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# The Interface of Regulation and Technology in the Electricity Sector



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**M.J. Bradley & Associates**

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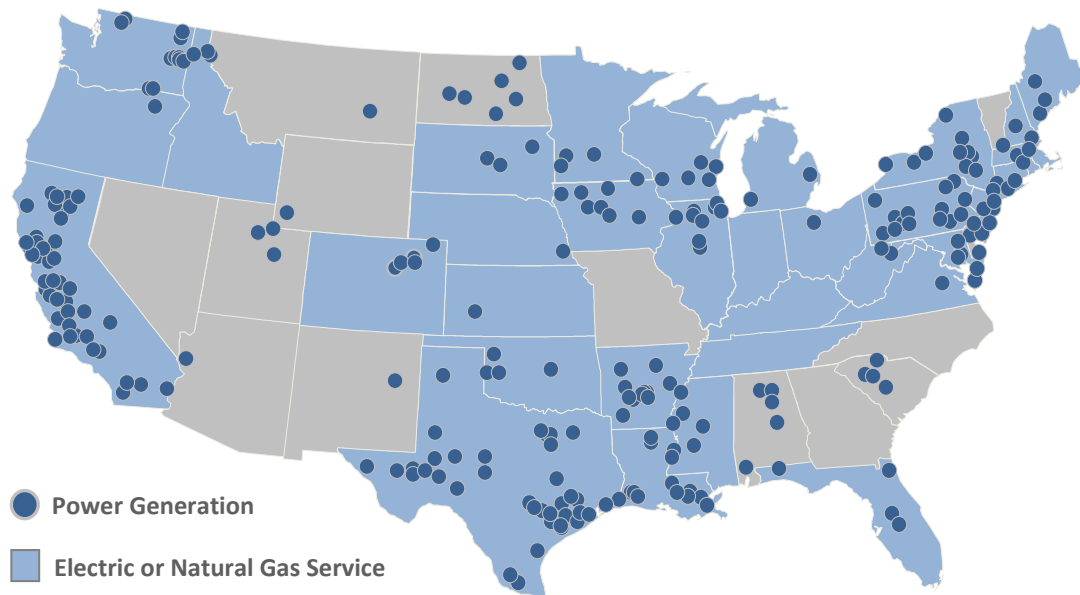
# The Clean Energy Group: Clean Air Policy Initiative

A coalition of electric power companies dedicated to responsible energy and environmental stewardship

Our members serve electricity to more than 57 million people (20% of U.S. population)

We have over 170,000 megawatts of generating capacity throughout the U.S.

Our members deliver natural gas to more than 8.3 million customers



## Reoccurring Issues in Response to Electric Sector Regulation

### Cost

What are the economic impacts?

### Reliability

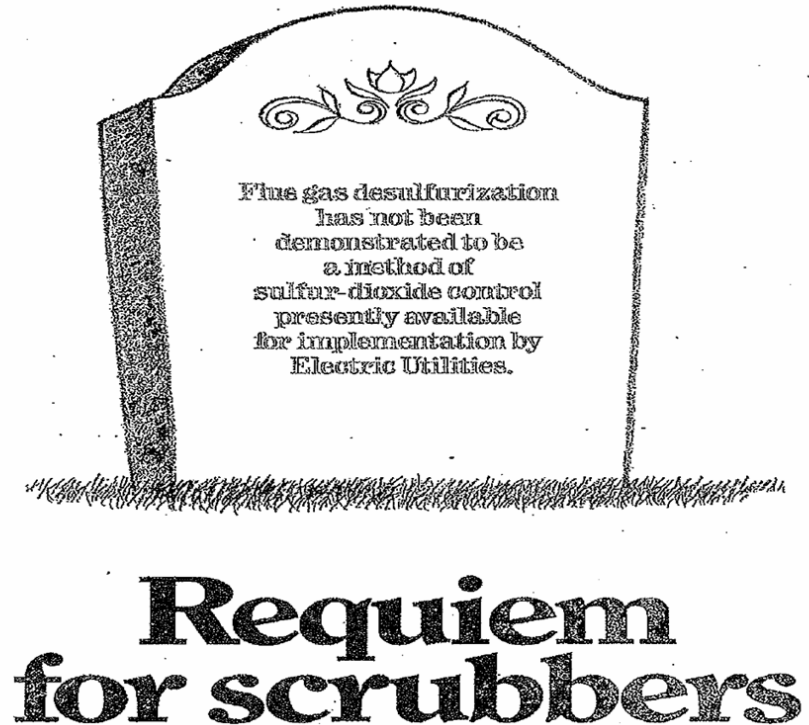
Will the reliability of the electric grid be compromised?

### Feasibility

Is the rule technically feasible (e.g., labor availability to install controls)?

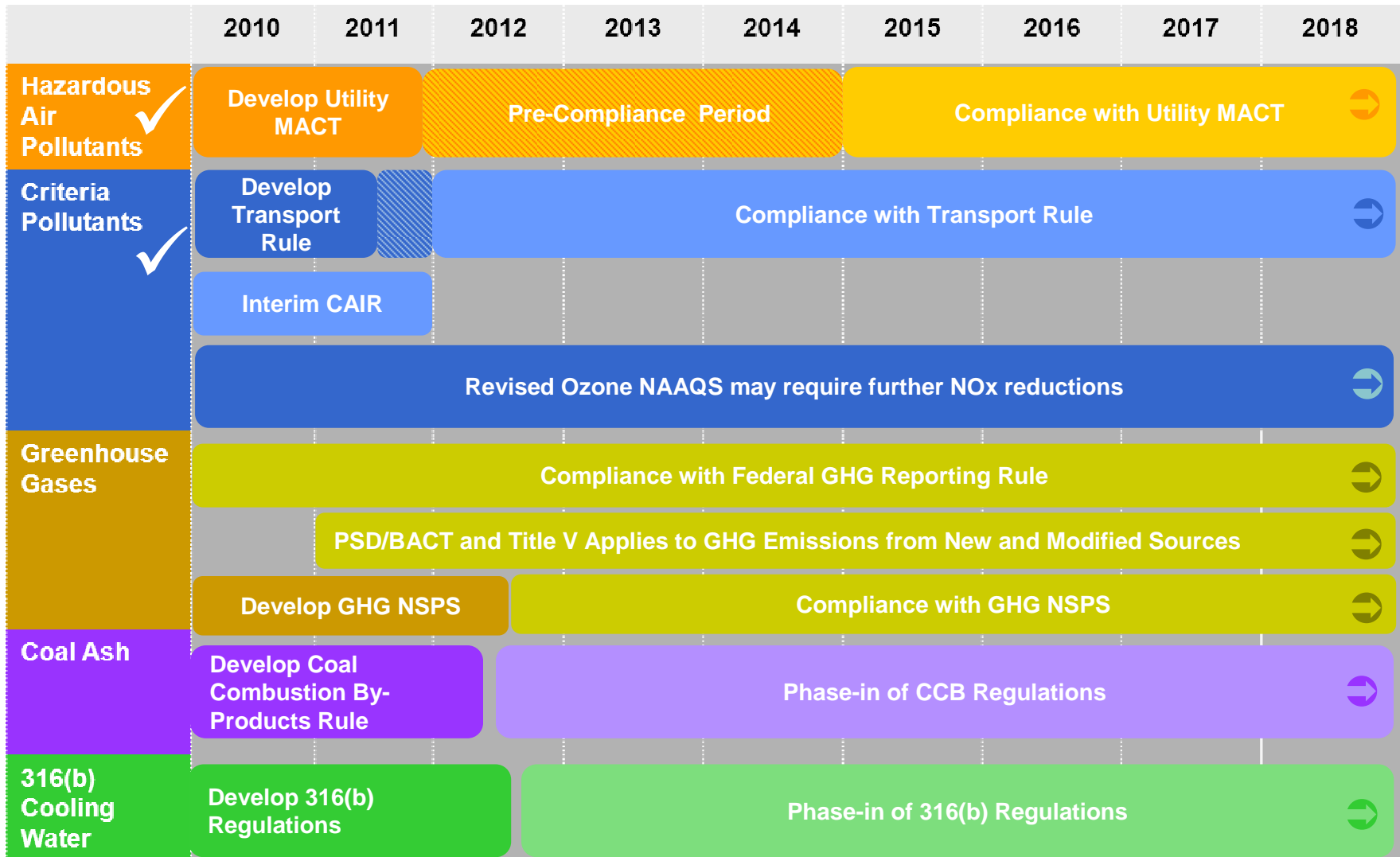
### Technology

Do we have the technology to comply cost-effectively?



American Electric Power (AEP) advertisement  
published in the Washington Post, 1974

# Electric Sector Regulations



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## EPA Air Pollution Rules: Paths to Compliance

Retrofit

Repower

Retire



# Pollution Control Retrofits for MACT Compliance

- Primary Pollutant Control
- Co-benefit Reductions

## Control Technologies

- Activated Carbon Injection (ACI)
- Wet Scrubber
- Dry Scrubber
- PM Controls (Fabric Filters & ESPs)
- Dry Sorbent Injection (DSI)

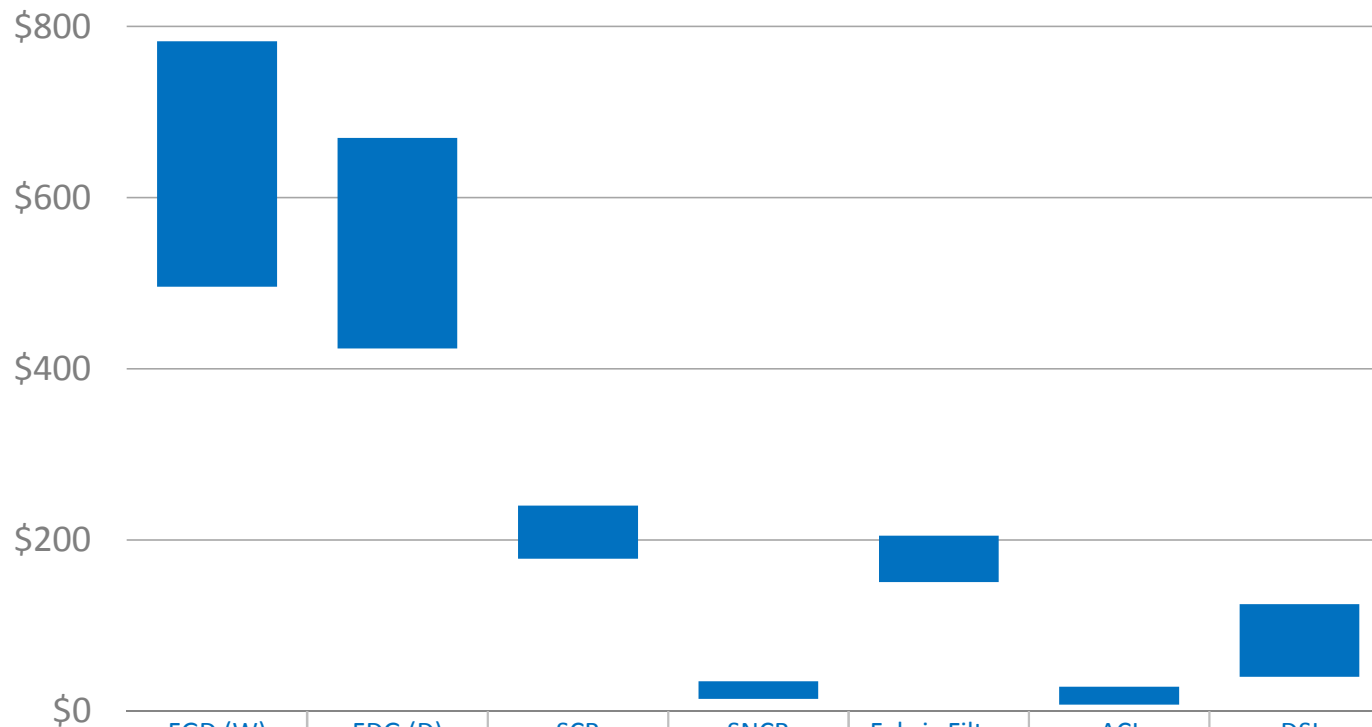
Pollutants				
	Mercury	Hydrogen Chloride	Sulfur Dioxide	Particulate Matter
	Hg	HCl	SO <sub>2</sub>	PM
Activated Carbon Injection (ACI)	Primary			
Wet Scrubber	Co-benefit	Primary	Primary	Co-benefit
Dry Scrubber	Co-benefit	Primary	Primary	Co-benefit
PM Controls (Fabric Filters & ESPs)	Co-benefit			Primary
Dry Sorbent Injection (DSI)	Co-benefit	Primary	Primary	

**Note:** DSI has emerged as a potential control option for smaller, subbituminous coal-fired generating units seeking to control SO<sub>2</sub> and acid gas emissions. EPA’s regulatory impact analysis of the Toxics Rule projects substantial installation of DSIs by the smaller uncontrolled units to achieve compliance.

# Capital Costs

## Control Technology Capital Cost

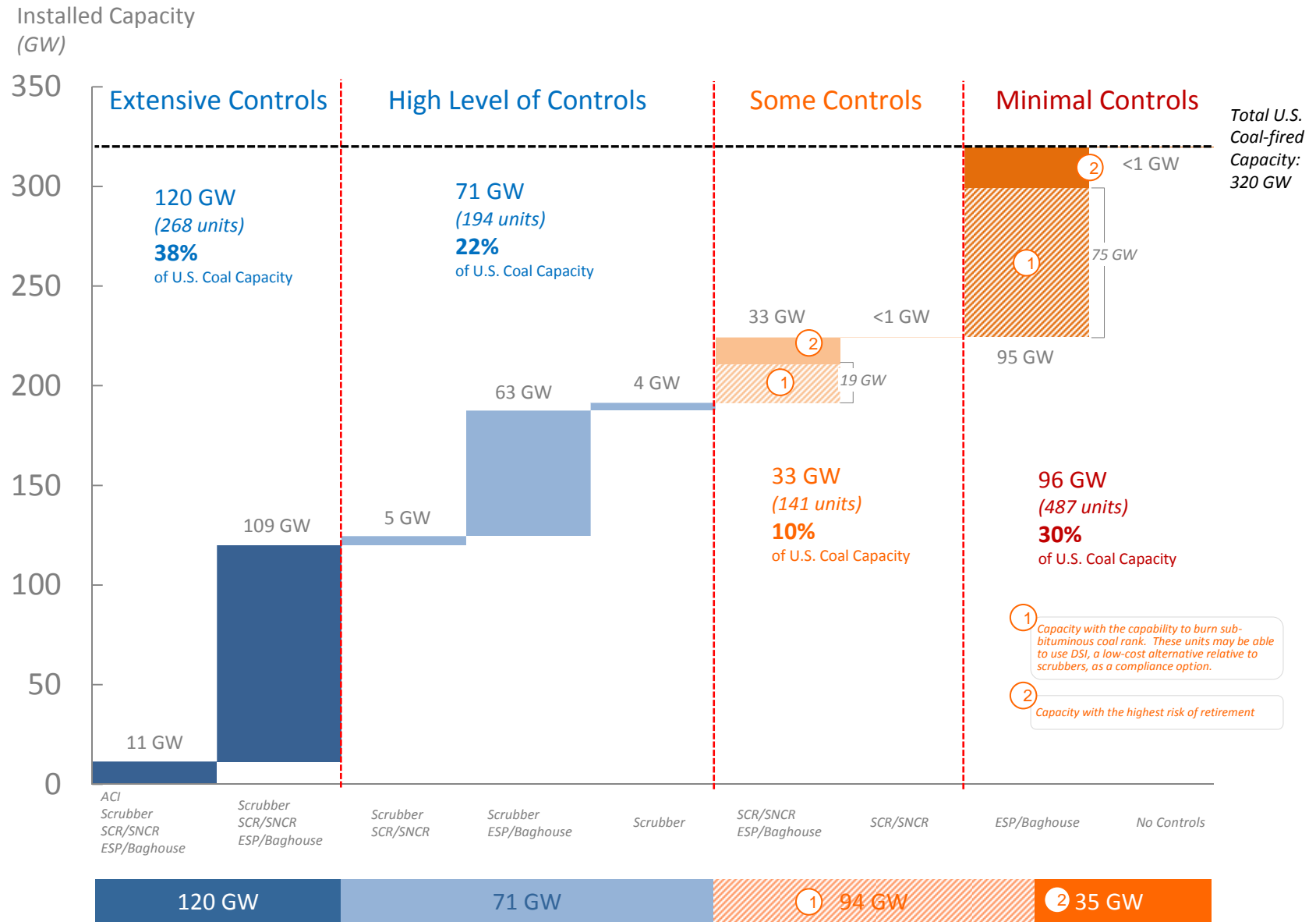
\$/kW



	FGD (W)	FDG (D)	SCR	SNCR	Fabric Filter	ACI	DSI
500 MW	\$496	\$424	\$178	\$14	\$151	\$7	\$40
300 MW	\$573	\$491	\$193	\$19	\$167	\$11	\$57
100 MW	\$783	\$670	\$240	\$35	\$205	\$28	\$125

Source: EPA

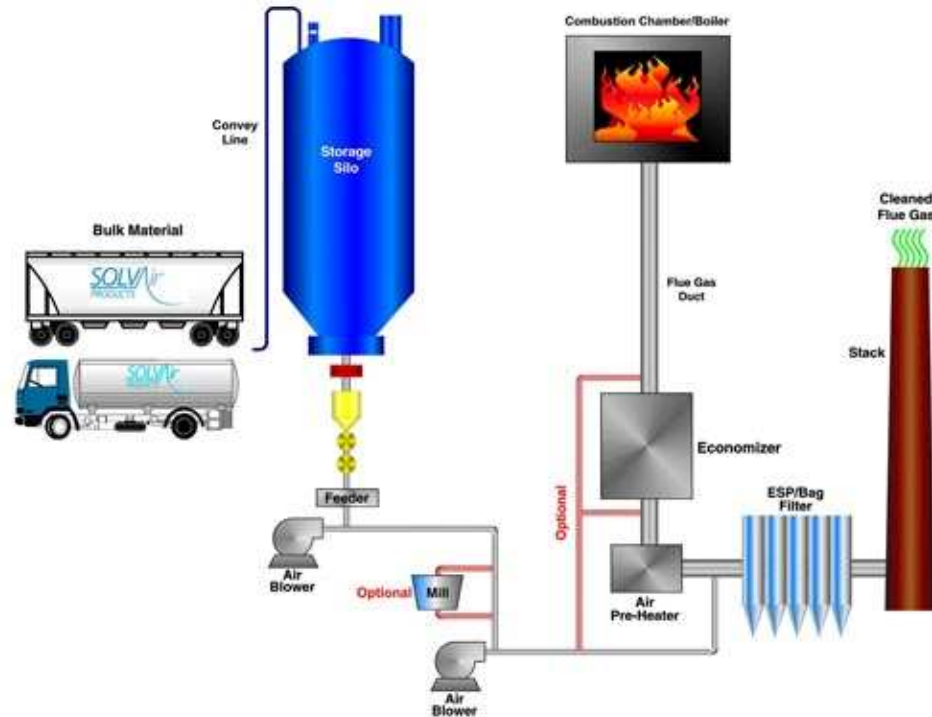
# Profile of Existing U.S. Coal-fired Fleet







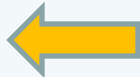
## Dry Sorbent Injection (DSI)

- DSI is used for HCl and SO<sub>2</sub> removal.
- DSI has a low capital cost relative to a wet scrubber. Wet scrubbers typically cost \$400/kw, and DSI systems typically cost between \$50 and \$60/kw.
- DSI technology consists of a relatively simple dry injection system.
- Sorbent is collected with a baghouse or ESP.



Source: Solvair

## Pollution Control Retrofits

Pollution Control Technology	U.S. EPA, EGU MACT Analysis, 2015	U.S. EPA, Transport Rule Analysis, 2014
Wet FGD	1 GW	5.9 GW <i>(wet and dry FGD combined)</i>
Dry FGD	25 GW	
SCR	5 GW	0 GW
DSI	56 GW 	3 GW
ACI	93 GW 	<i>n/a</i>
FF	166 GW 	<i>n/a</i>

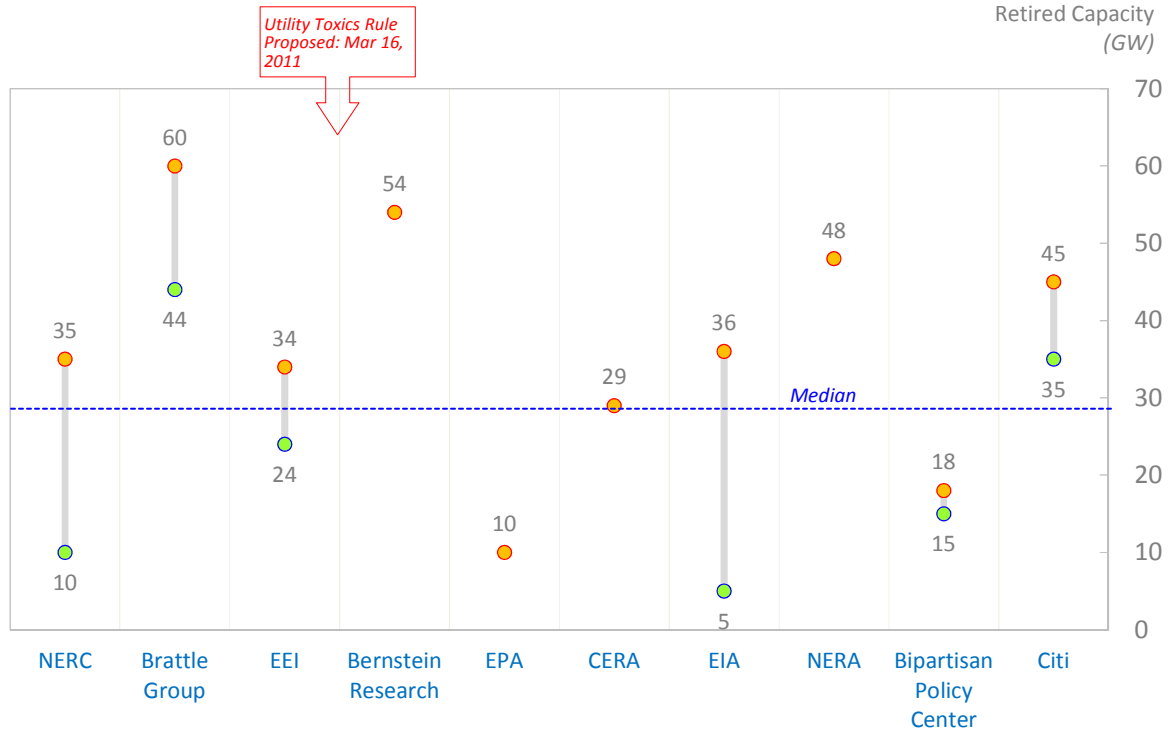
## Proposed Retrofits

Company	Planned Retrofits	Coal Capacity to Retrofit
Midwest Generation	DSI and Fabric Filters	5 GW
Southern Co.	ACI	16 GW
	Fabric Filter	7 GW
	Scrubbers	3.5 GW
Louisville Gas & Electric	New Scrubbers and Scrubber Upgrade	1.5 GW
	ACI and Fabric Filters	2 GW
Kentucky Utilities	ACI and Fabric Filters	3 GW
Kansas City Power & Light	Fabric Filter, SCR, and Scrubber	1.6 GW

# Coal Retirement Projections

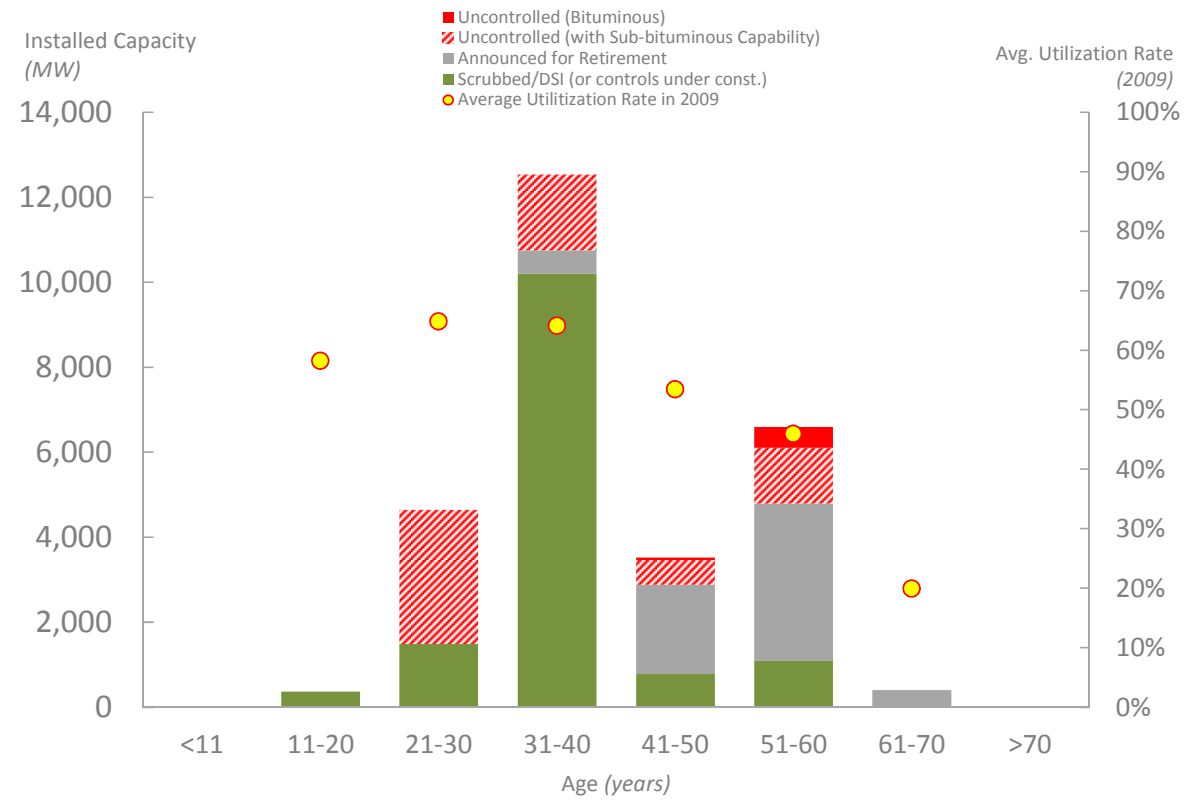
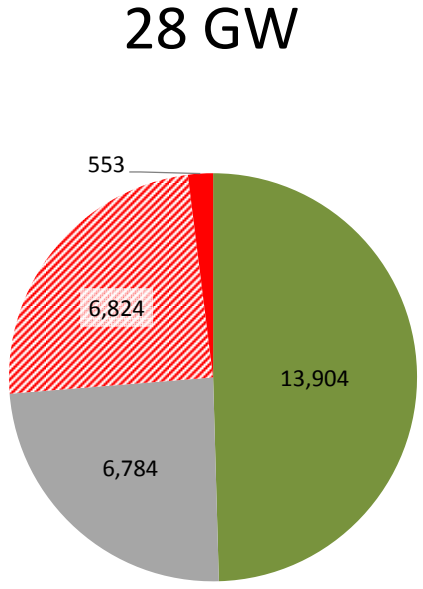
Retirement projections vary widely among studies primarily because of differences in assumptions –

1. Natural gas price and outlook
2. Control technologies available, especially DSI
3. Flexibility in EPA rules
4. Capital cost of control technologies
5. Scope of regulations considered



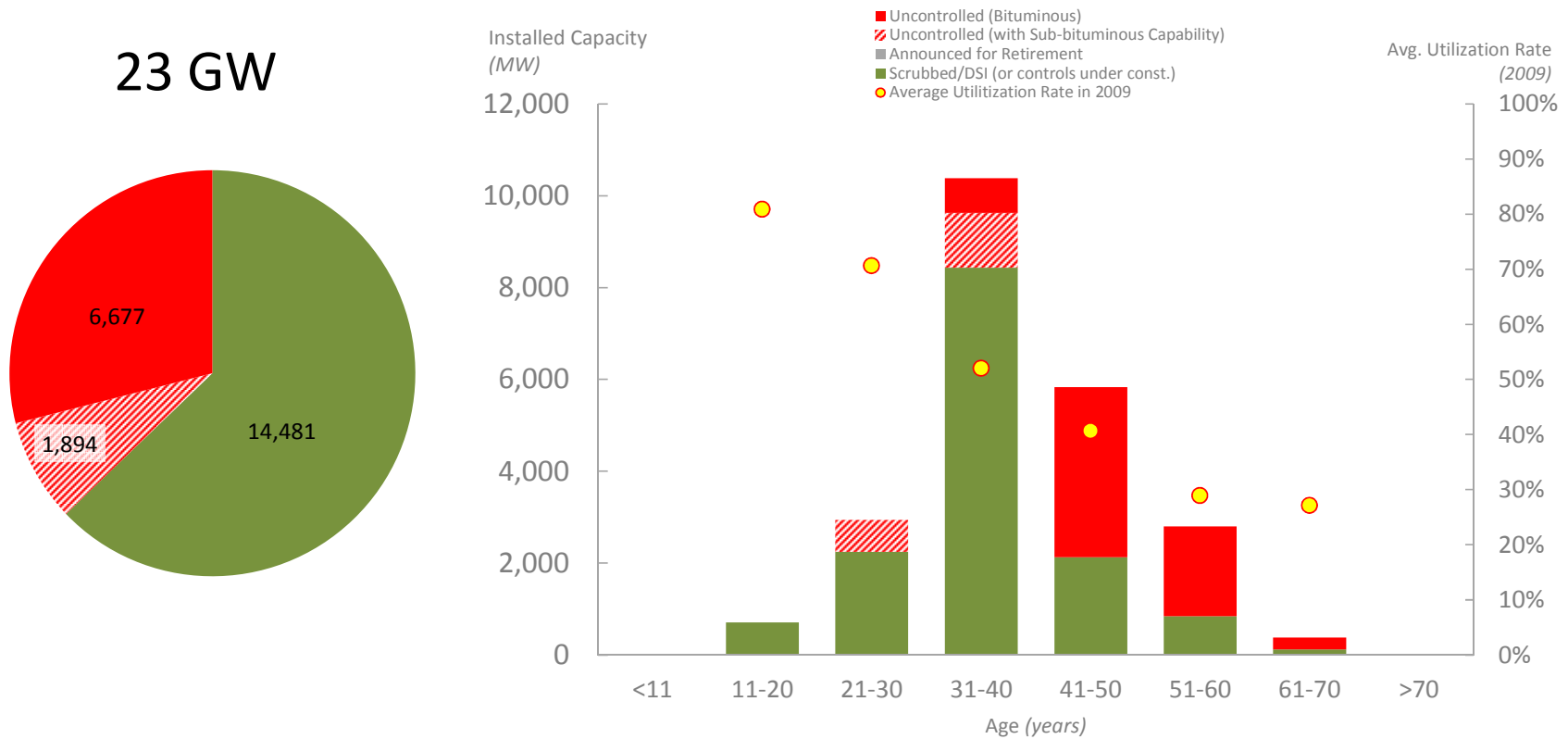
	NERC	Brattle Group	EEI	Bernstein Research	EPA	CERA	EIA	NERA	Bipartisan Policy Center	Citi
Date Released	Oct 2010	Dec 2010	Jan 2011	Mar 2011	Mar 2011	Apr 2011	Apr 2011	May 2011	Jun 2011	Jul 2011
Regulations Considered	Air, Water, Ash	Air, Water	Air, Water, Ash	Air	Air (Toxics Only)	Air, Water	Air	Air	Air, Water, Ash	Air, Water, Ash
Baseline Exclusions	13 GW of announced retirements (may include non-coal units)	6 GW of retirements	22 GW of retirements	12 GW projected to retire due to "unit age"	13 GW of retirements	Figure indicated above is the assumed total	9 GW of retirements	5 GW of retirements	14-17 GW of retirements	Figure indicated above is the assumed total

# AEP – 28 GW of Existing Coal-fired Capacity



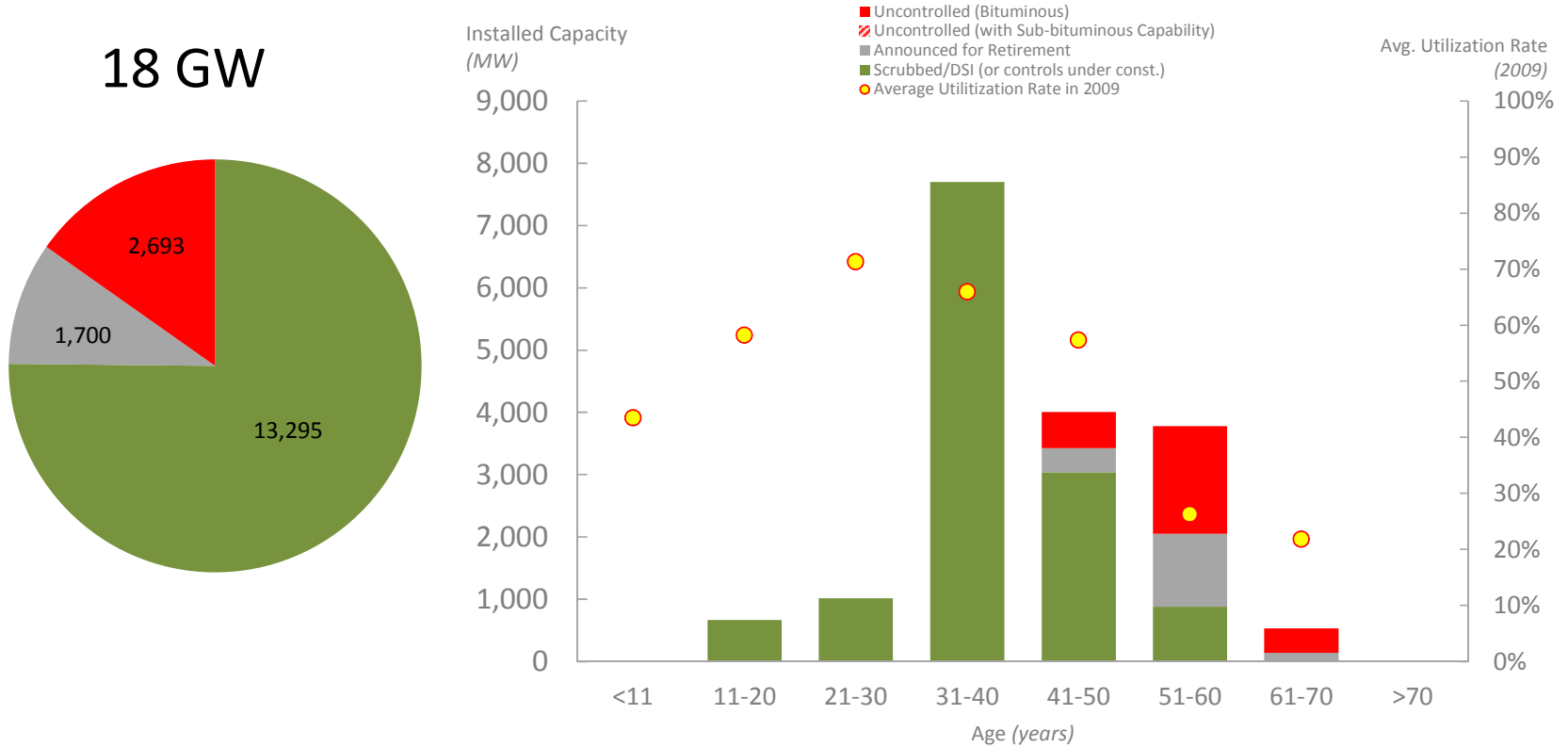
- On June 9, 2011, AEP announced the possible retirement of over 6 GW of coal-fired generating capacity.
- On October 9, 2007, AEP entered into a consent decree requiring the company to retrofit, repower with low sulfur coal or other fuel, or retire 46 units at 16 coal-fired power plants. They include 21 units (almost 5 GW) out of the 27 units marked for closure in the June 9, 2011 announcement.
- AEP plans to build over 2 GW of new or repowered natural gas capacity by 2015.
- The average utilization rate in 2009 of the units announced for retirement was 35%. In contrast, AEP’s well-controlled younger plants ran, on average, almost 60% of the time in the same year.

## Southern – 23 GW of Existing Coal-fired Capacity



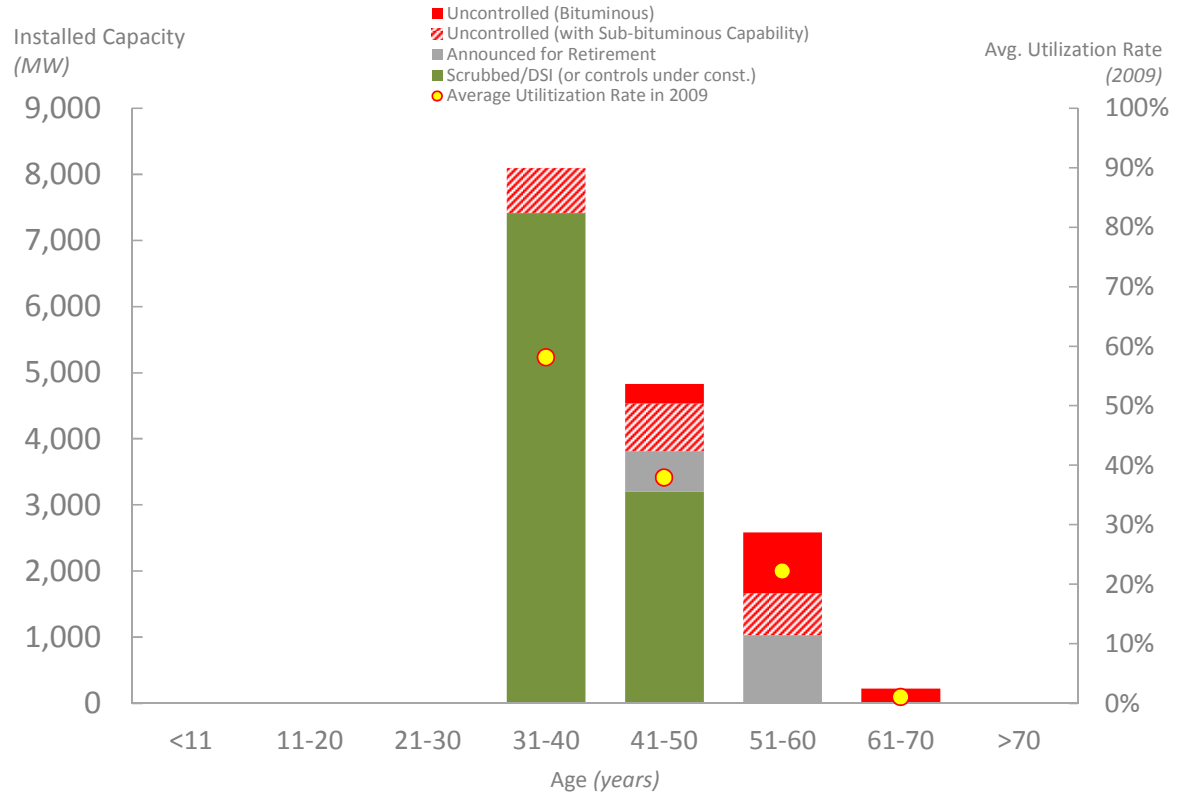
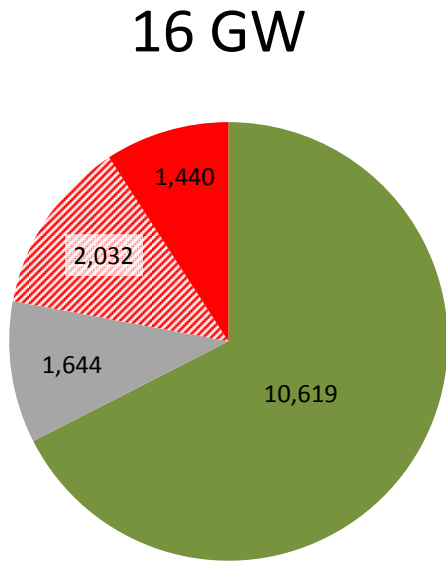
- On July 10, Georgia Power, a utility subsidiary of Southern Company, announced that it intends to close three coal-fired generating units in Georgia. They include two units at Plant Branch and another third unit. These unspecified retirements are not shown on the above charts.
- The company also plans to reduce system demand by 2.6 GW through energy-efficiency programs.

# Duke Energy – 18 GW of Existing Coal-fired Capacity



- The average utilization rate in 2009 of the units announced for retirement was 25%. In contrast, Duke Energy’s well-controlled younger plants ran, on average, over 66% of the time in the same year.

# FirstEnergy – 16 GW of Existing Coal-fired Capacity



- The average utilization rate in 2009 of the units announced for retirement was 33%. In contrast, FirstEnergy’s well-controlled plants ran, on average, nearly 60% of the time in the same year.



## Coal Plant Retirements

Assorted risk management procedures under the Clean Air Act (CAA), Federal Power Act (FPA), and other statutes provide the EPA, DOE, FERC, and the U.S. President an array of tools to moderate, when and where necessary, potential impacts on electric system reliability.

Agency	Source of Authority / Instrument of Implementation	Measure – Examples
Federal Energy Regulatory Commission – Regional Wholesale Electricity Markets (e.g: PJM, ISO-NE, etc.)	Enforcement of Market Rules, Reliability-Must-Run (RMR) agreements, Forward Capacity Markets, etc.	RMR agreements allow units to operate only to ensure reliability while minimizing adverse environmental impacts  Forward capacity markets provide a mechanism to signal the need for new capacity additions
State Public Utility Commissions	Regulatory oversight of utilities	Adopt ratemaking policies that encourage system reliability and environmental goals including ones that address utilities’ financial disincentives where EE and DR programs lower utility revenues
U.S. Department of Energy	Section 202(c) of the Federal Power Act	Override CAA-derived control requirements in limited emergency circumstances
U.S. Environmental Protection Agency	Cap-and-trade based regulations  Section 112(i)(3)(B) of the CAA	Emissions trading mechanisms enable greater compliance flexibility to manage potential reliability concerns  Extend deadlines in Toxics Rule, on a case by case basis, for up to one year to allow for installation of control technologies
U.S. President	Section 112(i)(4) of the CAA	Extend deadlines for the Toxics Rule where necessary to maintain electric system reliability

## Conclusion

### **Significant investments will be required to comply with EPA's air pollution regulations including retrofits, repowering projects, and retirements:**

- The electric industry has extensive experience installing and operating many of the required pollution control technologies.
- The pollution control systems required for compliance have already been deployed on a significant number of coal-fired generating units.
- Some companies have made more progress in terms of installing modern pollution controls.
- A variety of tools are available to manage electricity system reliability as we transition to a cleaner generating fleet.