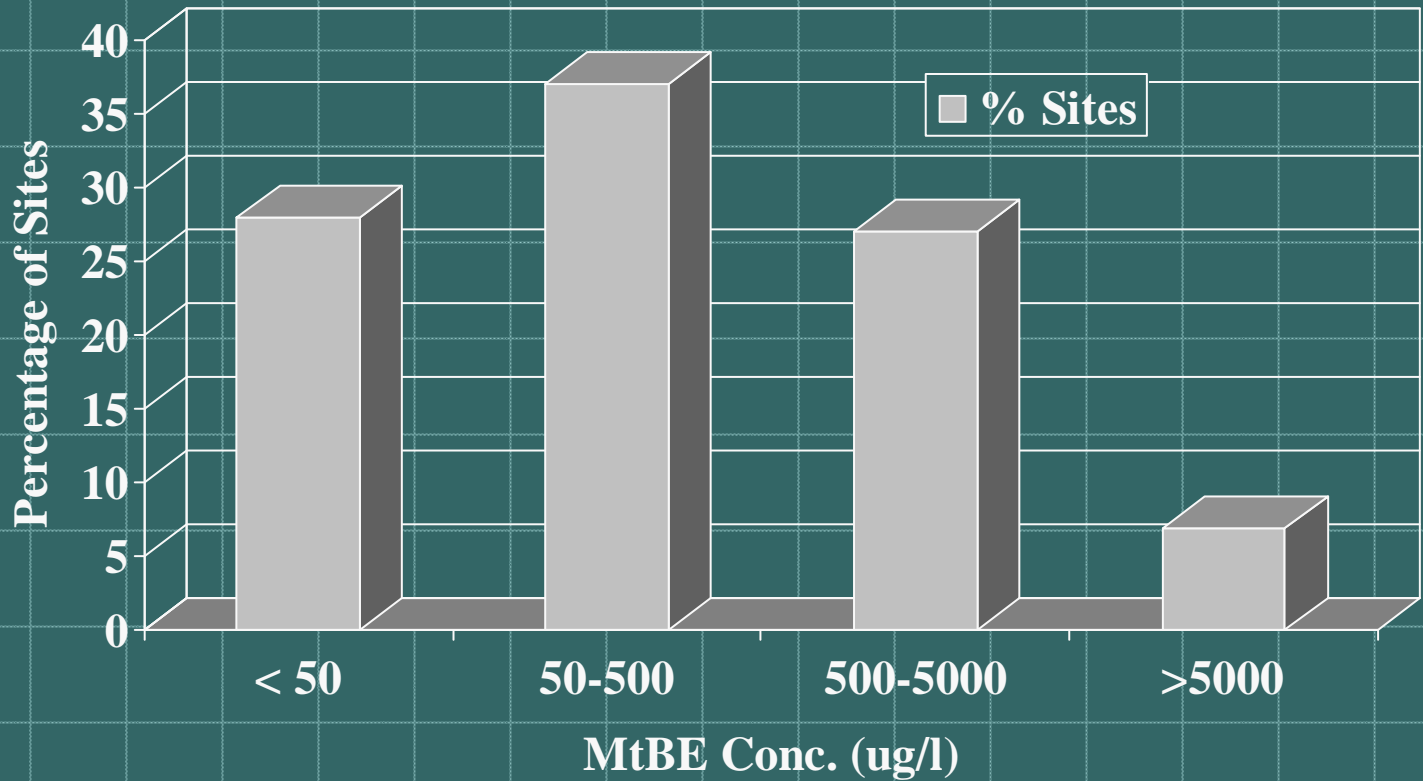


PQL - 15 ppb, 603 Sites

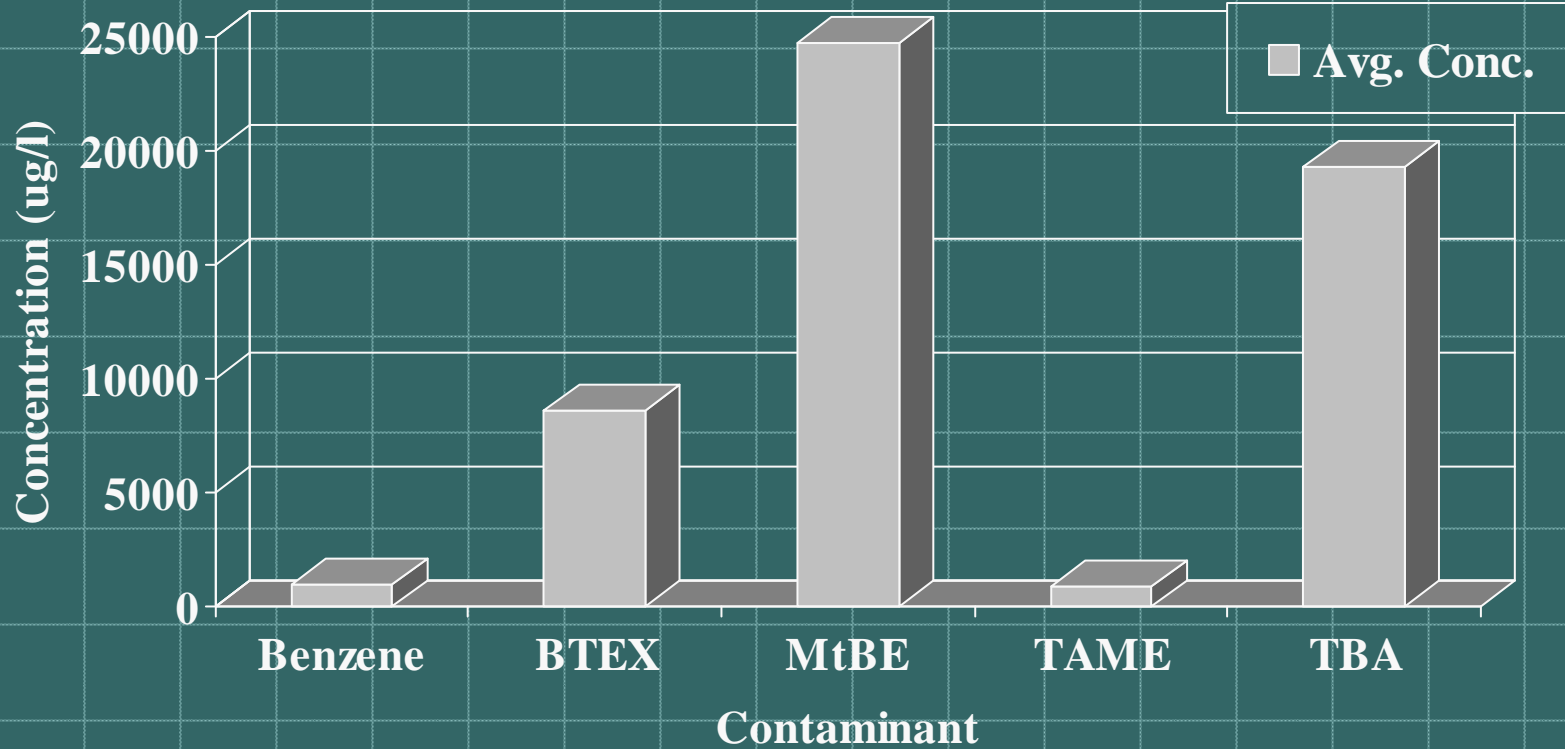
Oxygenates Detected at Iowa LUST Sites

Oxygenate	No. of Samples	No. of Sites	Max. Conc.
DIPE	13	6	Not measured
EtBE	33	14	Not measured
TAME	22	10	117 ug/l
TBA	22	11	3,480 ug/l

MtBE Groundwater Maximums at Kansas LUST Sites



Petroleum Contamination at Delaware LUST Sites



Data from 48 wells in plume "core" at 17 sites

Experiences Of Other States

- ◆ Kansas – Found only MtBE and TBA (1:1 with MtBE)
- ◆ Minnesota – MtBE at 85% of sites, TBA and ETBE also found
- ◆ Kentucky – MtBE found across state but analysis not required at LUST sites

Oxygenates Summary

- ◆ TBA present at most MtBE sites but low volume in gas
- ◆ TAME the next most common oxygenate in gas, often present at sites
- ◆ ETBE often present in gas but low volume, occasionally present at sites, low conc.
- ◆ DIPE not usually found in gas or at sites
- ◆ Sampling should not be limited to MtBE

Acknowledgements

- ◆ Pat Ellis, Delaware
- ◆ Bruce Hunter, Maine
- ◆ Greg Hattan, Kansas
- ◆ Mark Tosco, Minnesota
- ◆ Brad Highley, Kentucky
- ◆ Bob Haslam, Vermont
- ◆ Jim Humeston, Iowa