



COAL POWER
Smart Policies in Support of
CLEANER
STRONGER
ENERGY



Janet Gellici
Chief Executive Officer
National Coal Council

NCC Webcast Presentation

COAL POWER Report
Findings & Recommendations

July 16th, 2020



The Secretary of Energy
Washington, DC 20585

July 3, 2019

Mr. Danny Gray
Chairman
National Coal Council, Inc.
1101 Pennsylvania Avenue, NW, Suite 300
Washington, DC 20004

Dear Chairman Gray:

I am writing today to request the National Coal Council (NCC) develop a white paper assessing smart policies in support of advanced coal-fired power-generation technologies.

The white paper should focus on an industry perspective on the future of advanced coal technologies in the power sector, including carbon capture, utilization, and storage (CCUS); advanced energy systems to enhance energy efficiency and flexibility; high efficiency-low emissions technologies; small modular coal power plant technologies; and transformational technologies, such as supercritical CO₂ cycles and pressurized oxy-combustion.

The report would address how various regulatory and legislative policies could be employed to enhance and accelerate the deployment of these technologies. The prospective policies would include, but are not limited to:

- For CCUS: 45Q Federal Tax Incentive, USE IT Act, Master Limited Partnerships, Private Activity Bonds
- EPA's New Source Review Regulation
- Public Utility Regulatory Policies Act
- EPA Regulations on Coal Combustion Residuals and Effluent Limitation Guidelines
- Wholesale Electricity Markets
- State Initiatives and State Public Utility Commission Regulatory Oversight
- The newly-authorized U.S. International Development Finance Corporation
- Energy Infrastructure

Key questions to be addressed include:

- What regulatory and legislative initiatives could be advanced to help accelerate the deployment of coal-fired power-generation technologies?
- What coal-fired power-generation technologies would benefit from regulatory and legislative reforms?
- What energy infrastructure initiatives would support the deployment of advanced coal-fired power-generation technologies?

- ▶ Energy Secretary Rick Perry
- ▶ Assess smart **policies** in support of advanced coal generation technologies
- ▶ Power Sector Technologies
Existing & New Coal Generation
 - ▶ CCUS
 - ▶ Energy Efficiency/Flexibility
 - ▶ HELE
 - ▶ Small modular
 - ▶ Transformational
- ▶ Regulations & Legislation
 - ▶ 45Q
 - ▶ NSR
 - ▶ PURPA
 - ▶ CCR/ELG
 - ▶ Wholesale Markets
 - ▶ Int'l Development Finance Corp.
 - ▶ **State and Public Utility Commission**
- ▶ Energy Infrastructure



Report Leadership

Co-Chairs

Kipp Coddington

School of Energy Resources
University of Wyoming

John Harju

Energy & Environmental Research Center
University of North Dakota

▶ Chapter Leads

- ▶ Jeff Bloczynski, America's Power
- ▶ Kipp Coddington, Univ. of Wyoming
- ▶ Janet Gellici, NCC
- ▶ Neeraj Gupta, Battelle
- ▶ Jared Hawkins, Battelle
- ▶ Josh Stanislawski, EERC/Univ. ND

▶ Executive Editor

- ▶ Janet Gellici, NCC

▶ Contributors & Reviewers

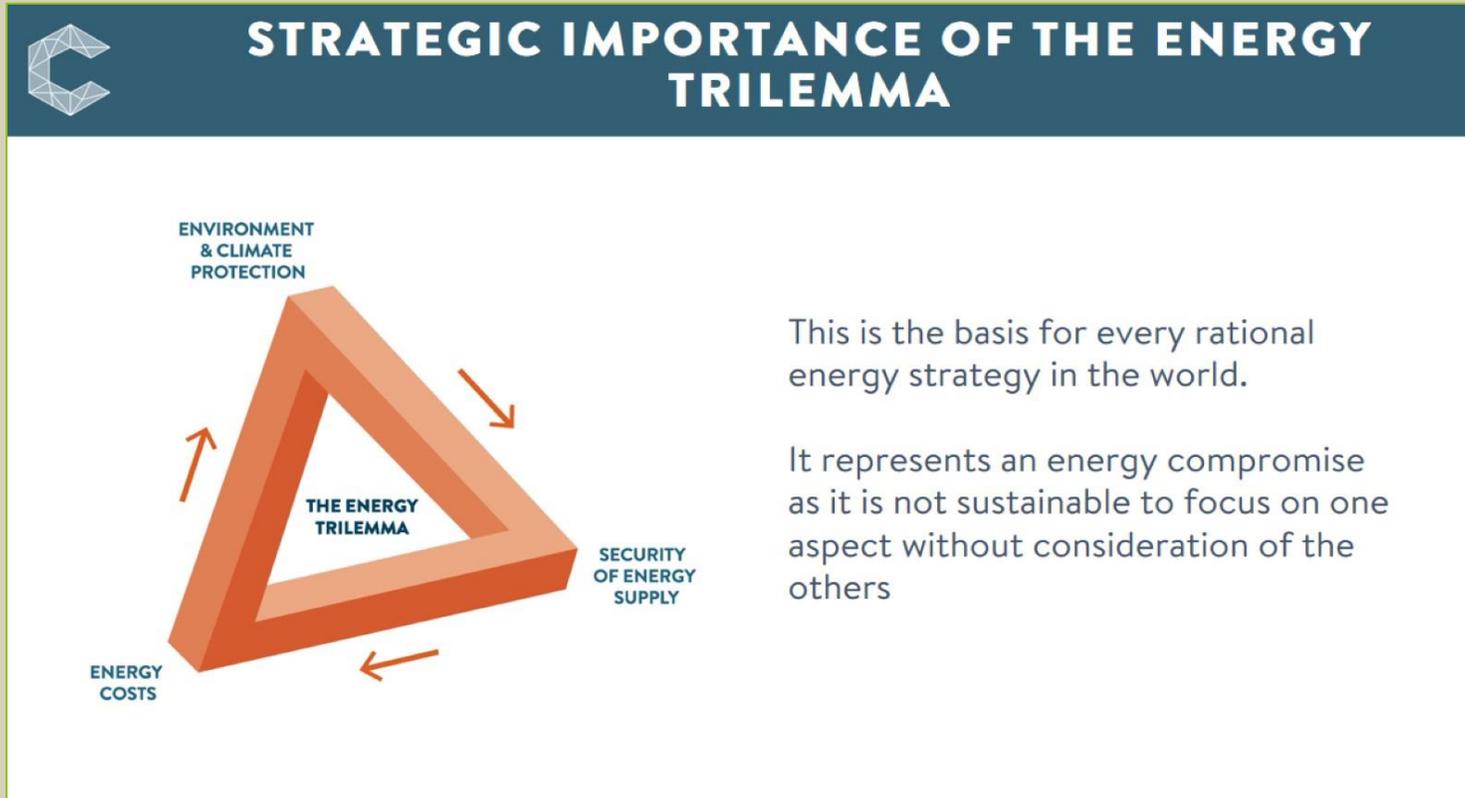
- ▶ Over 50 NCC Members & Associates

Chapter 1. Background

Key Findings

- Advanced coal generation technologies deliver significant benefits for the U.S. in furtherance of national security, energy, economic and environmental objectives.
- U.S. energy policy fails to adequately incentivize advanced coal generation technology deployment.
- Financial and insurance institutions' policies restricting funding/services for coal projects inhibit deployment of advanced coal technologies.
- Significant loss of coal generation capacity and lack of new capacity increases power prices and threatens grid reliability/resilience.

The Energy Trilemma

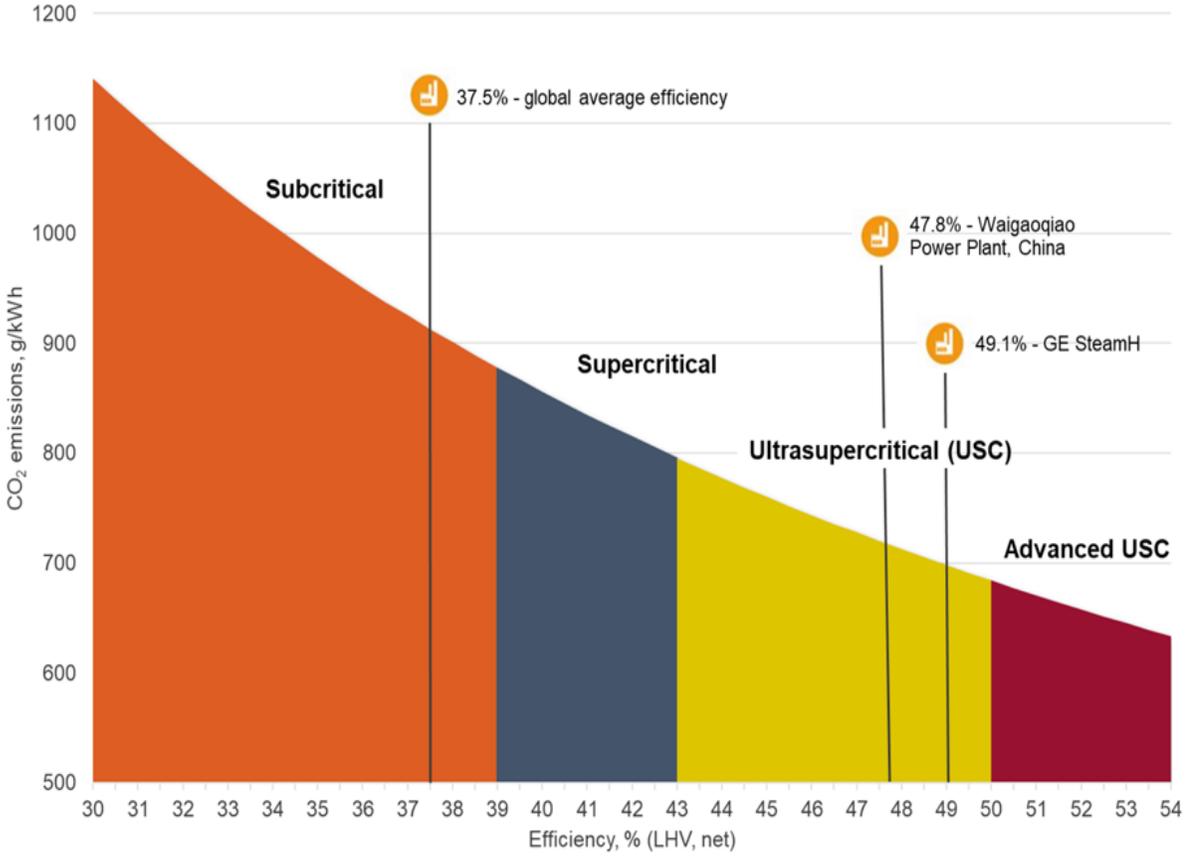


Source: International Energy Agency

The Value of Efficiency Improvements for Reduction of CO₂ Emissions

Potential for ~2 Gt of CO₂ savings if global average brought to state of the art

USC not strictly defined – broadly refers to use of material advances since the 1990s



Source: International Energy Agency

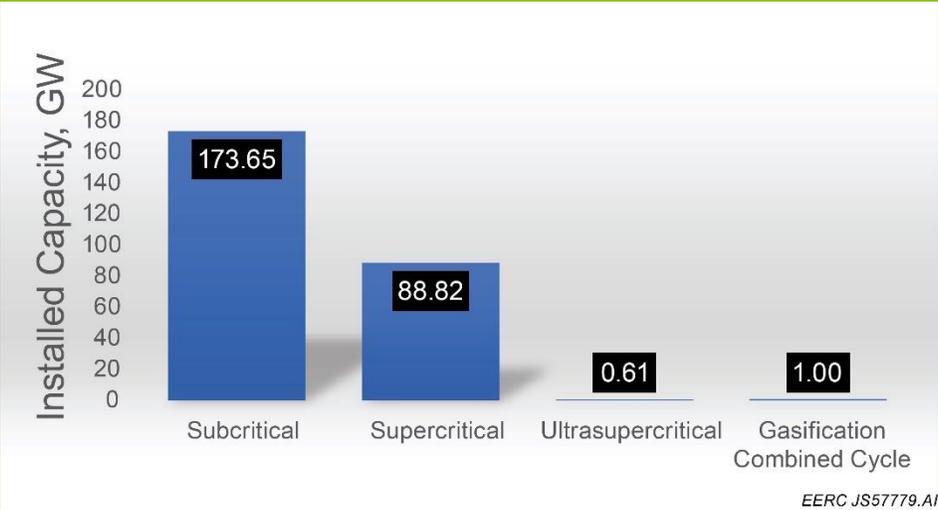
International & U.S. Deployment of Advanced Coal Generation Technologies

Worldwide Ultra-Supercritical Coal Capacity

REGION	IN OPERATION
	2018
Asia	224203
Europe	19208
Middle East	0
Eurasia	300
North America	665

Source: International Energy Agency

U.S. Installed Generation Capacity 2018



Source: U.S. Energy Information Administration



Chapter 2. Coal Generation Technologies

Key Findings

- Efficiency improvements are critical for reducing CO₂ emissions at both existing and new coal power plants.
- There is significantly limited deployment of advanced, highly efficient coal generation technologies in the U.S. today.
- The U.S. lags other nations in deployment of high efficiency-low emissions (HELE) technologies, hindered by higher capital costs and regulatory burdens.
- A greater investment in advanced coal generation technology R&D is needed, including enhanced support for demonstration and commercial-scale projects.

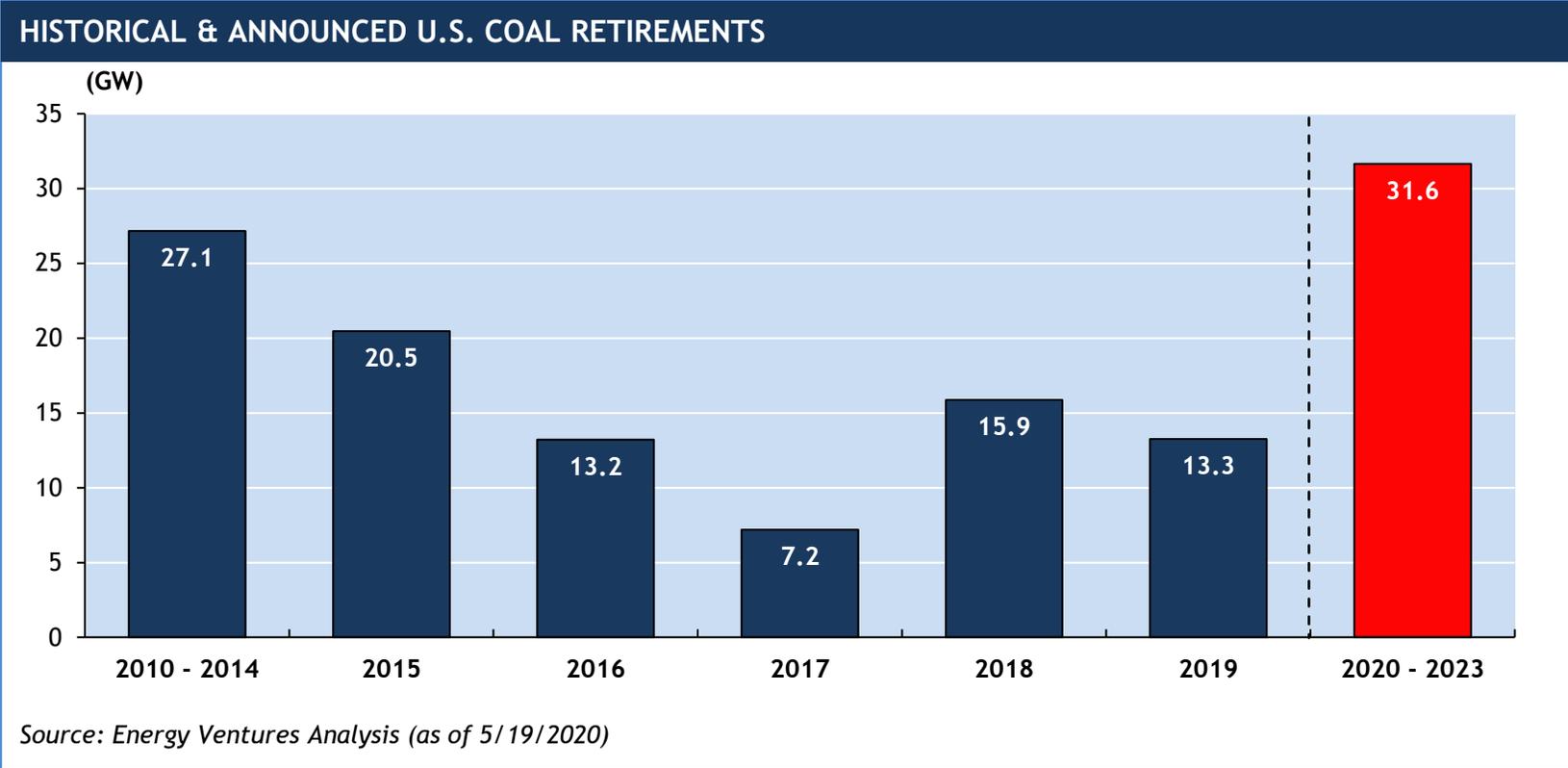
Advanced Coal Generation Technologies: Deployed and Under Development

Technology	Retrofit	New Plants	Flexible	Innovative	Resilient	Small	Transformational
Currently Deployed Technology							
USC	X	X	X	X	X	X	X
IGCC	X	X	X	X	X	X	X
Post-combustion CCUS	X	X	X	X	X	X	X
Technologies Under Development							
AUSC	X	X	X	X	X	X	X
sCO ₂	X	X	X	X	X	X	X
Post-combustion CCUS	X	X	X	X	X	X	X
Oxy-Combustion	X	X	X	X	X	X	X
Pressurized Oxy-Combustion	X	X	X	X	X	X	X
PFBC	X	X	X	X	X	X	X
Chemical Looping	X	X	X	X	X	X	X

Matrix of Technologies Related to Coal FIRST Energy Objectives



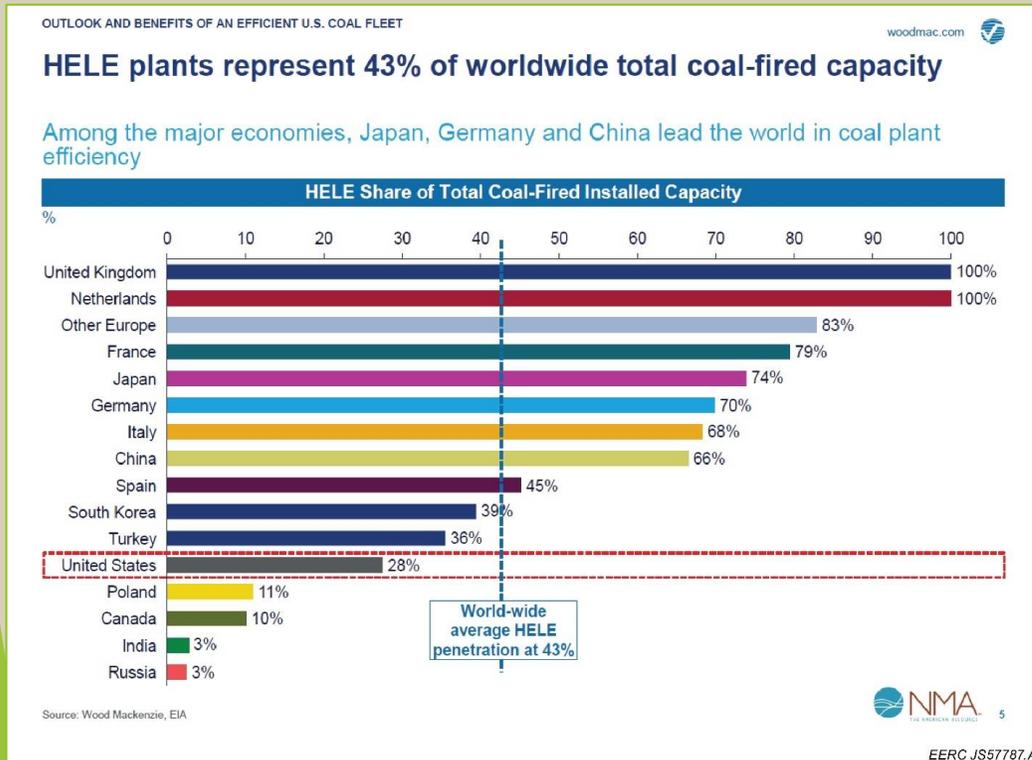
Existing U.S. Coal Fleet



Source: Energy Ventures Analysis



New Coal Generation - High Efficiency-Low Emissions



HELE Technologies and Efficiency Improvements

	Efficiency Rate*	CO ₂ Intensity	Coal Consumption	Steam Temperature
Advanced Ultra-Supercritical	45-50%	670-740g CO ₂ /kWh	230-320g/kWh	700°C+
Ultra-Supercritical	Up to 45%	740-800g CO ₂ /kWh	320-340g/kWh	600°C+
Supercritical	Up to 42%	800-880g CO ₂ /kWh	340-380g/kWh	Approx. 550°C-600°C
Subcritical	Up to 38%	>880g CO ₂ /kWh	>380g/kWh	≤550°C

* Lower heating value

Source: Adapted from IEA, *Technology roadmap: High-efficiency, low-emissions coal-fired power generation*, 2012

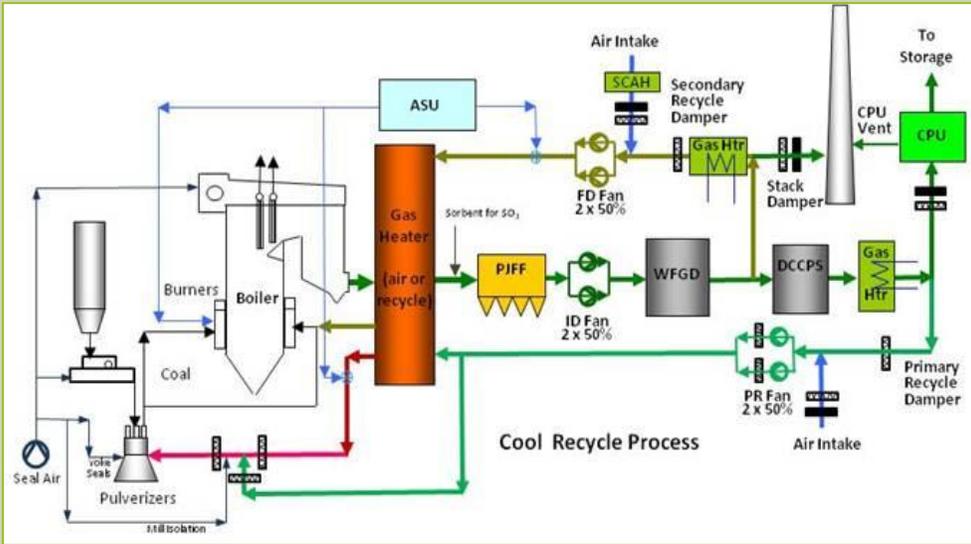
EERC JS57784.AI

Source: EERC – IEA Technology Roadmap

Source: National Mining Association/Wood Mackenzie

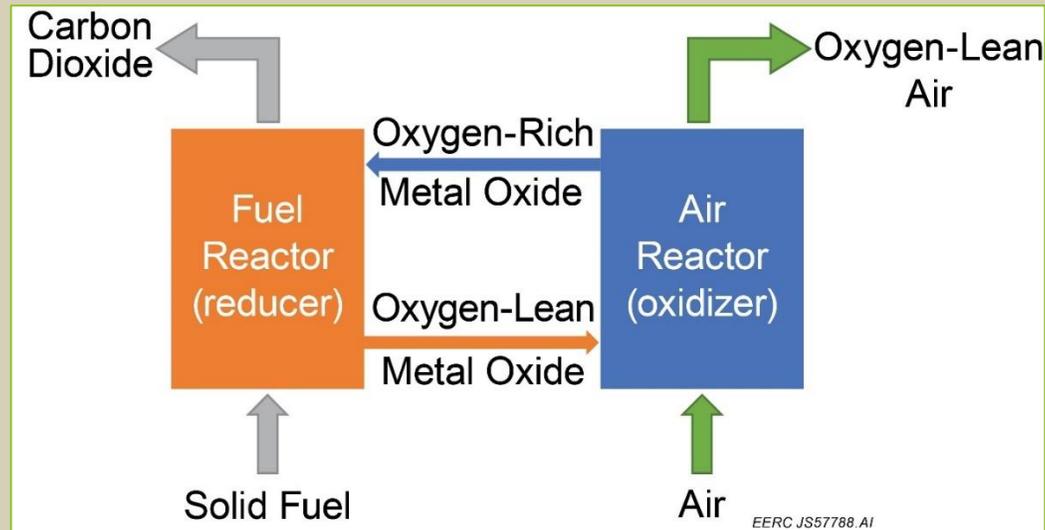


New Coal Generation - Transformational

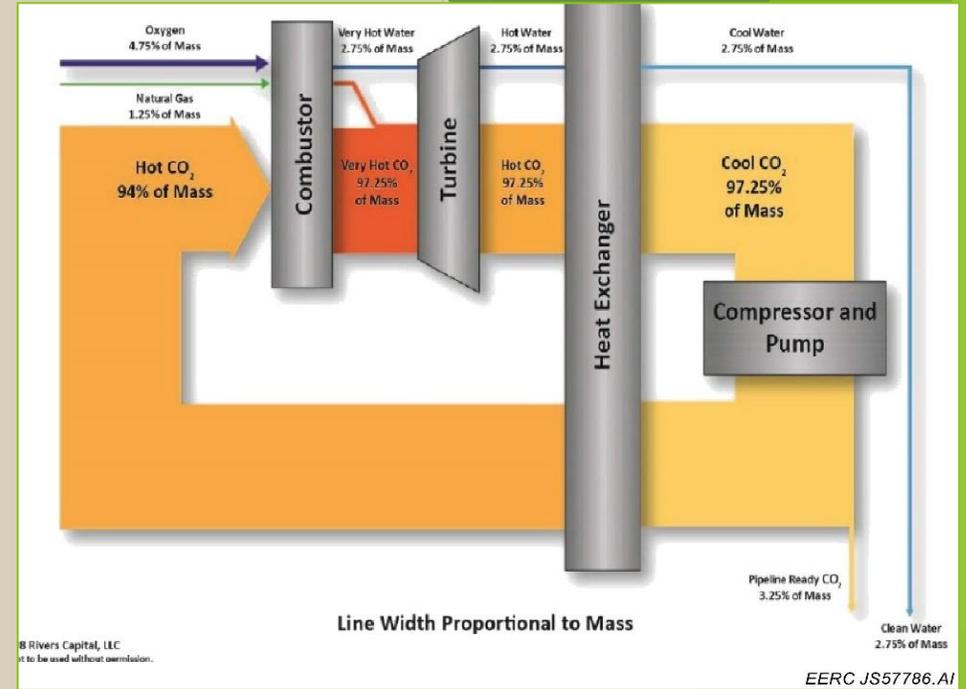


Oxy-Combustion
Source: Babcock & Wilcox

Chemical Looping
Source: EERC



EERC JS57788.AI



Line Width Proportional to Mass

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Allam-Fetvedt Cycle
Source: 8 Rivers Capital, LLC

Chapter 3. Federal Regulation & Legislation

Key Findings

- Advanced coal generation technologies face three main challenges:
 - Cost/Financial Risk - competitive challenges from low-cost natural gas and a limited deployment track record; new technology cost curves
 - Regulatory Risk - Federal and state carbon reduction programs
 - Shareholder/Investor Risk - Environmental/Societal/Governance (ESG) initiatives
- Public engagement of key stakeholders can enhance prospects for the successful deployment of coal generation technologies

Federal Support Opportunities

- Initiatives to Advance R&D
- Initiatives to Minimize Cost & Risk
- Initiatives to Bolster Emissions Abatement
- Initiatives to Address Regulatory Risk & Burdens
- Initiatives to Reform Energy Markets
- Initiatives to Support Energy Infrastructure

Technology	CCUS	HELE	USC/AUSC	Allam Cycle	Oxy-Combustion	Other Transformational	Small Modular	Energy Infrastructure	Other	Coal Conversion & Utilization	Exports Coal & Coal Technology
Policy											
Initiatives to Advance R&D											
Coal FIRST	x	x	x	x	x	x	x				x
EFFECT Act	x	x	x	x	x	x	x			x	x
Fossil Energy R&D	x		x	x	x	x	x				
Technology Transitions Act	x	x	x	x	x	x	x				
Initiatives to Minimize Cost & Risk											
45Q	x										
Master Limited Partnerships	x								x		
Private Activity Bonds	x										
BEAT Tax Relief	x										
48A	x	x	x								
Technology Neutral Tax Credit	x	x	x	x	x	x	x				
USDA RUS Leg.	x									x	
Contracts for Differences	x	x	x	x	x	x					
LPO Reforms	x	x	x	x	x	x					
Development Finance Corp	x	x	x	x	x	x	x	x	x		x
Initiatives to Bolster Emissions Abatement											
Clean Energy Standard	x	x	x	x	x	x	x				
Affordable Clean Energy	x				x						
Initiatives to Address Regulatory Risk & Burden											
USE IT Act	x							x			
NSR/Gain Act	x	x									
Coal Combustion Residuals								x	x	x	x
Effluent Limitation Guidelines									x		
Initiatives to Reform Energy Markets											
PURPA	x	x	x	x	x	x					
Capacity Market Reforms	x	x	x	x	x	x					
Initiatives in Support of Energy Infrastructure											
LIFT America Act								x			
INVEST CO ₂ Act								x			
FAST Act								x			

Initiatives to Advance R&D

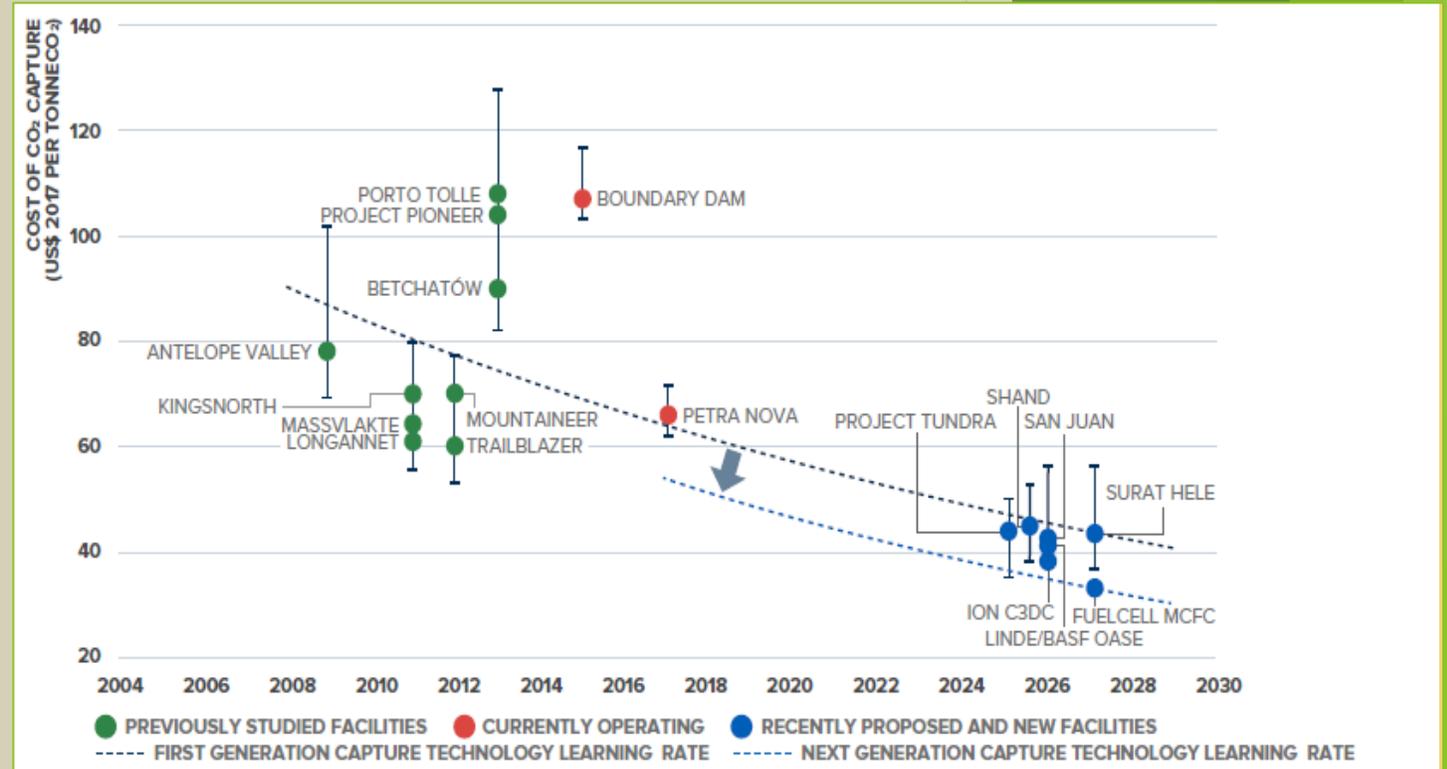
Legislative & Regulatory Initiatives

- The EFFECT Act - Enhancing Fossil Fuel Carbon Technology Act of 2019
- Fossil Energy Research & Development Act
- Technology Transitions Act

Coal FIRST: Small-scale Modular Coal Plants

Niche Market Applications

- Small capacity combustion & gasification units for co-fueling coal and biomass/waste
- Replacement of more costly diesel-fueled plants
- On-site coal mining operations for coal drying and other local applications
- Remote off-grid locations with limited access to other energy resources
- Captive power plants at industrial facilities



Cost of Coal Plant CO₂ Capture
Source: Global CCS Institute

Initiatives to Minimize Cost & Risk

Legislative & Regulatory Initiatives

- Section 45Q Tax Credit
- Master Limited Partnerships
- Private Activity Bonds
- BEAT Tax Relief
- Section 48A Tax Credit Reform
- Technology Neutral Tax Credit

Program Initiatives

- USDA Rural Utilities Service
- Contracts for Differences
- DOE Loan Guarantee Program
- Stakeholder Engagement
- U.S. Int'l Development Finance Corporation

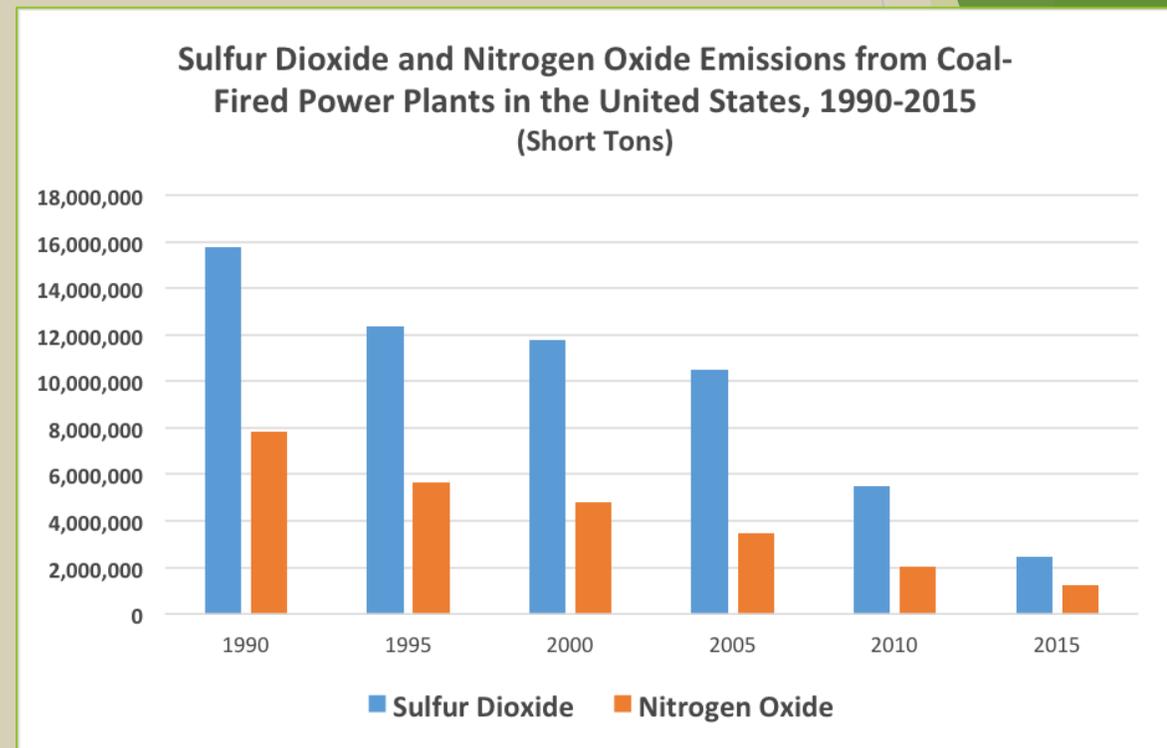
Perceived risk	Risk rating	Debt rate risk premium
Cross-chain	25	2.7%
Policy and revenue	20	2.2%
Storage liability	10	1.1%
Leakage	10	1.1%
Stranded asset	10	1.1%
Political risk	6	0.7%
Project financing	4	0.4%
Market design and regulation	3	0.3%
Social acceptance	3	0.3%
Operating and performance	3	0.3%
Legal system	3	0.3%
Construction	2	0.2%
Administrative risk	2	0.2%
CCUS risk premium		10.9%

Perceived Risk of CCUS Projects
Source: International Energy Agency

Initiatives to Bolster Emissions Abatement

Legislative & Regulatory Initiatives

- Clean Energy R&D
- Clean Energy Standards
- Affordable Clean Energy Rule

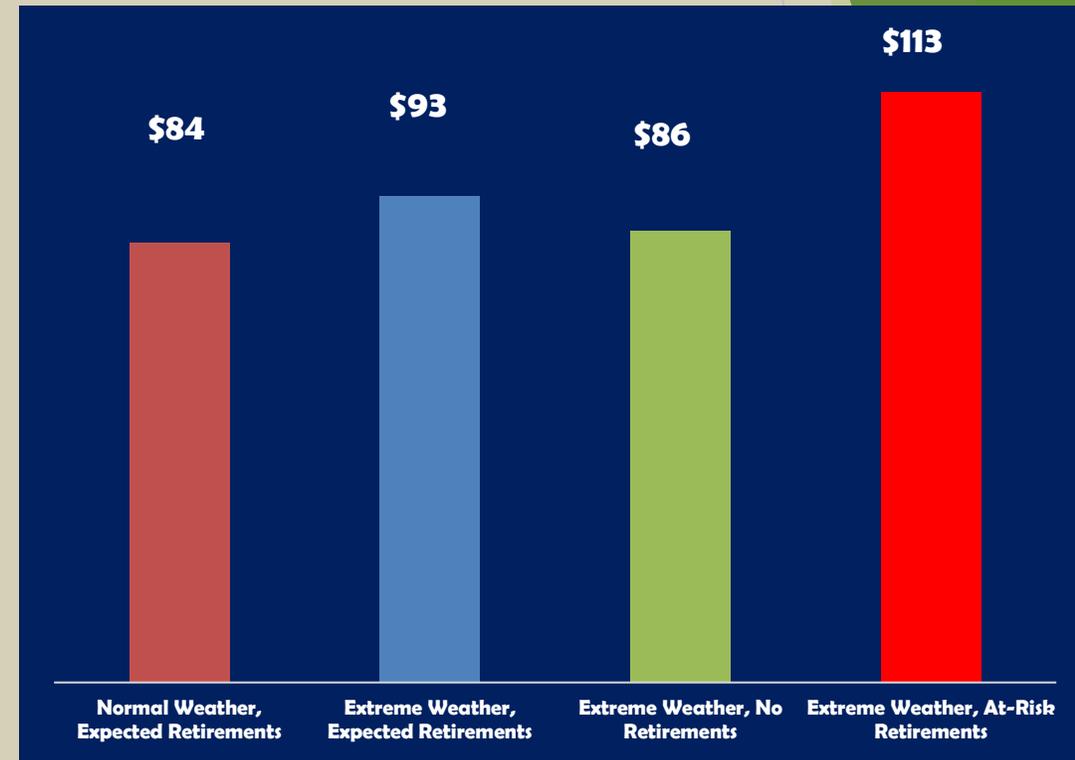


Source: EIA

Initiatives to Address Regulatory Risk & Burden

Legislative & Regulatory Initiatives

- USE IT Act - Utilizing Significant Emissions with Innovative Technologies
- New Source Review Reforms - GAIN Act (Growing American Innovation Now)
- Coal Combustion Residuals
- Effluent Limitation Guidelines

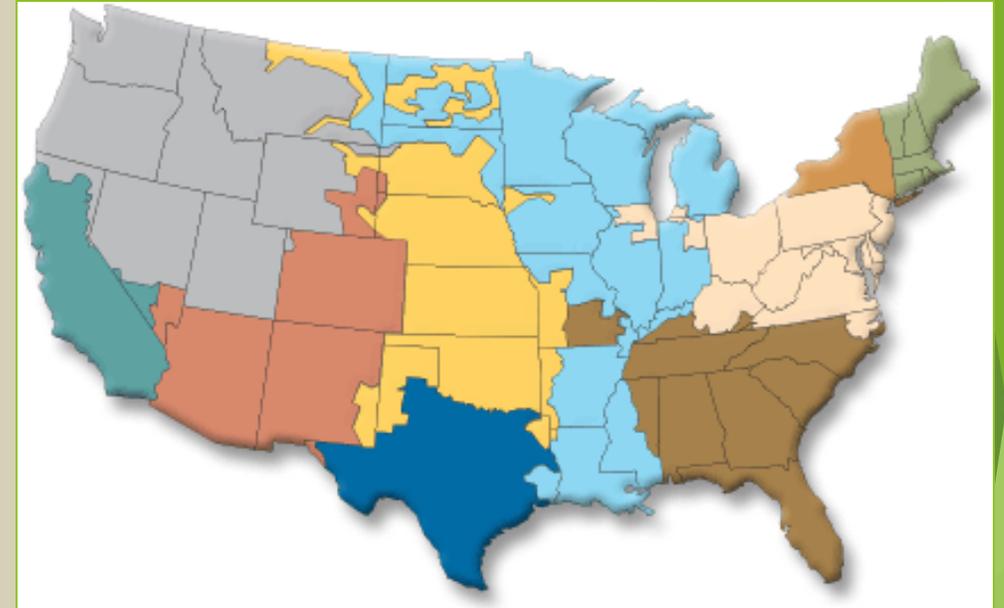


Cost of Electricity (\$billion)
Source: America's Power

Initiatives to Reform Energy Markets

Legislative & Regulatory Initiatives

- PURPA - Public Utility Regulatory Policies Act
- Wholesale Electricity Market Reforms



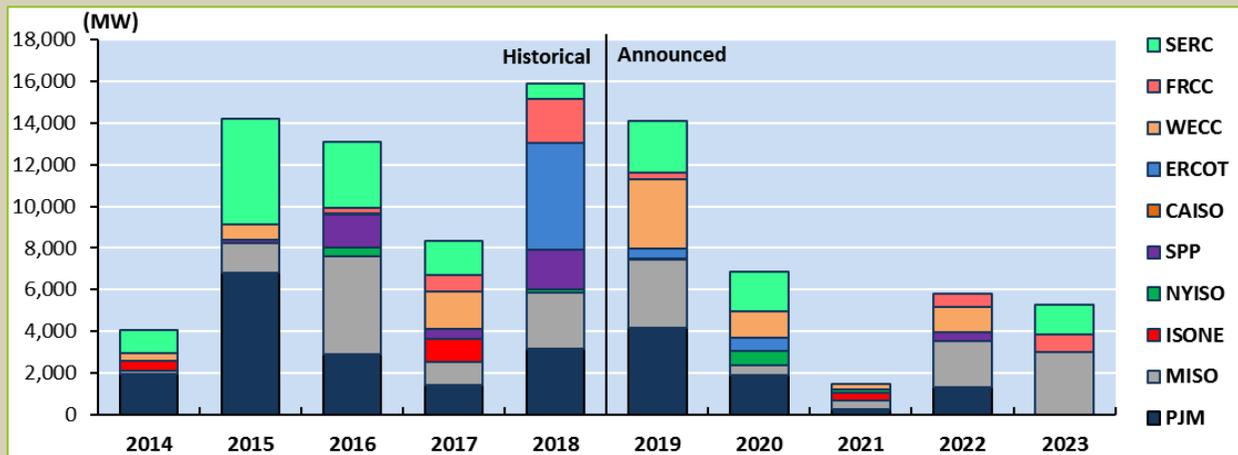
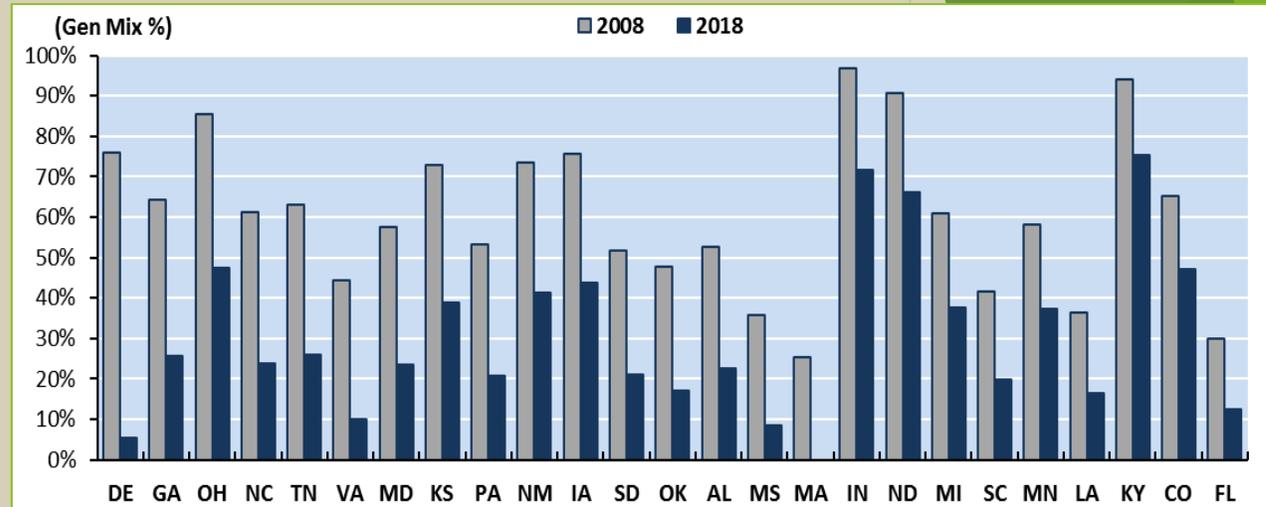
U.S. ISOs & RTOs
Source: FERC

Chapter 4. State-Regional-Tribal Initiatives

Key Findings

- States can take a unique leadership role in accelerating deployment of advanced coal generation technologies.
 - Regulatory certainty.
 - Infrastructure planning.
 - Streamlined permitting.
 - Technology & infrastructure investment incentives.
- Intra-state and regional cooperation among states, universities, industry and NGOs can support advanced technology deployment.
- State public utility regulators have tools at their disposal for bolstering the reliability and resilience of the power grid, advanced adoption of CCUS technologies, and extending the life of the existing coal fleet.
- Tribal entities must play an active role in establishing and implementing energy policies that support coal utilization.

Challenges for State Energy Regulators



Top 25 Declines in Coal Generation Share
By State 2008 vs. 2018
Source: NARUC/EVA

Historical Coal Retirements by Power Market
2008 to 2018
Source: NARUC/EVA

State Public Utility Commission Initiatives

Support for Advanced Coal Technology Deployment

- Clean Energy Standards
- Low-carbon Credits
- Cost Recovery for CCUS
- Pre-approval of Project Siting



Renewable Portfolio Standards
Source: NCSL

State Support for Coal Technologies

Legislative & Regulatory Initiatives

- Regulatory Certainty
- Clean Energy Standards
- R&D Support
- Expediting Coal Project Permitting
- Tax Incentives
- Measured Approach to Coal Plant Retirements

	GA	IN	IA	KY	MT	ND	OH	OK	VA	WV	WY
Financial Support	x			x	x						
Reliability & Resilience		x		x	x		x			x	x
R&D Support						x	x				
Regulatory Certainty			x			x					
Permitting & Environment	x		x						x		x
Tax Incentives				x	x	x		x		x	x

Intra-State/Regional/Tribal Support

- Intra-State
 - Collaborative efforts among state governments, universities, industry and NGOs
- Regional
 - State Carbon Capture Work Group
- Tribal
 - Sovereign Immunity
 - Energy Resource Agreements
 - Self-Determination

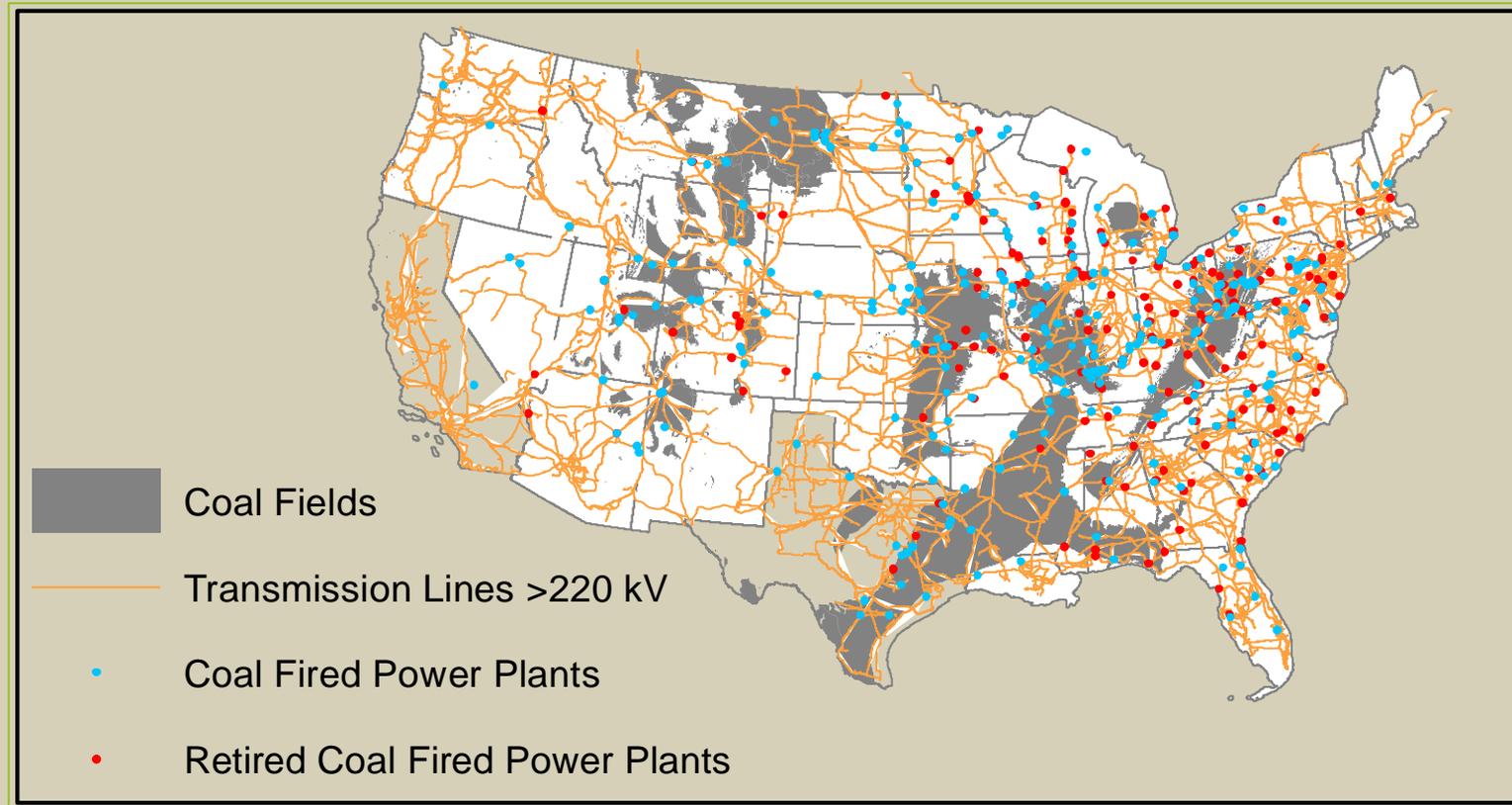
- State-specific Coal Technology Initiatives
 - Colorado - Comanche Generating Station
 - Illinois - Prairie State Energy Campus
 - New Mexico - San Juan Generating Station
 - North Dakota - Project Tundra
 - Texas - Texas Municipal Utilities
 - Wyoming - Dave Johnston CCUS-EOR Project
 - Wyoming - Dry Fork Station

Chapter 5. Energy Infrastructure

Key Findings

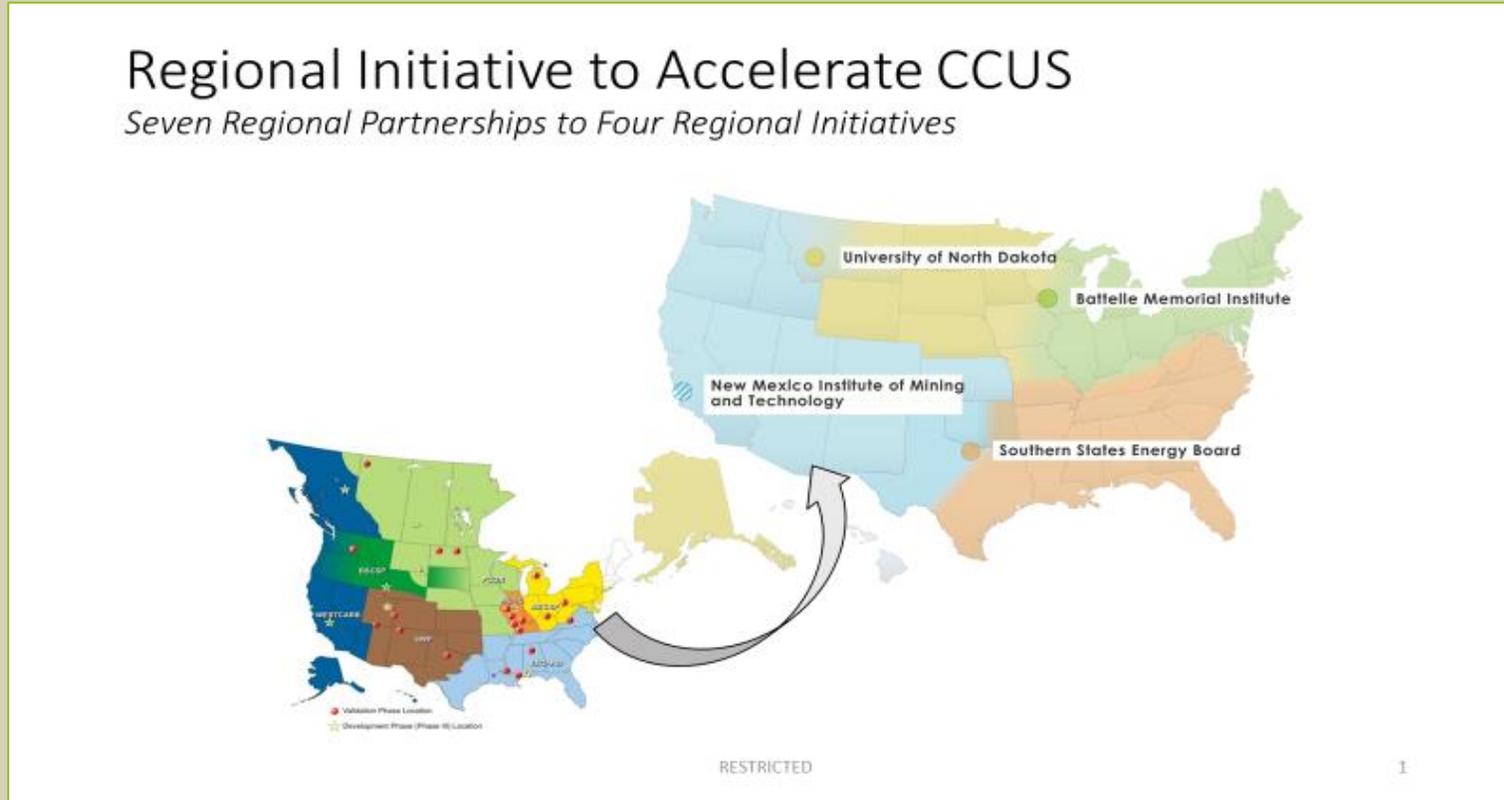
- Maintenance of existing energy infrastructure and development of new infrastructure are critical to ensuring the technical and environmental viability of the nation's energy grid.
- Policy and financial certainty are an important consideration for the development of CCUS infrastructure.
- Research, Development & Demonstration (RD&D) projects are needed to prove the economic viability of full-scale CCUS systems for widespread deployment.

Power Generation & Transmission Infrastructure



U.S. Coal Fields, Transmission Lines & Coal Power Plants
Source: EIA, USGS, HIFLD

CCUS Infrastructure



CCUS Regional Partnerships/Regional Initiatives
Source: Battelle

Demonstration Projects

Policies & project characteristics	 Carbon tax	 Tax credit or emissions credit	 Grant support	 Provision by government or SOE	 Regulatory requirement	 Enhanced oil recovery	 Low cost capture	 Low cost transport and storage	 Vertical integration
US									
Terrell						○	●	●	
Enid Fertiliser						○	●	●	
Shute Creek					●	○	●	●	
Century Plant		●				○	●		
Air Products SMR		●	○			○			
Coffeyville		●				○	●		
Lost Cabin		●				○	●		
Illinois Industrial		●	○				●	●	●
Petra Nova		●	○			○			
Great Plains						○	●		
Canada									
Boundary Dam			○	●	●	○		●	
Quest		●	○						●
ACTL Agrium			○			○	●		
ACTL Sturgeon			○			○	●		
Brazil									
Petrobras Santos				●		○	●	●	●
Norway									
Sleipner	●			●			●	●	●
Snohvit	●			●	●		●		●
UAE									
Abu Dhabi CCS				●		○		●	
Saudi Arabia									
Uthmaniyah				●		○	●	●	●
China									
CNPC Jilin				●		○	●	●	●
Sinopec Qilu*				●		○	●	●	
Yanchang*				●		○	●		
Australia									
Gorgon			○		●		●	●	●

CCUS Demonstration Projects
Source: Global CCS Institute

Chapter 6. Recommendations

Key Sectors

- U.S. Department of Energy Recommendations
 - Support for R&D
 - Support for Technology Projects
 - Small-scale Modular Coal Plants
- Federal Policy Recommendations
 - Initiatives to Advance R&D
 - Initiatives to Minimize Cost & Risk
 - Initiatives to Bolster Emissions Abatement
 - Initiatives to Address Regulatory Risk & Burden
 - Initiatives to Reform Energy Markets
- State/Regional/Tribal Recommendations
- Energy Infrastructure Recommendations

It's URGENT!

- By 2030 -
 - Retrofit a critical mass of existing coal power plants with carbon capture and efficiency enhancing technologies.
 - More fully demonstrate the viability and maturity of these technologies and their availability through competitive bids from multiple vendors.
- By 2035 -
 - Establish a growing network of CO₂ storage sites and pipelines approximately five times larger than what exists today.
 - The network will need to expand over time to meet 2050 needs of the power and industrial sectors.
- By 2040 -
 - A variety of new coal plant technologies will need to be commercially available, cost competitive and have a near-zero emissions profile.

By 2030 - Retrofit Existing Coal Fleet with Advanced Technology

PRIORITIES

- Enhance utilization of 45Q Tax Credits
- Government risk-sharing and incentives

By 2035 -

Deploy Infrastructure Supporting Advanced Technology

PRIORITIES

- Include CCUS in infrastructure revitalization initiatives.
- Support R&D and characterization of geologic storage.
- Support USE IT Act and INVEST CO₂ Act.

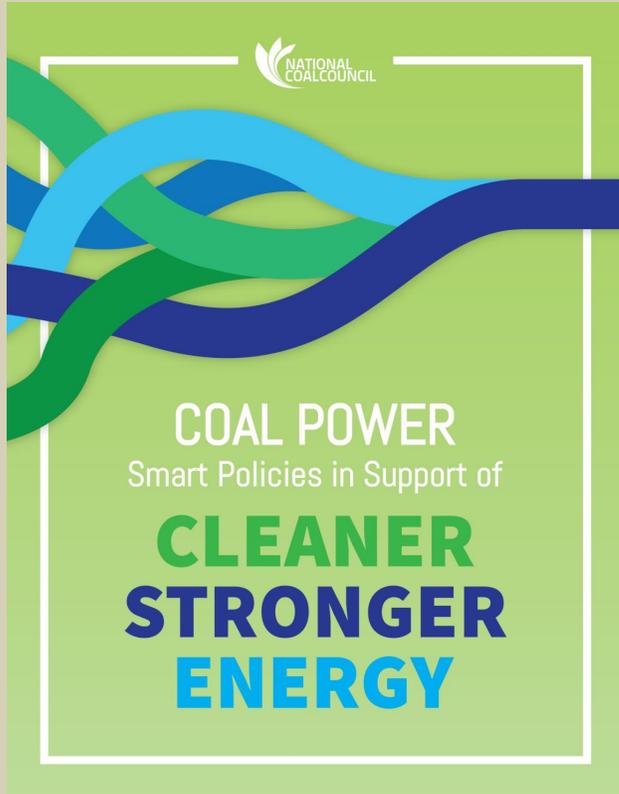
By 2040 -

Deploy Commercial, Cost Competitive, Low-Carbon Technology

PRIORITIES

- Federal FEED funding support.
- Federal funding for demonstration/commercial projects.

Conclusion



“... we can’t get rid of coal. It is essential to this nation.”

Dan Brouillette, U.S. Secretary of Energy

June 25, 2020 - Penn Live/Patriot News