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Opportunities for Financing CCS Projects & the Impact of Oil Prices on CO₂-EOR

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*National Coal Council
2015 Annual Spring Meeting*



CENTER FOR CLIMATE
AND ENERGY SOLUTIONS

C2ES.ORG



- **Independent, nonpartisan, nonprofit organization**
- **Working to advance strong policy and action to address the twin challenges of energy and climate change**
- **Founded in 1998 as the Pew Center on Global Climate Change**
- **Became C2ES in 2011**
- **Bob Perciasepe started as new President of C2ES in 2014**



- **Co-convene broad stakeholder coalition called the National Enhanced Oil Recovery Initiative (NEORI)**
- **NEORI issued consensus federal and state policy recommendations for advancing EOR with CO₂ captured from power plants and industrial facilities**
- **Legislation based on NEORI recommendations introduced in last two Congresses**

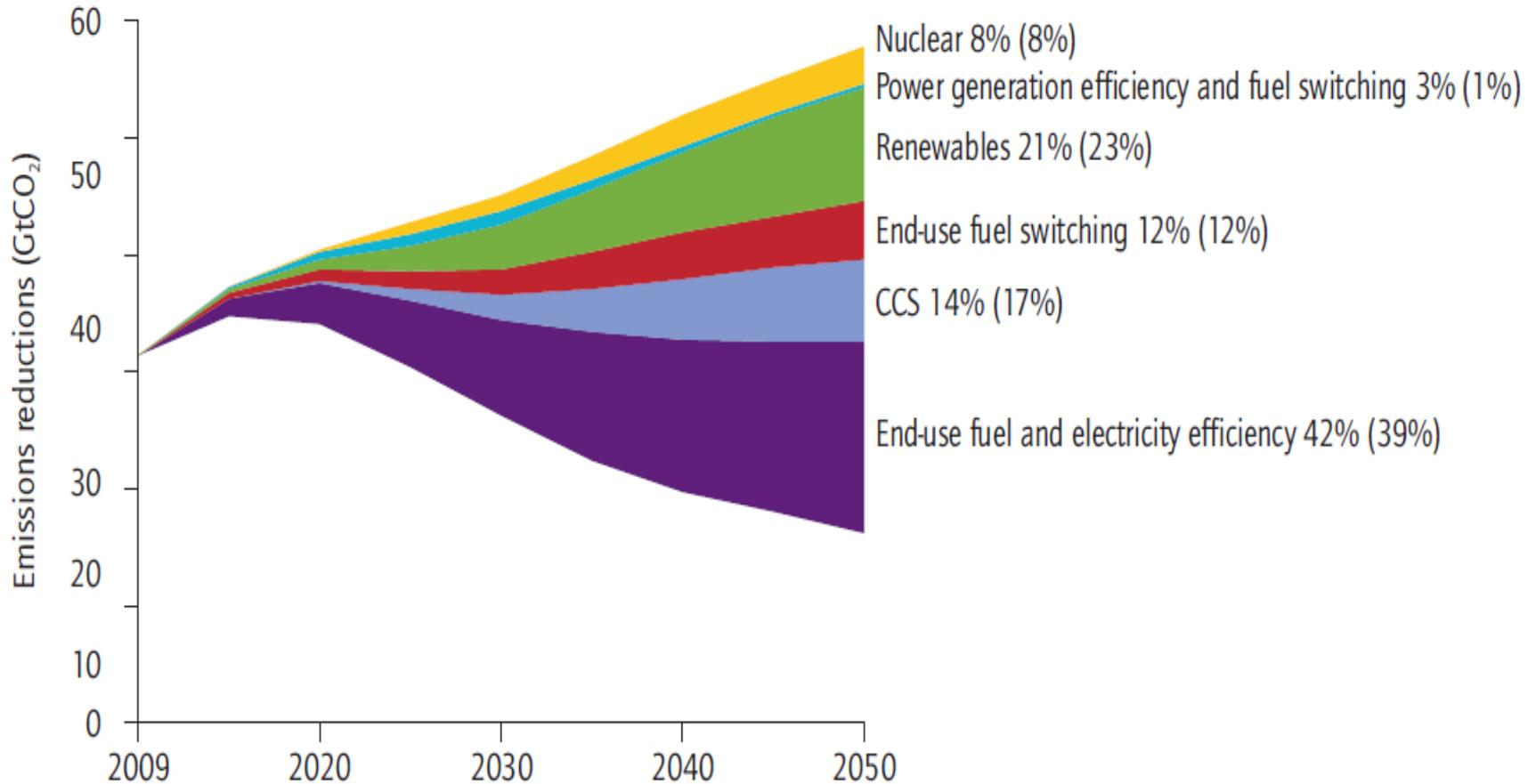
- **CCS - why it's needed and needed faster**

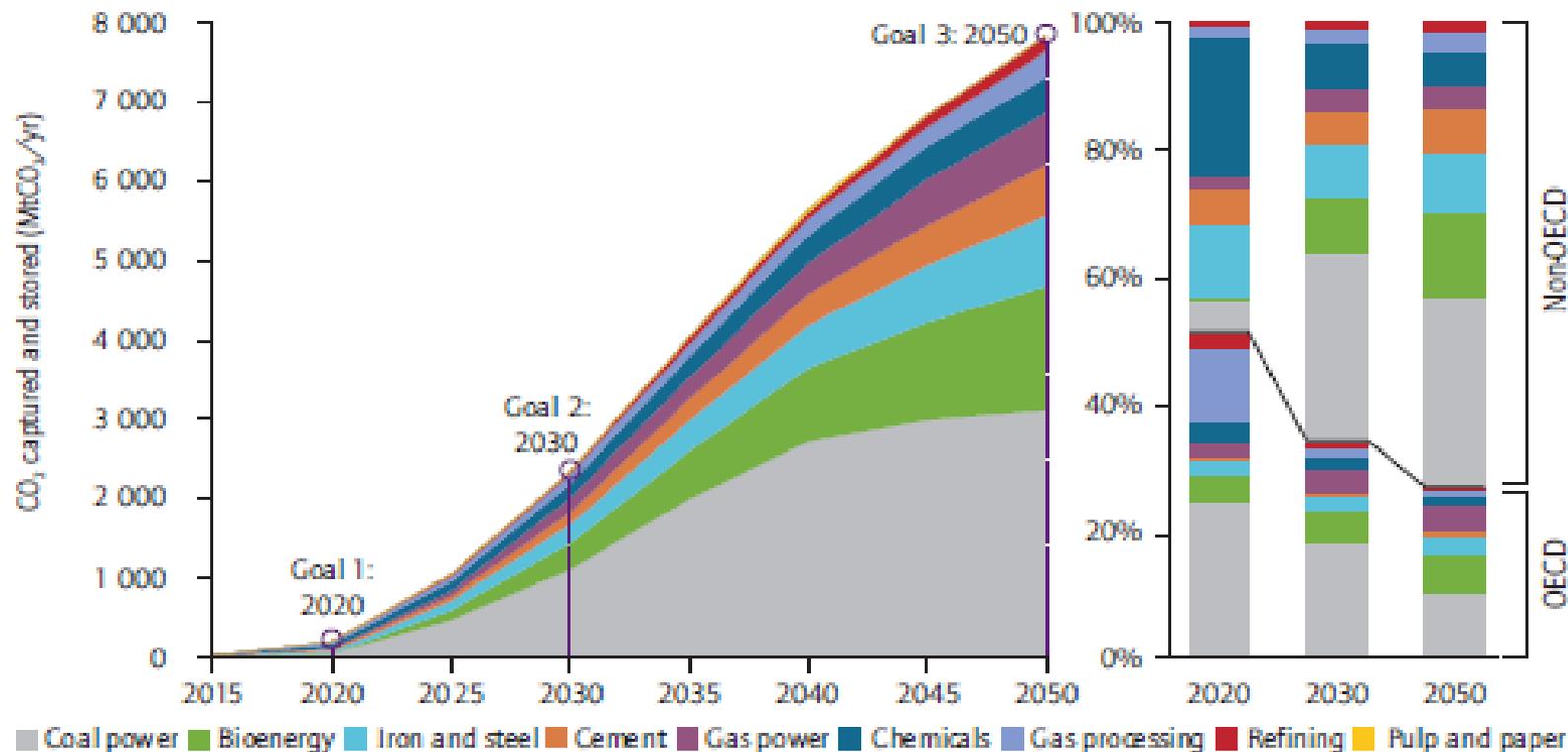
- **Closing the Cost Gap:**
 1. CO₂-EOR - how it affects CCS economics
 - How does an era of lower oil prices impact CO₂-EOR?
 2. What role can financial incentives play in closing the remaining cost gap?



- **CCS is an essential technology given our global continued reliance on fossil fuel**
- **IPCC, IEA, and others have estimated that CCS will play an important role in meeting climate objectives**
- **CCS is more than a power plant story**
 - A number of industrial sources of CO₂ have successfully deployed CCS to date
 - For certain industrial sources, CCS may be only option to significantly reduce CO₂ emissions

IEA - Estimates of various technologies' share of meeting 2 degree goals





- **Coal power is the largest opportunity to deploy CCS, but other power generation and industrial process account for large share of 2050 need**

- **CCS deployment is not on track - need more commercial-scale deployments to bring the cost of the technology down**
 - Only one commercial-scale power plant with CCS is running, just a handful more are under construction
 - Several industrial CCS projects are running, but many more needed and with industries where CCS not previously deployed
- **Improving the economic case of individual CCS projects is essential**
 - How to cover incremental cost of investing in equipment to capture and transport CO₂
 - Ability to sell captured CO₂ can create a revenue stream for a CCS project to overcome investment and financing challenges

- **To date, best example of utilizing CO₂ and creating a value for CO₂ has been CO₂-EOR**
 - In some cases, EOR operators have been willing to pay up to \$30 per tonne of CO₂, which could cover a significant percentage of the cost to capture and transport CO₂

Even after selling captured CO₂, a cost gap is likely:

Cost Gap =

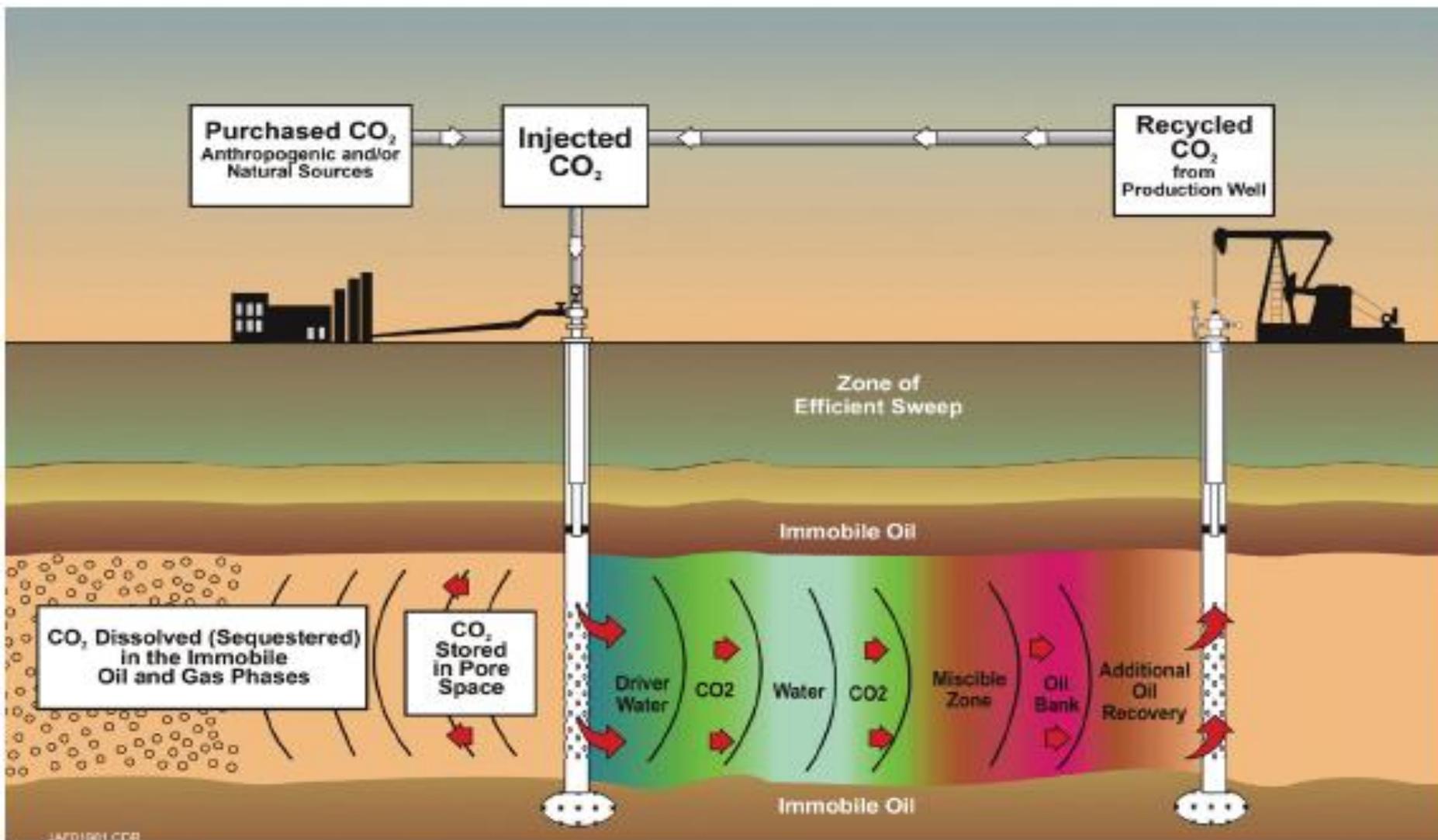
(Cost to Capture and Transport CO₂ to EOR Project)

minus

(CO₂-EOR operator willingness to pay for CO₂)

How does one cover the remaining cost gap??

How Does CO₂-EOR work?



Source: Advanced Resources International and Melzer Consulting, Optimization of CO₂ Storage in CO₂ Enhanced Oil Recovery Projects, prepared for UK Department of Energy & Climate Change, November 2010.



- **Practiced for over 40 years**
- **300,000 barrels of production per day as of 2014**
- **4,000 miles of CO₂ pipelines (some span hundreds of miles, cross state and Canadian border)**
- **65 million tonnes of CO₂ injected annually (only around 13 million tonnes from man-made source)**
- **History suggests can permanent sequester large volumes of CO₂**
- **Significant potential to expand >> address domestic energy security and environmental challenges**

Estimates of CO₂-EOR Potential



| | Recoverable Resource (BBbls)* | | Demand for CO ₂ (Billion Metric Tons) | | Average CO ₂ Utilization (bbls/mtCO ₂) | |
|------------|-------------------------------|-----------|--|-----------|---|-----------|
| | CBP* | Next Gen. | CBP* | Next Gen. | CBP* | Next Gen. |
| Technical | 36.7 | 79.3 | 17.0 | 20.4 | 2.2 | 3.9 |
| Economic** | 21.4 | 63.3 | 8.9 | 16.2 | 2.4 | 3.9 |

- Economically-recoverable - 21.4 to 63.3 billion barrels
- Technically-recoverable - 36.7 to 79.3 billion barrels
- Accessing these reserves would utilize billions of tonnes of CO₂

Source: Wallace, Kuuskraa, DiPietro., National Energy Technology Laboratory, 2013. "An In-depth Look at 'Next Generation' CO₂-EOR Technology"

Available at: http://www.netl.doe.gov/energy-analyses/pubs/Disag%20Next%20Gen%20CO2%20EOR_full_v6.pdf

Map of Current CO₂-EOR projects



CO₂-EOR OPERATIONS, CO₂ SOURCES: 2014

FIG.

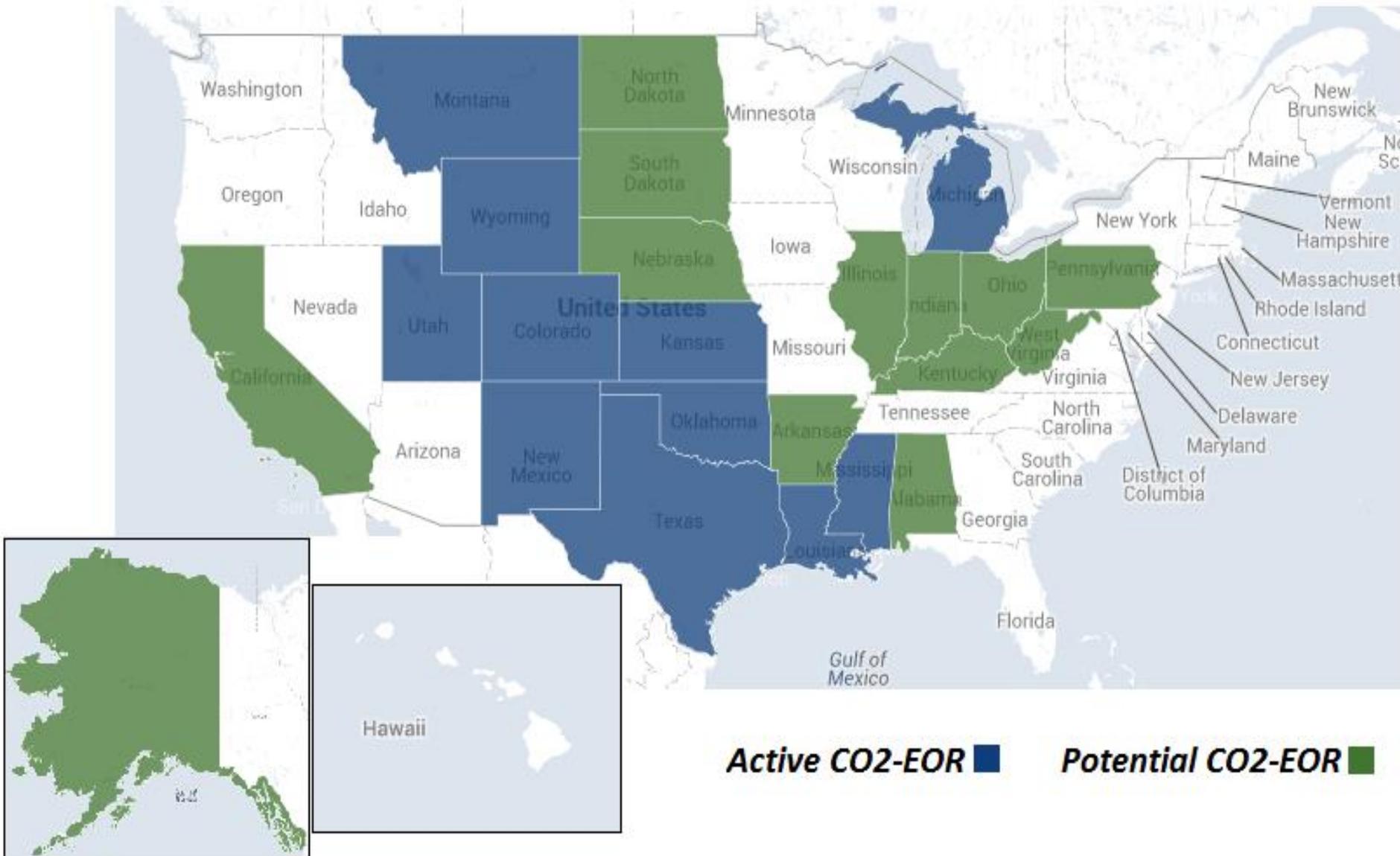


| Oil production, 2014 | |
|--------------------------------|-----|
| CO ₂ -EOR projects | 136 |
| Oil production, 1,000 b/d | 300 |
| CO ₂ supplies, 2014 | |
| Number of sources | 17 |
| • Natural | 5 |
| • Industrial | 12 |
| CO ₂ supply, MMcfd | 3.5 |
| • Natural | 2.8 |
| • Industrial | 0.7 |

| | |
|------------|---|
| 136 | Number of CO ₂ -EOR projects |
| ● | Natural CO ₂ source |
| ■ | Industrial CO ₂ source |
| — | CO ₂ pipeline |
| ⋯ | CO ₂ proposed pipeline |

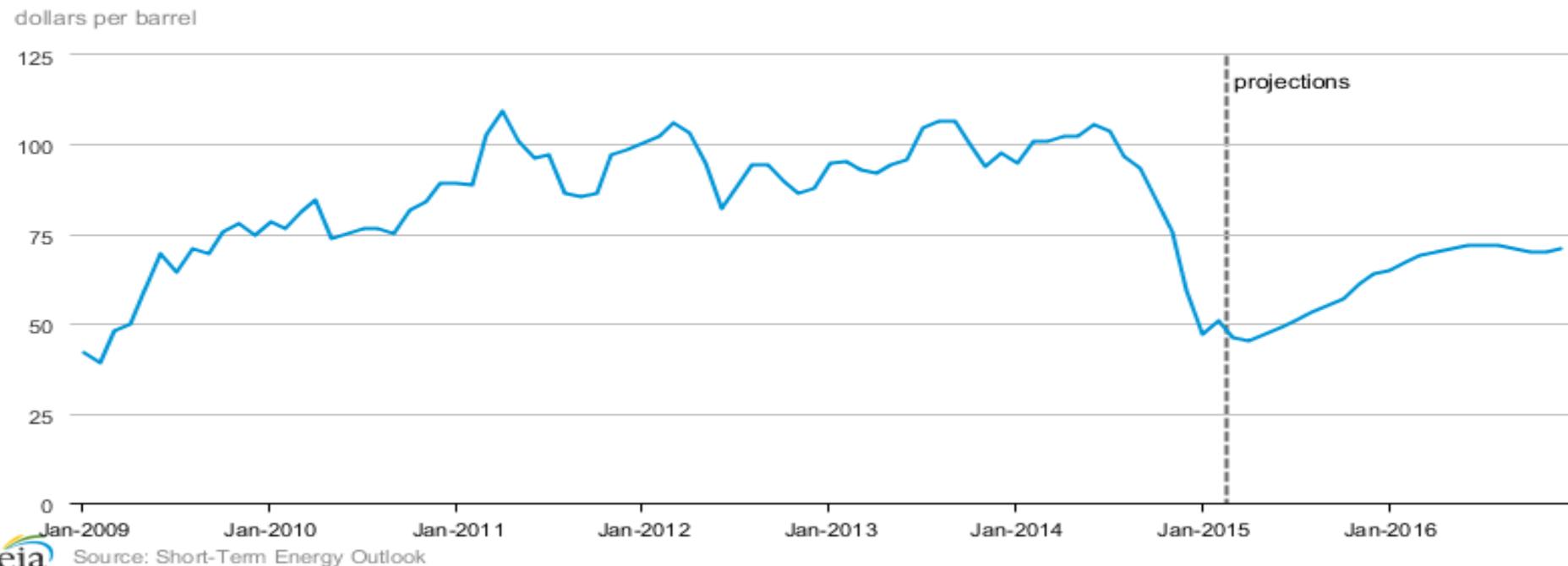
Source: Advanced Resources International Inc. based on OGI EOR/Heavy Oil Survey 2014 and other sources.

States with Active or Potential CO₂-EOR Projects



Oil price decline in recent months...

West Texas Intermediate Crude Oil Price



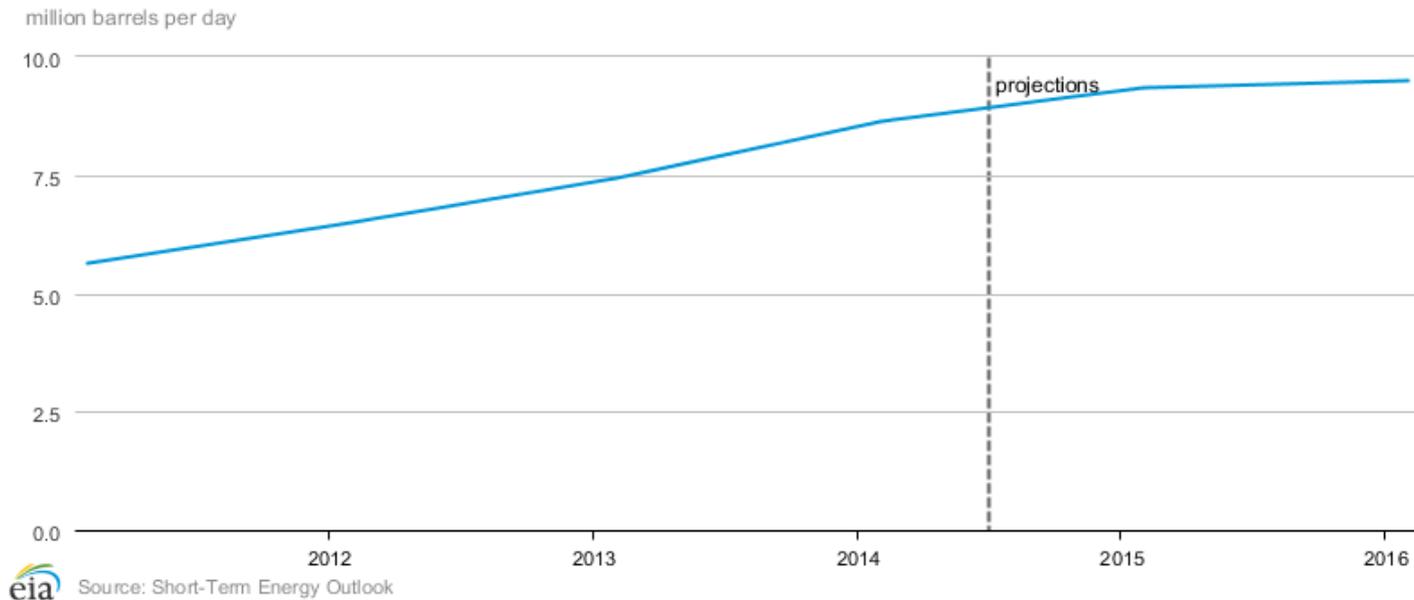
- **Average monthly WTI price (July 2011- July 2014): \$96.36 per barrel; on several occasions, monthly price > \$105 per barrel**
- **Fall 2014 - Winter 2015: quick drop, prices ~\$45 per barrel**
- **2015-2016: Potential rebound to range of \$55-\$70 per barrel**

Production volumes have not fallen yet...



- EIA still estimates that U.S. oil production will increase slightly in 2015 before plateauing in 2016

U.S. Crude Oil Production

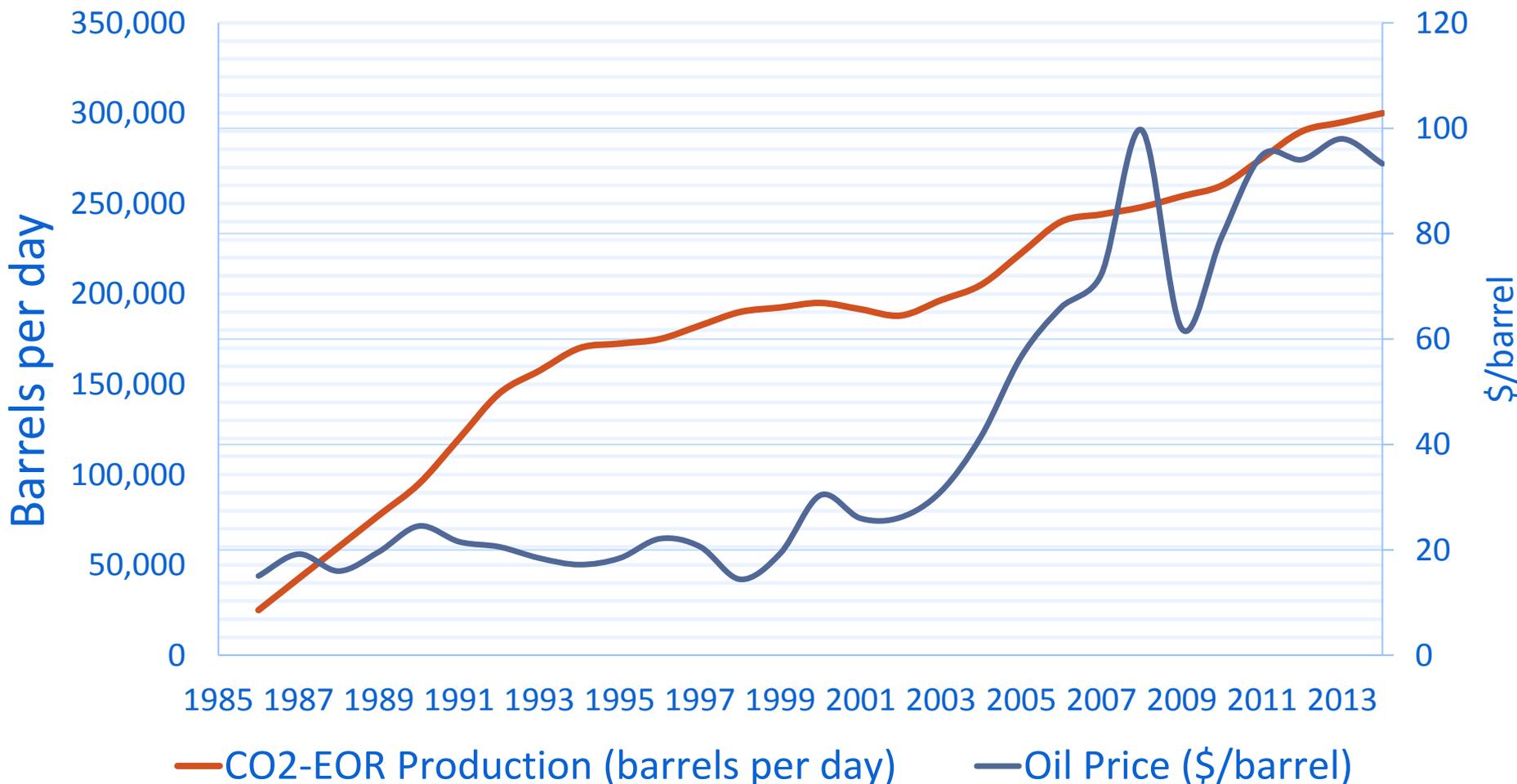


- General sense that period of lower prices will prevail; this could lead ultimately lead of production cutbacks
- Geopolitical event could change current dynamics quickly

How will CO₂-EOR fare under these circumstances?



- History suggests that CO₂-EOR production holds steady during periods of sharp oil price swings





- **CO₂-EOR project lifecycle:**
 - 0-1 year: CO₂ injection that eventually leads to oil production
 - 1-5 years: production ramps up
 - 5-15 years: sustained peak production
 - 15-30+ years: slowly declining production
- **Returns to an EOR project are not immediate; EOR operators have long-term perspectives**
- **Given expected decades of production for an individual EOR project, oil price volatility expected**

How could CO₂-EOR fare with period of lower oil prices?



- **Given relatively low operating costs, existing projects will maintain production volumes**
 - If supplied CO₂ tied to oil price, cost of CO₂ decreases
 - Potential for other operating costs to decrease

- **Ability to initiate new projects challenged**
 - Very low oil price makes difficult, but slight rebound to \$55-\$70 range could make possible
 - Low prices constrain capital budgets
 - EOR expansion already limited by constraints on supplies of natural and man-made CO₂

- **Energy security benefits of CO₂-EOR can have value to federal and state policymakers in face of global instability**
 - Projects maintain production during oil price swings and over long periods of time
- **CO₂ capture projects likely to receive decreased revenue from selling CO₂; but extent of impact on individual project economics not clear**
 - Variability of revenue derived from selling captured CO₂ is an inherent economic risk

Again, revenue from EOR cover some, but not all of CCS investment cost



Bridge the cost gap:

Cost Gap =

(Cost to Capture and Transport CO₂ to EOR Project)

minus

(CO₂-EOR operator willingness to pay for CO₂)

In some cases, EOR operators have been willing to pay up to \$30 per tonne of CO₂, which could cover a significant percentage of the cost to capture and transport CO₂

How can potential incentives for CO₂ capture cover the remaining cost gap?



- Grants for commercial-scale projects:
 - Available through Clean Coal Power Initiative, Industrial Carbon Capture and Storage Initiative, Recovery Act of 2009
 - Will similar levels of funding become available in the future?

- Tax incentives – 48A and 48B ITCs, 45Q PTC
 - ITCs allocated, but projects awarded credits still in process of moving forward
 - 45Q has limited allocation, could run out in the future without enabling broad deployment of capture projects
 - How can these or similar incentives be improved in the future?

- Loan Guarantee Program
 - No known awards by DOE to date



- **45Q Production Tax Credit**

- Likely running out
 - Only authorized for 75 million tonnes of CO₂
 - As of 2014, 27 million tonnes had been claimed per IRS
 - Existing pool exhausted in next 3-6 years without really getting critical mass of innovative projects under way
- Limited certainty for private sector
 - No process to reserve credits for future claiming
 - Taxpayer must own facility where CO₂ capture occurs
- Credit value potentially insufficient to attract private sector investment
 - \$10/tonne of CO₂ used in EOR
 - \$20/tonne of CO₂ injected in saline formations

Recent efforts to expand existing or create new incentives for CO₂ capture



- **Rockefeller/Heitkamp expansion and reform of 45Q**
 - Legislation (S. 2288) introduced in 2014
 - Based on NEORI consensus approach
 - Extend 45Q beyond existing limitation to support broader deployment of power plant and industrial CO₂ capture
- **Heitkamp ITC and competitively-awarded subsidy for CO₂ capture at coal-based projects**
 - Legislation introduced in 2014 and again in 2015
- **Bipartisan Master Limited Partnership (MLP) bills in Senate and House**
 - Would authorize MLP company structure for CO₂ capture projects
- **Baucus/Wyden comprehensive energy tax reform proposal**
 - CO₂ capture projects would qualify for ITC or PTC along with other clean energy sources
- **President Obama's FY 2016 budget**
 - Would authorize new ITCs and Sequestration Tax Credits (STCs) for CCS projects

- **How can incentives better address CO₂ capture project economics?**
 - Credits may not offer sufficient value to cover cost gap
 - Credits may not necessarily address high up-front investment costs
 - Ability to utilize tax credits depends on tax appetite (which may not exist for many debt-financed projects)
 - Can credits be refunded in exchange for cash grant? This provision has been available to other energy sources.
 - Potential volatility of CO₂ revenue an issue
 - Can incentives increase during periods of low oil prices? When oil prices are high, can incentives adjust down to avoid windfalls?
- **How to provide certainty to CO₂ capture projects?**
 - Complexity and uncertainties have limited private sector interest and ability to utilize available incentives
- **How can new federal tax revenue from new CO₂-EOR production cover the cost of potential incentives?**
 - Under existing tax treatment, oil produced via EOR generates federal revenue

- **Expansion would:**

- Create a separate new pool of credits, enough available to broadly support long-term development of CO₂ capture technologies
- Reserve credits for different sources of CO₂
- Allocate new credits through competitive bidding
- Adjust tax credit values on an annual basis to reflect oil price changes

- **Reform would:**

- Address uncertainties in current 45Q statute (req. to own facility and capture equipment)
- Allow CO₂ capture projects to reserve credits for future claiming
- Establish requirements to begin operations
- Require Treasury to estimate sum of federal tax revenue derived from new EOR production

- **Concept of applying PABs to CO₂ capture projects developed by Stanford University and Summit Power**
- **Federally-authorized for certain private sector projects**
- **State agencies authorize on behalf of private sector project; states subject to volume cap in terms of how many PABs can be issued annually**
- **Long-available for environmental technologies**
 - Had been available for power plant investments in scrubber technology, but tax reform of 1986 eliminated
- **Could enable much more favorable financial structures for CO₂ capture projects**
 - Private sector has familiarity with PABs, more and different kinds of investors could purchase bonds
 - Bonds could enable more favorable borrowing terms >> longer debt repayment periods at lower rates
 - Address barrier of high upfront investment costs for CO₂ capture projects



- **MLPs allow companies to register as partnerships**
 - Shares of MLPs on markets to investors
 - Income not subject to corporate income tax >> disbursed to shareholders (who pay capital gains taxes)
- **This innovative corporate structure has been available to different natural resource projects**
 - CO₂ capture project would be added to list of eligible MLPs (EOR projects and CO₂ pipelines already qualify)
- **Bipartisan teams in Senate and House introduced legislation authorizing RE and CE projects for MLP status**

- Even during periods of oil price volatility, experience suggests that CO₂-EOR projects will maintain production volumes
- CO₂ capture projects can be enabled by combination of revenue derived from monetizing CO₂ and taking advantage of available incentives
- There is significant political interest in addressing economic barriers to getting more CO₂ capture projects under development

BACKUP SLIDES

National Enhanced Oil Recovery Initiative (NEORI)



Coal and Coal-Based Generation

- Arch Coal
- Basin Electric Power Cooperative
- Cloud Peak
- Great River Energy
- Summit Power Group
- Tenaska Energy

Industrial Suppliers of CO₂/Technology Vendors

- Air Products
- Alstom
- Archer Daniels Midland
- C12
- GE Oil & Gas
- Jupiter Oxygen
- LI-COR Biosciences
- Linde
- Praxair

Project Developers

- Leucadia Energy

Environmental NGOs

- Clean Air Task Force
- Natural Resources Defense Council
- Wyoming Outdoor Council

Labor

- AFL-CIO
- United Transportation Union

State Officials

- California, Kentucky, Maryland, Michigan, New Mexico, and Texas

Academic Institutions

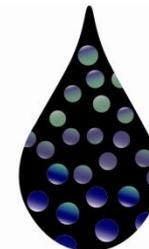
- Enhanced Oil Recovery Institute (University of WY)

Oil and Gas

- Breitling Energy

Observers

- **Oil and Gas**
 - Chaparral Energy
 - Core Energy
 - Tellus Operating Group
- **Associations**
 - Interstate Oil and Gas Compact Commission



**National Enhanced
Oil Recovery Initiative**



- **Consensus approach of National Enhanced Oil Recovery Initiative (NEORI)**
- **Adopted into legislation by Sen. Jay Rockefeller (S. 2288) in 2014; Sen. Heidi Heitkamp later co-sponsored**

113TH CONGRESS
2D SESSION

S. 2288

To amend the Internal Revenue Code of 1986 to expand existing tax credits to encourage the capture, utilization, and sequestration of carbon dioxide.

IN THE SENATE OF THE UNITED STATES

MAY 5, 2014

Mr. ROCKEFELLER introduced the following bill; which was read twice and referred to the Committee on Finance

A BILL

To amend the Internal Revenue Code of 1986 to expand existing tax credits to encourage the capture, utilization, and sequestration of carbon dioxide.

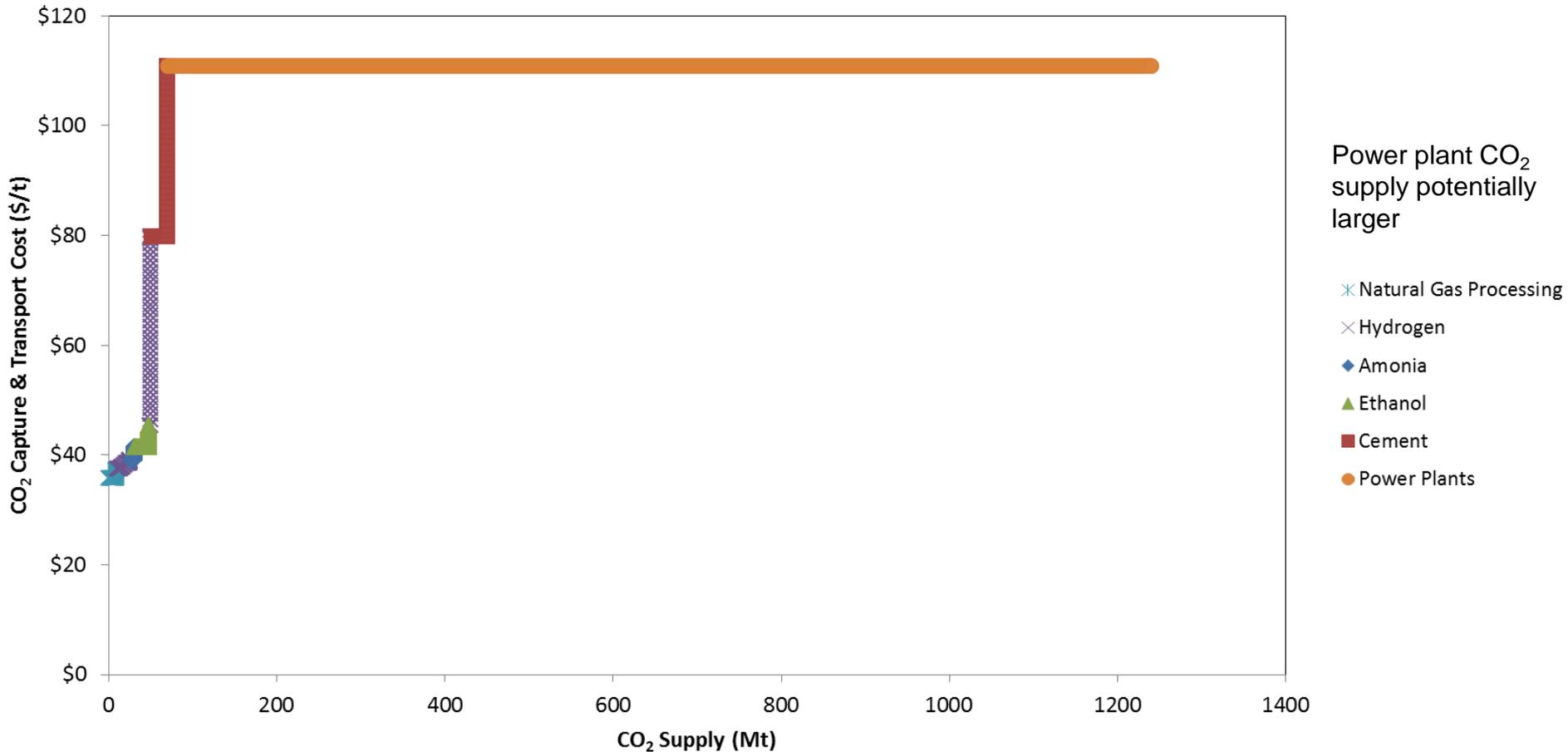
1 *Be it enacted by the Senate and House of Representa-*
2 *tives of the United States of America in Congress assembled,*

3 **SECTION 1. SHORT TITLE.**

4 This Act may be cited as the “Expanding Carbon
5 Capture through Enhanced Oil Recovery Act of 2014”.

More anthropogenic CO₂ can become available at higher prices . . .

(Illustration with EIA 2011 data, prices differ from previous slide)
CO₂ Supply Curve by Source





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