

**ALASKA STATE LEGISLATURE  
SENATE RESOURCES STANDING COMMITTEE**

March 8, 2023

3:30 p.m.

**MEMBERS PRESENT**

Senator Click Bishop, Co-Chair  
Senator Cathy Giessel, Co-Chair  
Senator Bill Wielechowski, Vice Chair  
Senator Scott Kawasaki  
Senator James Kaufman  
Senator Forrest Dunbar  
Senator Matt Claman

**MEMBERS ABSENT**

All members present

**COMMITTEE CALENDAR**

CARBON CAPTURE AND STORAGE (CCS)

- HEARD

ALLIANT INSURANCE DISCUSSION OF CARBON CAPTURE SEQUESTRATION

- HEARD

INTRODUCTION TO GEOLOGIC CARBON STORAGE

- HEARD

**PREVIOUS COMMITTEE ACTION**

No previous action to record

**WITNESS REGISTER**

TIP MERKEL, PhD., Senior Research Scientist  
Gulf Coast Carbon Center  
Bureau of Economic Geology  
Jackson School of Geosciences  
University of Texas at Austin  
Austin, Texas

**POSITION STATEMENT:** Delivered a presentation on carbon capture and storage.

HARRY BALLAN, Managing Director  
Global M&A Group  
Alliant Insurance Services, Inc.  
New York, New York

**POSITION STATEMENT:** Discussed carbon capture and sequestration.

AUSTIN CAHILL, Managing Director and Lead  
Tax Insurance Team  
Alliant Insurance Services, Inc.  
New York, New York

**POSITION STATEMENT:** Discussed carbon capture and sequestration.

DAVID LEPAIN, State Geologist and Director  
Division of Geological and Geophysical Surveys  
Department of Natural Resources (DNR)  
Fairbanks, Alaska

**POSITION STATEMENT:** Delivered a presentation on Geologic Carbon Storage.

#### **ACTION NARRATIVE**

[3:30:28 PM](#)

**CO-CHAIR CATHY GIESSEL** called the Senate Resources Standing Committee meeting to order at 3:30 p.m. Present at the call to order were Senators Kawasaki, Kaufman, Co-Chair Bishop, and Co-Chair Giessel. Senator Dunbar arrived during the introductions.

#### **CARBON CAPTURE AND STORAGE (CCS)**

[Contains discussion of SB 49.]

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**CO-CHAIR GIESSEL** stated that the committee would continue to discuss SB 49 relating to carbon capture, utilization, and storage. She welcomed Dr. Tip Merkel to begin his presentation.

[3:31:46 PM](#)

**TIP MERKEL**, PhD., Senior Research Scientist, Gulf Coast Carbon Center, Bureau of Economic Geology, Jackson School of Geosciences, University of Texas at Austin, Austin, Texas, stated that the Gulf Coast Carbon Center (GCCC) is an industry-sponsored applied research group that helps the private sector develop an economically viable industry to store CO<sub>2</sub>. He pointed to the names and logos of the current GCCC sponsors displayed on slide 3.

[3:34:29 PM](#)

DR. MECKEL reviewed the key points in the presentation:

- Carbon Capture, Utilization, and Storage (CCUS) is not a new topic.
- CCUS basics: Capture, Transport, Storage.
- Deployment focus is on emission hubs, including marine ports and other ports where there are concentrated industrial emissions.
- Economics driving the reduction of atmospheric emission projects are rooted in tax credits in IRS Section 45Q.

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DR. MECKEL reviewed the components of CCUS, paraphrasing the following:

The CCUS business is evolving, but at its core, it will likely be populated by emissions sources, service and technology providers, midstream transport, well and storage operators, and tax equity driven project investors / developers.

The diagram shows the CO<sub>2</sub> sources on the left that could be anything that is required to report under the Environmental Protection Agency (EPA). Each source requires the development of some type of capture equipment. Transport of the CO<sub>2</sub> is by either pipeline or ship. He noted that the US has about 50 years of experience with transport by pipeline. Transport by ship is coming. The last component is a sink to hold the CO<sub>2</sub> for some type of utilization or for permanent sequestration.

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DR. MECKEL displayed slide 6 and explained that CO<sub>2</sub> emissions from different industrial processes come out at different pressures, temperatures, and concentrations. The pictures on the top row of a coal power plant, a gas power plant, and air capture typically have low concentration emissions. The emission sources on the bottom row of a natural gas processing plant, an ammonia plant, an ethanol plant, and a cement plant typically have higher concentrations of pure CO<sub>2</sub>, which will be less expensive to address. The point is that there is no single cost associated with CO<sub>2</sub> capture; it is highly variable among emission sources.

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DR. MECKEL stated that the purpose of slide 7 is to convey the experience Texas has had with CCS. Over the past decade, nearly 1 gigatons of carbon dioxide has been injected into subsurface formations throughout Texas. It is primarily used for enhanced oil recovery in the Permian Basin of west Texas. He stated that 1 gigaton of CO<sub>2</sub> over a decade is on the scale that makes pure sequestration feasible.

DR. MECKEL said the map on slide 8 shows the locations of major US Department of Energy funded projects in the US and throughout the world over the last 20 years. The projects identified in red reflect the flagship carbon capture programs in the last 10 years. These led to opportunities in other states and regions.

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SENATOR CLAMAN joined the committee.

DR. MECKEL said slide 9 provides an overview of carbon storage. He clarified that the injection sites depicted have nothing to do with shallow underground sources of drinking water that are protected under the Safe Drinking Water Act (SDWA). The injections go 1-2 miles below the surface, into the depths from which hydrocarbons are recovered. These are either depleted oil fields or saline formations. The CO<sub>2</sub> that's injected stays in place much the same way as buoyant hydrocarbons that are trapped in the subsurface. The physics are the same.

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DR. MECKEL directed attention to the graphic on slide 10 that includes an example of offshore transport, CO<sub>2</sub> injection, and geological storage. He spoke to the following:

Why Offshore?

- Emissions hubs are at coast/ports
- Single land/mineral owner (GLO)
- Avoid NUMBY/Unitization
- Data availability
- Fewer, younger legacy wells
- Avoid USDW - Class VI focus
- Monitoring easier?
- Long term liability - GLO
- Vessel transport flexibility

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DR. MECKEL said slide 11 highlights the Porthos Project in the Netherlands. It illustrates the industrial emitters, the pipeline network, and/or offshore infrastructure that's being developed to inject CO<sub>2</sub> from the port sector. This model has been replicated throughout the world, including the Gulf Coast, UK, and the Baltics.

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DR. MECKEL turned to slide 12 that describes the Inflation Reduction Act of 2022 (IRA), noting that it followed the Bipartisan Infrastructure Law that passed in 2021. The graphic on the right illustrates the estimated 2022-2031 energy transition spending in the IRA and BIL. He said there was actually more funding for CCS in the BIL than the IRA, which has a lot to do with the Section 45Q tax credits. Their structure and effect are similar to the wind and solar tax credits. He said he can imagine capital engagement to develop CCS projects as the tax credits were expanded and made transferable in the IRA. He reminded the committee that the 45Q credits were introduced in 2009 and have enjoyed bipartisan support over the last decade.

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DR. MECKEL advised that slide 13 lays out how the 45K tax credit works. It has a base fee that is increased if prevailing wage, hour, and apprenticeship requirements are met. The credit for a CO<sub>2</sub> storage project is \$85/tonne without enhanced oil recovery and \$60/tonne with enhanced oil recovery. Congress is considering a bill that offers \$85/tonne for both types of project. The example on the slide suggests a project with 1 million tonnes of carbon capture and injection per year, which would accrue an \$85 million tax credit/year. The credit is available for 12 years which brings the tax credit value into the \$1 billion range. The credits are available for direct pay and now are transferable. This has stimulated interest in these projects.

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DR. MECKEL described slide 14 as dense with information about jobs and the economic impact of carbon capture deployment in Texas. He pointed to the link on the upper right that may have information about Alaska. He said most of the studies indicate that developing the CCS industry results in significant job growth and retention associated with long-term wealth generation.

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SENATOR WIELECHOWSKI joined the committee.

DR. MECKEL spoke to the following to discuss injection well permitting.

- EPA Class II - CO<sub>2</sub> used for enhanced oil recovery (EOR).
- EPA Class VI - CO<sub>2</sub> injected for storage/disposal.
- State Primacy

He noted that only North Dakota and Wyoming have Class VI primacy, although several other states, including Alaska, were applying for or thinking about applying for Class VI primacy.

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DR. MECKEL directed attention to the color-coded map of the US and spoke to the following in slide 16:

State legislative sessions are underway in 2023 in most states across the country and more than 70 carbon management, hydrogen, and procurement-related measures and bills of interest are under consideration.

He noted that the website cited on the bottom of the slide provides information about what other states are doing regarding CCS.

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DR. MECKEL stated that slide 17 provides a summary of his comments. It read as follows:

#### SUMMARY

- Carbon Capture Utilization and Storage (CCUS) is not a new topic.
- CCUS basics: Capture, Transport, Storage.
- Deployment focus is on emission hubs, including marine ports.
- Economics are rooted in tax credits.
- CCUS is an economic growth opportunity.

The takeaway is that CCUS is an opportunity for growth in many areas.

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DR. MECKEL described the following resources listed on the final slide of the presentation. It read as follows:

#### RESOURCES

- DOE-NETL CCS Newsletter:  
[https://listserv.netl.doe.gov/scripts/wa.exe?SUBED1=SEQUESTRA\\_TION&A=1](https://listserv.netl.doe.gov/scripts/wa.exe?SUBED1=SEQUESTRA_TION&A=1)
- GCCSI: <https://www.globalccsinstitute.com/>
- Gulf Coast Carbon Center:  
<https://www.beg.utexas.edu/gccc/>

3:49:15 PM

CO-CHAIR GIESSEL asked if he would talk briefly about the slides that discuss shipping liquefied CO<sub>2</sub>, because that topic is of significant interest to the committee.

DR. MECKEL turned to slide 20 and conveyed that he was a scientific advisor on the Norwegian Northern Lights Project that has liquid CO<sub>2</sub> built into the process. He continued to speak to the following:

#### Liquefied CO<sub>2</sub> (LCO<sub>2</sub>) Shipping

Topics of interest: rapidly evolving full-chain maritime solutions for low-C energy development and use.

- Capture of emissions from powering vessels
- Transport of low carbon energy (carbon-neutral hydrocarbons, Hydrogen, Ammonia)
- LCO<sub>2</sub> transport; synergy with LPG/LNG transport and design
- Leapfrogging into offshore storage without pipelines - FPSO/FSO for CCS, injection capabilities
- Onshore buffer storage capacity aspects

He turned to slide 21 and explained that it is a rendering of a site west of Bergen, Norway. It has two berths for vessels that will bring CO<sub>2</sub> from southern Norway where it will be offloaded into tanks and then transferred offshore through a subsea pipeline to a storage location. He said both the Southeast Asian and the greater North Sea communities are looking closely at shipping LCO<sub>2</sub>, and it is also becoming an important part of the US deployment of this technology.

CO-CHAIR GIESSEL noted that the last few slides had different maps of the US.

DR. MECKEL stated that the maps come from the tracker website he referenced earlier. They show different elements of CCS. Slide 22 shows in teal the states that are evaluating pore space ownership issues related to CCS. He noted that in Texas, and a number of other states, the surface owner is deemed to own the pore space into which CO<sub>2</sub> would be injected. Negotiating a lease requires negotiation with the surface owner, who is not necessarily the mineral owner.

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He noted that, as mentioned earlier, the next slide addresses the topic was Class VI primacy. Several states have applied but only North Dakota and Wyoming have received Class VI primacy. This means that there is a state agency that is permitting the CO<sub>2</sub> injection wells under a permitting process that is at least as rigorous as the EPA Class VI process.

DR. MECKEL said the states shaded green on the next slide are those that have a combination of ownership interests. His understanding is that this is about the interaction between hydrocarbon development and CO<sub>2</sub> storage. He noted that in Louisiana there's been a lot of discussion about whether entities can drill through a CO<sub>2</sub> storage complex to access minerals. The state has indicated that CCS projects will not condemn mineral development in any way. The details on what this means has to be worked out, particularly if the mineral and surface estates are separate.

He said the states shaded red on slide 25 reflect those that have long-term state stewardship. These states have existing legislation that addresses the long-term liability of a project so the process for closure and after a project ends is clearly laid out. He noted that companies and investors typically are hesitant to proceed with a project if there isn't some assurance of how the long-term liability will be handled.

DR. MECKEL said the last slide shows in dark blue the states that have considered how the trust will be funded, managed, and used.

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CO-CHAIR GIESSEL asked about the manufacturer of the vessels that will ship liquified CO<sub>2</sub> to Bergen, Norway, because the

vessels would need to be highly specialized to handle the highly corrosive LCO<sub>2</sub>.

DR. MECKEL answered that Mitsubishi is designing the vessels. They will have more but smaller and lower pressure containers that will hold 99.9 percent pure CO<sub>2</sub> with no water component because that's the catalyst for corrosion. His understanding is that the vessels currently under construction have some specialized engineering, but not as much specialized metallurgy as he had anticipated. Other companies that are interested in designing these types of ships have experience with LPG and LNG. He expects to see one of these vessels in the Gulf of Mexico within 2-5 years.

[3:59:07 PM](#)

SENATOR DUNBAR asked if it was fair to say that no CO<sub>2</sub> tankers were operating in the Pacific.

DR. MECKEL said he wasn't aware of any that were on the water.

SENATOR DUNBAR recalled that he anticipated the tankers would be built in 2-5 years.

DR. MECKEL clarified that he anticipates seeing one on the water in the Gulf of Mexico in 2-5 years and in Asia or Europe late this year or next year.

SENATOR DUNBAR noted Alaska's experience with hydrocarbon spills and asked what the impact would be if a tanker spilled an entire load of CO<sub>2</sub> into the water.

DR. MECKEL replied that it would look very different than a release of hydrocarbons. CO<sub>2</sub> is a natural compound in the environment and if it were released under pressure it would go to the gas phase and dissipate quickly. He noted that when a CO<sub>2</sub> well is out of control, the CO<sub>2</sub> vapor vents and forms dry ice until the well is under control. He also noted that when the Nord Stream Pipeline was damaged, there was a lot of dry ice formation that dissipated rapidly.

CO-CHAIR GIESSEL thanked him for the excellent presentation.

**ALLIANT INSURANCE DISCUSSION OF CARBON CAPTURE AND SEQUESTRATION**

[4:02:13 PM](#)

CO-CHAIR GIESSEL announced the next two speakers from Alliant Insurance Inc. would discuss carbon capture and sequestration (CCS).

4:03:06 PM

AUSTIN CAHILL, Managing Director and Lead of the Tax Insurance Team, Alliant Insurance Inc., stated he was a tax attorney by trade, which was how he got involved in the carbon capture industry. As Dr. Merkel discussed previously, the economics of these projects are related to the use of carbon capture sequestration and the tax credits derived therefrom.

He conveyed that he spent time with the international restructuring group KPMG before moving to insurance broking, where a large portion of what they do is to secure tax credits for tax credit investors. With passage of the Inflation Reduction Act, being a tax credit investor includes carbon capture. Alliant Insurance has been eager to become involved in this space to help de-risk these extremely large carbon capture projects and potential challenge from a taxing authority.

MR. CAHILL stated that Alliant Insurance Services was established in California in 1925 and is one of the largest insurance brokerages in the United States. Their tax insurance brokerage is the largest tax insurance brokerage worldwide by volume of premium placed. In policy limits, these tax credits account for tens of billions of dollars per year in protection, which shows this is already a very large industry. He said he and Mr. Ballan agree with Dr. Merkel that this is going to be a very economically fruitful area in terms of energy transition and carbon capture specifically.

4:05:10 PM

HARRY BALLAN, Managing Director, Alliant Insurance, stated he was a tax attorney who practiced at Davis Polk and Wardwell LLP from 1993 until a couple of years ago. He became a partner in 1999. He'd also been a professor of tax law since 2003, teaching mostly at NYU, and he spent a few years as a law school dean.

He agreed with the previous speaker that Section 45Q of the tax law and in particular Section Q, as amended and extended, and the Inflation Reduction Act was a game changer in the sense that the economic benefits that are available to participants in the capture and sequestration of carbon were unprecedented. As Dr. Merkel said, 45Q has been in the law for some time, but the availability of \$85/metric ton allocated between capture and

sequestration makes it quite profitable for all the parties involved.

MR. BALLAN stated that their role at Alliant Insurance Services was to insure the credits. Because there are questions around qualification, the party also has to qualify for the credit by capturing and sequestering the carbon. That means having a Class VI well or a Class II well that is properly certified by the federal government or by states that have applied successfully for primacy. Then there is the possibility of the recapture of the credits as a consequence of leakage, although experts say that is a remote possibility when sequestering in certified wells that are one or two miles below the surface of the earth in saline formations. He suggested that others could speak to that.

MR. BALLAN stated that robust insurance has developed and will continue to develop around qualification and recapture. This will be important for those who get the credits directly and for those who benefit from the capture and sequestration. It's possible for parties to enjoy tax exemption, and even governments are able to enjoy the credits through direct payments. Even non-taxpayers can enjoy the credits. And because it's also possible to transfer credits, the insurance of those credits is particularly important under that new bill.

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MR. BALLAN said one other aspect of the new legislation that has attracted a lot of attention is that in exchange for or as part of the deal relating to the \$85/metric ton, the credit is structured as a base credit amount of \$12/metric ton and a bonus credit rate of \$85/metric ton. Everybody they've spoken to expects to get the bonus credit rate.

He explained that in order to get that bonus credit rate of \$85/metric ton, it will be necessary to comply with prevailing wage requirements or prevailing wage and apprenticeship requirements. That is an aspect of qualification that needs to be developed and monitored. There is guidance from the Treasury Department about the type of record keeping that is necessary, including that the prevailing wage and apprenticeship requirements apply to the construction, repair, and maintenance of the capture and sequestration equipment and technology. They apply to both employees and independent contractors and all the people engaged in the subcontracts.

MR. BALLAM said there are perceived and real social cost benefits associated with complying with the prevailing wage and apprenticeship requirements. Insurance plays a very important role by helping with the maintenance of the appropriate records to ensure compliance so the parties are able to qualify for the credits.

[4:11:10 PM](#)

MR. CAHILL said key concerns their clients have are the specific risk associated with qualifying as a capture and sequestration facility and then meeting the wage and apprenticeship requirements. He suggested Mr. Ballan provide his insight and briefly describe what the recapture risk is and how it operates in Section 45Q. Doing so will set the stage for the discussion around how the insurance operates.

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MR. BALLAN explained that the carbon recapture risk relates to leakage. Once the sequestration has occurred in a Class VI well with permanent and secure geological storage, the occurrence of any leakage could result in the loss of the production tax credits in a subsequent year through recapture.

MR. CAHILL added that recapture provisions are typically limited to three years plus the open year of whatever period of credit year you are in. As Dr. Meckel alluded to, a client might receive production credits for 12 years, but if in year six they had a mass leakage event and all of the carbon that had been put into the ground leaked out, they would only be able to recapture three years plus whatever was put into the ground plus that open year. There is a cap on the liability resulting from recapture. He said that is important for the insurance piece.

[4:13:54 PM](#)

MR. CAHILL restated that the parties they work with want to ensure that that they are entitled to the tax credits worth \$85/metric ton. He noted that while solar and wind involve an additional sale of electricity and revenue stream, the full value of carbon sequestration projects is derived from the capture and sequestration of the carbon. He emphasized that it is critical to all parties that these credits are protected whether it is the capture company that is working with the emitter to take the carbon, the company that is taking responsibility for the storage and sequestration, or both companies that are vertically integrated. They all want protection.

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MR. CAHILL explained that tax attorneys offer the protection. Traditionally, this was an insurance solution that was required by large banks for traditional tax equity investors on large solar and wind projects. The large banks wished to transfer the risk of loss to an A-rated counterparty. There are many sponsors that will be working in renewable energies and not all the companies will be A-rated as a counterparty. The insurance wraps the risk of credit recapture or failure to qualify, thereby transferring that risk to an A-rated insurer. He noted that the insurance allows the original tax equity investor to be comfortable enough in this emerging technology to invest heavily in these projects. He added that while carbon capture and sequestration (CCS) and Section 45Q are not new, the projects have gained momentum as a result of the Tax Cuts and Jobs Act and the Inflation Reduction Act and are now going at full steam. He remarked that his group determines the best insurance for these projects by using the solar and wind model as a reference point.

MR. CAHILL continued to explain that the client, either the capture or the store company, is indemnified for the risk of loss associated with the qualification piece or the recapture piece. He compared the process to a seamless solution that transfers any risk of challenge from the Internal Revenue Service (IRS). The insured client would be whole, which de-risks the main value of the assets of these transactions, primarily the credits. All things considered, the cost of the insurance is relatively inexpensive. He summarized that the policy covers leakage risk and qualification risk. The latter involves wage and apprenticeship, which is difficult to comply with.

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MR. CAHILL continued to explain that a client works with a broker to transfer the risk to an insurer. To underwrite the risks, the broker needs the client's federally mandated Measurement, Reporting, and Verification (MRV) plan, and tax due diligence provided by a reputable tax advisor that has reviewed the project's implementation and determined that the project should qualify for the tax credits. If the underwriter determines that the project properly qualifies, the credits are insured with a one-time payment for a policy that will last ten years. Any challenge to credits from the federal government for the ten years that the project is in service will be protected. This is a true risk transfer. He explained that the client purchases the insurance and submits a one-time payment of two to five percent of the amount of insurance being purchased.

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MR. CAHILL advised that risk tolerance determines how much insurance a client purchases. For an extremely conservative party, 100 percent of the value of the credits is insured. Conservative clients choose this option because a loss of 100 percent of the credits is possible if a well blows up in year three, extinguishing the use of the well. In that circumstance, the party would lose the projected value of the credits in future years three through twelve. The policies also cover any interest, penalties, defense fees, and the extent to which the proceeds themselves will be taxable in gross-up. These policies place clients in the same position as never having been challenged by the IRS. He also spoke about transferring the credits to unrelated parties who were previously uninvolved, similar to municipal bonds. Wrapping the risk with insurance creates overall project economics. Investors who previously may have been reticent to invest in this technology, now are willing to put significant amounts of capital into these projects.

MR. CAHILL reported witnessing large amounts of capital pour into this space from all different types of investor classes. He witnessed investments from family offices, large alternative investment funds, big banks, and local banks. Additional investors include emitters who are not able to avail themselves of carbon capture technology because of jurisdiction or location. He opined that everybody wants these credits. The credits are worth a lot of money and the insurance solution makes these credits safe from all but things like fraud. He described these insurance policies as relatively straightforward.

MR. CAHILL added that the payment history on tax insurance is extremely high. He assured the committee that he has a 100 percent claim payment history for tax insurance policies. He reiterated that the policies can be trusted to backstop risk related to the Section 45Q credit qualification. He added that credits could be used to collateralize projected future cash flows. He stressed the benefit of carbon capture insurance and mentioned trusted companies that are involved in this space. He remarked that working with a trusted insurance broker can help to de-risk the transaction, bring certainty to projects, and create a new stable revenue source.

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MR. CAHILL suggested that they spend the remaining time discussing the model that Alaska might choose to use. The

approach could be to rent the land and certify through primacy the Class VI certifications and charge fees through that.

MR. CAHILL said a more profitable opportunity would involve ownership of the wells, the injection sites, and pipelines. That option establishes the ability to build pipe into various locations. He noted that the largest problem encountered in the Lower 48 was the ability to construct pipe over long distances. The pipe construction problems are complicated by private land ownership. He opined that anybody that can build pipe over long distances would be at a considerable advantage.

[4:22:41 PM](#)

SENATOR CLAMAN asked if the notion of making money off tax credits relies on having a federal tax structure that creates the credit so that there is a benefit to doing all this. He then asked if this would all stop working if Congress were to suddenly change its mind and stop the tax credits.

[4:23:38 PM](#)

MR. BALLAN said he would answer the question more as a tax professor than as an Alliant employee. One possibility was if the cost of emitting carbon was \$20/metric ton and as a consequence of capturing, transporting and sequestering, it was worth \$85/metric ton. For example, if the emitter were an ethanol plant, there might be a ratio of 85 to 20, the credit over the invested amount. Another scenario might be cement manufacturing where natural gas is converted to produce hydrogen with carbon as the byproduct. The cost of production doesn't approach \$85/metric ton. The models have different production costs per metric ton, but the production costs tend to be less than the credit per metric ton. That's what's so powerful; invest \$1 and get more than \$1 credit. To the question of whether the tax credit can be taken away, he said the obvious answer is that any tax credit can be taken away. But if the question is what's different about the structure of this credit as compared to prior iterations of energy-related credits, the answer is that there is something quite extraordinary about this credit.

MR. BALLAN explained that many of the credit schemes that have existed in the tax law have involved phase-downs and phase-outs over sometimes long periods of time. But something that caught everyone's notice and was quite deliberate in the Inflation Reduction Act was that in the investment tax credits, the firm level of 30 percent, assuming compliance with prevailing wage and apprenticeship requirements, was not set with a phase-down

or phase-out. It was set as 30 percent. The message was that this was intended to be a permanent credit. Because this is a production credit, a carbon capture credit that goes over 12 years, it would be difficult, as a matter of tax policy, to change a 12-year promise midstream. He expressed his belief that Congress intended this to be long term. There is some degree of bipartisanship, even around the Inflation Reduction Act at this point. He opined that the smart money is betting on it being a permanent credit.

[4:27:02 PM](#)

MR. CAHILL added that there are other uses for sequestered carbon. Even if the carbon credit were taken away, the pie-in-the-sky concept is that as carbon capture develops as an industry, smart industrial entrepreneurs will figure out better uses of carbon and manufacturing processes, and that will increase the demand for carbon such that, if the credit were taken away, there would be other industrial uses of carbon once sequestered. He opined that, at this point, it is fairly clear that the value of the projects are from the carbon credits. That is the asset. Carbon is being produced, and right now the federal government is a buyer of carbon. As Mr. Ballan pointed out, the carbon credit has been around since 2009 and isn't being phased down. It has bipartisan support so it will probably be here for the foreseeable future.

CO-CHAIR GIESSEL thanked the presenters.

### **Introduction to Geologic Carbon Storage**

[4:28:31 PM](#)

CO-CHAIR GIESSEL announced a presentation on geologic carbon storage by the state geologist.

[4:29:03 PM](#)

DAVID LEPAIN, State Geologist and Director, Division of Geological and Geophysical Surveys, Department of Natural Resources (DNR), Anchorage, Alaska, reviewed the outline of the presentation on slide 2:

- Physical and chemical characteristics of CO<sub>2</sub>
- Requirements for geologic CO<sub>2</sub> storage
- CO<sub>2</sub> storage mechanisms
- Storage in depleted oil fields and saline formations
- Storage in unmineable coal seams
- Geologic carbon storage in Alaska

- Cook Inlet
- North Slope
- Interior sedimentary basins

4:30:21 PM

MR. LEPAIN displayed slide 3 and described the physical and chemical properties of CO<sub>2</sub>. He made the following points:

- ~ On the surface of the earth, CO<sub>2</sub> is an odorless, colorless gas.
- ~ If CO<sub>2</sub> is sufficiently compressed, it takes on the characteristics of a liquid and a gas, but it is neither one nor the other. It is referred to as supercritical CO<sub>2</sub>.
- ~ Hydrostatic pressure increases with depth due to the weight of the overlying column of rock and water.
- ~ If supercritical CO<sub>2</sub> is injected below a depth of about 2,600 feet from the subsurface, the pressure is great enough that the CO<sub>2</sub> will remain supercritical.
- ~ Supercritical CO<sub>2</sub> is more dense, so more will fit in a reservoir.
- ~ Supercritical CO<sub>2</sub> is buoyant. It is less dense than H<sub>2</sub>O so it will rise up through a formation, which is important.

4:31:52 PM

MR. LEPAIN referred to slide 4 to discuss the criteria for subsurface formations to be attractive as reservoirs for storing CO<sub>2</sub>. He made the following points:

- ~ Sandstone is one of the most prospective sedimentary rock types for storing CO<sub>2</sub>.
- ~ Geologists are most interested in sedimentary basins that have interlayers of sandstone and shale.
- ~ The sandstones are prospective as storage containers for CO<sub>2</sub> but there must be impermeable formations overlying the sandstones.
- ~ CO<sub>2</sub> that's injected into sands rise through the water column until it reaches an impermeable layer and is trapped.
- ~ The sandstones must have porosity or void space.
- ~ The photo on the upper right is a sandstone in the Tyonek Formation in Cook Inlet, and the blue spaces around the sand grains are porosity.
- ~ The pores must be interconnected for the supercritical CO<sub>2</sub>, or any other liquid, to move through the rock.

- ~ The sands must be in a trapping configuration, as shown in the diagram on the left. It's a schematic cross section through a part of the Kenai Gas field. The sedimentary layers originally were deposited horizontally; they're domed due to large scale stresses in the earth's crust.
- ~ The structure is called a fold, and when rocks are domed it's called an anticlinal fold.
- ~ The yellow reflects sand, the brown and green are mudstones, and red is sand that's saturated with gas.
- ~ Gas is lighter than water so when a gas molecule goes into a sand bed it will migrate up until it reaches the apex of the fold structure with an overlying mud rock. At that point it's trapped.

[4:36:08 PM](#)

SENATOR CLAMAN asked what happens when the increased pressure from injecting the CO<sub>2</sub> causes a fracture, similar to what happens in the fracking process to produce oil.

MR. LEPAIN said it depends on how far the induced fracture propagates. If the induced fracture is contained in the sandstone formation into which the CO<sub>2</sub> is being injected, there probably wouldn't be any damage. But if the fracture propagates into the overlying mudstone, CO<sub>2</sub> could migrate into that seal.

SENATOR CLAMAN commented that the CO<sub>2</sub> would be lost.

MR. LEPAIN said yes, but there may be other opportunities for the CO<sub>2</sub> to be trapped and sealed in subsequent layers of mudstone. He added that this is well known technology and the industry understands how to keep the injection pressures below the frack pressure.

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MR. LEPAIN directed attention to the images on slide 5 to discuss the mechanisms for storing CO<sub>2</sub> in porous and permeable formation.

- ~ Buoyant trapping is illustrated in the image in the center that shows an injection well on the right. The CO<sub>2</sub> is buoyant and will migrate up to the crest of a fold structure.
- ~ Residual trapping is shown on the lower left. Some CO<sub>2</sub> is left behind as the CO<sub>2</sub> flows.
- ~ Solubility trapping occurs when CO<sub>2</sub> is dissolved in the formation water. It forms a weak acid that is trapped.

~ Mineral trapping takes place over hundreds of thousands to millions of years, so it's not relevant in this context.

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MR. LEPAIN turned to slide 6 to discuss what attracts geologists looking for CO<sub>2</sub> storage opportunities.

He described the well understood declining or depleted oil and gas fields as the low hanging fruit. He spoke to the following bullet points:

- Depleted oil and gas fields have:
  - Proven reservoir, trap, and seal
  - Extensive datasets that characterize reservoir properties, temperature, pressure, and water salinities
  - Sandstone body geometries and associated pore volumes are well-characterized
  - Known original oil-in-place and production history
  - Existing infrastructure
- Declining oil fields - CO<sub>2</sub> for enhanced oil recovery (EOR)

MR. LEPAIN stated that saline formations are much less well understood because there hasn't been the economic incentive to study them. The subsurface formations in Cook Inlet and the North Slope don't host hydrocarbons, but they have saline formation waters and have great potential to store CO<sub>2</sub>. He spoke to the following bullets:

- Saline formations:
  - Total dissolved solids >10,000 parts per million
  - Non-potable water
  - Isolated from potable water sources - saline aquifers deeper and separated from aquifers by seals
  - Depositional environment of sedimentary formation influences depth to non-potable water
    - Marine - shallower
    - Non-marine - deeper
  - Data may be lacking - not as well-known as depleted oil fields

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MR. LEPAIN turned to slide 7 to discuss the storage possibility of injecting CO<sub>2</sub> into unmineable coal seams. He described coal seams in the deep subsurface as largely unmineable because of the economics. He continued to say that most coals are naturally fractured. The primary fracture system runs throughout the coal seam, and secondary fractures connect primary fractures. CO<sub>2</sub> that's injected into the primary fractures helps in gaining access to the microform network in the body of the coal matrix. He continued to speak to the following bullets:

- CO<sub>2</sub> in coal is stored in naturally occurring fractures (cleats) and micropores in coal
- Cleats provide permeability and access to larger surface area (micropores)
- Methane (CH<sub>4</sub>) and CO<sub>2</sub> strongly attracted to coal particles
- CO<sub>2</sub> molecules attracted more strongly to coal particles than methane - displaces methane
- Coal rank influences storage capacity (IPCC, 2005)
  - Low rank coal - lignite
  - CO<sub>2</sub> storage capacity >10x methane -Anthracite
  - CO<sub>2</sub> storage capacity = methane
- Fate of displaced methane (CH<sub>4</sub>)?

MR. LEPAIN pointed to the image on the lower right that shows a 50 foot coal seam from the Tyonek Formation in Cook Inlet. The point it intends to make is that there is a lot of coal in the subsurface of Cook Inlet, and the same applies to the North Slope and several other Interior basins.

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SENATOR CLAMAN asked where the coal in Cook Inlet and the North Slope was located relative to the oil.

MR. LEPAIN replied that it depends on the formation, but strictly speaking they are separate. Most of the reservoirs on the North Slope are in sandstones that were deposited in a marine environment, which is different than the environment where the coals form. However, there is some interfingering, so some reservoirs on the North Slope may be in relatively close proximity to coals.

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SENATOR KAUFMAN wondered whether the displaced methane could be used as the fuel to provide compression and drive topside equipment.

MR. LEPAIN said yes, there are a lot of uses for the methane.

SENATOR KAUFMAN posited that the gas would be dry and fairly easy to condition.

MR. LEPAIN replied it would be similar to the gas that's produced from Cook Inlet today.

SENATOR KAUFMAN asked whether the materials used for this purpose were high alloy.

MR. LEPAIN said that was outside his area of expertise.

[4:49:19 PM](#)

MR. LEPAIN provided the following summary of geologic carbon storage on slide 8:

- Geologic storage options include depleted and declining oil and gas fields, saline formations, unmineable coal seams
- Subsurface formations must be deeper than approximately 2,600 ft
- Formations must have porosity and permeability
- Formations must include traps (folds, faults, stratigraphic pinch-out)
- Sandstones must be overlain by impermeable formations - seals
- Monitoring during and after CO<sub>2</sub> injection is required - must make sure CO<sub>2</sub> is going where intended; if leakage is detected, must take corrective action

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MR. LEPAIN transitioned to discuss Alaska-specific possibilities, starting with Cook Inlet. He directed attention to the colored column on the lower left of slide 9 and made the following points:

- ~ All the producing oil and gas fields in Cook Inlet are hosted in the younger stratigraphy.
- ~ The thick black bars reflect the coal-bearing stratigraphy.
- ~ The Hemlock Formation is a major oil reservoir in Cook Inlet.

~ Gas reservoirs are largely in the Tyonek Formation, which is overlain by the Beluga and Sterling Formations.

He said the column on the right reflects the older rocks that are present below the younger rocks described in the left column. He continued to make the following points:

- ~ When the younger rocks were deposited, the water in the pores was fresh.
- ~ The older rocks were deposited in an ancient ocean so the water in the pores was saltwater.
- ~ Over time the shallow pore waters increased in salinity. Today they are fairly concentrated brines.
- ~ The formation waters in the younger stratigraphy has dissolved material in it from long contact with the rocks. It's referred to as saline formation water but it wasn't seawater originally.

MR. LEPAIN described Cook Inlet as a long-lived sedimentary basin. He relayed the following about Cook Inlet:

- ~ It has thousands of feet of interbedded sand, mudstone, and coal
- ~ Cook Inlet hosts 10 oil fields, 5 of which are relatively large. They are all data rich.
- ~ There are about 28 gas fields that are also data rich. Not all are in production.
- ~ As of November, 2022, 1.389 billion barrels of oil have been produced from Cook Inlet fields; a little more than 7.5 trillion cubic feet of natural gas has been produced.
- ~ These numbers can be used to give a rough qualitative idea of the vacant pore space that could be used for CO<sub>2</sub> storage.
- ~ There are saline formations in Cook Inlet with a lot of coal, so unmineable coal seams are a possibility.
- ~ The seismic activity in the area is responsible for the fold structures that form the traps for the existing oil and gas fields in Cook Inlet.
- ~ Despite the seismic activity in the area, those seals have held back the hydrocarbons for millions of years.
- ~ With careful attention to injection pressures, there is every reason to believe that those formations can store CO<sub>2</sub> for a long time.

[4:54:07 PM](#)

MR. LEPAIN paraphrased the following summary of the CO<sub>2</sub> storage potential in Cook Inlet on slide 10:

**CO<sub>2</sub> storage in depleted and declining oil fields**

- Proven reservoir (porosity, permeability), trap, and seal
- Existing infrastructure
- 1.389 billion barrels of oil and 7.5 trillion cubic feet of gas production as of end November 2022 (AOGCC)
- Field sizes and cumulative production volumes provide a measure of CO<sub>2</sub> storage potential in existing oil and gas fields
- Seismic activity - trapped hydrocarbons prove seal capacity of mudstones not impacted

**CO<sub>2</sub> Storage in saline formations**

- Large pore volume - huge potential
- Uncharacterized

**Unmineable coal seams**

- Huge coal resource in basin
- Estimated storage potential - 43 billion tons (Shellenbaum and Clough, 2010)
- Fate of displaced methane? Must be captured

[4:55:29 PM](#)

MR. LEPAIN advanced to slide 11 and spoke to the following bullets to describe the CO<sub>2</sub> storage potential on the North Slope:

- Thousands of feet of interbedded sandstone and mudstone
- Abundant coal west of Umiat (Federal and Native land)
- More than 70 oil accumulations and several gas accumulations discovered since 1944 - several with original oil in-place > 1 billion barrels
- 17.88 billion barrels oil produced through November 2022 (AOGCC)
- Proven reservoirs and traps - many large fields in decline
- Saline formations are extensive but uncharacterized
- Large volume of pore space potentially available for CO<sub>2</sub>
- Marine and nonmarine rocks
- Coal
- Infrastructure
- Low seismic activity

- Numerous folds and faults
- Hydrocarbons trapped for millions years

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MR. LEPAIN paraphrased the following summary of the CO<sub>2</sub> storage potential on the North Slope on slide 12:

- Cumulative oil production from North Slope fields through November 2022 - 17.88 billion barrels of oil
- Many fields with original oil-in-place volumes estimated >1 billion barrels and recoverable oil volumes > 300 million barrels
- Large legacy fields have been in decline for decades - EOR potential
- Field sizes and cumulative production volumes provide measure of CO<sub>2</sub> storage potential in declining fields - U.S. Geological Survey estimates 0.9 billion metric tons mean recovery replacement storage
- U.S. Geological survey estimates mean total CO<sub>2</sub> storage potential at 270 billion metric tons (USGS Circular 1386; includes only deep saline formations and existing oil fields)
- Storage in unmineable coal seams estimated at 5.83 billion tons (Shellenbaum and Clough, 2010) - displaced methane must be captured

[4:59:10 PM](#)

MR. LEPAIN advanced to slide 13 to describe the Interior sedimentary basins. He noted that the retired land manager from Doyon referred to this area as Middle Earth.

- All basins are data poor
- Best known are Susitna, Nenana, and Yukon Flats
- Sedimentary rocks filling basins are nonmarine (river, coal swamp, flood plain, and lake deposits)
- Potable water extends to greater depths
- Nonmarine settings tend to have laterally discontinuous reservoirs and seals
- No infrastructure

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CO-CHAIR GIESSEL thanked Dr. LePain for the helpful presentation.

[5:00:49 PM](#)

There being no further business to come before the committee, Co-Chair Giessel adjourned the Senate Resources Standing Committee meeting at 5:00 p.m.