


The Role of Coal in an "All of the Above" Energy Strategy

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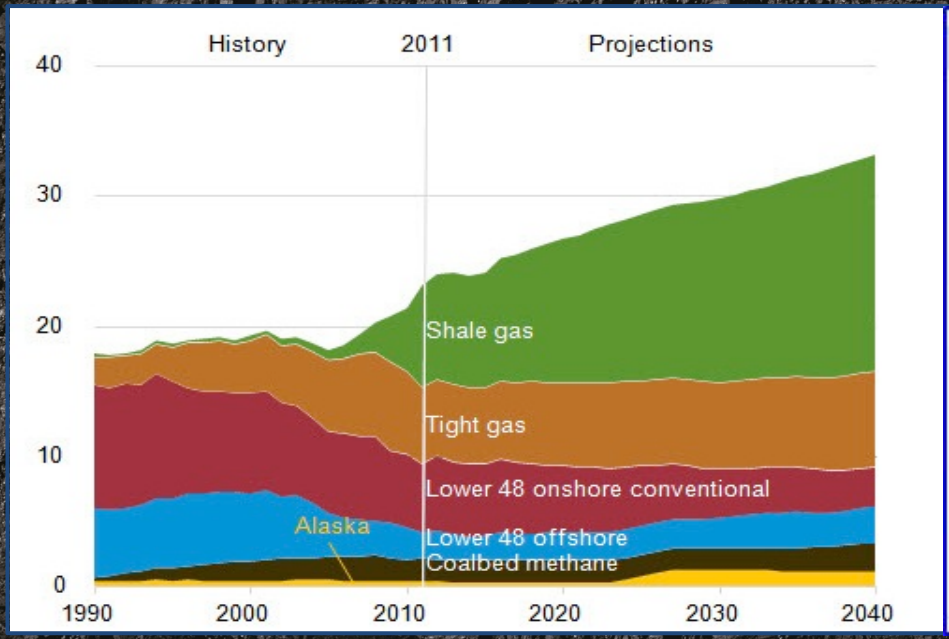
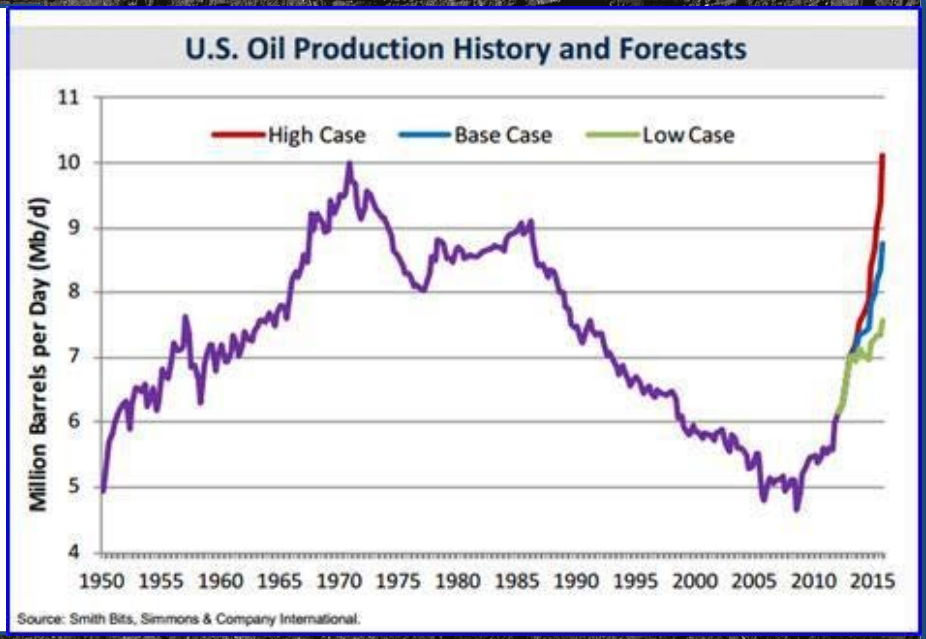
This is a time of fossil energy abundance





Once in a generation opportunity to build

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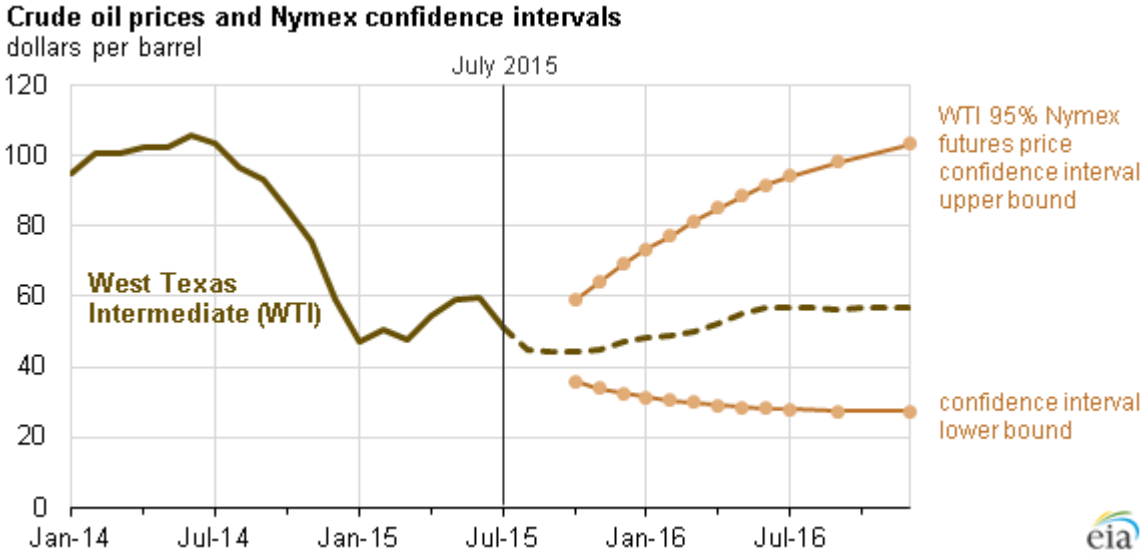

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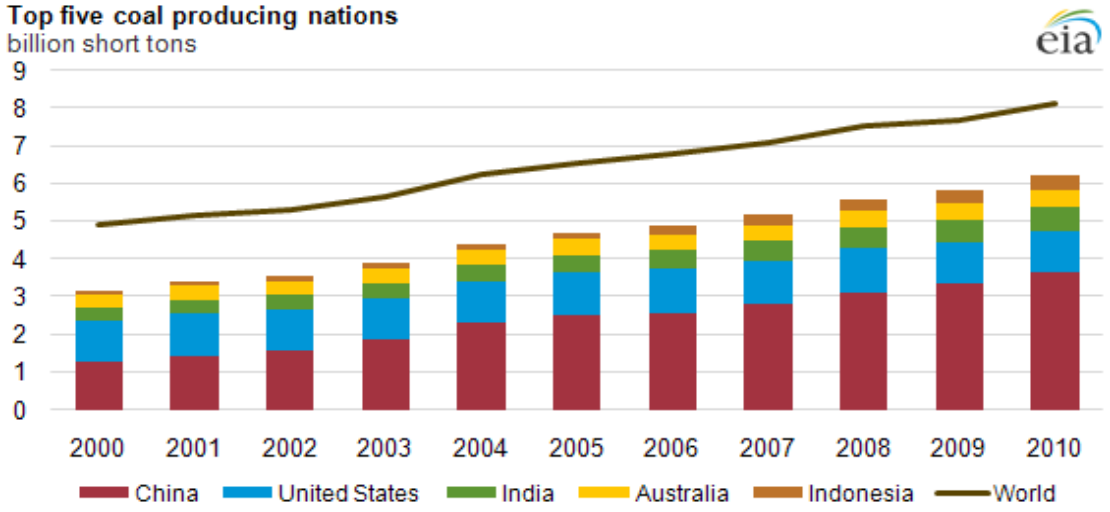
Coal Use Growing Overall and Important in Many Economies

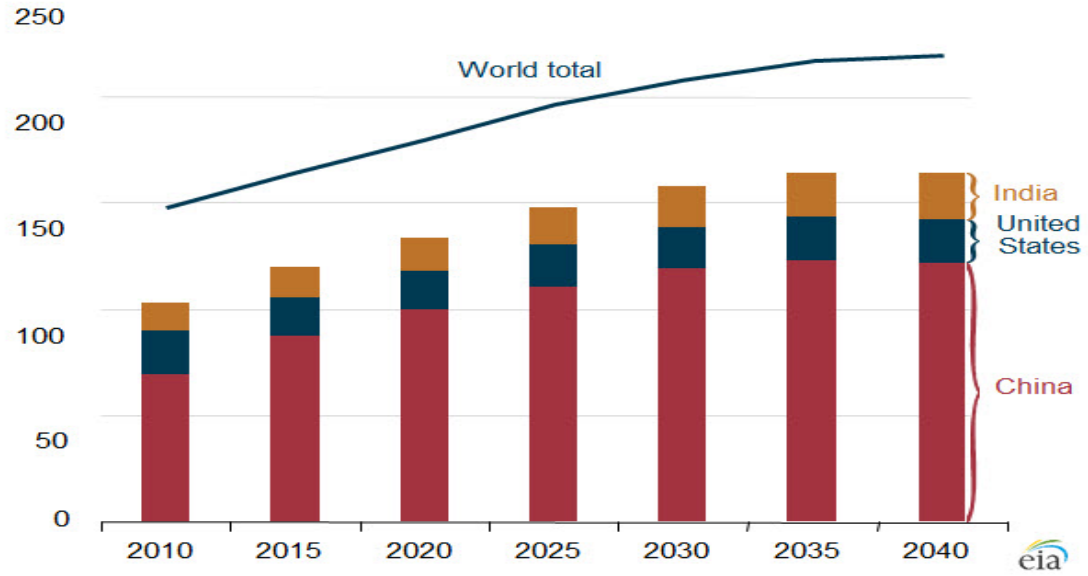
Continued recent growth
- China
- Europe
- India, Japan

Increased trade and exports

Energy security
- China
- Eastern Europe

Increased CO2 emissions





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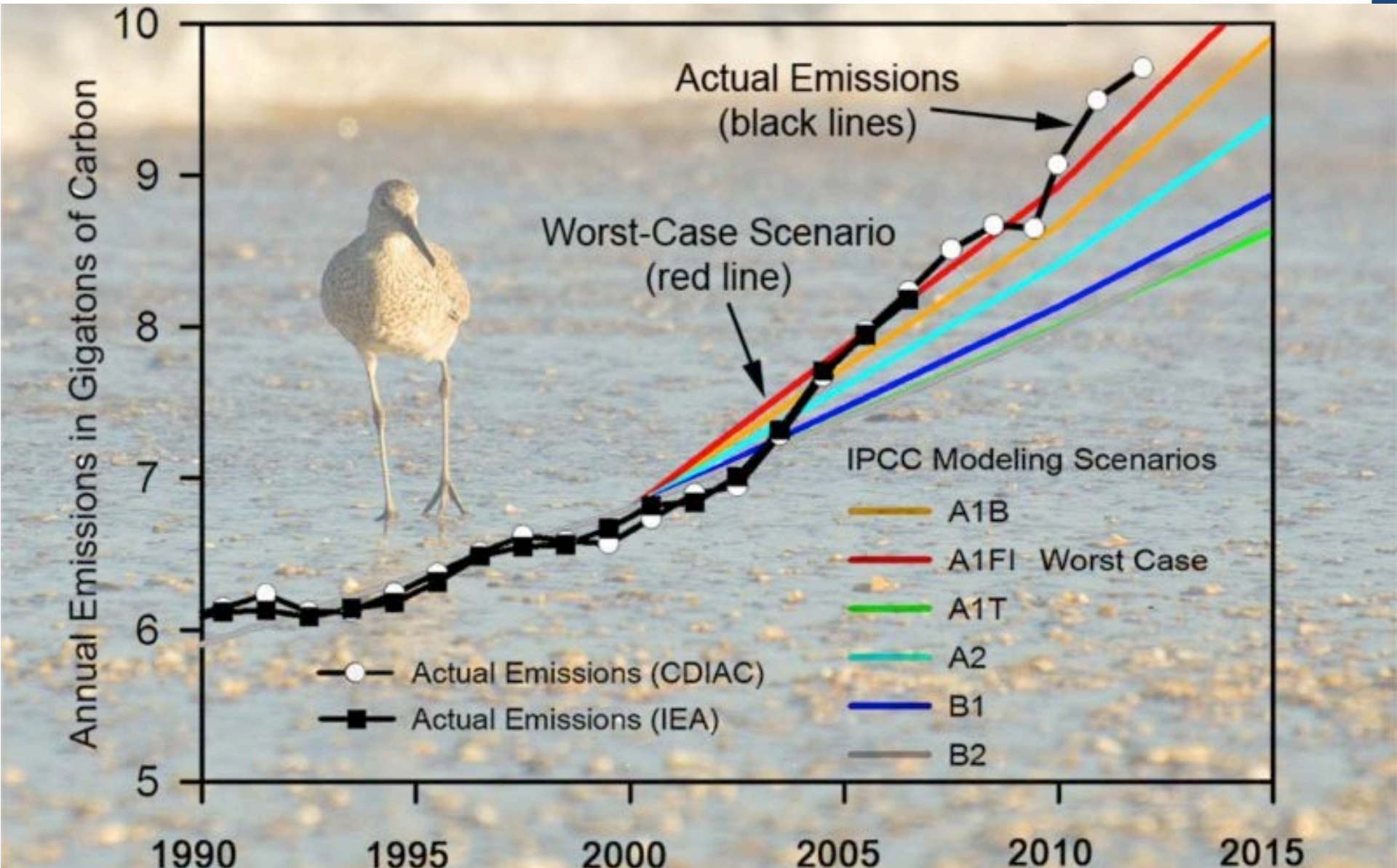
EIA Energy Outlook 2013

More than 40 Gtons /y



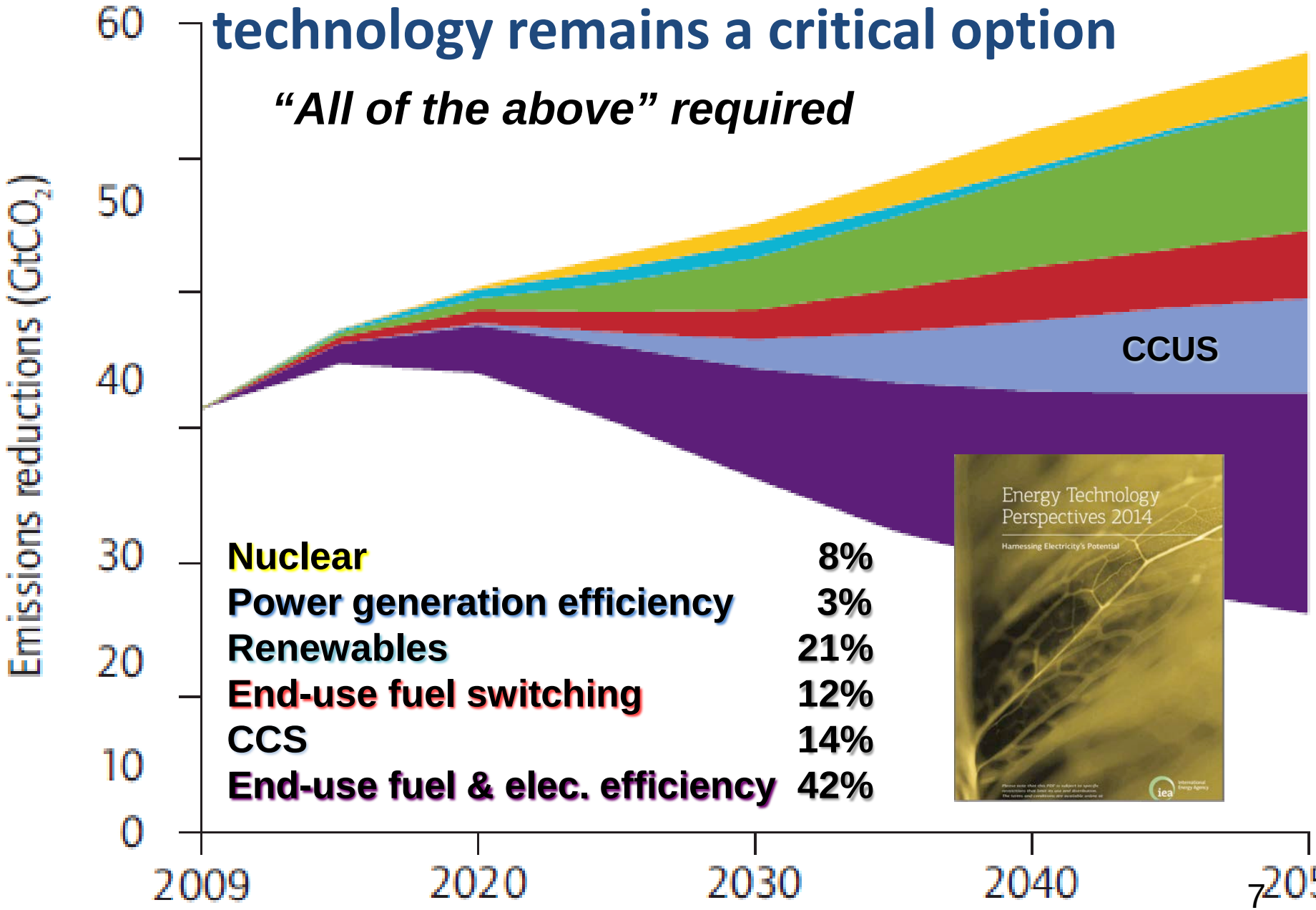
Fossil fuels use will continue in the US and worldwide

We must take action to reduce greenhouse gas emissions

CCUS deployment remains the critical action

We must strengthen our commitment to deployment of clean coal with CCUS

Because of abundant fossil energy, clean coal technology remains a critical option



Clean coal, with CCUS, will be the cheapest option in many markets

Percentage increase in total discounted mitigation costs (2015-2100) relative to default technology assumptions – median estimate

2100 concentrations (ppm CO_2eq)	no CCS	nuclear phase out	limited solar/wind	limited bioenergy
450	138%	7%	6%	64%

Symbol legend – fraction of models successful in producing scenarios (numbers indicate number of successful models)


All models successful


Between 80 and 100% of models successful


Between 50 and 80% of models successful


Less than 50% of models successful

Source: *IPCC Fifth Assessment Synthesis Report, November 2014.*

CCUS & President Obama's Climate Action Plan

Technical status: pretty much ready to go

15 years of concerted global research have shown:

- **Multiple world-wide large projects and large injections**
- **No major risks (geochemical, geomechanical, hydrologic)**
- **Cost reduction, with room for additional large reductions**

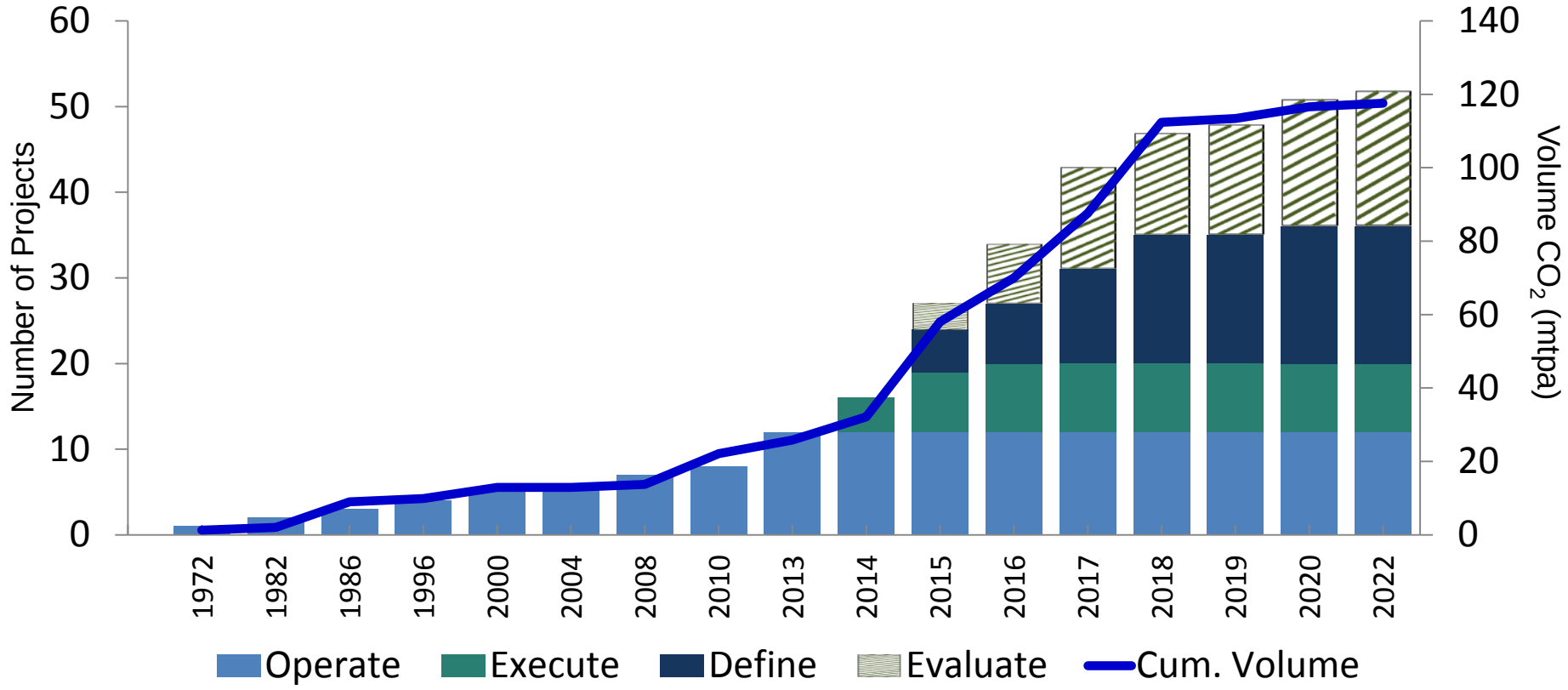
Office of Fossil Energy commitment: $6.5 billion

Work work to be done

- **More large-scale saline fm. Injections would help**
- **More Focus on transformational technology and large pilots**

Financing (cost recovery) is the main issue

Large Scale Integrated Projects World Wide



Data from Global CCS Institute

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Boundary Dam, : 1.1M tons/y CO2
Saskpower, Saskatchewan
SaskPower
Carbon Capture and Storage
Operational Oct. 1st


Kemper County, MS
Southern Co., 2013
(Anticipated start late 2014 or early 2015)

W.A. Parrish, TX
NRG/PetraNova project

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Broke Ground Last Week!!

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75,000 tons/y CO2 captured - >200,000 tons avoided

Algenol pilot project, Fort Myers, FL Operational !!

Scaling up technology with Duke Energy

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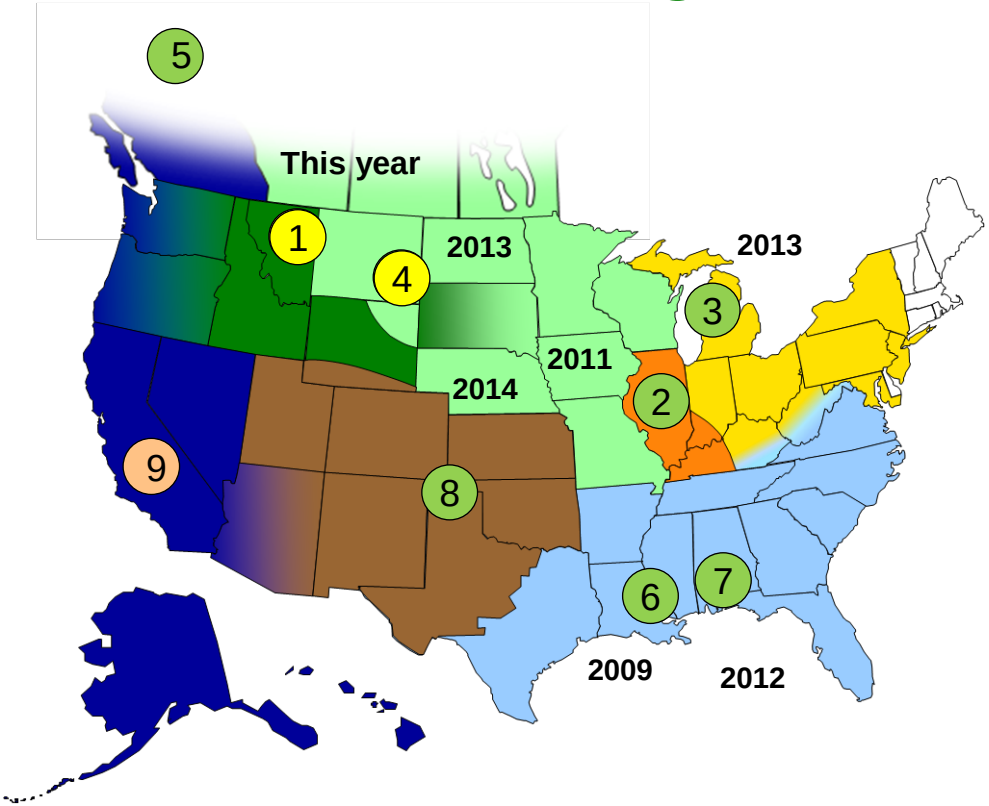
Regional Carbon Sequestration Partnerships

Large-Scale Geologic Tests



- Seven partnerships
- 40 states and 4 provinces
- Over $600M spent
- 23 small projects
- 8 large projects (100,000 to 3.5 million tons CO_2)

Provided critical knowledge and infrastructure to the states and to the US

Injection Ongoing

2014 Injection Scheduled

Injection Scheduled 2015+

Two projects in Montana
Wyoming in three partnerships
Montana in two partnerships

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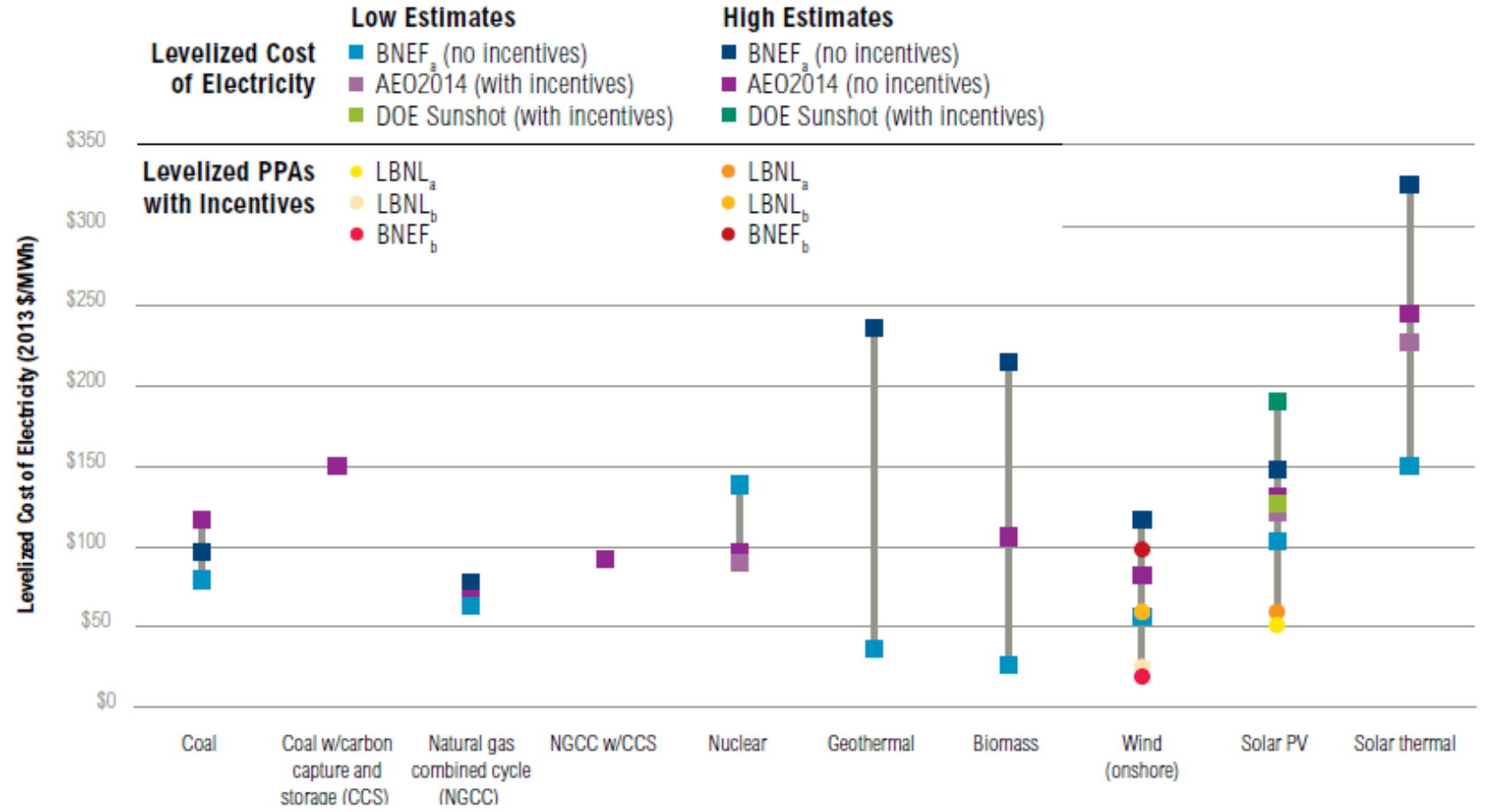
Cost, policy, and parity

Figure 1.2 | Levelized Cost of Electricity ($/MWh) for New Generation Sources and Levelized Power Purchase Agreement Prices for Recent Wind and Solar Projects



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President's FE portfolio and FY 16 budget

More than just FE RD&D budget

- **Loan Program Office: $8B in clean fossil authorities**
- **ARRA projects: >$4.5B commitment**
- **Tax credit proposal: comparable to renewable ITC's + PTC's**
    - **$2B ITC credits: 30% capital investment (incl. infrastructure)**
    - **Uncapped (!) STC's (sequestration tax credits) – scored at $3B**
        - **New authorities, not extendions/modifications of existing**

- ***FE RD&D: $564M for FY16; $400M for clean coal and CCUS***

Other policy actions

New EPA Rule

- CCUS is Best System or Emissions Reduction for new plants: 1400 lbs/MW-hr (~635 kg/MW-hr) standard
- CCUS is compliance mechanism for existing plants
- Great flexibility in implementation

Executive order: government power and efficiency

- >10% power from clean energy by 2016
- >25% power from clean energy by 2025
- Includes CCUS, nuclear, renewables

Clean Coal deployment: urgent and important

Not just about cost

- Costs are higher than plants without CCS
- Costs are lower than many clean energy alternatives

Not just about technology

- Many technologies are well demonstrated
- Improvement potential is very large

Policy Issue: could finance many ways

- Rate recovery; feed-in tariffs; direct grants
- Clean energy portfolios; tax-free debt financing; others

Financing is the priority action

International partnerships required

Many platforms (APEC; G7; Boao; UNFCCC; WEC)

CSLF: Multinational platform

- 22 countries + E.C.
- 11 years in practice
- Productive technical and policy working groups

Partnerships in Commerce

- Joint ventures
- International investment
- "Showcase" projects

Accelerated deployment

- Data sharing
- International Science Projects

Changing International Landscape for CCUS

New EU accord

- Policy Parity for CCUS and nuclear (also UNECE)
- Innovation funds

New actors

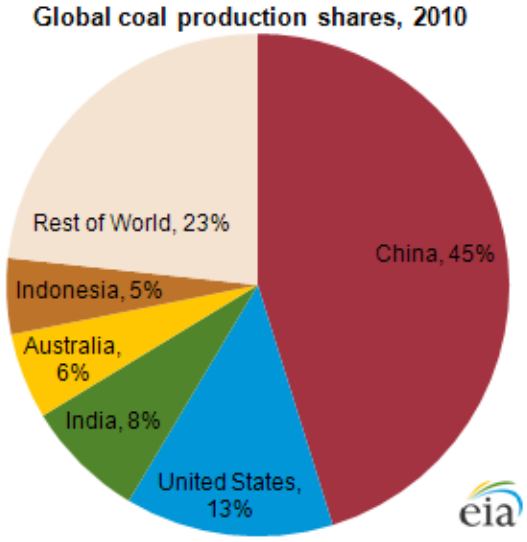
- UK: White Rose +
- KSA and UAE: EOR + coal
- Mexico: growing interest

US-China Accord

- Includes large CCS project
- Includes enhanced water recovery projects

China is the critical partner

- **China and US are #1 and #2 in**
  - **Economies**
  - **Energy use**
  - **Coal use**
  - **Emissions**
- **Coal use immense**
  - 67.5% of primary energy
  - near 4B tons/y today
  - Continued growth
- **Substantial govt. interest**
  - Focus on pollution reduction
  - Chiefly interested in CO2 utilization
  - New investment in clean energy, R&D (including CCUS)



Counterfacing projects under CCWG/S&ED

Includes three large-scale CCS-EOR projects

Technology leads and informs policy

Must build and deploy large projects

- Learning opportunity in CCS and clean fossil
- Information sharing: partnership as product
- Financing is the key challenge; many paths to success

Must develop 2nd and 3rd generation technology

Must partner with many

Coal will be used
CO_2 must be controlled
Time to build

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