Issues in Natural Gas End-Uses: Are We Really Focusing on the Real Opportunities?

Energy Bar Association Meeting
Natural Gas Supply-Demand Session
New Orleans, Louisiana, April 12, 2012

LSU
Center for Energy Studies

David E. Dismukes, Ph.D.
Center for Energy Studies
Louisiana State University

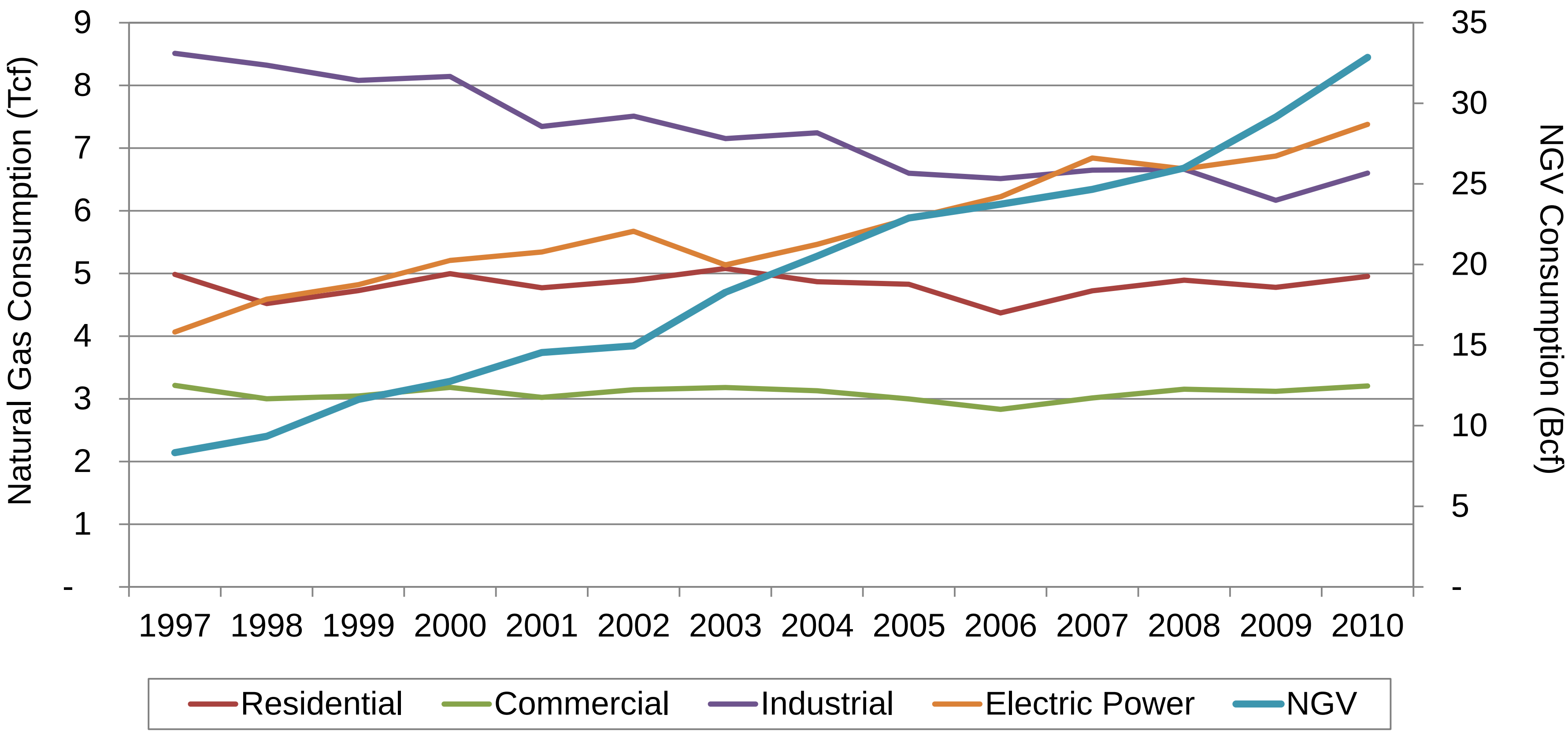
Overview

- Although natural resource estimates vary, there is increasingly clear consensus that the “shale gas revolution” is real, and is likely to continue into the foreseeable future.
- Shale oil development only re-enforces shale gas production returns and could revolutionize U.S. energy markets in the near future.
- Today’s problems are not “are we going to have enough gas?” (i.e., 2005) but “what are we going to do with all this gas?”
- Certain sense of desperation with some producers to really push new and novel end uses and markets. Created some “unhappy” relationship issues for industries commonly aligned on many energy policy issues.
- Likely room at the table for the “new” end uses and markets, BUT…
    - Considerable opportunities, and likely changes, in traditional end-use markets that need to be considered and examined.
    - Strong sense of “déjà vu all over again” has to be addressed.

New End Uses #1:
Natural Gas Vehicles

Natural Gas Consumption by Sector

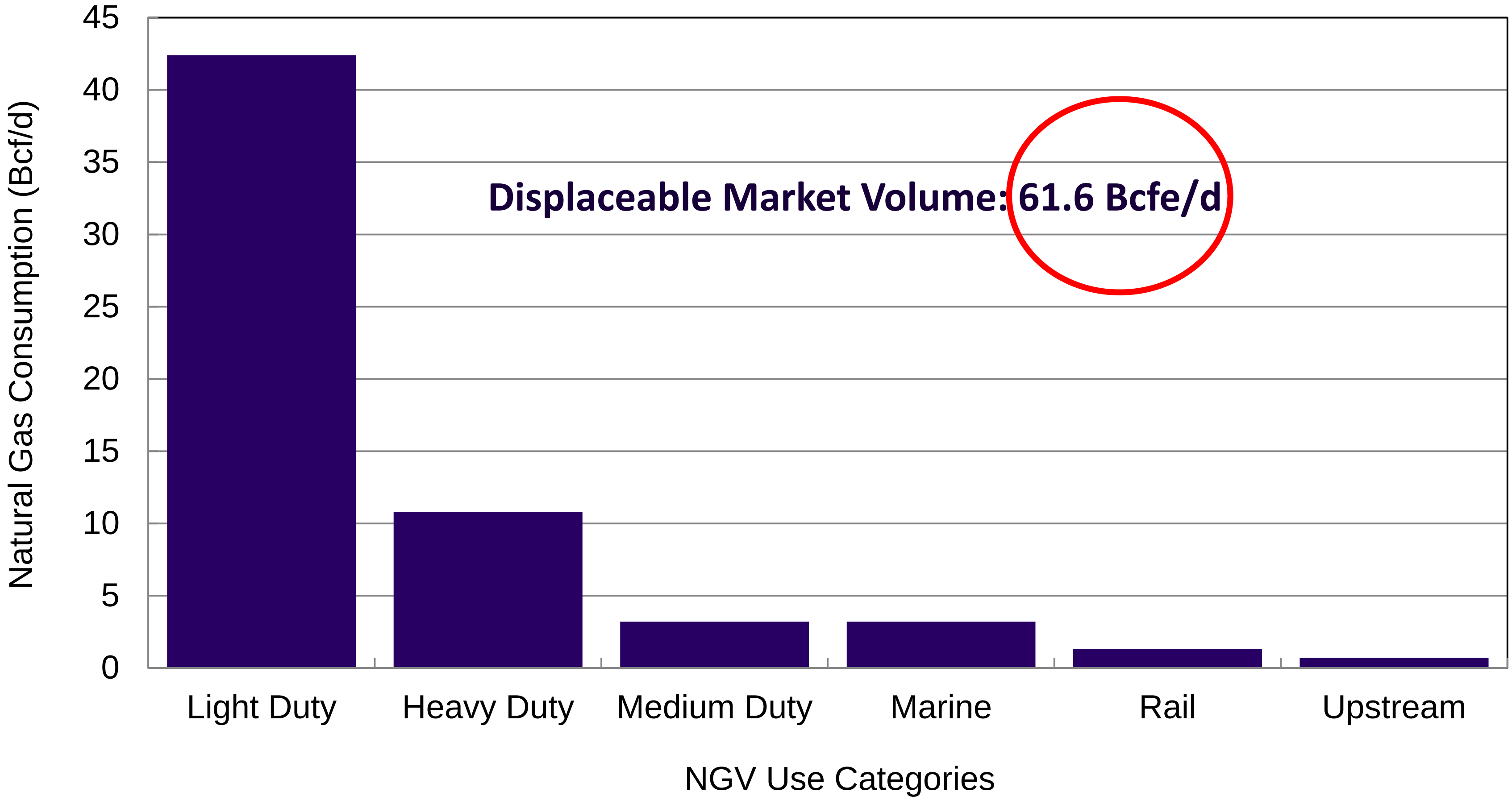
Currently, NGVs account for less than 0.18 percent of U.S. natural gas consumption, but the rate of growth in consumption (158 percent) over the past decade has surpassed all other end-uses.



Source: Energy Information Administration, U.S. Department of Energy

Potential NGV Usage

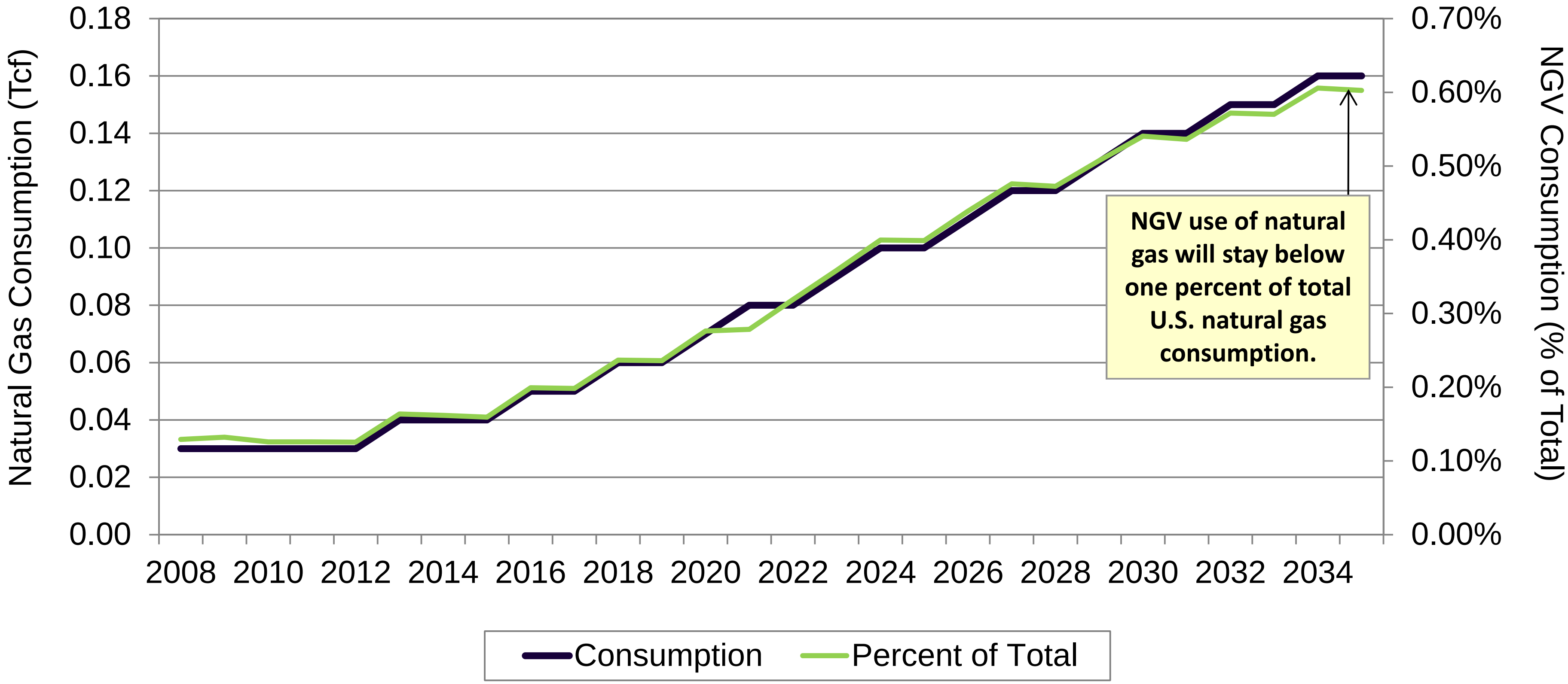
The large potential size of NGV market has a number of competing end-use categories (i.e., chemicals, manufacturing) concerned.



Source: Data and forecast from EIA, Encana, 2010
Displacement opportunities exclude Air, International Shipping, Military, Pipeline Fuel

Potential Natural Gas Consumption – NGV

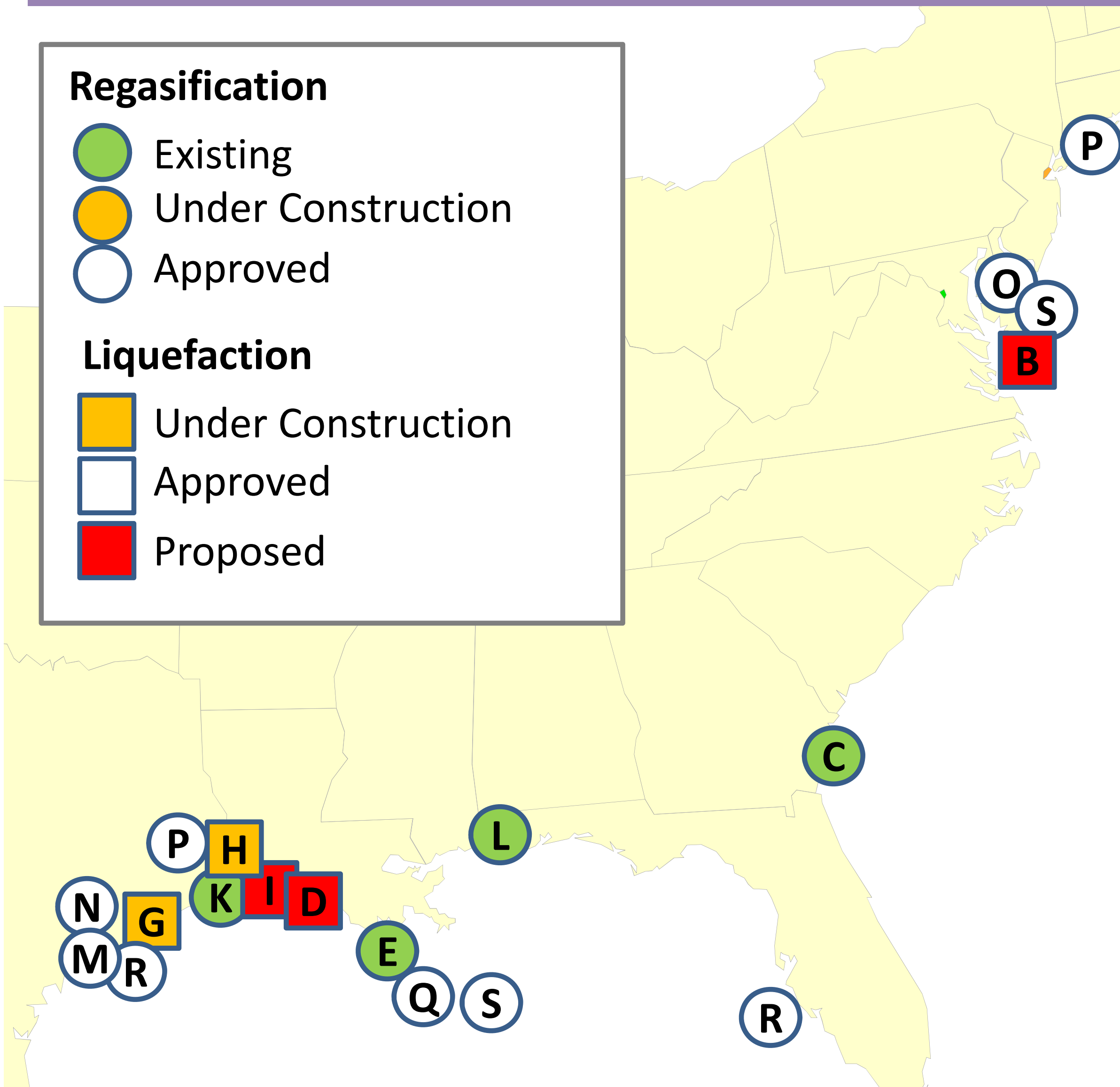
NGV consumption of natural gas is estimated to increase at an average annual rate of 7 percent through 2035. At best, this usage will be considerably less than 1 Tcf and slightly over one-half of one percent of total natural gas market.



Source: Energy Information Administration, U.S. Department of Energy

Policy Issue 2:
LNG and US Natural Gas Exports

Considerable Underutilized LNG Regasification Capacity along GOM



Existing Regasification

A. Everett, MA: 1.035 Bcfd
B. Cove Point, MD: 1.8 Bcfd
C. Elba Island, GA: 1.6 Bcfd (+0.5 Expansion)
D. Lake Charles, LA: 2.1 Bcfd
E. Energy Bridge, GOM: 0.5 Bcfd
F. Northeast Gateway, Offshore MA: 0.8 Bcfd
G. Freeport, TX: 1.5 Bcfd (+2.5 Expansion)
H. Sabine, LA: 4.0 Bcfd
I. Hackberry, LA: 1.8 Bcfd (+0.85 Expansion)
J. Neptune, Offshore MA: 0.4 Bcfd
K. Sabine Pass, TX: 1.0 Bcfd (+ 1.0 Expansion)
L. Pascagoula, MS: 1.0 Bcfd

Approved Regasification

M. Corpus Christi, TX: 2.6 Bcfd
N. Port Lavaca, TX: 1.0 Bcfd
O. Baltimore, MD: 1.5 Bcfd
P. LI Sound, NY: 1.0 Bcfd
Q. GOM Main Pass McMoRan: 1.0 Bcfd
R. Offshore Florida, Port Dolphin: 1.2 Bcfd
S. GOM, Bienville LNG: 1.4 Bcfd

Source: Federal Energy Regulatory Commission; and Office of Fossil Energy, U.S. Department of Energy.

LNG Value Chain

Feedstock (production) costs will be critical in determining the location of basin-specific production along the global LNG supply curve.



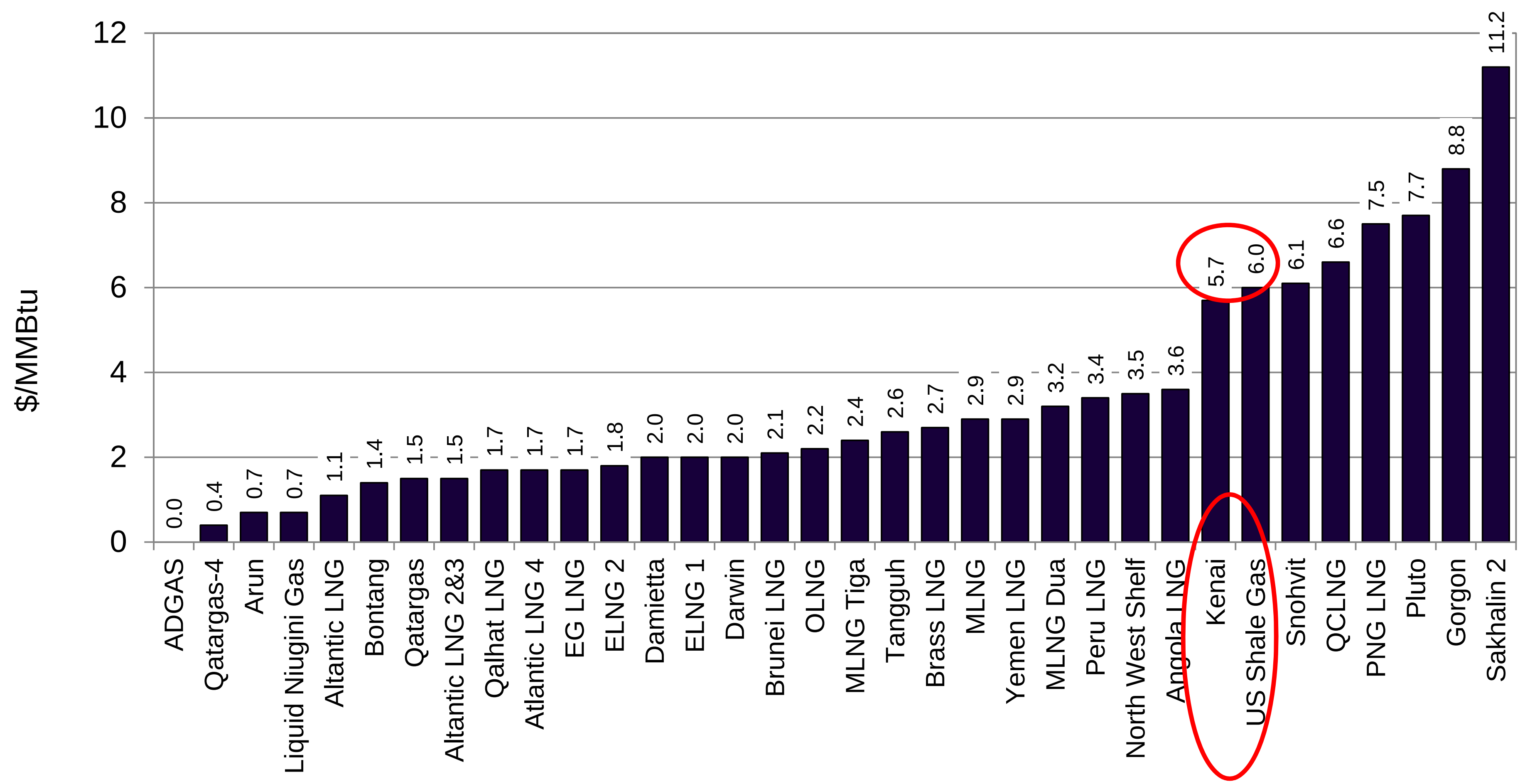

	Feedgas 56% ($/MMBtu)	Liquefaction 11%-17% ($/MMBtu)	Shipping & Fuel 20%-29% ($/MMBtu)	Regas 4%-7% ($/MMBtu)	Delivered Cost ($/MMBtu)	Equivalent Oil Price* ($/BOE)
Europe:						
Low	$4.00	$1.25	$1.40	$0.50	$7.15	$41.47
High	$6.50	$1.25	$1.65	$0.50	$9.90	$57.42
Asia:						
Low	$4.00	$1.25	$2.90	$0.50	$8.95	$51.91
High	$6.50	$1.25	$3.45	$0.50	$11.70	$67.86

Henry Hub:	WTI:
$4.50	$97.00
$5.00	$100.00

Note: *uses a BOE conversion of 5.8 Mcf/BOE.
Source: Cheniere.

FOB Gas Price Necessary to Yield 12 Percent Return (Atlantic Delivery)

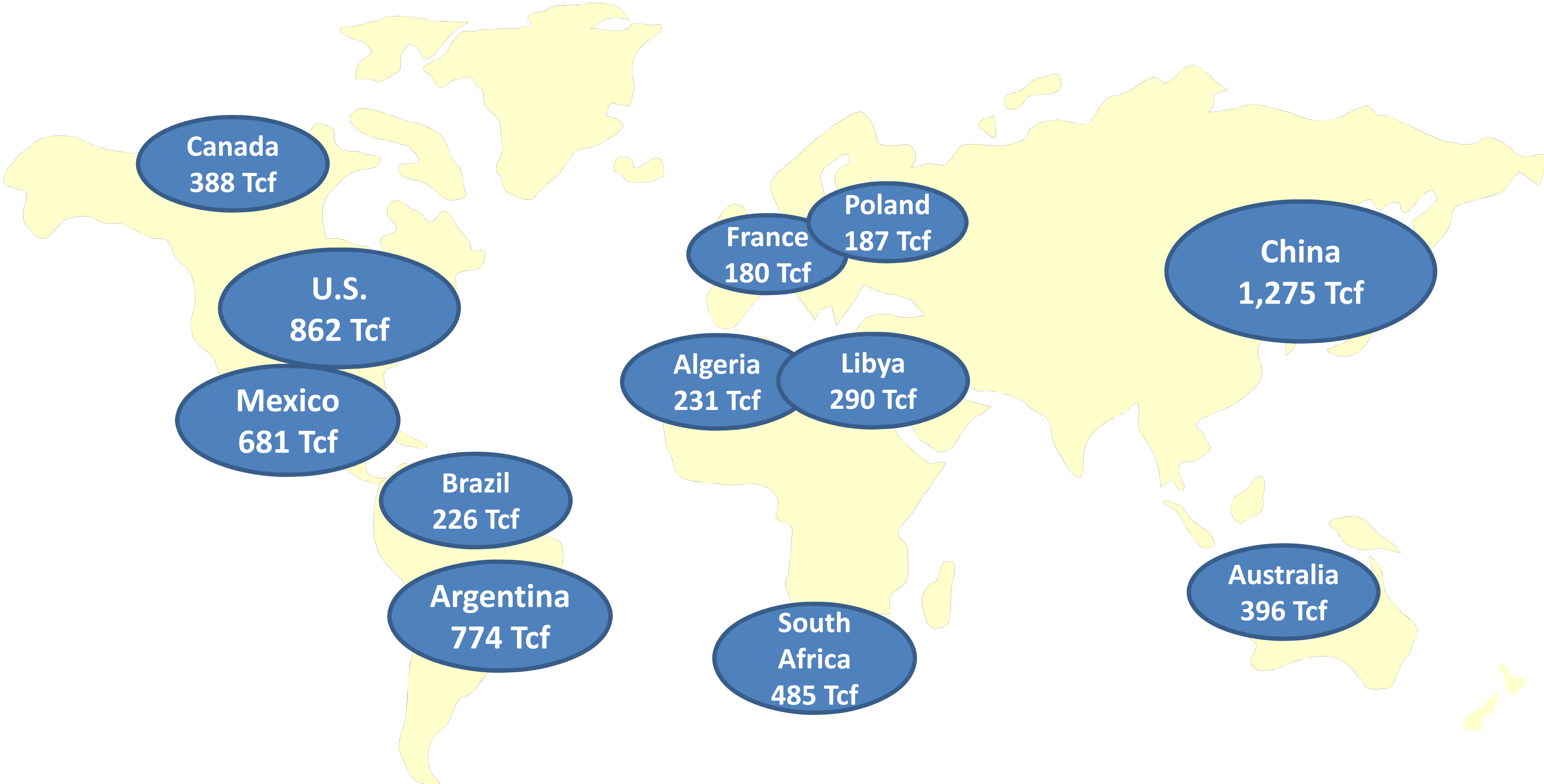
U.S. is likely to be at the upper end of the global LNG supply chain.



Source: Pacific LNG

Basin Competition

Close to 6,000 TCF of shale gas opportunities around the world. Coupled with 9,000 Tcf in conventional suggest a potentially solid resource base for many decades.

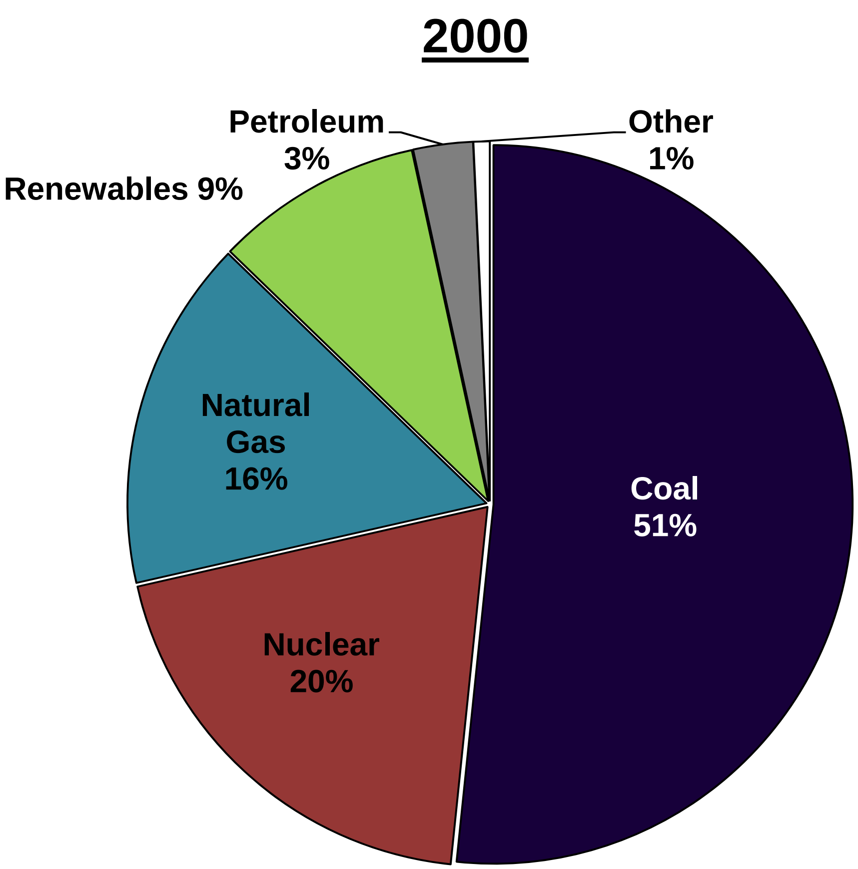


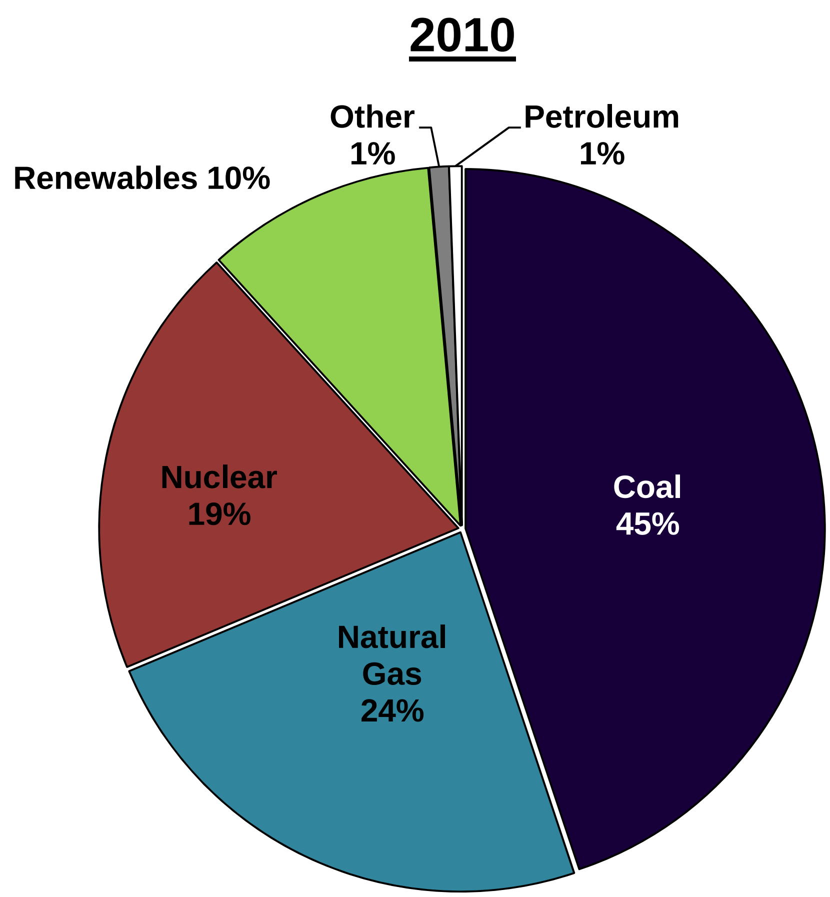
Source: MIT Energy Initiative.

What About "Traditional" End-Uses: Power Generation?

U.S. Power Generation – Fuel Mix

Over 250,000 MWs of natural gas power generation capacity has been added over the past decade at the expense of coal and nuclear.





Source: Energy Information Administration, U.S. Department of Energy

Electric Industry Environmental Regulations Create Uncertainty for Coal

National Ambient Air Quality Standards (NAAQS)

- Sets acceptable levels for six criteria pollutants (carbon monoxide, lead, nitrogen dioxide, particulate matter, ozone, sulfur dioxide).
- A network of 4,000 State and Local Air Monitoring Stations is used to determine if geographic areas are meeting or exceeding the NAAQS.

Transport Rule (now CSAPR) [proposed]

- Issued to replace the Clean Air Interstate Rule (CAIR) and its predecessor the Clean Air Transport Rule (“CATR”). Requires 31 states (and D.C.) to improve air quality by reducing power plant emissions (SO2 and NOX) that contribute to ozone and fine particulate pollution in other states (some annual, some on ozone season only).
- By 2014, the rule and other state and EPA actions would reduce power plant SO2 emissions by 80% over 2005 levels. Power plant NOx emissions would drop by 58%.

Utility Maximum Achievable Control Technology (MACT) [to be proposed]

- EPA must set emission limits for hazardous air pollutants. The rule is expected to replace the Clean Air Mercury Rule (CAMR) and add standards for lead, arsenic, acid gases, dioxins and furans.

Coal Combustion Residuals (CCR) [proposed]

- Would establish, for the first time under the Resource Conservation and Recovery Act (RCRA) requirements for the proper disposal of coal ash generated by coal combustion at electric power plants.

Power Plant Cooling Water Intake Structures Rule

- Section 316(b) of the Clean Water Act is intended to address environmental impacts from cooling water intake to and discharge from power plant cooling systems. Requires that the location, design, construction and capacity of cooling water intake structures reflect the best technology available for minimizing adverse environmental impact.

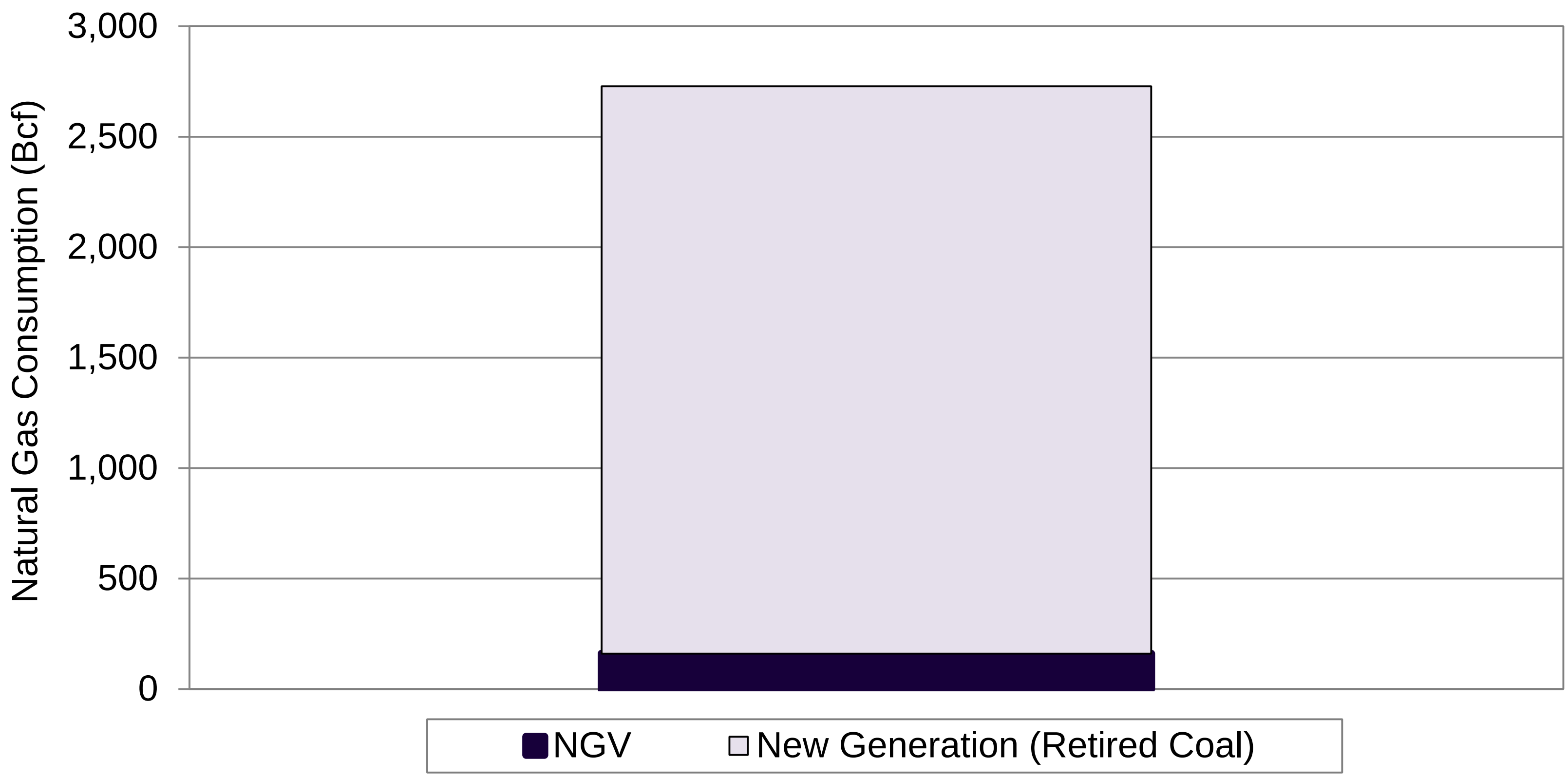
Summary of Retirement Studies Related to EPA Rules

Study	Retired Capacity	Regulation Requirements
NERC (October 2010)	47 to 76 GW by 2018 (total fossil fuel capacity, including oil and gas)	Levelized costs (@2008 CF) after retrofitting each unit for the environmental regulations compared to the cost of a new gas-fired unit. Scenario 1 - Transport Rule Scenario 2 - Transport Rule, MACT Scenario 3 - Transport Rule, MACT, 316(b) Cooling Water, Coal Ash
ICF/IEE (May 2010)	25 to 60 GW by 2015	Cost of retrofitting coal plant compared to cost of new gas CC Scenario 1 - Transport Rule, MACT Scenario 2 - Transport Rule, MACT, CWA 316(b)
Brattle Group (December 2010)	50 to 65 GW by 2020	Regulated Units - 15-year present value of costs > replacement power from a CC or CT. Merchant unit - 15-year present value of cost > revenues from energy and capacity markets. Transport Rule, MACT, 316(b) Cooling Water, Coal Ash
Credit Suisse (September 2010)	60 GW	Size and existing controls Transport Rule, MACT
Charles River Associates (December 2010)	39 GW by 2015	In-house model (NEEMS) optimizing costs of existing capacity and costs of potential new capacity. Transport Rule, MACT
MJ Bradley (August 2010)	30 to 40 GW	Switch to lower sulfur coal, install emission controls, or retire Transport Rule, MACT
Bernstein Research (October 2010)	51 GW	FGS + emissions on all coal fired units by 2015 Transport Rule, MACT

Source: Synapse Energy Economics, Inc., "Public Policy Impacts on Transmission Planning, Prepared for Earthjustice", December 10, 2010; and "Miller, P. A Primer on Pending Environmental Regulations and their Potential Impacts on Electric System Reliability. Working Draft, JD Northeast States for Coordinated Air Use Management. January 24, 2011.

Potential Natural Gas Consumption – New Generation Use (Retired Coal)

The retirement of 45 gigawatts of capacity would have considerably larger impact on natural gas markets than NGV and likely natural gas exports.

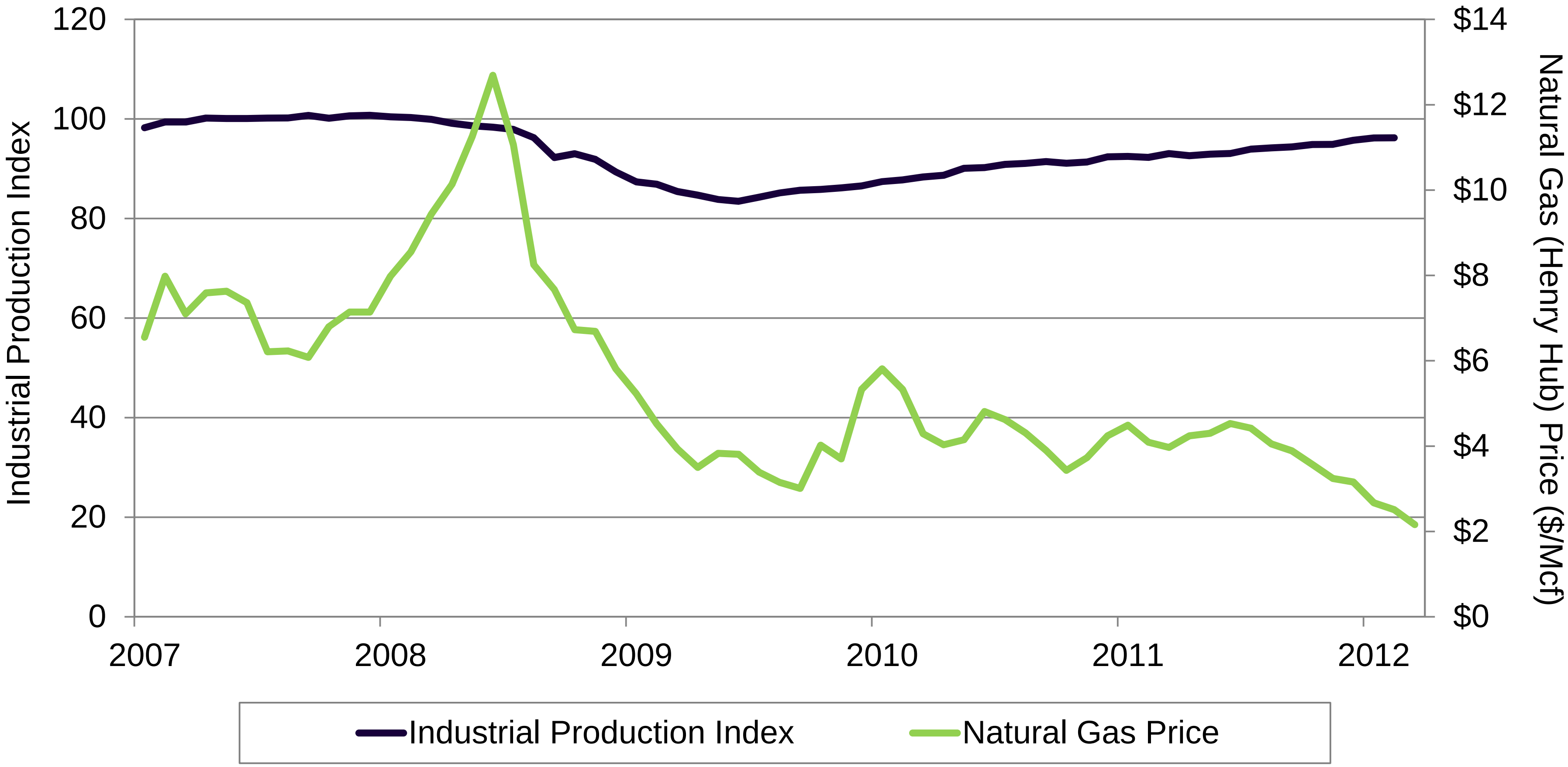


Note: Assumes 160 Bcf of NGV natural gas use. Also assumes retirement of 45 GW of coal-fired capacity, replaced with new natural gas generation with an 85 percent capacity factor and a 7,600 Btu/kWh heat rate.

American Natural Gas and the American Industrial Renaissance?

U.S. Industrial Production Index and Natural Gas Prices

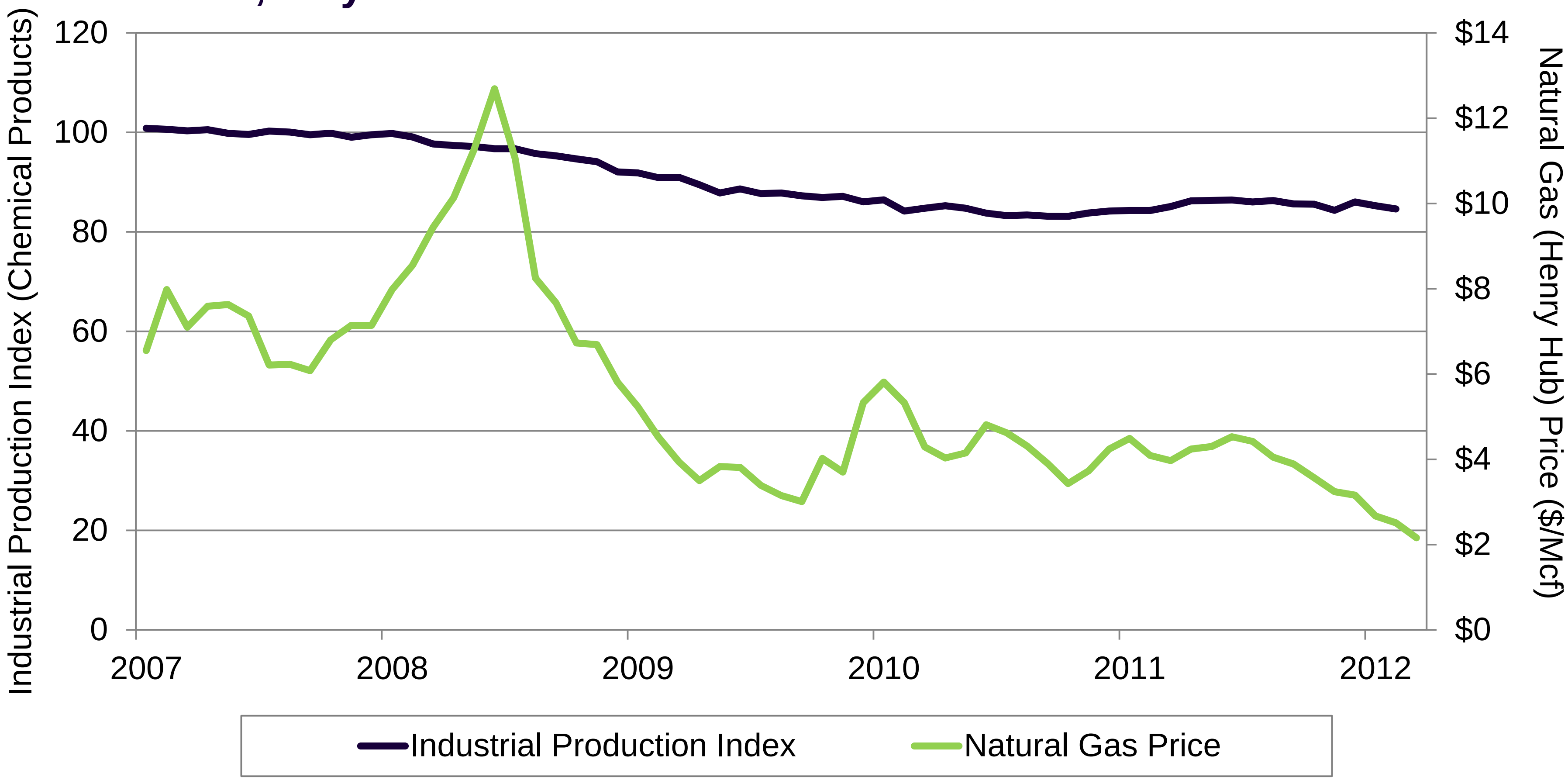
Industrial production showing significant strength. Low natural gas (energy) prices likely an important component for US manufacturing.



Source: Federal Reserve Bank

U.S. Industrial Production Index (Chemical Products) and Natural Gas Prices

Same trends holding in the chemical industry component of the US industrial production index. While these trends appear somewhat weaker, they mask future investment trends and announcements.



Source: Federal Reserve Bank

Recent Expansion Announcements

Sep-2011: Williams announced an expansion at its Geismar olefins production facility (Baton Rouge, LA). The expansion will increase the facility's ethylene production by 600 million pounds per year to a new annual capacity of 1.95 billion pounds and is expected to be in service by the third quarter of **2013**.

Apr-2011: Dow announced plans to increase its ethylene and propylene production, and to integrate its US operations into feedstock opportunities available from increasing supplies of US shale gas. Specifically, the Company plans to increase its ethylene supply and cracking capabilities at existing Gulf Coast facilities by:

- Re-starting an ethylene cracker at its St. Charles operations site near Hahnville, LA by the end of **2012**;
- Improving ethane feedstock flexibility for an ethylene cracker at its Plaquemine, LA site in **2014**;
- Increasing ethane feedstock flexibility for an ethylene cracker at the Freeport, TX site in **2016**;
- Constructing a new, world-scale ethylene production plant in the US Gulf Coast, for startup in **2017**.

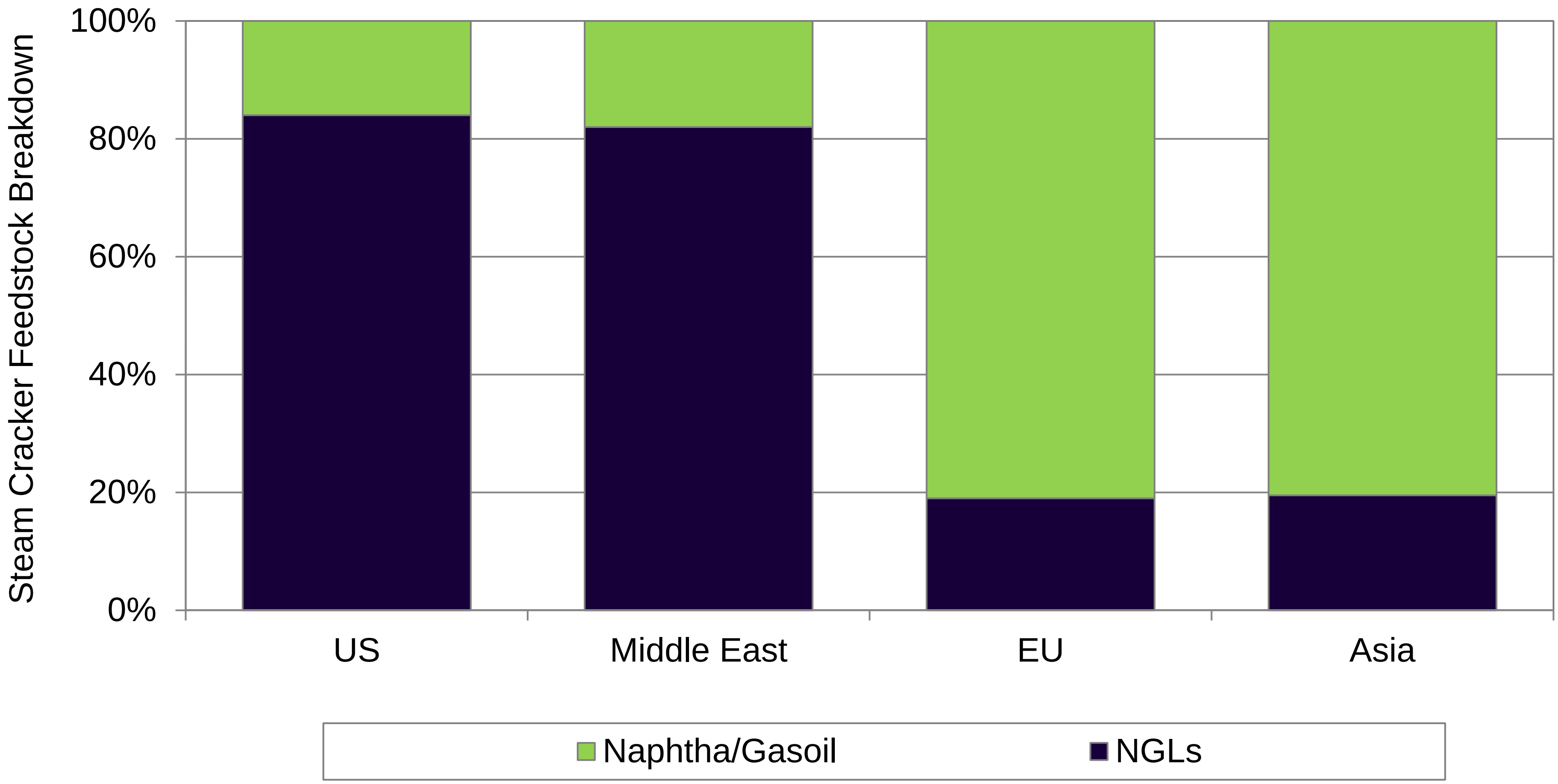
Apr-2011: Westlake Chemical Corporation announced an expansion program to increase the ethane-based ethylene capacity at Lake Charles, LA, and the evaluation of expansion options and the upgrade of ethylene production facilities at Calvert City, KY in order to capitalize on new low cost ethane and other "light" feedstocks being developed.

Mar-2011: Chevron Phillips Chemical announced it is advancing a feasibility study to construct a "world-scale" ethane cracker and ethylene derivatives at one of its existing facilities in the Gulf Coast region. The new facility would utilize the advantaged feed sources expected from development of shale gas reserves.

Dec-2010: Sasol announced plans to construct the world's first commercial tetramerization unit, capable of producing over 100,000 metric tons per year of combined 1-octene and 1-hexene, at its existing Lake Charles, LA Chemical Complex.

Global Steam Cracker Feedstock Breakdown by Region

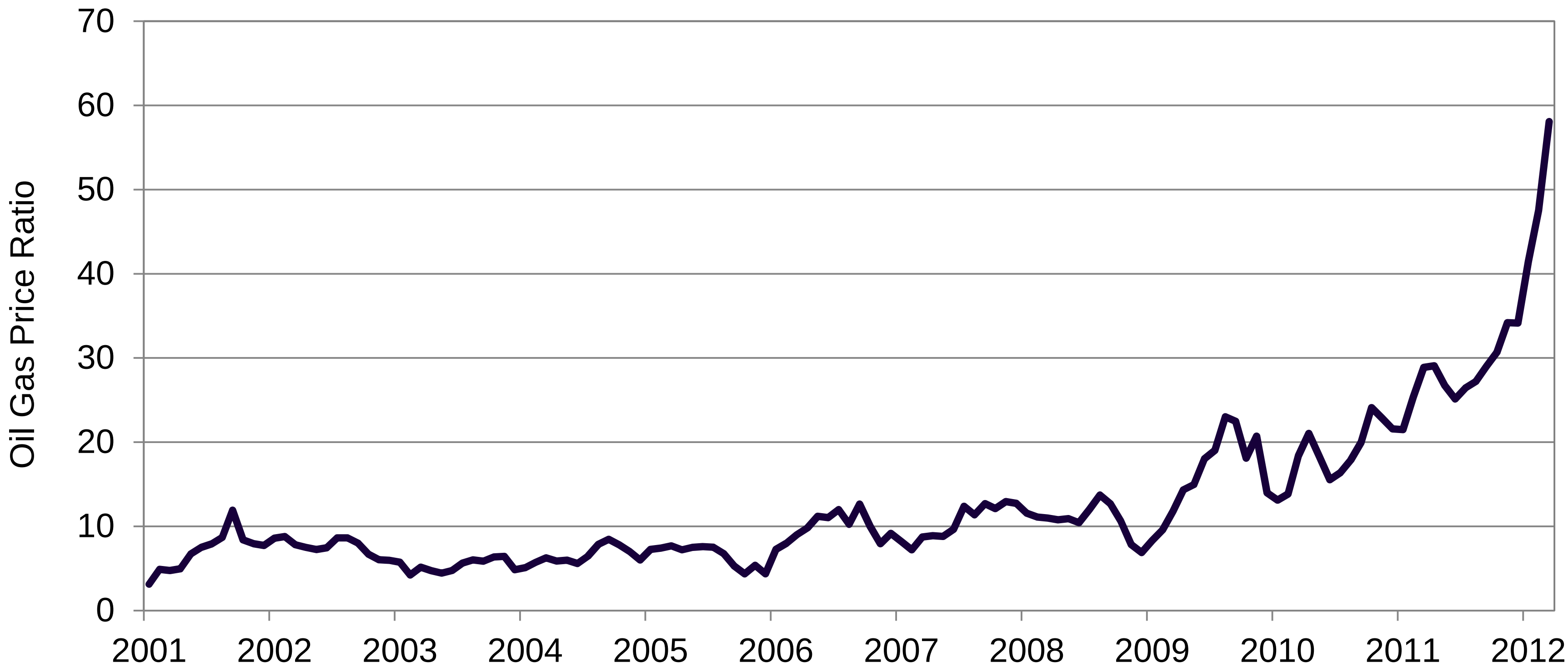
US chemical industry reliance on NGLs creates significant competitive advantage motivating these announcements.



Note: Figure is estimated and for illustrative purposes only.
Source: Navigant Consulting Inc., NGMarket notes, April 2012.

Oil Gas Price Ratio Curve

Increase in oil/gas price ratios also help leverage the opportunities for transforming natural gas to liquid fuels. Two announcements along GOM (Sasol, Shell) already made – billions in investment.



Source: Federal Reserve Bank of St. Louis; and Energy Information Administration, U.S. Department of Energy.

Is There Room of Residential Growth? What Happened to Natural Gas as An Efficiency Measure?

State Energy Efficiency Policies

WA: pursue all cost effective conservation: ~10% by 2025

OR: 1% annual savings by 2013

CA: save 1,500 MW, 7,000 GWh; reduce peak 1,537 MW: 2010-12

NV: 0.6% annual savings (~5%) to 2015; EE to 25% of RPS

CO: save 3,984 GWh, 2012-20; reduce peak 5% by 2018

AZ: at least 22% cumulative savings by 2020; peak credits

NM: 10% retail electric sales savings by 2020 .

OK: EE 25% of renewable goal

TX: reduce 30% annual growth; 0.4% winter and summer peaks beginning in 2013

HI: 4,300 GWh electricity reduction (~40% of 2007 sales by 2030)

MN: 1.5% annual savings to 2015

IA: 1.5% annual; 5.4% cumulative savings by 2020

WI: 1.5% electric savings and peak reductions by 2014

MI: 1% annual savings by 2012

IL: 2% energy reduction, by 2015; 1.1% from 2008 peak by 2018

IN: 2% energy savings by 2019

OH: 22% energy savings by 2025 ; 7% peak by 2018

ME: 30% reduction and 100 MW peak by 2013

VT: ~6.75% cumulative savings, 2009-2011 summer and winter peak reduction targets

MA: 2.4% annual electric savings by 2012

NY: reduce electric use 15% by 2015

CT: 1.5% annual savings, 2008-2011

RI: reduce consumption 10% by 2022

DE: reduce consumption and peak 15% by 2015

PA: reduce consumption 3%; peak 4.5% by 2013

MD: reduce electricity use and peak 15% by 2015

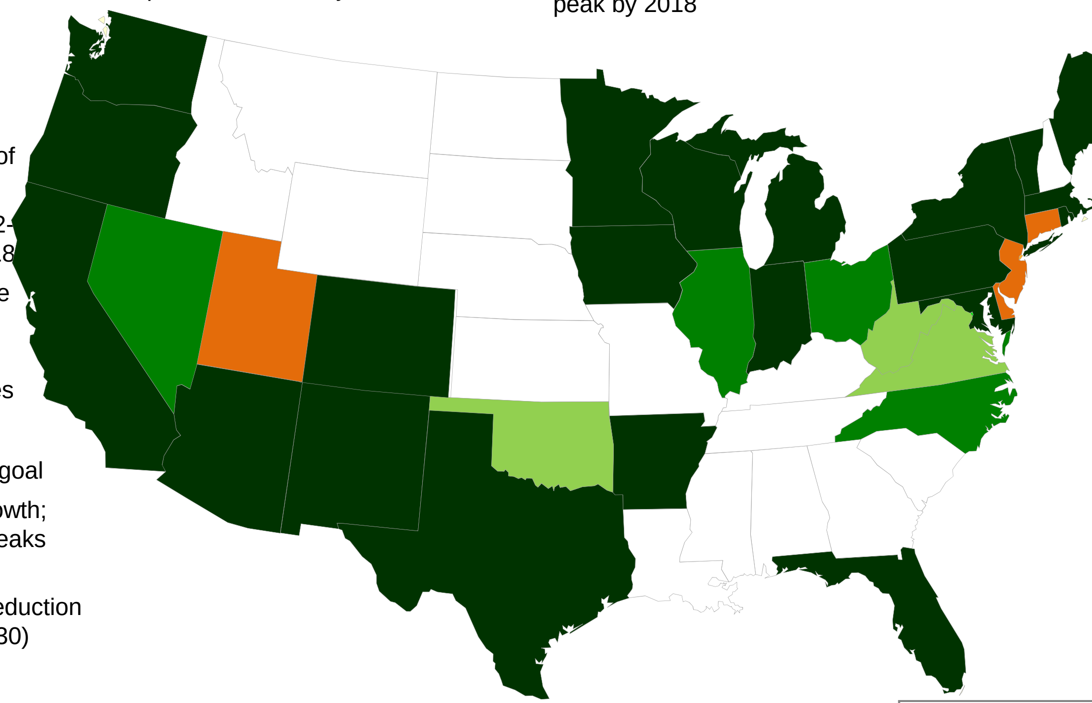
VA: reduce electric use 10% by 2022

WV: EE & DR earn credits in A&RES

AR: 0.75% electricity savings by 2013

NC: EE to meet up to 25% of RPS by 2011

FL: 3.5% energy savings and summer and winter peak reductions by 2019



EERS by regulation or law (stand-alone)

EE in RPS (hybrid)

EE in renewable goal

EE regulations pending

Note: As September 13, 2011.
Source: Federal Energy Regulatory Commission.

Conclusions

Conclusions

- **Energy policies, up to and including those associated with natural gas development, driven a lot by politics, expectations, and other factors. Economics and geology, to date, support robust development and supplies. There <u>should</u> be room at the table for everyone.**
- **Regulator and large user concerns that this is a resource that has large risks and cannot be counted upon, despite, what is a clear three to four year solid production and reserve development run that consistently beats expectations.**
- **Continued need to address (1) the "bread and butter" end uses and (2) the likelihood (unlikelihood) of the "déjà vu all over again" outcomes in natural gas markets.**
- **There are solutions to these problems, and for traditional end-uses, those solutions may rest with the acknowledging and placing contractual value on capacity (reserves).**

Questions, Comments and Discussion

dismukes@lsu.edu

www.enrg.lsu.edu