

Worldwide Pollution Control Association

Michigan Coal to Gas Seminar
June 5-6, 2012

All presentations posted on this website are copyrighted by the Worldwide Pollution Control Association (WPCA). Any unauthorized downloading, attempts to modify or to incorporate into other presentations, link to other websites, or to obtain copies for any other purposes than the training of attendees to WPCA Conferences is expressly prohibited, unless approved in writing by the WPCA or the original presenter. The WPCA does not assume any liability for the accuracy or contents of any materials contained in this library which were presented and/or created by persons who were not employees of the WPCA.



Visit our website at www.wpca.info

W
P
C
A



COAL TO GAS CONVERSION

A FEW THOUGHTS

SCOTT ELANS, CLEAN AIR ENGINEERING

A few good
resources...

**OVERVIEW OF NATURAL GAS CONVERSION
OPTIONS TO MEET EMISSION REQUIREMENTS
ON COAL-FIRED ELECTRIC GENERATING UNITS**

Prepared for
**Utility Air Regulatory Group
Control Technologies Committee**

Prepared by
**Lowell L. Smith
Consultant to UARG**

March 2011

**A few good
resources...**

OVERVIEW OF NATURAL GAS CONVERSION
OPTIONS TO MEET EMISSION REQUIREMENTS
ON COAL-FIRED ELECTRIC GENERATING UNITS

Prepared for
Utility Air Regulatory Group
Control Technologies Committee

Prepared by
Lowell L. Smith
Consultant to UARG

March 2011

A few good
resources...

White Paper

MS-14

*Natural Gas Conversions of Existing
Coal-Fired Boilers*

Authors:

F.J. Binkiewicz Jr., P.E.

R.J. Kleisley

B.E. McMahon

J.E. Monacelli

D.A. Roth

D.K. Wang

Babcock & Wilcox
Power Generation Group, Inc.
Barberton, Ohio, U.S.A.



FEASIBILITY AND COST OF CONVERTING OIL- AND
COAL-FIRED UTILITY BOILERS TO
INTERMITTENT USE OF NATURAL GAS
James A. Fay, Dan S. Golomb, Savvakis C. Zachariades
Energy Laboratory Report No. MIT-EL 86-009
December 1986

A few good
resources...



A few good
resources...


BERNSTEINRESEARCH

U.S. Utilities: Coal-Fired Generation Is Squeezed in the Vice of EPA Regulation; Who Wins and Who Loses?

OCTOBER 2010

EPA emissions regulations will speed coal plant retirements, raise prices – and benefit survivors

Under a court order to regulate hazardous air pollutants from coal-fired power plants by November 2011, EPA is readying tough new emissions standards for mercury and acid gases; the Clean Air Act requires that all coal plants comply by November 2014

To control hazardous air pollutants, the Clean Air Act requires "maximum achievable control technology," a costly combination of emissions controls; for many older, smaller coal plants, the cost of these retrofits will be prohibitive, forcing widespread retirements by 2015

We calculate that plants supplying 15% of U.S. coal-fired generation will cease operation; net of new coal plants coming on line, coal-fired generation could fall by 9% by 2015; utility demand for coal will drop commensurately; gas-fired generation, and utility demand for gas, will rise

This loss of coal-fired capacity will raise prices for energy and capacity, benefiting competitive generators whose nuclear or EPA-compliant coal plants are unaffected: FirstEnergy (FE), Exelon (EXC), Constellation (CEG), Mirant (MIR), PPL (PPL), PSEG (PEG), and Allegheny (AYE)

SEE DISCLOSURE APPENDIX OF THIS REPORT FOR IMPORTANT DISCLOSURES AND ANALYST CERTIFICATIONS

BERNSTEINRESEARCH

U.S. Utilities: Coal-Fired Generation Is Squeezed in the Vice of EPA Regulation; Who Wins and Who Loses?

OCTOBER 2010

EPA emissions regulations will speed coal plant retirements, raise prices – and benefit survivors

Under a court order to regulate hazardous air pollutants from coal-fired power plants by November 2011, EPA is readying tough new emissions standards for mercury and acid gases; the Clean Air Act requires that all coal plants comply by November 2014.

To control hazardous air pollutants, the Clean Air Act requires "maximum achievable control technology," a costly combination of emissions controls; for many older, smaller coal plants, the cost of these retrofits will be prohibitive, forcing widespread retirements by 2015.

We calculate that plants supplying 15% of U.S. coal-fired generation will cease operation; net of new coal plants coming on line, coal-fired generation could fall by 9% by 2015; utility demand for coal will drop commensurately; gas-fired generation, and utility demand for gas, will rise.

This loss of coal-fired capacity will raise prices for energy and capacity, benefiting competitive generators whose nuclear or EPA-compliant coal plants are unaffected: FirstEnergy (FE), Exelon (EXC), Constellation (CEG), Mirant (MIR), PPL (PPL), PSEG (PEG), and Allegheny (AYE).

SEE DISCLOSURE APPENDIX OF THIS REPORT FOR IMPORTANT DISCLOSURES AND ANALYST CERTIFICATIONS

May 2012

Coal to Gas Switching: Are We Done Yet?



A few good resources...

Oil & Gas - North American
Energy

Randy Ollenberger
BMO Nesbitt Burns Inc.
randy.ollenberger@bmo.com
(403) 515-1502

Pipelines

Carl Kirst, CFA
BMO Capital Markets Corp.
carl.kirst@bmo.com
(713) 546-9756

Utilities - Electric Utilities
& Independent Power

Michael S. Worms
BMO Capital Markets Corp.
michael.worms@bmo.com
(212) 885-4031

Utilities - Electric Utilities
& Independent Power

Ben Pham, CFA
BMO Nesbitt Burns Inc.
ben.pham@bmo.com
(416) 359-4061

Metals & Mining

Meredith Bandy, CFA
BMO Capital Markets Corp.
meredith.bandy@bmo.com
(303) 436-1113

Transport - Rails

Fadi Chamoun, CFA
BMO Nesbitt Burns Inc.
fadi.chamoun@bmo.com
(416) 359-6775

This report was prepared in part by an analysts employed by a Canadian affiliate, BMO Nesbitt Burns Inc., and who are not registered as research analysts under FINRA rules. For disclosure statements, including the Analyst's Certification, please refer to the Appendix.

BMO  Capital Markets

Advantages of Natural Gas for New Generation

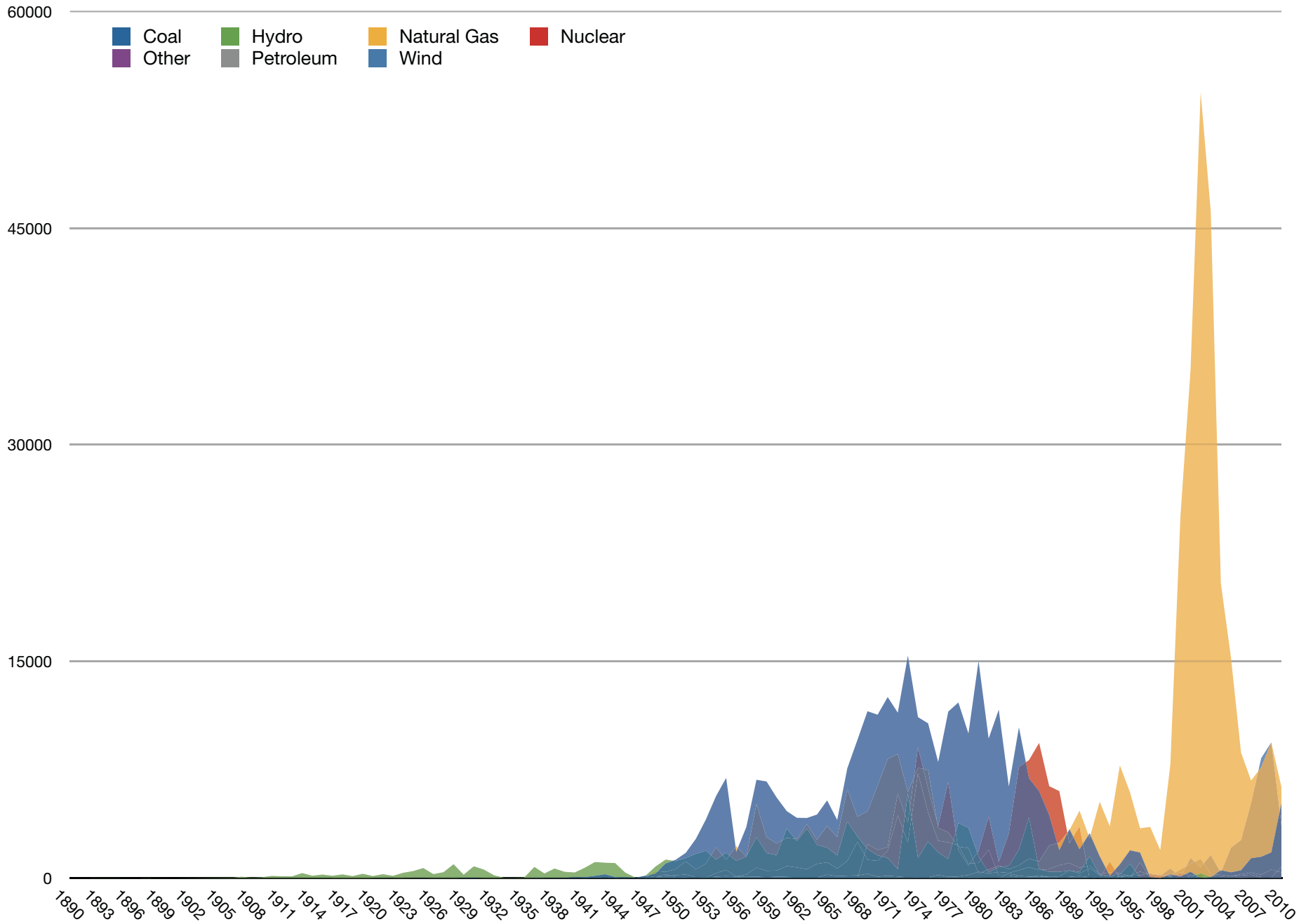
Substantially lower SO₂,
PM and CO₂ emissions

Lower capital costs (half that of coal)

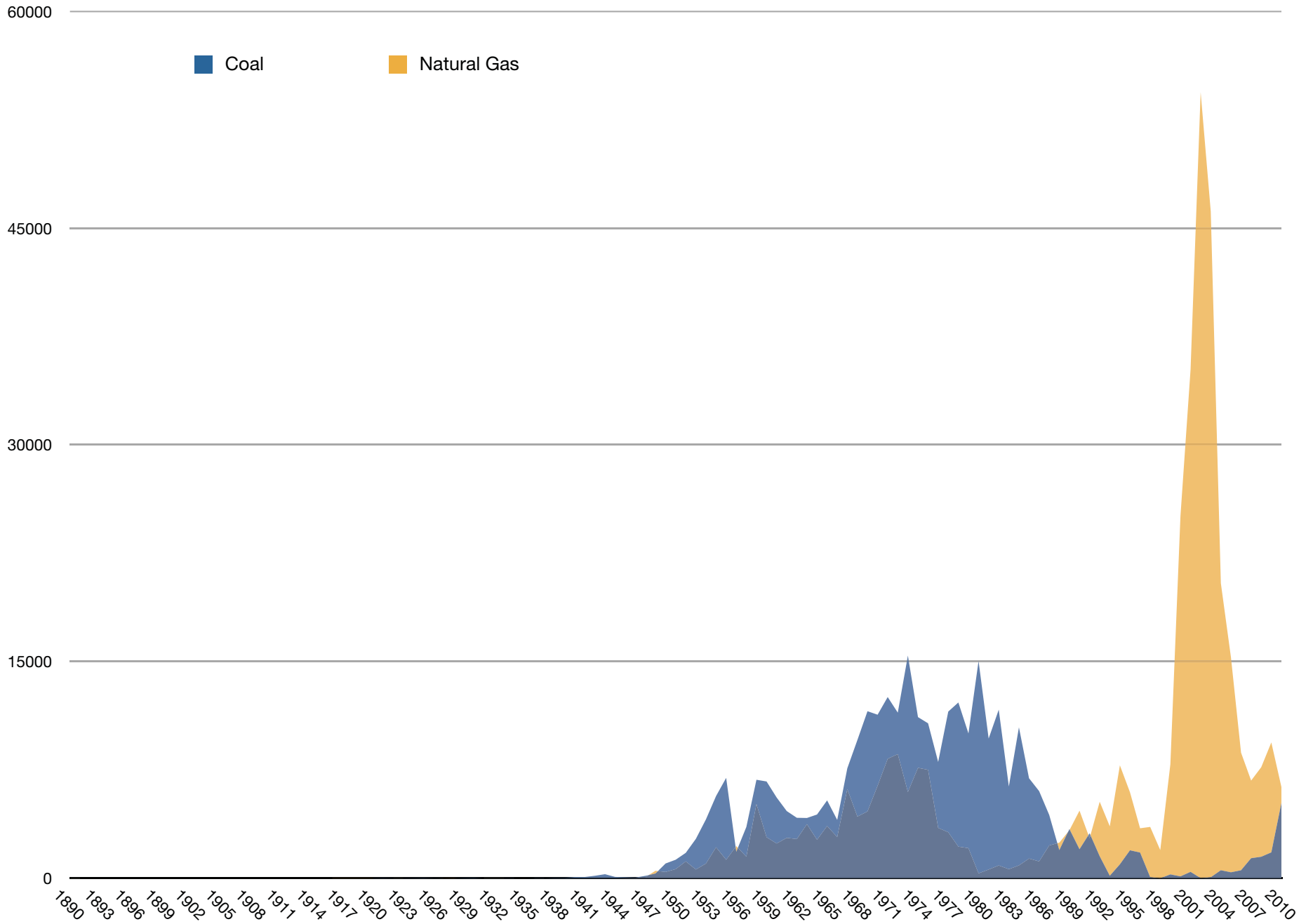
Quicker construction and
commissioning (2-3 years vs 5-6 for coal)

Suitability for small scale and
modular construction

Current Capacity by Initial Year of Operation and Fuel Type

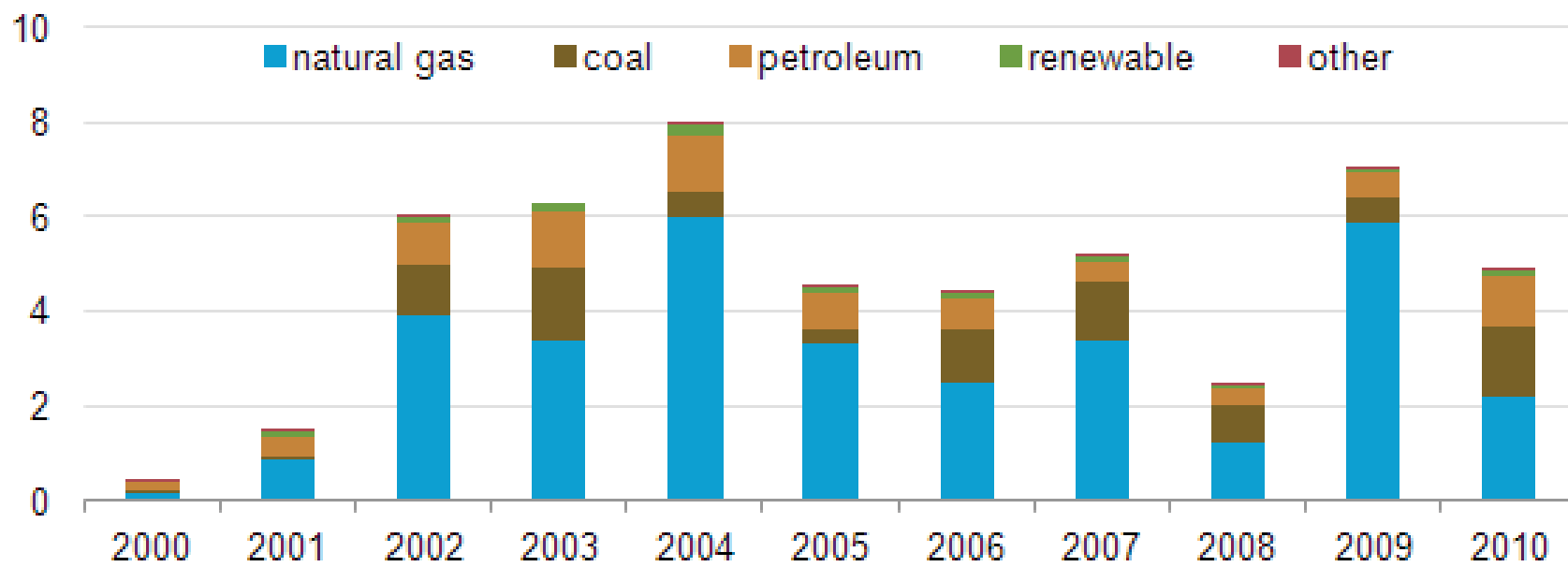


Current Capacity by Initial Year of Operation and Fuel Type



U.S. generator retirements by fuel type, 2000-2010

gigawatts



POTENTIAL GAS COMMITTEE REPORTS UNPRECEDENTED INCREASE IN MAGNITUDE OF U.S. NATURAL GAS RESOURCE BASE

POTENTIAL GAS COMMITTEE REPORTS UNPRECEDENTED INCREASE IN MAGNITUDE OF U.S. NATURAL GAS RESOURCE BASE

GOLDEN, Colo., June 18, 2009 – The Potential Gas Committee (PGC) today released the results of its latest biennial assessment of the nation's natural gas resources, which indicates that the United States possesses a total resource base of 1,836 trillion cubic feet (Tcf). This is the highest resource evaluation in the Committee's 44-year history. Most of the increase from the previous assessment arose from reevaluation of shale-gas plays in the Appalachian basin and in the Mid-Continent, Gulf Coast and Rocky Mountain areas.

"The PGC's year-end 2008 assessment reaffirms the Committee's conviction that abundant, recoverable natural gas resources exist within our borders, both onshore and offshore, in all types of reservoirs," said Dr. John B. Curtis, Professor of Geology and Geological Engineering at the Colorado School of Mines and Director of the Potential Gas Agency there, which provides guidance and technical assistance to the Potential Gas Committee.

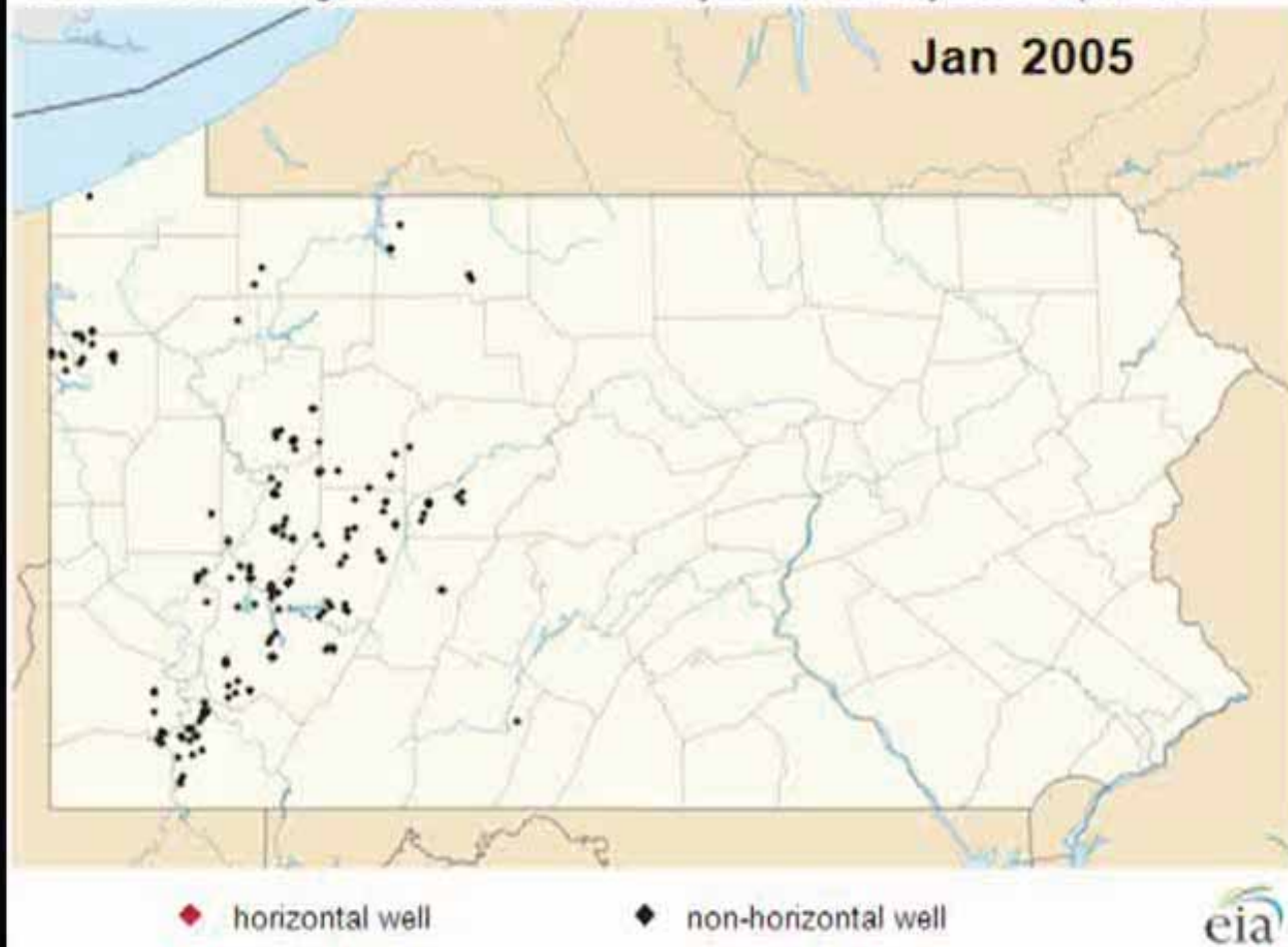
Dr. Curtis cautioned, however, that the current assessment assumes neither a time schedule nor a specific market price for the discovery and production of future gas supply. "Estimates of the Potential Gas Committee are 'base-line estimates' in that they attempt to provide a reasonable appraisal of what we consider to be the 'technically recoverable' gas resource potential of the United States," he explained.

The Committee's year-end 2008 assessment of 1,836 Tcf (statistically aggregated mean value) consists of 1,573 Tcf of gas attributable to traditional reservoirs and 163 Tcf in coalbed reservoirs. Compared to year-end 2006, traditional resources increased by nearly 519 Tcf (45%), while coalbed gas resources decreased by 3 Tcf (1.9%), resulting in a net increase in total potential resources of 515 Tcf (39%). (See accompanying Table 1.)

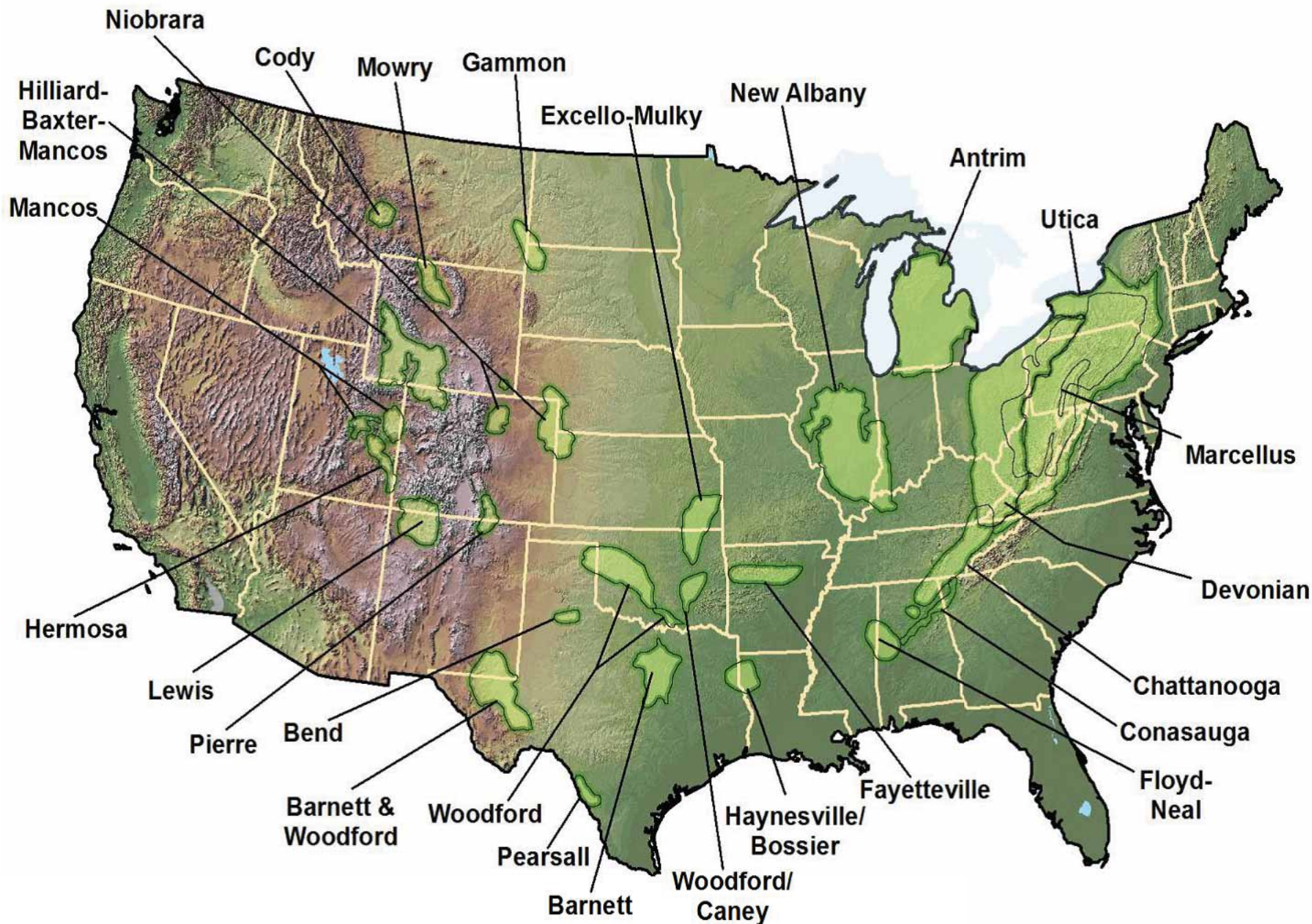
These changes have been assessed in addition to the 41 Tcf of marketed domestic natural gas production recorded during the two-year period since the Committee's previous report.

When the PGC's results are combined with the U.S. Department of Energy's latest available determination of proved gas reserves, 238 Tcf as of year-end 2007, the United States has a total available *future supply* of 2,074 Tcf, an increase

Cumulative natural gas wells drilled in Pennsylvania, January 2005 - April 2012

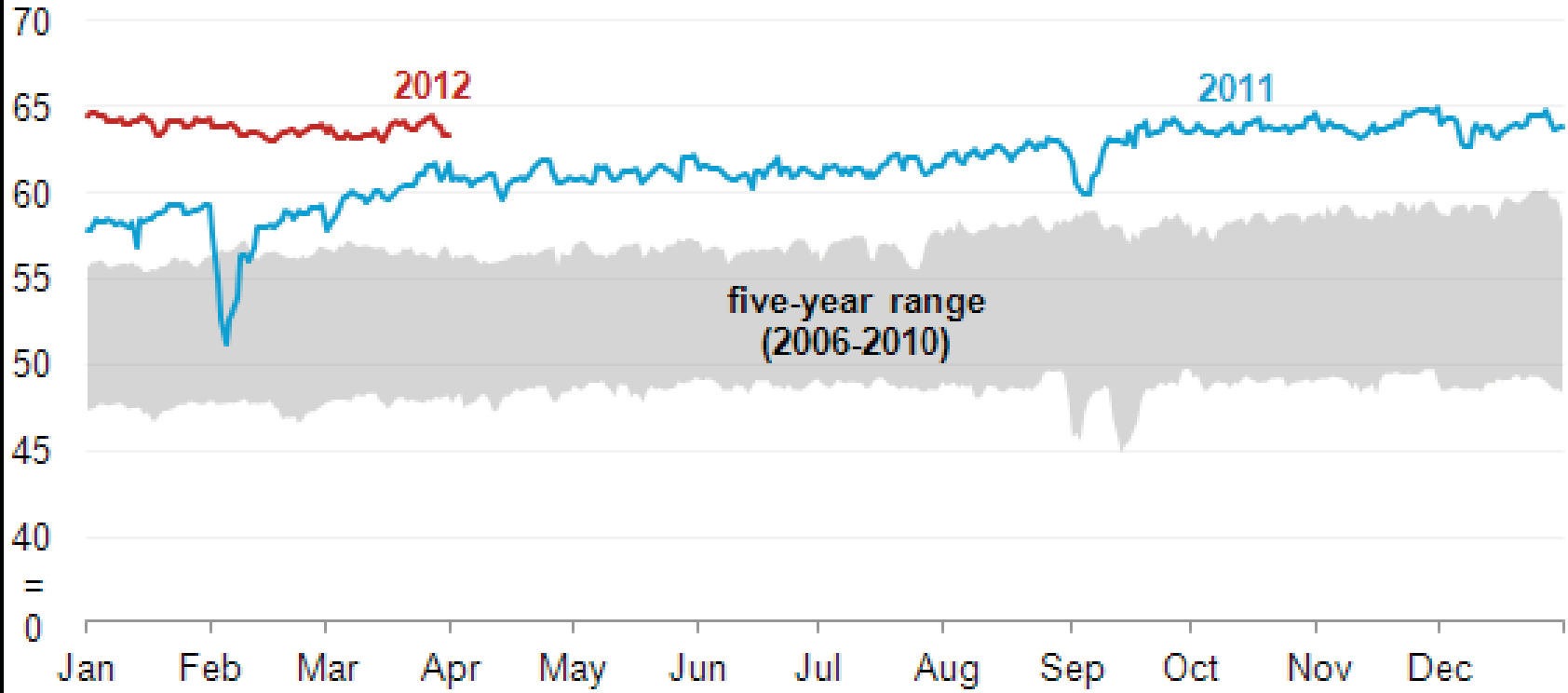


U.S. Shale Gas Plays



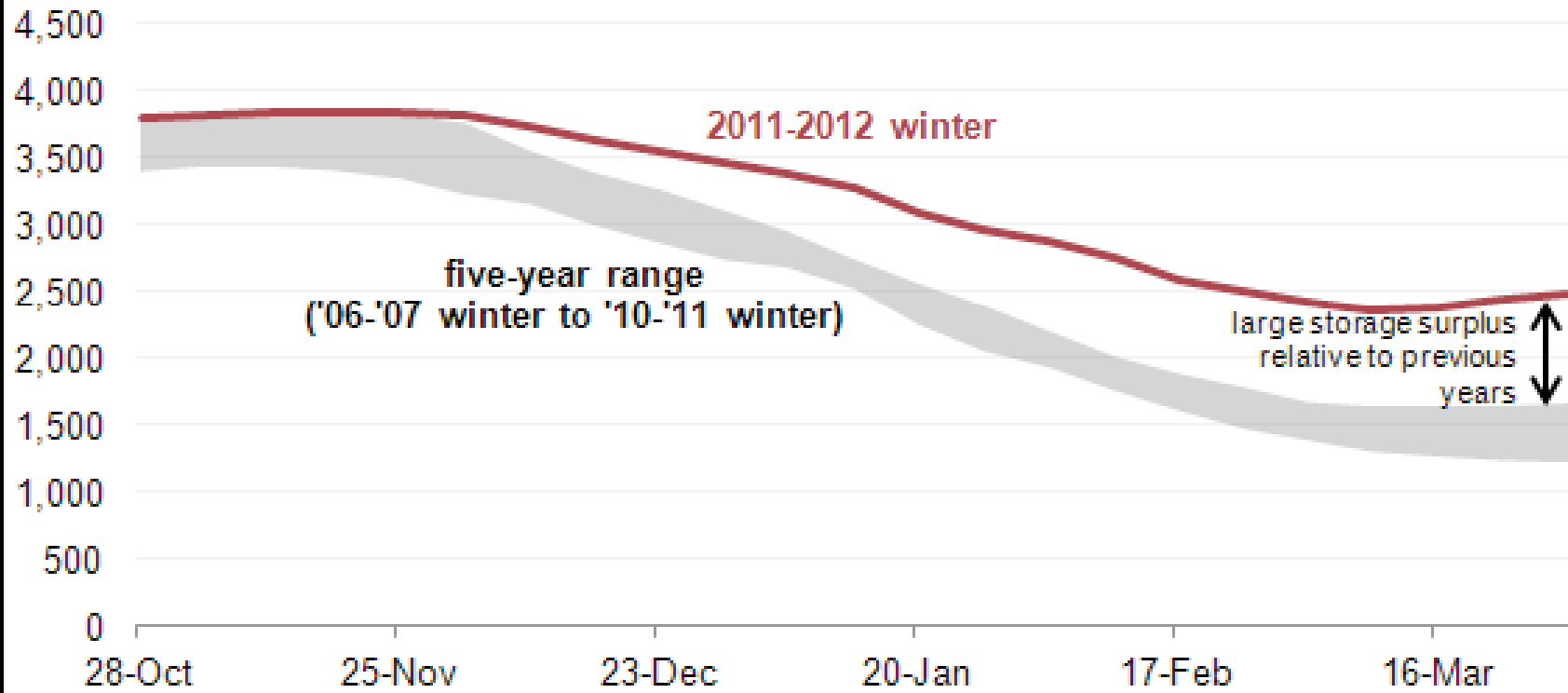
Estimated U.S. daily dry natural gas production

billion cubic feet per day

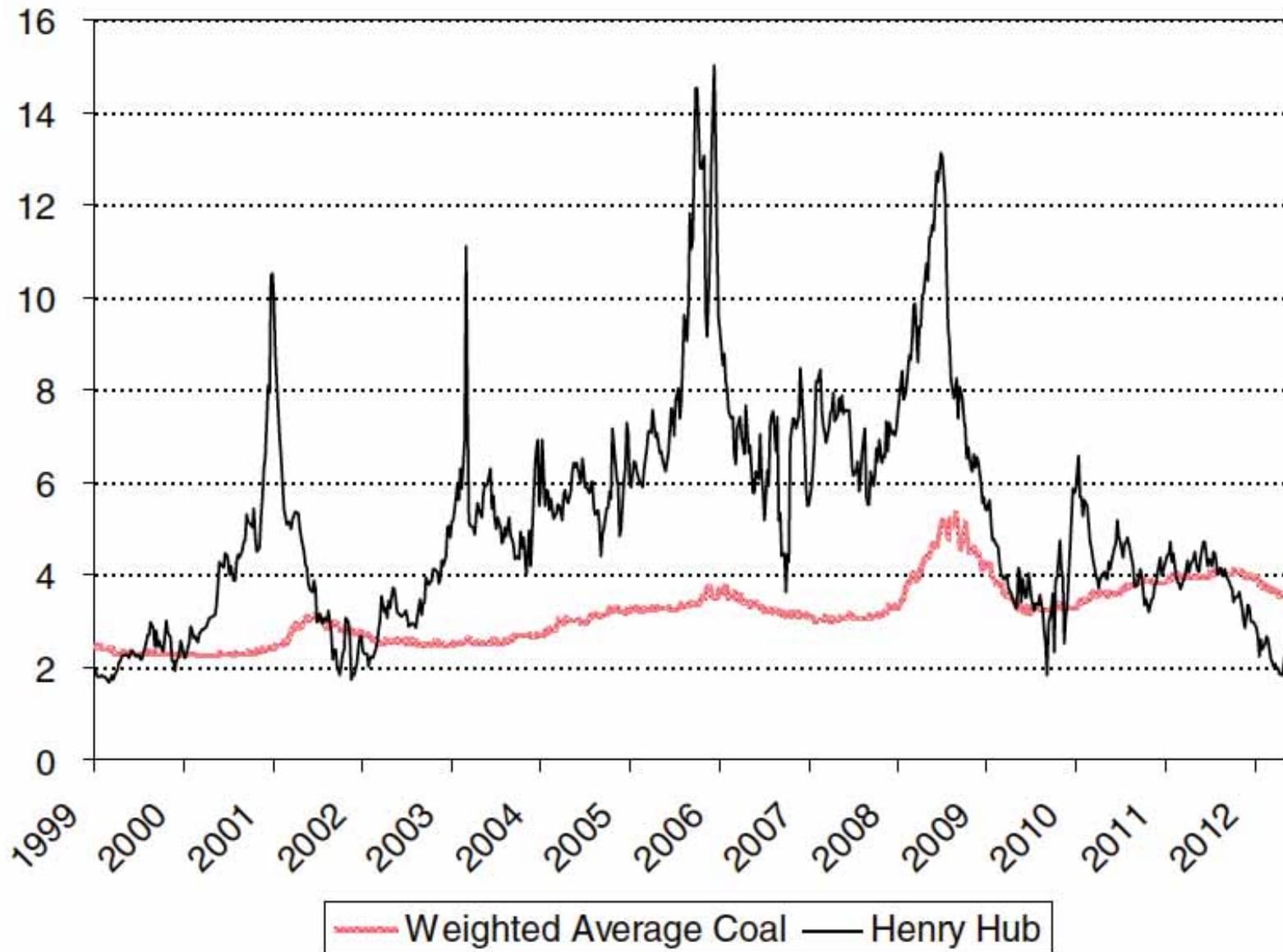


U.S. lower-48 natural gas storage inventories

billion cubic feet

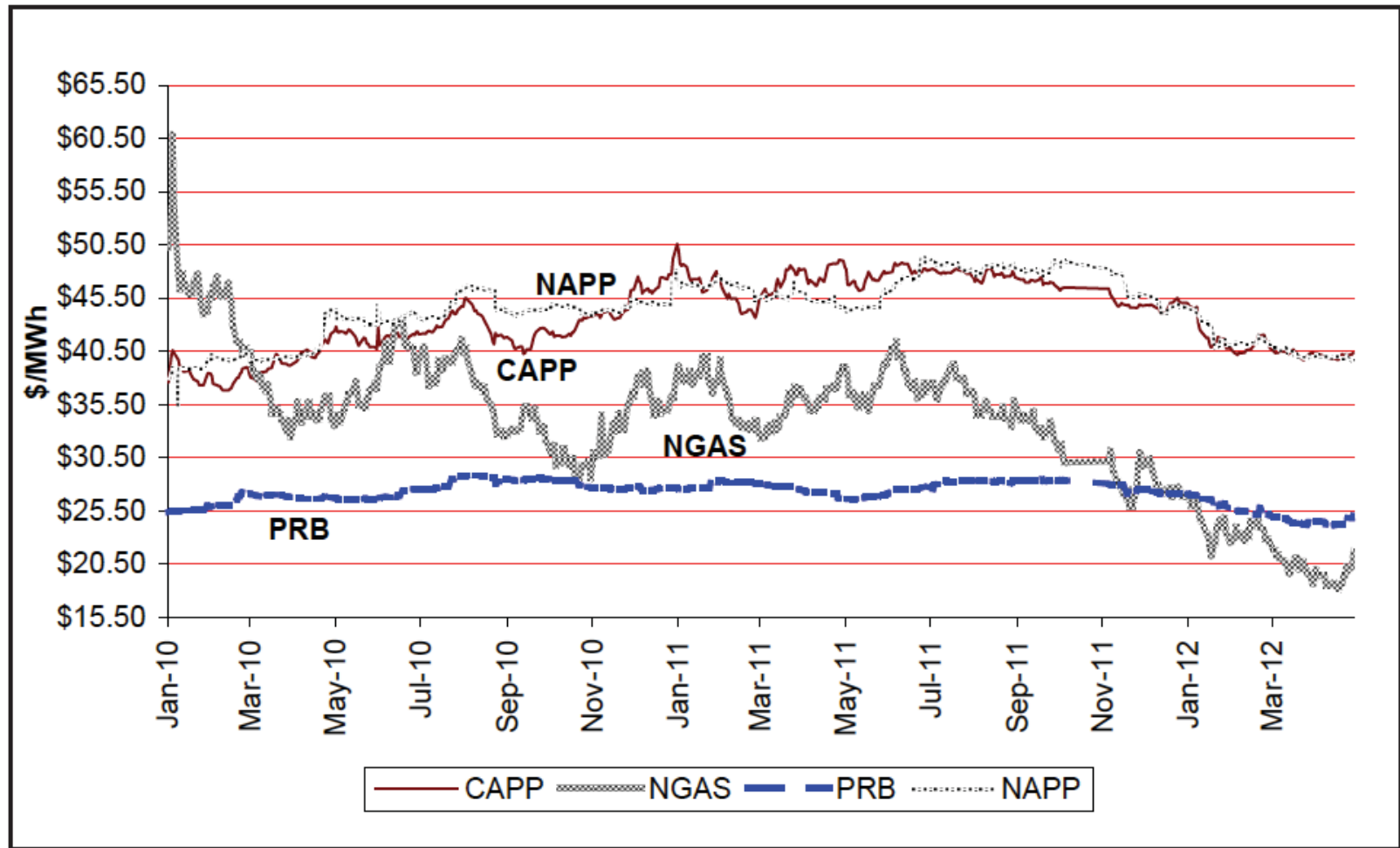


Coal vs NG Prices (\$/mmBtu)



Source: BMO Capital Markets

Increasing Competitiveness of Natural Gas by Coal Basin Type

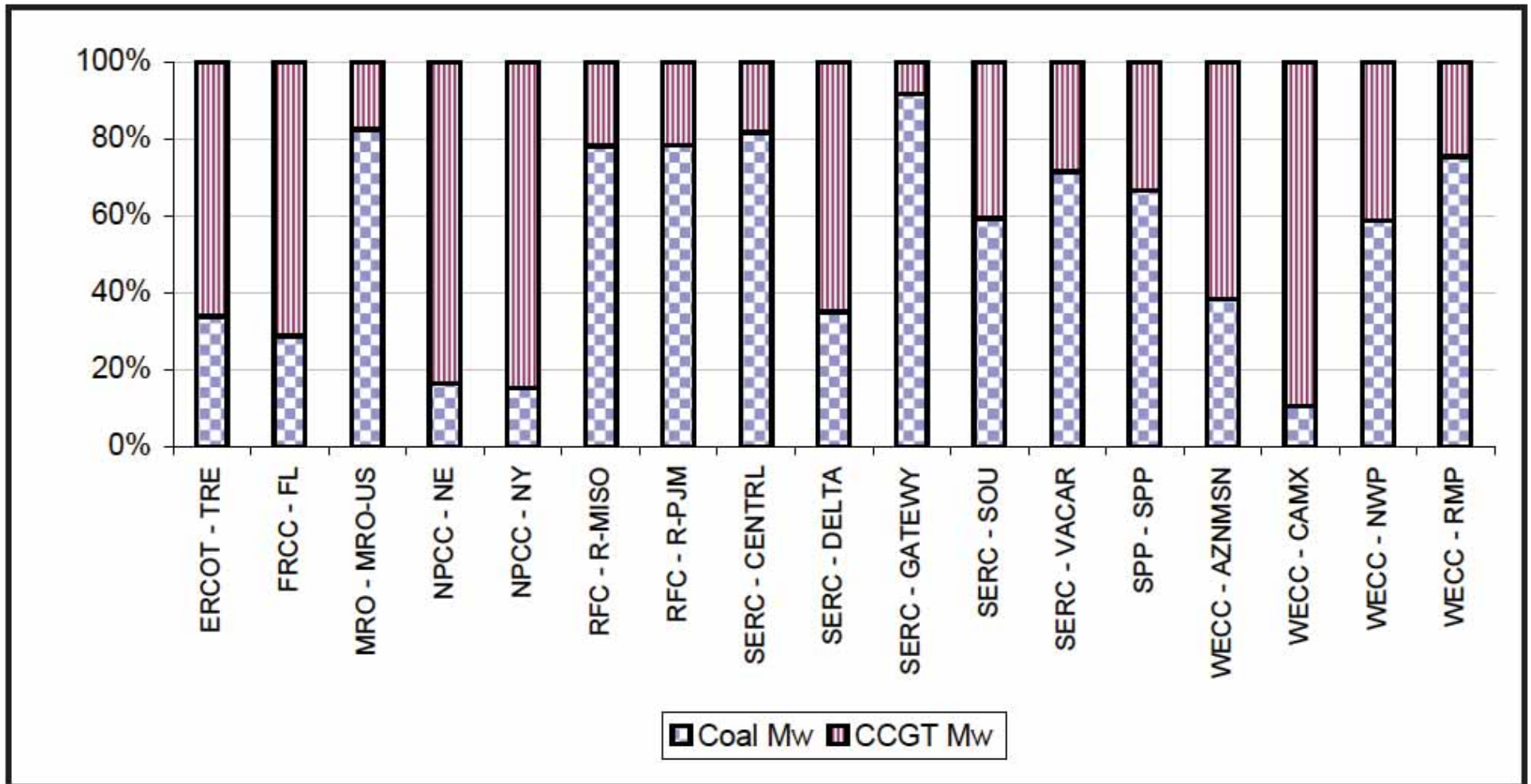


Notes:

1. Near month coal prices and spot gas prices used to compare power costs.
2. Average coal and gas plant heat rate assumed to be 10.5 and 7.5 mmBtu/MWh, respectively.
3. Transportation costs of \$25/Ton for CAPP and NAPP Coal and \$22.5/Ton for PRB coal
4. Non-Fuel total O&M costs of \$7.8, \$8.0, \$6.4 and \$4.5 for CAPP, NAPP, PRB and Gas-fired plants, respectively (C\$/MWh).

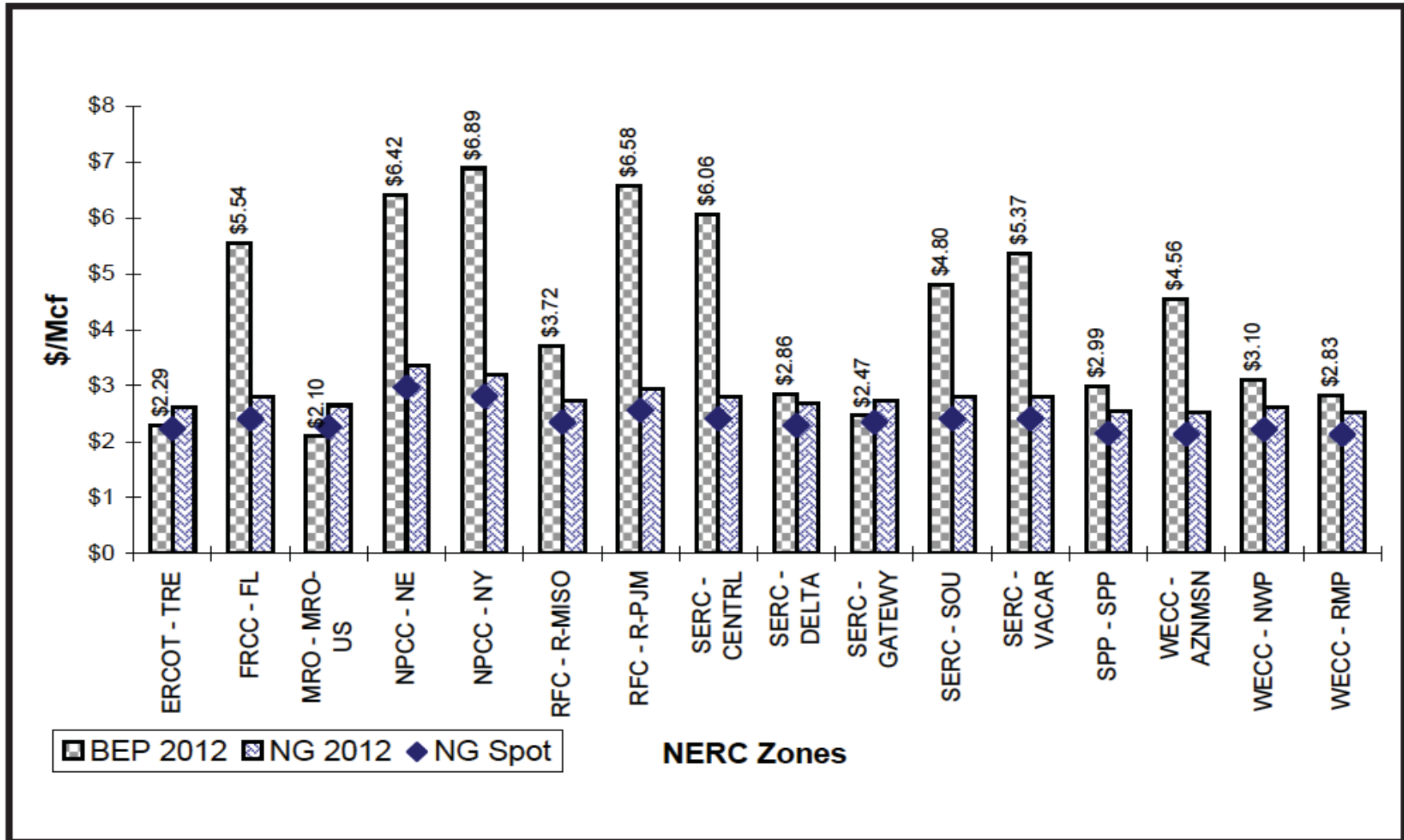
Source: EIA and BMO Capital Markets

Coal and Gas Generation Mix by NERC Subzone



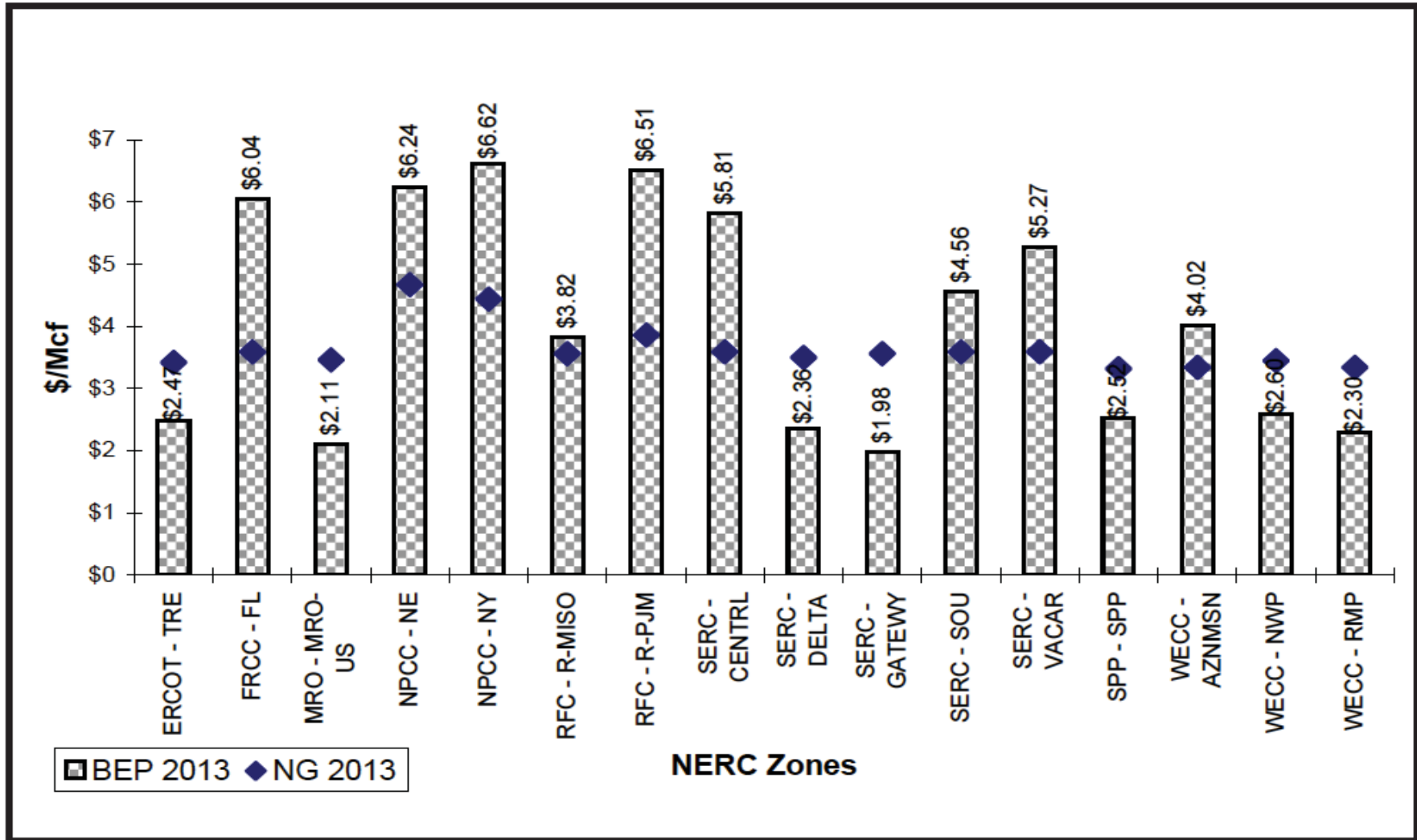
Source: SNL and BMO Capital Markets estimates
See glossary for description of regions.

Coal to Gas Price Parity 2012



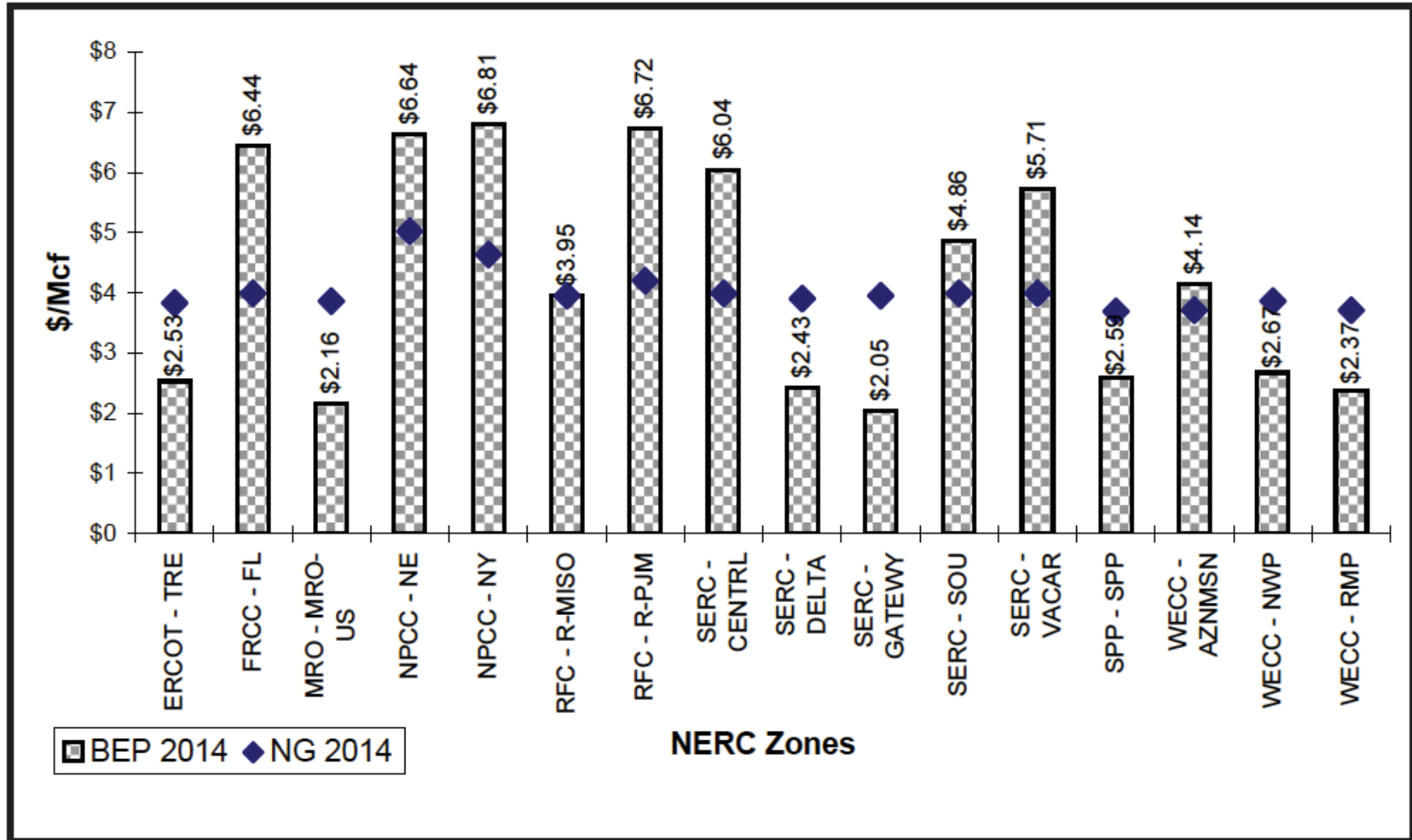
Source: EIA, SNL and BMO Capital Markets estimates

Coal to Gas Price Parity 2013



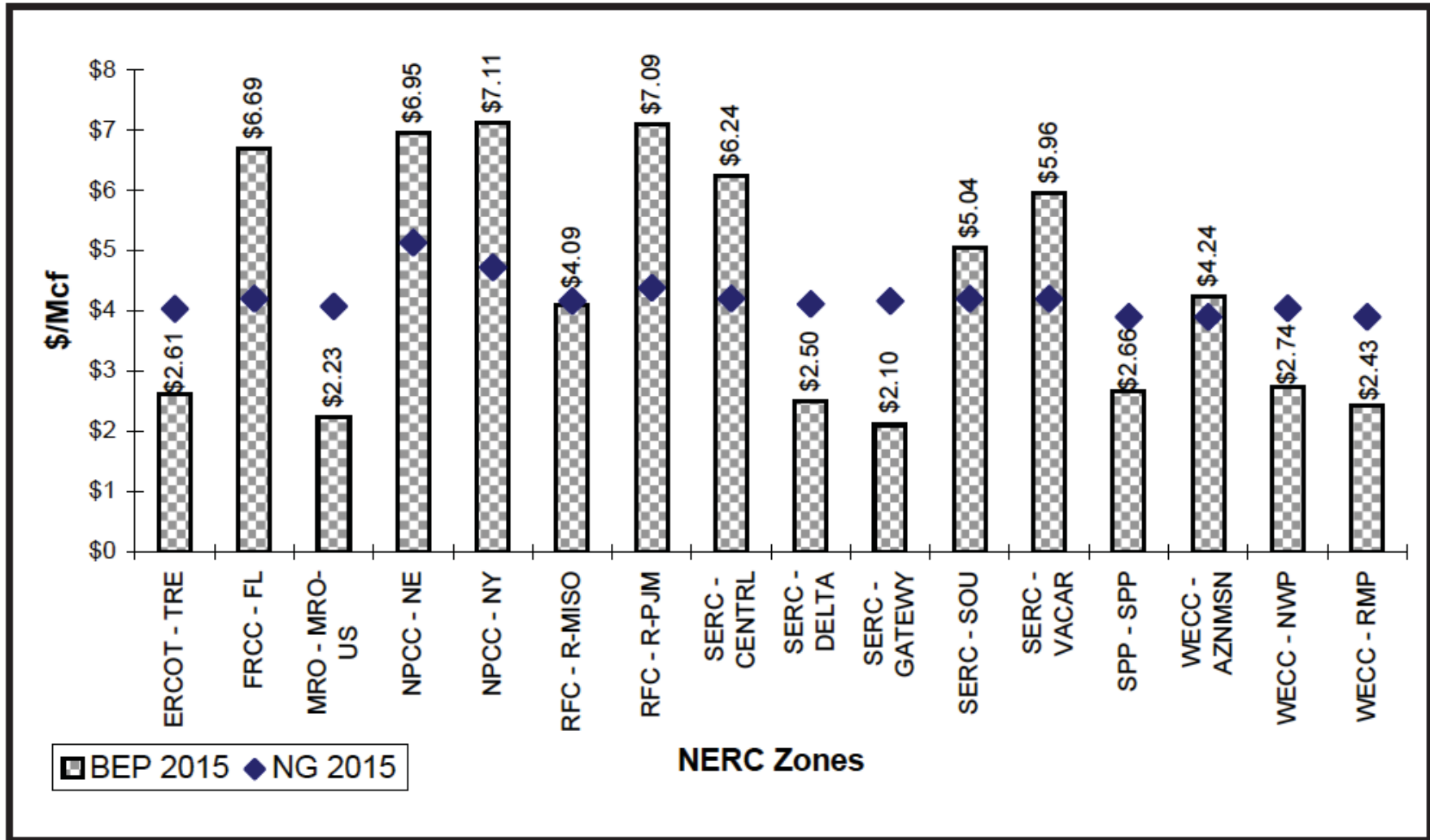
Source: EIA, SNL and BMO Capital Markets estimates

Coal to Gas Price Parity 2014



Source: EIA, SNL and BMO Capital Markets estimates

Coal to Gas Price Parity 2015



Source: EIA, SNL and BMO Capital Markets estimates

NOW IS THE TIME!

COAL CHEAP!

Coal coarse, measure warranted and no disappointment at **TEN MILE WORKS.** We are selling **FOR CASH** at \$4,00 per hundred, and extend the time at this price till the middle of October and hope to continue all Fall. We follow this as a business, and understand the wants of the people, and employ no hands but those skilled in the business. Works one and one-half miles from Waynesburg, close by Lantz's old mill--
R. A. SAYERS.

Sept. 7, 1868.

PLEASE POST UP IN A CONSPICUOUS PLACE.



ORDER COAL NOW

UNITED STATES
FUEL ADMINISTRATION



*So Clean-
So Carefully-
Prepared*

PHONE US TODAY FOR
A FULL SUPPLY OF
THIS TRULY
ECONOMICAL FUEL

CROWN COAL
KING OF ANTHRACITE
CROWN COAL

J. W. WOLGEMUTH ESTATE
COAL, GRAIN & FEED

Phone - Elizabethtown 175

Rheems, Pa.

For your protection, you will find **CROWN COAL** Tags in your coal







GREEN
JOBS

NO COAL

Sky

QUIT

C  AI



The Economist

JULY 6TH-12TH 2002

The politics of corporate scandals

PAGE 27

East Asia's economies, five years on

PAGES 13 AND 65-67

Why Arab countries have failed

PAGES 24-26

THE GLOBAL ENVIRONMENT

SURVEY, AFTER PAGE 50

CO₂AL

Environmental enemy No.1

student union presents

THE GREAT

C  AIL

DEBATE

moderated by

BRYAN WALSH *of* TIME

**Utility MACT (MATS)
40 CFR 63 Subpart UUUUU**

**Cross-State Air Pollution Rule (CSAPR)
Currently stayed**

**New Source Performance Standard (NSPS) for
Greenhouse Gas Emissions from Electric Utility
Generating Units
40 CFR 60 Subpart TTTT (Proposed)**

**316(b) Cooling Water Intake regulations
Proposed - Final Expected Late July**

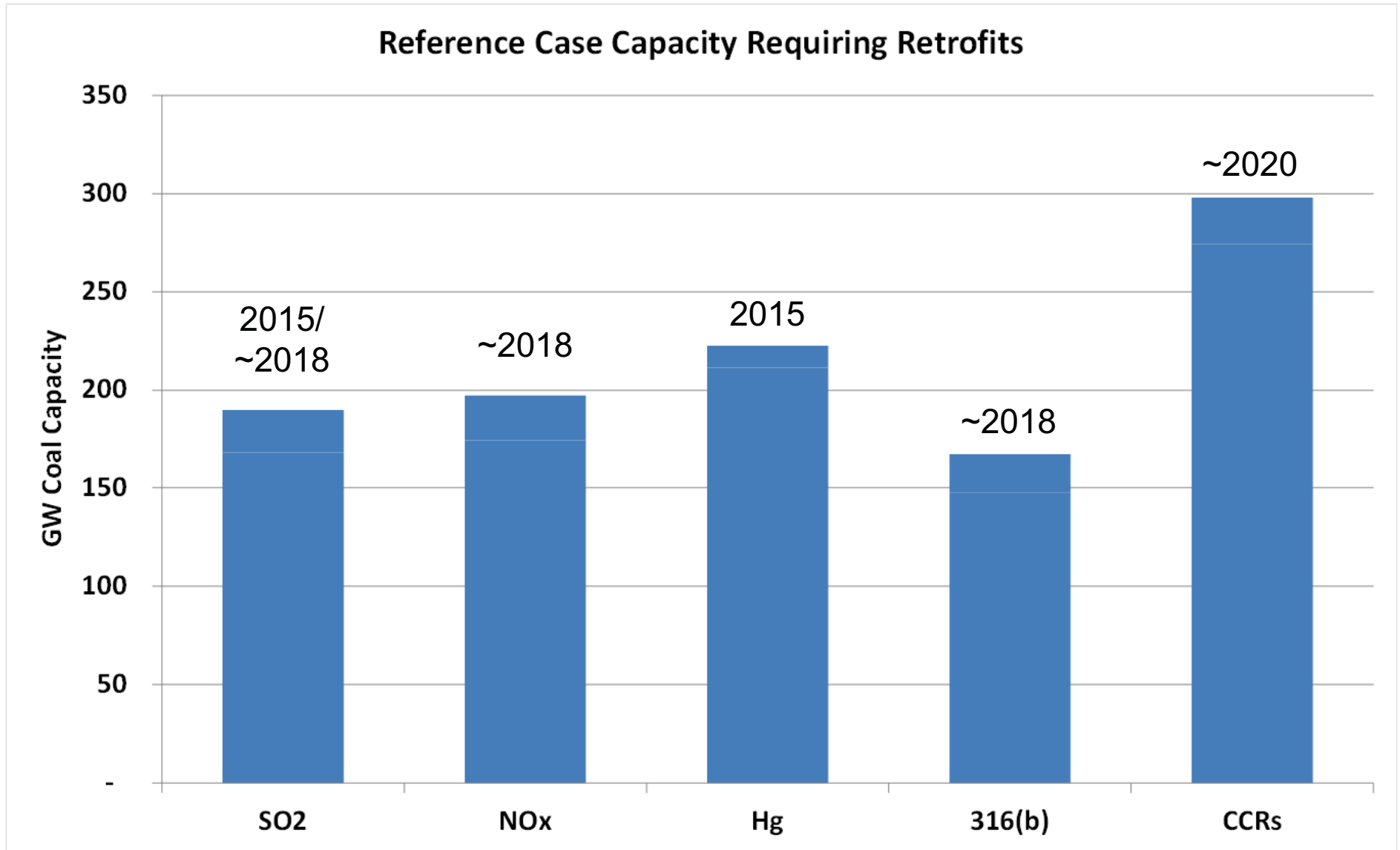


**National Ambient Air Quality Standard (NAAQS)
for PM 2.5 - Expected Summer**

**Coal-Combustion Residuals (CCR) Rule
Proposed - Final Expected This Year**

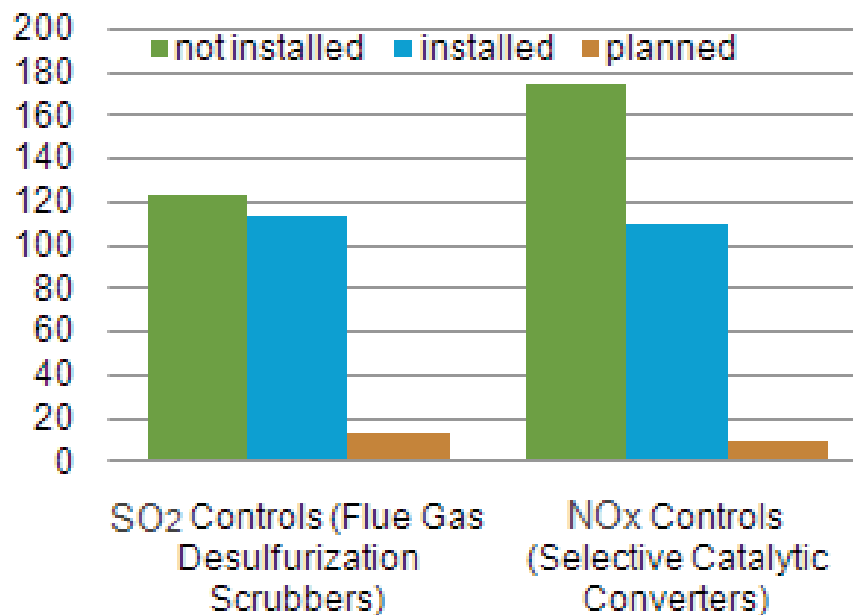
**Regional Haze
SIPs and FIPs Finalized This Year**

Retrofit Estimates

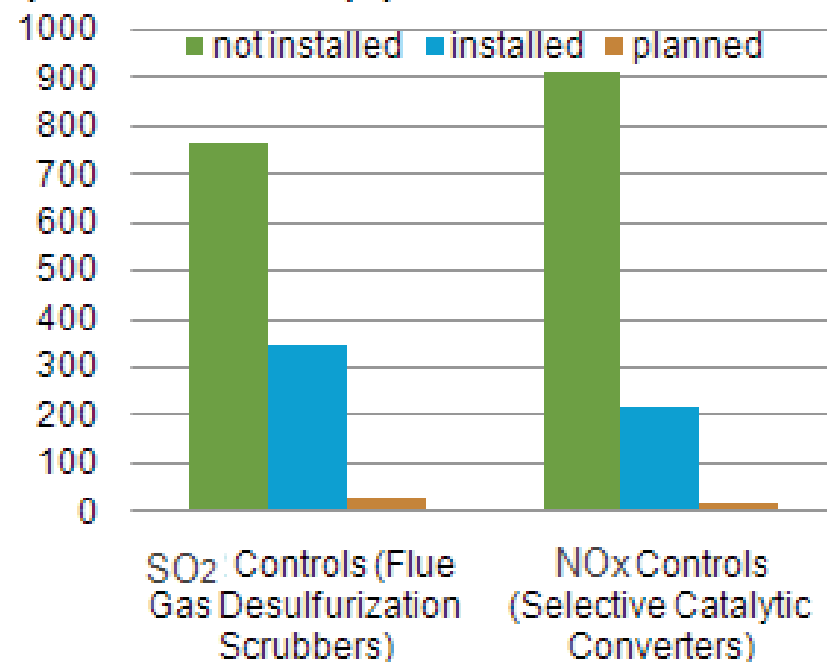


Installed vs Not Installed Controls

Coal power plant pollution control equipment installed in affected states
gigawatts



Number of coal power plant units with installed pollution control equipment in affected states



Coal-fired plants without controls...

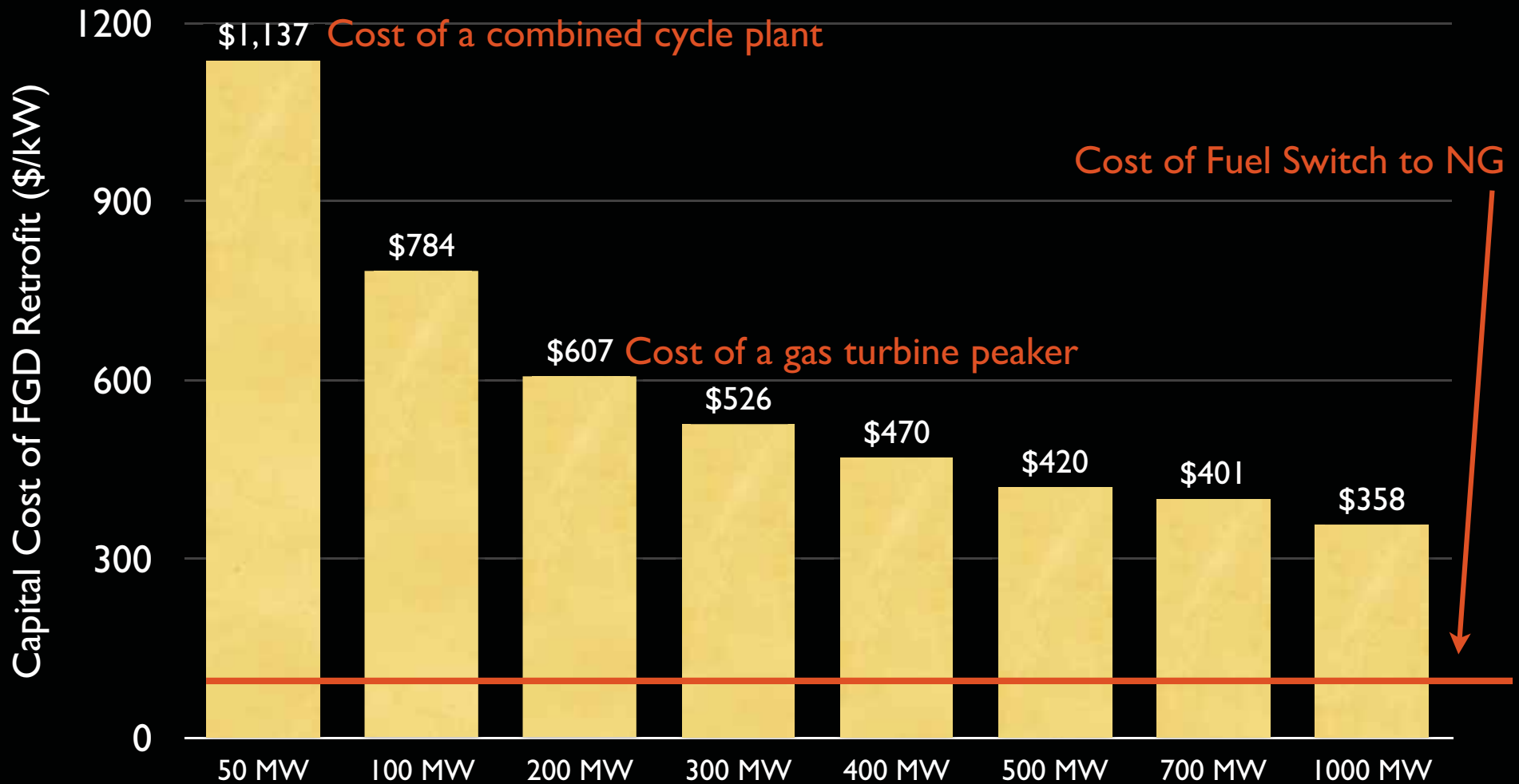
40% are over 50 years old

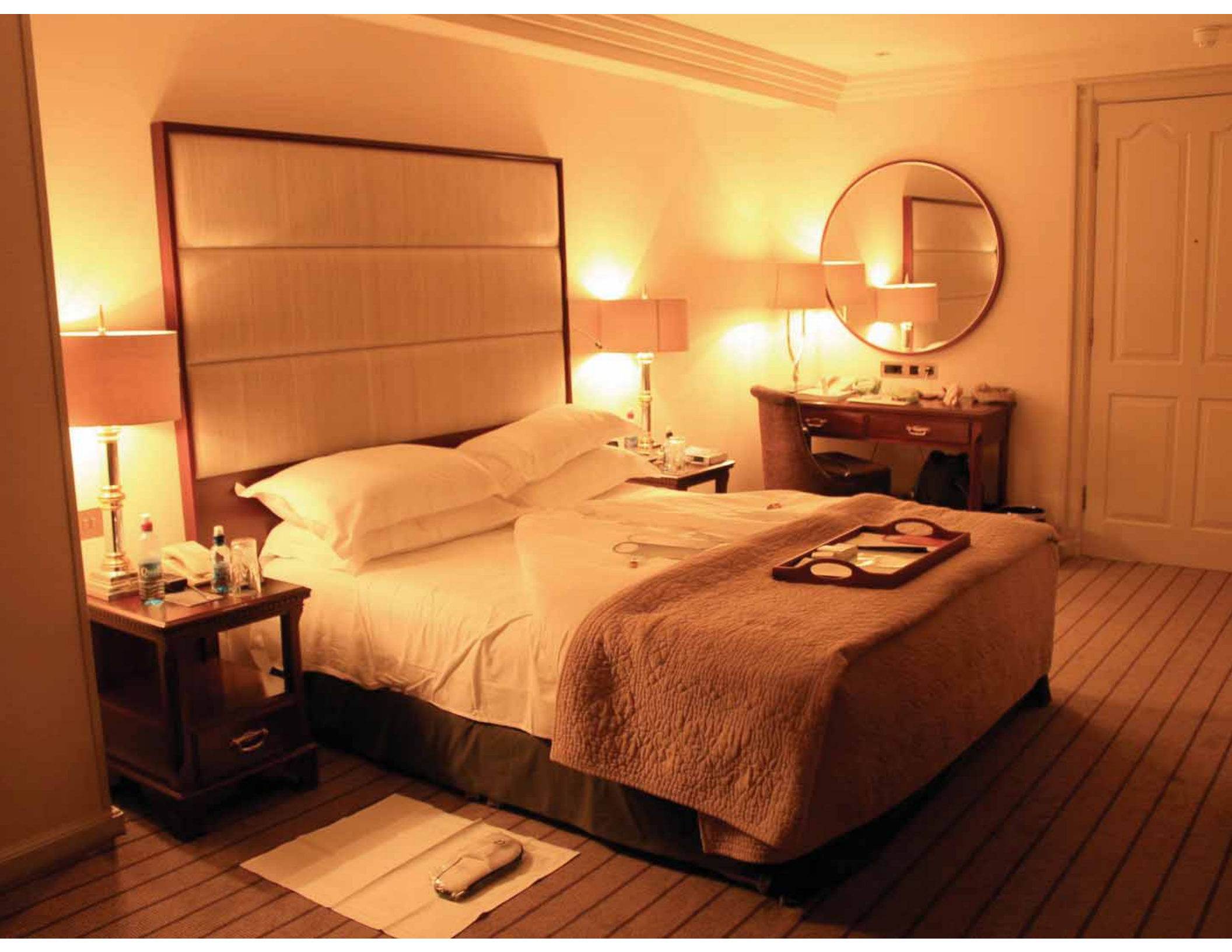
80% are less than 200 MW

50% are less than 50 MW

40% run less than 50% of the time

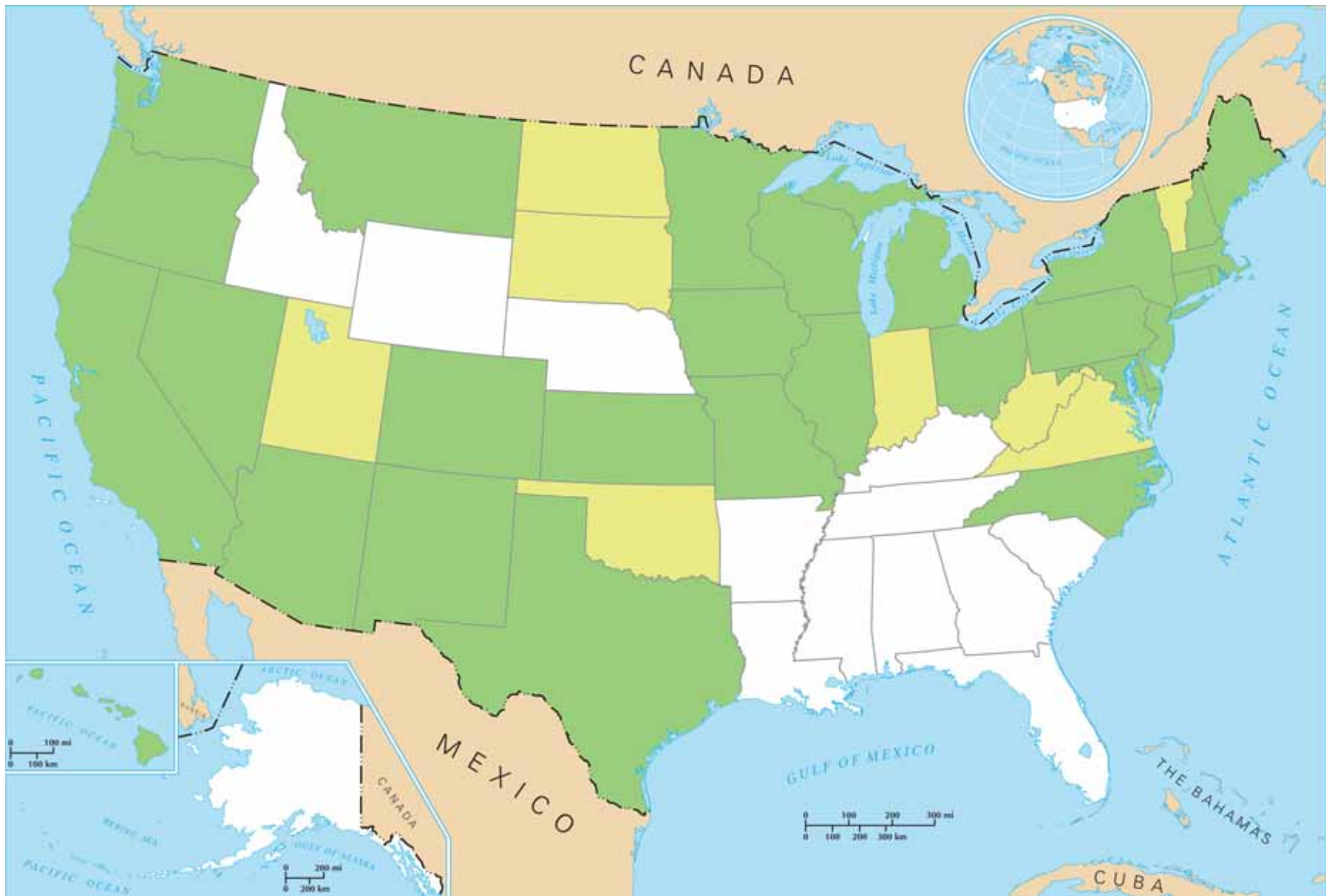
Scaleability of FGD Retrofit Costs



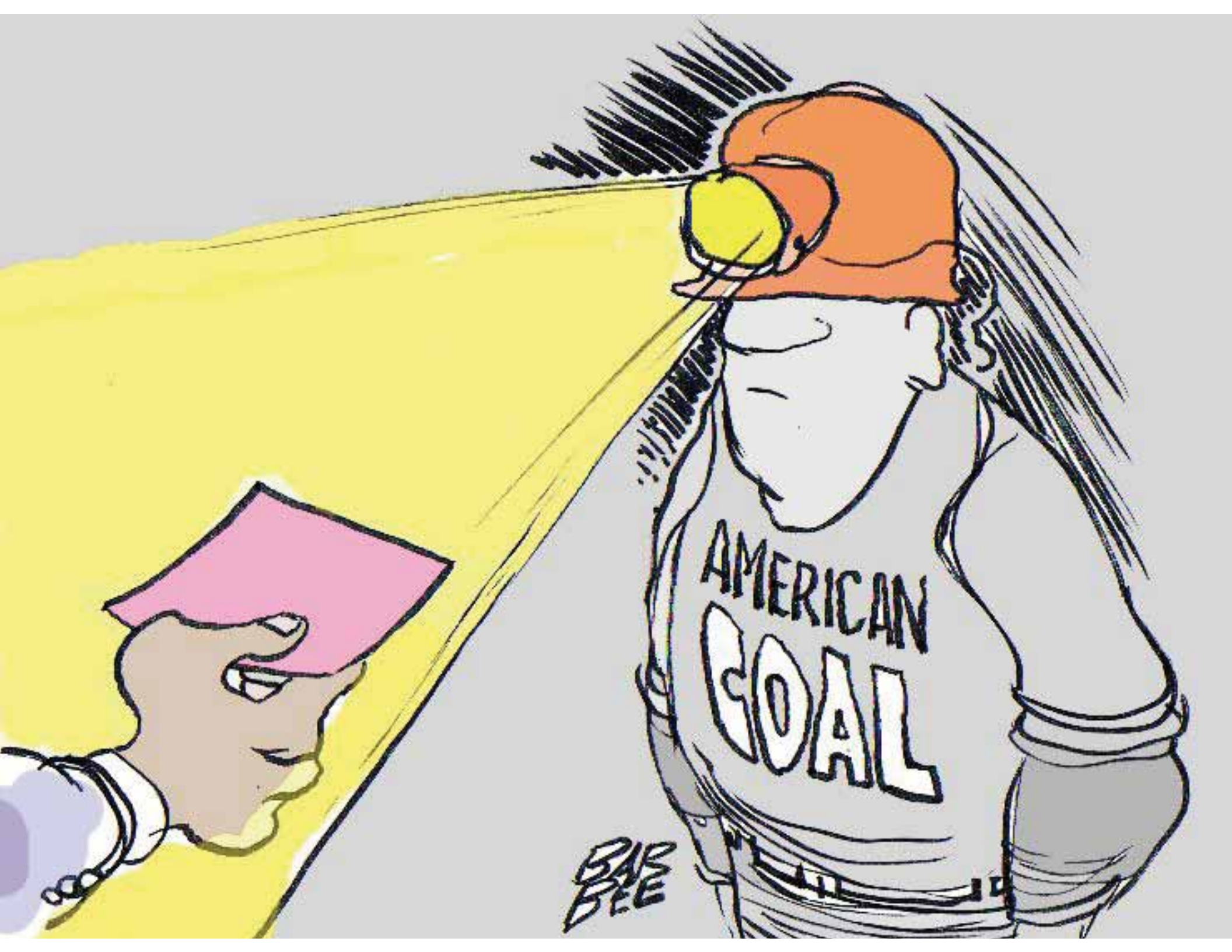


States with Renewable Portfolio Standards

April 2012



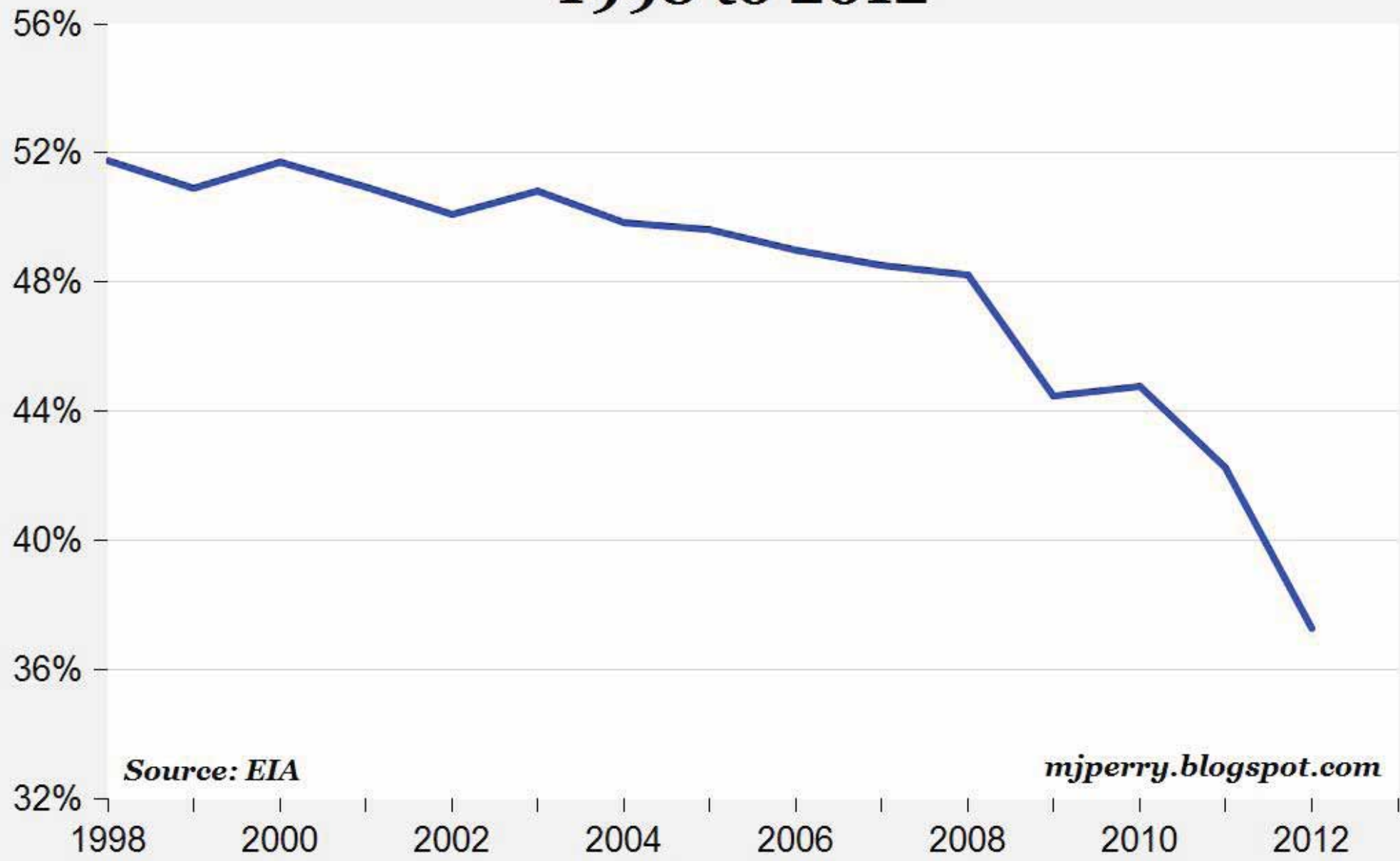
Source: www.dsire.org



AMERICAN
GOAL

BAR
BEE

Coal's Share of U.S. Electricity Generation 1998 to 2012



Source: EIA

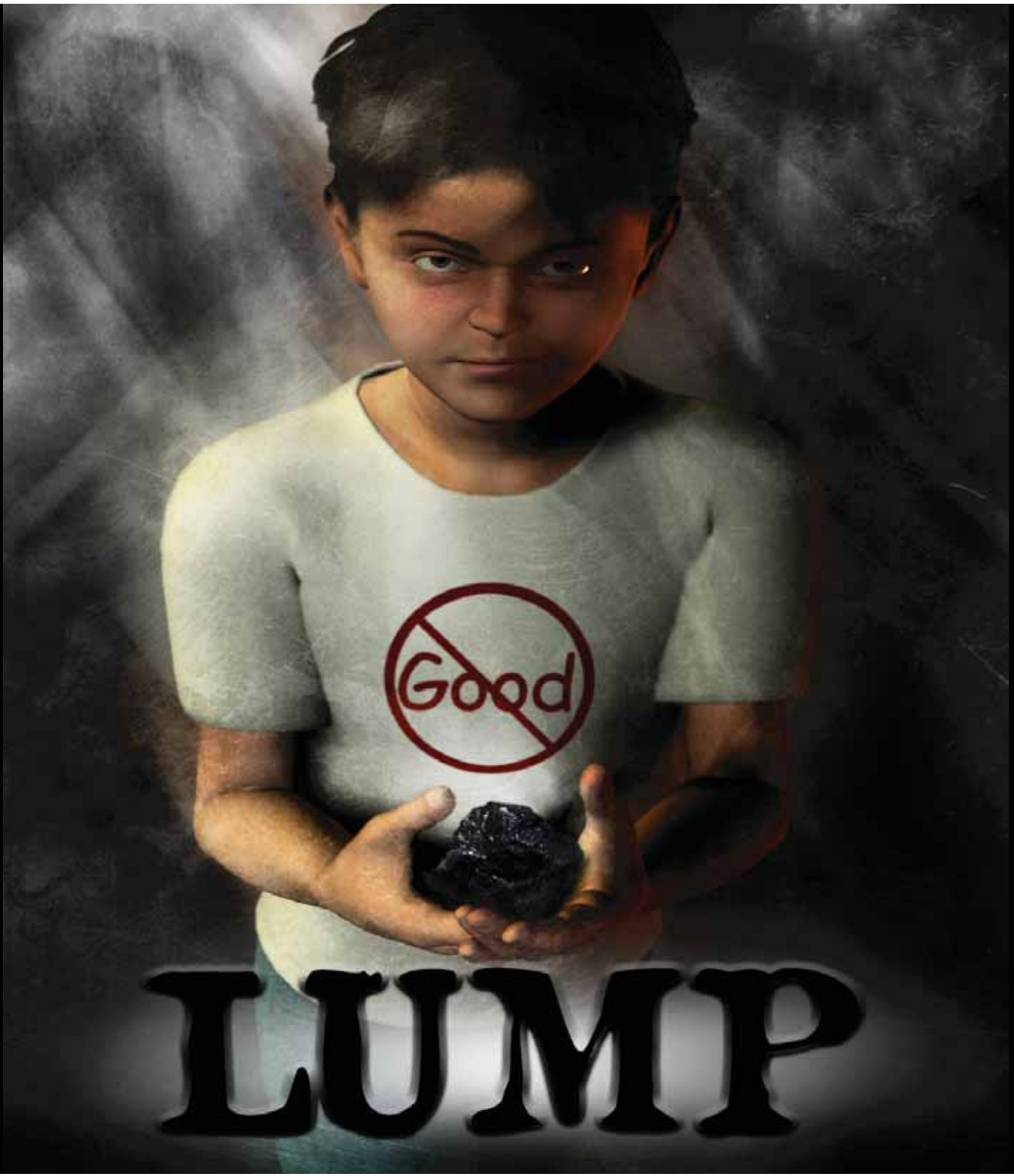
mjperry.blogspot.com

Coal use in Europe is up...



Low CO₂ credit prices causing resurgence of coal use

7€/metric ton down 60% from 2011



LUMP



ALL YOU
Lump of Coal
Dark Holiday
~ STOUT ~
Much More Than You Deserve for Xmas This Year.
IMPORTED BY
Shelton Brothers
BELCHERTON MA
GENUINE
ALE

A glass of dark beer with a thick head of foam.





Who's Switching?

Dover Municipal Power Plant

18 MW Stoker

Modified for 8-15%
Natural Gas Co-Firing

Complete and Operating





AEP Big Sandy

Unit 1 260 MW
Wall-fired boiler

Will rebuild as a 640
MW gas-fired boiler

Completion: 2016

AEP Clinch River

Units 1 and 2
470 MW Total
Vertical Firing

Will be refueled with
natural gas @ 422 MW

Completion: 2015



Xcel Black Dog Generating Station

Units 3 and 4 - 259 MW - Wall Fired

Convert to 688 MW gas-fired

Completion: 2016



Xcel Riverside Station

570 MW

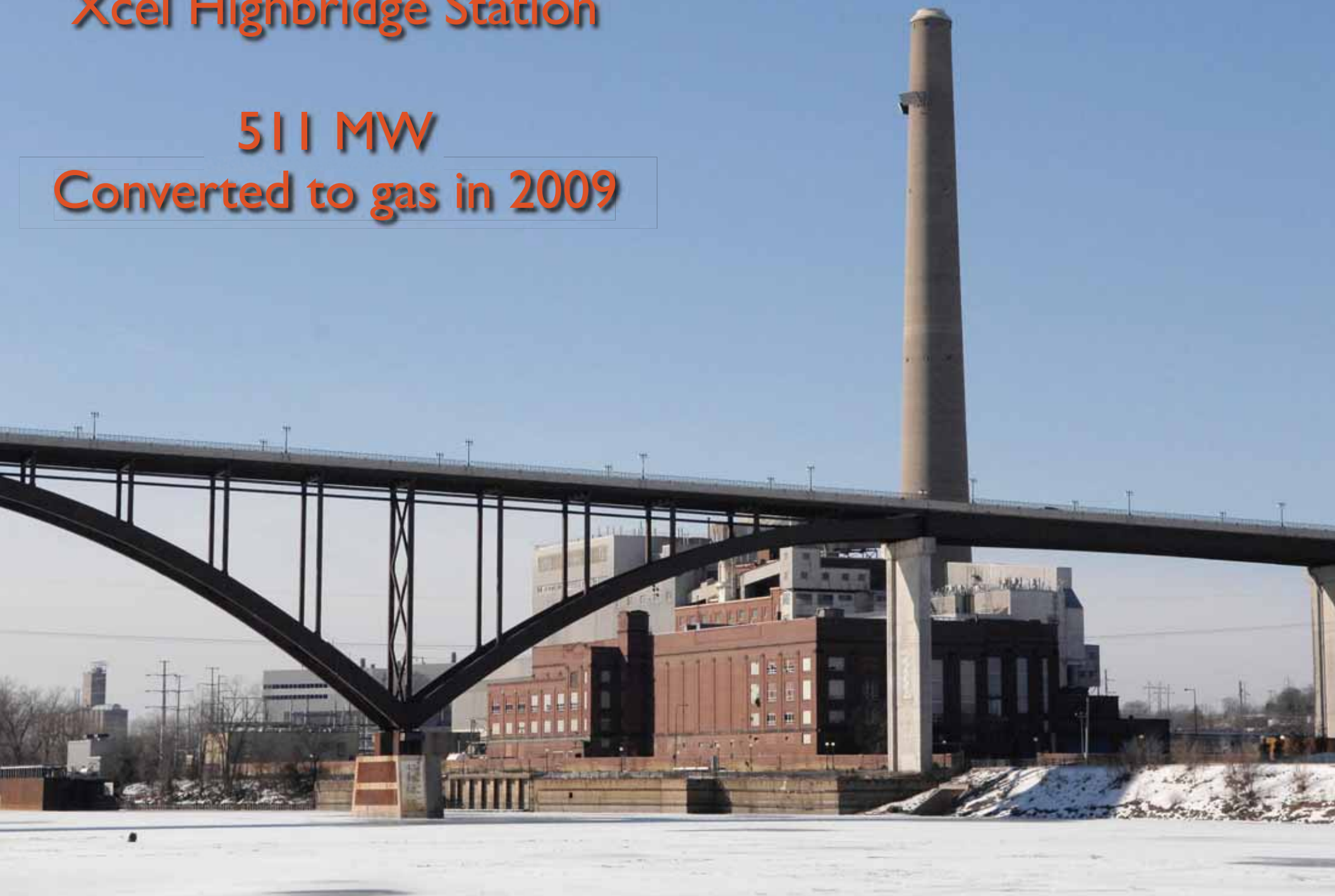
Converted to gas in 2008



Xcel Highbridge Station

511 MW

Converted to gas in 2009



AEP

Muskingum River Plant



Unit 5
585 MW cell-fired

May be refueled with
natural gas @ 510 MW

Completion: 2014

Penn State West Campus Steam Plant

Units 2 and 3

Co-gen plant

4 coal-fired stoker
boilers

110,000 pph steam
each

Completion: 2014





US Capitol Power Plant

In 2009 Congress directed the plant to switch from coal to natural gas

After some burner redesign, the plant now burns 88% NG

Planning on adding combined cycle unit

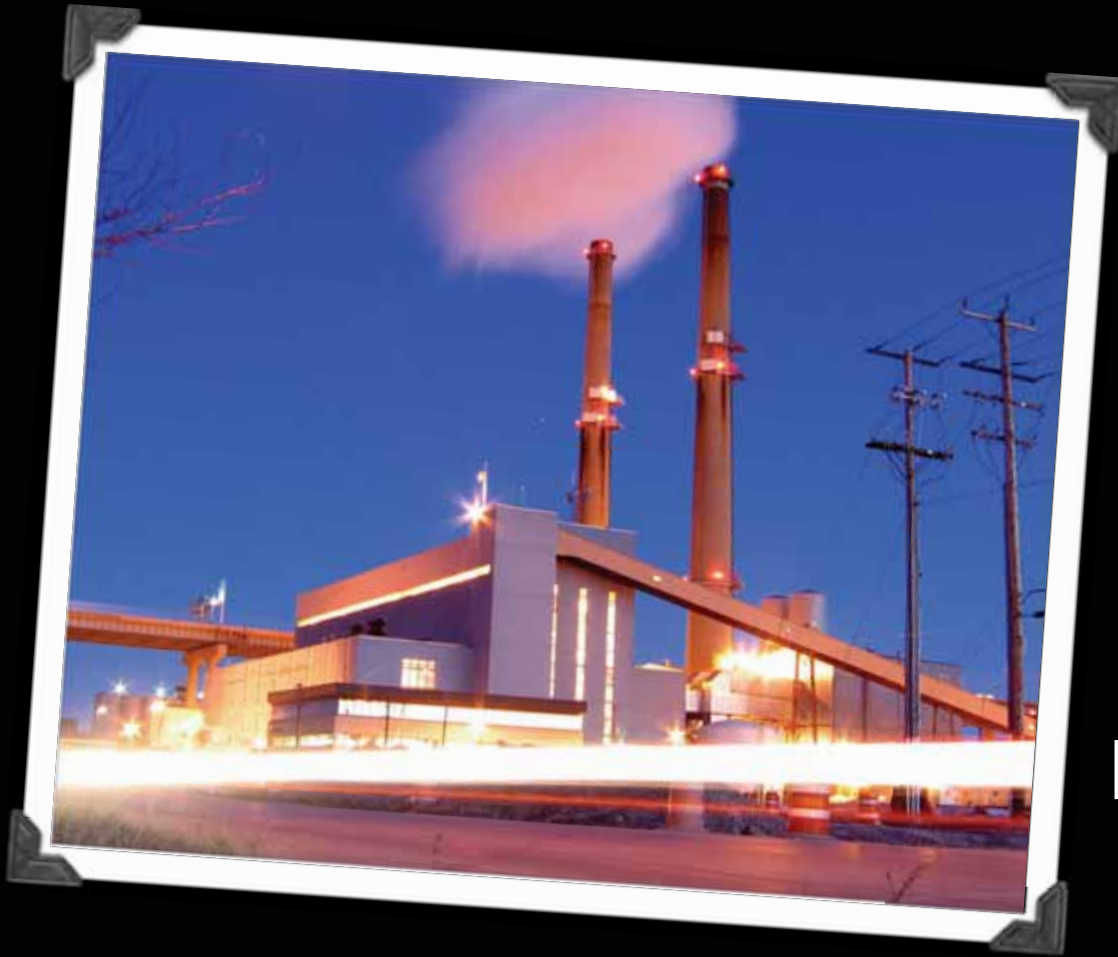
Units 7, 8, 9
190 MW Total
Wall-fired

Completed
transition to 100
MW natural gas
in 2010

Unclear as to
changes made



**Madison Gas and Electric
Blount Street Station**



Units 1-4
280 MW Total
Wall-fired

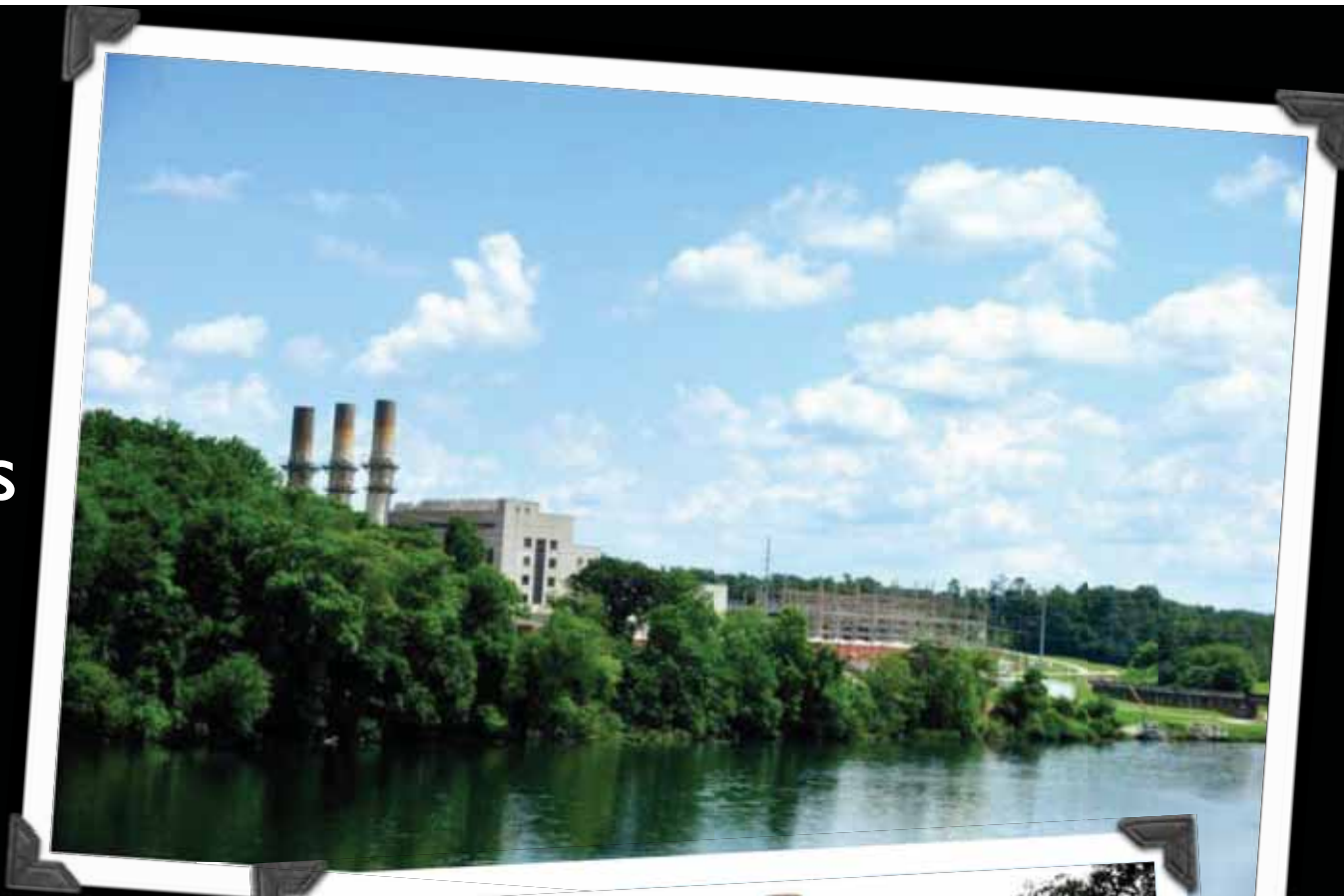
Announced in 2011

Limited details available

We Energies Valley Station

South Carolina Electric and Gas

Converting 5 Units
Retiring 6 Units



Converting

Urquhart Unit 3 (2012)

Canadys Units 2 & 3 (2015)

McMeekin Units 1 & 2 (2015)



Urquhart Units 1 and 2 converted in 2001



2 Units
306 MW Total

First unit online
with NG in 2014

Ontario Power
Thunder Bay Generating Station

Taylorville Energy Center



Taylorville Energy Center (TEC) is a proposed 716-megawatt (gross), 602-MW (net) coal-fed power plant using an advanced technology called *Integrated Gasification Combined-Cycle (IGCC)* with *Carbon Capture and Storage (CCS)* to make it among the cleanest power plants in the world.



Permitting Issues



GHG NSPS Proposal

“Although modified sources would not be subject to the 1,000 lb CO₂/MWh standard for new sources, the EPA anticipates that modified sources would become subject to the requirements the EPA would promulgate at the appropriate time, for **existing sources** under 111(d)” (p. 153).

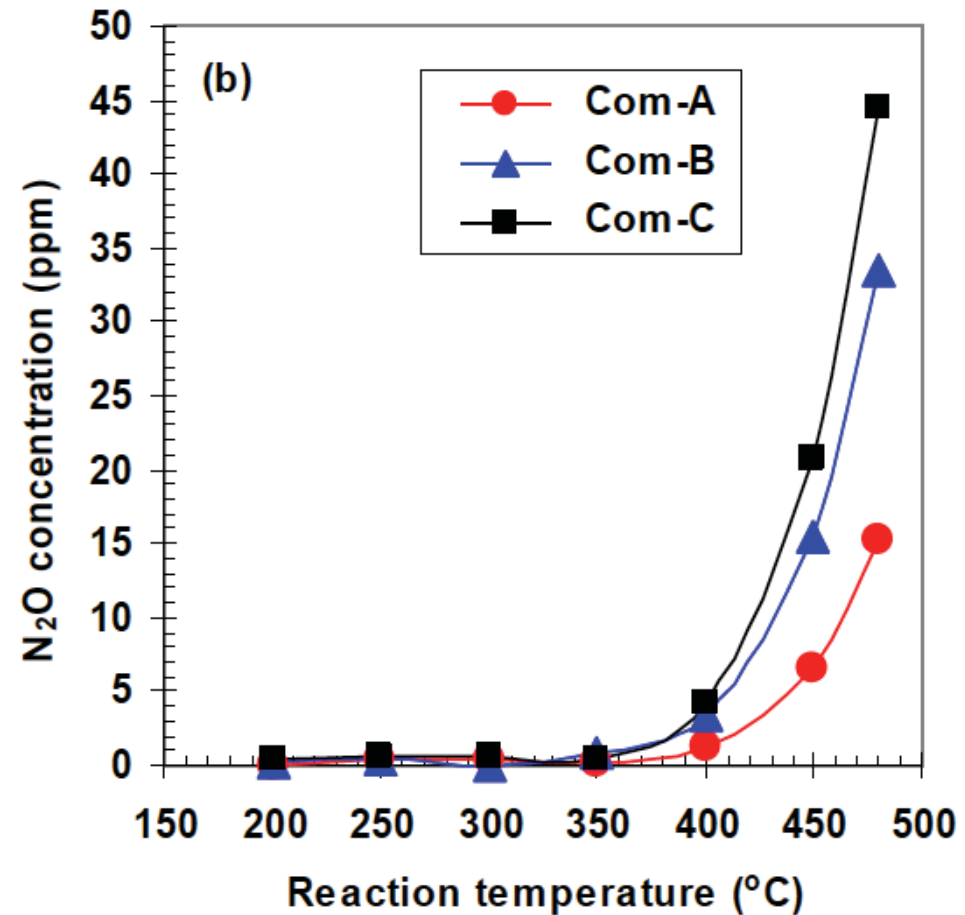
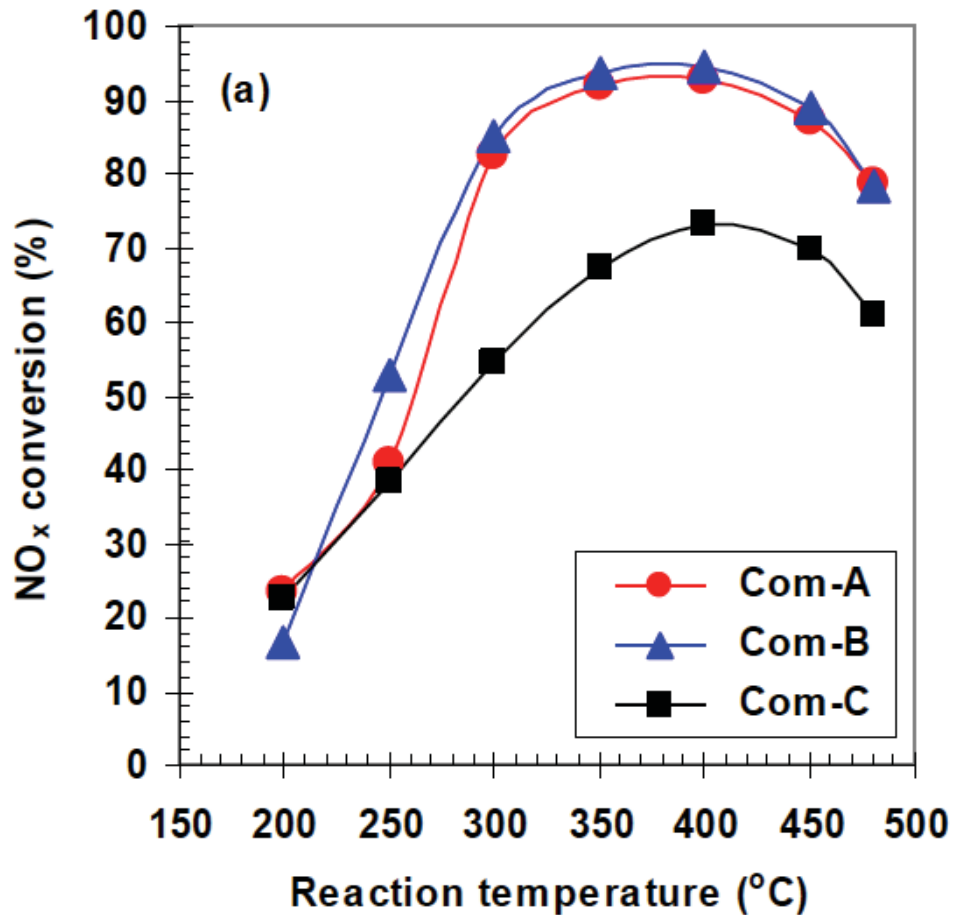
N₂O From SNCR and Urea

N₂O GWP = 310

About 9% of NO is converted to N₂O

N₂O From SCR Catalyst

N₂O GWP = 310



Source: Lee, Y.H., et. al. "The Formation of N₂O from NH₃ -SCR Reaction over Commercial V₂O₅/TiO₂ -Based Catalysts", North American Catalysis Society Meeting, 2009



“This is the battleground...”

“The reason we care desperately and have adopted a policy of leaving **no coal plant unopposed** is because each of them is such a massive new source of air pollution and a particularly large source of global warming air pollution.”

Bruce Nilles, Sierra Club
Kansas City Star, April 11, 2006

beyond oil.

BEYOND

COAL



BEYOND



NATURAL GAS



sevans@cleanair.com



