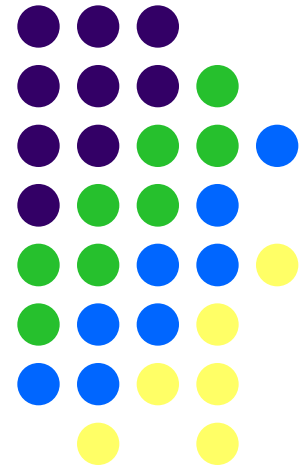


# Back to the Future? The Evolution of the North American Natural Gas Market

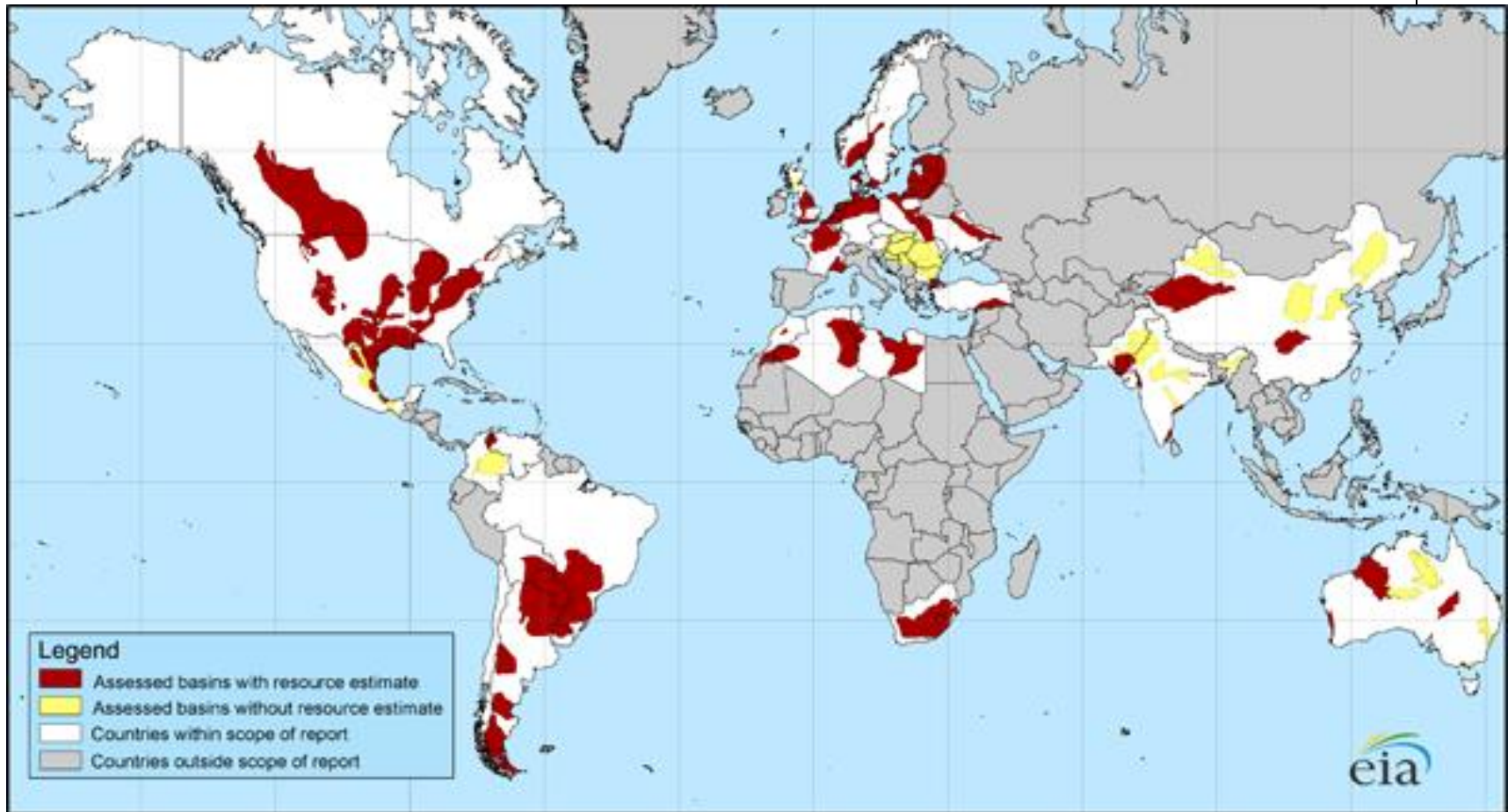
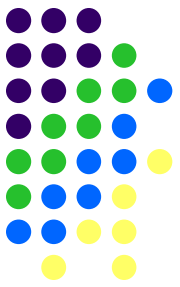
ELAEE Latin American Energy Conference  
8 April 2013  
Montevideo, Uruguay

Lori Smith Schell, Ph.D., ERP  
Empowered Energy

174 N. Elk Run, Durango, CO 81303 USA  
Tel: +1 (970) 247-8181 • Fax: +1 (970) 247-3761  
E-Mail: [LSchell@EmpoweredEnergy.com](mailto:LSchell@EmpoweredEnergy.com)

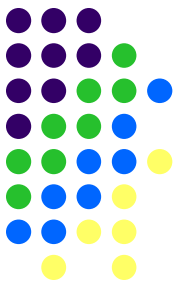


# Shale Plays Have Been Identified Around the Globe

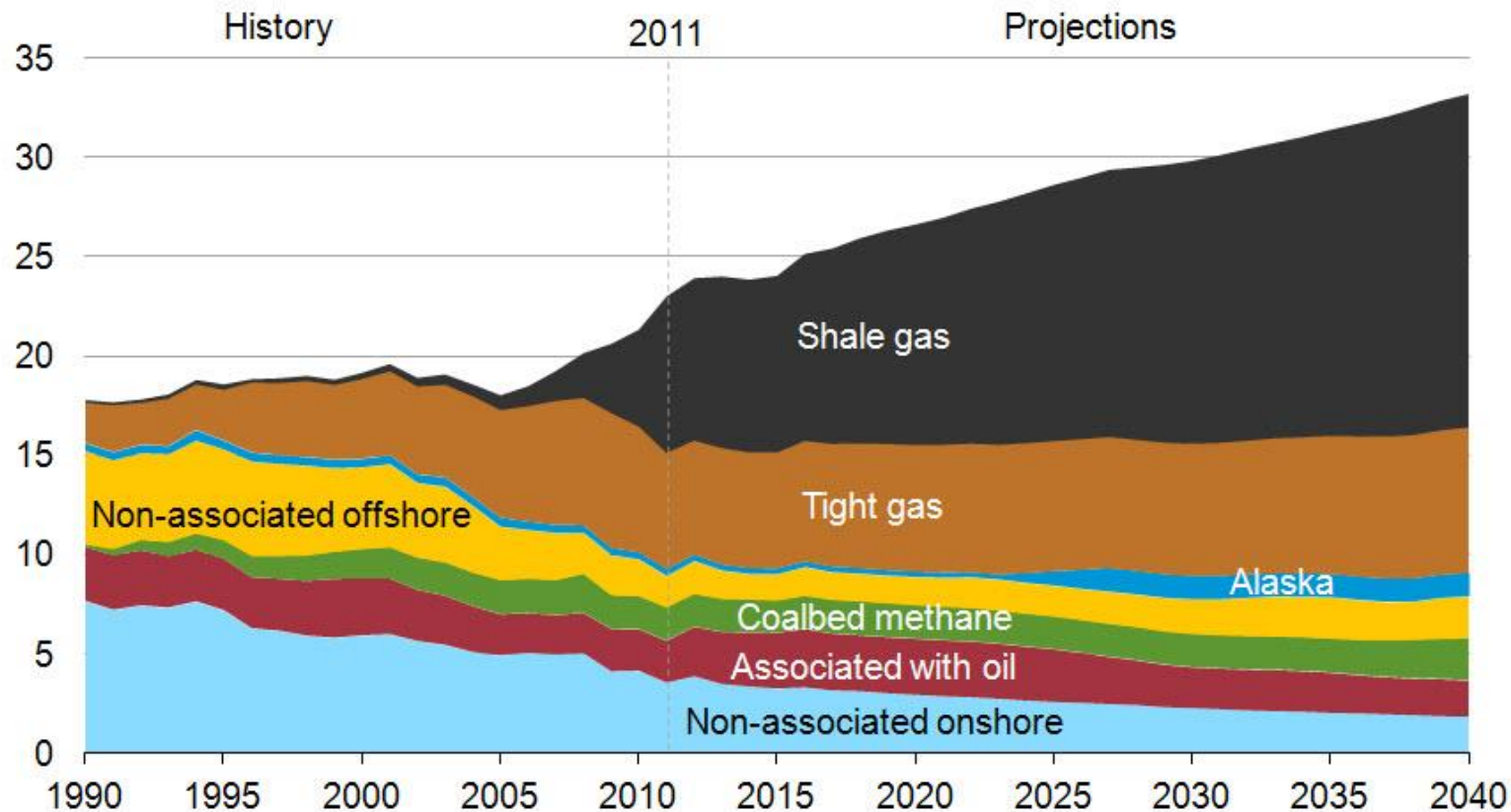


**Source:** *World Shale Gas Resources: An Initial Assessment of 14 Regions Outside the United States*, April 2011, p. 3,  
<http://www.eia.gov/analysis/studies/worldshalegas/pdf/fullreport.pdf>

# U.S. Shale Gas Production Is Fairly Recent Phenomenon

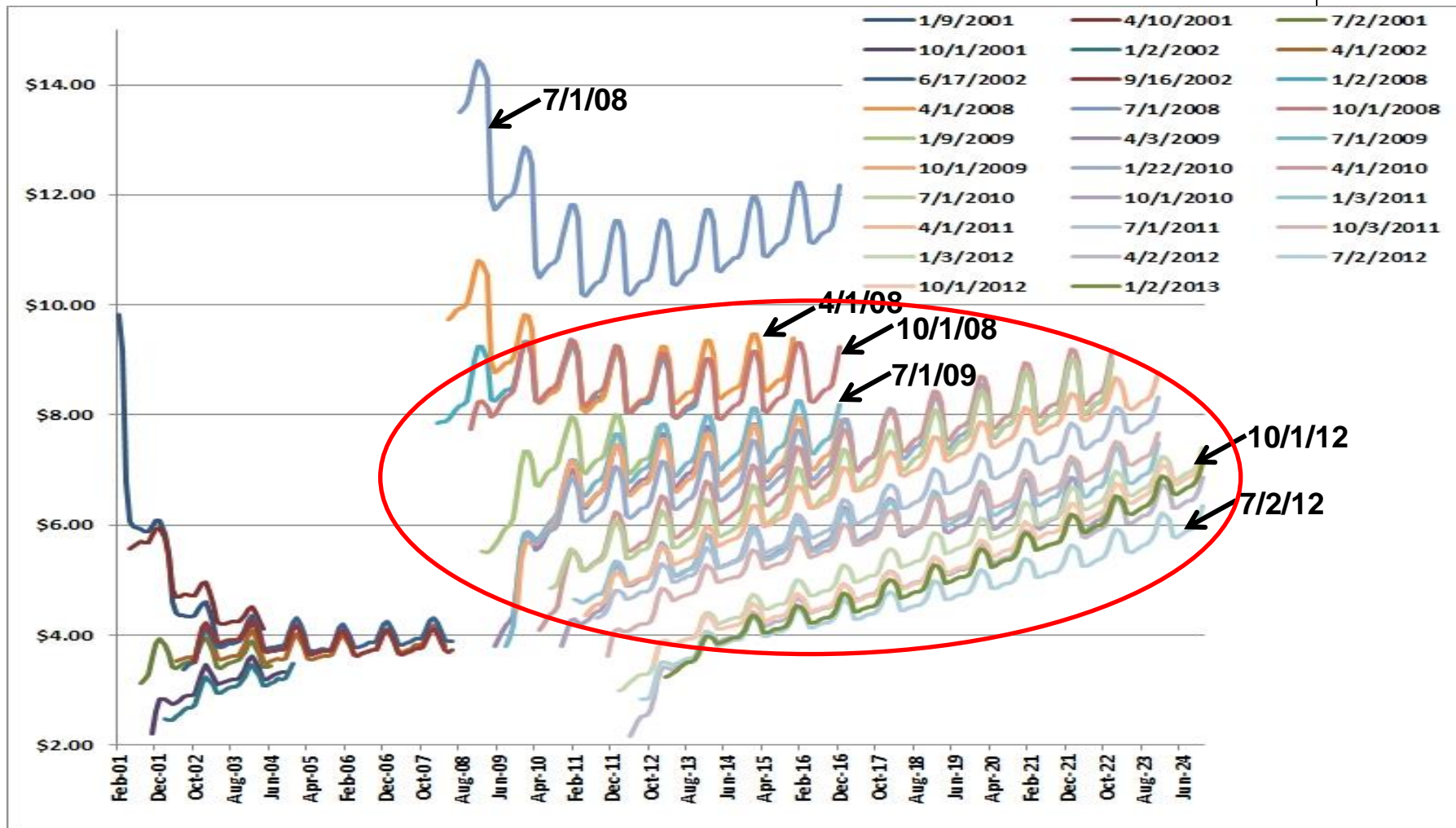
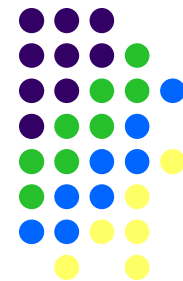


U.S. dry natural gas production  
trillion cubic feet

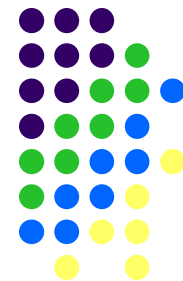


Source: U.S. Energy Information Administration, *Annual Energy Outlook 2013 Early Release*  
8 April 2013 [www.EmpoweredEnergy.com](http://www.EmpoweredEnergy.com)

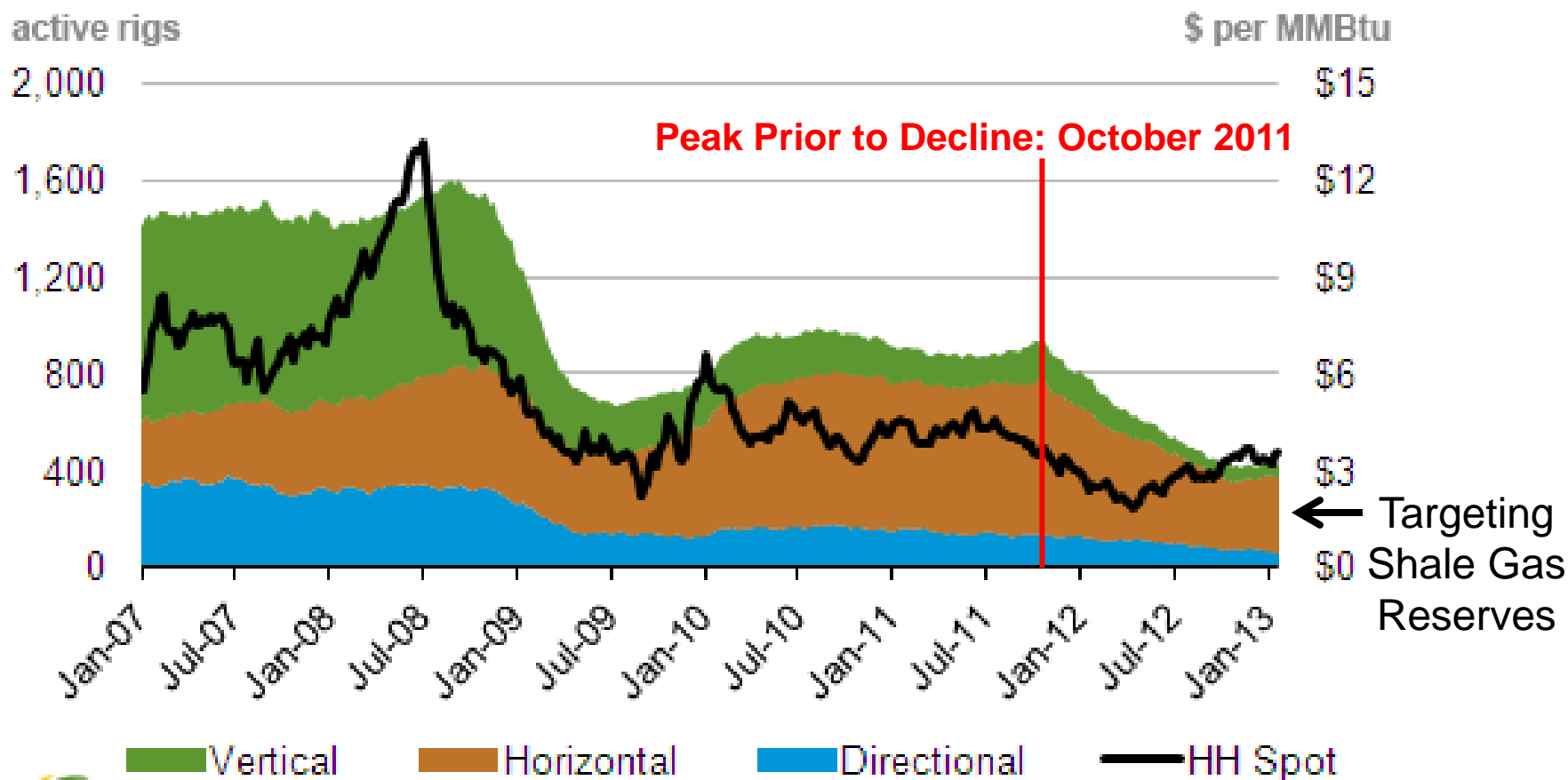
# Shale Gas Impact Clearly Seen in NYMEX Forward Curves



# Rig Count Responds to Low Prices Prices Respond to Rig Count



Weekly natural gas rig count and average spot Henry Hub



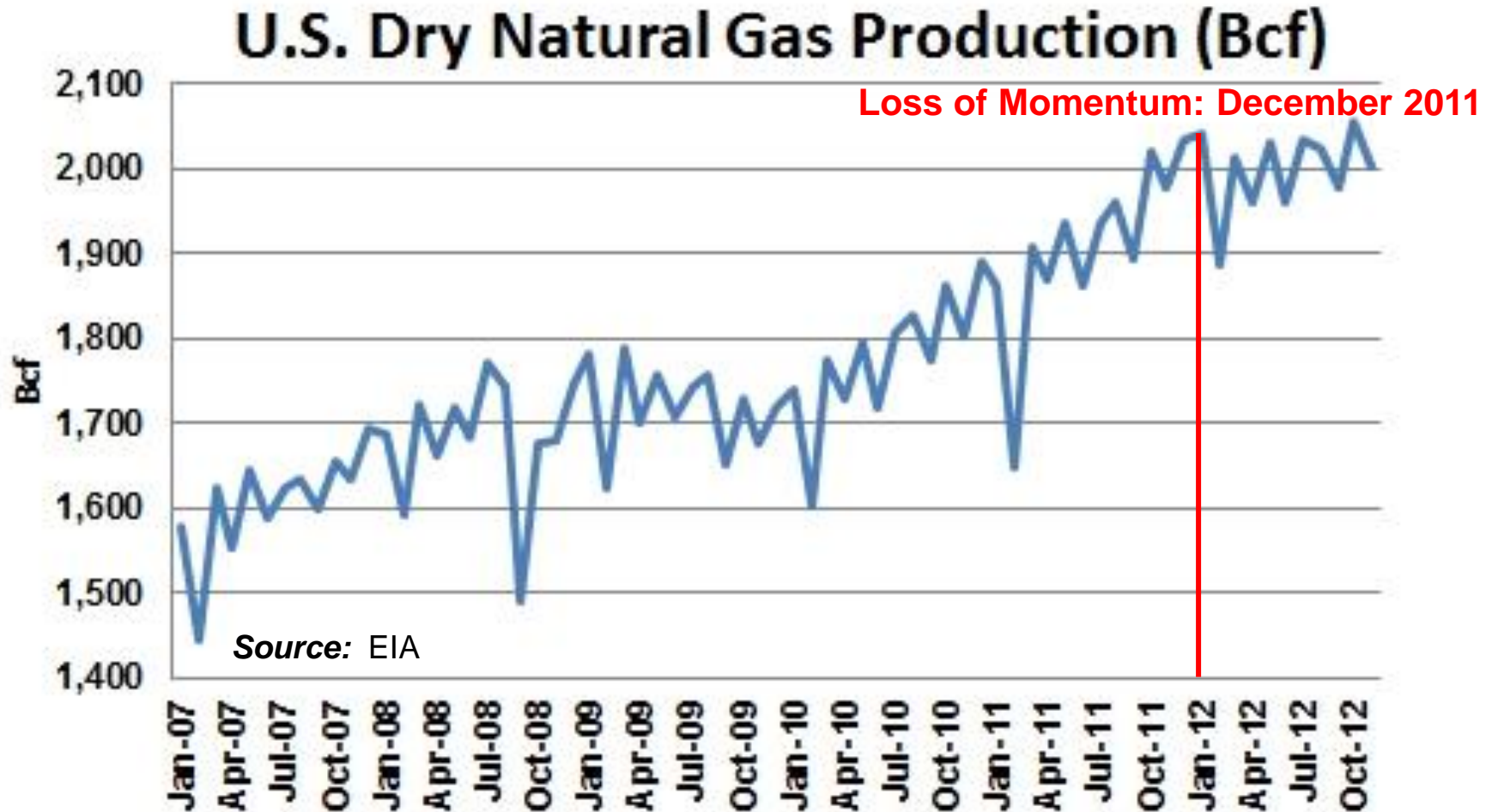
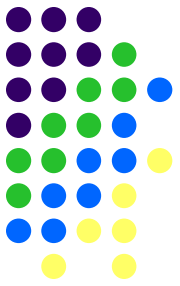
Source: Baker Hughes

8 April 2013

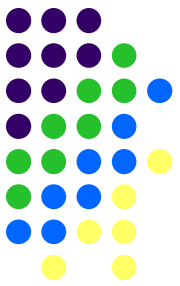
[www.EmpoweredEnergy.com](http://www.EmpoweredEnergy.com)



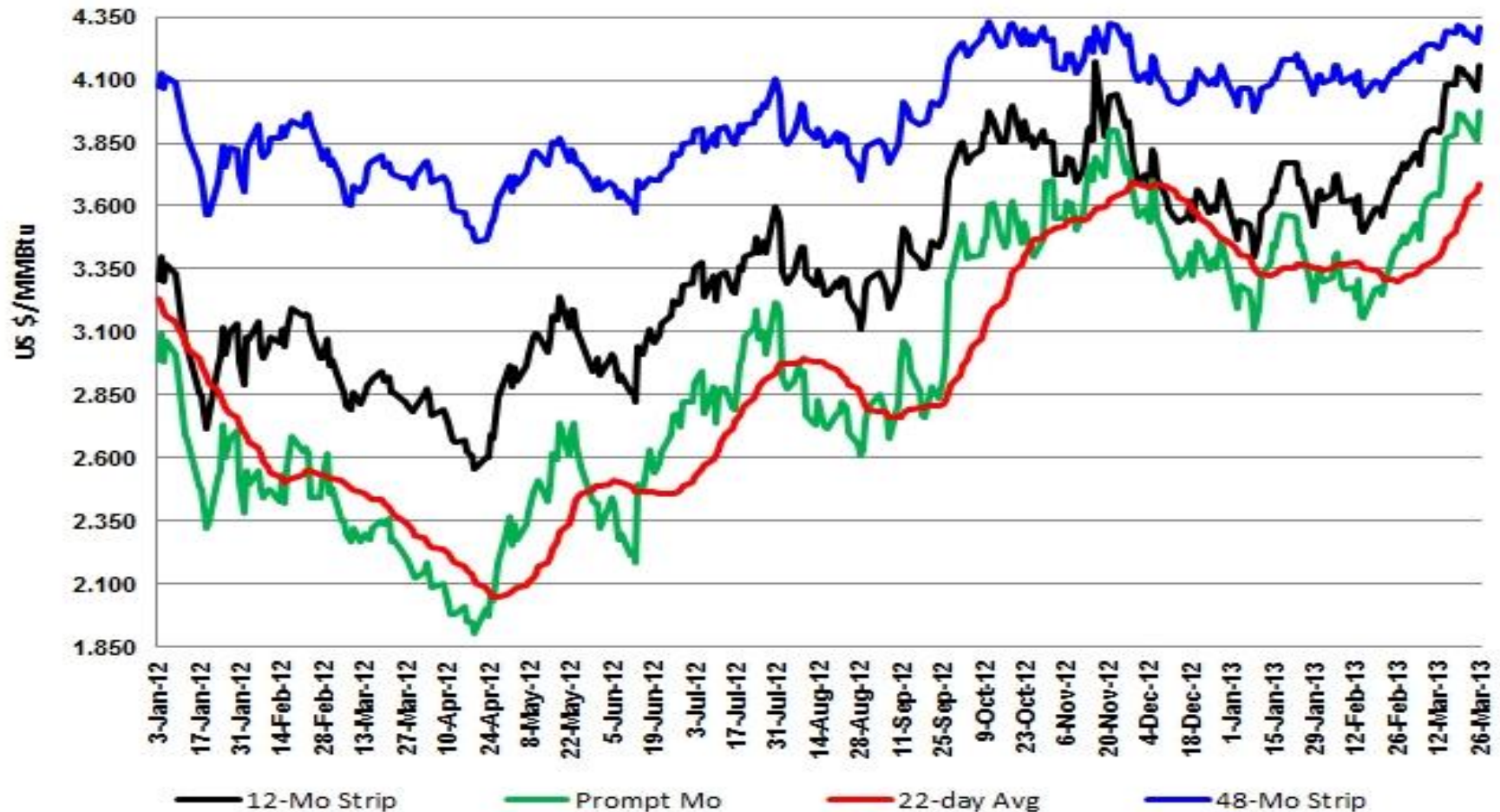
# Natural Gas Production Levels Off as Rig Count Nosedives



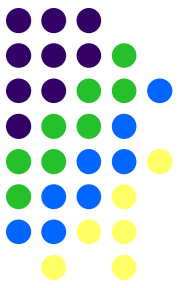
# NG Futures Prices Respond to Changing Production Levels...



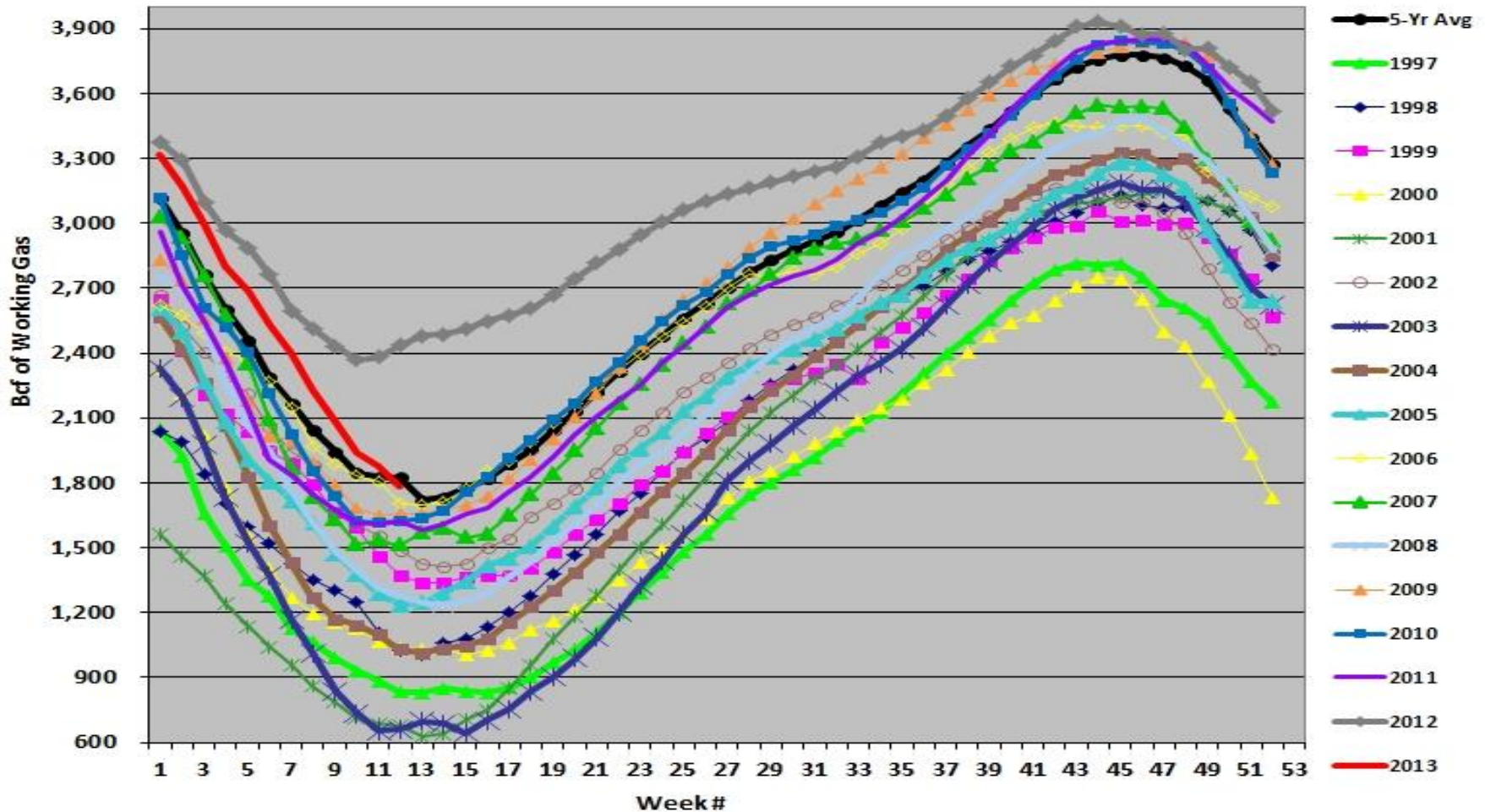
2012-13 NYMEX HH Natural Gas Settlement Prices



# And to Changes in Seasonal Natural Gas Storage Levels

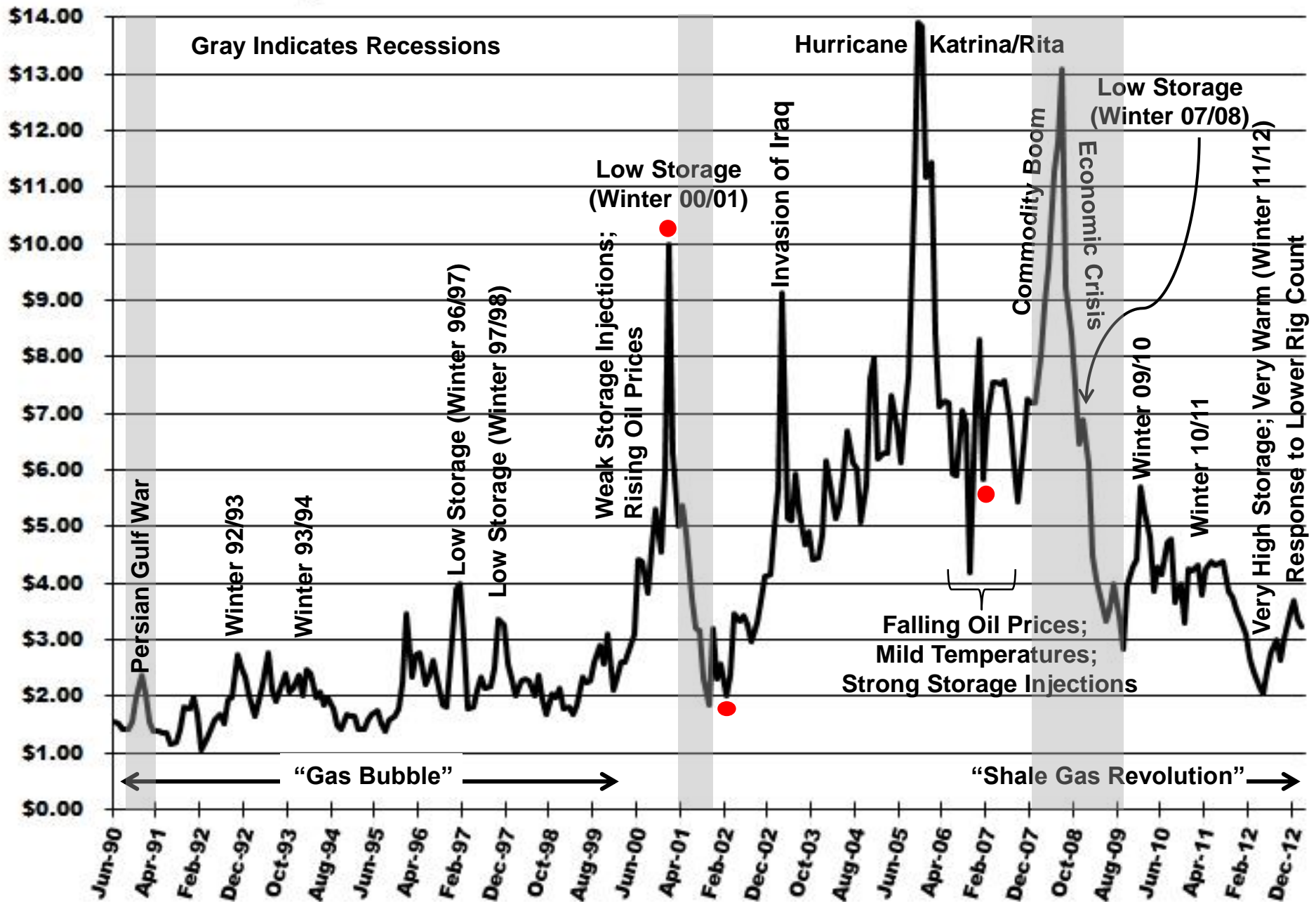


U.S. Natural Gas Storage: 1997-2013 Working Gas

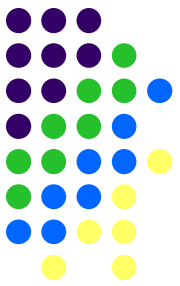




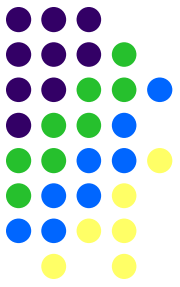
# Henry Hub: NYMEX Natural Gas Settlement Prices



# Distribution of U.S. Shale Gas Is Strongly Impacting Flows



# Interaction of Supply & Demand Determine Value of Gas “Coin”



**Supply: Significant Increase in Shale Gas Exerts Downward Pressure**

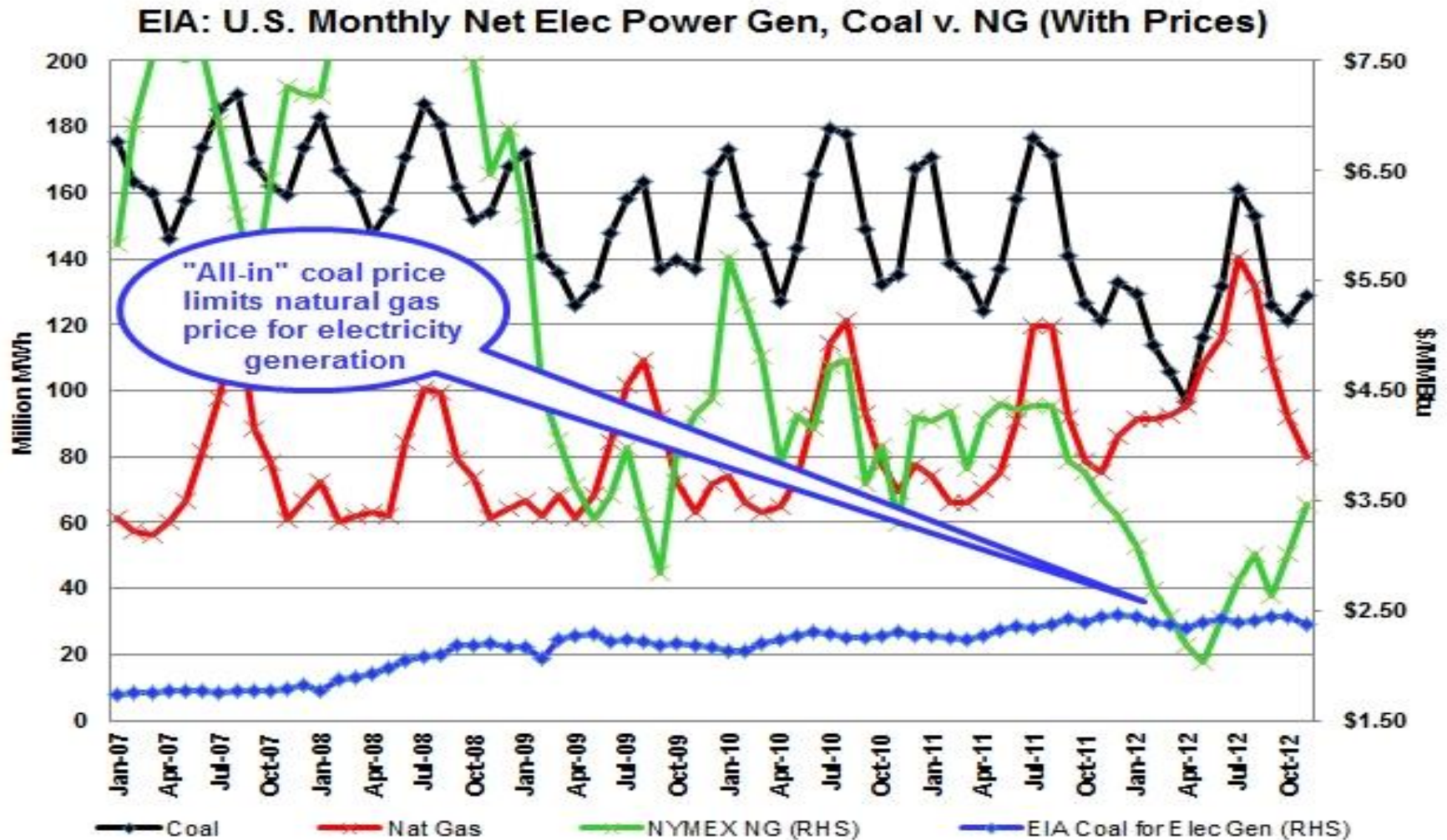
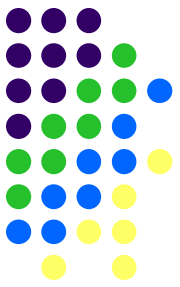
*Natural gas  
price set by  
the interaction  
of the two...*



**Demand: Lower Gas Price Increases Demand in All Markets**

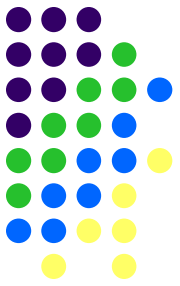


# Coal Price + Emissions Cost Caps NG Price for Electric Gen



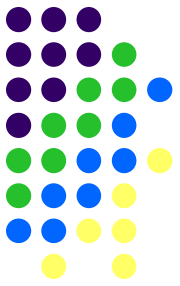


# But, Many Market U.S. Sectors Are Thriving on Low NG Prices



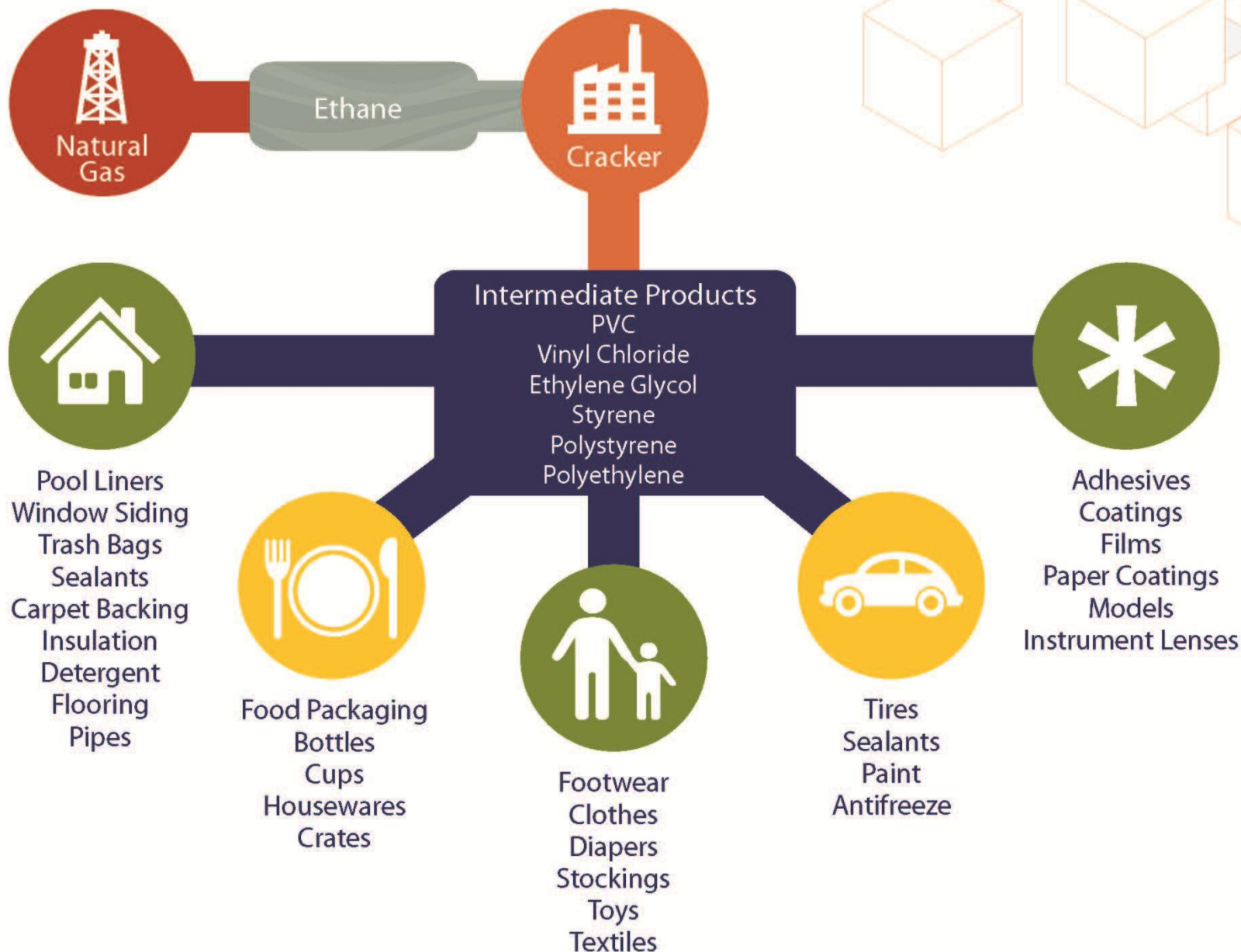
- Electricity generation
- Petrochemicals and derivative products
- Fertilizer
- Transportation
  - NGVs (compressed natural gas)
  - FCVs (natural gas-derived hydrogen)
  - ICEs (gas-to-liquids)
- Industrial Production
- Manufacturing

# Shale Gas is Rich in Natural Gas Liquids (“NGLs”)

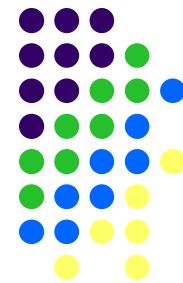


- NGLs must be removed to meet interstate pipeline specifications
- Amount of NGLs removed depends in part on relative prices of natural gas vs. NGLs
- Ethane rejection has led to low ethane prices in U.S. and increased global competitiveness
- Return of ammonia, fertilizer, and methanol production to U.S.

# ETHYLENE CHAIN

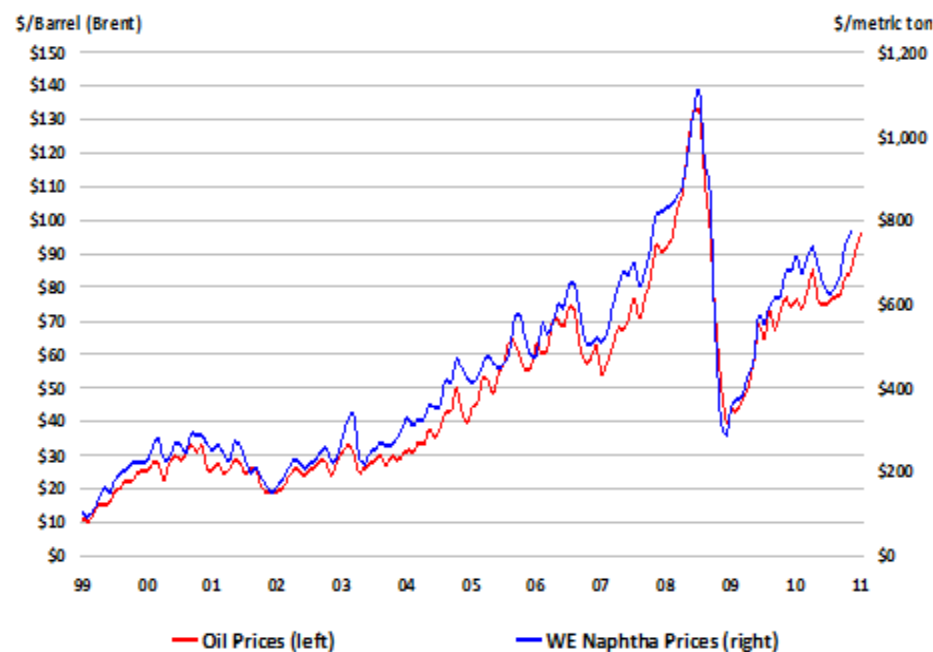
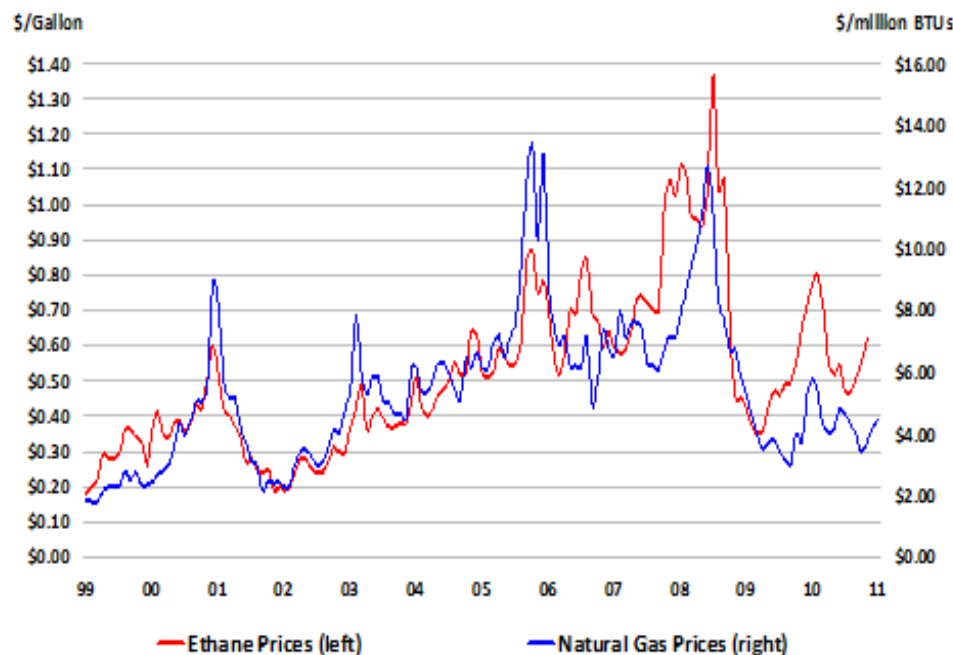


# Chemical Feedstock Price Drivers Differs by Continent



## US: Ethane Price Tied to Natural Gas

## Europe: Ethane Price Tied to Naphtha



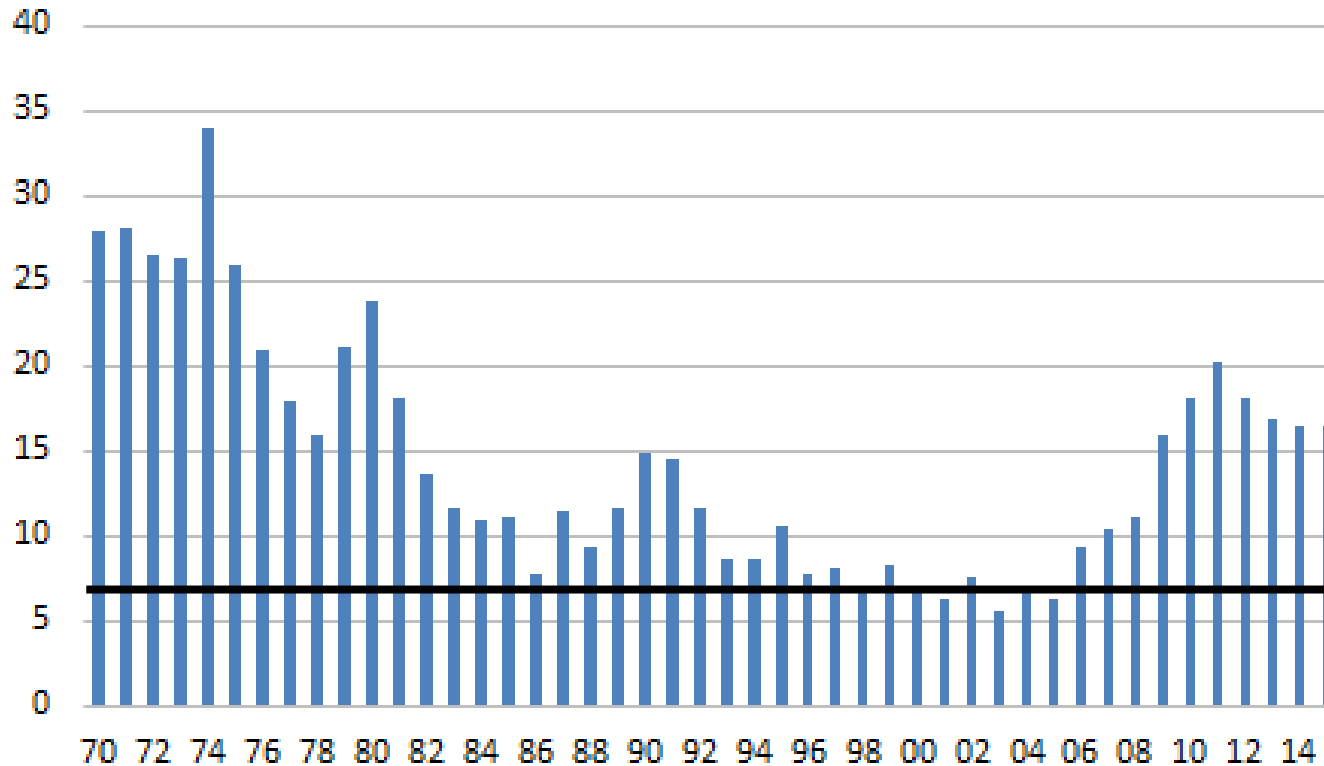
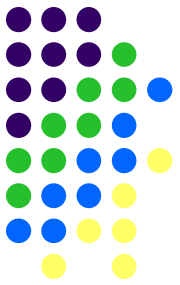
Source: EIA, Chemical Week Associates, Haver Analytics

Source: EIA, Chemical Week Associates, Haver Analytics

Source: American Chemistry Council, March 2012, "Shale Gas and New Petrochemicals Investment: Benefits for the Economy, Jobs, and US Manufacturing", pp. 13-14.



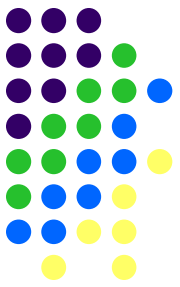
# Oil-to-Gas Ratio Determines Chemicals Competitiveness



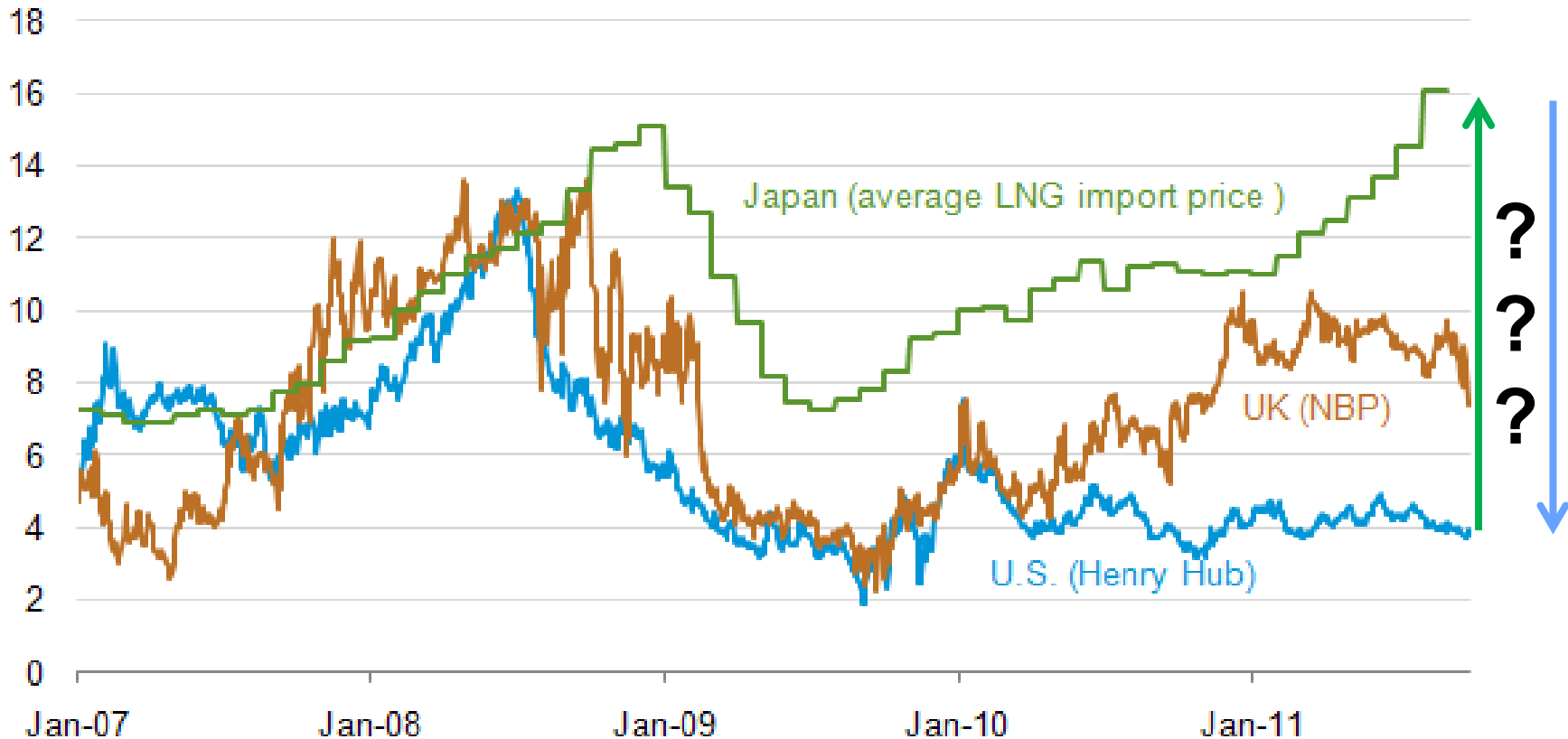
Source: EIA, CMAI, EIU, Global Insight

Source: American Chemistry Council, March 2012, "Shale Gas and New Petrochemicals Investment: Benefits for the Economy, Jobs, and US Manufacturing", p. 15.

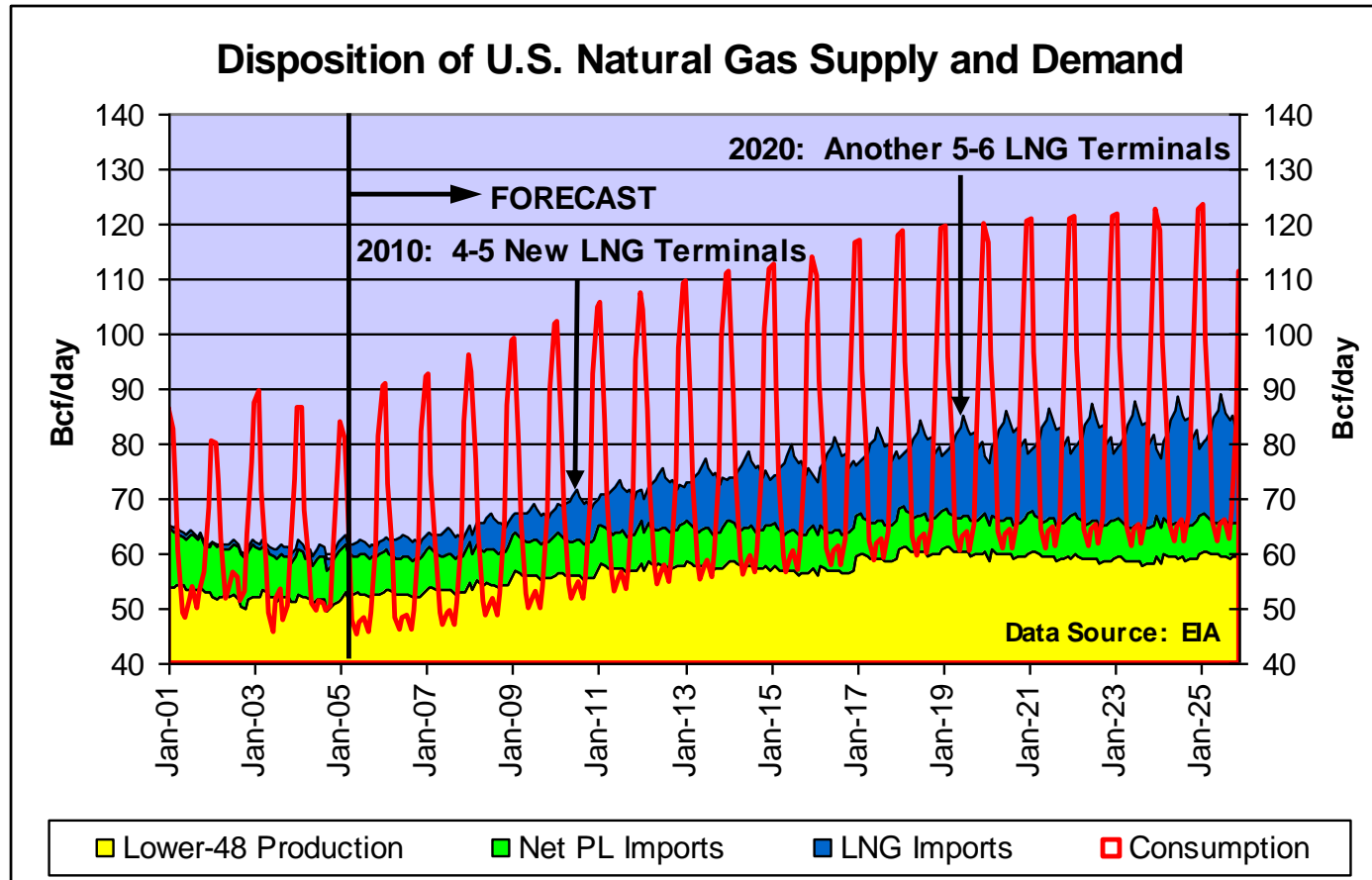
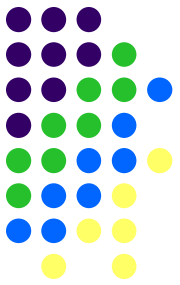
# Global Gas Price Disparity: OPPORTUNITY, but Whose?



Trends in natural gas spot prices at major global markets (September 2011)  
U.S. dollars per million British thermal units (MMBtu)

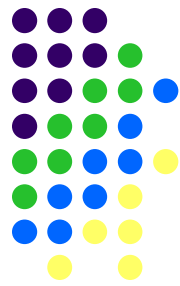


# Pre-Shale Gas “Revolution” Anticipated More LNG *Imports*



PRESENTATION MADE BY LORI SMITH SCHELL, Ph.D.,  
TO THE 18<sup>TH</sup> WORLD PETROLEUM CONGRESS,  
JOHANNESBURG, SOUTH AFRICA, SEPTEMBER 27, 2005

# Today's Expectations: U.S. to Become Net Overall Exporter \*



## North American LNG Import/Export Terminals

### *Proposed/Potential*

#### Import Terminal

##### PROPOSED TO FERC

1. Robbinston, ME: 0.5 Bcfd (Kestrel Energy - Downeast LNG)
2. Astoria, OR: 1.5 Bcfd (Oregon LNG)
3. Corpus Christi, TX: 0.4 Bcfd (Cheniere - Corpus Christi LNG)

#### Export Terminal

##### PROPOSED TO FERC

4. Freeport, TX: 1.8 Bcfd (Freeport LNG Dev/Freeport LNG Expansion/FLNG Liquefaction)
5. Corpus Christi, TX: 2.1 Bcfd (Cheniere - Corpus Christi LNG)
6. Coos Bay, OR: 0.9 Bcfd (Jordan Cove Energy Project)
7. Lake Charles, LA: 2.4 Bcfd (Southern Union - Trunkline LNG)
8. Hackberry, LA: 1.7 Bcfd (Sempra - Cameron LNG)
9. Cove Point, MD: 0.75 Bcfd (Dominion - Cove Point LNG)
10. Astoria, OR: 1.30 Bcfd (Oregon LNG)
11. Lavaca Bay, TX: 1.38 Bcfd (Excelerate Liquefaction)

##### PROPOSED CANADIAN SITES IDENTIFIED BY PROJECT

##### SPONSORS

12. Kitimat, BC: 0.7 Bcfd (Apache Canada Ltd.)
13. Douglas Island, BC: 0.25 Bcfd (BC LNG Export Cooperative)

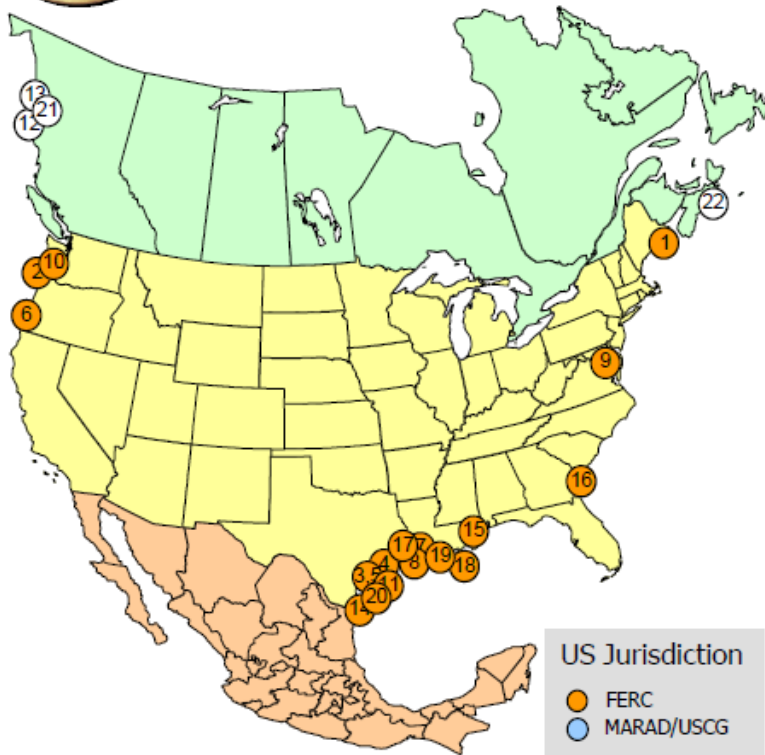
##### POTENTIAL U.S. SITES IDENTIFIED BY PROJECT SPONSORS

14. Brownsville, TX: 2.8 Bcfd (Gulf Coast LNG Export)
15. Pascagoula, MS: 1.5 Bcfd (Gulf LNG Liquefaction)
16. Elba Island, GA: 0.5 Bcfd (Southern LNG Company)
17. Sabine Pass, TX: 2.6 Bcfd (ExxonMobil - Golden Pass)
18. Plaquemines Parish, LA: 1.07 Bcfd (CE FLNG)
19. Cameron Parish, LA: 0.16 Bcfd (Waller LNG Services)
20. Ingleside, TX: 1.09 Bcfd (Pangea LNG (North America))

##### POTENTIAL CANADIAN SITES IDENTIFIED BY PROJECT

##### SPONSORS

21. Prince Rupert Island, BC: 1.0 Bcfd (Shell Canada)
22. Goldboro, NS: 0.67 Bcfd (Pieridae Energy Canada)



Source: <http://ferc.gov/industries/gas/indus-act/lng/LNG-proposed-potential.pdf>

\* Source: EIA, AEO 2013  
Early Release Overview;  
LNG by 2016, Overall  
Net Exporter by 2020.

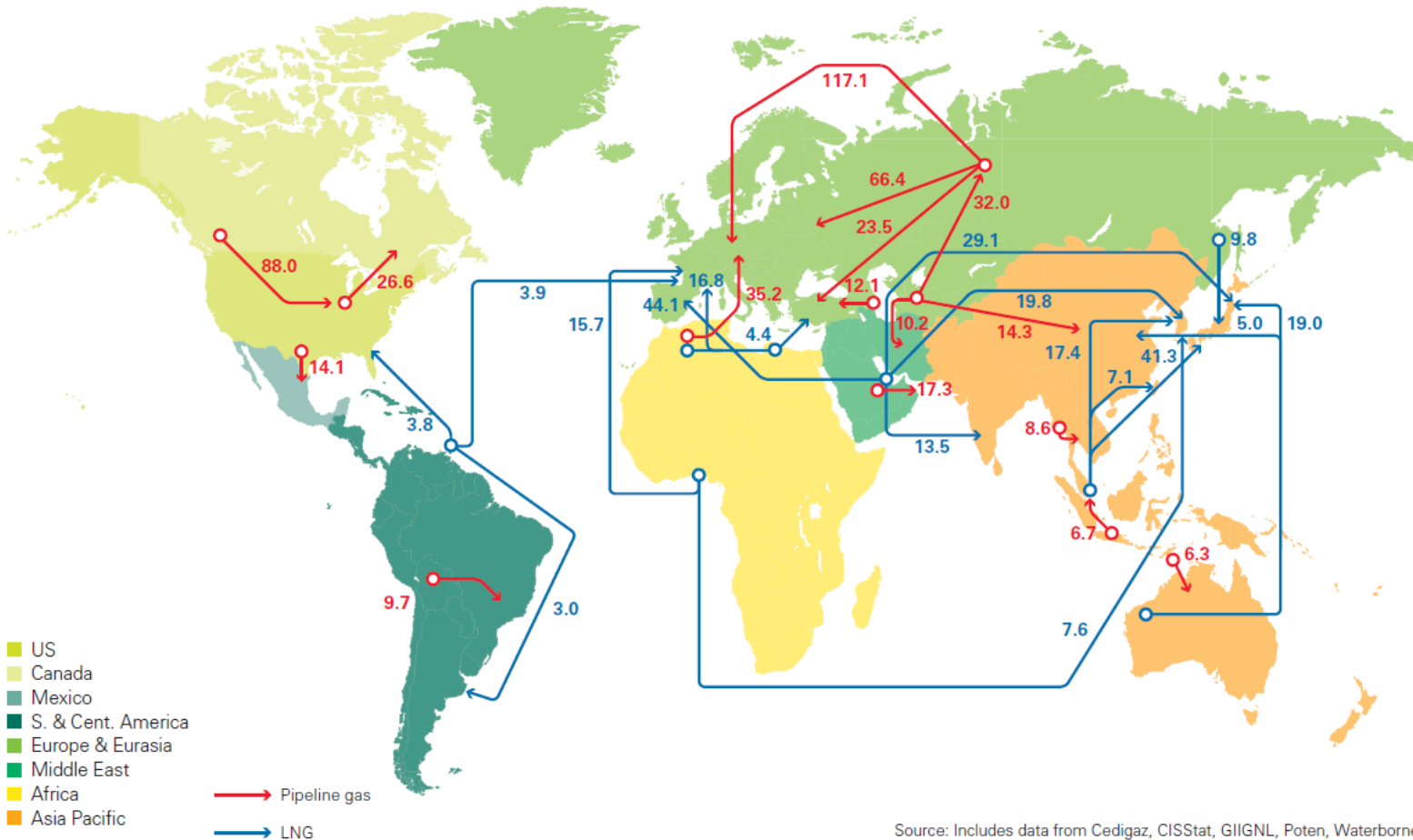
As of December 5, 2012

*Office of Energy Projects*



Trade flows worldwide (billion cubic metres)

**Source: BP, June 2012, “BP Statistical Review of World Energy”, p. 29.**

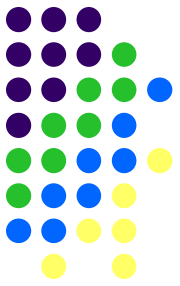


Source: Includes data from Cedigaz, CISStat, GIIGNL, Poten, Waterborne.

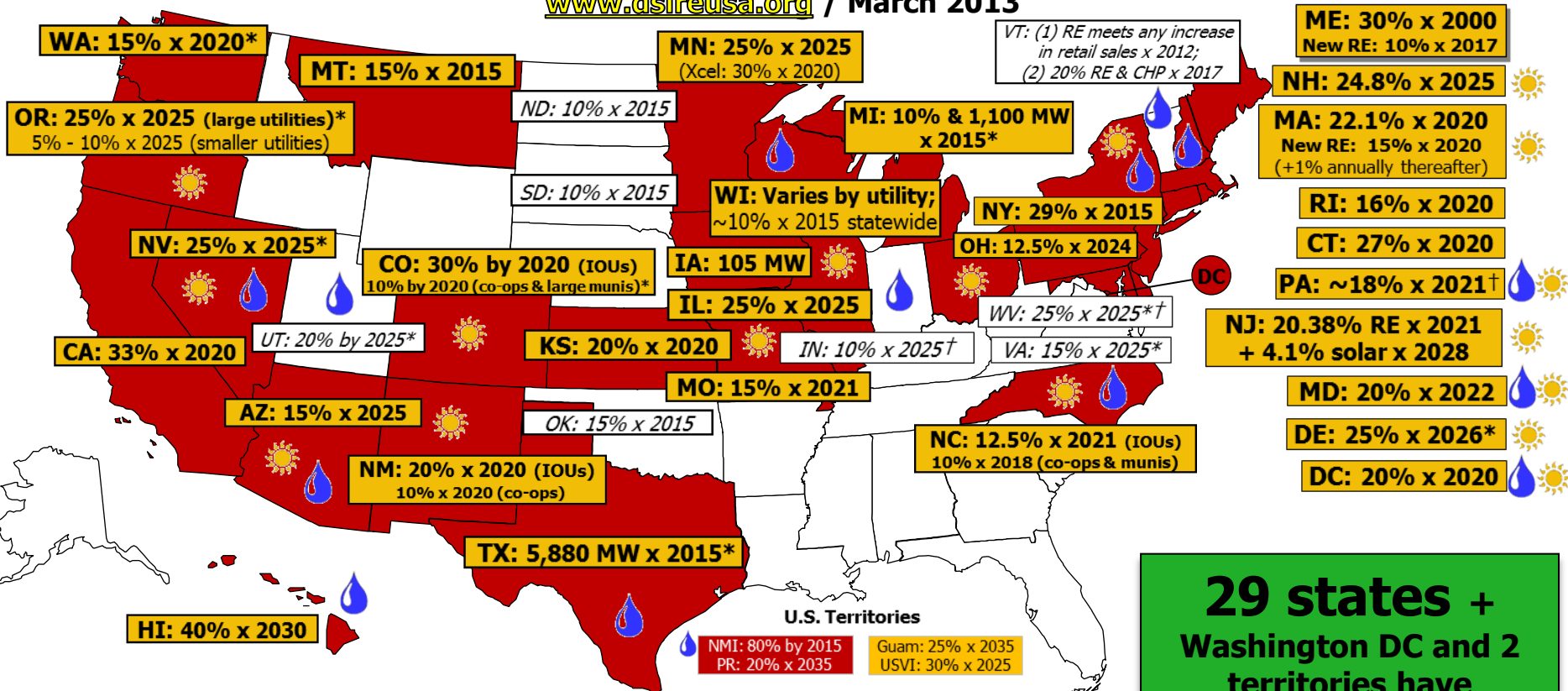
# Renewable Portfolio Standards

## Impact Natural Gas Demand

### *Renewable Portfolio Standard Policies*



[www.dsireusa.org](http://www.dsireusa.org) / March 2013



Renewable portfolio standard

Renewable portfolio goal

Solar water heating eligible



Minimum solar or customer-sited requirement



Extra credit for solar or customer-sited renewables

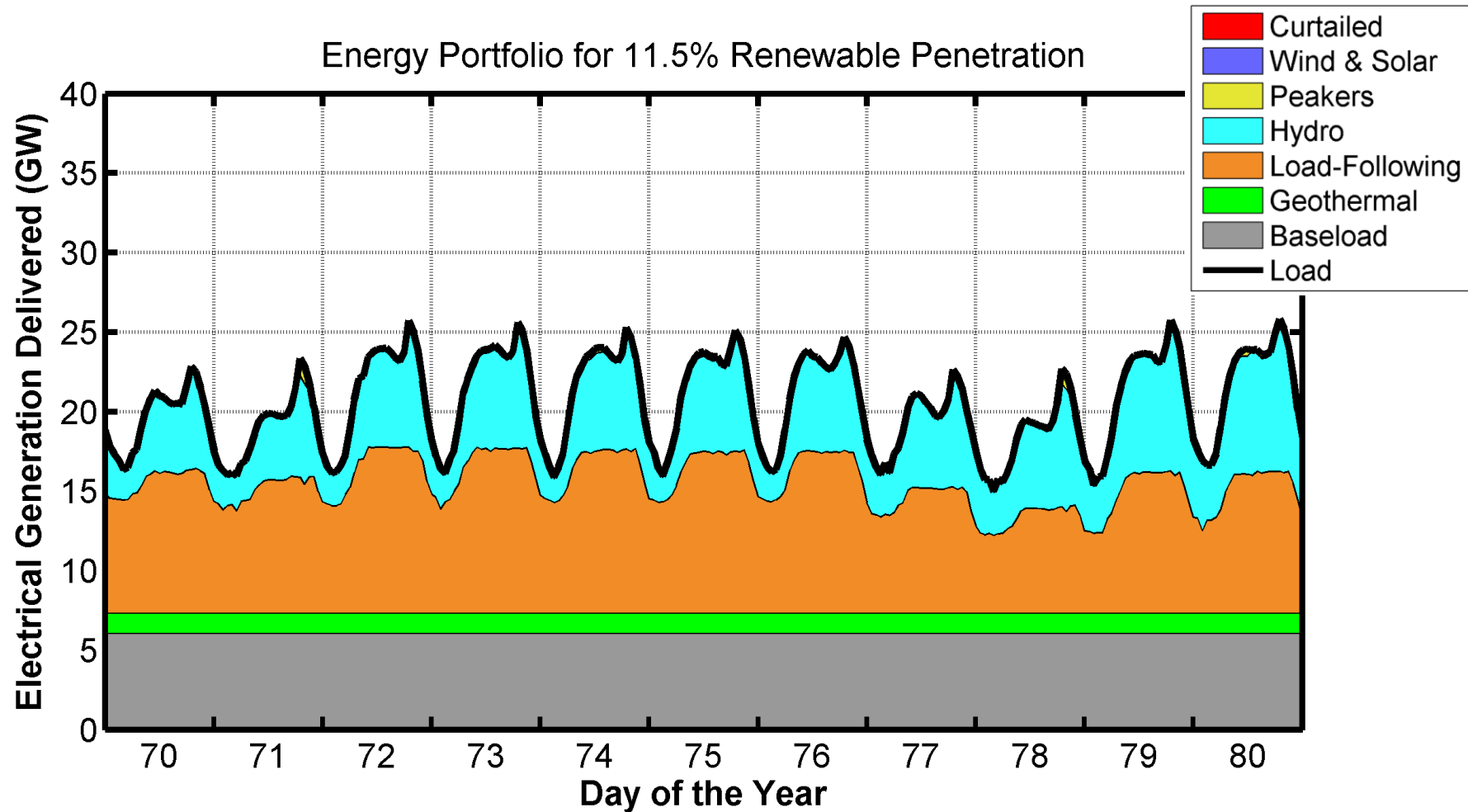
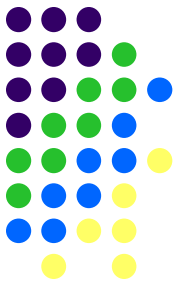


Includes non-renewable alternative resources

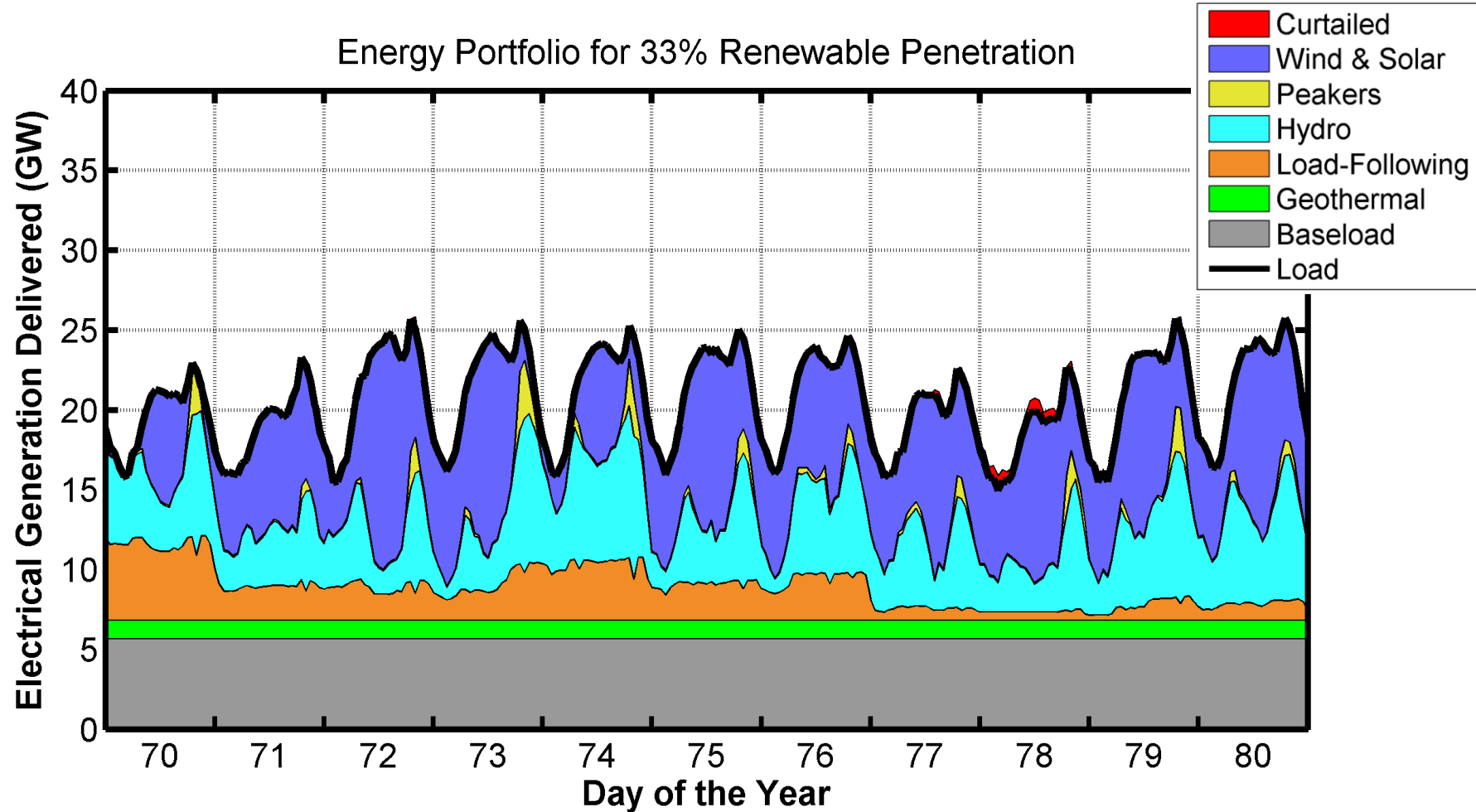
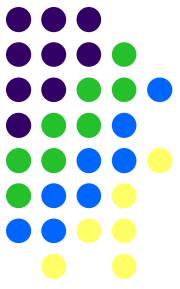
**29 states +**  
**Washington DC and 2**  
**territories have**  
**Renewable Portfolio**  
**Standards**

*(8 states and 2 territories have renewable portfolio goals)*

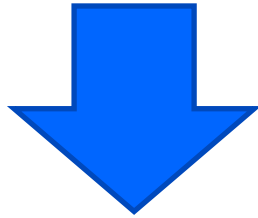
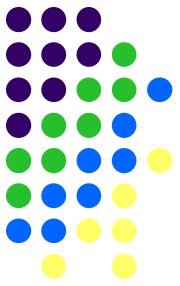
# Renewable Intermittency Must Be Balanced with Flexible Gen



# More Renewables Increases Value of Flexible Generation

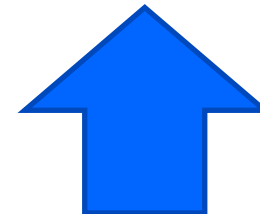


# Both Downward & Upward Forces Acting on NG Prices



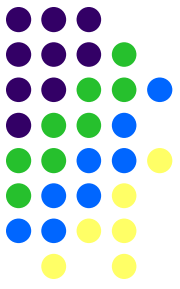
Increased Shale Gas  
Warm Winters/Cool Summers  
Economic Malaise  
Increased Energy Efficiency  
Lack of Emissions Constraints  
Pipeline Expansions (Regional)  
Increased Renewables

Midstream Investment Lag  
Cold Winters/Hot Summers  
Economic Recovery  
Population Growth  
Emissions Constraints  
Increased Industrial Demand  
Oil Displacement in Transportation  
Retired Coal/Nuclear Generation  
Increased LNG & Pipeline Exports  
Pipeline Constraints (Regional)  
Increased Renewables





# Back to the Future: What Comes Around Goes Around



- What we **do** know
  - *Volatility is here to stay.* Current natural gas *prices* appear to be repeating those of the late 1990s, though geography and flows differ.
- What we **don't** know
  - Will we also see a repeat of 2007/2008 high prices?
  - What conditions would lead to such a repeat?
- Advice in light of uncertainty
  - Consumers: Hedge your bets
  - Producers: Lock in market share.