NETHERLAND, SEWELL & ASSOCIATES, INC.

WORLDWIDE PETROLEUM CONSULTANTS

Introduction to Estimation of Oil and Gas Reserves

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NTCHBA Conference
September 29, 2025

What Are Hydrocarbon Reserves?

"Reserves are those quantities of petroleum anticipated to be **commercially recoverable** by application of **development projects** to **known accumulations** [hydrocarbon reservoirs] **from a given date forward** under defined conditions."

Therefore, all reserves volumes **MUST** be:

1. Economic to produce
2. Associated with a firm development plan
3. “Discovered”
4. Remaining recoverable from a certain date

Petroleum Reserves and Resources Classification and Definitions
(Excerpted from the Petroleum Resources Management System approved by the Society of Petroleum Engineers (SPE) Board of Directors, June 2018)

Why are Reserves Volumes Relevant to Fair Market Value?

Reserves estimation typically requires a combination of:

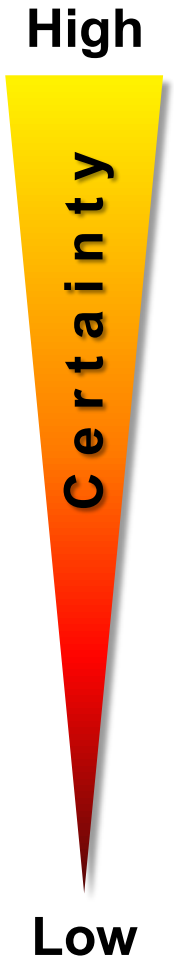
- Geologic analysis of the hydrocarbon volumes originally in place
- Engineering analysis of production potential based on operator's development plan
- Economic analysis and cash flow modelling to confirm economic viability

Therefore, all reserves evaluations produce:

1. Forecast of future sales volumes
2. Field-level cash flow model

A cash flow model incorporating both the physical and economic constraints of hydrocarbon production are critical to valuation of hydrocarbon assets

Reserves Are Categorized by Certainty of Recovery



Proved

- Lowest risk category, reasonable certainty of recovery under current economic conditions
- SEC defines reasonable certainty as "much more likely to be achieved than not"

Probable

- Moderate risk categorization
- Proved + Probable reserves have equally likely chance of being recovered as not (“most likely”)

Possible

- More speculative, low degree of certainty

Why Do We Need Reserves Definitions?

- To quantify the range of uncertainty of recoverable hydrocarbons
- To standardize classification of reserves/resources within the petroleum industry
- To provide capital markets with consistent standards for *asset valuation*

Authorities in Reserves/Resources Categorization

- Securities and Exchange Commission (SEC)
- Canadian Securities Administrators (CSA - NI 51-101)
- Petroleum Resource Management System (PRMS)
  - Society of Petroleum Engineers (SPE)
  - American Association of Petroleum Geologists (AAPG)
  - World Petroleum Council (WPC)
  - Society of Petroleum Evaluation Engineers (SPEE)
- Various foreign governments, professional societies, and financial markets (typically refer to PRMS definitions)

When & Why Are Reserves Reports Prepared?

External

- Security filings (SEC, International Exchanges - London, Hong Kong, Singapore)
- Public disclosure (press releases, annual reports)
- External financing/joint ventures/privatization
- Property sales/acquisition diligence
- Unitizations/equity determinations
- Reports for governmental agencies (foreign and domestic)

Internal

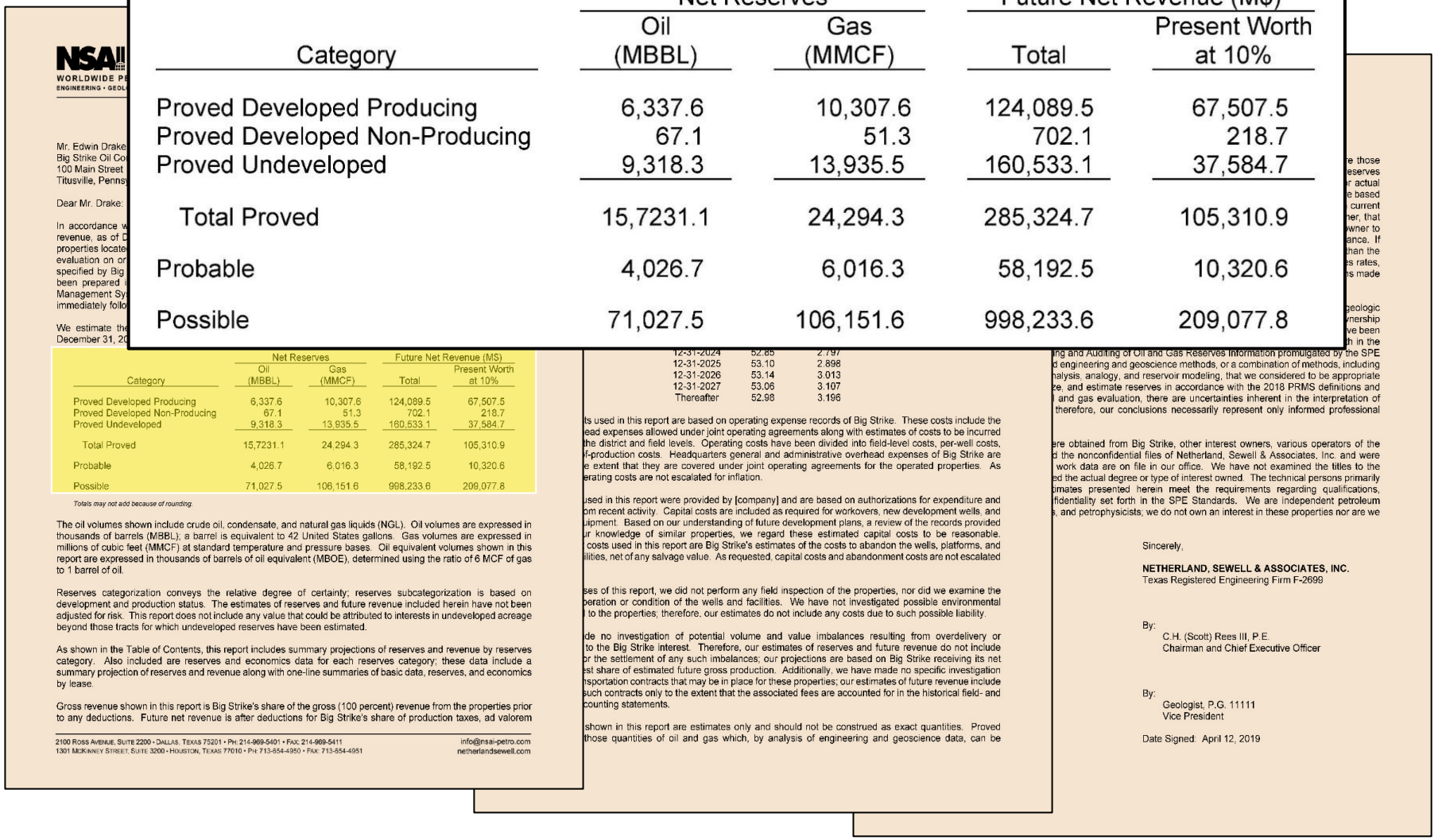
- Corporate planning and financial decisions
- Accounting requirements such as depletion calculations, etc.
- Monitoring success of exploration and acquisition programs

Regardless of the ultimate audience… independence of the evaluator is key.

Example - Report Letter

Estimates of Reserves and Revenue

Category	Net Reserves Oil (MBBL)	Net Reserves Gas (MMCF)	Future Net Revenue (M$) Total	Future Net Revenue (M$) Present Worth at 10%
Proved Developed Producing	6,337.6	10,307.6	124,089.5	67,507.5
Proved Developed Non-Producing	67.1	51.3	702.1	218.7
Proved Undeveloped	9,318.3	13,935.5	160,533.1	37,584.7
Total Proved	15,7231.1	24,294.3	285,324.7	105,310.9
Probable	4,026.7	6,016.3	58,192.5	10,320.6
Possible	71,027.5	106,151.6	998,233.6	209,077.8



Example - Summary Table

Reserves and Gross Revenue

NETHERLAND, SEWELL & ASSOCIATES, INC.

SUMMARY PROJECTION OF RESERVES AND REVENUE
AS OF DECEMBER 31, 2018

BIG STRIKE OIL CORPORATION INTEREST

CERTAIN PROPERTIES LOCATED IN KANSAS, LOUISIANA, AND TEXAS

TOTAL PROVED RESERVES

PERIOD ENDING M-D-Y	GROSS RESERVES OIL MBBL	GROSS RESERVES GAS MMCF	NET RESERVES OIL MBBL	NET RESERVES NGL MBBL	NET RESERVES GAS MMCF	NET RESERVES EQUIV MBOE	AVERAGE PRICES OIL $/BBL	AVERAGE PRICES NGL $/BBL	AVERAGE PRICES GAS $/MCF	GROSS REVENUE OIL M$	GROSS REVENUE NGL M$	GROSS REVENUE GAS M$	GROSS REVENUE TOTAL M$
12-31-2019	1,038.3	1,796.0	608.6	0.0	1,027.0	779.8	42.69	0.00	1.651	25,980.3	0.0	1,696.0	27,676.3
12-31-2020	1,504.8	2,274.8	883.3	0.0	1,310.3	1,101.7	44.75	0.00	1.381	39,523.8	0.0	1,809.2	41,333.0
12-31-2021	1,727.6	2,520.5	1,103.0	0.0	1,556.4	1,362.4	46.13	0.00	1.319	50,881.2	0.0	2,053.5	52,934.6
12-31-2022	1,722.6	2,582.7	1,087.5	0.0	1,596.4	1,353.5	47.15	0.00	1.455	51,274.0	0.0	2,322.6	53,596.6
12-31-2023	1,541.1	2,348.7	854.2	0.0	1,314.1	1,073.2	47.98	0.00	1.520	40,983.6	0.0	1,997.1	42,980.7
12-31-2024	1,755.1	2,563.4	1,066.3	0.0	1,525.7	1,320.6	48.69	0.00	1.685	51,914.3	0.0	2,571.1	54,485.4
12-31-2025	1,846.5	2,714.7	1,075.3	0.0	1,576.7	1,338.1	48.96	0.00	1.964	52,645.9	0.0	3,096.4	55,742.3
12-31-2026	1,390.4	2,181.5	812.6	0.0	1,264.3	1,023.3	48.93	0.00	2.027	39,761.1	0.0	2,563.1	42,324.2
12-31-2027	1,792.6	2,608.2	868.6	0.0	1,307.5	1,086.5	48.89	0.00	2.095	42,467.9	0.0	2,739.5	45,207.4
12-31-2028	1,542.1	2,343.8	710.4	0.0	1,123.6	897.7	48.77	0.00	2.196	34,647.1	0.0	2,467.2	37,114.3
12-31-2029	1,444.8	2,235.5	619.4	0.0	1,000.2	786.1	48.74	0.00	2.288	30,188.3	0.0	2,287.9	32,476.2
12-31-2030	1,156.1	1,859.6	545.0	0.0	888.9	693.2	48.72	0.00	2.372	26,552.1	0.0	2,108.2	28,660.2
12-31-2031	1,002.7	1,635.0	490.3	0.0	803.3	624.2	48.70	0.00	2.464	23,876.7	0.0	1,979.0	25,855.7
12-31-2032	896.0	1,476.9	446.8	0.0	736.1	569.5	48.69	0.00	2.453	21,754.1	0.0	1,805.4	23,559.5
12-31-2033	808.2	1,339.6	409.1	0.0	675.7	521.8	48.69	0.00	2.450	19,920.0	0.0	1,655.5	21,575.5
SUBTOTAL	21,168.8	32,481.0	11,580.4	0.0	17,706.2	14,531.4	47.70	0.00	1.872	552,370.3	0.0	33,151.6	585,521.9
REMAINING	8,132.2	13,274.8	4,142.7	0.0	6,588.1	5,240.7	48.68	0.00	2.523	201,655.8	0.0	16,621.3	218,277.1
TOTAL	29,301.0	45,755.8	15,723.1	0.0	24,294.3	19,772.1	47.96	0.00	2.049	754,026.0	0.0	49,772.9	803,798.9
CUM PROD	13,872.0	17,328.4											
ULTIMATE	43,173.0	63,084.1											

12-31-2027	113	79.0	3,787.7	0.0	9,431.3	60.8	13,662.2	18,265.4	111,261.8	63,512.7	80.000	6,944.8	
12-31-2028	112	76.1	3,049.4	0.0	1,020.0	213.5	12,467.3	20,364.1	131,625.9	71,771.4	100.000	5,167.7	
12-31-2029	112	76.1	2,638.2	0.0	0.0	0.0	11,728.1	18,109.9	149,735.8	78,440.9			
12-31-2030	112	76.1	2,302.3	0.0	0.0	0.0	10,867.8	15,490.1	165,225.9	83,625.2			
12-31-2031	108	73.5	2,059.1	0.0	0.0	264.5	10,164.4	13,367.7	178,593.6	87,690.7			
12-31-2032	105	71.1	1,868.4	0.0	0.0	242.9	9,595.9	11,852.3	190,446.0	90,968.4			
12-31-2033	102	69.5	1,703.0	0.0	0.0	160.9	9,051.3	10,660.3	201,106.3	93,648.0			
SUBTOTAL			46,023.3	0.0	147,179.2	1,734.6	189,478.4	201,106.3	201,106.3	93,648.0			
REMAINING			16,424.6	0.0	0.0	6,945.7	110,688.3	84,218.4	285,324.7	105,310.9			
TOTAL OF 50.0 YRS			62,447.9	0.0	147,179.2	8,680.3	300,166.7	285,324.7	285,324.7	105,310.9			

All estimates and exhibits herein are part of this NSAI report and are subject to its parameters and conditions.

BASED ON BIG STRIKE PRICE AND COST PARAMETERS

Example - Summary Table

Expenses and Net Revenue

NETHERLAND, SEWELL & ASSOCIATES, INC.

SUMMARY PROJECTION OF RESERVES AND REVENUE
AS OF DECEMBER 31, 2018

BIG STRIKE OIL CORPORATION INTEREST

CERTAIN PROPERTIES LOCATED IN
KANSAS, LOUISIANA, AND TEXAS

TOTAL PROVED RESERVES

PERIOD ENDING M-D-Y	GROSS RESERVES OIL MBBL	GROSS RESERVES GAS MMCF	NET RESERVES OIL MBBL	NET RESERVES NGL MBBL	NET RESERVES GAS MMCF	NET RESERVES EQUIV MBOE	AVERAGE PRICES OIL $/BBL	AVERAGE PRICES NGL $/BBL	AVERAGE PRICES GAS $/MCF	GROSS REVENUE OIL M$	GROSS REVENUE NGL M$	GROSS REVENUE GAS M$	GROSS REVENUE TOTAL M$
12-31-2019	1,038.3	1,796.0	608.6	0.0	1,027.0	779.8	42.69	0.00	1.651	25,980.3	0.0	1,696.0	27,676.3

PERIOD ENDING M-D-Y	NUMBER OF ACTIVE COMPLETIONS GROSS	NUMBER OF ACTIVE COMPLETIONS NET	NET DEDUCTIONS/EXPENDITURES TAXES PRODUCTION M$	TAXES AD VALOREM M$	CAPITAL COST M$	ABDNMNT COST M$	OPERATING EXPENSE M$	FUTURE NET REVENUE UNDISCOUNTED PERIOD M$	UNDISCOUNTED CUM M$	DISC AT 10.000% CUM M$	PRESENT WORTH PROFILE DISC RATE %	PRESENT WORTH PROFILE CUM PW M$
12-31-2019	85	60.6	2,413.8	0.0	9,641.5	323.1	11,451.7	3,846.2	3,846.2	3,922.1	8.000	124,462.8
12-31-2020	90	64.4	3,815.1	0.0	19,595.1	270.0	13,286.4	4,366.4	8,212.6	7,215.6	12.000	90,134.5
12-31-2021	97	70.8	3,397.5	0.0	48,610.7	73.1	14,894.8	-14,041.3	-5,828.7	-4,324.4	15.000	72,685.9
12-31-2022	98	71.3	3,426.5	0.0	3,400.0	0.0	15,291.8	31,478.3	25,649.6	18,240.6	20.000	52,834.1
12-31-2023	101	72.0	3,051.7	0.0	5,015.0	0.0	13,566.4	21,347.6	46,997.2	32,069.0	25.000	39,937.5
12-31-2024	107	77.3	4,422.0	0.0	35,672.0	0.0	14,830.1	-438.7	46,558.5	31,521.5	30.000	31,141.3
12-31-2025	109	78.3	4,649.2	0.0	10,200.0	51.1	15,273.1	25,568.9	72,127.4	45,151.1	40.000	20,364.9
12-31-2026	108	77.5	3,439.6	0.0	4,593.8	74.7	13,347.2	20,869.0	92,996.4	55,490.3	60.000	10,761.2
12-31-2027	113	79.0	3,787.7	0.0	9,431.3	60.8	13,662.2	18,265.4	111,261.8	63,512.7	80.000	6,944.8
12-31-2028	112	76.1	3,049.4	0.0	1,020.0	213.5	12,467.3	20,364.1	131,625.9	71,771.4	100.000	5,167.7
12-31-2029	112	76.1	2,638.2	0.0	0.0	0.0	11,728.1	18,109.9	149,735.8	78,440.9		
12-31-2030	112	76.1	2,302.3	0.0	0.0	0.0	10,867.8	15,490.1	165,225.9	83,625.2		
12-31-2031	108	73.5	2,059.1	0.0	0.0	264.5	10,164.4	13,367.7	178,593.6	87,690.7		
12-31-2032	105	71.1	1,868.4	0.0	0.0	242.9	9,595.9	11,852.3	190,446.0	90,968.4		
12-31-2033	102	69.5	1,703.0	0.0	0.0	160.9	9,051.3	10,660.3	201,106.3	93,648.0		
SUBTOTAL			46,023.3	0.0	147,179.2	1,734.6	189,478.4	201,106.3	201,106.3	93,648.0		
REMAINING			16,424.6	0.0	0.0	6,945.7	110,688.3	84,218.4	285,324.7	105,310.9		
TOTAL OF 50.0 YRS			62,447.9	0.0	147,179.2	8,680.3	300,166.7	285,324.7	285,324.7	105,310.9		

12-31-2026	108	77.5	3,439.6	0.0	4,593.8	74.7	13,347.2	20,869.0	92,996.4	55,490.3	60.000	10,761.2
12-31-2027	113	79.0	3,787.7	0.0	9,431.3	60.8	13,662.2	18,265.4	111,261.8	63,512.7	80.000	6,944.8
12-31-2028	112	76.1	3,049.4	0.0	1,020.0	213.5	12,467.3	20,364.1	131,625.9	71,771.4	100.000	5,167.7
12-31-2029	112	76.1	2,638.2	0.0	0.0	0.0	11,728.1	18,109.9	149,735.8	78,440.9		
12-31-2030	112	76.1	2,302.3	0.0	0.0	0.0	10,867.8	15,490.1	165,225.9	83,625.2		
12-31-2031	108	73.5	2,059.1	0.0	0.0	264.5	10,164.4	13,367.7	178,593.6	87,690.7		
12-31-2032	105	71.1	1,868.4	0.0	0.0	242.9	9,595.9	11,852.3	190,446.0	90,968.4		
12-31-2033	102	69.5	1,703.0	0.0	0.0	160.9	9,051.3	10,660.3	201,106.3	93,648.0		
SUBTOTAL			46,023.3	0.0	147,179.2	1,734.6	189,478.4	201,106.3	201,106.3	93,648.0		
REMAINING			16,424.6	0.0	0.0	6,945.7	110,688.3	84,218.4	285,324.7	105,310.9		
TOTAL OF 50.0 YRS			62,447.9	0.0	147,179.2	8,680.3	300,166.7	285,324.7	285,324.7	105,310.9		

All estimates and exhibits herein are part of this NSAI report and are subject to its parameters and conditions. BASED ON BIG STRIKE PRICE AND COST PARAMETERS

Example - One-line Summaries

Basic Data

BASIC DATA
AS OF DECEMBER 31, 2018

BIG STRIKE OIL CORPORATION INTEREST

CERTAIN PROPERTIES LOCATED IN KANSAS, LOUISIANA, AND TEXAS

PROVED DEVELOPED PRODUCING RESERVES

LEASE NUMBER	LEASE NAME	ACTIVE COMPLTNS OIL	ACTIVE COMPLTNS GAS	GROSS ULTIMATE OIL MBBL	GROSS ULTIMATE GAS MMCF	WORKING INTEREST START	WORKING INTEREST END	REVENUE INTEREST START	REVENUE INTEREST END	OIL $/BBL START	OIL $/BBL END	NGL $/BBL START	NGL $/BBL END	GAS $/MCF START	GAS $/MCF END	GROSS OPERATING EXPENSE M$/M START	GROSS OPERATING EXPENSE M$/M END	LIFE YRS
HASKELL COUNTY, KANSAS																		
LADNER FIELD, HASKELL COUNTY																		
003023	PDP 014	1	0	439.3	903.9	90.000	90.000	74.871	74.871	41.88	47.43	0.00	0.00	2.790	3.388	8.4	5.3	30.6
003025	PDP 015	1	0	139.6	665.7	90.000	90.000	90.000	90.000	41.88	47.43	0.00	0.00	2.790	3.388	3.7	3.1	23.3
003031	PDP 016	1	0	109.6	929.4	84.485	84.485	73.925	73.925	41.88	47.43	0.00	0.00	2.790	3.388	4.7	3.8	18.2
003032	PDP 017	0	0	93.7	376.5	45.000	45.000	37.125	37.125	41.88	41.88	0.00	0.00	2.790	2.790	2.8	2.8	0.0
003043	PDP 018	1	0	230.6	282.3	90.000	90.000	90.000	90.000	41.88	47.43	0.00	0.00	2.790	3.388	8.9	7.9	19.5
003059	PDP 021	1	0	847.7	966.5	90.000	90.000	90.000	90.000	41.88	47.43	0.00	0.00	2.790	3.388	7.0	5.7	49.1
003060	PDP 022	1	0	237.7	340.7	90.000	90.000	79.665	79.665	41.88	47.43	0.00	0.00	2.790	3.388	6.8	6.0	21.8
	FIELD TOTAL	6	0	2,098.2	4,465.0													
	FIELD TOTAL	8	0	2,535.5	1,869.0													
	PARISH TOTAL	8	0	2,535.5	1,869.0													
MIDLAND COUNTY, TEXAS																		
SPRABERRY FIELD, MIDLAND COUNTY																		
003019	PDP 001	0	0	52.6	90.1	77.754	77.754	64.031	64.031	41.88	41.88	0.00	0.00	1.490	1.490	8.7	8.7	0.0
003020	PDP 002	1	0	188.8	308.7	81.269	81.269	66.609	66.609	41.88	47.43	0.00	0.00	1.490	1.992	17.6	12.2	11.3
003037	PDP 005	1	0	247.7	142.6	66.375	66.375	54.009	54.009	41.88	47.43	0.00	0.00	1.490	2.088	6.2	3.0	31.7
003048	PDP 009	1	0	167.6	280.0	2.431	2.431	2.054	2.054	43.58	49.13	0.00	0.00	1.490	2.088	13.3	9.2	14.0
002007	PDP 019	0	0	180.9	229.9	67.500	67.500	54.000	54.000	0.00	0.00	0.00	0.00	0.000	0.000	1.4	1.4	0.0
002017	PDP 020	1	0	117.7	253.8	67.500	67.500	54.000	54.000	43.58	49.21	0.00	0.00	1.490	1.707	3.5	1.5	8.3
001028	PDP 023	1	0	388.1	461.9	81.048	81.048	63.895	63.895	43.58	49.13	0.00	0.00	1.490	2.088	17.5	7.4	29.2
003003	PDP 024	1	0	220.5	243.1	68.983	68.983	59.080	59.080	43.55	49.10	0.00	0.00	1.490	2.088	19.6	10.2	17.0
003004	PDP 025	1	0	160.2	255.1	68.983	68.983	59.080	59.080	43.55	49.10	0.00	0.00	1.490	2.088	17.6	10.1	14.8
003005	PDP 026	1	0	230.9	392.9	68.983	68.983	59.080	59.080	43.55	49.10	0.00	0.00	1.490	2.088	18.8	9.5	19.0
003133	PDP 027	1	0	399.5	450.6	90.000	90.000	72.881	72.881	43.33	48.88	0.00	0.00	1.490	2.088	21.9	6.5	37.3
002033	PDP 028	1	0	461.0	877.0	59.545	59.545	46.757	46.757	43.58	49.13	0.00	0.00	1.490	2.088	24.6	10.6	26.8
002040	PDP 029	1	0	317.1	504.3	59.545	59.545	46.757	46.757	43.58	49.13	0.00	0.00	1.490	2.088	23.6	11.9	18.2
002041	PDP 030	1	0	344.6	493.0	89.193	89.193	70.634	70.634	43.58	49.13	0.00	0.00	1.490	2.088	20.4	10.5	24.5
002042	PDP 031	1	0	320.9	569.7	59.545	59.545	46.757	46.757	43.58	49.13	0.00	0.00	1.490	2.088	24.1	11.5	21.5

Example - One-line Summaries

Reserves and Economics

RESERVES AND ECONOMICS
AS OF DECEMBER 31, 2018

BIG STRIKE OIL CORPORATION INTEREST

CERTAIN PROPERTIES LOCATED IN
KANSAS, LOUISIANA, AND TEXAS

PROVED DEVELOPED PRODUCING RESERVES

LEASE NUMBER	LEASE NAME	GROSS RESERVES OIL MBBL	GROSS RESERVES GAS MMCF	NET RESERVES OIL MBBL	NET RESERVES NGL MBBL	NET RESERVES GAS MMCF	NET RESERVES EQUIV MBOE	GROSS REVENUE OIL M$	GROSS REVENUE NGL M$	GROSS REVENUE GAS M$	TOTAL TAXES M$	NET CAP COST M$	ABDNMNT COST M$	OPERATING EXPENSE M$	NET REVENUE M$	CUM P.W. 10.000% M$
							HASKELL COUNTY, KANSAS									
	LADNER FIELD, HASKELL COUNTY															
003023	PDP 014	130.2	353.9	97.5	0.0	264.9	141.7	4,528.7	0.0	797.4	245.1	0.0	90.0	2,027.0	2,964.0	1,581.7
003025	PDP 015	16.9	186.1	15.2	0.0	167.5	43.1	708.6	0.0	512.1	47.2	0.0	90.0	836.0	247.5	162.5
003031	PDP 016	20.1	213.5	14.8	0.0	157.8	41.1	686.7	0.0	462.8	45.5	0.0	84.5	773.9	245.6	187.2
003032	PDP 017	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	45.0	0.0	-45.0	-41.1
003043	PDP 018	74.5	83.4	67.1	0.0	75.0	79.6	3,100.5	0.0	220.9	160.3	0.0	90.0	1,739.5	1,331.6	866.8
003059	PDP 021	230.4	276.3	207.4	0.0	248.6	248.8	9,705.1	0.0	777.4	988.0	0.0	90.0	3,265.7	6,138.8	2,464.1
003060	PDP 022	57.6	90.8	45.9	0.0	72.4	57.9	2,133.5	0.0	215.9	111.8	0.0	90.0	1,495.8	651.9	409.1
	FIELD TOTAL	529.7	1,203.9	447.8	0.0	986.3	612.2	20,863.2	0.0	2,986.5	1,597.9	0.0	579.5	10,137.9	11,534.3	5,630.4
	FIELD TOTAL	1,171.8	926.5	821.1	0.0	595.3	920.4	35,656.0	0.0	1,895.8	2,619.9	0.0	716.0	11,190.7	23,025.3	8,749.1
	PARISH TOTAL	1,171.8	926.5	821.1	0.0	595.3	920.4	35,656.0	0.0	1,895.8	2,619.9	0.0	716.0	11,190.7	23,025.3	8,749.1
							MIDLAND COUNTY, TEXAS									
	SPRABERRY FIELD, MIDLAND COUNTY															
003019	PDP 001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	77.8	0.0	-77.8	-71.0
003020	PDP 002	63.4	168.9	42.2	0.0	112.5	61.0	1,933.7	0.0	164.7	201.3	0.0	81.3	1,598.2	217.5	194.7
003037	PDP 005	106.5	68.9	57.5	0.0	37.2	63.7	2,662.6	0.0	62.5	268.9	0.0	66.4	944.5	1,445.3	811.7
003048	PDP 009	65.6	140.6	1.3	0.0	2.9	1.8	64.1	0.0	4.4	6.6	0.0	2.4	43.1	16.4	12.7
002007	PDP 019	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
002017	PDP 020	24.8	13.0	13.4	0.0	7.0	14.6	615.4	0.0	9.5	62.0	0.0	67.5	132.1	363.3	329.1
001028	PDP 023	198.7	264.5	127.0	0.0	169.0	155.1	6,111.7	0.0	289.0	623.1	0.0	81.0	2,969.3	2,727.3	1,461.1
003003	PDP 024	99.3	119.7	58.6	0.0	70.7	70.4	2,799.0	0.0	107.8	284.9	0.0	69.0	1,891.8	661.1	472.9
003004	PDP 025	74.4	154.8	44.0	0.0	91.5	59.2	2,096.3	0.0	142.3	216.1	0.0	69.0	1,571.3	382.3	290.8
003005	PDP 026	105.9	251.5	62.6	0.0	148.6	87.3	2,988.6	0.0	241.7	309.3	0.0	69.0	1,979.2	872.8	591.8
003133	PDP 027	297.2	336.0	216.6	0.0	244.9	257.4	10,353.9	0.0	417.9	17.3	0.0	90.0	3,747.1	6,917.4	3,527.0
002033	PDP 028	232.3	596.4	108.6	0.0	278.9	155.1	5,217.0	0.0	472.7	541.4	0.0	59.5	2,804.0	2,284.8	1,283.7
002040	PDP 029	136.0	303.5	63.6	0.0	141.9	87.3	3,037.0	0.0	229.4	313.7	0.0	59.5	2,061.2	831.9	574.6
002041	PDP 030	195.9	350.8	138.4	0.0	247.8	179.7	6,648.0	0.0	413.7	682.3	0.0	89.2	3,585.6	2,704.5	1,576.0
002042	PDP 031	167.4	348.5	78.3	0.0	162.9	105.4	3,755.4	0.0	267.6	387.0	0.0	59.5	2,426.0	1,150.4	704.8

Beware!

Reserves Reports Are Not Created Equal

- All reserves definitions leave significant latitude for interpretation and judgment to the evaluator
- Reserves evaluations can vary widely in their scope and depth of investigation
- Forward looking economic assumptions, especially commodity price, can have a significant impact on volumes and value

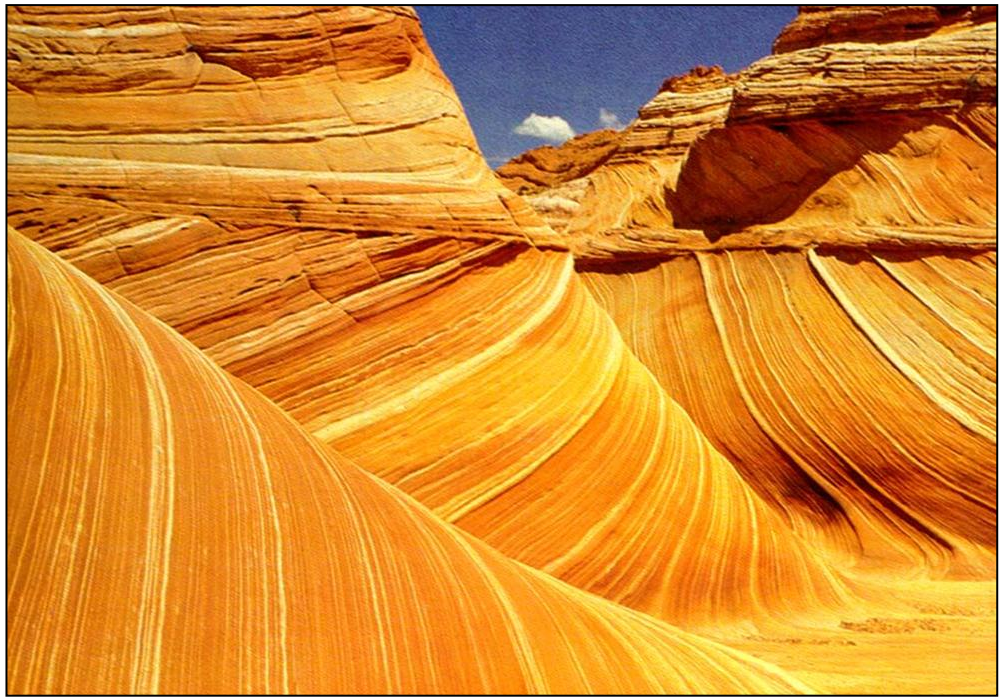
Therefore:

1. Reputation, expertise, and independence of the evaluator are critical to report reliability
2. Always carefully read the report letter to understand scope and base assumptions

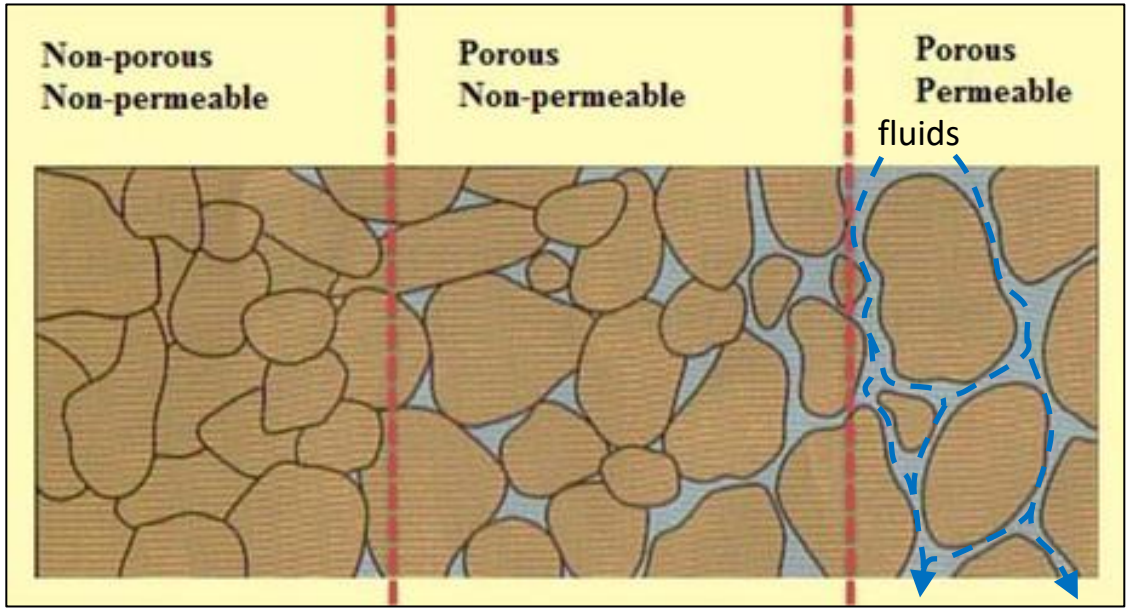
INTRODUCTION TO PETROLEUM SYSTEMS

What is a Reservoir Rock?

- A rock containing connected pore space (voids in rock) able to store and transmit fluids (water, oil, and gas)
  - Must have ***porosity*** **(pore space)** and ***permeability*** **(connection between pore spaces)**
  - The higher the porosity, the more storage capacity (more hydrocarbons in-place)
  - The higher the permeability, the easier it is to move hydrocarbons (higher production and recovery rates)



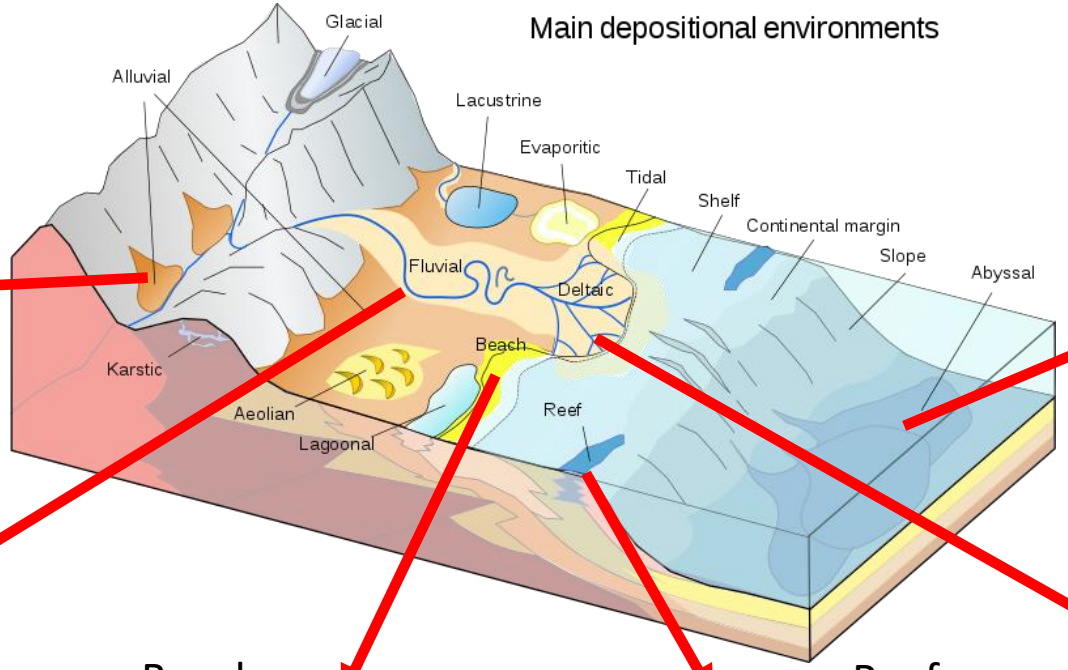
Sandstone, Paria Canyon, Utah



Soil Ecology Wiki

What is a Sedimentary Basin?

Alluvial Fan



Submarine Fan

River/Fluvial

Beach

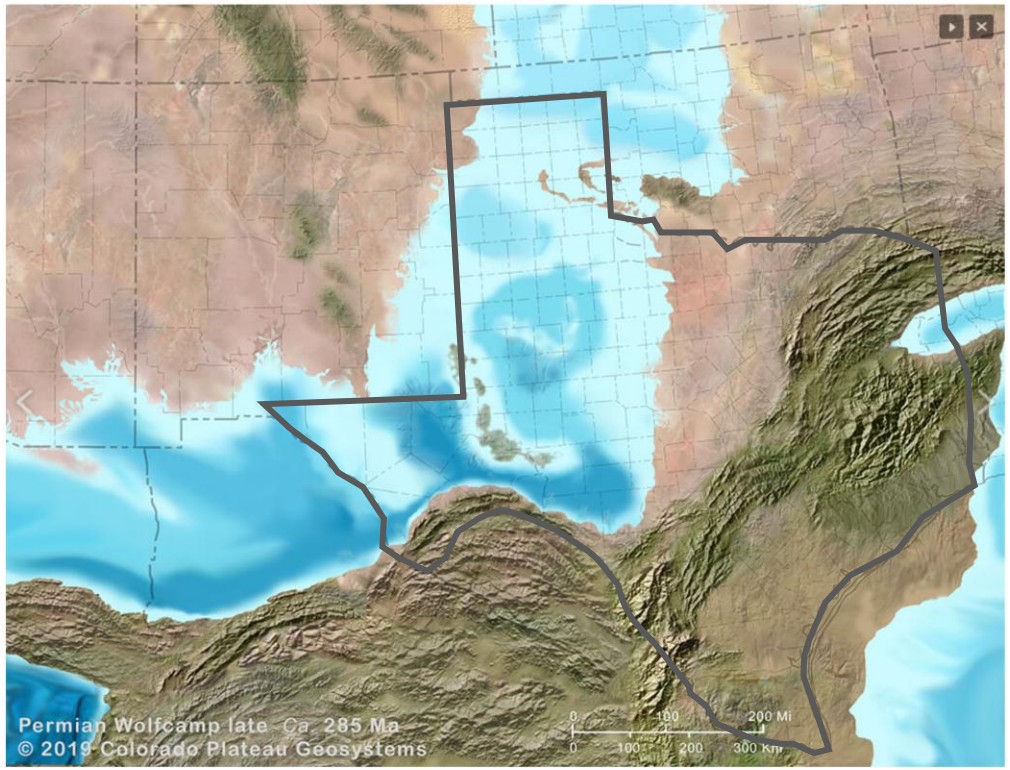
Reef

Delta

https://commons.wikimedia.org/wiki/File:Main_depositional_environments.svg

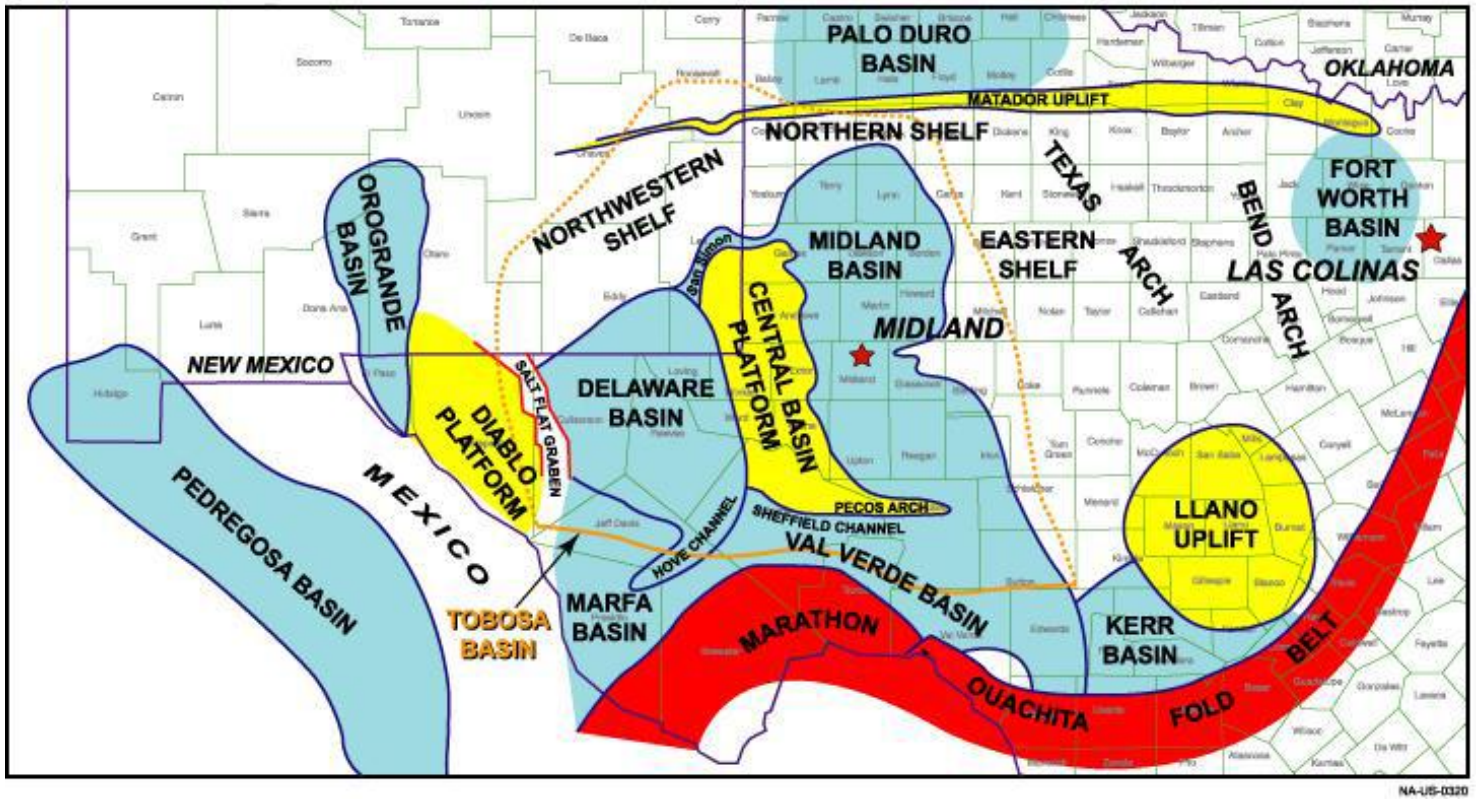
Example: Permian Basin

Texas, 200 – 250 million years ago



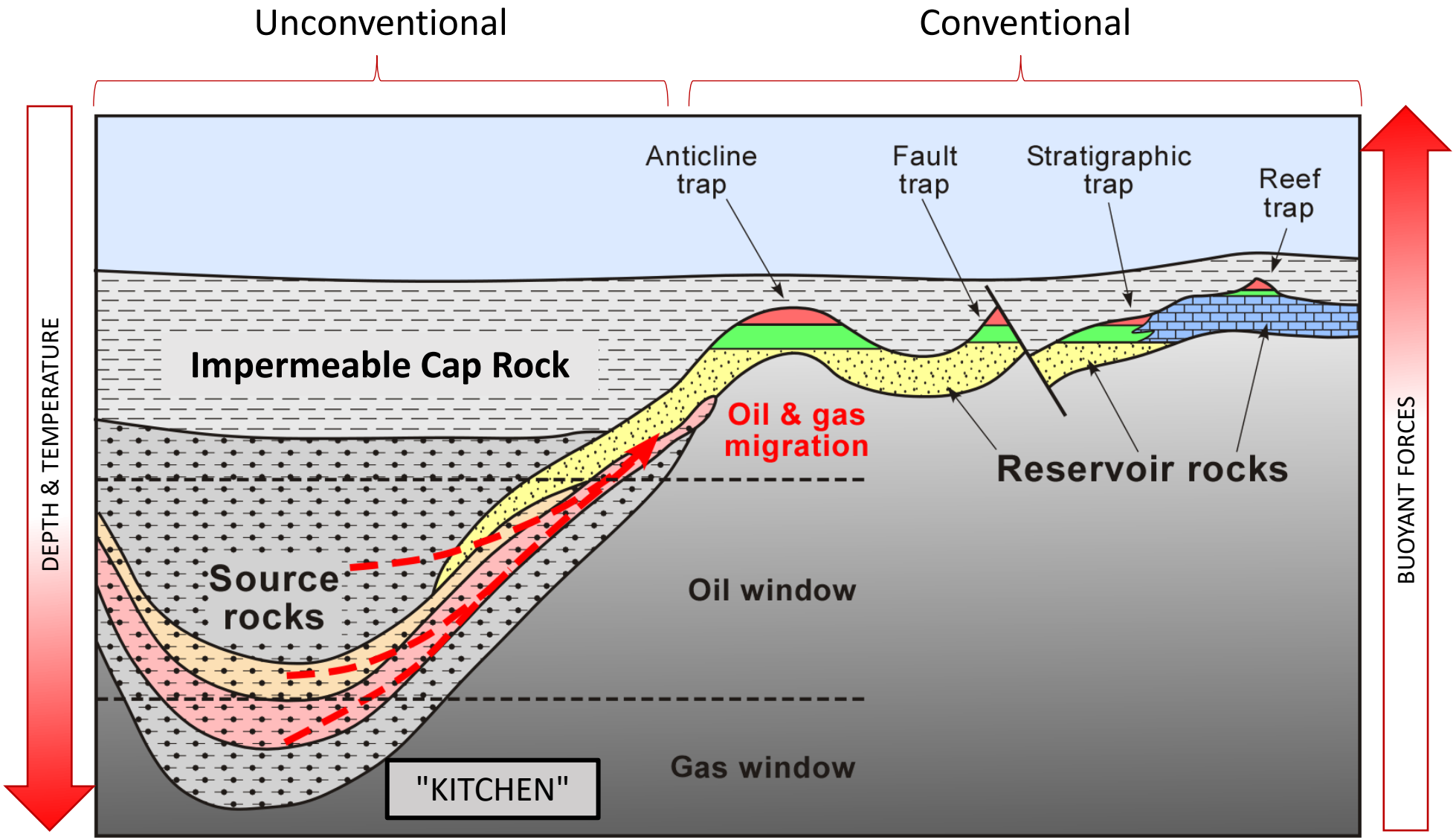
https://deeptimemaps.com/map-lists-thumbnails/greater-permian-basin/

Today's Geologic Regions…

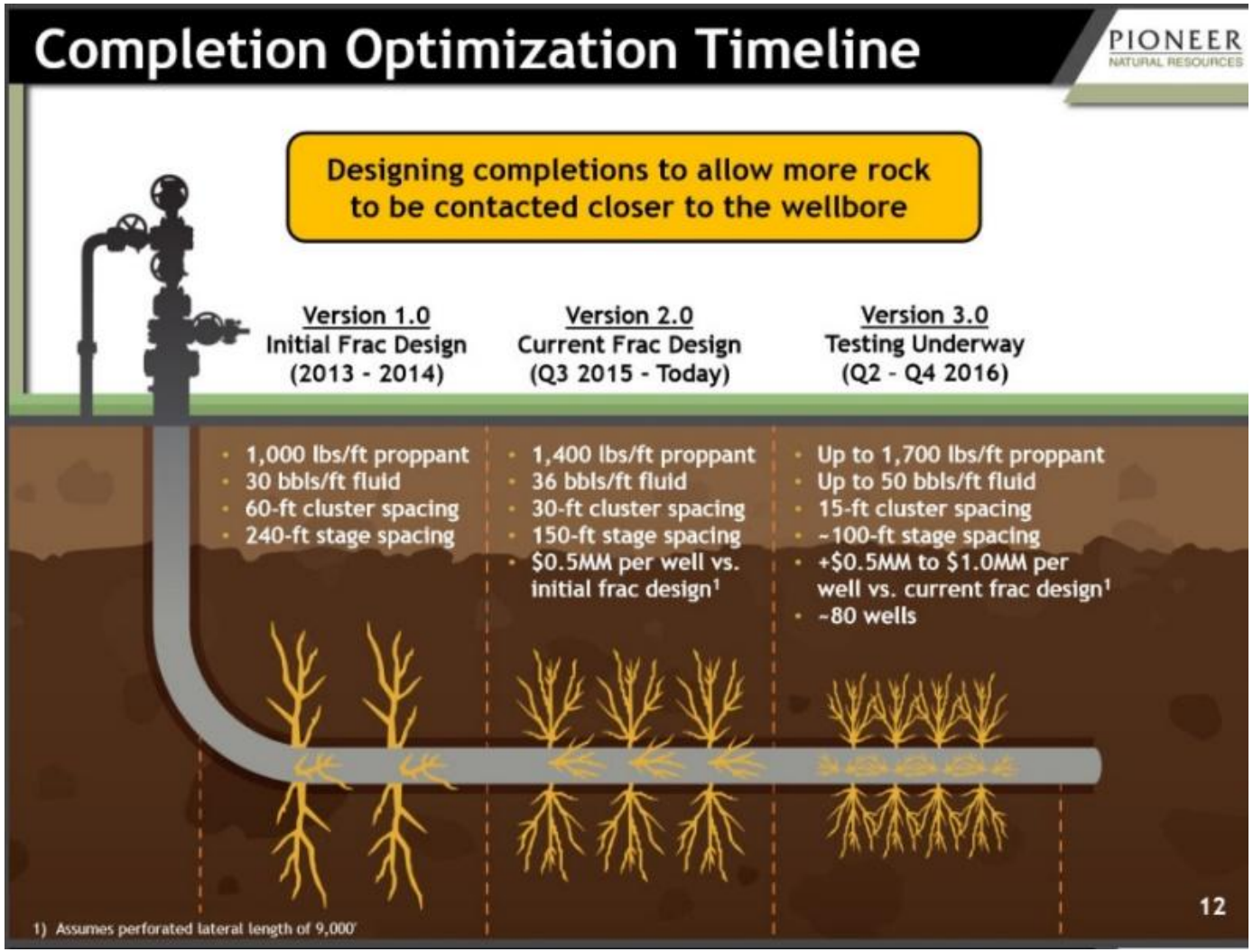


Source: Pioneer Natural Resources, Investor Presentation – September 2014

Types of Petroleum Reservoir

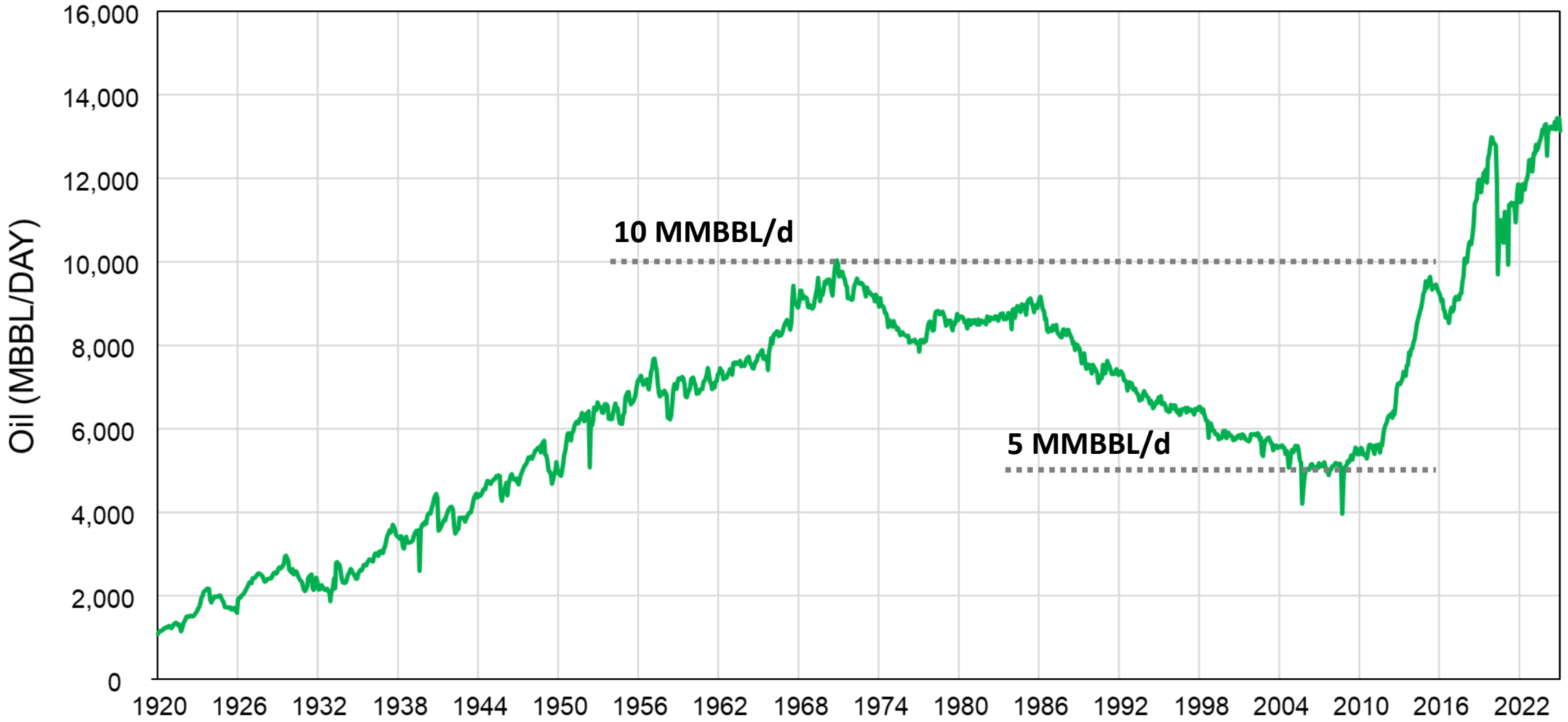


Hydraulic Fracturing – Make Your Own Permeability



Source: Pioneer Natural Resources, Investor Presentation, March 2017

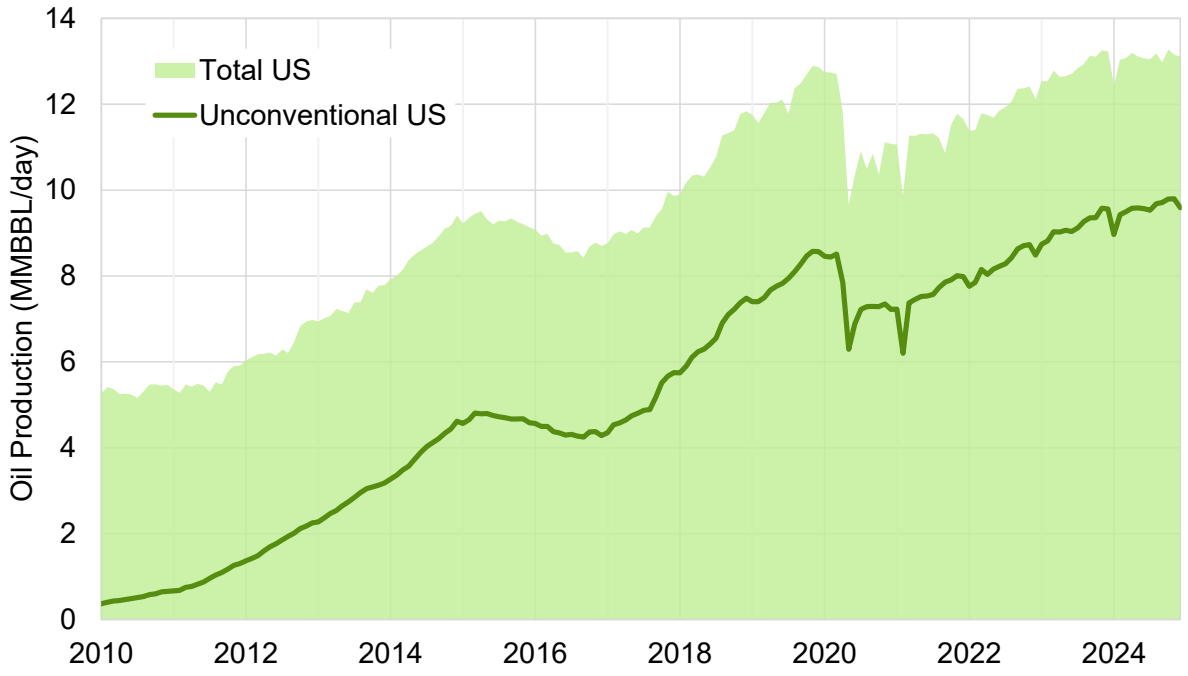
U.S. Crude Oil Production History



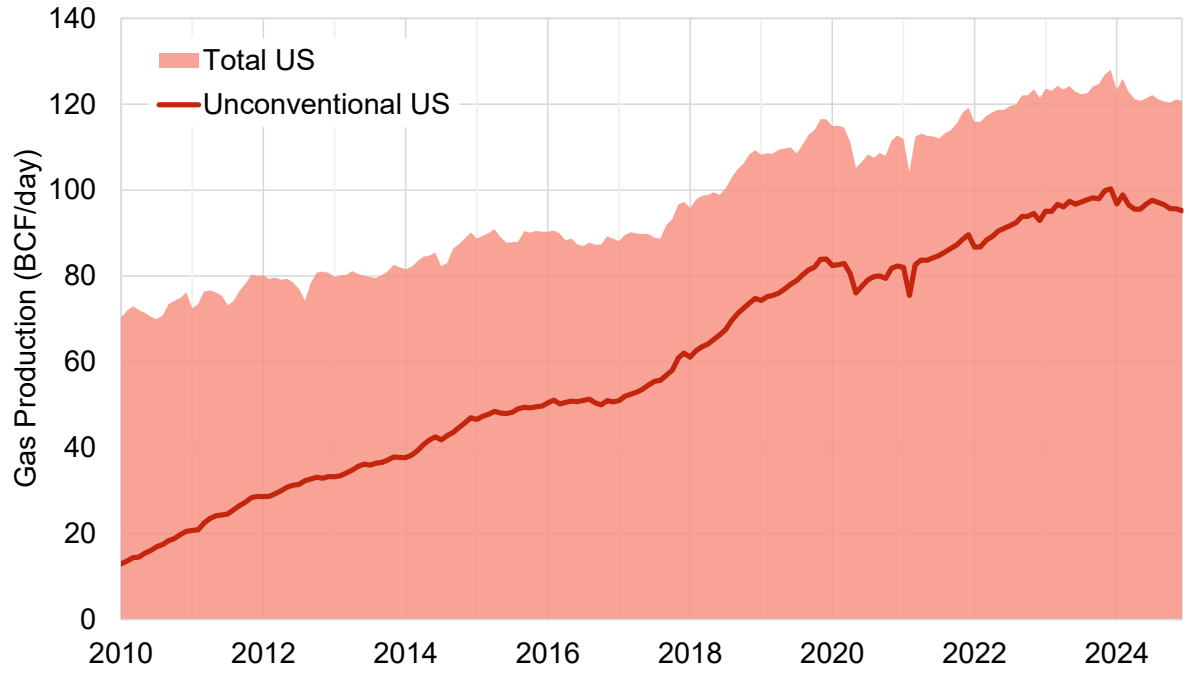
Data Source: U.S. Energy Information Administration

Unconventional Proportion of Production in the US

Oil Production

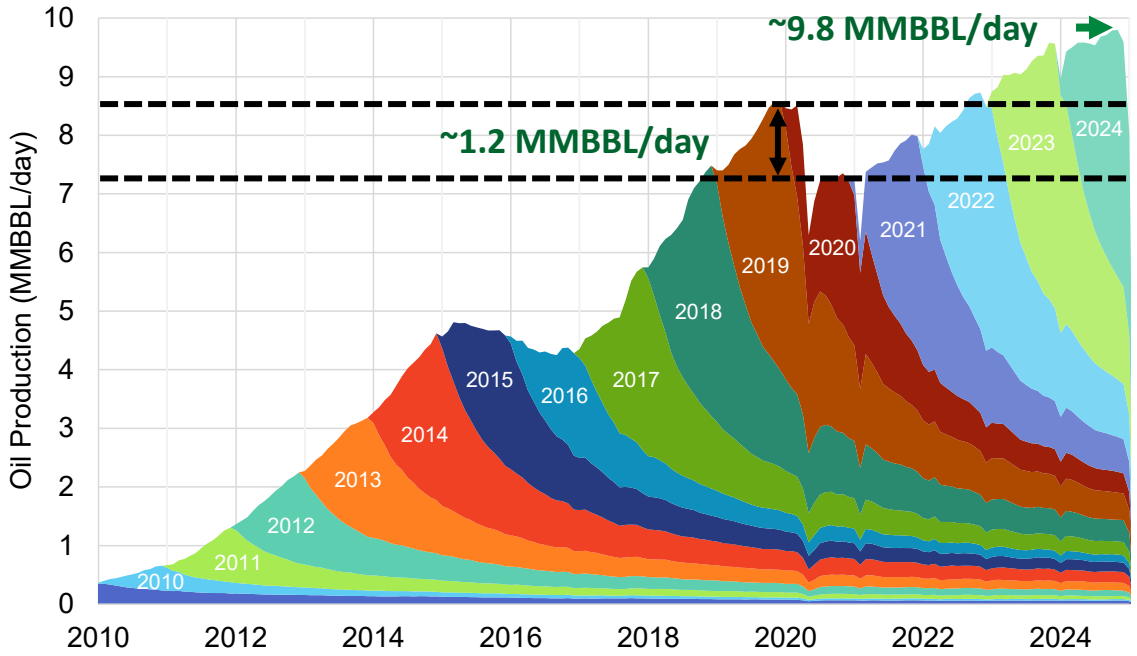


Gas Production

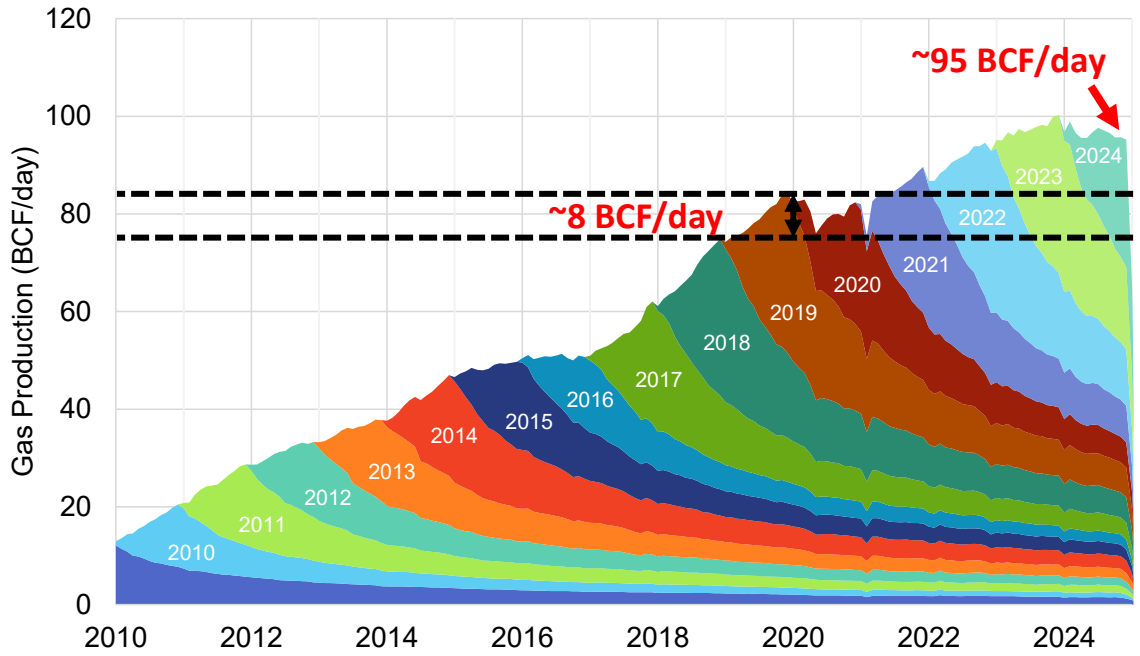


US Unconventional Production, by Vintage

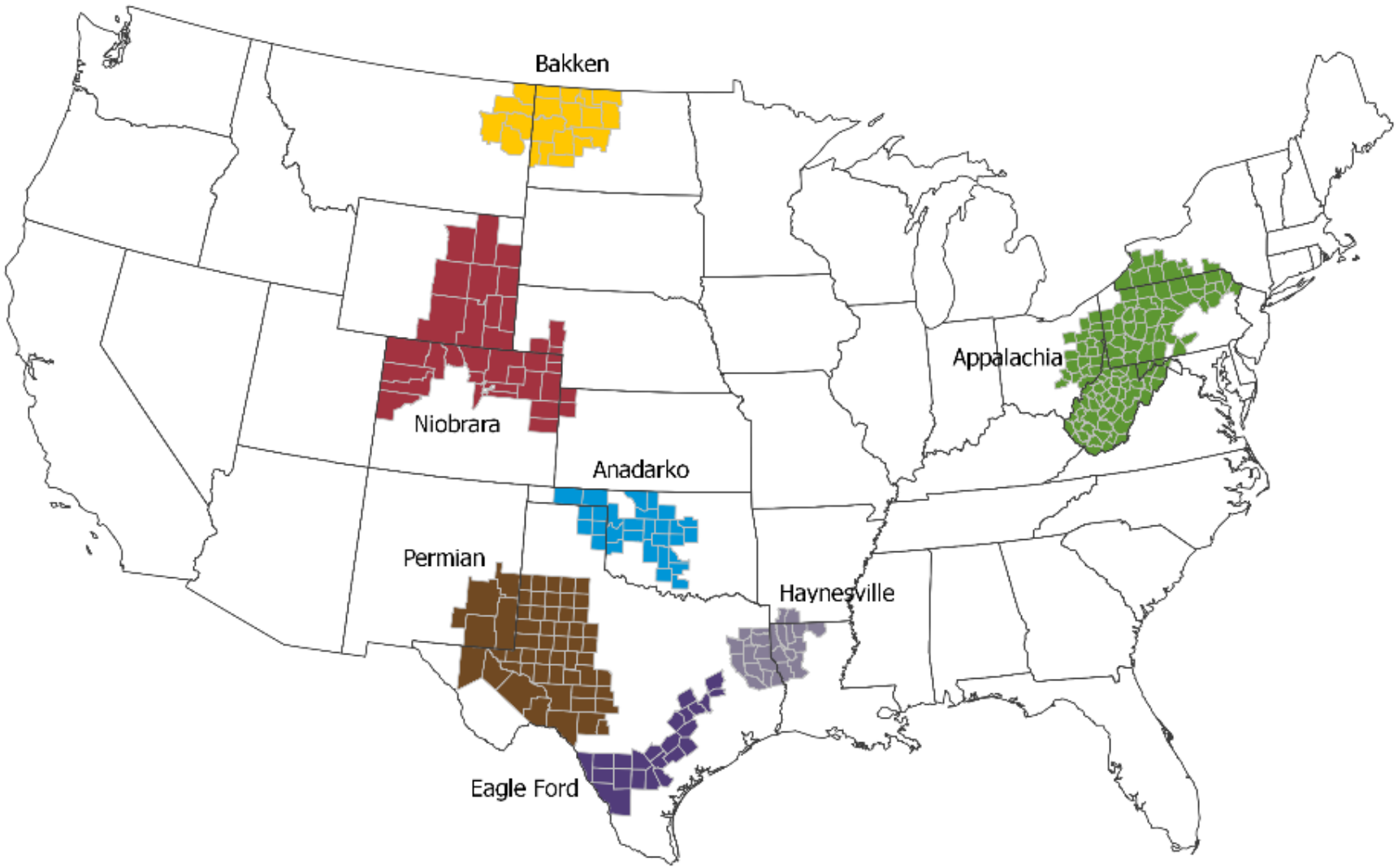
Oil Production



Gas Production



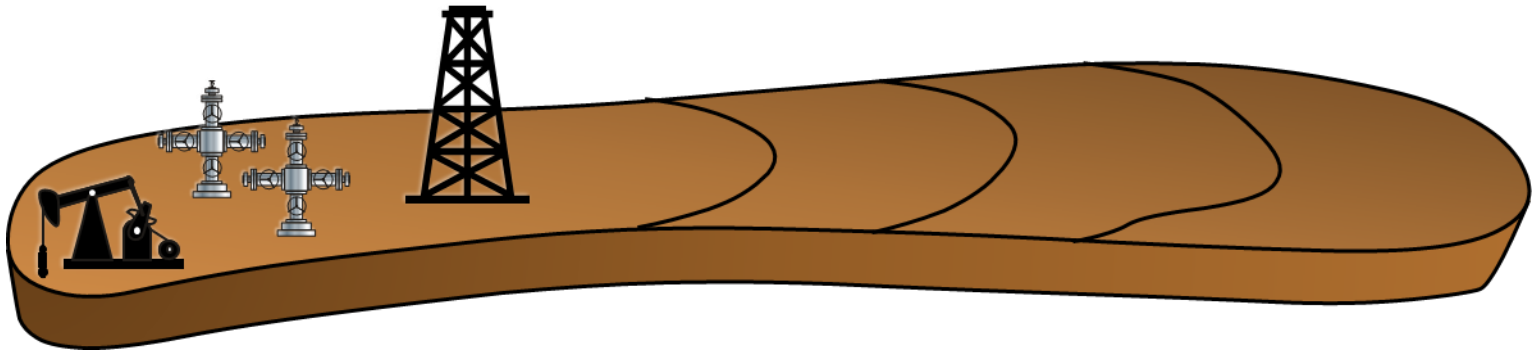
Key Unconventional Resource Areas



Source: U.S. Energy Information Administration

RESERVES EVALUATION PROCESS

Reserves Categorization Concepts

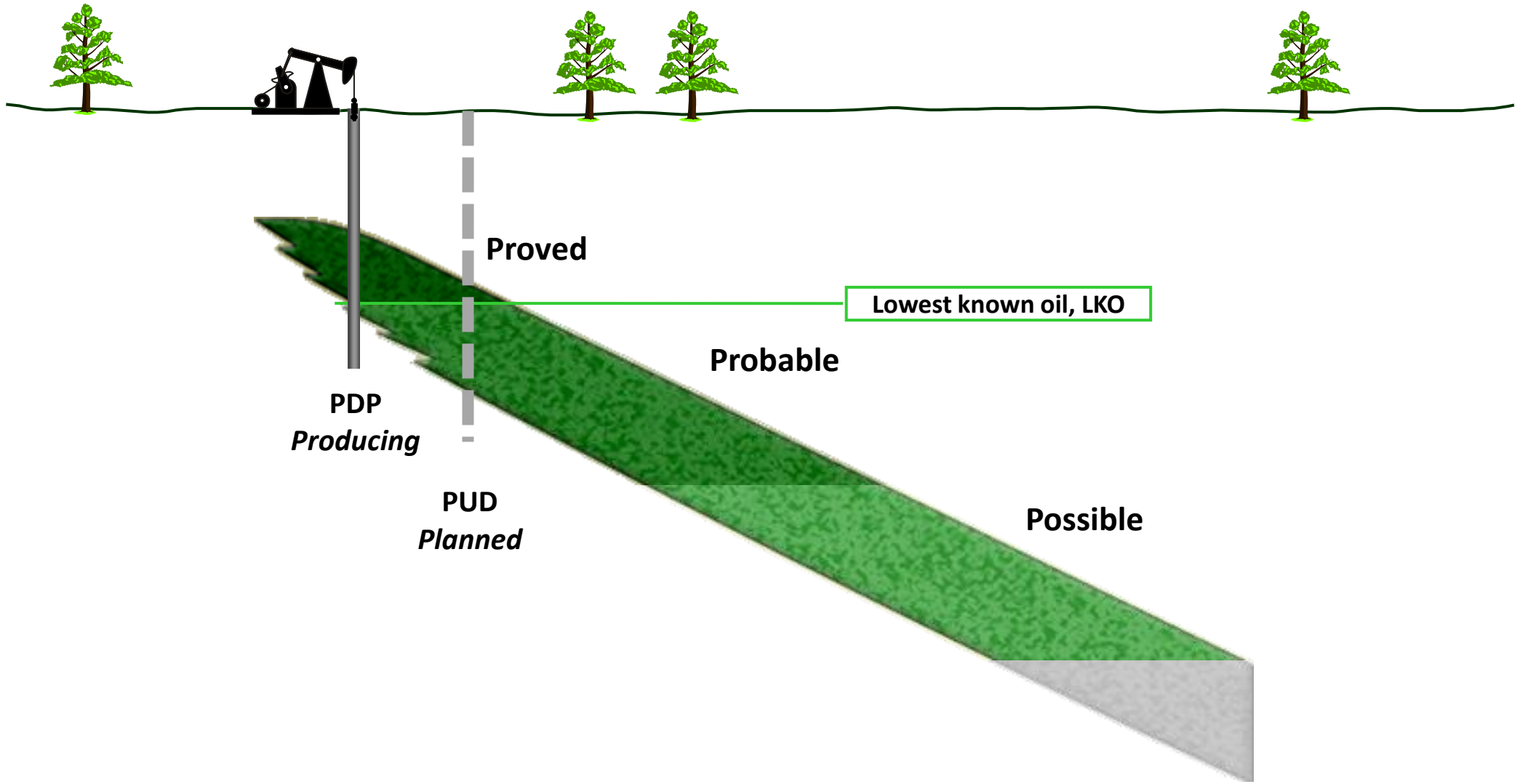


Proved Developed Producing	Proved Undeveloped	Probable Undeveloped	Possible Undeveloped	Contingent / Prospective Resources
“PDP”	**“PUD”**			

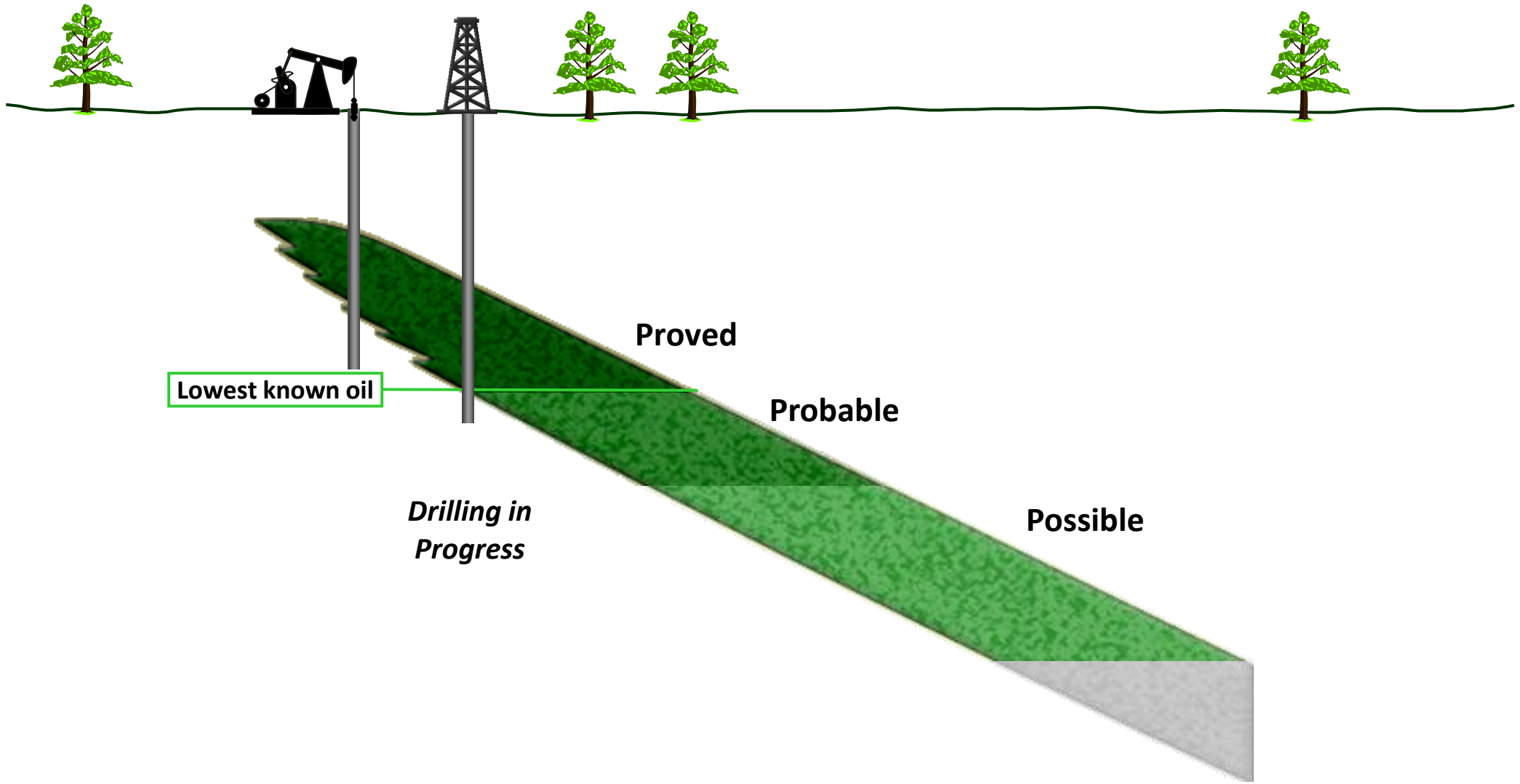
Reserves ***Resources***

Increasing Uncertainty

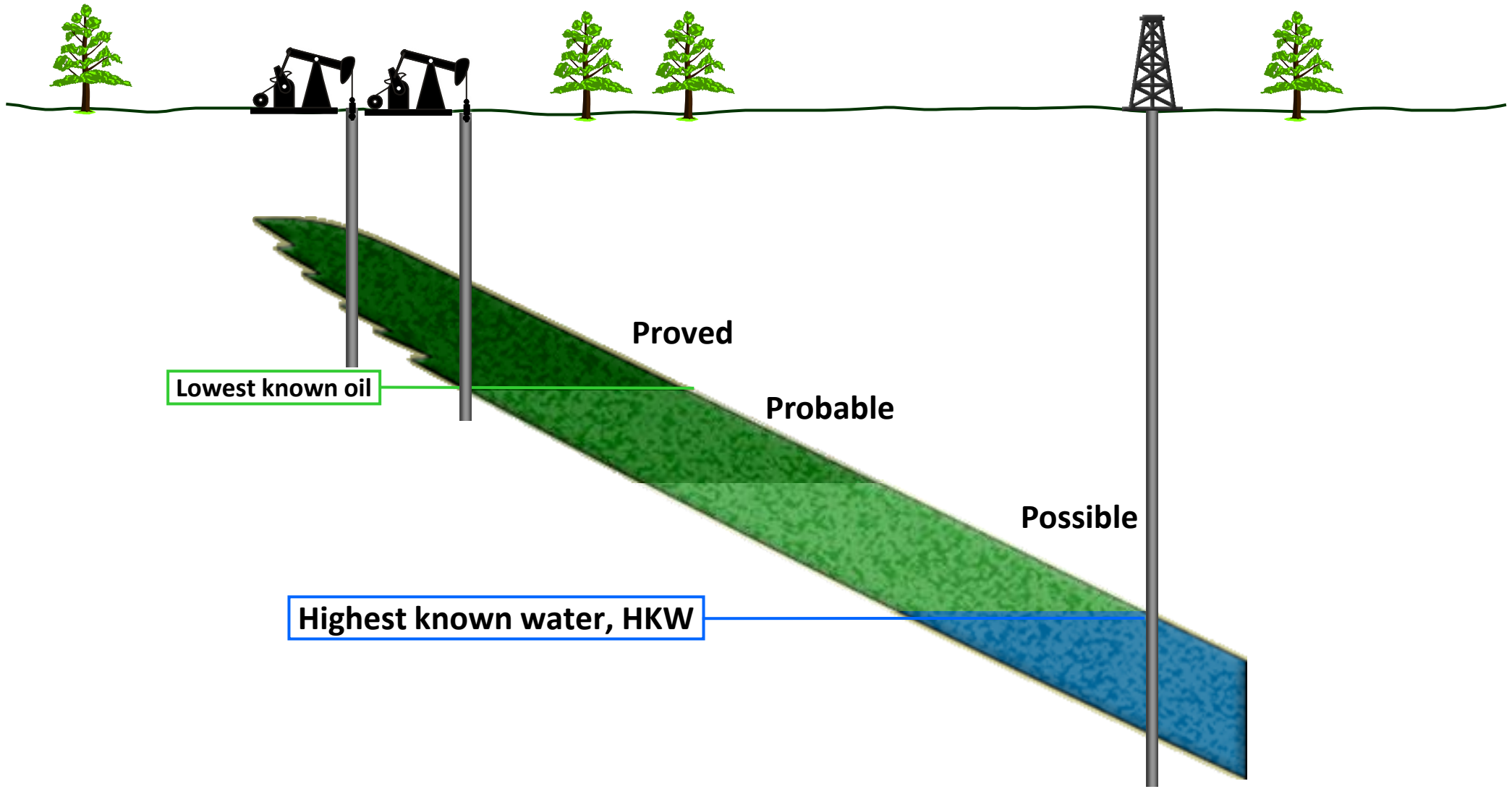
Reserves Categorization Example



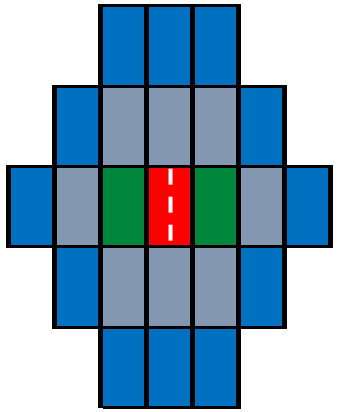
Reserves Categorization Example

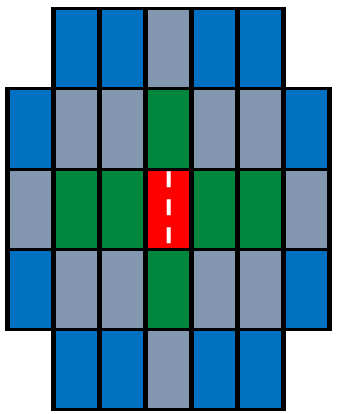


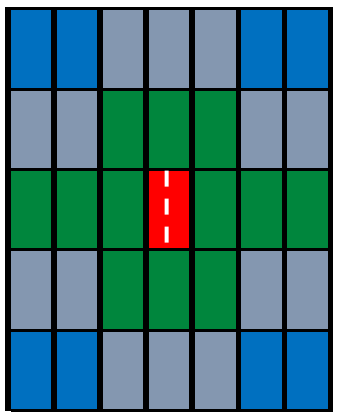
Reserves Categorization Example



Unconventional Plays – Data Maturity







		Tier 3	Tier 2	Tier 1
1.	Property maturity	Early	Moderate	Mature
2.	Data rich/poor	Poor	Good well control	Rich
3.	Consistency	?	Good	Very good
4.	Geologic understanding	Low	Still learning	High
5.	Analogy to other areas	Low	Good	Good
6.	Economic robustness	Marginal	Strong (most wells)	Very strong
7.	Leverage effect (PUD/PDP)	2.0	?	?

Reserves Determination Methods

Probabilistic - generates a range of estimates and their associated probabilities

- Quantitative/statistical risking
- Based on probability ranges of most significant variables
- In general, the utility and value of probabilistic methods decrease as uncertainty decreases
- **Proved: 90% chance of reserves increasing over time**

Deterministic - generates a discrete estimate of reserves for each reserves category

- Qualitative risking
- Based on relative certainty
- **Proved: likelihood of achieving reserves is “reasonably certain”**

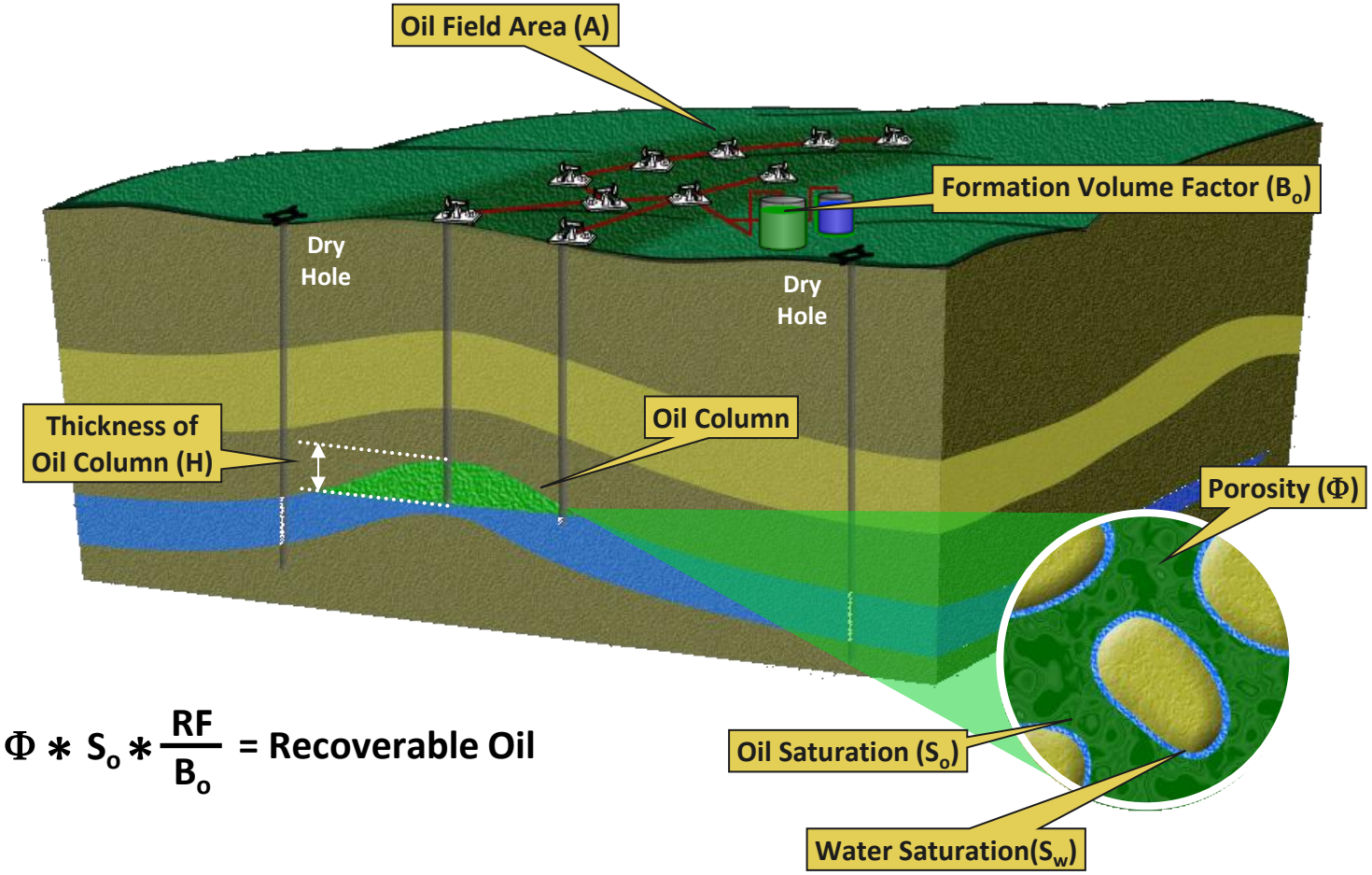
Reserves Determination Methods

	Deterministic	Probabilistic
Volumetrics	✓	✓
Performance Analysis		
Decline Curves	✓	
Material Balance	✓	
Reservoir Simulation	✓	
Analogy	✓	
Integrated Methods	✓	✓

Volumetrics

$$\text{Recoverable Hydrocarbons} = \left(\text{Hydrocarbons-in-Place}\right) \times \left(\text{Recovery Factor}\right)$$

Volumetric Equation



$$A * H * NTG * \Phi * S_o * \frac{RF}{B_o} = \text{Recoverable Oil}$$

NTG is the ratio of net pay to gross pay in the oil column.
RF is recovery factor, or the percentage of in-place volume that is recoverable.

Decline Curve Analysis

Ideal Applications

- Mature Properties
- Capacity Production (no artificial constraints)

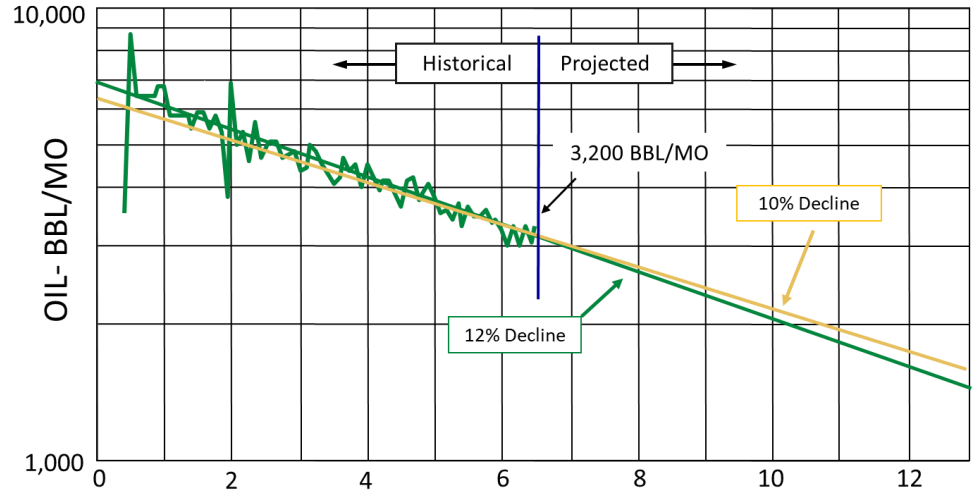
Most Common Decline Types

- Exponential
- Hyperbolic

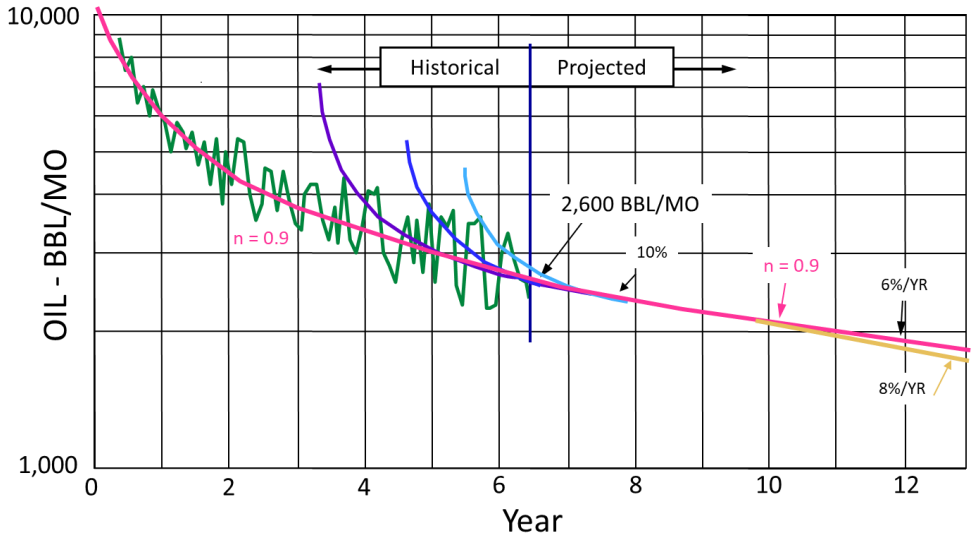
Potential Pitfalls

- Field level projection with significant activity levels
- Changing operational conditions
  - Lift capacity (GL, ESP, etc.)
  - Flowing tubing pressure

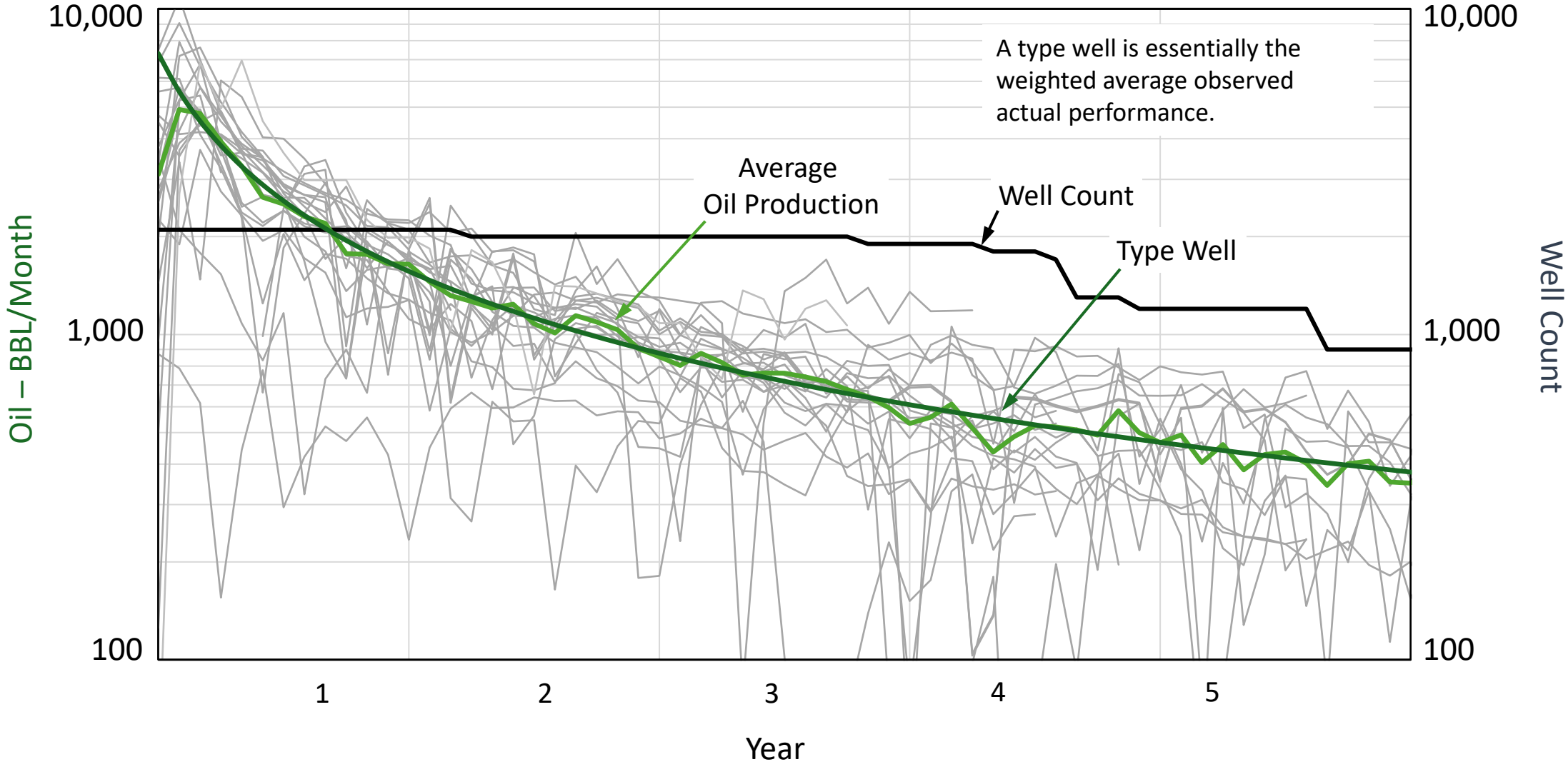
Exponential



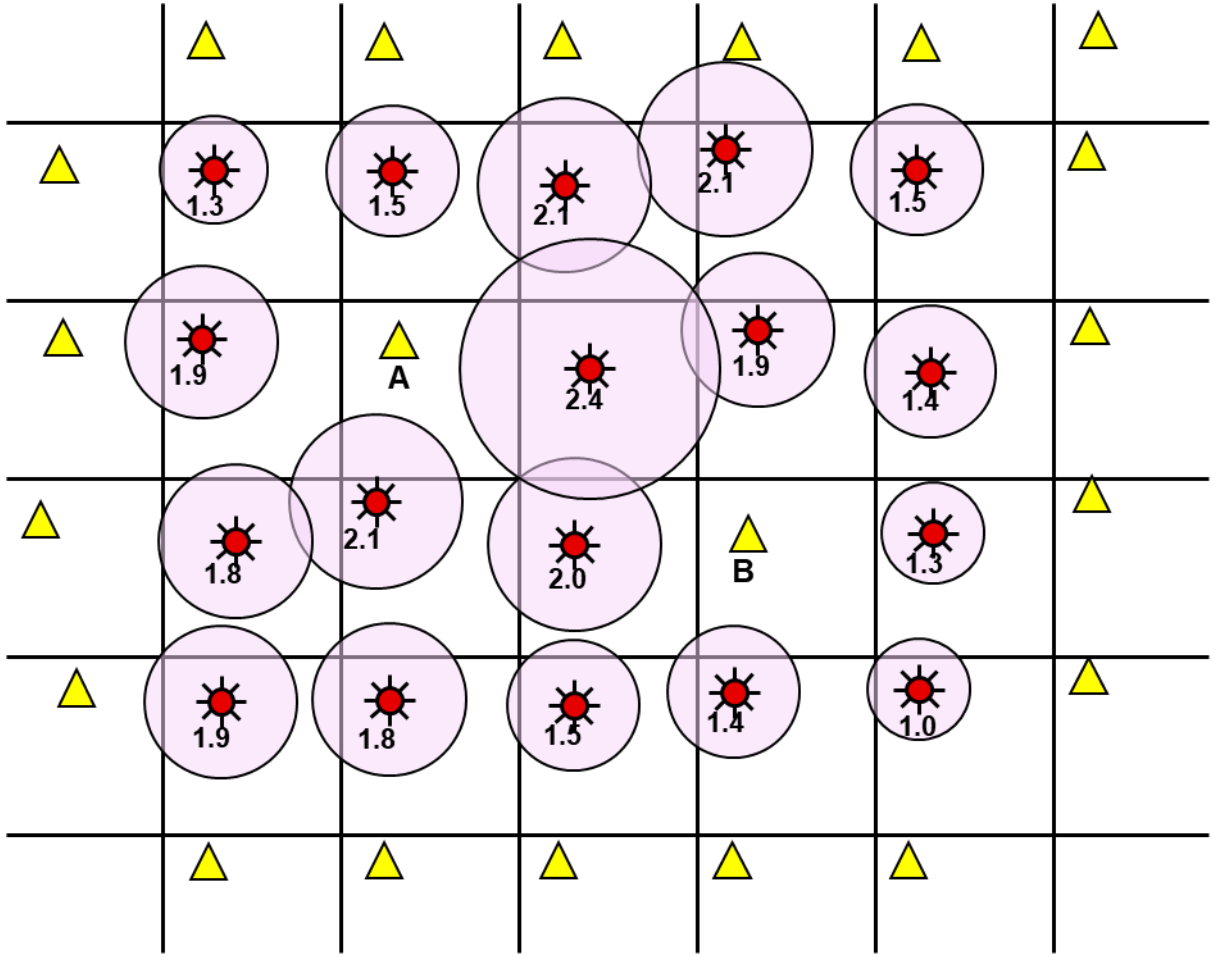
Hyperbolic



Analogy – Type Well Analysis ("Type Curves")



Analogy – Offset Analysis (Statistical)



Ideal Applications:

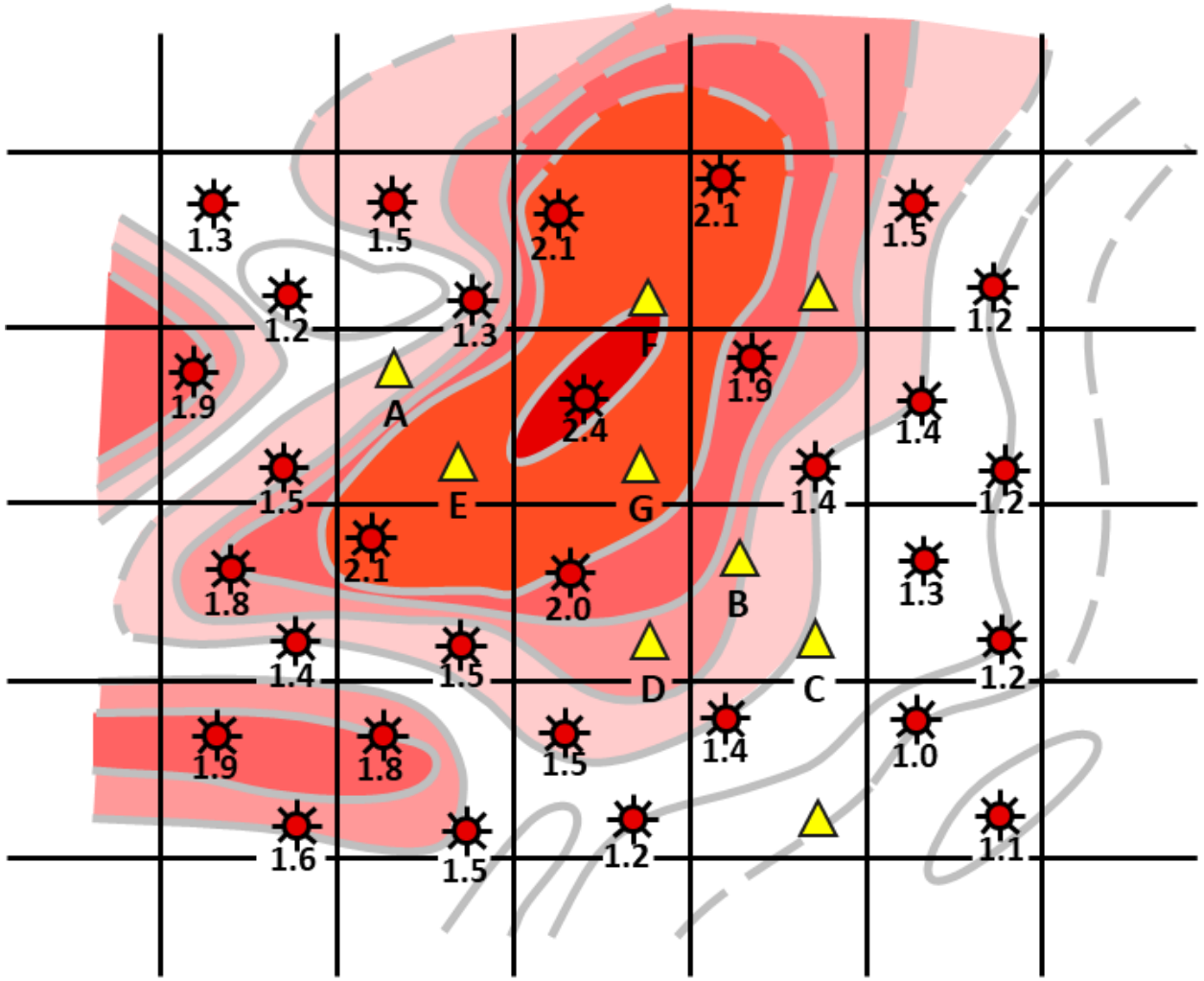
- Large fields with significant well count and production history
- Consistent geology, spacing, and well construction among PDP and PUD

Producing PDP

Size by Performance

Proposed PUD

Analogy – Offset Analysis (Statistics + Geology)



- Integrated analysis required if geologic characteristics change in field area
- Interference between new and old wells should be considered
- More sophisticated analysis, normalization, and extrapolation often required

Producing PDP

Reservoir Quality

Proposed PUD

ECONOMIC MODELING

Economics

By definition, reserves must be economic.

Therefore:

- The economic model determines the volume of reserves.
- More importantly, the economic model determines the "value" of reserves.

The Economic Model

Incorporates estimates of:

- Oil and gas production forecasts
- Product price estimates
- Operating expense estimates
- Capital cost estimates

Along with:

- Understanding of ownership
- Certain taxes
- Chosen price/cost escalation parameters

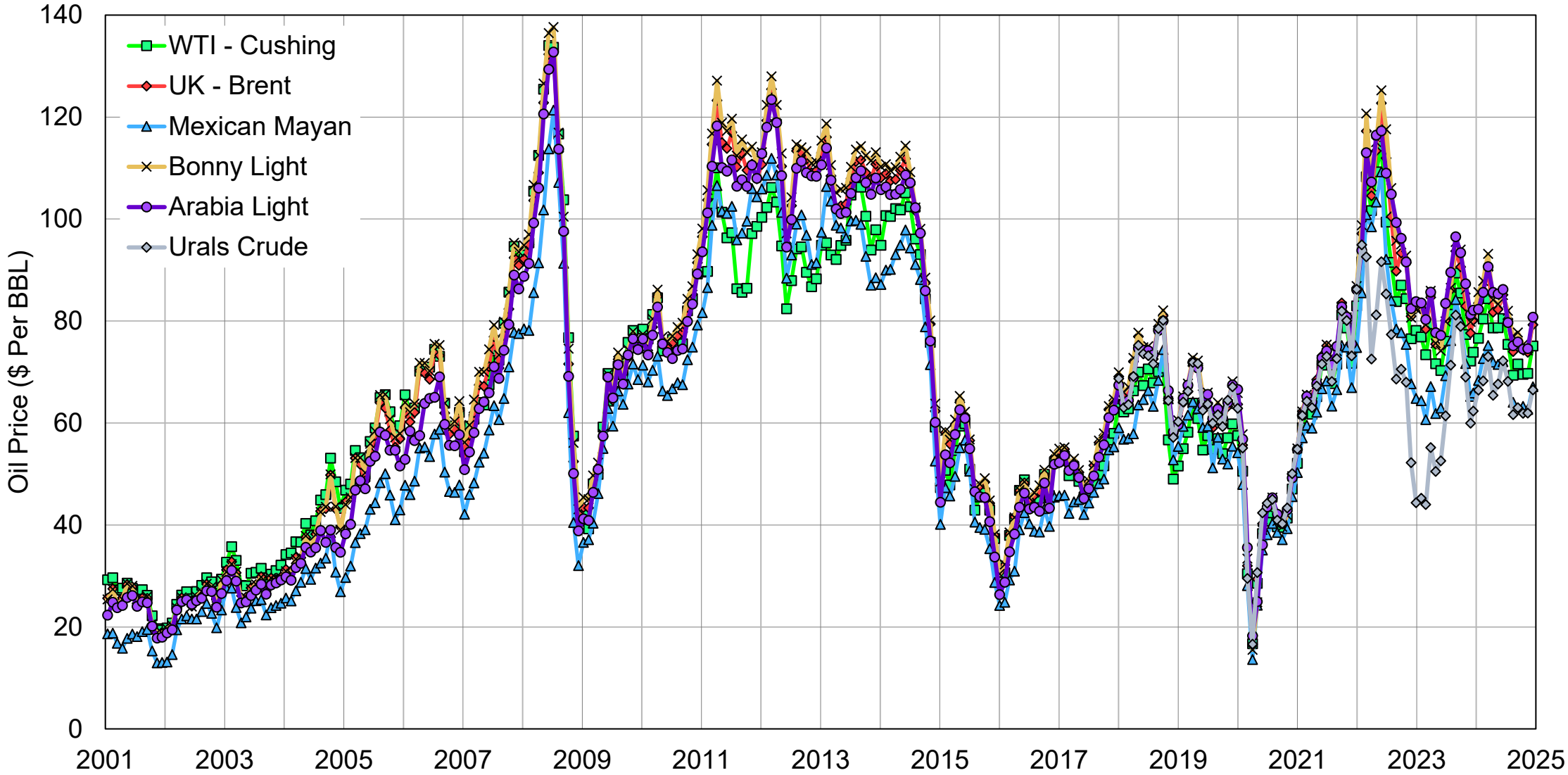
Important Pricing Terms

- **Benchmark Price**: Reference price of oil or gas, chosen because it is both familiar in the industry and relevant to the properties being evaluated.

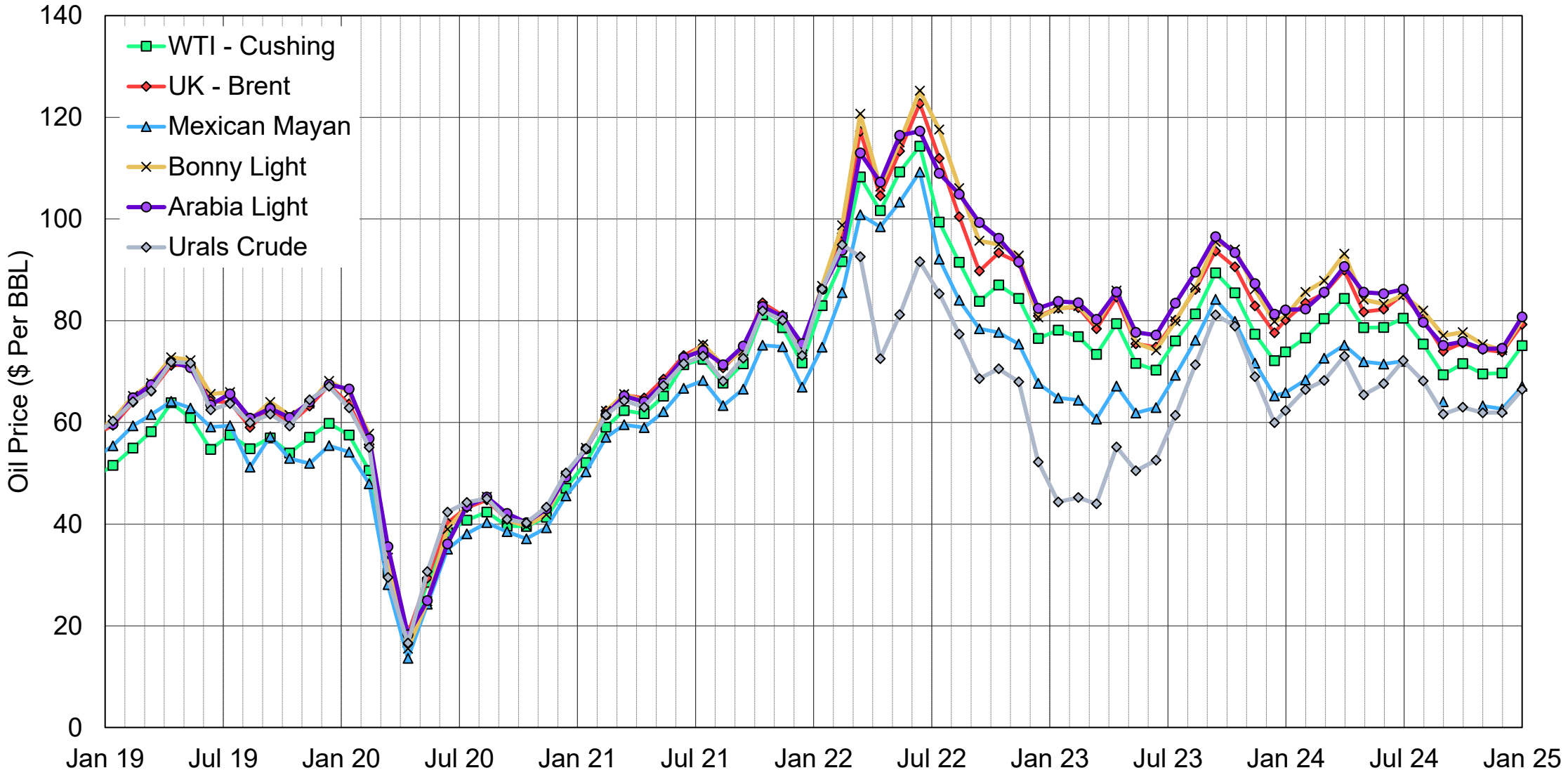
- **Field Price or Realized Price**: The price that is actually received for oil or gas sold from a given lease or field.

- **Price Differential**: The difference in price between an established benchmark and what is actually received at the lease or field. It can be positive or negative.

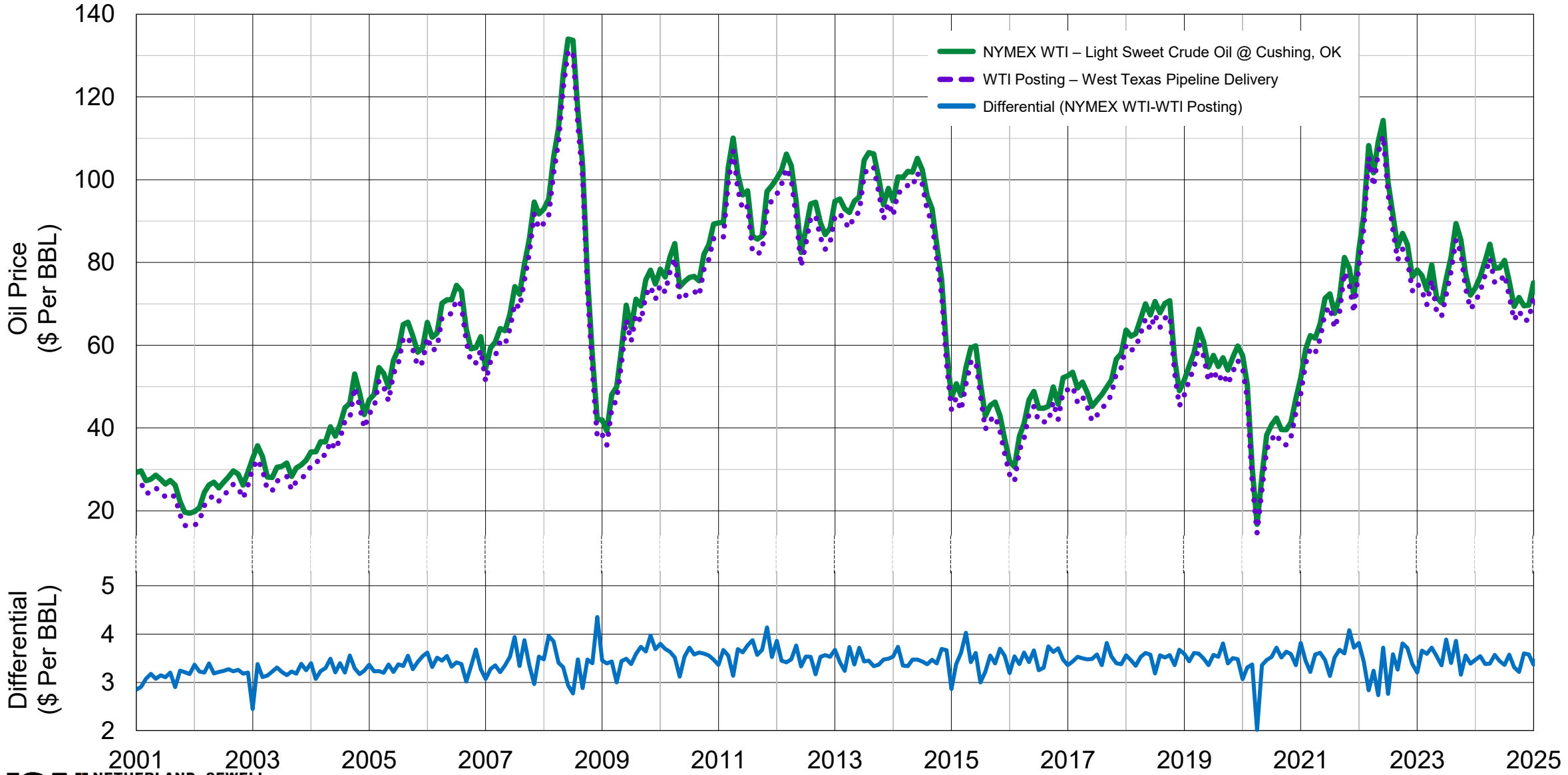
Worldwide Benchmark Crude Oil Prices



Worldwide Benchmark Crude Oil Prices



Historical Benchmark Oil Prices



Applying Ownership

Working Interest: The share of total development and operating expenses that an individual or company must pay in return for their revenue interest share of total oil and gas production on a given lease.

Revenue Interest: The share of total oil and gas production to which an individual or company is entitled on a given lease.

Royalty Interest: A revenue interest only, with no working interest.

Ownership can be complicated by unitization, payout balances, profit sharing/net profits interests, sliding scale royalties, etc….

Applying Taxes

Taxes generally accounted for in a reserves report:

- Severance taxes
- Ad valorem taxes
- Special/supplemental petroleum taxes
- Value added taxes (VAT)

Taxes generally beyond the scope of a reserves report:

- State/provincial income taxes
- Federal/national income taxes

The Economic Calculation - Volumes

Gross (100 Percent)
Oil and Gas Volumes
Produced

Less

Volumes Owned by Royalty Owners	+	Volumes Owned by Other Working Interest Owners	+	Volumes Consumed in Lease Operations

Equals

Net Produced
Oil and Gas Volumes
Available for Sale

Then oil and gas prices are applied…

The Economic Calculation - Net Revenues

Oil and Gas Revenues to Net Interest

Less

Direct Operating Expenses + Overhead or COPAS Charges + Production and Ad Valorem Taxes + Capital Expenditures (as spent)

Equals

Net Revenue Before Federal Income Taxes

Evaluation from Client Perspective

Data to be provided to engineer:

- Listing of properties by well (i.e. API) and decimal interest
- History of lease operating or revenue statements, ideally 12 months prior
- Development plans including drilling locations and capital requirements
- Acreage maps, if available

Typical work products provided to client:

- Reserves Report including letter, cash flow forecast, and summary results by well
- Reserves database (e.g. ARIES, PHDWin)
- Wide range of potential sensitivities and outputs possible from completed model

Disclaimer

This presentation is for general information and illustrative purposes only—its contents should be considered in context of the entire presentation and the date on which it is presented. All estimates, exhibits, and opinions presented herein are subject to change. As in all aspects of oil and gas evaluation, there are uncertainties inherent in the interpretation of engineering and geoscience data; therefore, our opinions necessarily represent only informed professional judgment. We make no representations or warranties of any kind, express or implied, about the completeness, accuracy, reliability, or suitability of the information contained herein; we will not be responsible for any consequence associated with the reliance on such information. Unless indicated otherwise, the information contained herein does not constitute professional advice or opinions, and it should be considered to be a work in progress. Netherland, Sewell & Associates, Inc. (NSAI) is a Texas Registered Engineering Firm, No. F-2699.

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