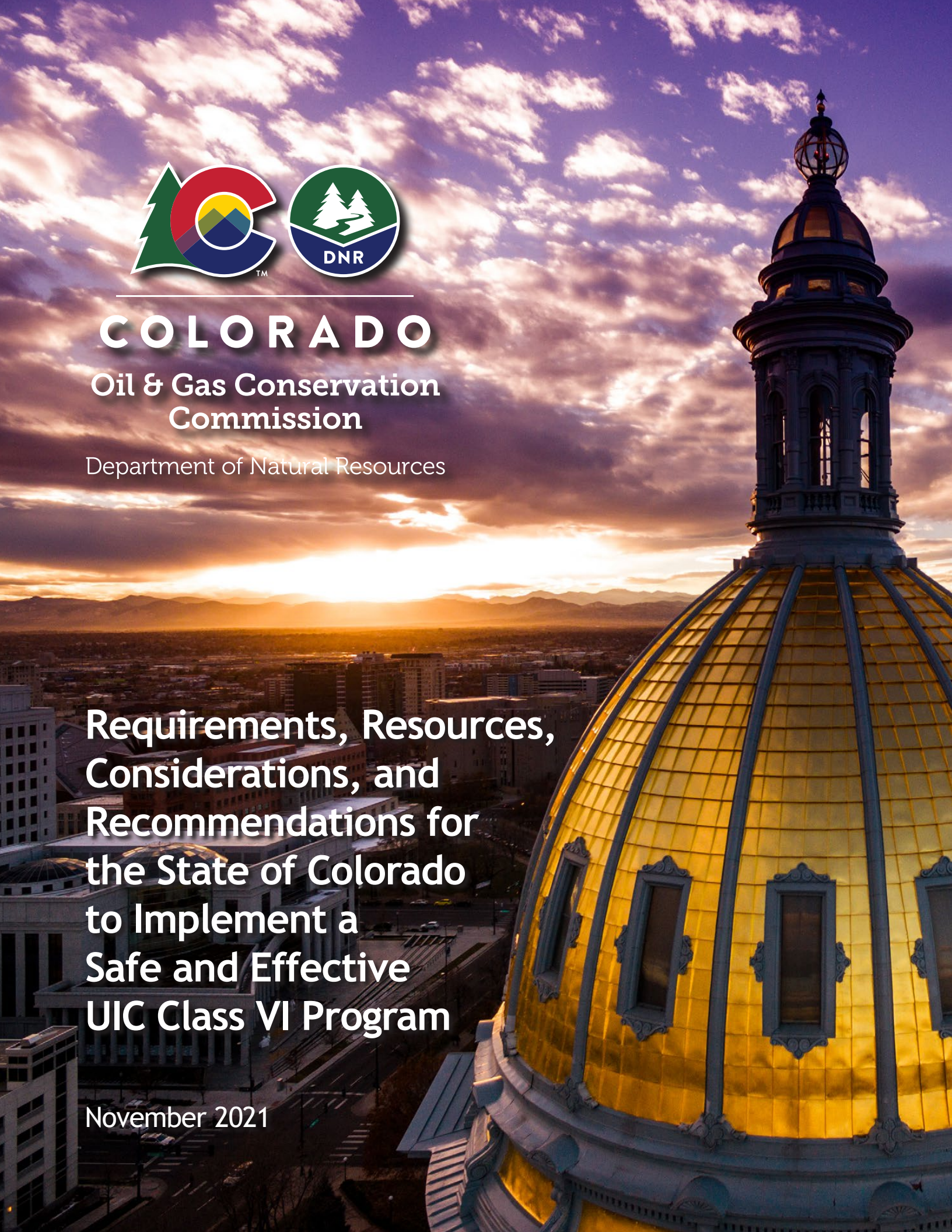

COLORADO

Oil & Gas Conservation Commission

Department of Natural Resources

Requirements, Resources, Considerations, and Recommendations for the State of Colorado to Implement a Safe and Effective UIC Class VI Program

November 2021

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The COGCC would like to thank and acknowledge the organizations and people that discussed and gave input on this report:

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Environmental Protection Agency—Douglas Minter, Wendy Cheung, Molly McEvoy, Christopher Brown, Nancy Dorsey

Colorado Department of Public Health & Environment:
Air Pollution Control Division—Clay Clarke, Joshua Korth, Lauren McDonell
Water Quality Control Division—John Duggan, Robert Murphy, Robert Hillegas
Hazardous Materials and Waste Management Division—David Snapp

Colorado Division of Water Resources—Matt Seres, Tracy Kosloff, Andrew Flor, Kevin Donegan

Colorado School of Mines—Ali Tura, Laura Singer

Great Plains Institute—Patrice Lahlum, Matt Fry, Emma Thomley

Plains CO_2 Reduction Partnership—Kevin Connors, Josh Regorrah

Wyoming Department of Environmental Quality—Lily Barkau

North Dakota Oil and Gas Division—Stephen Fried

Environmental Defense Fund—Scott Anderson

Geosyntec Consultants—Jill Cooper

Occidental Petroleum—Kimberly Mendoza-Cooke, William Swetra

NGL Energy Partners—Matthias Sayer

Adamantine Energy—Kayla Dolan

Faegre Drinker—Doug Benevento

Kinder Morgan—Brian Brister

Integrated Petroleum Technologies—Clayton Doke

Special thanks to the following people for helping finalize this report:

Colorado Oil and Gas Conservation Commission—Julie Murphy, Scott Cuthbertson, John Morgan, Diana Burn, David Andrews, Greg Deranleau, Chris Eisinger, Craig Burger, Mark Schlagenhauf, Megan Castle, Alex Acks

Integrated Document Solutions—Darren Eurich

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Executive Summary

SB21-264 tasked the Colorado Oil and Gas Conservation Commission (COGCC) with compiling a report to evaluate the resources needed for the state of Colorado to implement a safe and effective UIC Class VI program. In order to better understand the resources necessary for a state program, this report summarizes the requirements of a successful Class VI primacy application and outlines technical Class VI project components to inform what regulatory oversight may be appropriate. The report then details the existing and recommended state resources for a Class VI program with a primary focus on resources available at COGCC and summarizes potential funding sources for continued oversight of Class VI projects. In addition, there are legal, policy, and regulatory barriers to consider for Colorado to implement a safe and effective Class VI program.

If Colorado elects to seek primacy over Class VI wells for CO_2 injection, the COGCC likely is the agency best positioned to effectively pursue and implement a safe and effective UIC Class VI program from an established technical expertise perspective. While the COGCC does have existing staff and processes that would serve as a resource for a Class VI program, additional staff, expertise, and resources will be required. To successfully coordinate the primacy process, at least 1 FTE would be required as a Class VI coordinator. Immediate funding for staff training would be required in order to ensure an effective program. Leading up to gaining primacy or after obtaining primacy, the program will require additional funds for purchasing a modeling computer, licensing modeling software, updating the COGIS database to suit Class VI projects, and hiring at least 4 FTEs, including 3 UIC program positions and a data management specialist. Once the quantity of potential Class VI projects is better understood, staffing and resource requirements may need to be reevaluated.

There are a variety of available options for funding a state UIC Class VI program including injection funds and application and regulatory fees. State injection funds help meet the costs of a Class VI program, provide funding for long-term site care after site closure, and can be fully or partially funded through a fee based on the amount of CO_2 injected. By incorporating or creating multiple sources of funding, including per ton injection fees, processing fees, and federal grants, state injection funds can help create a sustainable and fully funded state UIC Class VI program in Colorado.

The safe and effective implementation of a UIC Class VI program in Colorado includes not only technical program considerations, but also requires addressing legal, policy, and regulatory barriers. Considerations include state regulatory authority, pore space ownership, aggregating property rights, liability issues, Class II wells, pipelines, and the need to promulgate Class VI rules. In order for the COGCC to seek and obtain Class VI primacy, the General Assembly would need to grant the COGCC authority over all Class VI wells by amending the Oil and Gas Conservation Act. An important consideration for carbon storage in Colorado is pore space including pore space ownership, split estates, competing uses, and the extent of pore space rights. As Class VI projects may span a large area, aggregating property rights is essential and considerations should be given to unitization and eminent domain. Due to their unique duration as well as the potential size of the storage area, Class VI projects raise liability issues that policymakers should also consider, including induced seismicity and long-term site stewardship. The COGCC looks forward to further discussions about these important topics with Colorado policymakers and stakeholders. Additional considerations and recommendations for CCUS in the state of Colorado will be discussed in the Colorado Energy Office's forthcoming CCUS Task Force Report.

Introduction

With the passage of SB21-264, the Colorado Oil and Gas Conservation Commission (COGCC) was tasked with compiling a report "to evaluate what resources are needed to ensure the safe and effective regulation of the sequestration of greenhouse gases, as that term is defined in section 25-7-140(6), C.R.S., and to identify and assess the applicable resources that the commission or other state agencies have." In addressing this task, the COGCC has compiled the following report, which summarizes the requirements and resources necessary to achieve primacy and implement a safe and effective Underground Injection Control (UIC) Class VI program in Colorado.

As Colorado moves to address climate change and meet clean energy goals, the path forward will necessarily include multiple strategies applied simultaneously in order to reduce greenhouse gas emissions. The geologic sequestration of carbon dioxide (CO_2) in the subsurface is an important, emerging tool for reducing emissions around the nation and meeting climate goals. Specifically, carbon capture utilization and storage (CCUS) is a critical strategy for mitigating emissions in advanced and developing economies.[1] Further, the availability of "firm" low carbon resources, including flexible power plants with carbon capture and storage (CCS), may be an important factor in containing the cost of power sector decarbonization.[2]

Colorado has an estimated CO_2 sequestration potential of over 720 billion tons, according to the Colorado Geological Survey. The storage potential is primarily in the Denver Basin, Cañon City Embayment, Piceance Basin, and Sand Wash Basin.[3] A significant quantity of the storage potential in Colorado is classified as "very low storage cost" due to the location of carbon sources in relation to existing infrastructure including pipelines and UIC Class II operations paired with suitable geology for permanent storage.[4] Considering these factors, the geologic sequestration of CO_2 through injection into the deep subsurface has the potential to become prevalent in Colorado.

Through the enforcement of the Safe Drinking Water Act (SDWA), the Environmental Protection Agency (EPA) regulates Class VI wells, which inject CO_2 into deep rock formations for long-term underground storage. The SDWA requires the EPA to develop minimum federal requirements for injection practices that protect public health and prevent contamination of underground sources of drinking water (USDWs) for different classes of injection wells. The EPA has established federal requirements for Class VI wells, referred to as the Class VI Rule.[5]

The EPA is authorized to review and approve state UIC program applications for primacy, which means the state is the regulatory entity for a particular class of injection wells. A state may seek primacy over all or some classes of injection wells. If Colorado elects to seek primacy over Class VI wells for CO_2 injection, the COGCC is the agency best positioned to effectively pursue and implement a safe and effective UIC Class VI program. Due to its existing UIC Class II primacy and experience with oil and gas operations, the COGCC has a variety of existing staff, resources, and processes that would be beneficial in efficiently and effectively implementing a Class VI program. In addition to the COGCC's resources, collaboration with other agencies on Class VI projects would be essential to a safe and effective Class VI program.

This report summarizes the requirements of a successful Class VI primacy application and outlines technical Class VI project components to better understand the resources required for a state to implement a UIC Class VI program. Following the synopsis of the technical aspects of a program, the report details the existing and recommended state resources for a Class VI program and summarizes potential funding sources for continued oversight of Class VI projects. Finally, the report reviews potential legal, policy, and regulatory considerations for the safe and effective implementation of a UIC Class VI program in Colorado, including regulatory authority, pore space ownership, aggregating property rights, liability issues, Class II wells, and pipelines.

The COGCC's intent in compiling this report is to provide the information necessary to evaluate the existing and additional resources required for the state of Colorado to safely and effectively implement a UIC Class VI Program.

1 Gosnell G, Singer L, Carbon Capture, Utilization, and Storage: What it is and Why it's Part of a Comprehensive Climate Solution, Payne Commentary Series: Explainer, September 13, 2021. https://payneinstitute.mines.edu/wp-content/uploads/sites/149/2021/09/Payne-Institute-Commentary-CCUS-climate-solution.pdf

2 Sepulveda N., Jenkins J., Sisternes F., Lester R., The Role of Firm Low-Carbon Electricity Resources in Deep Decarbonization of Power Generation, Joule, Volume 2, Issue 11, November 21, 2018, pg 2416, https://doi.org/10.1016/j.joule.2018.08.006.

3 Young G., Lintz V., Widmann B., Bird D., Cappa J., CO2 Sequestration Potential of Colorado, Colorado Geological Survey Resource Series 45, 2007, pg 1-13.

4 Abramson E., McFarlane D., Brown J., Transport Infrastructure for Carbon Capture and Storage: Whitepaper on Regional Infrastructure for Midcentury Decarbonization, Great Plains Institute, June 2020, pg 17, Figure 13, Accessed October 2021. https://www.betterenergy.org/wp-content/uploads/2020/06/GPI_RegionalCO2Whitepaper.pdf

5 40 C.F.R. § 146.81 - 40 C.F.R. § 146.95. https://www.ecfr.gov/current/title-40/chapter-I/subchapter-D/part-146/subpart-H

Seeking and Obtaining Primacy for a Class VI Program

Under the Safe Drinking Water Act and the EPA's Class VI Rule, the EPA is authorized to review and approve state UIC program applications for primacy. The EPA provides detailed guidance for states interested in pursuing UIC Class VI primacy.[6] The EPA encourages states to seek primacy to increase permitting speed by distributing the permitting and enforcement responsibilities to qualified states.

State interest in Class VI primacy is growing as climate goals have become more ambitious and geologic sequestration projects are moving forward. North Dakota and Wyoming have Class VI primacy, and North Dakota is actively working on Class VI permits. Louisiana has submitted a primacy application. Texas, Arizona, and West Virginia are in the pre-application phase, and additional states are exploring options for a UIC Class VI program.[7]

Interest in geologic sequestration projects is increasing throughout the nation although currently only two states have Class VI primacy. The EPA may be limited in the amount of time and resources to commit to future permitting projects from states without primacy. With that in mind, states with primacy may be positioned to process permit applications at a comparatively accelerated rate. Seeking and obtaining state primacy could therefore play an important role in the success of future Class VI projects in the state of Colorado.

Currently Colorado only has primacy over UIC Class II wells through a SDWA section 1425 primacy program, which is implemented by the COGCC. States with only Class II primacy can apply for independent primacy for UIC Class VI wells under SDWA section 1422. To apply for Class VI primacy, states are required to set up a regulatory framework that will ensure the protection of USDWs. The application must show that the state's statutes and rules are at least as stringent as all federal requirements. The application must also support the capability of the state to implement a safe and effective UIC Class VI program. The COGCC has an established record of regulating in a manner at least as stringent as the federal government, and often exceeding federal requirements for the protection of public health, safety, and welfare, the environment, and wildlife resources. Moreover, the COGCC coordinates closely with Colorado's Water Quality Control Division when implementing regulations to protect groundwater.

States that seek to obtain Class VI primacy must be able to demonstrate that the state UIC program will satisfy a number of federal requirements. A state UIC Class VI program is required to develop regulations that ensure the protection of USDWs, including requirements for permitting, siting, construction, operation, testing, monitoring, plugging, and site closure of Class VI injection wells. The general requirements for a state UIC Class VI Program include having the legal authority to implement all permit requirements, the necessary procedures for a state compliance evaluation and enforcement program, regulations that are at least as stringent as federal rules, and statewide jurisdiction over the underground injection projects for which it is responsible.[8] The EPA recommends pre-application meetings and discussion in order to ensure that a primacy application contains all required information.

Components of a Primacy Application for a New SDWA Section 1422 UIC Program

Under SDWA Section 1422 and 40 C.F.R. § 145.22, a state seeking UIC Class VI primacy must submit an application that includes the following six components.

1. Governor's letter requesting program approval
2. Program description describing how the state intends to carry out its responsibilities
3. Attorney General's statement
4. Memorandum of Agreement with the EPA
5. Applicable state statutes and regulations
6. Demonstration of the state's public participation activities

6 EPA.gov, Underground Injection Control (UIC) Program Class VI Primacy Manual for State Directors, April 2014, Accessed October 2021. https://www.epa.gov/sites/default/files/2015-07/documents/epa816b14003.pdf

7 Carbon Capture Coalition, Class VI Wells: Permitting & Primacy for Secure, Long-Term Storage of CO_2, April 2021, Accessed October 2021. https://carboncapturecoalition.org/wp-content/uploads/2021/06/Class-VI-backgrounder.pdf

8 EPA.gov, Underground Injection Control (UIC) Program Class VI Primacy Manual for State Directors, supra note 6, pg 8.

Governor's Letter

Class VI primacy applications must include a letter from the governor requesting the approval of the UIC program. The letter should include a reference to SDWA Section 1422 and express that the state is willing and able to administer the program in the application.

Program Description

The program description is a core component of an application and contains several required sections describing how the state intends to administer the UIC Class VI program. The federal requirements for a program description are listed in 40 C.F.R. § 145.23. The program description must demonstrate that the state's UIC Class VI program is at least as stringent as the federal standards with a primary focus of protecting USDWs. The minimum required elements of a program description are outlined below in Table 1. The EPA also recommends that the state include information on how the state will implement the financial responsibility requirements, although this is not explicitly stated in the rule.

In addition to the elements listed in the federal rule, the EPA recommends that the permitting authorities demonstrate in their application that they have the required in-house expertise or access to contractor support to effectively administer the program. This expertise should include the ability to evaluate and verify multiple types of information. Expertise in the following areas is recommended.[9]

1. Site characterization—geology, log analysis, geochemistry, etc.
2. Computational modeling—reservoir models for evaluating the area of review (project extents)
3. Well construction and testing—well engineering, log analysis, well construction, etc.

9 EPA.gov, Underground Injection Control (UIC) Program Class VI Primacy Manual for State Directors, supra note 6, pg 10-11.

Table 1. Elements of a Program Description per 40 C.F.R. § 145.23

	Program Element and Description
1	A narrative of the scope, structure, coverage, and processes of the state program. A general overview of the proposed state program including staff expertise and processes pertaining to the Class VI program.
2	A description of the organizational structure of the agency administering the program. This includes a description of program staff, organization charts, and estimated costs and sources of funding for implementing the program for the first 2 years.
3	A description of permitting, administrative, and judicial review procedures.
4	Copies of the current forms in use by the state or any available drafts or outlines of new forms.
5	A description of the state's compliance tracking and enforcement program.
6	A schedule for issuing Class VI permits within 2 years after program approval.
7	A statement of the state's priorities for issuing Class VI permits and the number of Class VI permits that will be issued during the first 2 years of program operation.
8	A description of how the state will meet the mechanical integrity testing requirements for Class VI wells.
9	A description of the state's procedures to notify owners or operators of existing injection wells of the requirement to apply for and obtain a Class VI permit.
10	A description of how the state will establish and maintain an injection well inventory.
11	A description of aquifers, or parts thereof, which the UIC Program Director has identified under 40 C.F.R. § 144.7(b) as exempted aquifers and a summary of supporting data.
12	A description of the state's procedures for notifying any states, tribes, and territories of Class VI permit applications where the AoR crosses jurisdictional boundaries and the procedures for documenting these consultations.

4. Finance—financial responsibility
5. Policy and regulatory information
6. Enforcement and compliance
7. Emergency and remedial response plans—risk analysis
8. Inspections

Attorney General's Statement

This statement is a certification that the laws of the state provide adequate authority to carry out the program described in the application. The statement shall include citations to specific statutes, regulations, and judicial decisions that support the state's authority. The statutes and regulations must be lawfully adopted by the time the statement is signed and must be fully effective by the time the program is approved.

Memorandum of Agreement with the Regional Administrator

A memorandum of agreement (MOA) with the EPA is required for all new primacy applications. The MOA establishes the arrangement between the state and the EPA in regards to the administration, implementation, and enforcement of a state UIC Class VI program. The agreement should clearly outline the role of the state and when the EPA will and will not be involved.

Applicable State Statutes and Regulations

A copy of all applicable state statutes and regulations is required in order to facilitate the application approval process. The EPA uses a regulatory crosswalk to compare and confirm that state regulations are at least as stringent as federal requirements. The crosswalk is a robust chart containing all federal regulations required for a UIC Class VI program. In the pre-application process and during rulemaking, the state and EPA typically spend a significant amount of time discussing and negotiating the regulatory crosswalk to ensure that the state program covers all federal requirements.

Demonstration of the State's Public Participation Activities

Prior to submitting a primacy application, a state must provide notice to the public about its intent to adopt the UIC program and seek program approval from the EPA. The public notice must follow the requirements in 40 C.F.R. § 145.31(a). A demonstration of how the state fulfilled this rule is a required part of the primacy application. The state must also include any public comments, a summary of any public hearings, and a summary of the entire process, including any responses to public comments.

Primacy Process Timeline and the EPA's Processing of a New Class VI Primacy Application

Based upon discussions with the EPA, Wyoming, and North Dakota, the best estimate for completing a successful primacy application and gaining EPA's approval for a UIC Class VI program is about 2 years. Once the rules are generally agreed upon, the state will need to go through a Class VI rulemaking and have those rules enacted prior to submitting its final primacy application. A significant portion of the pre-application time is spent developing and discussing state statutes and rules, comparing these to the federal requirements, and ensuring that the state rules are at least as stringent.

Once all of the application materials have been compiled and all requirements have been met, the state may submit the application to the EPA. The processing and approval timeline for a UIC primacy application is outlined in 40 C.F.R. § 145.31. The EPA will first determine if the application is complete. If determined complete, the statutory review period will begin on the date the application was received. Per 40 C.F.R. § 145.31(c), the EPA must issue public notice for 30 days including a public comment period. Within 90 days of receiving a complete application, the EPA will approve a state's UIC Class VI program that conforms to all requirements through a federal rulemaking.[10] For an approved program, the EPA will announce the program approval in the Federal Register and the state program will be codified in 40 C.F.R. § 147. The state program will become effective on the day of the announcement.

10 40 C.F.R. § 145.31(e).

Existing Class VI Primacy Applications

Existing approved applications can serve as a reference in understanding the scope of the primacy-seeking process. The approved primacy applications for both North Dakota[11] and Wyoming[12] are available and all components of each application can be downloaded for review. The program description for each state summarizes the planned technical aspects of the state's UIC program as well as initial program procedures and cost estimates. In addition to approved applications, Louisiana's final Class VI primacy application[13] can also be viewed.

11 Regulation.gov, North Dakota Underground Injection Control Program Revision Application to add Class VI wells to its §1422 program, Environmental Protection Agency, Primacy document download, Accessed October 2021. https://www.regulations.gov/docket/EPA-HQ-OW-2013-0280/document

12 Regulation.gov, Wyoming Underground Injection Control Program Revision Application to Add Class VI Wells to its §1422 Program, Environmental Protection Agency, Primacy document download, Accessed October 2021. https://www.regulations.gov/docket/EPA-HQ-OW-2020-0123/document

13 State of Louisiana Department of Natural Resources, CLASS VI USEPA PRIMACY APPLICATION, Updated September 17, 2021, Accessed October 2021. http://www.dnr.louisiana.gov/assets/OC/im_div/uic_sec/FinalClassVIUSEPAPrimacyApplication.pdf

Class VI Project Components: State Program Considerations

Class VI projects require significant resources, planning, evaluation, and coordination. A state Class VI program plays an integral role in ensuring safe geologic sequestration throughout the entire life of a project. This section summarizes the timeline and technical components of a Class VI project to better understand the scope of a UIC Class VI program and the expertise required for evaluating permits and ongoing Class VI projects.

A Class VI project can be categorized based on the progression of a project. The EPA organizes Class VI projects into 5 different phases,[14] summarized in Table 2 below. Many of the technical aspects of a Class VI project are reevaluated regularly or as needed through all of the phases of a project.

14 EPA.gov, Underground Injection Control (UIC) Program Class VI Implementation Manual for UIC Program Directors, January 2018, Section 1.3, Accessed October 2021. https://www.epa.gov/sites/default/files/2018-01/documents/implementation_manual_508_010318.pdf

Table 2. Class VI Project Progression

Project Phase	Description
Pre-permitting	This phase includes thorough communication with the operator to ensure all required activities have been performed and all required information has been obtained and prepared for permit submission. Pre-permitting discussions between the UIC program and the operator are essential for the success of a Class VI project.
Permit Review and Approval	This portion of the Class VI project requires the UIC program to review and evaluate all required permit information to ensure site suitability, including site geology, modeling, hydrogeology, engineering, financial information, and more. Communication with the operator will be required to resolve any deficiencies. Notifications to all required stakeholders will also occur. Any required hearings will be held. At the end of this phase, the permit will be approved as long as it meets all necessary requirements.
Pre-operation	After a Class VI permit is issued and while the injection well is drilled and constructed, the operator must acquire additional data and test the injection wellbore. All pre-operational testing and data must be submitted to the UIC program and incorporated into all project plans and the permit. Any necessary amendments to project plans and the permit will be completed and approved prior to authorizing injection. Injection will be authorized for the Class VI project at the end of this phase.
Injection	The injection phase of a Class VI project includes the operator conducting injection activities, performing tests and monitoring per rule requirements, and reevaluating the Area of Review (AoR) and project plans as needed. The operator will submit all required information to the UIC program for review. Several requirements must be met during injection to ensure the protection of USDWs.
Post-injection	At the cessation of injection, the post injection phase begins. During this time, the operator will plug all injection wells, perform all required monitoring of the CO_2 plume and pressure front, and reevaluate the AoR reservoir model as needed. Once the plume is stabilized and acting as predicted, site closure may occur, which includes the plugging of all monitoring wells and site reclamation.

Pre-permitting

For Class VI projects to be successful there are a large number of pre-permitting considerations for not only the operators, but also for a state program with primacy.

The state program should encourage all operators to reach out and discuss projects early in the process to ensure that the correct information is being compiled for the permit. In order to save time during the permit review, the operator and state program should discuss all aspects of the permit thoroughly prior to submission. This could include initial reviews of technical information and plans for the project and multiple discussions. Communication and outreach to affected parties will also need to be done at this time, including coordination with any other agencies and jurisdictions involved in a single project. This can include projects on federal lands or tribal lands, projects that extend across state boundaries, and the involvement of local governments. Each project will have site-specific considerations and requirements.

It is best if early in the process the operator evaluates the feasibility of a project to ensure the reservoir chosen for the project will provide the correct geologic environment for long-term CO_2 sequestration. For example, CO_2 source companies may be inclined to drill sequestration wells close to the source to limit infrastructure cost; however, the geology, site characterization, modeling, and surface siting must also support the location. It may be justified, and at times more protective, to add infrastructure (pipelines, etc.) to access better geological sites for sequestration. For permitting and planning purposes, the location of a sequestration well will need to be based on both the location of the source and the ability to transport the CO_2, as well as the quality of the reservoir for injection. Additionally, if the COGCC pursues primacy, surface siting of Class VI facilities will be an important consideration due to existing surface location regulations and the COGCC's directive to protect public health, safety, and welfare, including protection of the environment and wildlife resources.

Environmental Justice

The EPA requires an environmental justice (EJ) review for all Class VI permits. The operator must submit an EJ analysis for each Class VI permit that is thorough, contextualized, and considers demographic and environmental data. Louisiana, in the state's primacy application, references the EJ tool developed by the EPA, EJSCREEN,[15] as the tool that their Class VI program will utilize for permit review.[16] Within the state of Colorado, the Department of Public Health and Environment (CDPHE) is developing an interactive mapping EJ tool for the state called Colorado EnviroScreen.[17] This tool is scheduled to be available by the summer of 2022.

A state UIC Class VI program will be required to evaluate the EJ analysis for each permit and address if additional targeted outreach and extended public participation is needed or if siting needs to be reconsidered. An EJ analysis should be encouraged in pre-permitting discussions with the operator to ensure that a complete and thorough EJ report is submitted with the permit application. A state Class VI program may choose to utilize contractors for additional analyses if the EJ screening tool identifies the presence of an impacted community or other risk factors within an area of review (AoR).

The COGCC has experience in analyzing environmental justice issues that will aid the agency in reviewing Class VI applicants' EJ analyses. For new oil and gas locations, the COGCC requires the operator to include an analysis of disproportionately impacted communities (DI community) in its Oil and Gas Development Plan. This process is similar to an environmental justice analysis. Depending on the project, the DI community analysis may require extended public comment, extended consultation, additional outreach, a Community Outreach Plan, and/or an alternative location analysis to determine if a different site is better suited for the project.[18] This existing review process could be adopted and altered to fit the needs of a Class VI project, including incorporating additional screening tools as needed.

Site Characterization

Site characterization of a Class VI project is performed in order to ensure that the location of the project has a suitable injection zone for safely storing CO_2 and a confining zone that prevents movement of fluid out of the injection zone.[19] The process generally includes a characterization of the regional and site geology as well as a detailed analysis of the injection and confining zones. The Class VI Rule requires that the operator compile a comprehensive analysis of the site geology that includes maps, cross sections, and data analysis related to regional geology, hydrogeology, stratigraphy, structural geology, the geochemistry

15 EPA.gov, EJSCREEN: Environmental Justice Screening and Mapping Tool, Accessed October 2021. https://www.epa.gov/ejscreen

16 State of Louisiana Department of Natural Resources, CLASS VI USEPA PRIMACY APPLICATION, Supra note 13, pg 6.

17 CDPHE.colorado.gov, Colorado Enviroscreen, Accessed October 2021. https://cdphe.colorado.gov/enviroscreen

18 COGCC.state.co.us, Disproportionately Impacted Communities: Rules, GIS Mapping, Scenarios, & Outreach - Operator Training, February 2, 2021, Accessed October 2021. https://cogcc.state.co.us/documents/sb19181/Guidance/Mission_Change_Guidance/DIC_Presentation_2-2-2021.pdf

19 EPA.gov, Underground Injection Control (UIC) Program Class VI Well Site Characterization Guidance, pg 1, May 2013, Accessed October 2021. https://www.epa.gov/sites/default/files/2015-07/documents/epa816r13004.pdf

of the injection zone, petrophysics, and potential additional analyses depending on the project.[20] Finalized maps, cross-sections, a variety of data, and geologic interpretations are submitted with the Class VI permit for the UIC Class VI program to review for compliance with rule requirements.

Initial site characterization must be completed prior to the permitting process and may include drilling a stratigraphic science well for acquiring data; core, mapping, and well log analysis near the project site; or acquiring seismic data. Additional site characterization will occur after the permit is issued and prior to injection. Prior to injection authorization, the operator must acquire a variety of information from the injection well including well logs, core samples/analysis, injection formation fluid analysis, fracture pressure of the injection and confining formations, and complete hydrogeologic testing. As new data are acquired throughout the Class VI project, site characterization information will be updated and incorporated into the reservoir model.

The Department of Energy's National Risk Assessment Partnership (NRAP) is developing science-based methods, tools, and workflows to quantitatively assess and manage environmental risks at Class VI project sites.[21] The partnership has developed an integrated assessment model that incorporates site characterization data to help address questions about the ability of a formation to safely and effectively store the injected CO_2.[22] These tools or similar tools may play a future role in Class VI projects by assessing risks and encouraging science-based decisions using site characterization information.

UIC Class VI state primacy programs must have expertise in site characterization in order to evaluate the submitted information and ensure that the Class VI project prevents endangering USDWs. These roles are typically staffed with geologists with experience in interpreting geologic data and evaluating subsurface formation data. Collaboration with engineers is also encouraged due to the types of data incorporated into site characterization.

The COGCC does not currently have the necessary staff to dedicate time to the site characterization requirements of a Class VI program, despite having staff expertise. COGCC staff currently evaluate UIC Class II and oil and gas well applications for groundwater zones, hydrocarbon zones, subsurface hazards, and confining layers. For Class II injection wells, additional review of the injection formation is completed by the UIC lead. Therefore, the COGCC does have existing staff that can provide in-house expertise, but additional staff will be required to effectively address the quantity of work associated with the site characterization of Class VI projects.

Delineating the Area of Review

The area of review (AoR) is the region surrounding the proposed well where USDWs may be endangered by the injection activity. By federal rule, the AoR must be delineated using computational modeling and identify any potential conduits for flow, including geologic features such as faults and artificial penetrations (i.e., previously-drilled wells).[23] Computational models of proposed Class VI projects should be directly tied to the data and information that is acquired through the characterization of the site, including seismic data, core analysis, geochemical analysis, log analysis, and structural/stratigraphic modeling. The monitoring and operational data acquired throughout the project should also be incorporated into the model to properly delineate the AoR in a continuous improvement cycle.

The Class VI Rule requires computational modeling to account for the physical and chemical properties of all phases of the injected CO_2.[24] The model used to delineate the AoR must account for multiphase flow including thermal and hydrologic processes.[25] These processes concern the flow of heat and fluids and the pressure of the fluids in the subsurface. Additional model processes are not required by rule, including geomechanical and chemical, but they may be warranted in some site-specific scenarios. Geomechanical modeling accounts for possible failure and deformation of rock in response to the injection of the fluid, and chemical modeling includes subsurface chemical reactions between the preexisting minerals in the injection zone and the injected CO_2 (e.g., chemical precipitation), referred to as reactive transport.[26]

As part of the delineation of the AoR, an operator must perform corrective action on all wells in the AoR that require remediation to ensure that existing wellbores do not become conduits for fluid movement out of the injection zone.[27] The operator will submit detailed information with the permit on all wellbores in the AoR for a UIC Class VI program to review for compliance with wellbore construction standards. COGCC staff have extensive experience evaluating offset existing wellbores prior to allowing hydraulic fracturing stimulation of new oil and gas wells. This expertise

20 40 C.F.R. § 146.82.
21 EDX.NETL.DOE.gov, National Risk Assessment Partnership, Accessed October 2021. https://edx.netl.doe.gov/nrap/
22 Vasylkivska V., Dilmore R., Lackey G., Zhang Y., King S., Bacon D., Chen B., Mansoor K., Harp D.,NRAP-open-IAM: A flexible open-source integrated-assessment-model for geologic carbon storage risk assessment and management, Environmental Modelling & Software, Volume 143, 2021, https://doi.org/10.1016/j.envsoft.2021.105114
23 40 C.F.R. § 146.84.
24 40 C.F.R. § 146.84(a).
25 EPA.gov, Underground Injection Control (UIC) Program Class VI Well Area of Review Evaluation and Corrective Action Guidance, pg 7, May 2013, Accessed October 2021. https://www.epa.gov/sites/default/files/2015-07/documents/epa816r13005.pdf
26 BEST PRACTICES: Risk Management and Simulation for Geologic Storage Projects, National Energy Technology Laboratory, pg 68, June 2017. https://netl.doe.gov/sites/default/files/2018-10/BPM_RiskAnalysisSimulation.pdf
27 40 C.F.R. § 146.84(d).

will allow existing staff to effectively evaluate all information related to corrective action on existing wellbores; however, an additional engineer likely will be required to successfully administer the Class VI program.

Computational Modeling

Computational modeling is an important technical element of Class VI projects. States have different options and approaches for addressing the model verification requirements. A state has the option to work with a contractor to provide expertise throughout the project process. The state UIC program may also choose to use in-house staff to verify model accuracy or a combination of in-house expertise and consulting as needed.

The objective of a state's Class VI program is to verify the accuracy and rationale behind a model's inputs and parameters and to ensure the integration of all applicable site characterization data. Computational models for Class VI projects can be incredibly complex. A state UIC Class VI program, at minimum, will need in-house expertise to understand generally how a model works, the effects different parameters have on the model, what kinds of data were used to create the model, and to coordinate verification efforts with consultant modeling experts. In order to verify model accuracy, a state program will need to obtain a computer for running the models and a software license for a modeling program. The state does not need to build entirely new models for each project, but it will be required to verify model information provided by the operator to ensure that the model meets all necessary requirements for the protection of USDWs. With that in mind, a state program with in-house expertise would still want the flexibility to use third party modeling experts as needed for additional input on complex modeling projects. There is a variety of modeling software available that provides the typical models run for geologic sequestration projects, as well as additional analyses for site-specific issues.

The state does not currently have resources to dedicate to the modeling requirements of a Class VI program. The COGCC will need dedicated staff, computer hardware, and software resources to meet the modeling requirements of a Class VI program. At a minimum, model verification and review by staff would require the procurement of a specialized computer and software license. For more complex projects, outside reservoir modeling expertise may be necessary.

Wellbore Construction

Wellbore construction standards for Class VI wells draw on a wealth of well-documented information from existing UIC Class II wells and oil and gas wells. The materials used in Class VI well construction, including casing and cement, must meet or exceed standards set by the American Petroleum Institute or other comparable standards.[28] The materials used must provide adequate structural strength, be compatible with the fluids in a Class VI well, and be designed for the life of the geologic sequestration project.

During the permitting process, the operator must submit proposed schematics and procedures for the injection well construction. The UIC Class VI program must ensure that the construction plans, including all well components, are appropriate for the site and project, are compatible with CO_2 and injection zone chemistry, and will maintain mechanical integrity through the life of the project.

A typical injection well includes cement and casing to prevent fluid migration out of the wellbore. Tubing extends down the innermost casing to the injection zone and a packer isolates the end of the tubing and the injection zone from the remainder of the wellbore. Perforations within the injection zone provide formation entry for the injected fluid.

The COGCC has existing technical expertise in current well construction standards and regulating wellbore construction. The COGCC regulates well construction for both oil and gas wells and UIC Class II wells in the state of Colorado. Class II wells require similar construction standards to Class VI wells for the protection of USDWs. Existing engineering staff at the COGCC can evaluate the wellbore construction information for Class VI projects to prevent the endangerment of USDWs.[29] However, the addition of an engineer will be required to provide the resources necessary to implement a safe and effective program.

28 40 C.F.R. § 146.86(b).
29 COGCC.state.co.us, Well Integrity, Accessed October 2021. https://cogcc.state.co.us/reg.html#/well_integrity
30 EPA.gov, Underground Injection Control (UIC) Program Class VI Well Site Characterization Guidance, supra note 19, pg 66-74.
31 EPA.gov, Underground Injection Control Program Class VI Well Testing and Monitoring Guidance, Figure 1-1, pg 3, March 2013, Accessed October 2021. https://www.epa.gov/sites/default/files/2015-07/documents/epa816r13001.pdf
32 40 C.F.R. § 146.90.
33 40 C.F.R. § 146.93(b).
34 EPA.gov. Underground Injection Control (UIC) Program Class VI Well Plugging, Post-Injection Site Care, and Site Closure Guidance, Section 3.3, Pg 38-40, December 2016, Accessed October 2021. https://www.epa.gov/sites/default/files/2016-12/documents/uic_program_class_vi_well_plugging_post-injection_site_care_and_site_closure_guidance.pdf

Testing and Monitoring

Testing and monitoring of a Class VI well is regularly undertaken throughout the life of a project, from pre-injection to post-injection. The federal rule requires numerous testing and monitoring activities to determine if the project is operating as permitted, to detect risks of endangerment of USDWs, and to inform modeling and delineation of the AoR.

After the permit to construct has been issued but prior to authorizing injection for a Class VI project, additional data collection and testing of the wellbore is required to obtain site-specific data, help increase the accuracy of the reservoir model, and ensure the integrity of the wellbore and the protection of USDWs. Well logs are required for the injection wellbore and core samples and analyses are required for the injection and confining zones. Sampling of formation fluids for determination of chemical and physical properties is required. Additionally, hydrogeologic testing must be completed including pressure fall-off tests and injectivity tests to determine the transmissibility of the reservoir.[30] A mechanical integrity test must be completed to confirm wellbore integrity.

Once the well begins injecting, the well must be monitored and tested to ensure the protection of USDWs. Since risk of contamination is increased during the injection phase, additional testing and monitoring is required until a Class VI well is plugged.[31] The required activities include analysis of the CO_2 stream, monitoring operational parameters (injection rate, pressure, and volume), corrosion monitoring of wellbore materials, groundwater quality monitoring above the confining zone, mechanical integrity testing, pressure fall-off testing, monitoring the CO_2 plume extent and pressure, and surface air and soil monitoring as needed.[32] There are minimum federal requirements for how often these activities are completed, but the state may adopt more stringent rules for monitoring or additional site-specific monitoring may be required by the UIC program if necessary.

The Class VI Rule requires that the operator shall monitor the site following the cessation of injection to show the position of the carbon dioxide plume and pressure front and to demonstrate that USDWs are not being endangered.[33] Post injection site care (PISC) monitoring plans should be designed to address any site-specific needs or considerations to reduce project risk. Monitoring results during the PISC stage of a Class VI project are a core component of the demonstration required for site closure. In addition, monitoring the plume, pressure front, and pressure declines within the reservoir help confirm the accuracy of the project reservoir model. PISC monitoring may include direct and indirect monitoring such as monitoring wells or geophysical surveys.[34]

A state UIC Class VI program must be able to effectively evaluate testing and monitoring plans and the corresponding results to ensure the protection of USDWs. Many of the testing and monitoring requirements can be evaluated by engineers. Geologists and environmental scientists will also play a role in testing and monitoring planning and review.

The COGCC employs a variety of staff that could provide expertise for the testing and monitoring requirements of a Class VI program. The COGCC requires testing and monitoring of existing oil and gas wells and Class II injection wells including bradenhead monitoring and mechanical integrity testing.[35] These tests are reviewed for compliance by the existing engineering staff and the UIC lead. In addition, the COGCC employs environmental protection specialists with experience in groundwater, surface water, and soil monitoring as well as management of sampling data in the Colorado Environmental (COENV) database.

Any additional staff hired for a Class VI program would also be involved in the planning and review of testing and monitoring plans and results.

Plan Development

In order to meet all Class VI rule requirements, the EPA recommends that an operator develop project and site-specific plans to be implemented, periodically reviewed, and amended as necessary for successful management of a Class VI project.[36] The following table provides a description of the recommended Class VI project plans.

35 COGCC.state.co.us, 400 Series-Operations and Reporting, Rule 417 and Rule 419, Accessed October 2021. https://cogcc.state.co.us/documents/reg/Rules/LATEST/400%20Series%20-%20Operations%20and%20Reporting.pdf

36 EPA.gov, Underground Injection Control (UIC) Program Class VI Well Project Plan Development Guidance, Pg 1, December 2016, Accessed October 2021. https://www.epa.gov/sites/default/files/2015-07/documents/epa816r11017.pdf

Table 3. Recommended Class VI Project Plans

Project Plan	Description
Area of Review and Corrective Action Plan	The plan describes the methods that will be used to delineate the AoR, how often the AoR will be reevaluated, and how new data will be incorporated into the plan. Further, the plan requires that all wells within the AoR, active or abandoned, must be identified, described, and evaluated in order to determine if any replugging or remediation is required to prevent movement of fluid into or between USDWs. See 40 C.F.R. § 146.84.
Testing and Monitoring Plan	The plan describes how the operator intends to perform all required testing and monitoring for the entire life of a Class VI project. This includes analysis of the injected CO_2 stream, mechanical integrity testing, monitoring geochemical changes above the confining zone, corrosion monitoring of well materials, tracking the extent of and pressure within the CO_2 plume, and additional testing at the discretion of the UIC program to ensure the protection of USDWs. See 40 C.F.R. § 146.90.
Injection Well Plugging Plan	This plan describes how the operator intends to plug and abandon all injection wells in the Class VI project including using the appropriate tests, materials, and methods to ensure that the wellbore does not become a conduit for fluid movement. See 40 C.F.R. § 146.92.
Post Injection Site Care Plan	This plan describes how the operator intends to perform all required monitoring and modeling after the cessation of injection to ensure that the CO_2 plume and pressure front are behaving as predicted and will not endanger USDWs in the future. Additionally, the operator must provide details on how the Class VI site will be closed, including site reclamation and the plugging of monitoring wells. See 40 C.F.R. § 146.93.
Emergency and Remedial Response Plan	The plan describes potentially impacted resources within the AoR including USDWs, identifies potential risk scenarios for the site, describes all actions to be taken by the operator in response to the risk scenarios, and identifies all required personnel and equipment needed to implement the response scenarios. These plans will be site-specific and will address all potential project risks up to site closure. See 40 C.F.R. § 146.94.

A state UIC program must be able to evaluate these plans throughout the life of a Class VI project and recommend additions or amendments as needed to prevent the endangerment of USDWs. As additional data is incorporated or if the site is not behaving as predicted, plans may require updating. Any amendments must be reviewed and approved by the Class VI program. These project plans are interrelated, and when one plan requires updating, all other plans should be evaluated to ensure conforming changes are not required in any of them. For emergency and remedial response plans in particular, expertise in risk analysis is recommended.

The COGCC has a variety of staff that would participate in plan review. Engineering staff would take the lead on plan aspects that involve corrective action and well plugging. Engineering and any additional staff hired for a Class VI program could also successfully evaluate the testing and monitoring plan. Emergency and remedial response plans may be reviewed by numerous staff including environmental scientists, engineers, geologists, location specialists, and compliance staff depending on the risks associated with the specific project. The COGCC currently requires an operator to have an emergency response plan that provides for the effective management of situations that may arise from oil and gas operations.[37] Existing expertise within the COGCC would benefit the evaluation of all plans, and additional training can be sought as necessary to better inform staff of the particular needs of a Class VI program. In projects with higher than normal or unusual associated risks, outside expertise could be utilized to ensure proper verification of the emergency and remedial response plan.

Financial Assurance

Federal requirements for financial assurance of Class VI projects are listed under 40 C.F.R. § 146.85. An owner or operator of a Class VI sequestration well must provide and maintain financial assurance throughout the entire span of a Class VI project. The operator may utilize multiple financial responsibility instruments for a single project including trust funds, surety bonds, letters of credit, insurance, and others listed in 40 C.F.R. § 146.85(a)(1). The financial assurance must be sufficient to cover the cost of the following portions of a Class VI project:

1. Corrective action on existing wells within the area of review. This includes all wells within the project area that may require reentry, replugging, or additional downhole work to ensure wellbore integrity through the life of the project.
2. Injection well plugging, including the plugging of all injection wells in the project.
3. Post injection site care and site closure, including all post injection monitoring, site reclamation, and plugging of monitoring wells.
4. Emergency and remedial response, including addressing any movement of injection or formation fluids that may endanger USDWs or a loss of an injection well's mechanical integrity. This includes covering all of the potential remediation that may be required in different scenarios.

The amount of required financial assurance will depend upon multiple factors, and it will be project specific. In particular, the emergency and remedial response plans must be site-specific, risk-based, and describe all required actions to be taken in response to potential scenarios that may endanger USDWs. The size and scope of the project will also impact the required amount of financial responsibility, including how many existing wells need to be remediated, how many monitoring and injection wells will be in the project, and the cost of post-injection site care.

Total financial responsibility of a Class VI project can be close to or over $20 million for the entire span of a Class VI project. A recently approved Class VI permit application[38] in North Dakota lists the required financial assurance estimate at nearly $18 million. The large majority of this number is associated with emergency and remedial response ($16 million). This project contained no money for corrective action of existing wells since there were no wells in the project area that required remediation.

UIC Class VI state primacy programs are responsible for verifying that the proposed financial responsibility meets the criteria in the federal rule. Financial assurance is reviewed throughout the project to ensure compliance, and in the event that any project plan is updated, a review of the financial assurance is also completed. The EPA recommends expertise in finance in order to successfully review financial responsibility instruments for Class VI projects. This expertise can be provided by a contractor, if needed.

The COGCC has extensive experience in financial assurance for oil and gas wells, locations, and projects. The primary instrument utilized by the COGCC for financial assurance is surety bonding. The COGCC requires a variety of bonds for different purposes including surface protection, waste management facilities, seismic operations, plugging, and more.[39] In addition to bonds, all operators are required to maintain general liability insurance of $1 million per occurrence for property damage

37 COGCC.state.co.us, 600 Series-Safety and Facility Operations Regulations, Rule 602.j. Accessed October 2021. https://cogcc.state.co.us/documents/reg/Rules/LATEST/600%20Series%20-%20Safety%20and%20Facility%20Operations%20Regulations.pdf

38 Dmr.nd.gov, North Dakota Oil and Gas Division, CO_2 Storage Facility Permit Requests, Red Trail Energy LLC, NDIC Case No 28848, Pg 4-13(204), Accessed October 2021. https://www.dmr.nd.gov/oilgas/Red_Trail,_LLC_Draft_Permit,_Fact_Sheet,_Permit_Application.pdf

39 COGCC.state.co.us, 700 Series-Financial Assurance, Accessed October 2021. https://cogcc.state.co.us/documents/reg/Rules/LATEST/700%20Series%20-%20Financial%20Assurance%20and%20Oil%20and%20Gas%20and%20Environmental%20Response%20Fund.pdf

and bodily injury to third parties. Additionally, the COGCC is currently undertaking a financial assurance rulemaking in response to SB19-181 and is contemplating numerous rule changes and additions to existing rules to provide better mitigation of financial risks associated with oil and gas and injection operations.[40] Draft rules include additional information requirements to assess financial risk, additional insurance, and tiered financial assurance plans that are risk-based and provide necessary increases to financial responsibility as operational risk increases.

Existing COGCC financial assurance expertise and processes would be beneficial to a state Class VI program and would provide some of the necessary framework for successfully evaluating the financial assurance needs of a Class VI Program. Training of existing staff on particular Class VI requirements could be addressed as needed. Third party contractor support may be utilized for verifying cost estimates provided by the operator.

Database and Reporting

From the initial submission of a Class VI permit, a database is required for tracking Class VI permit and project information for the state program, operators, and the EPA. The reporting requirements of a Class VI program are outlined in 40 C.F.R. § 146.91. Operators are required by 40 C.F.R. § 146.91(e) to submit all reports, submittals, and notifications to the EPA in an approved electronic format regardless of whether the state has primacy. In addition, the EPA has reporting requirements for state Class VI programs. Existing state databases/form systems and/or additional software may be utilized to work and collaborate on Class VI projects and to meet the reporting requirements of state Class VI programs.

Annual and compliance reporting are required by the EPA for state Class VI programs. Required annual reporting for state programs includes permit review and issuance, mechanical integrity testing, remedial actions, and well inventory. The state must also report to the EPA all instances of noncompliance with rules or permit requirements and a description of each enforcement action taken. The COGCC is familiar with this process due to the existing Class II program.

The EPA has developed the Geologic Sequestration Data Tool (GSDT) to facilitate compliance with the electronic reporting requirements and to support UIC Class VI programs. An operator must submit all required information to the EPA in an approved electronic format. The state may consider using the GSDT for storing project information or sharing data. A state may also choose to coordinate a Class VI project in a state database system and submit required information to the EPA as necessary. Specifics of data collaboration with the EPA would require discussion during the primacy application process.

Developed through the Ground Water Protection Council (GWPC) and the DOE, the Risk Based Data Management System (RBDMS) is a suite of integrated software products that assist state regulatory agencies in oversight and management of oil and gas and UIC facilities and activities.[41] Modules for Class VI projects are being developed in cooperation with existing state Class VI programs to streamline communication and data interactions for state programs, operators, and the EPA. Additional input from more states is being requested to ensure successful development and integration into existing state database systems. A state may choose to incorporate a Class VI module developed by a 3rd party, or use in-house staff to integrate Class VI projects into an existing database system.

The COGCC requires operators to electronically submit permit applications, completion reports, reports of subsequent operations, monitoring tests, production reports, and various other types of data related to oil and gas operations. All of this information is stored in the Colorado Oil and Gas Information System (COGIS) and the Colorado Environmental (COENV) database. The COGCC uses an online electronic form (WebForm) system that allows for the efficient submission, review, and approval of information including attachments. COGIS also contains inspection reports, violation data, hearings orders, and other important legacy data. The current database content and structure are well suited for implementing and administering a Class VI program.

The COGCC also maintains an online interactive map system for use by COGCC staff, operators, the public, local governments, and more. The map displays several types of information including data within the COGIS and COENV databases, spatial information critical to permit approval, and various types of data such as topography, roads, water resources, federal and state lands, and aerial photography. The existing mapping system would be an excellent resource for implementing a Class VI program.

The COENV database was developed by the GWPC, in partnership with the COGCC, to create a comprehensive environmental database that now contains thousands of groundwater, surface water, gas, and soil sample data from various sources across Colorado. Required sampling data[42] are submitted through the WebForm system for evaluation by environmental protection specialists at the COGCC.

40 COGCC.state.co.us, Financial Assurance Rulemaking, Accessed October 2021. https://cogcc.state.co.us/hearings.html#/rulemaking_sb181_financial_assurance

41 RBDMS.org, About RBDMS, Accessed October 2021. https://www.rbdms.org/about/rbdms/

42 COGCC.state.co.us, 600 Series-Safety and Facility Operations Regulations, Rule 615, supra note 37.

The sampling data can be accessed through the mapping system for use by the public, operators, and COGCC staff. The samples date back several decades and would be a robust resource for a Class VI program.

In order to effectively implement a state program, the COGCC would need to incorporate Class VI project information into the existing database and the mapping system. New forms will likely need to be created and/or existing forms will need to be amended to allow for operator submission of all required information. Additional mapping layers will need to be created to support the permitting process. Existing database staff in the COGCC will be able to provide support for the development of database requirements of a Class VI program. However, additional database staff will be required to help with the integration of Class VI project data including the processing of all sampling information for the COENV database. Initial contractor support may be required for these tasks. Additionally, consideration must be given to whether or how to add existing modules from outside sources.

Post-Injection Site Care and Site Closure

After the cessation of injection, the post-injection site care (PISC) of a Class VI project will commence. The operator must plug and abandon all injection wells in the project area to ensure that the wellbores will not become conduits for fluid movement out of the injection reservoir. Continued monitoring of the injected plume and the generated pressure front is also required during the PISC phase in order to confirm how the CO_2 is behaving in the subsurface after injection has ceased. Reevaluations and modeling updates are also required throughout the PISC phase. If needed, based on modeling and monitoring results, project plans may require updating, including monitoring plans, financial assurance, emergency and remedial response, etc.

By federal rule, the default PISC timeframe is 50 years after injection has ceased. The operator is allowed to submit a technical demonstration to the UIC Class VI program, including modeling and monitoring data, to decrease the length of the PISC as long as the demonstration supports that no additional monitoring is required to prevent endangerment of USDWs.[43]

The requirements of the demonstration are listed in 40 C.F.R. § 146.93(c)(1). Wyoming has omitted the default 50 year timeframe from their rules and opted to just require a technical demonstration of subsurface site stability for site closure to be considered.[44]

Once the operator has provided a technical demonstration supporting CO_2 plume stabilization and confirming there is no endangerment to USDWs, the UIC program may initiate the site closure process. The operator must plug all remaining monitoring wells and reclaim the site. At the end of the process, the remaining financial assurance instruments will be released to the operator. At site closure, the transfer of site liability and long-term site stewardship is a consideration that will be addressed in the Liability section of this report.

43 40 C.F.R. § 146.93(b)(3).
44 Wyoleg.gov, Water Quality Rules and Regulations, Chapter 24, Section 16(b)(iii), Accessed October 2021. https://www.wyoleg.gov/ARULES/2010/AR10-067DEQ.pdf

Resources and Considerations for a State UIC Class VI Program

The state of Colorado has several existing resources that would provide immediate support for a UIC Class VI program. The COGCC has multiple existing groups with technical expertise, multiple existing processes, and a working database/form system for oil and gas wells that would complement the regulation of Class VI projects. In addition to the COGCC, there are other departments in the state that will be involved at different times in the permitting and implementation of a UIC Class VI program, which is discussed in more detail below. The COGCC has experience coordinating with these and other state agencies. The state will benefit from the collaboration of all involved agencies for the safe and effective implementation of a program. The Colorado Energy Office's forthcoming CCUS Task Force Report will be an additional source for state considerations and recommendations related to CCUS.

COGCC Resources for a Class VI Program

With the passage of SB19-181, the COGCC was directed to regulate the development and production of the natural resources of oil and gas in the state of Colorado in a manner that protects public health, safety, and welfare, including protection of the environment and wildlife resources.[45] With this mission change, the COGCC has developed numerous rules and processes to address this directive and has focused on division organization and staff expertise. With this in mind, the COGCC has multiple resources available that would be a foundation for a state Class VI program, including existing technical staff and processes to support the program.

COGCC technical staff include engineers, geologists, environmental scientists, permitting specialists, enforcement staff, inspectors, financial assurance staff, hearings staff, and database staff. The existing engineering staff have many years of expertise in wellbore construction, testing, monitoring, and subsurface well planning for oil and gas wells and Class II injection wells. Environmental staff have experience in investigating, evaluating, and monitoring dissolved gas and other contaminant migration in confined and unconfined aquifers. Enforcement staff provide expertise in compliance and regulatory evaluation and enforcement. Hearings staff provide expertise in Commission hearings, regulatory and policy matters, enforcement, spacing, unitization,

45 C.R.S. § 34-60-102(1)(a)(I).

and more. Permitting and location specialists have expertise in policies and regulations, oil and gas development planning, the siting of wells, subsurface well planning, spacing, unitization, and environmental justice. Inspectors are well versed in inspecting both oil and gas wells and Class II injection wells. Financial assurance staff routinely evaluate and process surety bonds for oil and gas wells. Database staff continually improve and add to the COGIS database and form system to streamline required operator submissions and to provide a public data repository and mapping system. The table below summarizes the existing expertise in the COGCC that would apply to a Class VI program as well as potential staffing, training, and consulting needs for a safe and effective Class VI program.

Table 4. COGCC—Potential Sources of Expertise for a Class VI Program

Expertise Area	Existing Expertise	Staff Training	Additional Staff	Contractor Support	COGCC Staffing Notes
Site Characterization, e.g., geologists, hydrogeologists, geochemists, and log analysts/experts to review site characterization data submitted during permitting and throughout the project duration.	X	X	X	X	The UIC lead and engineers provide existing staff expertise. Additional staff (Class VI Coordinator and UIC scientist/engineer) would be required in order to successfully address all site characterization requirements of a Class VI program. Class VI related training would be helpful. Potential use of a contractor could be an option depending on the complexity of the project.
Modeling, e.g., hydrogeologists and environmental/reservoir modelers to evaluate AoR delineation computational models during permitting and AoR reevaluation.		X	X	X	Additional staff (Class VI Coordinator and UIC scientist/engineer) would be required in order to successfully address all modeling requirements of a Class VI program. Additional training for modeling software would be required. Use of a contractor should be an option for more complex projects.
Well Construction, Testing, and Monitoring, e.g., well engineers, log analysts/experts, and geologists to review well construction information and operational reports on the performance of Class VI wells and review/evaluate testing and monitoring reports.	X	X	X		COGCC currently employs a staff of engineers with expertise in well construction standards, well testing, and monitoring. COGCC also has environmental staff with experience in groundwater and soil monitoring. The Class VI staff allocated to the modeling and site characterization would also be involved in plume monitoring by methods such as geophysical surveys. Despite existing expertise, a UIC engineer would be required to effectively administer the Class VI program. Training will be useful for specific types of testing and monitoring.
Finance Experts to review financial responsibility information during permitting and annual evaluations of financial instruments.	X	X		X	Existing financial assurance staff for oil and gas facilities provide in-house expertise. Additional training may be required in order to successfully evaluate the financial responsibility instruments that are allowed by the Class VI Rule. Contractor support may be utilized for verifying cost estimates provided by the operator.
Risk Analysts to evaluate emergency and remedial response scenario probabilities and remediation cost estimates.	X	X		X	Existing staff have expertise in evaluating emergency and remedial response plans for oil and gas locations and estimating remediation costs as needed for financial assurance. Additional training pertaining to Class VI risk analysis will be needed. Contractor support may be required on projects with higher than normal associated risks.

Table 4. COGCC—Potential Sources of Expertise for a Class VI Program (continued)

Expertise Area	Existing Expertise	Staff Training	Additional Staff	Contractor Support	COGCC Staffing Notes
Policy/Regulatory staff required by the UIC Program and the Class VI Rule to evaluate compliance with Class VI Rule requirements.	X				Existing staff in multiple groups in the COGCC have policy and regulatory expertise and have experience interpreting rules and regulations for compliance issues.
Enforcement/Compliance, e.g., staff who can initiate and pursue appropriate enforcement actions when permit or rule requirements are violated.	X				Existing staff in the COGCC have experience pursuing enforcement for compliance issues. An entire enforcement department is already in place and operating for oil and gas related issues.
Inspectors including well engineers or log analysts/experts to inspect wells or witness construction activities, workovers, and/or mechanical integrity tests.	X	X			Existing COGCC inspectors are already actively inspecting oil and gas locations and Class II injection wells. The existing staff could add the additional Class VI related inspections into existing work. Training on inspecting Class VI projects may be needed.
Environmental Justice experts to evaluate the Environmental Justice impact report, ensuring that the report is thorough, contextualized, and agrees with the demographic and environmental data.	X	X			The COGCC currently requires an analysis of disproportionately impacted communities as part of its oil and gas development plan process. The existing processes and staff expertise would be a benefit to a Class VI program. Additional analysis and staff training could be pursued as needed.
Database Staff including staff to integrate Class VI projects and data into the existing databases.	X	X	X	X	Existing database staff in the COGCC will be able to provide support for the development of database requirements of a Class VI program. Additional database management staff will be needed to help with the integration of project data and to process all information for the COENV database. This includes managing the data for groundwater, surface water, gas, and soil sampling related to Class VI. A UIC program technician will also be required for project and data support. Initial contractor support may be required. Existing modules (RBDMS) can be linked to existing state databases. Additional upgrades may be required as a program matures.

There are multiple active processes within the COGCC that would support a UIC Class VI program. The Commission and staff are experienced in effectively undertaking rulemakings and engaging in stakeholder and public outreach. This expertise would be a benefit to the primacy process. The existing Oil and Gas Development Plan process provides a comprehensive and protective development planning process that includes outreach to disproportionately impacted communities, allows for an alternative location analysis as needed, requires outreach to affected parties including local governments, incorporates strategies to reduce impacts on the public and wildlife, and accounts for spacing, unitization, and well planning. This process could be adapted and utilized for Class VI project siting including unitizing pore space, optimizing injection and monitoring well locations to reduce impact, and coordinating an outreach program for impacted communities. In addition, there are existing enforcement and hearings processes for compliance issues. Further, multiple technical processes are in place related to subsurface well permitting, Class II injection well permitting, wellbore construction, testing and monitoring, and plugging wellbores. Lastly, an existing WebForms system and the COGIS database provide a resource to streamline operator submissions, plot Class VI project information on an interactive map, and store project files and data.

Class VI Project Collaboration

In order to ensure a Class VI project abides by all federal, state, tribal, and local rules and regulations, a state-run Class VI program will be required to work with a variety of additional agencies depending on the project. The COGCC has initially identified that Class VI projects may include collaboration with federal agencies, tribal agencies, agencies in bordering states, additional departments and agencies of the state of Colorado, local governments, and potentially, research institutes and university research groups.

Within the state of Colorado, there are several agencies that may need to collaborate or be notified through the primacy process and throughout permitting and implementation of a Class VI project. Throughout the primacy process, the Colorado Attorney General's office (COAG) will play an active role in compiling the Attorney General's statement as well as giving input on state statutes and rules and how they satisfy federal requirements. A few different divisions within the CDPHE may also have a role in Class VI projects in Colorado, including the Air Pollution Control Division (APCD), the Water Quality Control Division (WQCD), and the Hazardous Materials and Waste Management Division (HMWMD). If primacy is pursued, further discussions will be conducted with the CDPHE to ensure that the needs of that Department are met and that any necessary agreements are set up prior to permitting a Class VI project. The Division of Water Resources (DWR) will also need to be notified prior to permitting a Class VI project and would likely want to provide input during rulemaking, similar to the Division's current involvement with Class II projects. The Colorado Geological Survey (CGS) may be a valuable resource for site characterization information as more projects begin the permitting process in Colorado. While not directly related to injection, pipelines are an important aspect for the transport of CO_2 to the injection well, and engagement with the relevant pipeline regulator will also need to occur. As new projects emerge, additional agencies may need to be involved. Each project will be evaluated, and at times, there may be site-specific outreach required.

The COGCC is an implementing agency for water quality standards and classifications adopted by the Water Quality Control Commission (WQCC) for groundwater protection. This authority was provided by Senate Bill SB 89-181 and is restated and clarified by a Memorandum of Agreement (MOA) between the COGCC and WQCC that was adopted in 1990. The COGCC has certain responsibilities as an implementing agency and reports to the WQCC and WQCD annually about how its programs assure compliance with those standards and classifications for the activities that are subject to COGCC jurisdiction.

Outside of Colorado state agencies, there are additional agencies that may require consultation depending on the project, including federal, tribal, and bordering state agencies. Projects that cross jurisdictional boundaries (state, etc.) will require collaboration between Class VI permitting authorities. This could entail working with states that already have primacy, like Wyoming, or collaborating with the EPA if a bordering state does not yet have primacy. There may also be additional state agencies (Oil and Gas Commissions, Environmental Protection Divisions, Public Health Departments, etc.) to notify and work with in addition to the EPA for projects that span the border of Colorado and a state without primacy. Lastly, even a project that is completely within the state of Colorado may require working with federal or tribal agencies if the project area contains federal or tribal lands.[46]

Following Senate Bill 19-181, the Oil and Gas Conservation Act (OGCA) provides a robust role for local governments in oil and gas permitting decisions. Before applying to the COGCC, oil and gas operators must first submit an application with the local government with jurisdiction over the location.[47] Local governments are empowered by statute to impose requirements that are more protective than those required by the state.[48] The COGCC's rules also require notifications to and consultation with local governments in many instances.[49] If the General Assembly elects to take the same approach to Class VI projects, significant collaboration with local governments will become part of the Class VI process as well.

Each Class VI project will have unique challenges associated with outreach and collaboration. Discussions should occur with applicants in the pre-permitting phase to determine who needs to be involved in the permitting and outreach process. It may also be beneficial to establish memoranda of understanding between the COGCC and other agencies and/or local governments to set forth processes for interagency consultation, sharing of confidential information, and other aspects of the Class VI process.

In addition to government agencies and local governments, research partnerships and university research groups may also collaborate or work on the technical aspects of Class VI projects and initial feasibility studies. The US Department of Energy (DOE)

46 In its Regional CO_2 Transport Infrastructure Action Plan, the Great Plains Institute noted that "Deployment of transport and storage infrastructure on federal lands is currently challenging" due to a lack of adequate rules, regulations, and guidance regarding permanent storage of CO_2 on federal lands. Action Plan, pg 5, October 12, 2021, Accessed October 2021. https://www.betterenergy.org/wp-content/uploads/2021/10/Regional-CO_2-Transport-Infrastructure-MOU-Action-Plan.pdf

47 C.R.S. 34-60-106(1)(f).

48 C.R.S. 34-60-131.

49 See, e.g., Rule 301.f. https://cogcc.state.co.us/documents/reg/Rules/LATEST/300%20Series%20-%20Permitting%20Process.pdf

has provided funding to a variety of research partnerships throughout the nation. In North Dakota, where Class VI permitting is ongoing, the Energy and Environmental Research Center (EERC), a division of the University of North Dakota, and its Plains CO_2 Reduction (PCOR) Partnership have played a significant role in advancing Class VI projects and permits in North Dakota. For Colorado, the Petroleum Recovery Research Center (PRRC), a division of New Mexico Tech, is the lead organization for the Southwest Partnership (SWP) that was established in 2003 by the DOE to study carbon management strategies in several states in the southwest including Colorado. In 2019, under the DOE's Regional Initiative to Accelerate CCUS Deployment, the PRRC was awarded additional funds. Headed by the PRRC, the Carbon Utilization and Storage Partnership (CUSP) was formed to advance CCUS research and development and address regional challenges. CUSP includes multiple partners from several states across the region, including state geological surveys, universities, and national laboratories. In particular, the Colorado School of Mines is a CUSP partner and is actively conducting research and feasibility studies for potential Class VI projects in Colorado. As projects progress from feasibility to permitting, a state UIC program may work with university and research groups on the technical aspects of Class VI projects and permits.

Considerations for Additional State Resources

States that have submitted their primacy application have given estimates on the cost of the first two years of the state's UIC Class VI program. Wyoming and North Dakota estimated an initial 2-year program implementation cost of $200,000 to cover staff salaries, modeling software licenses, computer hardware, database updates, and other indirect expenses. On the other hand, Louisiana has estimated the cost of the first year of the program to be around $345,000 and the cost of the second year to be $1.135 million.[50] These costs are largely associated with the phased hiring of 7 new staff, including 2 petroleum scientist/engineering supervisors, 4 petroleum scientists/engineers, and 1 attorney. Note there is a cost to coordinating the primacy process that would be in addition to these estimates. Also, all of these programs have some differences in how the state agencies are set up when compared to Colorado.

Within Louisiana's primacy application is a Class VI State Program Cost Analysis conducted by the GWPC.[51] The GWPC estimated that North Dakota expended approximately $270,000 to attain primacy through state program development and submission costs. This primarily included staffing expenditures related to program development and rulemaking. Based on example scenarios that include permitting, the implementation of a program, monitoring, and data management, the GWPC estimated that the total first 5 year cost for administering a state Class VI program can range from approximately $1.3 million to $22 million. This is highly dependent on the number of permits and active projects in the state. As the number of Class VI projects increases, the cost of implementing a safe and effective state Class VI program will increase due to growing staffing and resource needs.

In order for the state of Colorado to move forward with obtaining primacy and implementing a safe and effective Class VI program, additional staff and resources are required. The primacy process is estimated to take approximately 2 years from beginning pre-application activities to obtaining primacy. To successfully coordinate the primacy process, at least 1 FTE would be required as a Class VI coordinator within the COGCC. Funding for staff training should also be considered if primacy is pursued in order to initiate training prior to obtaining primacy. Additional staff training will be required for certain departments in order to effectively administer a Class VI program. This may include university courses, workshops, short courses, training seminars, attending meetings, and similar activities. Leading up to gaining primacy or after obtaining primacy, the program will require additional funds for purchasing a modeling computer, licensing modeling software, updating the COGIS database to suit Class VI projects, and hiring at least 4 FTEs including a UIC program scientist, a UIC program engineer, a UIC program technician, and a data management specialist. One of the 5 total FTEs would be a supervisor. For complex projects, there will be a need for contractor support through the permitting process for risk analysis and computational modeling. The state of Colorado would need to fund the program throughout the primacy-seeking process, and contribute additional funds for the first few years of implementing the program. Outlined in the next section are potential funding strategies that should be considered to lower the future need for state funds, and to potentially create a self-funded program. It is recommended that the funding and staffing requirements of the program be reevaluated once the quantity of potential Class VI projects is better understood.

50 State of Louisiana Department of Natural Resources, CLASS VI USEPA PRIMACY APPLICATION, Supra note 13, pg 3.
51 State of Louisiana Department of Natural Resources, CLASS VI USEPA PRIMACY APPLICATION, Supra note 13, pg 309-314.

Potential Funding Strategies for Continued Oversight

There are a variety of available options for funding a state UIC Class VI program. Existing state Class VI programs utilize multiple funding mechanisms to ensure their continued long-term financial stability.

Federal funding for state UIC Class VI programs was recently approved as part of the Infrastructure Investment and Jobs Act.[52] Through this legislation, the EPA is authorized to provide grants to state UIC programs with Class VI primacy. As approved, this bill provides $50 million for state Class VI programs for fiscal years 2022 through 2026. The exact structure of the federal grant is still unknown, but state UIC Class VI programs will have access to federal funding through fiscal year 2026.

Regulatory, permitting, application processing, and compliance fees are common strategies for helping fund the operational and administrative costs of a Class VI program. North Dakota's program charges operators application processing fees based on actual costs, including hours spent processing a permit application,[53] and also charges for all costs associated with publishing notices and holding hearings.[54] Louisiana has included in statute a fee structure that includes a one-time application fee not to exceed the cost of permit review and an annual site regulatory fee of up to $50,000 per year.[55] Fees and fines associated with instances of noncompliance are also standard for regulatory authorities.

State sequestration funds are another common funding strategy for Class VI programs that can be approached in different ways. North Dakota, Wyoming, and Louisiana have all established state trust funds to address program costs, as well as the potential costs of long-term site stewardship after site closure. Generally, these funds are fully or partially financed through a fee based on the amount of CO_2 injected.

North Dakota has two separate trust funds, one for administration[56] of the UIC Class VI program and another for long-term site stewardship[57] after site closure. The administrative fund receives 1 cent per ton of CO_2 injected and receives additional money through permitting, processing, and compliance fees. The administrative fund is generally used for defraying program costs associated with the active projects and permits. The CO_2 storage facility trust fund receives 7 cents per ton of CO_2 injected and may only be used for defraying the cost of long-term monitoring and management of a closed storage facility.[58]

In statute, Wyoming has established a geologic sequestration special revenue account.[59] The account will consist of money collected for monitoring a sequestration site after closure and may only be used after site closure certification. Wyoming has not yet promulgated any rules pertaining to this account, so specific details are unavailable.

Louisiana has established a Carbon Dioxide Geologic Storage Trust Fund.[60] This fund is the primary source for program funding through the entire life of a project and may acquire funds from a variety of sources including application fees, annual site fees, a fee levied per ton of CO_2 injected, penalties, bond forfeitures, private contributions, grants, donations, and more. The per ton site fee is set up to average a cost of $416,667 per year for 12 years of injection. The tonnage fee shall cease at $5 million per site until such time as the balance in the trust fund falls below an authorized amount, at which time the fee will be reinstated. The fund may be used for both the administration of the Class VI program and long-term site stewardship after site closure.

The COGCC's finance unit has experience managing the Oil & Gas Conservation and Environmental Response Fund[61] (OGCERF) for use in funding a portion of the COGCC's program cost. The OGCERF is similar to some of the funding strategies outlined above and receives money from a levy on oil and gas production, fines and penalties for noncompliance, and forfeiture of surety bonds. In addition, the COGCC participates in the EPA's grant program for administering the UIC Class II program and is awarded funds annually. The expertise demonstrated by the existing finance unit of the COGCC would facilitate implementation of a Class VI program in Colorado.

State injection funds help meet the costs of a Class VI program and provide funding for long-term site care after site closure. There are a variety of strategies for establishing and financing these funds. It is important to clearly state the purpose of the fund, the acceptable funding sources, and define what costs may be paid by the fund. By incorporating or creating multiple sources of funding, including per ton injection fees, processing fees, and federal grants, state injection funds can help create a sustainable and fully funded state UIC Class VI program in Colorado.

52 Congress.gov, H.R. 3684 — Infrastructure Investment and Jobs Act, Sec. 40306, Secure Geologic Storage Permitting, Accessed November 2021. https://www.congress.gov/bill/117th-congress/house-bill/3684/text
53 N.D. Cent. Code § 43-05-01-05(2).
54 N.D. Cent. Code § 38-22-05.
55 LA Rev Stat § 30:1110.C.
56 N.D. Cent. Code § 38-22-14.
57 N.D. Cent. Code § 38-22-15.
58 N.D. Cent. Code § 43-05-01-17.
59 Wyo. Stat. § 35-11-318.
60 LA Rev Stat § 30:1110.
61 C.R.S. § 34-60-124.

Legal, Policy, and Regulatory Considerations for the Implementation of a Safe and Effective Class VI Program in the State of Colorado

The safe and effective implementation of a UIC Class VI program in Colorado includes not only technical program considerations, but also requires addressing legal, policy, and regulatory barriers. Considerations include state regulatory authority, pore space ownership, aggregating property rights, liability issues, Class II wells, pipelines, and the need to promulgate Class VI rules.

Regulatory Authority

A threshold requirement for Colorado to obtain primacy and administer an effective UIC Class VI program is a regulatory agency or a group of agencies with authority to promulgate rules, administer the program, conduct oversight, and provide guidance for operators. Currently, the General Assembly has not expressly vested any state agency with that authority. Legislation that grants authority to regulate Class VI wells to the COGCC or some combination of agencies is therefore a prerequisite for the implementation of the state's Class VI program.

The OGCA explicitly grants the COGCC authority to regulate UIC Class II wells for enhanced recovery.[62] The statutory language is limited to "class II injection wells," and does not reference Class VI wells. The Act also includes "underground injection wells"—not qualified by the type of well—as part of "oil and gas operations," over which the COGCC has broad authority.[63] However, it is not clear whether these statutory provisions grant the COGCC authority over all Class VI wells, particularly those that are unrelated to oil and gas production.

The General Assembly would therefore need to amend the OGCA to grant COGCC express authority over all categories of Class VI wells for COGCC to seek blanket delegated authority from EPA over UIC Class VI wells.

62 C.R.S. § 34-60-106(9).
63 C.R.S. §§ 34-60-103(6.5); 34-60-106(2.5)(a).

Pore Space Ownership and Split Estates

When CO_2 is injected, it occupies pore space, which is the empty space within the subsurface that is unoccupied by solid material, including voids, spaces between grains, and fissures in the rock. Therefore, a key legal consideration to enable a Class VI program in Colorado is who owns, and therefore controls access to, the pore space where CO_2 will be sequestered. This issue is not yet addressed in Colorado law, and ambiguity in this area has been identified as a significant barrier to large-scale CCS development.[64] A statewide determination on pore space ownership is thus an important first step toward the adoption and implementation of an effective Class VI program in Colorado.

Colorado law recognizes split estates for property ownership, meaning that the surface of the land can be owned separately from the underlying mineral estate. Where the surface and mineral interests are owned separately, the mineral estate is said to be "severed." The mineral estate itself may also be divided into multiple estates, for instance, with oil and gas conveyed separately from other minerals. Where property rights have not been severed, pore space ownership is straightforward. However, for split estates, it is not currently clear whether pore space is part of the surface estate or mineral estate.

Longstanding common law principles and the experiences of other states indicate that pore space ownership should be vested in the owner of the surface estate. However, policymakers will also need to grapple with more nuanced issues, such as how to balance competing uses of the surface and subsurface.

Pore Space Ownership

Common law principles indicate that pore space is most properly considered part of the surface estate. This has also been the conclusion reached by the majority of other state courts and legislatures that have addressed pore space ownership.[65] The majority of participants in the 2010 Colorado Carbon Capture and Geological Sequestration Task Force convened by the Colorado Department of Natural Resources similarly agreed that where pore space has not been explicitly conveyed, it belongs to the surface owner.[66]

At common law, real property owners traditionally own property in "fee simple," meaning that they own the surface and everything above and below it, unless specific rights have been conveyed. Following this principle, courts typically interpret deeds and other conveyances narrowly, applying a presumption that any rights not expressly carved out are retained by the surface owner. It follows that, if pore space has not been specifically conveyed, it remains the property of the surface owner. Courts in other states resolving pore space ownership disputes have followed this logic to hold that the pore space belongs to the surface owner unless it has been expressly conveyed.[67] This presumption, referred to as the "American Rule," is followed by most states.[68]

Kentucky, Montana, North Dakota, Oklahoma, and Wyoming have each adopted statutes addressing pore space ownership. Each of these statutes establish that pore space is part of the surface estate and is generally conveyed along with surface ownership.[69]

The Kentucky, Montana, Oklahoma, and Wyoming statutes contemplate that pore space can be severed from the surface estate.[70] The Wyoming legislature provided additional guidance regarding conveyance of pore space ownership, specifying that pore space ownership may be transferred in the same manner as mineral interests.[71] In contrast, North Dakota prohibits severance of pore space ownership from the surface estate.[72] Allowing pore space to be severed from the surface estate increases flexibility in the ownership and use of the subsurface, while prohibiting severance promotes clarity in land title and stability useful for economic development, environmental protection, and government operations.[73] If Colorado follows the majority of states that allow the severance of pore space rights, pore space agreements and/or transfers of pore space may become common.

Split Estates: Competing Rights and Uses

Where multiple owners have real property interests in a slice of earth, conflicts can naturally arise. Colorado law regarding conflicts between surface owners and mineral owners is highly developed, but these issues have not been addressed in relation to pore space.

64 Lepore, M., Turner, D., Legislating Carbon Sequestration: Pore Space Ownership and Other Policy Considerations, The Colorado Lawyer, Volume 40, No. 10, October 2011.
65 Gray T., A 2015 Analysis and Update on U.S. Pore Space Law-The Necessity of Proceeding Cautiously With Respect to the "Stick" Known as Pore Space, pg 283, January 2015, Accessed October 2021. https://digitalcommons.law.ou.edu/cgi/viewcontent.cgi?article=1013&context=onej; Koski, K., Richardson, J., Righetti, T., Taylor, S., Study on States' Policies and Regulations, pg 123, September 2020, Accessed October 2021. https://usea.org/sites/default/files/event-/Study%20on%20States%E2%80%99%20Policies%20and%20Regulations%20per%20CO_2-EOR-Storage%20%281%29.pdf.
66 Report from the Colorado Carbon Capture and Geologic Sequestration Task Force, June, 2010. https://cogcc.state.co.us/documents/library/Technical/Miscellaneous/Final%20Report-Colo%20CCS%20Task%20Force.pdf
67 *See, e.g., Burlington Resources Oil & Gas Co., LP v. Lang and Sons Inc.*, 259 P.3d 766, 770 (Mont. 2011); *Humble Oil & Refining Co. v. West*, 508 S.W.2d 812, 815 (Tex. 1974); *Tate v. United Fuel Gas Co.*, 71 S.E.2d 65, 71 (W. Va. 1952); *Jones-Noland Drilling Co. v. Bixby*, 282 P. 382, 383 (N.M. 1929).
68 Burt, S., Who Owns the Right to Store Gas: A Survey of Pore Space Ownership in U.S. Jurisdictions, pg 2, Accessed October 2021. http://www.duqlawblogs.org/joule/wp-content/uploads/2016/04/Burt-Article-with-Burt-Edits-4.28.pdf; Gray, A 2015 Analysis and Update on U.S. Pore Space Law-The Necessity of Proceeding Cautiously With Respect to the "Stick" Known as Pore Space, supra note 65.
69 Ky. Rev. Stat. § 353.800(8); N.D. Cent. Code § 47-31-03 to -04; Wyo. Stat. § 34-1-152(a); Mont. Code § 82-11-180; 60 Okla. Stat. § 6(B)(2).
70 Wyo. Stat. § 34-1-152; Ky. Rev. Stat. § 353.800(8); Mont. Code § 82-11-180(3); 60 Okla. Stat. § 6(B).
71 Wyo. Stat. § 34-1-152.
72 N.D. Cent. Code § 47-31-05.
73 N.D. Cent. Code § 47-31-01.

In Colorado, the mineral estate has been referred to as dominant over the surface estate. However, the Colorado Supreme Court has held that the surface and mineral estates are "mutually dominant and mutually servient because each is burdened with the rights of the other."[74] The Court articulated what has come to be known as the reasonable accommodation doctrine: The owner of a severed mineral estate retains a right of "reasonable use" in the surface estate, which allows the mineral owner to access and use the surface to the extent that is "reasonable and necessary to the development of the mineral interest."[75] In turn, mineral developers have an obligation to "accommodate surface owners to the fullest extent possible consistent with their right to develop the mineral estate."[76] The reasonable accommodation doctrine was adopted by statute in the OGCA.[77]

To facilitate the geologic sequestration of CO_2, Colorado law will need to be developed to address conflicts between pore space owners, surface owners, and mineral owners. Conflicts may be addressed contractually or through statewide determinations by the General Assembly or the courts.

Pore Space—Surface Conflicts

To address potential conflicts between the rights of pore space owners and surface owners, it may be prudent to extend the reasonable accommodation doctrine to pore space rights, if Colorado determines pore space is part of the surface estate and allows pore space to be severed. Like mineral owners, pore space owners and Class VI injectors may need the right to necessary and reasonable access to overlying surface that they do not own in order to access the pore space. In turn, surface owners should have assurances that pore space owners will minimize intrusion upon and damage to the surface of the land.

Pore space—Mineral Estate Conflicts

The rights of mineral estate owners and pore space owners are similarly intertwined. The reasonable use doctrine has generally been interpreted to provide mineral owners with a right of reasonable use of the pore space necessary to extract the minerals.[78] Therefore, mineral estate owners also have a protectable interest in the pore space. For example, mineral owners have the right to drill into the pore space to extract minerals and the right to inject CO_2 into the pore space for Enhanced Oil Recovery (EOR) projects. Injection of CO_2 into pore space for sequestration could thus conflict with mineral development, and vice versa.

To provide legal certainty, other states have specified in their pore space statutes that the rights of the mineral estate are dominant over pore space rights.[79] This approach is similar to what Colorado has done with regard to natural gas storage. An application for underground natural gas storage may only be approved if, among other things, the applicant demonstrates "that the formation or formations sought to be condemned are nonproductive of oil or gas in commercial quantities under either primary or secondary recovery methods."[80] In other words, the state will only grant access to pore space for natural gas storage after the mineral estate has been depleted.

Because a mineral owner has a right to reasonable use of the pore space during mineral development, it may be necessary to determine when the mineral estate has been depleted if the proposed CCS project would inject into the same formation. This would establish when a mineral owner's rights to pore space terminate and give way to the pore space owner.[81] If Colorado determines that pore space ownership is vested in the surface owner, and the mineral estate owner has not expressly obtained those pore space rights, it follows that the pore space rights would automatically revert to the surface owner or to a third-party pore space owner for storage once the mineral estate is depleted. However, given that economics can change for mineral extraction, particularly oil and gas development, it may be difficult to determine when the mineral estate has been exhausted.

Extent of Pore Space Rights

Once pore space ownership has been determined, questions regarding the extent of the ownership right will naturally arise. Many of these questions lend themselves to judicial determination, and have not been addressed statutorily by other states.

For instance, questions are likely to arise related to subsurface trespass. If a person owns the pore space below their home, is any intrusion into that pore space (e.g., through migrating CO_2 that has been geologically sequestered) an actionable trespass? Or does a trespass only occur if the intrusion interferes with the surface owner's current or reasonably foreseeable use of the pore space? How does the state's creation of a Class VI permitting regime or a legislative declaration that geologic sequestration is in the public interest influence the analysis?[82]

74 *Gerrity Oil & Gas Corp. v. Magness*, 946 P.2d 913, 927 n.8 (Colo. 1997).
75 Id. at 926-27.
76 Id. at 927.
77 C.R.S. § 34-60-127.
78 *See, e.g.*, Lepore, M., Turner, D., Legislating Carbon Sequestration: Pore Space Ownership and Other Policy Considerations, supra note 64.
79 *See, e.g.*, Wyo. Stat. Ann. § 34-1-152(e) ("For the purpose of determining the priority of subsurface uses between a severed mineral estate and pore space as defined in subsection (d) of this section, the severed mineral estate is dominant regardless of whether ownership of the pore space is vested in the several owners of the surface or is owned separately from the surface.")
80 C.R.S. § 34-64-104.
81 Gray, A 2015 Analysis and Update on U.S. Pore Space Law-The Necessity of Proceeding Cautiously With Respect to the "Stick" Known as Pore Space, supra note 65, pg 283.
82 For a more in-depth discussion of these issues, see Klass, Alexandra B., Wilson, Elizabeth J., Climate Change, Carbon Sequestration, and Property Rights, 2010 U. Ill. L. Rev. 363 (2010), pg 391-409, https://scholarship.law.umn.edu/cgi/viewcontent.cgi?article=1175&context=faculty_articles; Lepore, M., Turner, D., Legislating Carbon Sequestration: Pore Space Ownership and Other Policy Considerations, supra note 64.

Another question that some commentators have suggested is whether private pore space rights should terminate at a certain depth, below which the pore space would be akin to a "public highway," similar to airspace.[83] Such a declaration could facilitate the development of large scale CCS projects deep in the subsurface.[84] However, none of the states that have enacted pore space legislation have taken this approach, perhaps due to concerns over limiting private property rights and spurring takings litigation.

83 *See, e.g.*, Klass, Alexandra B. & Wilson, Elizabeth J., Climate Change, Carbon Sequestration, and Property Rights, supra note 82, pg 405-06; Lepore, M., Turner, D., Legislating Carbon Sequestration: Pore Space Ownership and Other Policy Considerations, supra note 64.
84 Id.
85 Klass, Alexandra B. & Wilson, Elizabeth J., Climate Change, Carbon Sequestration, and Property Rights, supra note 82, pg 378.
86 Koski, K., Richardson, J., Righetti, T., Taylor, S., Study on States' Policies and Regulations, supra note 65, pg 149.
87 C.R.S. § 34-60-118.
88 C.R.S. § 34-60-118(1).
89 C.R.S. § 34-60-118(4).
90 C.R.S. § 34-60-118(5).

Aggregating Property Rights

When CO_2 is injected into the subsurface, it naturally spreads out to cover a large area—potentially tens to hundreds of square kilometers.[85] Therefore, Class VI projects will typically span numerous parcels of land under different ownership. A mechanism to combine subsurface property interests is thus necessary to enable large-scale projects. Unitization and eminent domain are two potential pathways to amalgamating property rights for CCUS.

Unitization

Unitization is one way to combine subsurface property interests for common operation. It combines the interests in a subsurface reservoir to be utilized for a project. Unitization allows for the combination of subsurface rights in an area larger than a spacing unit, which makes it compatible with geologic sequestration.[86] While most oil and gas producing states allow unitization for oil and gas development and/or EOR, only a handful of states have addressed unitization for geologic sequestration to date.

Colorado Unitization for EOR

In Colorado, unitization is authorized by statute for enhanced recovery of oil and gas.[87] The statute allows an operator to unitize interests as long as the COGCC finds that the unitization agreement is "in the public interest for conservation or is reasonably necessary to increase ultimate recovery or to prevent waste of oil or gas."[88] The Commission's order approving a unitization agreement must prescribe a plan for unit operations, including allocation of costs and revenues among the owners in the unit.[89]

A unitization agreement may be reached voluntarily among all of the owners in the unit, or the COGCC may order forced unitization. The COGCC may grant a unitization order if the unitization plan has been approved in writing by (1) those persons who will be required to pay at least 80 percent of the costs of the unit operation, and (2) the owners of at least 80 percent of the production or proceeds.[90] Up to 20 percent of owners in a unit may therefore be involuntarily unitized by order of the Commission. COGCC Rules 503, 504, and 505 set out the procedural requirements applicable to unitization applications.

Colorado law does not currently contemplate unitization for purposes other than enhanced recovery. If unitization is the chosen pathway for aggregating pore space property rights in Colorado, new legislation will be necessary to authorize it for UIC Class VI projects. Further, there are different ways to address unitization.

State Approaches to Pore Space Unitization

The pore space unitization statutes enacted by Wyoming, North Dakota, Kentucky, and Montana demonstrate a range of approaches to the issue.

Wyoming's unitization statute for geologic sequestration sites establishes requirements similar to Colorado's EOR unitization statute. The Wyoming legislature authorized the state oil and gas commission to unitize lands for geologic sequestration in order to protect the corresponding rights of pore space owners in a unit area, ensure compliance with environmental requirements, and facilitate the use and production of the state's energy resources.[91] Unit operators must submit an application to the oil and gas commission that identifies the relevant surface and pore space owners and sets forth a plan of unitization.[92] The commission then considers the application in a hearing.[93] Among other requirements, the commission's unitization order will not go into effect until the unitization plan is approved by at least 80 percent of the owners of the pore space in the unit.[94]

North Dakota's approach to pore space unitization is similar in some respects to Colorado's oil and gas pooling statute. North Dakota requires storage operators to make "a good-faith effort to get the consent of all persons who own the storage reservoir's pore space," obtain consent from at least 60 percent of the pore space owners, and equitably compensate all nonconsenting pore space owners.[95] If the operator satisfies these criteria and other permitting requirements, North Dakota's Industrial Commission is authorized to issue a pore space unitization order.[96]

Kentucky similarly requires storage operators to conduct good-faith negotiations with pore space owners prior to unitization. If an agreement with all necessary owners cannot be negotiated, Kentucky's oil and gas agency may order forced unitization if the storage operator has obtained written consent from at least 51 percent of the relevant pore space owners.[97]

The Montana legislature enacted contingent statutory provisions that will go into effect if Montana is granted Class VI primacy. Among these provisions is a statute authorizing the oil and gas board to order unitization for long-term storage of CO_2 upon the application of persons holding 60 percent of the pore space rights in the proposed storage area.[98] The board will grant the unitization order if it determines that it is (1) necessary for the long-term storage of carbon dioxide; (2) the value of the operation exceeds the estimated additional costs of unitization; and (3) "the full areal extent of the project has been reasonably defined and determined by drilling operations, geologic interpretation, seismic information, or other information acceptable to the board."[99]

Considerations for unitization legislation

These statutes illustrate a number of considerations that will be important if the General Assembly determines that pore space unitization legislation would help facilitate an effective Class VI program in Colorado. For example:

- Should the state authorize involuntary unitization?
- If so, should a threshold percentage of consenting owners be required, and what percentage?
- Should storage operators be required to first engage in good faith negotiations with all affected pore space owners?
- How will the storage area be measured to determine allocation of costs and revenues among owners?

Eminent Domain

Eminent domain is another potential mechanism for amalgamating property rights for carbon sequestration. The Colorado Constitution authorizes eminent domain, defined as the taking of private property for public use, provided that just compensation is paid to the property owner.[100] If carbon sequestration is deemed to be in the public interest (typically through a legislative declaration), the state could exercise eminent domain to acquire sufficient pore space for storage areas.

Colorado has also statutorily vested private actors, such as oil and gas pipeline companies, with the authority to exercise eminent domain.[101] The General Assembly could enact legislation recognizing carbon sequestration as being in the public interest and authorizing storage companies to exercise eminent domain to acquire pore space from nonconsenting owners. Additionally, it is currently unclear whether current gas pipeline statutes authorize pipeline companies to exercise eminent domain for pipelines carrying CO_2.[102] It may be prudent to consider whether legislative action is warranted to address that ambiguity.

If the General Assembly authorizes the use of eminent domain for CCS, it will become necessary to determine how to value pore space to determine what constitutes just compensation. Prices used in private agreements for the conveyance of pore space in Colorado and elsewhere may be instructive.

91 Wyo. Stat. § 35-11-314.
92 Wyo. Stat. § 35-11-315.
93 Wyo. Stat. § 34-11-316.
94 Id.
95 .D. Cent. Code § 38-22-08.
96 N.D. Cent. Code § 38-22-10.
97 Ky. Rev. Stat. §§ 353.806 to 808.
98 Mont. Stat. § 82-11-204 (contingent).
99 Mont. Stat. 82-11-205 (contingent).
100 Colo. Const. Art. 2 § 15.
101 *See, e.g., Akin v. Four Corners Encampment*, 179 P.3d 139, 145 (Colo. App. 2007); C.R.S. §§ 38-1-102; 38-1-202; 38-4-102; 38-1-101.5; 38-5-104.
102 Koski, K., Richardson, J., Righetti, T., Taylor, S., Study on States' Policies and Regulations, supra note 65, pg 26, 134.

Liability Issues

Due to their unique duration—storing carbon in perpetuity—as well as the potential size of the storage area—covering significantly larger areas than Class II wells—Class VI projects raise novel liability issues that policymakers should consider in order to create a safe and effective Class VI program. Among these concerns are induced seismicity and long-term site stewardship and liability.

Induced Seismicity

As more CO_2 storage projects progress, it will be important to manage any potential hazards of induced seismicity. However, induced seismicity related to active CO_2 sequestration projects (including Class VI and EOR) has generally been limited to small magnitude events and has generally not been felt on the surface.[103]

The Class VI Rule requires that the permit include information on seismic history including the presence and depth of seismic sources and a determination that the seismicity will not interfere with the containment of the CO_2.[104] If induced seismicity is a concern for the project, based on site characterization and modeling, it should be addressed in the emergency and remedial response plan. Monitoring strategies may also be incorporated, and the maximum injection pressure allowed could be reduced.[105] In addition, geomechanical analysis and modeling can be required by the UIC program for a specific project if it will help reduce risk of induced seismicity.

The COGCC has contemplated induced seismicity in regards to Class II injection wells and has established rules to prevent induced seismicity. Rules 801.d, 803.f.(1), 803.g.(6), and 810.b[106] are intended to prevent induced seismicity, which could otherwise create safety risks, by prohibiting injection in proximity to the Precambrian basement, limiting injection volumes to reduce induced seismicity risks, and requiring seismicity evaluations as a component of injection well permitting. Analogous rules could be implemented, or the existing rules amended to include Class VI injection wells, for the administration of a Class VI program.

Long-Term Site Stewardship and Liability

Because geologic sequestration projects are intended to sequester carbon in perpetuity, it is crucial that a state's Class VI program plans for long-term site stewardship and liability. Class VI projects are intended to remain in place for hundreds, if not thousands, of years. Therefore, policymakers must consider who will conduct long-term site monitoring, as well as who will be responsible for remediation of leaks, subsurface trespass, or claims for personal injury or property damage after the site has been closed, among other potential liabilities.

The Safe Drinking Water Act (SDWA) and the Class VI Rule do not provide the EPA with the authority to transfer site liability or release the operator from long-term responsibility after site closure.[107] This creates a valid concern for potential operators of sequestration sites due to the uncertainties of long-term site maintenance. The risk of remaining liable for sites in perpetuity may present a barrier to investment in Class VI projects.[108] Additionally, operators and companies do not exist in perpetuity, which creates another obstacle for long-term site stewardship and a state concern for future orphaned sequestration sites.[109] On these grounds, it is reasonable and common for states to establish mechanisms for long-term site care and monitoring of geologic sequestration sites.

The proper role of a state government in long-term site stewardship is a debated issue.[110] A National Petroleum Council report summarizes some options that have been proposed for long-term liability concerns.[111] These options generally contemplate the transfer of ownership and liability from the storage operator to the government post-closure. In considering such policies, key factors include the timing and scope of the transfer of site liability or facility ownership and the funding of long-term site stewardship by the state.

Class VI projects are anticipated to extend after injection ceases until an operator can prepare a technical demonstration that provides evidence that the CO_2 plume has stabilized and ensures that USDWs are not at risk. At this time, site closure may be considered and approved by the Class VI program and the transfer of liability or ownership of the geologic sequestration site from the operator to the state may occur. It is critical that site liability or ownership is

103 State Oil and Gas Regulatory Exchange, Potential Induced Seismicity Guide: A Resource of Technical & Regulatory Considerations Associated with Fluid Injection, 2021, pg 210, Accessed October 2021. https://www.gwpc.org/sites/gwpc/uploads/documents/publications/FINAL_Induced_Seismicity_2021_Guide_33021.pdf

104 40 C.F.R. § 146.82(a)(3)(v).

105 EPA.gov, Underground Injection Control (UIC) Program Class VI Implementation Manual for UIC Program Directors, supra note 14, pg 4-22 and 4-37.

106 COGCC.state.co.us, 800 Series-Underground Injection for Disposal and Enhanced Recovery Projects, Accessed October 2021. https://cogcc.state.co.us/documents/reg/Rules/LATEST/800%20Series%20-%20Underground%20Injection%20for%20Disposal%20and%20Enhanced%20Recovery%20Projects.pdf

107 EPA.gov, Underground Injection Control (UIC) Program Class VI Financial Responsibility Guidance, July 2011, pg 4, Accessed October 2021. https://www.epa.gov/sites/default/files/2015-06/documents/uicfinancialresponsibilityguidancefinal072011v.pdf

108 Great Plains Institute, Regional Carbon Dioxide (CO_2) Transport Infrastructure Action Plan, pg 9, October 12, 2021, Accessed October 2021. https://www.betterenergy.org/wp-content/uploads/2021/10/Regional-CO_2-Transport-Infrastructure-MOU-Action-Plan.pdf

109 IOGCC.ok.gov, Guidance for States & Provinces on Operational & Post-operational Liability of Geologic Storage, September 2014, pg 42, Accessed October 2021. https://iogcc.ok.gov/sites/g/files/gmc836/f/documents/2021/guidance_for_states_and_provinces_on_operational_and_post_operational.pdf

110 Global CCS Institute, Lessons and Perceptions: Adopting a Commercial Approach to CCS Liability, pg 27, 2019, Accessed October 2021. https://www.globalccsinstitute.com/wp-content/uploads/2019/08/Adopting-a-Commercial-Appraoch-to-CCS-Liability_Thought-Leadership_August-2019.pdf

111 National Petroleum Council, Meeting the Dual Challenge, A Roadmap to At-Scale Development of Carbon Capture, Use, and Storage, Chapter Three-Policy, Regulatory, and Legal Enablers, updated March 12, 2021, pg 3-15 - 3-17, Accessed October 2021. https://dualchallenge.npc.org/files/CCUS-Chap_3-030521.pdf

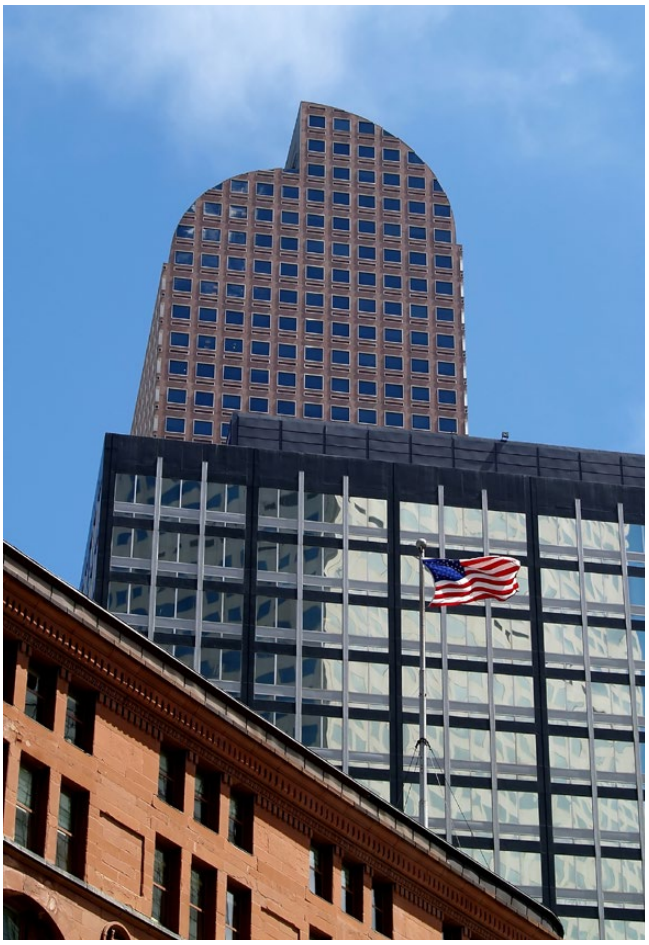
not transferred prior to site closure, in order to ensure that the operator demonstrates that the sequestered CO_2 presents no risks to USDWs.

In existing Class VI programs, it is common to create a state injection fund to provide funding for long-term monitoring and maintenance of a geological sequestration site after site closure. As described earlier in this report, states, including North Dakota, Wyoming, and Louisiana, have created state trust funds that are fully or partially financed through a fee based on the amount of CO_2 injected. Funds such as these provide long-term financial assurance for monitoring and managing sequestration sites after site closure.

The scope of the liability or ownership transfer is an essential consideration. States have taken varying approaches to this issue. Despite creating a long-term sequestration special revenue account, Wyoming does not assume the liability of geologic sequestration sites. Per Wyoming statute 35-11-318(d), "the existence, management and expenditure of funds from this account shall not constitute a waiver by the state of Wyoming of its immunity from suit, nor does it constitute an assumption of any liability by the state for geologic sequestration sites or the carbon dioxide and associated constituents injected into those sites." Louisiana does assume ownership of the stored CO_2 at a sequestration facility at site closure but has also enacted some provisions to protect the state.[112] Louisiana will not assume ownership if the trust fund has inadequate funds to perform post-closure site stewardship or if the operator has intentionally or knowingly concealed or misrepresented material facts about the sequestration site. In addition, the statute also provides that liability of the site is not transferred by the mere act of assuming ownership after site closure and that the state will not be expected to pay any costs beyond the funds collected for site stewardship. Careful consideration should be given to the scope of liability or ownership transfer to ensure that the state is protected from major costs associated with long-term sequestration site stewardship.

Class II Wells: Implications for Class VI Projects

UIC Class II wells are oil and gas related injection wells that include both disposal and EOR wells. Presently, Class II wells in Colorado are actively storing and disposing of CO_2 in the subsurface. Some of these projects may qualify for 45Q tax credits through Subpart RR of the Greenhouse Gas Reporting Program. Depending on how individual Class II projects progress, there may be a need to transition an existing Class II well to a Class VI well—recognizing, however, that the two injection programs serve different purposes.



The COGCC, through a 1425 primacy program with the EPA, implements the UIC Class II program and regulates Class II wells for the state of Colorado. As of January 13, 2021, this program had 977 wells (422 disposal wells and 555 EOR injection wells).

Disposal wells comprise over 40% of the active Class II wells in Colorado. Per 40 C.F.R. § 146.5(b)(1) and COGCC Rule 808.a.(3), CO_2 disposal in a Class II well is allowed as long as the CO_2 is considered non-hazardous and is brought to the surface in connection with oil and natural gas production. Active Class II disposal wells may be used for CO_2 disposal if the CO_2 meets the definition of an exploration and production waste (E&P Waste).[113] In the DJ Basin, several of the existing disposal wells inject into the Lyons Formation, which may be a future target for Class VI wells. Additionally, an Operator has recently submitted a permit application for a Class II disposal well in the North Park Basin, where a natural occurrence of CO_2 associated with hydrocarbons exists. Existing Class II disposal wells and associated infrastructure may be a resource for future Class VI projects.

112 La. Rev. Stat. § 30:1109.
113 C.R.S. § 34-60-103(4.5); COGCC.state.co.us, 100 Series, Definitions, Exploration and Production Waste, Accessed October 2021. https://cogcc.state.co.us/documents/reg/Rules/LATEST/100%20Series%20-%20Definitions.pdf

Class II enhanced recovery wells inject produced water, brine, freshwater, steam, polymers, or carbon dioxide into hydrocarbon bearing formations to recover additional oil and natural gas.[114] The state of Colorado has 555 EOR injection wells in 63 active EOR projects. The majority of EOR projects in Colorado primarily use produced formation water to displace oil in the formation in order to increase production and recoverable hydrocarbons. The Rangely Weber Sand Unit, located in northwestern Colorado, is the only active CO_2 EOR project in the state of Colorado. The CO_2 for the project originates near Labarge, Wyoming[115] and travels 178 miles via pipeline to Rangely Field. As of September 2021, the project includes 274 active injection wells and 316 active production wells, although these numbers can fluctuate throughout the year. As carbon capture technologies progress, there may be potential for additional anthropogenic CO_2 to be added to this project.

Class II EOR wells that store CO_2 in the subsurface may be required to transition to a Class VI well depending on several factors listed in federal rule 40 C.F.R. § 144.19 (Transitioning from Class II to Class VI). The determining factors for the transition to a Class VI well from a Class II well include increased reservoir pressure, decreased production rates, suitability of Class II regulations, and the source of injected CO_2. The most direct indication of increased risk is increased pressure in the injection zone due to significant quantities of stored CO_2.[116] The UIC program shall determine when there is increased risk to USDWs and require a Class VI permit. With this in mind, a portion of the existing infrastructure and wells associated with current and future Class II EOR injection projects may serve as a resource for future Class VI sequestration projects.

Aquifer Exemptions

An aquifer exemption[117] is allowed by the EPA when certain criteria are met for aquifers that do not currently serve as a source of drinking water and will not serve as a source in the future. Class VI permitting does not allow for new aquifer exemptions[118] but it does allow for the expansion of existing Class II EOR aquifer exemptions for Class VI Projects.[119] For Class I-V UIC wells, including Class II wells, an aquifer that does meet the definition of USDW[120] may be determined to be an exempted aquifer if it meets the criteria in 40 C.F.R. § 146.4.a.-146.4.c. Aquifer exemptions associated with existing Class II EOR projects may potentially be utilized and expanded in the future for use in a Class VI project.

Pipelines

The need to transport CO_2 is expected to increase significantly as CCUS projects become more prevalent in order to reduce CO_2 emissions and meet climate goals. Therefore, reliable transport from CO_2 sources to sequestration sites is important for the success of Class VI projects. Transport of CO_2 can be done either through the use of existing pipelines or the construction of new pipeline systems.

Transportation of CO_2 through pipelines has been successfully carried out in Colorado for many years, primarily for use in EOR projects. As previously described, CO_2 is already transported by pipeline and injected underground for EOR in Rangely Field in northwest Colorado. Additionally, CO_2 from a natural underground source in southern Colorado is transported through an interstate pipeline to EOR projects in west Texas.

The federal government has established minimum pipeline safety standards under 49 C.F.R. 190-199. The Office of Pipeline Safety (OPS), within the Pipeline and Hazardous Materials Safety Administration (PHMSA), has regulatory responsibility over the safety of hazardous liquid and gas pipelines under its jurisdiction in the United States. The OPS is the inspection and enforcement authority for all interstate pipelines and for liquid intrastate pipelines in Colorado. The OPS may delegate inspection and enforcement responsibilities for intrastate pipelines through a certification process and a 49 U.S.C. 60105 agreement.[121] The Colorado Public Utilities Commission's (COPUC) Gas Pipeline Safety Program has such an agreement with OPS for intrastate gas pipelines in Colorado.

The COGCC regulates the safety of flowlines related to oil and gas operations, which are defined by rule as a segment of pipe transferring oil, gas, or condensate between a wellhead and processing equipment to the load point or point of delivery to a PHMSA or COPUC regulated gathering line or a segment of pipe transferring produced water between a wellhead and the point of disposal, discharge, or loading.[122] Pipeline design and operation standards for transport of CO_2 are already included in COGCC rules. COGCC references the ASME (American Society of Mechanical Engineers)

114 EPA.gov, Class II Oil and Gas Related Injection Wells, Accessed October 2021. https://www.epa.gov/uic/class-ii-oil-and-gas-related-injection-wells#well_types
115 Parker M., Northrop S., Valencia J., Foglesong R., Duncan W., CO_2 Management at ExxonMobil's LaBarge Field, Wyoming, USA, Energy Procedia, Volume 4, 2011, Accessed October 2021. https://doi.org/10.1016/j.egypro.2011.02.531.
116 EPA.gov, Key Principles in EPA's Underground Injection Control Program Class VI Rule Related to Transition of Class II Enhanced Oil or Gas Recovery Wells to Class VI, April 23, 2015, Accessed October 2021. https://www.epa.gov/sites/default/files/2020-08/documents/class2eorclass6memo_0.pdf
117 EPA.gov. Aquifer Exemptions in the Underground Injection Control Program, Accessed October 2021. https://www.epa.gov/uic/aquifer-exemptions-underground-injection-control-program
118 40 C.F.R. § 144.7.
119 40 C.F.R. § 146.4(d); 40 CFR § 144.7(d).
120 40 C.F.R. § 144.3.
121 PHMSA.dot.gov, Gas Transmission and Hazardous Liquid Pipeline Safety Program Participating States, October 2021, Accessed October 2021. https://www.npms.phmsa.dot.gov/Documents/CoopAgreementsMap.pdf
122 COGCC.state.co.us, 100 Series, Definitions, Flowline, supra note 113.

Pipeline codes in its Flowline Regulations[123], which includes transport of CO_2. If Colorado pursues Class VI primacy, flowlines related to Class VI sequestration projects could be regulated similarly to oil and gas flowlines.

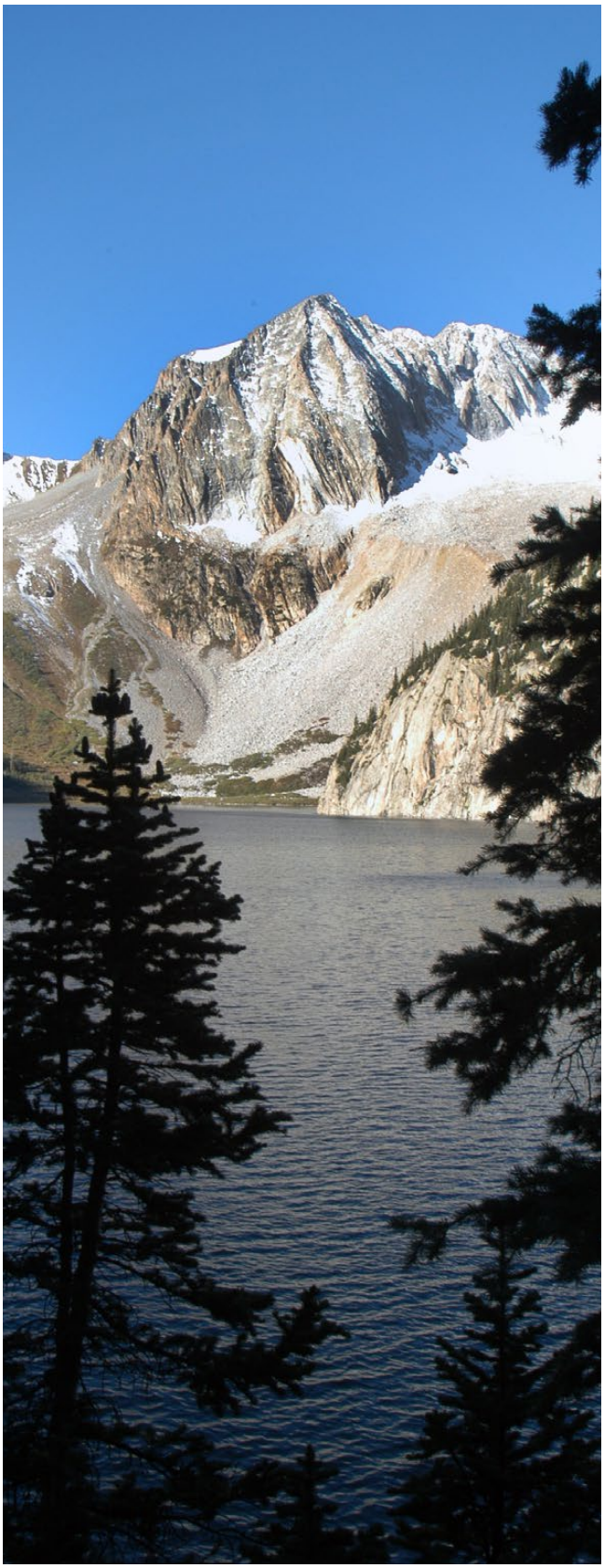
In order to ensure Class VI project feasibility and increase project efficiency, consideration should be given to establishing pathways for pipeline development, consolidating the regulation of pipelines, and developing strategies to provide clarity in the process. For example, the Wyoming Pipeline Corridor Initiative[124] aims to establish pipeline corridors for future use in CCUS. The Great Plains Institute is coordinating an effort to develop a Regional CO_2 Transport Infrastructure Action Plan[125] that includes potential policies for states to consider. Additional research and outreach would be warranted to determine how best to approach pipeline corridors and regulation. As CCUS projects transition from feasibility to permitting and planning, pipeline regulation and policy will impact the feasibility and implementation of Class VI sequestration projects. For additional recommendations related to pipelines, refer to the forthcoming CCUS Task Force Report prepared by the Colorado Energy Office.

Class VI Rules and Rulemaking

The EPA has established federal requirements for Class VI wells that set the minimum technical criteria for the purposes of protecting USDWs. A state UIC Class VI program is required to have statutes and regulations that are at least as stringent as the federal requirements.

For a state primacy application to be approved, the state must already have statutes and technical rules in place. Therefore, a Class VI rulemaking at the COGCC would be required prior to submitting a primacy application. Any Class VI rulemaking will need to be conducted in accordance with the Colorado Administrative Procedure Act, 24-4-101 to 24-4-108, C.R.S. A COGCC rulemaking must also comply with COGCC Rule 529, which establishes procedures for Commission rulemakings and facilitates robust stakeholder participation.

At times, the EPA may require changes in rules before approving an application. This can lead to additional, smaller rulemakings and delays in application approval. In order to speed the primacy review process, the EPA recommends using the majority of language in the federal regulations verbatim. With that said, the state will want the flexibility to add or adjust rule language to better accommodate the needs of Colorado.



123 COGCC.state.co.us, 1100 Series, Flowline Regulations, Accessed October 2021. https://cogcc.state.co.us/documents/reg/Rules/LATEST/1100%20Series%20-%20Flowline%20Regulations.pdf

124 WYOENERGY.org, Wyoming Pipeline Corridor Initiative, Accessed OCtober 2021. https://www.wyoenergy.org/portfolio/projects/wyoming-pipeline-corridor-initiative/

125 Great Plains Institute, Regional Carbon Dioxide (CO_2) Transport Infrastructure Action Plan, supra note 46 and 108.

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