Why Coal Remains Our Future Fuel

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Underlying Concepts

- Electricity is the first value
- Prudence
- Scale
- Reliability
- Affordability
- Clean
A Transmission Line for Much of the World
The Future of Electricity is Being Determined at the Global Level

Increase in Billion Kilowatt Hours
2010 - 2035

USA
870

Billion Kilowatt Hours

17,300
Rest of World
Coal’s Ever Growing Role

People dependent on coal for at least 38% of electricity

1990: 2,300 Million
2010: 3,000 Million
2030: 4,000 Million
Supercritical Technology has Significant Environmental Benefits

429 GW On Line and Under Construction

China and India House 50% of the World’s Developing Advanced Coal Fleet

Coal-Based Power Generation
+ 183%

-82% NOx Emissions
-88% SO2 Emissions

The Clean Air Act is Working

Million Tons / yr NOx

Over the past decade, coal provided at least 45% of electricity every single year.
Percent Change in U.S. SO₂ Emissions, 1999-2010

- Coal Power Plants: -57%
- Highway vehicles: -77%
- Off-hwy vehicles: -55%
- Industrial: -31%
- All other: -43%
The rising value of CO$_2$ to produce “Stranded Oil” through Enhanced Oil Recovery (EOR)

The U.S. has 100 billion barrels of oil resources amenable to CO$_2$ based EOR
The United States is a Growing Nation: Over 120 million more people in 40 years

By 2030 Population increase equal to:

By 2050 Population increase equal to:
In 2020, coal is projected to be only 28% of generating capacity but still produce 39% of electricity.
EPA Regulations: Converging, Interacting and Unprecedented

- New Source Performance Standards
- Utility Mercury and Air Toxics (MACT)
- Cross State Pollution Rule
- Best Available Control (BACT)
- Various other new rules and policies
Electric Power Research Institute (EPRI)

Findings on EPA Regulations:

- Hundreds of coal plants impacted
- Cost will be “Several $100 Billions”
- Significant increase in electricity rates
- GDP adversely impacted ($250 Billion)
- Extending time would save billions
- Gas price “uncertainty level very high”
Be Careful What You Wish For
(The danger of familiarity breeds contempt)

Probable U.S. Capacity by 2015 in GW

- **Hydro**: 80
- **Nuclear**: 103
- **Coal**: 275
- **Gas**: 450+

Coal Power Plants

- Important existing state-based ratepayer assets
- Affordable, stable prices
- Reliable electricity
- Major potential source of CO₂ for EOR

Data Source: Energy Information Administration, 2010
States with 1,000 MW or More Coal Retirements

Overall, closure of 37,000 MW in 26 states have already been announced

-6,004 MW
### EPA Estimate Versus Coal Retirements

<table>
<thead>
<tr>
<th>Source</th>
<th>Retirements (GW)</th>
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<tbody>
<tr>
<td>EPA (Projected)</td>
<td>-10 GW</td>
</tr>
<tr>
<td>ACCCE (Already/EPA Reg)</td>
<td>-25 GW</td>
</tr>
<tr>
<td>NETL (Announced)</td>
<td>-37 GW</td>
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<tr>
<td>EIA Forecast (no EPA)</td>
<td>-49 GW</td>
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<tr>
<td>NETL (per EPA Reg)</td>
<td>-70 GW</td>
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<tr>
<td>EPRI (per EPA Reg)</td>
<td>-100 GW</td>
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</tbody>
</table>
Hole in the Grid:
To replace 100 GW of coal capacity retirements

- 4,400 Bcf of gas (2 Gulfs of Mexico)
- 150 Hoover Dams
- 75 nuclear plants (have 104)
- 7 times U.S. wind generation in 2010
- Power production of Germany
EPA Presumes Gas to the Rescue

“the EPA and others project that NGCC (gas) will be the predominant choice for new fossil fuel-fired generation”
EPA, 2012
A Question Of Prudence

Our staggering bet on shale gas by 2020

Shale Gas
92%

2012 Forecast
In 2000 the Bet was Offshore

But now....

Projected Offshore Natural Gas Production in 2015 (Bcf)

- 2000: 6,680 Bcf
- 2012: 2,130 Bcf

Forecast for 2015
In 2002 the Bet was Conventional Onshore

Projected Conventional Onshore Natural Gas Production in 2002 (Bcf)

- 2002: 10,770 Bcf
- 2012: 3,400 Bcf

Forecast for 2020
In 2005 the Bet was LNG Imports

Forecast for 2020

Projected LNG Imports in 2020 (Bcf)

2005

5,540

2020

-740
LNG supply projections failed in only three years: From 2005 to 2008

*EMF-Energy Modeling Forum
“Those who cannot remember the past are condemned to repeat it” Santayana

“increased gas prices have already resulted in electricity bills jumping twice”

“gas…sharp increases in costs passed through to electricity prices”

“the fuel charge is increasing because of natural gas”

“Retail electric companies blame rising gas prices for the rate increases”

“Driving this increase is the major increase in the price of natural gas”

“The 260,000 customers of Virginia Natural Gas will see a 35% increase in their bill”

“utilities will pay 33 percent more for natural gas this year”

Last week we issued an early warning because of spiking natural gas prices” CPUC

Note: All quotations from 2008 news releases.
By 2035 these net declines represent over 5,000 bcf
What if We Are Wrong About Shale Gas 8 Years Out? By 2020 We Have:

- Upwards of 500 GW of Gas Capacity
- 65 Million Gas Homes
- 65 – 75 GW Wind/Solar Capacity
- 20 States Dependent on Gas for 50% of Electricity in Summer
- 50 – 100 GW Less Coal Capacity
Why Natural Gas Prices Matter (Indiana)
65% of Indiana homes are heated by gas

Million Cubic Feet of Consumption

July

2,500

January

30,000
Volatility: Industrial Gas Prices in Illinois Last Decade

![Industrial Gas Prices Graph]

- **2000** (Low): $3.78
- **2000** (High): $10.56
- **2001** (High): $8.79
- **2002** (Low): $4.45
- **2003** (High): $7.40
- **2004** (Low): $7.34
- **2005** (High): $13.07
- **2006** (Low): $9.82
- **2007** (High): $14.55
- **2008** (High): $5.61
- **2009** (Low): $8.27
- **2010** (High): $14.55

**Industrial Price of Gas ($/Mcf)**
States particularly vulnerable to natural gas spikes

- **States Dependent Upon Natural Gas for 40% or More of their Electricity**
- **States Where Natural Gas Usage Doubles In Winter**
Shale gas: (1) Surge in production, (2) We need it and (3) The resource is there

Yet Unknowns Predominate:

- Long term price?
- Can production be sustained?
- Other sources of demand
- Infrastructure requirements and pace
- Environmental impacts – water, land, air
- Not low carbon answer – requires CCS
- How much associated gas will show up?
- We are heading toward a Global LNG market (LNG $17.50 in Asia last month)