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July 1, 2014

MEMORANDUM

TO: Power Committee

FROM: Massoud Jourabchi

SUBJECT: Proposed Update of Key Demographic and Economic Drivers for the Seventh Power Plan

Staff is proposing to update the Council's forecast key demographic and economic drivers for the Seventh power plan. In July 2013, staff presented a detailed outlook for the demographic and economic drivers for the next plan. Staff will present our proposed updates to these drivers to the Power Committee during the July 2014 Power Committee meeting.

Compared to a year ago, the projected growth in population, square footage of commercial buildings and industrial output, are little changed. Population is projected to grow at around 0.9% per year or about 130,000 people per year. Growth in commercial real estate is projected to slow to about 40 million square feet per year compared to an historical annual average of about 52 million square feet. This year's forecast of industrial output is similar to last year's forecast, with manufacturing output expected to increase from the current \$400 billion in 2013 to about \$550 billion in 2035.

Staff worked with the Council's Natural Gas Advisory Committee (NGAC) to develop the proposed updates to its fuel price forecast. The NGAC provided valuable information and their views on significant changes in the fuel markets that they anticipate will impact future, natural gas prices and price volatility. Staff and the NGAC comparison of forecasts from many sources suggest a tightening in the natural gas markets. As a result the Advisory Committee recommended that the Seventh Plan use a wide-range forecast of future natural gas prices. In the 2013 outlook, forecast of natural gas prices in 2035 ranged from \$4-\$9 per mmBtu with medium price at \$6.5 per mmBtu. This year's forecast for natural gas prices in 2035 proposes prices between \$3.20 to \$11 per mmBtu, with medium price of \$7.5 per mmBtu.

Staff is requesting that the Council approve the proposed revisions of the key economic and demographic drivers and natural gas and other fuel prices at its July meeting. Staff is also

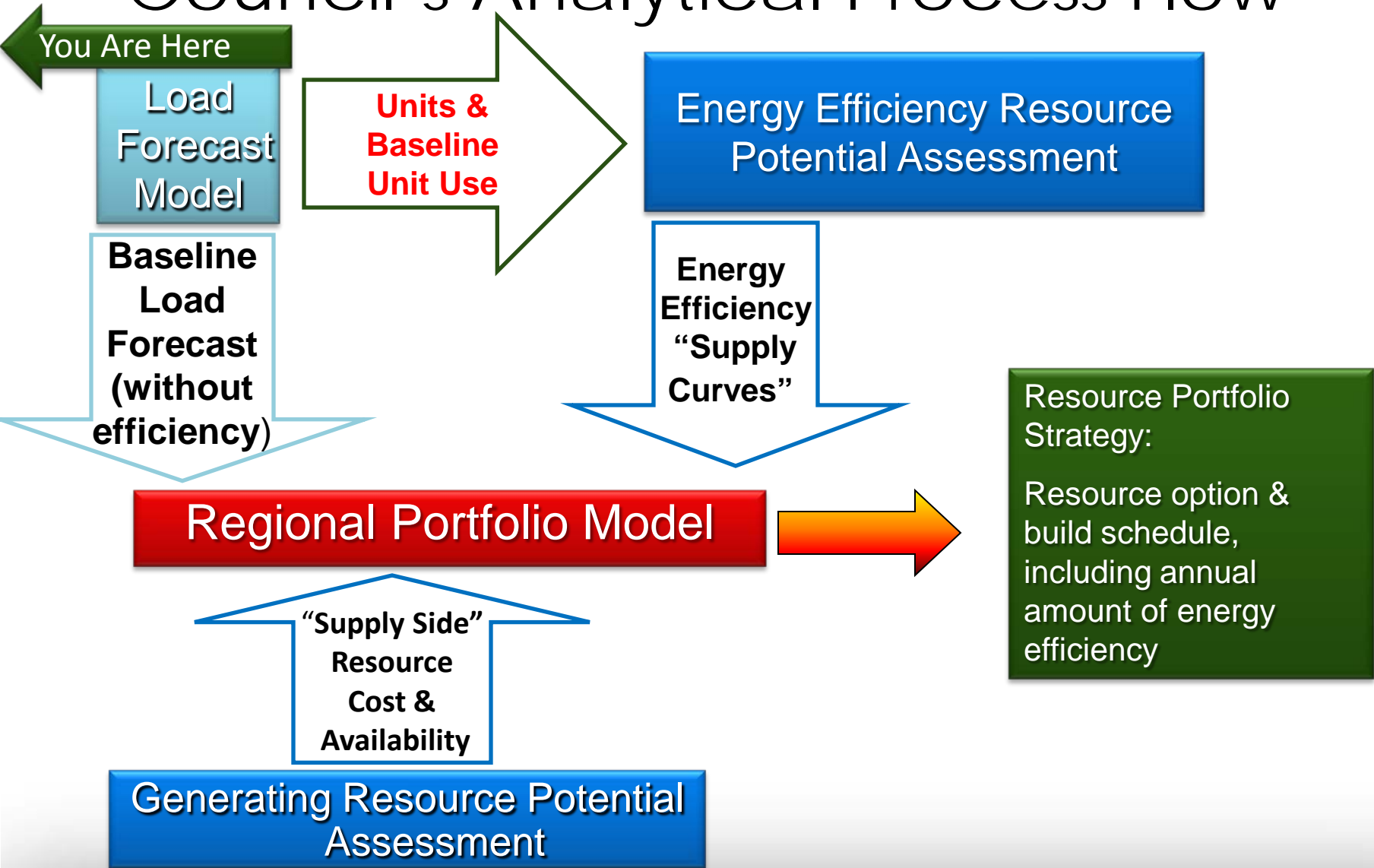
requesting that, if adopted by the Council, these updated forecasts be posted on the Council's website. The draft write-up for the 2014 report is in the packet for your review.

Attachment: Energy Forecast - 2014 Fuel Prices (Draft)

The Path to The Seventh Plan

Foundational Analytical Inputs and Assumption

Council's Analytical Process Flow



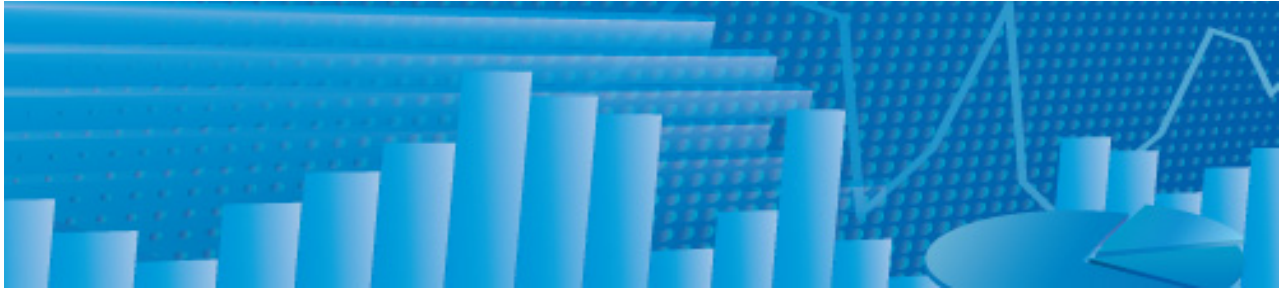
Plan Development Process

- Establish Values for Key Drivers
- Identify Major Issues
- Estimate cost and availability of conservation and generating resources
- Conduct Resource Portfolio Analysis
 - Identify resource needs
 - Test alternative portfolios and “decision rules”
 - Agree on a preferred draft plan, including action plan
- Issue Draft Plan for Comment
- Conduct Additional Analysis/Revise Existing Analysis in Response to Comments on Draft Plan
- Adopt Final Plan

Upcoming Decisions on Global Values and for the Seventh Plan

- Fuel price forecast range
- Load forecast range
- Financial Assumptions
 - Base Year Dollars: Constant 2012\$?
 - Discount rate: Societal or Weighted After Tax Cost of Capital?
 - Inflation rate (2013-2035)
 - Standardized GDP Deflators to Adjust to Constant Years Dollars
 - (Single data table, 2005- 2035)
- Study Horizon: 2016 – 2035?
- Study Start in Quarters: Q4 of 2015?
- Treatment of state and federal taxes and tax incentives
- Treatment of Transmission & Distribution system losses and costs.
 - Load Forecast
 - Aurora
 - ProCost
 - RPM
- Peak Period definition
 - Driven by Resource Adequacy Assessment and LOLP
 - Single hour coincident peak for a month, or year?

Fuel Price Forecast



Revised Fuel Price Forecasts for the Seventh Power Plan Draft as of June 2014

July 2014



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Executive Summary

The Council monitors its power planning assumptions on a regular basis to identify any significant changes that would affect its power plan. This revised forecast for fuel prices will be used to develop the Council's [Seventh Power Plan](#) for 2015 to 2035.

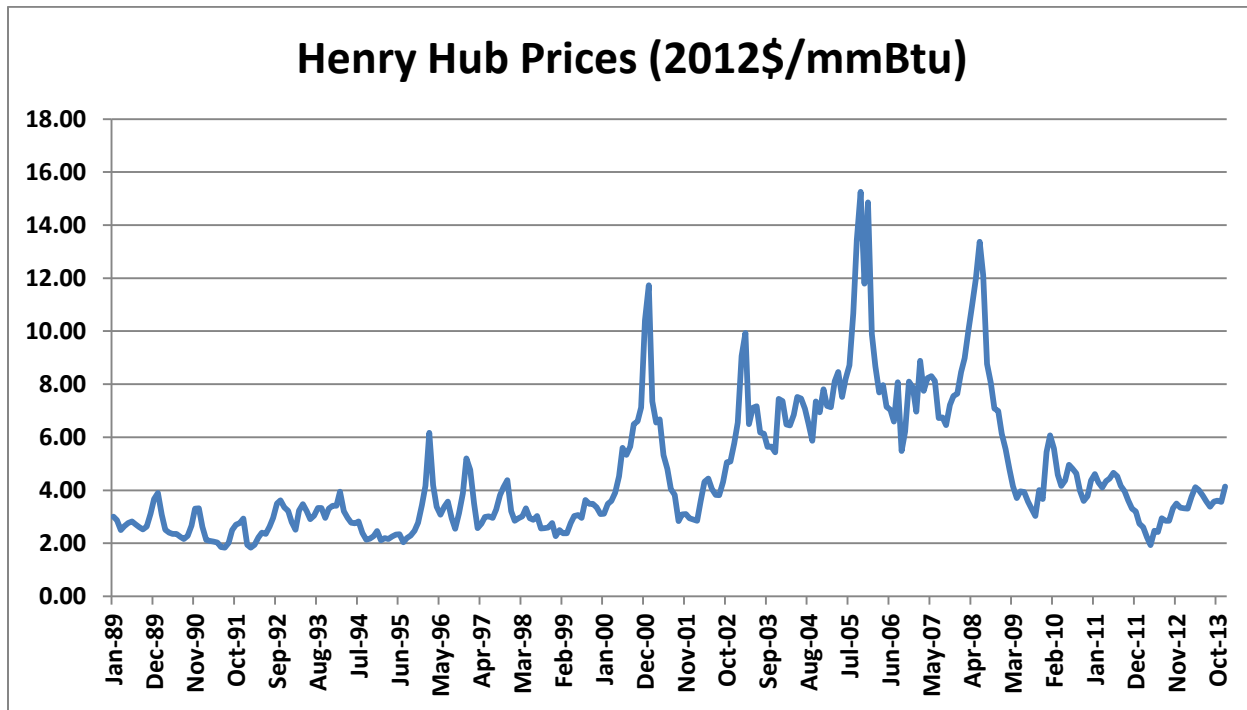
The natural gas price forecast is the most important fuel forecast for the plan, and it's also widely used by others in the region for their analyses. The projected price range for this fuel is broader, reflecting greater uncertainty about its future supply and demand. Unlike the natural gas price forecast, the oil and coal forecasts have little effect on the Council's power plan, and are also not used as much in the region.

Low natural gas prices would mean lower electricity prices, while high prices would mean higher wholesale prices for electricity. A more complete picture of how these fuel prices would play out will be tested during the development of the Seventh Power Plan.

Background

Henry Hub natural gas prices fell to their lowest levels--\$2 dollars per mmBtu--in 2012, the result of a milder winter and increasing supplies from shale gas. The low prices were temporary, however, as the price of natural gas in 2013 and first two quarters of 2014 have been in the \$3.5-\$4.5 dollars per mmBtu range, with a spike of \$20-\$30 dollars per mmBtu because of the extreme winter experienced in much of the country that year. Recently, the forward market for natural gas prices has tightened, due in part to higher demand from utilities, industrial customers, and the need to refill the storage inventory exhausted during the winter. Analysts are now expecting prices in the \$3-\$5 per mmBTU range for 2014-2015 at Henry Hub in constant 2012 dollars.

Historic Perspective: Natural Gas Prices at Henry Hub

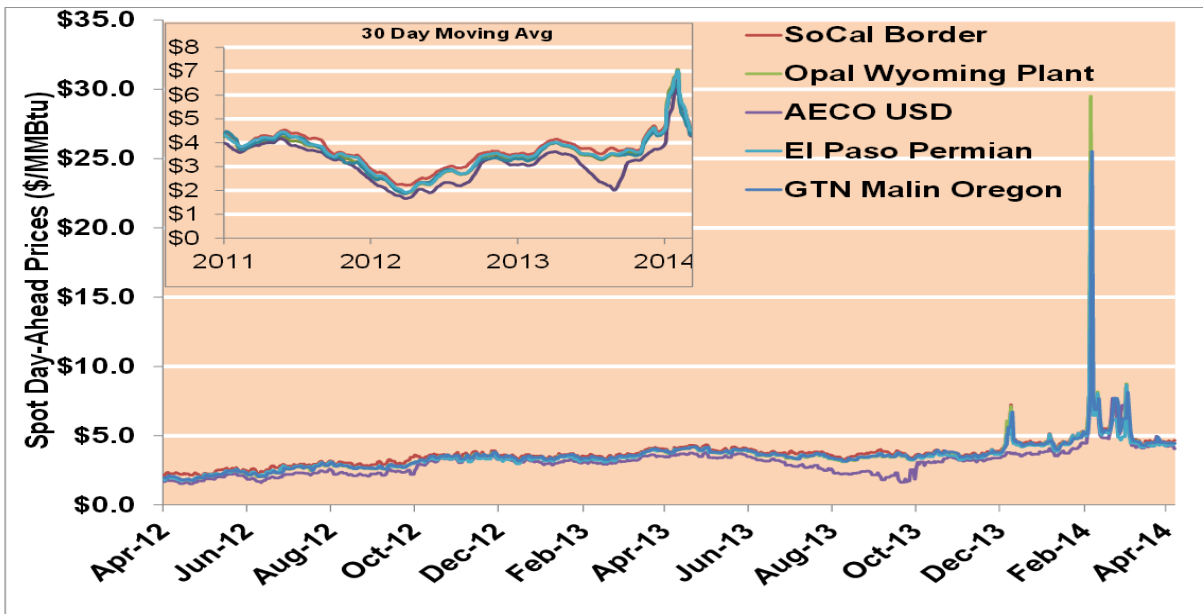


Jump in Prices Feb 2014 source- FERC

West Natural Gas Market: Day-Ahead Prices

Federal Energy Regulatory Commission • Market Oversight • www.ferc.gov/oversight

West Daily Day-Ahead Prices



Notes:
Source: ICE

Updated 4/15/2014

Data from regional and national organizations were used in developing this forecast, including the Energy Information Administration's [Annual Energy Outlook 2014](#), the analyst reports from [Natural Gas Week](#) (Energy Intelligence), [Avista](#), consulting company [HIS-Global Insight](#), and the [SNL Natural Gas](#) forward price curves. The Council also polled its [Natural Gas Advisory Committee](#) for information and guidance. When comparing this forecast with others, it's advised to use 2012 constant dollars, the dollar value used in all Seventh Power Plan analysis.

2014 Natural Gas Price Forecast

In the past few years, working with the Natural Gas Advisory Committee, the Council has [revised](#) its range of natural gas prices downward. This year, the price range is broader, with a higher and lower range of prices. This reflects greater uncertainty about its future supply and demand. The Council uses a range of prices to reflect the differing views on the supply and demand for natural gas. The high price forecast reflects rapid economic growth in the U.S. and worldwide; opposition to hydraulic fracturing; aggressive regulation to limit carbon emissions, which would promote natural gas generation over coal; increased use of natural gas vehicles; increased demand for exports of liquefied natural gas from Canada and the United States; and increased demand from gas-to-liquid projects. In contrast, the low forecast reflects conditions that limit the demand for natural gas and promote the rapid development of supply.

Proposed Natural Gas Price Projections at Henry Hub (2012\$/mmBtu)

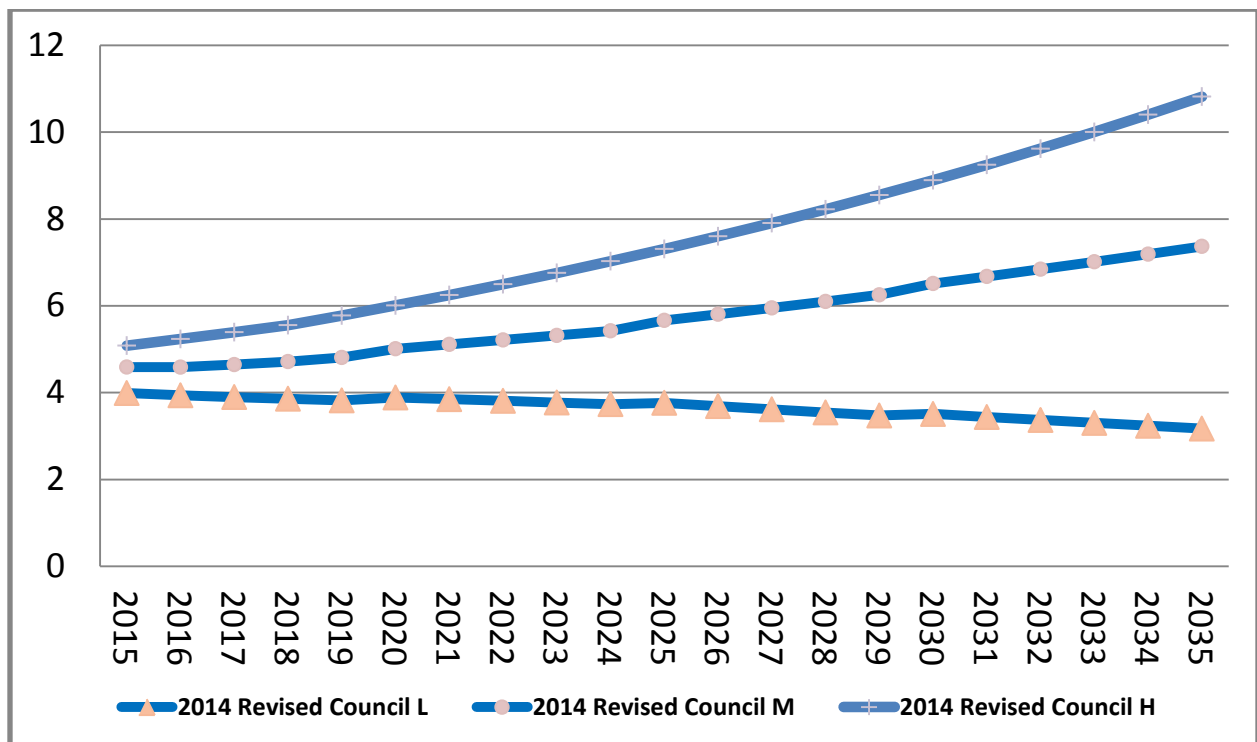
	Low	Medium	High
2013	3.7	3.7	3.7
2014	3.9	4.7	4.9
2015	4.0	4.6	5.1
2020	3.9	5.0	6.0

2025	3.8	5.7	7.3
2030	3.5	6.6	8.9
2035	3.2	7.4	10.8
Average 2015-2035	3.8	5.8	7.5

Implications for the Seventh Power Plan

Low natural gas prices correlate to lower electricity prices, and conversely, high natural gas prices would mean higher wholesale prices for electricity. A more complete picture of how these fuel prices would play out will be tested during the development of the Seventh Power Plan. Natural gas generation is already the fall-back resource in the current plan; renewables are limited by renewable portfolio requirements; and efficiency is constrained by assumed rates of penetration and development.

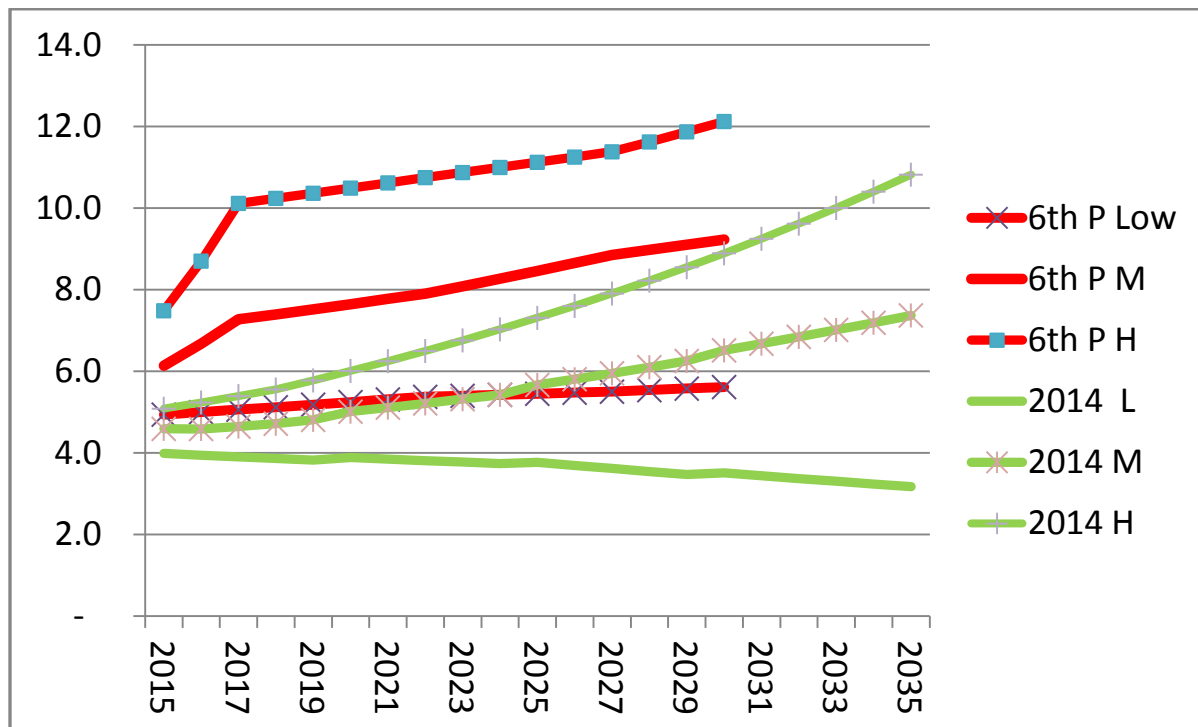
Proposed Natural Gas Prices at Henry Hub (constant 2012 dollars per mmBtu)



Comparing the Sixth Power Plan and 2014 Price Projections

The following figure shows the forecast prices used to develop the [Sixth Power Plan](#) and the draft 2014 forecast. Natural gas prices were significantly higher in the Sixth Power Plan. For example, by 2030 the plan's prices were in the \$5.6-\$12 range, while the new forecast puts the prices in the \$3.5-\$11 range.

Sixth Power Plan and Draft Natural Gas Price Forecasts
Henry Hub Cost \$2012/mmBtu

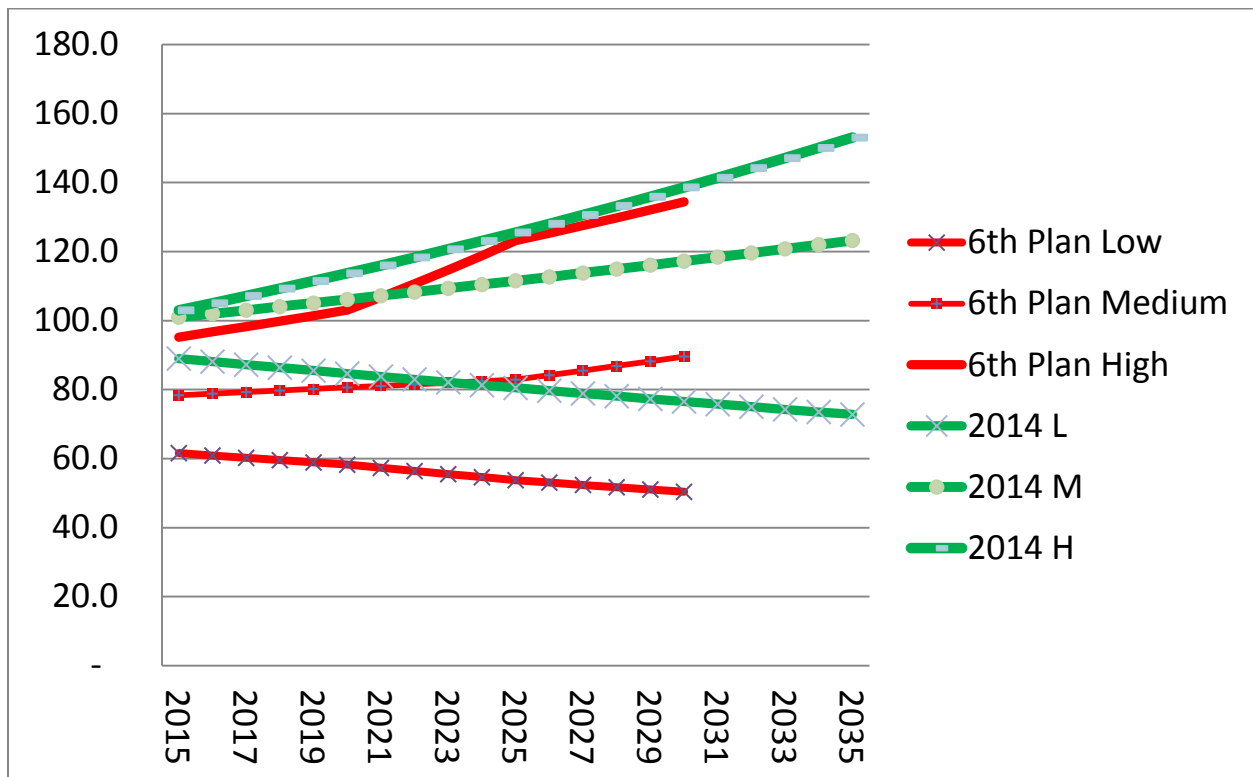


Oil Price Forecast

World oil prices have little effect on the Council's power plan because oil has, to a large degree, been relegated to a transportation fuel in the U.S. The primary effect might be on electric vehicle development, but that is largely determined by other factors relating to technology, consumer adoption, and infrastructure development. A big unknown at this time is the decision on removing the ban on crude oil exports from the United States.

Although the range of world oil prices hasn't changed as much as natural gas prices, the price levels have increased for the medium and low price forecasts. Compared to the Sixth Power Plan forecast, the high-range is slightly higher in the short-term, though not in the long-term.

Sixth Power Plan and Draft Oil Price Forecasts
Refiners Acquisition Cost \$2012/barrel

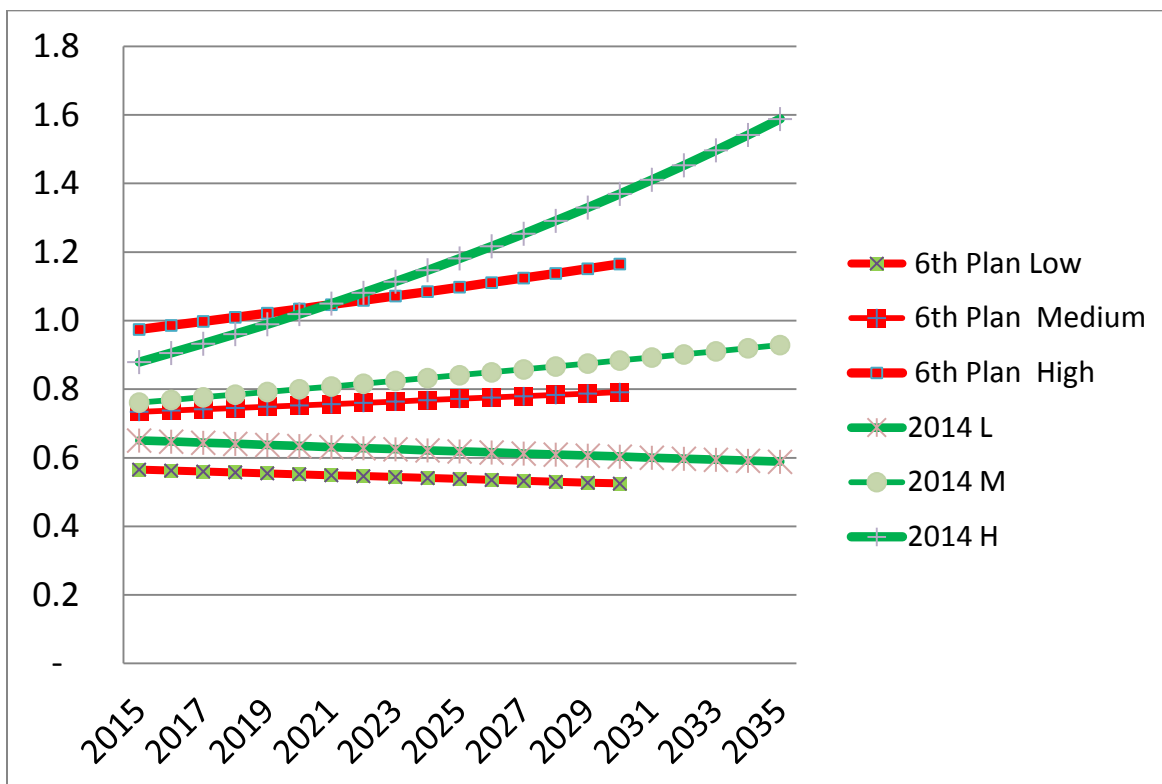


Coal Price Forecast

Like oil, coal prices have relatively little effect on the Council's power plan. They affect electricity market prices in relatively few hours and they affect the operating cost of existing coal-fired power plants. However, new coal development is unlikely and the Council's power plan reflects this.

The revised forecast incorporates 2013 actual prices and extends the long-term range. The long-term range of prices was increased to better reflect the uncertainty about global demand for U.S. coal; the accelerated pace of coal power plant closures; the continued decline in Powder River Basin production; and the increased cost of its transportation. The 2014 annual energy outlook puts the range of PRB coal price at \$0.70-\$3.2 in 2012\$ per short tons. Unlike the natural gas price forecast, neither the oil nor the coal price forecasts are used extensively in the region.

**Sixth Power Plan and Draft Coal Price Forecasts
Powder River Basin \$2012/mmbtu**



The following tables present the numeric values for the proposed:

Table 1: Range of natural gas price forecast: Henry Hub prices in constant 2012 dollars

Table 2: Range of refiners cost of acquisition for oil in constant 2012 dollars

Table 3: Range of cost of Powder River Basin coal in constant 2012 dollars

Table 4: Inflation adjustment factors to convert from constant 2012 dollars to nominal dollars.

Table 1: Proposed Natural Gas at Henry Hub Price Range (\$2012/MMBTU)

	Low	Medium	High
2013	3.75	3.75	3.75
2014	3.89	4.73	4.94
2015	3.99	4.59	5.08
2016	3.94	4.59	5.24
2017	3.90	4.65	5.39
2018	3.86	4.72	5.55
2019	3.82	4.81	5.78
2020	3.89	5.01	6.01
2021	3.85	5.11	6.25
2022	3.81	5.21	6.50
2023	3.77	5.32	6.76
2024	3.73	5.42	7.03
2025	3.76	5.66	7.31
2026	3.69	5.81	7.60
2027	3.62	5.95	7.91
2028	3.54	6.10	8.22
2029	3.47	6.25	8.55
2030	3.51	6.51	8.89
2031	3.44	6.68	9.25
2032	3.37	6.84	9.62
2033	3.30	7.01	10.00
2034	3.24	7.19	10.40
2035	3.17	7.37	10.82

Table 2: Proposed Refiners Acquisition Cost (\$2012/Barrel)

	Low	Medium	High
2013	99	99	99
2014	89	100	101
2015	89.0	101	103
2016	88.1	102	105
2017	87.2	103	107
2018	86.4	104	109
2019	85.5	105	111
2020	84.6	106	114
2021	83.8	107	116
2022	83.0	108	118
2023	82.1	109	121
2024	81.3	110	123
2025	80.5	112	126
2026	79.7	113	128
2027	78.9	114	131
2028	78.1	115	133
2029	77.3	116	136
2030	76.6	117	139
2031	75.8	118	141
2032	75.0	120	144
2033	74.3	121	147
2034	73.5	122	150
2035	72.8	123	153

**Table 3: Proposed Powder River Basin Coal Price
(\$2012/mmBTU)**

	Low	Medium	High
2015	0.65	0.76	0.88
2016	0.65	0.77	0.91
2017	0.64	0.78	0.93
2018	0.64	0.78	0.96
2019	0.64	0.79	0.99
2020	0.63	0.80	1.02
2021	0.63	0.81	1.05
2022	0.63	0.82	1.08
2023	0.62	0.82	1.11
2024	0.62	0.83	1.15
2025	0.62	0.84	1.18
2026	0.62	0.85	1.22
2027	0.61	0.86	1.25
2028	0.61	0.87	1.29
2029	0.61	0.88	1.33
2030	0.60	0.88	1.37
2031	0.60	0.89	1.41
2032	0.60	0.90	1.45
2033	0.59	0.91	1.50
2034	0.59	0.92	1.54
2035	0.59	0.93	1.59

Table 4: Conversion Factors

To change from constant 2012 dollars to nominal dollars,
multiply the constant dollar prices by these factors

2012	1.00
2013	1.02
2014	1.03
2015	1.05
2016	1.07
2017	1.08
2018	1.10
2019	1.12
2020	1.14
2021	1.16
2022	1.18
2023	1.20
2024	1.22
2025	1.24
2026	1.26
2027	1.28
2028	1.31
2029	1.33
2030	1.35
2031	1.38
2032	1.40
2033	1.43
2034	1.45
2035	1.48

Proposed Economic, Demographic and Fuel Prices Assumptions for the Seventh Power Plan

July 8, 2014

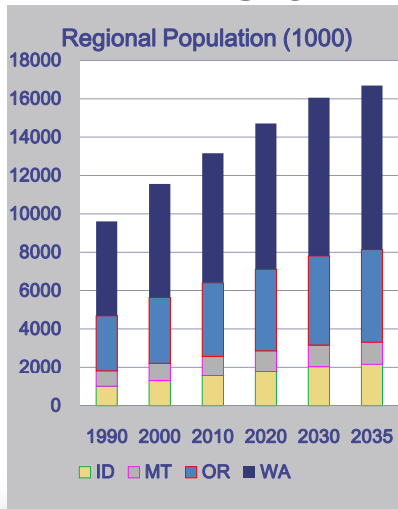
What Are The Key Demographic and Economic Drivers

- **Population growth**
- **Business drivers**
 - **New Home Construction**
 - **Additions to Commercial Floor Space**
 - **Industrial Output**
- **Fuel Prices**
 - **Natural Gas**

Why Do We Need to Forecast These "Drivers"

- **Forecast of regional electricity growth is function:**
 - **Population growth**
 - More people >more housing>greater demand for electricity
 - **Business and industrial activity**
 - More jobs,>more economic output> greater demand for electricity
 - **Fuel prices, especially natural gas**
 - Natural gas is both an alternative to the use of electricity
 - And, a primary source of new electric generation

Regional Population Is Expected To Grow More Slowly



	1985-2014	2015-2035
ID	1.73%	1.30%
MT	0.77%	0.50%
WA	1.64%	0.90%
OR	1.37%	0.80%
4 States	1.50%	0.90%
USA	1.03%	0.90%

Average Annual Addition to Population (1000)	1985-2015	2015-2035
ID	21	24
MT	7	6
WA	90	66
OR	43	34
4 States	162	130

Overall regional population growth projected to slow down.

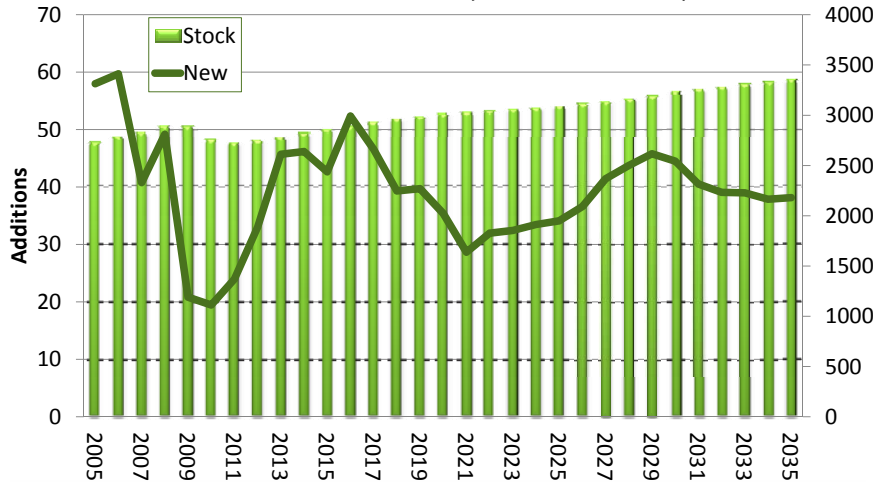
Northwest population remains about 4% of national population.

While Employment Growth Is Forecast to Recover From the Recession, Commercial Sector Floorspace Growth Is Expected to Be Slower*

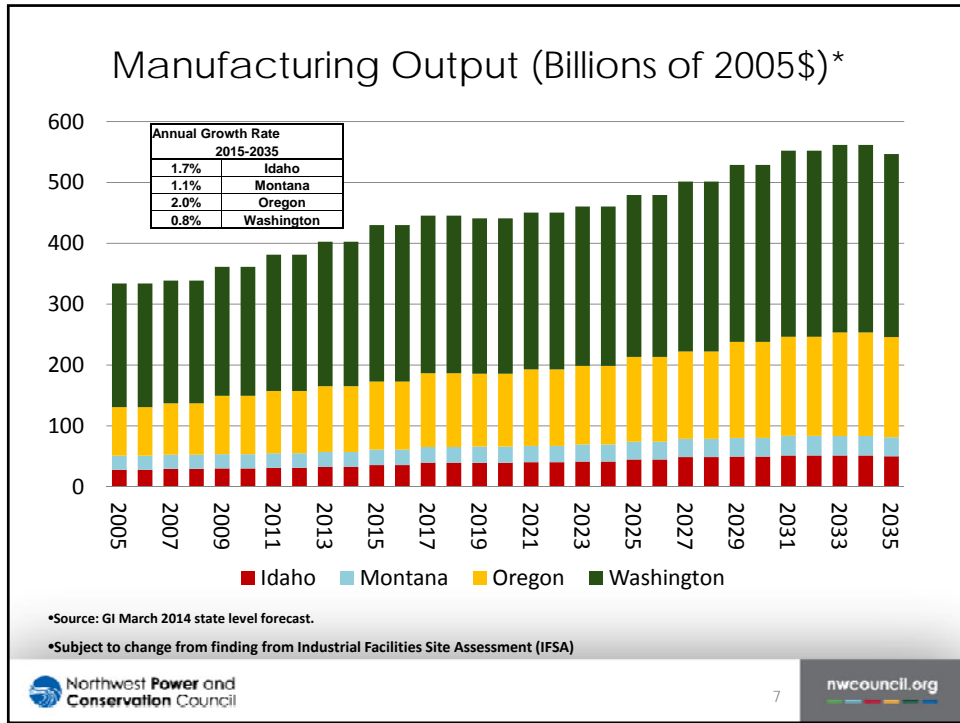
	Annual Growth Rate		
	2005-2011	2011-2020	2020-2035
Employment	0.8%	1.4%	0.6%
Floor space Stock Req.	0.4%	1.0%	0.5%
Millions of square Feet	Cumulative	Annual Average	
1985-2011 Addition	1,406	52	
2015-2035 Requirement	951	40	

* Subject to change as Commercial Building Stock Assessment becomes available

Commercial Floor Space Requirements New and Stock (millions SQF)*

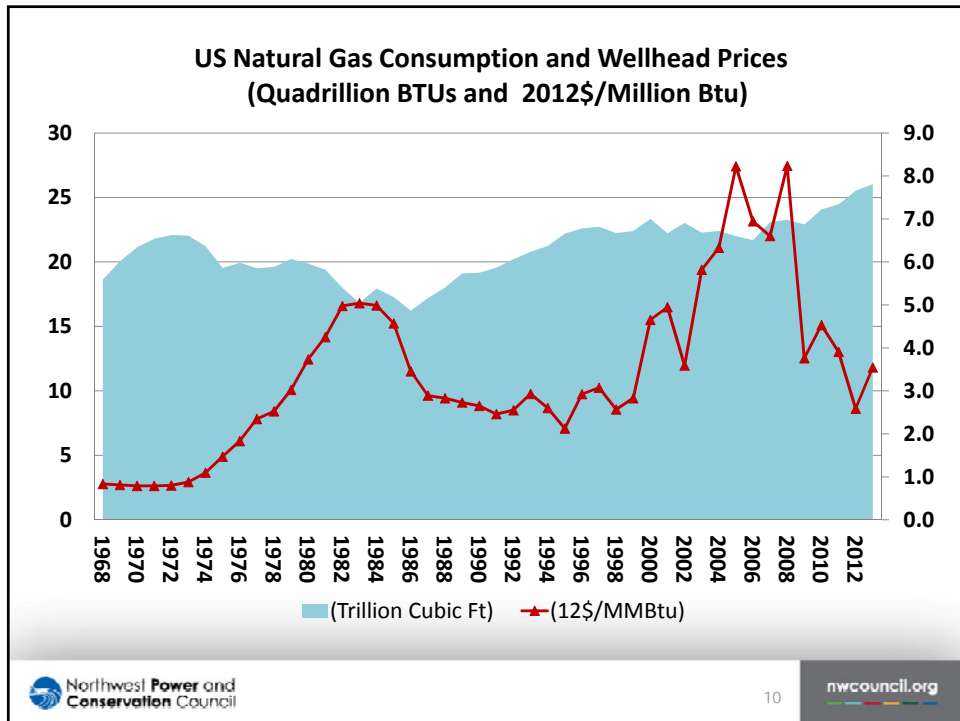
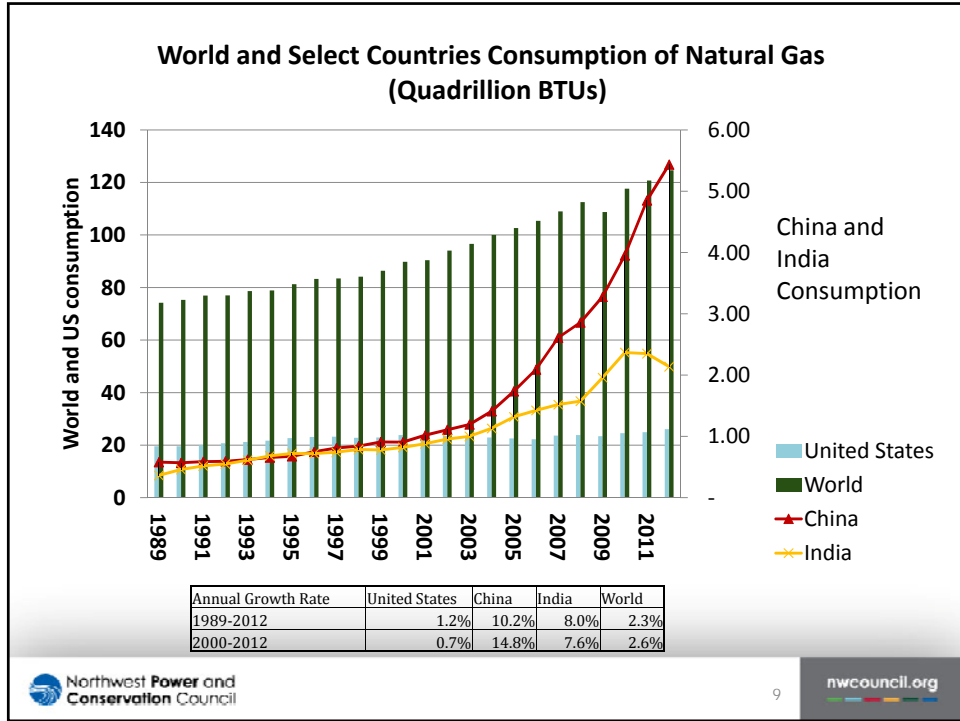


* Source: GI state level employment forecast /internal analysis.
 * Subject to change as 2014 Commercial Building Stock Assessment becomes available



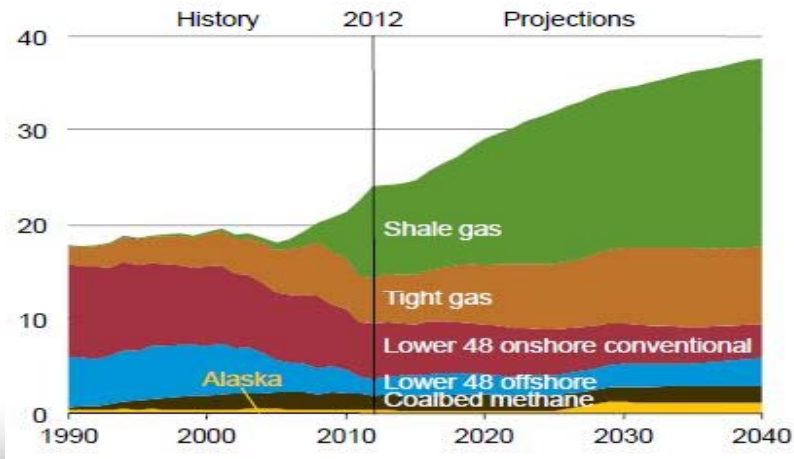
Natural Gas Prices

- Natural gas price is a key driver because in large part it sets the wholesale price of electricity, which in turn is used in valuation of resources.
- Price of natural gas is influenced by
 - Demand (national → global) for natural gas
 - Supply (national → global) of natural gas
 - Market constraints
 - Price of oil



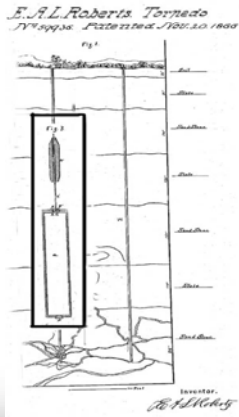
Shale gas provides the largest source of growth in U.S. natural gas supply

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



To Better Understand Natural Gas Prices Let's Review the Story of Fracking From Milkshakes To Atomic Bombs

- **1865 Civil War Veteran invents an Oil Well "Torpedo"**

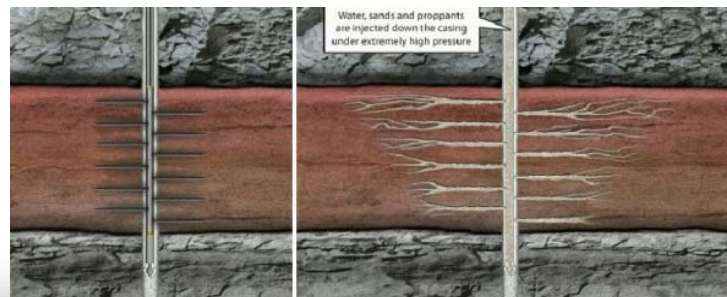


A Brief Story of Fracking

- 1901 - California/Texas/Oklahoma fields were giant and rich in oil and gas. No explosive were needed. This was the area of gushers.
- 1932 - Dow Chemicals started use of hydrochloric acid to dissolve rocks and create channels for oil. This method worked best for Limestone formation.
- 1940s - First use of liquids to fracture the rock.
- 1948 - Farris Field received a patent for fracking. An exclusive license for use of hydro fracking was issued to HOWCo, the Halliburton oil well cementing company.

First Commercial Application of Hydraulic Fracturing

- On March 17, 1949, a team of petroleum production experts converges on an oil well about 12 miles east of Duncan, Oklahoma – to perform the first commercial application of hydraulic fracturing.



"Gasbuggy" tests Nuclear Fracking



Scientists lower a 13-foot by 18-inches diameter nuclear warhead into a well in New Mexico. The experimental 29-kiloton Project Gasbuggy device will be detonated at a depth of 4,240 feet. *Los Alamos Lab photo.*

- *It's the first of a series of nuclear denotations conducted by the Atomic Energy Commission to test the feasibility of using nuclear explosions to release natural gas trapped in dense shale deposits. This is "fracking," late 1960s style.*

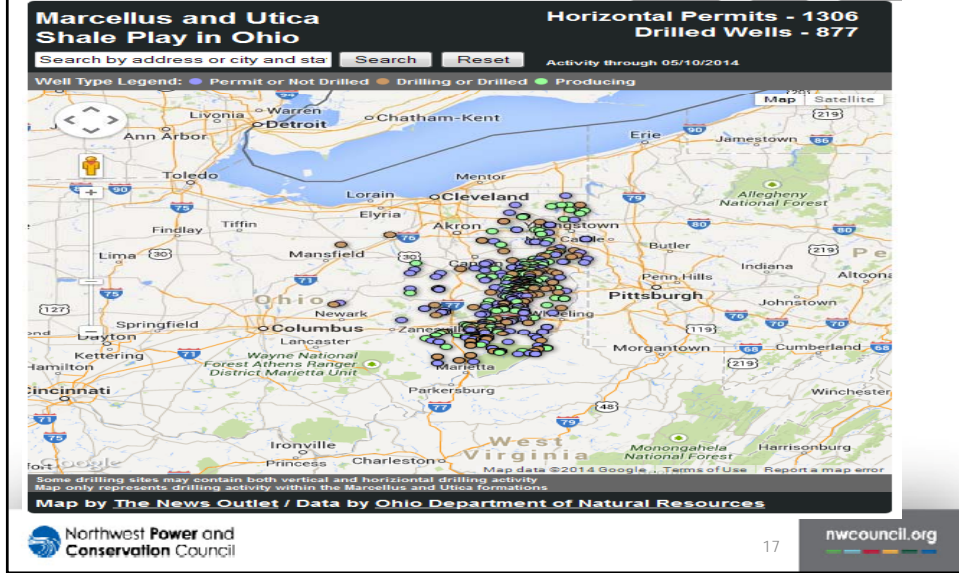


Hydraulic Fracturing Liquids

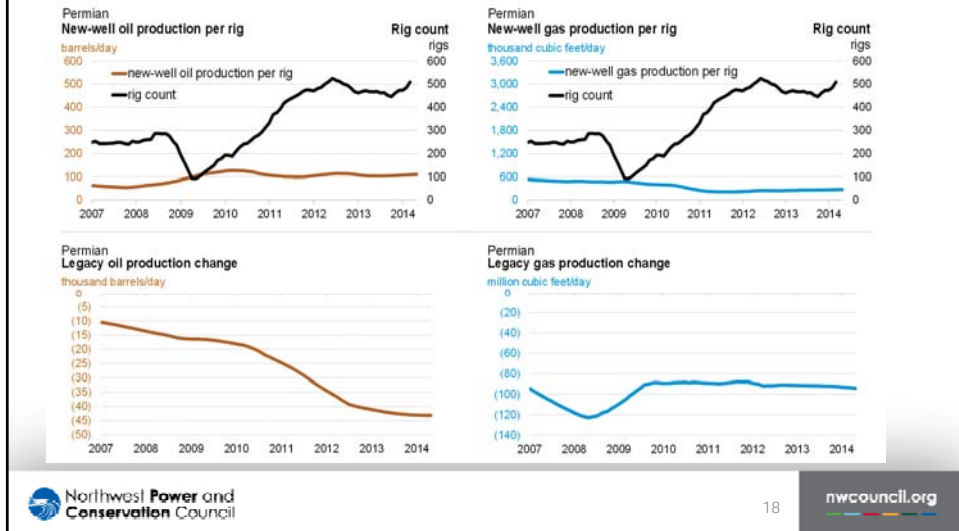


- Water and Chemicals to produce a gelatinous glop.
- Liquefied guar
- Water and guar is 99.1% of liquid rest are chemicals.
- E&P industry in opening up to disclosing components of various fracturing liquids.
- The recipes depend on each play and well.
- Big problem is in the disposal of water.

Hydraulic Fracturing of Shale Source Rock (NIMBY or Banana)



A well may need to be fracked multiple times



Now – Back to Natural Gas Prices

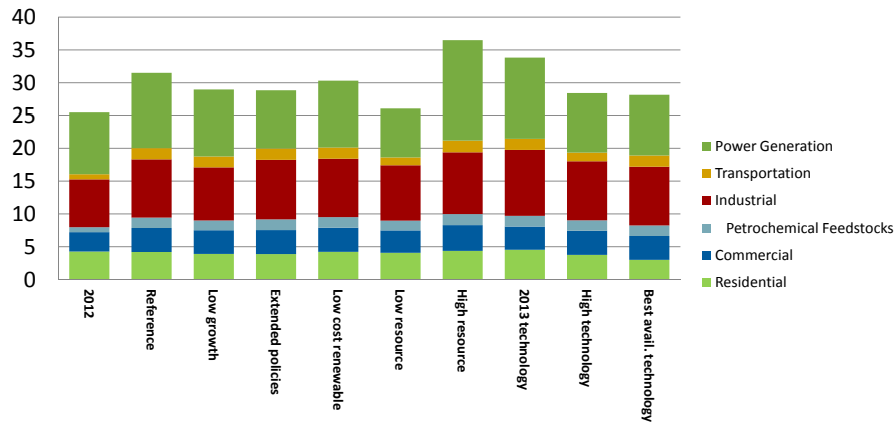
Short-term prices



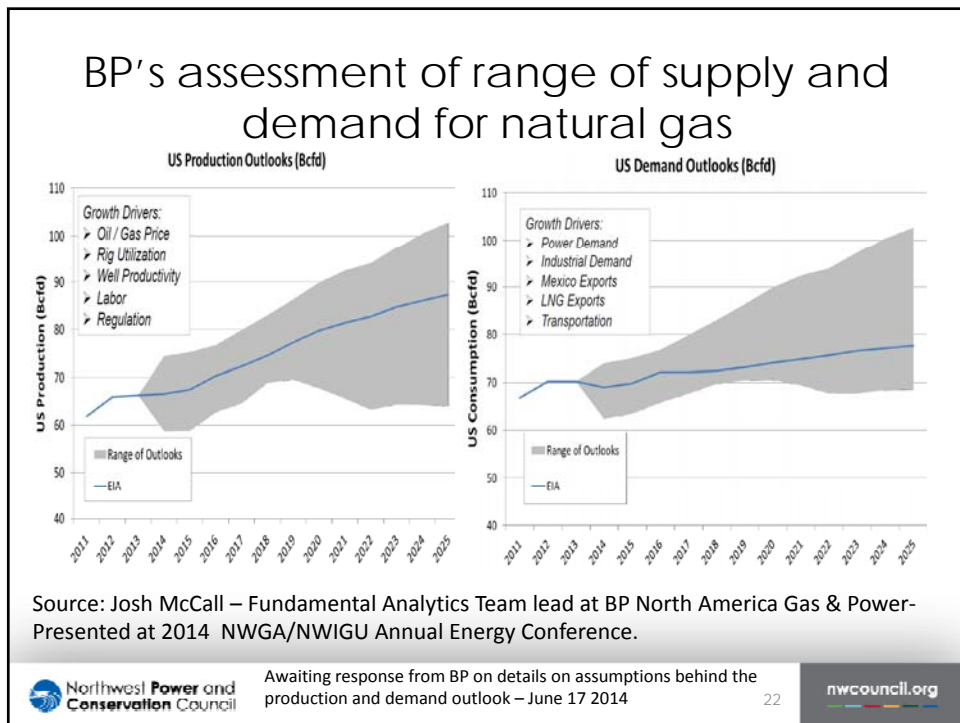
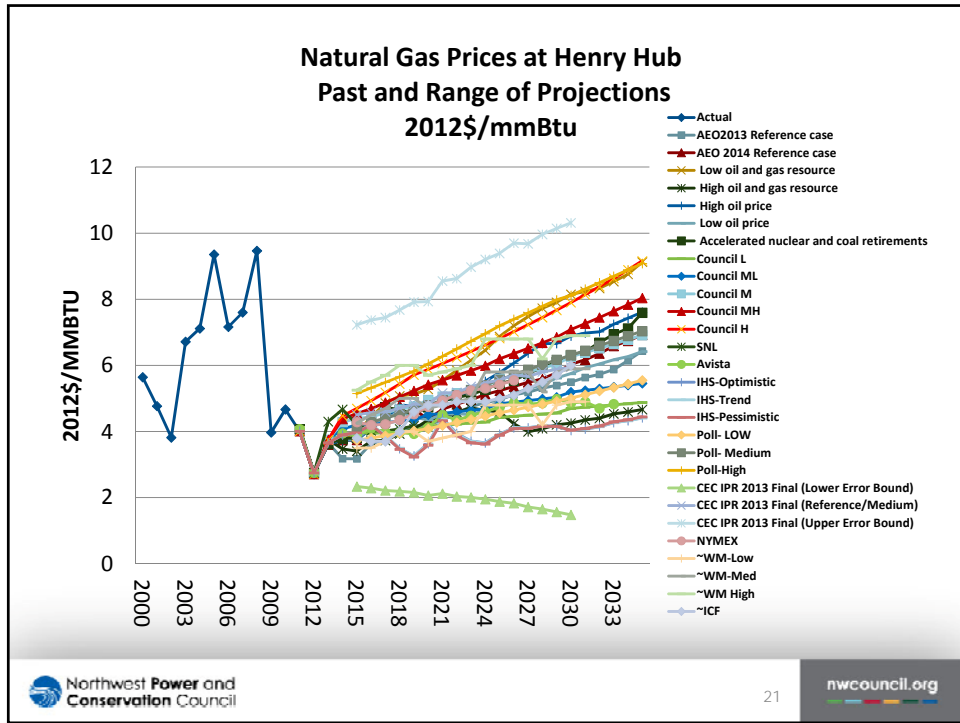
Long-term prices

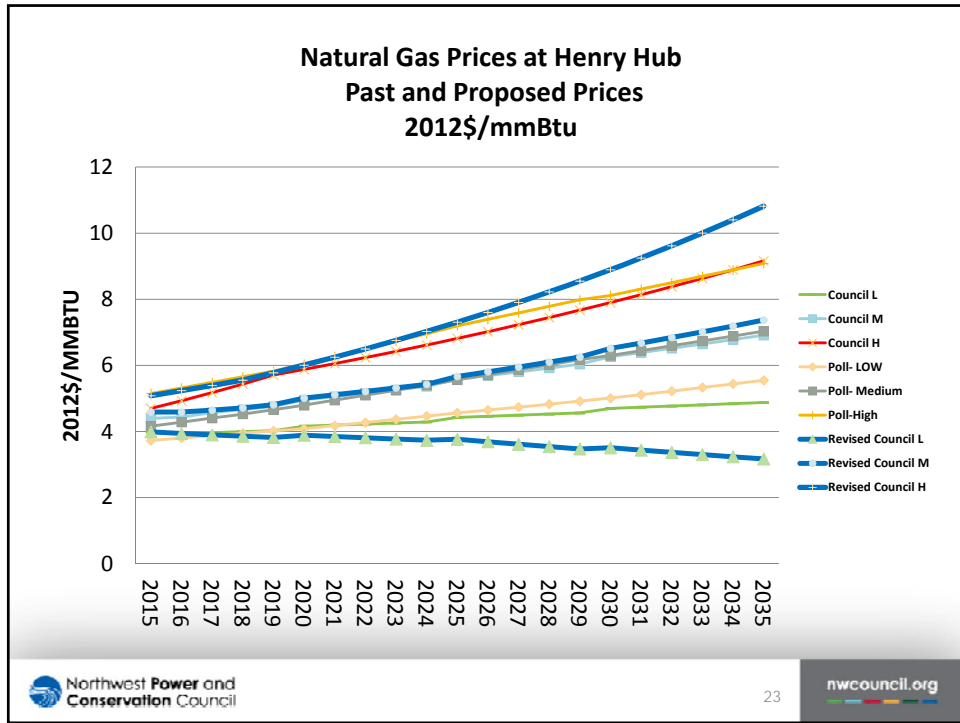
- National and global Demand
- National and global supply
- Market constraints
- Price of oil

Range of Annual Demand for Natural Gas by 2040 (quadrillion Btus)



	Reference	Low growth	Extended policies	Low cost renewable	Low resource	High resource	2013 technology	High technology	Best available technology
2012-2040	0.76%	0.46%	0.44%	0.62%	0.08%	1.29%	1.01%	0.39%	0.35%





Proposed Natural Gas Prices 2012\$ and Nominal \$

Proposed Henry Hub Price Forecasts as of July 2014 (\$2012/MMBTU)			
	Council Low	Council Medium	Council High
2013	3.7	3.7	3.7
2014	3.9	4.7	4.9
2015	4.0	4.6	5.1
2020	3.9	5.0	6.0
2025	3.8	5.7	7.3
2030	3.5	6.6	8.9
2035	3.2	7.4	10.8
Average 2015-2035	3.8	5.8	7.5

Proposed Henry Hub Price Forecasts as of July 2014 (Nominal Dollars)			
	Council Low	Council Medium	Council High
2014	4.0	4.9	5.1
2015	4.2	4.8	5.3
2020	4.4	5.7	6.8
2025	4.7	7.1	9.1
2030	4.7	8.9	12.0
2035	4.7	11.0	16.0
Average 2015-2035	5.7	8.7	11.4

Northwest Power and Conservation Council nwccouncil.org

Summary and Next Steps

- **Compared to 2013 key driver assumptions**
 - Updated population forecast shows no material change
 - Residential/commercial/industrial outlook similar
 - Some increase in long-term outlook for natural gas prices.
- **Next step**
 - Upon approval by Council, produce and make available the Fuel Forecast 2014 report.
 - Update forecast for commercial and industrial sectors based on updates from CBSA and IFSA.

End of presentation