Before the

130th General Assembly

House Ways and Means Committee

The Honorable Peter A. Beck
Chair

Interested Party Testimony on:

House Bill 375

Presented By:
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Introduction

Chairman Beck, Ranking Member Letson, and members of the House Ways and Means Committee, thank you for the opportunity to offer interested party testimony regarding House Bill 375. My testimony will focus on projected severance tax revenue as envisioned under the Bill from recoverable oil & natural gas produced from newly drilled and producing Utica shale wells. I am not here to comment on public policy issues but only to provide commentary from a petroleum engineering perspective.

I am Dr. Benjamin H. Thomas. I am an Associate Professor in the Department of Petroleum Engineering at Marietta College. Since 2003, I have taught a range of courses which include Petrophysics, Drilling Engineering, Formation Evaluation, Reservoir Engineering, Environmental Geology, Operations Management and Economic Analysis. I am also President of Thomas Consulting, LLC. I routinely provide petroleum engineering consulting services; primarily in the Appalachian Basin. My clients have included banks, E&P companies, attorneys, accountants and landowners (mineral owners).

Prior to working in academia, I worked in the oil & natural gas (exploration and production) industry. My prior positions included Staff Petroleum Engineer, Senior Petroleum Engineer, Manager of Operations and Development, Vice President of Operations, Chief Operations Officer, and President. I have been a resident of and have worked in Ohio most of my career. I currently live in Marietta, Ohio.

I received my Bachelor of Business degree from Kent State University and my Bachelor of Science degree in Petroleum Engineering from Marietta College. In addition, I received my Masters of Business degree from Ashland College and my Masters of Science in Petroleum and Natural Gas Engineering from West Virginia University. I earned both of my Master degrees while working in Canton, Ohio. In 2002, I received my Doctor of Philosophy degree in Petroleum and Natural Gas Engineering from West Virginia University.

I have been appointed by two Ohio governors and served four consecutive terms on the Ohio Technical Advisory Council for Oil & Gas as a member, Vice Chairman and Council Secretary. I am also a trustee for the Ohio Oil & Gas Association. I have been a member of the Association since the late 1980's, and have served on various committees and at the trustee level. I have also been a member of the Society of Petroleum Engineers for over thirty years.

My primary area of interest is economic analysis of oil and gas properties and the estimation of their associated reserves and/or expected ultimate recovery (EUR). I became interested in reserve estimation in 1979 while working part-time for Quaker State Oil as an engineering technician, while attending Marietta College. I routinely teach economic analysis and provide consulting services related to property valuation. I have followed the favorable economic impact that shale development has had for Ohio and our nation.

During the Fall of 2012, Thomas Consulting, LLC completed a report for the Ohio Oil & Gas Association which provided preliminary estimates of ultimate recoveries/well of the newly drilled Utica shale wells and the associated economics. The report was for a limited number of newly drilled Utica shale wells having production results reported in the public domain.

On March 13, 2013, I provided a recap of the prior work via testimony before the Tax Subcommittee of the House Ways and Means Committee.

Thereafter the Ohio Oil & Gas Association requested that I supplement my previous work with additional efforts directed toward developing a useful severance tax forecasting tool specifically focused on new well drilling of the Utica shale formation. My testimony today will be focused on providing a brief recap of certain portions of the prior testimony and presenting the results of the severance tax forecast model developed.

Defining the Term: Expected Ultimate Recovery (EUR)

EUR Definition

As an introduction, a definition of a commonly used term is needed. The Society of Petroleum Engineers define the Expected Ultimate Recovery (EUR) as those quantities of petroleum which are estimated, on a given date, to be potentially recoverable from an accumulation, plus those quantities already produced there from. In the case of a new well, the EUR is an estimate of the quantities potentially recoverable during the productive economic well life.

Determining the Estimated Ultimate Recovery (EUR)

A common method to determine the EUR of shale wells is the application of production decline curves for forecasting future production. Based on past production history, a forecast of the future production is made graphically. This type of forecasting is referred to as "decline curve" analysis. The production decline curve is used to forecast future production for future periods. It is often observed that wells producing from a given formation have similar production decline rates over time. After a "typical" decline curve is established for a given formation, the early known well production history is utilized in order to develop an EUR for the well. The typical decline curve shape is often referred to as a "type curve".

Decline Curve Discussion

The production decline curve presented on the following page is an example of the expected production decline for Utica shale horizontal wells. The decline curve is similar to type curves being utilized in the Marcellus shale and other U.S. shale formations. Thomas Consulting utilized Aires software with a "b" factor of (1.6) and an initial decline rate (67.25%) in establishing the type curve utilized herein (refer to the earlier March 13, 2013 testimony for further details).

Decline Curve Observations

As observed from the decline curve, initial production volumes during the first twelve months commence at very high rates and decline rapidly. As an example, referring to the green decline curve (bottom curve); in year one the initial monthly oil production rate is approximately 3,200 barrels/month and declines to 1,200 barrels/month at the end of year one. Yearly production volumes are forecasted to decline each year the well is producing. This is due to the pressure in the reservoir rock (Utica shale) declining as the well is produced (oil and natural gas is removed from the Utica shale formation).

The type curve is fitted to the early well production data. If initial production rates are higher, the type curve is shifted upward to match the production data. If initial production data is lower, the type curve is shifted downward to match the production data.

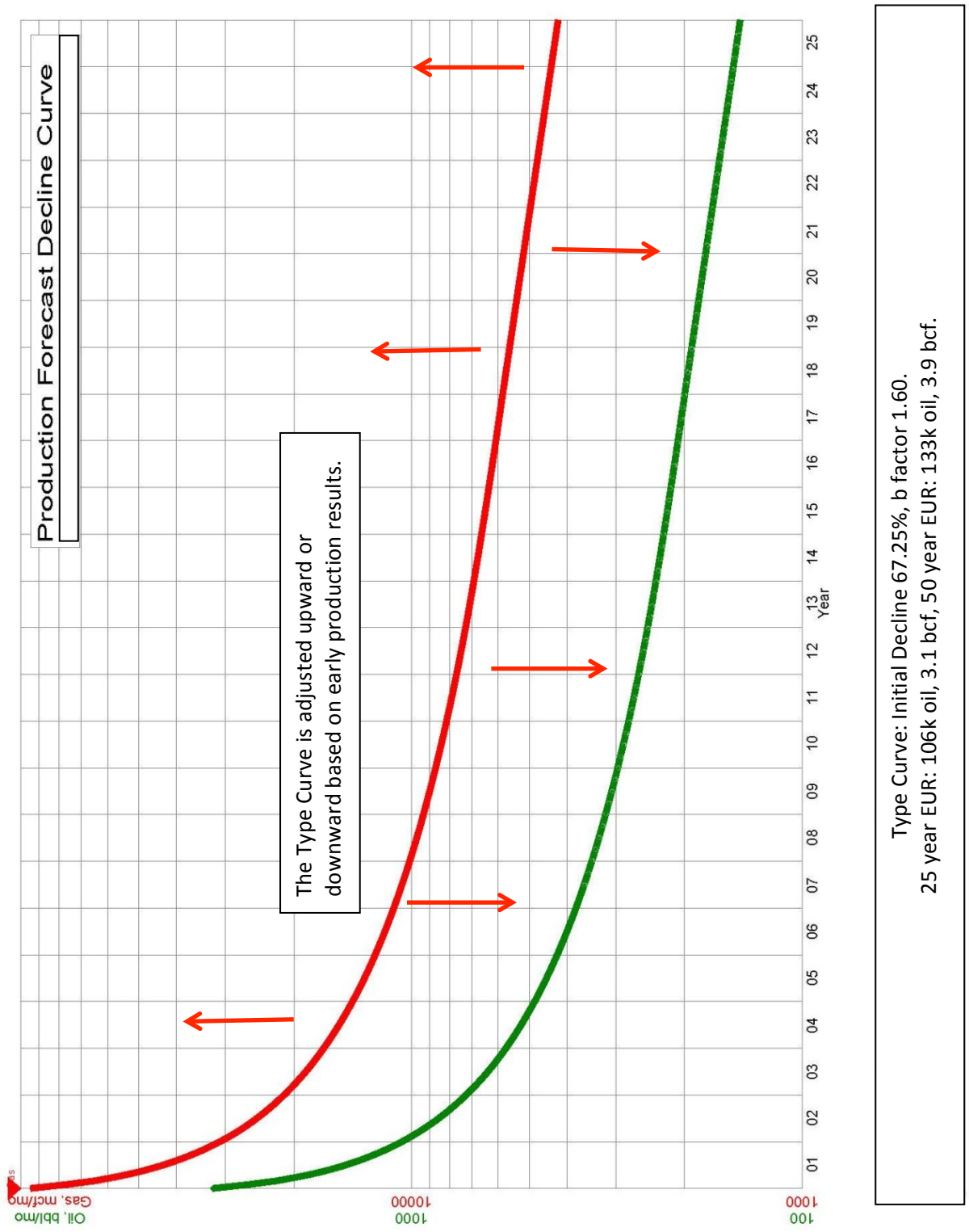

Production Forecast Decline Curve
The Type Curve is adjusted upward or downward based on early production results.
Type Curve: Initial Decline 67.25%, b factor 1.60.
25 year EUR: 106k oil, 3.1 bcf, 50 year EUR: 133k oil, 3.9 bcf.
Oil, bbl/mo
Gas, mcf/mo
Year
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
100
1000
10000
1000

Table 1 (page 6) provides further insight into the rapid production decline associated with newly drilled Utica shale wells. The early production years account for the majority of the total forecasted well production. Based on the type curve it is expected that nearly 30% of the fifty-year EUR will be produced in the first three production years of a new well.

As compared to the early well life, the later years of the productive well life account for only a marginal percentage of the fifty year EUR. As observed in Table 1, forecasted annual production during the last fifteen years of the productive well life (years 35 through 50) will account for less than 10% of the total fifty year EUR. Refer to Table 1 for other noted observations regarding declining production characteristics.

Table 1. Allocation of the 50 Year EUR by Year Newly Drilled Horizontal Utica Shale Well			
Year	**Annual**	**Cumulative**	**Observations**
1	14.94%	14.94%	
2	7.80%	22.74%	
3	5.79%	28.53%	Approximately 30% of the 50 Year EUR in the first three years.
4	4.74%	33.27%	
5	4.08%	37.35%	
6	3.61%	40.96%	
7	3.26%	44.22%	
8	2.99%	47.22%	
9	2.77%	49.99%	
10	2.59%	52.58%	Approximately 50% of the 50 Year EUR in the first 10 years.
11	2.44%	55.01%	
12	2.30%	57.32%	
13	2.19%	59.50%	
14	2.09%	61.59%	
15	2.00%	63.59%	
16	1.92%	65.50%	
17	1.84%	67.34%	
18	1.77%	69.11%	
19	1.69%	70.80%	
20	1.63%	72.43%	Approximately 70+% of the 50 Year EUR in the first 20 years.
21	1.56%	73.99%	
22	1.50%	75.49%	
23	1.44%	76.93%	
24	1.38%	78.31%	
25	1.33%	79.64%	Approximately 80% of the 50 Year EUR in the first 25 years.
26	1.27%	80.91%	
27	1.22%	82.13%	
28	1.17%	83.31%	
29	1.13%	84.43%	
30	1.08%	85.51%	
31	1.04%	86.55%	
32	1.00%	87.55%	
33	0.96%	88.51%	
34	0.92%	89.43%	
35	0.88%	90.31%	From Year 35 through Year 50 approximately 10% of the
36	0.85%	91.15%	of the 50 Year EUR is produced.
37	0.81%	91.97%	
38	0.78%	92.75%	
39	0.75%	93.50%	
40	0.72%	94.22%	
41	0.69%	94.91%	
42	0.66%	95.57%	
43	0.64%	96.20%	
44	0.61%	96.82%	
45	0.59%	97.40%	
46	0.56%	97.96%	
47	0.54%	98.51%	
48	0.52%	99.02%	(Type curve utilized average b factor of 1.6 and an initial
49	0.50%	99.52%	decline rate (Qi) of 67.25%)
50	0.48%	100.00%	

Severance Tax Model

Development and Inputs Required

The recent work completed by Thomas Consulting was related to developing a simple model to project severance tax revenue, as envisioned under House Bill 375 from recoverable oil & natural gas produced from newly drilled and producing Utica shale. Thomas Consulting utilized the described decline curve method for new well production forecasting and allocated the EUR to each production year.

Thereafter Thomas Consulting developed a severance tax model for projecting the associated tax revenue for a ten year period (2014 – 2023). The model required certain inputs. As the model was being developed, Thomas Consulting requested assistance from the Ohio Oil & Gas Association with respect to establishing the needed model inputs. The Association reached out to industry participants and other knowledgeable parties to determine appropriate needed model inputs.

In summary, the first key project step was to develop a methodology to forecast annual production results for wells drilled (type curve). The second step (based on needed model inputs) was to calculate the Utica shale wellhead revenues and the resulting severance tax envisioned by House Bill 375. The Needed Inputs are as follows:

1. Estimated Ultimate Recovery/Well:
The model required an estimate of the 50 year EUR for a new horizontal Utica well. It was determined that an approximate EUR of 10 bcfe was a reasonable estimate of what is currently being experienced by the producer community for recent Utica new well development. Refer to the below section "Understanding Unit Equivalents" for additional EUR unit explanation.

2. Severance Tax Rate:
The model provides for a lower severance tax rate for the five year period after initial production commences. Referred to as the Capital Cost Recovery (CCR) period the modeled tax rate is 1% of the gross receipts at the wellhead from the sale of oil and natural gas. When the CCR period expires (five years after production commences) the severance tax is increased to 2% of the gross receipts from the sale of oil and natural gas.

3. Number of New Wells/Year:
The number of new wells placed in production each year is a constant input number in the model. Consideration to new well development to-date, new well drilling permits, observations about the areas of interest and other factors lead to the determination that an annual average of 1,000 wells would be used for the ten year model.

4. NYMEX Natural Gas Price:
The model input of $4.00/mmbtu was the market price in late 2013. Price expectation was upward. Future natural gas prices have increased. The current three year average NYMEX natural gas price is $4.20/mmbtu. (source: 1/3/2014 Bloomberg via Rivington Holdings). The ten-year constant $4.00/mmbtu price realized by the producer (wellhead) was utilized in the model.

5. Heat Content of Natural Gas:
The model input of 1,258 btu/cf is considered to be a typical expected value. It is consistent with industry reports related to the gas quality being encountered in newly drilled Utica shale wells. The input value was also provided by a mid-stream company active in purchasing, transporting and processing natural gas from the newly drilled Utica shale wells.

6. Liquids Uplift Adjustment:
The model input of $1.09/mmbtu was a needed model input. This value represents the enhanced value of the natural gas as a result of liquids removal from the natural gas stream. The uplift input is as a result of the mid-stream natural gas processing. The mid-stream company, discussed above, provided this input value as well.

The model input page for projecting severance tax revenue as envisioned under House Bill 375, from recoverable oil & natural gas produced from newly drilled and producing Utica shale is presented below. Certain model assumptions are also noted on the input page (page 9).

Understanding Unit Equivalents
When discussing the expected recoverable from a given well, comparing projects or companies the forecasted oil and gas production is often converted into "equivalent units".

For gas wells which produce some oil liquids, the EUR would be typically be presented in bcfe (billions of cubic feet equivalents). For oil wells which produce some natural gas, the EUR would be typically presented in beq (barrel equivalents). The below example illustrates the equivalents concept:

Example:
Assume the producer receives $5/mcf and $80/bbl.
The 50 year well EURs are 8,000,000 mcf of natural gas and 25,000 barrels of oil.
Expected Revenue: (8,000,000 mcf x $5/mcf) + (25,000 bbl x $80/bbl) = **$42 million**

The ratio of 1 bbl of oil ($80) divided by 1 mcf ($5) = 16
This means that 1 barrel of oil = 16 mcf of gas (in terms of revenue or value)

For gas wells the well EUR would be:
8,000,000 mcf + (25,000 barrels * 16) = 8,400,000 mcfe (Note this equates to 8.4 bcfe)
Expected Revenue: 8,400,000 mcfe x $5/mcf = **$42 million**

Although not typically done for gas wells, the two EURs could also be presented as beq:
25,000 bbl + ((8,000,000 mcf divided by 16) = 525,000 beq
Expected Revenue: 525,000 beq x $80/bbl = **$42 million**

Useful Conversion Units:

1 mcf = 1,000 cf	1,000,000 mcf = 1 billion cubic feet (1 bcf)
1 barrel = 42 U.S. gallons	1,000,000 btu = mmbtu

	Severance Tax Analysis			
	Prepared for the Ohio Oil & Gas Association			
	January 2014			
Program Description:				
This spreadsheet has been developed as a forecasting tool related to oil & gas well production from the Utica shale formation and more specifically (subject to the below parameters/model inputs) a tool to estimate potential severance tax revenues.				
User Inputs:		**Inputs**		
1.	The assumed Estimated Ultimate Recovery/well is:	10.00	50 year well life (bcfe)	
2.	During the Capital Cost Recovery Period (CCR)			
	the Severance Tax % is:	1.00	% of revenues received	
	During the Full Severance Period the Severance Tax % is:	2.00	% of revenues received	
3.	The assumed number of new wells drilled each year:	1,000	wells/year	
4.	The assumed NYMEX gas price (wellhead) is:	$4.00	$/mmbtu	
5.	The assumed natural gas heat content is:	1,258	btu/cf	
6.	The assumed liquids uplift adjustment is:	$1.09	$/mmbtu	
		$1.37	$/mcf	
Model Assumptions				
1.	The same number of new wells are drilled each calendar year			
2.	New well production is assumed to commence January 1 of each year.			
3.	Severance tax calculation commences January 1 of the effective year.			
4.	The calculated Full Severance Tax is assumed to commence after the Capital Cost			
	Recovery Period has expired. The Capital Cost Recovery Period provides the Producer with			
	a period of time to recover land,well and pipeline costs.			

Model Outputs

Based on the decline curve analysis and the inputs discussed above, a forecast of annual volumes for years 2014 through 2023 was generated. For purposes of severance tax determination, the volumes were identified as those during the five year CCR period (1% of gross receipts) and those after the five year period (2% of gross receipts).

The pricing inputs were applied to the forecasted gross volumes and forecasted annual severance tax revenue was calculated. The modeled estimated gross volumes and annual severance tax revenues are presented on page 11.

The forecasted severance tax revenue (model output) is presented in chart form on page 12. The annual forecasted severance tax revenue and the cumulative severance tax revenue during the ten year period are incorporated in the same chart.

Questions and Answers

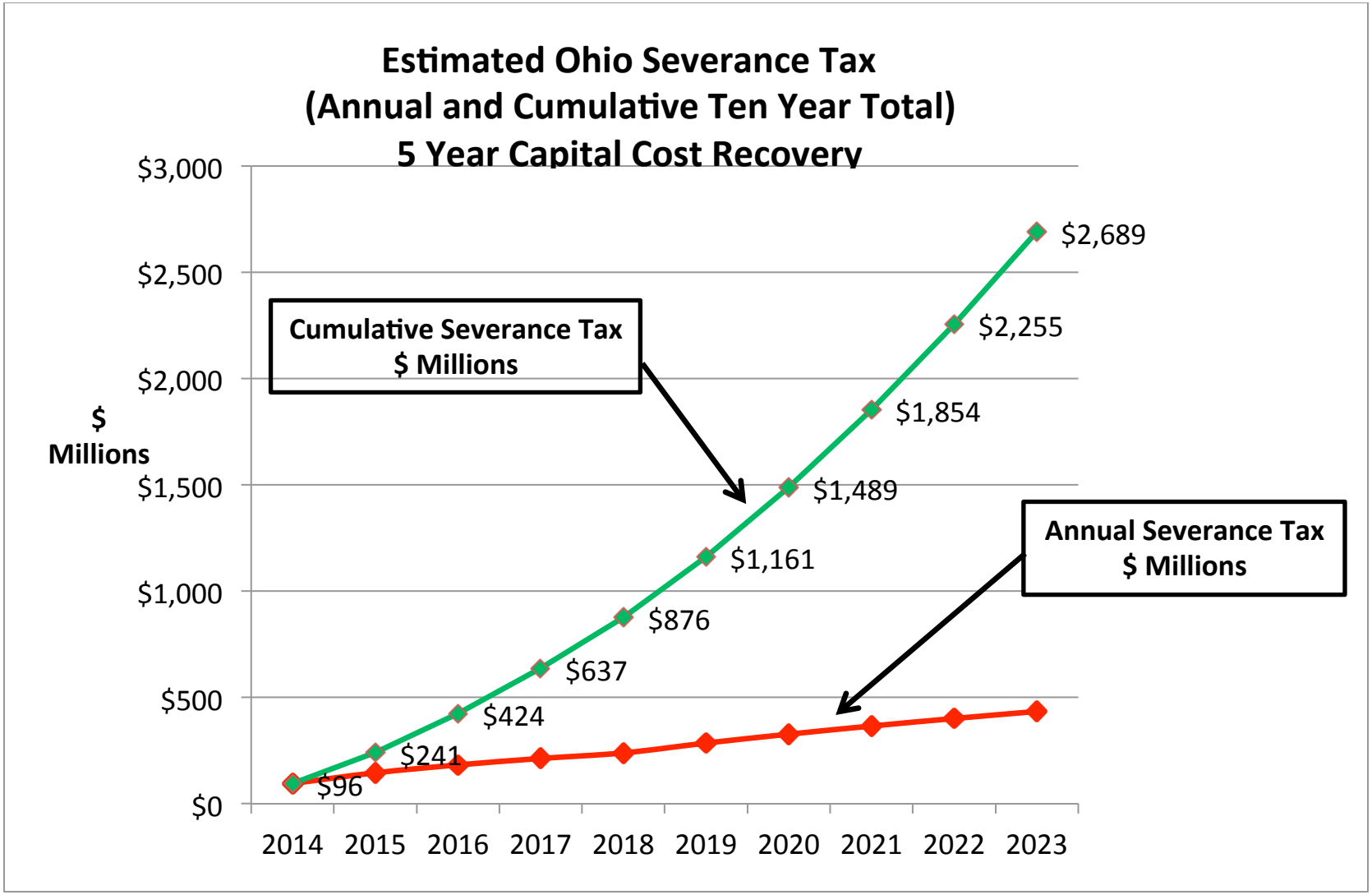
I would like to thank the committee for allowing me to testify today and your interest in my testimony. I am happy to answer any questions.

Severance Tax Analysis
Prepared for the Ohio Oil & Gas Association
January 2014

	Single Well Yearly % of 50 Year EUR									
Year	1	2	3	4	5	6	7	8	9	10
	14.935%	7.801%	5.789%	4.742%	4.078%	3.613%	3.265%	2.992%	2.772%	2.590%

	Ten Year Development Spreadsheet									
Year	See Input Sheet for EUR and # Wells/Year									
Drilled	Gross Annual bcfe produced (FIVE YEAR CCR Period)									
↓	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
2014	1493.55	780.084	578.911	474.159	407.844	361.31	326.481	299.23	277.2	258.96
2015		1493.55	780.084	578.911	474.159	407.844	361.31	326.481	299.23	277.2
2016			1493.55	780.084	578.911	474.159	407.844	361.31	326.48	299.23
2017				1493.55	780.084	578.911	474.159	407.844	361.31	326.48
2018	YELLOW = FULL SEVERANCE PERIOD				1493.55	780.084	578.911	474.159	407.84	361.31
2019	GREEN = CCR PERIOD					1493.55	780.084	578.911	474.16	407.84
2020	$4.00	NYMEX $/mmbtu					1493.55	780.084	578.91	474.16
2021	1,258	btu/cf						1493.55	780.08	578.91
2022	$1.09	$/mmbtu Liquids Uplift Adj.							1493.5	780.08
2023										1493.5

	Ten Year Development Spreadsheet									
Year	See Input Sheet for EUR and # Wells/Year									
Drilled	Total Annual Severance Tax Revenues (Millions $)									
↓	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
2014	$95.64	$49.95	$37.07	$30.36	$26.12	$46.27	$41.81	$38.32	$35.50	$33.16
2015		$95.64	$49.95	$37.07	$30.36	$26.12	$46.27	$41.81	$38.32	$35.50
2016			$95.64	$49.95	$37.07	$30.36	$26.12	$46.27	$41.81	$38.32
2017				$95.64	$49.95	$37.07	$30.36	$26.12	$46.27	$41.81
2018	YELLOW = FULL SEVERANCE PERIOD				$95.64	$49.95	$37.07	$30.36	$26.12	$46.27
2019	GREEN = CCR PERIOD					$95.64	$49.95	$37.07	$30.36	$26.12
2020	$4.00	NYMEX $/mmbtu					$95.64	$49.95	$37.07	$30.36
2021	1,258	btu/cf						$95.64	$49.95	$37.07
2022	$1.09	$/mmbtu Liquids Uplift Adj.							$95.64	$49.95
2023										$95.64
Before	$95.64	$145.59	$182.65	$213.02	$239.13	$239.13	$239.13	$239.13	$239.13	$239.13
After	5 YR Capital Cost Recovery Period					$46.27	$88.08	$126.40	$161.90	$195.07
Total	**$95.64**	**$145.59**	**$182.65**	**$213.02**	**$239.13**	**$285.40**	**$327.21**	**$365.53**	**$401.03**	**$434.20**



Conversion: $1,000 million = $1.0 Billion, Example: At 10 Years: $2,689 Million = $2.689 Billion.

Discussion of Report Assumptions and Material Verification
In order to develop the severance tax model presented herein certain reasonable assumptions were employed:

- All wells are expected to produce at full production capability with no restriction.
- The type curve utilized will be representative of actual future well production including oil and natural gas.
- Model inputs and noted assumptions described on page 9.

Additional well production data will lead to average EUR revisions either upward or downward as additional production data becomes available. Efforts were made to utilize the most current information available coupled with reasonable assumptions. No attempt was made to audit or verify the production data captured from the public domain or other information used.

This analysis should be viewed as preliminary and subject to revision either upward or downward as additional production data, rate of new well drilling, liquids uplift updates and other related factors become known.

This report assumes that there is sufficient mechanical and wellbore integrity to produce for the fifty year period in order to achieve the EUR. This is not a reserve report but rather an estimate of the ultimate recovery which is dependent upon the accuracy of the assumed type curve, profitable operating economics in order to achieve the EUR and no major mechanical failures or other down-hole event which results in early abandonment.