The Brattle Group

Natural Gas Price & Environmental Regulation: Effect on Utility Coal Consumption

Presented by

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Agenda

- Power market conditions – gas vs. coal
- Emerging environmental regulations and current U.S. coal fleet
- Cost of compliance
- Economics of retirement vs. retrofit
- Impact on coal demand and shipments

The Demand for Coal Generation

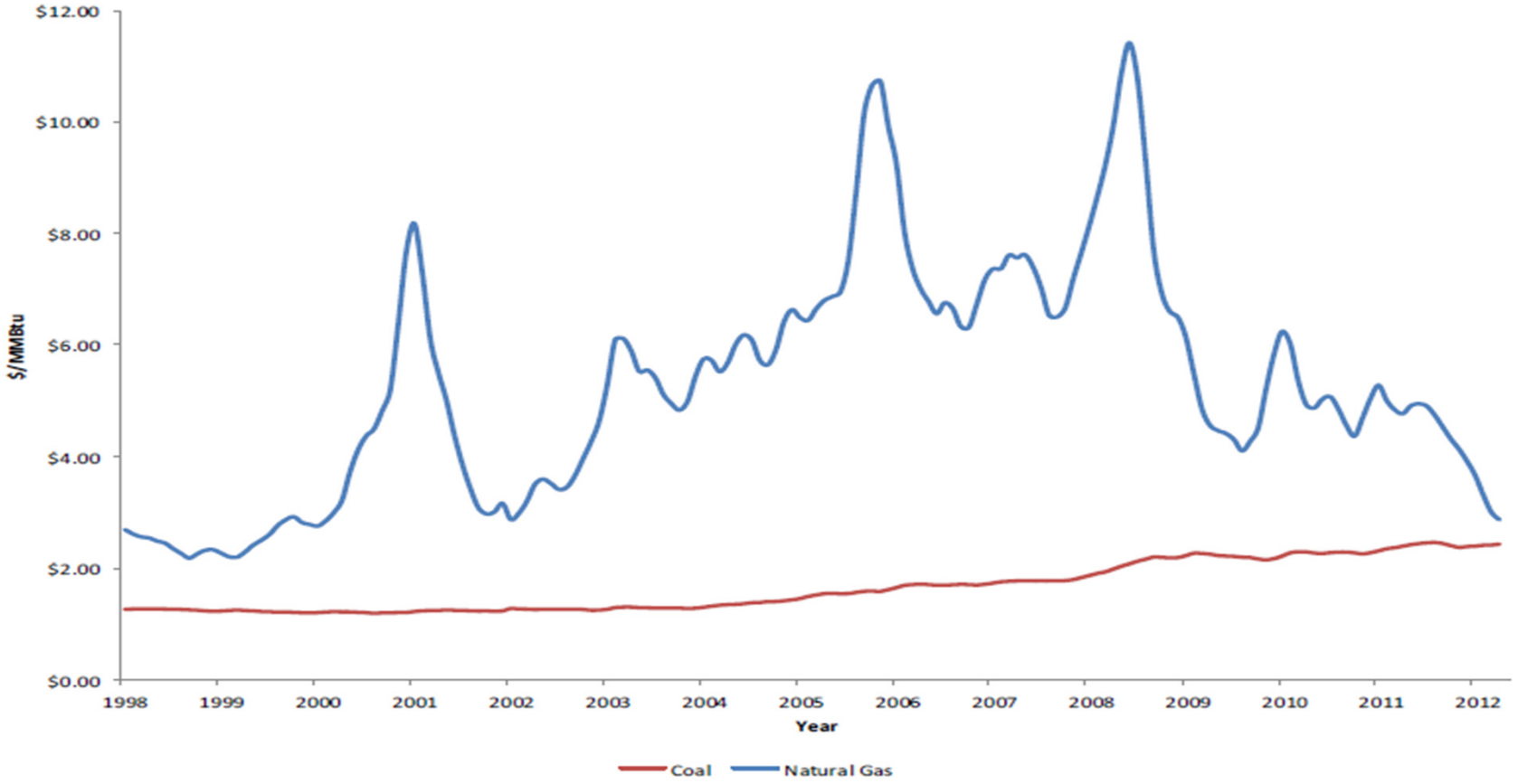
Power markets in the US have undergone a substantial transformation in the past 5 years:

- The economic downturn and customer conservation have virtually eliminated demand growth
- Gas prices that had been high and volatile for about a decade have fallen sharply
- New natural gas fired capacity continues to come on line along with mandated renewables
- Proposed coal plants have been cancelled, and utilization of existing capacity has fallen sharply
- New environmental regulations in the next few years will cause a wave of coal plant retirements – what impact will those retirements have on coal consumption and transport?

Coal vs. Gas Generation Fuel Cost

Figure 15

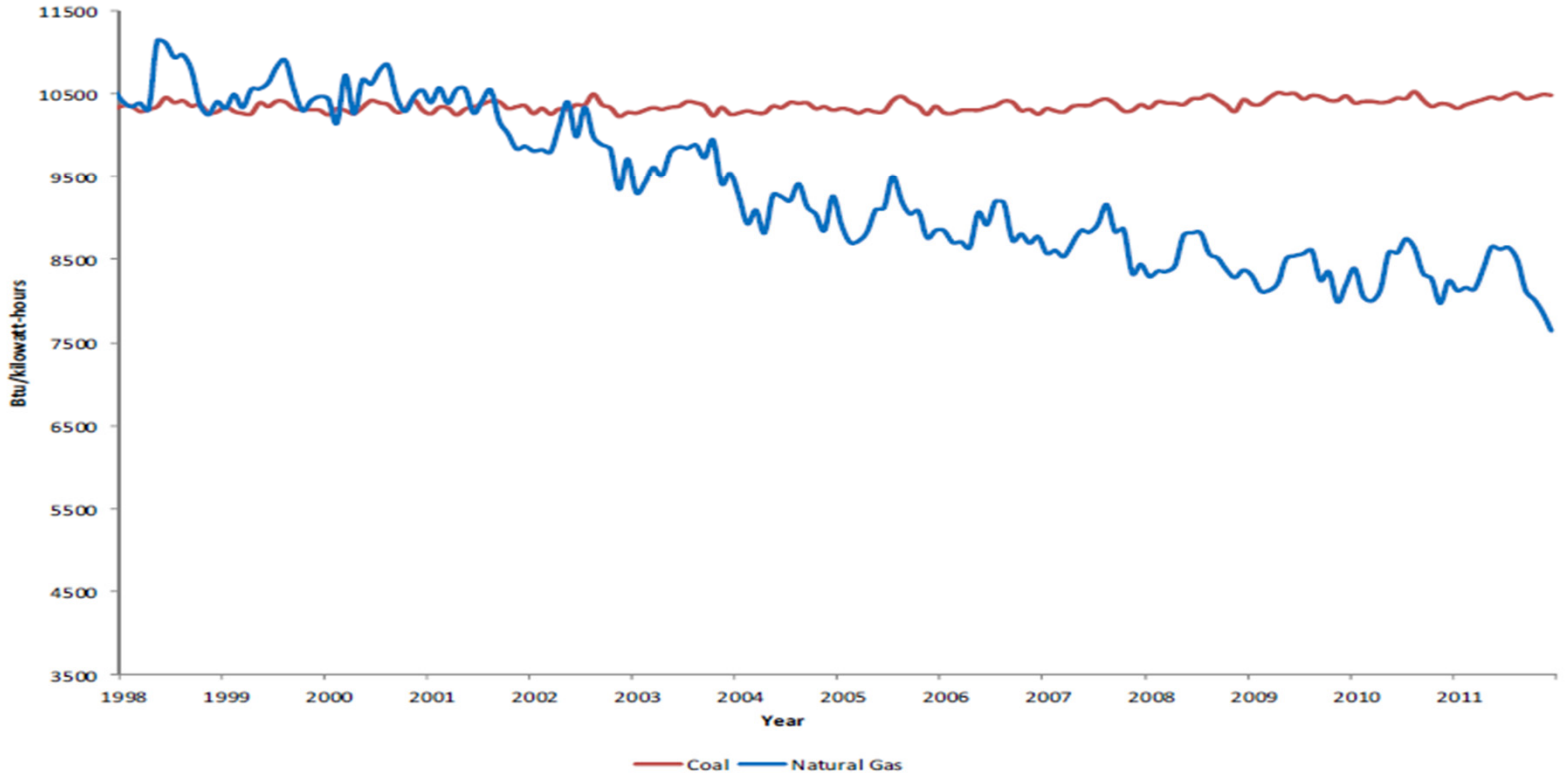
COST OF DELIVERED FUEL TO THE ELECTRIC POWER INDUSTRY
NATURAL GAS v. COAL
January 1998–May 2012



Note: Figure 15 shows a three Month centered moving average price. Dollars per MMBtu includes taxes.
Source: U.S. Energy Information Administration, August 2012 Monthly Energy Review.

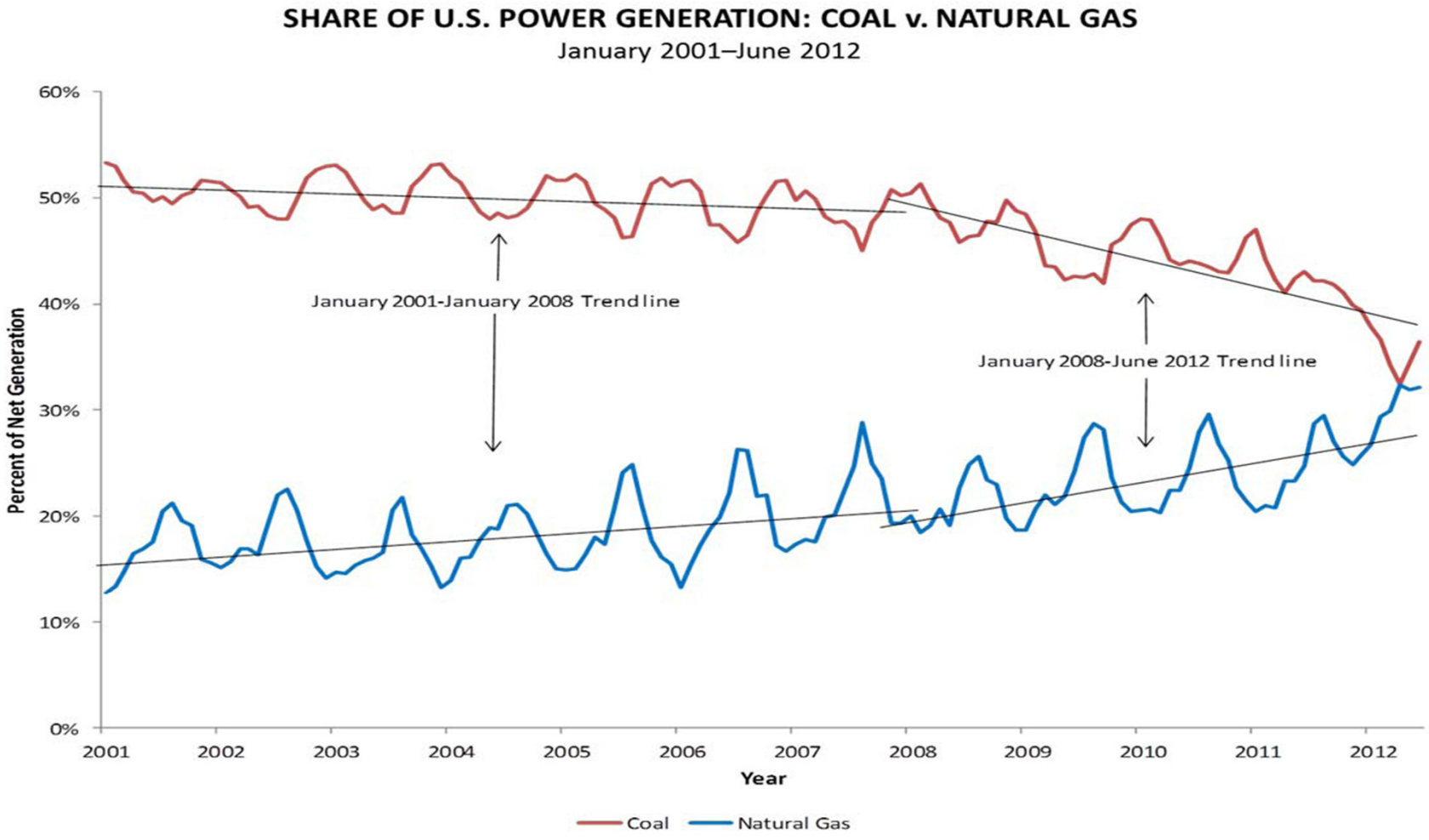
Coal vs. Gas Conversion Efficiency

Figure 14
AVERAGE ELECTRIC GENERATION HEAT RATE BY FUEL TYPE
January 1998–August 2011



Note: Heat rate is based upon plant operation, maintenance and fuel costs reported in the FERC Form 1, EIA-412 or RUS-12.
Source: Ventyx, Unit Generation and Emissions Dataset.

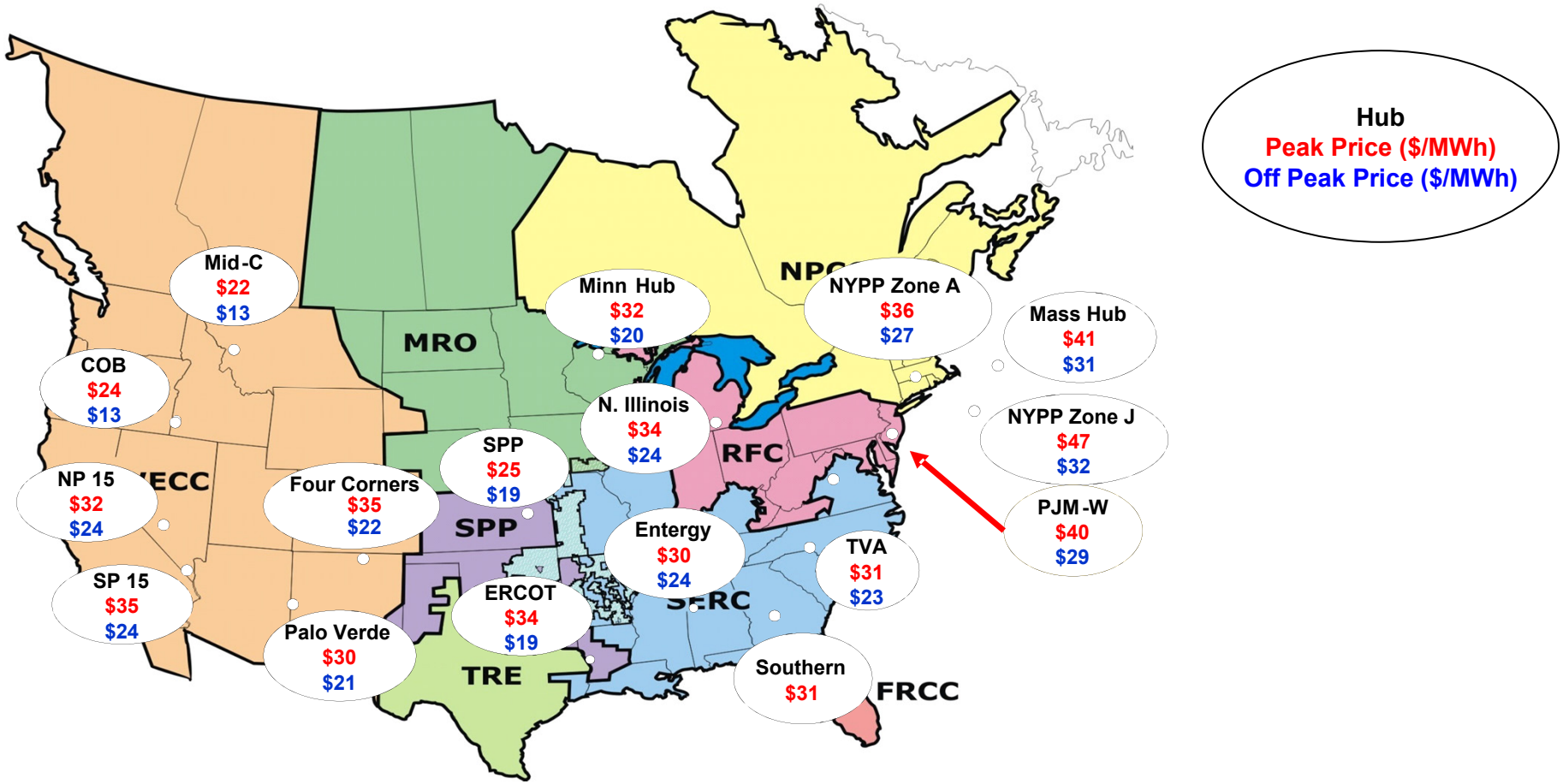
Coal vs. Gas Generation Market Share



Source: U.S. Energy Information Administration, Electricity Data Browser, Net Generation Dataset.

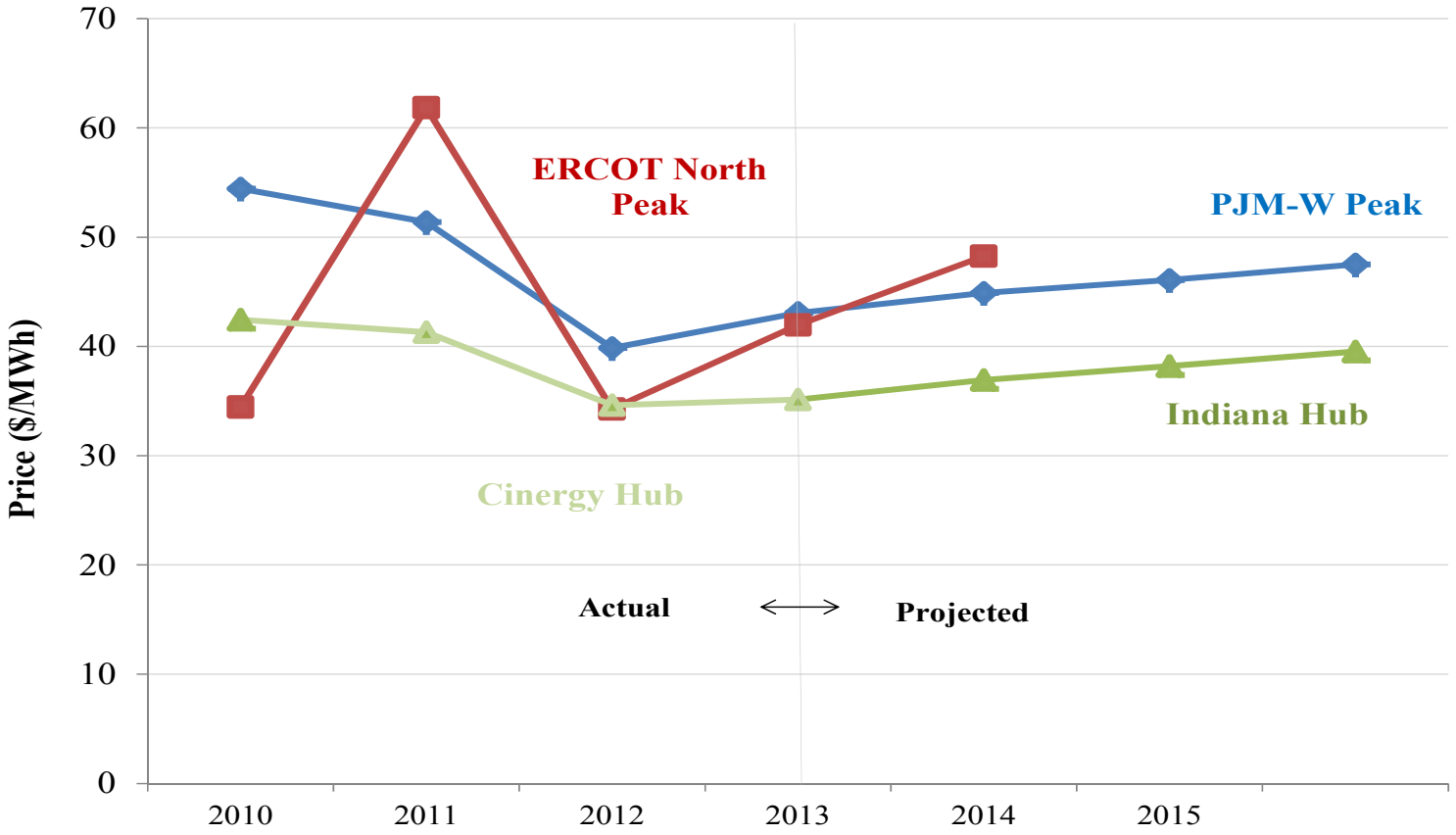
Wholesale power prices in 2012

Recent power prices are low due to low gas prices and depressed load conditions.



Peak Electricity Futures Contract Prices

Forward markets show very modest price increases



Note: Forward prices as of January 2013 trading days.

Emerging EPA Regulations for Existing Coal Units

Examine the implications of MATS, a replacement rule for the vacated CSAPR, and regional haze rules on coal plant retire/retrofit decisions

Regulation	Status	Pollutant Targeted	Compliance Options	Expected Date of Compliance
Revised CSAPR	Vacated by Court	NO_x, SO_2	SCR/SNCR, FGD/DSI, fuel switch, allowance purchases	After 2015?
MATS	Final	HAPs (mercury, acid gases, PM)	ACI, baghouse, FGD/DSI	2015/2016
Regional Haze	Final	NO_x, SO_2, PM	SCR/SNCR, FGD/DSI, Baghouse/ESP, combustion controls	Typically in 5 years
316(b)	Proposed	Cooling water	Impingement: Mesh screens; Entrainment: Case-by-case, may include cooling towers	2018
Combustion by-products (ash)	Proposed	Ash, control equipment waste	Bottom ash dewatering, dry fly ash silos, etc.	2015

Regulatory Outlook: Two Scenarios

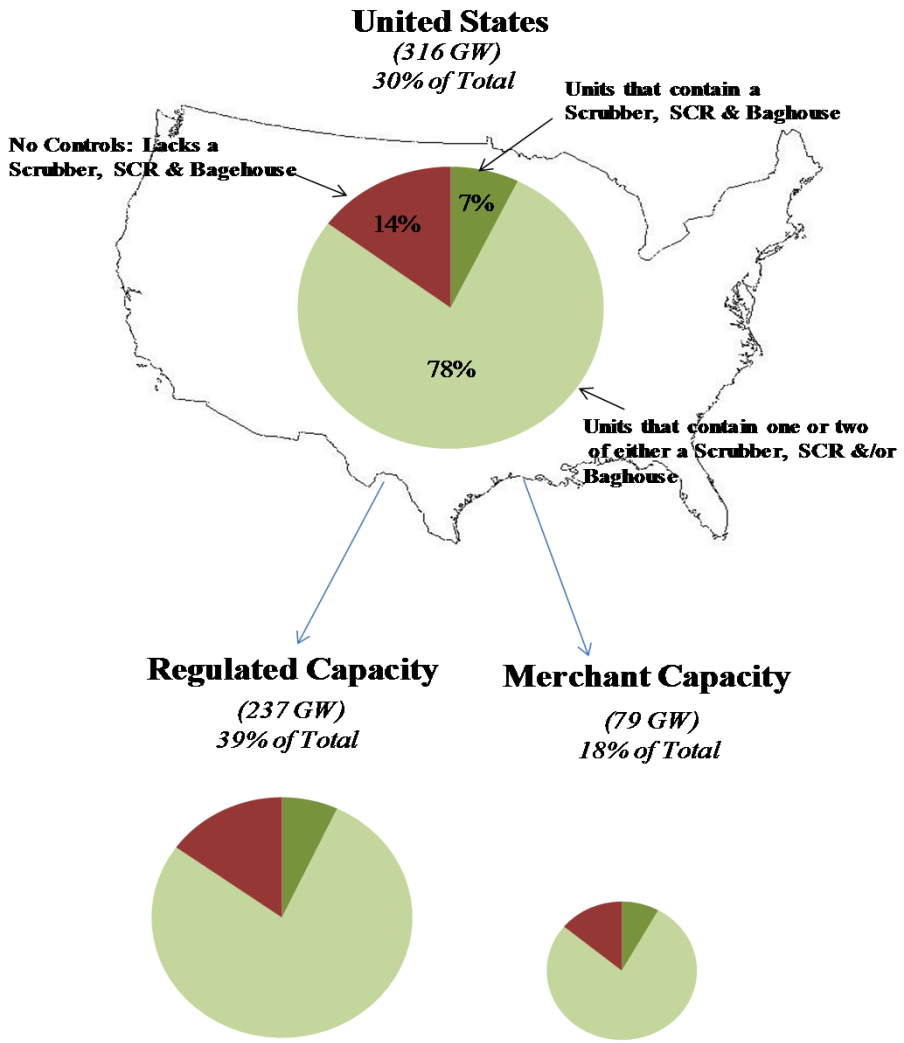
	Required Retrofit Equipment
Lenient EPA Regulations	• SNCR and ACI on all units • DSI and Baghouse on units in WECC and on small units (< 200 MW) in other regions • Wet FGD on large (≥ 200 MW) units outside WECC
Strict EPA Regulations	• SCR on all units • DSI, ACI and Baghouse on units in WECC and on small (< 200 MW) units in other regions • Wet FGD on large (≥ 200 MW) units outside WECC

U.S. Coal Fleet

Coal-fired capacity (316 GW) represents about 1/3 of the total U.S. generation fleet

- 237 GW owned by *regulated* companies (IOUs, munis/coops, etc.)
- 79 GW owned by *unregulated* merchant companies

Majority (93%) of the coal capacity lacks at least one major piece of equipment (scrubber, SCR and baghouse) to control air emissions



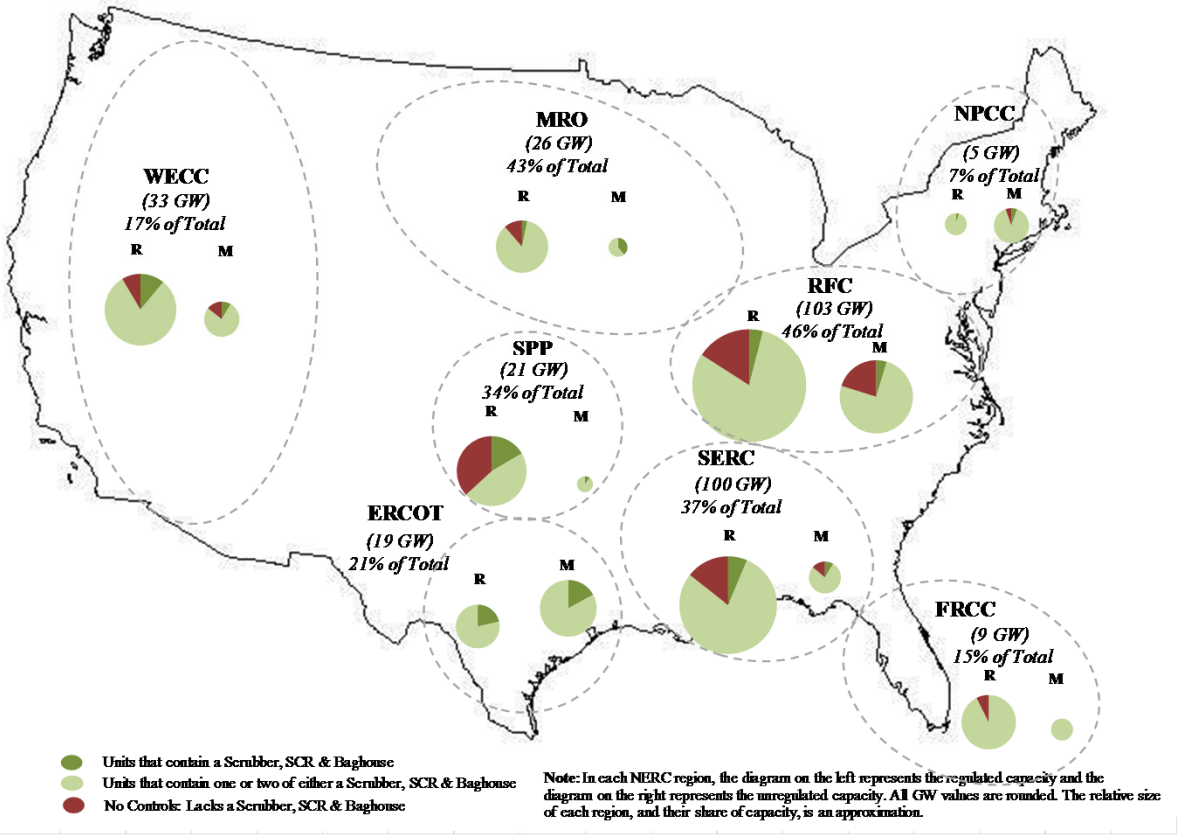
Regional View

Coal-fired capacity is largely in the eastern interconnect (~265 GW) , and primarily in the RFC and SERC regions

RFC and SERC coal fleet faces twin challenges:

- most of the capacity lacks at least one major equipment, and
- coal is a large share of regional capacity

Most of the US merchant coal capacity is in the RFC and ERCOT regions



Capital Costs of Major Control Equipment

Capital costs ($/kW) show returns to scale, expensive for smaller units. Retrofit costs for major equipment such as wet scrubber plus SCR and baghouse are comparable to cost of a new gas combined cycle (CC) unit (~$1000/kW) for mid-size (200 – 400 MW) units

CAPITAL COST OF CONTROL EQUIPMENT
(2011 $/kW)

	Unit Size (MW)		
Equipment	**50**	**200**	**600**
Wet Scrubber	904	734	513
Dry Scrubber	774	628	448
DSI	42	39	39
SCR	273	234	188
SNCR	51	51	51
Baghouse	504	387	219
ACI	29	27	19

Source: EPA IPM 4.10 Basecase assumptions and EEI 2011 Study

Levelized Costs of Major Control Equipment

Levelized all-in (capital, FOM, VOM) cost of major control equipment for a 200 MW coal unit could be as high as $50/MWh depending on capacity factor and type of equipment

LEVELIZED COST OF CONTROL EQUIPMENT ($/MWh)
(200 MW Unit, 15-Year Recovery with 15% Capital Charge Rate)

	Capacity Factor	
Equipment	**30%**	**70%**
Wet Scrubber	$ 50.80	$ 22.91
Dry Scrubber	$ 43.57	$ 20.13
DSI	$ 10.10	$ 8.15
SCR	$ 15.40	$ 7.37
SNCR	$ 4.38	$ 2.48
Baghouse	$ 23.25	$ 9.98
ACI	$ 2.88	$ 1.91

Current operating margins are low for coal plants due to low gas prices, low demand growth, and new renewables

- Current dispatch costs:
  - Existing coal plant about $20-35/MWh
  - New gas fired CC about $25 - $30
- Current wholesale power prices about in 2012 in Midwest and Southeast about $25 - $35/MWh

Brattle analysis of coal plant retirement exposure

A tool to analyze economics of <u>retrofit vs. retirement</u> for every coal unit in the U.S. under various scenarios of environmental regulation, fuel and power prices

- Estimate **<u>future capacity factor for each unit</u>** by dispatching against projected hourly power prices
- Decide each year whether to retire based on comparing **<u>15-year projected avoidable costs of retrofit against</u>**:
  - **<u>Revenues</u>** from energy and capacity markets **for *merchant units***
  - **<u>Cost of replacement power</u>** from gas CCs or CTs **for *regulated units***.

Announced Coal Plant Retirements

As of January 2013, about 30 GW of coal capacity have announced retirement by 2021

- About 80% (22 GW) by 2015
- Most lack major environmental controls

Year of Retirement	Number of Units	Summer Capacity (MW)
2013	28	3,442
2014	47	6,559
2015	82	12,714
2016	6	937
2017	16	2,787
2018	6	1,085
2019	1	670
2020	7	1,653
2021	1	162
Total	194	30,008

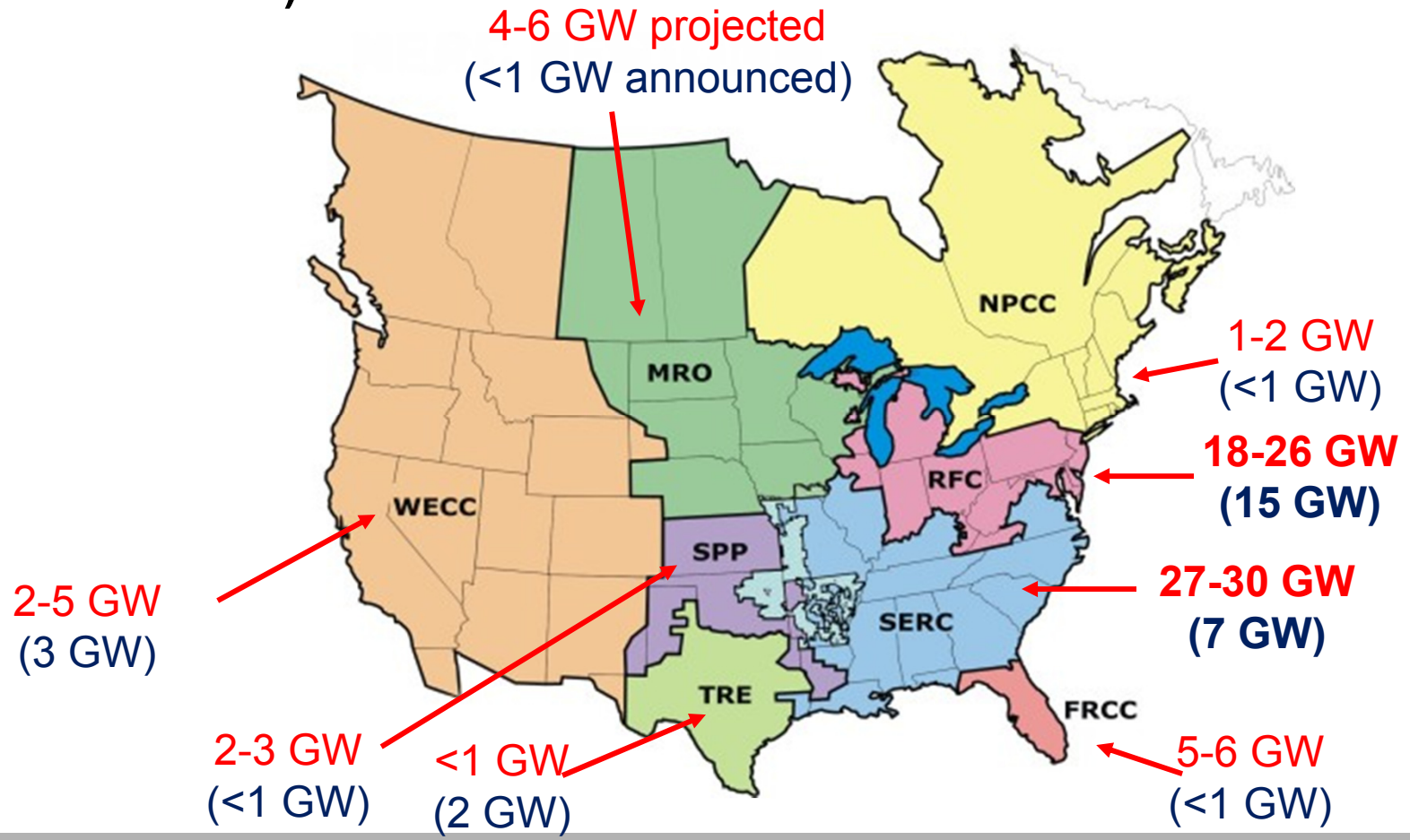
Potential Coal Plant Retirements: *Brattle* Results

Projected Retirements by 2016 (GW)

		Market Scenario				
		Base (Recent Fwds)	Base Gas $-1/MMBtu	Base Gas $+1/MMBtu	Base $+5/MWh in Power Prices	Base $+30/ton $C0_2$ in 2020
Regulatory Scenario	None	5	18	2	6	35
	Lenient	59	115	21	61	127
	Strict	77	141	35	77	149

Projected (& announced) Coal Plant Retirements

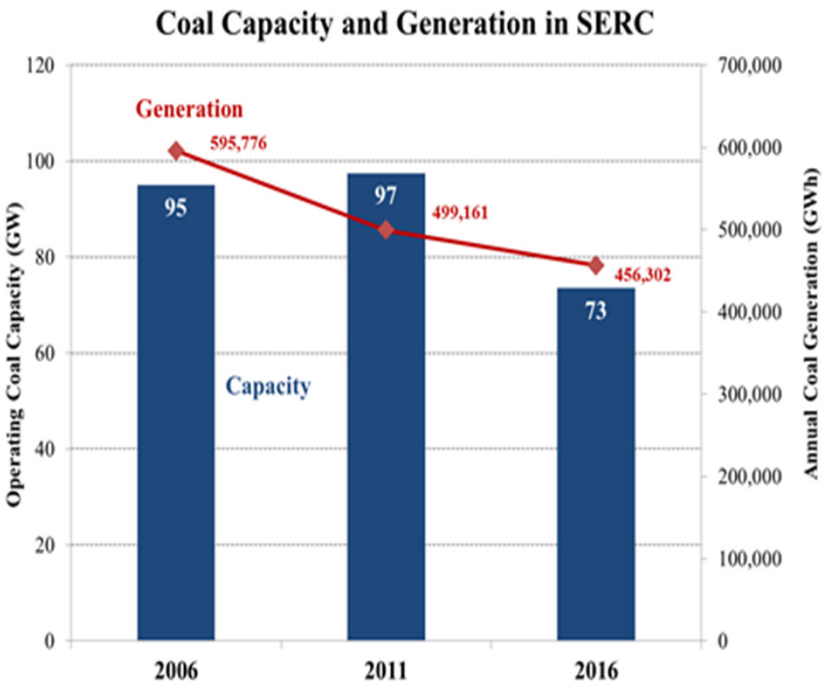
Most of the projected and announced coal retirements are in NERC regions SERC (27-30 GW, 7 GW announced) and RFC (18-26 GW, 15 GW announced).

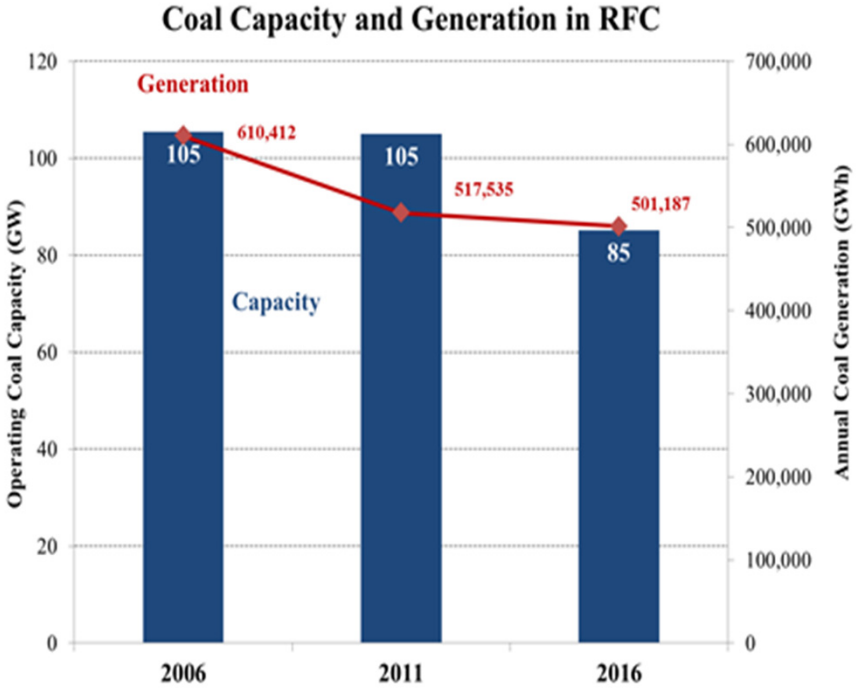


Eastern Coal Generation & Capacity 2006 - 2016

<u>2006–2011</u>: Coal *generation* declined about 15% with no net capacity retirement

<u>2011–2016</u>: Coal *capacity* declines 20% - 25% through retirements while generation only falls by 3% – 9%.

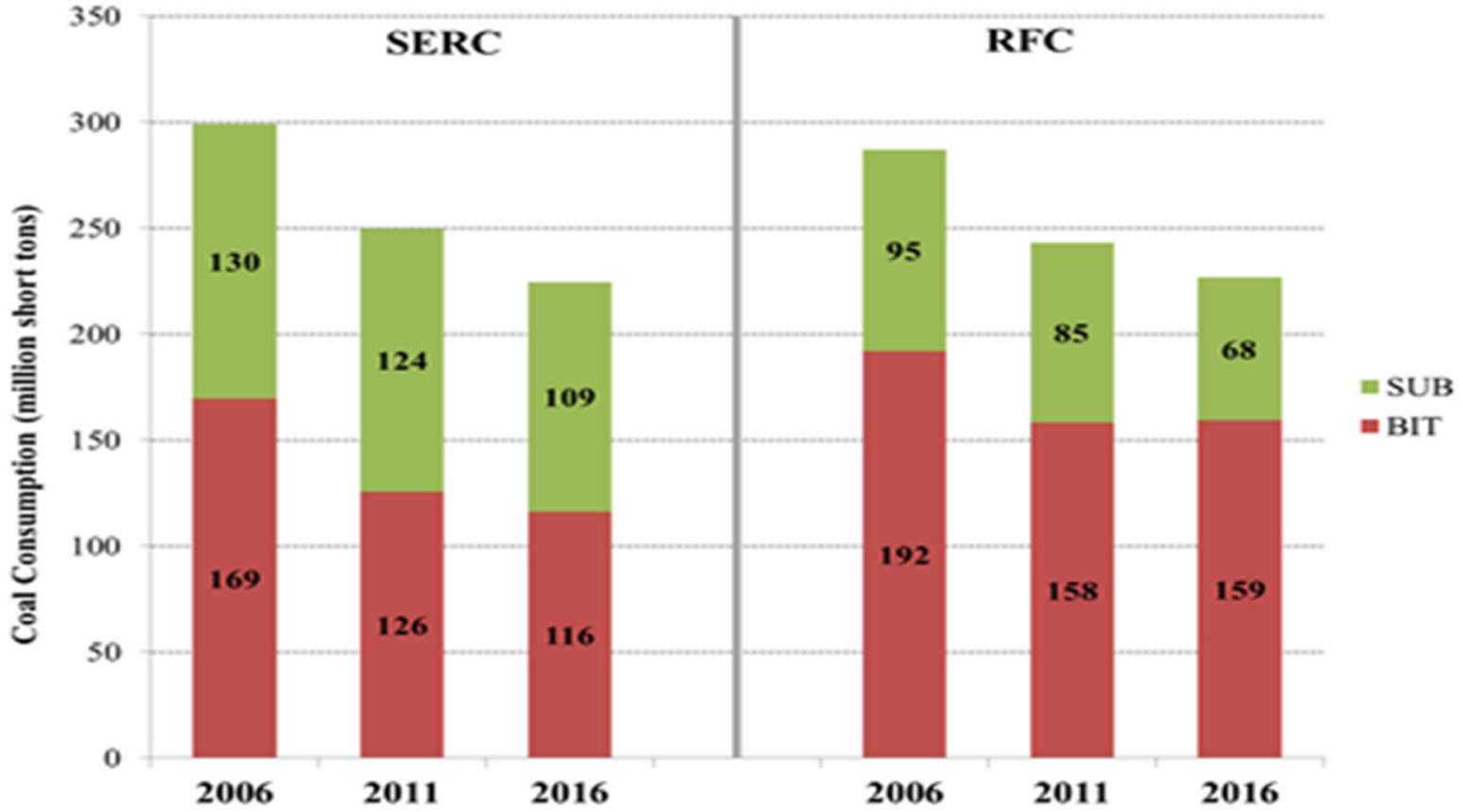




Eastern Coal Consumption 2006 - 2016

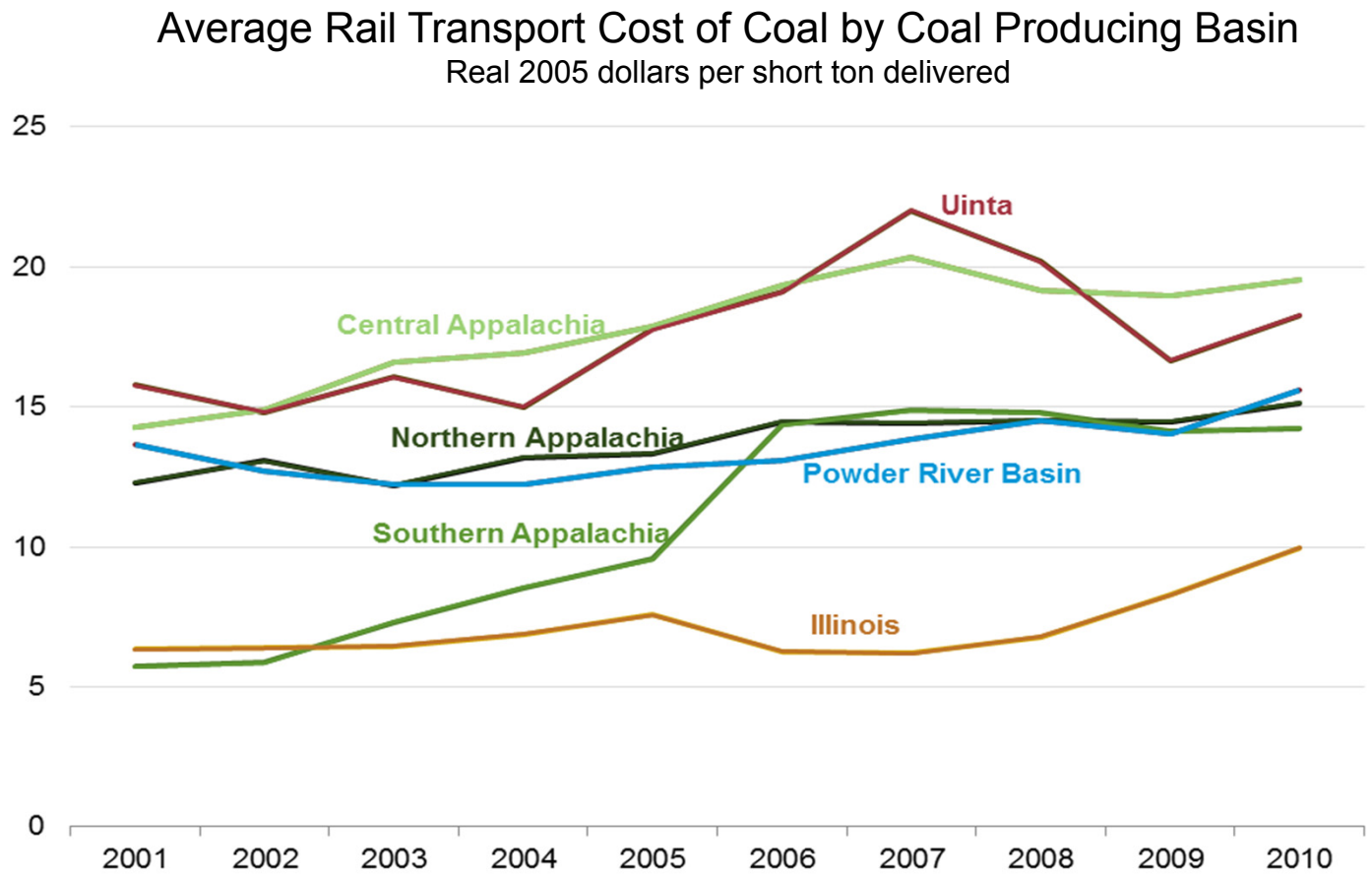
2006-2011: BIT declines 18 – 25%, SUB declines 5 - 10%

2011-2016: BIT declines 0% - 8%, SUB declines 13% - 20%



Implications for Coal Transportation

Shipping costs increased during the previous decade, but this is unlikely to persist in the face of declining coal demand



Implications for Coal Transportation (cont.)

About 75% of coal is transported by rail (rest by barge & truck) – so lower coal demand will reduce rail revenues

- Coal carloads down about 10% in calendar 2012
- Other rail shipments increasing (including for higher Eastern coal experts), creating some offsetting shipping demand
- AAR petitioned the Surface Transportation Board to consider the role of "indirect competition" (coal-gas competition in generation) in market dominance analysis
- Coal transport contracts that contain minimum volume requirements are beginning to enter mediation, arbitration, and ultimately litigation
- Its possible that most of the damage has been done already, and that further declines will be modest

Contact Information

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Mr. Chupka provides expertise on the market impacts of both domestic and international energy and environmental policy. He assists energy market clients and counsel in a broad span of management analysis, regulatory proceedings, and litigation support. Mr. Chupka has focused on integrated resource planning, electricity and fuel procurement policies, renewable energy policy design, and climate change policies.

The Brattle Group provides consulting and expert testimony in economics, finance, and regulation to corporations, law firms, and governmental agencies around the world.

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