Assumptions and Expectations for *Annual Energy Outlook 2013:* Oil and Gas Working Group

AEO2013 Oil and Gas Supply Working Group Meeting
Office of Petroleum, Gas, and Biofuels Analysis
July 31, 2012 | Washington, DC

WORKING GROUP PRESENTATION FOR DISCUSSION PURPOSES
DO NOT QUOTE OR CITE AS RESULTS ARE SUBJECT TO CHANGE

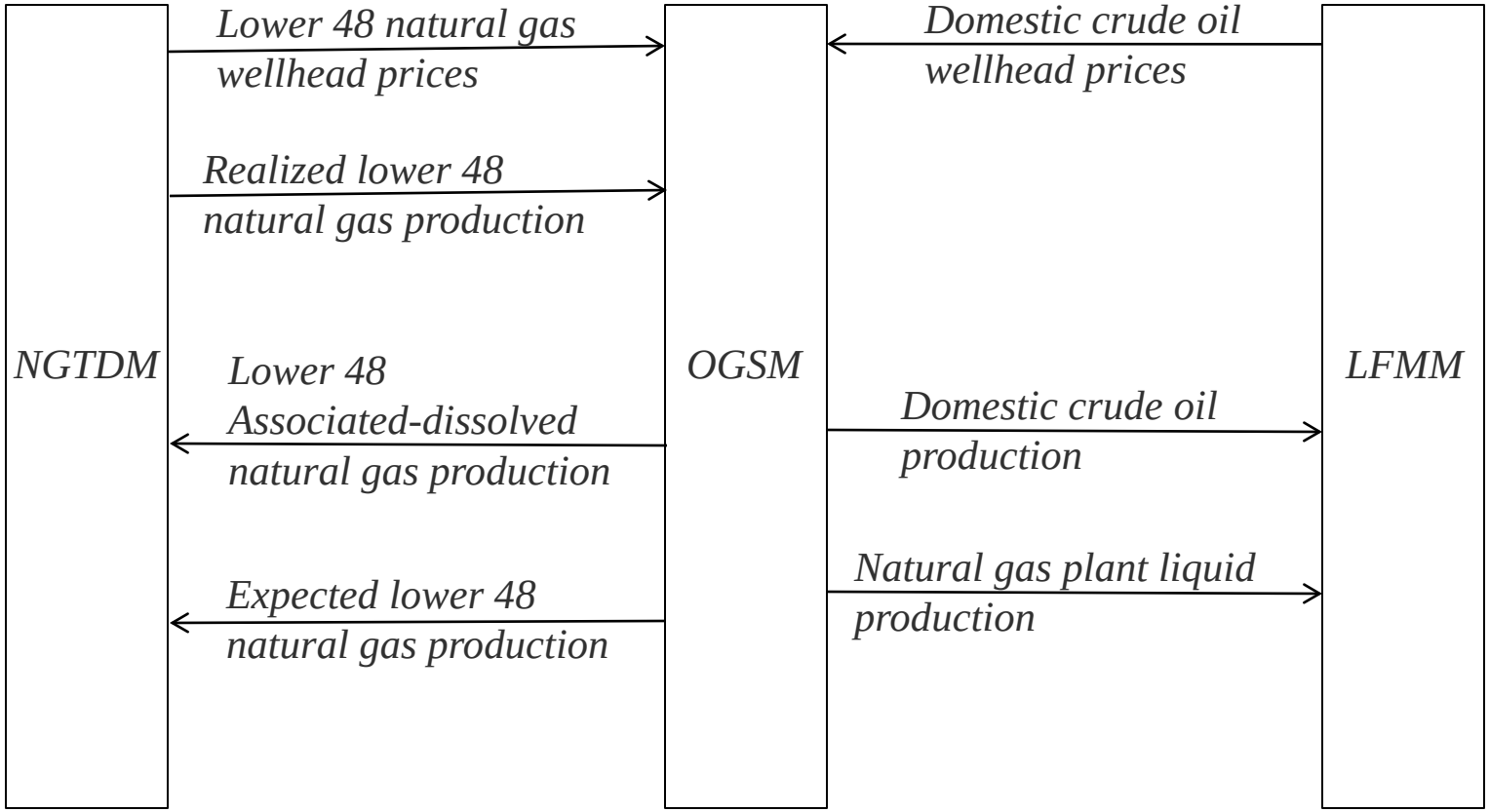
Overview

- Introduction/background
- Oil and natural gas supply assumptions
  - Offshore
  - CO2 EOR
  - Lower 48 continuous plays
- Side cases/Issues in focus

Introduction/Background

- Working group (history, purpose)
- National Energy Modeling System (NEMS)
  - Annual Energy Outlook
  - Requested service reports
  - Assumptions/Documentation
  - Model code and data input files
- Natural gas, petroleum, and biofuels modules
  - Oil and Gas Supply Module (OGSM)
  - Natural Gas Transmission and Distribution Module (NGTDM)
  - Liquid Fuels Market Module (LFMM)
    - Formerly Petroleum Market Module (PMM)
    - Discussed in earlier working group

Primary data flows between oil and gas modules of NEMS



Assumptions
Oil and Gas Supply Module (OGSM)

Lower 48 Offshore

Lower 48 offshore leasing availability

	AEO2012	AEO2013
North Atlantic	none	None
Mid Atlantic	2018	2018
South Atlantic	2018	2018
Northern & Central California	none	none
Southern California	2023	2023
Eastern GOM	2022	2022

Lower 48 offshore deepwater projects

BOEM Field Name	Nickname	Water Depth	Field Size (MMBoe)	Discovery Year	Start Year of Production
AC815	Silvertip	9226	89	2004	2011*
AC815	Tobago	9627	89	2004	2011*
MC460	Appaloosa	2805	372	2008	2011*
MC800	Gladden	3116	89	2008	2011*
GC448	Condor	3266	89	2008	2011*
MC754	Anduin West	2696	45	2008	2011*
GB515	Ozona	3000	89	2008	2011*
MC876	Callisto	7788	45	2001	2011*
EW998	EW998	1000		2009	2011*
GC238	Little Burn	2600		2005	2011*
MC503	Who Dat	3100		2007	2011*
WR250	Cascade	8143	372	2002	2012*
GC683	Caesar	4457	45	2006	2012*
GC726	West Tonga	4674	372	2007	2012*
MC241	MC241	2427	45	1987	2012*
MC292	Raton South	3400	12	2008	2012*
LL400	Cheyenne East	9200	12	2011	2012*
MC199	Mandy	2478	182	2010	2012*
MC562	Isabela	6535	45	2007	2012*
MC563	Santa Cruz	6515		2009	2012*
MC519	Santiago	6500		2011	2012*
GB293	Pyrenees	2100	89	2009	2012*
WR469	Chinook	8831	372	2003	2012
GB463	Bushwood	2700	89	2009	2012
GC299	Clipper	3452	45	2005	2012
GC490	Wide Berth	3700	89	2009	2012
MC751	Goose	1624	45	2003	2012
GB506	Danny II	2800		2012	2012
GC512	Knotty Head	3557	372	2005	2013
GB782	Entrada	4690	372	2000	2014
WR029	Big Foot	5235	182	2005	2014
KC875	Lucius	7168	182	2009	2014
MC725	Tubular Bells	4334	89	2003	2014
WR678	St. Malo	7036	372	2003	2014
WR759	Jack	6963	372	2004	2014
KC964	Hadrian South	7586	182	2009	2014
DC048	Dalmatian	5876	89	2008	2015
DC004	Axe	5822	89	2010	2015
GB605	Winter	3400	45	2009	2015
GC432	Samurai	3400	89	2009	2015
GC468	Pony	3497	372	2006	2015
MC771	Kodiak	4986	182	2008	2015
GB427	Cardamom Deep	2720	182	2010	2015
MC762	Deimos South	3122		2010	2015
MC792	West Boreas	3112		2004	2015
GC955	Mission Deep	7300	182	1999	2016
KC102	Tiber	4132	691	2009	2016
KC292	Kaskida	5860	691	2006	2016
MC984	Vito	4038	182	2009	2016
WR508	Stones	9556	89	2005	2016
MC948	Gunflint/Freedom	6095	691	2008	2016
GC859	Heidelberg	5000	182	2009	2016
WR052	Shenandoah	5750	182	2009	2017
KC872	Buckskin	6920	182	2009	2018
LL370	Diamond	9975	45	2008	2018
WR627	Julia	7087	89	2007	2018
KC736	Moccasin	6759		2011	2018
DC353	Vicksburg	7457	372	2007	2019
MC392	Appomattox	7217	691	2009	2019
WR848	Hal	7657	45	2008	2019
DC004	Dalmatian N	5831	89	2010	2020
KC919	Hadrian North	7000	372	2010	2020

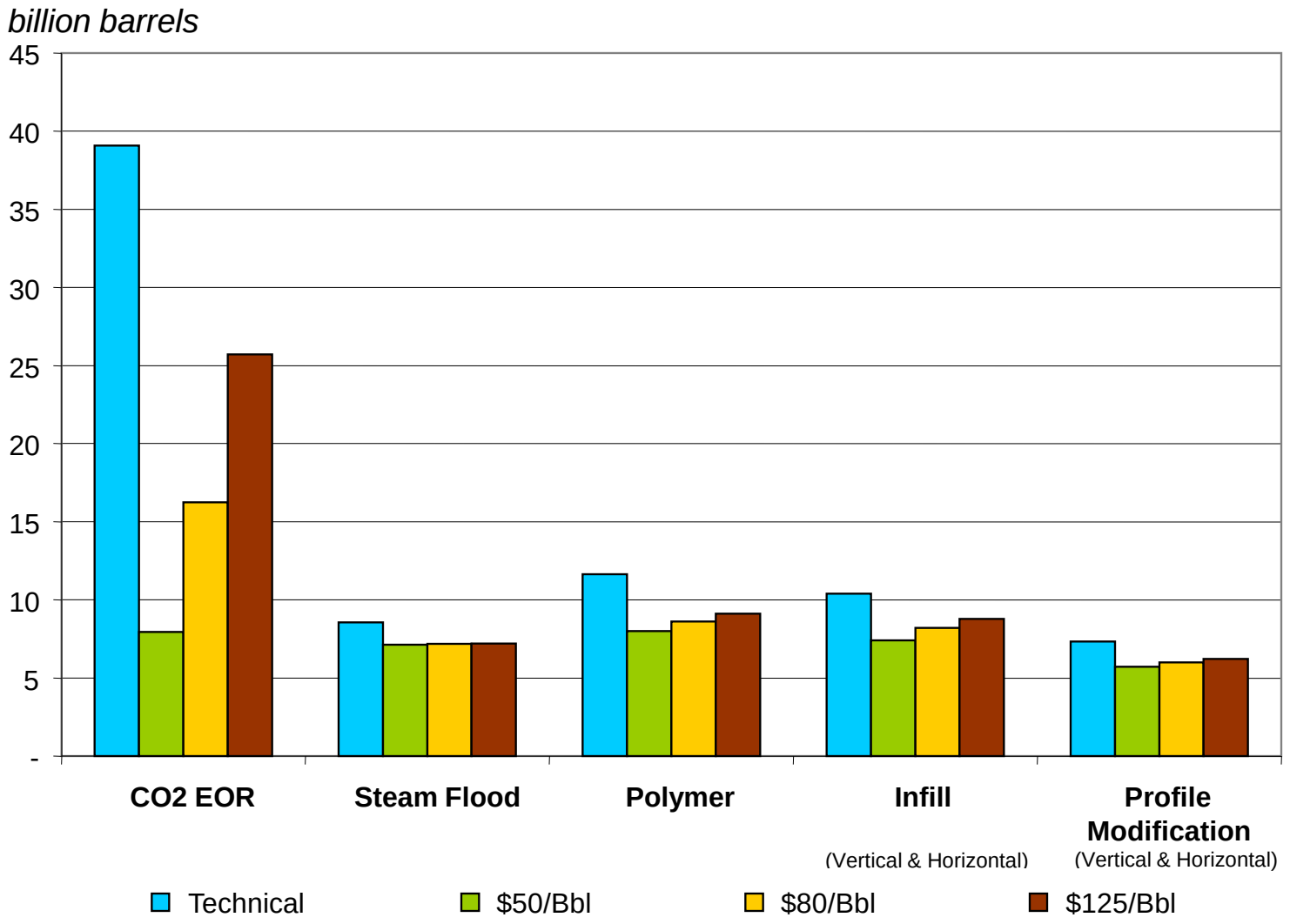
•Currently producing

OCS undiscovered technically recoverable resources (mean estimates)

Region	BOEM 2006 Assessment			BOEM 2011 Assessment		
	Oil (Bbo)	Natural Gas (tcf)	BOE (Bbo)	Oil (Bbo)	Natural Gas (tcf)	BOE (Bbo)
Alaska	**26.61**	**132.06**	**50.11**	**26.61**	**131.45**	**50.00**
Atlantic	**3.82**	**36.99**	**10.40**	**3.30**	**31.28**	**8.87**
North	1.91	17.99	5.12	1.35	9.87	3.11
Mid	1.50	15.13	4.19	1.42	19.36	4.87
South	0.41	3.86	1.10	0.53	2.04	0.89
Gulf of Mexico	**44.92**	**232.54**	**86.30**	**48.40**	**219.46**	**87.45**
Western	10.70	66.25	22.49	12.38	69.45	24.74
Eastern	3.88	21.51	7.71	5.07	16.08	7.93
Central	30.32	144.77	56.08	30.93	133.90	54.76
Pacific	**10.53**	**18.29**	**13.79**	**10.20**	**16.10**	**13.07**
WA/OR	0.40	2.28	0.81	0.40	2.28	0.81
Northern CA	2.08	3.58	2.71	2.08	3.58	2.71
Central CA	2.31	2.41	2.74	2.40	2.49	2.84
Southern CA	5.74	10.03	7.52	5.32	7.76	6.70
Total U.S. OCS	85.88	419.88	160.60	88.59	398.37	159.49

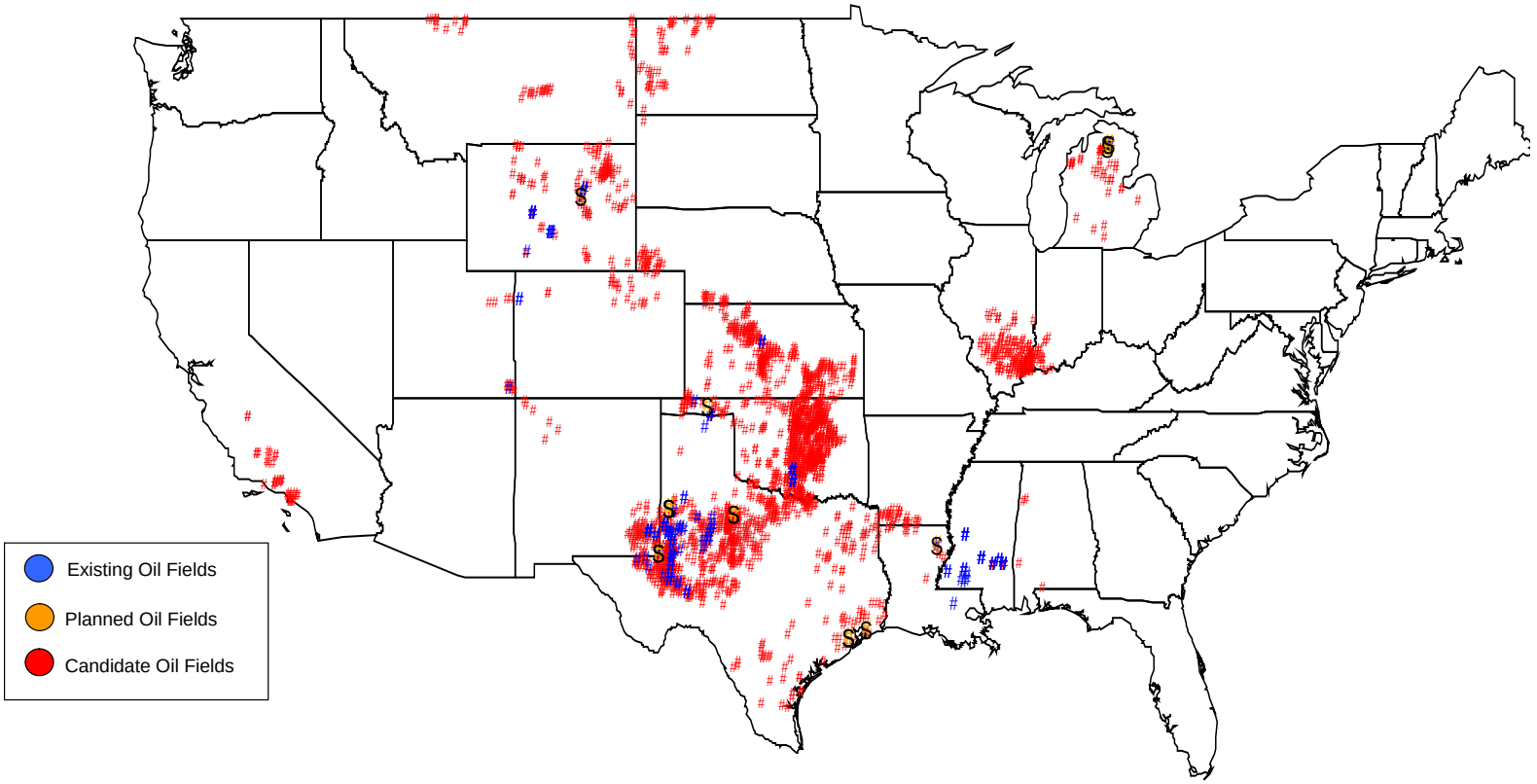
CO2 EOR

Recoverable EOR/ASR resources



Potential and current CO_2 EOR projects

Category	Field Count
Active (as of Jan. 1, 2012)	120
Planned (including ROZ)	11
Candidates	2,229



CO_2 availability assumptions

Source Type	Infrastructure Development (years)	Market Acceptance (years)	Ultimate Market Acceptance	Maximum CO_2 Volumes (million tons)	Average Carbon Capture & Transportation (within Region) Cost ($/ton)
Ammonia Plants	2	10	100%	4.5	31
Natural Gas Processing	2	10	100%	10.9	27
Ethanol Plants	4	10	100%	18.4	33
Hydrogen Plants	4	10	100%	0.2	37
Refineries	4	10	100%	16.7	29
Cement Plants	7	10	100%	21.6	70
Fossil Fuel Plants	12	10	100%	1,209.0	100
Coal-to-Liquids	Determined by the Petroleum Market Module			77.2	27

Estimated Ultimate Recovery – continuous plays

Estimated ultimate recovery (EUR) – continuous plays

- USGS 2011-2012 updates
  - Paradox Basin
- Play-level EURs are based on historical well performance
  - Individual well performance analyzed (2008-2012)
  - Hyperbolic decline

$$Q_t = \frac{Q_i}{(1 + b \times D_i \times t)^{1/b}}$$

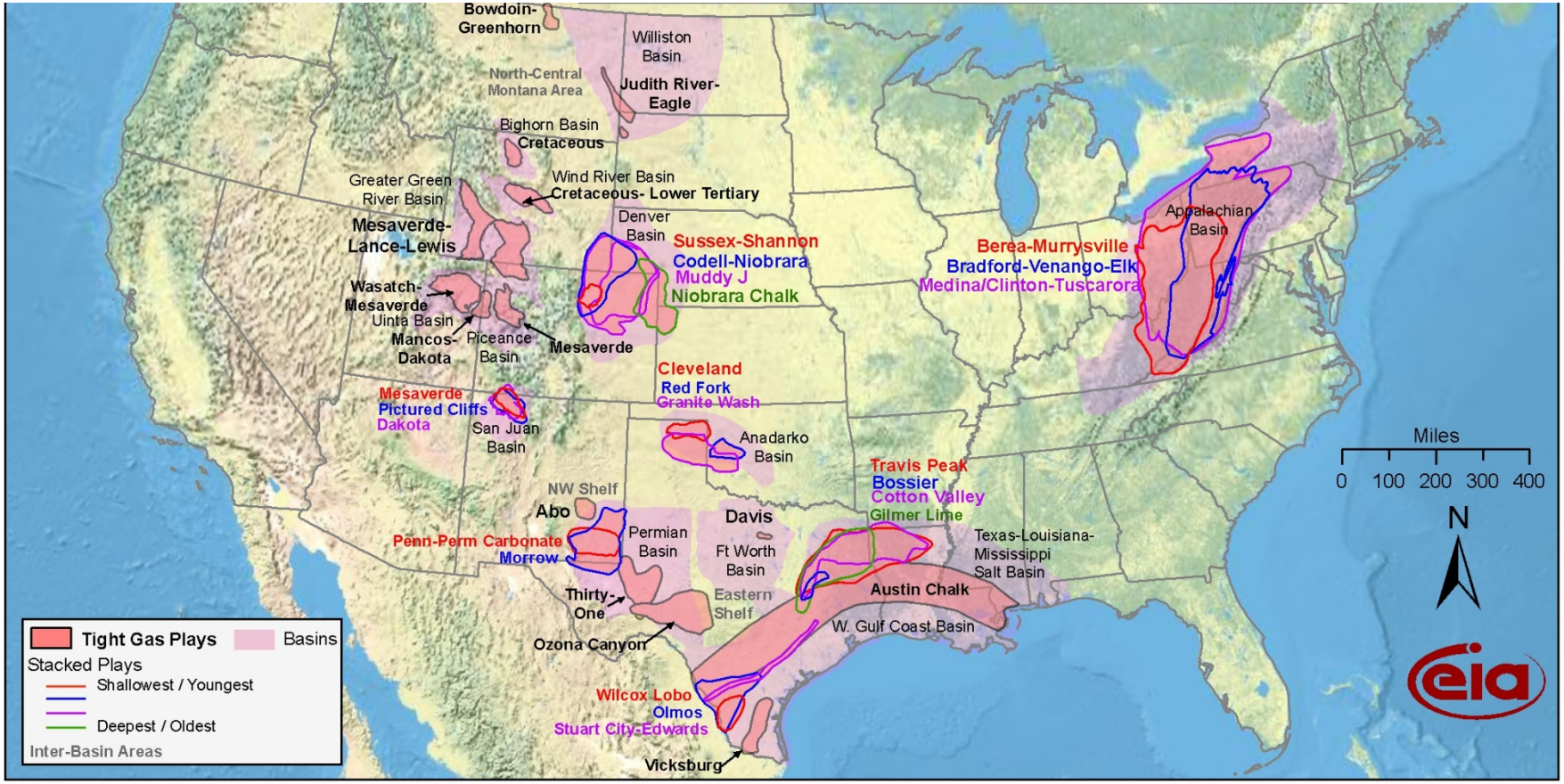
where, $0 < b < 2$ and $0 < D_i < 1$

  - Converts to exponential decline when decline rate reaches Q_∞

Lower 48 states shale plays

Source: Energy Information Administration based on data from various published studies.
Updated: May 9, 2011

Lower 48 states major tight gas plays



Source: Energy Information Administration based on data from various published studies
Updated: June 6, 2010

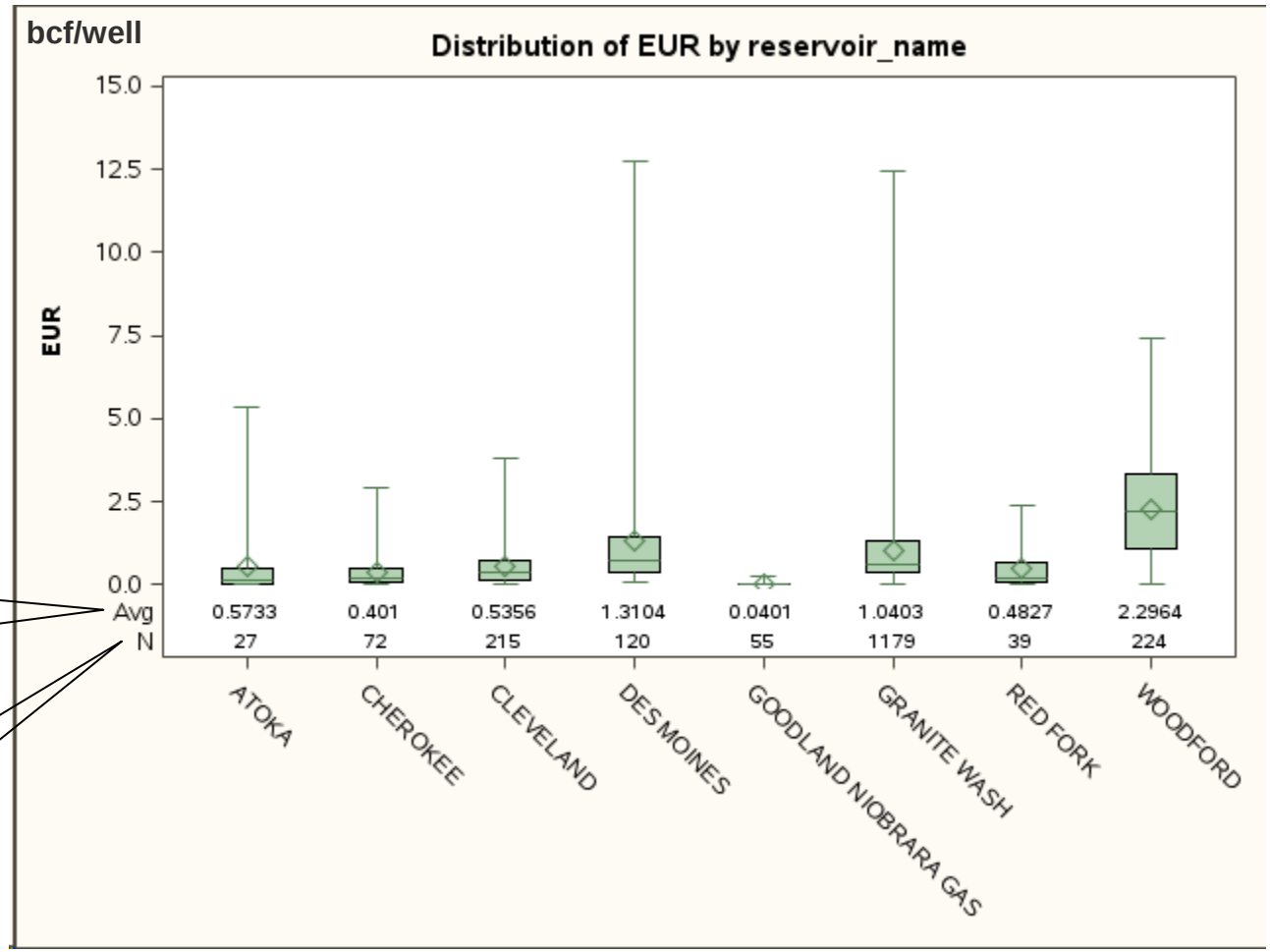
Unproved technically recoverable shale gas

	AEO2013						AEO2012	
Basin/Play	Area (mi²)	Average Well Spacing (wells/mi²)	% of area untested	% of area with potential	Average EUR (bcf/well)	TRR (bcf)	Average EUR (bcf/well)	TRR (bcf)
Appalachian								
Marcellus	104,067	5	99%	19%	1.65	148,857	1.56	140,565
Utica	16,590	4	100%	21%	1.13	15,712	1.13	15,712
Arkoma								
Woodford	3,000	8	98%	23%	1.97	10,669	1.97	10,678
Fayetteville	5,853	8	93%	23%	1.09	11,088	1.30	13,240
Chattanooga	696	8	100%	29%	0.99	1,617	0.99	1,617
Caney	2,890	4	100%	29%	0.34	1,135	0.34	1,135
TX-LA-MS Salt								
Haynesville/Boosier	9,320	8	98%	34%	3.25	80,076	2.67	65,860
Western Gulf								
Eagle Ford	18,451	6	99%	43%	1.05	49,473	2.36	50,219
Pearsall	1,420	6	100%	85%	1.22	8,817	1.22	8,817
Anadarko								
Woodford	3,350	4	99%	41%	2.30	12,616	2.89	10,981
					Sum of select plays	**340,060**		318,825
					Total U.S. shale	**490,277**		481,783

Unproved technically recoverable tight oil

			AEO2013						AEO2012	
Region	Basin	Play	Area (mi²)	Average Well Spacing (wells/mi²)	% of area untested	% of area with potential	Average EUR (mmb/well)	TRR (mmb)	Average EUR (mmb/well)	TRR (mmb)
Gulf Coast	West Gulf	Austin Chalk	16,078	3	72%	46%	0.043	687	0.127	2,688
Gulf Coast	West Gulf	Eagle Ford Shale	12,500	5	97%	25%	0.197	2,980	0.284	2,461
Midcontinent	Anadarko	Woodford Shale	3,120	6	100%	88%	0.036	590	0.024	393
Southwest	Permian	Avalon/Bone Springs Shale	1,313	4	100%	78%	0.067	274	0.390	1,593
Southwest	Permian	Spraberry	1,085	6	99%	72%	0.031	144	0.110	510
Rocky Mountains	Paradox							471	--	--
Rocky Mountains	Rocky Mountain basins	Niobrara	20,385	8	97%	80%	0.062	7,902	0.051	6,500
Rocky Mountains	Williston	Bakken Shale	39,000	2	96%	54%	0.221	8,955	0.550	5,372
West Coast	San Joaquin/Los Angeles	Monterey/Santos Shale	2,520	12	98%	93%	0.497	13,709	0.497	13,709
								35,710		33,226

Anadarko Basin – natural gas



Average EUR

Number of wells

maximum

75th percentile

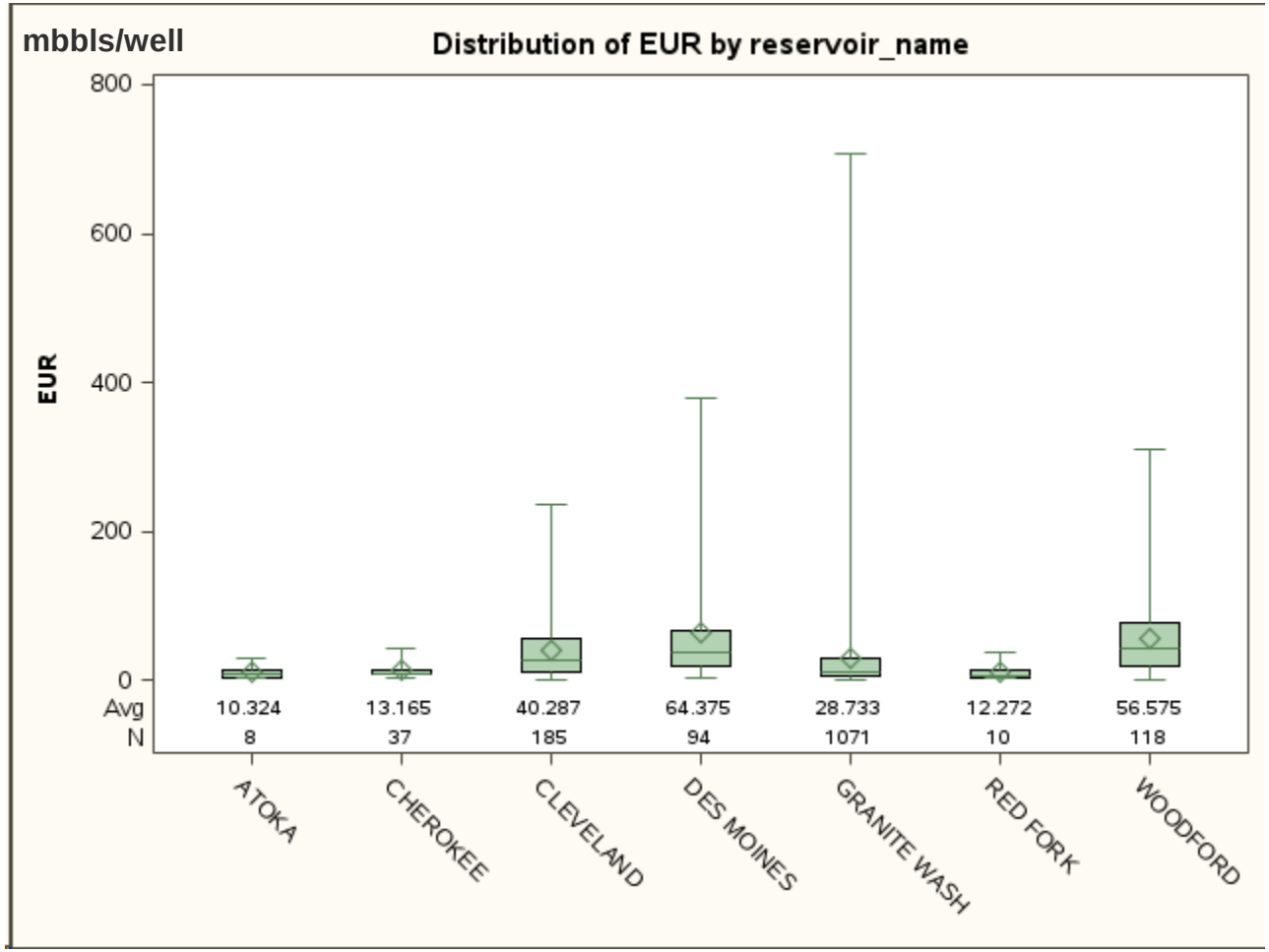
mean

median

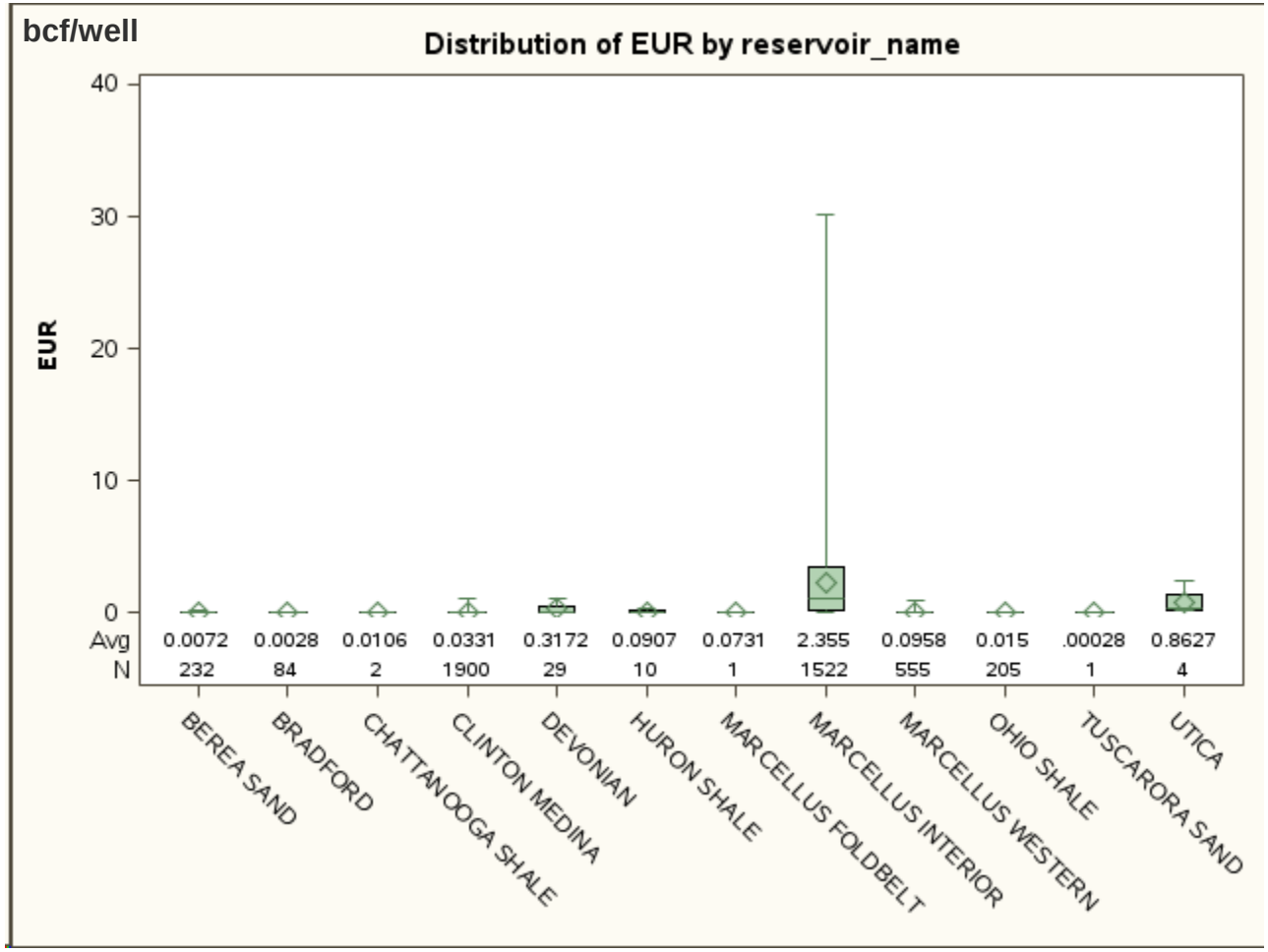
25th percentile

minimum

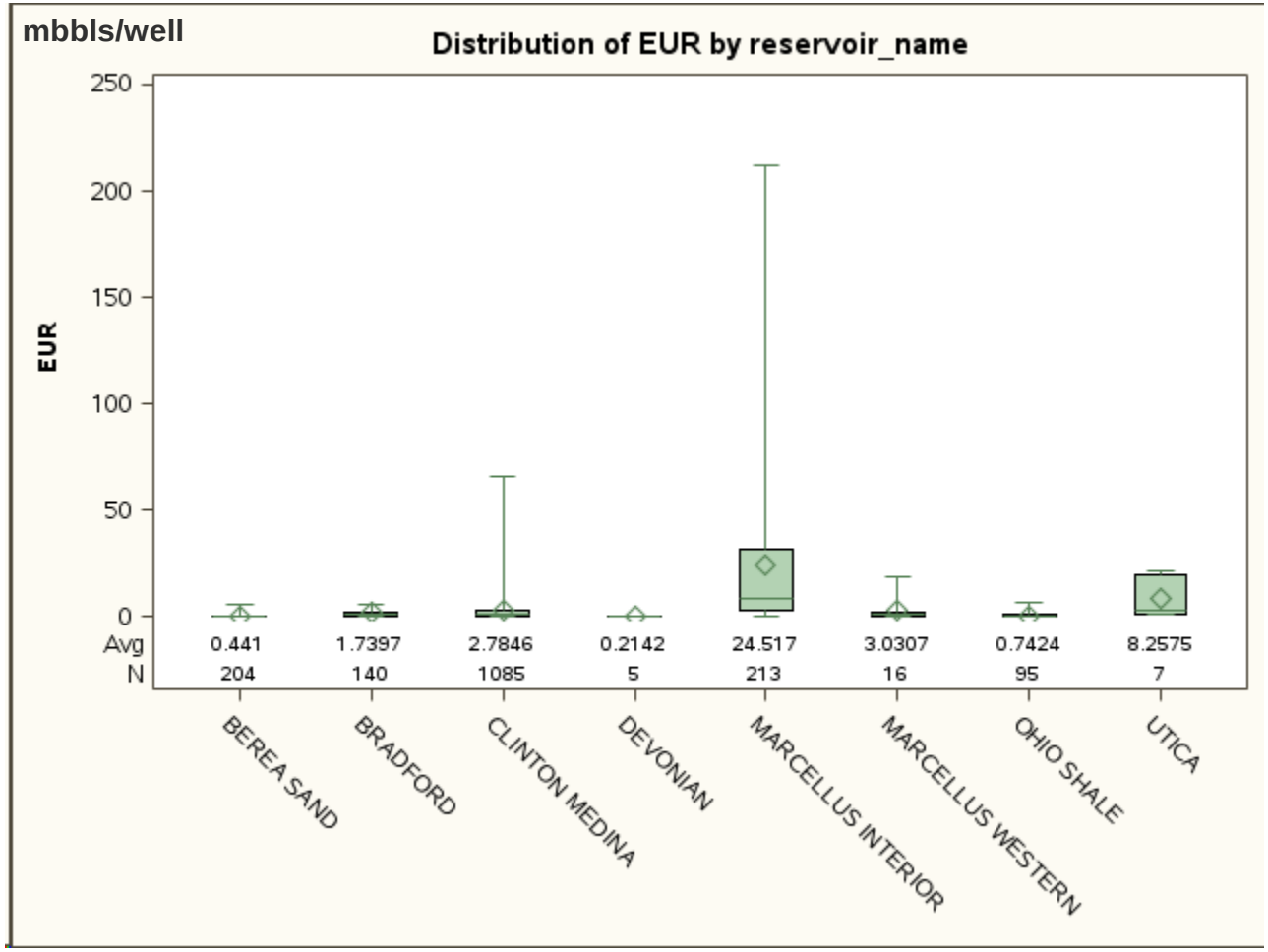
Anadarko Basin – crude oil/condensate



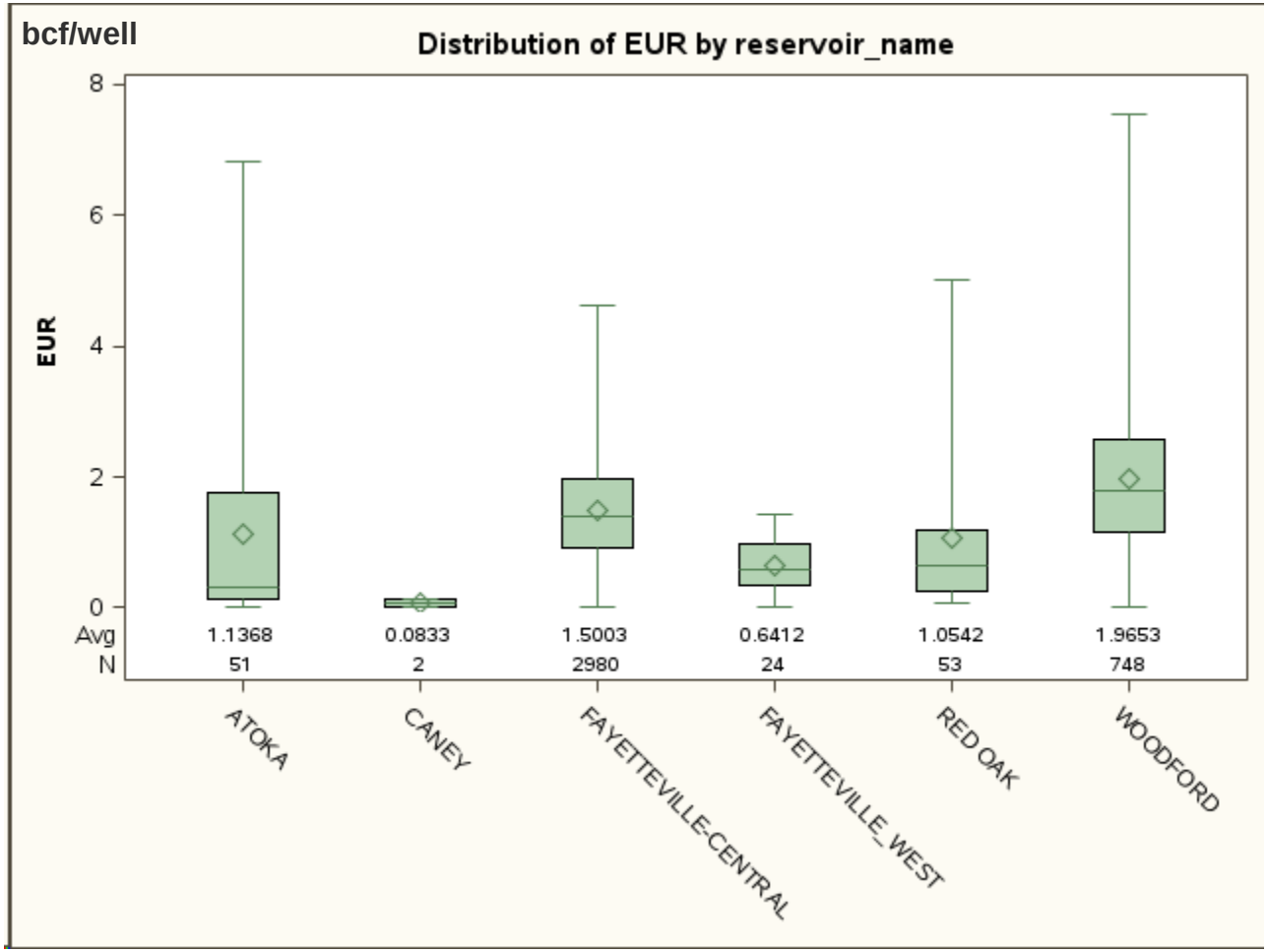
Appalachian Basin – natural gas



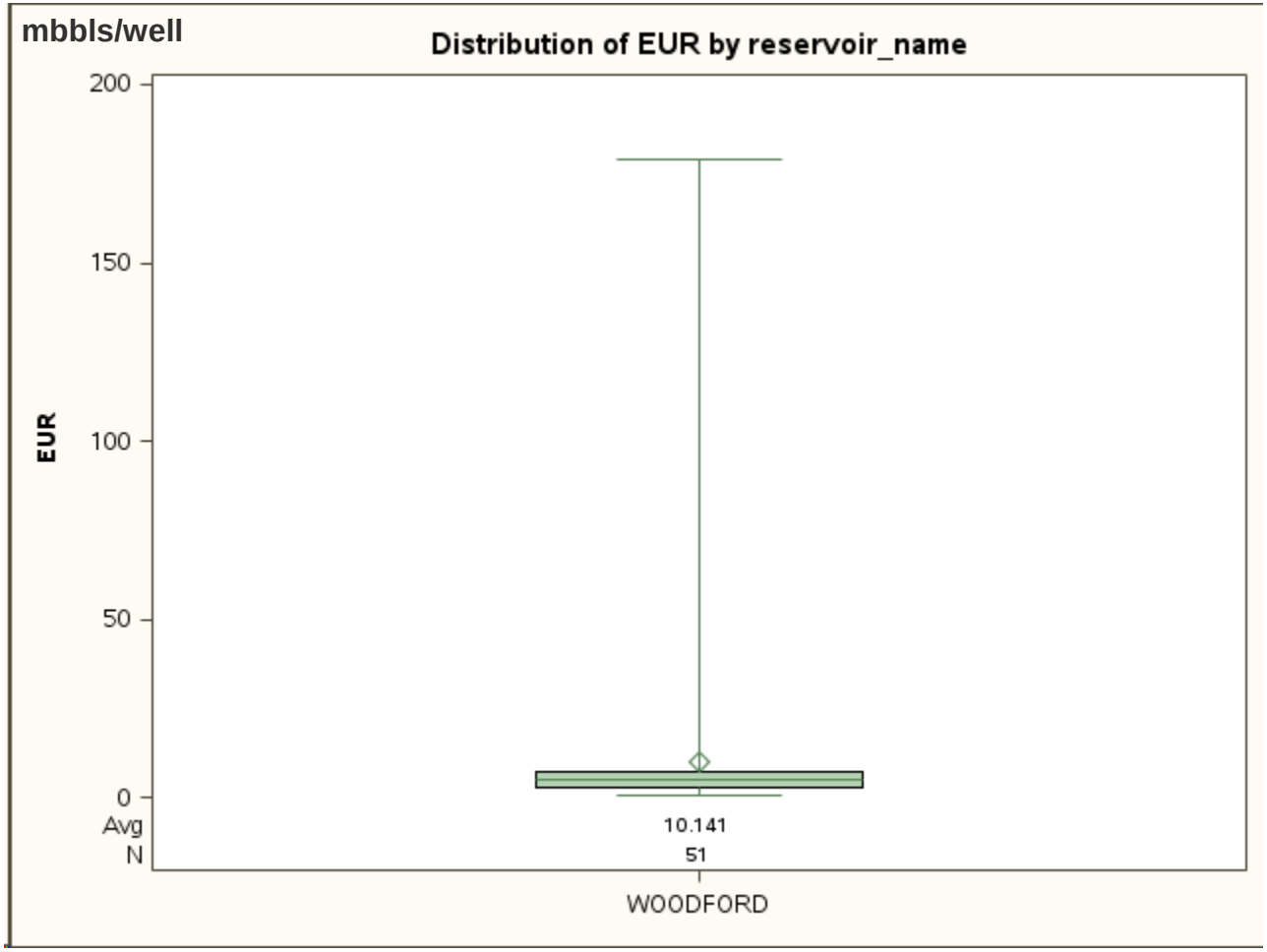
Appalachian Basin – crude oil/condensate



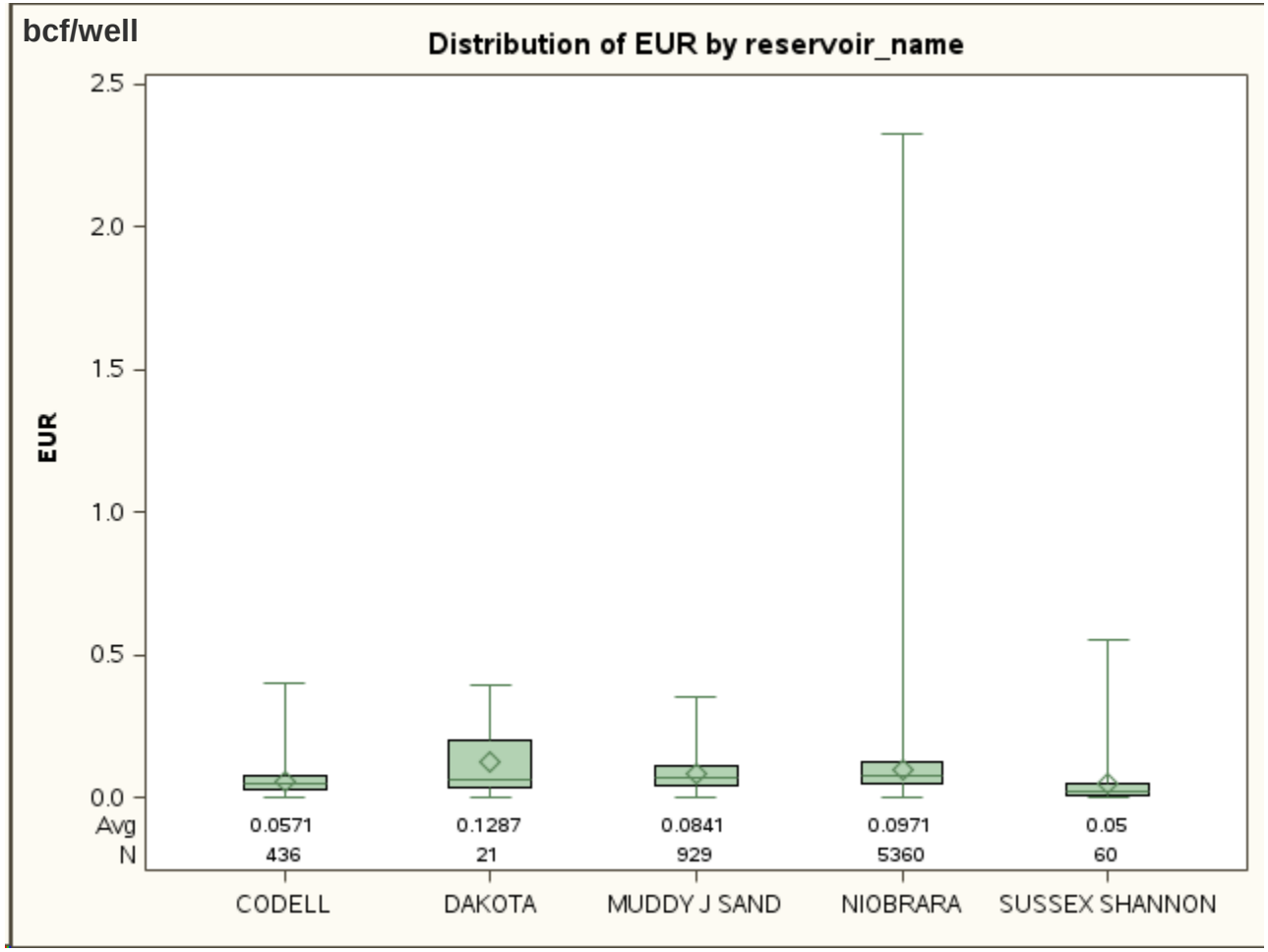
Arkoma Basin – natural gas



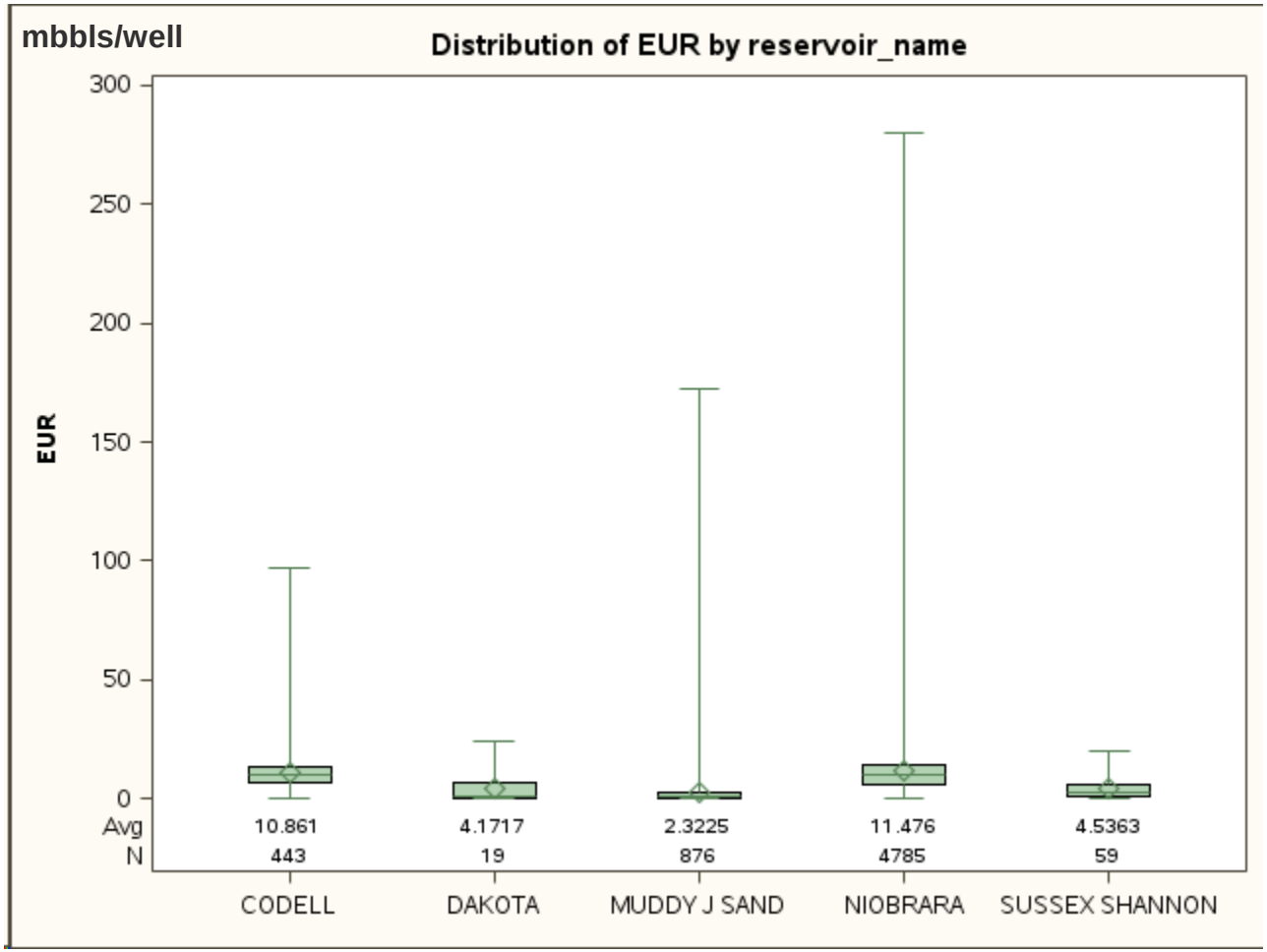
Arkoma Basin – crude oil/condensate



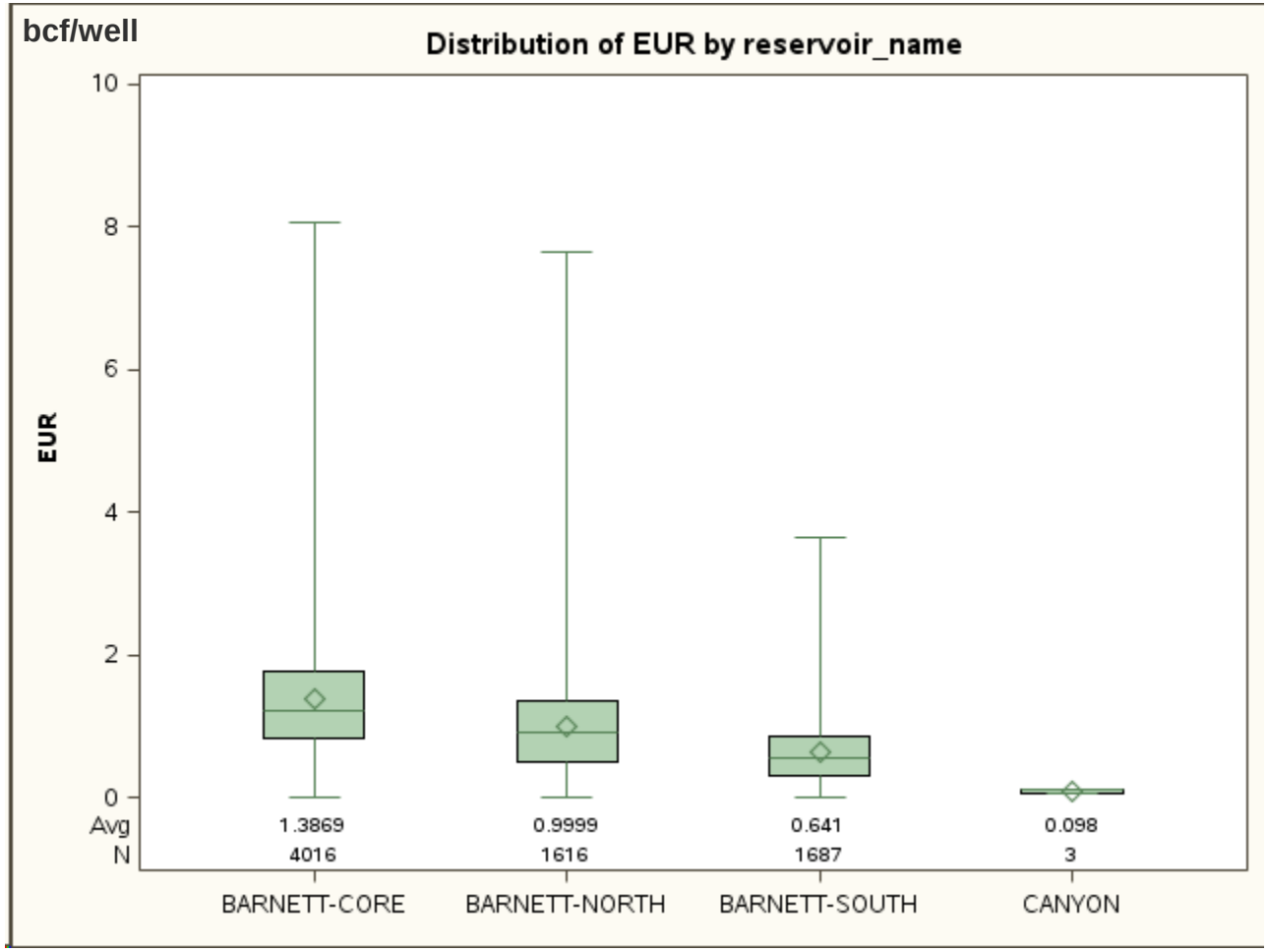
Denver Basin – natural gas



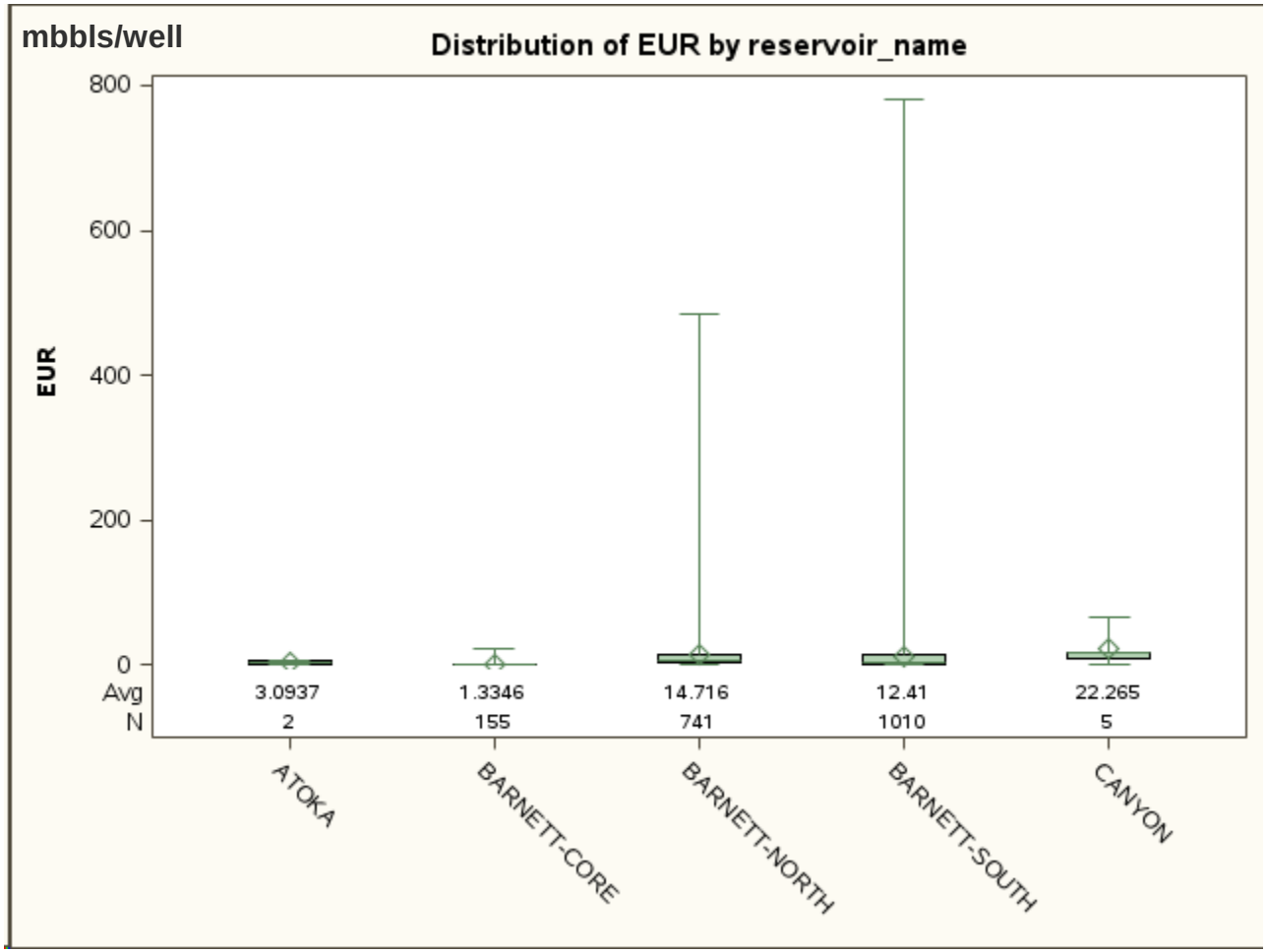
Denver Basin – crude oil/condensate



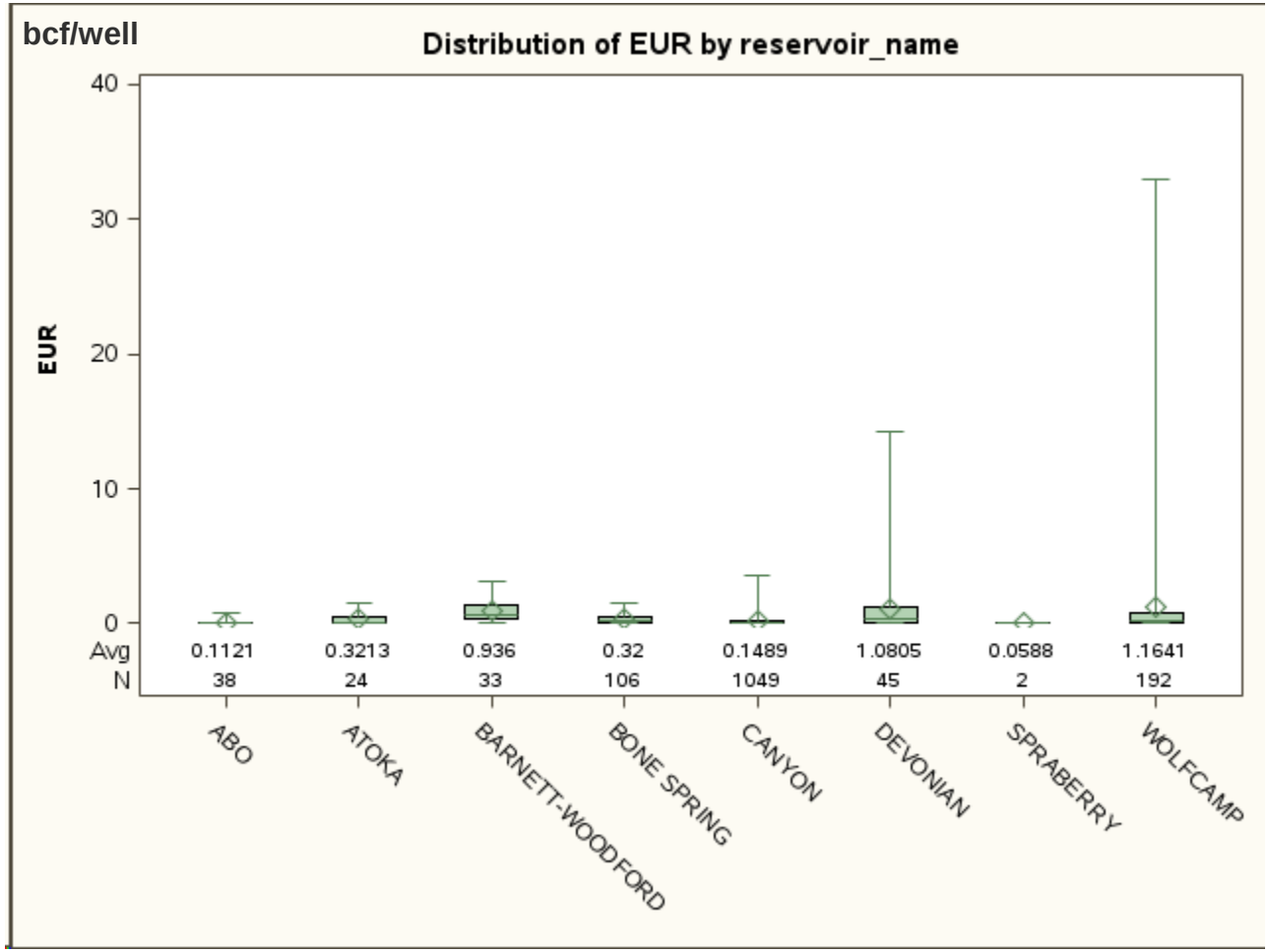
Fort Worth Basin – natural gas



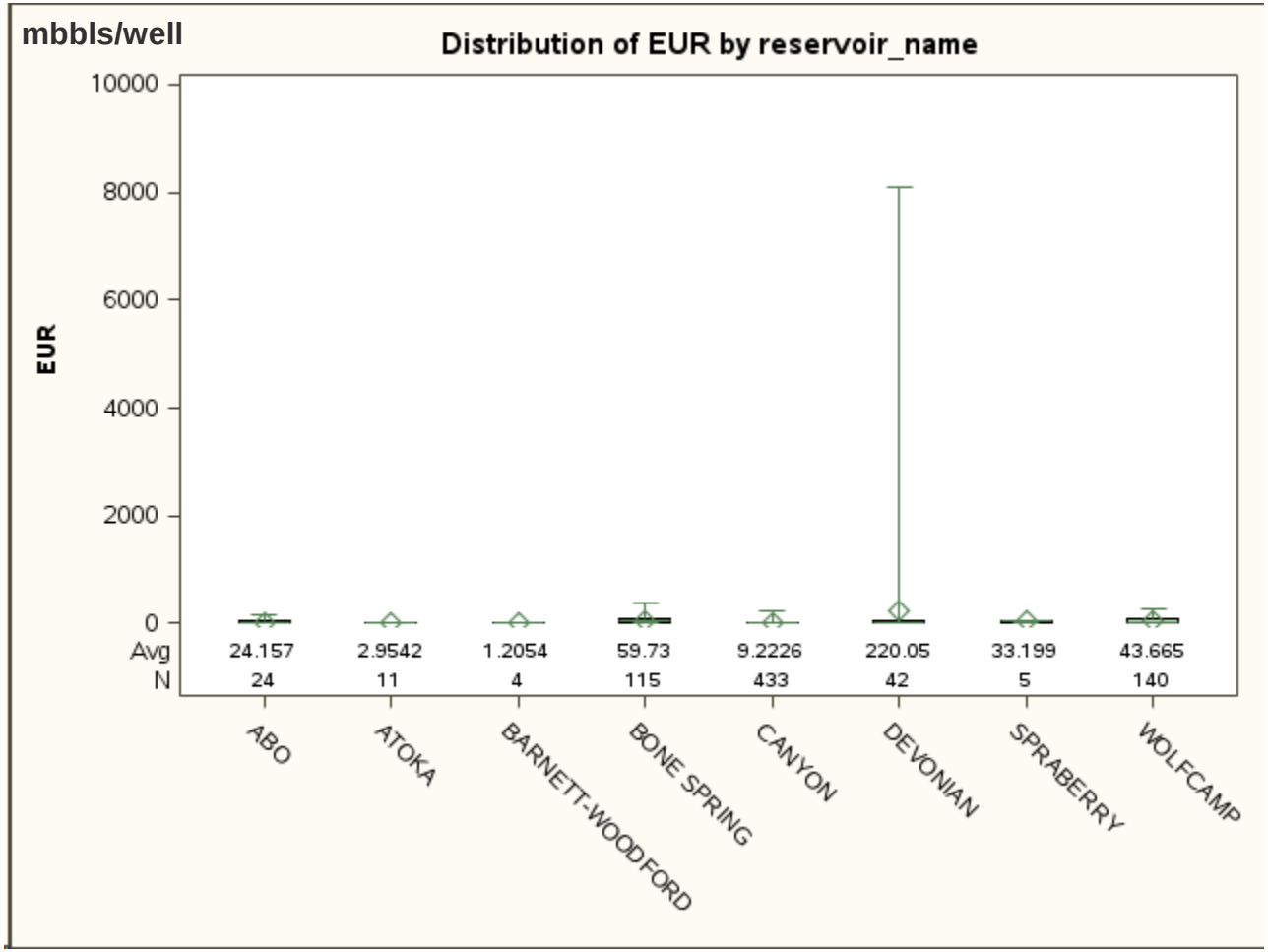
Fort Worth Basin – crude oil/condensate



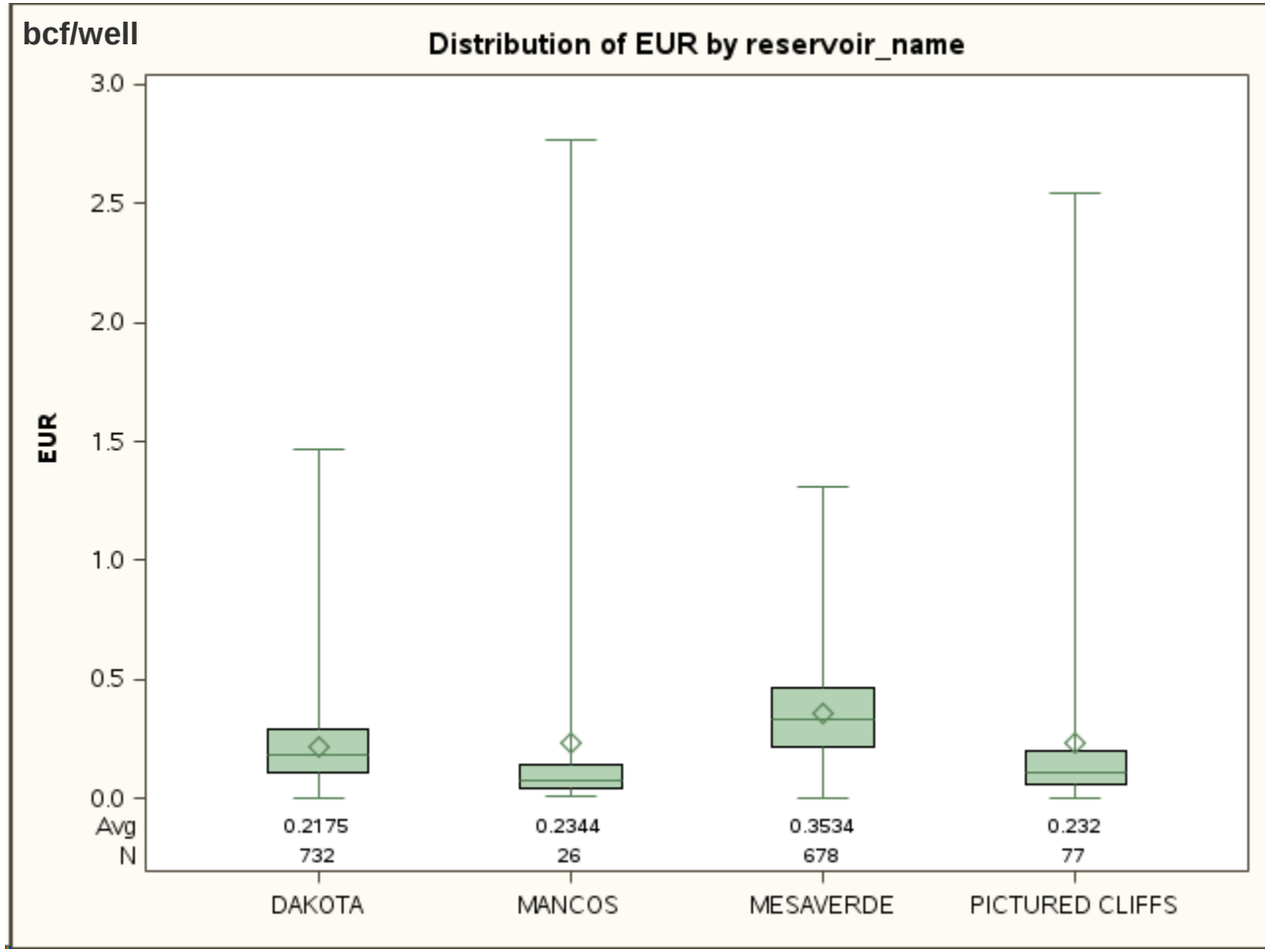
Permian Basin – natural gas



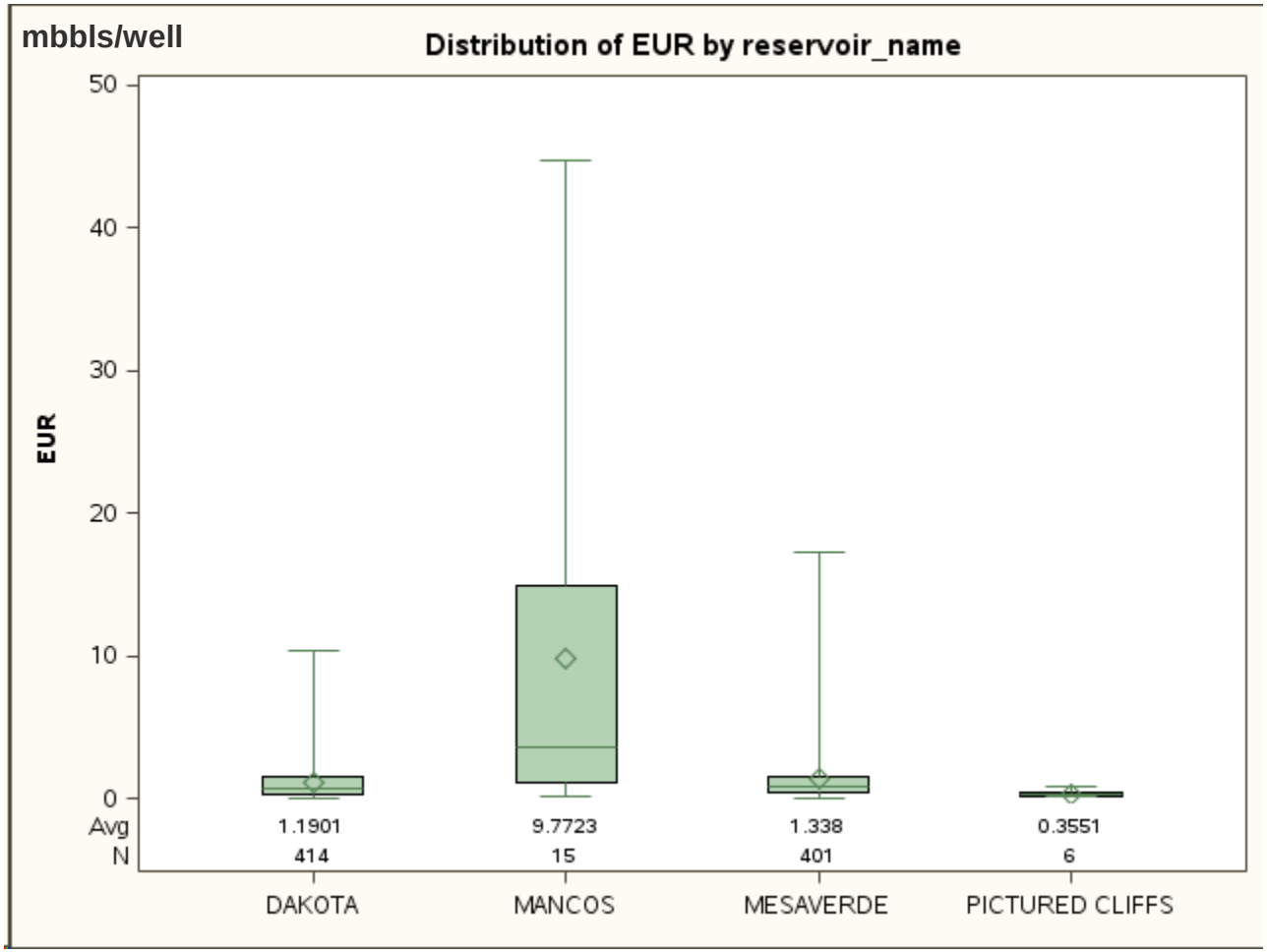
Permian Basin – crude oil/condensate



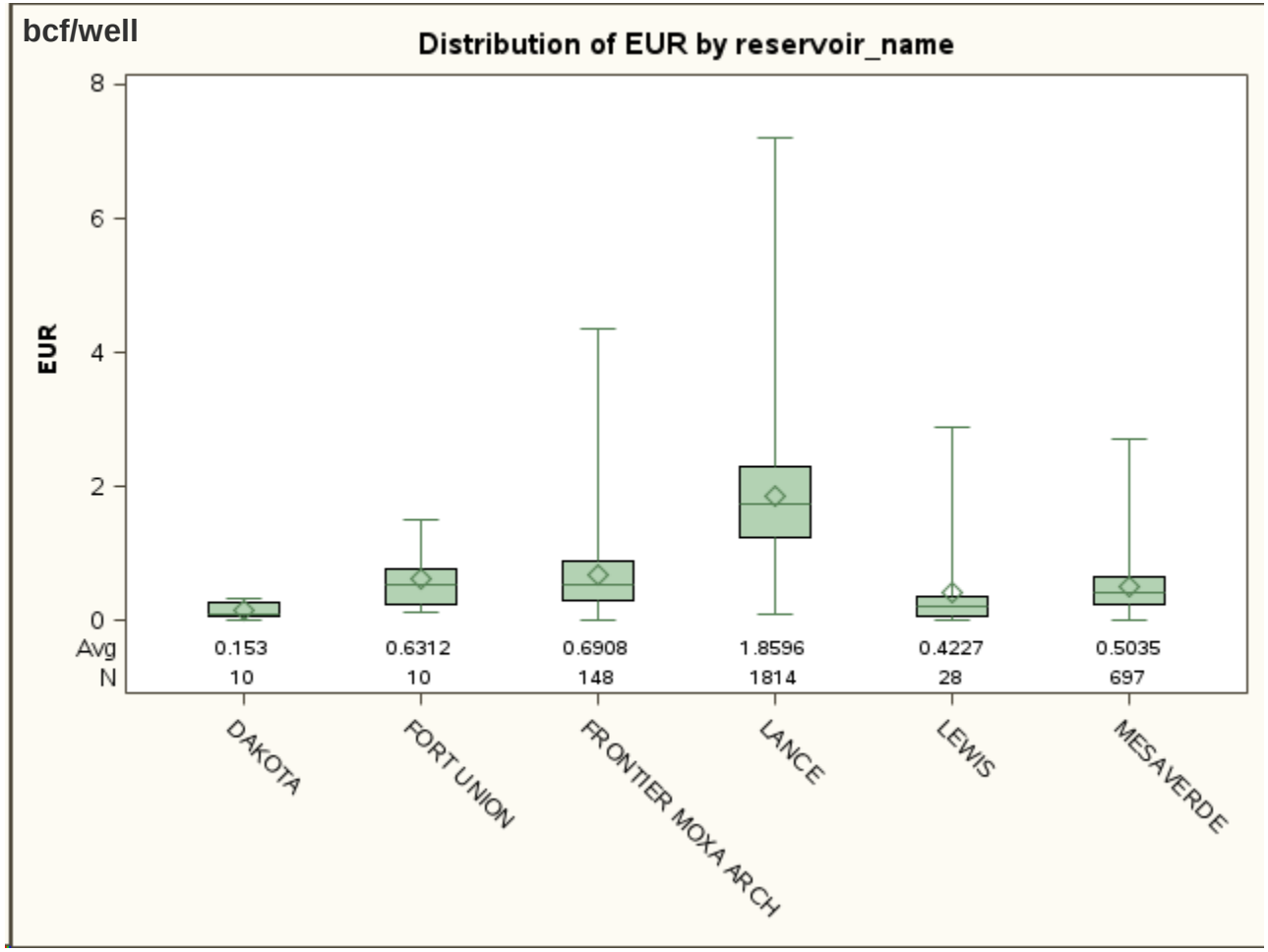
San Juan Basin – natural gas



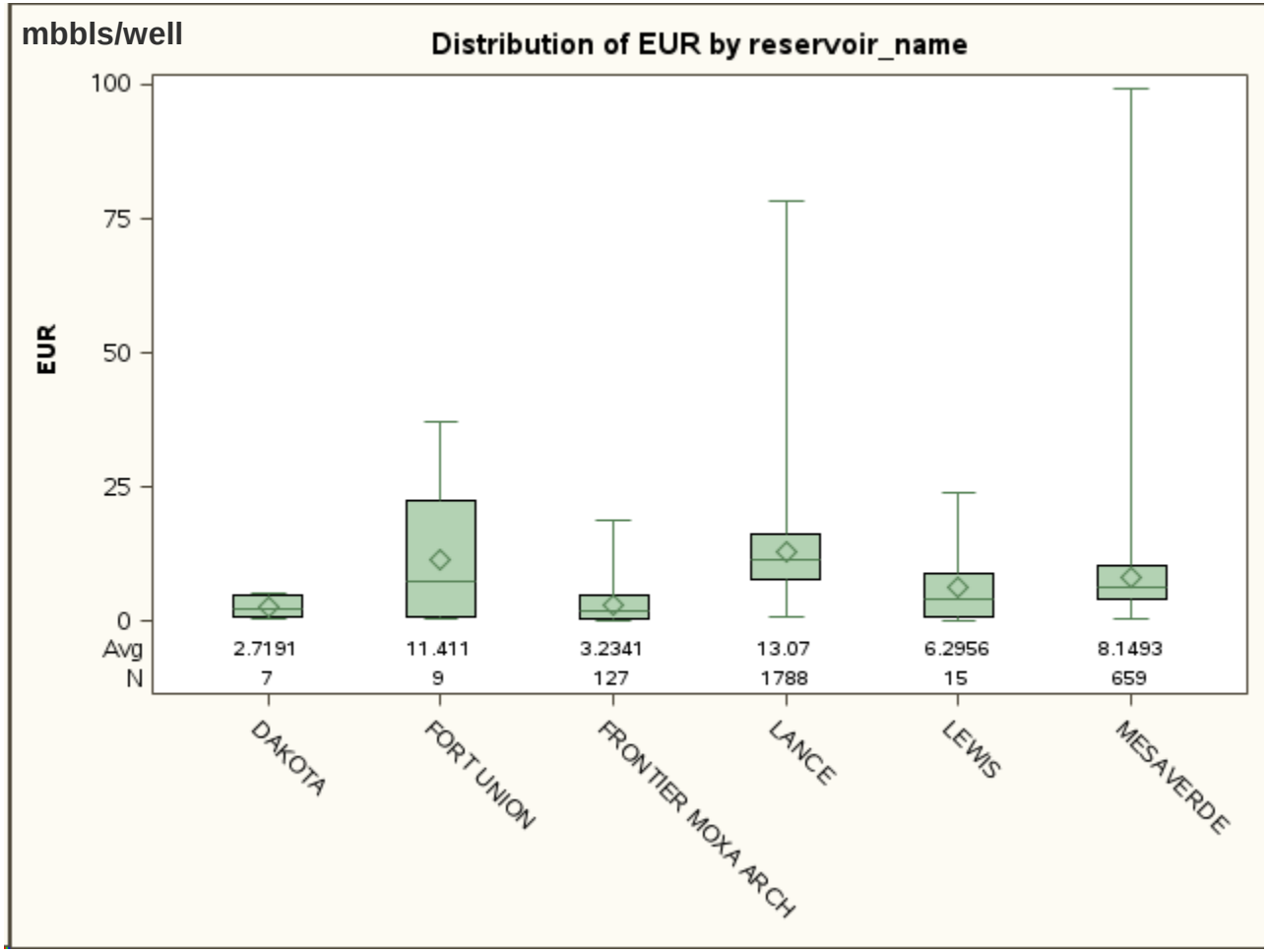
San Juan Basin – crude oil/condensate



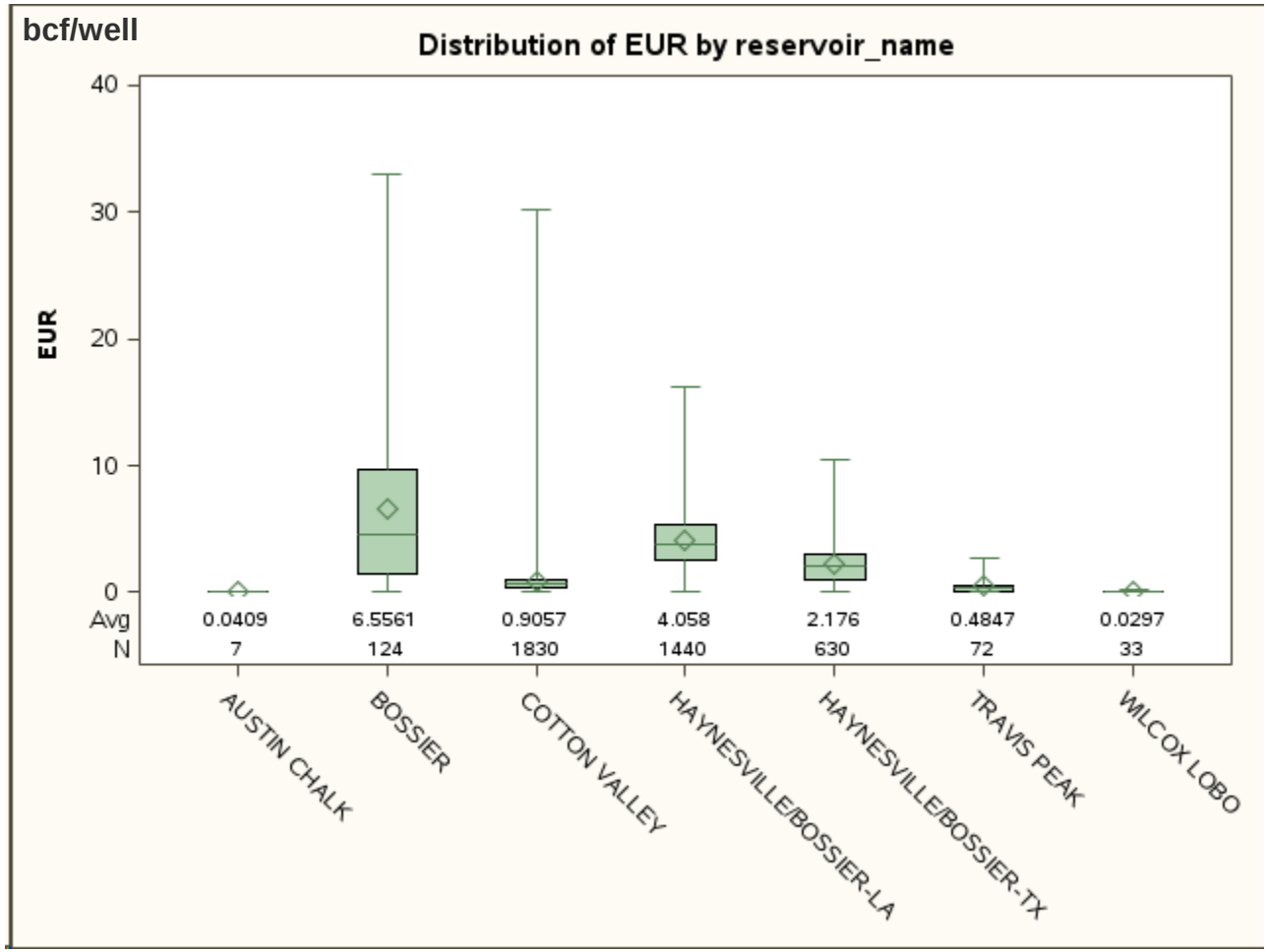
Southwestern Wyoming Basin – natural gas



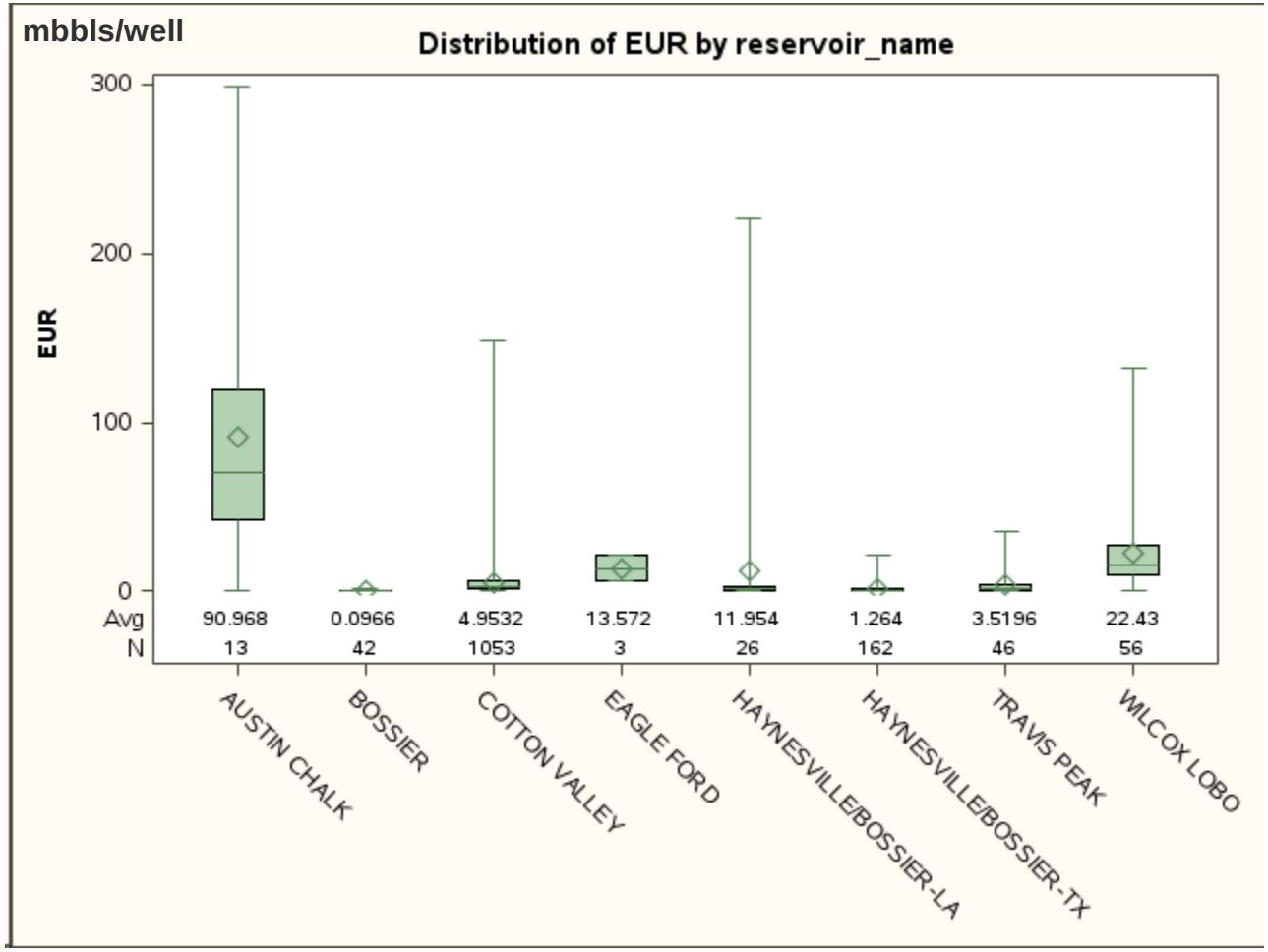
Southwestern Wyoming Basin – crude oil/condensate



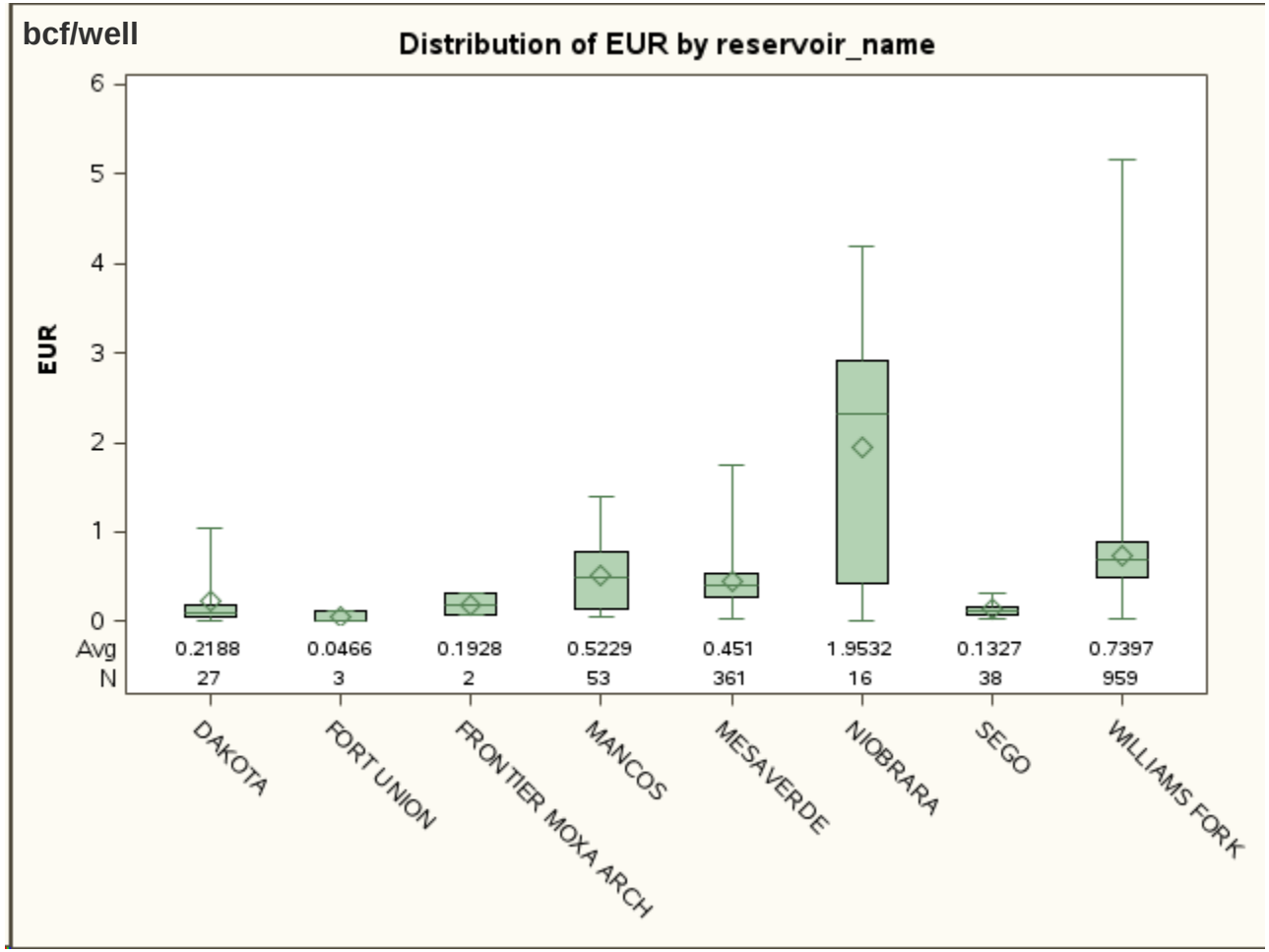
TX-LA-MS Salt Basin – natural gas



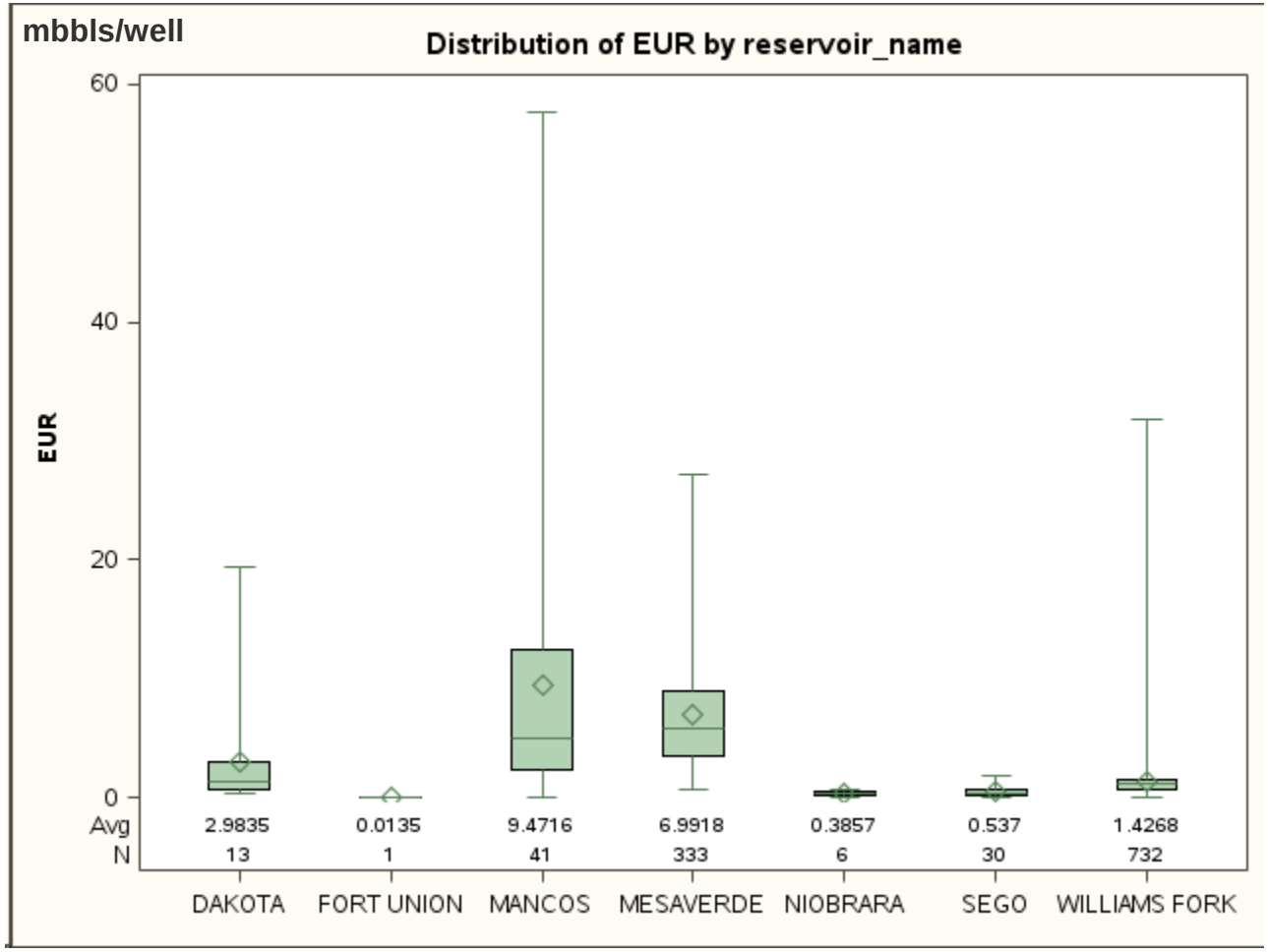
TX-LA-MS Salt Basin – crude oil/condensate



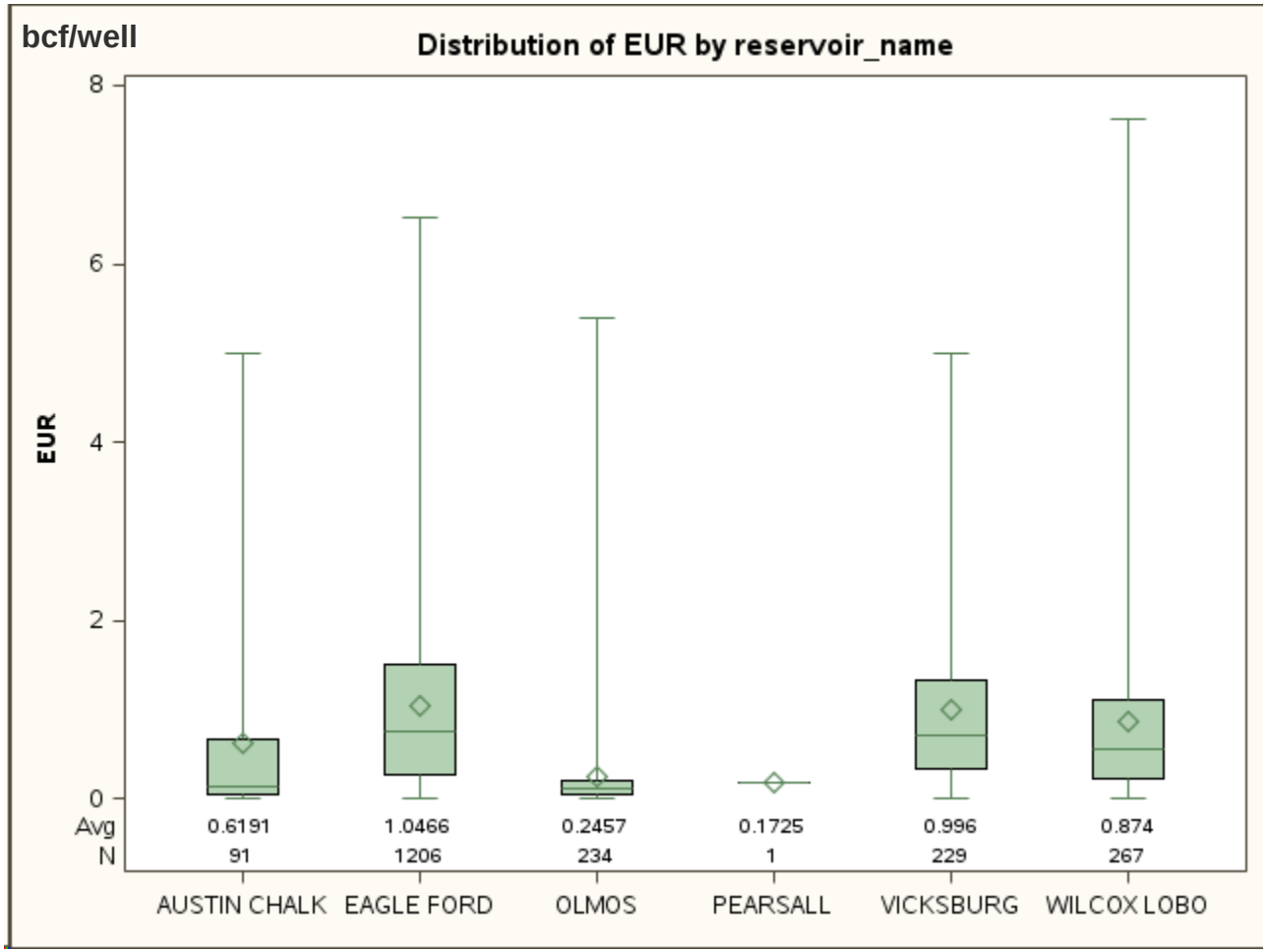
Uinta-Piceance Basin – natural gas



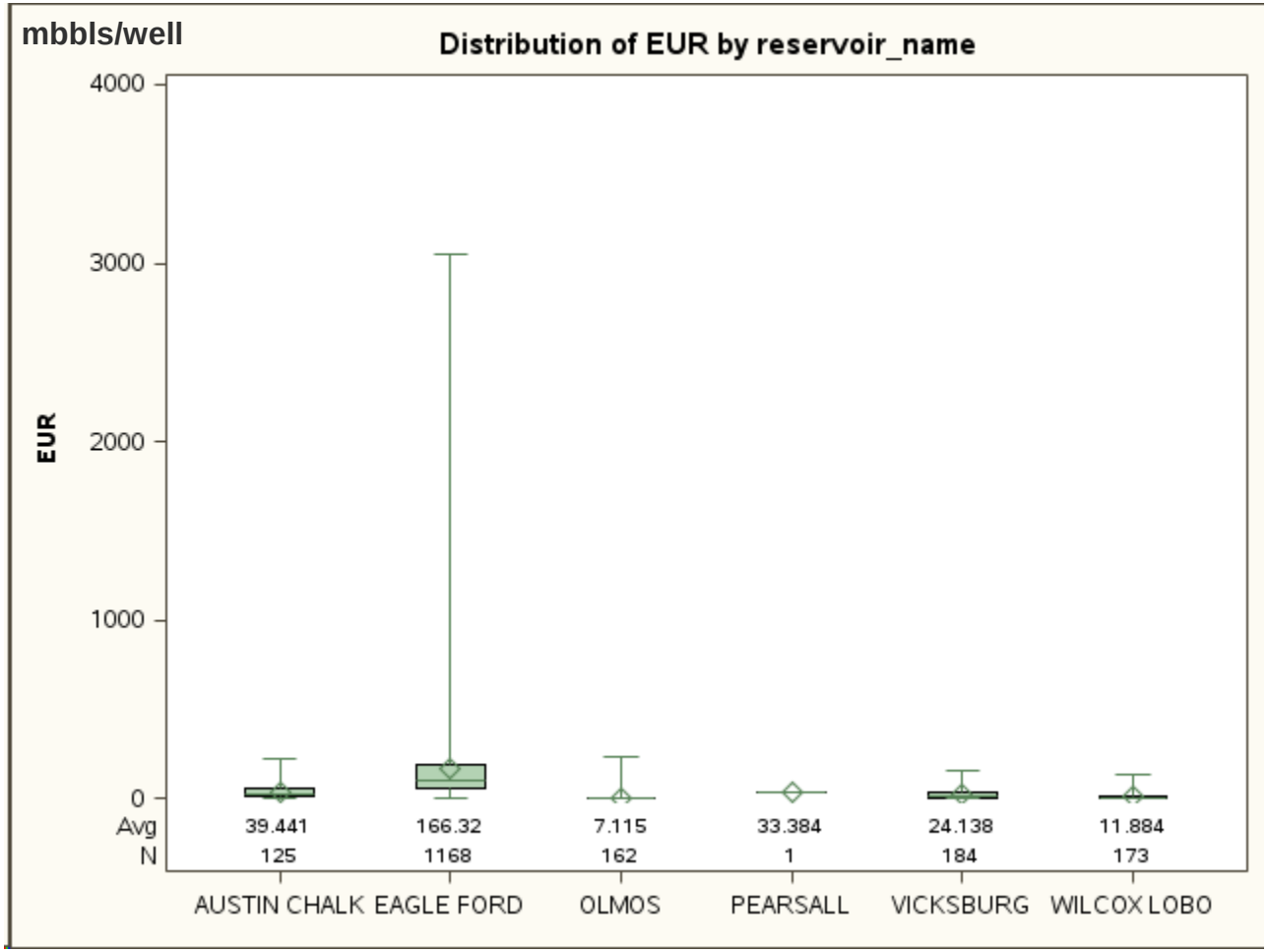
Uinta-Piceance Basin – crude oil/condensate



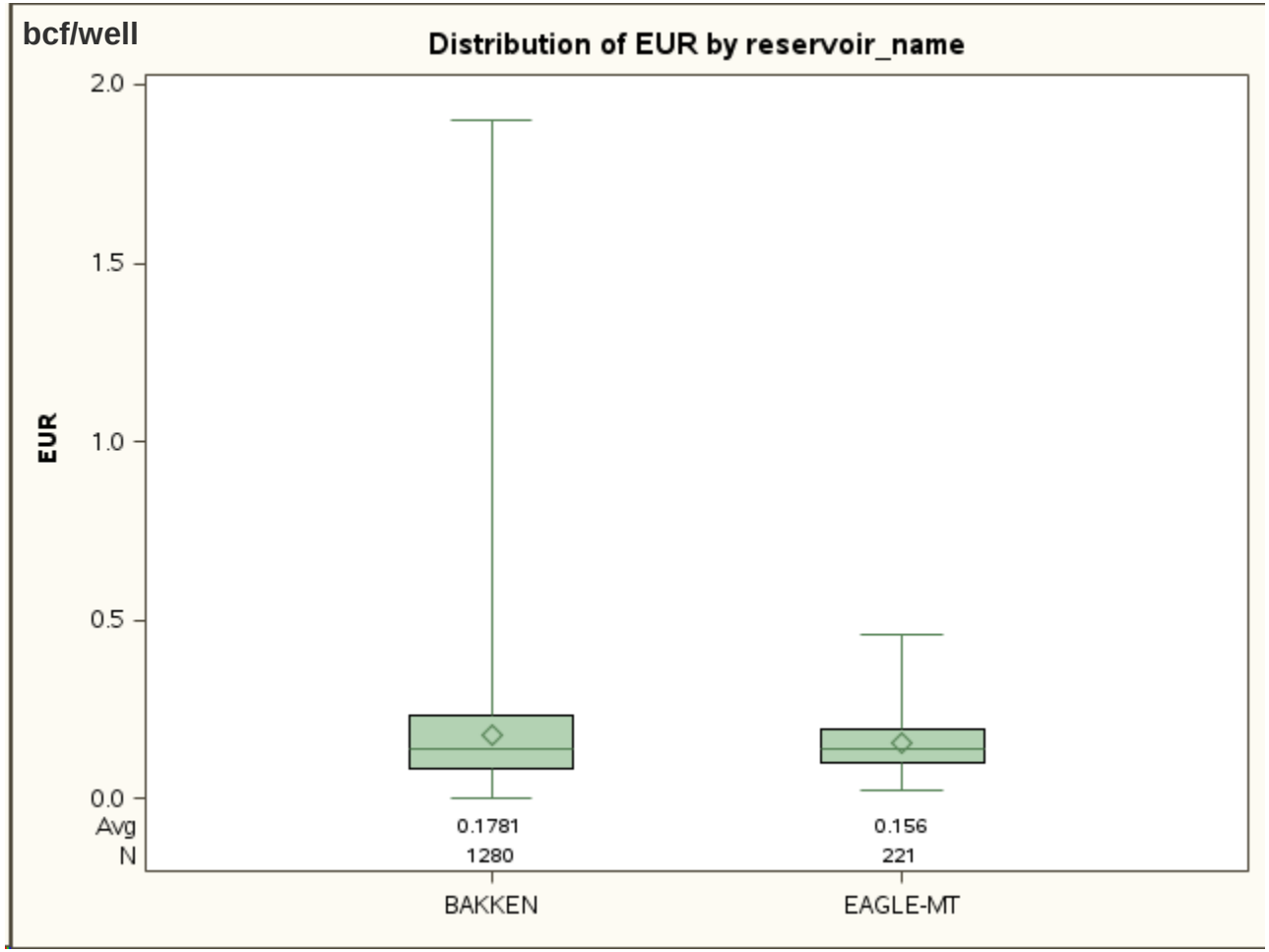
Western Gulf Coast Basin – natural gas



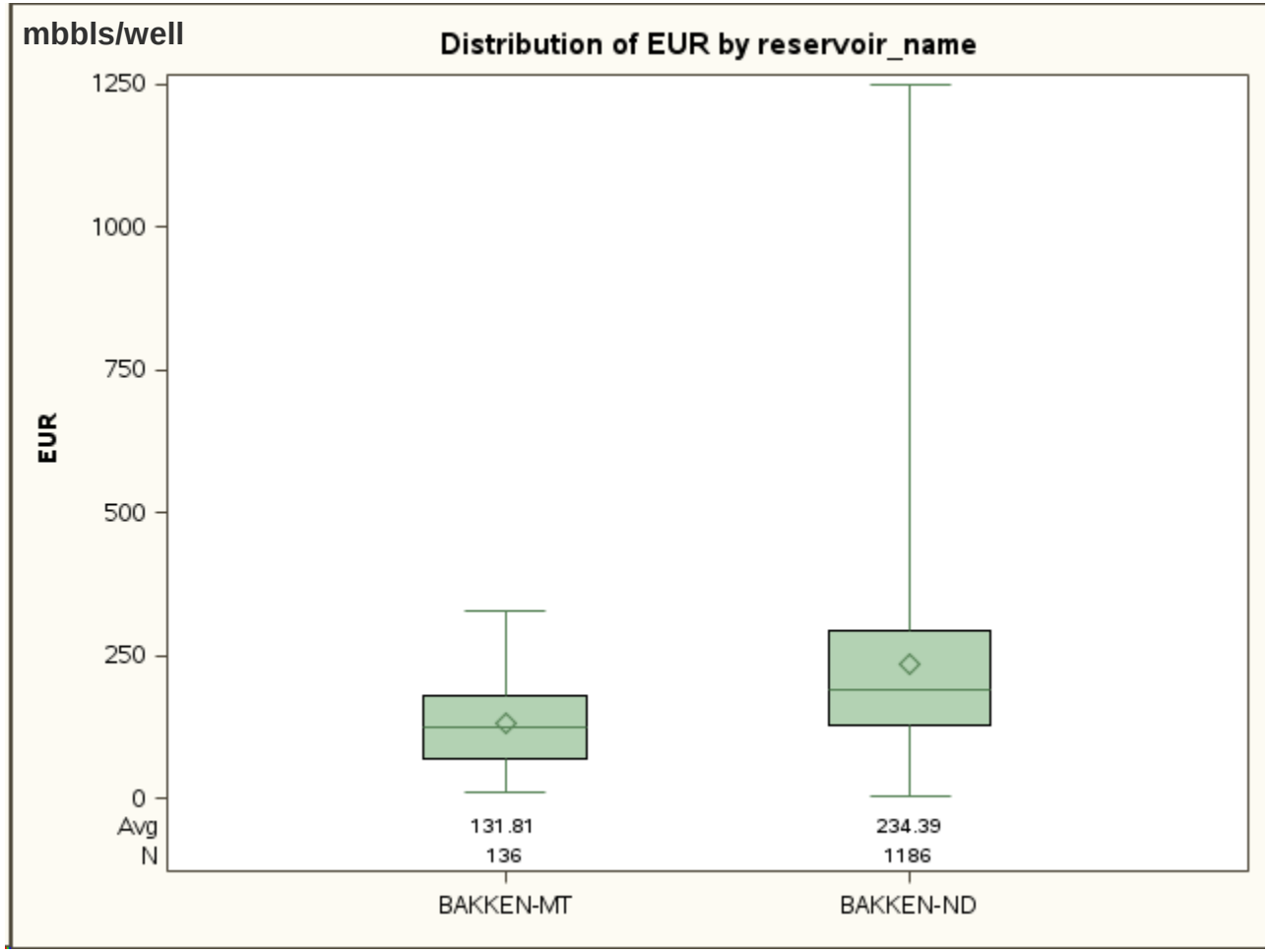
Western Gulf Coast Basin – crude oil/condensate



Williston Basin – natural gas



Williston Basin – crude oil/condensate



Side cases

Side cases and Issues and Focus articles

- *AEO2012* Side Cases
  - High/low world oil price
  - High/low macroeconomic growth
  - High/low shale gas and tight oil EUR
  - High shale gas and tight oil TRR
- *AEO2012* Issues and Focus
  - Potential impact of minimum pipeline throughput constraints on Alaska North slope oil production
  - U.S. crude oil and natural gas resource uncertainty
  - Evolving Marcellus shale gas resource estimates
- AEO2013 Issues and Focus?

Contacts

Lower 48 oil and gas supply | dana.vanwagener@eia.gov

Alaska oil supply | philip.budzik@eia.gov

General oil and gas questions | john.staub@eia.gov

EIA Information Center

(202) 586-8800 | email: InfoCtr@eia.gov

For more information

U.S. Energy Information Administration home page | www.eia.gov

Short-Term Energy Outlook | www.eia.gov/steo

Annual Energy Outlook | www.eia.gov/aeo

International Energy Outlook | www.eia.gov/ieo

Monthly Energy Review | www.eia.gov/mer

EIA Information Center

(202) 586-8800 | email: InfoCtr@eia.gov

USA Tight Oil Basins and Plays in forthcoming study