

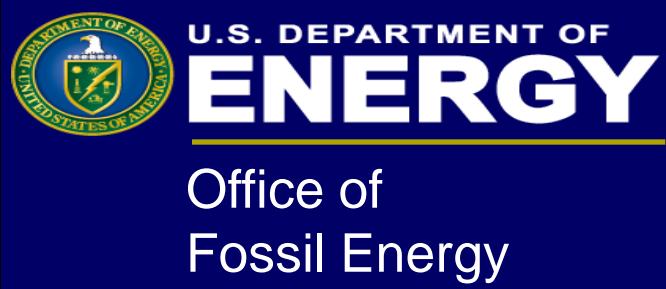


U.S. Clean Coal and Carbon Management RD&D Program

David Mohler

Deputy Assistant Secretary for Clean Coal and Carbon Management

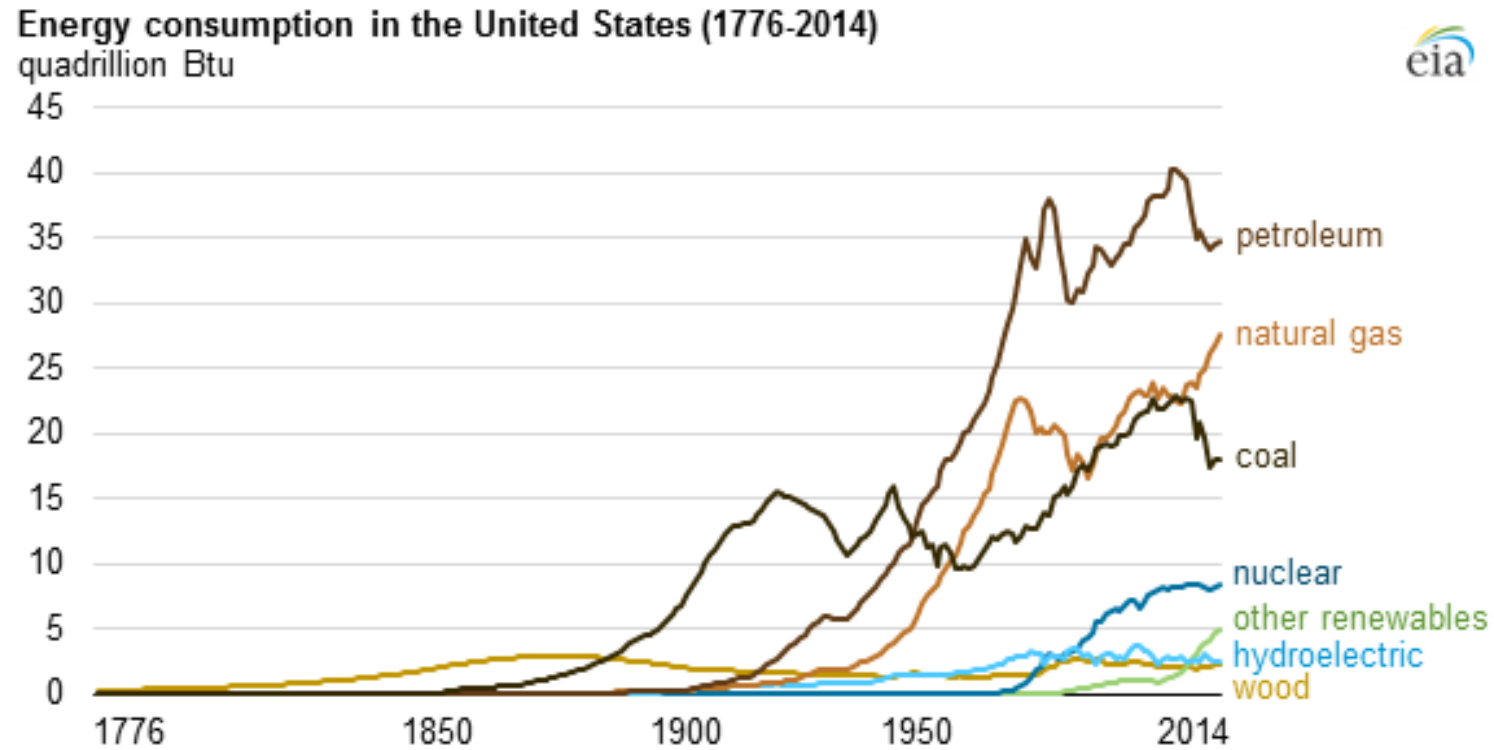
U.S.-China Clean Coal Industry Forum
25-26 August 2015



Fossil Energy Makes Our Modern World Possible

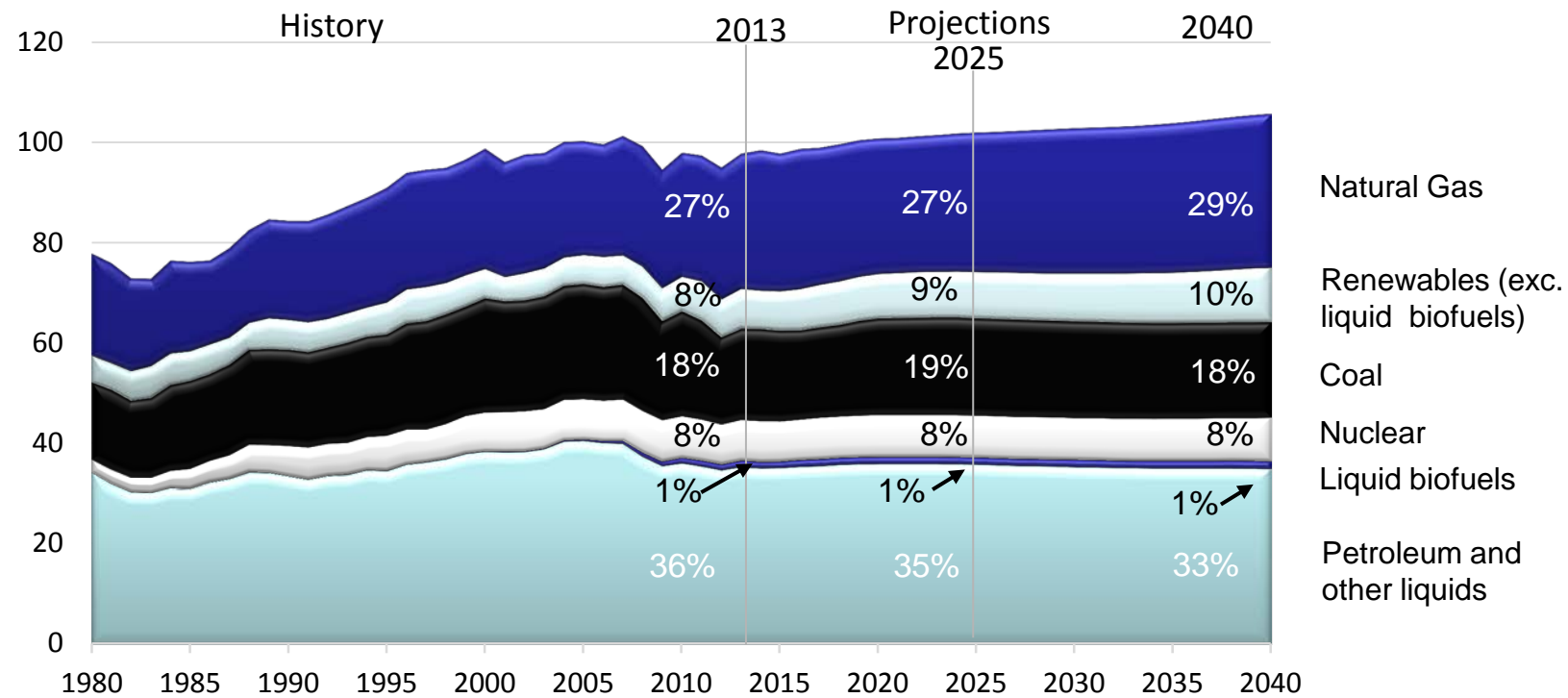


Fossil Fuels Have Been the Primary Energy Source for Most of Our History...



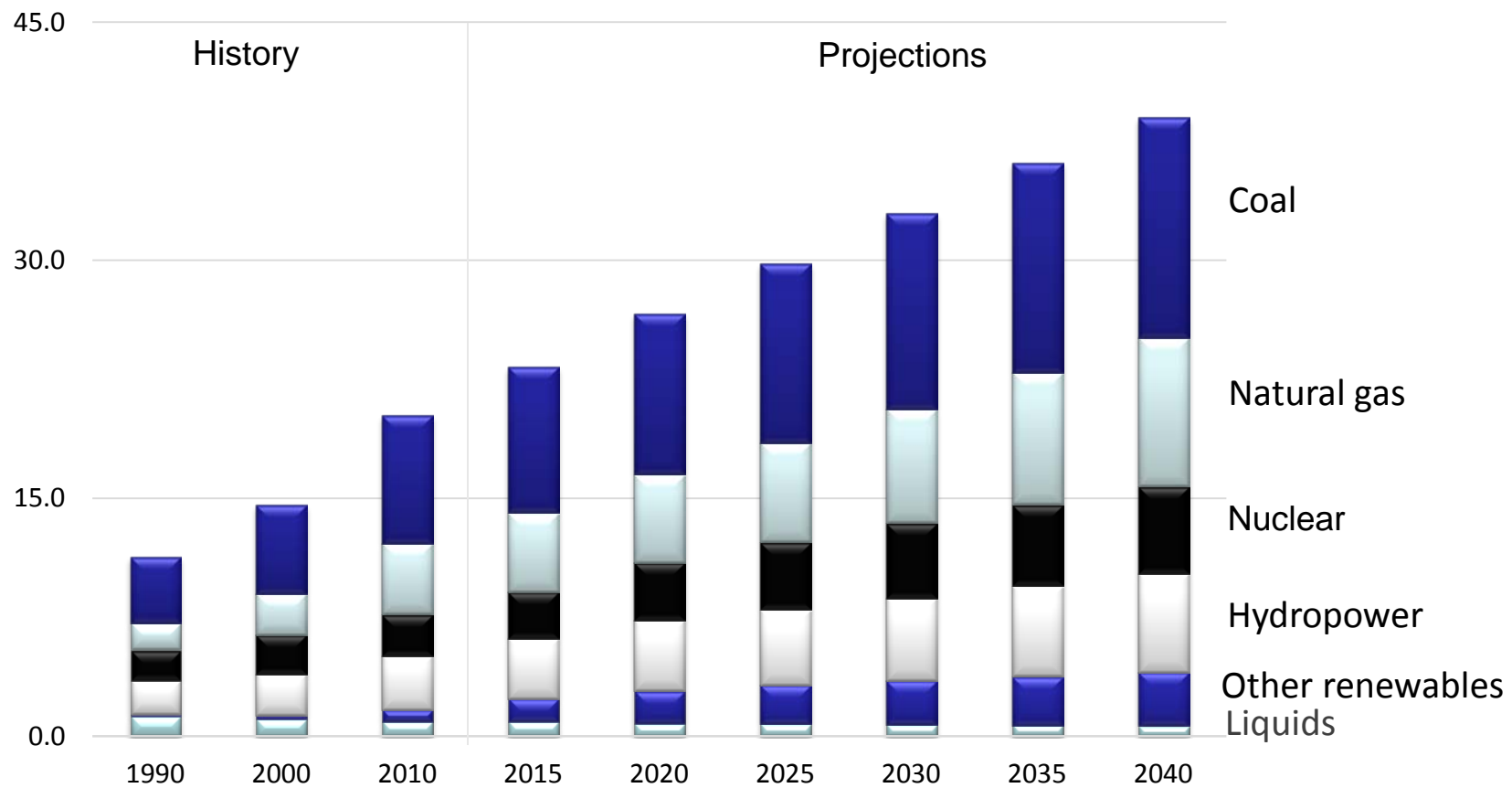
...They Still Provides the Lion's Share of our Energy

Fossil fuels provide about 80% of U.S. primary energy consumption (in quadrillion Btu)



Source: EIA, Annual Energy Outlook 2015 Reference case

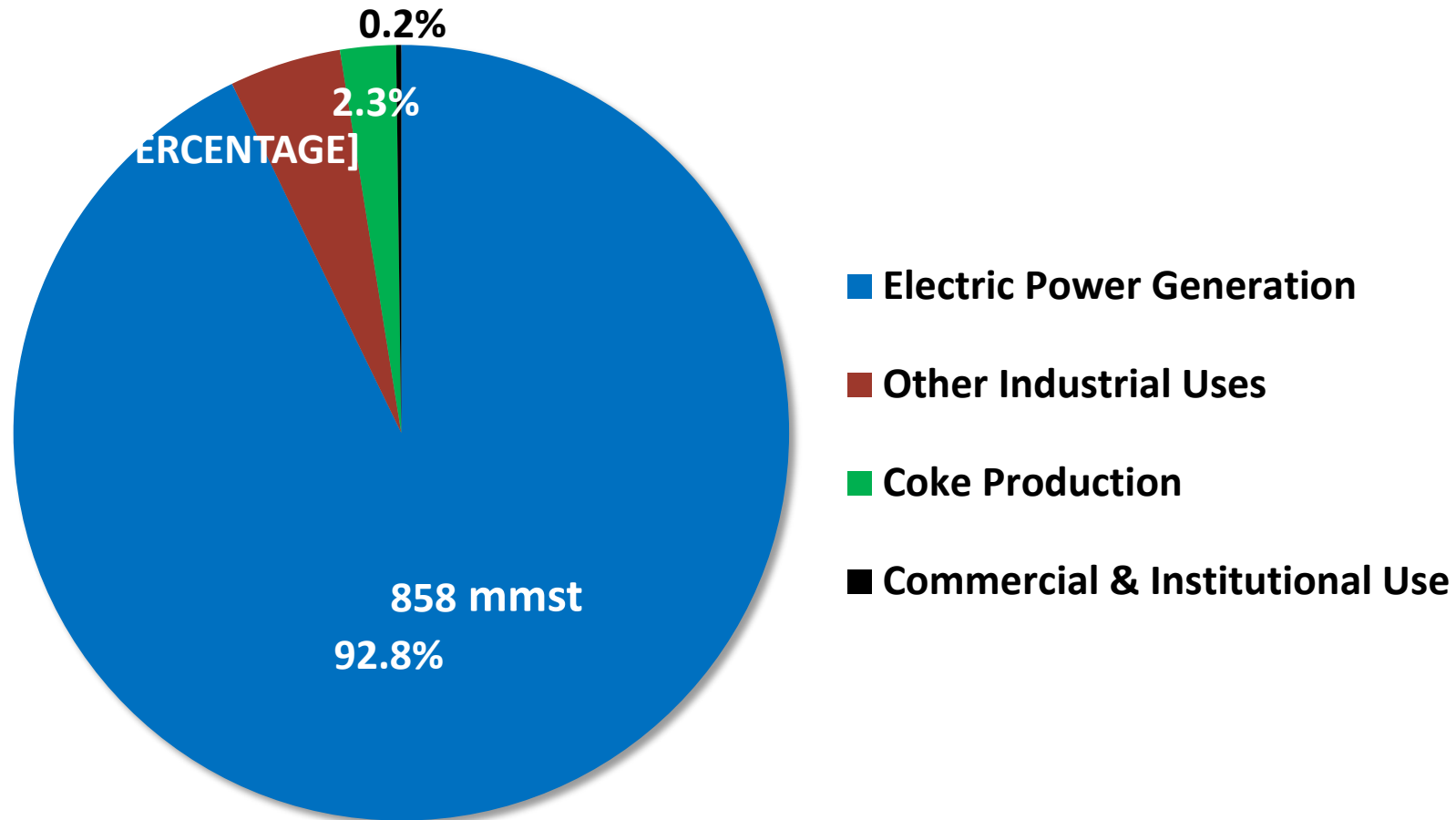
**World electricity generation by fuel
billion kilowatt hours**

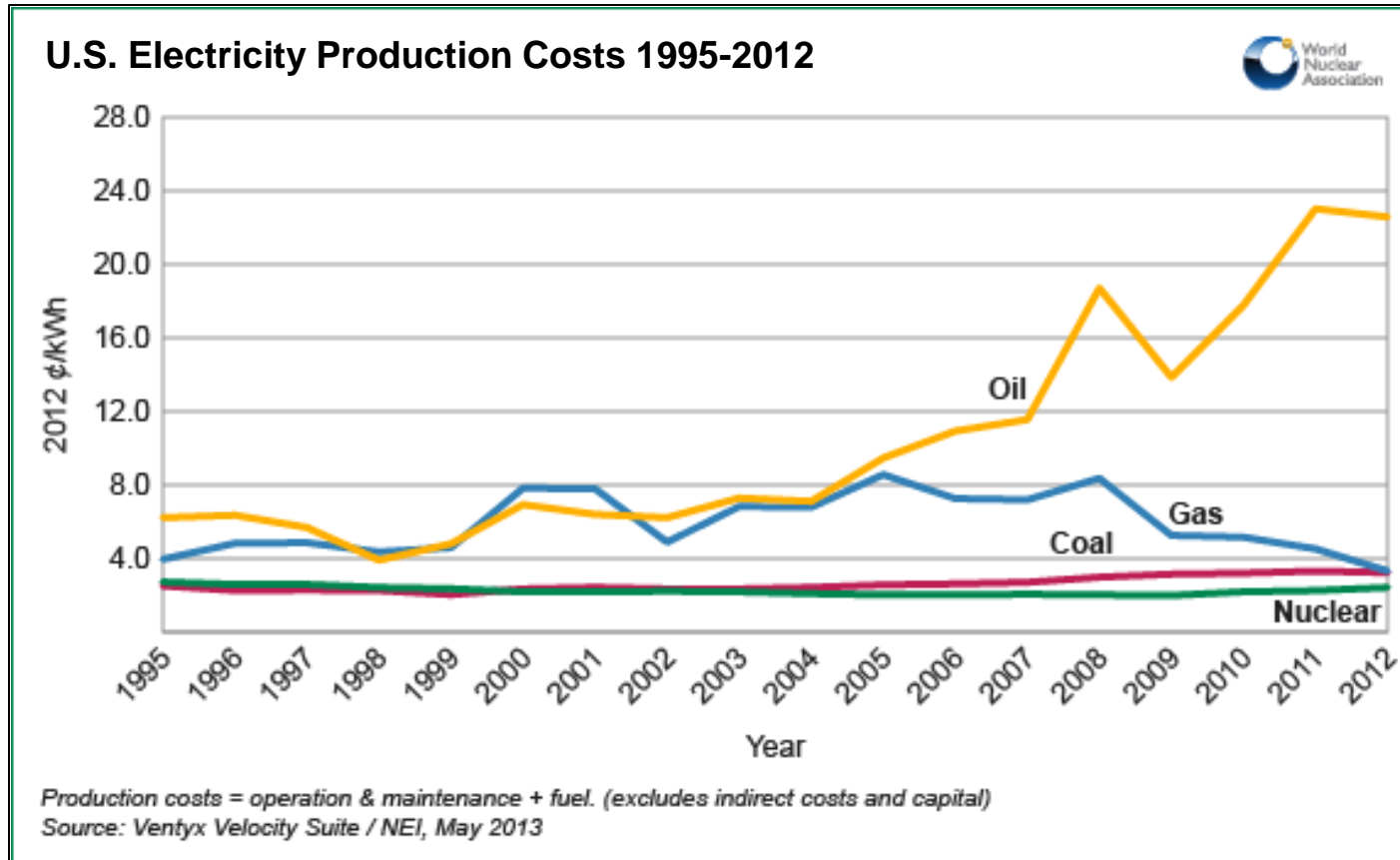


Source: EIA, International Energy Outlook 2013

Unlike China, Majority of U.S. Coal Consumption is Used for Electricity Generation

U.S. Coal Consumption by End Use Sector (2013)
Total 2013 Consumption: 925 million short tons

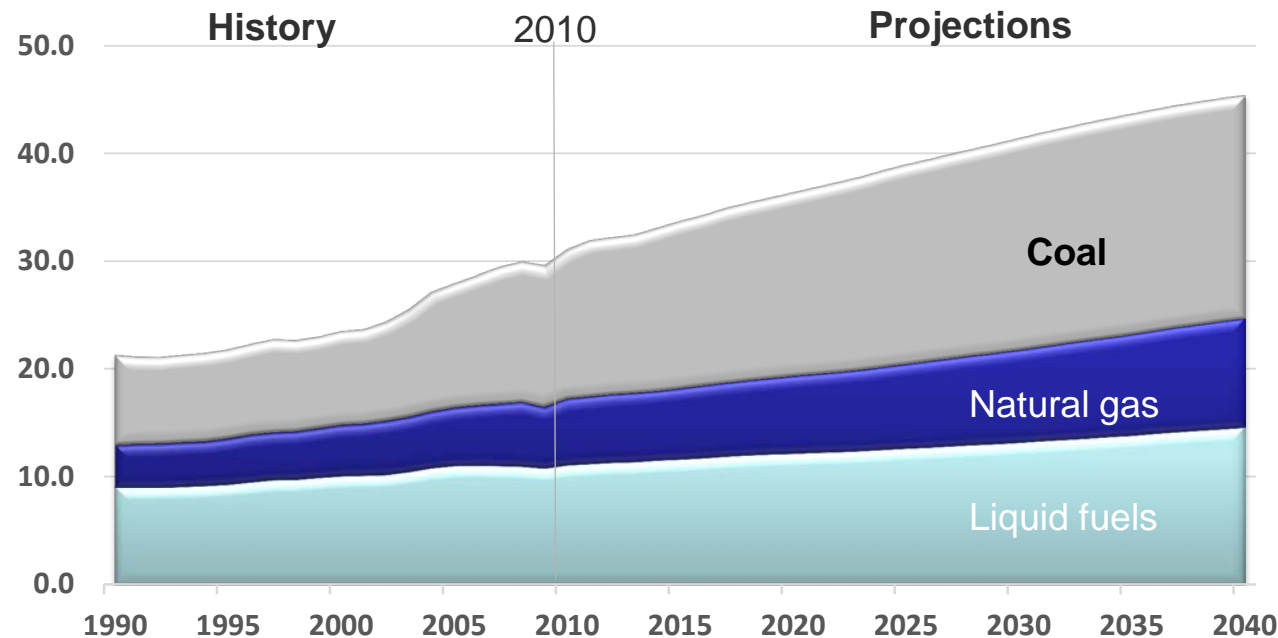




Managing Our Fossil Energy Abundance is in the Public Interest

CO₂ emissions from fossil fuels, especially coal, are contributing to climate change

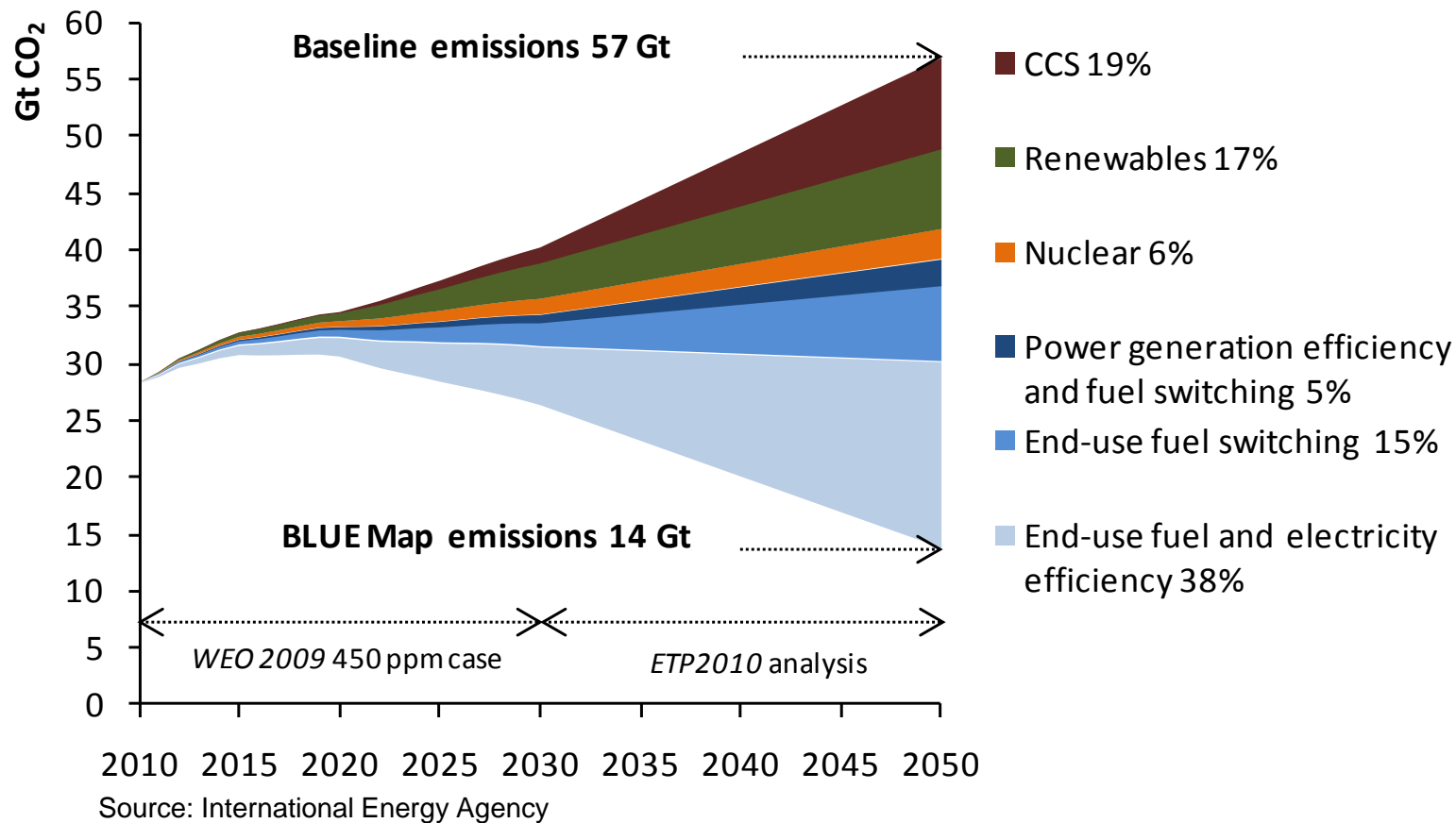
World energy-related carbon dioxide emissions by fuel
billion metric tons



Source: EIA, International Energy Outlook 2013

So managing our abundance is critical – to address climate change, ensure environmental sustainability, and secure our energy future

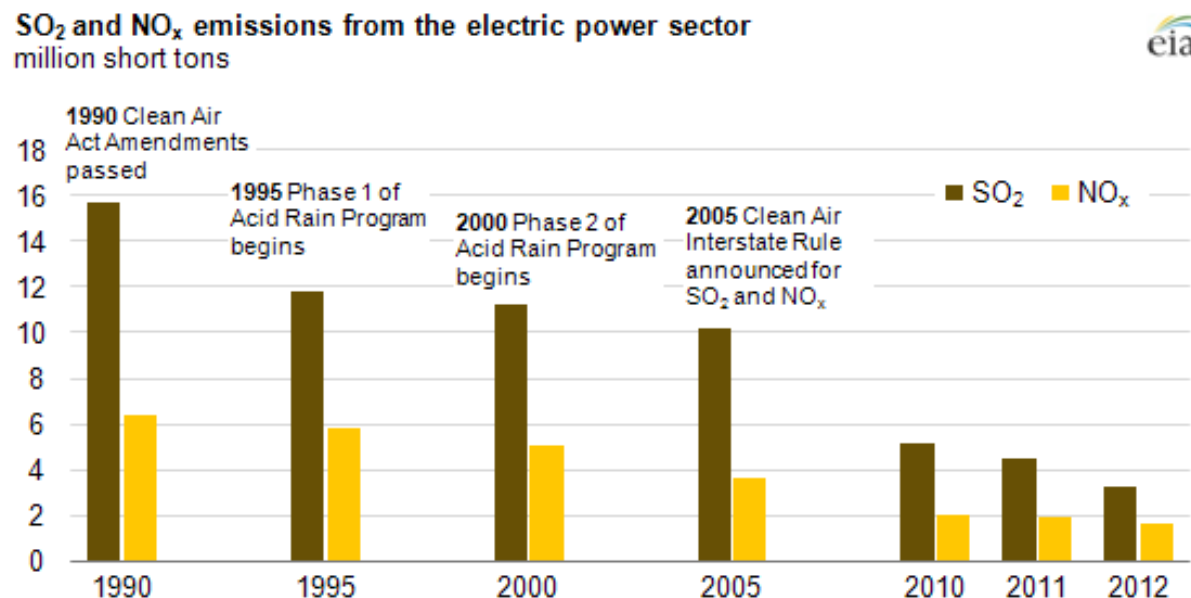
CCS Will Be Required To Meet Our Carbon Emission Reduction Goals



New 111(b) and 111(d) regulations address CO₂ under Final Clean Power Plan

Clean Air Act of 1963 (extended in 1970, amended in 1977 and 1990)

- Required EPA to develop and enforce regulations to protect the public from airborne contaminants known to be hazardous to human health
- Early regulations focused on pollutants, such as SO₂, NO_x, Mercury, and PM, from coal plants



**U.S. Air Pollution Has Decreased Significantly
Despite Coal Use for Electricity Generation Tripling Since 1970**

The Office of Fossil Energy: Ensuring We Can Use All Our Energy Resources Cleanly, Safely, and Securely

Office of
Fossil Energy

Through three major programs...

Coal and Power Systems



Oil and Natural Gas



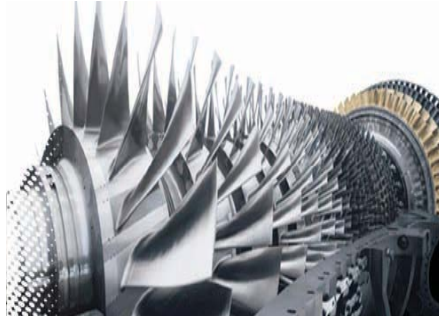
Strategic Petroleum Reserve



...And a world-class National Laboratory

National Energy Technology Laboratory (NETL)





Making Coal Plants More Efficient

Gasification, Advanced
Turbines, Advanced
Combustion, CBTL, and
Fuel Cells



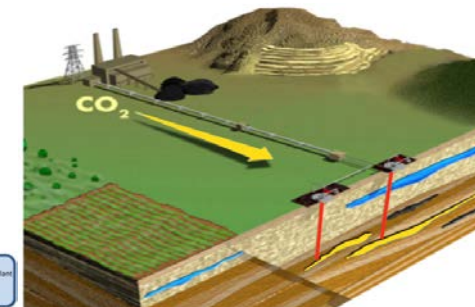
Capturing More CO₂

Cost-effective carbon
capture for new and
existing power plants



Turning CO₂ into Valuable Products

New pathways to utilize
captured CO₂



Storing CO₂ Underground

Safe, permanent storage
of CO₂ from power
generation and industry

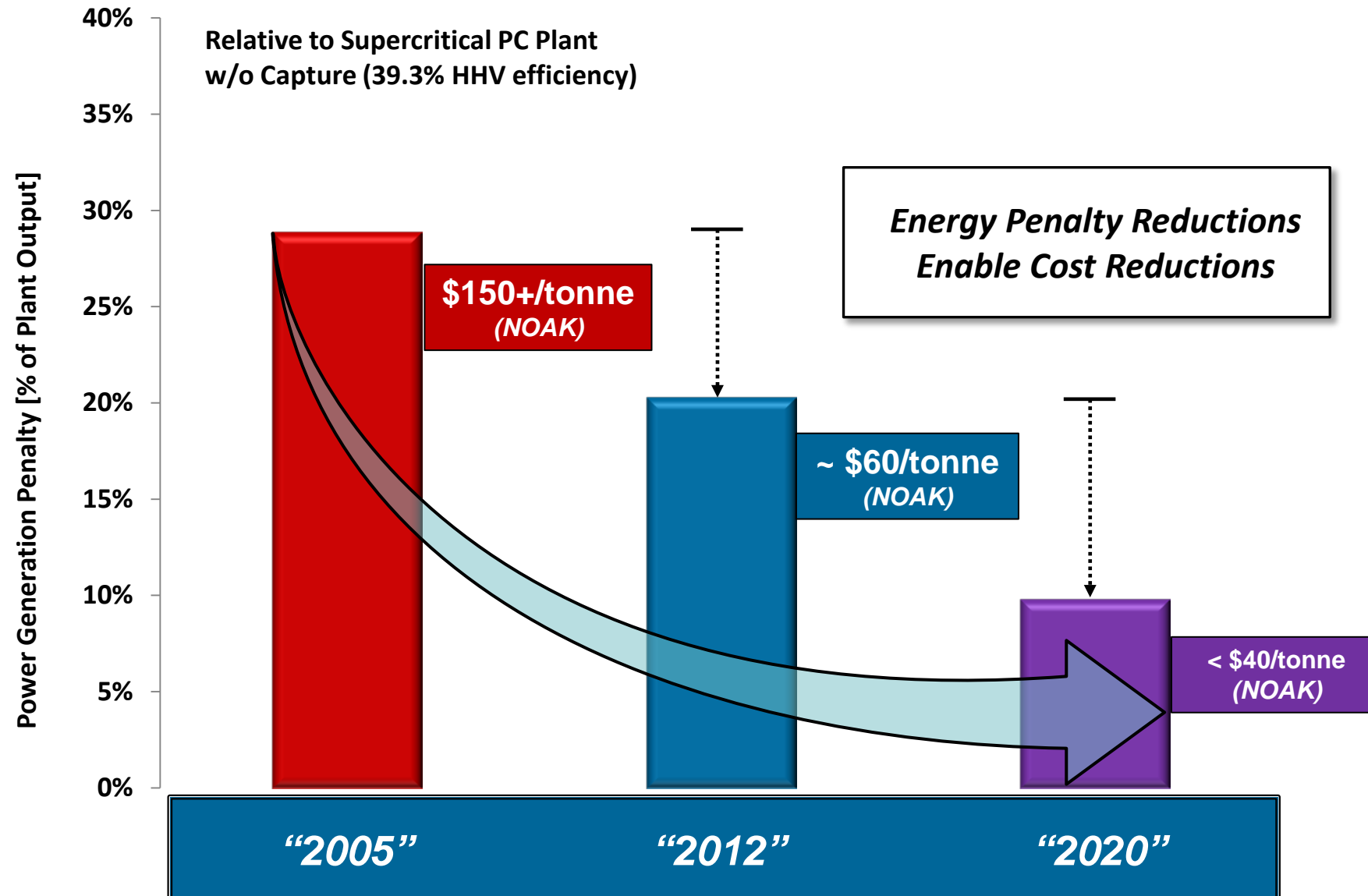


Bringing it All Together

Crosscutting technology
development program

Clean Coal RD&D Progress

Performance Improvement is Driving Cost Reductions

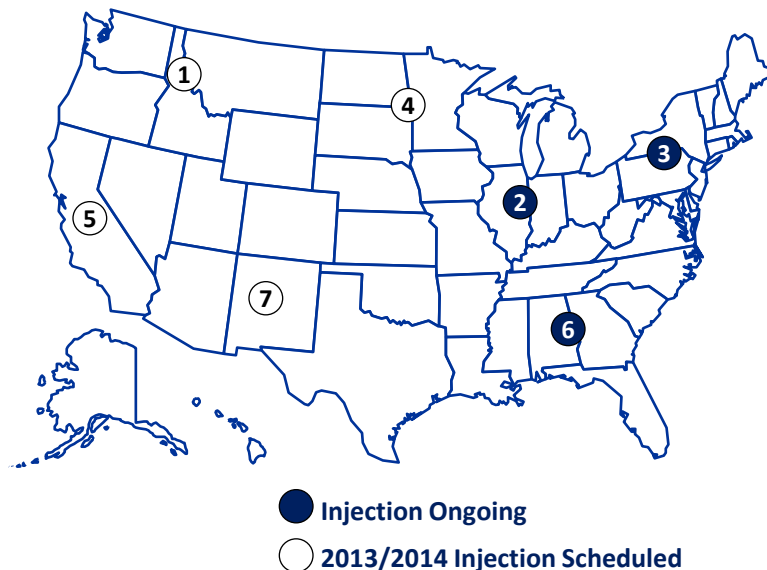


Costs of capturing CO₂ from greenfield plants, excluding CO₂ transport and storage, expressed in 2011 dollars

CO₂ Storage Demonstrations

7 Regional Partnerships to Conduct CO₂ Injection Projects

Regional Carbon Sequestration Partnerships

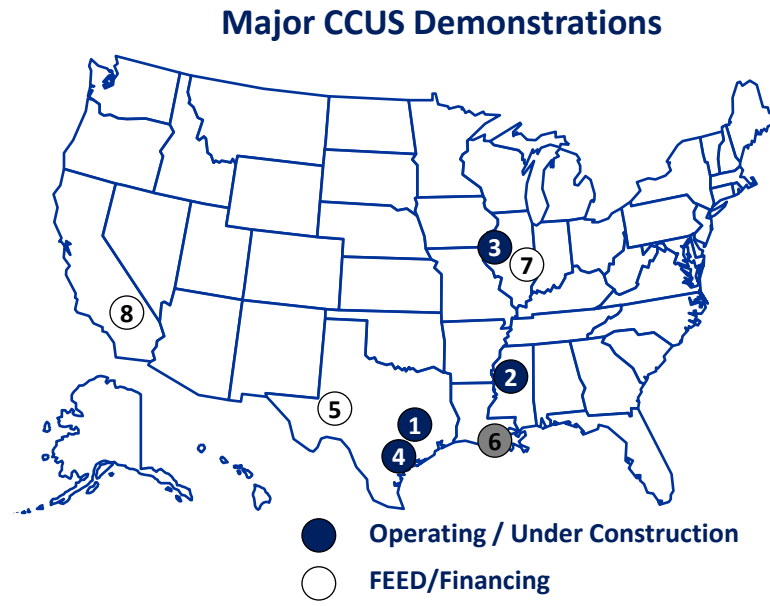


- **Geology:** Projects represent 6 of 11 identified depositional environments in the United States
- **Storage methodology:** Projects include EOR and saline aquifer storage
- **Preceded by 20 small-scale projects that cumulatively injected over 1 million tonnes**

	Partnership	Project	Status
1	Big Sky Carbon Sequestration Partnership	Saline storage of naturally occurring CO ₂ (1 million tonnes over 4 years)	Site operations; Injection 2014
2	Midwest Geological Sequestration Consortium	Saline storage of CO ₂ from ADM biofuel production (1 million tonnes over 3 years)	Injection began Nov. 2011
3	Midwest Regional Carbon Sequestration Partnership	EOR using CO ₂ from gas processing plant (1 million tonnes over 4 years)	Injection began Feb. 2013
4	Plains CO ₂ Reduction Partnership	<ol style="list-style-type: none"> 1) Project 1: EOR using CO₂ from ConocoPhillips Gas Plant (1 million tonnes over 2 years) 2) Project 2: Saline storage of CO₂ from Spectra Energy gas processing plant (1.3 million tonnes over 2 years) 	<ol style="list-style-type: none"> 1) Injection June 2013 2) Site operations; injection 2015
5	West Coast Regional Carbon Sequestration Partnership	Regional Characterization	No large-scale injection
6	Southeast Regional Carbon Sequestration Partnership	<ol style="list-style-type: none"> 1) Project 1: Saline leg of EOR; storage natural CO₂ 2) (Over 3.6 million tonnes by Sept. 2014) 3) Project 2: Saline storage of amine captured CO₂ from coal-fired generation (250,000 tonnes over 2 years) 	<ol style="list-style-type: none"> 1) Injection began 2009 2) Injection began Aug. 2012
7	Southwest Regional Partnership on Carbon Sequestration	EOR storage of CO ₂ from fertilizer and ethanol plants (1 million tonnes over 5 years)	Site operations; injection late 2013

Major CCS Demonstrations

8 Projects Advancing Carbon Capture and Storage

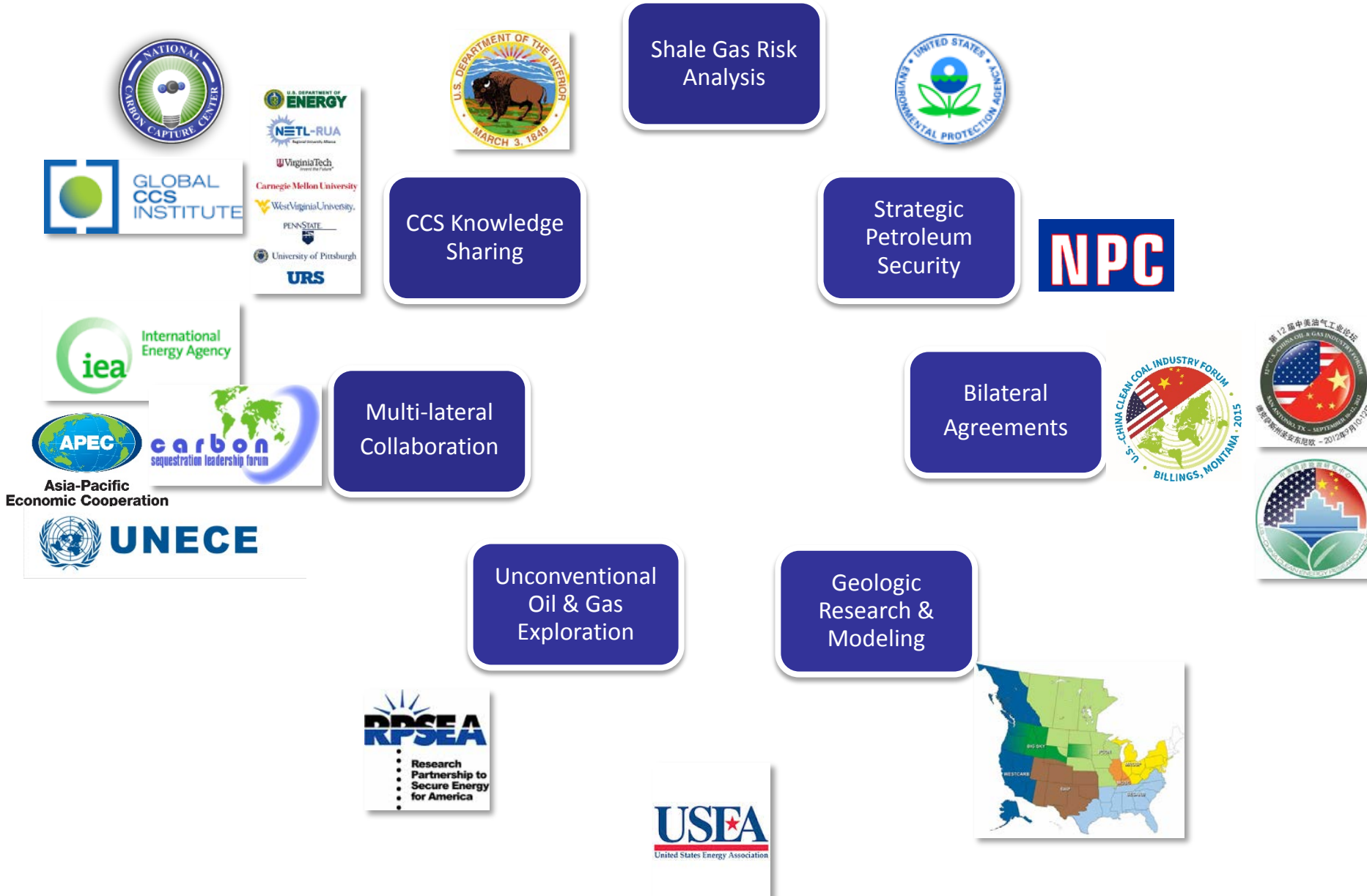


- Portfolio represents both EOR and storage in saline aquifers
- Portfolio includes industrial and power capture
- Portfolio includes pre-, post-, and oxy-combustion capture

	Partnership	Project	Status
1	Air Products	Steam Methane Reformer Hydrogen Production EOR utilization ~925,000 MT/year	Operations
2	Southern Company Services (Kemper)	Integrated Gasification Combined Cycle (IGCC) EOR utilization ~3,000,000 MT/year	Under Construction
3	Archer Daniels Midland	Ethanol Fermentation CO2 Saline storage ~900,000 MT/year	Under Construction
4	NRG Energy (Petra Nova) WA Parish	Retrofit Pulverized Coal Plant. EOR utilization ~1,400,000 MT/year	Under Construction
5	Summit Texas Clean Energy Project	Integrated Gasification Combined Cycle Polygeneration EOR utilization ~2,200,000 MT/year	Financing
6	Leucadia Energy, LLC	Methanol from Petcoke Gasification. EOR utilization ~4,500,000 MT/year	Front End Engineering & Design
7	FutureGen 2.0	Oxycombustion Pulverized Coal Boiler Retrofit Saline storage ~1,000,000 MT/year	Front End Engineering & Design
8	Hydrogen Energy California (HECA)	Integrated Gasification Combined Cycle Polygeneration EOR utilization ~2,570,000 MT/year	Front End Engineering & Design

Wide-Ranging Partnerships At Home and Around the World

Our Cooperation with China is Critically Important





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