U.S. Likely Past Peak Coal??

“New” Developments in the Powder River Basin

IEEFA Coal Finance Workshop
March 17-19, 2014
New York University
Leslie Glustrom
Clean Energy Action,
Boulder, Colorado

lglustrom(at)gmail.com  303-245-8637
Accelerate the Transition to the Post-Fossil Fuel World

Clean Energy Action
Boulder, Colorado
Began in 2005
Clean Energy Action
Boulder, Colorado
Began in 2005

2005 and on—Helped Begin National Movement to Oppose New Coal Plants

2006 and on—Began Detailed Analyses of US Coal Cost and Supply Issues

2007 and on—Directed Nat’l Attention to the Powder River Basin Coal Region

2007-2008—Defeated “Clean Coal” Plant Proposed for Colorado

2008 and on—Developed Local Clean Energy Future/Franchise Strategies

2010 and on—Opposed Old Coal Plant Retrofits under “Clean Air Clean Jobs”

2010-2013--Key Role in Winning Three Boulder Elections Against Xcel

2013 and on—Pioneering Strategies to Accelerate Decarbonization

Essentially No Funding from National Foundations
Xcel’s Approx. Projected Fuel Mix
2015 - 2030

Data provided by Xcel to City of Boulder, December 2010
Graph by Tom Asprey with RenewablesYes.org
Xcel’s Colorado Coal Commitments Extend to 2069

Coal for Another 55 Years?????????
Boulder’s Projected Fuel Mix
Assuming Xcel Maintains 2011 Rates

Questions on modeling and graphs to Tom Asprey
Contact through www.renewablesyes.org
Strategies for Reducing Coal Generation

Reduce Coal Use With:
- Community Clean Energy/Franchise Campaigns
- Oppose 100% Pass Through of Fossil Fuel Costs
- Question Discounting of Future Fuel Costs
- Oppose Unnecessary Use of Water to Produce Electricity
- Provide Clear Data on Coal Cost and Supply Issues
- Address “Stranded (or Sunk)” Cost Issue

Data provided by Xcel to City of Boulder, December 2010
Graph by Tom Asprey with RenewablesYes.org
Strategies for Reducing Natural Gas Use

- Anti-Fracking Campaigns
- Solar Thermal Adoption
- More Efficiency and Renewable Energy

Data provided by Xcel to City of Boulder, December 2010
Graph by Tom Asprey with RenewablesYes.org
Available for free download from
http://cleanenergyaction.org/2013/10/30/warning-faulty-reporting-on-us-coal-supplies/
Coal Deliveries to Power Plants by Region—Graphic by Ventyx

Red = Powder River Basin
2005 Data
US Electrical Grid
(Approximate)

#1) Oops—

Faulty Reporting of US Coal Reserves...

Report issued Oct-2013 by Clean Energy Action
#2) Repowering the US Electric Grid for the 21st Century Is an Imperative--Not a Choice
#3) Clean Energy Action
Will Help Analyze Your Coal Issues

Essentially No Funding from National Foundations
US Coal Production 2002-2012

Data from EIA Annual Coal Reports

Billion Short Tons

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<tr>
<th>Year</th>
<th>Tons</th>
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<td>2011</td>
<td>1.095</td>
</tr>
<tr>
<td>2012</td>
<td>1.016</td>
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</table>

http://www.eia.gov/coal/annual/
UK Coal Industry
1946-1994 Nationalized

http://www.its.caltech.edu/~rutledge/DavidRutledgeCoalGeology.pdf
US Coal Production by County 2012

Wyoming 1990-2012 Coal Production
Peak 2008 (??)

Data from EIA Coal Reports, Table 2
http://www.eia.doe.gov/fuelcoal.html
Coal Deliveries to Power Plants by Region—Graphic by Ventyx

Red = Powder River Basin

2005 Data
Twelve Major Coal Mines in the Powder River Basin, Wyoming

- Gillette, Wyoming

- Bucksin Rawhide (BTU)
- Eagle Butte (ANR)
- Dry Fork
- Wyodak
- Caballo (BTU)
- Belle Ayr (ANR)
- Cordero Rojo (CLD)
- Coal Creek
- Black Thunder/Jacobs Ranch (ACI)
- N Antelope/ Rochelle (BTU)
- Antelope (CLD)

BTU = Peabody Energy
ACI = Arch Coal Inc.
ANR = Alpha Natural Resources
CLD = Cloud Peak

Source: EIS South Gillette Area Coal Lease Applications
Bureau of Land Management, Casper, Wyoming Field Office
Find Data on Your State’s Coal Supply from EIA 923 Database

http://www.eia.gov/electricity/data/eia923/
## Select Coal Deliveries to Sherer Coal Plant
### October 2013

Data from EIA 923 Database

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<tr>
<th>Year</th>
<th>Month</th>
<th>Mine</th>
<th>State</th>
<th>Type</th>
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<th>Origin</th>
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<td>10</td>
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<td>10</td>
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<td>SUB</td>
<td>Coal</td>
<td>S WY BLACK THUNDER</td>
<td>95,155.0</td>
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</table>

Overburden Above Coal in the Powder River Basin (Wyoming and Montana)

750->2250 Feet

50-200 Feet

Source: US DOE, DOI and DOA Inventory of Federal Coal Resources August 2007
70% of the Coal In the Powder River Basin is Not Surface Accessible

Blue Hatched Areas = Areas Where Surface Mining Is Not Anticipated...

Source: US DOE, DOI and DOA Inventory of Federal Coal Resources August 2007
Powder River Basin Mines
Wyoming

Black Thunder Mine

Remaining Life:  *About 6 Years*

Life Extension:  *About 7 Years*

Current Overburden:  282 Feet

Expansion O-burden:  400+ Feet*

*For the West Hilight Major Expansion

Source: Environmental Impact Statements PRB Coal Mines
Bureau of Land Management, Casper Wyoming Field Office
and 2012 and 2013 Arch Coal 10-K Annual Report
North Antelope/Rochelle Mine

Remaining Life: 20 (??) Years

Life Extension: ?? Years

Current Overburden: 211 Feet

Expansion O-burden: 340+ Feet

Rising Coal Production Costs in the Powder River Basin

Powder River Basin Mine Production Costs 2004-2013
Arch Coal and Peabody

$/Ton


Peabody Coal PRB Mine Production Cost
Arch PRB Mine Production Cost
Delivered Cost of Coal to Regulated Utilities from 3 Major Coal-Producing Regions over the Last 25 Years

Sources: EIA Form 923 (and predecessor forms); Conversion to 2011 dollars from US Budget Section 10 - Gross Domestic Product and Implicit Outlay Deflators Analysis by Appalachian Voices, March, 2013
Colorado Delivered Coal Costs 2004-2013

Data from Table 4.10B in the Energy Information Administration's Electric Power Monthly
http://www.eia.gov/electricity/monthly/

Average Cost per MMBTU

$2.50

$2.00

$1.50

$1.00

$0.50

$0.00


$0.97 $1.06 $1.26 $1.26 $1.44 $1.56 $1.57 $1.72 $1.85 $1.91

Colorado Delivered Coal Costs Up 7.7% Per Year 2004-2013

Data from Table 4.10B EIA Electric Power Monthly
http://www.eia.gov/electricity/monthly/
Arch Coal (ACI) Powder River Basin
Profit Margins Very Thin

Arch Coal is Owner of Black Thunder Mine, Powder River Basin, WY

Data from Year End Reports Arch Coal Inc.
Alpha Natural Resources (ANR) Negative Profit Margins from Eastern Mines

Alpha Natural Resources Eastern Coal Sales Price, Production Cost, Net Margin 2005-2013

Coal Production Cost/Ton

Coal Sales Price/Ton

Coal Margin Per Ton

$8.63 $11.52 $9.67 $17.30 $10.80 $7.60


($8.27) ($7.85) ($9.09)

(Data from Year End Reports Alpha Natural Resources and Predecessors)
STOP the WAR on COAL FIRE OBAMA
Gillette Arrest April 29, 2013

Peabody Annual Meeting, Gillette Wyoming April 2013
Coal Company Debt Coming Due

#1 Peabody ("BTU")

- $650 Million due 2016 (7.375%)
- $1.52 Billion due 2018 (6%)
- $650 Million due 2020 (6.5%)
- $1.185 Billion (2020) Term Loan Facility
- $1.34 Billion due 2021 (6.25%)
- $247 Million due 2026 (7.875%)
- Others due later ......

Total over $6 Billion in Debt....

From Peabody 2013 10-K Annual Report, page 64
...there has been discussion going around, around what is the – what’s the capacity out in the Powder River Basin that can come back in as prices continue to increase. As we have talked before, our view is it’s fairly limited.
“…people are going to have to start spending real cash to repair equipment that’s been parked, replace engines, rear motors and the like. …people have not spent capital to replace equipment that ultimately reached the end of its useful life or spent capital to overcome the annual increase in stripping ratio that naturally occurs in the Powder River Basin.”
How Much Longer For a Financially Healthy US Coal Industry?

A) 200 Years—Vanishingly Small
B) 20 Years—Not Likely...
C) 10 Years—Maybe
D) 5 Years—??
E) 3 Years—??
Source of the Confusion:

Faulty Reporting of

US Coal Reserves

By the

US Energy Information Administration
2012

EIA US Coal

Estimated Recoverable "Reserves"

258 Billion Tons

Table 15 EIA Annual Coal Report
2012
EIA US Coal
Estimated Recoverable "Reserves"
258 Billion Tons

Table 15 EIA Annual Coal Report
Coal “Reserves” Should Be Economically Accessible: “Resources” are Technically Recoverable If Making a Profit is Not Required.

Figure 1. McKelvey-type diagram illustrating the relationship of coal resources and reserves (modified from Falkie and McKelvey, 1976).

Source: Chapter D, National Coal Resource Assessment
In 1997, the EIA acknowledged that its “Estimated Recoverable Reserves” did not include an estimate of economic recoverability stating:

“The usual understanding of the term "reserves" as referring to quantities that can be recovered at a sustainable profit cannot technically be extended to EIA's estimated recoverable reserves because economic and engineering data to project mining and development costs and coal resource market values are not available. “

Source: http://www.eia.doe.gov/cneaf/coal/reserves/chapter1.html
Coal: Cheap and Abundant... Or Is It?
Why Americans Should Stop Assuming That The U.S. Has a 200-Year Supply of Coal

Available for free download from www.cleanenergyaction.org
The Journal Report: The Best Online Tools for Personal Finance

THE WALL STREET JOURNAL.

MONDAY, JUNE 8, 2008 - VOL. CCLII NO. 182

U.S. Foresees a Thinner Cushion of Coal

BY REBECCA SMITH

Every year, federal employee George Warholic calculates America's vast coal reserves the same way his predecessors have for decades: He looks up the prior year's coal-reserve estimate, subtracts the year's nationwide production and arrives at a new official tally.

Coal provides nearly one-quarter of the total energy consumed in the U.S., and by Mr. Warholic's estimate, the country has enough in the ground to last about 240 years. A belief in this nearly boundless supply has led officials to dub the U.S. the "Saudi Arabia of Coal."

But the estimate, recent findings show, may be wildly overconfident.

While there is almost certainly as much coal in the ground as Mr. Warholic's Energy Information Administration believes, relatively little of it can be profitably extracted. Last year, the U.S. Geological Survey completed an extensive analysis of Wyoming's Gillette coal field, the nation's largest and most productive, and determined that less than 6% of the coal in its largest beds could be mined profitably, even at prices higher than today's.

"We really can't say we're the Saudi Arabia of coal anymore," says Brenda Pierce, head of the USGS team that conducted the study.

No one says the U.S. is facing a coal shortage. But the emerging ranks of "peak coal" theorists argue that current production levels may be unsustainable and, if anything, create a false sense of security. David Rutledge, an electrical-engineering professor at the California Institute of Technology who has studied global coal production, figures the U.S. has about half as much recoverable reserves as the government says, which would work out to about 120 years' worth.

The Energy Information Ad

Peak Coal

U.S. bituminous coal production by region:

100 million short tons

East of Miss. River

West of Miss. River

Source: Energy Information Administration

Please turn to the next page
Trio of Coal Reports
Released October 30, 2013

Available for free download from
http://cleanenergyaction.org/2013/10/30/warning-faulty-reporting-on-us-coal-supplies/
December 2013: Energy Information Administration ("EIA") Again Acknowledges US Coal "Reserves" Have Not Been Analyzed for Economic Recoverability

Table 15, EIA Annual Coal Report
December 2013: Energy Information Administration (“EIA”) Again Acknowledges US Coal “Reserves” Have Not Been Analyzed for Economic Recoverability

Table 15, EIA Annual Coal Report

<table>
<thead>
<tr>
<th>State</th>
<th>Underground - Mineable Coal</th>
<th>Surface - Mineable Coal</th>
<th>Total</th>
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<td>Proven</td>
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EIA’s Estimated Recoverable Reserves Do “Not Include Any Specific Economic Feasibility Criteria”

i.e. US Coal “Reserves” ARE NOT Reserves....
Oops—
Faulty Reporting of US Coal Reserves...

Report issued Oct 2013 by Clean Energy Action
Extra Slides
### U.S. Coal Costs 2004-2012

#### United States Average Coal Costs 2004-2012

<table>
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<tr>
<th>Year</th>
<th>Average Cost per MMBTU</th>
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<td>2004</td>
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<td>2011</td>
<td>$2.41</td>
</tr>
<tr>
<td>2012</td>
<td>$2.43</td>
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Data from Table 4.10B EIA Electric Power Monthly
http://205.254.135.24/electricity/monthly/
Average US Coal Prices vs Projections from Six Editions of the *Annual Energy Outlook*

- **2012 AEO**
- **2011 AEO**
- **2010 AEO**
- **2007 AEO**
- **2004 AEO**
- **1999 AEO**


From Matt Wasson, Appalachian Voices
Alpha Natural Resources ("ANR")
5-Year Stock Price

http://www.reuters.com/finance/stocks/overview?symbol=ANR
Loss in Share Price—US Coal Companies 2011-2013

Boulder’s Greenhouse Gas Inventory

Electricity

Source: City of Boulder Climate Action Plan Assessment July 2009
Repowering and Decarbonizing Colorado

Colorado’s Wind Potential
Approx 96 GW

Colorado’s Solar Potential
Over 200 GW

To Meet Peak Demand, Colorado Needs About 12 GW (12,000 MW)

Colorado has the Potential for Over 300 GW of Wind and Solar....
And Many Companies Ready to Build Projects.

Clearly, we can largely decarbonize our electricity--IF we decide to do it!

Maps and Resource Potential from Colorado Governor’s Energy Office based on NREL Data
Information on Wind and Solar Bids from Xcel Energy
Costs Going Forward

2010-2020

Fossil Fuels

Renewable Energy
Coal data from Pawnee (11A-325E) and Hayden (11A-917E) Dockets Colorado PUC
Wind data from Limon I and Limon II Dockets 09A-772E and 11A-689E
These costs do NOT include any price on carbon and assume there is no societal cost for coal...
Example of Xcel Modeling Results
September 9, 2013

Adding PTC Wind Lowers Costs!!

Adding Solar Lowers Costs!!

Figure 22 - Annual Cost Savings of 450 MW Wind and 170 MW PV

Xcel’s 120 Day Report, Docket 11A-869E Colorado PUC, Page 70
US Wind Resource

Source: National Renewable Energy Lab
Figure 12, TSGT Resource Plan Report, November 2010, Page 116
US Solar Resource

Source: National Renewable Energy Lab
Figure 12, TSGT Resource Plan Report, November 2010, Page 116
Thank You

Leslie Glustrom  lglustrom@gmail.com  303-245-8637

www.cleanenergyaction.org