From: DamascusCitizens
Sent: Friday, November 15, 2013 7:37 PM
To: ord.docket@epa.gov; Hanlon, Edward
Subject: Attention Docket ID No. EPA-HQ-ORD-2010-0674

Comment from:
On behalf of Damascus Citizens for Sustainability and NYH2O we are submitting the following information for consideration by the EPA Science Advisory Board and the researchers conducting the nationwide study of high volume hydraulic fracturing impacts.
B. Arrindell
Director
Damascus Citizens for Sustainability

This comment contains a citation and material on the decline rate of hydraulic fractured gas wells - so much damage for instant quick return, then in two years only a fraction of the gas rate continues - in the Barnett down to 15% of initial production in two years. Attached is Chesapeake's Spring 2010 filing to the Security Exchange Commission - see page 10 for the decline rate - the dark colored exponentially declining curve. items in the same area are also attached - one paper from Schlumberger looking at 4 gas fields - just about the same curve. also material from Pennsylvania on the decline rates of gas wells there. AND here http://www.damascuscitizensforsustainability.org/2011/06/insiders-sound-an-alarm-amid-a-natural-gas-rush/ are the NY times articles about the gas industry over stating the gas drilling economic situation calling it a "ponzi scheme". A graph of the overestimation of reserves is available through the New York Times (See: Overestimating Natural Gas Production; New York Times; June 26, 2011).

Citation:

Baihly, J., Altman, R., Malpani, R., and Luo, F. Study Assesses Shale Decline Rates. 2011. The American Oil and Gas Reporter. May 2011.

Marcellus Shale

Bill Wince, Vice President – Transportation & Business Development
Chesapeake Energy Marketing, Inc.

Chesapeake ENERGY

CHK Overview

- **The second largest producer of U.S. natural gas**
  - 4Q'09 natural gas production of 2.440 bcf/d
- **Most active driller in U.S. – CHK is responsible for 1 of 7 gas wells being drilled in the U.S.**
  - 118 operated rigs currently, down from 158 in 8/08 (~25%); ~70 non-operated rigs & ~15 info only rigs; collector of ~20% of all daily drilling information generated in the U.S. (~25% in our areas of interest); ~91% of our operated rigs are in the Big 6 shale and Granite Wash plays
  - It's a great time to drill, costs are down 20-25% from 2008 highs, plus JV carries go further in this lower cost environment
- **Consistent production growth – 20 consecutive years of sequential production growth**
  - Projecting increases of ~8-10% in 2010 and ~15-17% in 2011 to ~2.7 and ~3.1 bcfe/d, respectively (after curtailments and asset sales)
- **Best assets in the industry**
  - ~14.6 tcfe of proved reserves at 12/09, targeting 20-22 tcfe by 2012[(1)(2)]
  - ~65 tcfe of risked unproved resource potential (~177 tcfe of unrisked unproved resource potential) >10-year inventory of ~36,000 net drilling locations[(2)]
  - BP, PXP, STO and TOT JV's confirm asset quality directly; XOM/XTO and APC/MITSY confirms indirectly
- **Unparalleled inventory of U.S. onshore leasehold and 3D seismic**
  - 13.7 mm net acres of U.S. onshore leasehold and ~23.6 mm acres of 3D seismic data

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Data above incorporates:
- CHK's Outlook dated 2/17/10
- Risk disclosure regarding unproved resource estimates appears on page 29

(1) Based on 10-Year average NYMEX strip pricing pro forma for Barnett JV; 14.3 tcfe at 12/31/09 using SEC pricing before Barnett JV
(2) As of 12/31/09, and pro forma for Barnett JV

CHK Overview, Continued

- **High quality U.S. shale asset base within the "Big 6"**
  - #1 in Marcellus Shale; ~1,570,000 net acres
  - #1 in Haynesville Shale; ~535,000 net acres
  - #2 in Fayetteville Shale; ~455,000 net acres
  - #2 in Barnett Shale; ~220,000 net acres (post Barnett JV)
  - #1 in Bossier Shale; ~180,000 net acres
  - Top-10 in Eagle Ford Shale; ~150,000 net acres[1]
- **Advantageous joint venture arrangements**
  - $10.7 billion of value captured vs. cost basis of $2.7 billion
  - $33 billion of remaining implied value based on JV terms
  - $3.4 billion of remaining joint venture carry receivables
- **Built-in finding cost advantages**
  - Able to add 2.0-2.5 tcfe per year of new proved reserves (after replacing production) at <$1.50/mcfe per year for years to come
  - Reserve maintenance cap-ex only ~25% of projected 2010 and 2011 operating cash flow
- **Substantial scale and vertical integration advantages**
- **Strong hedging track record**
  - ~$4.4 billion in realized gains 2001-2009

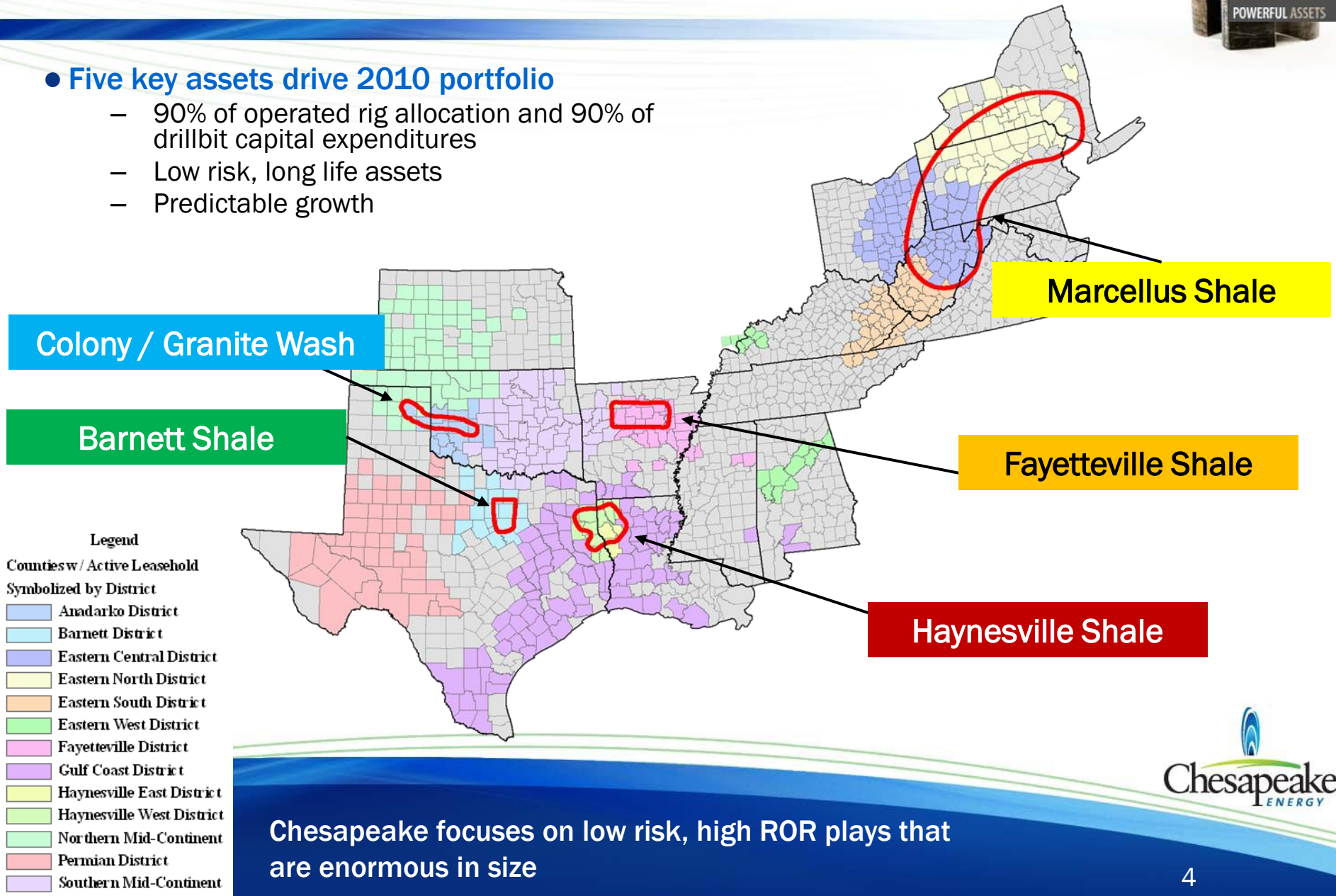
1) As of 2/17/2010

CHK has many unique competitive advantages in this tough economic environment – unmatched asset quality, high returns, low finding and operating costs, great hedges and world class JV partners

Chesapeake ENERGY

Focused on Low Risk, High ROR Plays

- **Five key assets drive 2010 portfolio**
  - 90% of operated rig allocation and 90% of drillbit capital expenditures
  - Low risk, long life assets
  - Predictable growth



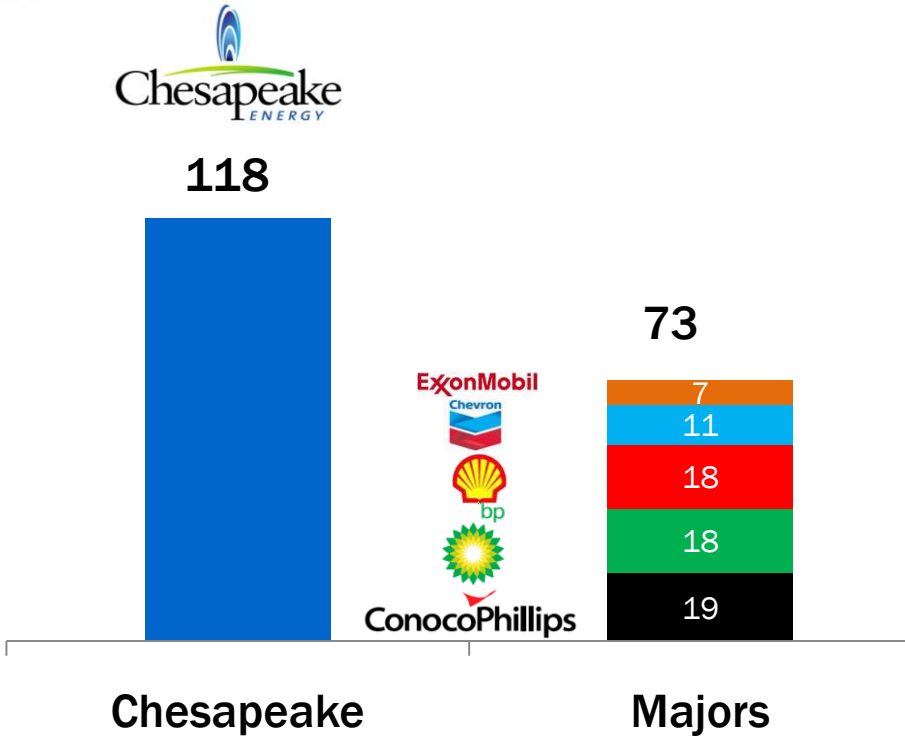
Chesapeake focuses on low risk, high ROR plays that are enormous in size

Independent Producers Leading the Effort

Top 10 Natural Gas Producers – U.S.

Rank	Company	Bcf/d	% of U.S. Production
1.	Exxon Mobil*	3.6	6.4%
2.	Chesapeake	2.4	4.2%
3.	BP	2.3	4.1%
4.	Anadarko	2.1	3.7%
5.	Devon	1.9	3.4%
6.	ConocoPhillips	1.8	3.2%
7.	EnCana	1.6	2.8%
8.	Chevron	1.4	2.5%
9.	Williams	1.2	2.1%
10.	EOG	1.1	2.0%
	Subtotal: Top 10	19.4	34.6%
	Rest of Industry	36.6	65.4%
Total		56.0	bcf/d

Chesapeake Operated Rigs vs. 5 Majors



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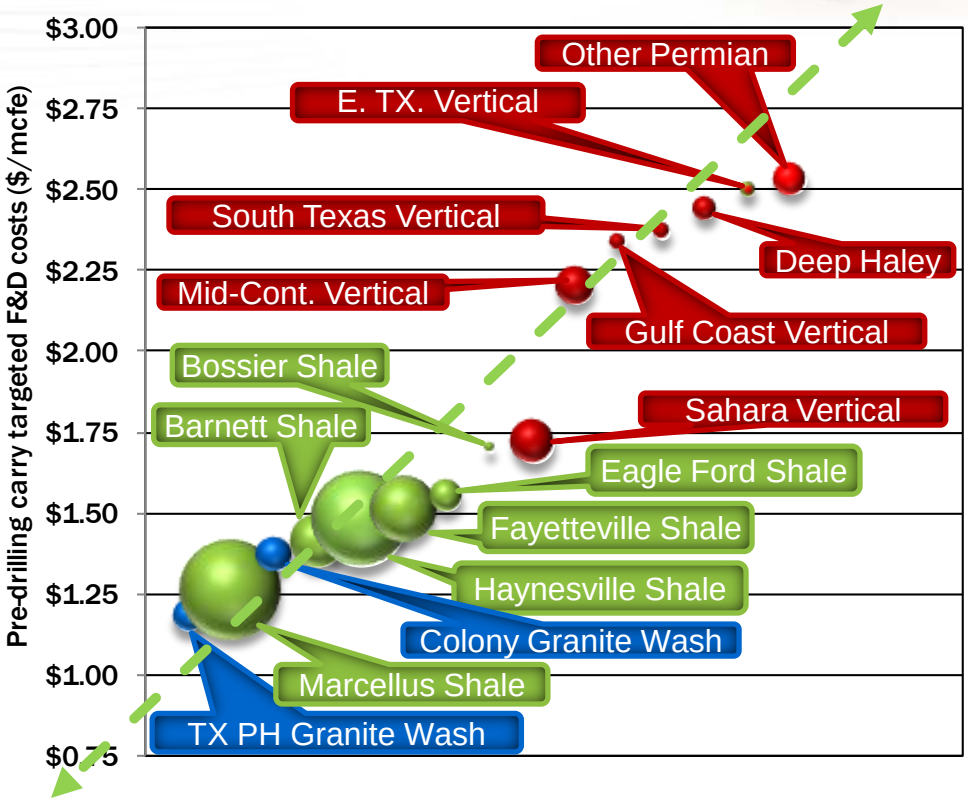
Source: Company reports as of 12/31/09 and Smith Tool 2/12/10

*Pro forma for the acquisition of XTO Energy

What is the Marginal Cost of Supply?

- **Natural gas prices not likely to stay permanently low because of the great success of the "Big 6" Shale plays**
  - Only 10-15 companies have captured meaningful positions in the plays
  - The remainder of the E&P industry is challenged to generate acceptable returns in higher cost, less-efficient plays
  - Greater bifurcation between the "shale haves" and the "shale have-nots"
    - The "shale haves" asset bases will continually improve while the "shale have-nots" asset bases will continually degrade
- **Marginal industry supply is determined by the highest cost one-third of U.S. production, not the lowest cost one-third**
- **Natural gas prices will ultimately rise to levels supporting drilling on higher cost assets and lead to strong margins in CHK's low cost shale plays**
  - A substantial majority of the ~85% of U.S. natural gas production that is non-shale needs $7-8/mcf NYMEX prices to be economically viable for enough drilling to stabilize declining non-shale production

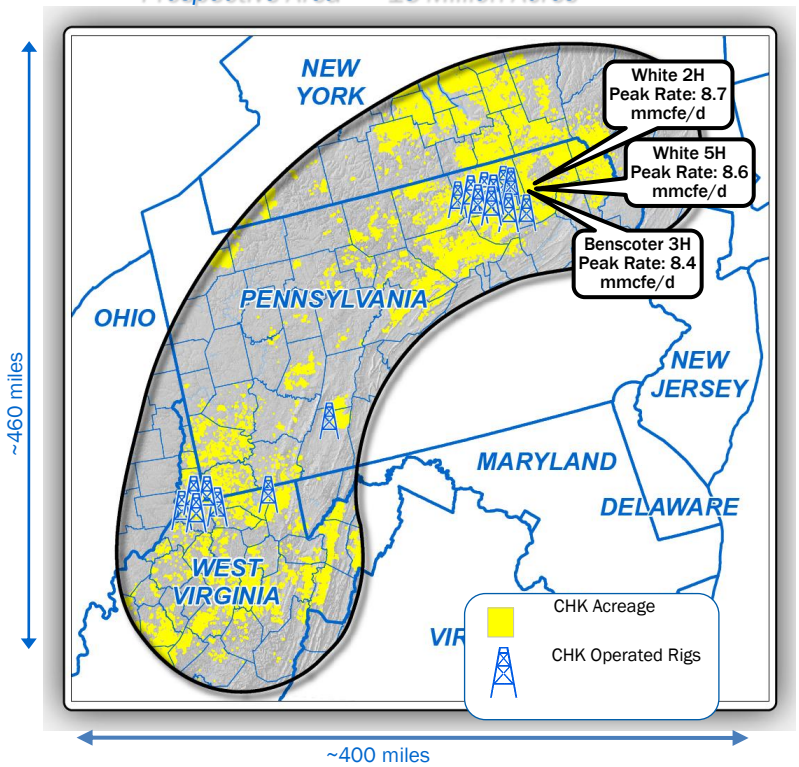


(1) Size of bubble corresponds to relative size of CHK proved and risked unproved resources in each play

The Marcellus Shale

Marcellus Shale – Overview

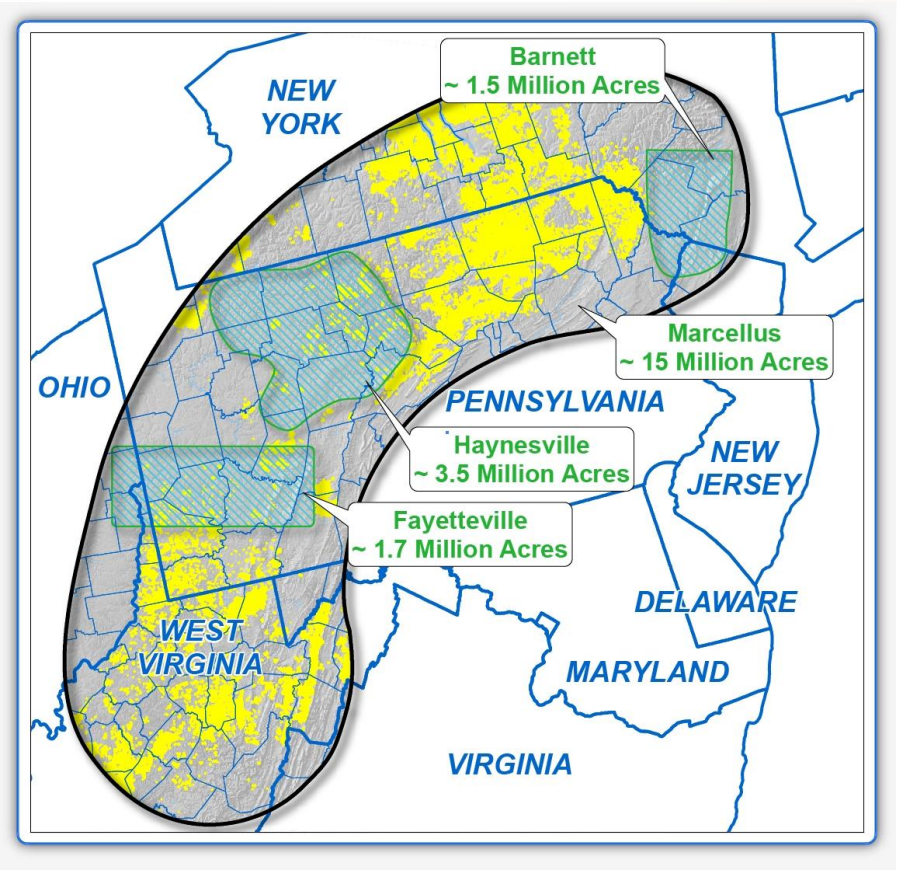
Prospective Area = ~15 Million Acres



- The Marcellus Shale play is likely to become one of the two largest gas fields in the U.S. (Haynesville the other)
- CHK is the second largest producer, the most active driller and the largest leasehold owner in the play with 1.6 mm net acres of leasehold
- 67.5/32.5 JV with Statoil (STO) in 11/08; $3.375 billion in cash and drilling carries
- Currently operating 24 rigs in the play; plan to average ~32 rigs in '10 to drill ~175 net wells
- Anticipate net production reaching ~270 mmcfe/d by year-end '10 and 450 mmcfe/d by year-end '11
- After Statoil sale, CHK's leasehold investment in the Marcellus is only ~$330/net acre on average, by far the lowest in the industry

Marcellus Shale Potential – How Does it Compare?

- Marcellus fairway is larger than other Barnett, Haynesville and Fayetteville combined
- Marcellus has favorable depths, thickness, pressures and rock characteristics across large portion of basin
- Published estimates of ~489 tcf of potentially recoverable reserves from the Marcellus[1]
  - Haynesville - 250 tcf[2]
  - Barnett - 44 tcf[2]
  - Fayetteville - 42 tcf[2]
- Still in exploration and delineation phase
  - Gathering core and log data
  - High-grading leasing efforts
  - Drilling to retain acreage
  - Refining drilling and completion methods
  - Building gathering systems
  - Cataloging shallow and deep prospects



1) Dr. Terry Engelder - Penn State University
2) Modern Shale Gas Development in the U.S. A Primer – April 2009

Marcellus Shale – Targeted Horizontal Well Profile

4.2 bcfe EUR Type Curve
IP Rate: 4.0 mmcfe/day
First month average: 3.5 mmcfe/day
Finding Cost: 1.28 ($/mcfe)
Well Cost: $4.5 mm

Daily Rate
Cumulative Prod

Production Rate (mmcfe/day): 4.00, 3.50, 3.00, 2.50, 2.00, 1.50, 1.00, 0.50, 0.00

Cumulative Production (bcfe): 2.50, 2.00, 1.50, 1.00, 0.50, 0.00

Annual Decline Rate: 70% | 33% | 22% | 17% | 13% | 11% | 9% | 8% | 7% | 6%

End of Year: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

As of 10/15/2009

	CHK	Range	Ultra	Cabot	Talisman
IP	4.0 MMcf/d	4.9 MMcf/d[2]	7.5 MMcf/d[1]	6.9 MMcf/d[1]	4.5 MMcf/d
EUR	4.2 Bcf	3-4 Bcf	3.75 Bcf	5.5 Bcf	5 Bcf

[1] 30 day IP [2] Average Horizontal IP

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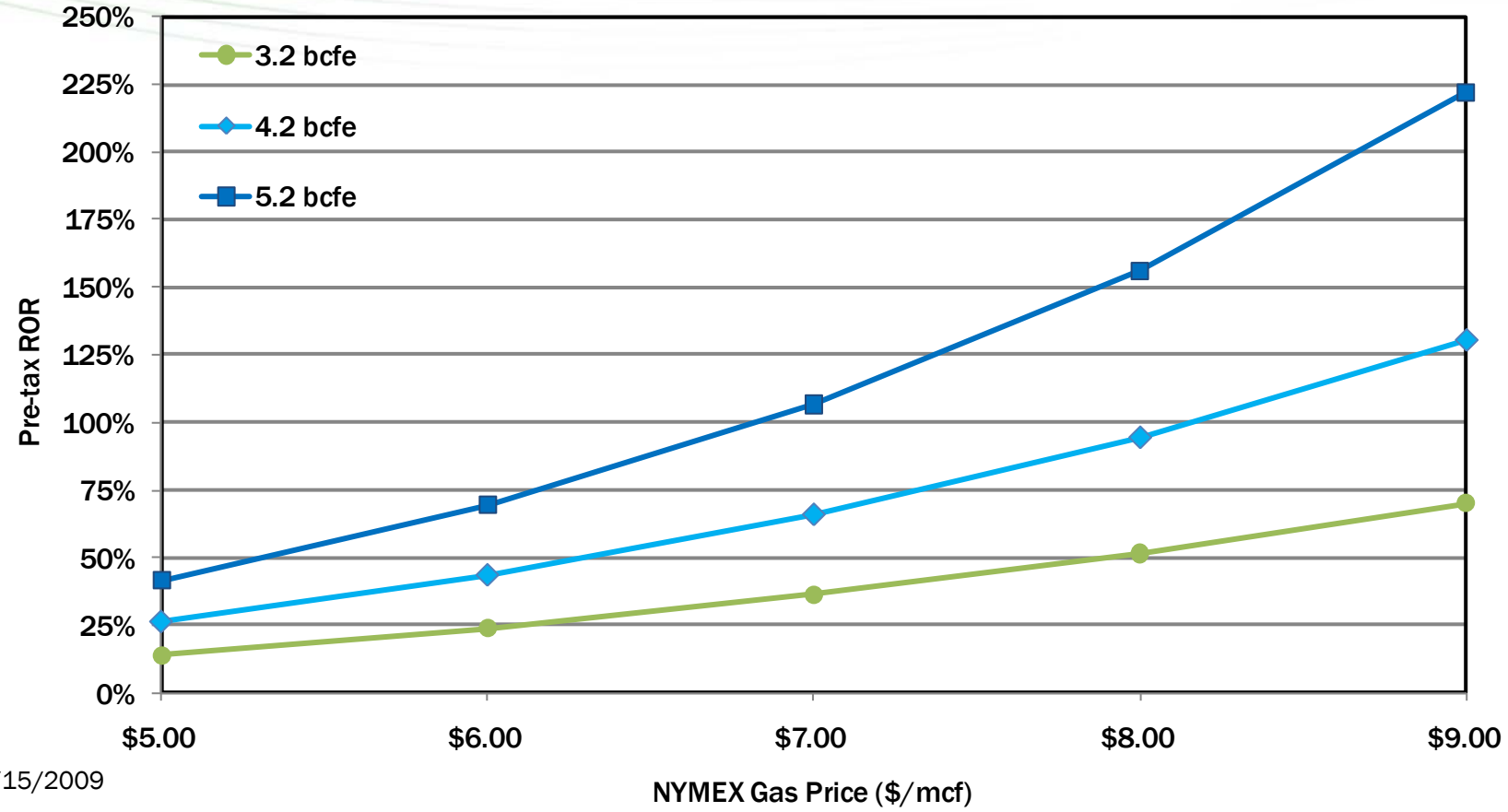
Marcellus Shale – Rate of Return Profile



As of 10/15/2009

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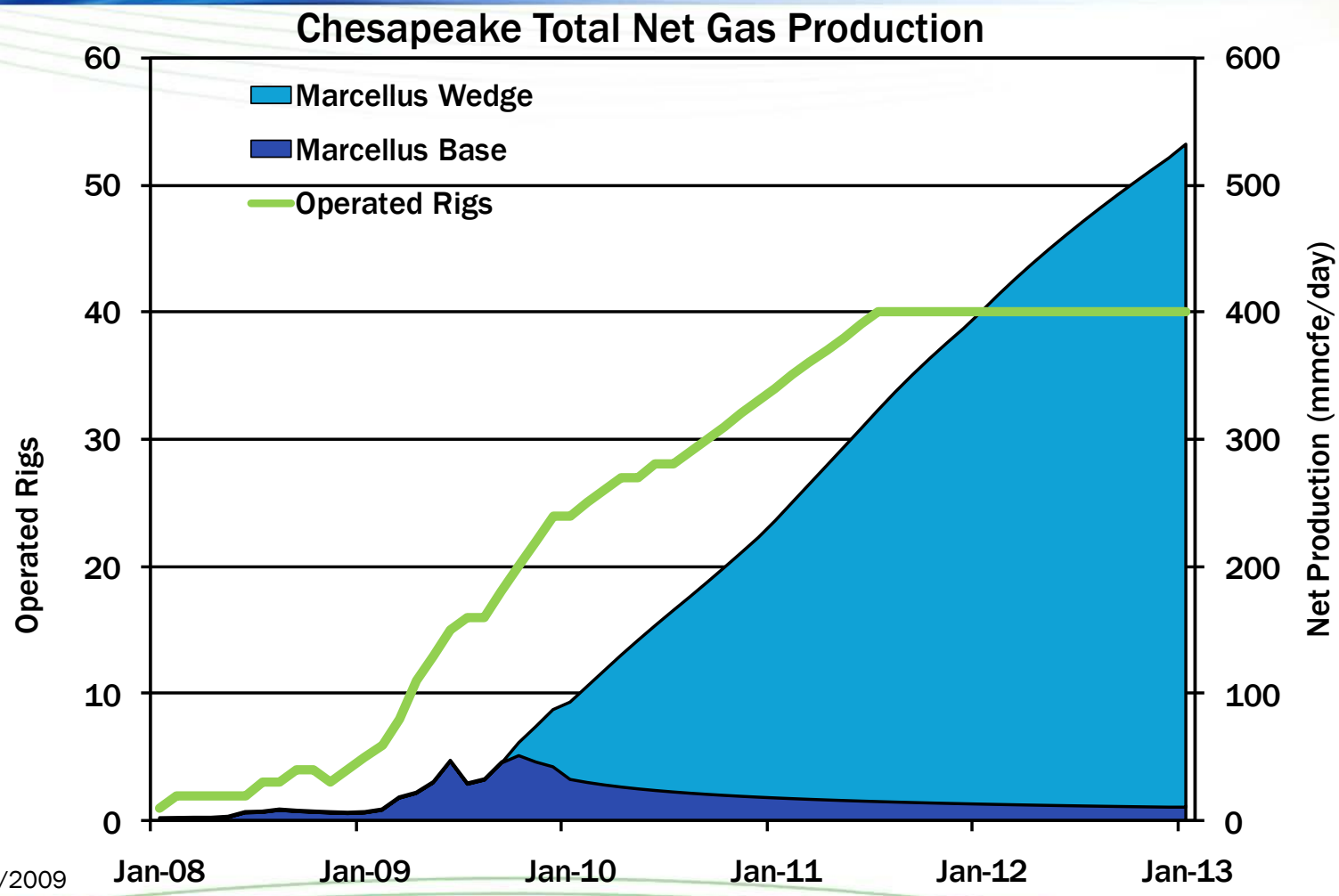
All RORs are pre-drilling carry from Statoil for 75% of CHK's share of drilling costs

Marcellus Shale – CHK Growth Profile



As of 10/15/2009

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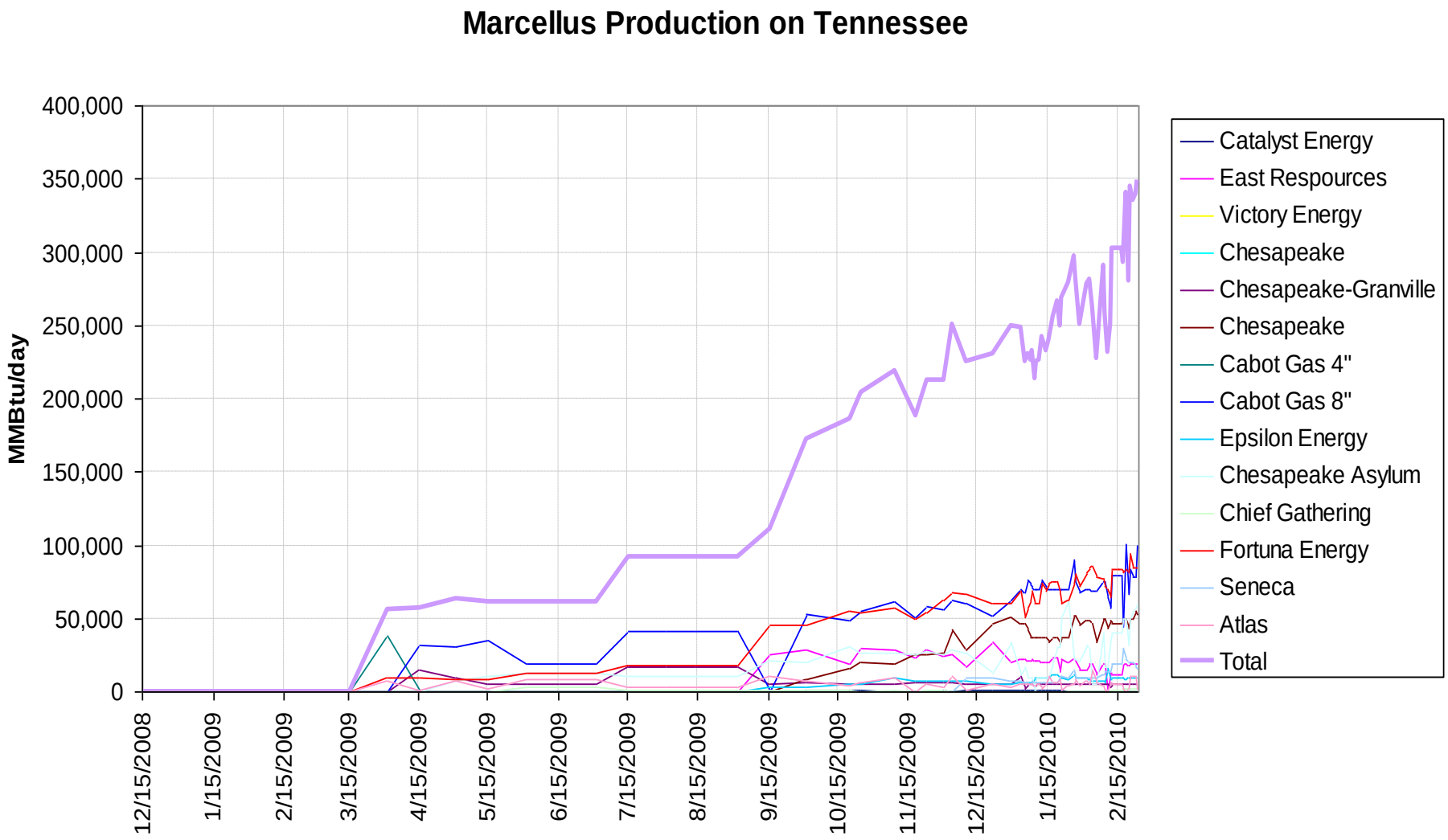
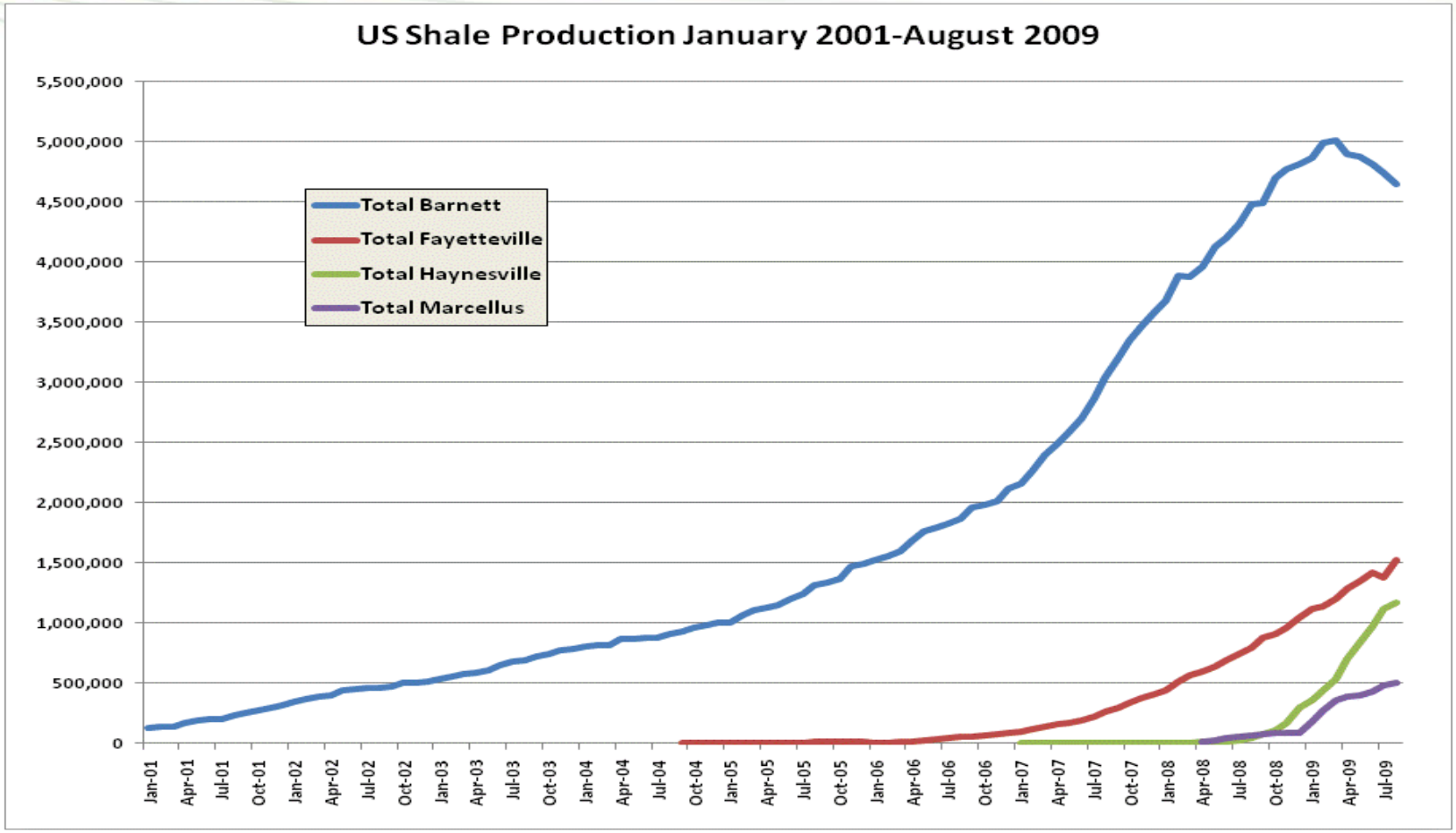
Current Northeastern PA Marcellus into Tennessee Gas Pipeline

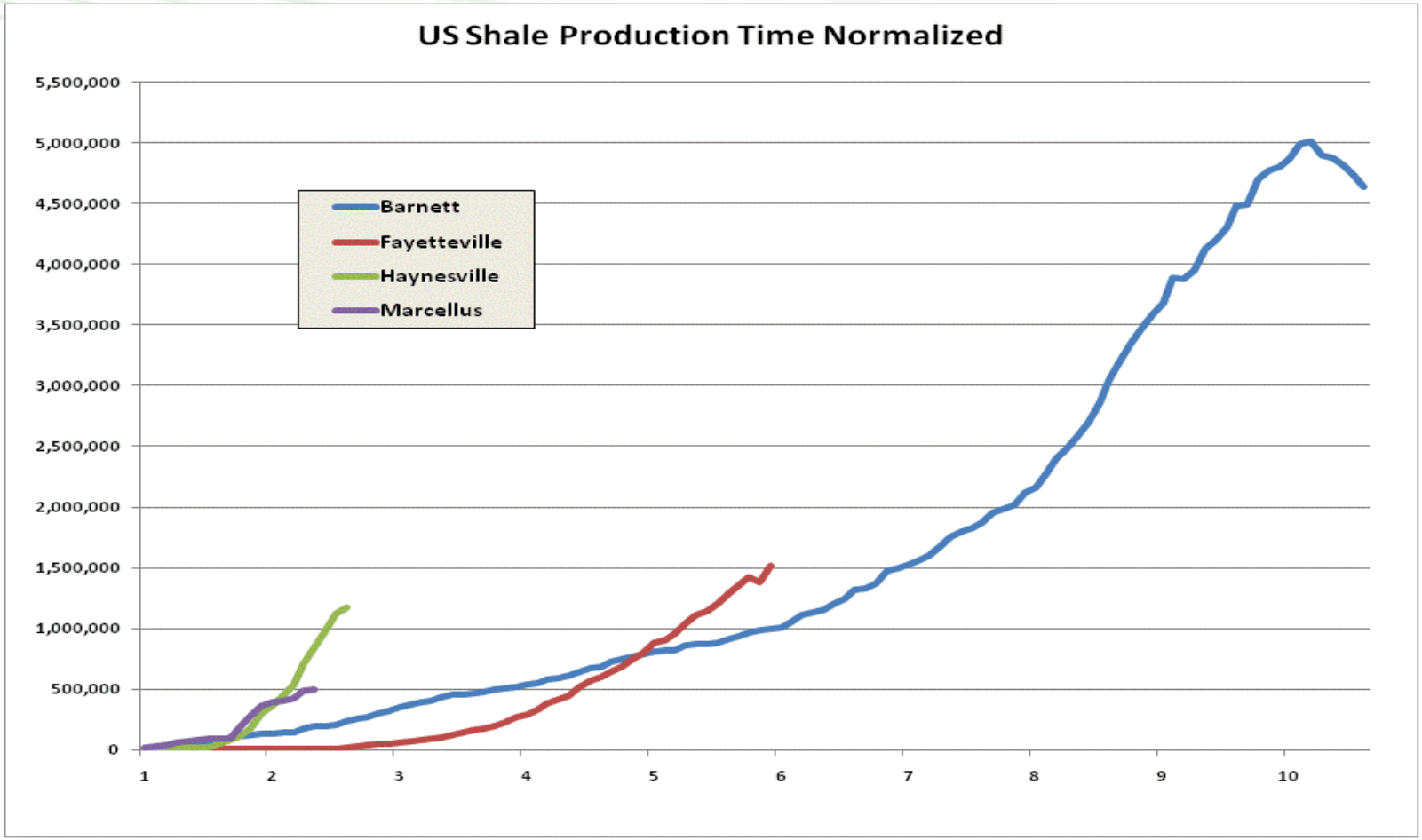


Source: Vantage Advisors, LP and Tennessee Gas Pipeline

US Shale Development



Shale Development Acceleration



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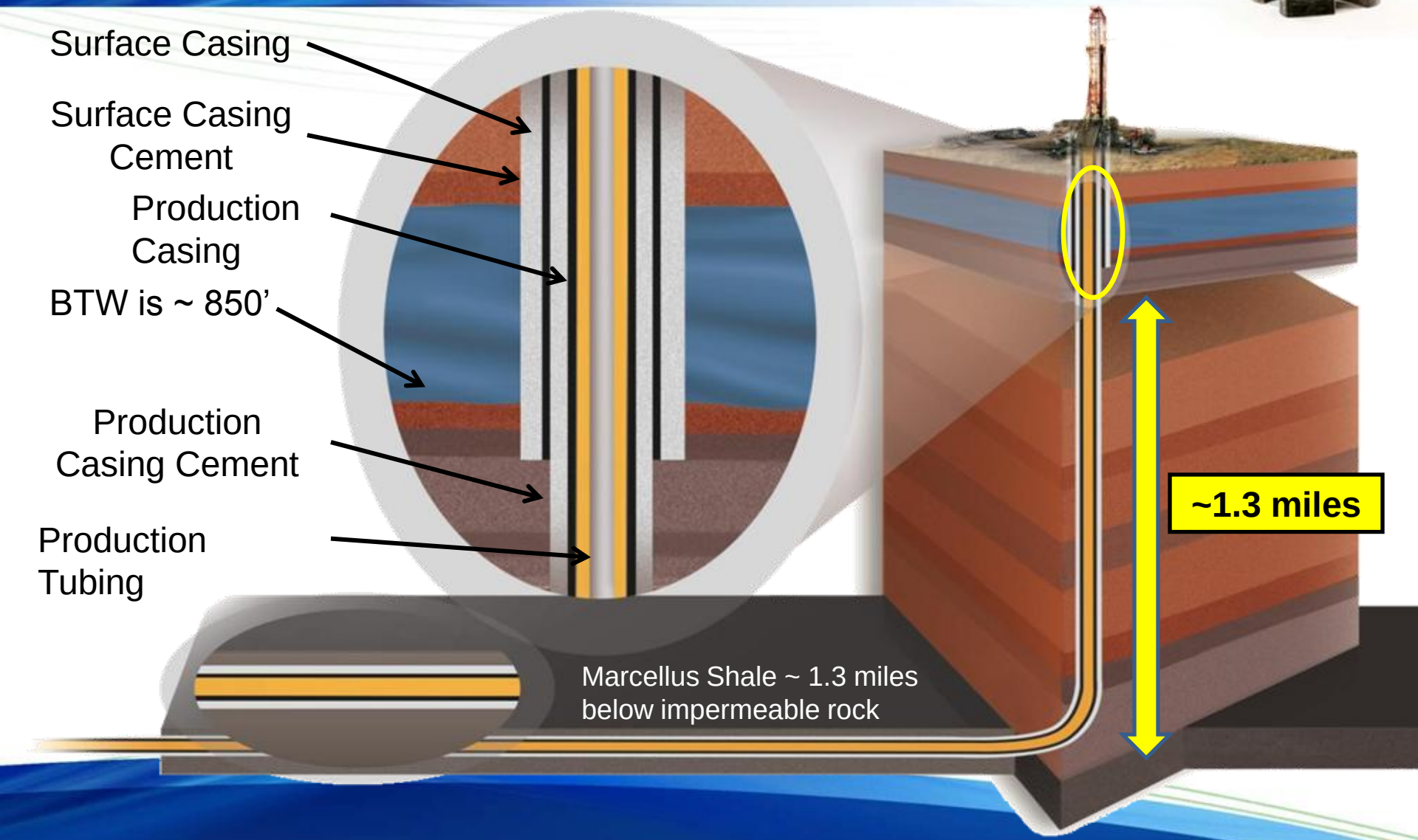
Marcellus Shale – Advantages

- **Advantages of the Marcellus Shale:**
  - World class basin size
  - Spans 15 million acres; 5x the Haynesville and 10x the Barnett
  - Close to U.S. population centers and best natural gas markets
  - Over-pressured reservoir
  - Significant portions of play are geologically stable - structurally uncomplicated
  - Largely located in rural areas

Is Hydraulic Fracture Stimulation Safe?

Fracture Stimulation and Gas Production Are Completely Isolated From Fresh Water



Components of Frac Fluid – The Facts

Product Category	Main Ingredient	Purpose	Other Common Uses
Water	99.5% Water & Sand	Expand fracture and deliver sand	Landscaping, manufacturing
Sand (Proppant)		Allows the fractures to remain open so the gas can escape	Drinking water filtration, play sand, concrete and brick mortar
Other	~ 0.5%		
Gel	Guar gum or Hydroexyethyl cellulose	Thickens the water in order to suspend the sand	Cosmetics, baked goods, ice cream, toothpaste, sauces, and salad dressings
Friction Reducer	Petroleum distillate	"Slicks" the water to minimize friction	Used in cosmetics including hair, make-up, nail and skin products
Acid	Hydrochloric acid or muriatic acid	Helps dissolve minerals and initiate cracks in the rock	Swimming pool chemical and cleaner
Anti-Bacterial Agents	Glutaraldehyde	Eliminates bacteria in the water that produces corrosive by-products	Disinfectant; sterilizer for medical and dental equipment
Scale inhibitor	Ethylene glycol	Prevents scale deposits in the pipe	Used in household cleansers, de-icer, paints, and caulk
Breaker	Ammonium Persulfate	Allows a delayed break down the gel	Used in hair coloring, as a disinfectant, and in the manufacture of common household plastics
Corrosion inhibitor	Formamide	Prevents corrosion of the well casing	Used in pharmaceuticals, acrylic fibers and plastics
Crosslinker	Borate Salts	Maintains fluid viscosity as temperature increases	Used in laundry detergents, hand soaps and cosmetics
Iron Control	Citric Acid	Prevents precipitation of metal oxides	Food additive; food and beverages; lemon juice ~7% citric acid
Clay Stabilizer	Potassium Chloride	Creates a brine carrier fluid that prohibits fluid interaction with formation clays	Used in low-sodium table salt substitute, medicines, and IV fluids
pH adjusting agent	Sodium or potassium carbonate	Maintains the effectiveness of other components, such as crosslinkers	Used in laundry detergents, soap, water softener and dish washer detergents
Surfactant	Isopropanol	Used to reduce surface tension of the fracturing fluids to improve liquid recovery from the well after the frac	Used in glass cleaner, multi-surface cleansers, antiperspirant, deodorants and hair-color

Putting Natural Gas Water Usage Into Perspective

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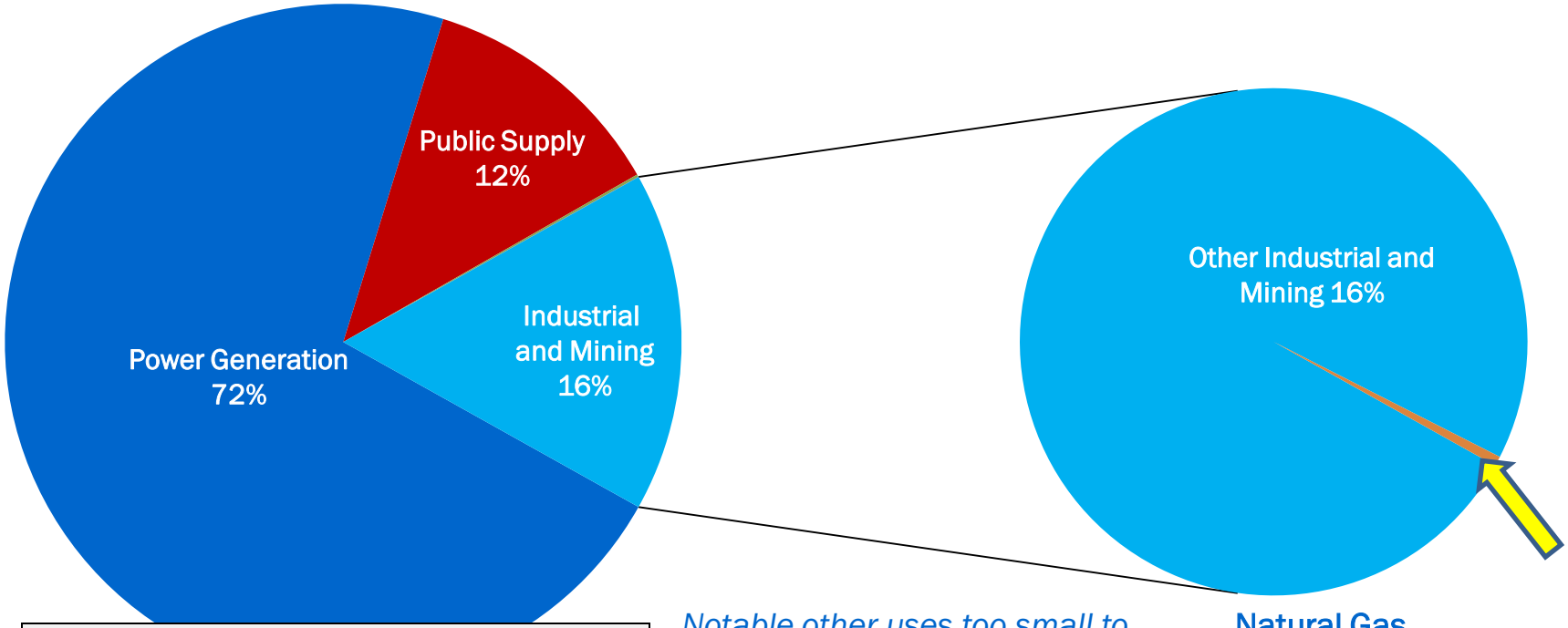
Water Use in Marcellus Shale Area

Marcellus Shale water usage pales in comparison to other industries



Total water use in Marcellus area:
3.6 trillion gallons per year

Notable other uses too small to show on chart: Irrigation: 0.1%, Livestock use: 0.01%

Natural Gas Industry Projected Use 0.1%

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Source: USGS Estimated Use of Water in US, County Level Data for 2000

Total water use (surface water and groundwater) in central PA (32 county area), southern NY (10 County Area), northern WV (29 county area), western VA and MD (5 county area) and eastern OH (3 county area) by sector

CHK is Successfully Managing Water

- Hydraulic fracturing will typically require ~4-5 million gallons of water for a 4,500' lateral length well
- Water is piped to most sites and stored in a lined impoundment near one or more padsites
- Impoundments and piping minimize water truck traffic
- Flow back water from the frac is stored on site in tanks for reuse

Marcellus Fresh water impoundment

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The Economic Case for Natural Gas

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The Marcellus Shale Will Be PA's Future Economic Driver

- **2008 economic impact**
  - $2.3 billion in direct economic impact
  - 29,000 new jobs for Pennsylvania
  - $240 million in state and local tax revenue
    - More than 30% of all tax revenue stays at the local level
- **2010 projected economic impact**
  - $14.7 billion in direct economic impact
  - 100,000 new jobs for Pennsylvania
  - $800 million in state and local tax revenue
- **2009 - 2020 total projected economic impact**
  - $265 billion in economic impact
  - $15 billion in state and local tax revenue
  - Potential for ~200,000 new jobs for Pennsylvania by 2020
- **Bigger economic impact on Pennsylvania than oil in late 1800's or steel in early 1900's?**

SOURCE: Penn State University – 8/5/09 Prospects and Economic Impacts of Developing the Marcellus Shale

Marcellus Landowner Impact Illustration

4.2 Bcf/well@ $5 = $12.3 MM NPV@6%

One Well = 80 Acres
Average Royalty -16.34%
NPV Royalty per well - $2.01 MM
NPV Royalty per acre - $25 K
NPV Royalty per Dth - $0.48

Royalty NPV 1 Bcf/d	Royalty NPV 3 Bcf/d	Royalty NPV 5 Bcf/d	Royalty NPV 10 Bcf/d
$175 MM	$525 MM	$875 MM	$1,750 MM

The NGV Opportunity

- The transportation sector accounts for 30% of U.S. CO_2 emissions
- Converting one heavy-duty truck from diesel to natural gas is the pollution-reduction equivalent of removing 325 cars from the road.
- There are more than 10 million NGVs worldwide, with only about 120,000 in the U.S. – ranking the U.S. 12th in the world

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CHK Marcellus Capacity Subscriptions

Inergy North-South

Spectra - Manhattan

Inergy - Marc 1

TGP – Mahwah

TCO 150 MDth/d - Deliver to TETCo M2

NEW YORK

PENNSYLVANIA

NEW JERSEY

Stagecoach

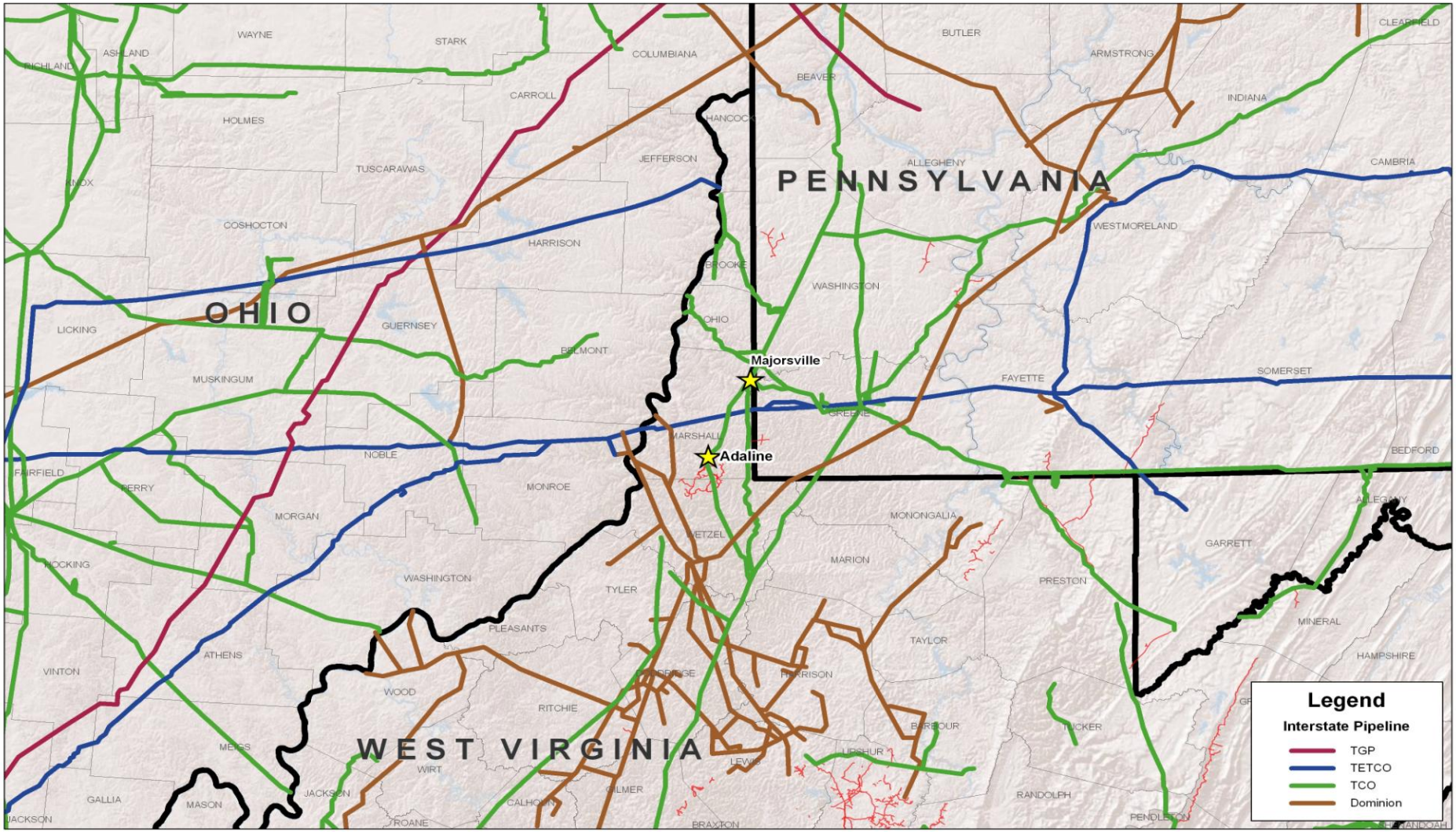
Legend

- CHK Meter

Interstate Pipeline

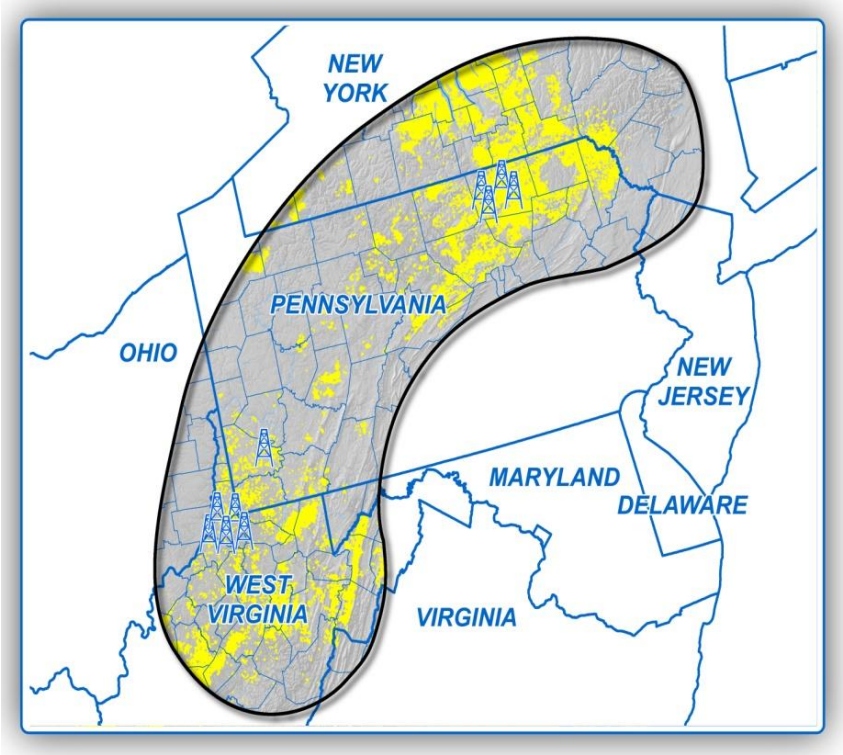
- TGP
- TETCO
- Transco
- Millennium
- Marc 1 Proposed
- AGT
- TCO
- Dominion
- Iroquois
- Stagecoach

Southern Marcellus Development



Final Thoughts on Marcellus

- **Reduced pipeline variable cost to NE and Canadian markets**
  - Marcellus should be the first choice for supply
- **First round of pipeline expansions - NYC**
  - Next destination(s)?
- **Potential new trading hubs – best location(s)**
  - An expanded Leidy market?
  - A new M2 market?
  - An expanded Niagara market?
- **Should increase natural gas market share**
- **Will increase NGL availability**
- **Storage implications – need more in the region**
- **Pricing implications – should reduced volatility**



Certain Reserve & Production Information

- The Securities and Exchange Commission requires natural gas and oil companies, in filings made with the SEC, to disclose proved reserves, which are those quantities of natural gas and oil that by analysis of geoscience and engineering data can be estimated with reasonable certainty to be economically producible from a given date forward, from known reservoirs, and under existing economic conditions, operating methods, and government regulations. In this presentation, we use the terms "risked and unrisked unproved resources" and "estimated average resources per well" to describe Chesapeake's internal estimates of volumes of natural gas and oil that are not classified as proved reserves but are potentially recoverable through exploratory drilling or additional drilling or recovery techniques. These may be broader descriptions of potentially recoverable volumes than probable and possible reserves, as defined by SEC regulations. Estimates of unproved resources are by their nature more speculative than estimates of proved reserves and accordingly are subject to substantially greater risk of actually being realized by the company. We believe our estimates of unproved resources, both risked and unrisked, are reasonable, but such estimates have not been reviewed by independent engineers. Estimates of unproved resources may change significantly as development provides additional data, and actual quantities that are ultimately recovered may differ substantially from prior estimates.
- Our production forecasts are dependent upon many assumptions, including estimates of production decline rates from existing wells and the outcome of future drilling activity. Although we believe the forecasts are reasonable, we can give no assurance they will prove to have been correct. They can be affected by inaccurate assumptions and data or by known or unknown risks and uncertainties.

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Forward-Looking Statements

- This presentation includes "forward-looking statements" within the meaning of Section 27A of the Securities Act of 1933 and Section 21E of the Securities Exchange Act of 1934. Forward-looking statements give our current expectations or forecasts of future events. They include estimates of our natural gas and oil reserves and resources, expected natural gas and oil production and future expenses, assumptions regarding future natural gas and oil prices, planned asset sales, budgeted capital expenditures for drilling and acquisitions of leasehold and producing property, and other anticipated cash outflows, as well as statements concerning anticipated cash flow and liquidity, business strategy and other plans and objectives for future operations. Disclosures concerning the fair value of derivative contracts and their estimated contribution to our future results of operations are based upon market information as of a specific date. These market prices are subject to significant volatility. Although we believe the expectations and forecasts reflected in forward-looking statements are reasonable, we can give no assurance they will prove to have been correct. They can be affected by inaccurate assumptions or by known or unknown risks and uncertainties.
- Factors that could cause actual results to differ materially from expected results are described under "Risk Factors" in our 2008 Form 10-K and our 2009 second quarter Form 10-Q filed with the U.S. Securities and Exchange Commission on March 2, 2009 and August 10, 2009, respectively. These risk factors include the volatility of natural gas and oil prices; the limitations our level of indebtedness may have on our financial flexibility; impacts the current economic downturn may have on our business and financial condition; declines in the values of our natural gas and oil properties resulting in ceiling test write-downs; the availability of capital on an economic basis, including through planned asset monetization transactions, to fund reserve replacement costs; our ability to replace reserves and sustain production; uncertainties inherent in estimating quantities of natural gas and oil reserves and projecting future rates of production and the amount and timing of development expenditures; exploration and development drilling that does not result in commercially productive reserves; expiration of natural gas and oil leases that are not held by production; hedging activities resulting in lower prices realized on natural gas and oil sales and the need to secure hedging liabilities; uncertainties in evaluating natural gas and oil reserves of acquired properties and potential liabilities; the negative impact lower natural gas and oil prices could have on our ability to borrow; drilling and operating risks, including potential environmental liabilities; transportation capacity constraints and interruptions that could adversely affect our cash flow; potential increased operating costs resulting from legislative and regulatory changes affecting our operations; and losses possible from pending or future litigation.
- We caution you not to place undue reliance on our forward-looking statements, which speak only as of the date of this presentation, and we undertake no obligation to update this information.

Chesapeake ENERGY

A TYEE Series

'The Shale Gale Is a Retirement Party'

So concludes an expert analyst of the natural gas boom. Brace for bust.

By Andrew Nikiforuk, 27 Mar 2013, TheTyee.ca

Natural gas: After the boom killed prices, expect the flame to diminish as production declines, says energy consultant Arthur Berman.

Every day a government agency or industry group in North America still hails natural gas mined from deep shale rock formations as "the bridging fuel" that will power a brighter if not cleaner energy tomorrow. Cheap natural gas, goes the mantra, will solve our energy woes and build a new energy foundation.

The government of British Columbia, for example, dutifully salutes the ancient hydrocarbon as "a transition fuel to a low carbon global economy" that will fill government coffers.

And the Massachusetts Institute of Technology (MIT) calculates that the continent's growing gas supply can retire the majority of the continent's aging coal-fired plants. Others claim that natural gas will make the continent energy independent altogether.

IS NATURAL GAS CLIMATE FRIENDLY?

Pressure to embrace shale gas as a so-called "transition fuel" in British Columbia faces a number of scientific challenges.

Several social scientists, including Karena Shaw at the University of Victoria, have concluded that government claims that portray B.C.'s shale gas as climate friendly bridge fuel aren't backed up by the facts.

For starters, fugitive greenhouse gas emissions (from leaking infrastructure) appear to be much higher for shale gas than conventional gas and are poorly understood. Estimates for emissions range from 3.5 per cent higher than conventional gas or as dirty as coal.

In particular, the leakage rates of methane from well sites appear to much higher than industry models. Industry math offers a two per cent leakage rate, but real time studies in actual gas fields suggest nine per cent. (Imagine the smell of an orange with one needle prick: now imagine the scent with 100 pricks. Oil and gas wells do the same to the earth's atmosphere with hydrocarbon emissions.)

Second, B.C.'s shale gas is not really clean. Many deposits contain impurities such as hydrogen sulfide. Others contain 12 per cent carbon dioxide. (Conventional natural gas contains two to 4.5 per cent CO2) As a consequence, shale gas development could grossly inflate B.C.'s carbon footprint the same way bitumen development has in Alberta. Rapid development would release nearly five million tonnes of GHG gases a year and make it impossible for the province to achieve its climate change targets.

Third, liquid natural gas facilities are heavy polluters. Emissions from these complex terminals tend to be 18 to 21 per cent higher than conventional natural gas processing due to the amount of energy needed to liquefy and compress the methane.

Reliable scientific studies on emissions from LNG facilities are in their infancy. One 2005 U.S. study suggested that didn't they didn't differ from coal-fired power stations: overall lifecycle "emissions from electricity generated with coal and electricity generated with natural gas (from LNG) could be surprisingly similar."

Lastly, shale gas's designation as a "bridge fuel" depends on its end use. Burning gas in a 95 per cent efficient furnace is an appropriate use. But 10 to 20 per cent of the natural gas produced in western Canada, whether from shale rock or other sources, now serves as feedstock for bitumen production in the tar sands.

That's not a green use. Furthermore, if unconventional shale gas displaces renewable energy investments and thereby prevents an energy transition to low carbon energy, "this would be a disaster for the climate."

The study concluded that government claims made about the "sustainability" of shale gas "are currently unsubstantiated and amount to greenwashing." -- A.N.

Big Oil such as Exxon Mobil and Shell have invested so much money in shale resources that they now want to export U.S. and Canadian natural gas to Asia. Exuberant corporate leaders also predict that natural gas will surpass coal as the second-largest energy source on the planet, after oil, by 2040.

Eager to cash in on the shale gale, pipeline companies can't wait to build another 450,000 miles of new pipelines to ship gas from heavily fracked rural landscapes to urban markets over the next two decades.

But that's not Arthur Berman's take. The oil patch consultant sees the shale gas frenzy as "magical thinking" as well as a full-blown commercial failure. In fact, the 62-year-old Houston-based petroleum geologist doesn't view natural gas as "a bridge to anywhere."

What others call the "shale gas revolution," he rudely describes as an "industry retirement party."

Industry supporter, skeptical eye

Now don't get Berman wrong. With more than 30 years of technical experience in the oil and gas industry, the consultant recognizes the intensive mining of shale gas and shale oil across the continent as significant events.

He clearly supports the industry. But he's the kind of thoughtful and critical guy that quotes Samuel Johnson or Tao Te Ching in his presentations. As such, he has persistently challenged corporate gold rush economics that crushed natural gas prices as well as persistent government ignorance about the resource's longevity, volume and cost.

His blunt refusal to cheerlead for the industry has also earned him some grief. The magazine World Oil cancelled his long-running column in 2009 after Berman repeatedly questioned the accuracy of inflated shale gas reserves in the absence of real production data. The editor got sacked too.

In the last couple of years, a Devon Energy spokesperson dubbed Berman a "dinosaur" for questioning industry hubris. Former Chesapeake CEO Aubrey McClendon, now under investigation by the U.S. Securities Exchange Commission, also dished the prominent analyst as "third tier geologist."

But Berman's no-nonsense technical assessments have been damningly accurate. In many quarters the prescient Berman is now hailed as an energy fox.

Compulsive drilling

It all began six years ago when the savvy geologist started to question the economics of shale gas drilling in Texas as well as a manufacturing model that promised endless energy. After checking real geology and real production numbers he warned that industry had overhyped the potential of many fields while ignoring falling prices, rising costs and sharp depletion rates.

Nevertheless, the shale boom became a verifiable mania in the mid-2000s. With heavy promotional hoopla and flush with easy credit from Wall Street, companies such as Chesapeake and Encana individually acquired land bases as large as the State of West Virginia.

Then they compulsively drilled them with repeated fracture treatments. Not surprisingly, industry flooded the market and drove down the price of natural gas from a historic high of $14 a million metric BTU in 2008 to lows of $2.

Yet cracking rock miles underground remains a high cost and high-risk business. In 2010 Berman predicted the shale gas manufacturing model "was unsustainable" and that overproduction would create killing debt loads and force companies to divest their assets.

Most shale gas companies need a price between $6 and $8 a mm BTU to be economic. Yet the market price for gas remains around $3. Hence the sell-offs, mergers and acquisitions and corporate resignations in the natural gas industry now making media headlines.

Two of the loudest shale gas promoters, Chesapeake and Encana, have suffered major train wrecks due to the shale gas glut. Their CEOS have resigned. They've not only reduced drilling but have tried to sell off a billion dollars worth of assets to cover their unsustainable debt loads.

They are not alone. BP has written off nearly $2 billion in assets. In addition Quicksilver has temporarily suspended drilling in the Horn River shale play due to low natural gas prices. Even Rex Tillerson, the bombastic CEO of Exxon Mobil, admitted last year that the company was "losing our shirts" on shale gas investments.

Or as Berman duly warned in one article: "Improbable stories that great profits can be made at increasingly lower prices have intersected with reality."

Berman was also one of the first to question the abundance of the resource too. Formations blasted open by water, sand and chemicals often yield great gushers of gas for six months but then drop off as dramatically as a Wall Street market crash. In many shale gas plays, production declines average more than 40 per cent a year, says Berman. (In contrast conventional plays deplete by an average of 20 per cent.)

Nevertheless, industry and industry-funded academics often boasted that the so-called shale gale could spew enough methane to meet North America's energy needs for 100 years. But real-time depletion rates and problematic geology (not all shale resources are equal) have totally rewritten those optimistic claims.

The Marcellus shale formation in Pennsylvania and New York, for example, was supposed to hold 410 trillion cubic feet of gas or nearly 20 years worth of natural gas. (The U.S. burns about 22 TCF a year).

But in 2011 the U.S. Geological Survey slashed that estimate by 80 per cent to 84 trillion cubic feet, or a four-year supply. Other studies "show that commercially recoverable per-well shale gas reserves may be considerably smaller than some believe."

Two decades to transition

Given such downgrades in shale fields from Haynesville to Woodford, Berman believes that the unconventional gas may represent only between 20 and 25 years worth of supply. That's not a bridge given dramatic declines in conventional gas, says Berman. In short, most shale gas deposits are too deep, too marginal or too inaccessible to be economically viable.

A 2013 comprehensive report based on the study of 60,000 oil and shale wells in the United States confirmed Berman's own analysis and research.

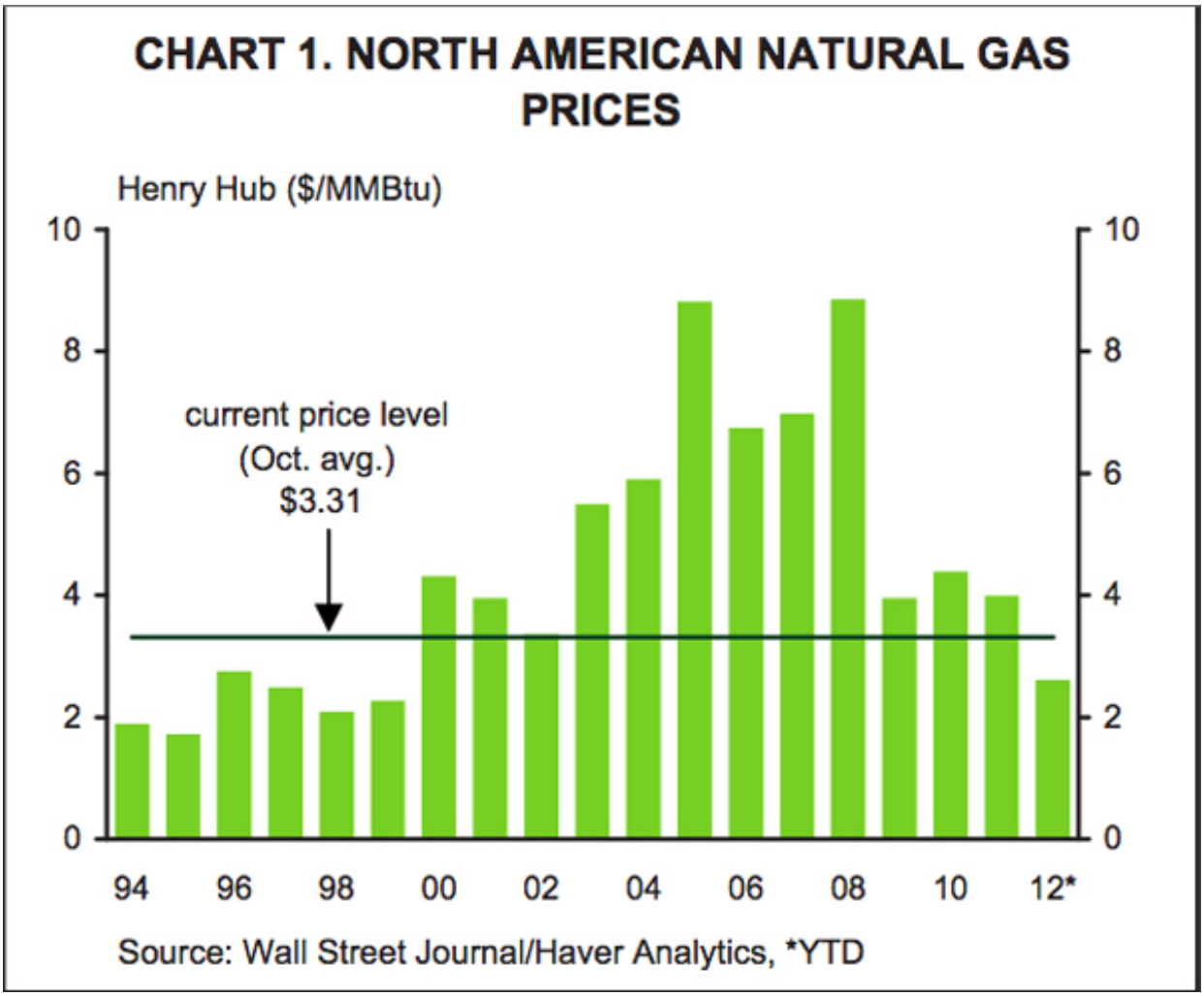
The Post-Carbon Institute study reported that 80 per cent of all shale gas production comes from just five of 20 developed fields. Moreover, the majority of these fields had peaked after five years of production and were now in decline. "In the Haynesville play (a major shale gas field in north Louisiana and east Texas), an average well delivered almost one-third less gas in 2012 than in 2010," reported Hughes.

David Hughes, a retired Canadian geologist and author of the report, estimated that it would cost $42 billion to maintain current production (that's 40 per cent of US gas supply) with 7,000 more wells even though the 2012 market value of shale gas production was but $32.5 billion.

Rapid decline rates have taken the wind out of the shale gale. Industry once advertised shale wells as assets that could be milked for up to 40 years. Now it appears that some wells might not be economic after fives years of production. As a consequence, an increasing number of high cost wells must be drilled (a veritable treadmill) in order to maintain supply. "We are spending more and more to get less and less," explains Berman.

Given such poor thermodynamics, shale gas is a temporary phenomenon and another sign of peaking supply in hydrocarbons explains the consultant. "But it is not sustainable. By 2020 or 2025 it will be pretty much played out. And what comes after that?"

Now that the gold rush is over, Berman thinks the future for natural gas could be equally dramatic.



Conventional gas production, which supplies 60 per cent of the market, is steadily declining. In 2001 the decline rate was 23 per cent; today its 33 per cent.

That means 12 billion cubic feet of new gas was needed every year to offset consumption rates of 54 billion cubic feet. Today industry needs to replace 22 billion cubic feet a year to sustain the consumption of 64 billion cubic feet of gas. Calgary-based Arc Financial estimates that major gas producers must spend $22 billion per quarter to replace what's being burned. But most firms are only spending half of that.

It's unlikely that shale gas will be able to make up the difference.

'Retirement' looms

This reality coupled with increasing demand for natural gas to replace coal-fired power based

on illusions of cheapness, will soon increase prices as well as the volume of shale drilling. But even hundreds of thousands of newly fracked shale gas wells won't be able to keep up the depletion rates, making natural gas an ugly treadmill industry.

"Shale plays are not a renaissance or a revolution. This is a retirement party."

As a consequence Berman doesn't think industry, now in a panic mode over low prices, should rush to build high-risk LNG terminals to export shale gas to Asian markets. "Just because we have a temporary supply of abundant natural gas, why should we race to use it up as fast as we can?"

Nor does he believe that government should subsidize the fossil fuel industry. "We'll never develop effective or alternative technologies as long as government gains profit from fossil fuels."

B.C.'s shale gas industry, for example, is entirely subsidized by low royalties, free water and tax-payer funded roads and other infrastructure. All horizontal drilling in Alberta gets a hefty royalty break, too, in addition to free water.

Nor should the illusion of temporary cheap gas dissuade governments from investing in public transportation, energy conservation or encouraging green renewables such as solar and wind power, adds the consultant. "I think our energy future is quite bleak and we are going to need everything we can get."

"The transition we're in now is one from energy abundance to scarcity. I know it doesn't play well. But right now we don't have a bridge to anything. We have a bridge to nowhere and we don't know where the future is."

"Shale gas is a retirement party because we now have to live on what we have left," he explains.

"We have reached the bottom of the resource pyramid. All the good resources are gone. So, like a reluctant retiree, we try to convince ourselves that the best is in front of us but we know it is really not. We will have a nice retirement party -- these are usually awkward events -- and in coming days will resign ourselves to the hard truth."

Berman adds that he's an optimist. "I think we are an adaptable species."

Read more: Energy, Environment

Award-winning journalist Andrew Nikiforuk has been writing about the energy industry for two decades and is a contributing editor to The Tyee. Find his previous Tyee articles **here.**

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http://www.damascuscitizensforsustainability.org/2013/03/dramatic-decline-rates-of-4-gas-fields-confirmed-by-industry-study/

Dramatic Decline Rates of 4 Gas Fields Confirmed by Industry Study

March 26, 2013

This report (click here) shows the dramatic decline rates of 4 gas fields -

Barnett, Fayetteville, Woodford and Haynesville. Nearly 2,000 horizontal shale gas wells were included in this study, so these rates are not statistical flukes.

http://www.slb.com/~/media/Files/dcs/industry_articles/201105_aogr_shale_baihly.ashx

FROM THE REPORT:
To examine the history of any era or series of events, one must have a statistically significant database. One or two points do not define a trend. Accordingly, the portion of a shale gas production decline rate study detailed in this article [has examined] wells in the Barnett, Fayetteville, Woodford and Haynesville plays. The following figures from the report clearly show the rapid downward trend in production.

FIGURE 1

Barnett Shale First-Year and Total Production Rates Color-Coded by Year

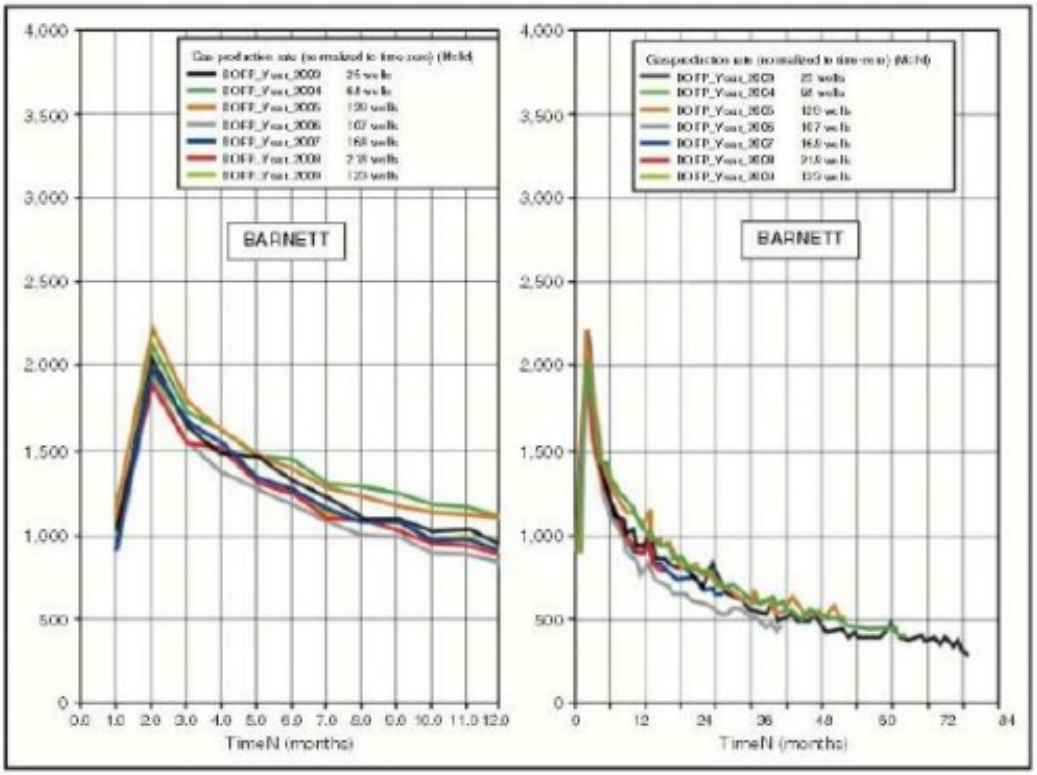


FIGURE 2

Fayetteville Shale First-Year and Total Production Rates Color-Coded by Year

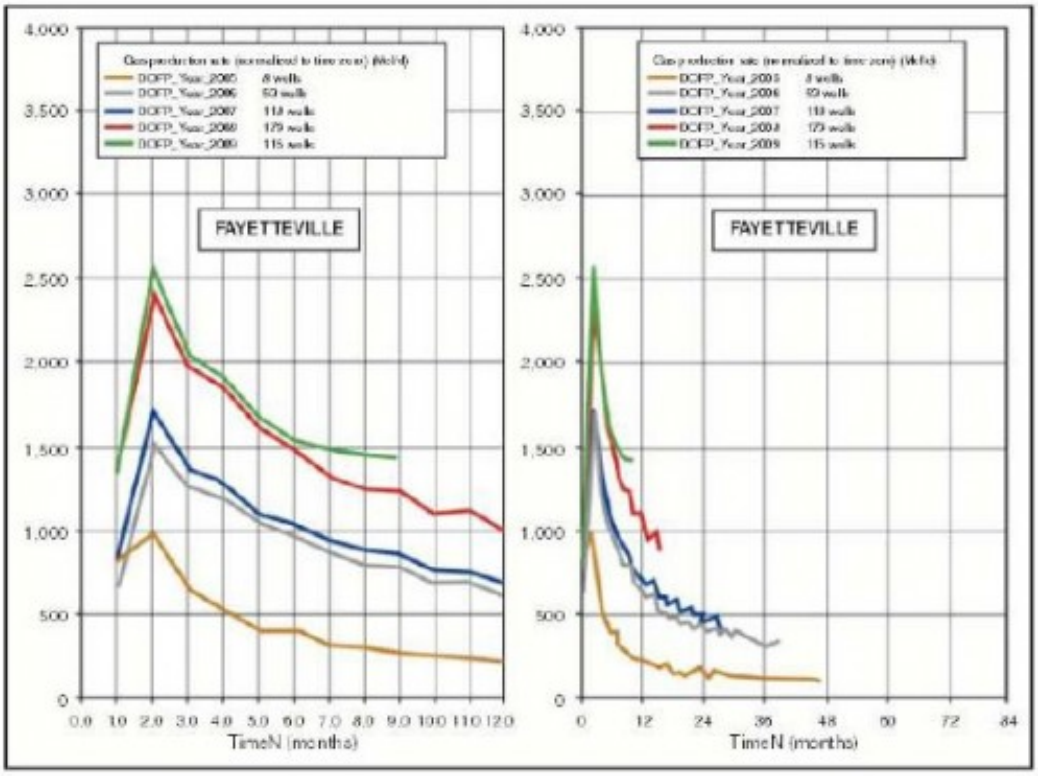


FIGURE 3

Woodford Shale First-Year and Total Production Rates Color-Coded by Year

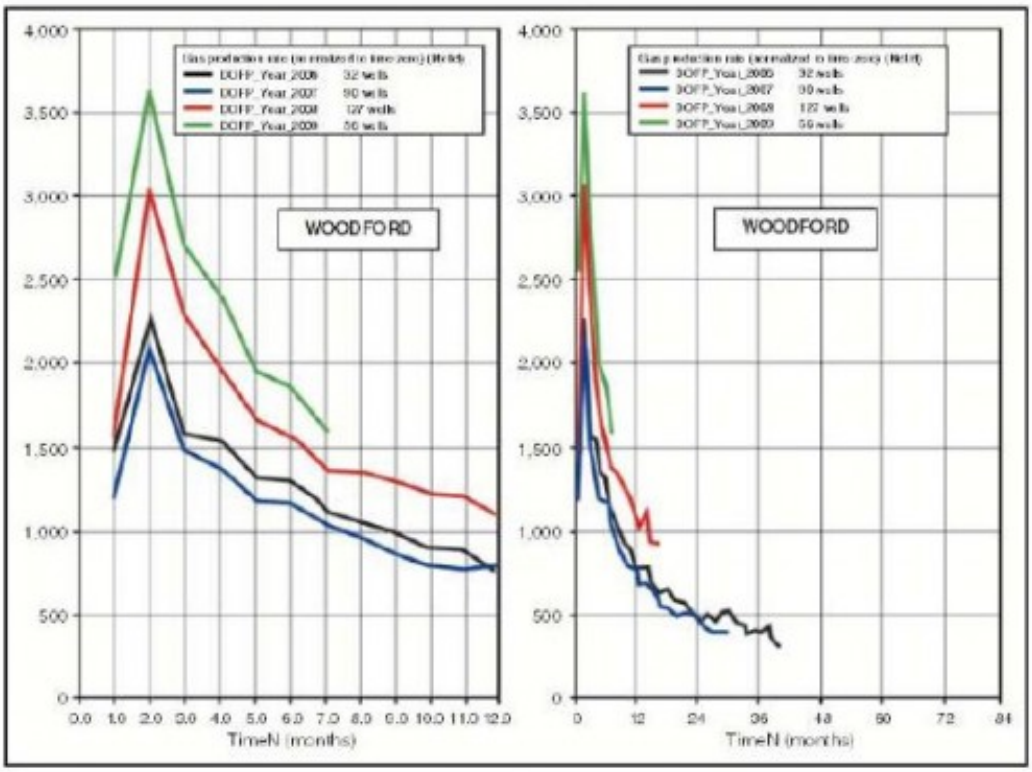
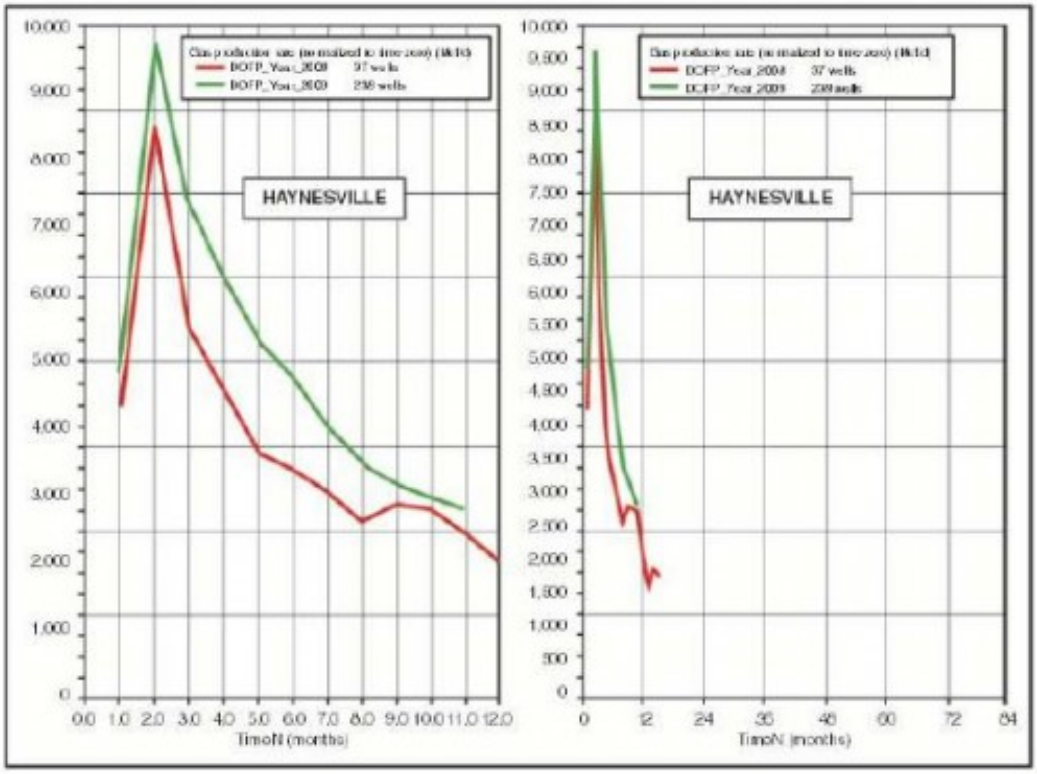


FIGURE 4

Haynesville Shale First-Year and Total Production Rates Color-Coded by Year



- See more at: http://www.damascuscitizensforsustainability.org/2013/03/dramatic-decline-rates-of-4-gas-fields-confirmed-by-industry-study/#sthash.1hNt6cn1.dpuf