Decarbonizing the West Initiative Appendix

Decarbonizing the West, the central policy initiative of WGA Chair and Wyoming Governor Mark Gordon, examined how decarbonization strategies can position western states at the forefront of innovation and reduce carbon dioxide in the atmosphere. The initiative explored a wide range of engineered decarbonization approaches as well as natural sequestration through enhanced land and agriculture management practices. The initiative included a series of four workshops held across the West. Workshops were held in: Gillette, Wyoming; Denver, Colorado; Boise, Idaho; and Portland, Oregon. WGA also hosted a webinar series that examined discrete policy issues on decarbonization strategies. Finally, WGA solicited perspectives on decarbonization through a survey instrument, which collected responses throughout the course of the initiative.

The workshops, webinars, and survey generated an enormous amount of information and diverse perspectives on decarbonization efforts. The input received throughout the initiative informed the recommendations of the June 2024 initiative report. This appendix captures the paraphrased viewpoints expressed by participants during the initiative. It is organized by major themes and sub-themes as follows:

- CCUS and Engineered Carbon Dioxide Removal
    - Carbon Capture and Removal, Transport, Utilization, and Storage
    - Research and Development
    - Regulatory Certainty
    - Market Development and Expansion
- Natural Sequestration
    - Biomass and Forest Products

    - Land Management
    - Agriculture
- Cross Cutting and Regional Opportunities
    - Community Engagement
    - Monitoring, Reporting, and Verification
    - Carbon Markets
    - Regional Development

CCUS and Engineered Carbon Dioxide Removal

Subcategory: Carbon Capture and Removal, Transport, Utilization, and Storage

Installing CCUS systems for hard-to-abate, energy-intensive industries to either store carbon or use it to produce other products is one approach. However, CCUS technologies are still being developed and are not widely implemented or available. Permitting policies for siting the facilities, transporting the carbon, and storing it are also still under development at the state and federal levels. Additionally, the technology needs to be accepted by the communities where it will be installed, so greater information sharing on the benefits of CCUS is needed for the public at large. (Energy)

Pre- and post-combustion capture technologies, coupled with deep saline sequestration or EOR, represent the greatest opportunity for carbon dioxide removal before it enters the atmosphere. This approach applies to both power generation and industrial processes like steel milling or cement production, which account for the bulk of emissions sources today. (Government – Federal)

Oil & gas producing companies present the greatest opportunity for CO_2 removal because they already have the equipment and manpower in place. (Nonprofit Organization/Foundation)

As we look out to 2050, we must look at our carbon emissions on a number of fronts. CCUS is one component that we use in addition to strategies like reducing clinker fuels and decarbonizing electricity can help us drive towards goals in the interim, before CCUS is fully commercially deployed. (Construction)

We view ourselves as being on the clock to decarbonize. Unlike other environmental challenges that are still somewhat stagnant while we work on solutions, every year we delay in reducing carbon increases the damages and risks from a warming climate. While we work towards full-scale CCUS implementation, we must also use alternative fuels, alternative raw materials, and renewable energy to meet climate and emissions needs in the interim. (Construction)

We do a lot of utilization where integration is also a barrier. From the perspective of integrating manufacturing processes, it can be a huge barrier, both in process and cost. With chemicals, concrete, and other products, product quality and quality standards are huge. We need to be able to produce the same products, make them profitable, with different processes and feedstocks with decarbonization in mind. (Government – Federal)

As USFS starts to consider how to ensure that the lands and resources we manage are healthy, sustainable, and adapted, it is important to also think about what other kinds of climate solutions we can contribute to, which may include industrial CCUS. (Government – Federal)

When working with digester developers, they recognize our industry's staying power and our ability to support their investments. Our dairy industry is high volume and low margin, running at scale with very large processors. The top eleven processors handle 95% of the milk in the state. Going forward, we should focus on capturing the renewable energy potential of our industry. Significant investments are being made in this space, and we should capture the additional economic activity created from renewable energy sources. (Agriculture)

If I am a dairyman and my goal is to decarbonize and meet the Idaho dairyman's goal of being net zero emissions by 2050, and I look across what I have, how do I reduce those carbon emissions? And one way to do that is just by using the gas that is already present at your dairy farm. (Energy)

The transition to a lower carbon global economy is a significant challenge, requiring decisive action from both governments and the private sector. However, it also presents a tremendous economic opportunity, catalyzing job creation across the western United States. (Financial)

Emissions mitigation without carbon capture and storage is more expensive because it is an essential part of our portfolio of options. Additionally, it will take longer to reduce emissions without it, both in the US and globally. (Education)

The biggest partnership opportunities will be for SAF, a huge market that DAC can significantly contribute to. (Environmental)

We need an all-of-the-above approach. We have tested the idea of issuing requests for procurement to renewable energy developers and see potential for seeking partnerships for behind-the-meter energy, but we're not there yet as an industry. (Environmental)

In the context of decarbonization, the cement and concrete industry deserves attention. Cement is the most transacted material in the world after water and is globally responsible for 8% of emissions. It is essential to build smarter and cleaner to reduce our climate impact. (Construction)

We make low-carbon products today that perform as well as or better than Portland Cement, the industry standard. However, these products must receive a low-carbon designation to be sold. The current standard is recipe-based, not performance-based, so even if our product outperforms the standard, it doesn't qualify. (Construction)

Thirty percent of our energy-related emissions come from the industrial sector, which includes hard-to-abate sectors as well as agriculture, mining, and construction. We must recognize that growth in these sectors can limit the impact of CCUS on carbon management. (Government – Federal)

We take a sector-specific approach, recognizing that each sector may require specific strategies. There are also cross-sector opportunities, the biggest being thermal processes and systems. About 60% of CO_2 emissions in manufacturing come from process heating alone. We also have opportunities in low-carbon fuels, feedstocks, emerging efficiency, waste, and wastewater treatment. (Government – Federal)

American data centers consume about 15 gigawatts today and are expected to rise to 30-35 gigawatts by the end of this decade, driven by AI and energy-intensive graphics processing computers. With the rise of AI, these challenges will grow exponentially. Current data centers are being converted to support higher-energy computing, making it crucial to consider how and where we source that energy, especially with climate goals in mind. One problem could solve another, with the energy demand from one sector being met by the waste of another. (Energy)

CDR can help address legacy emissions in the atmosphere. Some emissions categories have limited or no GHG abatement options, making active removal of carbon dioxide essential. CCS technology has been effectively demonstrated and is used across the US and Europe. CDR is supported by hundreds of scientists and is necessary for both removing emissions and supporting low and zero carbon energy supplies. (Government – State)

Not all projects are one size fits all. You have to leverage your cost to capture versus your cost to transport and find a balance. For us, we're proximal to significant emissions sources, within 25 miles or less. Our trona emitters are less than 12 miles away, so we don't face major disruptions with pipeline construction. That's a huge selling point for some of our landowners. (Environmental)

To meet the needs of various sectors, including industrial, waste, and built environment settings, a suite of transportation options is needed. Pipeline infrastructure is not necessarily the best way to transport carbon. The merchant market for CO_2 distribution has existed for decades, with many companies successfully operating in this space. An alternative method for smaller carbon sources is transportation via rail and tanker, which is regulated, safe, and has established protocols. (Engineering)

When it comes to CCUS, geology is king. Projects are concentrated in areas with favorable geologic resources. You need the right depth for supercritical CO_2, formations with porosity and permeability, and impermeable rock layers to trap CO_2. Additionally, low-quality water within these formations ensures drinking water sources are not impacted. The goal is to develop projects in areas without identifiable leakage pathways like faults or legacy wellbores. (Education)

The best scenario is to find sequestration sites that can be pooled and utilized by multiple capture sources. CarbonSAFE sites are advantageous because they're open to pooling from different industrial sources, which is crucial for attracting smaller companies and developers. There are also significant opportunities around utilization. (Engineering)

There is a lot of infrastructure support needed to make these projects work. This creates challenges because there is a large amount of risk involved, especially when the credit market or regulatory body's requirements are uncertain. (Energy)

There are many products that currently rely on fossil fuel inputs that need alternatives. Carbon utilization explores what alternatives can be developed. (Government – Federal)

If you have a power plant or industrial facility and want to capture and store your CO_2 emissions, you won't invest capital unless you know you have a pipeline and a CO_2 storage site that is available or will be available. The same issue exists for developing geologic storage—why proceed if there isn't a guaranteed CO_2 supply and customers willing to pay for storage services? With the IIJA and the Inflation Reduction Act, we're working to advance this value chain simultaneously and overcome the chicken and egg problem. (Government – Federal)

To achieve our overall goals, we need an all-of-the-above approach, including clear messaging to those who may not agree with carbon capture and storage or CCUS as a path forward. (Government – State)

Utilization technologies are in their earliest stages. They are high risk, high reward, with significant opportunities for things like SAF or drop-in fuels. There is a lot of interest, and our program focuses specifically on opportunities for CO_2 use in these processes. (Government – Federal)

Mineralization is an inorganic pathway often considered for CO_2 in building products. It is one of the more market-ready pathways. (Government – Federal)

In carbon management, particularly carbon dioxide removal, carbon conversion might be a smaller slice of the overall pie. The scale of storage in some U.S. geologic reservoirs presents significant opportunities. Some

carbon conversion approaches are more energy-intensive and expensive. While it might not be the majority, it could be an important part of the pie. Alternative revenue streams also serve as a decarbonization pathway for technologies or industries without other great storage options. (Government – Federal)

Greater useful life is an important part of the product portfolio when discussing carbon conversion. Opportunities in carbon conversion, like SAF, are significant but ultimately combusted, lacking the same kind of permanent storage opportunity that building materials offer. (Government – Federal)

Another area with significant potential is the chemicals or petrochemical sector. Carbon conversion can help remove feedstocks responsible for co-pollutants and environmental challenges from refining, while providing alternative pathways for low-carbon products like fuels and chemicals. These industries fall under the hard-to-decarbonize sector. (Government – Federal)

Even in conversion processes, we need to transport carbon, which brings up the pipeline question. CDR is place-based, meaning what works in the Gulf Coast might not work in the Northeast or Pacific Northwest. We are determining the best opportunities for these conversion technologies moving forward. (Government – Federal)

If we can do chemical conversions of CO_2 while capturing it, we could convert maybe 5% of the CO_2 from large point sources, with the rest going for permanent sequestration. In the near term, we aim to reduce the energy demand and costs of making carbon-neutral fuels and chemicals. (Government – Federal)

There needs to be interstate collaboration. We must educate distributors who know how to distribute CO_2 through commercial and commodity markets about CO_2 distribution. If not by pipeline, CO_2 can be transported by rail, barge, or truck. We need to bridge these transportation pathways, leveraging existing expertise in efficient product delivery. (Engineering)

From a safety perspective, we are confident in our ability to store carbon, considering our known stable geology. We conduct additional research upfront, such as seismic surveys to map potential faults, and adhere to permit requirements for injection to ensure containment and prevent fracking into overlying zones. We have robust safety risk mitigation measures in place. (Government – State)

There are applications in urea fertilizer, where mixing carbon dioxide with ammonia creates urea, a low-carbon fertilizer easier to store. Particularly when sourcing carbon dioxide from ethanol or bio facilities and creating hydrogen from natural gas with CCS or electrolysis, this is a valuable use. (Education)

The biggest sector will always be enhanced oil recovery. Value-added sectors can produce higher-value products, such as those in the X Prize competition. Both winners at the Integrated Test Center in Wyoming and in Canada found that concrete technologies can use carbon. However, storage through enhanced oil recovery or direct storage will remain major focuses. (Education)

When working with the LPO, they often take the lead coordination role with respect to other agencies. They are efficient, moving projects along at a pace consistent with FAST-41 goals. (Government – Federal)

Having a federal-level point person to drive your project forward is invaluable. Additionally, having someone, or a few people, work with different states and state agencies is crucial. (Environmental)

Pipelines usually involve multiple federal agencies at different points. Our role is to help coordinate federal authorities and reviews to make the process as efficient as possible. (Government – Federal)

When seeking DOE funding, there is typically limited communication with the funding agency until after selection for negotiation. The Loan Programs Office is different. They interact with applicants, answering questions, helping them understand programs, and working through the application process to ensure applications are properly and efficiently reviewed. (Government – Federal)

The top priority in geology is funding for more characterization. The Department of Energy's CarbonSAFE program pays for drilling and characterization before pre-injection, but requires a 20% cost share, and drilling is expensive in this region. This is challenging without a commercial entity to fund the project. We want to conduct characterization work despite not having enough capturable CO_2 in the region yet. (Nonprofit Organizations/Foundations)

Workforce development is crucial. As a new industry creating new types of jobs, we need people to enter this field and help build, grow, and operate these facilities. There is significant opportunity for collaboration with government, NGOs, and research institutions to establish workforce development programs and develop the talent needed to grow what we foresee being an industry as large as oil and gas. (Environmental)

Industry represents the bulk of global emissions, making it a critical partner in addressing climate change, both in decarbonization and managing residual and hard-to-abate emissions. Industry is essential for CDR offtake, buying credits from facilities like ours to help finance them. We need partners for storage, transport, land, and other infrastructure elements required for our technology. Capture companies will rely on partnerships to facilitate transport or storage. (Environmental)

Flexibility in how we think about renewable energy, whether through behind-the-meter solutions, virtual power purchase agreements, or regional matching of renewable energy credits, is a significant unlock for the industry. (Environmental)

We need to deploy large amounts of renewable energy to decarbonize our grid. DAC requires energy, so we must figure out how to power it with low-carbon electricity sources. Additionally, we need broad community support to grow an enormous following and support for DAC to reach the necessary scale. (Environmental)

We shouldn't confine CCUS to one approach. Flexibility in options is crucial, and developers should consider the full suite of technologies available, including for sequestration. We need to consider the time-value of carbon. If a facility is limited to one pathway that isn't feasible or cost-effective, they won't take any action. At this critical moment, we must promote as many pathways as possible to incentivize decarbonization now. (Engineering)

CO_2 transport and storage are emerging topics, but we can learn a lot from the oil and gas industry. They transport their product to refining, so there are clear parallels we can draw about common carrier pipelines and transporting CO_2 to geologic sinks or storage sites. (Energy)

A current issue is the acceptance of pipelines and understanding landowner concerns, primarily related to eminent domain. We need to define whether CO_2 is a pollutant or a commodity that needs to be transported for utilization. This distinction affects the use of eminent domain laws. We should treat landowners properly and negotiate to avoid invoking these laws, similar to the success seen in the oil and gas industry. (Energy)

We need science-based, fact-based materials to assure people that CO_2 pipelines are the safest way to transport large volumes of carbon. (Energy)

Subcategory: Research and Development

Fund pilot scale activities to de-risk the technologies, with a particular emphasis on carbon capture and utilization that is aligned with wildfire risk reduction efforts. (Government – Federal)

Over the past decades, there has been a major change; we got serious about investing in carbon management. One way we did that was by investing in the NETL DAC Center. At its inception, DOE recognized it took 25 years to get point source capture technology-ready for the main stage. We have a lot more technologies capable of capturing carbon dioxide, and the CDR industry is less developed. The goal was to leverage the expertise of existing technology developers to advance other CDR technologies. The DAC Center will allow for

testing different technologies in various environments. (Government – Federal)

In most cases, especially in first-of-their-kind plants, electricity is used to produce thermal energy, becoming a huge part of the cost structure. Depending on where we are in the timeline, it can account for 40% or more of our total costs. The focus is on how we reduce our energy consumption—some of that comes from material science, and we have many technical partnerships to develop low-temperature sorbents and explore potential uses of waste heat. (Environmental)

There are other things we can do beyond engineering our sorbents to help reduce costs. Right now, we use steam, but regeneration and the potential for direct heating provide technical opportunities to mitigate costs—the role of energy can't be underplayed. (Environmental)

We're talking about hundreds or thousands of terawatt hours of energy needed for DAC to achieve the scale we need. There is a lot of capital needed to drive down energy costs, and decreasing overall energy demand is something we need to prioritize. (Government – Federal)

By using things like boilers there are ways to potentially recover heat in our DAC system. Mechanical parts of the process present opportunities for cost reduction. (Environmental)

These processes are cyclic and involve large capital investments to build. Reducing material costs and enabling more efficient cycling with smaller amounts of heat in the system as a whole are optimal. (Government – Federal)

Siting is a challenge because you need space, geology, and energy in one place. Intermittency is also an issue: capturing CO_2 from a natural gas-fired power plant versus from the atmosphere requires processing 100 times more gas to get the same amount of CO_2. When you consider the capacity factor, costs increase as the capacity factor decreases. Integrating capacity factor with DAC and renewables is critical. (Government – Federal)

In the DAC space, we are critically short on operability. Nobody has thousands of hours of data to show the need for intermittency. At the DAC Center, we can take a DAC skid and simulate its climate/environment, and we also provide a place to test DAC skids in relevant energy scenarios. (Government – Federal)

Utilities are under pressure to decarbonize. Many states have renewable energy portfolio standards and performance-based regulations focused on reliability and cost maintenance, which PUCs can impose on utilities for both point sources and DAC. Creative thinking on making it feasible for utilities to work with DAC developers is crucial to advancing these projects. (Environmental)

Within the hard-to-abate industry sector, we know it's capital-intensive. Infrastructure for manufacturing processes is large and long-lasting. Adding new components can be challenging, and transitioning entire processes is difficult. We need to ensure this is something people are willing to do. (Government – Federal)

We know how to capture, transport, and store CO_2. This will evolve over the next decade. We can improve capture rates, energy consumption, and technology. The technology readiness level will continue to improve with time. (Environmental)

If you're trying to get rid of CO_2, permanent storage is great. But we look at it as a waste stream that we can capture and convert into products. Nearly 90% of products are made using fossil fuels. Replacing fossil fuel feedstock with captured carbon offers technical opportunities. Skipping the capture step and directly utilizing waste streams with 10% CO_2 for useful products can avoid infrastructure costs, but this technology is limited today. Overcoming this hurdle can significantly impact the LCA, product, and market factors. (Government – Federal)

We have such large dairies that make it more feasible to build these projects. As those dairies start to develop projects, the dairies start to get smaller and smaller. Yet more reductions are needed. More decarbonization

is needed. To make projects more feasible for those smaller dairy farms, we need longer crediting periods. We need higher market prices. We need additional markets to drive opportunity and competition. (Energy)

At the ITC, we can demonstrate not only the core technology but also the operability and performance of the entire plant on a larger scale. This is crucial for gaining confidence from lenders and investors, as project financing hinges on demonstrated success. It's a de-risking step essential for project advancement. (Engineering)

It's about creating win opportunities. The easiest way for a dairy farmer to get involved in a project like [a digester] is to partner with a developer. Because as a developer, we can build a project at no cost to a dairy farmer, and we share the cash flows, and the majority of our partners have equity positions in our projects as well. That's the easiest way to go about it because these projects are expensive. (Energy)

To be able to manufacture quickly, it also makes it less capital-intensive in the sense that you don't have to have a giant building or some massive capex project. You just make new modules and upgrade them as quickly as possible. We think that's a really important model for making this costly, otherwise industry be less costly. (Environmental)

I think R&D can go in blind and can make things worse if you don't actually start working with those partners right up front to be able to tell you exactly what they need. I think that's what's made us successful, at least with respect to what we've been doing for carbon capture – bringing in companies to actually tell us how their engineering works and discuss how we can design our chemistry to be able to work with those types of systems. (Government – Federal)

The Bipartisan Infrastructure Law and the CHIPS and Science Act created new authorizations for programs related to carbon dioxide removal, carbon capture, and sequestration technologies. They're investing in hubs that can get pilot-scale demonstrations out there and get those learnings happening so we can better understand how to bring costs down for carbon capture and sequestration and then deploy it in the context, perhaps, of BECCS. It's always a journey to see how these technologies can reach scale. (Nonprofit Foundations/Organizations)

You're not building one facility at a time; you're building multiple at a time. Your shop is always open, and you have constant workers. We have a real opportunity to bring down costs as this technology scales up and is further deployed. (Education)

One thing that's really important to acknowledge is that we have not reached economies of scale for this technology. Like we've seen with wind and solar and basically any energy technology, as you increase deployment, the cost comes down. And that comes down to learning by doing and having less redundancy in your plant. (Education)

Scaling up membranes involves inherent risks, and small-scale testing doesn't always guarantee success at larger scales. The ITC provides an invaluable opportunity to address technology risks at a relatively low cost. It's like having a playground in our backyard, offering flexibility and support for custom systems. The ITC team has been instrumental in facilitating our demonstrations. (Engineering)

While we develop our technology internally, the ITC provides a vital opportunity for demonstration, which is crucial for securing commercialization support and credibility. (Engineering)

Our development work has primarily been funded by the Department of Energy. They issue funding opportunities targeted at specific technical areas and scales, and we apply for those grants. Over the course of 15 years, we've incrementally advanced our technology with DOE support. While this approach has its benefits, such as validation and oversight, it also has limitations in terms of pace. If there were a magical wand, it would be the ability to advance technology at a faster pace without the constraints of grant funding cycles. However, this could lead to concerns about favoritism towards certain technology providers. Nonetheless, significant time could potentially be saved with more flexibility in funding mechanisms.

Fortunately, recent developments such as the introduction of 45Q credits and the growing focus on sustainability have increased interest and investment in these technologies. Commercial companies are now licensing early-stage technologies, driven by the goal of achieving net-zero emissions and aligning with green energy initiatives. This renewed interest and influx of funding from various sources are likely to accelerate the development of carbon capture technologies. While it took us 15 years to reach our current stage, new entrants in the field may achieve similar milestones in much shorter timeframes, possibly within three to five years, given the increased financial support available. (Engineering)

Subcategory: Regulatory Certainty

CCS/CCUS projects require extensive permitting and financing. Facilitating the permitting processes for carbon capture facilities as well as the storage and transport (pipelines) will help reduce the uncertainty of being able to build a CCS or CCUS facility. (Energy)

Policy makers should be clear-eyed of the history of emissions and the under-reporting from high-emitting sectors. Regulatory frameworks should include robust emissions data tracking, monitoring, and reporting programs, and rely on consistent and strict penalties for malfeasance and non-compliance, while leaving room for ample incentives and funding for innovation and improvement. (Nonprofit Organizations/Foundations)

Government officials and agencies should work to ensure that these markets are catalyzed and protected through any government action. Specifically, government agencies should aim to ensure that policies, rules, and bills enacted that stand to impact energy markets refrain from picking winners and losers when it comes to technologies and instead maintain a level playing field for all decarbonization technologies to compete. (Energy)

There are roughly 150 applications with EPA for Class VI permitting, and my numbers at the time were 76 Class VI permits with EPA for consideration in different regions around the country. Of those 76 at the time, two of them have been issued by EPA, and it took nearly six years for those permits to be approved. Whereas in Wyoming, there's a permit to construct and then there's a modification that will occur, which would be for the injection itself. Combined, that process will take Wyoming about a year and a half to permit so from a timing standpoint, it's really important that the state has primacy. (Government – State)

One of the challenges everyone is facing is that we're at infancy with Class VI wells. The whole ecosystem is stuck asking whether to chase wells or chase energy, because right now, areas where wells can be built aren't close to transmission lines where the energy is. The question is siting and whether a project is better off being close to transmission lines and having to build pipeline infrastructure, or do you site near the storage, but have to build transmission? If you want more transmission, where do we sit in the queue for our utility? The timeline for that alone could span years. We need to work more with utilities and PUCs to figure out how we can prioritize these projects. (Environmental)

Clarify CO_2 Storage on Federal Lands: In 2022, the Bureau of Land Management took the first step to authorize Rights of Ways to allow potential carbon sequestration developers to access pore space. However, the current guidance is limited, and Congress would need to provide support in the form of legislation to ensure that agency actions are legal and direct agencies involved in CO_2 storage to clarify how CO_2 companies can access pore space. (Energy)

I think about this as enabling conditions: it's not like we don't know how to do this, but it's a big undertaking and there is a lot of big infrastructure that needs to go along with it. It's not just installing necessary technologies on different manufacturing processes, but it's also transporting and storage. All these components have been done and exist and have been proven numerous times over. But putting everything together in an integrated system and siting it in the U.S., in a real place with community engagement and buy-in is a very different thing. (Construction)

It's important for states to have primacy to streamline those permitting processes, mainly because, as we say, Wyoming knows Wyoming. Our geologists know the formations, they know the seals, they know the faults and fractures and everything that goes into that site characterization. They ask about how to permit projects versus the individual wells. (Government – State)

You have to have a supportive legislative framework. I don't think I could be here today and say I have three Class VI permits if I were in an EPA jurisdiction state. There are a lot of states that lack this energy IQ and thankfully, I have that in Wyoming and that's been huge. As we go out and talk to landowners, they understand oil and gas, and carbon capture sequestration is just a derivative of that. Energy IQ is just huge. (Government – State)

We're working on those aquifer exemption processes. But when we've got big sandstone, that CO_2 is moving through those tiny little pores, and it gets stuck within those pores. And so that's represented by that residual trapping. That CO_2 then starts dissolving into the water. It's not really its own free phase anymore. And over geologic time, that CO_2 turns to rock. (Environmental)

Class VI primacy is the biggest driver for project development. Regulatory certainty is a very important piece to this puzzle and project developers and investors need to have certainty and states need to regulate this activity. The goal would be for all states to have primacy. (Education)

Transportation is where the industry probably needs the most help from state and federal governments. The bridge between the emitters and the sites where CO_2 can be disposed of is where there needs to be more help. (Engineering)

When people talk about CO_2, there is this idea that it's a waste product. States have the ability and should regulate this activity. There are two different policy frameworks that work: Waste disposal frameworks, which we see through Class VI. EPA started with Class I, hazardous and non-hazardous waste, and has built everything on top of that. States like ND, WY, CO, and many other western states are looking at a resource management framework, much like the way we regulate oil and gas. Instead of the oil and gas being the resource the state wants to maximize, the pore space becomes the resource. CO_2 has a value and ND, as well as other states, determine in their statutes that carbon has a value and is treated as a commodity. When we look at it that way, that's how we can adjudicate pore space rights – the surface owner owns the pore space. (Education)

If the pore space is a resource, the state wants to maximize that. Operators would need to define the pore space boundary and that becomes the unit, like how we unitize O&G resources. Both are currently playing out before us – EPA is managing a backlog of projects and permits. The multi-year, extensive process creates uncertainty for developers about when and what is needed to receive approval. Defined permitting processes like what we have in ND and WY help ensure certainty. (Education)

Class VI primacy is one of, if not the biggest, drivers. There are several states actively pursuing primacy and are in the early stages. There is a lot that goes into the pre-application process; states have to decide what agency will regulate the activity, enact statutory authority, and also adopt the regulations to show EPA as they apply that their program is as stringent as the federal program at protecting underground sources of drinking water – that's the framework we're working in. (Education)

This is derived from the Safe Drinking Water Act – looking at aquifer exemptions, those have been in place for decades, they're deep subsurface formations where the water quality may meet safe drinking water standards, but they're deep enough and there are shallower groundwater systems with abundant freshwater resources, so when we look at the deeper formations that may meet drinking water criteria, it might not economically make sense to use those sources for ground or drinking water or municipal purposes. Historically, different industries have used those formations for a disposal zone using aquifer exemptions. When EPA created the Class VI rule, they prohibited aquifer exemptions for Class VI, so that's taking suitable formations for geologic storage and taking them off for carbon project developers, although they would be ideal. That's an easy rulemaking EPA could do to address some of the storage challenges we're seeing today –

a company can have a Class I hazardous or non-hazardous authorization to inject waste into a formation and to dispose of a waste product, but that same formation cannot be used for geologic carbon storage. (Education)

This is up to the states to determine their structures for [liabilities]. We need to consider factors like ownership and liability for the CO_2 in the enclosure, as well as funding mechanisms such as an injection fund. Some states have enacted statues that transfer liability to the state after site closure, the theory behind that being that states will be around longer than these companies and this provides longer term protection for communities where these sites are. They set up these programs through injection fees to support long-term monitoring stewardship. (Government – State)

Technical proponents look at the Class VI permitting requirements and understand them to be stringent enough to ensure a safe process, but there are always going to be people that you can't convince of that. There is a lot to be said about operating in the U.S. in a litigious environment. There are issues with private insurers trying to step in and capitalize. This is a role where the state and the federal government could step in, but it may take some more growing pains to really get landowners on board with long-term issues. (Education)

Wyoming is one of two states right now that has primacy. It's likely Louisiana will get that here very soon too. That's very important to us because the DEQ moves way faster than the EPA. (Environmental)

Class VI permitting is where we need to do better as a federal government. More and more states are wanting to submit the applications and be able to take over that authority to do the federal Class VI permitting at the state level. That will address what I think is a huge problem. (Government – Federal)

To have primacy, a large factor is that Wyoming knows Wyoming, and that's going to be true with North Dakota and other states as well. They're going to know their states better than the federal agencies will. We've had Class I-V primacy as a state since 1983. We have a lot of experience, as does the Oil and Gas Commission, on how to do these types of projects. (Government – State)

We've seen NEPA actions take on average, about four and a half years to complete. 25% of those NEPA actions take more than six years to complete. We've seen projects here in Wyoming for wind or transmission that have taken up to 15 years to complete - that's half of somebody's career, and that's something that really needs to be looked at and reduced. I know there's lots of discussions occurring currently to try to improve that process. So often overlooked or not understood by federal agencies is the impact of not only federal lands, but also factors that we deal with things such as sage grouse and ensuring that those sensitive species don't unnecessarily become impacted. There are a lot of factors that western states have to take into consideration as they implement or propose new rules. (Government – State)

The scale and pace of new rules from the federal government is taxing on all the state agencies that deal with new federal rules. It's a bandwidth and resource issue, not just for Wyoming, but for all states. What I would say is, target the rules that are going to give you the biggest bang for your effort and slow the pace down and focus on implementing programs that will be successful. (Government – State)

Some of the issues that we have to deal with are cost recovery, bonding, and rentals. The big issue is rentals because it's a new process. We haven't come up with a set rental policy yet. One thing the BLM has been doing over the last two and a half years is we work very closely with the Department of Energy, and several other agencies to have an interagency process. DOE is bringing together a group of various agency members to try to develop and talk about the valuation process for carbon sequestration. (Government – Federal)

You can get aquifer exemptions for Class II. We're injecting CO_2 into the ground already with aquifer exemptions, and they're not currently available for Class VI wells. I think that's an arbitrary distinction based not on the risk profile, but on how the CO_2 is being used. Whether we are disposing of it as a waste or whether we're disposing of it for storage, [aquifer exemptions] would immediately open up a lot more area for potential subsurface storage if there were solutions there. And then it becomes figuring out how to use federal land in the subsurface, addressing those NEPA questions, figuring out how to do the valuations.

(Education)

States cite CO_2 pipelines. States control when eminent domain can be used, whether that's available for surface facilities and rights of way or whether that's going to be available for pore space. For example, if utilities that have normally exercised broad condemnation rights are required to put in CCUS as part of the new rules, will they need to be able to exercise condemnation authority to do that? (Education)

States, in general, don't have statutory frameworks that allow for deployment of projects in Wyoming. We're advantaged because we do have a strong statutory framework, but many states, if not most of the states, just don't have the ability to attract investment in these projects. There's a lot of projects or applications that are being pushed through in the process. The challenge we see is there have only been two applications that have been approved in the history of the program. (Nonprofit Foundations/Organizations)

Moving towards performance standards is a big way to open up the opportunity for more innovative technologies to get their low-carbon products into the supply chain. (Engineering)

It seems like we currently see it as a waste and have a waste disposal type of regulatory framework when we really should be looking at it as a beneficial use type of regulatory framework. With waste disposal, we see it as a liability and these activities are really lacking incentives. I would argue there really is a public benefit; we should see it as a beneficial use, focus more on the use side of CCUS, and foster some of those markets and incentive developments, seeing CO_2 as a resource for future use. I argue that would be a truly global solution. (Government – State)

There is a need for clear regulatory authority around different tasks and functions. I think that it's different for every state and there are a lot of issues that you don't see until they come up. The more time that states can spend early on, as their CCS industries are developing, in answering those questions and looking to other states and seeing what has worked, that's a great way to build trust in the public and make sure that those risks are balanced with all the information that we have. (Education)

The early work that goes into site characterization and ensuring that the reservoir is going to be totally secure is the best way to balance against potential risks that could result… we've traditionally followed the "polluter pays" principle for many years in the United States. And this presents a different issue because CCUS is serving a societally beneficial end use by helping mitigate climate change, potentially. (Education)

Having publicly available data really helps manage some of that early risk. Having a stable and consistent regulatory environment, where, for example, we think about some of the early survey or seismic work that's required, having a clear set of rules and regulatory requirements for conducting that work, clear lines of communication, and a clear jurisdiction for which agency would have jurisdiction and which agency you would work through. I think that is key to help facilitate some of that early work. I think one of the huge areas of rising uncertainty really lies within the engagement between the local, county, and township officials and how they engage with project sponsors, as well as state agencies. (Government – State)

There seems to be quite a bit of uncertainty as to where the regulatory authority lies. I think just having that clearly laid out is a key for managing some of that early risk. Within the regulatory framework, whichever agency is regulating the injection would set within their permits, any sort of injection rate limitations, injection pressures, and continue to follow up with monitoring of that to ensure that there are no fractures into overlying formations or wellbore integrity issues. (Government – State)

It has been attractive to project developers knowing that they have the certainty they don't have that kind of long-term liability hanging over their head. Once they demonstrate post injection, it's not that we're giving them a free pass. Of course, there's a balance there, but having that long-term certainty, I would argue, certainly has been attractive for them as well. (Government – State)

There are statutes in place both in Wyoming and North Dakota that would allow a storage operator to apply to transfer liability to the state after receiving a certificate of project completion. In Wyoming, the earliest

you can apply for that certificate is 20 years after injections have ceased. At that point, there's a geologic sequestration trust fund with a per ton fee for CO_2 that will be deposited to keep the state prepared should any future liability arise. (Education)

NEPA is a process that not only has an internal technical review by the agency, but it also has a lot of public input steps, publications of notices in the Federal Register, public hearings, review of public comments, and reissuing of notices etc. That can be an 18-to-24-month process. One of the difficulties for pipeline projects is that they're long projects with hundreds of miles of pipelines and laterals, it's hard to conceive of these projects not requiring us to do a full environmental impact statement. Working that timeline into the timeline of these pipeline projects that are trying to get into construction, they already have other significant environmental permitting reviews that they need to do. That can be tricky. That is why it's important to talk to [federal agencies] early on in your project. (Government – Federal)

New PHMSA regulations will be for critical phase CO_2. The reason that's important is that it allows you to transport a much larger volume in less time. We want to do things well. We want to do things safely. We want to be good neighbors. We want to work well with the people in the communities that we're investing in. But we still have to be in the black. (Environmental)

As somebody who has multiple federal agencies that you're trying to deal with, FAST-41 allows you to get a clearinghouse. I think you get a point of contact to try to coordinate those different agencies. (Government – Federal)

In the wake of all the expanded interest and new reasons to be transporting CO_2, PHMSA is going to be coming out with new regulations. I think that is going to be something the community and the states can look to and rely on. A new set of standards, that as long as they are complied with, hopefully will raise people's feelings that there aren't safety issues related to transportation. (Environmental)

Whether you like it or not, whatever the regulation is, as long as you have certainty, then you will have investment by organizations, by companies, by developers. It's when you have uncertainty that people and companies are far less willing to invest because whether it's good or bad, they don't know what's coming next, and they can't make those long-term investments. With pipelines and with CO_2 transportation and with these projects, we're looking at 10 - 12 years at a minimum, and I would argue, probably much longer. (Environmental)

We've been getting some engagement with EPA on basalts as well as just EPA Region 10 to talk about this permitting process and make sure they're aware that projects may come. Getting them motivated and organized has actually been a really fruitful discussion. We were able to do that long before any project comes their way so that they know it is coming and can gear up if they do receive an application. (Nonprofit Organizations/Foundations)

The NHPA is the cultural equivalent of NEPA. The NHPA, we found, would be triggered by this project because there's a federal nexus here. That would be the EPA's issuance of the Class VI permit or funding from the US DOE. Section 106 requires federal agencies to stop, look, and listen before they take an action related to a project, including making sure that historic properties aren't adversely impacted. Historic properties include traditional cultural properties and traditional cultural landscapes, which can be vast viewsheds. They're areas of significance to Indian tribes, and this can be a little complicated because those areas are often kept confidential. So, from the very beginning, we retained an archaeologist and cultural resource specialist who worked with us on this project. (Professional Services)

There's a lot of projects in the queue. These are typically managed by the EPA regional infrastructure, but headquarters is guiding and helping them along. There are some questions to do with the applicability of all of the class six requirements for basalt only. There are one or two areas that need some clarification and EPA is aware of this and hopefully working on it to give some guidance for basalt in particular. (Nonprofit Organizations/Foundations)

Pore space is a question of whether the surface and mineral estates have been severed. There's no easy legal answer to this question. Washington and Oregon don't have laws on it. There's no federal law, but case law indicates that under the American rule, the owner of the surface estate would own the pore space. This makes sense because the pore space is the absence of minerals. So why would the mineral owner own the pore space? But it's somewhat of an open question at this point in time. It's made even trickier because of the Stock Raising Homestead Act, which affects us in the western states. The Stock Raising Homestead Act applies in areas of the West where the federal government gave away surface rights but kept mineral rights. It's possible that the federal government could argue they also kept the pore space. They haven't spoken to this question. There's no easy, convenient way to figure out what parcels in the west are impacted parcels. They're like popcorn all around the west. Having clarity at the state and federal levels on pore space ownership would reduce the risk to project developers trying to do sequestration projects in the CRBG. That could reduce their risks, so they know who to negotiate with for ownership rights, and so they don't face a trespassing action. (Professional Services)

Washington and Oregon have delegated authority to enforce RCRA. RCRA is our federal law for managing dangerous waste. It exempts carbon dioxide injected into class six swells. If the carbon stream is captured from an emission source, it's silent as to carbon directly captured from the air. There is a hole here where if this project were to use DAC, then RCRA permitting would also have to apply. And RCRA is onerous. (Professional Services)

The other essential component is regulatory certainty. In CA, there was a lot of initial uncertainty as the program got off the ground because of lawsuits etc. But we were successful now. Our protocols look to create regulatory certainty – we have one for CCS and hope to establish one for DAC soon. We want to signal that there are clear protocols for projects, but there is certainty that should those be met, the project will be approved. (Government – State)

The Class VI program is a federal program that allows the safe permitting of CO_2. We need to figure out how to accelerate the permitting of Class VI storage and figure out how we can encourage more states to take on primacy to permit their own wells. This has been hugely impactful in Wyoming. That's clearly the best way for us to store CO_2. It's permanent with low leakage and capture with storage is a very high-quality form of CDR. (Environmental)

Class VI primacy is the biggest driver for project development. Regulatory certainty is an important piece to this puzzle and project developers and investors need to have certainty and states need to regulate this activity. The goal would be for all states to have primacy. (Energy)

Subcategory: Market Development and Expansion

The Inflation Reduction Act included an extension and increase in the 45Q tax incentive for CO_2 storage to try and encourage CCUS projects. It should be noted that the IRS has not published final guidance for implementing the 45Q tax incentive. It is also important to ensure that federal funding flows through state agencies and processes to reach the projects it is intended for. Ensuring that state agencies have the capacity and the necessary understanding of the process to move the funding forward is critical. (Energy)

As private industry continues to call for greater use of carbon-free energy, it will be critical for state and federal agencies to ensure that market frameworks are in place that facilitate clean energy supply to meet demand. If financial incentives are to be initiated by government agencies, either through loan programs, tax credits, or other incentives, it is critical that such efforts are transparent and clear in their administration. (Energy)

State and federal agencies can provide education, tax credits, grants, and other incentives for sustained investments in renewable forms of energy as a matter of priority. There may be opportunities for certain state or federal (e.g., IRA) programs to help incentivize CCS beyond direct infrastructure development funding, such as establishing environmental product declaration (EPD) programs for high carbon products

(such as concrete and steel), which may contribute positively by reflecting a lower carbon intensity profile for products developed with CCS as an increasing number of consumers make sustainable procurement decisions. (Nonprofit Organizations/Foundations)

This gets into different strategies and opportunities: one of which is the idea of co-benefits or co-optimization. This is an opportunity and a lot of the time, people who have been running these processes or businesses are reticent to change because the physical act of doing it is so daunting and it leaves other questions like what to do with stranded gas etc. In many ways, it's an opportunity to address criteria air pollutants and conversion of desirable products. Making that value proposition more relatable and accessible is an easy way to address these challenges. (Government – Federal)

One of the biggest barriers, assuming you can cross the permitting, is economics. For something that produces 100% CO_2, it's quite economic with 45Q if you can capture and sequester that carbon. But for post-combustion, where the CO_2 concentration is very low, maybe even single digit, you then have to put in an amine concentration process, which a significant capital expense. 45Q payments don't pay for that, even for permanent sequestration. There is going to need to be an added layer of incentives to make post-combustion capture work. (Energy)

Canada has a very generous sequestration payment, even more so than 45Q, and an investment tax credit that can fund 40-60% of the cost of the project. Those mechanisms really work and have been really effective. Currently, there is a big gap between 45Q and the rest of the necessary enabling framework to do a lot of these things. Ultimately, state and federal incentives are necessary to really encourage hard-to-abate CCUS. (Energy)

A vast majority of suppliers in the industry have yet to sell a thousand tons and we need lower cost options out there. Only 4% of CDR purchasers are willing to spend between $750-1000 per ton. We've seen great improvements in reducing the costs of DAC, but we need to go even further. Clearly there is a need to support low cost, novel DAC solutions and that's what the DOE American Made Challenges program does. (Government – Federal)

It is really hard to start a business in the U.S. According to the Bureau of Labor and Statistics, 48% of businesses closed within their first 5 years. This is why we started the DAC EPIC Prize, which gives money directly to incubators and accelerators with programming for DAC startups. Of the $3.7 million, we've given 13 awards so far with more to come this year. Spread across the country, these teams have developed programming specifically to help direct air capture startups succeed. (Government – Federal)

If we want to get to gigaton scale removal eventually, we need to start implementing smaller scale projects today. The same is true for funding programs. If we want to get to large scale government purchasing, we need to start on a smaller scale, which is what the CDR purchase prize does. We need to learn how to do things like design purchasing agreements for the government. If you talk to the product developers out there, everyone wants more money and more time, but the reality is that both of those things are finite resources, so we need to figure out how to develop the market while also catalyzing the market. (Government – Federal)

The IRA provides significant ongoing federal incentives for CCS and DAC and CA is looking to provide stacking of LCFS and other credits to provide the added financial incentives. The federal proposed power plant rule includes CCS and other nature-based solutions, which is the other part of carbon removal and is integral to CA's march towards decarbonization. (Government – State)

The tax incentives are helpful and there are two things that could be better on the 45Q side. When we think of utilization, we don't think of EOR specifically – we think of concrete, SAF, polymers etc. Those things are not equal in the 45Q, and utilization gets less credit – we would like to see that leveled out. (Engineering)

Co-digestion, we believe, is the future for renewable natural gas right now. The manure mono digestion facilities are the ones that capture the most credits in the value chain right now. We believe that by just adding 10% more food waste or agricultural waste, you can drive up a lot more renewable natural gas and

provide a much cleaner energy product for customers downstream. It is disincentivized because the credits at a D5 versus a D3. EPA RINS are discounted when you compare the two. It's actually disincentivized to do co digestion. We need to change the ruling so that more players can come online, do co digestion, bring on more renewable natural gas, reduce food waste, organic waste from going to landfills, and it's really a win proposition. (Energy)

The idea that you need to prove that the gas flows to California, similar to what they've proposed in the RFS, is what really locks out a lot of potential opportunities in the western states. (Energy)

The LCFS is a successful program because it's helping the dairy industry become environmentally sustainable, and it's economically viable because of the way the program operates. There are other inset opportunities with credits on the voluntary market, generating credits on-farm and then selling them to processors, so it stays within the supply chain. (Energy)

There's this give and take right now within the food production industry of who should get credit for this. Can the dairy claim the reduction, even though Shell oil made the investment? And the reality is, we can't exist without each other. We need each other to make this work. We've got to find a credit scheme and an accounting metrics that will continue to incentivize. I think that's what America gets right, is we are very much taking an incentive-based approach to trying to decarbonize, as opposed to a punitive approach. (Energy)

One of the barriers is low market prices. We started out high, $200, $190 a metric ton, when we first started building a lot of our projects. Now we're trading somewhere between $70 and $80 for three RINS, which dairy digesters qualify for. Those are way up. They're over $3 an ethanol gallon equivalent. Some of the barriers, especially on the LCFS side, are the low credit market prices. We need higher credit prices; we also need longer crediting periods. We're all anticipating CARB's scoping plan, which should come out this month, so we can see what their plans are for dairy digesters in California, and that also impacts dairy digesters across the country. They're using book and claim to get gas to California and to fleets. (Energy)

RFS would definitely increase project development. It would increase opportunities for a lot of dairies that are isolated. Without RINS, you need a big dairy to pull off projects. We've built one on a 10,000-cow dairy, 5000 cow dairy, things like that. But with RINS that brings into play isolated, standalone dairies. For us, it would lead to more project development for dairy farmers. I know for sure in California it would lead to more accessibility into being able to achieve economic and environmental sustainability through digesters. (Energy)

As far as voluntary incentives, there's a growing movement for value chain emissions accounting. There are now some big players in agriculture that are interested in paying farmers or incentivizing them in some way to use climate smart practices so that the GHG emissions associated with a different company's value chain are reduced. I've yet to see that represented as a real funding stream for farmers, but I know it's out there and it's growing. Hopefully, that becomes a real funding stream. (Forestry)

One of the biggest things that would be helpful to us and something that we are starting to advocate for, and the U.S. government is starting to think about a little bit more is the tax code again. But if you're a company now that wants to purchase carbon removal credits, there is no tax incentive for you to do so. We as the developer take the section 45Q tax credit, but if you are a purchaser and you're trying to get a tax benefit for that, you can't do that. (Environmental)

In thinking about deductions for expenses, if you're considering this as a necessary expense because you're trying to do your part for climate, there should be some incentive there. Thinking about a tax deduction under those necessary expenses type of thing, we need a range of solutions, this would help get more sectors involved. (Environmental)

The incentives and funding that we have in national legislation is supercharging deployment and project development, and that's getting ahead of our capacity to permit. If carbon management is going to fulfill its

potential contribution to addressing our climate goals, then we've got to be able to permit the projects. One of the things that we're doing, in addition to supporting EPA and companies and applicants, we're providing national lab staff to work with EPA to support the specific work on the permits themselves. (Government – Federal)

I can't underscore enough the value and the importance of policies that increase the opportunity for companies to provide disclosure, whether it's scope three or across their entire emissions spectrum. Especially with the recent rulings by the SEC, part of what you're doing when you're doing that is making visible what a company's value chain and supply chain emissions look like. That helps to create value for it, and it creates a demand for products like ours to pull more decarbonization to the market. (Manufacturing)

We've been talking to quite a few companies, a lot in the state of Washington, that have been looking to buy some type of CO_2 negative material, like an energy star certification to ensure that there would be something to show a green premium, that they will pay to demonstrate. There is going to be a potential market, but I don't think outside of cement, some of the other technologies are really ready yet. It's good to see that industry is now starting to think about that and they're going to start welcoming those types of products if they start making their way to the market. (Government – Federal)

The penalty for doing something where cement concrete fails is high. Those factors don't make ingredients for a really highly innovative place or highly innovative sector. Offering incentives, providing the work to support certification, are big factors. None of our producers would be working with us if the only revenue sources they were getting were expanded business and the savings from their cement cut. The role of carbon revenue and having a functioning liquid carbon market is a key driver not only for our business model, but for many of the others. (Manufacturing)

There is also a federal buy clean standard as well, so the federal government is really trying to think about the vast amount of materials that they procure and how we can start to build in some of those standards, starting first and foremost with the things that we're building on site or our own construction projects. That's a lot of money to move in some of these industries. Getting that off the ground could be valuable because that could spur more movement around things like performance-based standards. (Government – Federal)

Procurement standards have just been released and passed in Washington state. New York and New Jersey are also cutting-edge states who have created incentives on the tax side for procurement of low carbon energy. Part of that happens by states also doing the work to evolve performance standards for cement and concrete and other building materials to make sure that the standards themselves are less prescriptive. (Manufacturing)

The combination of a procurement standard with a flexible accounting mechanism is a golden combination to increase proliferation of these technologies across sectors. (Manufacturing)

In addition to California's policies, there's a lot of states in the West that are doing a ton of really innovative work on looking at things like how to deal with forestry residues. Also, there's a lot of state funding for orphan wells. Something that we're looking at is figuring out how do we partner with states around dealing with those, with the environmental harms associated with orphan wells. There are several states that are really looking at how they look at carbon management. For instance, the state of Colorado is working on their first carbon management plan for the state, and they've been very forward leaning on these issues. (Environmental)

To do BiCRS, you need to value carbon removal somehow. There are some gaps in that at the federal level, even though we have, for example, the 45Q credits for direct air capture, it doesn't encompass biomass carbon removal yet. And those gaps need to be filled. And there are some workarounds right now like private markets for carbon removal. Since we're making hydrogen, we can take advantage of fuel-oriented credit programs like LCFS, the 45 V tax credits for hydrogen, and the federal renewable fuel standard. Going forward, states and the federal government need to have specific policies that values carbon removal and they should because it's a service that we all need. (Energy)

One of the challenges that we have is just knowing the solution that we offer basically was nascent when the provisions in IRA were being discussed. What is the next generation of tax credits going to look like for carbon removal? How do we make sure to level the playing field for a full range of solutions? I think there are a lot of different approaches that currently don't fit within the current framework and looking at that for also frameworks like the low carbon fuel standard in California, which does have a bill that was passed, SB 905, that creates the opportunity for pathways to be added, but that is still in the works in terms of how that gets scaled. (Environmental)

The Department of Energy has an initial carbon removal purchase prize, which is the first time the federal government is committing federal dollars to purchasing carbon removal outside of the DAC hubs and the other programs that were in the Infrastructure Act and IRA. That is a really exciting program for us and a lot of people in the industry to start to get really the government to weigh in, not just to actually purchase carbon removal, but also to create some frameworks around the right standards for high quality measurement, reporting, and verification as well. (Environmental)

We've just been really excited to see the increasing interest in low carbon fuel standards and similar programs, which I think are another opportunity to integrate carbon removal, especially as states get farther along in their goals and get to a point where it's hard to get those last tons of carbon out of the atmosphere without carbon removal. (Environmental)

We're not necessarily optimizing for the energy contribution that BECCS could also be making towards meeting the growing U.S. energy demand. As we have seen throughout the West, in addition to the rest of the country, there has been more load growth on the system than was really expected a couple of years ago, given new manufacturing incentives that have come from the Inflation Reduction act, other federal tax credit incentives, more emphasis on electrification, and the growth of data centers that are underpinning a lot of the modern technology that we all rely on. (Nonprofit Foundations/Organizations)

If you are in an area where maybe you don't have great geology everywhere, you wouldn't necessarily be seeing storage as your only option. We're seeing utilization really grow out of it as well, really having an incentive to implement it anywhere. When we think about specifically what we could be doing at the federal level, one area that we have pushed and discussed is the 45 Q tax credit, which currently offers $85 per ton for storage, but only $65 a ton for utilization. Whether you're storing it or if you're utilizing it, we would argue for a consistent treatment across the board and for a 45Q tax credit not being a disincentive for utilization but having the same incentive for both storage and utilization; seeing this from a beneficial use framework versus a waste disposal framework, really seeing future opportunity in CO_2 in particular on the utilization side. (Government – State)

On the government side, government procurement and compliance markets are absolutely essential. Probably the most important thing for us to grow this market is to figure out how we can continue to grow regulatory support for credit offtake. Supply side incentives like 45Q are great and can be effective, but we also need CapX incentives to help drive down costs early on when we are relatively early and expensive. (Environmental)

The most critical component to scale up is the commercial aspect. We need to figure out how to build an industry and a huge market around CO_2 removal. If we want to truly reach gigaton scale removal, we're talking about hundreds of billions of dollars of market size, which is huge, and today, is very small. We need to find ways to develop markets that provide investors with the assurances that they need to help us invest in and develop projects, unlock nondilutive capital and project finance, give us stable, long-term revenue streams that are predictable. We can then pump capital into these projects and start developing them. That's a big missing piece right now that is in a very nascent stage. (Environmental)

The oil and gas industry will certainly use that CO_2 in enhanced oil recovery. Those reservoirs are suited to be able to take large volumes of CO_2 and we have a long history of those activities. Oil and gas fields lose production value rapidly after the primary production phase and pressure maintenance is needed to enhance

the recovery of oil. CO_2 can be used in this way and can mobilize oil that is not otherwise technologically recoverable. This is actually a low carbon oil, and the U.S. has a phenomenal opportunity right now, as we look at deploying these technologies, which would put CO_2 EOR very much on the table. Right now, the 45Q tax credit is incentivizing saline storage, and I would like to see a level playing field. We could enable the production of low-carbon oil at high volume. It's a real opportunity that we have that just takes some adjustments to the incentives. (Education)

Natural Sequestration

Subcategory: Biomass and Forest Products

Geology is king meaning that CCUS may not be viable everywhere – this is the time to think outside the box with developing private-public partnerships and long-term contracts that can ensure supply of biomass to generate secondary sources and ultimately CO_2 as a commodity stored. (Government – Federal)

U.S. Congress directed federal agencies to establish "clear and simple policies" that "reflect the carbon neutrality of forest bioenergy and recognize biomass as a renewable energy source" and "recognize State initiatives to produce and use forest biomass." BECCS projects can provide the clean, firm power needed to balance variable renewable generation, while offsetting emissions from hard-to-abate facilities. (Environmental)

USFS' primary focus is coping with the wildfire crisis. There are practical ramifications to that, such as in doing so, we are removing biomass that has overgrown forests. We will pile that and burn it in place unless we can find a source or a sink for it. Ideally, as we think about carbon capture and utilization, we can generate a massive amount of biomass from national forests where we are engaging in this reduction of hazardous fuels. That generates wood that doesn't have an industry to take it. (Government – Federal)

In the context of the West, we have abundant sources of waste biomass, particularly in the agricultural and timber industries. As we're facing increased fire risk across the West, there's a real push to incentivize these large-scale fuel reduction treatments on vast acreages of land. But it's extremely expensive. There's real potential that producing biochar, particularly using these small mobile units that you can bring out to the woods, there's a way to help add some revenue to those projects, to help offset some of the cost of those large-scale treatment projects. (Forestry)

A lot of the people that are going to be most affected are those that live in rural communities. There's a lot of gasoline consumption in small rural towns. If we can get the financing right and get the pieces in place, there's a way to drive a lot of value back to rural communities who are going to be disproportionately affected by carbon pricing. (Forestry)

The carbon credit value has really changed the biochar industry dramatically, and that only became available about three or four years ago. Those equate to something like 300-400 per ton of biochar produced is the carbon removal value you can get. There's some real value there. Ideally, you'd get something like a beneficial reuse or beneficial use tax credit for using things like slash. At least in the Pacific Northwest, there's vast amounts of slash and the standard practice is torch it in giant burn piles. We're trying to advocate for a beneficial use policy that would at least provide some amount of tax credit per ton of feedstock. That would improve the economics of biochar. (Forestry)

Mass timber is a solution economically, environmentally, and socially. Environmentally, it has carbon benefits, but also active, proactive forest management. It's a benefit economically to our citizens. It's repurposing one of our state's most abundant and renewable resources, trees, for greater purposes while also increasing jobs and contributing to the state's economy. And we believe that now more than ever. It's important the choices we make regarding building materials and mass timber are a solution. (Forestry)

We know without question that wood is the most sustainable building product there is on the planet. And now, through engineered components and mass timber, it's rivaling its counterparts in steel and concrete because now we have these new forms with greater structural integrity. (Forestry)

Support our architects and engineers and contractors in continuing education so that they can learn how to utilize these materials. That is a huge barrier. Once the code is in place, then you need all the experts to know what they're doing to put them on the ground. That is one of our largest obstacles; folks just don't know how to use it. (Forestry)

Wood products are a right now climate solution that helps not only the health of our forests that are struggling under the weight of climate change, but also add vibrancy to rural economies. (Forestry)

By bringing wood products into more urban and densely populated areas, we can start to bridge the gap between rural and urban and demonstrate that our rural communities are offering up a right now solution to climate change that the urban communities sometimes struggle with finding. (Forestry)

If carbon is your only management objective, you'd be harvesting more and harvesting earlier before that point of diminishing return. There are many reasons why certain areas aren't harvested, national parks; carbon is not it. It is not justified by science. Once the tree is harvested, wood is 50% dry weight carbon. If you put that wood into a building, all that carbon is sequestered. (Forestry)

It is a Farm Bill priority is to get money into higher education to provide education to architects and engineers. Currently, concrete will pay for their own modules and teach folks how to build with concrete. The wood sector doesn't have the same financial backing, but we are doing our part through the farm bill to try and expand the knowledge base of folks to build with wood in tall buildings. (Forestry)

Make decisions that support the use of wood and mass timber in projects that will stimulate the economy, increase the presence of the industry, and get some more mills. In the IRA, no dollar went towards increasing, enhancing, or rebuilding mill infrastructure in the United States. Given our wildfire challenge and that we are one of the primary structural materials, which is problematic and a lost opportunity. (Forestry)

The reason Europe has adopted mass timber faster than we have been because they have a performance-based code. If you can prove it, you can build it. The U.S. model codes are really based upon a prescriptive set of rules. (Forestry)

Ensuring a robust market for low-grade forest products is essential. The availability of workforce and mills capable of processing such material is crucial. This challenge is not unique to any specific region but needs to be addressed nationwide. A significant concern is the concept of leakage, where policies restricting tree harvesting in one area may lead to increased harvesting elsewhere, potentially in less sustainable practices. This could result in higher transportation and energy costs or the substitution of wood with other materials. Therefore, having a skilled workforce of foresters and loggers is vital to support sustainable forest management practices. (Land Conservation)

BiCRS is a way to use biomass waste and residues to give valuable services that otherwise take a lot of energy or land or water or other resources to produce. To do the carbon removal, you need the amount of land in that box, 7000 acres or 11 sq mi, mostly of solar panels, because both those things are really energy intensive. And by using the biomass to do the hard parts of gathering CO_2 from the air, with BiCRS projects, we can save a lot of that stuff. (Energy)

I can say the California low carbon fuel standard is the killer app for us because it values negative carbon intensity. We make hydrogen, which has negative carbon intensity. Federal incentives don't give you VAT credit for that, but LCFS does. There are other important policies that are pushing biomass toward valuable uses, like a ban on field burning of ag residues or incentives for doing forest management. That's creating a bunch of material that we have to do something with. There are supported policies, and other states can pursue those as well, that have co benefits for communities. (Energy)

Transportation is a challenge, and there are multiple steps that must be achieved, and I will say that we should not collectively rest on the BiCRS companies or the bioenergy companies to pay for all of that. The value of reducing fuel in the forest is something that needs to have other financial support. Getting the material from the slash piles in the forest to facilities is a seasonal activity, and it does cost some money, but it's a manageable cost. (Energy)

There is a role for the biomass provided from these bioenergy crops in certain examples; they don't always compete with food. If you're using them on land that isn't particularly good agricultural value, or if there's a particular reason why a farmer doesn't want to be having their whole farm committed to certain crops, it can help diversify the farm income. There's also quite interesting co benefits associated with purpose grown bioenergy crops, including things like grasses like miscanthus and switchgrass or fast-growing trees like poplar and willow. You can get quite good biodiversity improvements from using agricultural land for these, and that can then have improvements, say pollinators, for improving crop yields. It's not as clear cut as don't use agricultural land for purpose grown biology crops. (Government – Federal)

Thinking about feedstock, and especially focusing on waste and residues, is a way to ensure that you have a life cycle impact that's positive. Thinking about biomass to do carbon removal is new in the thousands of year-old history of bioenergy, and it is a higher value use of biomass than any of the energy uses, because carbon removal, getting CO_2 out of the air, is so hard to do. The fact that plants can do it for us gives us a product that is, on balance, more important than any fuels that we could make from biomass and that changes how we think about biomass now. (Energy)

One really great thing about these technologies is the diverse pathways that you have with biomass. When there are logistical challenges for transporting the biomass, you can look at opportunities on site to deal with that biomass. Where you have opportunities to do longer distance transport, you can do that for other pathways. On CO_2 transportation, there are again, opportunities to deal with the CO_2 on site. You can produce something like biochar. We don't have to worry about moving the CO_2. Explore where you have local opportunities to do certain pathways over others, where, say, you're in remote, challenging areas to transport the carbon, and that's which is more difficult on the pipeline side. (Government – Federal)

There are possibilities where communities can have quite small-scale projects that deal with lower volumes of biomass, dealing the stuff on site, providing useful products for that community. That may be a particular right sizing of the approach, rather than much bigger projects dealing with material that's going further out. (Government – Federal)

When we think about what feedstocks to use, we're really thinking about what's the way to maximize the amount of carbon we've removed, which is really based on our life cycle analysis and our protocol. When we think about feedstock sourcing, it's really related to a lot of work that we've done to do research on how to do that responsibly, ethically, and in ways that are supportive of communities, as well as actually finding those feedstocks. (Environmental)

You can use that biomass resource to produce an end product that can be useful, as well as carbon removal. And this report that the lab published looks at 27 pathways, and each of those pathways is doing something different. You can produce aviation fuel as well as carbon removal. You can produce hydrogen, you can produce other transportation fuels, you can use building materials, electricity. And that makes it quite a complicated as well as exciting and interesting technology set of technologies to look at. (Government – Federal)

We're really focused on residues, primarily in the case of woody biomass, looking at residues that are connected to wildfire prevention. We're looking at forest management in different ways and what we found is that there's a sweet spot of at a certain size wood can be used as timber, and at a certain small size it can be mulched, but there's an in between that really doesn't have a lot of use cases. And in California, for instance, there aren't as many biomass-based energy plants anymore, because there's a lot of social license issues with that. (Environmental)

One of the challenges for us is we are currently not eligible for 45Q or many of the other programs. That said, the amount of progress that's been made to just increase the awareness of carbon removal and increase incentives to help grow the industry is extremely helpful to us overall. One of the challenges with policy is that it moves slowly, and technology and innovation often move more quickly than policy. (Environmental)

With multiple technologies that require different government agencies, for example agriculture and energy agencies, it can be a challenge bringing those different government agencies together and getting them to work together, but also the intermediaries in the industry as well. Some of the intermediaries can be important for helping smooth out some supply chain challenges. (Government – Federal)

We're seeing a lot of emphasis in federal policy conversations around the use of biomass for energy, or biomass as a carbon negative or negative emissions. Technology really emphasizes that sustainable supply chain and on lifecycle analysis, we need to be sure that what we're producing and what we're sourcing, is creating that net negative. Otherwise, you're not really getting the maximum climate value out of it. (Nonprofit Foundations/Organizations)

BECCS, and for that matter, offsets, are all familiar projects and initiatives in other regions. [The West] is unique. I see a lot of private investors get excited, come to this region looking for BECCS opportunities, and then it's the same pattern over and over again. They get out here and they see just how different this area is relative to other areas that they've been looking at. And frankly, a lot of times, they get scared off. I think the difference in the West is the significant role of the public sector across this industry. (Forestry)

Compared to other regions, BECCS projects are often looked upon, in terms of social and environmental justice, as being on the negative side of the ledger. There's always concerns about what BECCS projects are going to do in terms of low-income communities, vulnerable communities, and so forth. It's a very different discussion once you turn to the West, because wildfire disproportionately affects vulnerable communities, then the benefits disproportionately accrue to vulnerable communities. You're looking really, by and large, at a positive environmental justice and social justice aspect here, and that, I believe, makes this potentially a very promising bipartisan issue, bridging urban and rural communities. (Forestry)

The mismatch between the 12-year financing schedule under 45Q and industry standards like 20-year schedules complicates project development and financing. Aligning these standards could alleviate some challenges. (Engineering)

Subcategory: Land Management

Use of Nature-based solutions and natural infrastructure present some of the greatest opportunities for carbon dioxide removal, while also providing incidental benefits for ecosystems such as improving water quality, reducing erosion, recharging aquifers, and preventing devastating and catastrophic floods, droughts, and wildfires. Oregon, Wyoming, and Utah have strong regulatory and incentive-based environments for advancing, implementing, and increasing use of nature-based solutions. Some of these factors relate to state water laws, the amount of public lands, and/or the willingness of private landowners to try innovative approaches to managing their lands and forests (e.g., regenerative agricultural practices, willingness to install beaver dam analogues (man-made beaver dams)). (Land Conservation)

Encourage the federal agencies to expand programs like Good Neighbor Authority to include counties and tribes. Include the ask for landscape scale projects and longer contracts. Another possibility is encouraging a federal tax credit to landowners who manage their lands in such a way as to sequester carbon. The same market concept could be applied to the energy sector. (Land Conservation)

With agriculture and forestry, so much of our land is managed by private landowners, by private farmers and ranchers, and helping them figure out what's the best way to manage their land. Oftentimes they already know the best way to manage that land and incentivizing the right choices is key. (Government – State)

While geologic sequestration is important, it should not be seen as a "highest and best use" so as to avoid incentivizing sub-optimal land use. There needs to be a clear process for prioritizing carbon sequestration sites for stability and co-benefits, and that avoids inefficient land use consequences that increases risks to the public, productive farmlands, waterways and aquifers, wildlife, and biodiversity, etc. (Nonprofit Organizations/Foundations)

Intersection between drought, pine beetle impacts, tree mortality associated with increasingly dense forests because of a lack of active management, and wildfire suppression, all lead to carbon emissions from wildfire. There are many important forest health issues we need to address in the West to harness the potential for our forests to function as carbon sinks and address the climate crisis. That's really what lies at the heart of this concept of carbon stewardship. (Government – Federal)

Forests are a very important natural climate solution. Forests store about two thirds of the terrestrial carbon in the U.S., and they also, importantly, are about 90% of the land sector's capacity to sequester additional carbon. Through this process of sequestration, forests are able to offset about 12 - 16% of our carbon emissions from burning fossil fuels. This varies depending upon the year; the most recent estimate was that about 12.4% of our emissions are offset by forest sequestration. That analysis also shows that the capacity of our forests to sequester carbon really differs depending upon where you are. (Government – Federal)

Private lands are still a key component of it. Policy, funding, and things that facilitate partnerships and collaboration help private landowners. I think we're seeing a lot of momentum around climate-smart forestry, and a lot of climate-smart forestry is the good ecological silviculture that we've already been trying to do, but it's about incentivizing landowners to participate in those things. Finding ways in policy to help build the infrastructure back up with the mills and with the workforce are some gaps that it's going to take some time and investment. (Land Conservation)

Many of these forests are naturally adapted to fire, but human intervention has disrupted this balance by suppressing fires. As a result, there's an accumulation of carbon in many forests, making them more vulnerable to volatile release and its subsequent downstream effects. This presents an opportunity for how to manage this carbon not only within the forest itself but also in harvested wood products, embodied carbon, and biochar. (Forestry)

A key concept in carbon stewardship is understanding the long-term perspective and acknowledging that carbon management is indeed a "long game." This perspective involves recognizing the temporal aspects of trade-offs. While there may be initial upfront costs associated with carbon management, such as fuel reduction treatments that remove carbon from ecosystems, the benefits unfold over time. By reducing the risk of unintended consequences from wildfires and the associated carbon emissions, these efforts yield significant payoffs in the long run. (Forestry)

Healthy forests and grasslands are scientifically proven to sequester carbon. Therefore, active forest and rangeland management is crucial. Unhealthy forests are prone to catastrophic wildfire that contribute massive amount into the atmosphere. States that are part of the Good Neighbor Authority program are in the best position to manage the landscape, keep jobs and rural communities healthy. (Land Conservation)

I don't want to see wildlife left out of the conversation or left on the side of the road as we seek policies and strategies to maximize carbon gains. I think if we're thoughtful and we're willing to consider tradeoffs, we can develop projects and management strategies that address our carbon needs while continuing to provide for all the other services and benefits we want. (Land Conservation)

Maintaining forests as forests is perhaps the simplest and most effective approach to reap immediate carbon and other ecosystem benefits. However, it's crucial to adopt a long-term perspective on carbon management, understanding that habitat management might initially result in some emissions. Particularly in western forest systems, the focus lies on enhancing carbon stability and restoring resilience by reintroducing

complexity and diversity, which have been diminished due to past land use policies and lack of management. (Land Conservation)

The goal of regulated forest management is to achieve a balance where we harvest what we grow while maintaining a diverse age distribution across the landscape. This approach provides numerous benefits, including supporting wildlife, ensuring clean air, and preserving water quality. (Government – State)

The key lies in better communication about forests, spanning from seedling to final use and storage. Regardless of the landowner's objectives, it's crucial to convey the reasons behind forest management practices to dispel misconceptions. Often, people misinterpret management activities, like leaving reserve trees after harvesting, leading to misunderstandings. It's essential to educate and inform the public about these practices, as the consequences of inaction, such as devastating wildfires, are evident, particularly in the western United States. By sharing the complete story, including the positive impacts on rural communities reliant on the forestry industry, we can foster a better understanding of the importance of forest management. (Land Conservation)

As stewards of the land, we must also consider our fiduciary responsibilities. This includes exploring opportunities related to carbon leasing and how it could potentially generate additional revenue. While we're just beginning to delve into this aspect of management, we recognize the importance of adapting to the current focus on carbon and exploring how it can benefit both our operations and our stakeholders. (Government – State)

90% of our land is adjacent to federal ownership, whether that's BLM or Forest Service. And then we have mixed in with, between wildland urban interface, private timber, and then large industrial timber owners as well. When you look at all this stuff on the planning side, you have to know what your neighbors are or aren't doing. And sometimes that dictates your management. (Government – State)

We have to get through the NEPA process on federal lands and state lands. We have to plan a budget two years in advance of actually getting our budget. Private landowners are more sensitive to a market and when markets are down, they're less likely to want to invest or to do management action because it's not going to pay as well as they wait. All these things factor in and create situations that as a neighbor, you may have to react to later. (Government – State)

Incentivize smaller landowners because they're probably the least capable and able to react, to treat things and look at it from a bigger perspective and not just purely driven by economics. (Government – State)

Reforestation is quite expensive, and those financiers are paid back through carbon revenue. That enables us to create excellent outcomes on the landscape, ecologically important ones for the land, to generate revenue for landowners, to help them fulfill their ability to steward their land for future generations. It enables active management. (Forestry)

We fund our projects with long term management endowments that help to create resilient forests in the long term, and it creates long term, durable, and additive carbon sequestration for those who are interested in leaning in and taking steps forward towards carbon neutrality. (Forestry)

There's also potential in leveraging carbon markets for wildfire-related expenses, especially for Forest Service lands. (Nonprofit Foundations/Organizations)

We are very fortunate with reforestation, to rest foundationally on a lot of good science that's lasted over a long period of time to measure and predict how trees will grow and convert it into carbon. One of our challenges is less of a question about how much carbon is going to be sequestered, but a question of the timelines of some purchasers. Our western forests don't grow as fast as the tropics or even the southeastern United States. (Forestry)

Workforce is going to be an issue, and it doesn't matter if it's planting trees, cutting trees, or doing watershed restoration. We have not invested in our natural resources for about 40 to 50 years, and it shows in the workforce that's coming up and in forestry markets. (Forestry)

The Bureau of Reclamation could fund water management projects with the large amount of funding that they received from the Inflation Reduction act, using funding for ecosystem restoration that they have not decided what to do with yet. That is an opportunity to fund projects across the basin that will make a difference for water. (Nonprofit Foundations/Organizations)

Much of our focus revolves around solving implementation challenges. Owning nurseries and maintaining the largest private seed bank in the western U.S. entails significant responsibility in the reforestation supply chain. We're concerned about seed shortages, which are critical for reforestation efforts. Innovating funding for cone collection is vital; traditional lenders are unfamiliar with pinecones as assets. Workforce challenges are another aspect we're addressing by training and hiring individuals for forestry roles. (Forestry)

We are a fund aggregator and a fund leverage and that's the only way that we believe we can get projects done at the scale that they need to be done, instead of doing what some people refer to random acts of conservation, which are good, but they're not good enough to be at the scale that we need to be in today. (Forestry)

Because most of our work occurs on federal lands, we can't give them any kind of credit. For those who really want to invest big in credits to offset their emissions, right now, federal lands can't play in that arena. (Forestry)

Most people experience climate change as water change. That's where we really see an entry point for all of us to come together to see how these issues are all united. (Nonprofit Foundations/Organizations)

Funding is essential for every stage of the project lifecycle. Most federal grant programs cater to shovel-ready projects but lack funding for early development stages. Philanthropic support helps, but unlocking federal funding for these early stages would accelerate project execution and enable watershed-scale conservation. (Nonprofit Foundations/Organizations)

I'm excited by what we've seen in terms of the benefits to the people on the farms and the downstream, freshwater and saltwater effects. When farmers can implement and then convert systems to ones that do not require chemical fertilizers and inputs, they are saving money. They're growing their own feed with the grass. (Food)

Interagency integration is such a big issue that the focus is on public private partnership. I've worked extensively on wildfire and trying to develop projects that really harness the power of the private sector and the public sector. (Forestry)

Across the WGA region there is significant federal ownership. What we saw was that if you look back over the last decade, about 93% of the burned acres here in Oregon occurred on federal ground. It's a significant and consistent pattern that if you're going to deal with the wildfire crisis here, you'll have to address public land ownership. That's inescapable and anybody who knows anything about federal forest policy knows it's a very significant challenge and has been for decades. I would say that one significant distinguishing factor is the need for public sector ownership. (Forestry)

It's important to talk about what do we mean by fuel treatments. It's generally two types. It's prescribed burning, but also mechanical thinning. It'll be on a site-by-site basis as to which one of those prescriptions works. With prescribed burning, you won't have biofuel as a byproduct, but certainly with mechanical thinning you will. But under any scenario, you're talking about a historic increase in biomass availability. A lot of that right now is stacked and burned, which has its own set of issues, including emissions and residual fire risk. I think to a certain degree, one of the opportunities here is to the extent you're integrating with basalt

and creating a new revenue stream from carbon capture and storage, that potentially could unlock very significant revenues to help pay for this restoration work that's coming. (Forestry)

Land use is really a critical component to any kind of conversation, whether it's around climate change, economic development, et cetera. And so, in the world of coastal resilience activities, one of the challenges around land use is that it is static. You have ordinances, they have to have clear and objective standards. (Government – State)

Tribal lands are a definition that does not currently include the historic and traditional lands of the tribes. If there was an opportunity to expand the definition of tribal lands and to give capacity grants to those tribes as well. (Professional Services)

Those are incentives that are available to steward land traditionally for fish and wildlife habitat, but can be, I think there's an opportunity to incorporate carbon value into that, particularly, the protection mode, trying to keep stocks where they're at. But there's a large discussion about tradeoffs. If you're incentivizing personal landowners through tax breaks, that also means that taxes aren't being paid to counties. And in Oregon, counties are rural. They're already underfunded. (Government – State)

We've been working with local jurisdictions through these kinds of efforts and through our agency, just trying to get to a place where we can create some support and structure to allow organizations to build that nimbleness into their ordinances and then figure out how that implements on the ground. Getting everybody to the table to understand how land use can actually be a positive force on change in the landscape that can accommodate these and build these coastal ecosystem resiliencies is the challenge. (Government – State)

We are continually refining the way we think about this very carbon-centric work and how it fits into the rest of the work we do. As coastal managers, we've been managing the many benefits of coastal habitats and working to ensure we sustain coastal processes and those habitats for 50 years now. We have an extra value now that we can talk about this ecosystem service that can be measured consistently and produce a calculated metric as we work to reduce greenhouse gas emissions in Oregon and as we move forward with our work around building climate resilient coastal communities, these efforts and partnerships are going to be key. (Government – State)

Blue carbon is one of the many valued coastal ecosystem services. It's only one dimension of these coastal ecosystems. When we think about our coastal blue carbon, we want to think about it in four different ways. The first is we want to be able to quantify, we want to be able to know how much carbon stock is currently in these coastal blue carbon systems, and we want to think about how we can conserve that carbon stock. (Land Conservation)

Climate mitigation and climate adaptation are foundational elements of climate action to create resilience and wetlands, both coastal and in freshwater space. Tick both boxes in Oregon and other states. Part of our work has been to leverage nature to help slow climate change, specifically by protecting and restoring wetlands, as a strategy that can have substantial return on investment by reducing or avoiding greenhouse gas emissions and enhancing carbon sequestration… Working to increase the resilience of coastal communities through adaptation strategies that include nature based approaches like wetland restoration to handle floodwaters, reduce shoreline erosion, and capture sediment. (Nonprofit Organizations/Foundations)

We can always use more information. I think that we have a good level of information in our tidal marsh system. When we start thinking about the tidal swamps down to the emergent marshes, we have a good understanding of where the carbon stocks are. There's been an excellent push to better understand greenhouse gas emissions in restored wetlands over the last four or five years. That information is forthcoming. There's some really excellent research right now that's going to help us better understand where to best place those restoration projects to minimize methane and nitrous oxide emissions from the restoration. So those data gaps are starting to get filled. (Land Conservation)

Helping to bring the right researchers and consultants to the table with the agencies into the working group was key. (Nonprofit Organizations/Foundations)

There's some research that we need to do to better understand how that carbon moves and where those seagrasses are most resilient and able to capture that carbon. I think there are still questions related to increasing stressors on these systems and what that means in terms of continued carbon sequestration and climate mitigation as we look towards warming climates, as we look towards other kinds of threats like invasive species or other diseases, plant diseases and things like that. (Land Conservation)

In recent history, financial revenue from forests has primarily come from the harvesting of trees. This has created a significant challenge for many Indigenous peoples across North America. These communities often face a dilemma: should they adhere to their cultural and traditional values and a conservation ethic that is deeply tied to the land, or should they pursue economic development through industrial logging practices that may not align with their traditions? The introduction of forest carbon markets disrupts this dynamic. Globally, carbon considerations are now influencing forest land valuations, management decisions, and fiber procurement prices. Through our conversations and collaborations with tribes and Indigenous groups, we have learned that these communities consider nature-based carbon projects for various reasons (Professional Services)

One of the first things a landowner needs to do is determine their objectives. This is an area where we can play a significant role, helping them develop management plans and understand their real goals for their forest and property, which is often lacking among smaller landowners. In my experience, assisting them in comprehending the trade-offs of various options and deciding on a direction has been extremely beneficial. Providing training, technical assistance, and planning support, even down to helping them write their own management plans or finding a contractor who can assist, is a key starting point for small landowners that we can offer. (Government – State)

Another potential pathway to reduce burdens for small landowners is through aggregation. This approach can be particularly beneficial for field sampling, as the more land you have, the less intensively you need to sample it. This principle also applies to remote sensing. However, there are numerous operational and logistical challenges to aggregating different neighbors into a single carbon project. (Professional Services)

The upfront costs are very significant. To get a traditional forestry project off the ground, all these projects need a full carbon inventory. That is a set up as like a continuous forest inventory across the project to be revisited through the project's lifetime on a periodic basis. The measurements have to be at the level to inform all the various technical quantification of the carbon stocks on the project. Then they also come along with the monumentation and the documentation that's necessary for the verification body to visit the site, get back to those sample plots, and test that inventory as part of the verification. (Professional Services)

For standalone small landowners, they can either find a project developer or an entity to underwrite the project. It's crucial to also consider the end buyers of the offset credits generated. These upfront costs aren't covered until the project is developed, credits are verified, and then issued and sold or retired. This process can take one and a half to two years, delaying any potential cash revenue for the landowner. Perhaps bridge loan financing could be an option, with a pool of funds available for small landowners. Continuing to explore state and federal grant opportunities to support these landowners would also be beneficial. (Professional Services)

Subcategory: Agriculture

At the USDA level, there's NRCS equip funding, the Renewable Energy for America Program, and other programs. And the Inflation Reduction act has been instrumental in generating the investment tax credit and the production tax credit, which is seriously helping finance projects and build projects and make projects more economic. We need more opportunities like this. (Energy)

One of the things that is hard as a producer is to change practice. There's so much risk involved in a tight margin sector where when we ask producers to take on, to address an issue related to be part of the conversation around addressing carbon or be part of the solution around addressing climate related issues, we're also asking people to take a risk with their livelihood and to think about changes in practice. Initiatives like the ones that we are involved in and like some of the funding that Colorado Department of Agriculture has have the potential to risk the potential for producers to step in and be part of the solution related to use. (Nonprofit Foundations/Organizations)

There is this trend to go big or get out in agriculture that has negative impacts in terms of the experience of small farms and the role of keeping farmland in farm production. The implications of that change and the extent to which our public funding streams don't actually meet the needs of those who have difficulty navigating difficult markets and difficult public funding streams. (Forestry)

Any solution related to water carbon environmental impact that neglects the role of agriculture is missing those who are going to be some of the most impacted and can have some of the deepest potential to have positive outcomes. (Nonprofit Foundations/Organizations)

The STAR program can be a real model for meeting farmers where they are. STAR is a soil health assessment and monitoring and incentive-based payment that is voluntary, that is tied to a rating scale around adoption of conservation practices. Meeting people where they are and then getting dollars into the system that are more than the taxpayer dollar or just the philanthropic dollar, we're excited to see, in part due to the work of Colorado Department of Agriculture, this climate smart commodities grant allow for the expansion of voluntary soil health practices to other states in the west. (Nonprofit Foundations/Organizations)

Currently, there's an NRCS conservation practice that will pay farmers to use biochar. There are very similar practices for lots of conservation practice standards for many other climate smart agricultural practices. NRCS is a fairly cumbersome organization - those dollars are real, but they're not fast. There are also some state programs that try to mimic NRCS. Washington state has some and California has some programs. Those are voluntary incentives. (Forestry)

The challenges that the average producer faces in accessing things like EQUIP funding or CIG funding out of NRCS are really substantial, huge barriers. And this is a place WGA has an important role; folks in this room have a role in engaging in the farm bill and engaging in USDA's ability to move money. It is difficult for your small farm or ranch to engage in accessing the public dollar. When we think about the existing programs at the federal level, the incentives oftentimes don't match the experience of the farmers and ranchers. (Forestry)

There's a real role for states in reducing some of the barriers for entry and using that capacity and doing the bureaucracy and administrative support so that our producers don't have to deal with it. I think a lot of producers don't want government subsidies. They're too much of a hassle and would much prefer to see the value that they're creating valued in the supply chain. (Government – State)

I think the opportunities that IRA funding is going to provide for producers is going to be huge over the next few years. Not only are we pumping more money into innovation, into adoption of conservation system, into adoption of regenerative agriculture systems. With that funding, we also have the ability to add technical assistance back into the system and try to reduce that bottleneck. We have lots of innovation and lots of opportunity out there. But if we don't have the manpower to get it on the ground, to get that funding out to producers so that it can be used effectively and efficiently, we are not doing ourselves any favors. (Food)

Opportunities that IRA funding through the CSP and the EQUIP program as the two main farm bill programs for conservation, really is going to be a benefit in the near future. And I think that's something that we can all be proud of. When you think about how farm bill programs work, we're supposed to be incentivizing producers to try conservation. We don't try to say that it's paying for conservation. We're trying to make it apparent that this is a good process for your operation. This is a good process for your system, and this is

something that can function beyond the Farm Bill financial assistance. This is something that can function in order to keep your farms living and functioning. (Food)

There's a significant amount of work that we could do there to reduce our impacts through the prevention of food waste. We're interested in composting so that we can return those nutrients to the soil, most hopefully in agricultural production and have the full circular benefit. (Government – State)

We think about methane every day, and we know that methane is not only a problem, but an opportunity. But since it only lasts in the atmosphere seven to twelve years, if we can actually get the global methane footprint down to where it was, or less than it was seven to twelve years ago, then we actually start being not part of the problem, but perhaps part of the solution. (Food)

Technical assistance and opportunities for farmers to share experiences with each other would be helpful. Even if the funding is there, understanding the benefits to the costs to their overall system, and then understanding how it works with others in their context. The West is interesting because it's really different depending on where you are and how much precipitation you get and what soil types there are. There's also this need for really localized conversations around practices, because they're so different depending on where you deploy them. (Food)

I think the farmer is often the one who we don't talk that much about and who bears the brunt of so much of this work. What we're also hearing is the cost difference for farmers. When you don't have to spend tens of thousands of dollars a year on inputs, you can suddenly invest back in your animals and in your farm infrastructure. The collaboration that we're seeing amongst farmers and the USDA funds and brands themselves, who have said we recognize that we are part of the food system, and the food system is broken, and how can we come together via funding and support, to get back to the farm and help them get what they need to be productive in a sustainable way. (Food)

Some of the systems, of course, are complex in terms of moving animals around, but many times it's not that complex. They've adopted systems where that holistic grazing method can be done in an elegant way that works really well for the animals. You have happier animals and more nutrient dense foods. The impacts and outcomes of that on biodiversity are huge in terms of beneficial insects, bird populations, stream health, and we see less eutrophication in the ocean because there's fewer chemicals going downstream. The farmer impact, I think, is a huge part of the ecosystem service of regenerative and organic agriculture that has been important to call out. (Food)

We have limited capacity to act on farm production, so what we're really focused on is appropriate use of materials. We should work with businesses and consumers up and down the value chain to try to reduce food waste in the first place so that when we put those production inputs into food production, that we don't waste them and can perhaps mitigate the amount of additional food production that we have to engage in. It is sad but true that about a third of all the food that is produced or imported into the US for human consumption is wasted. (Government – State)

I think we have a real opportunity here to bridge the rural urban divide. Consumers are getting increasingly interested in where their food comes from and how it's produced. The agricultural sector is coming to an understanding that they need to tell a story about how people's food is produced. And whether that's a story about a small farm, a medium sized farm, or a big farm. There is an opportunity for a discussion that will lead to greater understanding and appreciation on both sides. (Food)

Farmers are largely price takers. Certain prices are commoditized, set by the federal government. That tends to ingrain in them a little bit of a conservative approach, not an orientation against innovation, but they're just conservative. One of the biggest ways to get them to overcome their barriers to adoption is to let them see somebody else do it. (Food)

When the soil food web starts functioning, it is helping to not only provide aggregation in the soil, so increasing the ability of the soil to withstand erosive forces, we're also increasing the opportunities for

nutrient processing. When we increase nutrient processing, we're providing a platform for better, more healthy plants to grow and exist. When we have more healthy plants growing and existing, they're able to put more above ground biomass up, which provides the opportunity for more below ground biomass. Lots of agriculture is annually based in the Pacific Northwest and the West. But that doesn't mean we can't look at that system differently and think about how can we address the opportunity to have a constant living root growing in that environment, putting those root exudates down, holding that soil together, binding that soil and resisting erosive forces, if we shift and function, or shift over to thinking about livestock, and how livestock management can address that opportunity to promote plant health, thinking about how we graze, how heavily we graze, and what that plant looks like after a grazing opportunity takes place is important. (Government – Federal)

A lot of times that goal that they're accomplishing, that project that they're working on is something that could be spread across multiple producers, but because they don't have that network, that ability, that time to have that interaction, a lot of this innovation that happens on farm doesn't go any farther than across the road. The NRCS has the CIG, or conservation innovative grant program, and it's both a national and a state level opportunity. And individual entities, extension conservation districts, they all put applications in and try to get this proven technology out so that it can be used and seen by producers, so that they can adopt it and get it working, get it functioning on their operation. (Government – Federal)

A focus has been made within the NRCS to promote landowners' and managers' attention on how the soil is treated and what conservation effects can be employed to address the four main principles of soil health. These principles include maximizing soil cover, minimizing soil disturbance, maximizing continuous living roots, and maximizing biodiversity. So, if you look at those four principles, we're really breaking it up into protection and feeding that soil system. (Government – Federal)

Utilizing farm bill programs like equip, the Environmental Quality Incentive Program, and CSP conservation Stewardship program, the agency has a suite of conservation practices and enhancements that can continue to move the dial towards regenerative systems and managements that focus on healthy soils and improving biological ecosystems beneath our feet. Attention to healthy soil is no longer stimulated by the increase in input prices. Producers across the country are truly embracing healthy soil and what ecological benefits that can bring to their operations for long term sustainability. (Government – Federal)

That's really hard for a farmer to actually access those match funds, and they need technical assistance. All these innovations that are coming are, in my view, and I worry about a technical assistance bottleneck in terms of being able to support the farmers and get them to actually deploy these innovations on farms. They're already having trouble, quite frankly, finding repair people to fix their tanks and to fix their feed lines and all the rest of this type of stuff. Because rural communities are suffering, we start doing all sorts of new things on farms without the technical assistance ecosystem around them. (Food)

Production agriculture at the field level is a dynamic system where land managers weigh their input opportunities to forecast the return on investment for the commodity that they're producing. In production systems, yields have often been prioritized and that return on investment has been reached through improvements in technology and the ability to utilize easily obtained fertilizer and chemical solutions, which help producers with both quality and quantity. (Government – Federal)

If we think about soil as a living ecosystem, a living environment, which it is, we begin to reevaluate the input cost, the dollar spent on inputs going into that system, and think about what we're doing when we're sending money off farm to do something that the soil could provide at least a portion, a fraction of what we're sending money off farm to purchase and bring in. If we can increase the amount of time that we have a living root growing in the soil, if we can increase the amount of time that natural intelligence, the plant functioning, is pulling carbon out of the air through photosynthesis and pumping root exudates down into the soil, we're attracting microbial populations. When we attract those microbial populations, we start the soil food web. (Government – Federal)

Our dairy farmers are milking cows 24 hours a day, so who's going to help them actually write the application request or get the grant or that type of a thing? We've tried to do some things in Tillamook where we actually at times have contracted with grant writers or with other types of service offerings in order to try to help them access that. But fundamentally that's some arms and legs, but the thinking's got to be done by the farmer and it's a very tough, hard life. It is about bandwidth as well as liquidity to a certain extent. When are they going to get the time, in the midst of a really busy day, of a business that goes twenty-four seven to stop and go, okay, how do I access this? We do our best to make it plug and play for them as they're cooperative and I work for them. But even then, it's just really hard. I think having the abilities for farmers to understand what resources are out there and available to them is also a big thing. (Food)

Cross Cutting and Regional Opportunities

Subcategory: Community Engagement

Engaging and educating communities where CCS/CCUS projects may be located to help facilitate information on the benefits and safety of carbon storage, as well as the possibilities for employment will also help facilitate project implementation. It is important to engage communities before projects are announced to help reduce concerns. (Energy)

It is also critical that any government support programs and policies are paired with accountability and oversight mechanisms. Public perception and support in the long-term are needed to ensure that markets can mature and develop, but if attempts by agencies to catalyze markets are poorly administered, abused with fraudulent or deceptive actions, and are perceived as unaccountable to the public who fund such efforts, decarbonization efforts face the threat of pushback by the populous on administrative grounds. (Energy)

Explore how to ameliorate stakeholder issues, including policy options to give landowners and communities their own incentives or value streams – independent of the developer – to host carbon management projects. (Environmental)

Community engagement is a really underplayed and underdiscussed aspect of this. One of the big hurdles that we have is having an honest and effect-based conversation about what the technology is, how it gets deployed, what it means or doesn't mean for communities involved in it, and what the value proposition is for the climate/atmosphere. It is my observation that the more information we can have and the better dialogue we have about what it takes to make these systems real, we'll have an easier time advancing these technologies. (Construction)

We need to transport liquefied CO_2 over distances and put it in underground storage. But we need to build that pipeline and communities must be on board with that. (Construction)

I think it's important for people to understand that there is opportunity here, and while people are interested in becoming more sustainable, a lot of people don't know where to start and that initial step is a barrier, so we're hoping that programs like Better Climate Challenge and DOE Better Plants can acknowledge those technical and workforce challenges. (Government – Federal)

The idea of bringing people together around this issue is obviously important. From a technical perspective, I can tell you that it's difficult to know how to approach the conversation and talk about barriers. (Government – Federal)

There are mechanisms in place that are important but could always be improved based on what we know or don't. For IEDO's funding announcements, we make teaming lists where you can put your name in and self-organize. This is how we have been able to build partnerships and coalitions between industry, national labs, and other stakeholders to get the technology out into the world and commercialized faster. (Government – Federal)

In Wyoming, we have a very thorough outreach program that the operator has to submit public notice for four consecutive weeks just to notify everyone within 1 mile of the project boundary that they submitted an application and then putting our contact information and we immediately go to work. The company is going out there talking to the community regarding pore space leasing. At the agency level, we're talking to county commissioners, we're talking to environmental interest groups. We're picking up the phone and making those first calls that most people would be scared of or not interested in. But you're going to have to talk to them at some point, and having that team is important, especially once you get to the public comment period. (Government – State)

We go out there and know what kind of communication they are going to want. They want that face-to-face interaction, and they want that honest interaction. When it comes down to it, they're not going to trust industry. They realize industry is there for the bottom line. They're not going to trust the government because they're afraid we're trying to take over. (Government – State)

I think operators are still holding it close to their vest that what are they going to go with. So sometimes it's a surprise when someone shows up and they're going to have twelve applications submitted in the next week. My feedback to operators is to talk to your regulators often, early, and often, and just understand it's collaboration and we're here to work with you. (Government – State)

I think from a fundamental perspective, I think we've been trying to do it using comfortable frameworks that we've used in past industries. How far is that getting us? From a public perception, stakeholder perception perspective, I think we absolutely need to be thinking about the stakeholders from a policy perspective as well. (Environmental)

Public perception of CCS and how and when we do stakeholder engagement will dictate whether a social license to operate is granted. All this engagement work is really difficult, and we face challenge as CCS communicators, we face a lot of issues in dealing with the public, partially because the public has a limited understanding of CCS, even in cities where local economies are underpinned by energy. Climate change is a gradual process, which makes it hard for people to understand the urgency of climate change in general, let alone why we're talking about carbon dioxide in the first place. People don't understand why it's such a pertinent issue, yet when we tell them we want to transport it or store it geologically near them, people recoil at that. Collectively there is work to do to bring people up to speed but also do that in a manner that acknowledges the needs of different communities but also addresses environmental justice issues. (Nonprofit Foundations/Organizations)

We have a lot of harms in communities across the state that we need to address. We need to partner with communities to ensure the projects we are putting in place are creating meaningful benefits. (Government – State)

If we can create regulatory certainty around what it means to operate in a community and create baseline expectations that meet community needs, we don't need to reinvent the wheel for every project and can put the starting point at the right spot for a lot of communities. Communities shouldn't have to feel like they are constantly fighting for basic protections and provisions. Some of the communities have needs that don't tie into specific projects, and as we develop policy and regulatory frameworks for this emerging industry, we have an opportunity to think about things creatively about how we can meet communities where they're at and create structures that are addressing needs that communities are actively facing. (Government – State)

We need to make sure that communities have what they need to evaluate projects and engage with project developers, related to community benefit plans. We also need to make sure that project developers and recipients of our funding understand and uphold requirements for community engagement. (Government – Federal)

Because it's a new industry there is also a lack of coordination between different agencies and project developers and we need an opportunity to really coordinate so that we're being thoughtful and strategic with

the asks we're placing on communities – especially for community members who are doing this because they care, not because it's their job. This is part of the reason CO compensates communities for their time in this process. (Government – State)

We need to make sure that information is digestible for local communities. The current system is not necessarily set up to empower local communities and representation on boards and commissions becomes critical to solving this in the interim. (Government – State)

Fatigue is an important concern, especially because it's a requirement for each project that receives financial assistance to conduct engagement and develop engagement plans. Across the board at FECM, we get feedback that there is either no engagement and people haven't been contacted, or that local governments and community-based organizations are inundated with letters of support and there isn't yet a follow up. Recognizing that, particularly in the West, rural energy communities might have a small number of people running them and have people wearing a lot of hats and capacity is a big ask. (Government – Federal)

We need to look at the quality of engagement we're performing and underscore the importance of doing research to understand the local context and history and understand their relationship with industrial developers – and looking at other developments in the area to coordinate development and engagement. Finding local partners and making engagement easy and clarifying the process so they are clear where their input is taken. (Government – Federal)

In every project, we need to understand what the community needs are and understand the actual risks and benefits a project may bring. Particularly when we're working with communities who have trauma from past industrial and intergenerational harms, we need to be sensitive to those realities and are actually creating robust benefits for those communities. (Government – State)

We also encourage our projects to formalize the mechanisms of community engagement; whether that's something like an oversight committee or a community advisory board. We also encourage developers to formalize community benefit plans and address issues related to workforce development, monitoring programs and can articulate how the community feedback is integrated – this becomes a binding agreement that can be enforced. (Government – Federal)

Justice 40 requires that 40% of overall benefits of federal benefits are directed to disadvantaged communities. Our work over the past few years has been really focused on addressing environmental justice concerns and incorporating meaningful participation into our guidance. One of the key tools DOE uses is for the community benefit plan framework. These principles are directly tied to funding decisions, so it's really critical for project operators to add this to their skillset and their capacity. (Government – Federal)

Engagement fatigue is a risk, and disadvantaged communities in particular don't want to just feel like a box checked by the operators to achieve the community benefit goals. No two communities are the same and the early stages need to involve a lot more listening than education. In these meetings we always open with education but there's a balance. Every community has a different perception of risk, and early stages should aim to understand and characterize what that perception is, and then go in with the engagement and education. (Education)

Another mechanism for proponents, especially in rural areas, is to get on someone else's agenda. Meet people where they are, where these conversations may not be happening formally, and bring it to them and you can learn the community contexts in that way. (Government – Federal)

People who aren't involved in their communities are probably still online or on social media. There probably is a role for that kind of marketing, but the industry is still figuring out how to do that tastefully and effectively. If people have a genuine desire to speak to a project, having easy mechanisms to do so is critical and having somewhere to go to have their questions asked. (Education)

We need to find ways to help owners and operators incorporate all the engagement work they have been doing into their applications. As the regulatory authority, EPA Is also working to update our transparency to the public, especially since it is not readily apparent what the application process is. (Government – Federal)

In EPA's Class VI Environmental Justice Guidance, we are encouraging folks who are developing Class VI projects to engage with communities early on in development, and then use the feedback that they are receiving from communities, particularly in the development of their testing and monitoring and emergency remedial response plans, and then going a step further and highlighting in their Class VI application exactly how they engaged community members and where that feedback was incorporated. (Government – Federal)

We hear a lot of requests from communities for more engagement. Some of the regional EPA offices have started hosting these community workshops, so we're looking at the success of those to build community engagement protocols across the country as we see more and more Class VI activity. (Government – Federal)

So much of this is about meeting people where they are. We know ag producers are innovators, problem solvers, and want to be part of these larger conversations around whether it be water, whether it be climate carbon. But the entry points are too narrow for your average farmer or rancher. Derisking this notion of taking on a challenge, taking on an innovation and saying, Using flexible funding. We know we can leverage other dollars to help those farmers try something out. (Nonprofit Foundations/Organizations)

Collaboration of federal agencies, state agencies, private landowners play an important part in this, too. You have to show, and not just tell. You have to be doing the outreach, showing what the benefits of management are. (Government – Federal)

To simplify engagement, we should avoid burdening every buyer with analyzing specific projects. Instead, we could consider categorizing projects by type, streamlining participation and alleviating concerns about scrutiny. This approach parallels the concept of insurance—creating a system where individuals can engage without fear of backlash. (Financial)

Transparency in standards and companies identifying suitable avenues for involvement are key facilitators. Additionally, there's a crucial educational component. Understanding one's carbon footprint is essential, not to shame individuals, but to instill awareness of the environmental costs associated with our lifestyles. This awareness can lead to a more informed approach to carbon management. (Environmental)

The expectation of what's enough in terms of consultation is fundamentally changed and the system hasn't kept up. The biggest thing we could change right now for the better is timing. The conversations, in some instances because of procedural rules that regulatory agencies have, started off with eminent domain. There were just so many things that were counterproductive. We will have the opportunity with other projects, both in our region and around the country, for a do-over. I think what really needs to happen is there needs to be a real, intentional effort to go to communities and stakeholders before the projects are fully finalized and in their engineering studies. It gets to a point where it's very costly to pull back and make fundamental changes to a project. (Government – Federal)

[Federal agencies] have to rethink how we work with communities and stakeholders, what states and local governments do, and in particular, companies developing projects. It no longer works to come in with a fully baked project, do a public meeting and expect the community to support you. There has to be a lot more front-end work to make sure that community concerns and interests are not just listened to, but actually affect the design of projects. That's a big change over how things have been done historically (Government – Federal)

We need an education program from the ground up so our public understand how complex our energy systems are, so then we can move forward with addressing the transition. (Nonprofit Foundations/Organizations)

We're trying to do all of this, putting communities and stakeholders first. We've all seen with project development, the growing challenges, even opposition to projects. It's not just projects related to fossil energy, it's also renewables. As we advance this technology and infrastructure, it's crucial to carefully consider community and stakeholder engagement. (Government – Federal)

Community benefit plans and community benefit planning in pursuing these applications for demonstration projects, for DOE funding. I think that there's a great opportunity for communities to be upfront even earlier in the process, not only with preparing letters of support for applications, but starting to work through the details of what are those workforce development plans going to look like, how are these projects going to be? Investing in the community and putting that into enforceable agreements at the application stage I think really will carry things forward and advance social license as well. (Education)

The public perception of carbon management, generally speaking, isn't great right now. It doesn't necessarily focus on a particular class. It doesn't necessarily focus on any particular group or labor industry or anything. Just we're not winning the battle of public perception. And until we do, through education and other means, we're going to have real challenges deploying these projects at scale. (Nonprofit Foundations/Organizations)

Foundationally, the country has a problem with education on these issues, but I don't think that most of our population understands what happens when you turn on a light switch. They don't know what happens from the point of that gas well to the point it burns on your stove. They don't know what happens from the coal fired power plant to the time determining light switch. That provides a challenge for us, but if they really understood the complexity of our energy systems, it would be a lot easier, I think, to have these stakeholder engagements in these conversations that we need to make projects move forward. (Nonprofit Foundations/Organizations)

There's the opportunity at the local government level for some pre-planning work to be done, outreach to landowners, potential opportunities for pathways of lease, resistance to develop projects. It comes at a cost, but I think the benefits would likely outweigh the cost. Local governments have a more established understanding and relationship with their neighbors and have the opportunities to be real project champions to allow us to build out this infrastructure. (Nonprofit Foundations/Organizations)

One really big challenge we have is, because it's somewhat daunting, the scale of the carbon dioxide removal challenge. We need to make sure that it's successful socially and politically, and that means looking at opportunities where we can get buy in from communities and where it's politically successful because we haven't got time to be rolling this out in an incorrect way. (Government – Federal)

With social license to operate, often this isn't about the proposed project itself, it's about how you communicate with the community. I think there are definitely opportunities for this new infrastructure to be successful. When the people who are bringing that infrastructure are engaging properly with communities, there's a role for policymakers and scientists to help broker those kinds of relationships. And it's often about how you bring the communities on board. Early on, you talk about the benefits and you right size that project for that location. (Government – Federal)

When we think about building trust, I think clear communication is key, but also acknowledging that you need to clearly communicate to a nontechnical audience. If you use a lot of technical jargon or industry slang, the general public may not understand and then you lose that trust. So, acknowledging that you need to communicate this to a nontechnical audience, but having a clear methodology for meter proving, regular calibration. But I think follow up, of course, is key. Having frequent inspections, frequent audits, having that publicly available, but once again, being able to present that in a non-technical way to a general audience. And we mentioned our trust fund dollars, using that as a sort of insurance. If future discrepancies occur, you can have that to fall back on. (Education)

I think the importance of community engagement and that's timely and targeted and conscientious is really critical for the success of this industry in the long term. But I think one way to do that and show that this is a safe and effective technology is to point exactly to what Reese is talking about. Wyoming has used CO_2 and

enhanced oil recovery for many years now, as has North Dakota. And I think that's the greatest example of how we know that this technology is safe. (Education)

There's much more involved in these types of pilot projects than just a class six injection well. To start with tribal outreach and engagement, obviously, that's not a law, but we want to underscore that it's important to respect tribal treaty rights and make sure that you are not adversely impacting tribal treaty rights or cultural resource. (Professional Services)

Nearly all of those permitting processes require engagement of stakeholders and tribal nations. And so that's asking a lot of these different groups in this region to be engaging through each and every one of those permit approvals processes. (Environmental)

Building the tribe's capacity to engage in a project like this from the very beginning, we've tried to think about it, but you also don't want to risk appearing as if you're buying tribal treaty rights. And this isn't a check the box exercise. So how to do that engagement meaningfully and respectfully is building their capacity is also a barrier. (Professional Services)

I'd make the point that's consultation between government to government. The tribes are sovereign nations and that's embedded in the laws. But it's important for project developers to engage in their own consultation if the tribe is willing to do that with them. We call it informal consultation because obviously a project developer is not a government, but that's an opportunity to hear what their priorities are, what their needs are, and then if you do it early enough to incorporate it into your project design, and I've seen that worked very successfully on other projects. This one isn't quite that far along yet. So early and often, and staying in frequent contact, we sent letters updating tribes on the status of the project at every major milestone. Always welcoming conversation. (Professional Services)

The primary onus likely does lie with our project developers to do this engagement work, but there is most certainly a role for governments, NGOs, and research organizations to prime the waters so that people do know what's happening. (Government – Federal)

Make sure that community engagement is at the forefront of everything we do in the CDR space. There is hesitancy in communities about this new technology and the first thing we really need to do is to make sure everyone is informed about the technology. A lot of times, people are hesitant because they don't understand the technology. One of the challenges is educating people about the benefits and informing them about the things perceived to be concerns. A lot of the pushback is about limited knowledge about this space. (Government – State)

Something we've learned on the engagement piece is that the community concerns have a lot less to do with direct air capture and more to do with basic human needs like limiting pollution from existing industries, limiting traffic and construction, food access, workforce development programs, etc. We absolutely need to be mitigating the risks of our projects by looking at things like water usage and reducing strains to the electricity grid, driving down particulate emissions, etc. But we also should consider how we can add in additional economic or programmatic impacts back to the community, which means community benefit agreements in the places we deploy and that's not always tied to direct air capture. It's usually not tied to direct air capture. (Environmental)

As part of the Direct air capture hub program, we have been working very closely with DOE on our community engagement program. It has been tremendously helpful to have local, third-party perspectives, independent views, and to have not just a project developer talking to people about what they're doing, but to also have third party validation or translation of some of those community concerns and attitudes. (Environmental)

One of our biggest focuses is looking at and asking how we can build robust and long term relationships with these communities. These are assets that last decades and will physically exist for a long time. For us, key learnings were varied based on location, but that's the whole point – people are different and have different

needs in different places. One of the things we've found in CA is there are a lot of concerns with pollution from heavy industry. So, one of the things we committed to do to address that is report on everything we're doing in a transparent way. We have a community engagement council to appoint community members to give us regular feedback on community attitudes. We open the facility for regular tours so people can see and experience what we're doing, and we're committed to having an ongoing dialogue throughout the life of our facility. (Environmental)

It's so important for the agency to coordinate internally to ensure that outreach is aligned and that the same tools and the same approach are being used across the agency. I think that's been ecology has a tribal liaison, has an office that manages that work. And so having that top-down leadership has been really useful for our agency. But I would say coordination both within the agency and between agencies is always top of mind. (Government – State)

As we continue to have these conversations, it's crucial that we acknowledge and prioritize the inclusion of tribal and community voices and to place them in positions of leadership to help set policy. If we don't, we risk overlooking crucial insights and continuing to perpetuate systemic marginalization. Our goals today are really laudable. We want to find out how we can maximize benefits for tribes. We want fair and equitable project development, and we want to know how these projects can be vehicles for environmental justice. But to do that, we really do need partners that can help define what community benefit really means and to help hold us all accountable. So, I encourage all of us to seek partnerships, input, engagement. That's long lasting and really relationships based with black, indigenous and communities of color in every community that we operate in. (Environmental)

We need to make sure we have mechanisms in place to bring smaller tribes together, just like what was talked about on the first panel in terms of aggregation, many of the tribal forest carbon projects right now are on fairly large land holdings. And so, there's this challenge for small landowners of all types, including indigenous small landowners, to access the market. So, if we could develop a framework for smaller indigenous landowners to aggregate to bring the project to scale (Government – State)

we've seen as a significant barrier, just tribe's capacity to be able to engage with state agencies and grant programs or engage with legislature on deciding where the money goes, that in many cases there may be no staff that the tribe has available to do that consultation work, or there may be one person half time, and now all of a sudden they're getting requests from not just the state agencies, but county and federal agencies as well. So, one thing we've really seen a lot of interest in from tribes is in that funding to be able specifically to have capacity to engage with CCA, with cap invest auction proceeds decisions, as well as with clean energy siding projects. I've had 21 tribes apply for this grant program for capacity funds. (Government – State)

We often come with our set agendas, and I think it's equally as important to stop and listen and build the relationship first before you come with an ask and a need. And I really do appreciate the idea that there is training, there's cultural competency to that question of how do we all do this work in a better, more intentional way, and also with grace. And so I think that's something we're really taking very seriously, is how to build that long term trust and work with our other state agencies and taking the opportunity we have with the environmental justice mapping tool, too, to think about opportunities for engagement where we can be working together instead of multiple people coming at someone. (Government – State)

set up an ongoing group that is committed and there is the ability to bring resources to them similar to the equity advisory committee with the community climate investments, so that you have that ongoing relationship building happening instead of it being a one off. And then there is that trust, loss of trust. (Government – State)

in terms of certain channels that have been really helpful and successful. There's a Pacific Northwest climate change tribal leaders' network that is run out of Oregon State university. It's a monthly call that I've found to be really wonderful spot to share information and also hear about the challenges and priorities that tribes are bringing up on a regular basis. I would also say that I see a great opportunity in the environmental justice

technical assistance centers that we're just starting to get set up another program through EPA. (Government – State)

The question about timing and approach has been a challenging one for us because this opportunity from EPA through the Inflation Reduction act has held us to a fast timeline. And so, we have been trying to engage as best as possible on the timeline that we have. But I think one of the lessons I've learned is to keep asking and not necessarily hearing no response but taking that as an opportunity to reach out again. And it just might not be the right timing that we reached out to connect on that first time, but making sure that we remember there are so many things going on and so much attention being drawn away from this one specific topic, so needing to go back time and time again. And I would also add that one of the successes we've had, especially in engaging with tribes in Oregon for the climate pollution reduction grant, is being there in person and physically saying hello, introducing myself, and almost making the excuse to be there for a reason, (Government – State)

When we say communities here, we're often referring to the oldest sovereign governments on this continent. And as we all know, there's been a long history of actions over the past 400 years which have eroded trust with indigenous people of this land. And there's consequences to that reverberate to this day. And it's all of our responsibility to take actions to build that foundation of trust up. (Professional Services)

Within our team. We've had the opportunity now for two years in a row to participate in the Institute for tribal government's certificate in tribal relations. And it was actually through the climate pollution reduction grant that I feel like we're really able to say, this is a need. We need to be able to show up meaningfully and have that cultural competency to start having those conversations. (Government – State)

we're working really intentionally in coalitions as well to make sure that coalitions are co led by environmental justice and BIPOC community leaders, so that there's a shared sense of what the outcomes and principles and priorities are, so that it's not just on overburdened communities to lift up what the needs are and what the outcomes are, and so that there's a collective community and public interest community that's moving these issues forward because it is incumbent upon all of us. And I think it's also really fulfilling to see multiple issues being addressed at once in more comprehensive ways. And so, I think there's a lot of benefits and upsides to that work as we. (Environmental)

There is opportunity for strong integration of Indigenous values, harvesting with using traditional cultural forest practices, land stewardship, land tending while also supporting self-determination, air and water quality, healthy soil biodiversity, and so on. benefits that the Indigenous communities that we've worked with have realized from developing and implementing carbon projects, largely the ability to diversify and increase revenue from their sustainably managed working forests. And as you can imagine, this revenue can be used in a variety of ways as desired and needed by the community, from the reclamation of traditional ancestral lands, investing in community development and health, forest stewardship in a changing climate and management to reduce risk of catastrophic wildfire. (Professional Services)

Subcategory: Monitoring, Reporting, and Verification

All of the different things that we have to monitor in CCS in order to make sure that all of that CO_2 is where we're predicting it is going and we've got lots and lots of tools and technologies to be able to monitor all of these things. And what the beautiful thing about that geologic sequestration is we're tracking molecules of CO_2 that we can pretty easily track and measure, which is pretty different than the nature-based solutions. That's important for public confidence. We need to be able to apply these technologies to demonstrate to the public, yes, the CO_2 is in the ground. It's where we predict it's going to be. It's not causing any problems. Generating that kind of public confidence is a key part of it. (Environmental)

We have to do all of this monitoring, reporting and verification in order to be able to claim the 45 Q tax credit. There are well designed methodologies and accounting protocols to take all the data we get from all of these

different systems, put them into all of our material balance calculations to be able to demonstrate that verification and storage. (Environmental)

The key determinant of how much ccs we get to do in America hinges entirely on community and social acceptance. (Environmental)

We need to figure out the rules around measurement and verification. It is important, especially for a carbon capture company that sends the carbon somewhere else, where the capturer is dependent on a third party also being able to demonstrate knowledge and compliance with the rules. It's important to have rules that are clear but also fair and doable and that's where the regulatory process is lacking. (Engineering)

We lean on monitoring that provides data that is approachable and digestible and that can assure the public that the water and air quality are acceptable, and the land isn't being harmed. (Education)

EPA is developing tools for class six developers and operators to better bridge the gap for environmental justice. We need to take really technical stuff like testing and monitoring reports, and present that in a more digestible format. (Government – Federal)

The tools that have been developed to do that don't always include biochar. And so another place, where is there a role now for building that evidence base, but also pushing the public dollar to be more responsive to the small farmer and to have space for innovation or space for proving out the practice, as opposed to simply funding what we know works. (Forestry)

Carbon serves as a measurable proxy for various ecosystem services and benefits in the forest. While it is crucial for addressing climate change, it also represents good stewardship practices related to wildlife, water management, and more. Viewing carbon as a starting point allows us to consider other metrics and data to assess overall forest health and management effectiveness. By quantifying these aspects and integrating them into reporting systems, we can better communicate the broader story of sustainable forest management. (Forestry)

We all need to have the same information, we all need to have the same data, we need to understand where key biodiversity habitat is, where a lot of high-density carbon is, all of this information. And it needs to be flexible such that partners can come to the table, they can bring the data that they have, but that we can all look at it together, that we can all assess the tradeoffs together, because we need all of those voices in the room at the same time, because we have to make these decisions collaboratively. (Forestry)

There does need to be a coalescence on a standard for these things. However, we need to recognize they're all very different. Planting trees is different than managing forests, is different than reforesting, is different than kelp sinking, direct air capture. There's a whole bunch of technologies out there. They're all a bit different. (Financial)

We have an auditing report that we give to everyone when we sell a carbon removal credit that shows how we're tracking CO_2 through all of our inputs, so you know exactly what you've paid for. We fully expect our carbon credits are expensive and we don't fully expect that many companies are able to pay for that, but we think that there is a place for within the value chain when companies have really hard to abate or legacy emissions for certain sectors. (Environmental)

The VCM needs science based and equitable criteria to ensure carbon credits represent genuine emissions reduction or removal. That's why we support transparency and seek to deliver on a science driven strategy for carbon management. We know that we have the opportunity to help define and promote the practices that will help an effective and trusted market to develop. We share with the goal of strengthening voluntary carbon markets in support of decarbonization because it will help a broad effort for the world to deliver the pace and scale of emission reductions and removals required to continue to grow our economy and create jobs for a more sustainable. (Financial)

For each one of our carbon removal credits that we are selling, we use a standard space organization to certify what we are tracking and how we did it. Maybe if we find a company that's really interested in a high-quality carbon removal credit, they will pay the cost of this auditing. I think that would be really helpful: to incentivize the developer side of being able to get into this business of driving down the costs paying for that certification process. (Environmental)

Simplifying standards would be immensely beneficial. We observe this trend with direct air capture as well. Having the ability to assess various carbon removal methods and determine what aligns best with your objectives is empowering. (Environmental)

Corporations are interested in two things: water benefits and carbon benefits. The water benefits are easier to quantify, and they can be verified through a third party. The carbon benefits are harder. (Forestry)

All the people that buy our credits have their own integrity and their own transparency concerns. They want to know where the credits came from. They want to know geographically where they were located. They want to be sure that those credits weren't purchased by somebody else or double counted or that if they're going to retire them, they're retired in a particular way that increases the integrity of the claims that those companies who buy those credits make. The fundamental to that promise is transparency and clear systems that allow us to show the integrity of where these credits came from and how they're being used. (Engineering)

The technology standards on the concrete side and the voluntary standards, which help describe to companies what a high integrity credit looks like and what a high integrity claim that a company makes with that credit looks like, are really important features and dimensions of this working and require us to be very reliant on both those customer bases, but also the NGO bodies who are writing and designing those standards. (Manufacturing)

Carbon accountings is another piece of the puzzle that needs to be solved in order for BECCS and BiCRS to hit scale, because not all of these policies are valuing perhaps the carbon negativeness of BECCS also don't necessarily have standard, widely accepted, non-controversial ways of calculating, quantifying that aspect, that benefit of these technologies. And some of the conversation right now at the federal level around the sustainable aviation fuel tax credit, for example, hinges on this question of what model are you using? Like, what methodology is going to be accepted by the US treasury when you go to then claim your tax credit and get that financial incentive? If we're not creating consistency across all of these federal programs that may be using different models or maybe using different ways of calculating the net negative value of these technologies, then that also creates problems for businesses who may want to use different programs and use different kinds of incentive ways of putting together their business plans for these projects. (Nonprofit Foundations/Organizations)

You can't expect someone who isn't working in this field day in and day out to understand, to parse through MRV reporting themselves or try to figure that information out. Class six permits can be nearly 1000 pages was the most recent one I was looking at. I think any monitoring or reporting or verification that comes afterwards needs to be in a place that's publicly accessible and from sources that they can also trust as well. And potentially getting third party validators could be helpful. (Education)

CDR is the service, MMRV is the product. (Government – Federal)

Currently, we're not looking at homogenizing the standards but more so doing quality control on them. So, we'll take the top of the funnel, universal MMRV providers, apply a consistent criterion which we will select against, and then will eventually put out a list of MMRV providers that we think are doing it in a really robust manner. What that will do is tell the industry that these are the players doing MMRV in a way that you can believe the results. That type of market validation is needed because there are a lot of players out there doing this well, but there are also ones who are new and still developing science. That's where we see our role on the validation side. (Government – Federal)

In our programs, we try to do things as transparently as possible, which may be an opportunity for other people to get into the space. It's not just putting a number out saying this is the value of you crediting or your instrument – it calling out how do you do the verification and what is the process and procedure to accomplish it? Transparency is a key factor in that process. (Government – State)

It would be amazing to have a harmonized standard and methodology. The EU is about to come out on their own and there are a lot of relevant stakeholders who can be really impactful in those conversations. But as a developer, we're going to choose the most rigorous of those standards with the assumption that that is where the world will go. But we want to be operating our facilities under the most rigorous standards so that we don't get left high and dry if and when those requirements do change. But there is a huge opportunity for standardization, and it would give a huge amount of confidence to investors, developers, and customers to figure out how we do that across the board. (Environmental)

The thing that we hand off to our customers is not a physical product, but rather a certificate that says we did something. Customers don't just have to take our word for it because of MRV. MMRV is really the cornerstone of CDR; this external, third-party validation that shows what we have done, and the benefit of those actions, and that the associated climate benefits are real and quantifiable. The benefit of DAC is that when we capture CO_2 from the air, it goes into a pipeline to transport it to storage. In the pipeline, flow meters and other measuring technologies can help us be very certain about the amount of CO_2 coming out of the air and we can be confident about the efficacy of our service, assuming we have reliable parties performing MRV. (Environmental)

MRV and setting standards that can applied industry wide to ensure that the carbon dioxide removal we are doing is additional, permanent, and high quality and that everyone understands what that means, its transparent, and standardized. (Environmental)

We need to figure out the rules around measurement and verification. It is important, especially for a carbon capture company that sends the carbon somewhere else, where the capturer is dependent on a third party also being able to demonstrate knowledge and compliance with the rules. It's important to have rules that are clear but also fair and doable and that's where the regulatory process is lacking. (Engineering)

Lidar has been key for a lot of our different projects, whether that's looking at a landslide movement or riparian corridors. But as far as, like, biometrics of the forest, it's not used to the degree that I think it will be in the future. So that's definitely an area that we see growth in. It does take a lot of computing power and a lot of technical expertise to be able to utilize all of that. And that's one of the areas that hopefully we will be able to build with some added capacity that we've had and looking to the future. (Government – State)

to date, the carbon markets for forestry have really relied on statistical sampling, tried and true forestry practices that have been employed since the inception of forestry as a practice, really. And remote sensing does offer this potential pathway to reduce a lot of those costs. Things can happen on a greater scale with less work and are more cost-effective. At the same time, there's a lot of specialization that goes into being able to deploy a remote sensing approach. So, thinking about barriers to small landowners, there has to be some technical expertise to pull that off. (Professional Services)

Remote sensing is going to be a really valuable tool for long term MRV. I just don't think it's there yet. There's a lot of considerations for standardizing. In a competitive marketplace to develop some of these remote sensing products, we all have to come around a common standard. They all have to get verified. So whatever underlying methodologies in place that is used to extrapolate the conditions of the forest and then the registries, have to assess that, assess the methodology that the landowner developer used, how it was verified, and deem it appropriate underneath the relative standards and methodologies that are in place. (Forestry)

We have accredited, improved verification bodies out there and we need more of them. There's only a select few, and that's a significant capacity limitation that we see from our perspective. And they verify the project from initial development through a site visit of the inventory. And then there's desk audit work that

continues through time on that verification. And so, the inventory and the verification and of course, the technical expertise to get a project off the ground is very expensive. It's even very expensive for a large landowner. Specifically for a small landowner, it's pretty much a nonstarter. (Professional Services)

In a competitive marketplace to develop some of these remote sensing products, we all have to come around a common standard. They all have to get verified. So whatever underlying methodologies in place that is used to extrapolate the conditions of the forest and then the registries, folks like Andy have to assess that, assess the methodology that the landowner developer used, how it was verified, and deem it appropriate underneath the relative standards and methodologies that are in place. (Professional Services)

we develop these remote sense products and approaches, but then ultimately, it's up to a third-party verifier to verify that method. And if they don't have the tools and the technology, and if they don't have a rulebook to do that verification on that specific methodology, then we're still disconnected. So maybe a role between the philanthropic community and the Western Governors association and some of the corporations that are interested in buying these offset credits, convening a roundtable on this very topic could be a very useful thing. I think this is where one thing the government has a very strong role in is convening power. And so, to me, using the governors as a mechanism to create convening of interest, to really hammer some of these roadblocks. (Professional Services)

Subcategory: Carbon Markets

We would welcome a regional carbon credit trading system that allows CCS and CDR projects to generate credits. Emitters could buy credits generated from CCS or CDR projects to achieve emissions reduction requirements, and/or they could undertake their own CCS or CDR projects to offset their emissions and/or generate credits to sell to others. This would create an incentive for CDR deployment that doesn't exist anywhere else in the country. (Environmental)

With market validation and development, we want to signal to the market that high quality CDR providers exist today across all technological pathways, and we want to develop that market not only by purchasing credits but also working with private buyers. One of the evaluation criteria for this program is the ability for competitors to gain additional external buyers by leveraging DOE's money. (Government – Federal)

[Markets] can help to mobilize capital by generating economic value for reducing or removing emissions. Second, the market enables flexibility for when, where and how emissions are reduced or removed. And finally, the VCM can also create a range of potential environmental, social and or economic co benefits. WGA should rightly recognize the opportunity to contribute to the growth of the VCM as part of driving capital towards these carbon capture technologies and growing local economies in the process. (Financial)

We see where there is a demand from people and companies, businesses that want to be able to trade carbon credits with others that offset a certain amount of CO_2 per ton. And I think it doesn't necessarily have to be driven by the state government. It doesn't have to be driven by the federal government. It can be a voluntary credit market where businesses come together to reduce their carbon emissions by people showing up as producers as well as people that are showing up as offtakers. (Energy)

I think a national market would be great. It'd open up a lot more opportunities across the country and you wouldn't see an influx of fuels heading to California and draining that market. (Energy)

Offsets create all the economic value that makes these technologies possible. You have the low carbon fuel standard in California, which has been extremely successful in driving projects across the country. You also have the renewable fuel standard with the EPA at the federal level. But outside of that, there's some new markets. There's the clean fuel standard in Oregon and the clean fuels program that's starting up in Washington, but outside of that, there's not many markets for projects like these. (Energy)

To drive more opportunity, we need more markets, we need more variability, we need more optionality. (Energy)

We have focused primarily in Idaho and in the western states because of the LCFS credit market. If it is on a national scale or level, then that opens a lot of opportunities. Those areas and hubs of large farms and large agricultural areas would benefit from a national carbon market. (Energy)

One of the interesting things about in the carbon removal world, for long durability carbon removal credits, all the buzz right now is around technological solutions, things like direct air capture carbon capture. But if you go look at which technologies are supplying the bulk of the actual carbon credits, to date, something like 90% of the delivered carbon removal credits are biochar. There's a lot of potential to increase that value. (Forestry)

There are also similar voluntary carbon credits for soil carbon. I have heard concerns that the MRV requirements associated with soil carbon credits are onerous, so they'd only really make sense for extremely large-scale projects. The price for a lot of those soil carbon-based credits is very low, in the $20 a ton of CO_2 e range as compared to biochar, which is in the $130 range, or DAC right now, which a lot of those facilities are currently getting $600 a ton per ton of CO_2 e. There's just a vast difference in how much the market is willing to pay for these different types of credits. (Forestry)

The voluntary carbon market operates differently—it's voluntary, requiring a conscious decision to participate. This aspect presents a challenge, as involvement often demands an intricate understanding of forest management, akin to needing a PhD. This complexity hinders accessibility and adoption. (Financial)

We do need more incentives on the buy side. Right now, we're incentivizing supply, but there's no benefit really to buying these things other than the goodwill and halo effect of doing the right thing. Other than that, there's probably more risk associated with doing these things than not. (Financial)

Currently, there isn't a compliance market for carbon removal in the US or anywhere globally. Europe is progressing with its emissions trading scheme, undergoing a certification framework process to assess and certify various carbon removal methods. It's anticipated that the EU will eventually integrate carbon removal into its emissions trading scheme, allowing companies to purchase carbon removal credits if they're unable to mitigate their emissions. This development could have significant implications, potentially leading to trade agreements in carbon removal with other regions. (Environmental)

In California, there are discussions about similar initiatives within its cap-and-trade system. These policy conversations are motivating larger companies to engage in carbon removal efforts, which is beneficial for developers like us. (Energy)

Insurance is a really important part of the equation because the market has this perceived lack of quality and integrity, but also many what-if scenarios. One of the things that helps these markets is creating some surety, and that's what insurance really provides you with. Having insurance to back those things and to be able to replace the economic value that was lost is important in these equations. (Financial)

We need all of it, we need to manage forests better, we need to plant more trees, we need to develop engineered removal, we need carbon capture, we need point source removal, we need industrial removal, we need all of it. I think that really is what the voluntary car market can get us to a place where you can bring buyers and sellers together to trade the economic value for capital and incentives to move the market. (Financial)

Pricing is a part of how we get carbon into revenue streams. Procurement is a part of that, making it more visible within the supply chain is a part of that. That involves not just fulfilling the economic prospect, but also being able to validate the performance of the technology and be transparent about those data. (Engineering)

By 2045, CA hopes to be carbon neutral. This is where we have a multitude of assembly bills and initiatives, looking to get to carbon neutrality by using different initiatives and policies. We have looked carefully at how to decarbonize California's economy and the outcome of that in SB 905 and AB 1757, is that traditional approaches to emissions reductions will not get us to carbon neutrality, which is why we are looking at opportunities for active carbon removal and additional strategies to meet those goals. CCS protocol for permanence certification allows crediting of CCS and DAC projects on the LCFS. On incentives, the LCFS is one of the successful programs based in California and is providing credit for these carbon capture projects. We need to start today to deploy these projects at scale, to meet these climate goals in a decade. (Government – State)

Cap and trade and LCFS are market-based programs and have worked very well with respect to bringing project developers and the compliance-required parties together. That is a functioning market mechanism. And with CARB, any rulemakings that we institute go through a public comment period so anything we do goes through public engagement. Projects cited in California have to go through those requirements and if they don't meet them, they can't be permitted. There are places to implement similar mechanisms, especially as we work on the crediting mechanisms, to establish value. (Government – State)

All of the actors, except for CARB, are voluntary. We need to be figuring out how we continue to develop those markets, as well as compliance markets and government procurement programs and find ways that we can give predictable cash flows to projects to encourage private capital to come into the industry and start to build these things at meaningful scale. (Environmental)

There is a one to two year lead up for issuance of credits, and you're referring to improved forest management or IFM projects that's basically harvest. Deferral is typically what we think of, but just existing forests and increasing their sequestration potential. But that period is a lot longer for reforestation projects. Typically, it can be a decade or longer before trees are large enough to really generate credits effectively. And there's a lot of risk and a lot of uncertainty along the way. That's particularly an area where different funding sources to cover that gap would be really critical. And those exist to some degree, but it's a patchwork. (Professional Services)

there's a lot of crossovers with traditional timber-based forestry in terms of the expertise that's needed, but it's also different. And the longer the carbon market is around, and it keeps specializing and specializing, and there's just an ever-growing need for professionals committed to this. And thinking about that at the university level is wise, Oregon Department of Forestry, and I know many other agencies here in the west, natural resource agencies have programs that work to support family landowners. (Professional Services)

Subcategory: Regional Development

There needs to be interstate collaboration. But we also need to get the distributors who know how to distribute CO_2 through the commercial market and regular commodity markets, educated about this kind of CO_2 distribution. If you're not doing it by pipeline, but rather by rail, barge, or truck, that market is completely separate from the CCUS world. We need to bridge those two pathways because we can rely on their expertise on how to deliver products most efficiently. (Engineering)

This is a place where the government can hopefully help. Coordinating projects in the area and connecting developers with local governments who are very attuned to their communities to reach the people they need to reach. (Government - State)

To achieve net-zero goals, the US will need to undertake a concerted effort to permanently store hundreds of millions of tons of carbon dioxide each year. This will require a major infrastructure buildout and cannot be accomplished without partnerships and coordination across local, state, and federal governments, and most importantly, communities. (Government – Federal)

The Forest Service is one of our most important partners. We've been very successful using the stewardship agreement tools to conduct on the ground forest management to improve wildfire risk reduction. where we're improving watershed health, we're improving forest health, reducing the risk of wildfire. We have diverse partnerships with the BLM, Forest Service, state agencies, other NGOs, focused on repair and restoration and conserving stream systems on both public and private lands. (Land Conservation)

We need to look at the opportunities there are for state leadership and policy making in this area and then cooperation with our neighbors regionally on regional projects and regional policies that are congruent to allow projects to move forward and then working together with federal agencies so that the federal lands that defines so much of the west can be part of these projects. (Education)

One of the key trends I'm seeing in this work is there is a strong regionalization component. There's a very strong regional interest component to all this work. That's where I think state government particularly can really come in and hone some of its specific interests. (Government – Federal)

I think one way that this is coming into some of our considerations or ways that we're looking at opportunity for conversion is through some of the hub efforts that are coming out of the Department of Energy. We have the direct air capture hubs as well as the hydrogen hubs and I think given the kind of convening nature that those projects have had, given that they're touching along multiple pieces, the capture of the carbon dioxide, obviously, but then either the storage or the potential for use cited within a hub infrastructure or in some other industrial community. I think it's a good case that we think will probably make good sense for carbon utilization. (Government – Federal)

We've been socializing this project all across Oregon and across the northwest with unanimous, bipartisan support, because the public value proposition of wildfire mitigation, climate job creation is pretty darn compelling. I think the big picture is one that's very promising in terms of the opportunity here to do something meaningful. (Forestry)

To get a pilot project, the capex is so significant from the private sector, you're going to have to derisk that. And that is going to take one stop shop leadership from the public sector, somebody that's just going to own this work in partnership across the value chain, including pipelines, the infrastructure. But the private sector is going to need a very reliable public sector partner to pull this together. (Forestry)

If we could have some sort of a program that is about regional study and doing it right and really looking across all the different regions, as I said, there's a big green area. There's a lot to explore here that's less tied to commercialization at this point in time. I think that would be extremely helpful to move this whole system forward and then all of the associated scientific work that goes along with that. I think that would be a huge unlock for this region, particularly on the geology. (Nonprofit Organizations/Foundations)

This is a massive integrated vision that's multi state, and you need somebody to pick it up and take the reins. That needs to start at the highest levels of government and requires strong leadership on projects. (Professional Services)

We are hoping that the DAC hub that was recently awarded some funding from the Department of Energy in the Pacific Northwest will really bring a whole group of different DAC companies to the region. And then we can start to co-locate the sinks or the storage resource with the capture of CO_2 from the atmosphere. (Nonprofit Organizations/Foundations)

We see a multi-industry integrated carbon management approach, and with really anchored around carbon storage in the Columbia River basalt group, which is a massive formation. And the exciting part to us, as we started looking at this region, and this potential is in around actually storing CO_2 underground in such a way that it mineralizes. Pacific Northwest is one such region and a really big one. Then we started looking at, well, what are the CO_2 sources in this region? It is actually one of the unique things that it's a very clean grid in this region. There's vast clean power with hydroelectric power, large scale renewables and others. (Nonprofit Organizations/Foundations)

It's very regional and the methodologies and the markets exist for both protection and for restoration of these systems. But our understanding at this point is that it would take thousands of acres instead of hundreds of acres in the Pacific Northwest to make that pencil out to make a carbon market really a feasible mechanism. And so, I think we could think creatively around how we aggregate these kinds of projects. But at this point, the carbon markets don't appear to be a feasible, viable initial funding mechanism for this work in the Pacific Northwest. (Nonprofit Organizations/Foundations)

Investor interest has grown with the expansion of the federal 45Q credit and new funding opportunities from DOE, the economics of CCS and DAC projects remain challenging, especially because new pipeline and sequestration infrastructure must be developed along with the installation of carbon capture technology. Most state budgets are too tight to provide the level of funding needed for rapid CCS/DAC deployment, but a regional strategy for decarbonization, backed by a fund that allows Western states to pool their resources, could provide more meaningful dollars while sending an important signal to investors. (Environmental)