Natural Gas Advisory Committee

June 6th 2014

Tentative Agenda

Natural Gas Advisory Committee

Northwest Power and Conservation Council
851 S.W. Sixth Avenue
Suite 1100
Portland Oregon 97204-1348

June 6h, 2014
9:00 AM to 12:30 PM
Instructions for GoToMeeting provided below

1. Welcome and introductions	9:00 to 9:15
2. Future of industrial use of natural gas in the NW (Ed Finklea)	9:15 to 9:45
3. Range of natural gas production and costs (Fred Heutte)	9:45 to 10:15
4. Impact of regulatory costs (Ken Zimmerman)	10:15 to 10:45
5. Break	
6. Strawman proposal for 7th Plan	11:00 to 12:00
a. Preliminary result of fuel price poll	
b. Comparison to other forecasts	
7. Monthly Burner-tip gas prices	12:00 to 12:20
8. Next steps	12:20 to 12:30

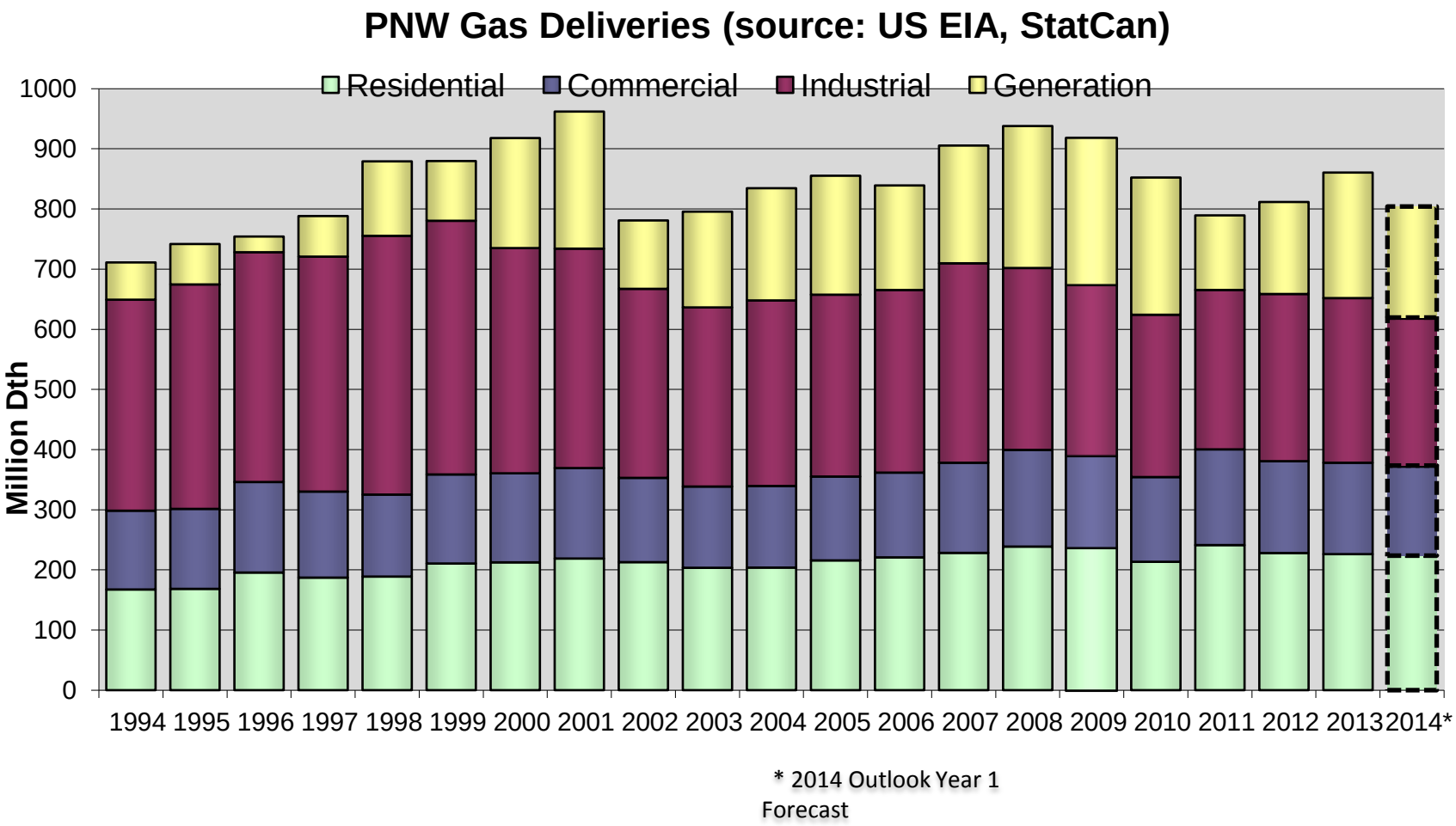
Industrial Demand For Natural Gas
Is There Growth on the Horizon?

Ed Finklea

Executive Director

Northwest Industrial Gas Users

Recent PNW Gas Demand



US Industrial Projects In the Works Could Raise Current Natural Gas Demand of 19 Bcf per day by 4.9 Bcf a day by 2018

- Bentek identifies 298 industrial projects that have been announced.
- Projects are mostly in Southeast, Texas Gulf Coast, and Midwest.
- Methanol, ammonia fertilizer, ethylene, metals, chemicals, can all take advantage of lower natural gas prices relative to global markets.
- 3 Bcf a day is a mid range of forecasts of new industrial demand for process gas sector by 2018.

Gas Induced Industrial Development Is Leading to Creation of Family-Wage Jobs in US

- American Chemistry Council reports that nearly 100 chemical industry investment projects have been announced as of March, 2013 valued at $71.7 billion.
- By 2020, chemical industry investments could lead to 46,000 new direct jobs, 264,000 supplier industry jobs and 226,000 “payroll induced” jobs in impacted communities.
- PNW could take advantage of the industrial renaissance.

Announced Methanol Plants Indicate Magnitude of Potential Industrial Renaissance

- Four Individual Facilities Have Been Announced Each With Potential Gas Use of .13 MMDth/day.
- If All Four Facilities Were Built, total capacity need would be .72 MMDth/day. Total NW Pipeline Existing Capacity is 3.1 MMDth/day.

LNG Export Can Also Be Viewed As Incremental Demand

- Jordan Cove Has Export Permit From US Department of Energy to Export 1 Bcf per day of LNG to Non-free Trade Agreement Nations.
- Oregon LNG Project Now Must Await Studies Ordered Last Week by US DOE. It's pending application is for another 1 Bcf per day of exports.
- Some estimate US exports of LNG could reach 10 to 15 Bcf per day by 2020.

Carbon Tax Would Hit Energy Intensive Businesses

- $30.00 per ton carbon tax is $1.59 per MMBtu price increase on commodity that sells for approximately $4.50 per MMBtu today.
- Washington Business Consumers of Natural Gas Would Experience $211.1 million Price Increase and Electric Generators $59.2 million.
- Oregon Business Consumers of Natural Gas Would Experience $137.2 million Price Increase and Electric Generators $138.3 million.
- Industrial Demand Would Be Impacted, Especially in Energy Price Sensitive Industries Such As Food Processing, Pulp and Paper, and Metals.

Fred Heutte presentation

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State of Play

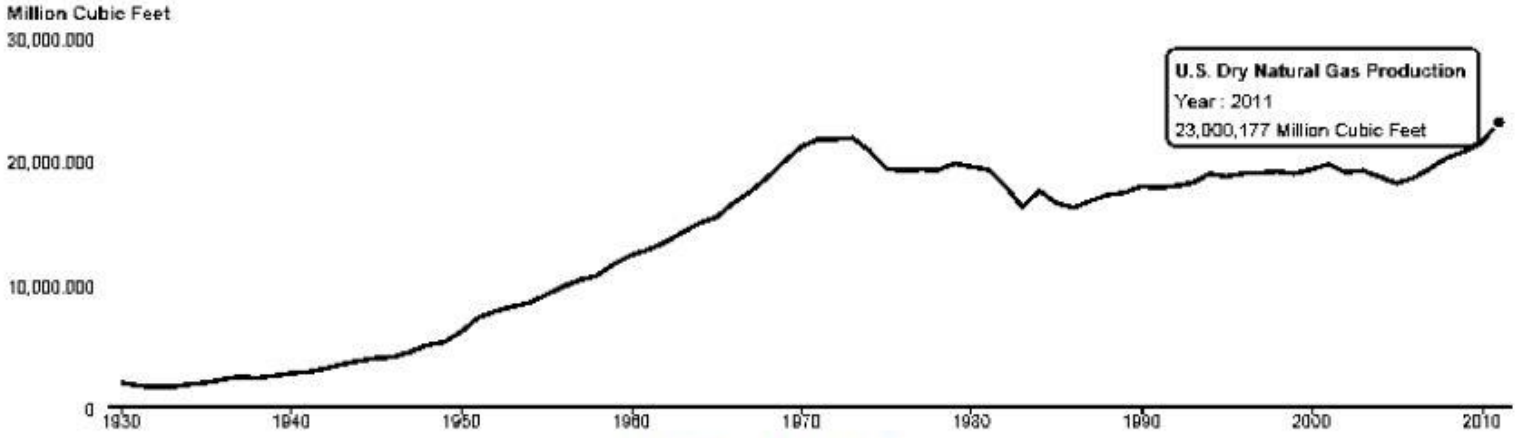
Natural Gas Past, Present and Future

Fred Heutte
NW Energy Coalition

Northwest Power and Conservation Council
Natural Gas Advisory Committee
June 6, 2014

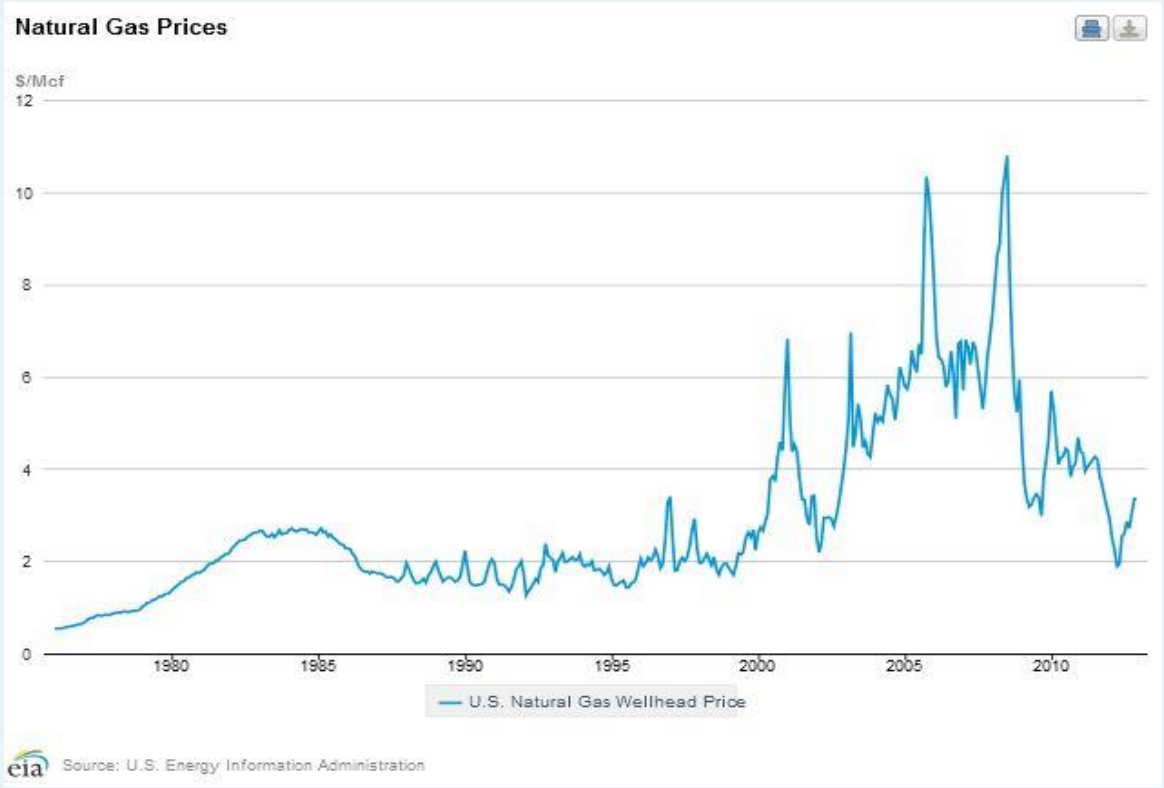
Two ways to see natural gas -- *Steady Sailing . . .*

Figure 5: U.S. Dry Natural Gas Production



Source: U.S. EIA

. . . or *Stormy Seas* . . .



The narrative has inverted . . .

- Old narrative: flat supply, variable pricing (with shocks)
- New narrative: growing supply, flat pricing

. . . or has it, really?

Conventional Wisdom

- The United States is on the verge of Energy Independence thanks to the Shale "REVOLUTION".

- Shale Gas production will continue to grow for the foreseeable future (2040 at least) and prices will remain below $4.50/mcf for the next 10 years and below $6.00/mcf for the next 20 years.

- Shale Gas can replace very substantial amounts of oil for transport and coal for electricity generation.

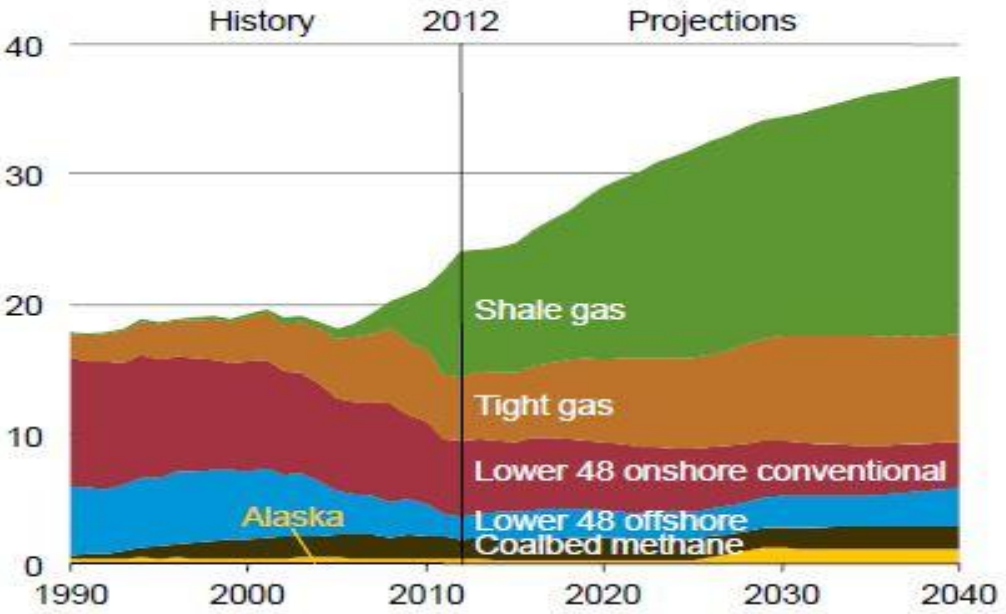
- The way is clear for U.S. LNG exports to monetize the shale bounty.

David Hughes

The new narrative is certainly consistent . . .

Shale gas provides the largest source of growth in U.S. natural gas supply

Figure MT-44. U.S. natural gas production by source in the Reference case, 1990-2040 (trillion cubic feet)

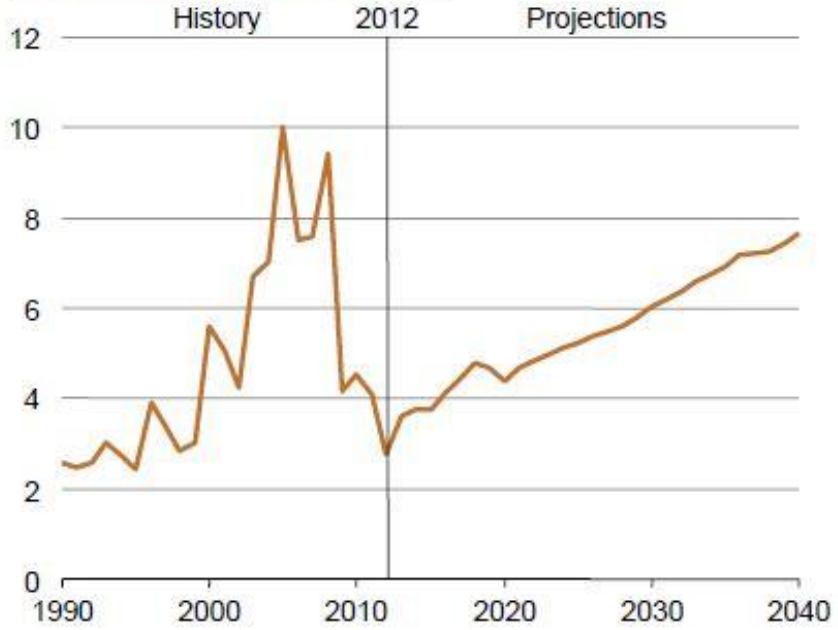


AEO 2014

And the “price is right” . . .

Natural gas prices rise with an expected increase in production costs

Figure MT-40. Annual average Henry Hub spot natural gas prices in the Reference case, 1990-2040 (2012 dollars per million Btu)



AEO 2014

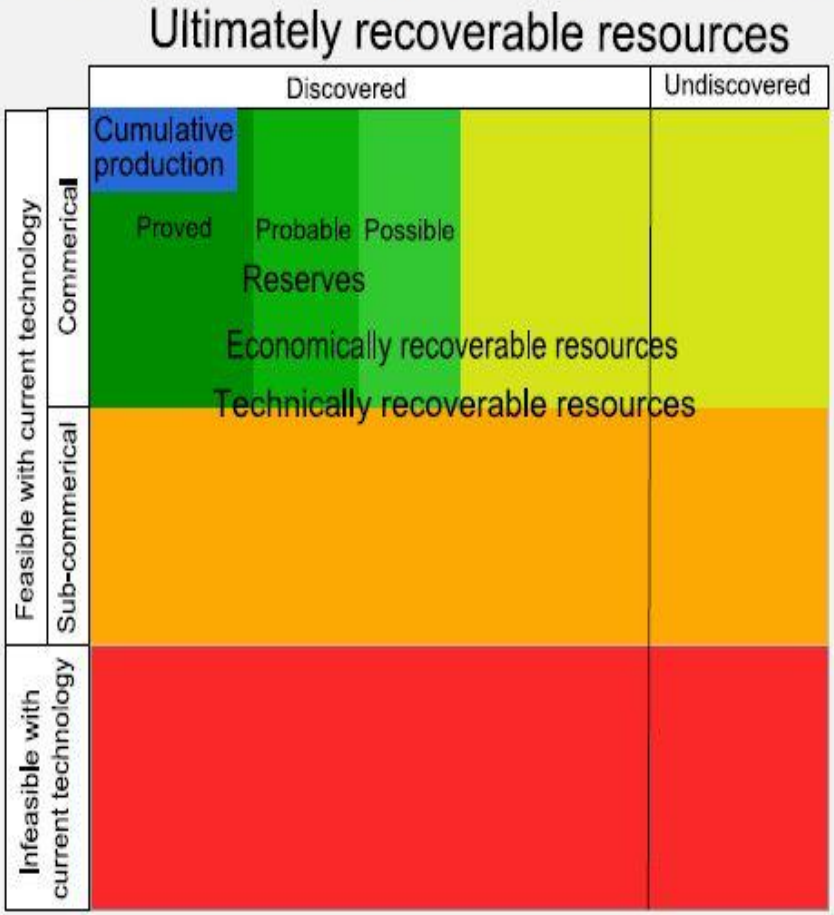
. . . until you look at the data from the field . . .

Even smart people can get this wrong . . .

"We have a supply of natural gas that can last America nearly 100 years."

President Obama, State of the Union, January 24, 2012

Figure 2: McKelvey box of resource classifications for unconventional gas



Resources = "Original Gas In Place"
Reserves = "Commercially Viable Gas"

The United States has 22 Years of Natural Gas, not 100 Years

Potential Gas Committee Category	Tcf Gas
Probable resources (current fields)	537
Probable resources (coal-bed methane)	13
Total Probable	550
Optimistic reserve fraction (50%)	225
Years of supply when drilled & developed	10
Proved reserves	273
Years of supply when drilled & developed	12
Maximum years of supply when drilled & developed	22

The myth that the U.S. has 100 years of natural gas comes from confusing resources with reserves.

Art Berman

Factors of gas price variability

- **Short term variability/supply-demand balance:**
  weather, inventory/storage, peak congestion, relative cost for fuel switching (gas v. coal in swing plants) ...
- **Upside drivers**
  demand growth -- end use (buildings, equipment), industrial (process heat/feedstock), power plants, vehicles, import/export
- **Downside drivers**
  competition (renewables, efficiency, coal), supply chain optimization, E&P innovation
- **Market price limits**
  upside: supply fuel substitution, demand destruction
  downside: balance sheet (shut in production, and/or go broke)

Drivers of gas price trends

- **Production cost**
  land leasing and royalties, equipment, labor, financing, marketing, taxes, profit ...
- **Policy (not a topic today)**
  market structure and competition, supply chain environmental regulation, carbon pricing

“It's complicated . . .”

Is Shale Gas really different? Yes...

- Source rocks, not pools/traps
- 3D seismic imaging – no more (very few) “dry holes”
- “Fracking” == directional horizontal drilling multiple stage slickwater hydrofracturing with advanced proppants and well logging [very innovative technology!]
- Fracking is *very efficient* but that has a flip side . . .
  high initial production
  very fast decline rates
  => shorter well/field/play/region commercially viable production period
  => no effective restimulation (refracs < 5% total EUR)
  => high replacement rates/costs required (“shale treadmill”)

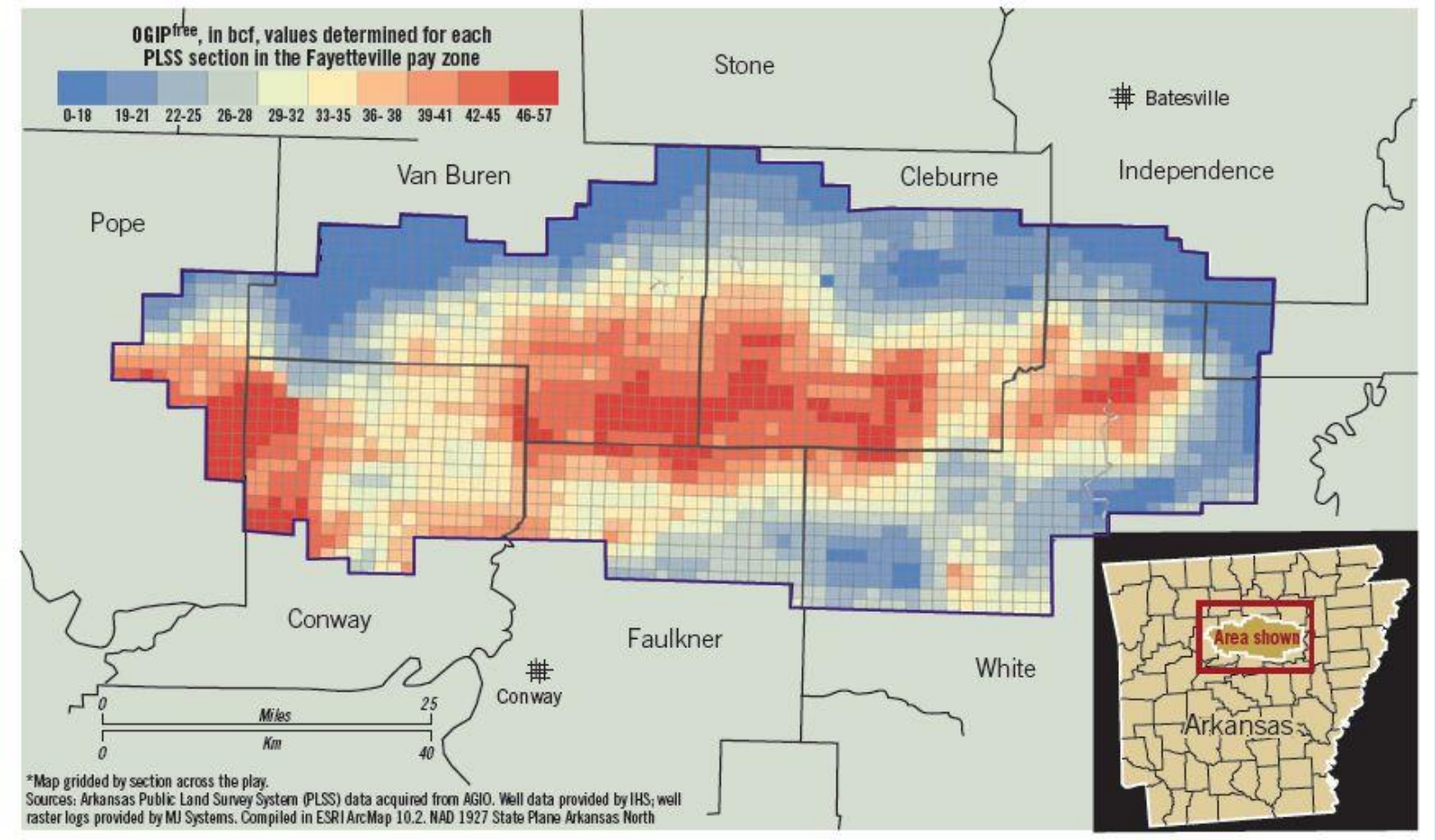
Is Shale Gas really different? Not so much . . .

- “Manufacturing model” is misleading

  well/field/play production declines and costs increase over time just like conventional production

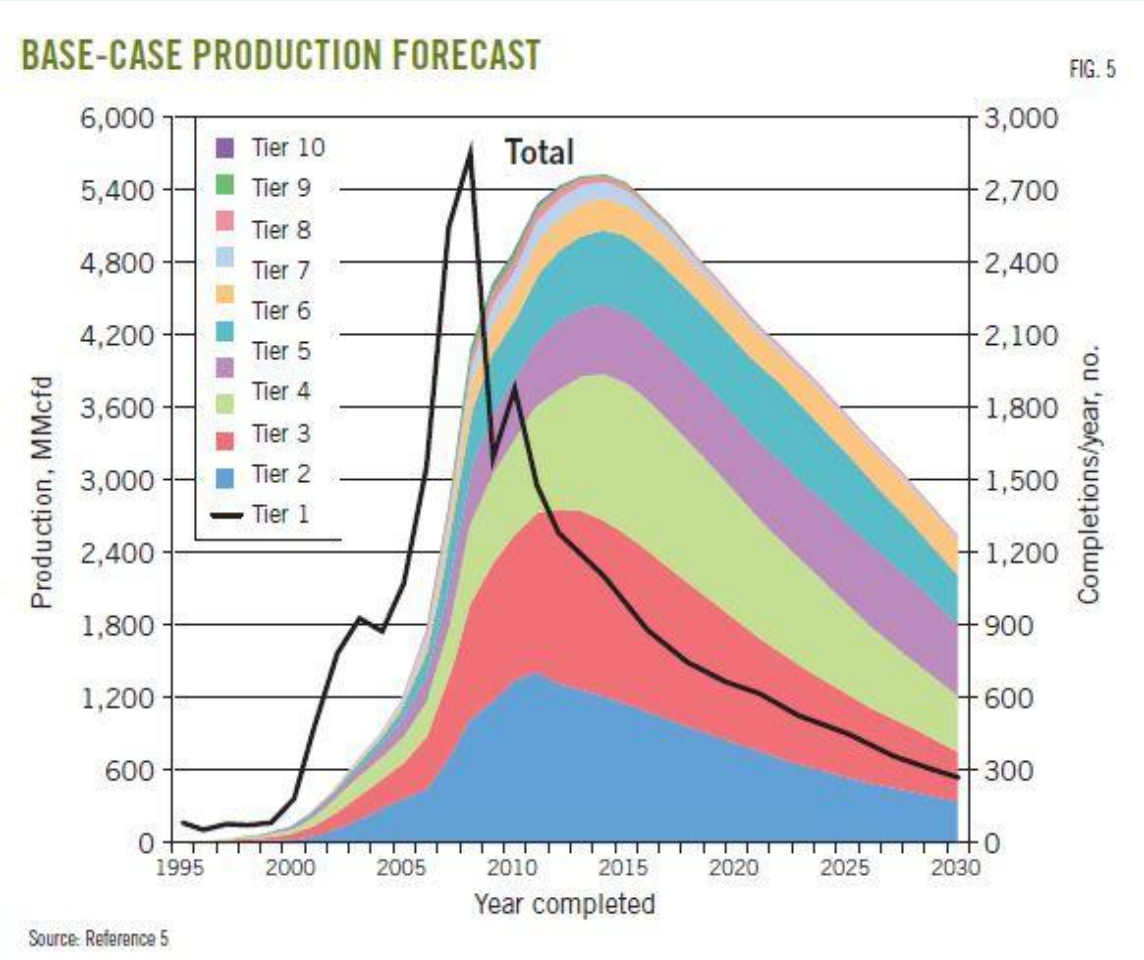
- This is a pivotal point – shale plays cannot produce uniformly across the play
- And the number of major basins is limited so new plays cannot indefinitely replace old declining ones
- In fact we are probably getting close to that point

Shale play: core, periphery, tiers



Fayetteville Shale

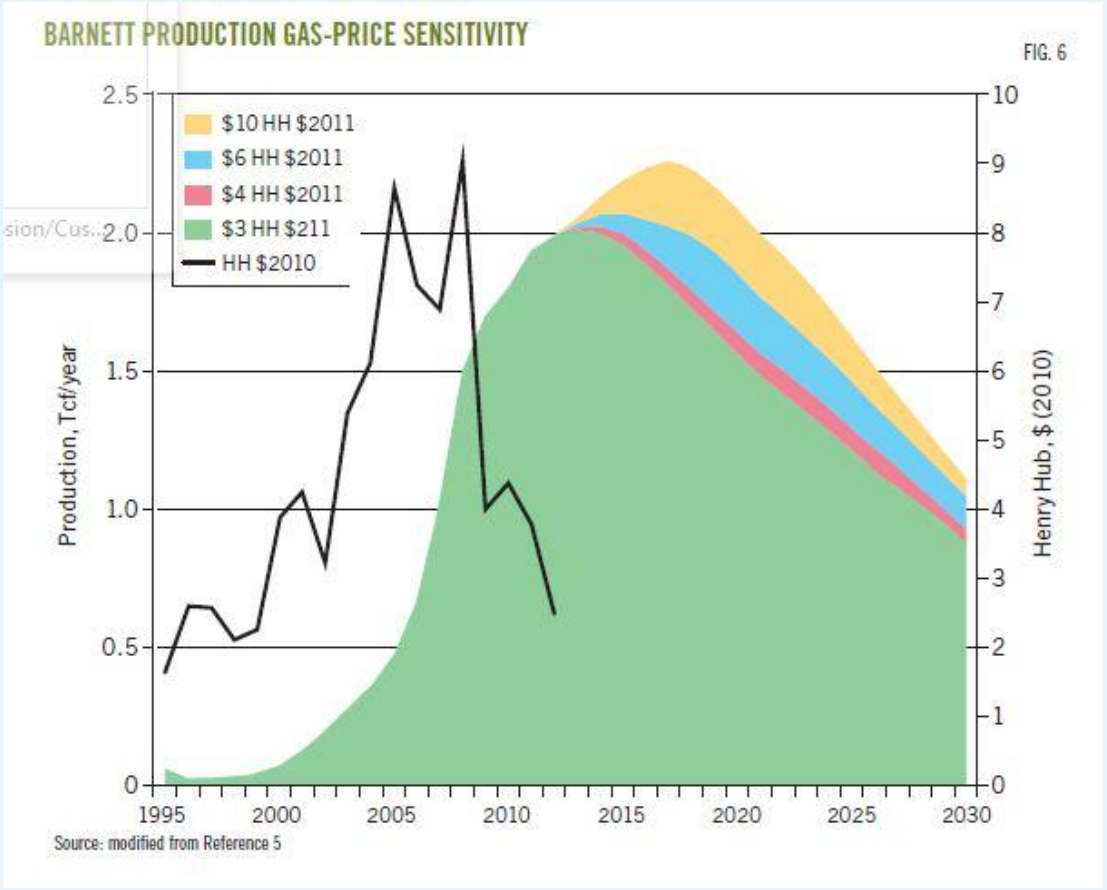
Tiers 1-5 most likely to be commercially viable



UT Austin Bureau of Economic Geology

Barnett Shale

Higher Tiers – higher cost, but not much more gas



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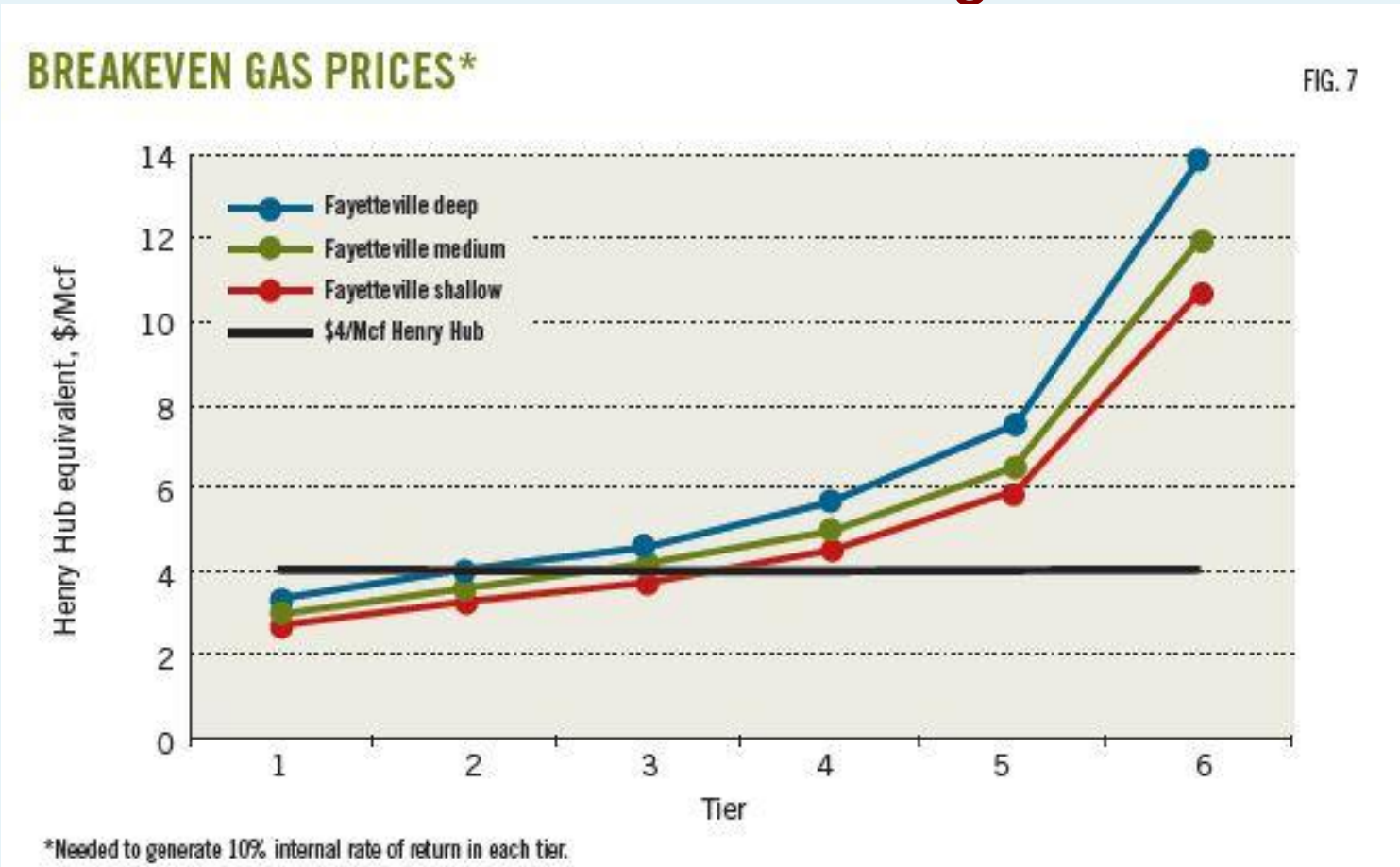
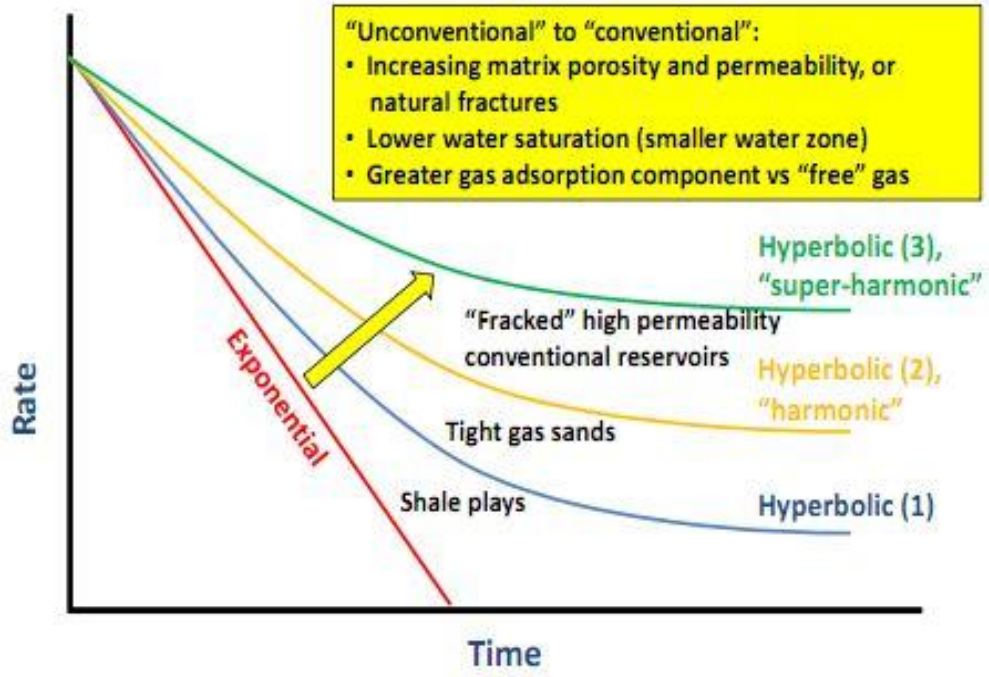


Fayetteville Shale

Shale wells decline fast . . .

Figure 18: Simplified Illustration of Shale Gas Decline Curves

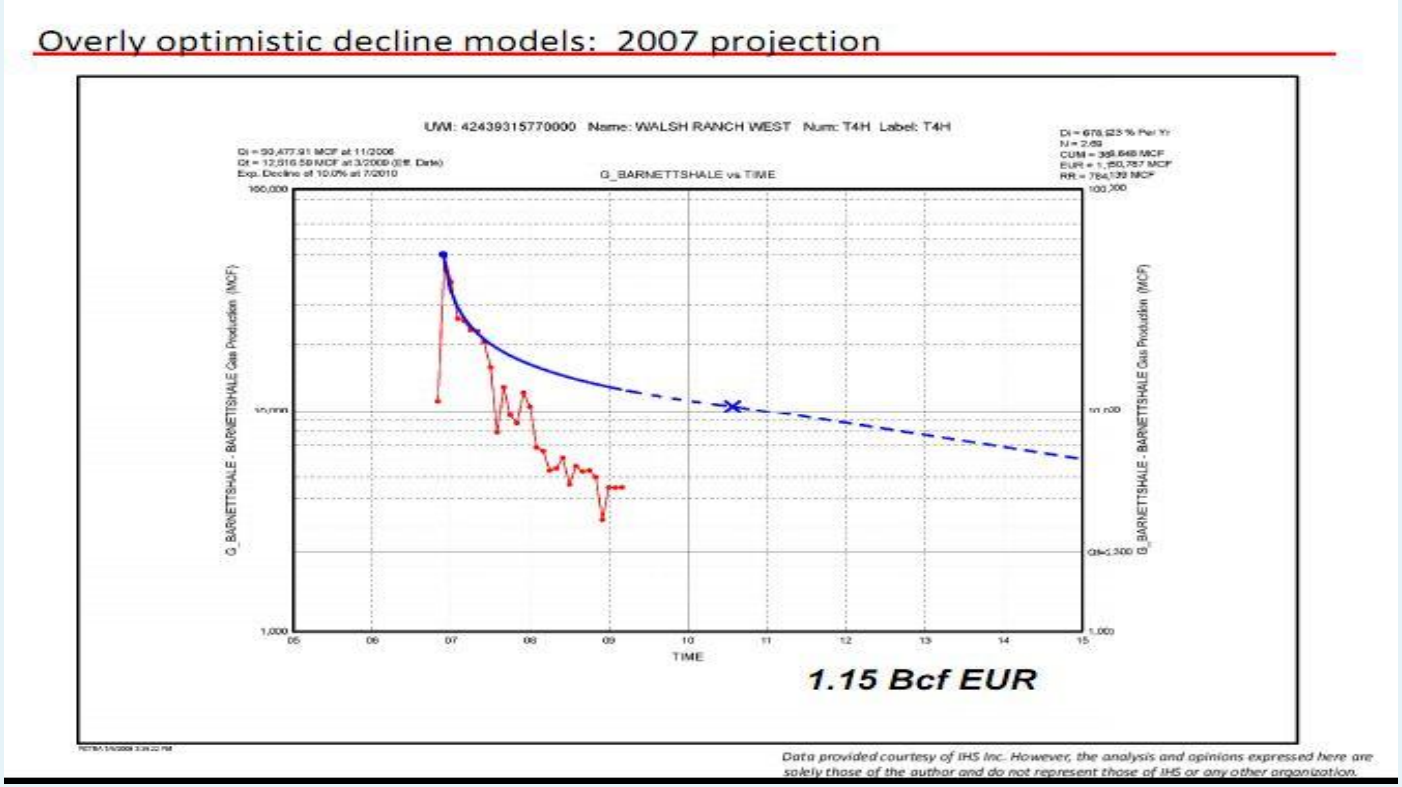
Note: Initial rates set to common value for example only



Sources: Author's compilation.

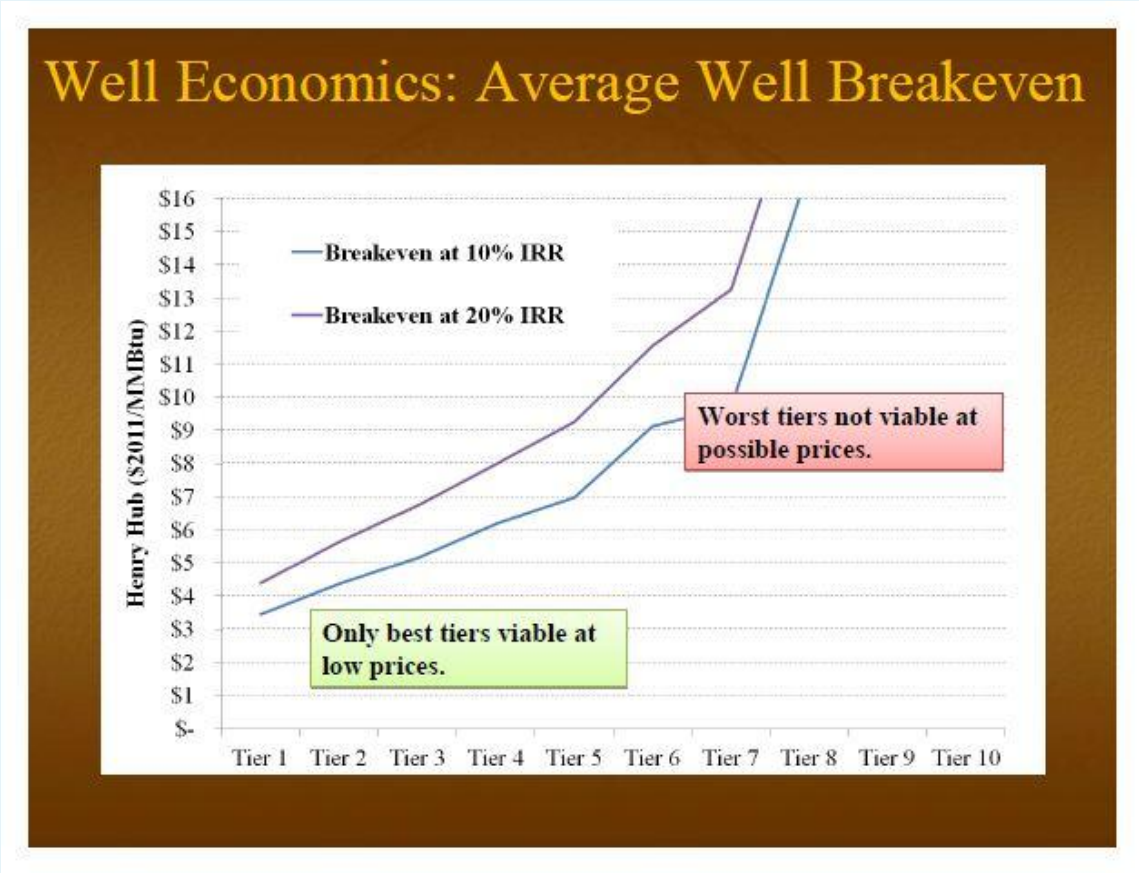
Michelle Foss
UT Austin Bureau of Economic Geology

Early estimates reported best wells in Tiers 1-2-3 -- but experience reduced EURs significantly



Berman's early 1.15 EUR estimate compared to operator reported 3.0+ -- recent analysis by USGS and BEG shows ~ 1.5 Bcf EUR. New modeling at BEG confirms Berman's two-stage hypothesis and creates a replicable physical model of shale production (see Patzek et al, www.pnas.org/cgi/doi/10.1073/pnas.1313380110)

The cost *must* go up . . .



Barnett Shale

Svetlana Ikonnokova
UT Austin Bureau of Economic Geology

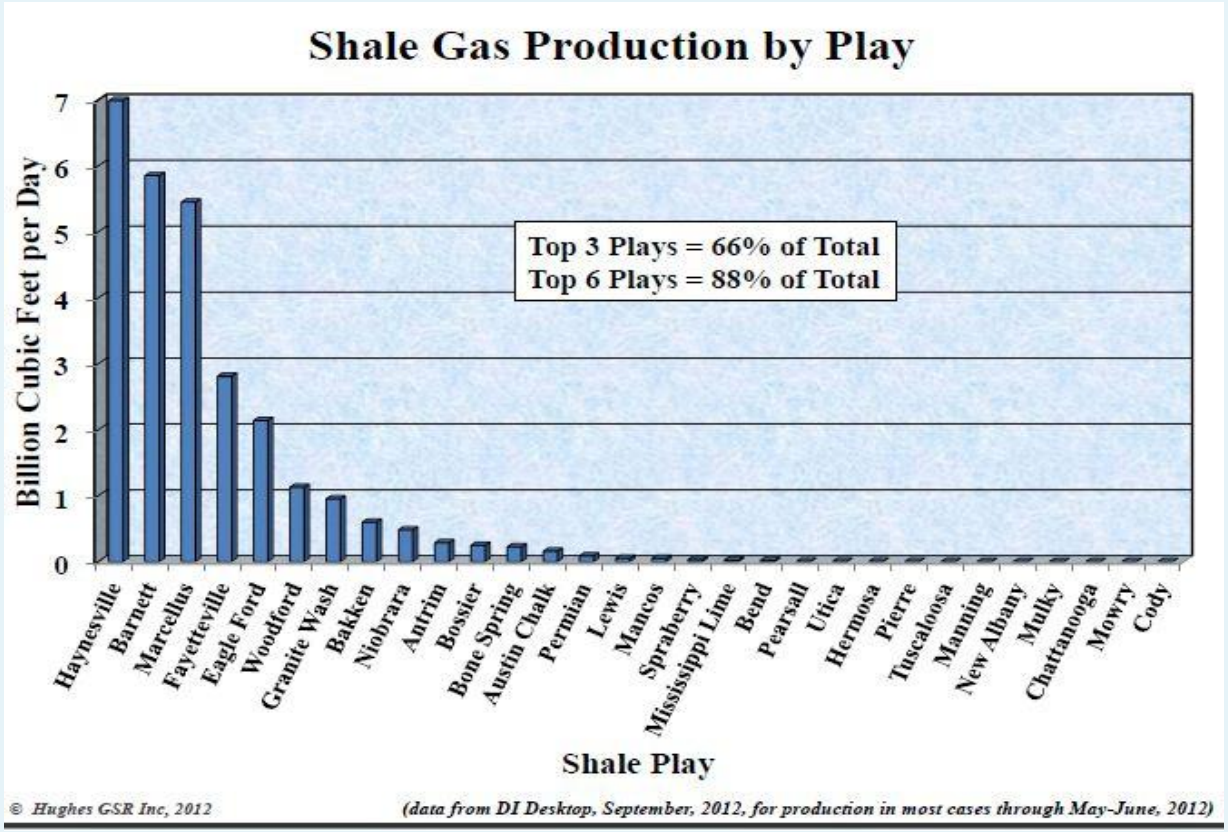
Many Shale Plays

Prepared by Spectra Energy based on information provided by the U.S. Energy Information Administration (EIA).

FIGURE 2. NORTH AMERICAN SHALE PLAYS

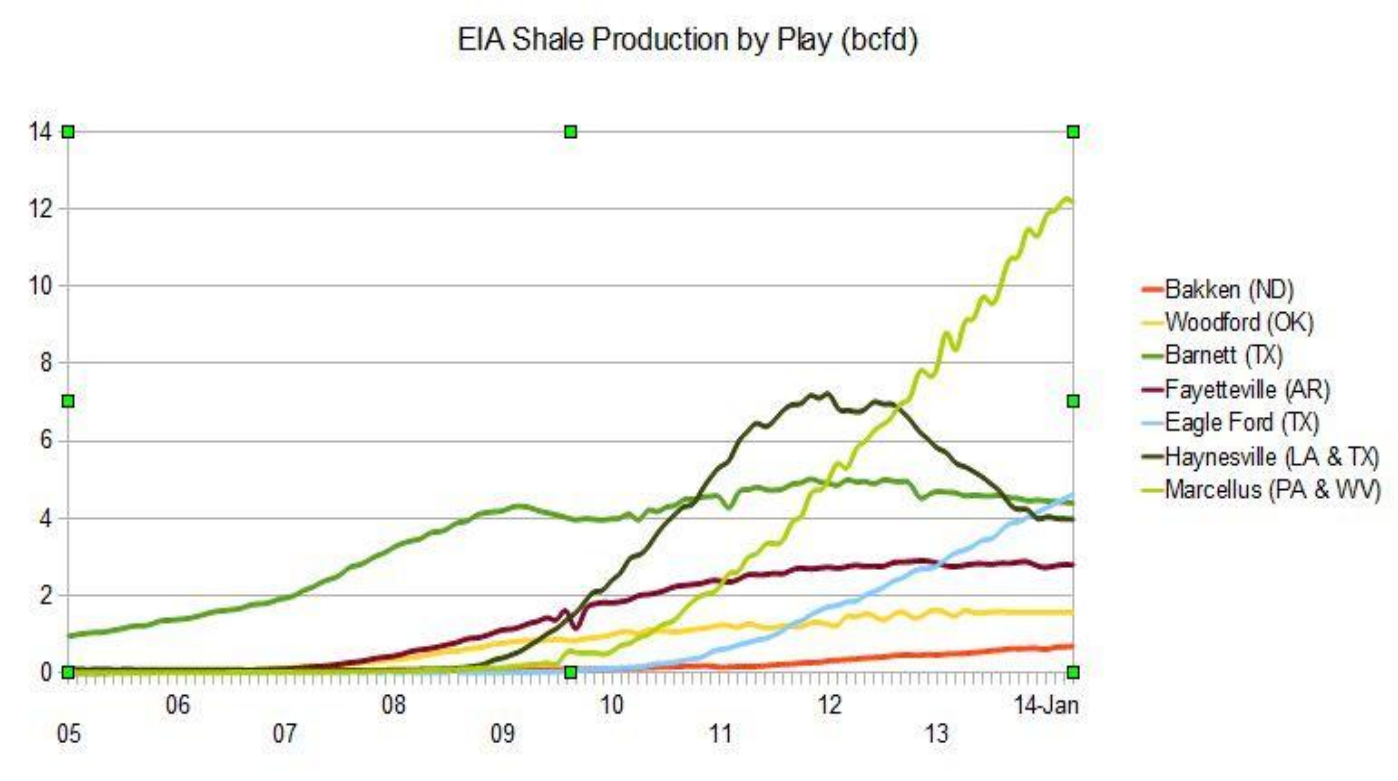
. . . but only 6 really matter . . .

and there is no #7



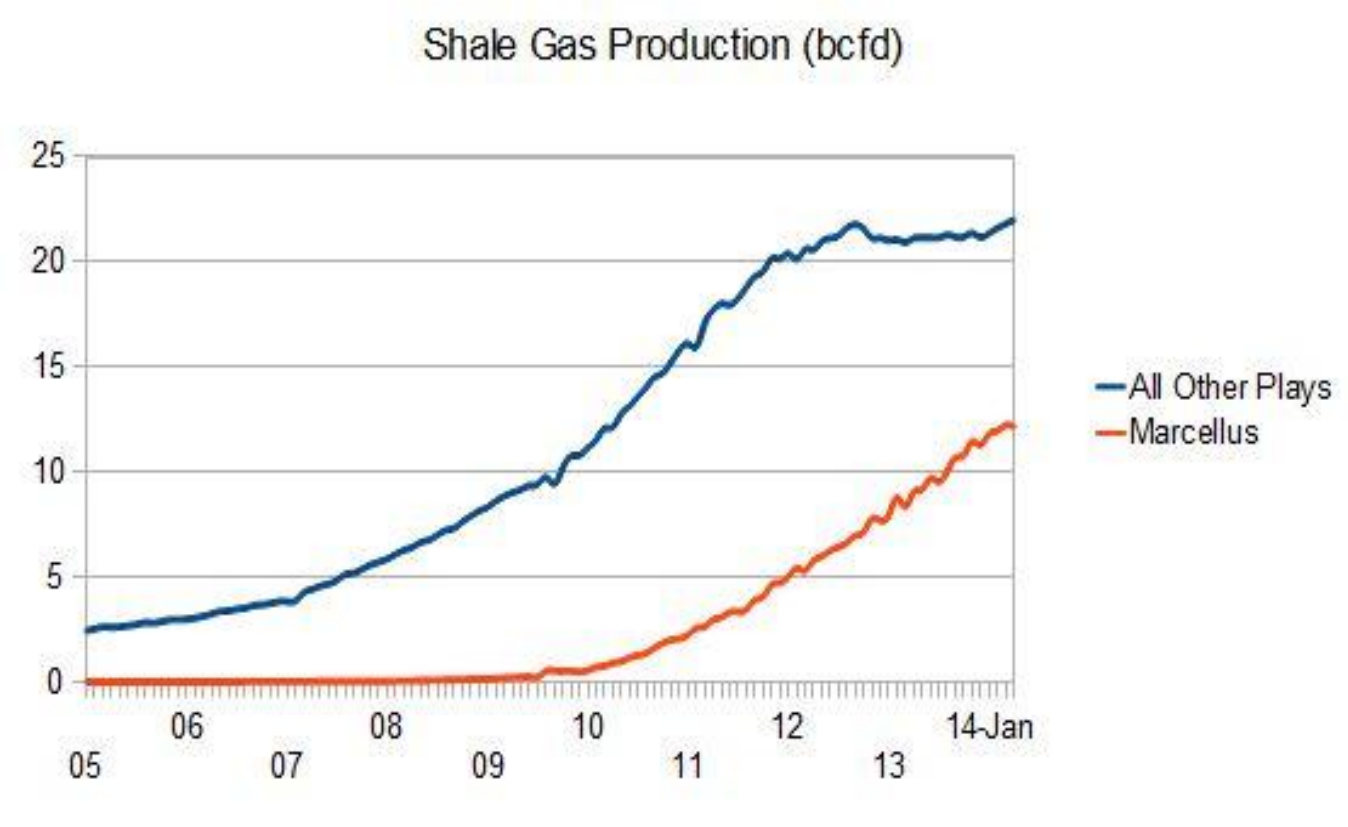
Barnett, Eagle Ford, Fayetteville,
Haynesville, Marcellus + NE BC

State of Play



NWEC

State of Play



NWEC

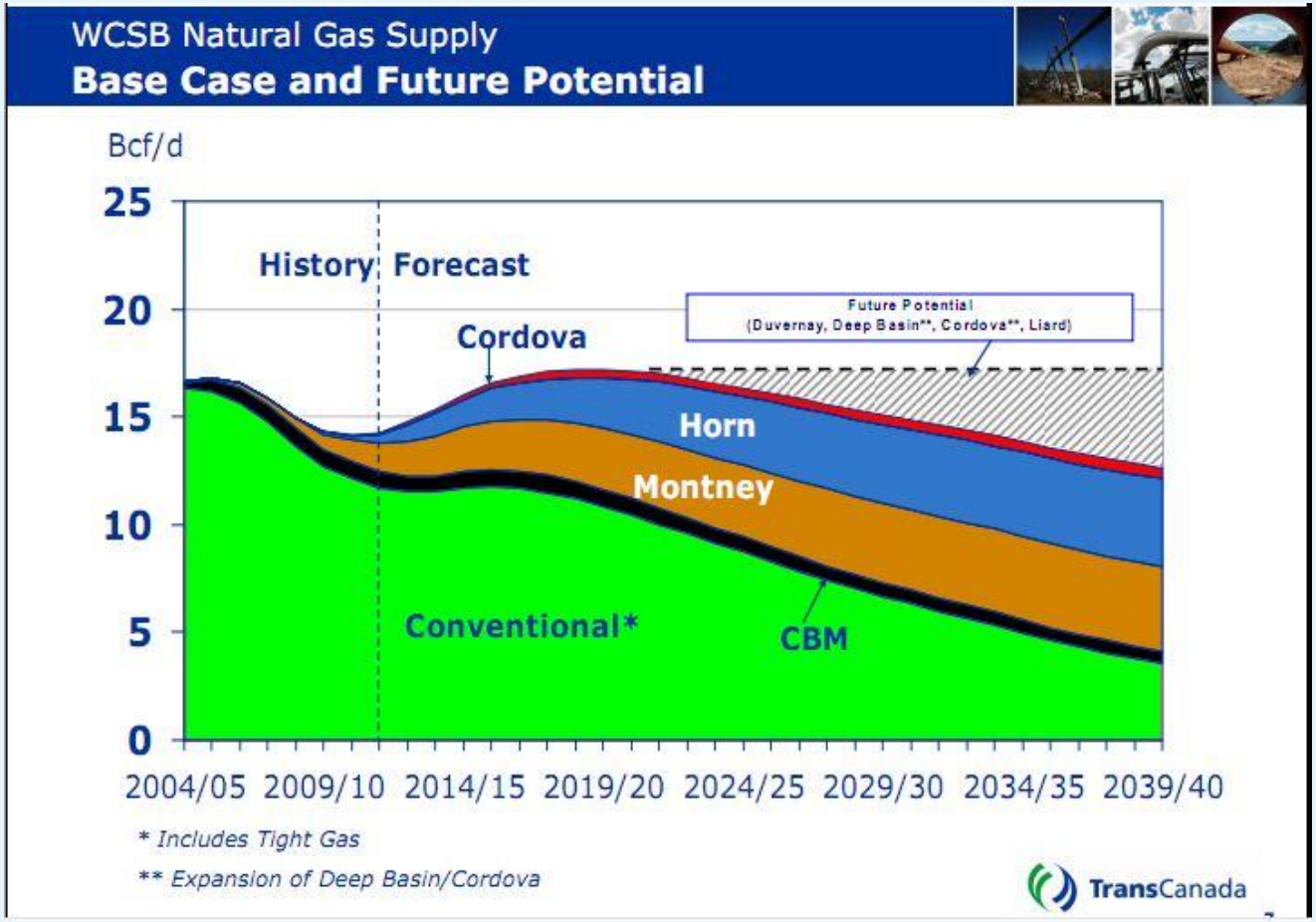
Prognosis for Future Production based on Latest Rig Count

Field	Rank	Number of Wells needed annually to offset decline	Wells Added for most recent Year	October 2012 Rig Count	Prognosis
Haynesville	1	774	810	20	Decline
Barnett	2	1507	1112	42	Decline
Marcellus	3	561	1244	110	Growth
Fayetteville	4	707	679	15	Decline
Eagle Ford	5	945	1983	274	Growth
Woodford	6	222	170	61	Decline
Granite Wash	7	239	205	N/A	Decline
Bakken	8	699	1500	186	Growth
Niobrara	9	1111	1178	~60	Flat

David Hughes

No miracle in #6 either . . .

projections



No miracle in #6 either . . .

BC actuals increasing but --

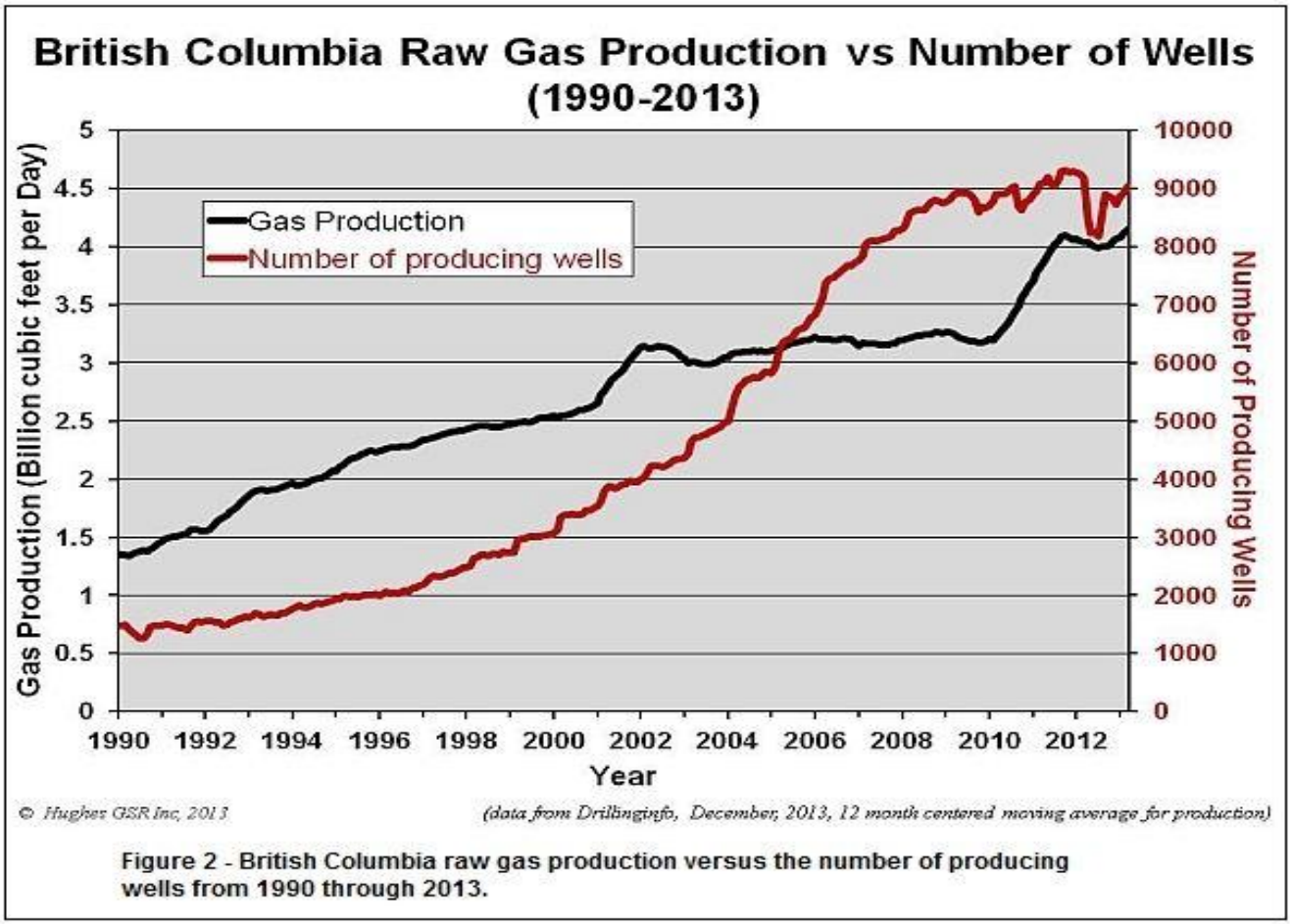


Figure 2 - British Columbia raw gas production versus the number of producing wells from 1990 through 2013.

No miracle in #6 either . . .

WCSB conventional in terminal decline

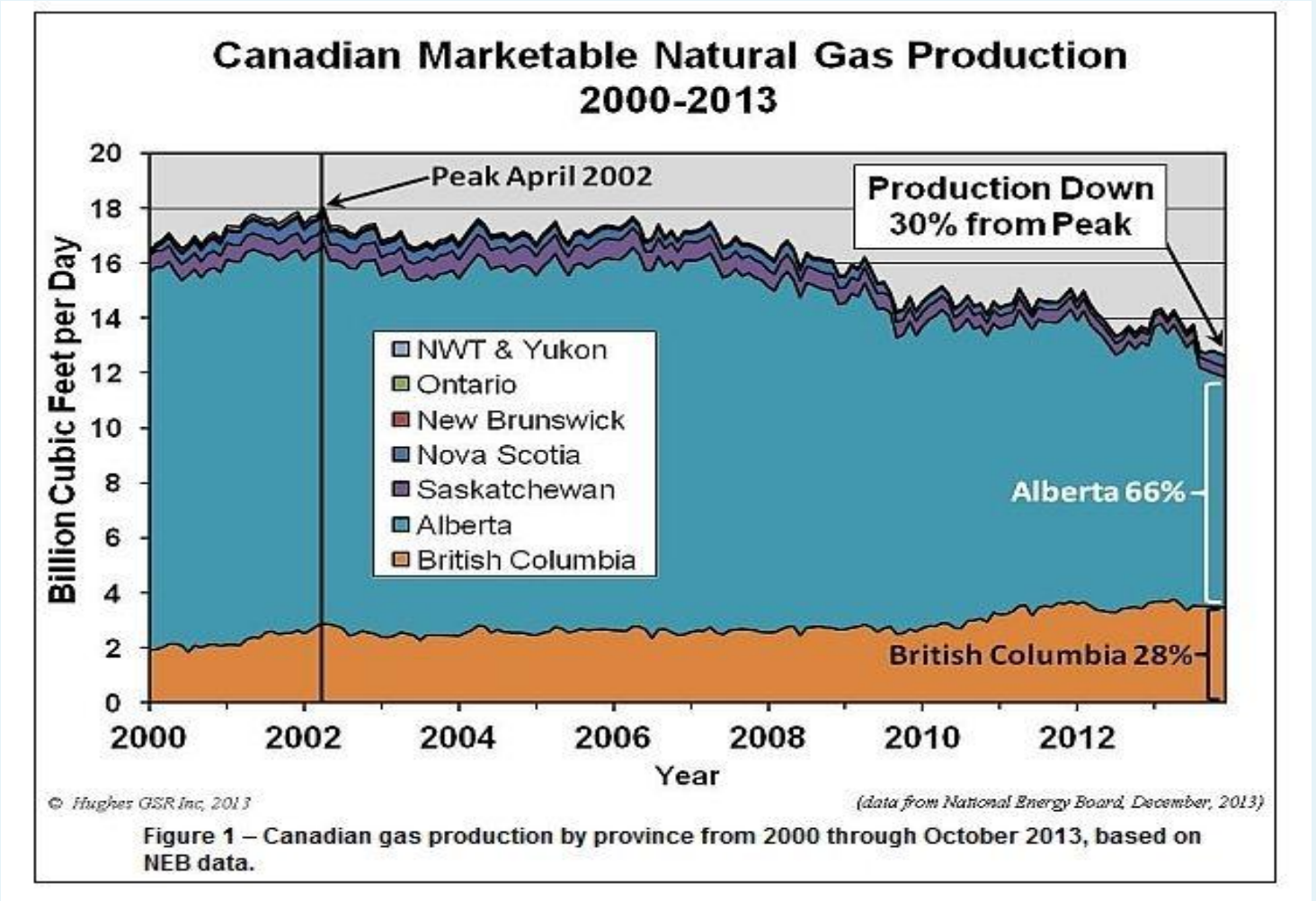
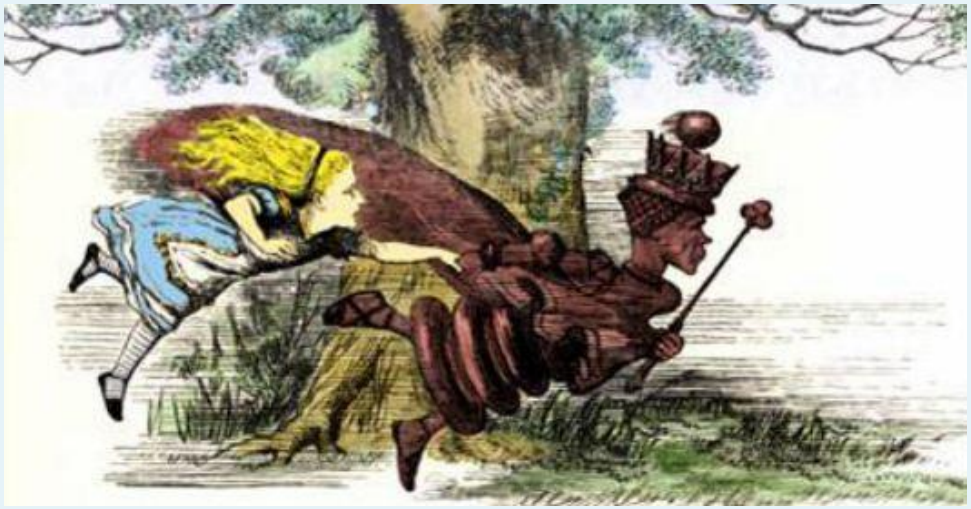


Figure 1 – Canadian gas production by province from 2000 through October 2013, based on NEB data.

The Red Queen Effect



'Well, in our country,' said Alice, still panting a little, 'you'd generally get to somewhere else — if you ran very fast for a long time, as we've been doing.'

'A slow sort of country!' said the Queen. 'Now, here, you see, it takes all the running you can do, to keep in the same place.

If you want to get somewhere else, you must run at least twice as fast as that!'

Shale Treadmill: $40+ Billion (and rising)

Annual Capex Required to Offset Overall Annual Decline by Shale Play

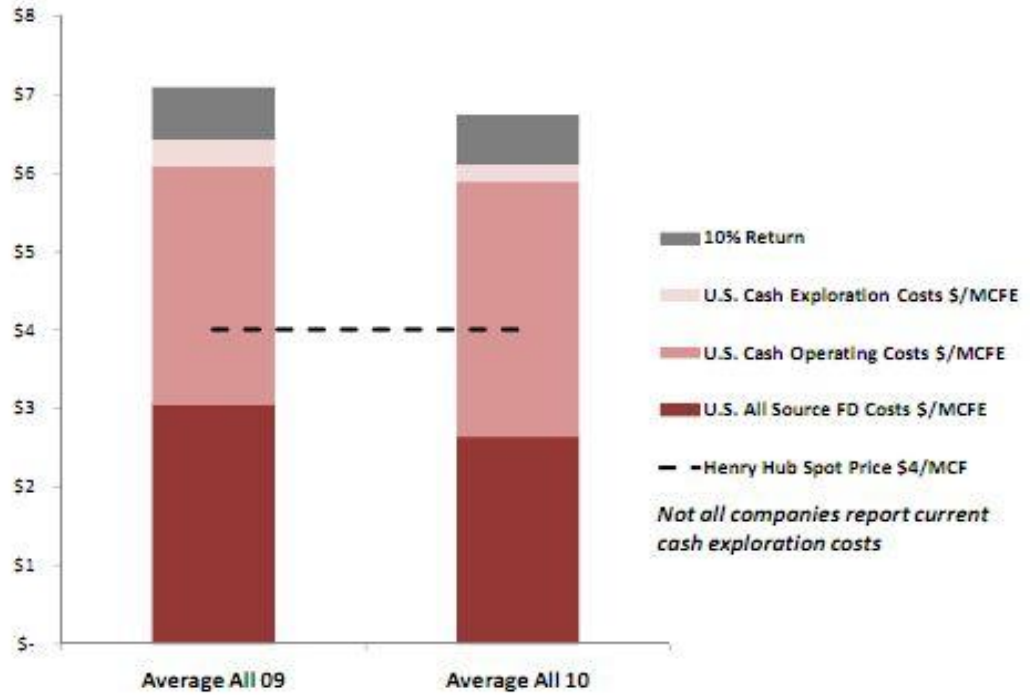
Field	Rank	Number of Wells needed annually to offset decline	Approximate Well Cost (million $US)	Annual Well Cost to Offset Decline (million $US)
Haynesville	1	774	9.0	6966
Barnett	2	1507	3.5	5275
Marcellus	3	561	4.5	2525
Fayetteville	4	707	2.8	1980
Eagle Ford	5	945	8.0	7558
Woodford	6	222	8.0	1776
Granite Wash	7	239	6.0	1434
Bakken	8	699	10.0	6990
Niobrara	9	1111	4.0	4444
Antrim	10	~400	0.5	200
Bossier	11	21	9.0	189
Bone Spring	12	206	3.7	762
Austin Chalk	13	127	7.0	889
Permian Delaware Midland	14	122	6.9	842
Total		7641		41829

(well cost data from various sources and is approximate)

David Hughes

Shale Gas (true) cost: ~ $6

Figure 14: Total Average Breakeven Costs, All U.S. Natural Gas Producers



Sources: Compiled by author based on work by Foss and Wainberg using industry financial reports.

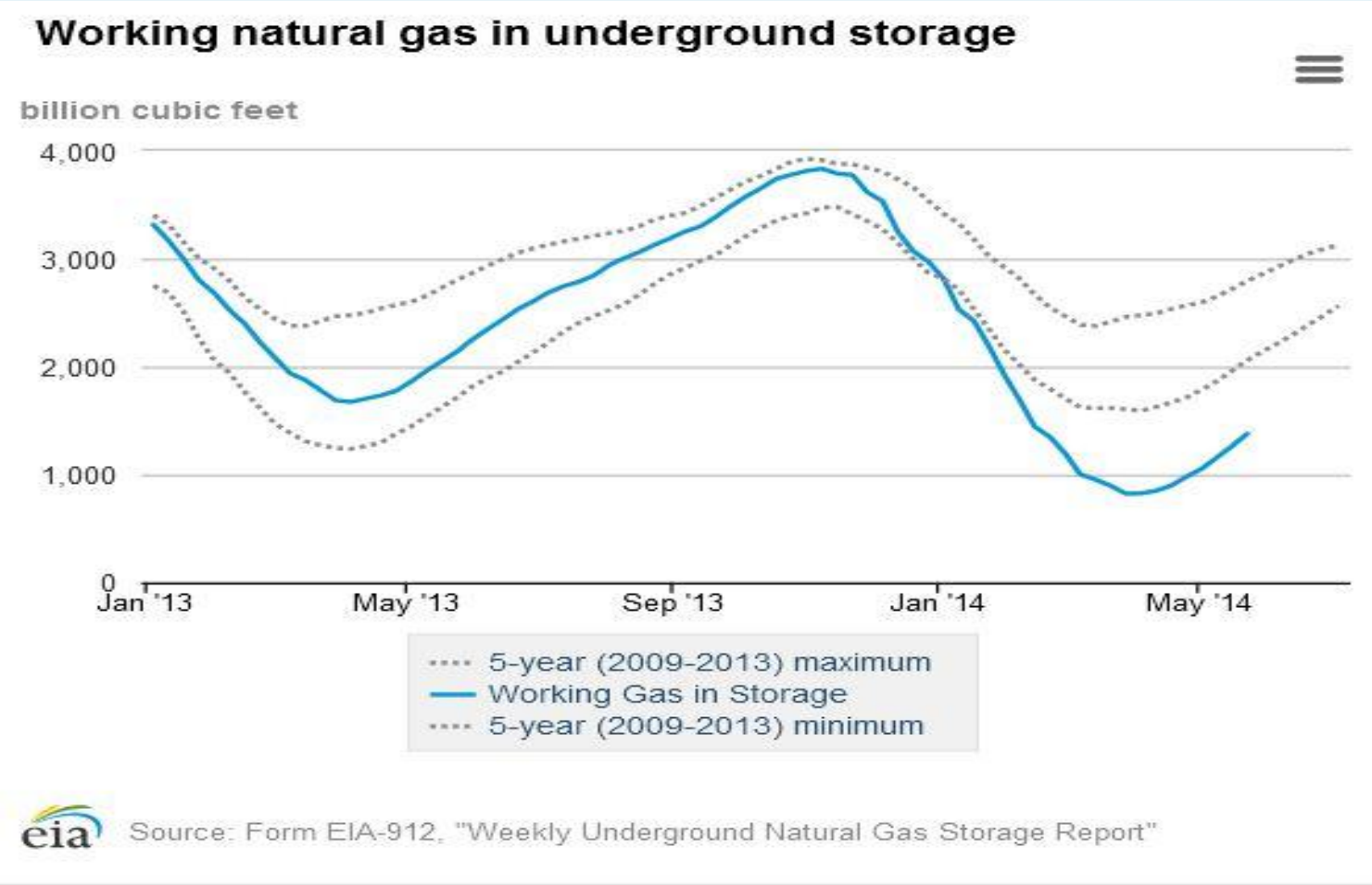
Michelle Foss
UT Austin Bureau of Economic Geology

How could $6 gas sell for $4 (or less) for 4+ years?

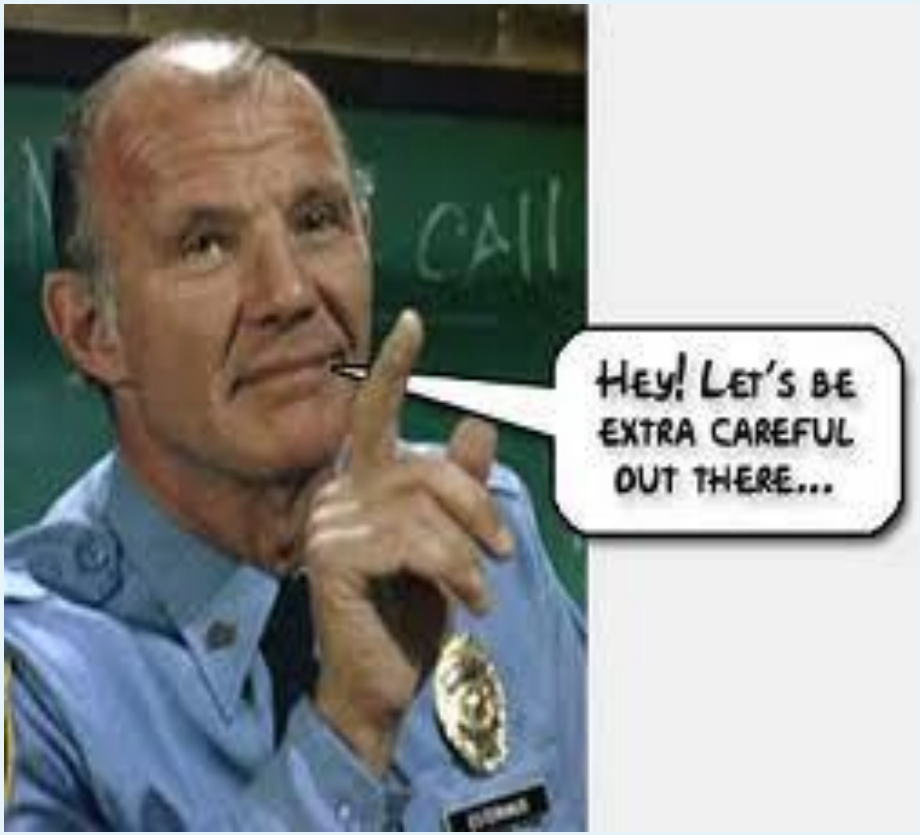
- “imperfect storm” -- 2010-14 chronic oversupply condition
  new plays/low cost tiers came in early
  post-recession demand slump
  “held by production” leasing model
  subsidies from associated production (oil, NGL)
  weather: series of mild winters
- consequences
  demand rebuilt (market share from coal, industrial rebound)
  eroding inventory/storage levels
  writeoffs/loss sales/negative free cash flow (undercuts new drilling)
- "the market is working" (slowly)

Polar vortex marks “return to normal volatility”

Trouble ahead . . .



Thank you for your attention and . . .



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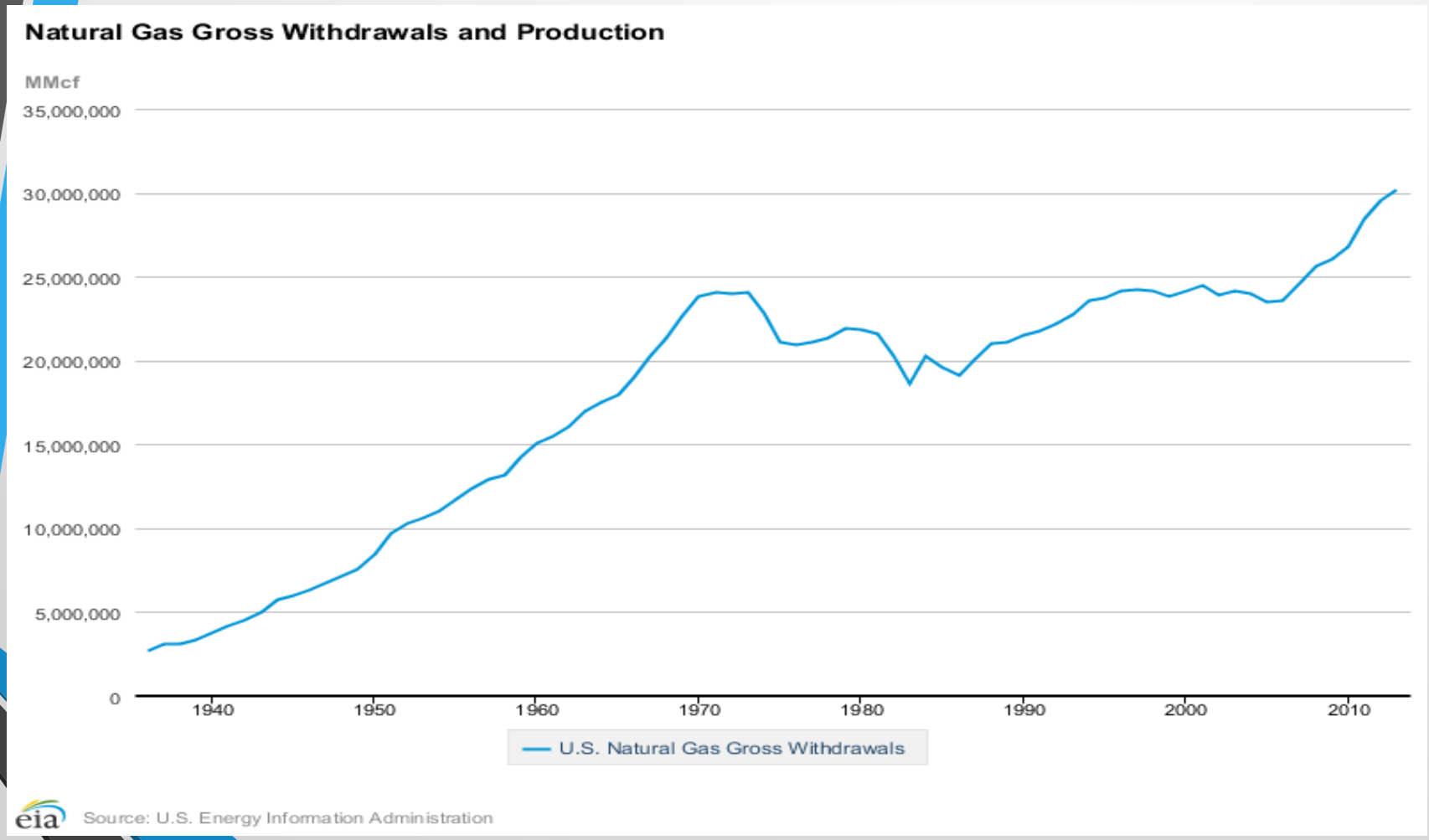
Shale Natural Gas – Need for and Possible Results of Regulations

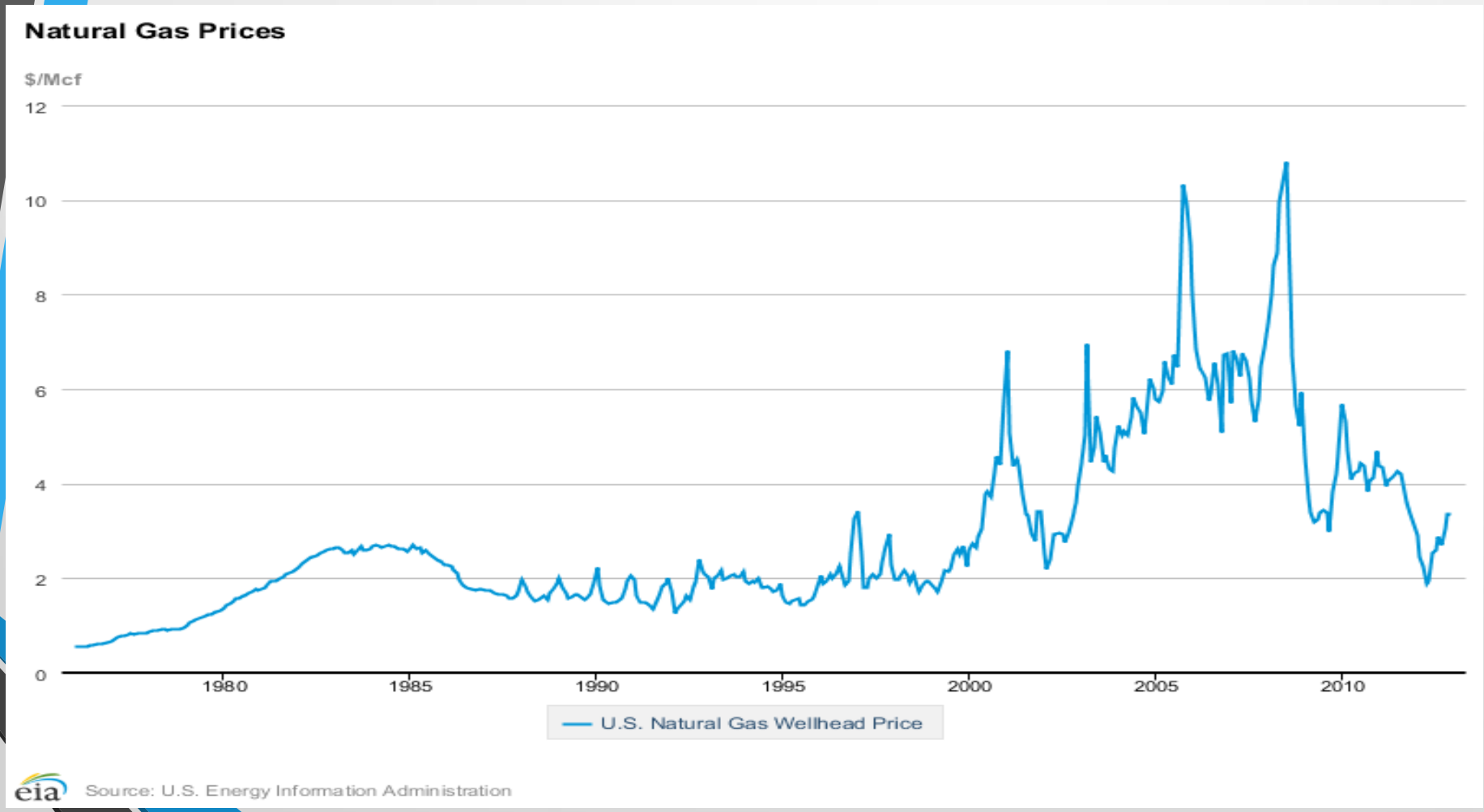
Kenneth R. Zimmerman, PhD

The History Business

Shale Gas has lead to increased production



Shale Gas has lead to lower natural gas prices



Shale Gas has helped reduce CO_2 emissions

U.S. greenhouse gas emissions, 1990, 2005, 2008, and 2009

	1990	2005	2008	2009
Estimated emissions (million metric tons CO_2e)	6,133.2	7,109.4	6,983.1	6,575.5
Change from 1990 (million metric tons CO_2e)		976.1	849.8	442.3
(percent)		*15.9%*	*13.9%*	*7.2%*
Average annual change from 1990 *(percent)*		*1.0%*	*0.7%*	*0.4%*
Change from 2005 (million metric tons CO_2e)			-126.3	-533.8
(percent)			*-1.8%*	*-7.5%*
Change from 2008 (million metric tons CO_2e)				-407.5
(percent)				*-5.8%*

But Shale gas has also lead to new concerns

- What chemicals are injected and what impacts do they have?
- Does the injection process itself have negative results, e.g., earthquakes?
- What are the impacts on air quality? Climate change?
- What are the impacts on water quality and conservation (water over use)?
- What are the impacts on "quality of life?"
- With extra supply, should the US export natural gas? What are the consequences if it does? If it does not?
- Does shale gas impede the switch from prime reliance on fossil fuels to prime reliance on "renewable energy?" If so, with what consequences.

Regulations For these Concerns and Results

- **Fracking Chemicals**
  - ✓ **Data base**
  - ✓ **Lawsuits about each chemical**
  - ✓ **Liability for damage from chemicals**
- **Injection Process**
  - ✓ **Drinking water (ground, aquifer, well) contamination – Testing and compensation**
  - ✓ **Earthquakes and damages to building and persons resulting from these**

Regulations For these Concerns and Results

- **Air Quality**
  - ✓ **Violations of Clean Air Act requirements**
  - ✓ **Restrictions on trucks and numbers of well sites and platforms**
- **Climate Change**
  - ✓ **Even with added shale gas CO_2 in the atmosphere reached a record level in 2012 of 393.1 ppm, an increase of 0.56 percent**
  - ✓ **Methane emissions increased by 6 ppm per year since 2006, perhaps in part due to increases in shale drilling**

Regulations For these Concerns and Results

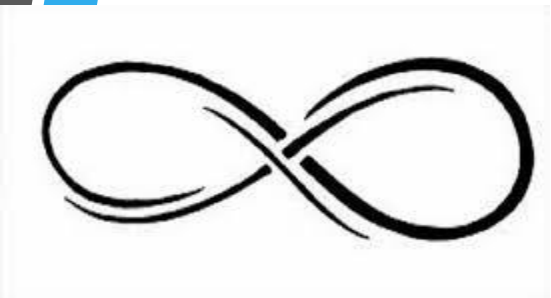
- **Water**
  - ✓ **Fixing and/or reversing impacts on drinking water under Clean Water Act**
  - ✓ **Finding, testing, using alternatives to portable water for fracking, e.g., waste water, other chemicals**
  - ✓ **Dealing with restrictions on volume of water use**
- **Quality of life**
  - ✓ **Industrialization of rural areas and communities**
  - ✓ **Thousand fold or more increase in industrial truck traffic**
  - ✓ **New pipelines and other transport/storage infrastructure in rural areas**

Regulations For these Concerns and Results

- **Expansion of natural gas exports**
  - ✓ **Controlling and/or mitigating added GHG emissions**
  - ✓ **Impacts of new export terminals on various US coasts, e.g. Pacific Northwest**
- **Impeding switch to renewable energy and reductions in use of fossil fuels**
  - ✓ **Making up for losses in rate and level of new technology development in US**
  - ✓ **Addressing the climate and weather consequences of failures to reduce use of fossil fuels, since fracking helps prolong the use of these fuels**

The rejection of an Ohio fracking ban on Monday affirms the notion that many people are opening up to the idea of allowing fracking in their community, despite large opposition and some very valid concerns about its safety. This is the third time in the past year that the ban has been rejected. Armed with support from local unions and industry groups that think fracking is safe and can help create jobs, this rejection was a blow to groups trying to condemn the practice. Even though there have been recent reports of mild earthquakes in Ohio tied directly to fracking, it appears that residents of small towns are not fearful of them yet.

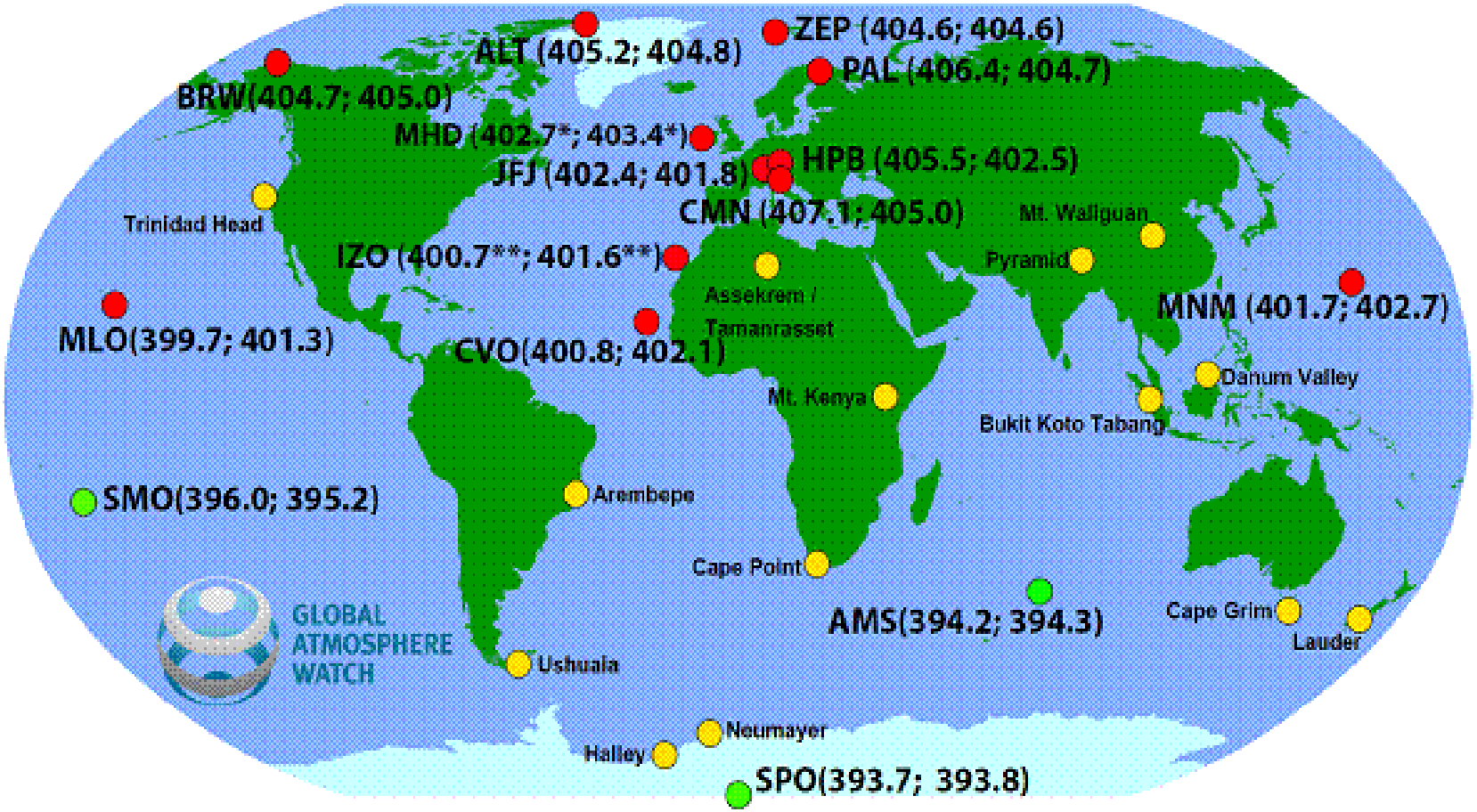
Wayne Kovach – Your Energy Blog, May 14, 2014



The History Business

History is always new and unexpected

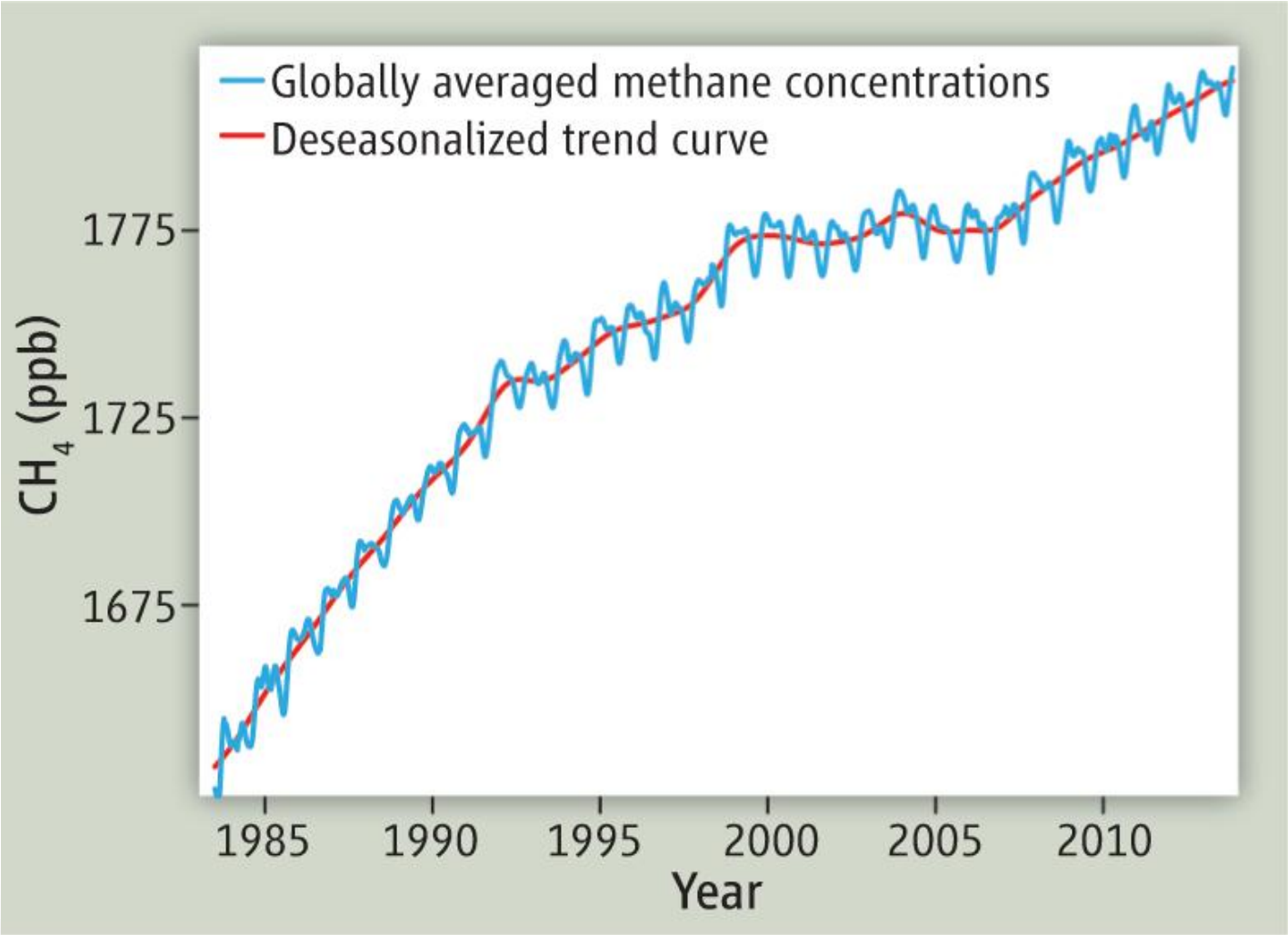
Preliminary CO2 mole fractions at the GAW global stations (March 2014; April 2014)



* data are filtered for clean sector

** only night-time values are used to calculate monthly mean

Methane ups and downs.
Globally averaged atmospheric methane concentrations rose quickly before 1992.

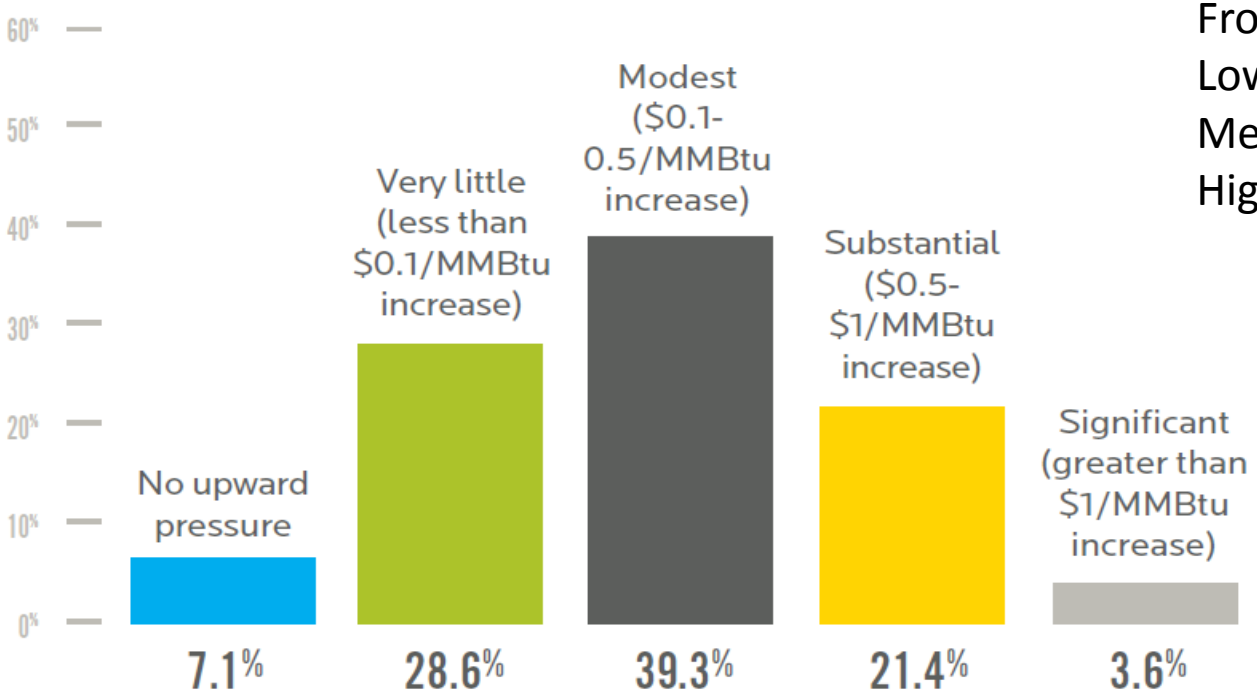


Science
AAAS

E G Nisbet et al. Science 2014;343:493-495

Impact of Environmental Concerns on Shale Gas Prices

FIGURE 25
IMPACT OF ENVIRONMENTAL CONCERNS ON SHALE GAS PRICES



From Poll in (2012$/mmBtu)*
Low: $0.28
Med: $0.45
High: $0.67

Source: Black & Veatch
More than 75 percent of Upstream value chain participants believe environmental concerns regarding the hydraulic fracturing process will have no to only a modest impact on the price of shale gas.

What would you recommend

- Should we add the regulatory costs to the natural gas prices?
- Consider the regulatory cost as already included in the high price range?

Break

Tentative Agenda
Natural Gas Advisory Committee
Northwest Power and Conservation Council
851 S.W. Sixth Avenue
Suite 1100
Portland Oregon 97204-1348

June 6h, 2014
9:00 AM to 12:30 PM
Instructions for GoToMeeting provided below

1. Welcome and introductions	9:00 to 9:15
2. Future of industrial use of natural gas in the NW (Ed Finklea)	9:15 to 9:45
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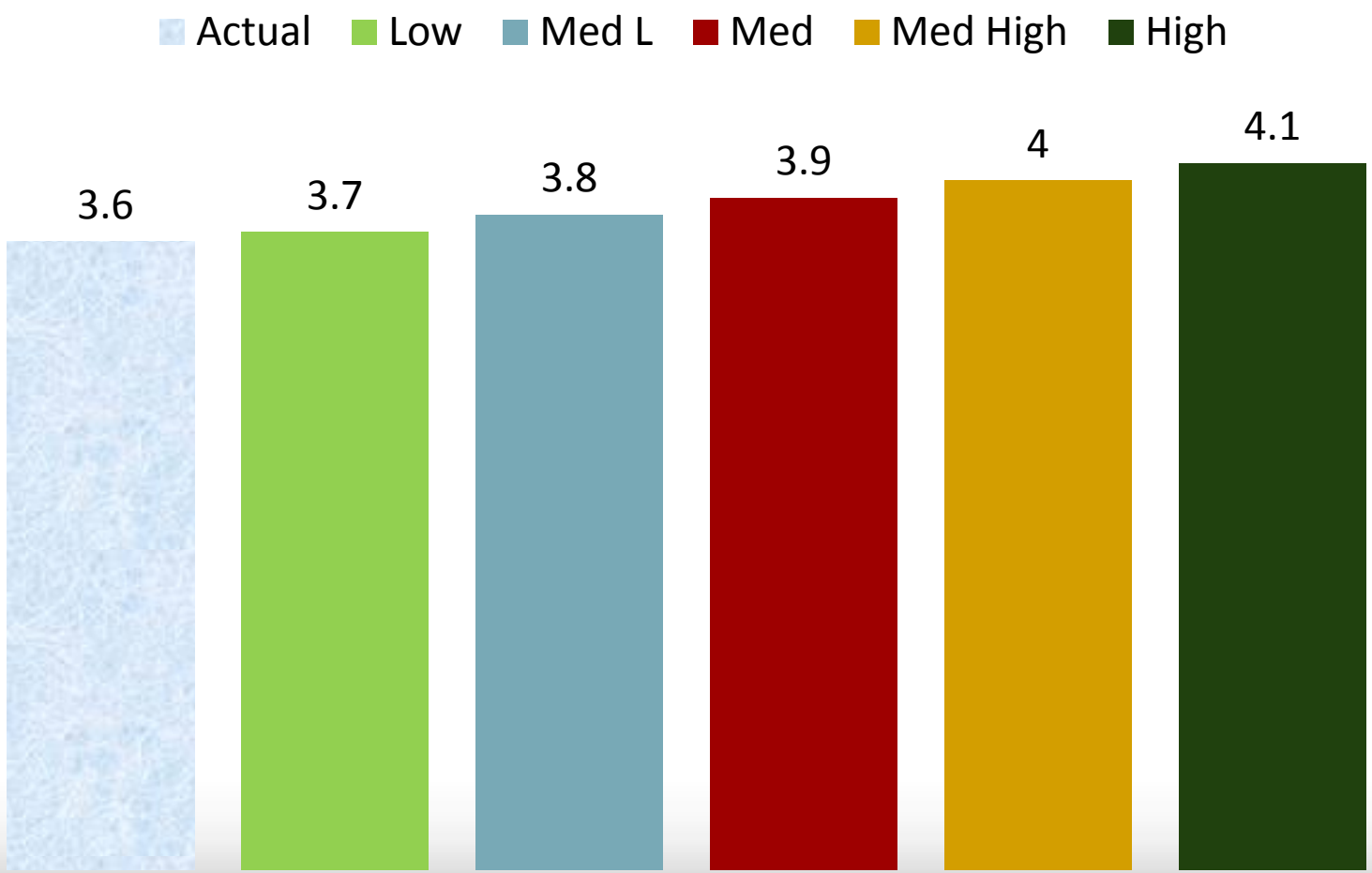
a. Preliminary result of fuel price poll	
b. Comparison to other forecasts	
7. Monthly Burner-tip gas prices	12:00 to 12:20
8. Next steps	12:20 to 12:30

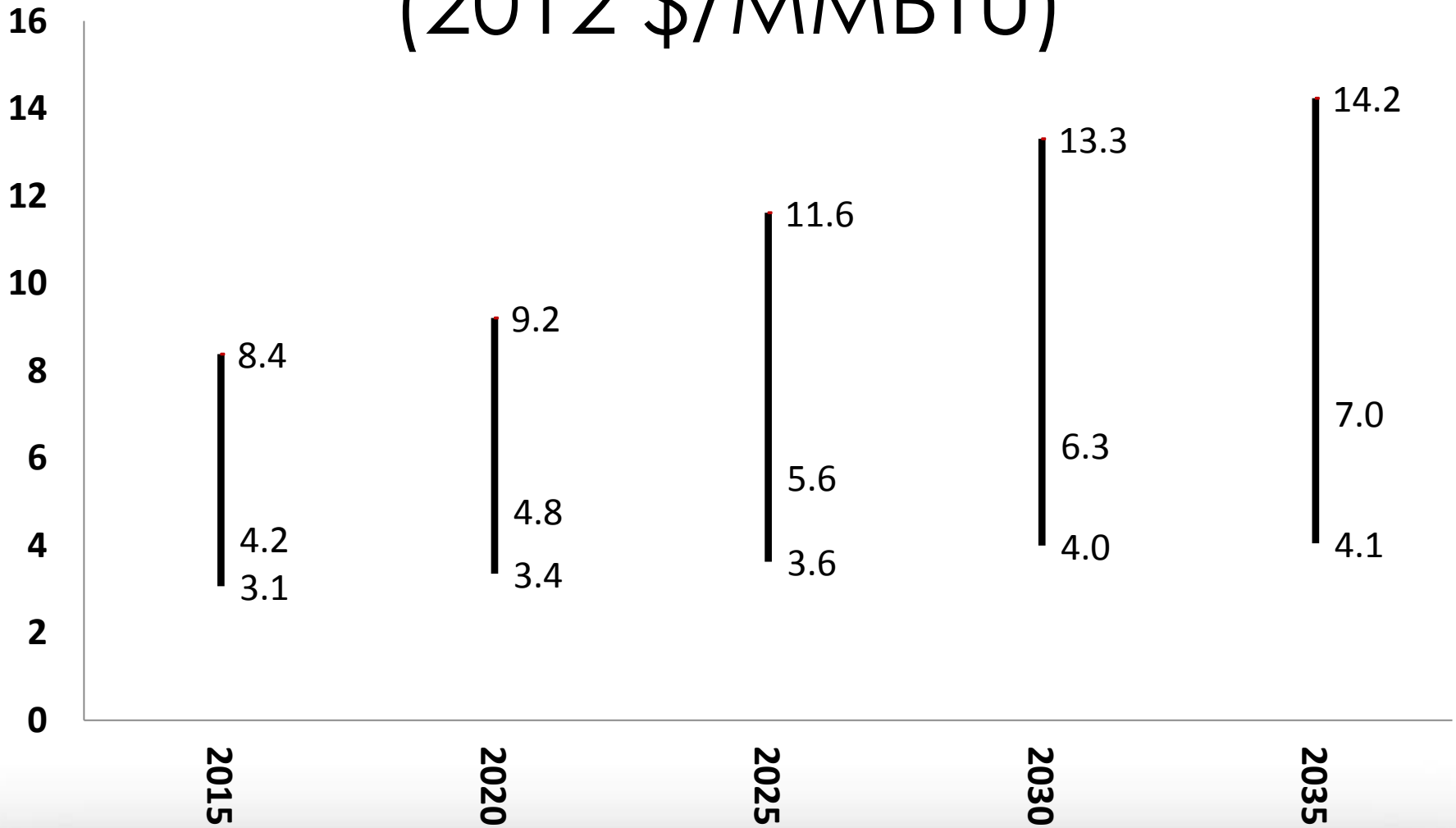
Natural Gas Strawman Price Proposal for 2015-2035

- Actual vs projected prices for 2013

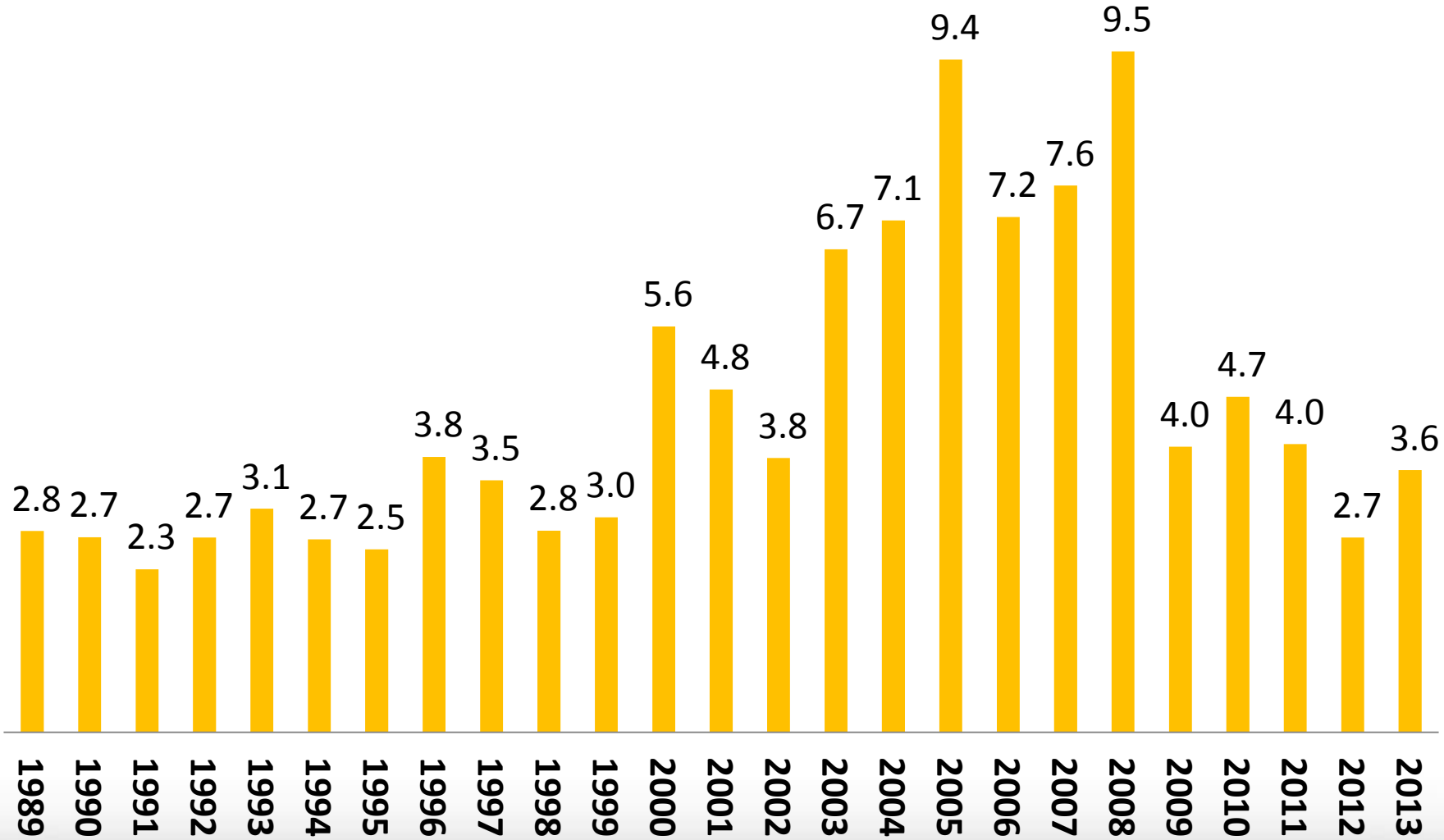
Comparison of 2013 Actual & Forecast of Henry Hub natural gas Prices in $2012/mmbtu



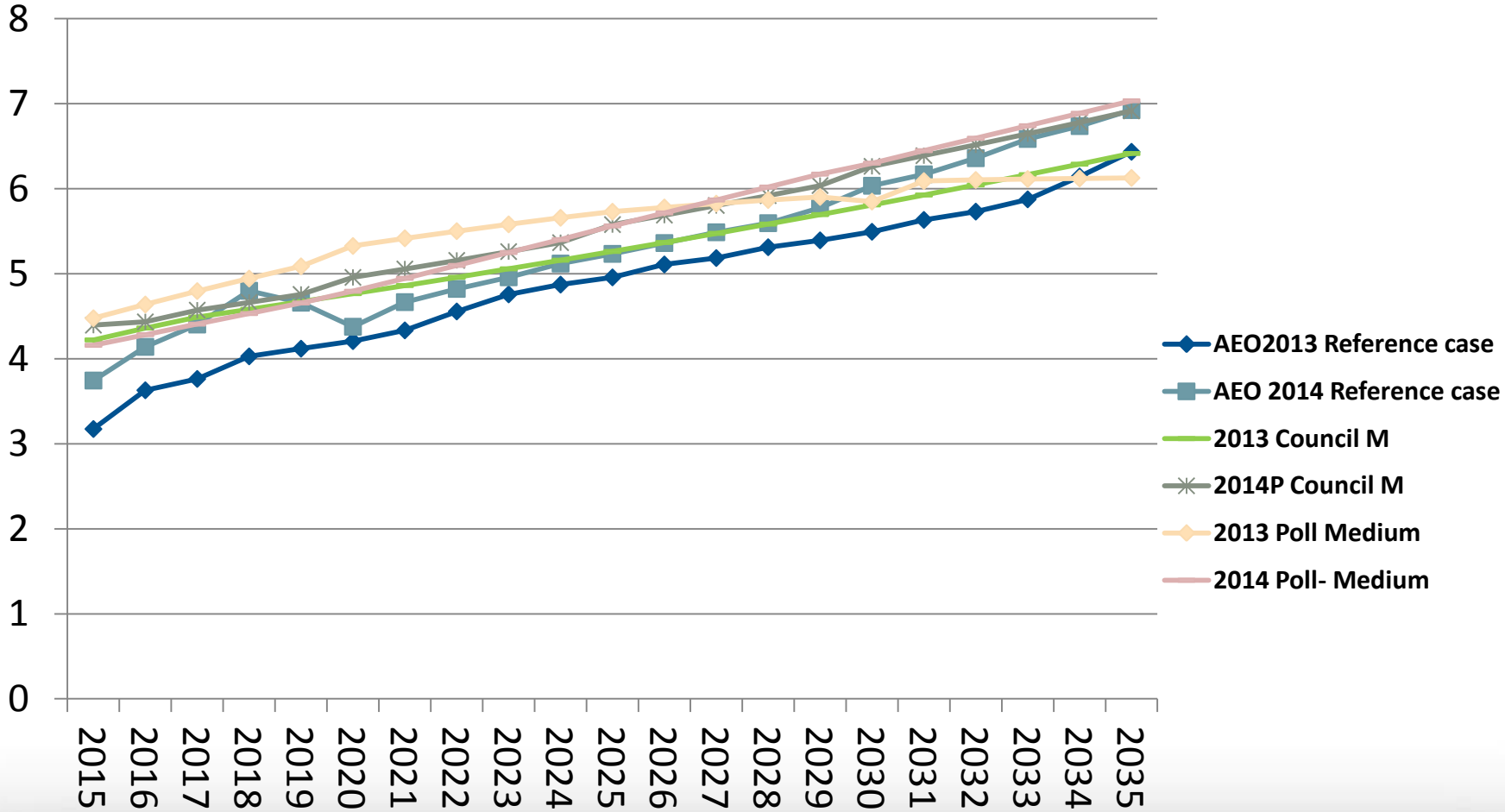
Range of HH Prices from Poll (2012 $/MMBTU)



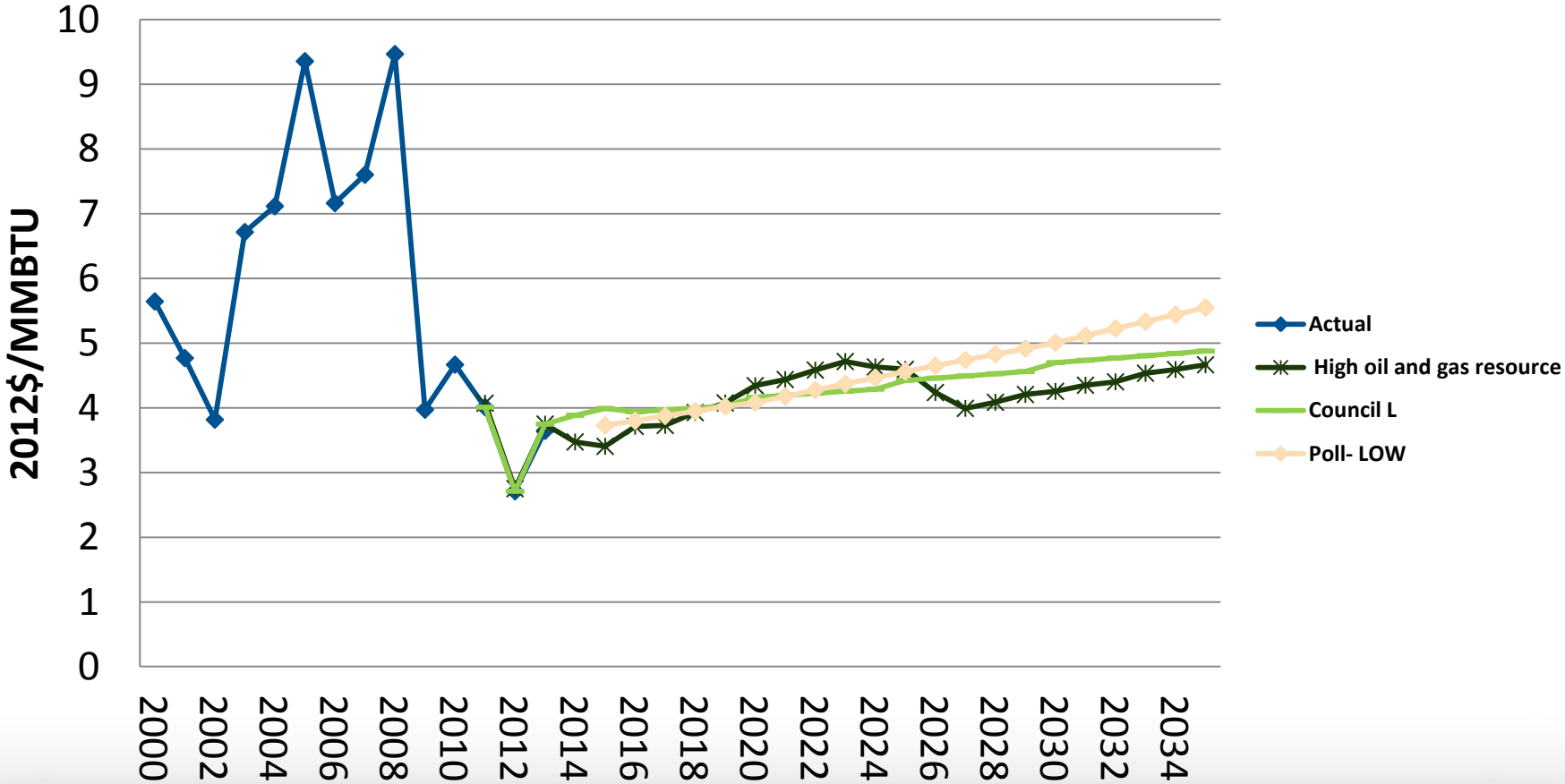
History of Natural Gas Prices at Henry Hub (2012$/Million Btu)



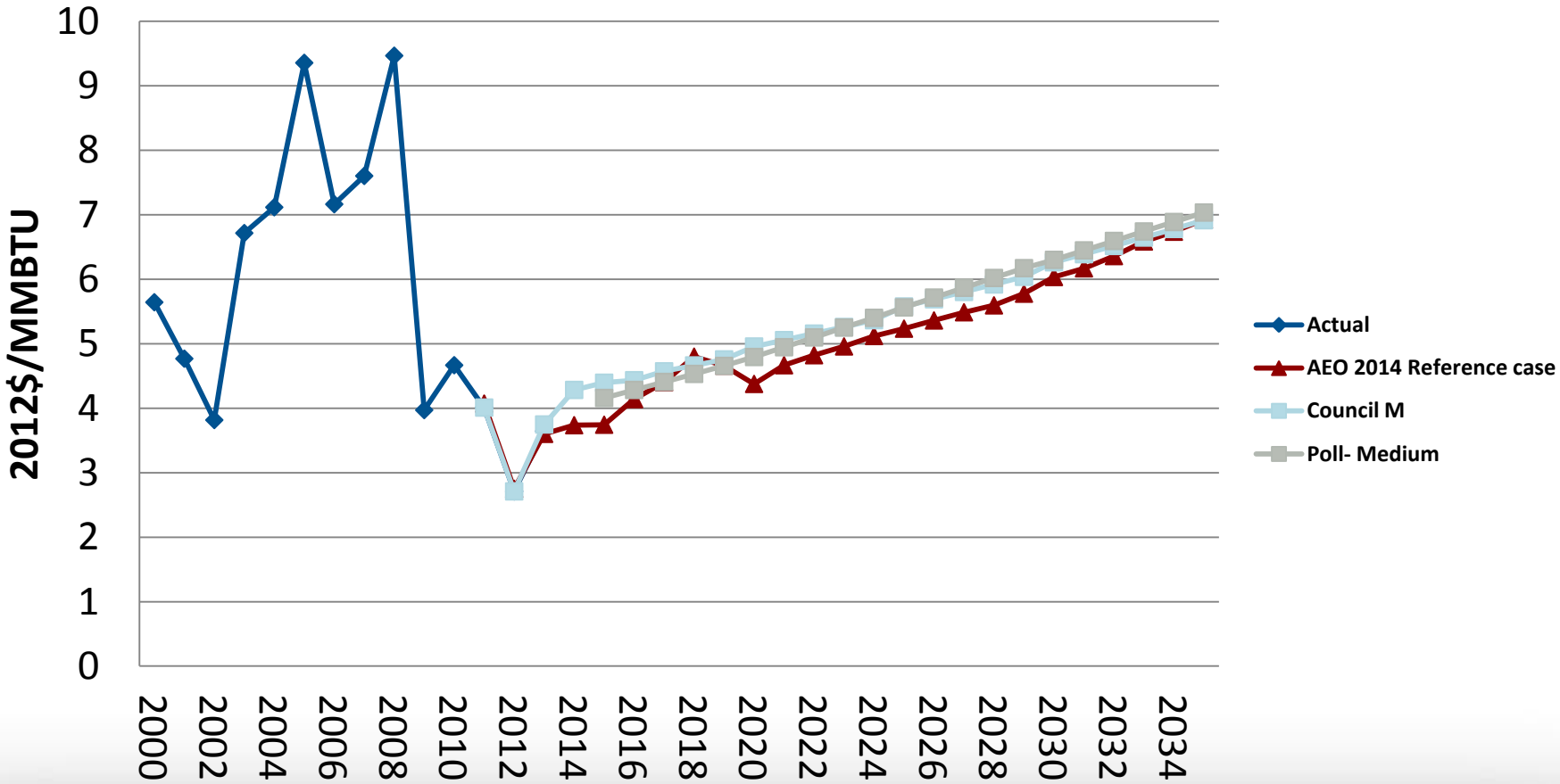
Comparison of 2013 and 2014 Projections for Henry Hub Long-term Prices $2012/mmBtu



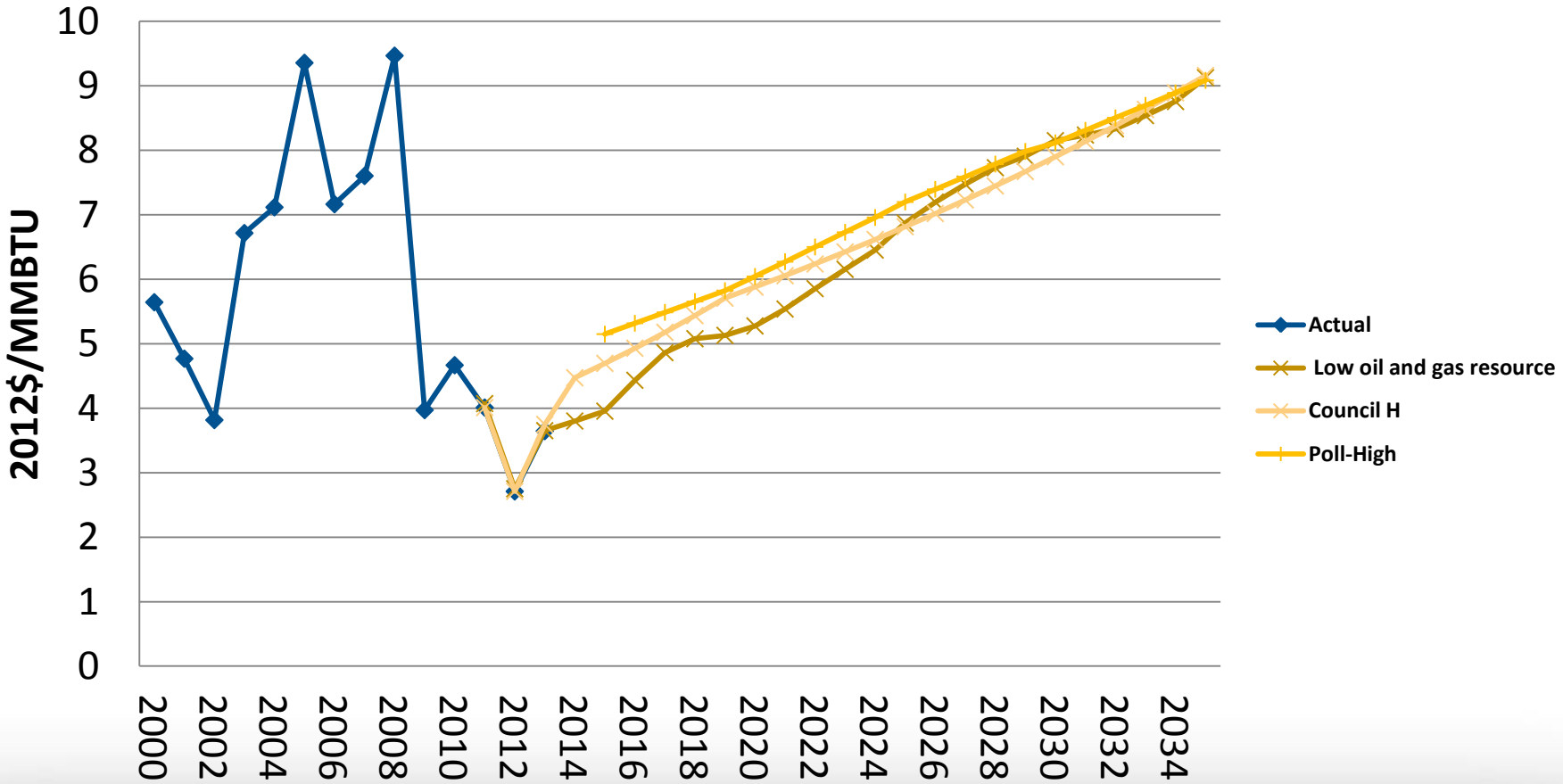
Natural Gas Prices at Henry Hub
Past and Projections
Low Price range
2012$/mmBtu



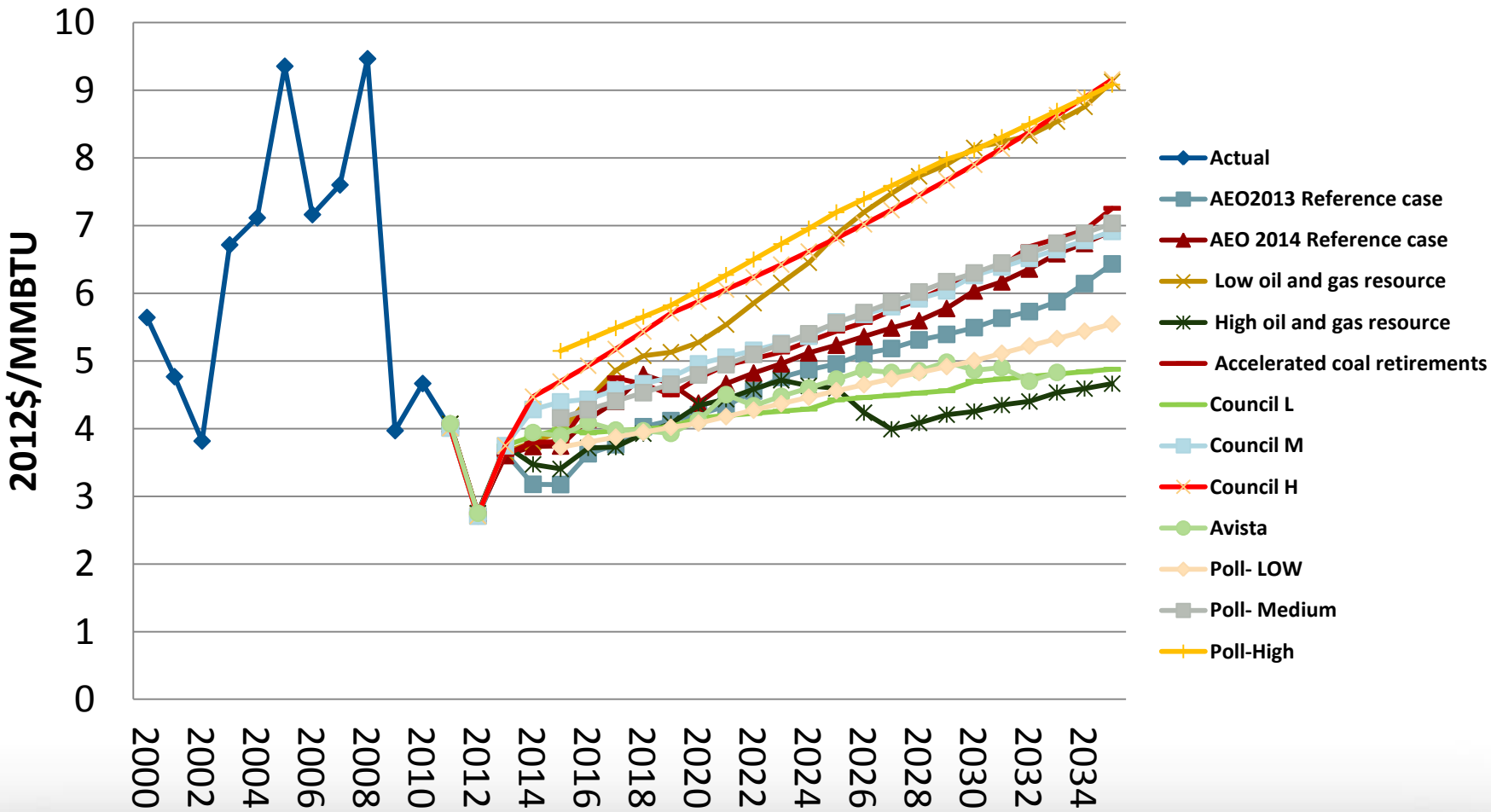
Natural Gas Prices at Henry Hub
Past Projections
Medium Range
2012$/mmBtu



Natural Gas Prices at Henry Hub
Past and Projections
High Range
2012$/mmBtu



Natural Gas Prices at Henry Hub
Past and Projections
2012$/mmBtu



Proposed Natural Gas Prices 2012$ and Nominal

Proposed Henry Hub Price Forecasts as of May 20 2014					$2012/MMBTU
	Council L	Council ML	Council M	Council MH	Council H
2013	3.7	3.7	3.7	3.7	3.7
2014	3.9	4.1	4.3	4.4	4.5
2015	4.0	4.2	4.4	4.5	4.7
2020	4.2	4.5	5.0	5.4	5.9
2025	4.4	4.8	5.6	6.2	6.8
2030	4.7	5.2	6.3	7.1	7.9
2035	4.9	5.5	6.9	8.0	9.2
Average 2015-2035	4.4	4.8	5.6	6.2	6.9

Proposed Henry Hub Price Forecasts as of May 20 2014					Nominal Dollars
	Council L	Council ML	Council M	Council MH	Council H
2014	4.0	4.2	4.4	4.5	4.6
2015	4.2	4.4	4.6	4.8	4.9
2020	4.7	5.1	5.6	6.2	6.7
2025	5.5	6.0	6.9	7.7	8.4
2030	6.4	7.0	8.5	9.6	10.7
2035	7.2	8.1	10.2	11.9	13.6
Average 2015-2035	6.6	7.2	8.4	9.4	10.4

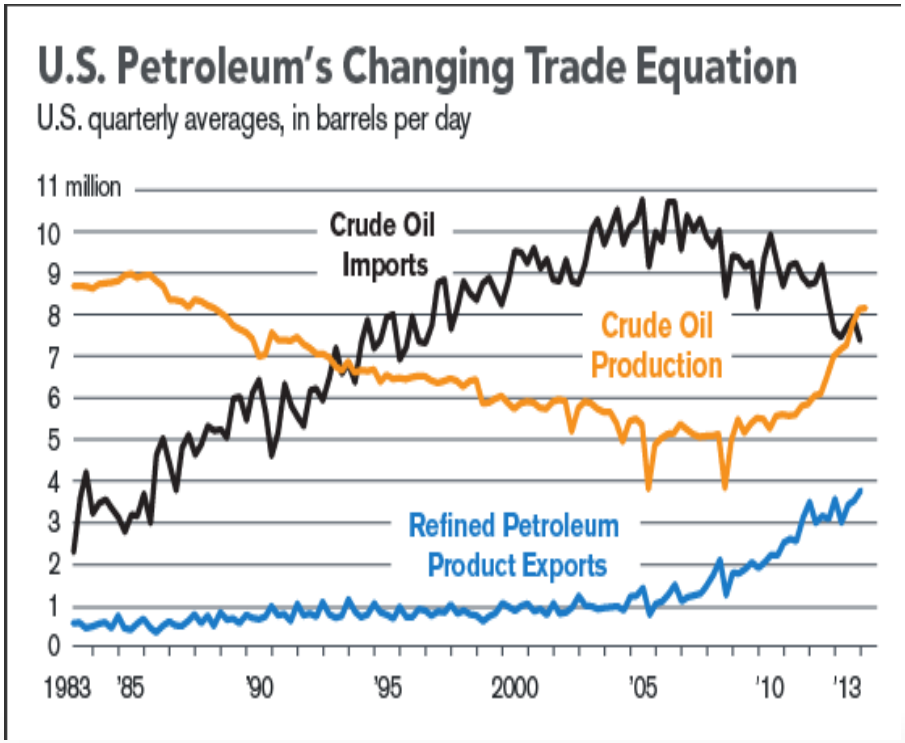
Your recommendations?

- Lower growth rate in long-term (post 2025 prices)?
- Increase high range of prices?
- Add explicit Regulatory Cost to the prices?

Issues impacting Forecast of Oil Prices

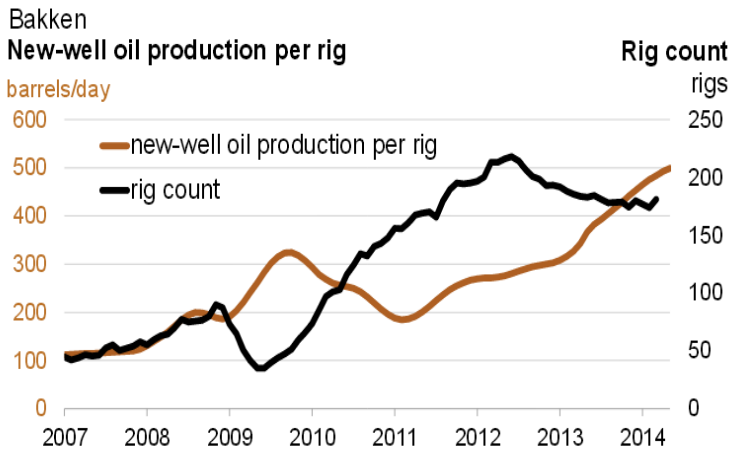
- Ban on export of crude oil
- Transportation (trains and pipelines)
- Monterey shale downgrade
- Rapid decline in production- need for new non-conventional wells
- High capital cost

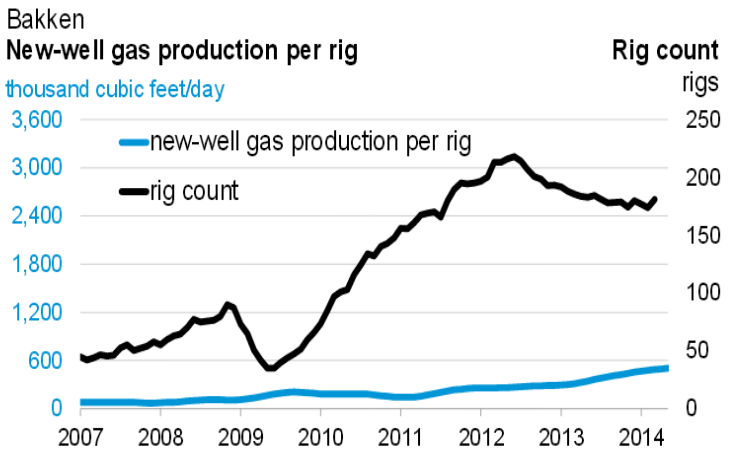
Issues Impacting Oil Prices

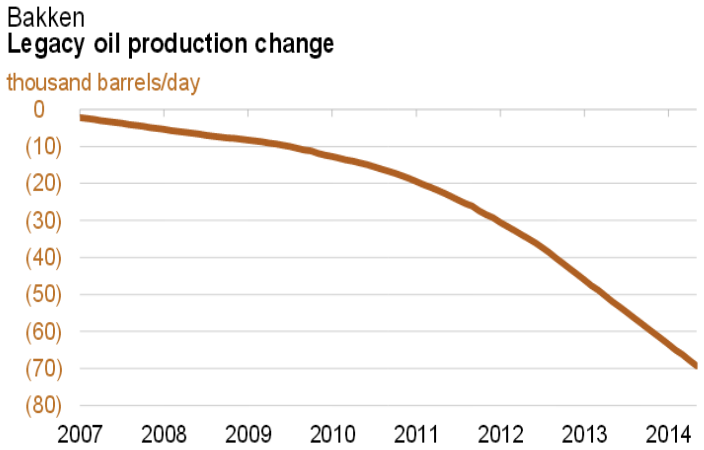


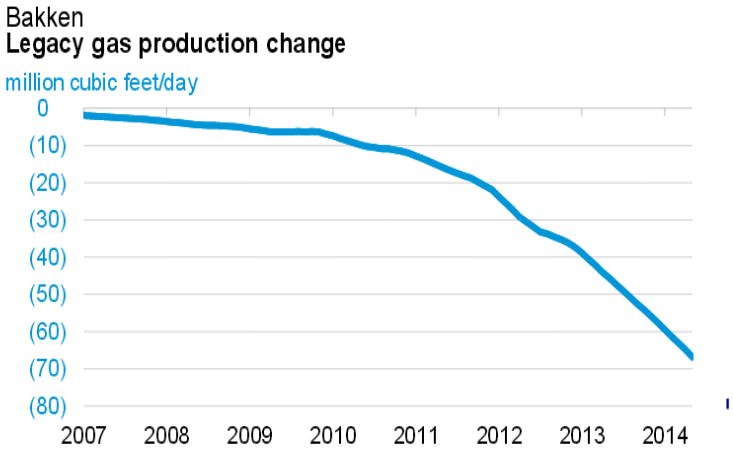
- Ban on export of crude oil
- Mismatch between refining capability and tight oil supplies
- Transportation (trains and pipelines)
- Monterey shale downgrade

2500 New Wells a year are needed to sustain output of 1 Million barrels a day in Bakken Shale

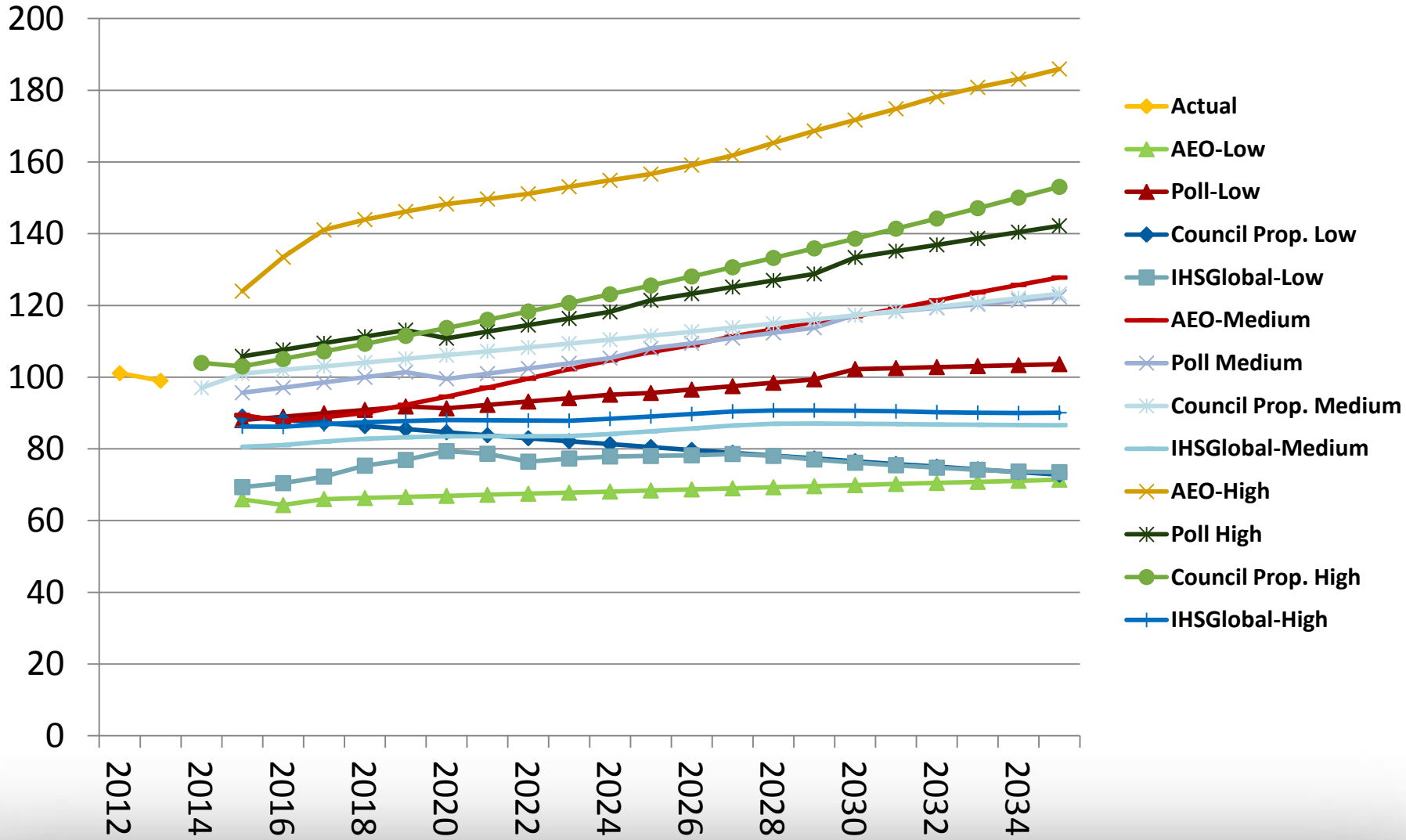








Proposed Refiners Acquisition Costs Forecast $2012/Barrel



Range of Proposed RAC Forecast 2012$/Barrel

Council	Low	Mediur	High	Poll-Low	Poll Medi	Poll High	IHS-Low	IHS-Medium	IHS-High	AEO-Low	AEO-Medium	AEO-High
2015	89.0	101	103	88	96	106	69	81	86	66	89	124
2020	84.6	106	114	91	100	111	79	84	88	67	95	148
2025	80.5	112	126	96	108	121	78	85	89	68	107	157
2030	76.6	117	139	102	117	133	76	87	91	70	117	172
2035	72.8	123	153	104	122	142	73	87	90	71	128	186

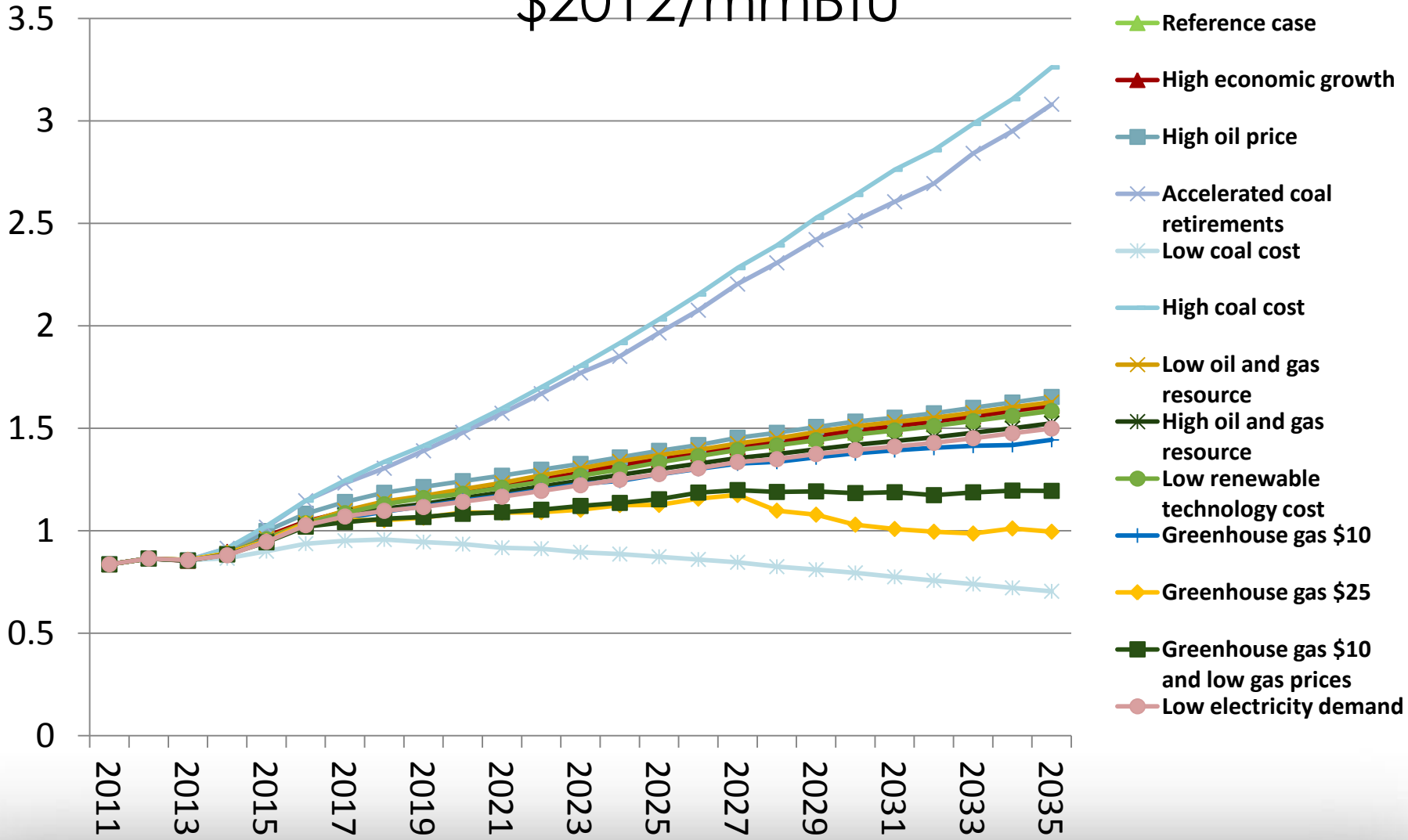
Refiners Acquisition Cost of Oil 2012 $ and Nominal $ per Barrel

Council Proposed RAC $2012 dollars per Barrel				Refiners Acquisition Cost $dollars per Barrel			
Council	Low	Medium	High	Council	Low	Medium	High
2015	89.0	101	103	2015	93	106	108
2020	84.6	106	114	2020	96	121	129
2025	80.5	112	126	2025	100	138	156
2030	76.6	117	139	2030	104	159	188
2035	72.8	123	153	2035	108	182	227
2015-2020	-1.0%	1.0%	2.0%	2015-2020	0.6%	2.7%	3.7%
2020-2025	-1.0%	1.0%	2.0%	2020-2025	0.7%	2.7%	3.8%
2025-2030	-1.0%	1.0%	2.0%	2025-2030	0.7%	2.8%	3.8%
2030-2035	-1.0%	1.0%	2.0%	2030-2035	0.8%	2.8%	3.9%

Your recommendations?

- Keep the proposed prices?
- Lower the long-term growth in price of oil?
- Increase the high range of prices?

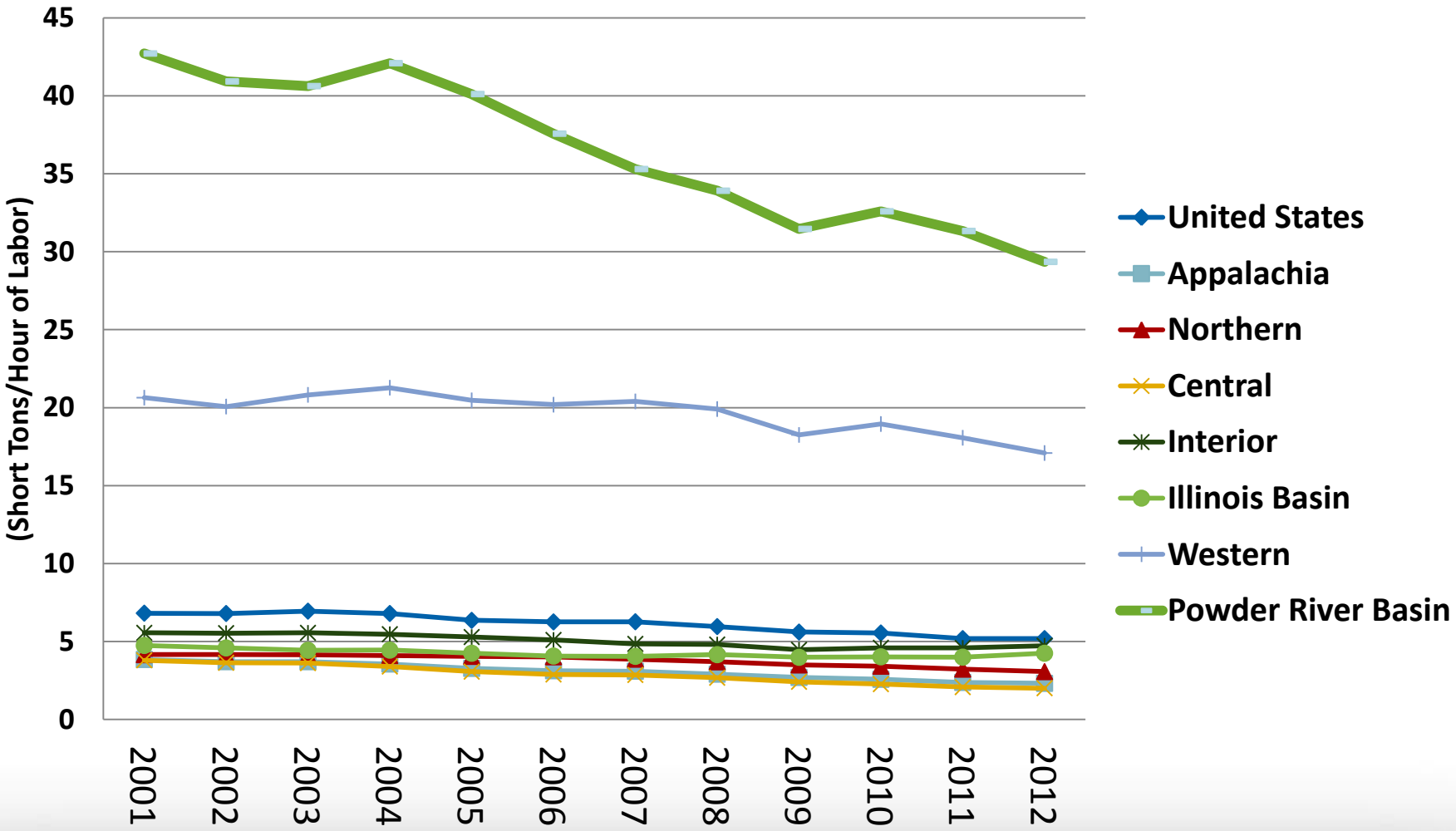
Annual Energy Outlook 2014
Powder River Basin Price Forecast
$2012/mmBtu



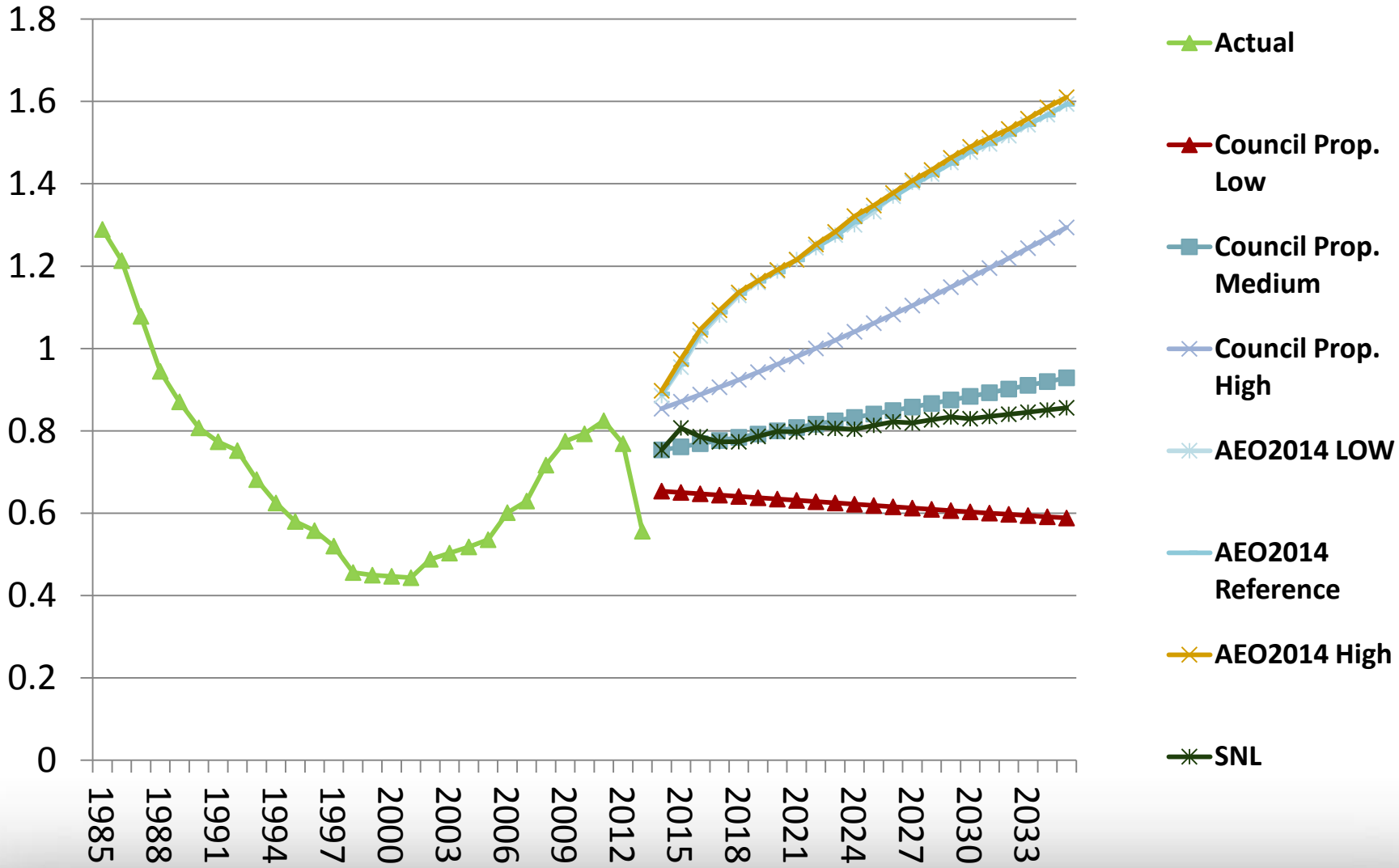
Coal Issues

- Retirement of existing coal power plants.
- Impact of EPAs New 111D regulations
- Declining productivity

Coal Production Productivity



Proposed Powder River Basin Minemouth Coal Price Forecast
$2012/mmBtu



Proposed Powder River Basin Coal Price Forecast

(2012$/mmBtu)	Low	Medium	High
2015	0.65	0.76	0.88
2020	0.63	0.80	1.02
2025	0.62	0.84	1.18
2030	0.60	0.88	1.37
2035	0.59	0.93	1.59

Nominal Dollars/mmBtu	Low	Medium	High
2015	0.67	0.79	0.91
2020	0.71	0.90	1.14
2025	0.75	1.03	1.44
2030	0.80	1.17	1.82
2035	0.86	1.35	2.31

Your recommendations

- Keep the proposed prices?
- Lower the long-term growth in price of Coal?
- Increase the high range of prices?

Monthly Burner-tip gas prices

Tentative Agenda
Natural Gas Advisory Committee
Northwest Power and Conservation Council
851 S.W. Sixth Avenue
Suite 1100
Portland Oregon 97204-1348

June 6h, 2014
9:00 AM to 12:30 PM
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a. Preliminary result of fuel price poll	
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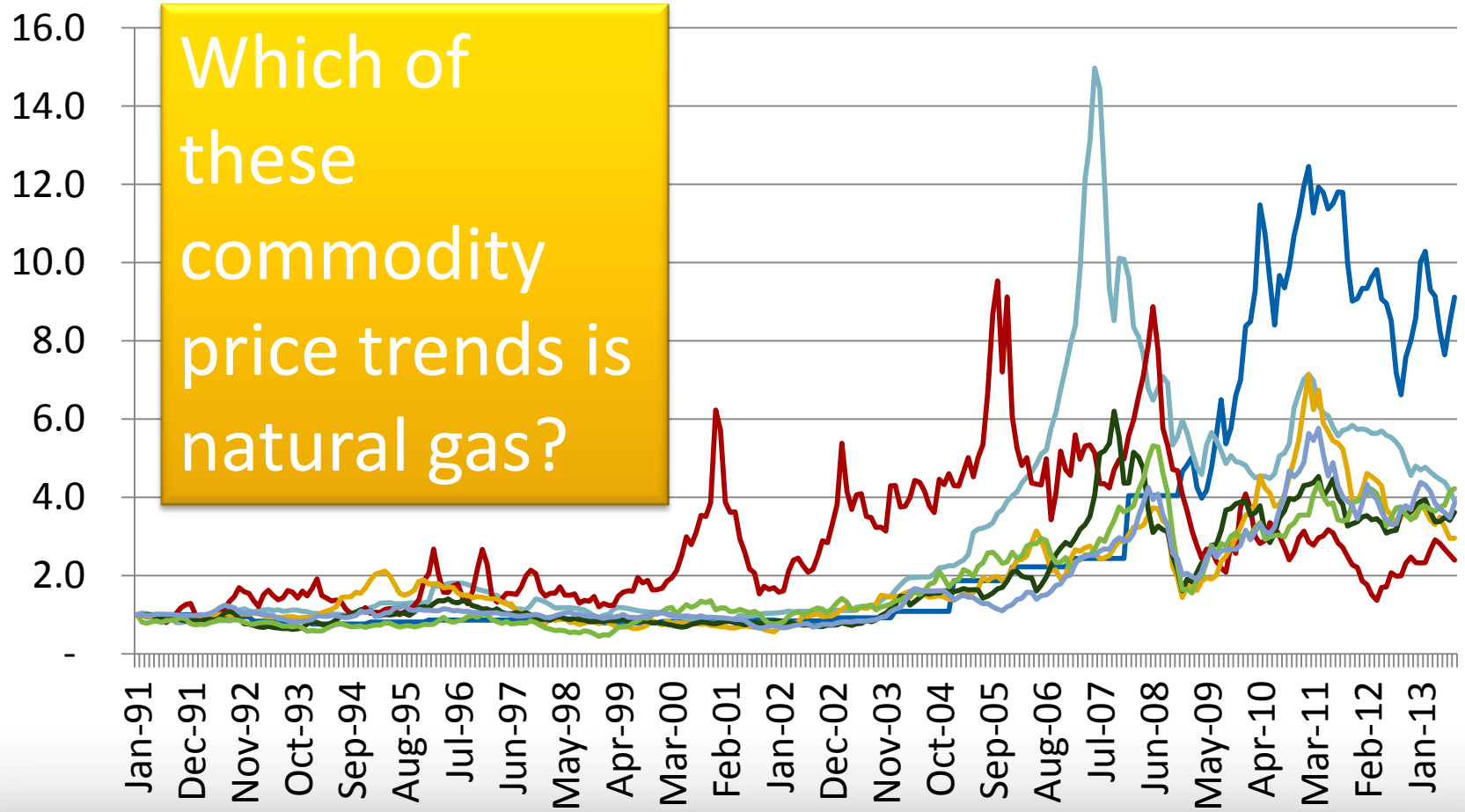
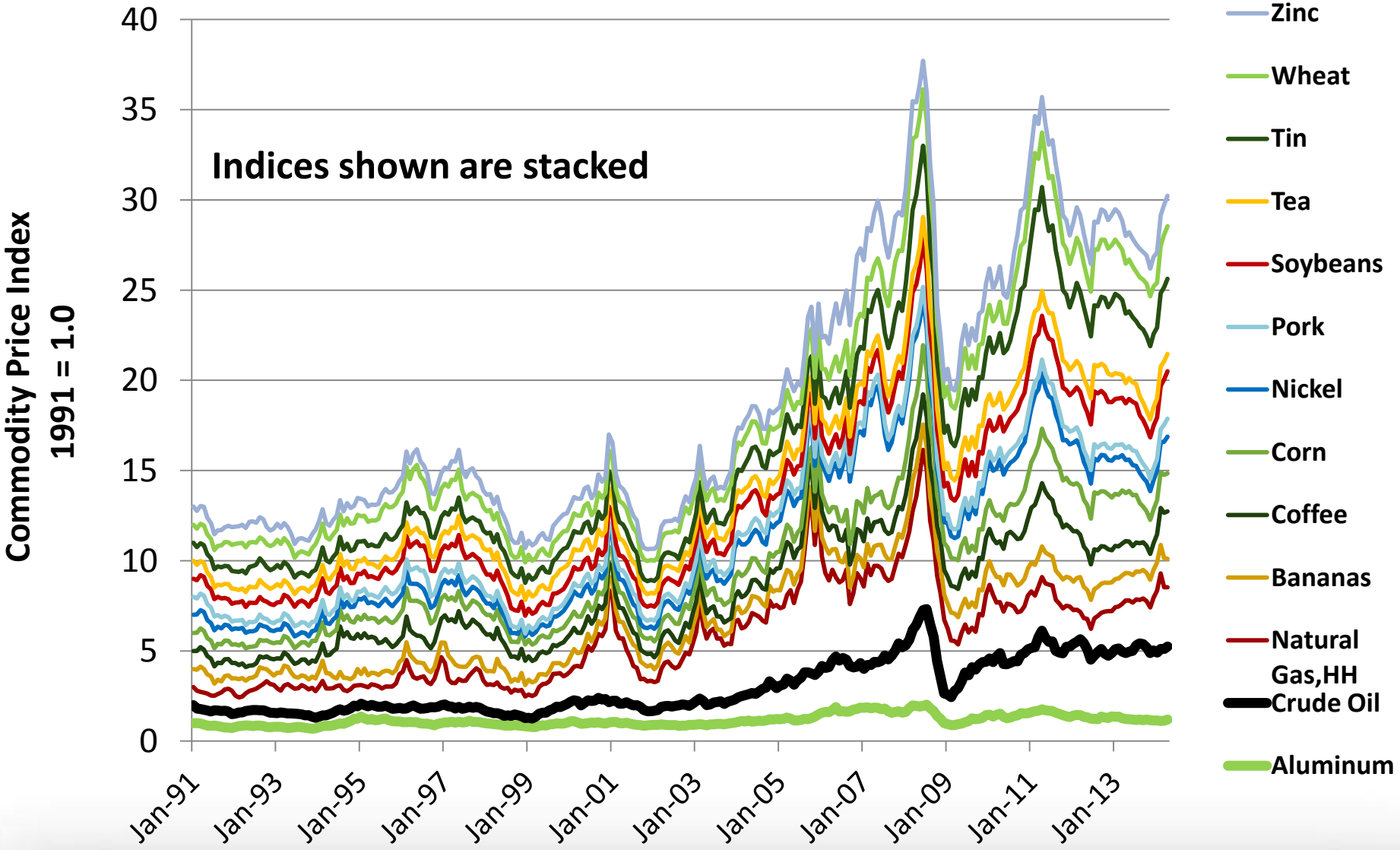
Next steps

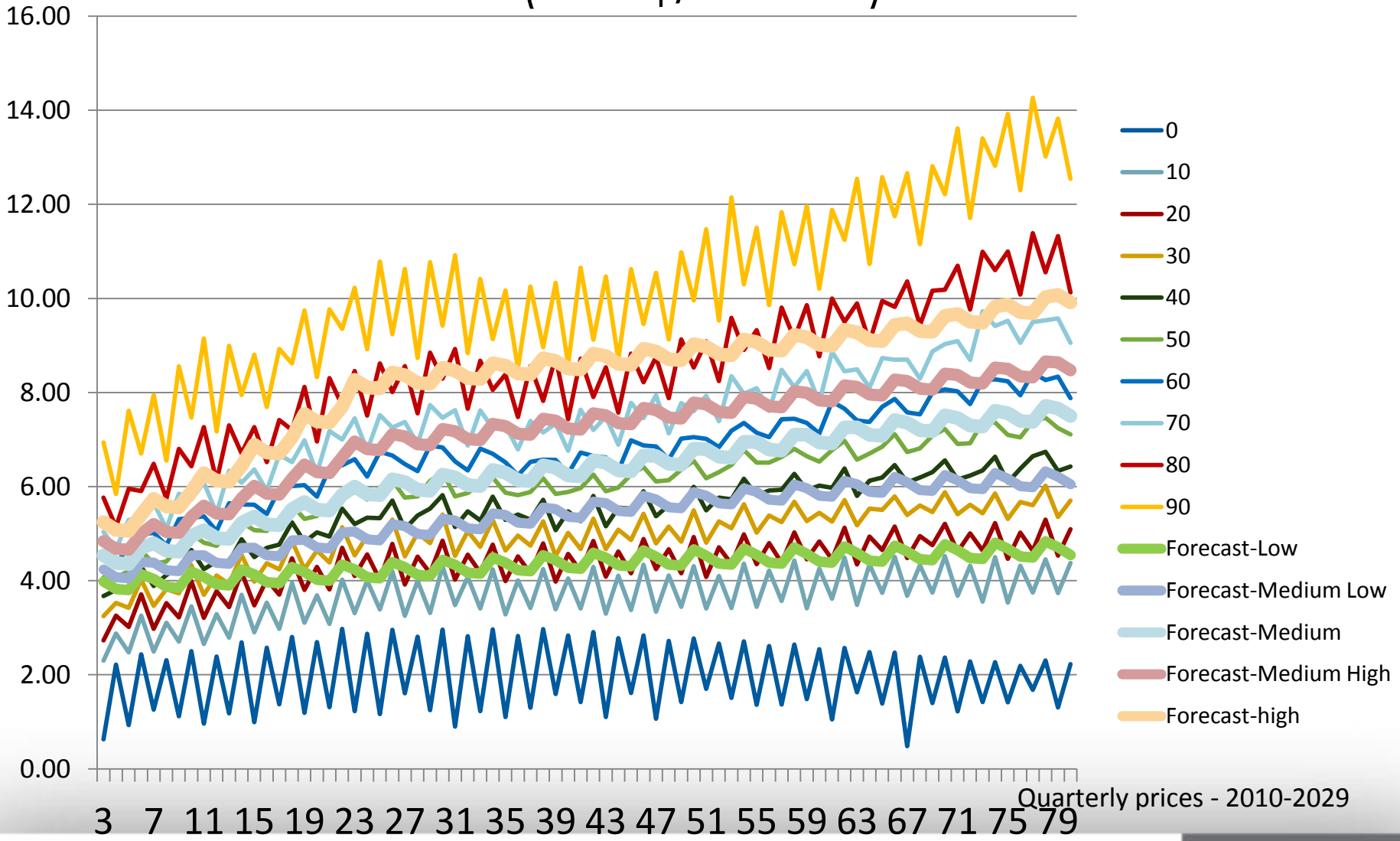
- Data from natural gas price forecast is used
  - Demand forecasting model- to calculate retail rates
  - In RPM model, where stochastic shock to prices are introduced.
  - In Aurora model, where future wholesale price of electricity is estimated.

Forecasting Natural Gas Prices Is Like Engaging in Commodity Trading




Commodity Price Index
1991 = 1.0
Indices shown are stacked
40
35
30
25
20
15
10
5
0
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Jan-03
Jan-05
Jan-07
Jan-09
Jan-11
Jan-13
Zinc
Wheat
Tin
Tea
Soybeans
Pork
Nickel
Corn
Coffee
Bananas
Natural Gas,HH
Crude Oil
Aluminum

Range of Forecast Natural Gas Price Delivered to Electric Utilities PNW East &Deciles used in RPM (2006$/mmBTU)

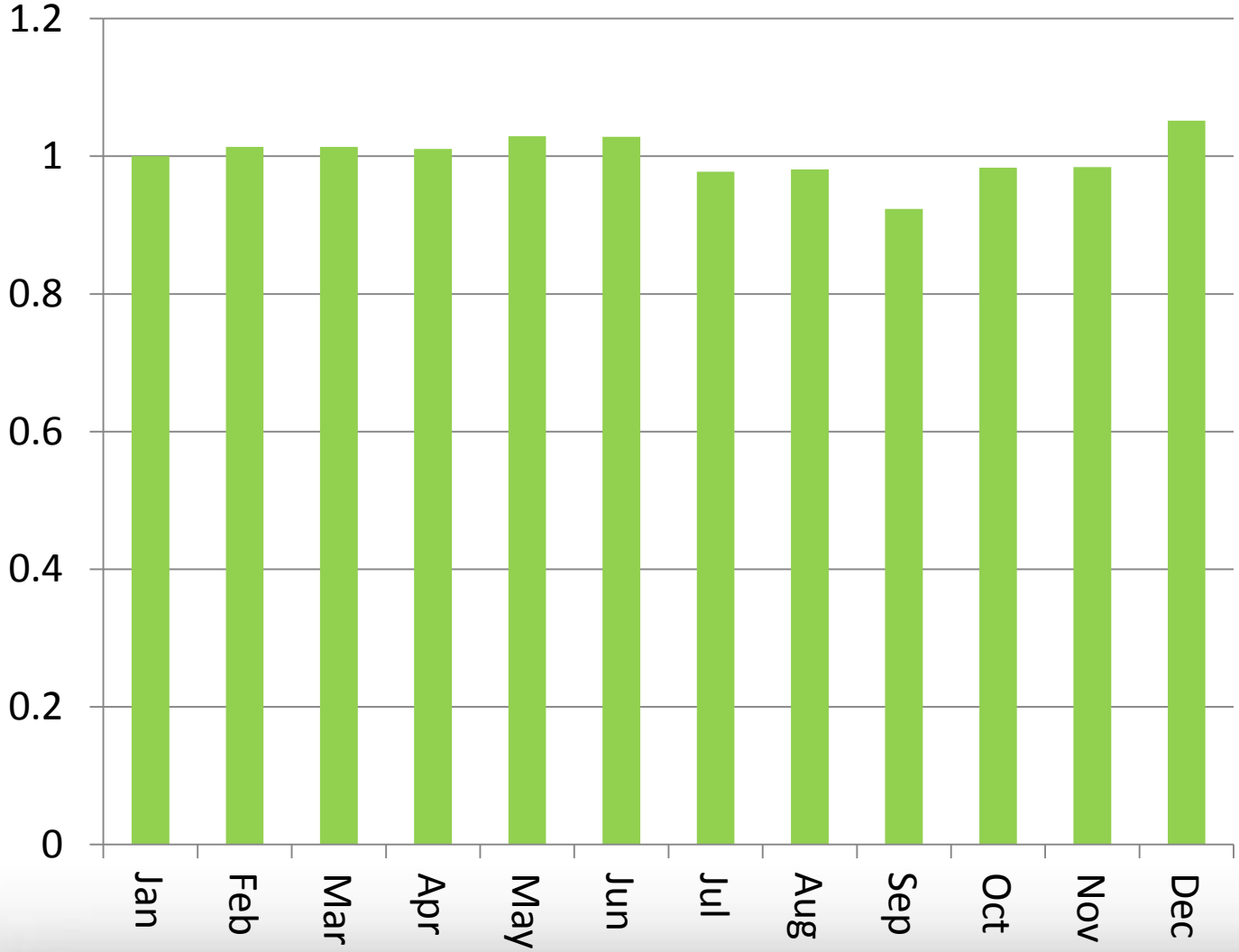


For illustration only

Analytical Steps in Forecasting Wholesale Electricity Prices (Aurora)

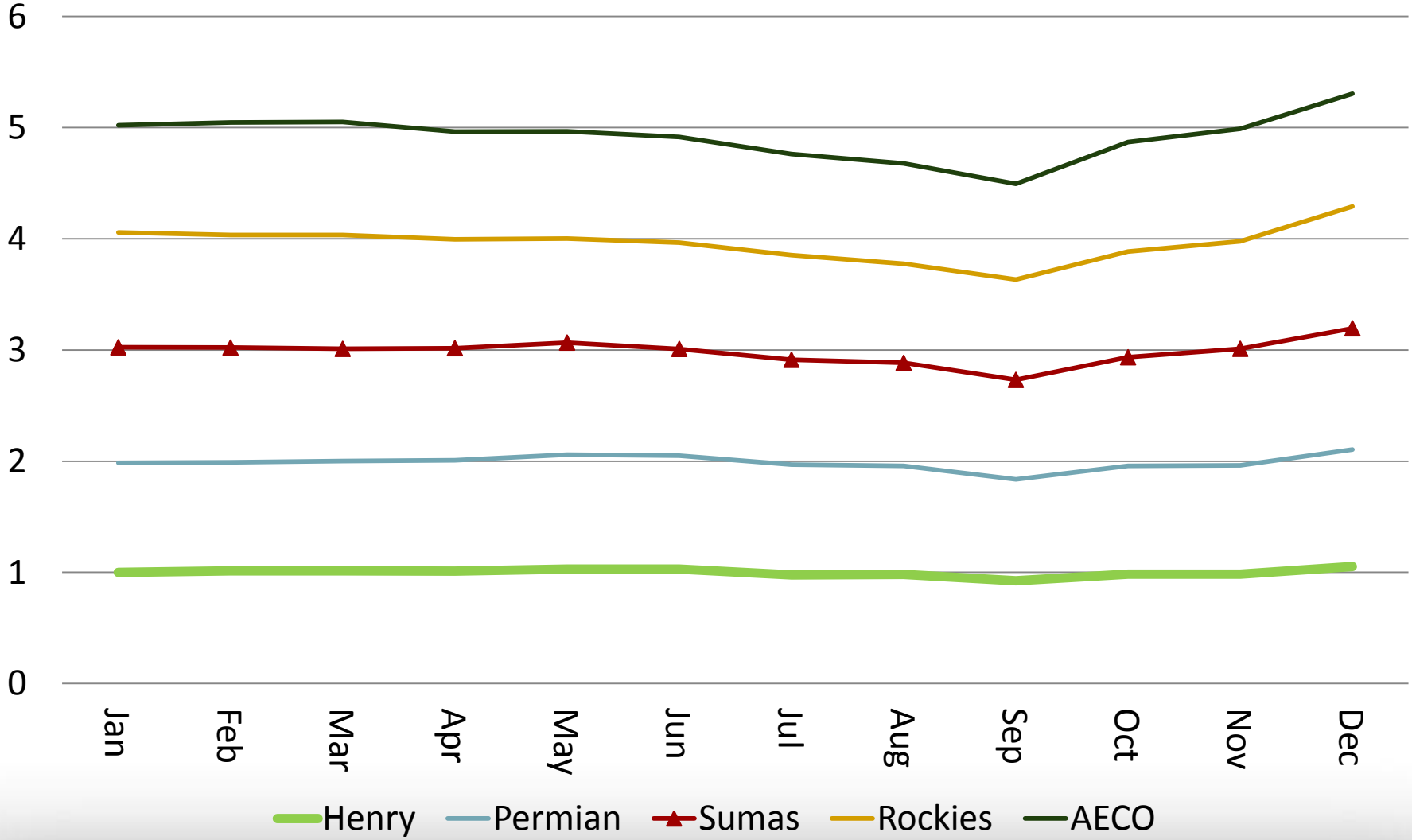
- Estimate monthly shape factors
- Forecast monthly prices for each hub
- Regress utility delivered cost of fuel against hub prices.
- Estimate fixed and variable cost of transportation.
- Forecast monthly variable cost of fuel for each generation node.

Monthly Shape of Natural Gas Prices at Henry Hub



Ratio of Monthly to Annual Prices -Based on 2000-2013 Data

Monthly Shape of Natural Gas Prices at Various Hubs



- Are there further issues we need to consider in our fuel price projections?

Thank You
for your participation
&
Safe Travels