



DOE's CCS and Power Systems R&D

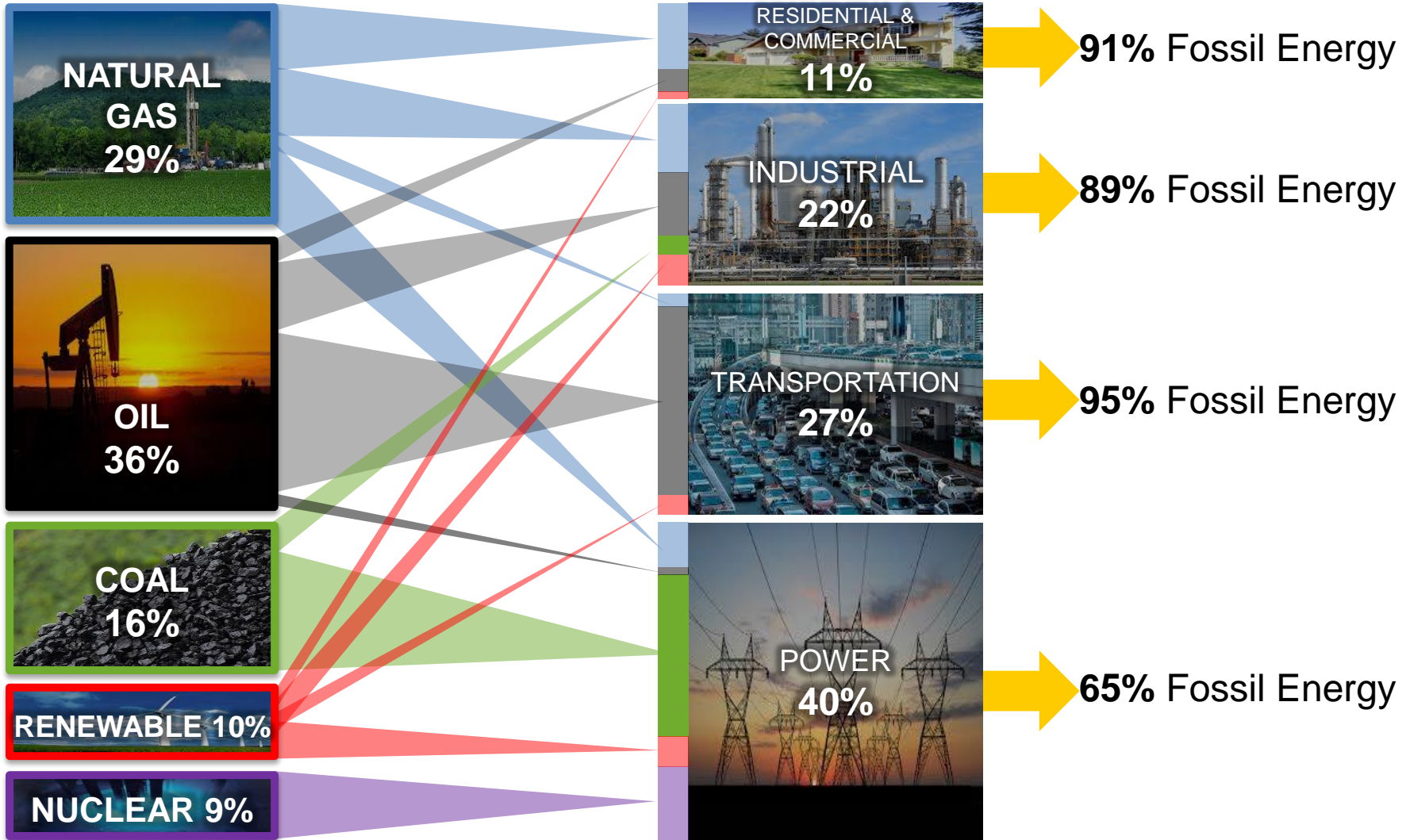
May 2, 2016

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Systems

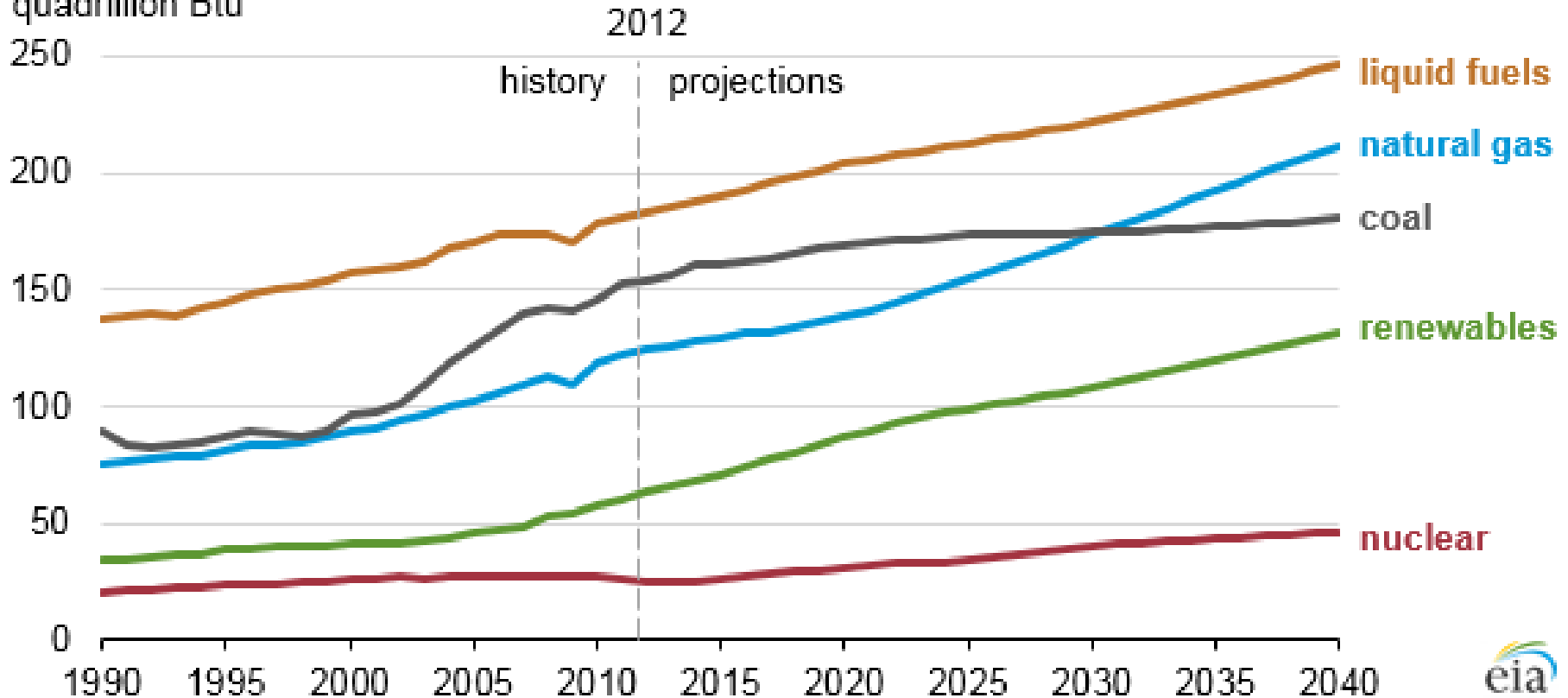
Office of Clean Coal and Carbon
Management

Fossil Energy Critical in All Domestic Sectors

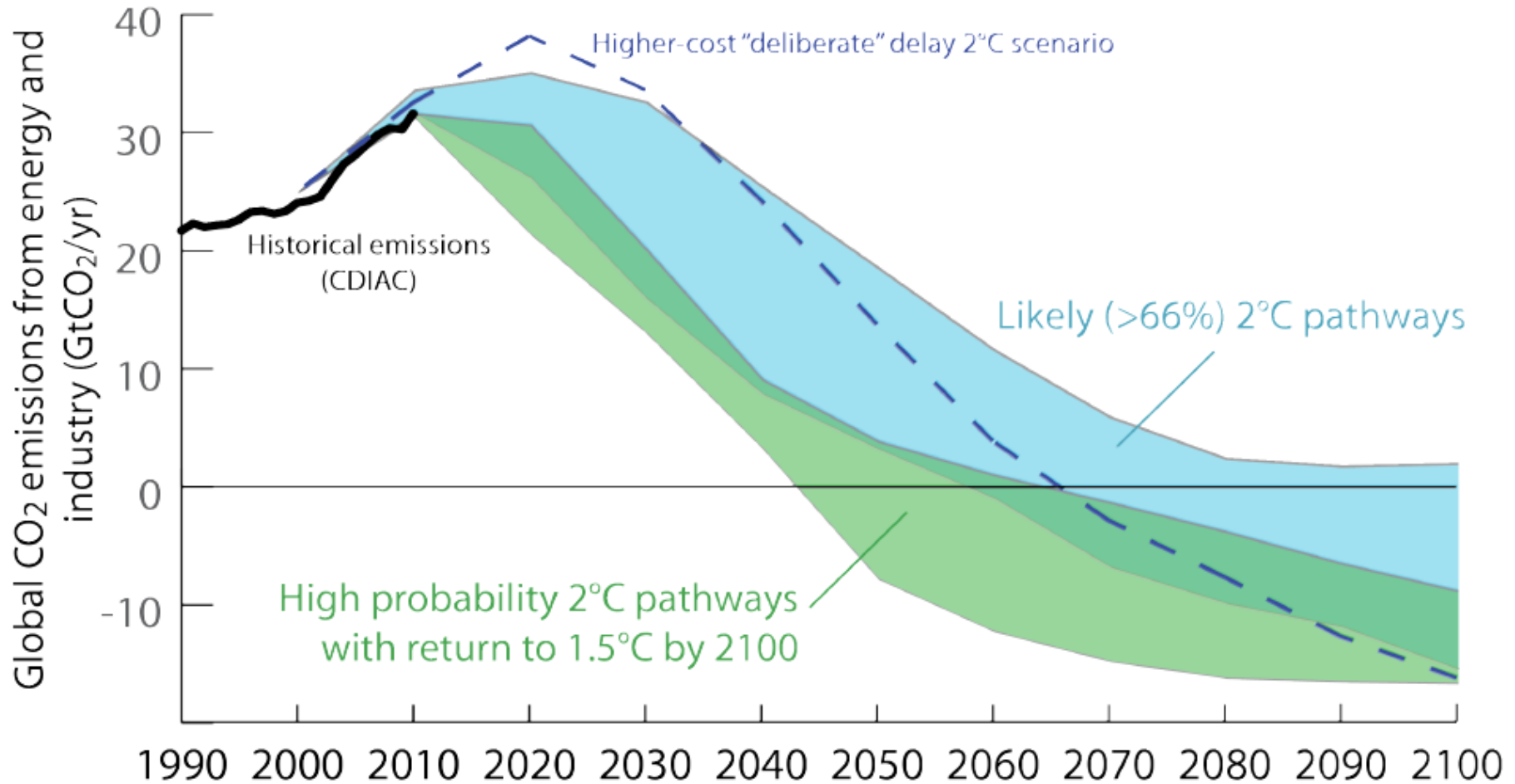


48% increase in world energy consumption by 2040, coal still needed

World energy consumption by source, 1990-2040
quadrillion Btu



To meet 2C scenario, >90% of all electricity must be low carbon or carbon free by 2100



Source: Climate Action Tracker, Sept. 2015, Calculations based on IPCC AR5 WGIII emissions scenario

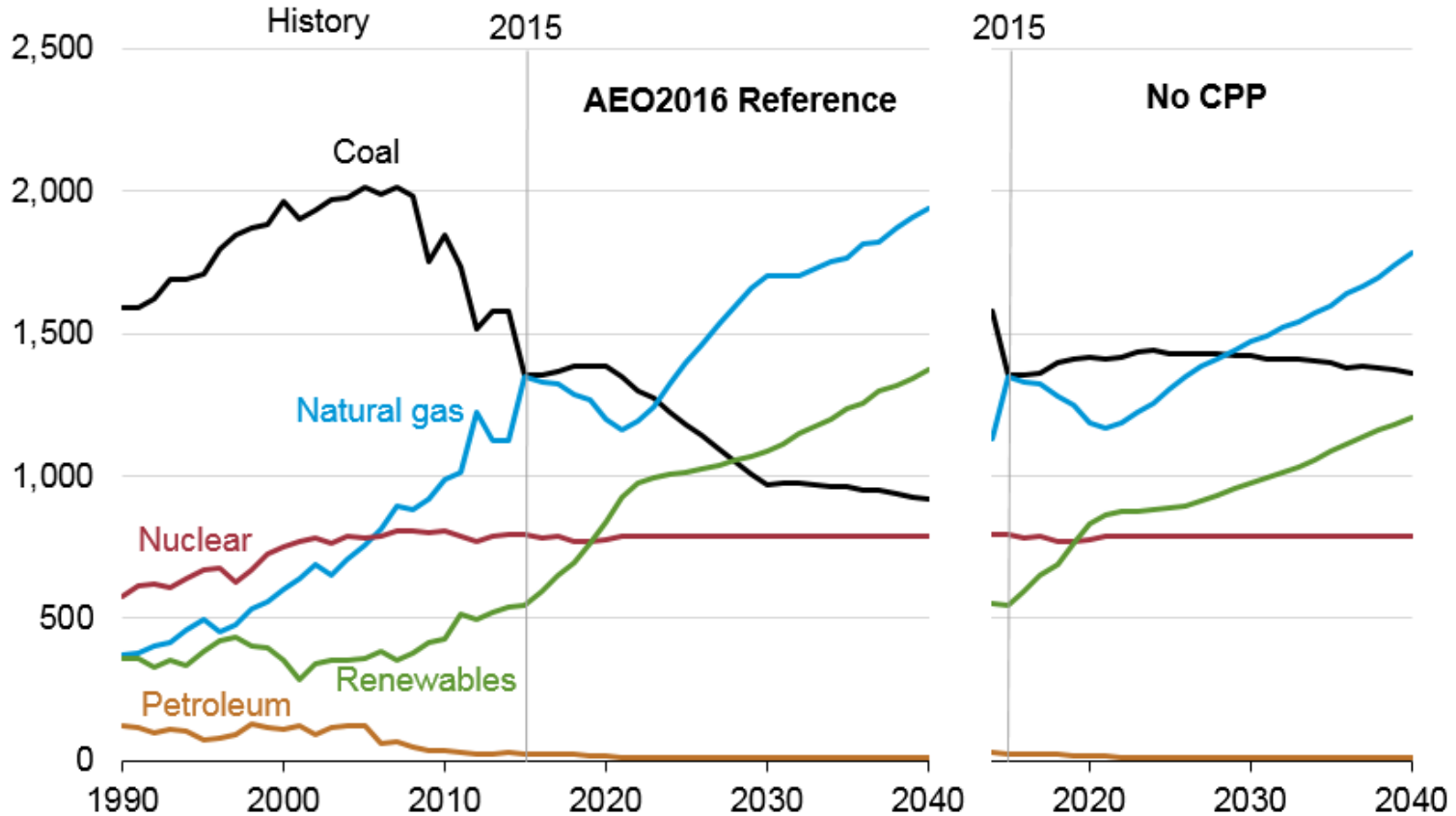


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Fossil
Energy

United States Energy Generation - 2040

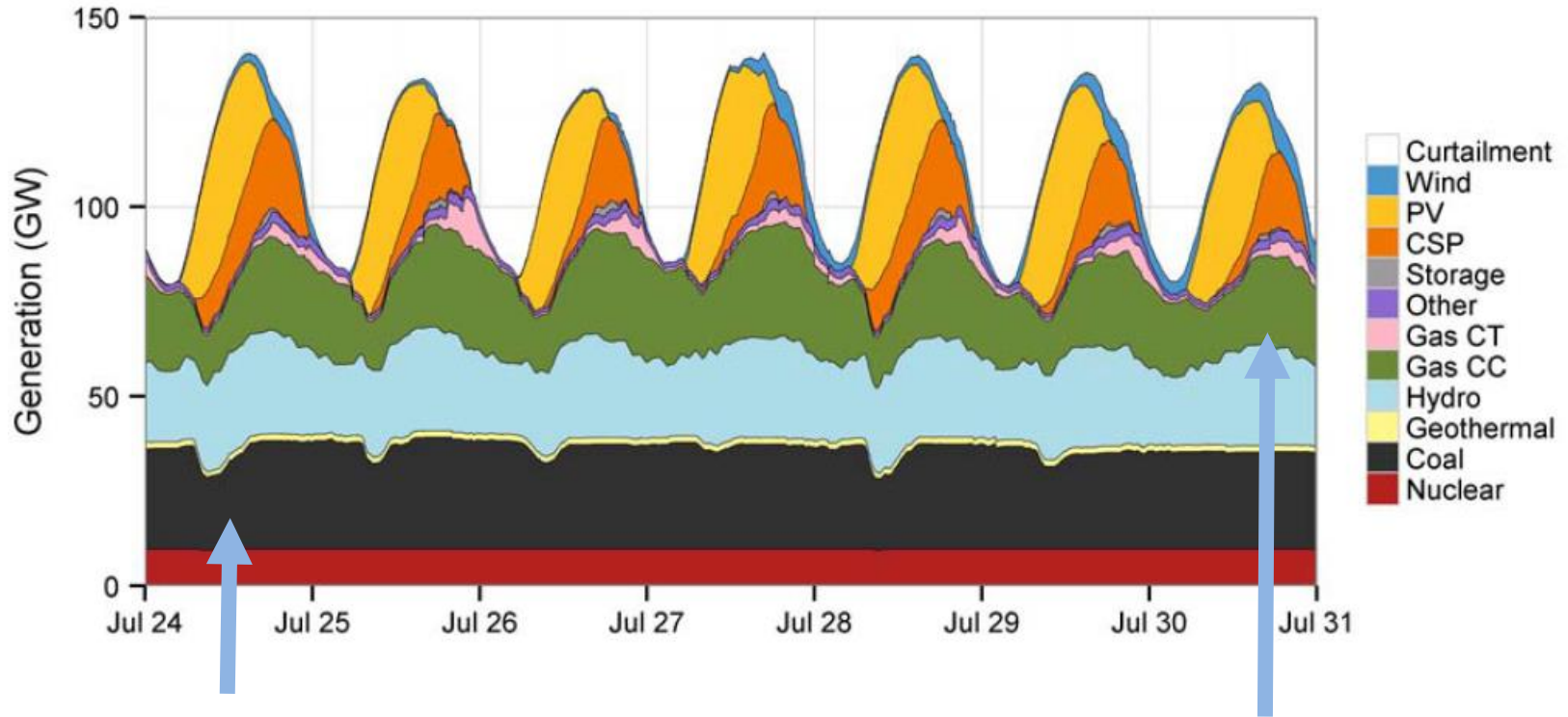
net electricity generation
billion kilowatthours



Source: EIA, Annual Energy Outlook 2016



CCS is complementary to Renewable



Even in high renewable scenarios, there remains a need for low-carbon baseload

CCUS required to decarbonize even with renewables

Ramping of Fossil Units putting demands on:

- Materials
- Efficiency and controls
- Life of facility
- Fuel supply infrastructure



Clean Power Plan

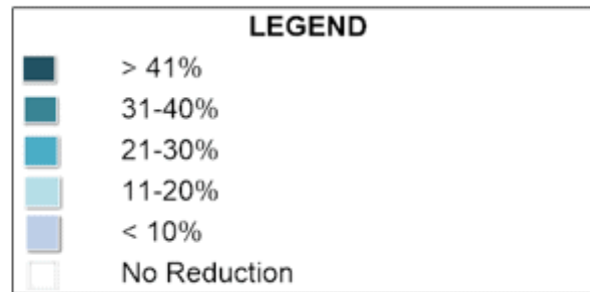
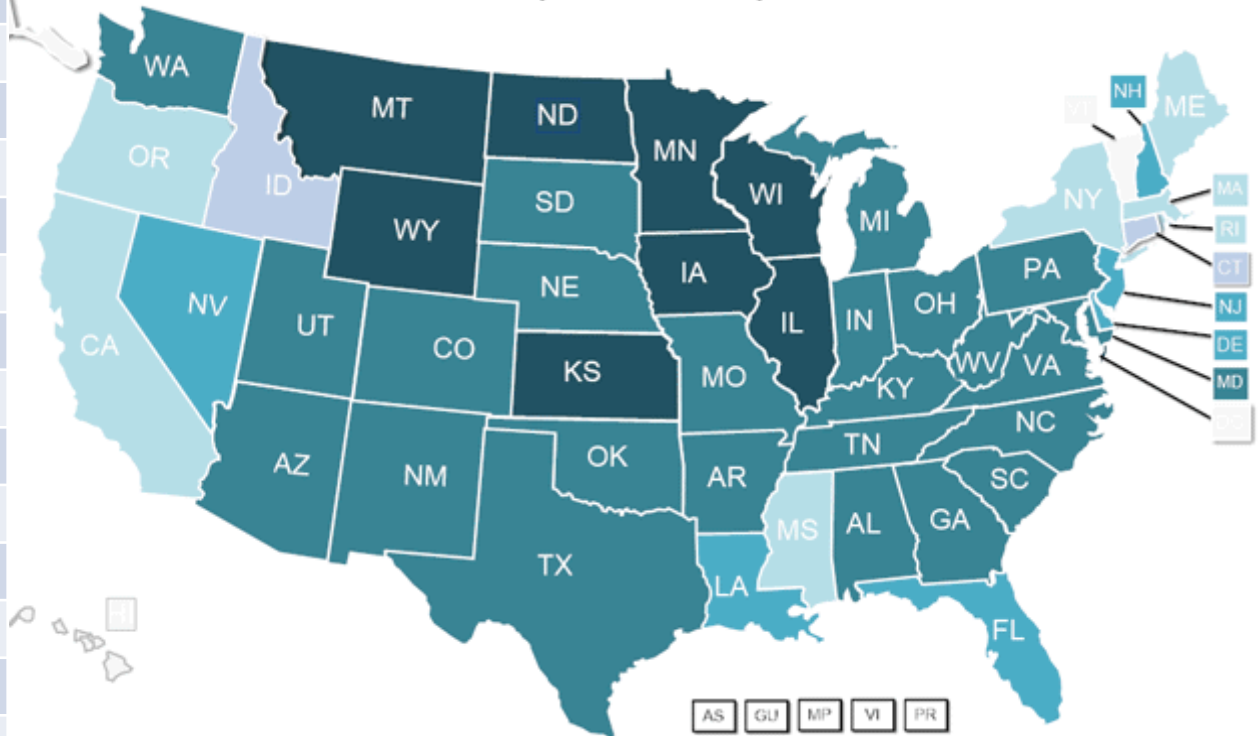
15 Coal States Emission Reductions (MMT/year)

State	2012	2030	Delta
MT	17.92	11.30	6.62
WY	50.00	31.63	18.37
ND	33.37	20.88	12.49
WI	42.32	27.99	14.33
IL	96.11	66.48	29.63
IA	38.14	25.02	13.12
IN	107.30	76.11	31.19
KS	34.35	21.99	12.36
WV	72.32	51.33	20.99
KY	91.37	63.13	28.24
PA	116.6	89.82	26.78
OH	102.24	73.77	28.47
TX	240.73	189.59	51.14
AZ	40.47	30.17	10.3
NM	17.34	12.41	4.93
Total Reduction 2030 (MMT/yr)			308.96

Source: USEPA

Total Emission Reductions Percentage by 2030

(from 2012 levels)



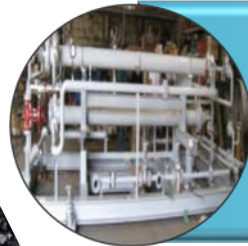
Source: National Council of State Legislatures - <http://www.ncsl.org>

Advanced Fossil Technologies



Advanced Energy Systems

Technologies that greatly improve plant efficiencies, reduce CO₂ capture costs, increase plant availability, and maintain the highest environmental standards



Carbon Capture

R&D and scale-up technologies for capturing CO₂ from new and existing industrial and power-producing plants



Carbon Storage

Safe, cost-effective, and permanent geologic storage of CO₂



Cross Cutting Research

Materials, sensors, and advanced computer systems for future power plants and energy systems integrated with CCS



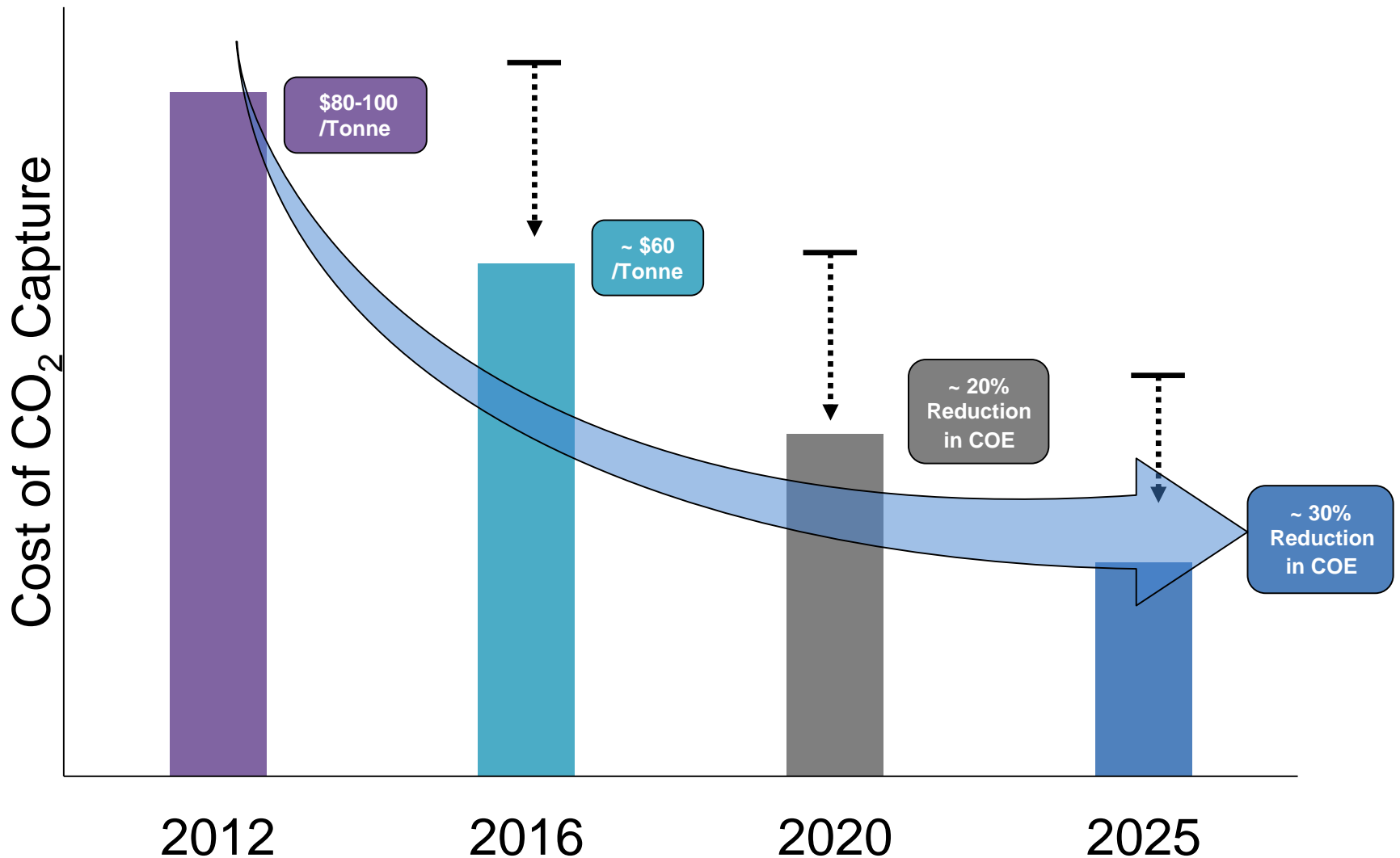
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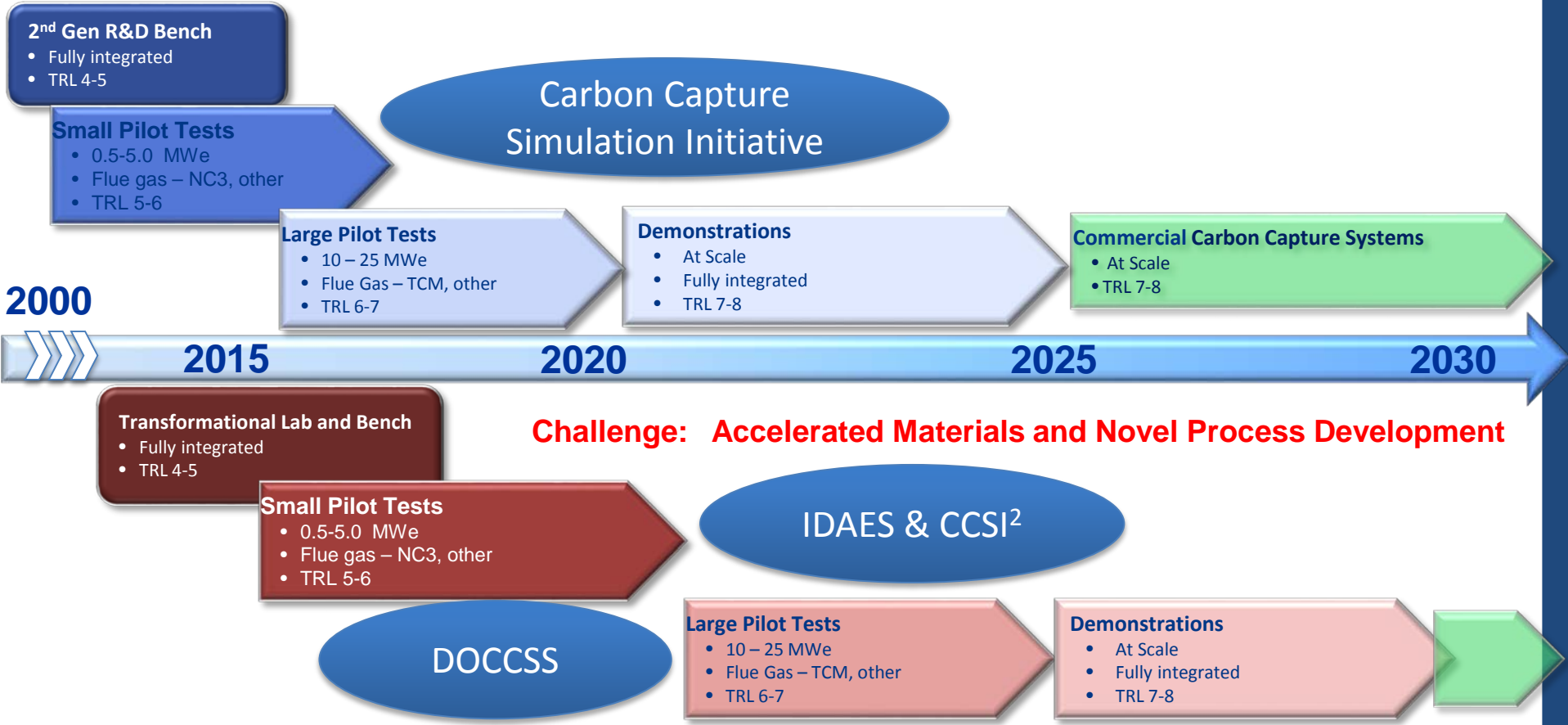
DOE's Fossil Energy Priorities

- ▶ Large Scale Pilots - AES and Capture
- ▶ Accelerate Transformational Technologies
- ▶ CCS and AES for Natural Gas Power Systems
- ▶ Industrial applications for carbon capture
- ▶ CO₂ Utilization and Carbon Negative Technologies
- ▶ Reducing water demand/use

Carbon Capture and AES Goals

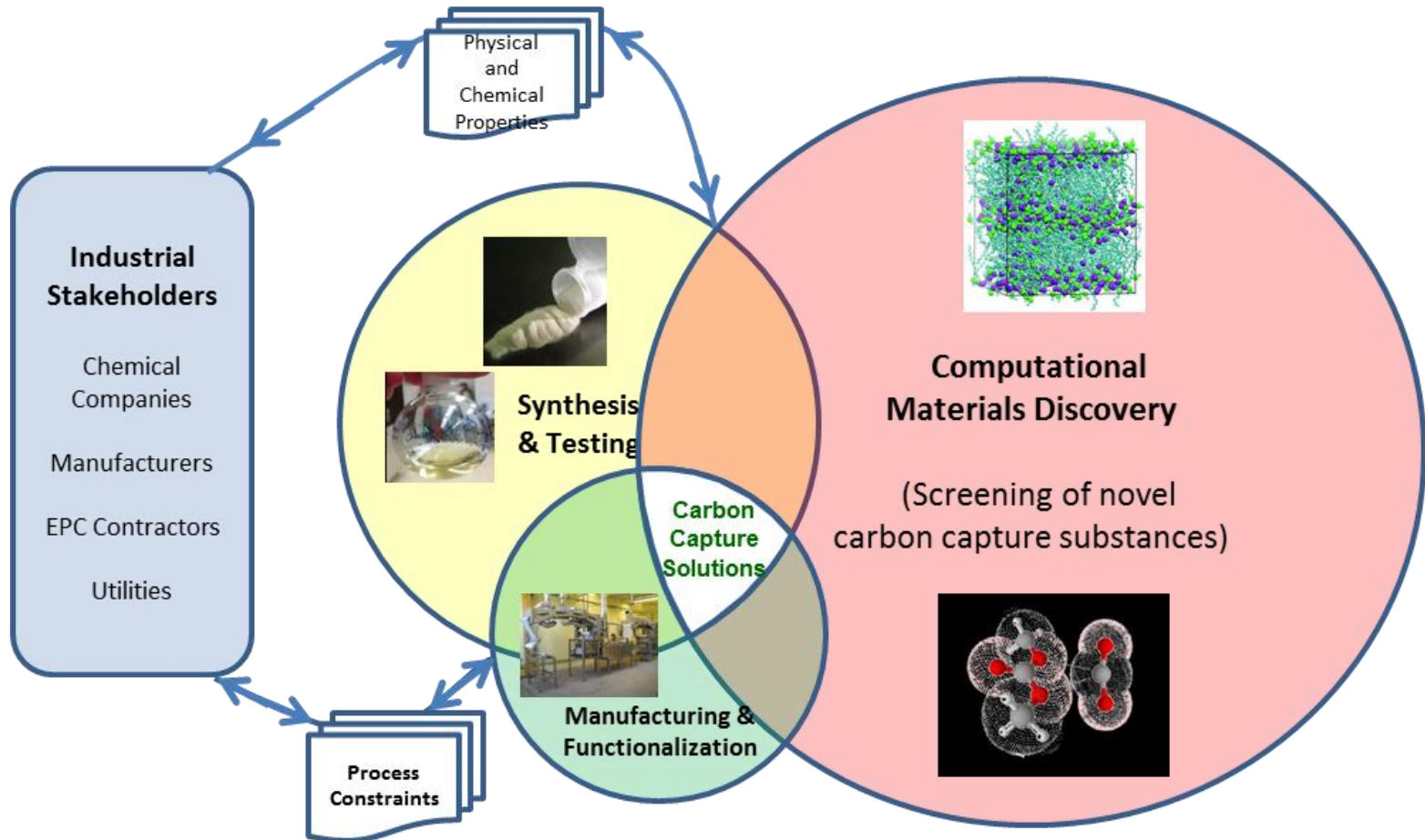


DOE Technology Development Schedule



Discovery of Carbon Capture Substances and Systems

Principle Elements – *Accelerating Deployment*



CCUS Demonstrations in North America

Need to go further, faster

Kemper



Syngas Production, July 14, 2016

W.A. Parrish, TX NRG/PetraNova project



Broke Ground Sept. 2014 - On time & budget for 2016

Port Arthur Refinery, TX – Air Products 2013



3+ million tons CO₂ stored

Knowledge Sharing Opportunities

ADM Agricultural Processing and Biofuels Plant, Decatur IL



Construction complete – Operational Jan 1 2017



Boundary Dam



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Thank You