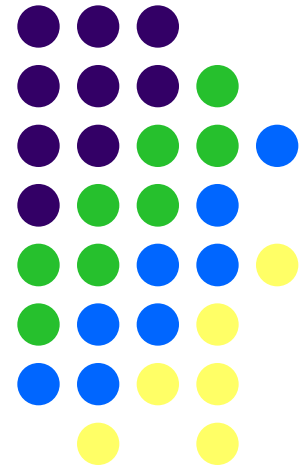


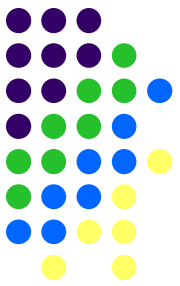
# The New Market Paradigm for Natural Gas, or Not?

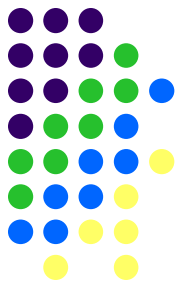
Electric Generation Landscape Conference  
October 9, 2012  
Chicago, Illinois

Lori Smith Schell, Ph.D.  
Lschell@EmpoweredEnergy.com



# Shale Gas Plays are Widely Distributed Geographically

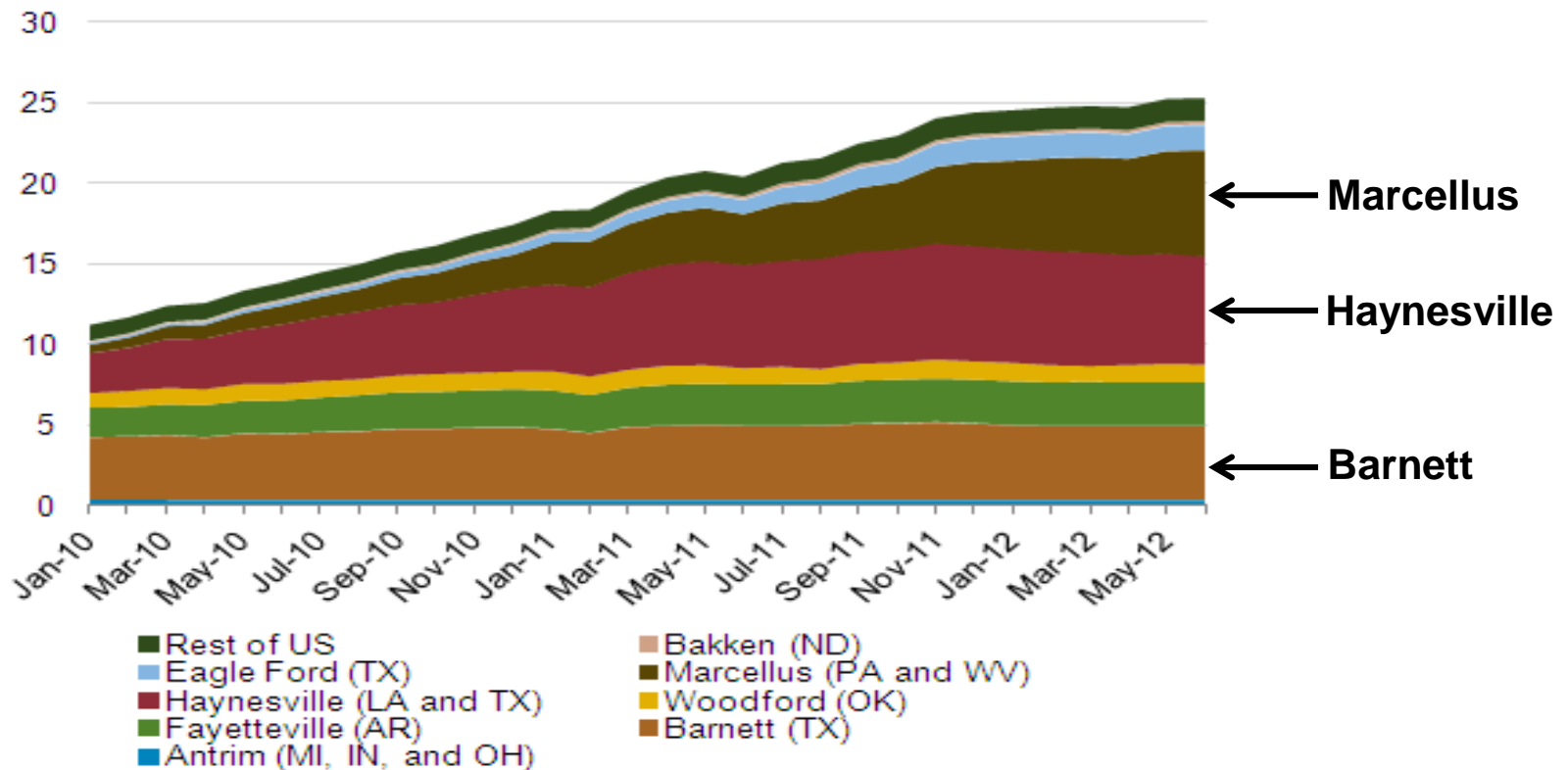




# But Marcellus, Haynesville & Barnett Dominate Production

Monthly dry shale gas production

billion cubic feet per day



Source: Lippman Consulting, Inc. Gross withdrawal estimates are as of July 2012 and converted to dry production estimates with EIA-calculated average

# Horizontal/Directional Drilling Target Shale Gas Reserves

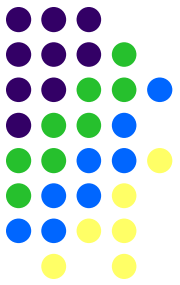
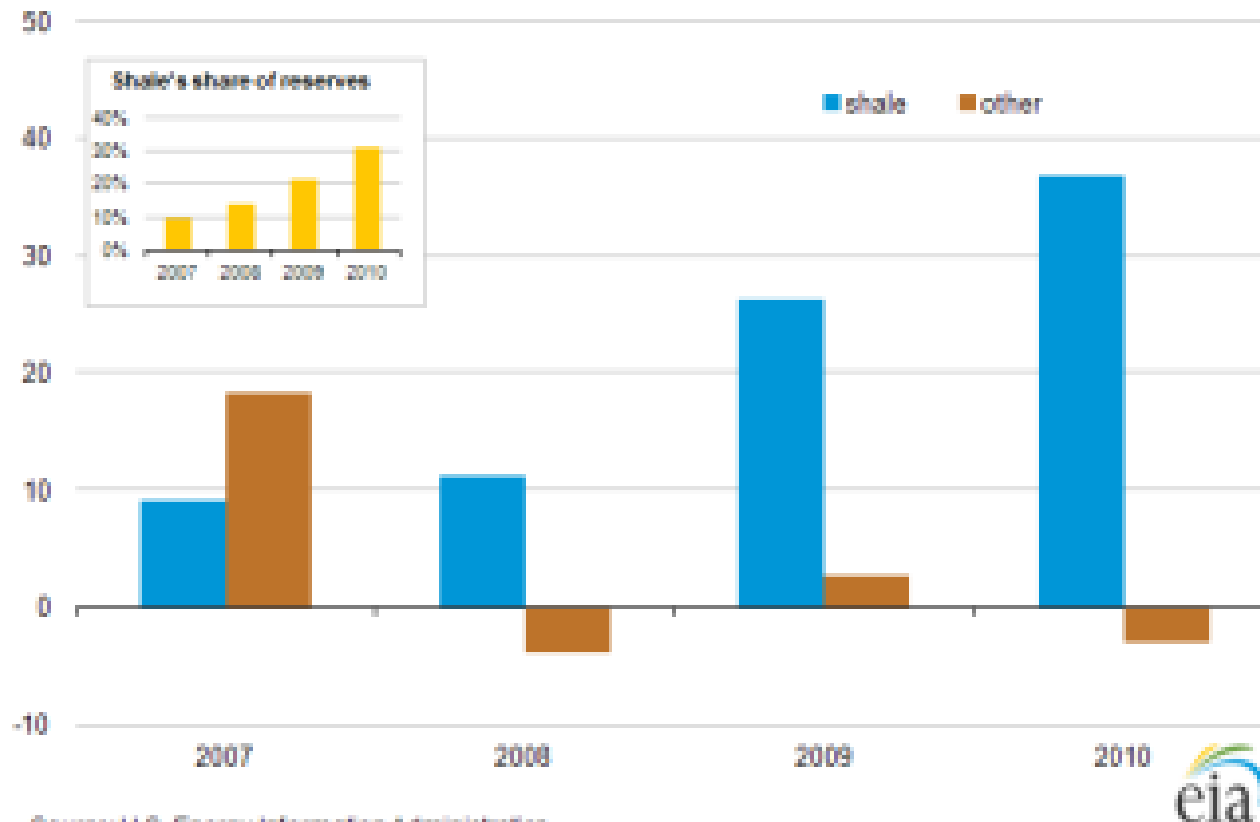
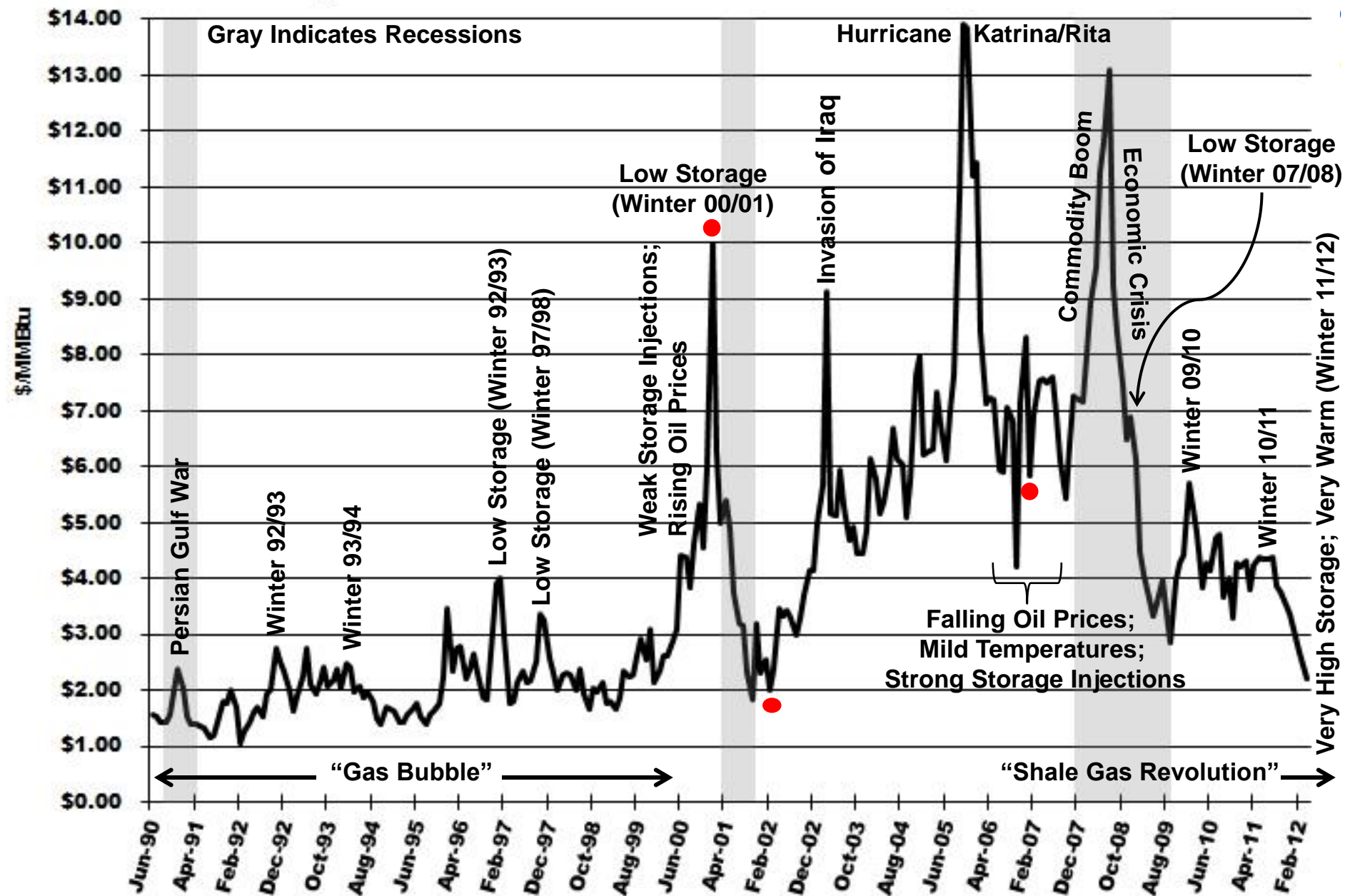


Figure 6. Annual change in U.S. natural gas proved reserves, shale and other sources, 2007-2010

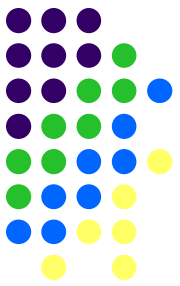
annual change trillion cubic feet



# Henry Hub: NYMEX Natural Gas Settlement Prices



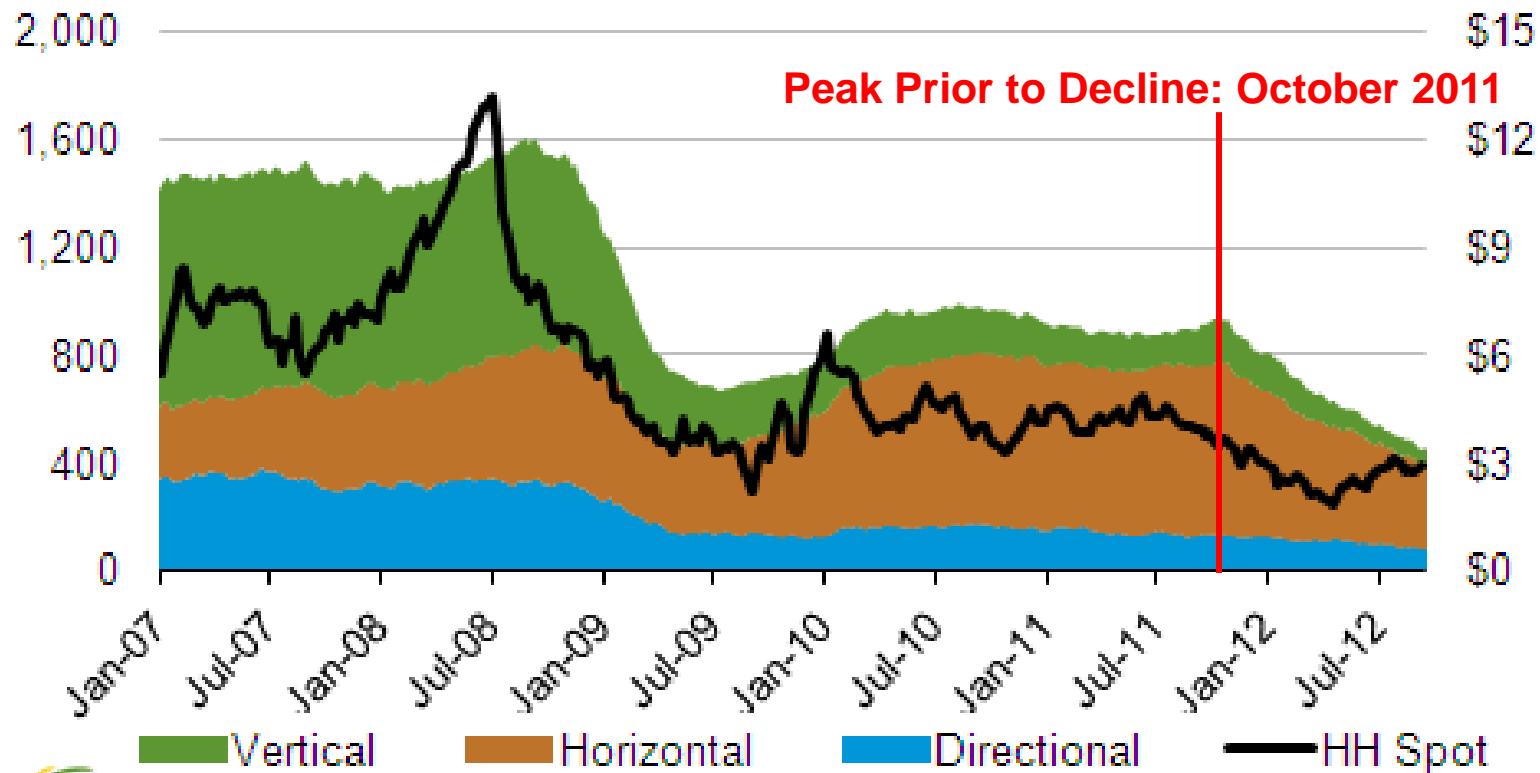
# Rig Count Responds to Low Prices Prices Responds to Rig Count



Weekly natural gas rig count and average spot Henry Hub

active rigs

\$ per MMBtu

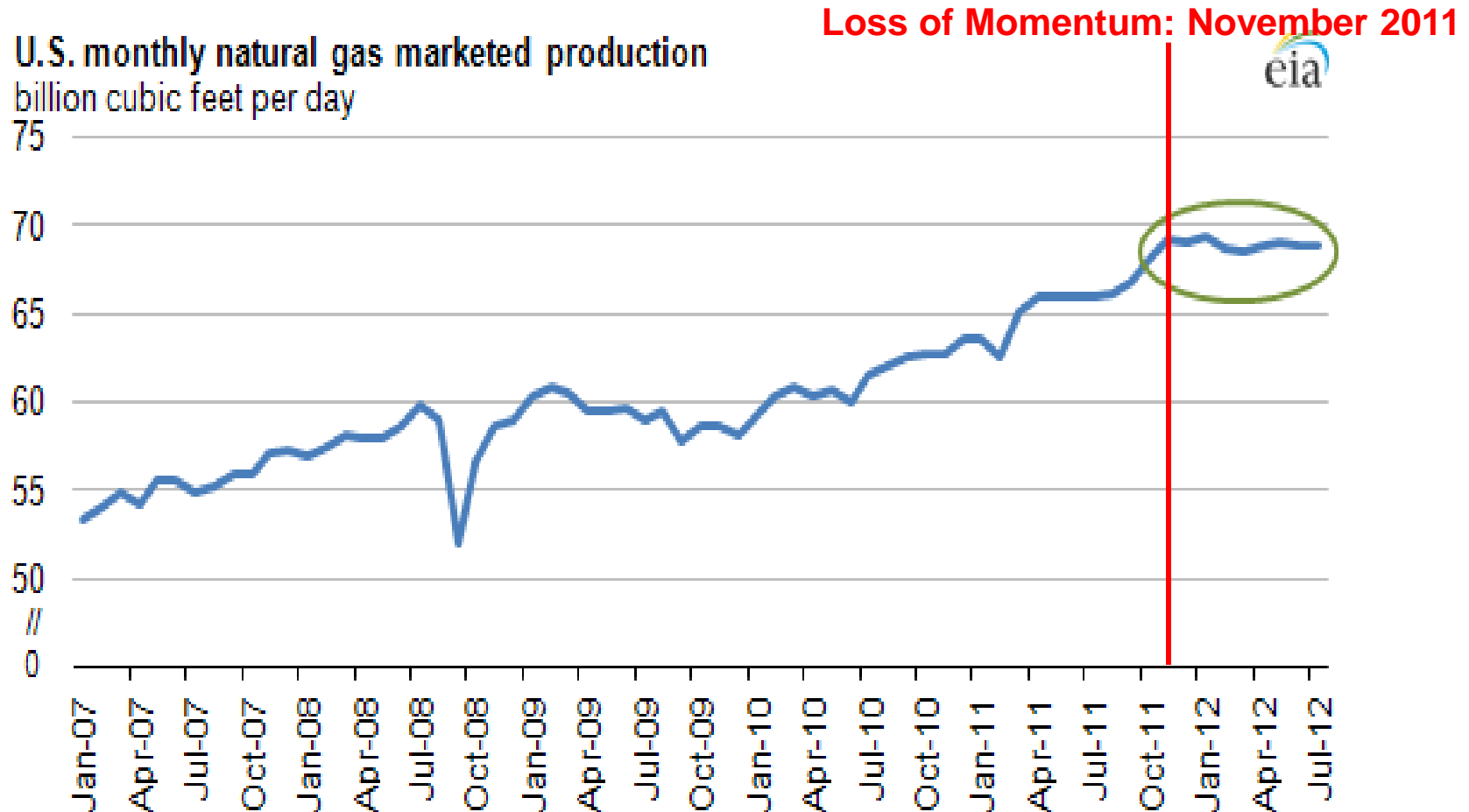
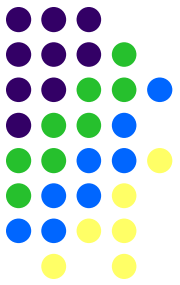


Source: Baker Hughes

October 9, 2012

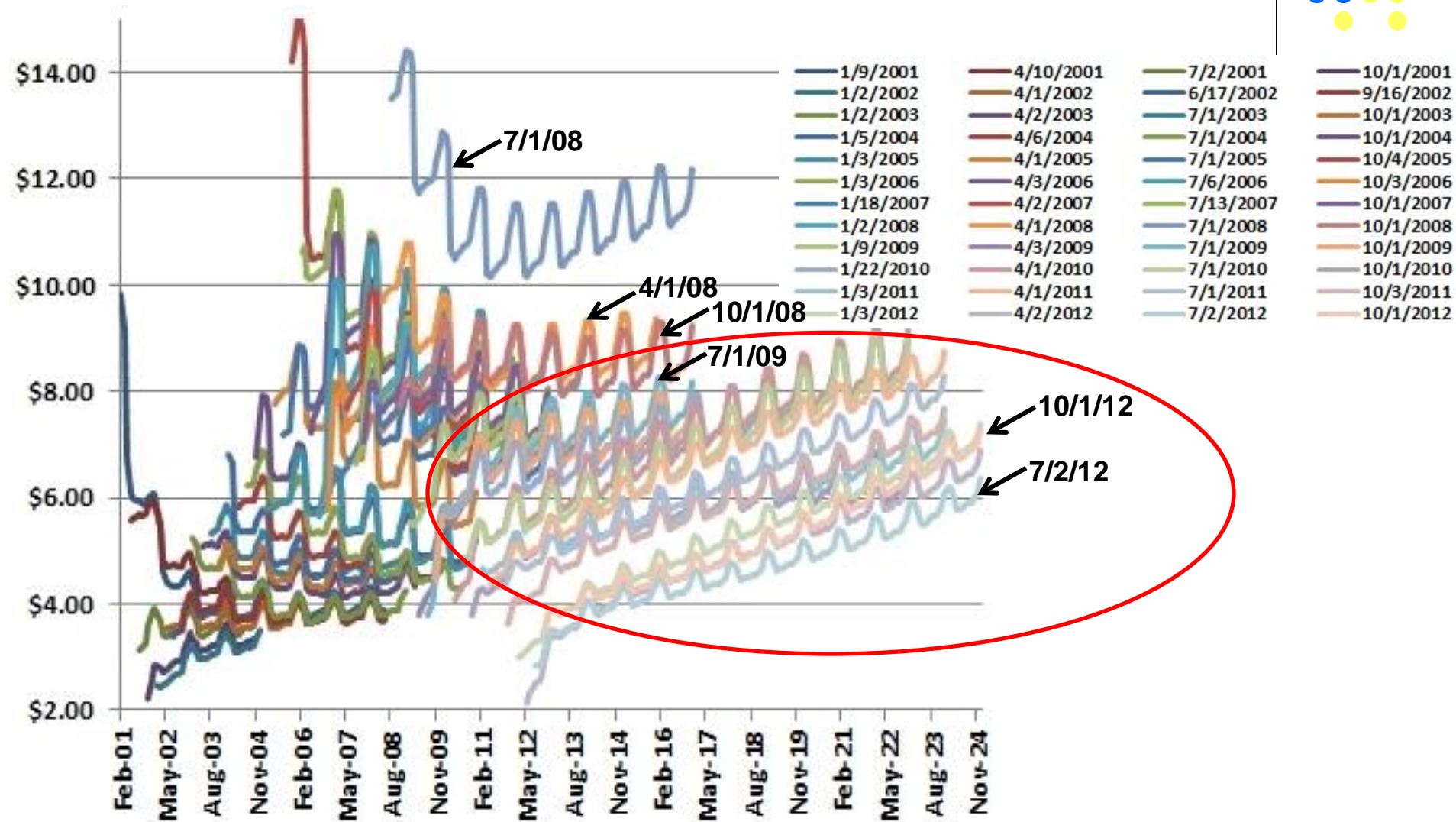
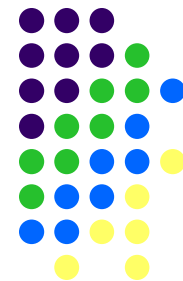
[www.EmpoweredEnergy.com](http://www.EmpoweredEnergy.com)

# Natural Gas Production Levels Off as Rig Count Nosedives



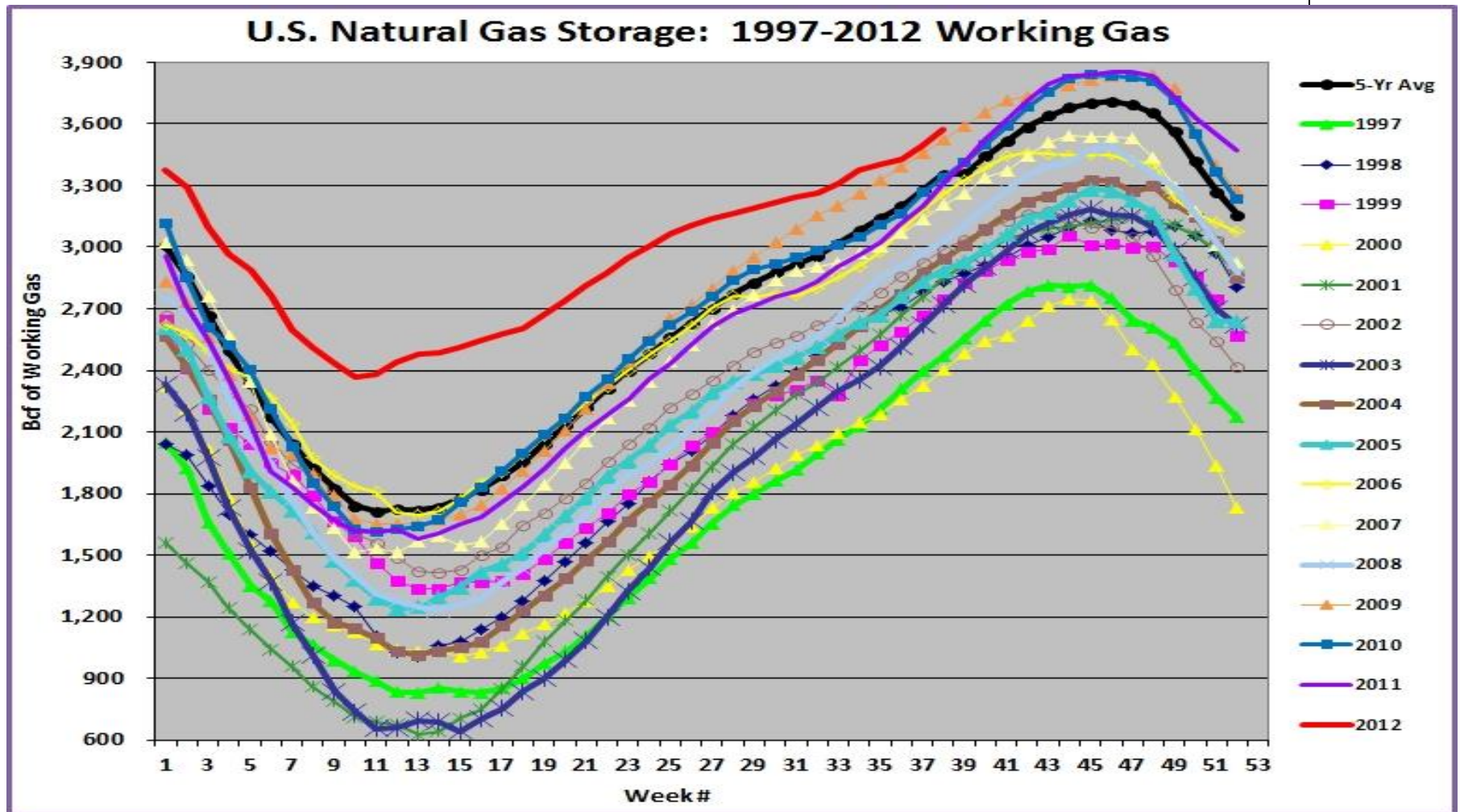
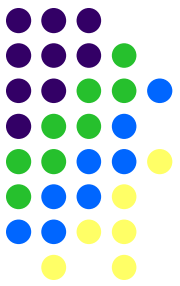


# Shale Gas Impact Clearly Seen in NYMEX Forward Curves

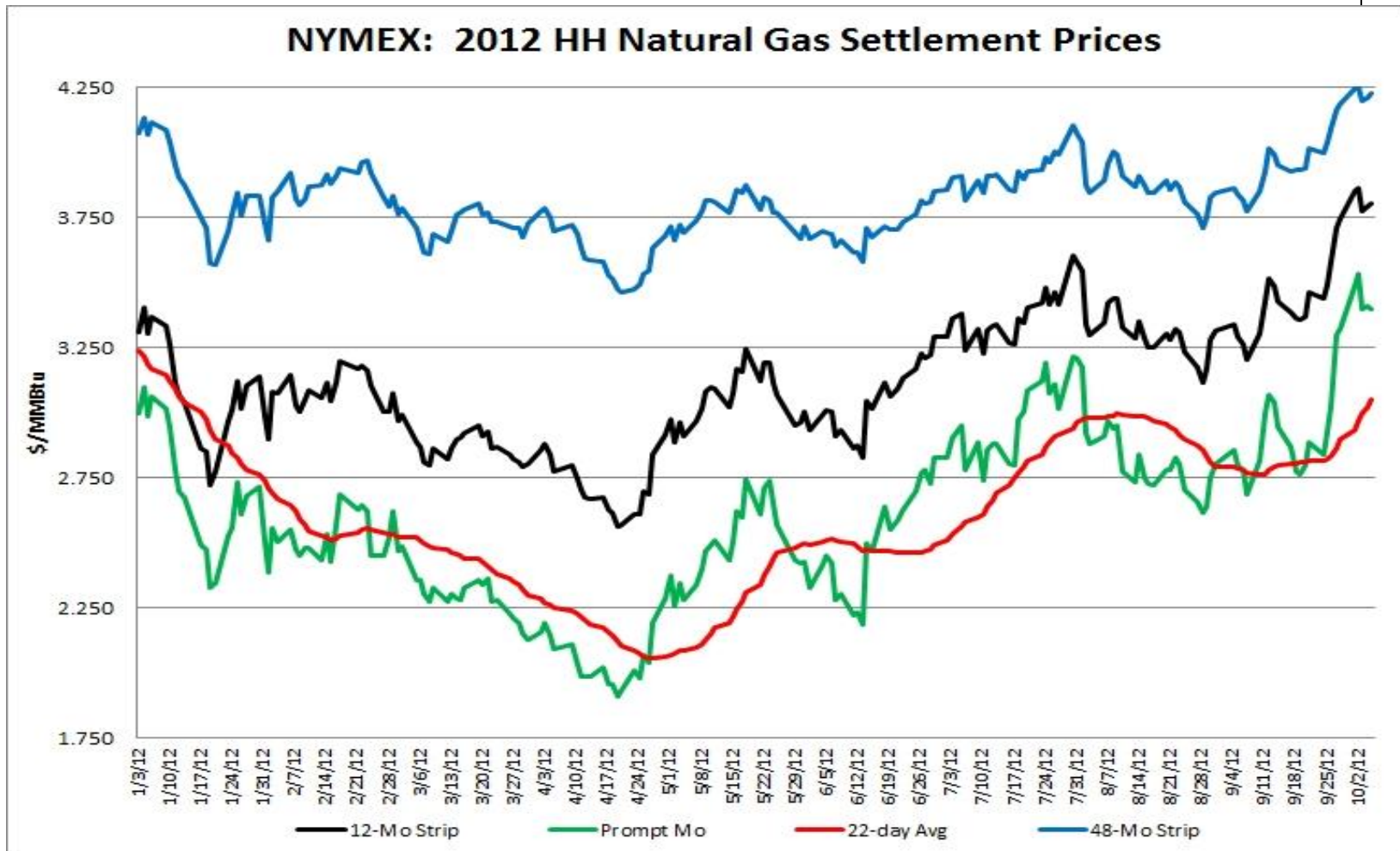
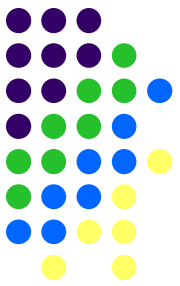




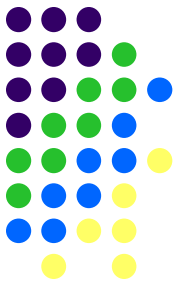
# Natural Gas Storage Is Key to Balancing Seasonal Demand



# NG Futures Prices Respond to Changes in Storage Levels



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



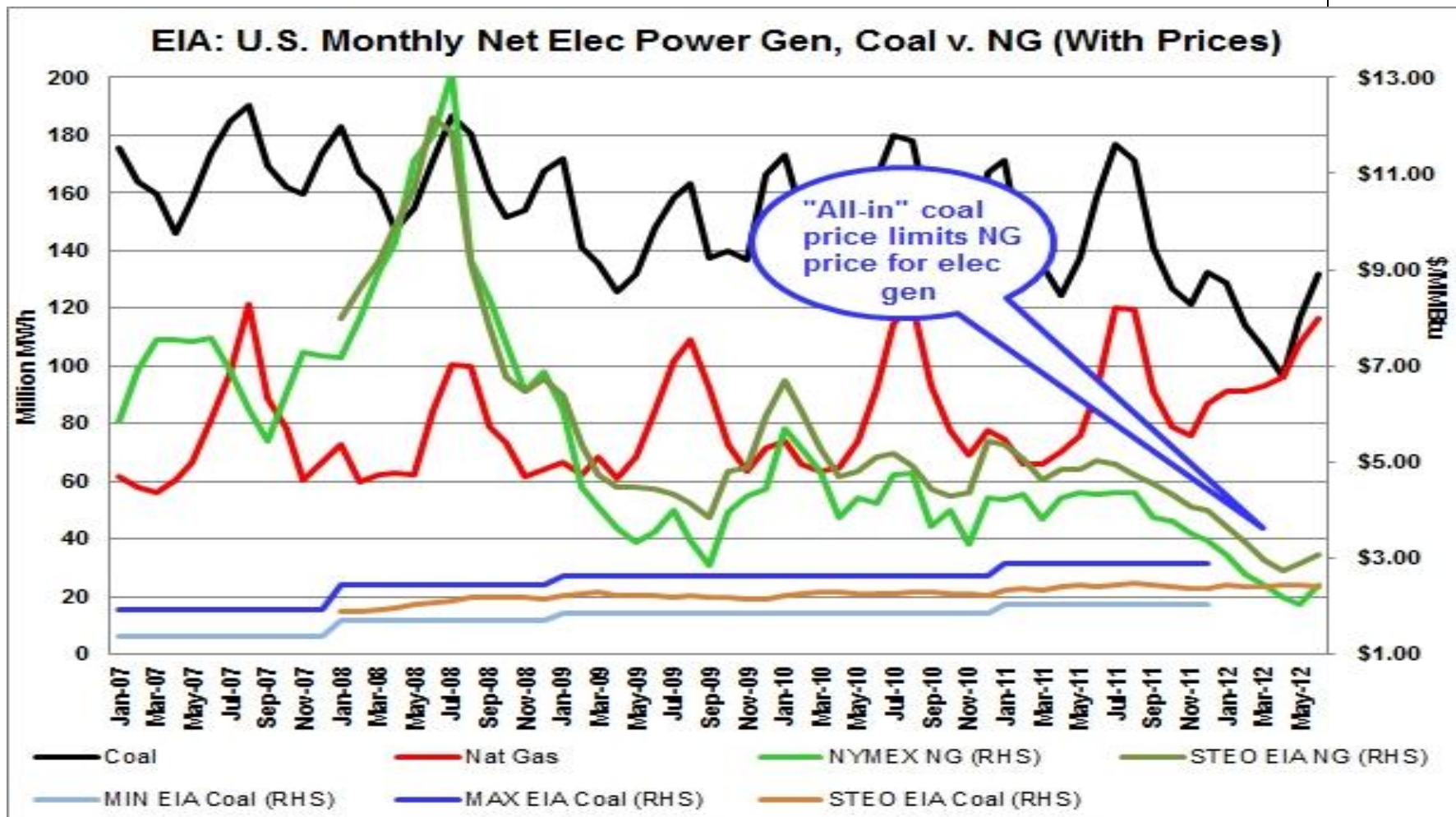
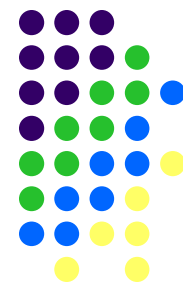
**Supply: Significant Increase in Shale Gas Exerts Downward Pressure**

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



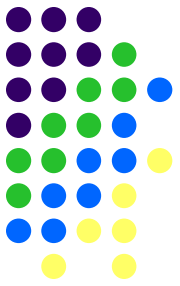
**Demand: Lower Gas Price Increases Demand in All Markets**

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



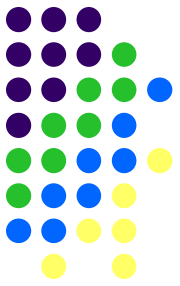


# But, Elec Gen Only One Market Sector Loving Low NG Prices



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

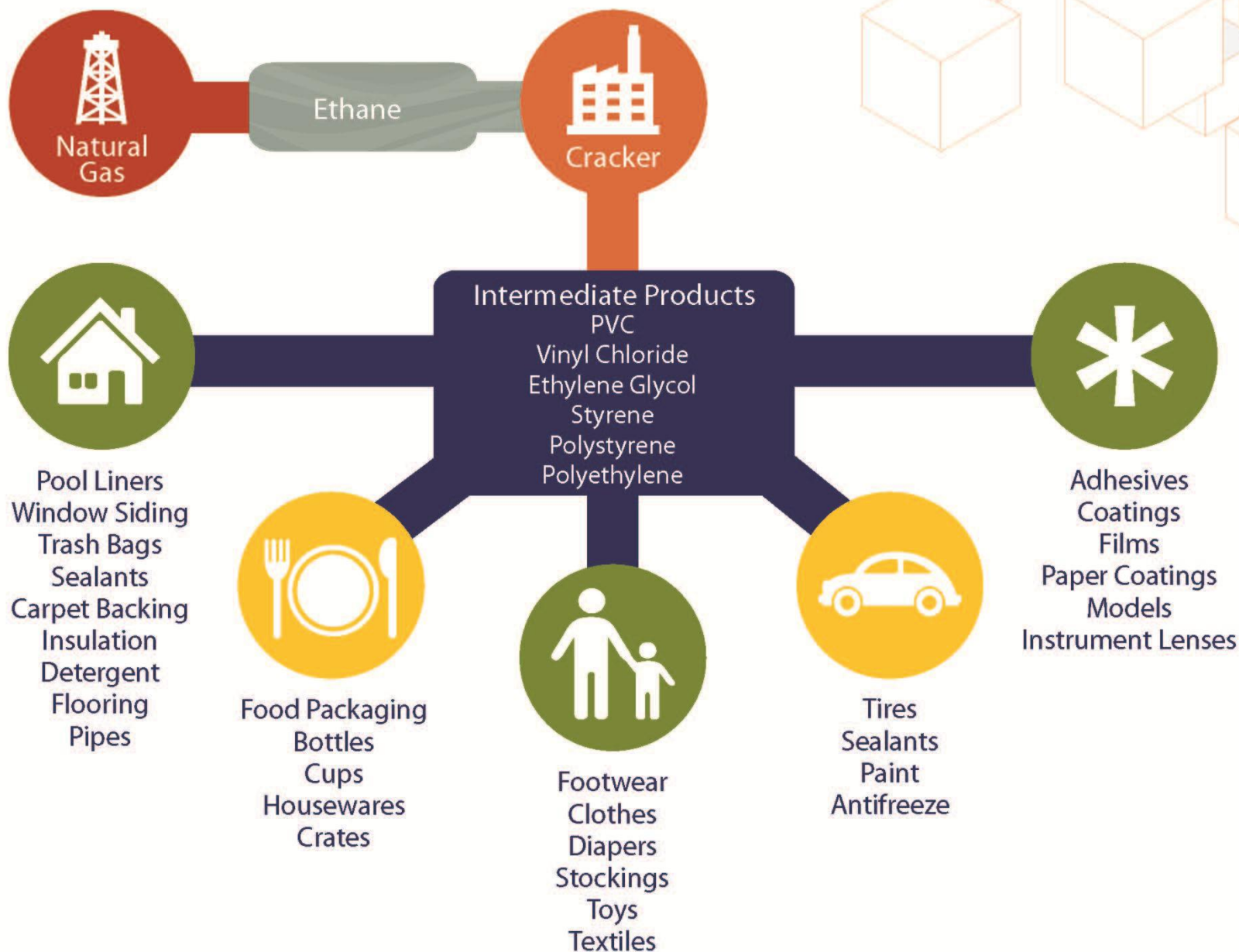
# Shale Gas is Rich in Natural Gas Liquids (“NGLs”)



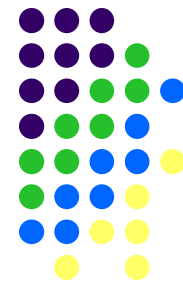
- Must be removed to meet interstate pipeline specifications
- Amount of NGLs removed depends in part on relative prices of natural gas vs. NGLs
- Ethane rejection has led to low ethane prices in US and increased global competitiveness
- Return of ammonia and methanol production to US



# ETHYLENE CHAIN

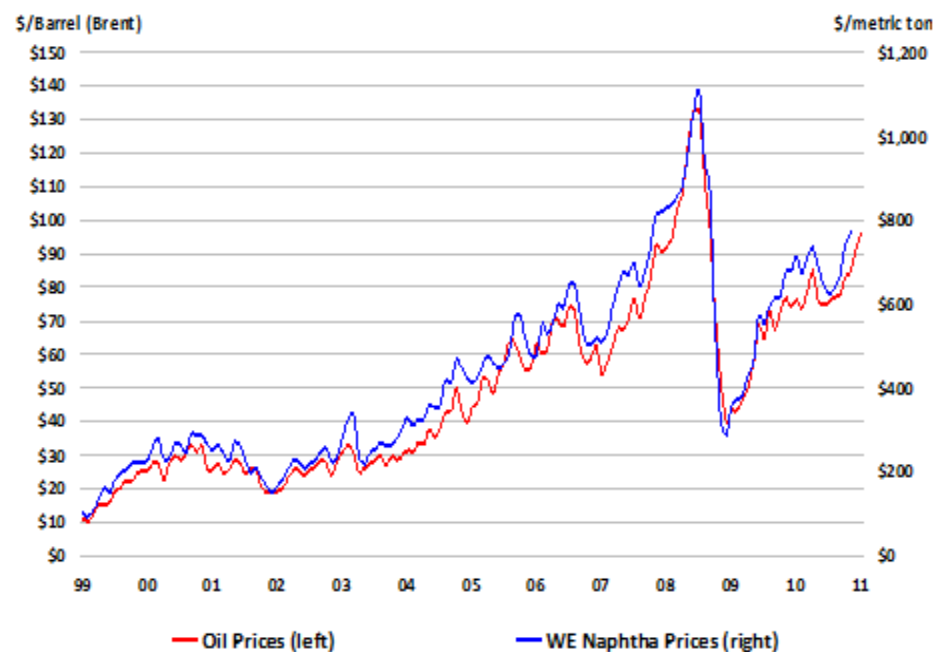
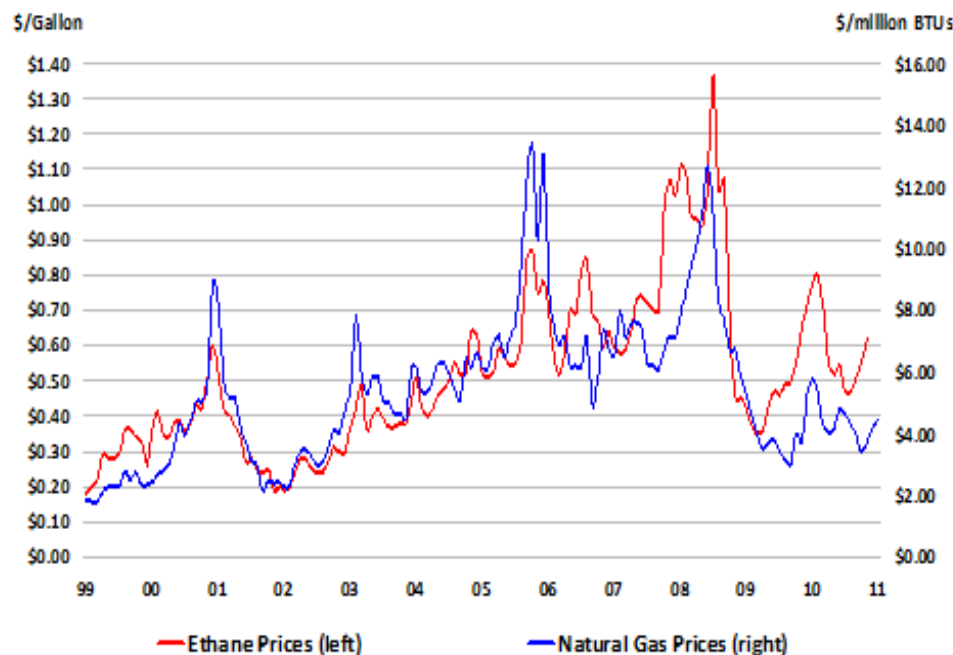


# Chemical Feedstock Price Drivers Differs by Continent



## US: Ethane Price Tied to Natural Gas

## Europe: Ethane Price Tied to Naphtha

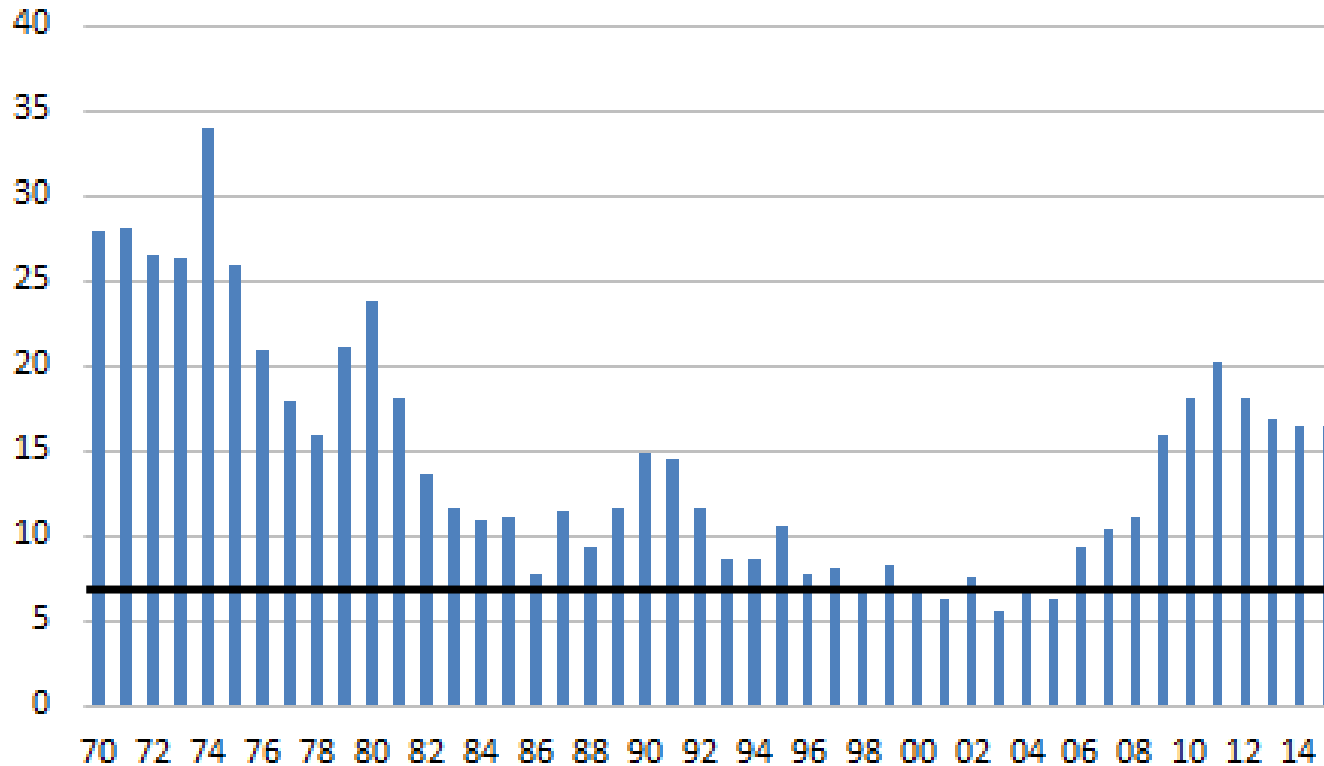
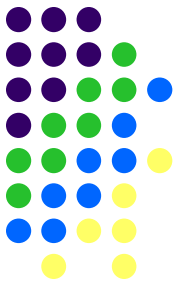


Source: EIA, Chemical Week Associates, Haver Analytics

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.

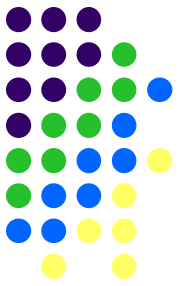
# Oil-to-Gas Ratio Determines US Chemicals Competitiveness



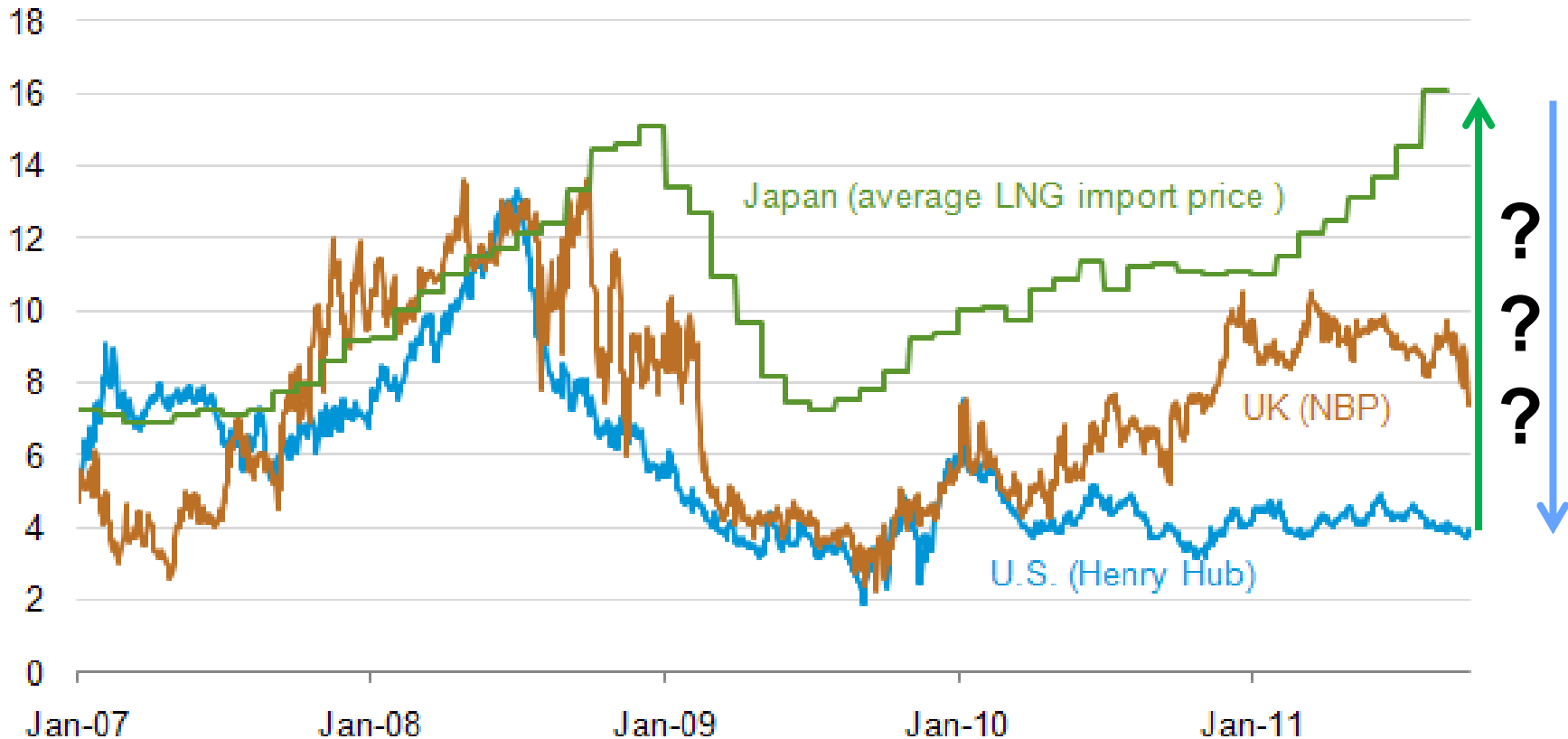
Source: EIA, CMAI, EIU, Global Insight

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

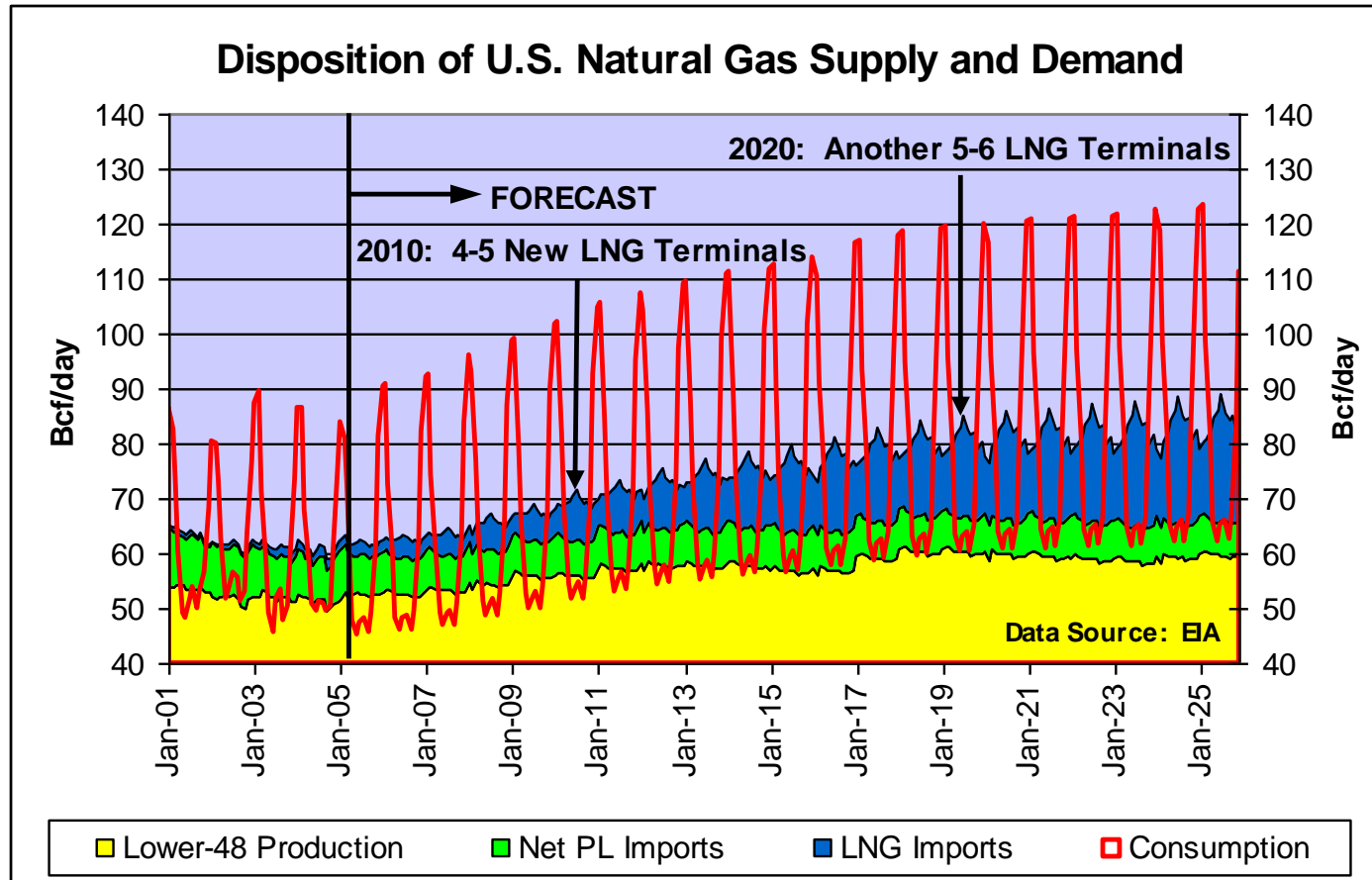
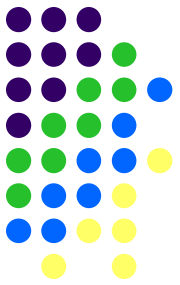
# Global Gas Price Disparity: Can you spell OPPORTUNITY?



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

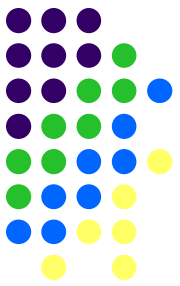


# Pre-Shale Gas “Revolution” Anticipated More LNG *Imports*



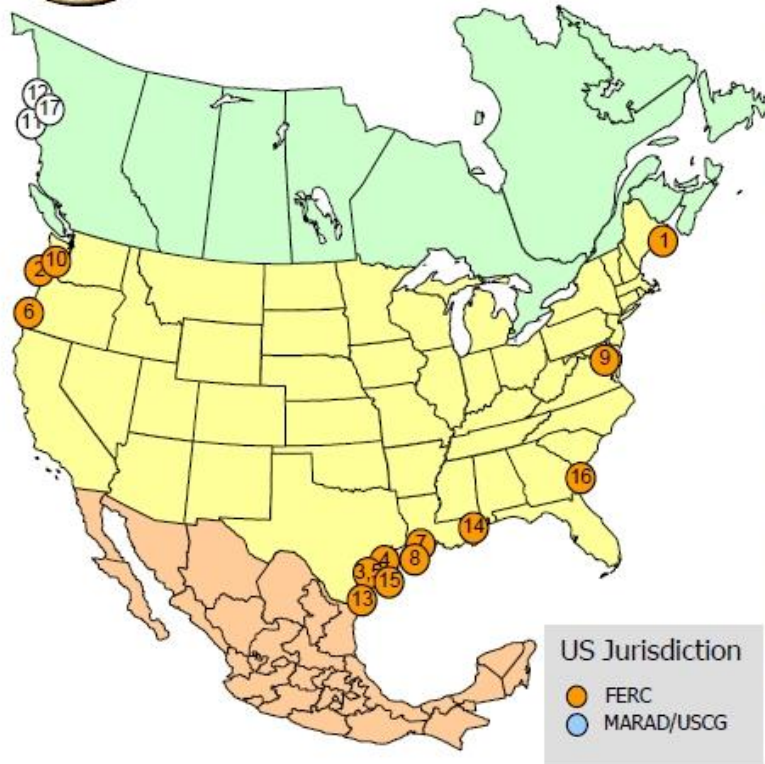
PRESENTATION MADE BY LORI SMITH SCHELL, Ph.D.,  
TO THE 18<sup>TH</sup> WORLD PETROLEUM CONGRESS,  
JOHANNESBURG, SOUTH AFRICA, SEPTEMBER 27, 2005

# Today's Expectations: US 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: 1.8 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)

##### PROPOSED CANADIAN SITES IDENTIFIED BY PROJECT SPONSORS

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

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

13. Brownsville, TX: 2.8 Bcfd (Gulf Coast LNG Export)
14. Pascagoula, MS: 1.5 Bcfd (Gulf LNG Liquefaction)
15. Lavaca Bay, TX: 1.38 Bcfd (Excelerate Liquefaction)
16. Elba Island, GA: 0.5 Bcfd (Southern LNG Company)

##### POTENTIAL CANADIAN SITES IDENTIFIED BY PROJECT SPONSORS

17. Prince Rupert Island, BC: 1.0 Bcfd (Shell Canada)

\* **Source: EIA, AEO 2012 Reference Case; LNG by 2016, Overall by 2022.**

As of July 17, 2012

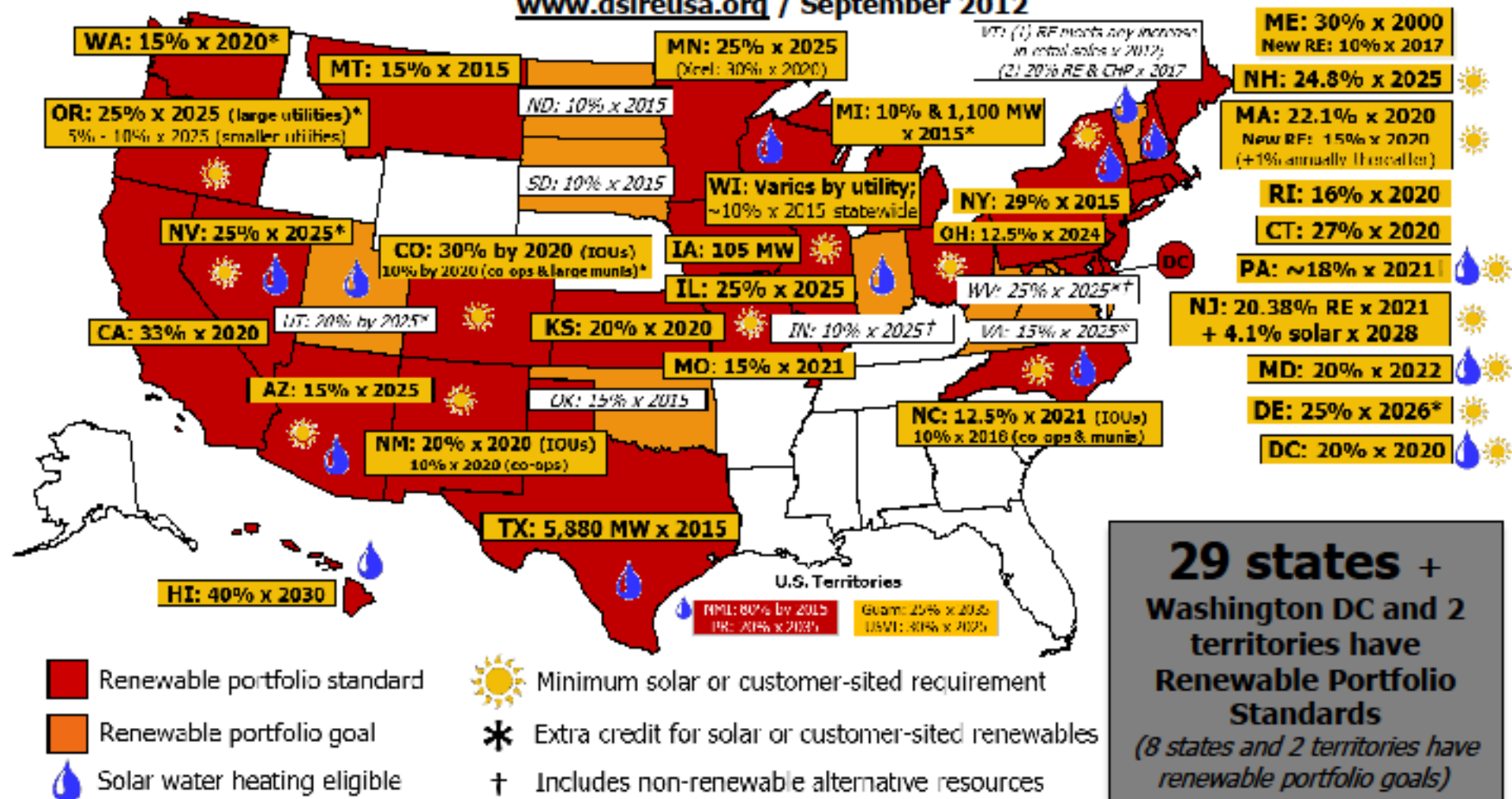
*Office of Energy Projects*





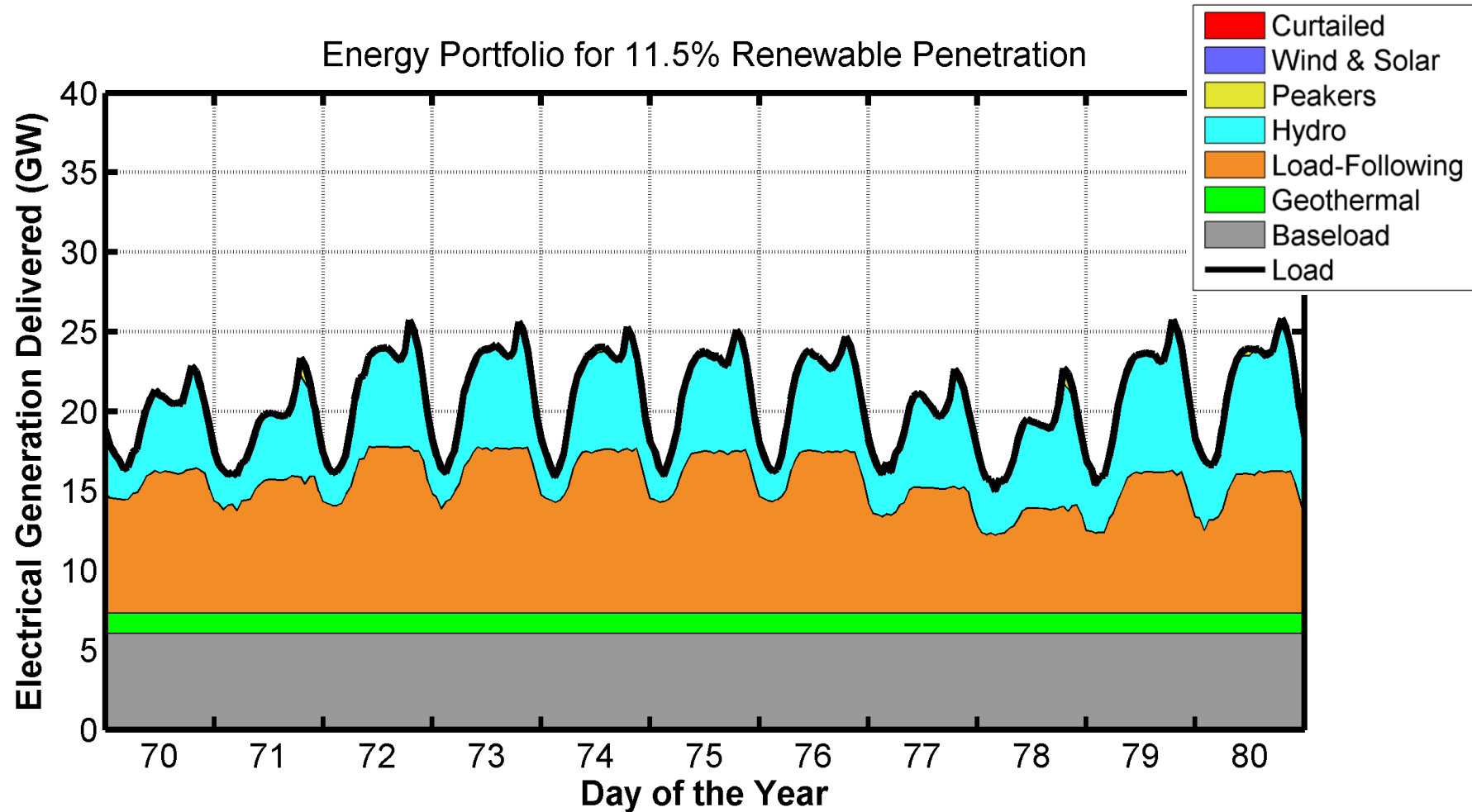
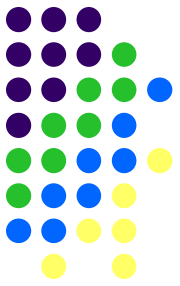
## Renewable Portfolio Standard Policies

[www.dsireusa.org](http://www.dsireusa.org) / September 2012

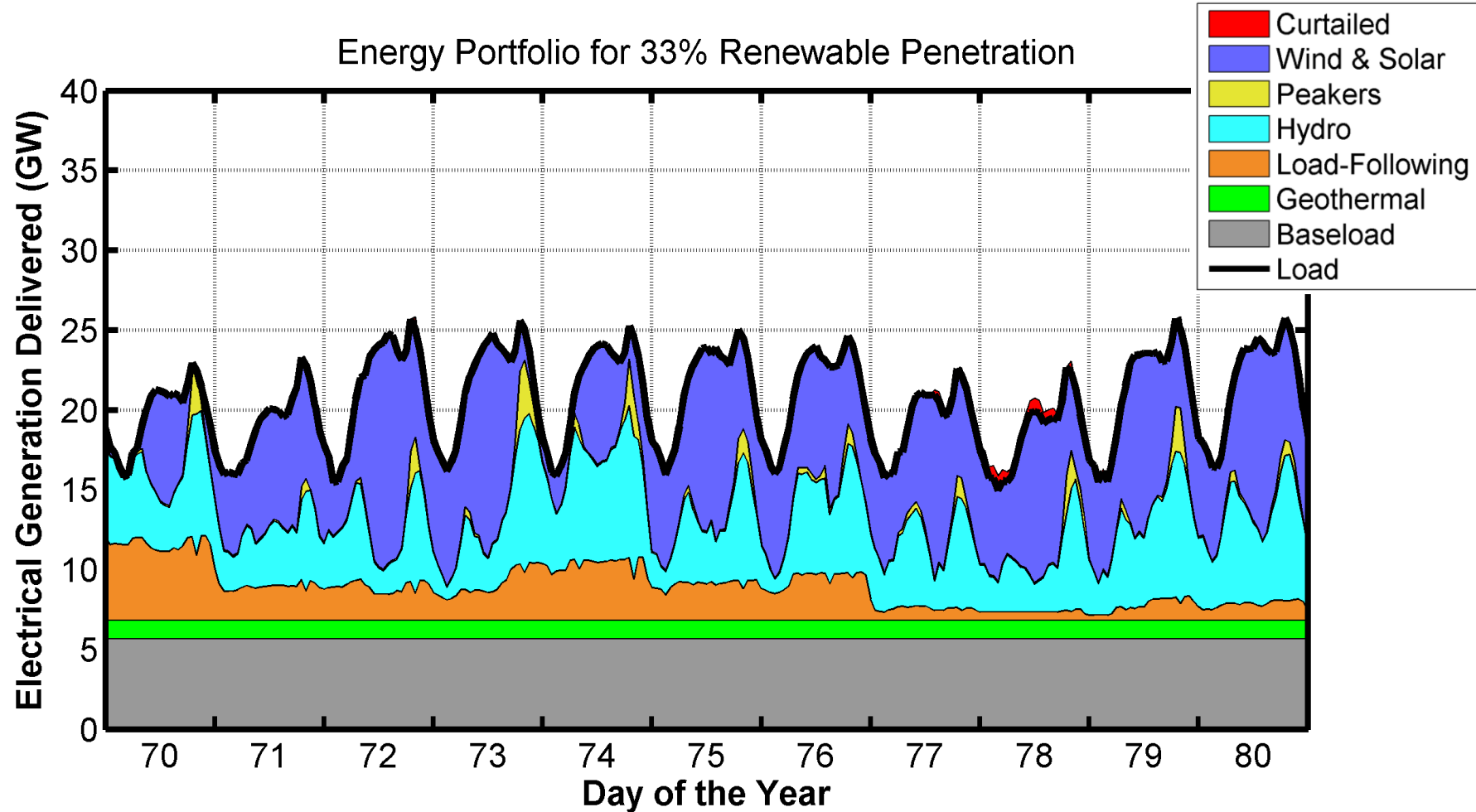
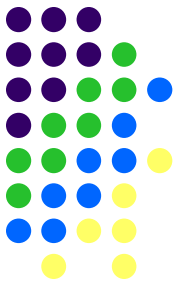


**29 states +**  
Washington DC and 2  
territories have  
**Renewable Portfolio  
Standards**  
(8 states and 2 territories have  
renewable portfolio goals)

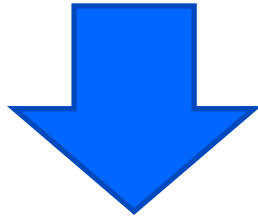
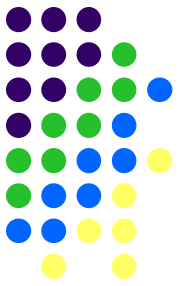
# Renewable Intermittency Must Be Balanced with Flexible Gen



# More Renewables Increases Value of Flexible Generation

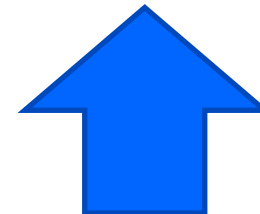


# Both Downward & Upward Forces Acting on NG Prices

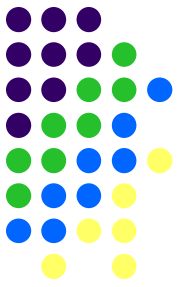


Increased Shale Gas  
Warm Winters/Cool Summers  
Economic Malaise  
Increased Energy Efficiency  
Lack of Emissions Constraints  
Pipeline Expansions (Regional)  
Increased Renewables

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



# (Inconclusive) Conclusions: Nothing New Under the Sun



- What we **do** know: Prices go up and prices go down and many competing factors influence where they end up. *Volatility is here to stay.*
- What we **don't** know: Exactly where natural gas prices are headed
  - If we knew, we'd be drinking umbrella drinks on a beach in the South Pacific...
- Best advice: Hedge your bets, especially if you a natural short!

