Environmental Perspectives on CCUS/EOR

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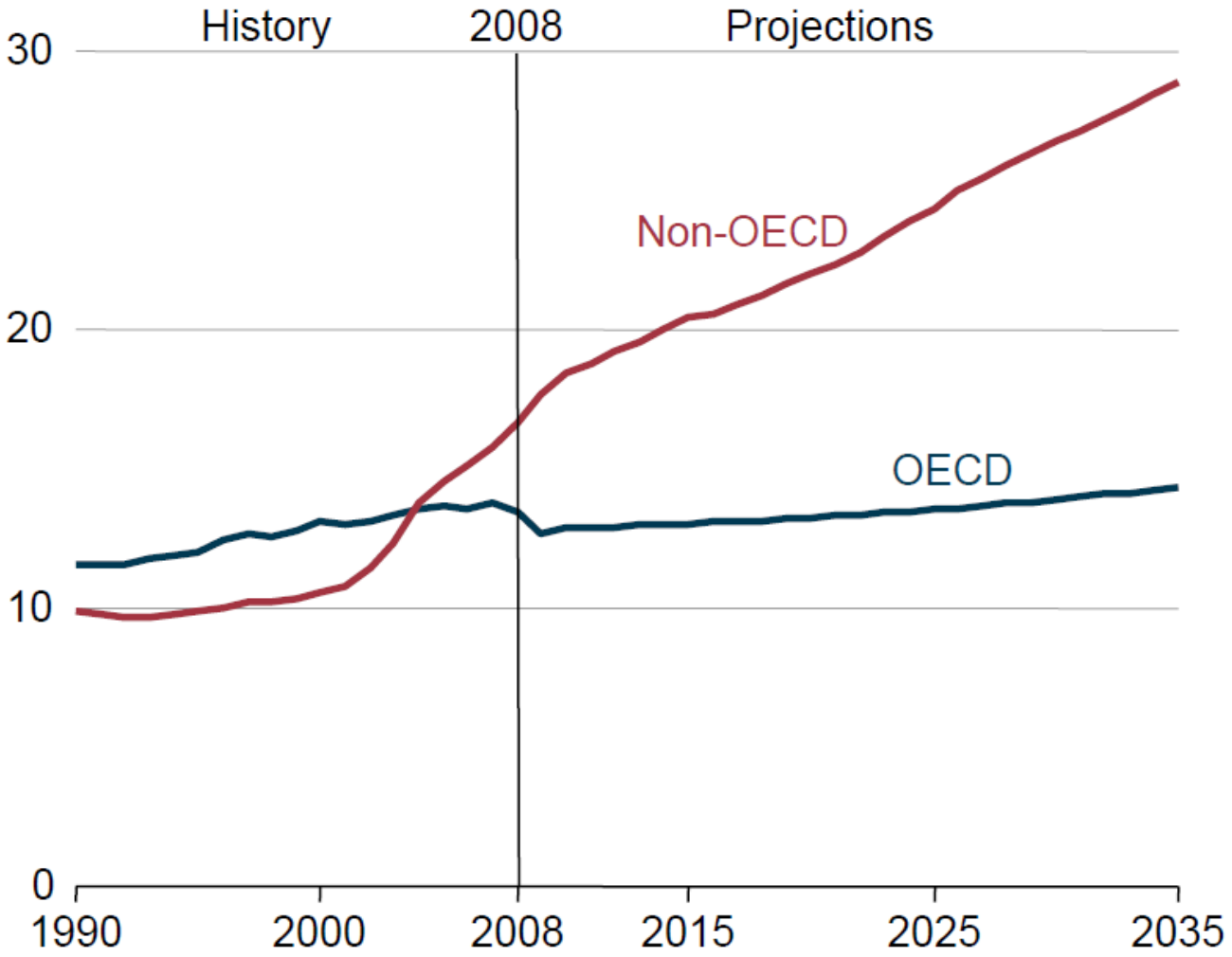
Outline

- World trends
- CA: the path to 2050 climate goals
- Role and status of CCS
- EOR in the U.S.
- Regulatory considerations

World emissions forecast

NRDC
THE EARTH'S BEST DEFENSE

Figure 110. World energy-related carbon dioxide emissions, 1990-2035 (billion metric tons)

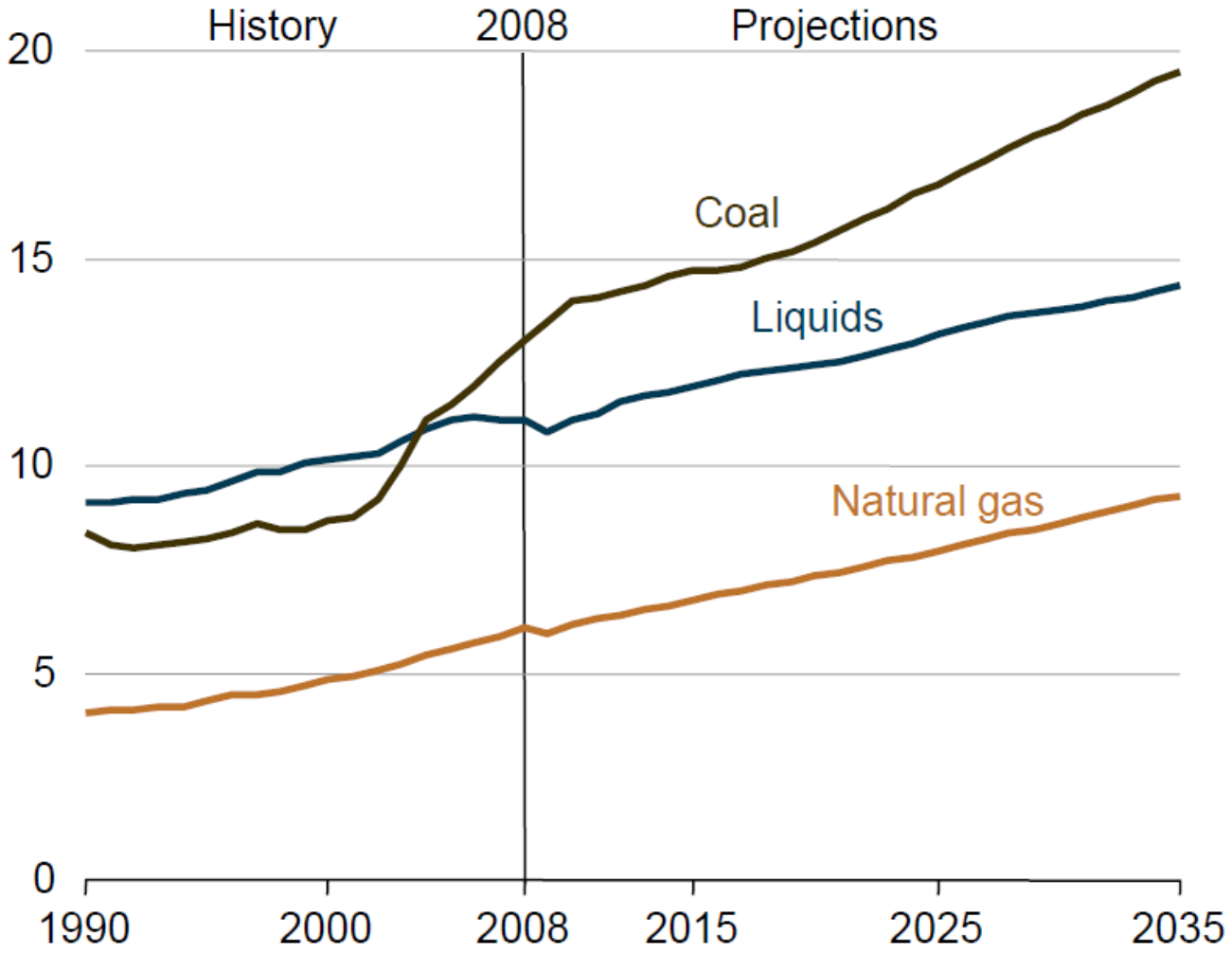


International Energy Outlook 2011

eia

By fuel

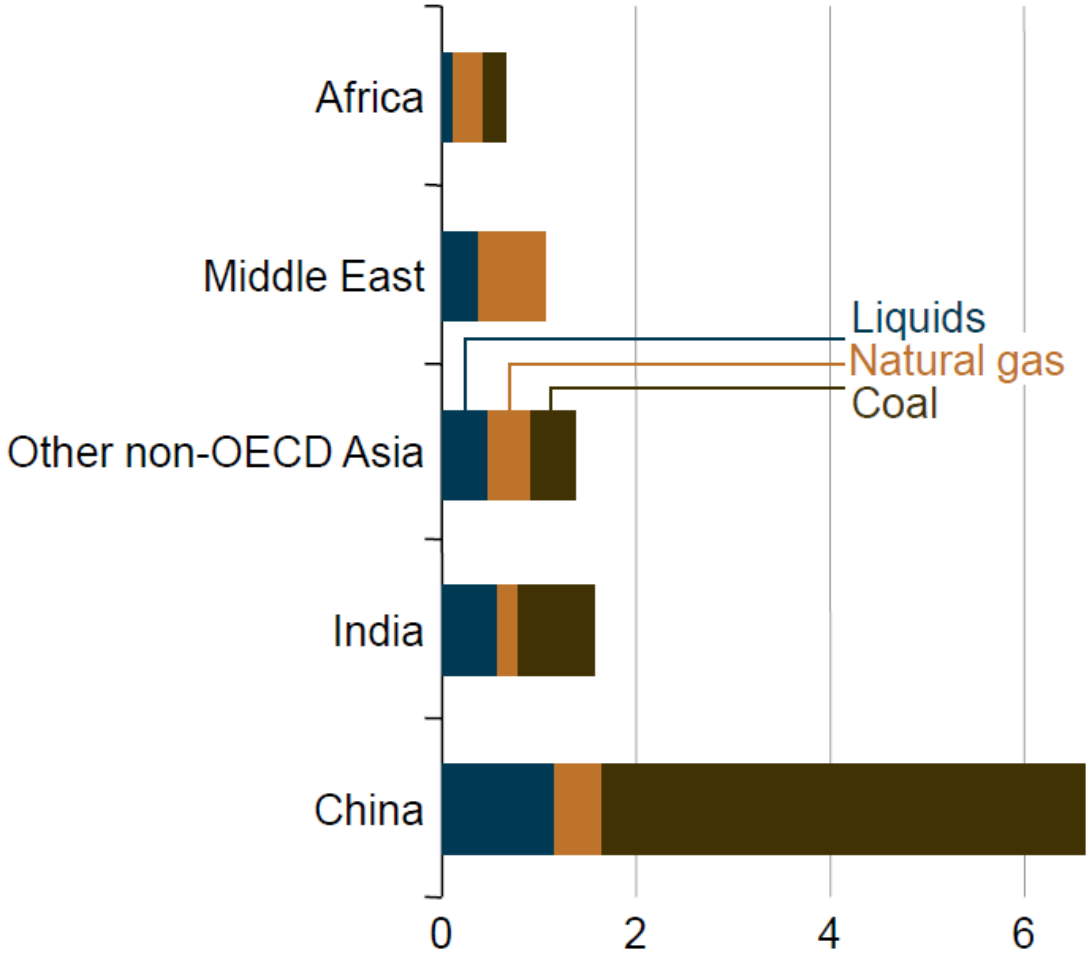
Figure 111. World energy-related carbon dioxide emissions by fuel type, 1990-2035 (billion metric tons)



International Energy Outlook 2011

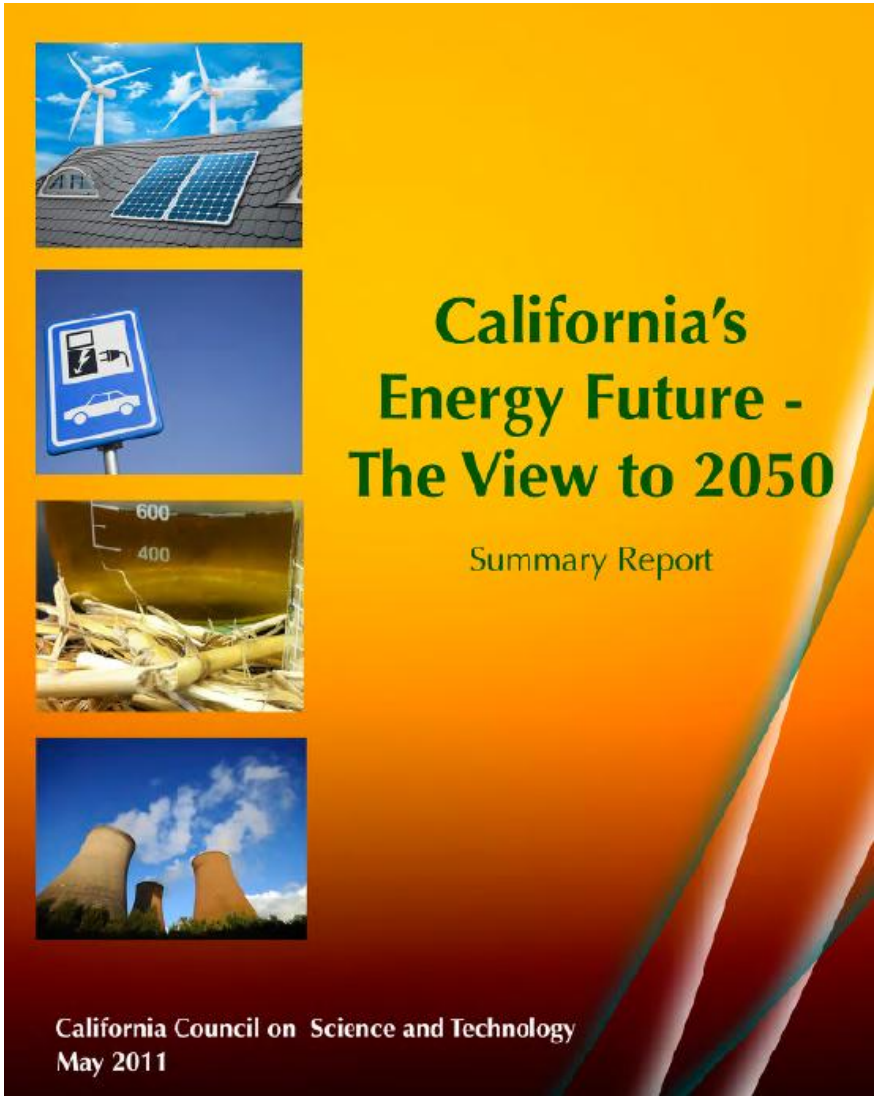
Largest growth

Figure 115. Increases in carbon dioxide emissions by fuel type for regions with highest absolute emissions growth, 2008-2035 (billion metric tons)



International Energy Outlook 2011

California's goals



- "California can achieve emissions roughly 60% below 1990 levels with technology we largely know about today if such technology is rapidly deployed at rates that are aggressive but feasible"

- "We could further reduce 2050 greenhouse gas emissions to 80% below 1990 levels with significant innovation and advancements in multiple technologies that eliminate emissions from fuels. All of these solutions would require intensive and sustained investment in new technologies plus innovation to bridge from the laboratory to reliable operating systems in relatively short timeframes"

Achieving 60%

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Strategy	Assumed Plant Size	Total Plant Capacity Needed in 2050	Build Rate 2011-2050 (Plants/Year)
Nuclear	1.5 GW	44 GW	0.73
Fossil/CCS	1.5 GW	54 GW*	0.90
Renewables Mix total		165 GW**	
- Wind	500 MW	59 GW	3.0
- Central Solar (CSP and PV)	500 MW	65 GW	3.3
- Distributed Solar PV	5 kW	22 GW	110,000
Biomass/CCS	500 MW	1.5 GW	0.77
CA Biofuels	50 $Mgge/yr$	5.5 $bgge/yr$	2.8
Hydrogen		8.0 $bgge/yr$	
- Natural Gas Reforming	0.5 $Mgge/yr$	0.8 $bgge/yr$	40
- Central Plant	440 $Mgge/yr$	7.2 $bgge/yr$	0.41

Table 5. Summary of supply build rates required.
*Gross capacity, assuming 10% parasitic loss from CCS (net capacity = 49 GW)
**Includes geothermal and hydropower not included in this table

Achieving 80%

- “CCS is likely to be an important part of several possible schemes to provide hydrogen, low-carbon fuels or offsets that allow continued fossil fuel use. For California, the utility of CCS in achieving a low carbon fuel portfolio could be as important as the utility of CCS for electricity production per se”

CCS – NRDC's view

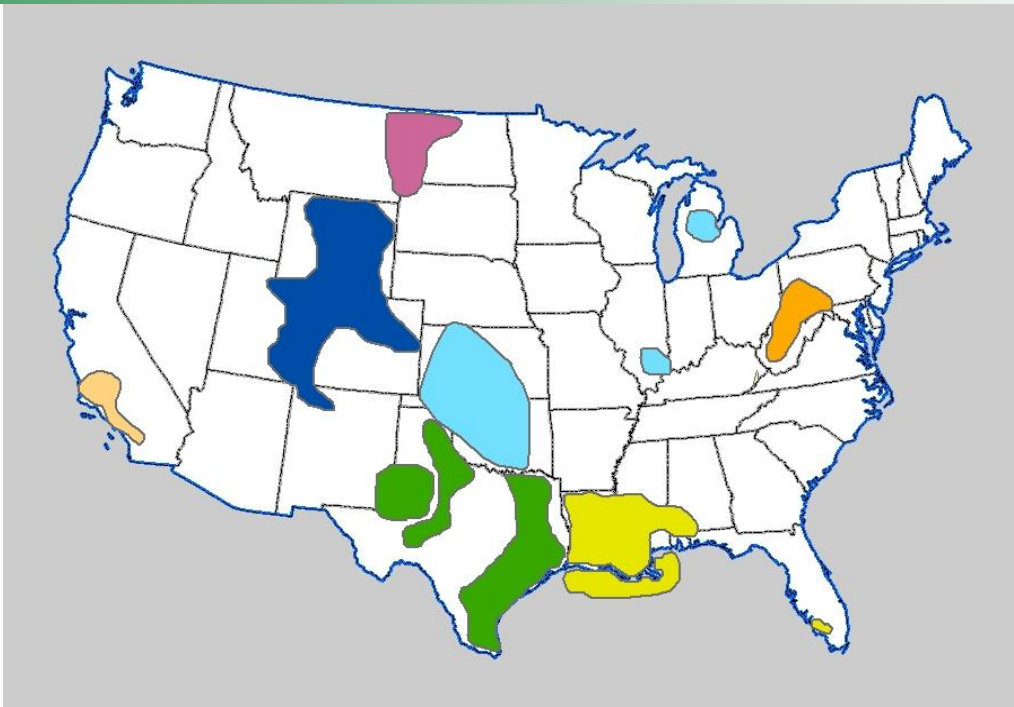
- Ready to begin deployment: safe and effective if sites are chosen, operated and regulated appropriately
  - Nature did CCS well before we thought of it
  - Industrial analogues
  - Several international projects with excellent results
  - Large scientific body of knowledge
  - Significant research efforts worldwide
  - Reliable commercial services available

EOR – NRDC's view

- Win-win-win for the environment, energy security and the economy: EOR+GS
  - Developed fields
  - Faster, cheaper and larger than drilling in offshore or protected areas
  - Huge untapped potential for domestic oil production
  - Energy independence

http://www.nrdc.org/energy/eor.pdf

EOR and CO_2 demand in lower 48



- Economic potential between 38-58 bn bbl, at \$70/bbl and \$45/t CO_2
- CO_2 demand between 10-12 bn tons
- 75% of lower-48 potential in four basins in Gulf, Texas, Mid-Continent

Class VI vs. Class II

- Information for a permit application
  - Class VI: Properties of confining zone, faults/fractures, seismic history, wells.
  - Class II lacks such requirements/ relies on known wells or public record.
- Siting requirements
  - Class VI: injection zone with sufficient properties to receive total anticipated CO2, a confining zone big enough to contain injected and displaced fluids, sufficient integrity to allow injection without initiating or propagating fractures.
  - Class II: confining zone free of transmissive faults and fractures.
- Monitoring
  - Class II: analyzing injected fluids, injection rate, pressure and volume.
  - Class VI: testing and monitoring plan covers operational parameters for the well, tracking of CO2 plume and area of elevated pressure, water quality measurements, optional surface monitoring.
- Well plugging
  - Class VI: tailored to individual situations. Class II: off-the-shelf methods.

Class VI vs. Class II

- Post-injection site care and site closure requirements
  - Class VI: post-injection monitoring for [50]yrs. Class II: none.
- Area of review and corrective action:
  - Class VI: No default distances, update at least every 5yrs, modeling, more extensive identification of penetrations within the area of review.
- Financial responsibility obligations under Class VI more comprehensive than under Class II
- No emergency and remedial response provisions in Class II
- Other differences:
  - Construction requirements, logging, sampling and testing, primacy standard.

EPA GHG Reporting

- Inject CO_2: subpart UU
  - Basic flowmeter readings
- Sequester CO_2: subpart RR
  - Additional Monitoring, Reporting & Verification Plan
  - Identify leakage pathways
  - Strategy for:
    - Detecting and quantifying leakage
    - Establishing baselines
- Voluntary for EOR operations
- No mandate to operate in a way that prevents or avoids emissions
- Considerable Administrator discretion
- No public comment on MRV plan until final

EOR as GS: Options

- Class VI + subpart RR reporting
- New federal regulations for EOR + GS
- New state regulations for EOR + GS
- Case-by-case treatment of projects under existing authorities + regulations

Closing thoughts

- Federal driver for CCS deployment?
  - Legislative
  - Regulatory
  - ARRA
- CA is an exception
- Role of EOR more prominent
- Needs to be done right
- Spillover of mistrust from shale gas?

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