Climate Change, Climate Policy, and Carbon Capture, Utilization, and Storage

NIXON PEABODY

May 14, 2019

Agenda

Keynote Address

Brad Crabtree (Great Plains Institute)

Federal Legislative Update — Climate Change and Carbon Capture Utilization and Storage (CCUS) Policies and Initiatives

Speakers: Eric Cesnik (Nixon Peabody) and Ryan Edwards (Office of Senator Sheldon Whitehouse D-RI)

Presentation — Summary of IRC 45Q

Speakers: Ellen Friedman (Nixon Peabody) and Brad Crabtree (Great Plains Institute)

Panel Discussion — CCUS Engineering, Design and Innovation

Speakers: Paul Plath (E3 Consulting), and Damien Gerard (OGCI Climate Investments)

Moderator: Ernie Chung (Nixon Peabody)

Panel Discussion — Financing CCUS; Monetization of 45Q Tax Credits

Speakers: Matt Shanahan (Marathon Capital), Stephen Johnson (Illinois Clean Fuels), Bret Logue (GrandView Capital)

Moderator: Shariff Barakat (Nixon Peabody)

Keynote:

Financing Carbon Capture Technologies: IRC 45Q Monetization Strategies

GREAT PLAINS INSTITUTE | Better Energy. Better World.

Brad Crabtree | Vice President, Carbon Management, Great Plains Institute

Great Plains Institute: Background

Mission

GPI works collaboratively with government, industry, labor, agriculture, NGOs and other stakeholders transform the energy system to benefit the economy and the environment.

Objectives

Increase energy efficiency and productivity.

Decarbonize electricity production.

Electrify the economy and adopt zero and low-carbon fuels.

Capture carbon for beneficial use and permanent storage.

CARBON CAPTURE COALITION

A diverse partnership of 60+ energy, industrial and technology companies, labor unions, and environmental, clean energy and agricultural organizations dedicated to fostering economywide deployment of carbon capture.

STATE CARBON CAPTURE WORK GROUP

Convened by former Gov. Matt Mead (R-WY) and Gov. Steve Bullock (D-MT), the Work Group brings together officials from 15 states to support carbon capture and CO_2 pipeline infrastructure deployment.

Carbon Capture Leadership Council

Brings together top industry, government, labor, NGO and philanthropic leaders to advance a national technology, policy and deployment agenda.

REGIONAL CARBON CAPTURE DEPLOYMENT INITIATIVE

Initiatives of state officials and stakeholders to promote regional-scale deployment of carbon capture and CO_2 pipeline infrastructure in Midwestern and Western states.

GOVERNORS' PARTNERSHIP FOR CARBON CAPTURE

Bipartisan initiative of governors to provide leadership, focus and a stronger state voice for mutual carbon capture policy and deployment priorities.

Carbon Capture Works:

Efforts to Deploy CO2 Capture and Pipeline Infrastructure Build on Nearly 50 Years of Commercial Experience

1972: Val Verde Gas Processing Plants in Texas

1982: Koch Nitrogen Company Enid Fertilizer Plant in Oklahoma

1986: Exxon Shute Creek Gas Processing Facility in Wyoming

2000: Dakota Gasification's Great Plains Synfuels Coal Gasification Plant in North Dakota

2003: Core Energy/South Chester Gas Processing Plant in Michigan

2009: Chaparral/Conestoga Energy Partners' Arkalon Bioethanol Plant in Kansas

2010: Occidental Petroleum's Century gas processing plant in Texas

2012: Air Products Port Arthur Refinery Hydrogen Production in Texas

2012: Conestoga Energy Partners/PetroSantander Bonanza Bioethanol Plant in Kansas

2013: ConocoPhillips Lost Cabin Gas Processing Plant in Wyoming

2013: Chaparral/CVR Energy Coffeyville Fertilizer Gasification Plant in Kansas

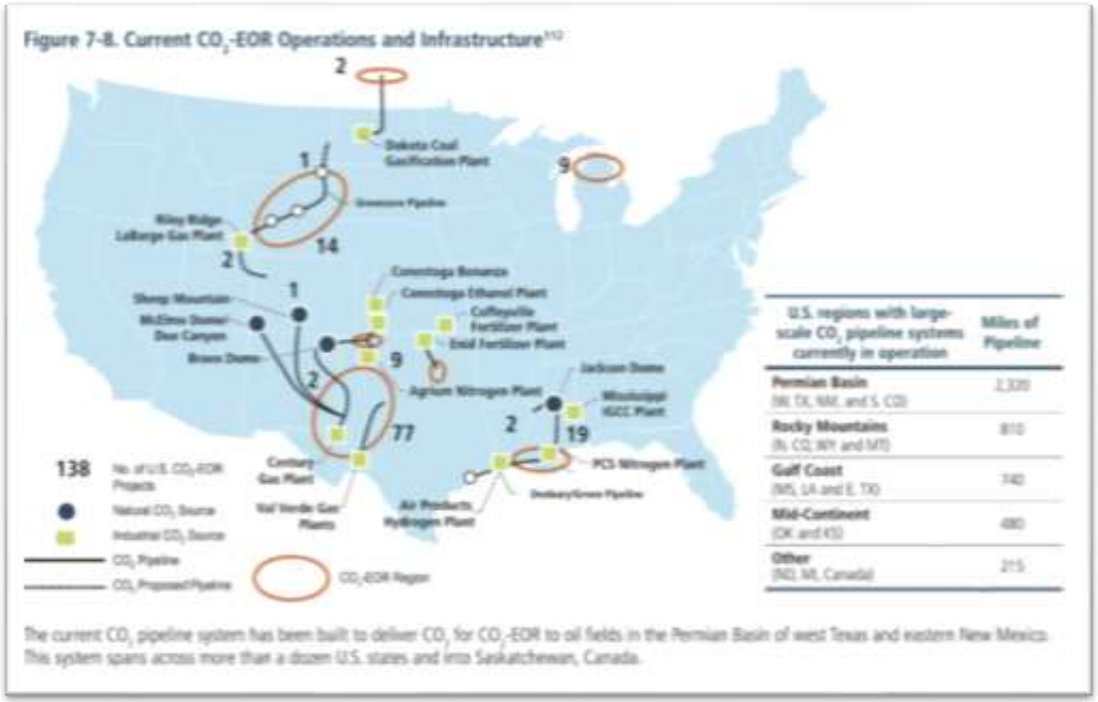
2014: SaskPower Boundary Dam Coal Power Plant Post-Combustion Capture Retrofit in Saskatchewan

2015: Shell Quest hydrogen production at bitumen upgrader in Alberta.

2016: Emirates Steel's Mussafah direct reduction iron plant in the United Arab Emirates.

2017: NRG Petra Nova Coal Plant Post-Combustion Retrofit in Texas

2017: Archer Daniels Midland large-scale ethanol capture in Illinois



Nearly 5,000 miles of CO_2 Pipeline Infrastructure in the U.S.

Carbon Capture is Scalable and Delivers Domestic Energy Production, Jobs & Emissions Reduction Benefits

- U.S. oil industry has purchased, transported and injected nearly 1.5 billion tons of CO2 over the past half century with no fatalities, serious injuries, or major environmental incidents (~65 million tons of CO2 annually; nearly 4 percent of U.S. oil production).
- Geologically storing industrial and power plant CO2 through enhanced oil recovery (EOR) results in an estimated net lifecycle emissions reduction of 37 percent, *including the additional oil produced (IEA analysis).*
- Saline geologic storage of CO2 has been demonstrated successfully at scale (e.g. ADM in Illinois and Equinor in the North Sea) and achieves even greater lifecycle emissions reductions, including potentially atmospheric carbon removal for negative emissions.
- More than a niche: Over a century's worth of U.S. annual stationary source emissions can be stored in oil and gas fields; thousands of years' worth in saline formations.
- Carbon capture provides direct economic and fiscal benefits from oil and other related energy production, and it protects and creates good-paying, highly-skilled jobs across the value chain of capture, pipeline transport, use and storage.

*Source: IEA

Carbon Capture: Essential to Meeting Mid-Century Climate Goals and Doing So Affordably

- Under the IEA's scenario to limit warming to 2 degrees C, carbon capture contributes 14% of cumulative 2015-2050 CO2 reductions and 20% annually by 2050.
- Carbon capture is an essential control strategy for industrial sources, not just coal and natural gas power generation:
  - In IEA's 2°scenario, 45% of CO2 captured comes from industrial sources.
- The IPCC's 5th Assessment finds that carbon mitigation under the 2 degree C scenario costs 138% more, if carbon capture is excluded.
- Recent IPCC modeling of 1.5 degree C scenario: Meeting this goal requires extensive deployment of carbon capture at power and industrial facilities *and* removal of CO2 from the atmosphere through direct air capture, biomass and carbon capture, and other strategies.

Carbon Capture Unites Diverse Interests
as Reflected in 60+ Coalition Membership

Greene Street Capital
Impact Natural Resources LLC
ION Engineering LLC
International Brotherhood of Boilermakers
International Brotherhood of Electrical Workers
Jackson Hole Center for Global Affairs
Jupiter Oxygen Corporation
Lake Charles Methanol
LanzaTech
Linde LLC
Mitsubishi Heavy Industries America, Inc.
National Audubon Society
National Farmers Union
National Wildlife Federation
NET Power
New Steel International, Inc.
NRG Energy
Occidental Petroleum Corporation
Peabody Energy
Prairie State Generating Company
Praxair, Inc.
Renewable Fuels Association
Shell
SMART Transportation Division (of Sheet Metal, Air, Rail and Transportation Workers)
Summit Power Group
Tenaska Energy
The Nature Conservancy
Third Way
Thunderbolt Clean Energy, LLC
United Mine Workers of America
United Steel Workers
Utility Workers Union of America
White Energy
Wyoming Outdoor Council

Observers

Algae Biomass Organization
Carbon Engineering
Cornerpost CO_2, LLC
Enhanced Oil Recovery Institute, University of Wyoming
Institute for Clean Air Companies
Melzer Consulting
Tellus Operating Group
World Resources Institute

Carbon Capture Coalition and partners marshaled unparalleled bipartisan support for reform of the 45Q Tax Credit

S. 1535, the **FUTURE** Act (**F**urthering carbon capture, **U**tilization, **T**echnology, **U**nderground storage, and **R**educed **E**missions), was introduced with one quarter of U.S. Senators cosponsoring the legislation: 18 Democrats, 6 Republicans and 1 Independent

The same legislation in the House gained 50 cosponsors: 35 Republicans and 15 Democrats.

Support spanned entire political spectrum and all regions of the country.

CARBON CAPTURE COALITION

Federal Policy Agenda Going Forward

- Ensure effective implementation of 45Q by the U.S. Treasury to provide the investment certainty and business model flexibility intended by Congress;
- Provide a portfolio of federal carbon capture policies to complement 45Q, similar to wind and solar;
- Incorporate CO2 pipeline infrastructure into national infrastructure legislation, including measures for federal financing of extra capacity; and
- Support a robust U.S. Department of Energy budget for carbon capture, utilization, removal and storage R&D, demonstration and deployment to ensure that lower-cost next-generation technologies enter the market.

STATE CARBON CAPTURE WORK GROUP

REGIONAL CARBON CAPTURE DEPLOYMENT INITIATIVE

State Carbon Capture Work Group convened in 2015 by former Gov. Matt Mead (R-WY) and Gov. Steve Bullock (D-MT). Staffed by Great Plains Institute.

- Officials from 15 states* with industry and NGO stakeholders and experts.

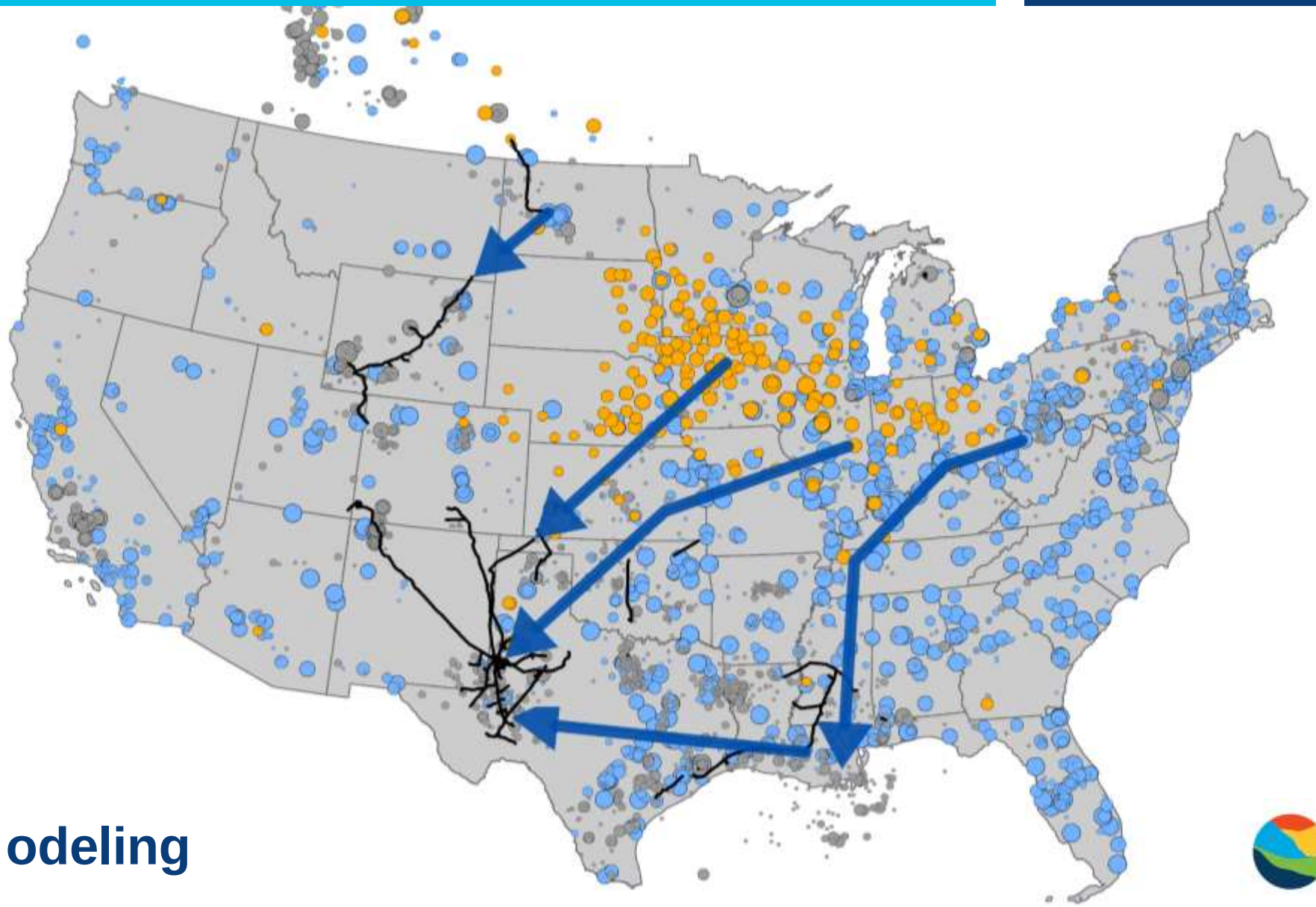
Work Group launched Midwestern and Western Carbon Capture Deployment Initiatives in 2018 to:

- Undertake modeling and planning to support project deployment;
- Identify additional state and federal policies to close remaining cost gaps after 45Q;
- Engage stakeholders, policymakers and media to marshal support for projects to meet 45Q end of 2023 deadline to begin construction; and
- Prepare for 2020 state legislative sessions.

*State participation varies and includes governors' staff, cabinet secretaries, utility commissioners and agency and commission staff.

CO_2 Pipeline Infrastructure Corridors

STATE CARBON CAPTURE WORK GROUP



2016 Modeling

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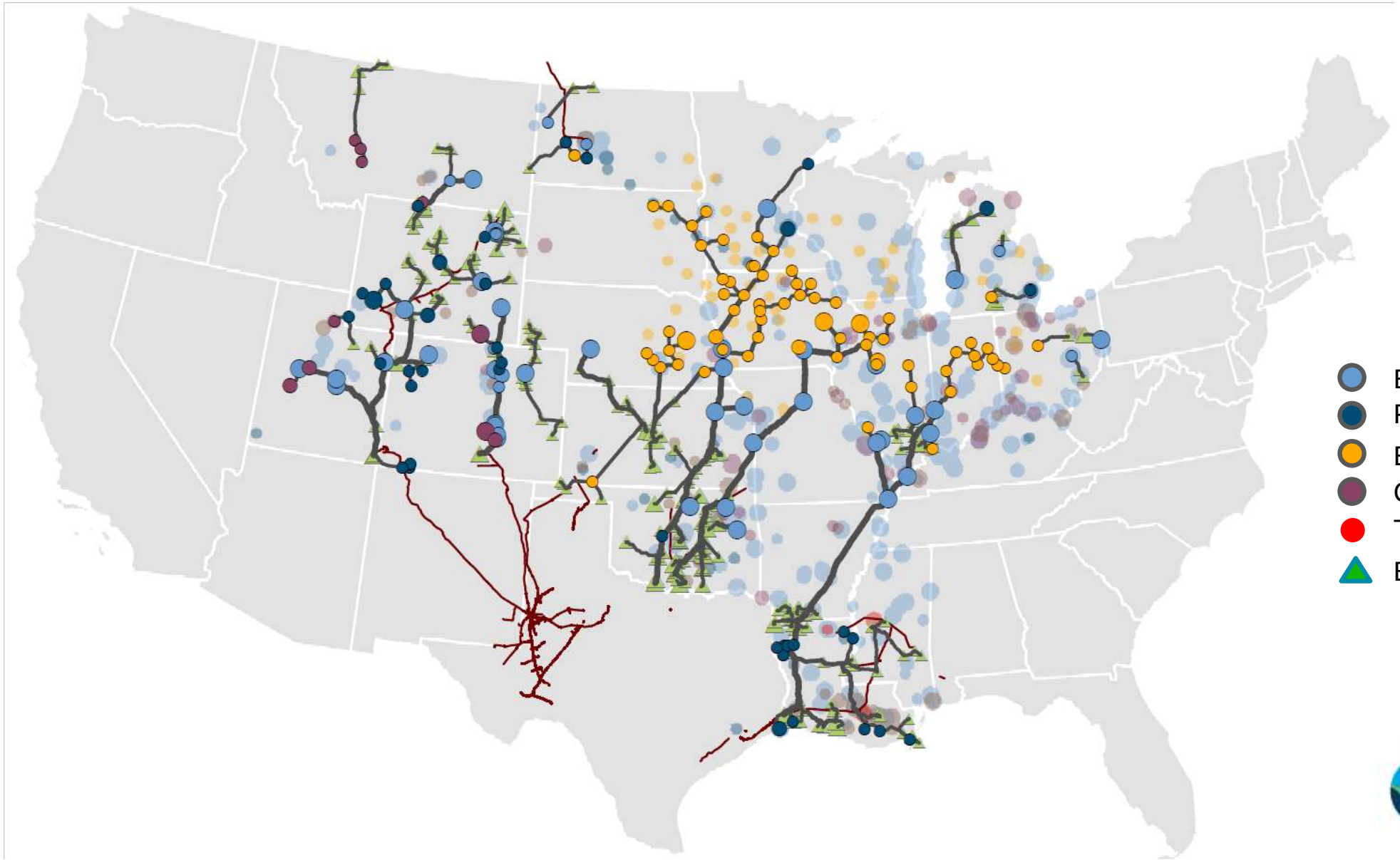
Most Recent Modeling Scenario

REGIONAL CARBON CAPTURE DEPLOYMENT INITIATIVE



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THANK YOU

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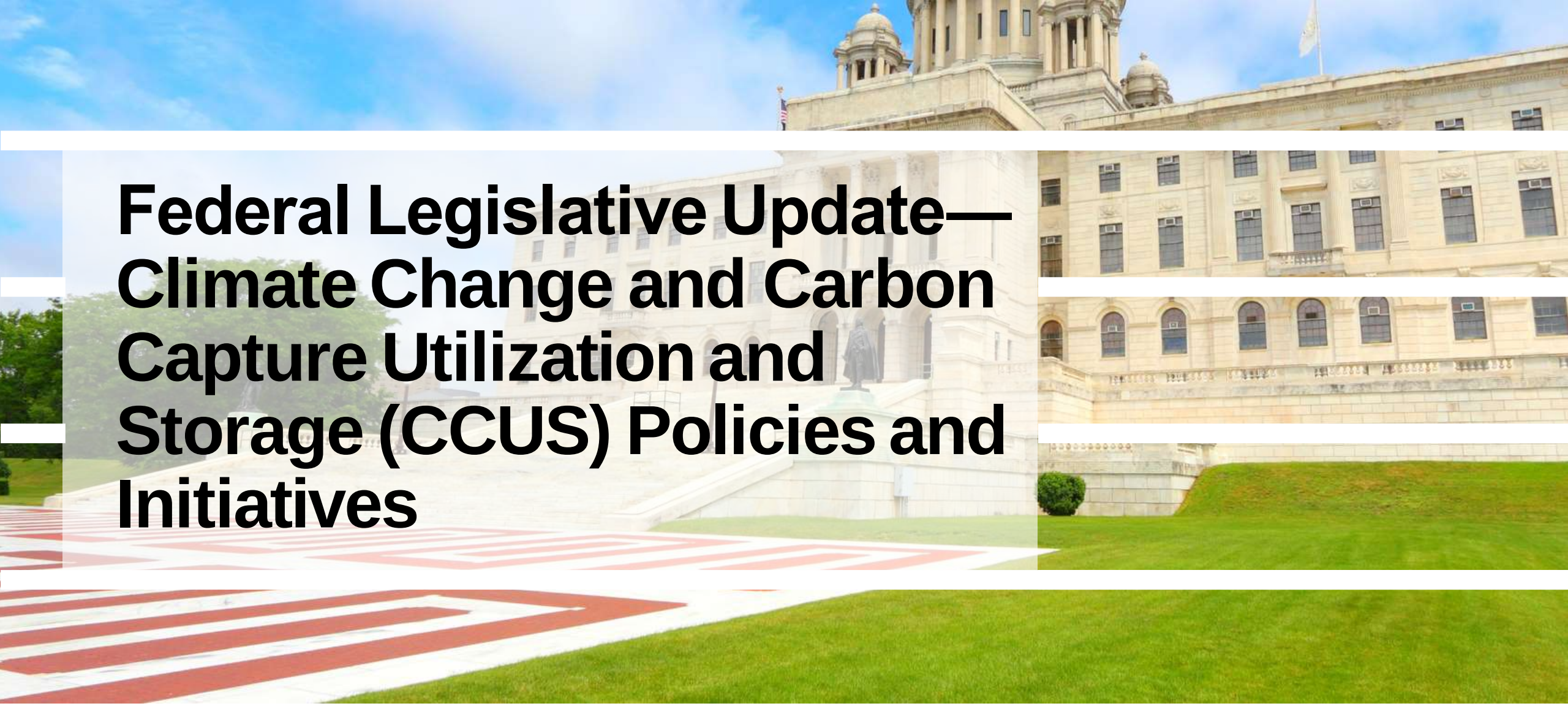


Federal Legislative Update—Climate Change and Carbon Capture Utilization and Storage (CCUS) Policies and Initiatives

NIXON PEABODY

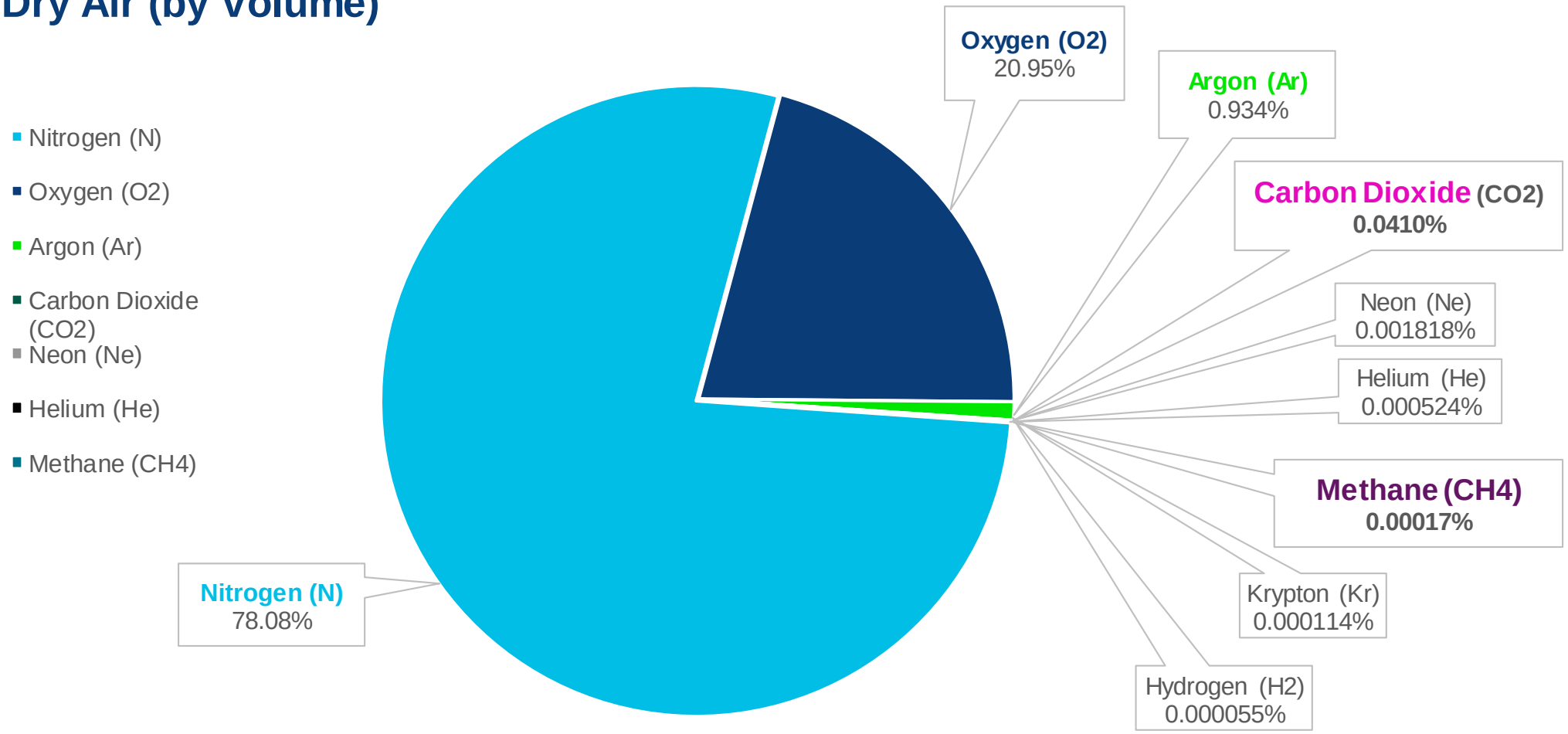
Speakers: Eric Cesnik (Nixon Peabody) and Ryan Edwards (Office of Senator Sheldon Whitehouse D-RI)

Ryan Edwards

(Office of Senator Sheldon Whitehouse D-RI)

Atmosphere

Dry Air (by volume)



Energy Balance

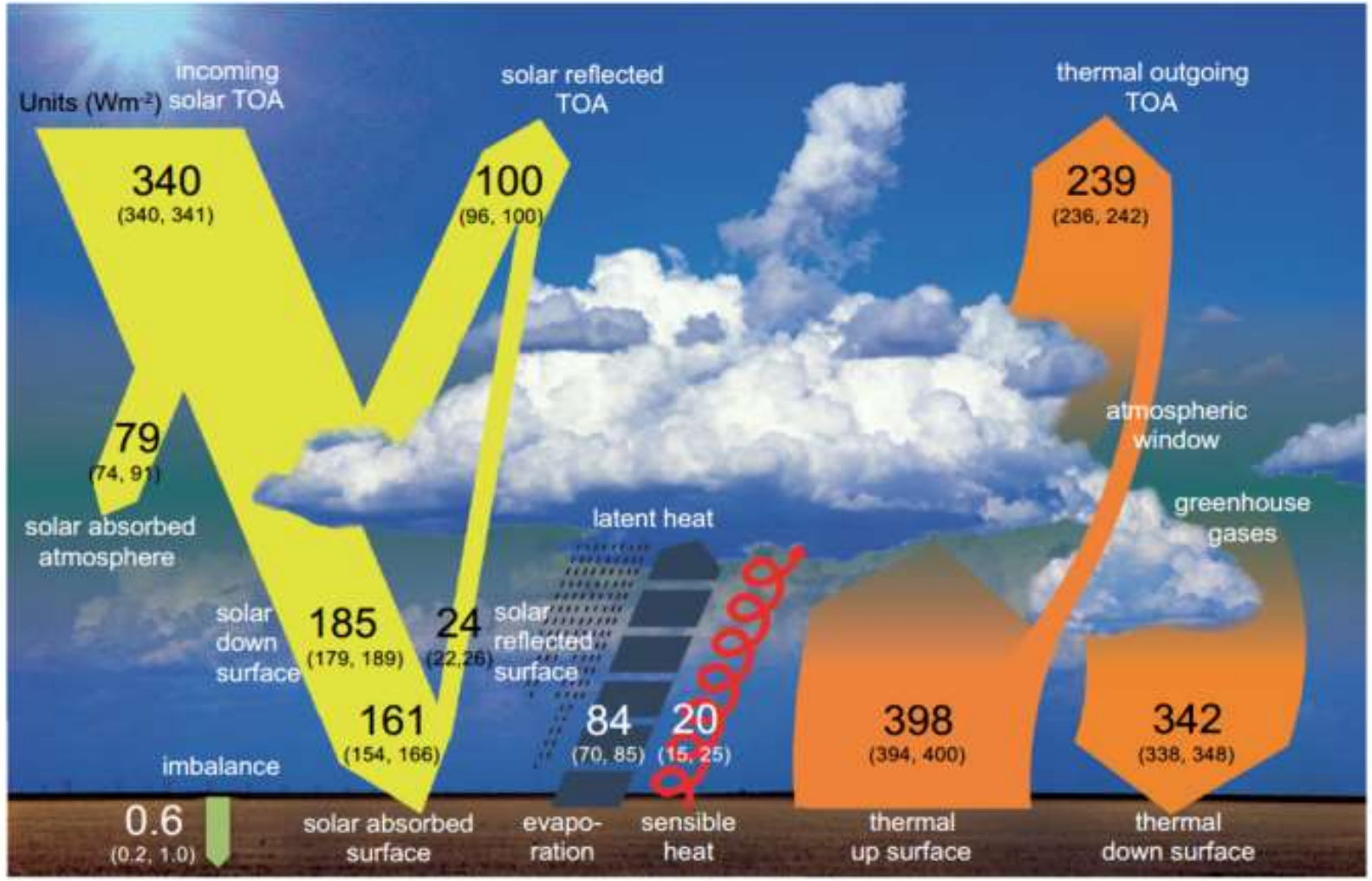


Figure 2.11: | Global mean energy budget under present-day climate conditions. Numbers state magnitudes of the individual energy fluxes in W m^{-2}, adjusted within their uncertainty ranges to close the energy budgets. Numbers in parentheses attached to the energy fluxes cover the range of values in line with observational constraints. (Adapted from Wild et al., 2013.)

IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp.

Radiative Forcing

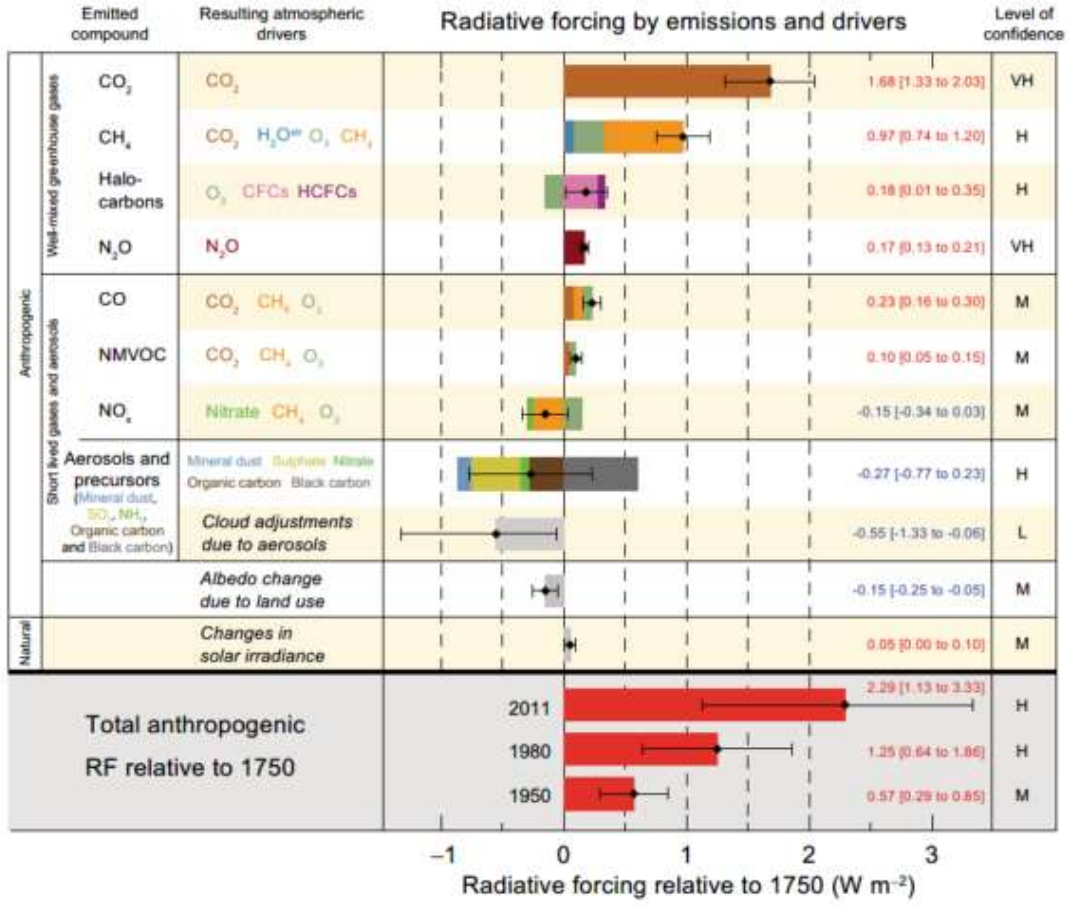
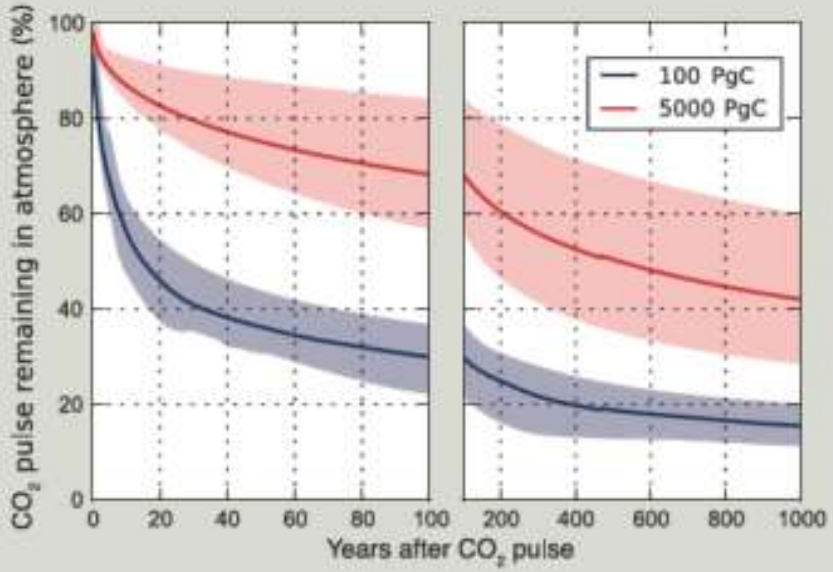


Figure SPM.5 | Radiative forcing estimates in 2011 relative to 1750 and aggregated uncertainties for the main drivers of climate change. Values are global average radiative forcing (RF[14]), partitioned according to the emitted compounds or processes that result in a combination of drivers. The best estimates of the net radiative forcing are shown as black diamonds with corresponding uncertainty intervals; the numerical values are provided on the right of the figure, together with the confidence level in the net forcing (VH – *very high*, H – *high*, M – *medium*, L – *low*, VL – *very low*). Albedo forcing due to black carbon on snow and ice is included in the black carbon aerosol bar. Small forcings due to contrails (0.05 W m^{-2}, including contrail induced cirrus), and HFCs, PFCs and SF_6 (total 0.03 W m^{-2}) are not shown. Concentration-based RFs for gases can be obtained by summing the like-coloured bars. Volcanic forcing is not included as its episodic nature makes is difficult to compare to other forcing mechanisms. Total anthropogenic radiative forcing is provided for three different years relative to 1750. For further technical details, including uncertainty ranges associated with individual components and processes, see the Technical Summary Supplementary Material. [8.5; Figures 8.14–8.18; Figures TS.6 and TS.7]

IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp.

CO_2 Lingers and Lingers and…



TFE.7, Figure 1 | Percentage of initial atmospheric CO_2 perturbation remaining in the atmosphere in response to an idealized instantaneous CO_2 emission pulse in year 0 as calculated by a range of coupled climate–carbon cycle models. Multi-model mean (line) and the uncertainty interval (maximum model range, shading) simulated during 100 years (left) and 1 kyr (right) following the instantaneous emission pulse of 100 PgC (blue) and 5,000 PgC (red). {Box 6.1, Figure 1}

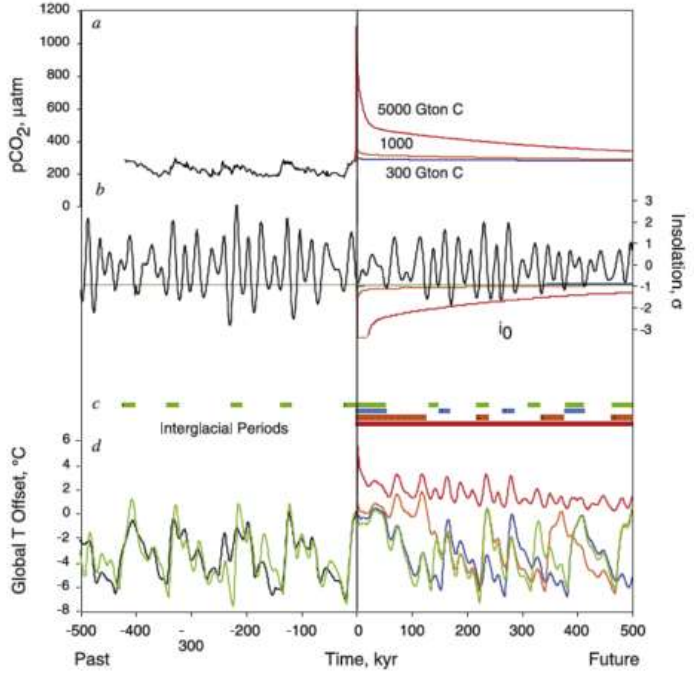
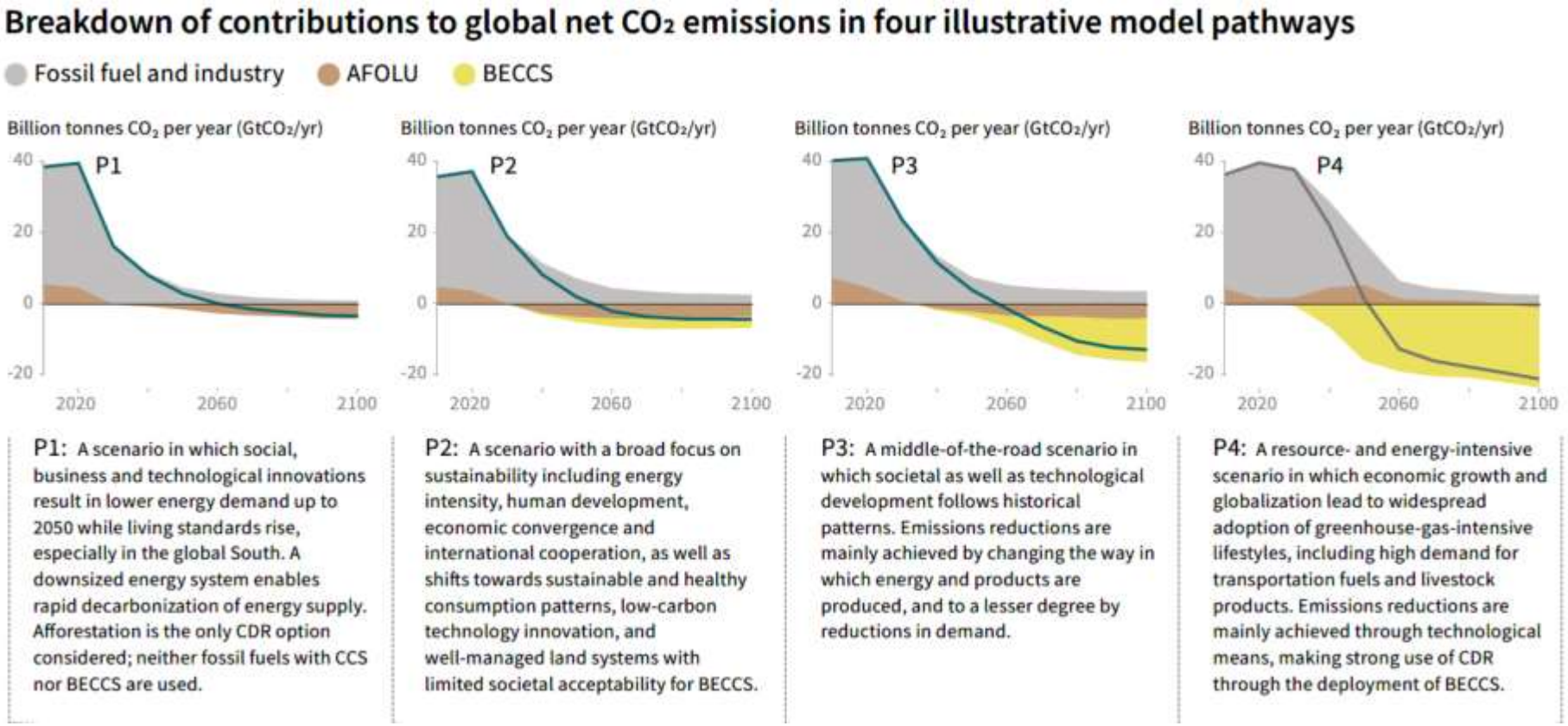


Figure 3. Effect of fossil fuel CO_2 on the future evolution of climate. Green represents natural evolution, blue represents the results of anthropogenic release of 300 Gton C, orange is 1000 Gton C, and red is 5000 Gton C. (a) Past and future pCO_2 of the atmosphere. Past history is from the Vostok ice core [*Petit et al.*, 1999], and future anthropogenic perturbations are from a carbon cycle model [*Archer*, 2005]. (b) June insolation at 65°N latitude, normalized and expressed in σ units. 1 σ equals about 20 W m^{-2}. Green, blue, orange, and red lines are values of the critical insolation i_0 that triggers glacial inception. The i_0 values are capped at −3 σ to avoid extrapolating beyond model results in Figure 3; in practice, this affects only the 5000 Gton C scenario for about 15 kyr. (c) Interglacial periods of the model. (d) Global mean temperature estimates.

Sources: Stocker, T.F., D. Qin, G.-K. Plattner, L.V. Alexander, S.K. Allen, N.L. Bindoff, F.-M. Bréon, J.A. Church, U. Cubasch, S. Emori, P. Forster, P. Friedlingstein, N. Gillett, J.M. Gregory, D.L. Hartmann, E. Jansen, B. Kirtman, R. Knutti, K. Krishna Kumar, P. Lemke, J. Marotzke, V. Masson-Delmotte, G.A. Meehl, I.I. Mokhov, S. Piao, V. Ramaswamy, D. Randall, M. Rhein, M. Rojas, C. Sabine, D. Shindell, L.D. Talley, D.G. Vaughan and S.-P. Xie, 2013: Technical Summary . In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA;
Archer, D., and A. Ganopolski (2005), A movable trigger: Fossil fuel CO2 and the onset of the next glaciation, Geochem. Geophys. Geosyst., 6, Q05003, doi:10.1029/2004GC000891.

1.5˚C Scenarios Rely on CO_2 Removal

Remaining budget of ~420 $GtCO_2$ for a 2/3 chance of limiting warming to 1.5˚C and ~580 $GtCO_2$ for an even chance. (~42 $GtCO_2$/year.)



IPCC, 2018: Summary for Policymakers. In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. World Meteorological Organization, Geneva, Switzerland, 32 pp.

Policy Options

Policy Option	Example
Do Nothing	
Traditional Regulation	Effluent limitations; ban on new fossil fuel projects
Advanced Regulation	RPS, CAFE standards
Subsidies	ITC, PTC, EV tax credits
Direct Government Action	Fleet purchases, expedited permitting, GND
Carbon Tax	Canada, ~~Washington State~~
Carbon Cap	EU-ETS, RGGI, California (WCI)

Policy Options

Policy Option	Example	Adding Carbon Capture within Policy Regime
Do Nothing		
Traditional Regulation	Effluent limitations; ban on new fossil fuel projects	Require CCS technology on plants; Set performance criteria that defacto require CCS for fossils
Advanced Regulation	RPS, CAFE standards	Potential credits toward an RPS standard; Require CCS percentage?
Subsidies	ITC, PTC, EV tax credits	45Q
Direct Government Action	Fleet purchases, expedited permitting, GND	Eminent domain support; Future Gen; Build DAC projects; afforestation
Carbon Tax	Canada, ~~Washington State~~	Tax reduction for CCS use; potential for “tax offset”?
Carbon Cap	EU-ETS, RGGI, California (WCI)	Offset credits equal to permits

A Condensed History of Climate Policy

President Bush defended United States opposition to certain environmental initiatives yesterday in his speech at the Earth Summit.

With Climate Treaty Signed, All Say They'll Do Even More

By WILLIAM K. STEVENS

RIO DE JANEIRO, June 12 — With President Bush's signing of the landmark treaty on climate today, the world's nations have embarked on the lengthy and uncertain road of trying to avert the feared warming of the globe from the continued buildup of heat-trapping gases.

ment for controlling heat-trapping gases.

"The foundation for meeting the challenge is there, but it needs the mortar and the bricks to get beyond the basement," said Scott Hajost, a former official of the Environmental Protection Agency now with the Environmen-

IN THE SENATE OF THE UNITED STATES

JANUARY 9, 2003

Mr. LIEBERMAN (for himself, Mr. MCCAIN, Mr. DURBIN, Mr. ALLEN, Mrs. FEINSTEIN, Ms. SNOWE, Mrs. MURRAY, Mr. LAUTENBERG, and Mr. NELSON of Nebraska) introduced the following bill, which was read twice and referred to the Committee on Environment and Public Works

13 SEC. 115. COMMERCIAL DEPLOYMENT OF CARBON CAP-
14 TURE AND SEQUESTRATION TECHNOLOGIES.

Calendar No. 97

111TH CONGRESS
1ST SESSION

H. R. 2454

IN THE SENATE OF THE UNITED STATES

JULY 6, 2009

Received and read the first time

JULY 7, 2009

Read the second time and placed on the calendar

7II of the Clean Air Act (as added
Act) is amended by adding the fol-
er section 785:

AL DEPLOYMENT OF CARBON CAP-
D SEQUESTRATION TECHNOLOGIES

NS.—Not later than 2 years afte
of this title, the Administrator sha
is providing for the distribution
llocated pursuant to section 782(

POLITICS AND POLICY

Senate Rejects Mandatory Curbs On Gas Emissions in 55-43 Vote

By John J. Fialka Staff Reporter of THE WALL STREET JOURNAL
Updated Oct. 31, 2003 12:01 a.m. ET

WASHINGTON — By a vote of 55-43, the Senate rejected a measure that would have imposed the nation's first mandatory limits on emissions of carbon dioxide.

Bush, in Reversal, Won't Seek Cut In Emissions of Carbon Dioxide

By DOUGLAS JEHL WITH ANDREW C. REVKIN MARCH 14, 2001

Under strong pressure from conservative Republicans and industry groups, President Bush reversed a campaign pledge today and said his administration would not seek to regulate power plants' emissions of carbon dioxide, a gas that many scientists say is a key contributor to

(F) establishment of standards for obtaining the Secretary's approval of the suitability of geological storage sites that include evaluation of both the geology of the site and the entity's capacity to manage the site; and

(G) establishment of other features that, as determined by the Secretary, will allow enti-

The New York Times

Politics

WORLD U.S. N.Y. / REGION BUSINESS TECHNOLOGY SCIENCE HEALTH SPORTS OPINION

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The Caucus »

House Passes Bill to Address Threat of Climate Change

By JOHN M. BRODER
Published: June 26, 2009

WASHINGTON — The House passed legislation on Friday intended to address global warming and transform the way the nation produces and uses energy.

The vote was the first time either house of Congress had approved a bill meant to curb the heat-trapping gases scientists have linked to climate change. The legislation, which passed despite deep divisions among Democrats, could lead to profound changes in many sectors of the economy, including electric power generation, agriculture, manufacturing and construction.

Related

Blog

E.P.A. Announces Repeal of Major Obama-Era Carbon Emissions Rule

Donald J. Trump
@realDonaldTrump

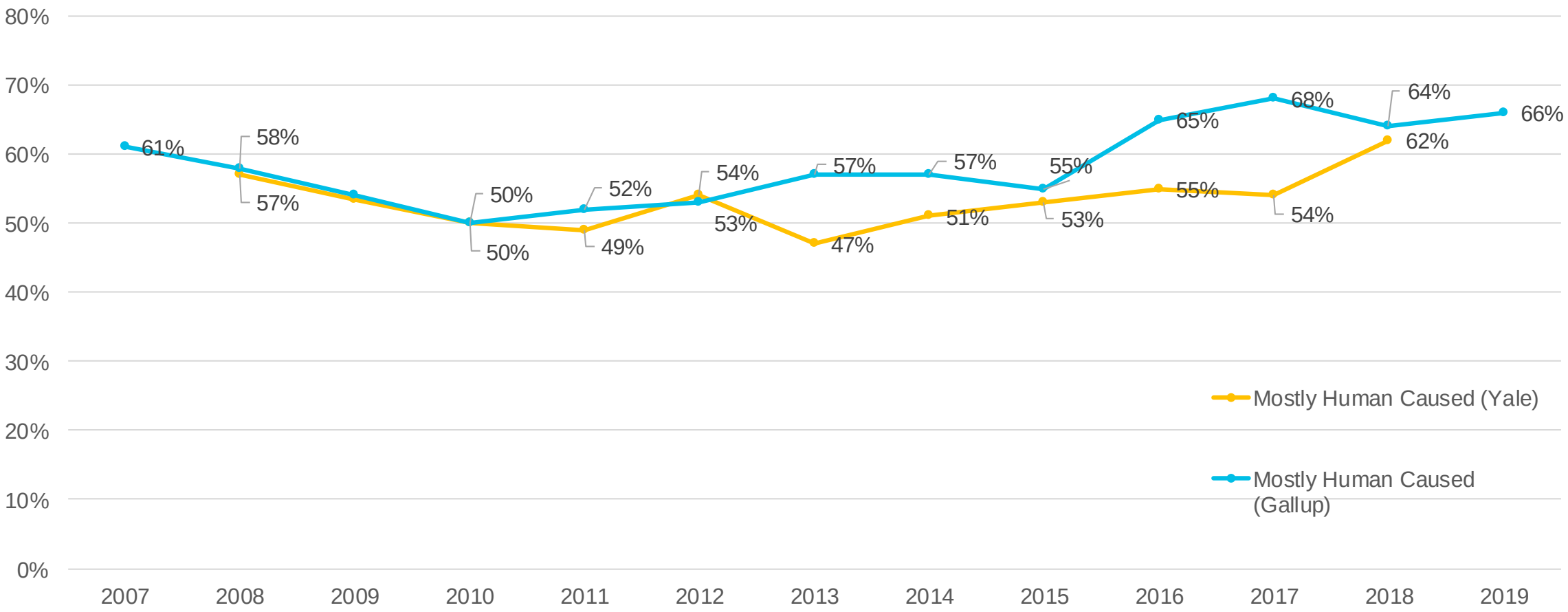
Follow

In the beautiful Midwest, windchill temperatures are reaching minus 60 degrees, the coldest ever recorded. In coming days, expected to get even colder. People can't last outside even for minutes. What the hell is going on with Global Waming? Please come back fast, we need you!

6:28 PM - 28 Jan 2019

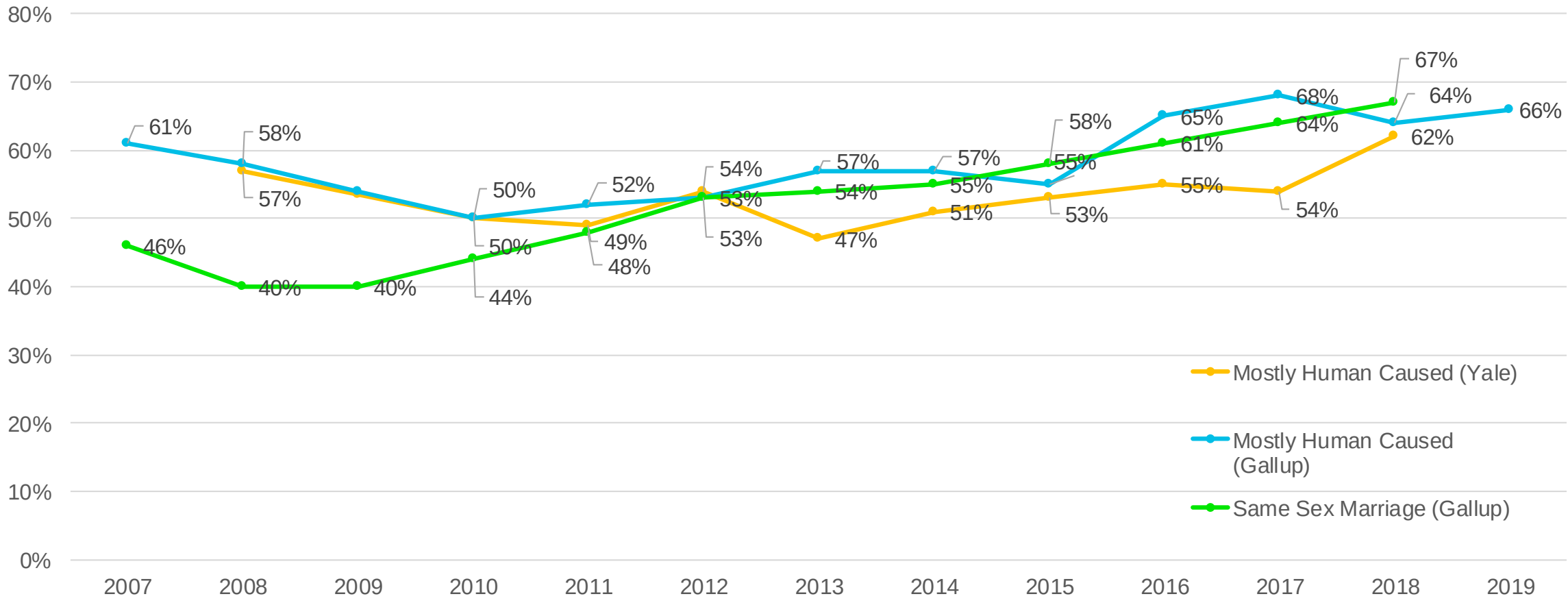
June 12, 1992 → **January 28, 2019**

Public Opinion Rebound



Sources: Gallup New Service, March 1-10, 2019; Data from https://climatecommunication.yale.edu/visualizations-data/americans-climate-views/; Leiserowitz, A., Maibach, E., Rosenthal, S., Kotcher, J., Goldberg, M., Ballew, M., Gustafson, A., & Bergquist, P. (2019). *Politics & Global Warming, December 2018.* Yale University and George Mason University. New Haven, CT: Yale Program on Climate Change Communication.; Leiserowitz, A., Maibach, E., Rosenthal, S., Kotcher, J., Goldberg, M., Ballew, M., Gustafson, A., & Bergquist, P. (2019). *Politics & Global Warming, December 2018.* Yale University and George Mason University. New Haven, CT: Yale Program on Climate Change Communication; 2009 figures are interpolated.

Public Opinion Rebound—Comparison



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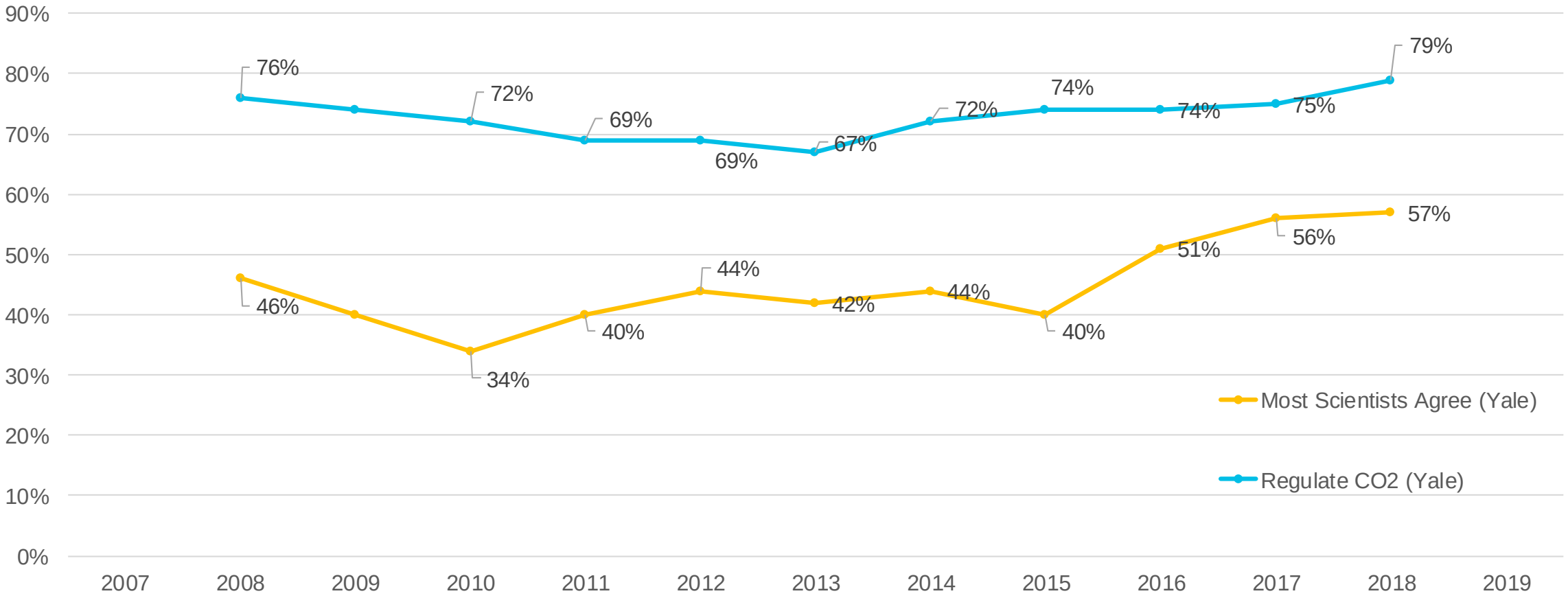
Public Opinion Rebound—Related Items



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Legislative Outlook

Sheldon Whitehouse (D-RI), **Heidi Heitkamp** (D-ND), **John Barrasso** (R-WY) and **Shelley Moore Capito** (R-WV)

IRC Section 45Q

Furthering carbon capture, Utilization, Technology, Underground storage, and Reduced Emissions Act or "FUTURE ACT"

NIXON PEABODY

Presentation by Ellen Friedman (Nixon Peabody) and Brad Crabtree (Great Plains Institute)

2008—IRC 45Q Carbon Sequestration Tax Credit enacted under Energy Improvement and Extension Act

- Business tax credit under IRC 38—reducing tax liability dollar-for-dollar
- Available for capture and disposal of carbon dioxide in USA
- 75,000,000 metric tons of carbon ("MTC") cap for credit. The IRS reported on May 14, 2018 that 59,767,924 MTC of such credits have been utilized based upon information gathered through the reporting regime adopted in IRS Notice 2009-83. This volume cap did not provide the level of required long term certainty to incentivize significant CCUS investment.
- No transferability of tax credit
- Credit limited to:
  - storage in secure geologic formations, or
  - secure geologic storage through use of carbon dioxide as tertiary injectant (IRC 193(b)(1)) in a qualified enhanced oil or natural gas recovery project (EOR) as defined in IRC 43(c)(2) (substituting "Crude oil or natural gas" for "crude oil")
- Credit value of $20 per MTC for geologic storage and $10 per MTC for EOR, subject to inflation adjustments provided in 45Q(f)(7)

Furthering carbon capture, Utilization, Technology, Underground storage, and Reduced Emissions Act or "FUTURE ACT"

- Introduced in 2017 by Senators **Heidi Heitkamp** (D-ND), **Shelley Moore Capito** (R-WV), **Sheldon Whitehouse** (D-RI) and **John Barrasso** (R-WY). It was cosponsored by one-fourth of the U.S. Senate, including 18 Democrats, six Republicans and one Independent. A companion bill, the Carbon Capture Act, was introduced in the House by Congressman Mike Conaway (R-TX) and cosponsored by 50 members, including 35 Republicans and 15 Democrats. In 2018, the bill was included in the Bipartisan Budget Act which was enacted February 9, 2018.
- The bipartisan support for both bills was unprecedented for legislation of its kind, spanning the political spectrum from all regions of the country and underscoring the breadth of support for carbon capture.
- The successful passage of the bill is largely the result of effective working relationships with both parties by the Carbon Capture Coalition supported by organized labor, ethanol producers, industrial and technology companies, coal and oil companies and environmental groups.
- New law largely leaves intact the tax credit regime in place for facilities using carbon capture equipment placed in service before February 2018. Provides pre-Act facilities which expand the benefits under the new law for incremental capacity.

2018 Updates to 45Q Tax Credit for Carbon Oxide Sequestration—Availability and Duration

Continues to be a Business Tax Credit under IRC 38

Credit on New Equipment No Longer Capped at 75,000,000 MTC

- Carbon capture equipment originally placed in service at a qualified facilities after Feb 2018 no longer subject to 75,000,000 cap.
- No allocation restrictions or limits
- No competitive process of awarding credits

Duration – Credit is now provided for **12 years** beginning on the date equipment is placed in service

2018 Updates to 45Q Tax Credit for Carbon Oxide Sequestration— Credit Value

Dollar Value of Credit Increased

- For new carbon capture equipment, dollar value established by linear interpolation for geologic storage through EOR and other commercial uses from $12.83 to $35 per MTC (2016-2026) and for geologic storage between $22.66 to $50 per MTC. Credit for other commercial uses is based upon MTC emissions reduced in the process on a lifecycle basis, . Dollar value after 2026, calculated based on product of $50/$35 and inflation adjustment factor determined under IRC 43(b)(3)(B) for such year.
- Evidences legislative recognition of need to subsidize an activity such as carbon storage that may not be currently profitable. IRS provided interpolated credit values in publication issued December 17, 2018.
- Lifetime (12 yr) credit value for an industrial facility capturing 100,000 MTC py approx. $42-$60 million and for a large scale coal power plant capturing 90% of its CO2 emissions py approx $1.89-$2.7 billion

2018 Updates to 45Q Tax Credit for Carbon Oxide Sequestration—Deadlines and Capture Thresholds

Deadline for Start of Construction: Credit applies to industrial facilities and clean air capture facilities provided the **construction of which begins before January 1, 2024** and either the construction of the carbon capture equipment begins before such date or the original planning and design includes carbon capture equipment. Allows for "add-on" carbon capture equipment to existing facilities.

Capture Thresholds: Establishes separate carbon oxide capture thresholds for electricity generating facilities, direct air capture facilities, and facilities using carbon for other commercial purposes under 45Q(f)(5). These thresholds are lower than the that included in the 2008 legislation allowing for wider range of industries to participate.

- Facility emitting ≤ 500,000 MTCY must capture at least 25,000 MTCY for 45Q(f)(5) use
- Electric generating facility ("EGU") emitting > 500,000 MTCY must capture at least 500,000 MTCY
- Direct Air Capture and all industrial facilities other than EGUs for which credits for EOR and other geologic storage are being claimed, minimum capture not less than 100,000 MTCY

2018 Updates to 45Q Tax Credit for Carbon Oxide Sequestration—Who Can Claim Credit?

Carbon Capture Equipment Owner ("CCE Owner")—Except as otherwise provided in any regulations prescribed by Secretary, the credit shall be **"attributed to"** in the case of qualified carbon oxide captured using carbon capture equipment originally placed in service at a qualified facility after Feb 2018, **the person that owns the carbon capture equipment and physically or contractually ensures the capture and disposal, utilization or use as a tertiary injectant of such qualified carbon oxide.**

- Will lead to establishment of partnerships with flip structures similar to those in the wind industry and safe harbor rules established under Rev. Proc. 2007-65

2018 Updates to 45Q Tax Credit for Carbon Oxide Sequestration—Who Can Claim Credit?

Transferable by CCE Owner to Carbon User—CCE Owner may **elect to transfer credit**—in such time and manner as the Secretary may prescribe—to a person disposes of, utilizes the qualified carbon oxide or uses the qualified carbon as a tertiary injectant.

- 45Q(f)(3)(B)(i) silent as to whether a Carbon User may similarly "contractually ensure" the capture and disposal, utilization or use" of carbon.
- More flexible approach to address situations where the CCE Owner lacks tax appetite, including in the case of electric cooperatives, municipal utilities or developers.
- This ambiguity will need to be addressed in regulations to provide clarity to financial parties interested in monetizing the credit using structures where they are not a CCE Owner.

2018 Updates to 45Q Tax Credit for Carbon Oxide Sequestration—Use Cases Expanded

Expands use of carbon eligible for Credit to include other commercial activities beyond EOR, including:

- Photosynthesis or chemosynthesis—algae, bacteria growth
- Chemical conversion to material or chemical which stores carbon—utilization of carbon in the making of concrete
- Other commercial uses as determined by the Secretary

Expanded definition of "qualified carbon oxide"

- Now includes both "carbon dioxide" or "carbon oxide" which is captured from an industrial source by carbon capture equipment which would otherwise be released into the atmosphere as industrial emission of greenhouse gas or lead to such release and measured at point of capture and verified at point of disposal, injection or use.
- Expansion allows capture of carbon monoxide from industrial facilities, notably steel.
- Direct air capture, any carbon dioxide which is captured from the ambient air.
- In the case of EOR, only CO2 that is stored based upon monitoring and reporting the mass balance of CO2, after subtracting any recycled CO2, may attract the credit.

2018 Updates to 45Q Tax Credit for Carbon Oxide Sequestration—Terminology Used

"Secure Geologic Storage"—45Q(F)(2)—regulations to be established by Secretary in consultation with EPA, DOE and DOI. To include deep saline formations, oil and gas reservoirs and un-minable coal seams under conditions as determined under regulations to be promulgated. An overview of the current state of the law is discussed in https://carboncapturecoalition.org/wp-content/uploads/2018/11/Carbon_Capture_Coalition_Overview_Accounting_CO2Storage_EOR.pdf

"Lifecycle Greenhouse Gas Emissions"—Term used only in the context of determining the amount of credits claimed for commercial use of carbon (other than EOR) and is defined as "the aggregate quantity of greenhouse gas emissions (including direct emissions and significant indirect emissions such as significant emissions from land use changes), as determined by the EPA/Administrator, related to the full fuel lifecycle, including all stages of product and feedstock production and distribution, from feedstock generation or extraction through the distribution and delivery and use of the finished product to the ultimate consumer, where the mass values for all greenhouse gases are adjusted to account for their relative global warming potential."

2018 Updates to 45Q Tax Credit for Carbon Oxide Sequestration— Open Issues for Regulators to Address

- Recapture of Tax Credits—for carbon leakage or release (45Q(f)(4)
- Allocations of Tax Credits—45Q(h)(1)
- Beginning Construction requirements—45Q(h)(2) – Carbon Capture Coalition (CCC) suggests reliance on existing IRS guidance for wind and solar
- Refinements to Transfer Election—suggestions made by the Carbon Capture Coalition include clarity as to ability to transfer to multiple parties over the 12 year period and to ability of transferee to "contractually ensure" use or disposal of carbon
- Additional "commercial use" cases for carbon
- Measurement methodology for alternative commercial use cases of carbon permanently captured and isolated from the atmosphere or displaced from being emitted into the atmosphere based upon an analysis of lifecycle greenhouse gas emissions and subject to requirements as the Secretary in consultation with EPA, DOE determines

2018 Updates to 45Q Tax Credit for Carbon Oxide Sequestration—Status

February 9, 2018—45Q amendment enacted under BBA

February 28, 2018—IRS Office of Chief Counsel Memorandum (Passthroughs and Special Industries) on Refined Coal Tax Credit under IRC 45(e)(8)(A) and related partnerships; Number: AM2018-002 Release Date: 3/9/2018. This may provide a useful framework for 45Q partnership analysis.

November 21, 2018—CCC submitted model guidance to Treasury and the IRS for implementation of 45Q which suggests:

- Clarify "Contractually ensure" to mean entry into a contract with a third party containing "commercially reasonable terms" to permit enforcement, rather than dictating specific remedies or enforcement mechanisms
- Clarify that transferee of credit may "contractually ensure" disposal
- Clarify that transfers of credit may be in part or over less than the full 12 year credit term (akin to IRC 45J credit)
- Advocates for "safe harbor" for recapture of tax credits for projects and operators thereof complying with Subpart RR of EPA Greenhouse Gas Reporting Program or an "Equivalent Program" with a one year lookback

May 2019—IRS Issues Informal Request for Comment on Issues Raised by 45Q

May 2019—IRS Notice 2019-32 Request for Comment on Credit for Carbon Oxide Sequestration on issues arising from the BBA amendments to 45Q that should be addressed in regulations and other guidance. Very broad, tentative questions posed, including, without limitation, on these specific issues:

- Should different or additional technical criteria should be used to demonstrate secure geologic storage besides what is currently required in the EPA's Greenhouse Gas Reporting Program? Are there existing guidelines available?
- Reporting requirements—should the EPA's rules continue to be the reporting requirements and should an approved EPA MRV Plan be a precondition to receipt of 45Q credits? Are there viable alternatives to the subpart RR reporting requirements?
- Recapture standards, triggers and measurements
- Is further clarification of these terms needed—"carbon capture equipment, qualified carbon oxide, direct air capture facility, qualified facility, tertiary injectant utilization, lifecycle greenhouse gas emissions?

May 2019—IRS Issues Informal Request for Comment on Issues Raised by 45Q

- Is guidance needed on certain new utilization cases and boundaries for lifecycle emissions analysis?
- Comments sought on types of contractual arrangements that investors anticipate with parties that will capture or dispose of carbon. What common terms are found in contracts today? What should be the result if terms are determined to be insufficient?
- How should transfer election be accomplished and what issues arise regarding such transfer?
- What constitutes “beginning construction”?
- Guidance with respect to partnership structures, credit allocations and recapture among partners?
- Issues relating to measurement of carbon subject to tax credit for purposes of new commercial use cases.

2018 Updates to 45Q—May 2019—CCC Additional Suggested Comments and Clarifications

CCC is also developing additional guidance recommendations relating to:

- Implementation of the statutory lifecycle greenhouse gas analysis requirement for projects claiming the 45Q tax credit for emissions reductions achieved through beneficial utilization of CO_2 captured from power plants and industrial facilities;
- Extending allowed time for continuous construction (after beginning construction) for a period longer than currently provided by the IRS for wind and solar projects, given the longer project development timeframes required for carbon capture projects;
- Defining a power plant to allow distributed generation for primarily non-grid applications to qualify for lower industrial 45Q thresholds (100,000 MTPY for industrial facilities, rather than 500,000 MTPY for electric generating units); and
- Allowing for aggregation of individual facilities below statutory 45Q thresholds for annual CO_2 capture into a single project that reaches the threshold.

CCC is also exploring the compatibility and potential application of the recently finalized ISO 27916 standard—*Carbon dioxide capture, transportation and geological storage—Carbon dioxide storage using enhanced oil recovery* –as part of an equivalent methodology in addition to the existing federal Subpart RR for demonstration of secure geologic storage through CO_2-EOR for the purposes of qualifying for the 45Q tax credit.

Panel Discussion – CCUS Engineering, Design and Innovation

NIXON PEABODY

Speakers: Paul Plath (E3 Consulting), Wayne Rowe (Schlumberger Carbon Services) and Damien Gerard (OCGI Climate Investments)
Moderator: Ernie Chung (Nixon Peabody)

Financing Carbon Capture Technologies

CO_2 Capture Technology Overview

E3 Consulting

Presented by: Paul Plath, P.E.

Our Record

Independent Engineering

- Owner's Engineering
- Project Development Support
- Distressed Asset Support
- Construction Monitoring and Commissioning

1,200 Projects

Technical advisor on 1,200 energy, infrastructure and industrial projects in North America and LatAm with an estimated transaction value of U.S. $80 Billion

Our Technology Competencies

SOLAR

WIND

BIOMASS

HYDRO-ELECTRIC

GEOTHERMAL

STEAM GENERATING PLANTS

COMBUSTION TURBINE PLANTS

WASTE-TO-ENERGY

NUCLEAR

POWER TRANSMISSION

BIO-REFINING

LNG

GASIFICATION

CO2 Concentrations in Gases

CO_2 Sources	CO_2 Concentration (% of dry volume)
Ambient Air	0.04% (400 ppm)
Natural Gas Turbine/CCGT	3-4%
Natural Gas Rankine	7-9%
Coal Rankine	12-14%
Ammonia/fertilizer production	15-20%
Iron Blast Furnace (coke-fired)	23-27%
Cement Kilns	25-33%
Anaerobic Digesters	30-40%
Fermentation (ethanol, breweries, distilleries)	80-98%

Proven Carbon Capture Technologies

Technology	Uses	Advantages/Disadvantages
Cryogenics	Food and industrial grade CO_2 production	Well-known technology, scalable, many vendors, established sales channels. High capex and opex.
Membranes	CO_2 removal from natural gas and biogas	Scalable, multiple vendors, relatively low capex. Gas must be clean and pressurized before capture. High opex.
Amine Absorption	Nat Gas "sweetening", CO_2 and pollutant removal from power and industrial plant emissions, fertilizer production	Can be retrofitted to existing plants. Multiple technology vendors. Also removes other pollutants. High capex and opex
Gasification with pre-combustion CO_2 capture	EOR, fertilizer production	Large scale, proven equipment. High capex and opex.

Developing Carbon Capture Technologies

Technology	Uses	Advantages/Disadvantages
Oxy-Combustion (Allam Cycle supercritical CO_2 cycle)	EOR	Integrated power generation and carbon capture process. CO_2 is clean and pressurized at end of process. Near zero emissions. Complex integrated process, not proven at large scale. High capex.
Solid Sorbents	Aggregate/concrete production, mineral production	Modular, scalable. Readily available raw materials. Low capture rates, high flow volumes required, energy intensive post-capture processing.
Carbonite Fuel Cells	Energy production	Direct energy production. Hydrogen source required, CO_2 source must be concentrated.
Biological (microbes/algae)	Energy and food production	Low tech. low capex. Low capture rates, large land areas needed with good solar resource.

NRG Petra Nova Project (Amine Capture, CO_2 to EOR)

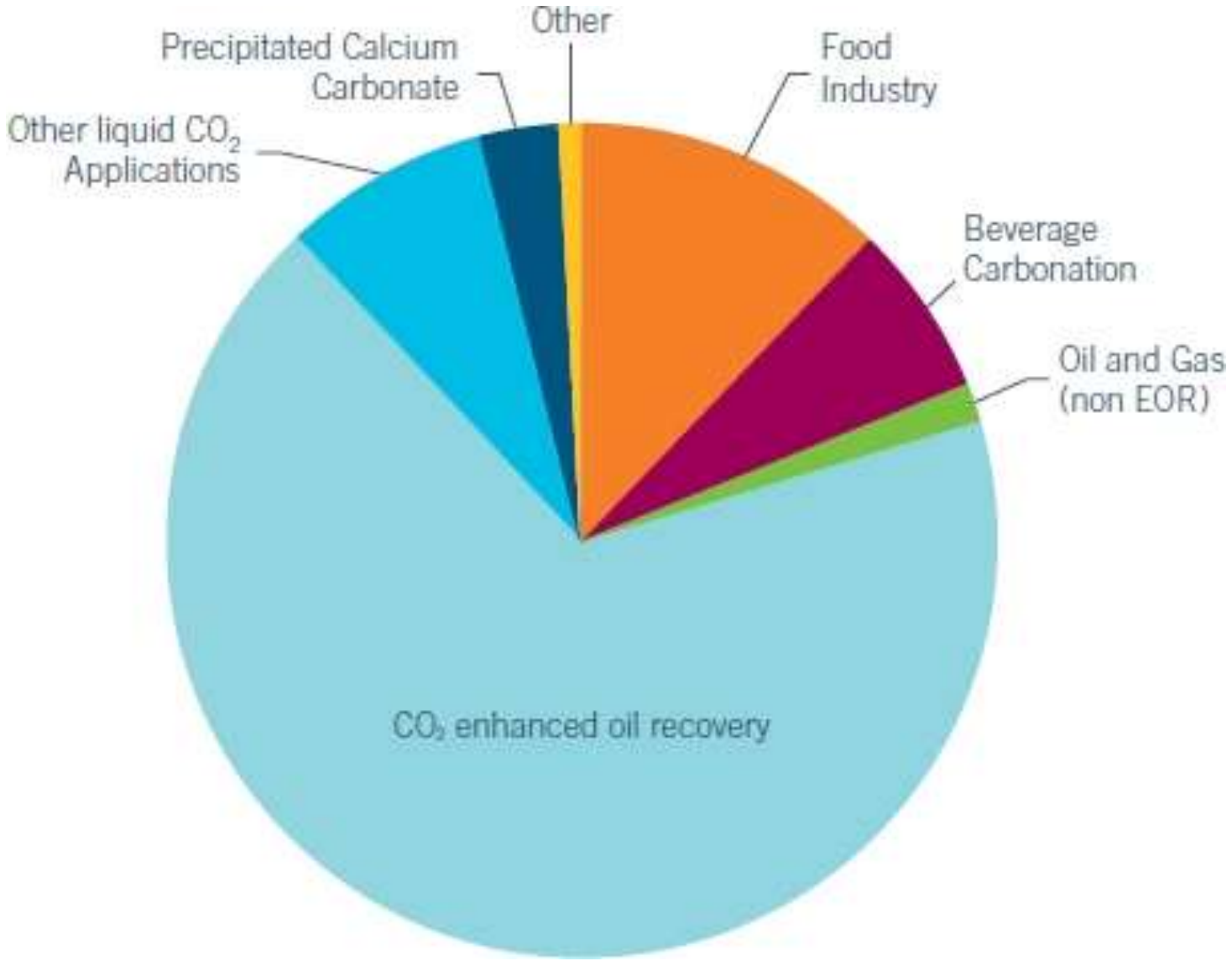
NetPower Allam Cycle Demonstration Project (LaPorte, TX)

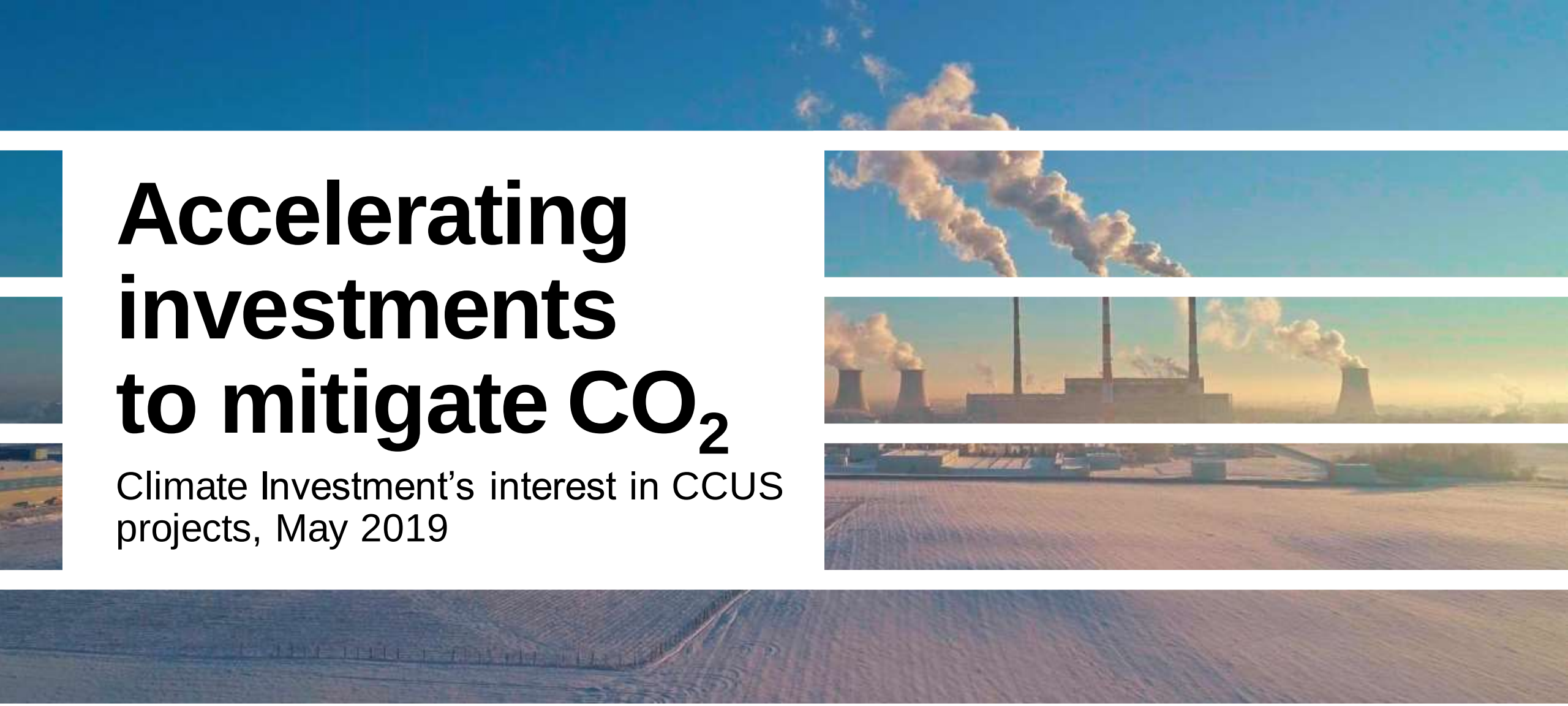
Climeworks Direct Air Capture System (Switzerland)

Uses of CO_2


Fuels
Food
• Algae
• Greenhouse Gases
Biological Conversion
Carbonated Beverages
Food/Products
• Flavors/Fragrances
• Decaffeination
Extractant
Carbonates
Mineralization
CAPTURED CO_2
• Oil
• Gas
• EOR
• EGR
• ECBM
Enhanced Fuel Recovery
Chemicals
• Methanol
• Urea
• CO
• Methane
Liquid Fuels
Fertilizer
Secondary Chemicals
Plastics
Polycarbonate Polymers
Refrigerant
• Refrigeration
• Dry Ice
Fire Supression
Fire Extinguishers
Inerting Agent
• Blanket Products
• Protection for Carbon Powder
• Shield Gas in Welding
Miscellaneous
• Injected Into Metal Castings
• Respiratory Stimulant (Added to Medical O_2)
• Aerosol Can Propellant
• Dry Ice Pellets Used for Sand Blasting
• Red Mud Carbonation

Major Uses of CO_2 in the U.S.





Accelerating investments to mitigate CO_2

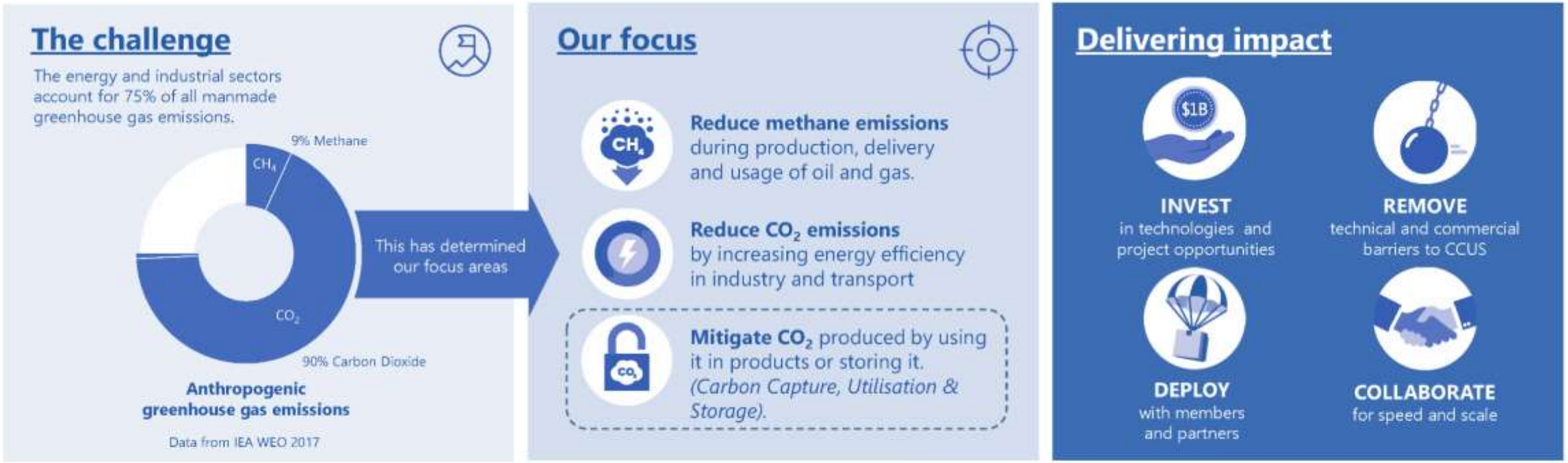
Climate Investment's interest in CCUS projects, May 2019

Damien Gerard | OCGI Climate Investments

Climate Investments

Our mission

Climate Investments is a $1B fund established to lower the carbon footprint of the energy and industrial sectors. The fund was created by the CEOs of the Oil and Gas Climate Initiative to take practical action on climate change.



WHAT ROLE CAN CCUS PLAY?

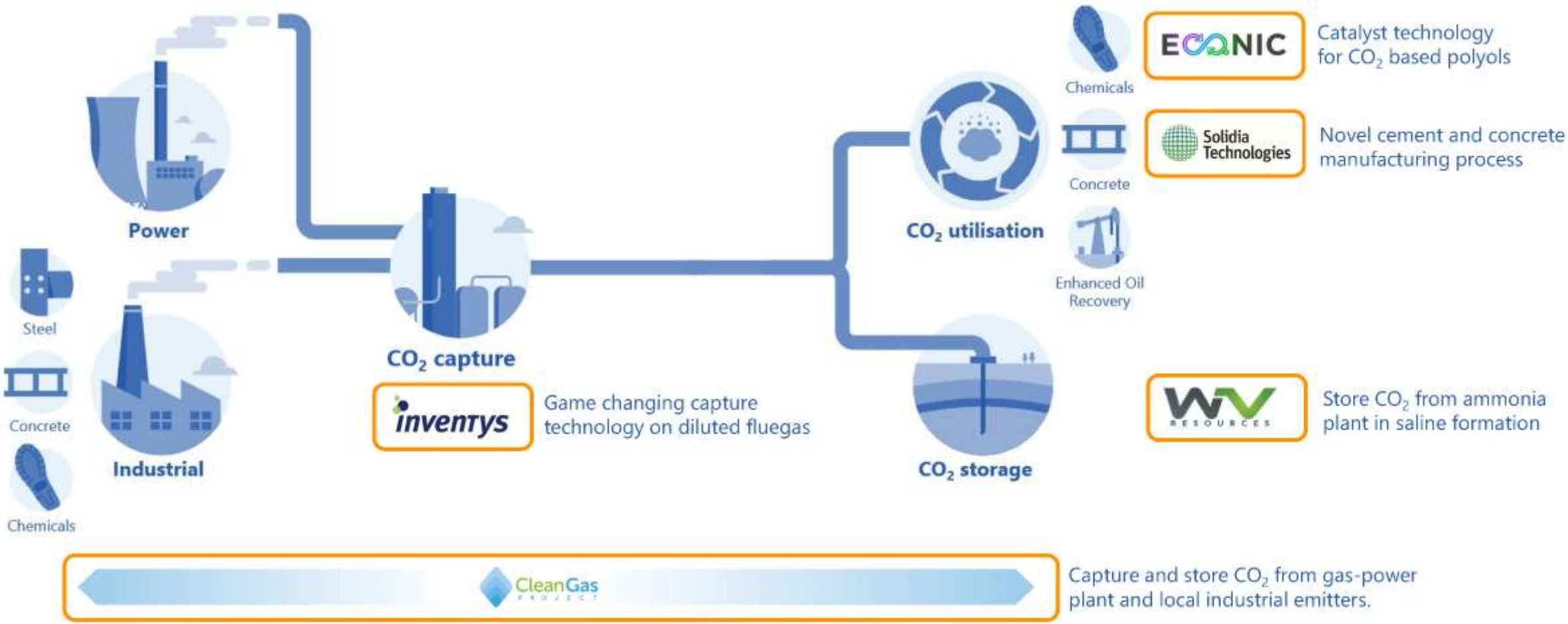
To reach the <2°C goal, the world needs to increase capture and storage of CO_2 from:

~25x **30 million tonnes per year today to 850 million tonnes by 2030,** a ~25-fold increase

Source: IEA WEO (2018)

The Carbon Capture, Utilization and Storage (CCUS) Value Chain

CI's CCUS investments across value chain



CI's Investment Goals and Value Proposition

Accelerate CCUS deployment

- Investing in early project stages (Pre-FEED & FEED)
- Supporting creative business models
- Promoting scalable technologies and repeatable projects
- Facilitating de-risking CCUS projects for long-term impact

Unlock Capital Markets

- Deploying OGCI capital to catalyse investment
- Fostering innovative commercial value chains
- De-risking the CCUS value chain to increase investor confidence

Near term US is key focus area for viable CCUS projects and technology (45Q & LCFS Tax Credits)

CCUS Investments Day

OGCI CLIMATE INVESTMENTS

OIL AND GAS CLIMATE INITIATIVE

Carbon Capture, Utilization and Storage (CCUS) Investments Day

Every year, the world emits >35 billion tonnes of CO_2 into the atmosphere, causing global warming. CCUS allows us to capture CO_2 and recycle it into useful products or store it. Our goal is to invest in projects and technologies that will keep CO_2 out of the atmosphere.

SEPTEMBER 12–13 2019

Applications open **April 2019**

Chicago IL

OGCI Climate Investments invites you to our 2019 CCUS Investments Day

- We will invest in CCUS projects and supporting technologies that are near commercialization and can be deployed at scale with a goal of reducing the CO_2 footprint of the energy and industrial sectors. We are looking for:
  - Commercial projects that result in significant utilization or storage of CO_2
  - Technologies that can significantly lower the cost of CO_2 capture or can create products that utilize CO_2
- OGCI member companies, selected financial firms, business partners and policy makers will attend with a view to investing and incentivizing projects to completion
- Presentations by a selected shortlist of projects and companies seeking investment
- Invitation-only event hosted by Climate Investments

DUAL CHALLENGE BY 2040:

+38% in Energy Demand driven by population growth to 9.2B and economic growth nearly doubling global GDP

-45% in GHG emissions needed to limit global warming to <2°C above pre-industrial levels

Sources: IEA WEO (2018), OECD (2018) & UN (2017)

WHAT ROLE CAN CCUS PLAY?

To reach the <2°C goal, the world needs to increase capture and storage of CO_2 from:

~25x

30 million tonnes per year today to 850 million tonnes by 2030, a ~25-fold increase

Sources: IEA WEO (2018)

Panel Discussion – Financing CCUS; Monetization of 45Q Tax Credits

NIXON PEABODY

Speakers: Matt Shanahan (Marathon Capital), Stephen Johnson (Illinois Clean Fuels), Bret Logue (GrandView Capital)
Moderator: Shariff Barakat (Nixon Peabody)

Financing Carbon Capture and Sequestration – Project Components

CO_2 Source

- Ethanol
- Methanol
- Coal
- Natural Gas
- Waste-to-fuel
- Etc.

+

Capture Equipment

- Power: Amine
- Power: Allam Cycle
- Industrial: Compression
- Industrial: Syngas cleanup

+

Transport

- Pipeline

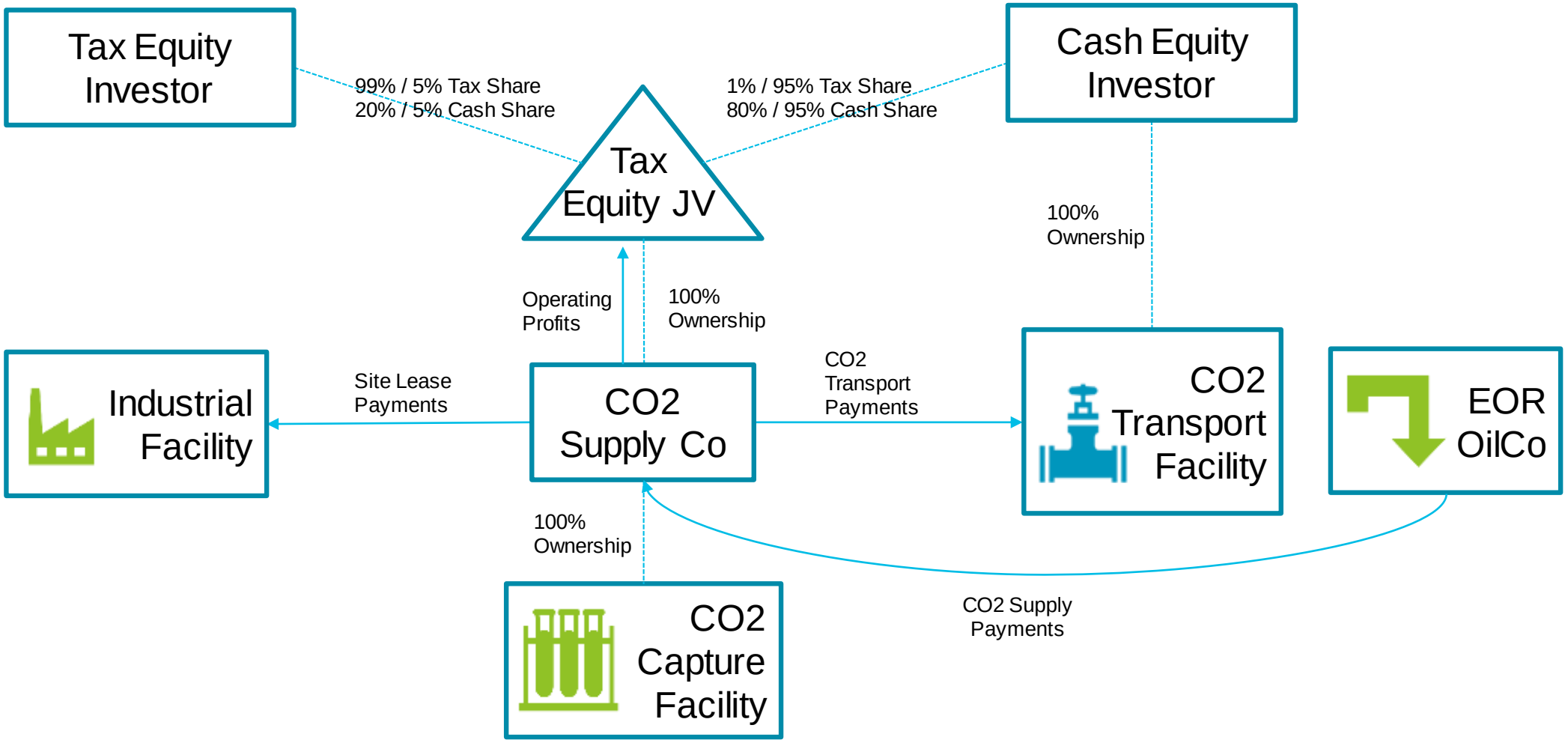
+

CO_2 Sink

- Contracted Off-take
- New EOR Opportunity
- Depleted Oil & Gas Wells
- Saline Formation

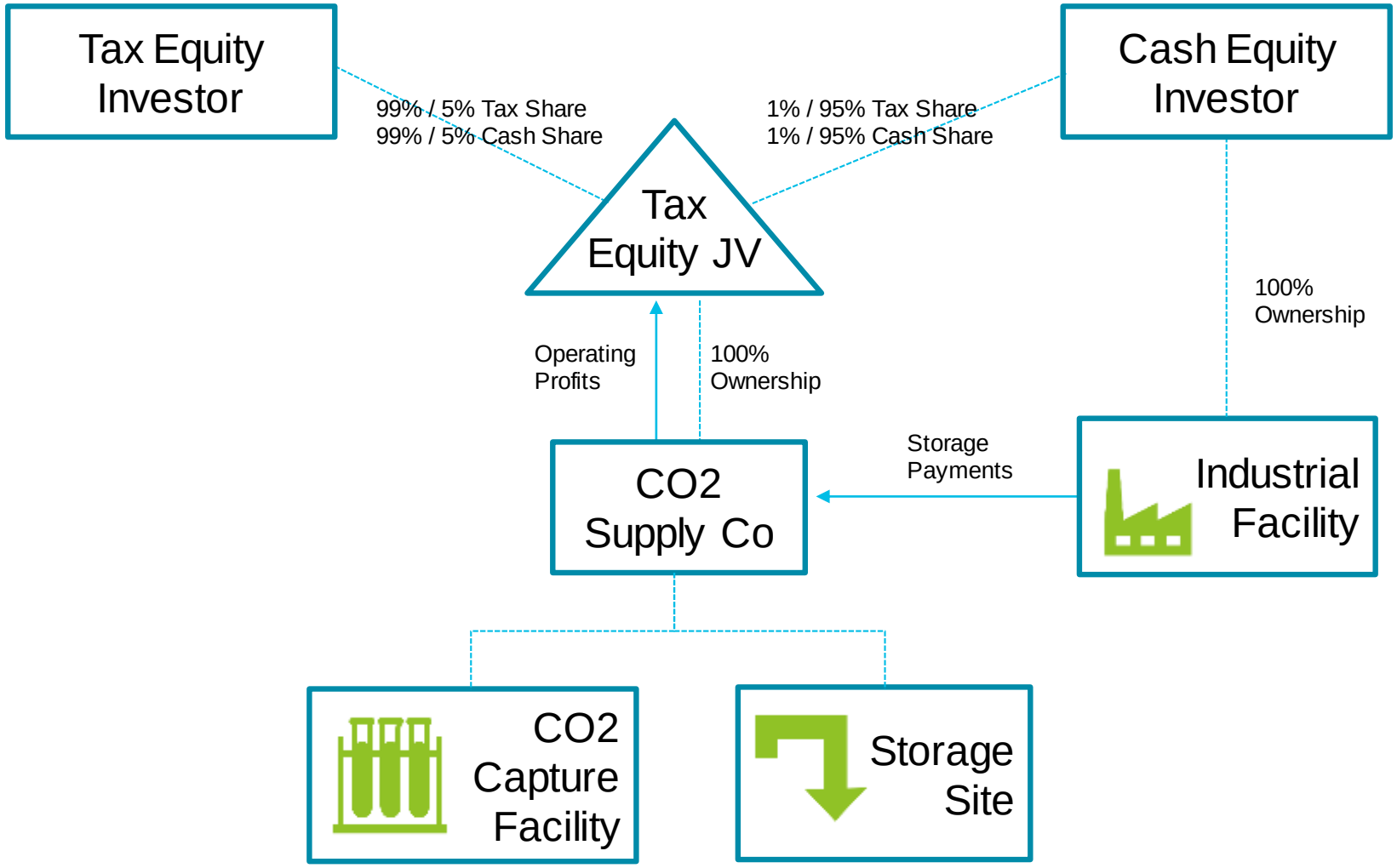
45Q Tax Equity Structure – EOR Sequestration

Partnership Flip



45Q Tax Equity Structure – Sequestration Only

Partnership Flip



THANK YOU

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Brad Crabtree
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Vice President Carbon Management, Great Plains Institute

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Office of Sen. Sheldon Whitehouse

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Stephen Johnson
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Bret Logue
Managing Partner, Grandview Capital

Paul Plath
President and CEO, E3 Consulting

Wayne Rowe
Carbon Services Business Manager, Schlumberger

Matt Shanahan
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