

Vision and Leadership on Natural Gas – The RPSEA Model

C. Michael Ming

RPSEA

Denver, Colorado

April 19, 2011



PHOTOGRAPH BY JEFF RIEDEL FOR TIME

Fukushima 2011



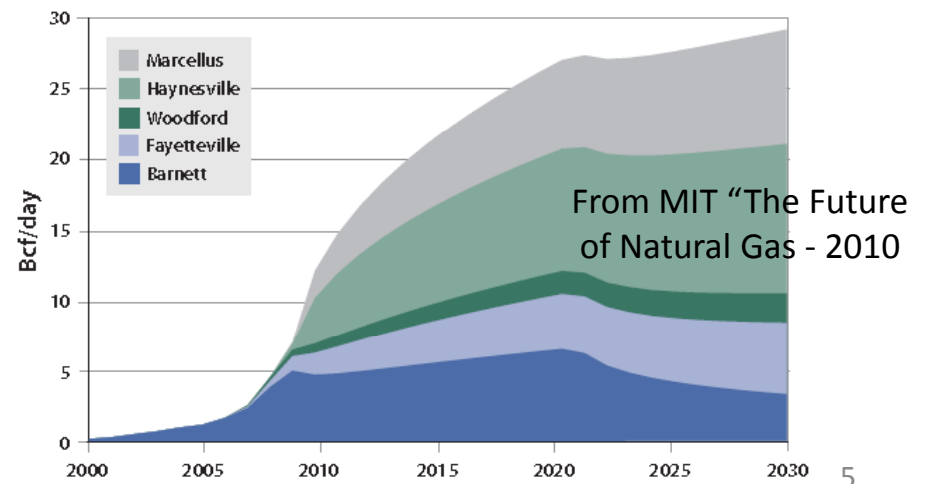
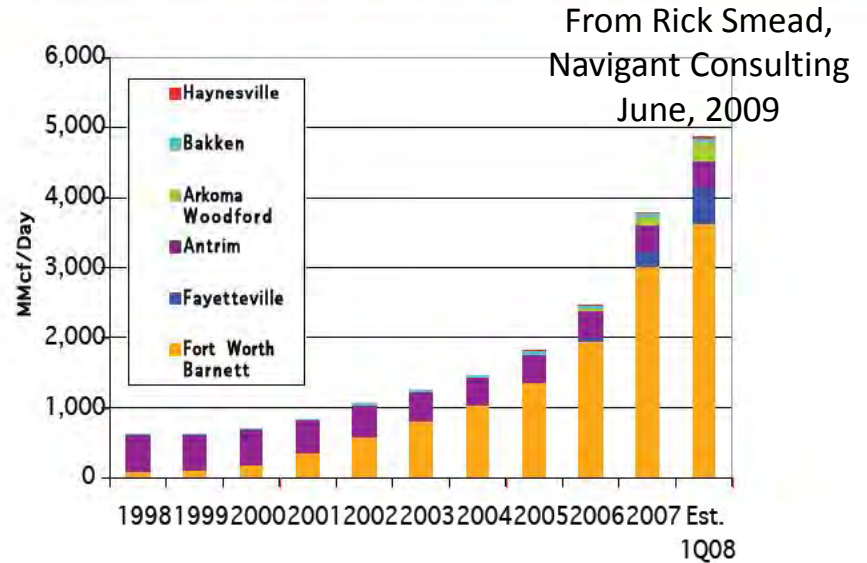
Deep Water Horizon 2010



The U.S. Gas Shale Ramp

- The Barnett grew 3000% from 1998 to 2007
- The Eagle Ford, Fayetteville, Haynesville, Marcellus, and Woodford will dwarf this
- Technology improvements in horizontal drilling and fracturing have economically enabled vast new unconventional and conventional resources.

U.S. Shale Gas Production* (MMcf/day)

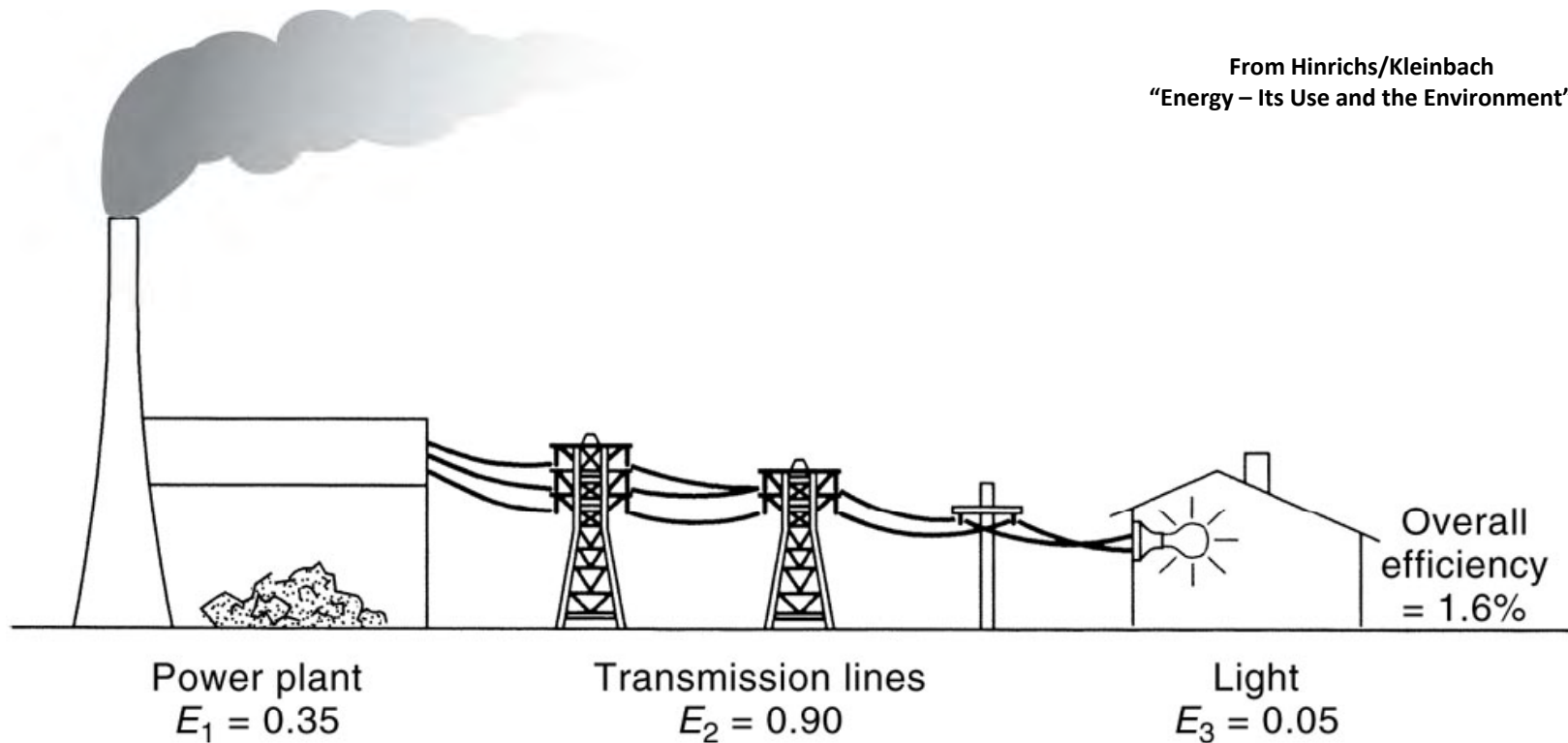


The Issues

- Addressing political and public perception
 - Erasing the supply concern
- Minimizing environmental impacts
 - Hydraulic fracturing and water
- Driving down the cost curve
 - Or continuing to “tunnel thru the cost barrier”
- Mitigating price volatility
 - Ensuring adequate deliverability
- Developing a better clean energy system
 - Domestically but also lead the world by example

Look at the System Backwards

From Hinrichs/Kleinbach
"Energy – Its Use and the Environment"



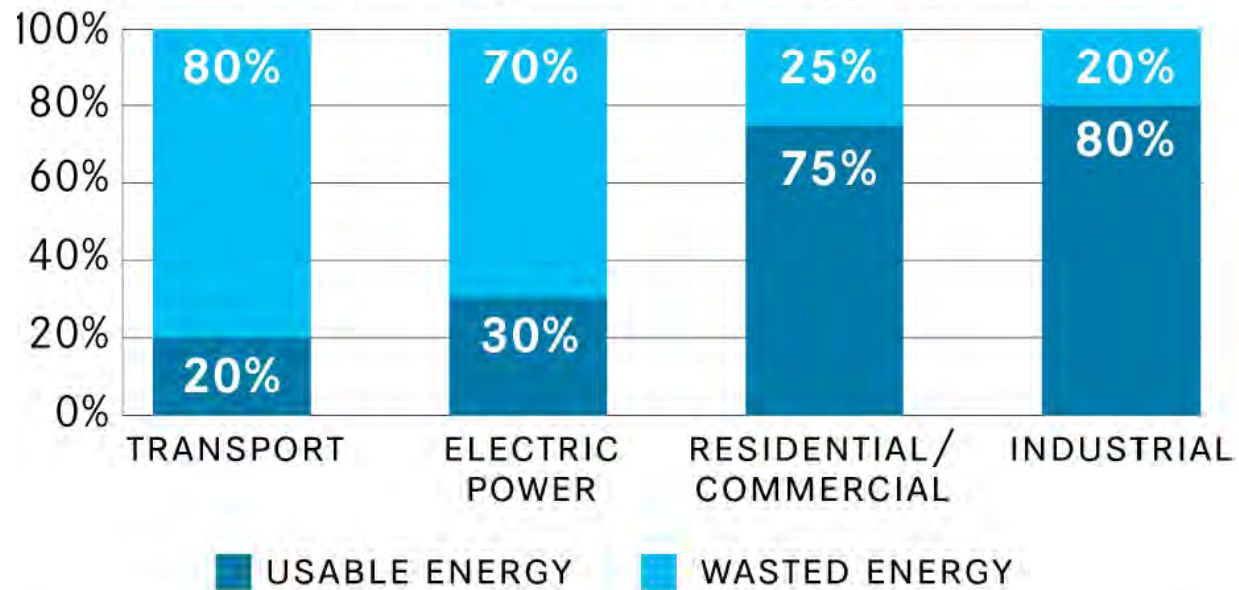
Overall efficiency
for
chemical energy
to light energy conversion

$$= E_1 \times E_2 \times E_3 = 0.35 \times 0.90 \times 0.05 = 0.016$$

Comparative Efficiency by Sector

U.S. Energy Efficiency By Sector

“More Than 60% Of The Fuel We Use Is Wasted”



SOURCE: [HTTPS://EED.LLNL.GOV/FLOW/00FLOW.PHP](https://eed.llnl.gov/flow/00flow.php)

Natural Gas Demand

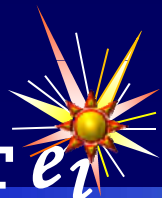
- Resilience in gas use across sectors
- Potential major growth areas:

Electricity

- Natural gas substitution for coal
- Intermittent sources/variability & uncertainty

Transportation

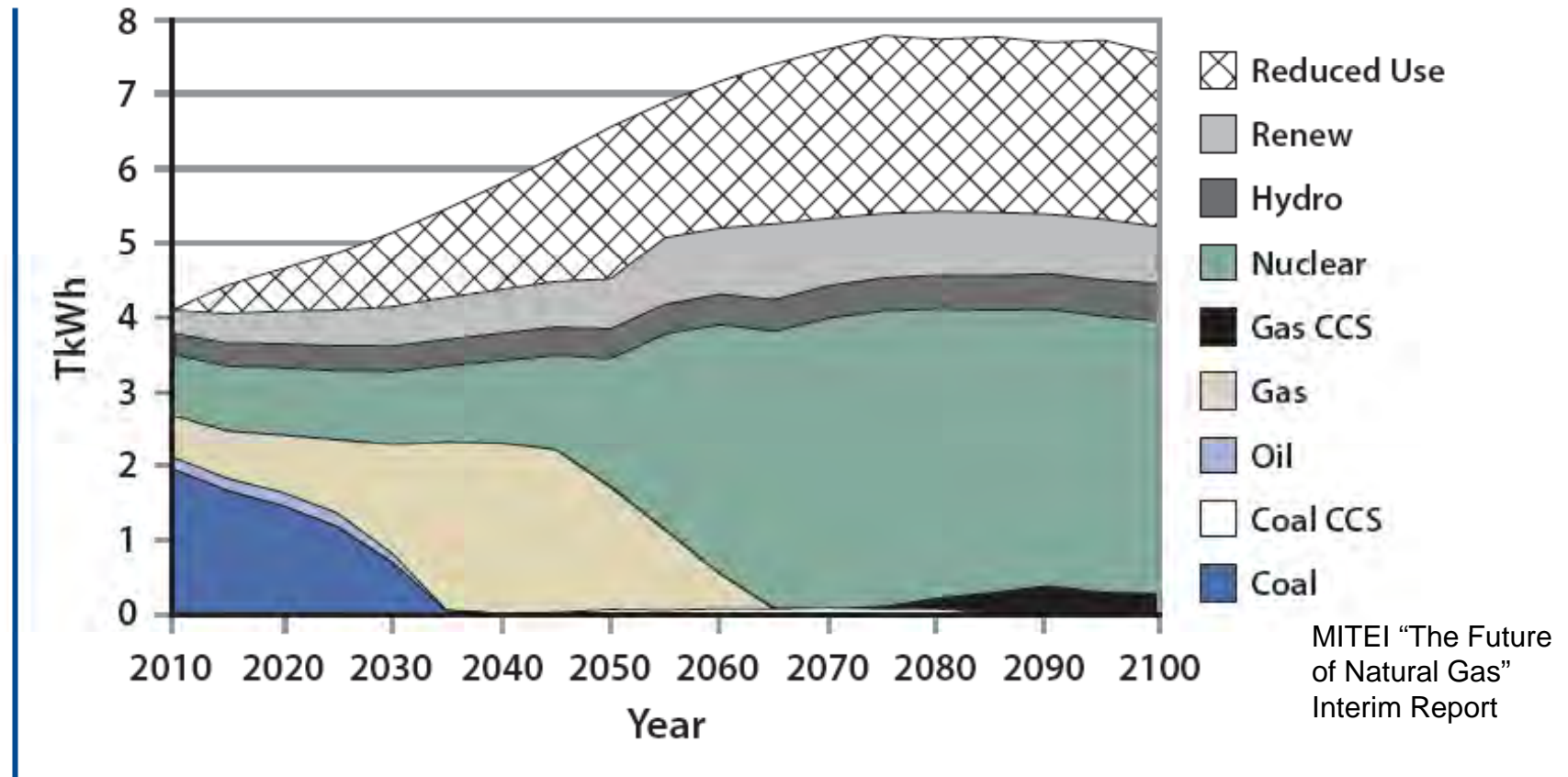
- Long term potential for CNG
- LNG not currently attractive



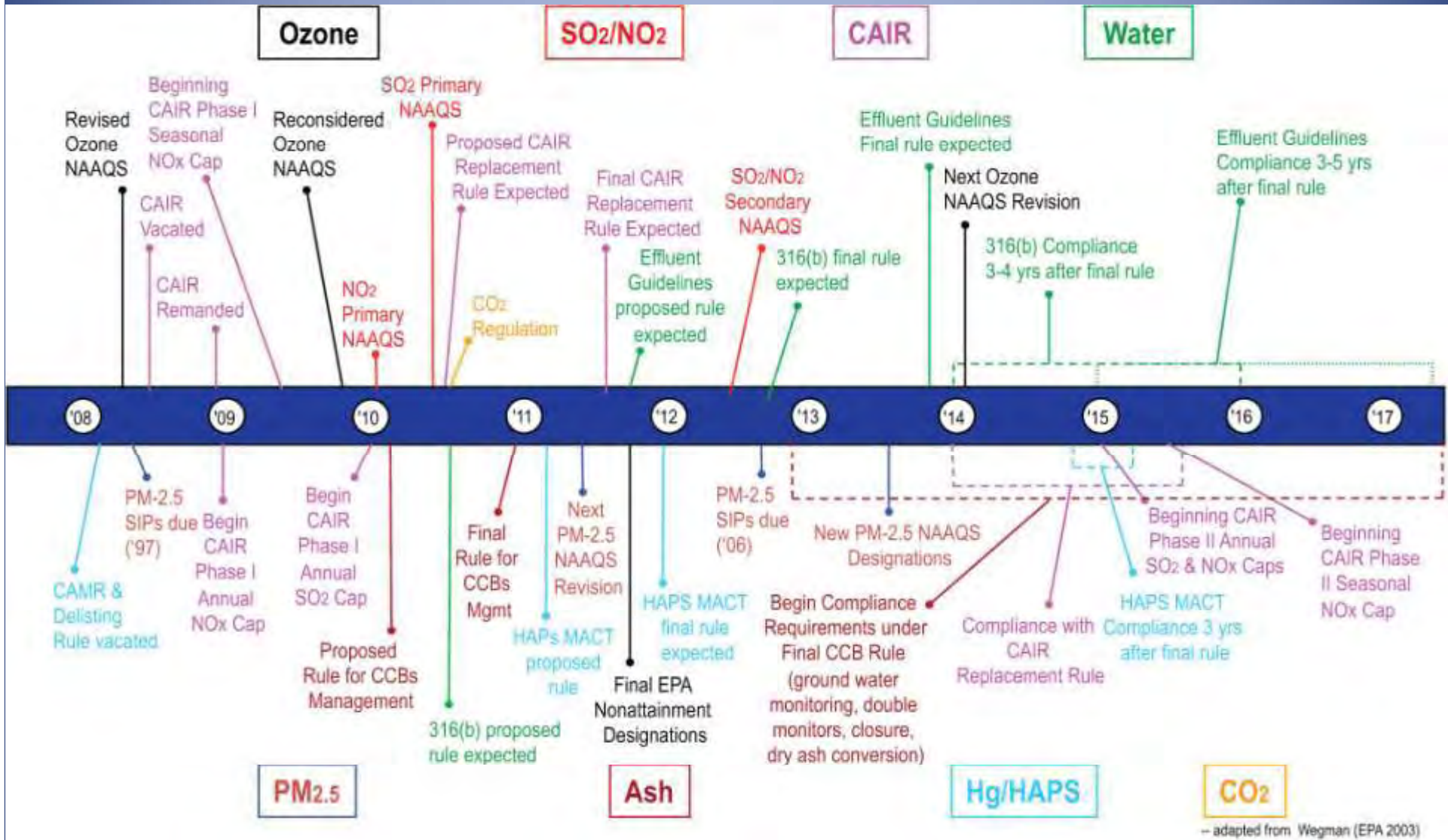
Share of U.S. Electric Generation from all Sources, 2010-2100

Natural Gas – At least a “60 Year Bridge”

Figure 3.9 Energy Mix in Electric Generation under a Price-Based Climate Policy, Mean Natural Gas Resources and Regional Natural Gas Markets (TkwH)



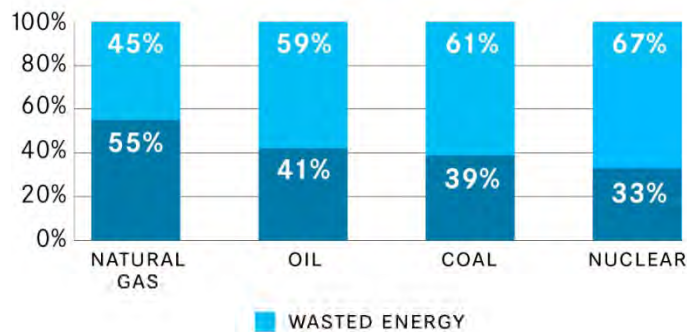
Possible Timeline for Environmental Regulatory Requirements for Electric Utilities



Source: Edison Electric Institute

An Optimal Energy System can Drastically Lower Emissions

Power Generation Efficiency By Fuel



From the American Clean Skies Foundation

Emission Levels: Natural Gas vs. Oil & Coal

Pounds per Billion Btu of Energy Input

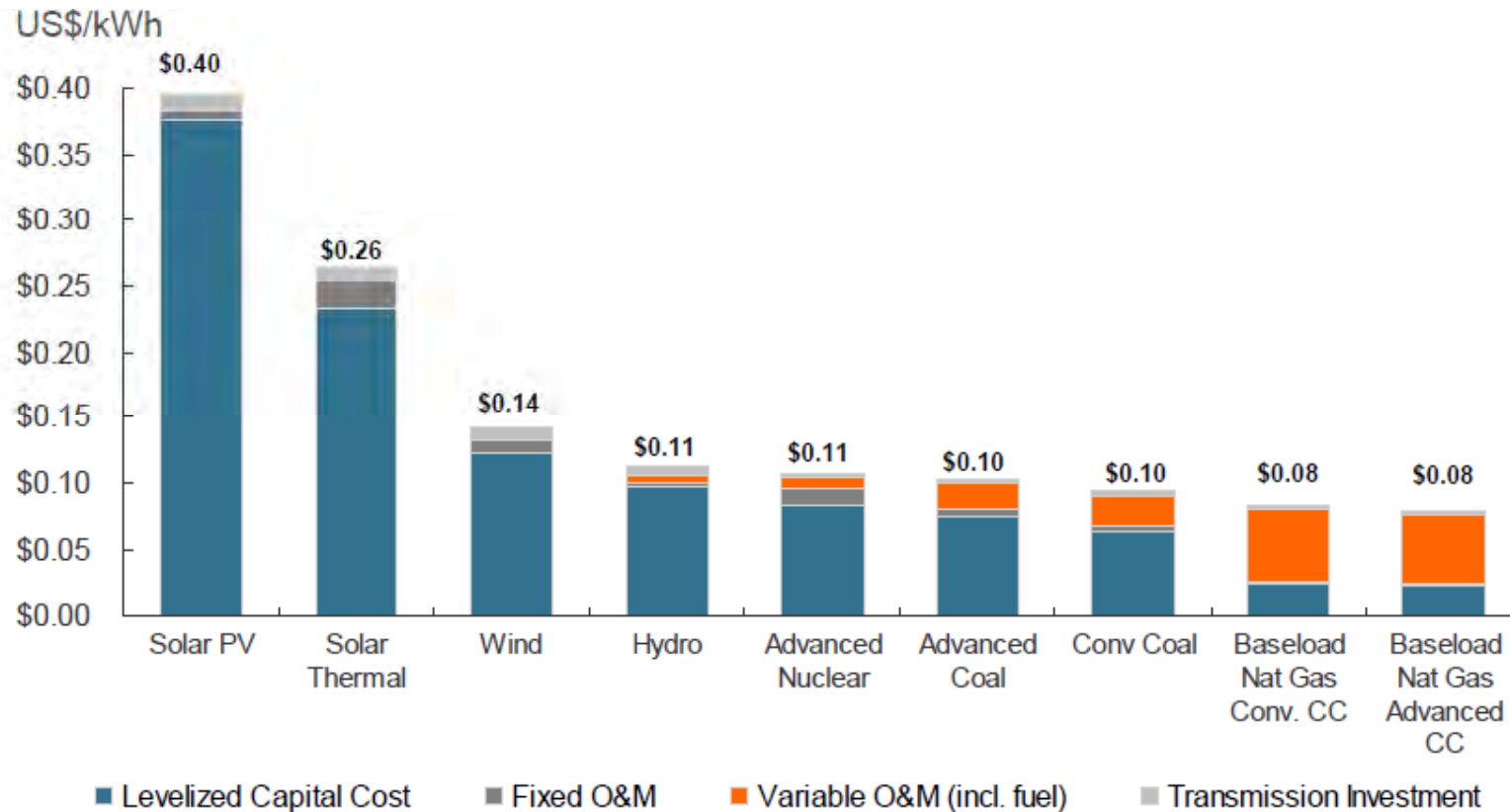
POLLUTANT	NATURAL GAS	OIL	COAL
CARBON DIOXIDE	117,000	164,000	208,000
CARBON MONOXIDE	40	33	208
NITROGEN OXIDES	92	448	457
SULFUR DIOXIDE	1	1,122	2,591
PARTICULATES	7	84	2,744
MERCURY	0.000	0.007	0.016

SOURCE: EIA-NATURAL GAS ISSUES AND TRENDS

At minimum a 60% reduction in CO₂ intensity, not even accounting for other potential efficiencies!

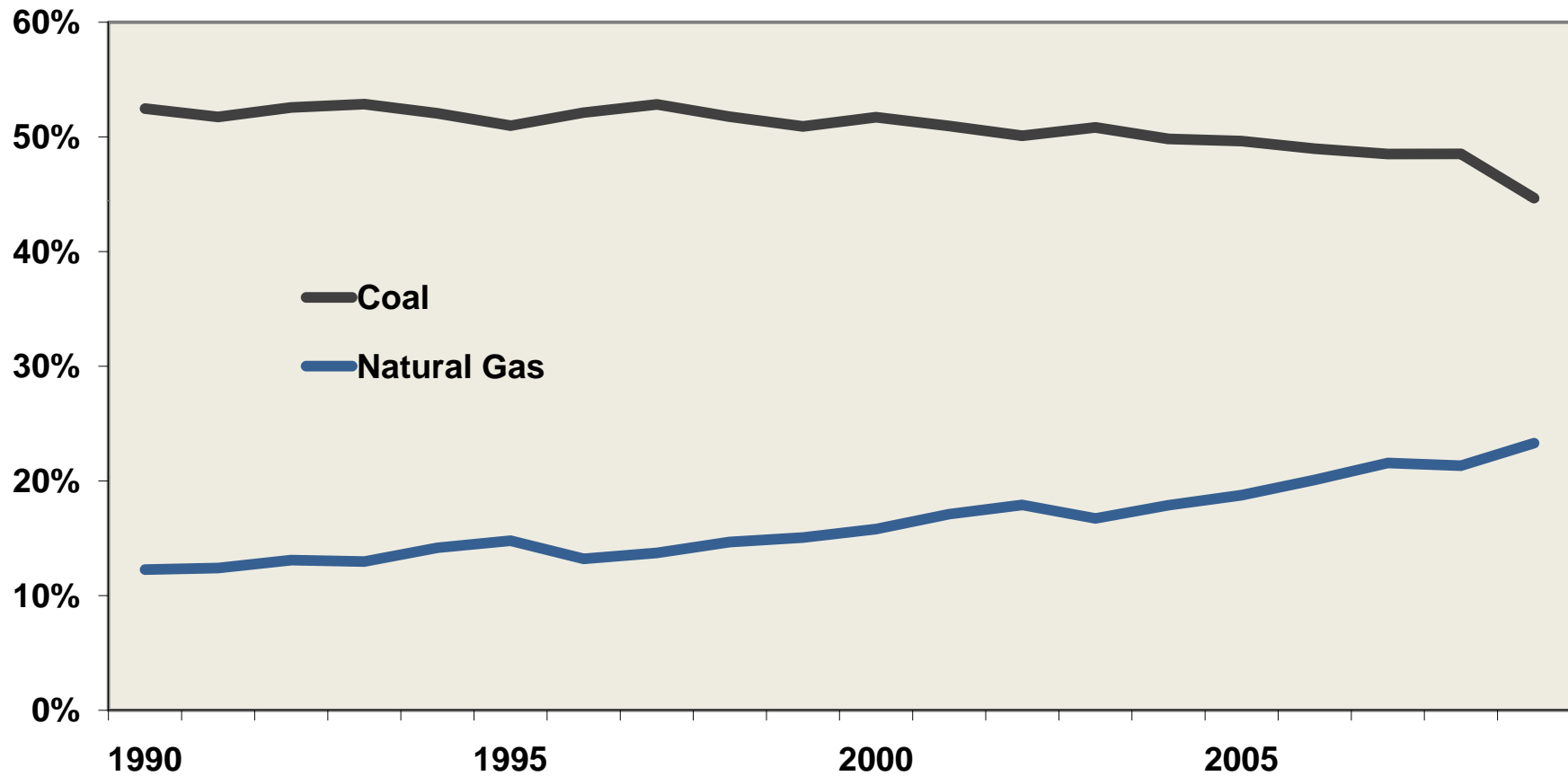
Natural Gas is the Least Cost Option for New Power Generation

Average Cost for Plants Entering Service by 2016



Source: EIA Annual Energy Outlook 2009, EnCana

Share of U.S. Electric Generation from Coal and Gas, 1990-2009

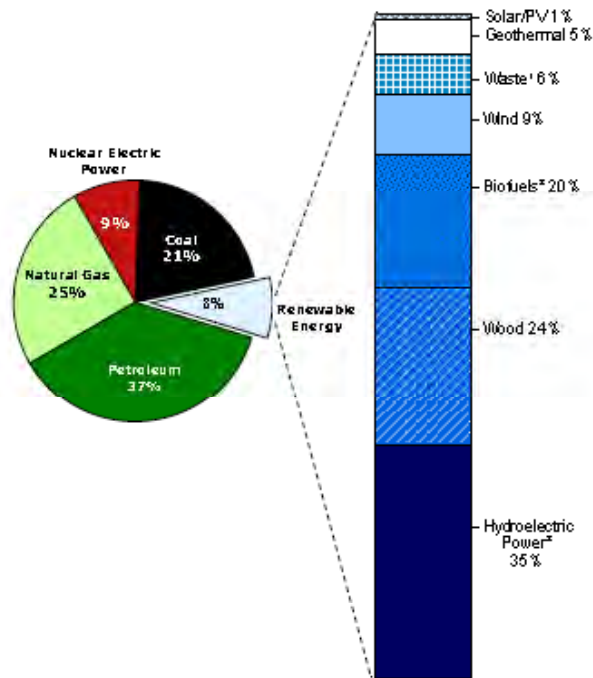


Source: EIA

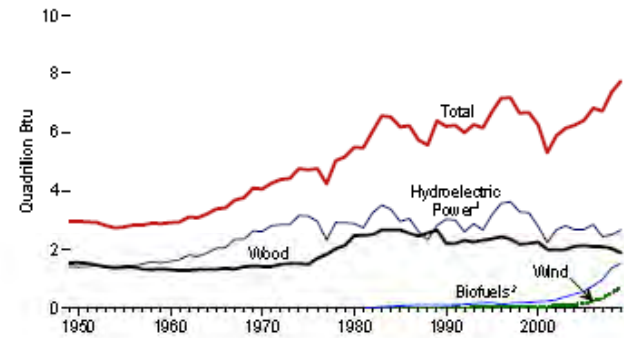
The Issue of Scale

Figure 10.1 Renewable Energy Consumption by Major Source

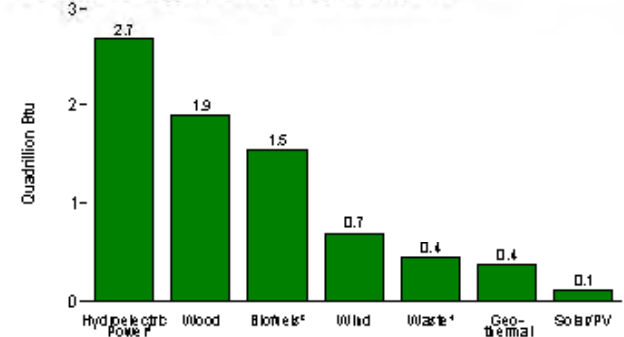
Renewable Energy as Share of Total Primary Energy Consumption, 2009



Renewable Energy Total Consumption and Major Sources, 1949-2009



Renewable Energy Consumption by Sources, 2009



¹ Municipal solid waste from biological sources, landfill gas, sludge waste, agricultural byproducts, and other biomass.

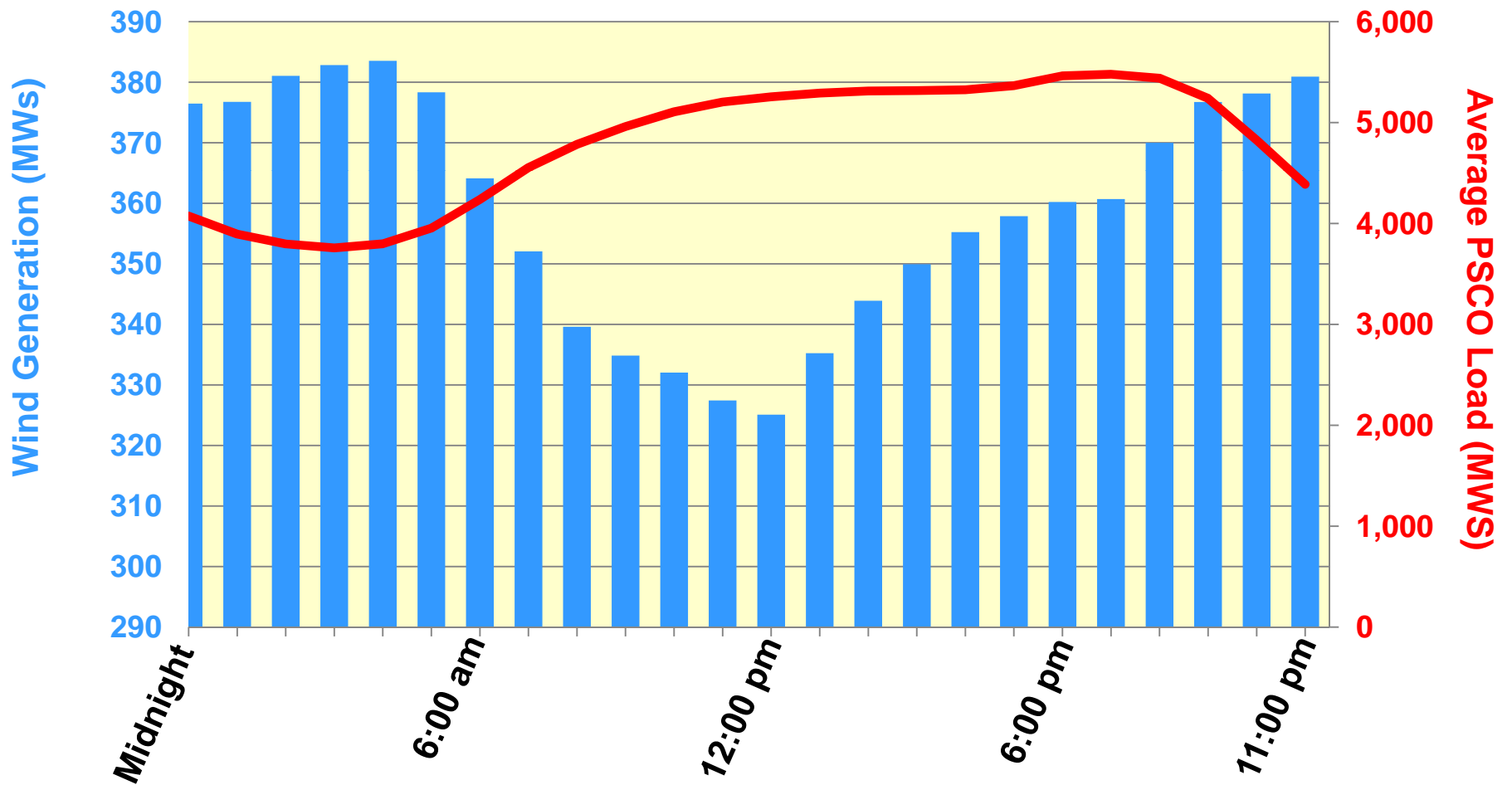
² Free thermal (mill) residue, and biomass consumption, plus losses and co-products from the production of free thermal and biomass.

¹ Conventional hydroelectric power.

Sources: Tables 1.3 and 10.1.

Where The Wind Blows Most Often At Night

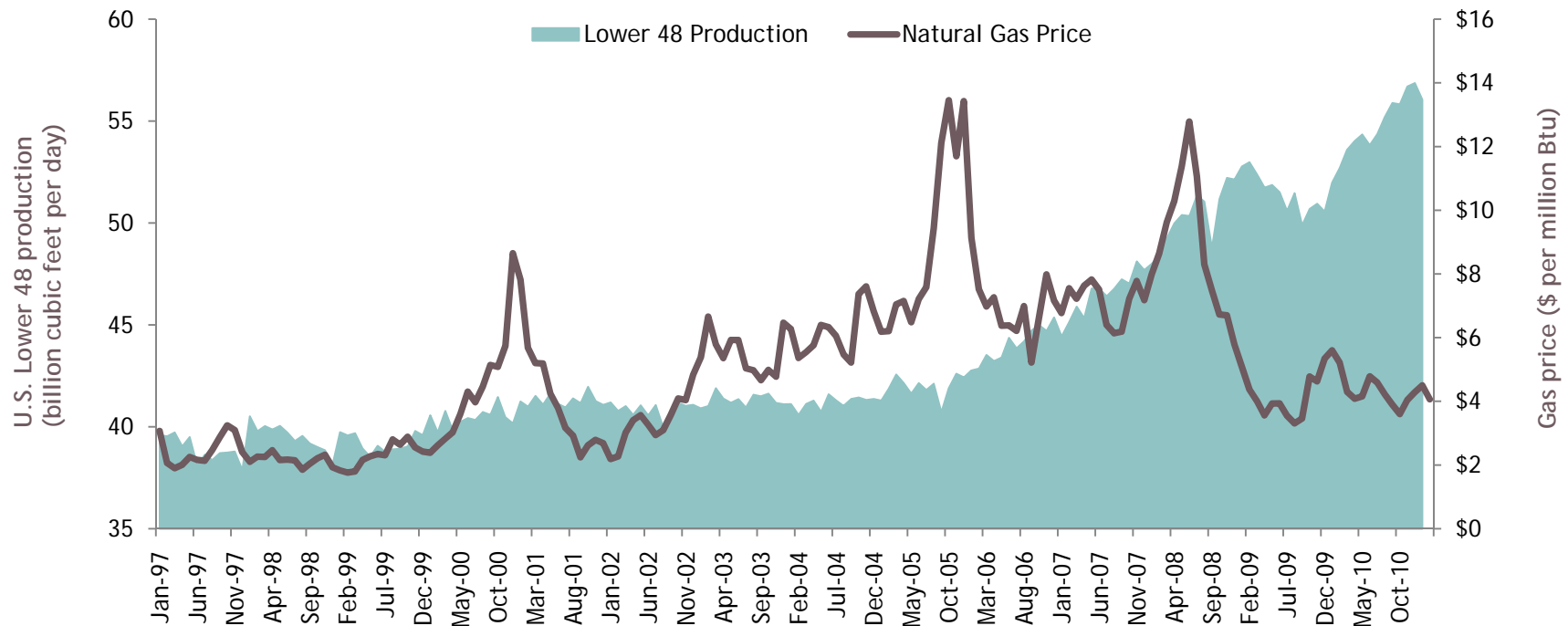
Wind Blows Strongest Between 9:00 pm & 5:00 am, When Demand Is Weakest



Gas price stability

As supply grows, price remains low and stable

- Lower 48 supply has grown by 13.5 billion cubic feet per day since 2004, up 33%
 - Driven by horizontal shale and infrastructure development
 - Impact has been more stable pricing



Note: Natural gas price and range are for Henry Hub trading point

NYSE: DVN

www.devonenergy.com

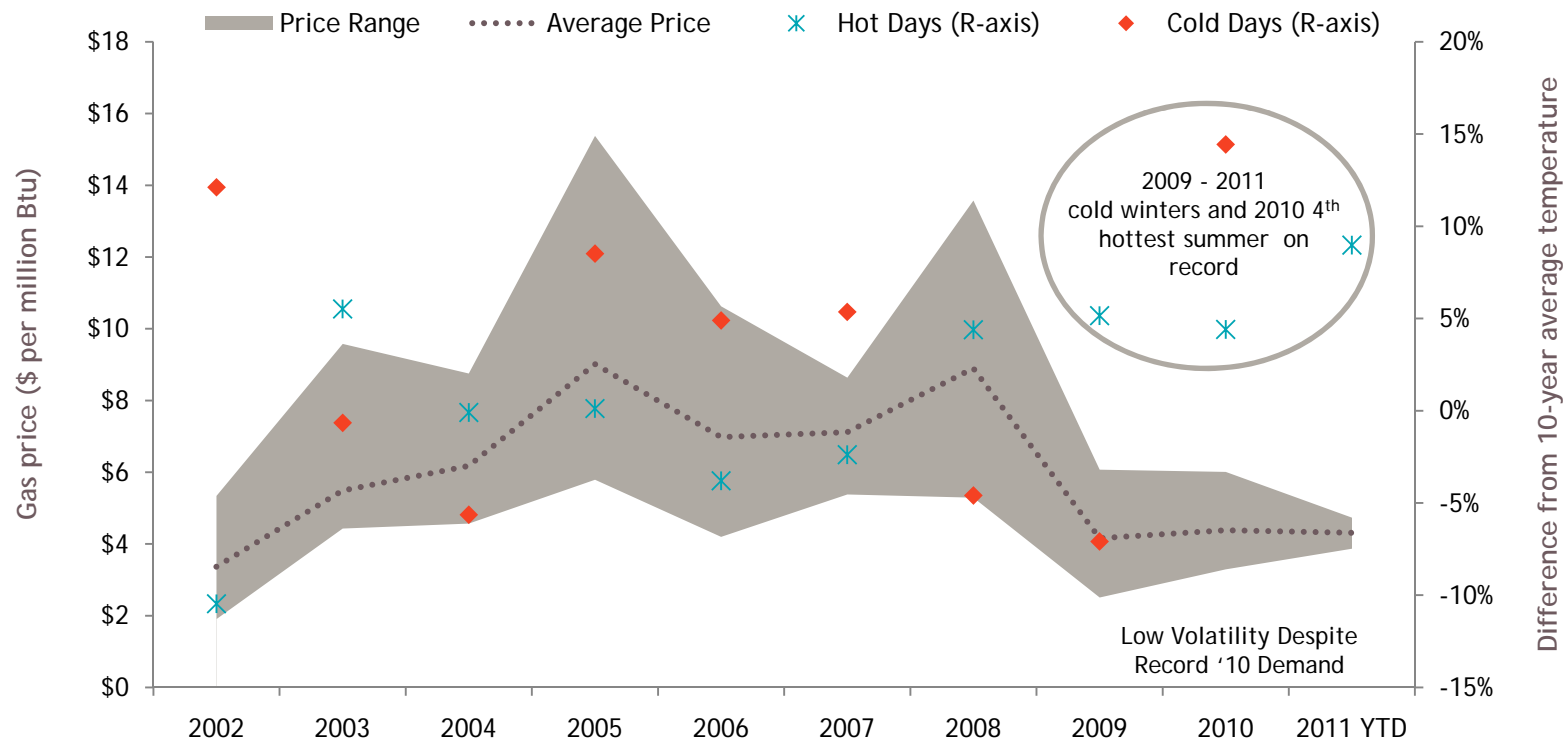
page 17



Gas price stability

Range narrows despite temperature extremes

Despite record 2010 demand, price traded in a narrow band



Note: Natural gas price and range are for Henry Hub trading point

NYSE: DVN

www.devonenergy.com

page 18



“Do or do not, there is no try.”

Yoda