Coal: Homegrown Energy Abundance in a World of Energy Shortfalls

The Resource: 27% of the World’s Coal is in the United States

250 Billion Tons of Recoverable Coal
China, U.S. and India Represent Vast Majority of Global Coal Growth

Long-Term Coal Demand Forecasts Continue to Rise

Amounts in million short tons.
Projected Australia export flow for 2004-2030.

India Now Says Growth Could Exceed 1.5 Billion Tons by 2030
Energy is Key to All Human Activity

● Man’s first great invention was also its first energy resource: the ability to create and harness fire using wood

● Modern energy is responsible for everything from:
  – Transportation
  – Manufacturing
  – Heating & Cooling
  – Communications
  – Medical Advancements
  – Education
  – Clean Water / Sewage Treatment
  – The list goes on and on and on …
Electricity = Life;
In America, Coal is Electricity

“The top-rated engineering improvement to the life of earthlings in this century was electrification… If anything shines as an example of how engineering has changed the world during the twentieth century, it is clearly the power that we use in our homes and businesses.”

- Neil Armstrong
   Speaking on behalf of the National Academy of Engineering to the National Press Club; Feb. 22, 2000
Beneficial Electrification – Five Basic Premises

● Electricity is essential to increases in quality of life, economic well-being and a clean environment

● All societies should facilitate the development of additional electric generation capacity to provide affordable and reliable electricity

● Unlike standard fuels, electricity has no waste product at the point of use

● At the point of electricity generation, carbon capture and near-zero criteria pollutant emission control allows us to utilize our most reliable and affordable fuel – coal

● Electrotechnologies, ranging from microwave applications to electric vehicles, can be increasingly utilized to improve environmental quality
“Electricity use and gross national product [are] strongly correlated. The relationship … is so important that it should be considered in developing … energy and economic policies…. policy should … promote the implementation of electrotechnologies … and seek to lower the real cost of electricity supply.”

– National Academy of Science

“Technology innovation in electricity use is a cornerstone of global economic progress (and) environmental benefits … deploying the technology of an enhanced electricity infrastructure would include … a 13-25% reduction in carbon dioxide emissions (and) a 10% increase in real GDP.”

– Electric Power Research Institute
More Electricity, Less CO₂ per GNP

Electricity Consumption and CO₂ Efficiency

- More Electricity, Less CO₂ per GNP

Graph showing trends in CO₂ / GNP and Electricity consumption from 1980 to 2005.
U.S. Household Electricity Consumption

Household Consumption (Billion kw hr)
The Nature of Energy Demand is Changing: The Digital Age is Here

- There are over 15 billion microprocessors in the U.S. alone

- Digital load is now over 10% of electricity demand but could reach 40% by 2030

- Digital devices are highly sensitive to even slight variations in power quality, surges and sags

- The current electricity structure must be upgraded from analog to digital
“Economic factors, such as income, employment and socioeconomic status, affect disease and death.”

“Climate change bills… could result in the displacement of up to 78% of U.S. coal-based electricity generation with high-cost energy sources.”

“Increasing the cost of goods and services, such as energy, can… harm the socioeconomic status of individuals.”

“Premature mortality from reduced income and increased unemployment would exceed 150,000 deaths annually.”

Full Use of Our Coal Resource Ensures the Well-Being of the American People

**U.S. Economic and Energy Growth**

- **GDP +149%**
- **Electricity Use +111%**
- **Per Capita Income +80%**
- **Coal Use +77%**

<table>
<thead>
<tr>
<th>Year</th>
<th>Life Expectancy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1974</td>
<td>72</td>
</tr>
<tr>
<td>1980</td>
<td>73.9</td>
</tr>
<tr>
<td>1985</td>
<td>74.7</td>
</tr>
<tr>
<td>1990</td>
<td>75.1</td>
</tr>
<tr>
<td>1995</td>
<td>75.7</td>
</tr>
<tr>
<td>2000</td>
<td>76.7</td>
</tr>
<tr>
<td>2004</td>
<td>77.6</td>
</tr>
</tbody>
</table>

China and India Driving Global Demand Growth for Energy

**Electricity Usage per Capita**

<table>
<thead>
<tr>
<th>Country</th>
<th>Usage (Thousand Kilowatt-hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>13.1</td>
</tr>
<tr>
<td>Australia</td>
<td>10.7</td>
</tr>
<tr>
<td>South Korea</td>
<td>7.0</td>
</tr>
<tr>
<td>UK</td>
<td>6.2</td>
</tr>
<tr>
<td>Italy</td>
<td>5.6</td>
</tr>
<tr>
<td>Russia</td>
<td>5.5</td>
</tr>
<tr>
<td>Malaysia</td>
<td>3.0</td>
</tr>
<tr>
<td>China</td>
<td>1.4</td>
</tr>
<tr>
<td>India</td>
<td>0.4</td>
</tr>
</tbody>
</table>

**Energy Consumption per Capita**

<table>
<thead>
<tr>
<th>Country</th>
<th>Consumption (Million Btu)</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>326</td>
</tr>
<tr>
<td>Australia</td>
<td>239</td>
</tr>
<tr>
<td>Russia</td>
<td>198</td>
</tr>
<tr>
<td>South Korea</td>
<td>190</td>
</tr>
<tr>
<td>UK</td>
<td>157</td>
</tr>
<tr>
<td>Italy</td>
<td>128</td>
</tr>
<tr>
<td>Malaysia</td>
<td>99</td>
</tr>
<tr>
<td>China</td>
<td>49</td>
</tr>
<tr>
<td>India</td>
<td>16</td>
</tr>
</tbody>
</table>

**Per-Capita Electricity Use Just 1/10th (China) and 1/30th (India) the U.S. Level**

On the Road to Peak Oil – Driver A: The Inexorable Growth of Population

World Population in Billions

<table>
<thead>
<tr>
<th>Year</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>4.4</td>
</tr>
<tr>
<td>1990</td>
<td>5.3</td>
</tr>
<tr>
<td>2000</td>
<td>6.1</td>
</tr>
<tr>
<td>2010</td>
<td>6.8</td>
</tr>
<tr>
<td>2020</td>
<td>7.6</td>
</tr>
<tr>
<td>2030</td>
<td>8.2</td>
</tr>
</tbody>
</table>
On the Road to Peak Oil – Driver B: The Momentum of Economic Growth

**World GDP in Trillion 2000 Dollars**

<table>
<thead>
<tr>
<th>Year</th>
<th>Trillion Dollars of GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>34</td>
</tr>
<tr>
<td>2000</td>
<td>46</td>
</tr>
<tr>
<td>2010</td>
<td>88</td>
</tr>
<tr>
<td>2020</td>
<td>129</td>
</tr>
<tr>
<td>2030</td>
<td>154</td>
</tr>
</tbody>
</table>
On the Road to Peak Oil – Driver C: The Rise of the Automobile

In 2002, there were 812 million vehicles. By 2030, there will be 2.1 billion

Source (Dargay and Gately 2006).
Demand for Energy: The Rising Tide

One quad equals 170 million barrels of oil.
U.S. is Past Peak for Oil and Natural Gas Production
Matt Simmons: World Crude Oil Production Peaked in May 2005
Our Growing Dependence on Foreign Oil Has Been Bipartisan and Is Not Sustainable

- Peak, 1970
- Alaska Pipeline
- EIA Forecast
- Dependence
- Imports
- Production
- EIA Forecast
Cost of U.S. Oil Imports are Exorbitant and Avoidable

**Annual Cost of U.S. Petroleum Imports 2002 – 2006**
Peak Natural Gas a Reality in U.S. Leaving Uncertain Imports for New Supply

Imports Unlikely to Close the Gap

Iran, Russia, Qatar, Algeria & Indonesia Have Announced an LNG Cartel

**Most Gas Reserves Are in the Middle East and Asia**

LNG is a Global Commodity, Priced Off of Oil Benchmarks
It is No Different than Importing Foreign Oil
Expensive Natural Gas Now Limits Usefulness of Most Gas Generating Plants

Generation Could Drain Natural Gas Storage

U.S. Gas Plants by Capacity Factor

GAS PLANTS
2005 Capacity Factor (Jan-Aug)
- Under 20%
- 20%-40%
- 40%-60%
- 60%-80%
- Over 80%
- Unreported or Unutilized

Gas Capacity in MegaWatts
- UNDER 100
- 100-500
- 500-1,000
- OVER 1,000 MW
LNG Becomes Default Fuel for Generation if Coal Use is Limited for Any Reason

- U.S. will voluntarily cede control of its energy future to a foreign energy cartel
- Project Energy Independence led to a reduction of oil used for electricity generation
- LNG is global & priced off of oil benchmarks
- LNG risks:
  - Political
    - Risky regions
  - Physical
    - Security of terminals
  - Financial
    - Balance of payments

U.S. Actions in the 1970s Reduced Use of Oil for Generation

Graph showing Oil's Share of Petroleum Share: 17% in 1977, 2.5% in 1997.
More Natural Gas for Electricity Means Higher Prices
Clean Coal Technologies are Only Path for Affordable & Adequate Energy Supply

- **Coal-to-Liquids** – CTL with CCS can produce better fuels at the same rate of CO$_2$ emissions as imported oil. Adding biomass increases cost but improves CTL’s carbon footprint.

- **Coal-to-Gas** – Coal can be gasified to create NG for power plants and the CO$_2$ can be captured and stored. SNG from coal with CCS has a better carbon footprint than natural gas and much better footprint than LNG.

- **Coal-to-Electricity** – New clean coal plants emit 15% less CO$_2$. FutureGen plants will have near-zero emissions.
States that Rely on Coal Have Low-Cost Electricity

16 States: 21% from Coal & 12.7 Cents/kWh Average
31 States: 65% from Coal & 7.0 Cents/kWh Average

States that Rely on Coal Have Low-Cost Electricity

¢ = average retail price per kilowatt hour for 2006
% = percent of total generation from coal for 2006

EIA: Coal Generation to Outpace All Other Forms Three to One Through 2030

Projected U.S. Electricity Generation Growth Through 2030

Source: Energy Information Administration 2007 Annual Energy Outlook, Table A8; Monthly Energy Review, June 2007, Table 7.2A.

2006 – 2030 CAGR

- Coal 2.2%
- Natural Gas 0.6%
- Nuclear 0.5%
- Renewables 1.3%
- Petroleum 2.2%
Increased Long-Term Coal Demand
Due to Increased Coal Generation

41 Units in 21 States Represent More Than 90 MTPY of Coal Use

- **3,880 MW**
  - EKPC Spurlock 4 278 MW
  - CU Springfield Southwest 2 300 MW
  - TXU Oak Grove 1 860 MW

- **6,110 MW**
  - EKPC JK Smith 1 278 MW
  - Duke Power Cliffside 6 800 MW
  - AEP Meigs IGCC 600 MW

- **820 MW**
  - SRP Springerville 4 400 MW
  - Springfield CWLP Dallman 200 MW
  - TXU Oak Grove 2 860 MW
  - KCP&L Iatan 2 850 MW
  - AEP John W. Turk 600 MW
  - AEP WV Project 600 MW

- **1,370 MW**
  - Santee Cooper Cross Unit 4 580 MW
  - WE Energies Oak Creek 2 615 MW
  - GenPower Longview 695 MW
  - River Hill Power 290 MW
  - Tri-State Holcomb 2 650 MW

- **820 MW**
  - CLECO Rodemacher 600 MW
  - LS Power Plum Point 665 MW
  - Hastings Whelan 2 220 MW

- **400 MW**
  - Black Hills Wygen 2, #4 90 MW
  - WE Energies Oak Creek 1 615 MW
  - CPS Spruce 2 750 MW
  - Prairie State Unit 1 800 MW
  - NRG Big Cajun II, 4 775 MW
  - Otter Tail Big Stone II 600 MW

- **400 MW**
  - Santee Cooper Cross Unit 3 580 MW
  - Newmont TS Plant 230 MW
  - OPPD NC2 660 MW
  - NRG Two Elk 1 320 MW
  - City of Lamar 39 MW

- **400 MW**
  - MidAmerican Council Bluffs 4 790 MW
  - WPSC Weston 4 500 MW
  - Xcel Comanche 3 750 MW
  - Prairie State Unit 2 800 MW
  - NAPG City of Lamar 39 MW

Prairie State Energy Campus Provides Low-Cost, Clean Coal Generation

- 1,600 MW long-term low cost, mine-mouth generating plant
  - Largest new coal plant built in US in over 25 years
  - 70% cleaner than average US coal plant
  - 15% lower CO2 than average US coal plant
- Over 90% of project committed to Midwestern municipals & cooperatives
- EPCM contract signed with Bechtel
- Largest investment in Southern IL
  - Investment 10 times the size of the new Cardinal Stadium
- Targeting generation in the 2011/12 timeframe
Prairie State Partners Serve More Than 1.7 Million Families In Six States

- **Amp-Ohio**: 368 MW
- **Illinois Municipal Electric**: 240 MW
- **Missouri Joint Municipal Electric Utility Commission**: 195 MW
- **Prairie Power, Inc.**: 130 MW
- **Southern Illinois Power Cooperative**: 125 MW
- **Northern Illinois Municipal Power Agency**: 120 MW
- **Indiana Municipal Power Agency**: 200 MW
- **Kentucky Municipal Power Agency**: 124 MW
Reserve Margins Have Reached Dangerously Low Levels

**Electricity Demand is Far Outpacing Generation Growth**

- U.S. baseload generation capacity reserves margins have greatly declined
- Generation capacity to grow just 6% in the next 10 years while demand grows 19%
  - 2006 North American Electric Reliability Council study
- “Brace yourselves”: FERC says consumers to face 20-30% increase in electricity prices this summer due to natural gas
  - Energy Daily May 18, 2007
NERC Forecasts U.S. Generation Reserve Margin Decline

NERC Forecasts U.S. Generation Reserve Margin Decline

Source: NERC 2006 Long-Term Reliability Assessment, October 2006.
GHG Control Bills Introduced in Congress

- Emissions reduction targets (reduction from reference case assuming no GHG control legislation); for example:

<table>
<thead>
<tr>
<th></th>
<th>2020</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boxer- Sanders (S. 309)</td>
<td>42%</td>
<td>63%</td>
</tr>
<tr>
<td>McCain-Lieberman (S. 380)</td>
<td>39%</td>
<td>59%</td>
</tr>
<tr>
<td>Feinstein-Carper* (S. 317)</td>
<td>25%</td>
<td>45%</td>
</tr>
<tr>
<td>Lieberman-Warner**</td>
<td>25%</td>
<td>52%</td>
</tr>
</tbody>
</table>

- These would require large reductions in fossil fuel electricity generation, reduce electric system reliability, and decrease capacity margins to dangerous levels

- They could also cause new coal plants planned or under construction to be halted, thus causing immediate reliability problems

*Electricity only
**To be introduced
GHG Bills Would Severely Reduce Reliability

GHG Bills Would Severely Reduce Reliability

Coal’s Future is Secure With Advanced Technologies

*If Carbon is the Question, Technology is the Answer*

**Building New, Efficient Supercritical & IGCC Coal Plants**
15% Lower CO$_2$ Emissions

**Demonstrating FutureGen and Developing Coal-to-Liquids with CCS**
Up to 90% Lower CO$_2$ Emissions

**Retrofitting Existing Coal-Based Generation with Carbon Capture/Sequestration**
Up to 90% Lower CO$_2$ Emissions

**The Goal:**
Near-Zero Emissions
U.S. Has Ample Room for Carbon Dioxide Sequestration

**DOE: Storage Potential of 3.5 Trillion Tons**
$1+ Billion FutureGen Plant to Capture and Sequester Carbon Dioxide

**U.S., China, India and South Korea Governments Participating**

**FutureGen Alliance**
- Peabody Energy
- American Electric Power
- Anglo American
- BHP Billiton
- China Huaneng
- CONSOL Energy
- E. ON. U.S.
- Foundation Coal
- Kennecott
- PPL Corporation
- Southern Co.
- Xstrata Coal
Meeting America’s Energy Security & Environmental Goals

- Encourage clean coal R&D to commercialize technology
- Support clean coal generation, coal-to-liquids and coal-to-gas projects for electricity & transportation needs, and to replace scarce natural gas
- Create a legal framework for carbon capture and sequestration at scale
- Provide a dedicated revenue source for energy R&D, tax credits and other means of financial support to unlock the full value in the Nation’s coal reserves
- Support training for engineers and technicians to keep America Number One!

The United States spent $100+ billion to fund the 13-year Apollo program; U.S. energy security deserves the same commitment
Energy = More Clean Coal