REPORT TO CONGRESS

FRAMEWORK FOR GEOLOGICAL CARBON SEQUESTRATION ON PUBLIC LAND

In Compliance with Section 714 of the Energy Independence and Security Act of 2007 (P.L. 110-140, H.R.6)

Submitted to the Committee on Natural Resources of the House of Representatives and the Committee on Energy and Natural Resources of the Senate

Prepared by the U.S. Department of the Interior (DOI) in Consultation with the Department of Energy (DOE) and the Environmental Protection Agency (EPA) and U.S. Geological Survey (USGS)

Table of Contents

Energy Independence and Security Act of 2007

SEC. 714. FRAMEWORK FOR GEOLOGICAL CARBON SEQUESTRATION ON PUBLIC LAND.

(a) REPORT.—Not later than 1 year after the date of enactment of this Act, the Secretary of the Interior shall submit to the Committee on Natural Resources of the House of Representatives and the Committee on Energy and Natural Resources of the Senate a report on a recommended framework for managing geological carbon sequestration activities on public land.

(b) CONTENTS.—The report required by subsection (a) shall include the following:

(1) Recommended criteria for identifying candidate geological sequestration sites in each of the following types of geological settings:

(A) Operating oil and gas fields.

(B) Depleted oil and gas fields.

(C) Unmineable coal seams.

(D) Deep saline formations.

(E) Deep geological systems that may be used as engineered reservoirs to extract economical quantities of heat from geothermal resources of low permeability or porosity.

(F) Deep geological systems containing basalt formations.

(G) Coalbeds being used for methane recovery.

(2) A proposed regulatory framework for the leasing of public land or an interest in public land for the long-term geological sequestration of carbon dioxide, which includes an assessment of options to ensure that the United States receives fair market value for the use of public land or an interest in public land for geological sequestration.

(3) A proposed procedure for ensuring that any geological carbon sequestration activities on public land—

(A) provide for public review and comment from all interested persons; and

(B) protect the quality of natural and cultural resources of the public land overlaying a geological sequestration site.

(4) A description of the status of Federal leasehold or Federal mineral estate liability issues related to the geological subsurface trespass of or caused by carbon dioxide stored in public land, including any relevant experience from enhanced oil recovery using carbon dioxide on public land.

(5) Recommendations for additional legislation that may be required to ensure that public land management and leasing

laws are adequate to accommodate the long-term geological sequestration of carbon dioxide.

(6) An identification of the legal and regulatory issues specific to carbon dioxide sequestration on land in cases in which title to mineral resources is held by the United States but title to the surface estate is not held by the United States.

(7)(A) An identification of the issues specific to the issuance of pipeline rights-of-way on public land under the Mineral Leasing Act (30 U.S.C. 181 et seq.) or the Federal Land Policy and Management Act of 1976 (43 U.S.C. 1701 et seq.) for natural or anthropogenic carbon dioxide.

(B) Recommendations for additional legislation that may be required to clarify the appropriate framework for issuing rights-of-way for carbon dioxide pipelines on public land.

(c) CONSULTATION WITH OTHER AGENCIES.—In preparing the report under this section, the Secretary of the Interior shall coordinate with—

(1) the Administrator of the Environmental Protection Agency;

(2) the Secretary of Energy; and

(3) the heads of other appropriate agencies.

(d) COMPLIANCE WITH SAFE DRINKING WATER ACT.—The Secretary shall ensure that all recommendations developed under this section are in compliance with all Federal environmental laws, including the Safe Drinking Water Act (42 U.S.C. 300f et seq.) and regulations under that Act.

Executive Summary

Geological carbon sequestration has been discussed as one potential approach to reducing greenhouse gases in our atmosphere. Sequestration of carbon in geological formations on public lands presents many challenges, and it is essential that those challenges be recognized in developing a regulatory framework.

First, a proposed regulatory framework must recognize carbon dioxide (CO_2) as a commodity, resource, contaminant, waste, or pollutant. Unlike most other resources that are managed, CO_2 is a material that is either being stored for disposal or is extracted for use. CO_2 is currently leased under the Mineral Leasing Act (MLA) for uses such as refrigeration (in its solid form as dry ice), fire extinguishers, and carbonation of water and soft drinks. CO_2 also is used to enhance oil recovery which to some extent results in its sequestration. It is also important to recognize that any discussion addressing the geologic sequestration of "carbon dioxide" must distinguish between pure CO_2 and CO_2 mixed with other gases such as hydrogen sulfide, carbon monoxide, methane, and oxides of nitrogen and sulfur. These impurities have the potential to impact the economics, technical feasibility, location preferences, land use planning requirements, environmental impact mitigation, multiple-resource conflict potential, and regulatory oversight of geologic CO_2 sequestration. Impurities in CO_2 impact its value as a commodity, as well as its behavior in storage.

Second, carbon sequestration may potentially conflict with other land uses including existing and future mines, oil and gas fields, coal resources, geothermal fields, and drinking water sources. For example, sequestration in a formation would limit all future possibility of extracting minerals from the formation without some risk of venting the captured CO_2. Carbon sequestration could also have potential impacts on other surface land uses and programs such as recreation, grazing, cultural resource protection, and community growth and development. These impacts need to be addressed.

Third, a proposed statutory and regulatory framework must recognize the long-term liability of any permitting decision to sequester CO_2 and the required commitment for stewardship of facilities over an extended period of time. The scope of liability and term of stewardship will be among the longest ever attempted, lasting up to thousands of years or more. This may prove to be a potential limiting factor for siting, transportation, processing, and storage on Federal lands given the Bureau of Land Management's (BLM) multiple-use mission for long-term management of the public lands.

Many existing Federal statutes and regulations potentially apply to some aspect of the management of geologic sequestration of CO_2. These include management of other resources, waste disposal, groundwater protection, and human health and safety. However, due in part to the many unique challenges discussed above, gaps may exist in the current laws and limit our ability to address the range of circumstances, scope of potential liability, required timeframe of stewardship, and regulatory primacy differences between the states and Federal Government.

It must be recognized that effective risk management of any geologic sequestration decisionmaking and regulation of consequent activity is limited by the current state-of-the-art of scientific assessment, monitoring, measurement, verification, and mitigation of any potential undesirable consequences occurring on or beneath the surface of the land. Additional investment in ongoing scientific and engineering research will be essential as geological sequestration is a rather new option to reduce greenhouse gas emissions.

While a number of challenges will need to be evaluated, we do have information that can inform such future discussions. For example, we have the results of research at sites at which large quantities of CO_2 have been injected for as many as 12 years and have operated safely and shown no signs of CO_2 leakage.

Lastly, geological carbon sequestration on split estate lands or lands where the surface is managed by other Federal agencies presents other complications due to ownership issues of pore space and limitations that may need to be placed on surface and subsurface uses to ensure integrity of storage.

The main body of this report displays the requirements of the Act as stated in section 714(b) and (d) in italic font followed by the agencies' recommendations, identifications, and descriptions in regular font.

Section 714(b):

(1) Recommended criteria for identifying candidate geological sequestration sites in each of the following types of geological settings:

(A) Operating oil and gas fields.

(B) Depleted oil and gas fields.

(C) Unmineable coal seams.

(D) Deep saline formations.

(E) Deep geological systems that may be used as engineered reservoirs to extract economical quantities of heat from geothermal resources of low permeability or porosity.

(F) Deep geological systems containing basalt formations.

(G) Coalbeds being used for methane recovery.

A. Geological Criteria

1. General Criteria

All prospective injection formations share common characteristics that could be used potentially as criteria for identifying candidate geological sequestration sites.

Injection zone: The injection zone is a layer or layers of porous rocks that is sufficiently porous to receive the CO_2 without fracturing and extensive enough to receive the anticipated total volumes of injected CO_2. Sufficient scientific data, such as geologic core data, outcrop data, seismic survey data, cross sections, well logs, and other data should exist to demonstrate the lateral extent and thickness, strength, capacity, porosity, and permeability of the subsurface formations. Structural features of a potential injection zone reservoir, such as the lateral extent, dip, or the presence of "pinch-outs" (i.e., thinning or tapering out), can affect storage potential and, therefore, should be examined.

Seal or cap: The injection zone should be overlain by a low-permeability confining system (or primary confining zone) consisting of a geological formation, part of a formation, or group of formations that prevents the injected fluid from migrating upwards out of the injection zone. The buoyancy of CO_2 necessitates good characterization of potential conduits for fluid migration upward through the confining system. The confining system should be of sufficient regional thickness and lateral extent to contain the entire CO_2 plume and associated pressure front under the confining system following the plume's maximum lateral expansion.

Geologic structure: The local geologic structure, including the presence of any faults and fractures that transect the confining zone, should be of a nature to not interfere with long-term containment of the CO_2. These types of features, if present, could potentially become conduits for movement of CO_2 or other fluids to shallower layers, depending on site-specific characteristics of fault stability and rock stress, ductility, and strength.

Seismic stability: The seismic history of the area must be understood and the risk of future earthquakes should not create the potential for disruptive fault movement and fracture dilation that may cause loss of seal integrity and subsequent leakage of the CO_2.

Induced seismicity: Underground injection wells, if improperly sited and operated, have the potential to induce seismicity, which may cause damage to reservoir and fault seals, creating conduits for fluid movement as well as other damage that earthquakes cause. The confining zone should be of sufficient integrity to sustain maximum injection pressures without deleterious effects. Geomechanical studies of fault stability, fracture systems, rock stresses and strength, based on examination and interpretation of geological maps and cross sections, seismic and well surveys, determination of local stress fields, and modeling, can also help exclude sites with unacceptably high potential for seismic activity (IPCC, 2005).

Geochemistry: The geochemistry of formation fluids can also affect whether a site is suitable for geologic sequestration. The CO_2 may act as a solvent and can mix with native fluids to form carbonic acid; carbonic acid can react with minerals in the formation. Dissolution of minerals may liberate heavy metals into the formation fluids. Reactions may also break down the rock matrix or precipitate minerals and plug pore spaces, thereby reducing permeability (IPCC, 2005).

Underlying science base: The site must be sufficiently accessible to allow collection of the necessary data to determine site suitability and monitoring should sequestration occur. For example, a parcel of suitable Federal land surrounded by extensive inaccessible land (public or private) may prevent the characterization of the full extent of the expected CO_2 injection plume.

Capacity: The site must have sufficient capacity to accept the volume of CO_2 expected for the life of the sequestration project. In November 2008, the Department of Energy (DOE), in conjunction with other Federal and state agencies, produced the second edition of the "National Carbon Sequestration Atlas" which estimated capacity for CO_2 sequestration in all regions of the Nation and Western Canada. In addition, the U.S. Geological Survey (USGS) is developing an enhanced assessment methodology for use in future assessments in accordance with Section 711 of the Energy Independence and Security Act of 2007 (EISA). The regional assessments provide context for site specific estimates based on geological information from the target sequestration area.

2. Formation-Specific Criteria

Operating oil and gas fields: Use of pure CO_2 to enhance the recovery of hydrocarbons on Federal leases is a well-established practice and is currently regulated under BLM and EPA authority. To the extent that injected CO_2 is stranded and not produced with the recovered hydrocarbons, it may be possible to permanently sequester CO_2 in the producing geologic horizon. Criteria are currently undefined for determining which oil and gas fields are suitable for sequestration, but all producing oil and gas fields are potentially suitable.

Depleted oil and gas fields: Depleted oil and gas fields are all potentially suitable for CO_2 sequestration. Criteria for depleted field acceptance should include, first, the extent to which abandoned wells may be plugged or demonstrated to be secure and, second, the lack of known leaks from the reservoir from sources such as reactivated faults, production-related subsidence, and seal damage from water-flood or hydraulic fracturing.

Unminable coal seams: Criteria to determine “unminability” have yet to be developed but would be based on economic and other factors. While it is certainly definable at the present using current economic factors, projection into the future for the centuries to millennia scale of carbon sequestration reservoirs is currently not determined.

Deep saline formations: The general geologic criteria above apply as well as the non-geologic criteria below.

Deep geological systems that may be used as engineered reservoirs to extract economical quantities of heat from geothermal resources of low permeability or porosity: The general geologic criteria require an injection formation of suitable porosity and permeability. By definition, low permeability or porosity geothermal systems are not suitable for sequestration of large volumes of CO_2.

Deep geological systems containing basalt formations: The general geologic criteria above apply as well as the non-geologic criteria below. Large volume flood basalts, however, can have unique characteristics of wide areal extent and many repeated porous layers. This raises the possibility of stacked reservoirs and potentially makes the demonstration of a suitable seal more critical and possibly more difficult. Planned tests are expected to significantly increase the knowledge base in these formations.

Coalbeds being used for methane recovery: The general geologic criteria above apply as well as the non-geologic criteria below. The permeability criterion is potentially affected by fractures or cleats and by coal rank (degree of alteration or maturity). Coal also has characteristics which may negatively affect injectivity over time and positively affect immobilization of the CO_2. The future minability of the target coal seam is of critical importance as injection of CO_2 for both enhanced recovery of coalbed methane and CO_2 storage potentially degrades the economic value of coal. Future mining of coal used for sequestration similarly lowers or eliminates the value of the sequestration. The likely future of a coal seam is, therefore, a key determinant of its suitability for storage. Conflicts between mining, coalbed methane production, and CO_2 storage are possible, particularly for shallow coals.

B. Other Criteria

1. Effects of Impurities on Storage Capacity

Under the proposed Environmental Protection Agency (EPA) rules for Underground Injection Control (UIC) for CO_2 sequestration, impurities in amounts that exceed regulatory limits under other authorities are not allowed to be sequestered. Accordingly, only trace impurities will be in injected CO_2 streams and the effect on storage capacity will be minimal.

However, contaminants such as hydrogen sulfide are routinely co-injected with CO_2 in enhanced oil recovery operations. The EPA also issues Class 1 injection permits for contaminants such as hydrogen sulfide. Thus, it is possible that impurities in more than trace amounts may be injected on public lands in association with geologic sequestration. The presence of impurities in the CO_2 gas stream affects the engineering processes of capture, transport, and injection as well as the trapping mechanisms and capacity for CO_2 storage. Some contaminants in the CO_2 stream may require classification as hazardous, imposing different requirements for injection and storage than if the stream were pure. Gas impurities in the CO_2 stream affect the compressibility of the

injected CO_2 and reduce the capacity for storage because of the storage space taken by these gases. In addition, depending on the type of geological storage, the presence of impurities may cause reduction or enhancement of permeability or mobilization of otherwise immobile of heavy metals or other materials.

In the case of CO_2 storage in coal seams, impurities may also have a positive or negative effect, similar to enhanced oil recovery (EOR) operations. If a stream of gas containing hydrogen sulfide or sulfur dioxide is injected into coal beds, these components will likely be preferentially adsorbed because both have a higher affinity to coal than CO_2, thus reducing the storage capacity for CO_2. If oxygen is present, it will react irreversibly with the coal, reducing the sorption surface and, hence, the adsorption capacity. On the other hand, some impure CO_2 waste streams, such as coal-fired flue gas, may be used for enhanced coalbed methane recovery because the CO_2 is stripped out or retained by the coal reservoir due to the fact it has higher sorption selectivity than diatomic nitrogen and methane.

From a public lands perspective, the type and quantity of impurities in the transported, processed, and sequestrated CO_2 may have implications for multiple use, public health and safety, and environmental impacts, as well as other resource uses. Gaseous impurities include, but are not limited to, nitrogen, water vapor, oxygen, sulfur dioxide, nitrogen dioxide, carbon monoxide, and hydrogen sulfide. This may add an additional dimension to land use planning decisions and National Environmental Policy Act (NEPA).

2. Geographical Distribution and Storage Capacity Estimates on the Public Lands

The geographical distribution of carbon sequestration capacity on public lands is important for the efficient matching of CO_2 sources with economic sequestration formations. The second edition of the DOE Carbon Sequestration Atlas of the United States and Canada tabulated and mapped the major stationary sources of CO_2 and estimated the potential CO_2 capacity within prospective geologic formations. It also estimated that about 5.5 percent of the onshore U.S. CO_2 storage capacity is beneath potentially leasable Federal lands.

In addition, the USGS is developing methodology to assess probable CO_2 storage capacity as outlined in Section 711 of the EISA. Upon completion of the new USGS assessment methodology, it will be possible to distinguish between the capacity that could be identified as usable with present-day technology and conditions and the remaining much larger, but less well-characterized, in-place resource as estimated in the DOE's Atlas. Use of the new methodology will allow refinement of the estimates presented in the Atlas as well as incorporation of uncertainty in capacity estimates. Having refined estimates will assist policy and decisonmakers in the future as they address mitigation strategies for CO_2 emissions and the role of public lands in those policy decisions.

3. Federal Lands and Land Use Planning Implications

Criteria for geologic sequestration recognizing the multiple uses of Federal lands include potential interference with other uses and resources, as well as future uses and resources yet unknown or yet to be discovered, long land use planning cycles, a strong technical basis to support decisionmaking, and historical uses of the land.

Potential resource interferences include existing and future mines, oil and gas fields, coal resources, geothermal fields, and drinking water sources. The criteria and processes for determining the most appropriate land use are contained in existing land management statutes and regulations and can be logically extended to include the additional use of geologic sequestration. The land may be withdrawn for other uses such as military or other Federal priorities. At the present time, it is assumed that sequestration will not take place on lands otherwise reserved. Federal land and resource use planning typically involves long time cycles and may involve extensive environmental reviews under NEPA. Again, the current statutory authority may be used to perform the required reviews, including stakeholder participation. For informed land use planning to take place, prospective sequestration sites must have a sufficiently developed technical basis and understanding of their geologic characteristics. The criteria above can be used to develop the information needed for adequate planning.

It is anticipated that Reasonable Foreseeable Development Scenarios (RFDS), analogous to those currently developed for oil and gas, will be used to project long-term activities related to geologic sequestration on the public lands. Such scenarios assume that all potentially suitable areas will be open under standard terms and conditions except those that are closed by law, regulation, or Executive Order. RFDS used as supporting information for planning decisions are a critical part of the NEPA analysis under the various alternatives associated with land use plan development and are published as a stand-alone report. However, the in-house technical data and expertise to perform these projections for geologic sequestration is currently quite limited and may require that special attention be paid to ensuring adequate organizational resources and investment into further research.

(2) A proposed regulatory framework for the leasing of public land or an interest in public land for the long-term geological sequestration of carbon dioxide, which includes an assessment of options to ensure that the United States receives fair market value for the use of public land or an interest in public land for geological sequestration.

Currently, there is no specific statutory authority for leasing public land or an interest in public land for the long-term sequestration of CO_2. However, there are several existing authorities that could be used under various circumstances to authorize CO_2 sequestration activities. Determination of the authority available to approve a project depends on the particular circumstances of that project, including ownership of the surface and mineral estates. However, these existing authorities, and their implementing regulations, provide flexibility and opportunity

to receive fair market value for the use of public land or an interest in public land for geological CO_2 sequestration. In addition, there is existing authority and regulation for managing pipelines, roads, and other infrastructure. These existing authorities are not likely to address all the unique issues that carbon sequestration presents, and specific statutory authority may be preferred.

A. Existing authorities available for regulating and managing long-term geological sequestration

Cooperative or unit plan of development: The Mineral Leasing Act (MLA) allows for lessees to join together and collectively operate under a cooperative or unit plan of development where it is determined by the Secretary of the Interior to be necessary or advisable in the public interest.[1] There are unit plans of development in operation today that utilize the injection of CO_2 into the producing formation for the enhanced recovery of the oil resource (EOR). Such EOR unit plans of development are a form of geological carbon sequestration, as the oil producing formation is flooded with CO_2 to transport the oil to the surface. That CO_2, injected into the producing formation and remaining behind, is sequestered. Such units could be modified in their terms and operation to more effectively sequester CO_2 as the oil recovery operations wind down; that is, continue to inject CO_2 after the oil resource is essentially fully produced until the formation is at or just below its original pressure. Such operations could continue under the authority of the MLA up to the point that hydrocarbons are no longer being produced.

When considering the conversion of EOR projects into sequestration efforts, it is worth noting that well integrity requirements for CO_2 sequestration purposes may be much more rigorous than current requirements for oil and gas wells. Existing plugged, abandoned, and orphaned wells within a proposed geologic sequestration area would require reevaluation for integrity and, if necessary, remediated and/or re-plugged to meet the more rigorous requirements. Conversion also would require an entity to take responsibility for the sequestration phase – potentially outside the expertise or interest of extractive industries.

Gas storage agreement: The MLA also allows the Secretary to approve the subsurface storage of gas, whether or not the gas is produced on federally owned lands or whether or not the lands are leased, in order to promote conservation of resources.[2] Such gas storage agreements are used

[1] 30 U.S.C. 226(m) "Cooperative or unit plan; authority of Secretary of the Interior to alter or modify; communitization or drilling agreements; term of lease, conditions; Secretary to approve operating, drilling or development contracts, and subsurface storage…

"For the purpose of more properly conserving the natural resources of any oil or gas pool, field, or like area, or any part thereof…lessees thereof and their representatives may unite with each other…in collectively adopting and operating under a cooperative or unit plan of development or operation of such pool, field, or like area, or any part thereof, whenever determined and certified by the Secretary of the Interior to be necessary or advisable in the public interest…"

[2] 30 U.S.C. 226(m) "Cooperative or unit plan; authority of Secretary of the Interior to alter or modify; communitization or drilling agreements; term of lease, conditions; Secretary to approve operating, drilling or development contracts, and subsurface storage…

today for the temporary storage of produced natural gas in order to balance production rates and address delivery issues. However, the broad language of the MLA could allow for the use of gas storage agreements to authorize long-term geological sequestration in order to promote conservation of resources.

It is important to note that some existing and potential underground gas storage facilities may not be viable for CO_2 sequestration use over the required long timeframes currently envisioned for geological sequestration.

2920 authorizations: The Federal Land Policy and Management Act (FLPMA) authorizes the Secretary of the Interior to issue leases, permits, and easements for the use, occupancy, and development of the public lands.[3] The regulations implementing this authority are at 43 CFR 2920. The statute and regulations are sufficiently broad to allow for a variety of authorizations related to geologic sequestration and related activities while sufficiently flexible in form and terms to accommodate many different actions and activities, including surface and subsurface rights-of-way and leases for subsurface storage. Such land use authorizations may be issued for any use not specifically authorized under other laws or regulations and not specifically forbidden by law, including uses that cannot be authorized as rights-of-way under Title V of the FLPMA or Section 28 of the MLA.

B. Open issues

Liability: Liability under the authorities cited above is a complicating factor in the development of CO_2 sequestration projects. Liability is also an issue that is directly connected to the issue of the ownership of the subsurface pore space.

Liability, as an issue, is further complicated by the length of time contemplated for long-term geologic sequestration. For how many years are any agreements, leases, permits, or rights-of-way granted and maintained? What amount and type of bonding or other financial considerations are incorporated into the authorization and their regulation, and for what period of time?

"…The Secretary of the Interior, to avoid waste or to promote conservation of natural resources, may authorize the subsurface storage of oil or gas, whether or not produced from federally owned lands, in lands leased or subject to lease under this chapter…."

[3] 43 U.S.C. 1732(b) "Easements, permits, etc., for utilization through habitation, cultivation, and development of small trade or manufacturing concerns; applicable statutory requirements…

"In managing the public lands, the Secretary shall, subject to this Act and other applicable law and under such terms and conditions as are consistent with such law, regulate, through easements, permits, leases, licenses, published rules, or other instruments as the Secretary deems appropriate, the use, occupancy, and development of the public lands…."

Where CO_2 sequestration is authorized on Federal lands by lease, permit, or right-of-way, who has ownership of the CO_2 and the liability at the end of the term of that lease, permit, or right-of-way? Will the Federal Government assume ownership of the CO_2 and, therefore, any future liability?

Who is liable for any potential migration or leakage of CO_2 and the impacts to subsurface and surface resources during the course of any lease, permit, or right-of-way and after its expiration? Will the Federal Government be indemnified for any damage to subsurface and surface resources after the expiration of the lease, permit, or right-of-way?

What surface or subsurface uses would need to be limited to ensure proper storage? How would unauthorized uses that have the potential to disturb proper storage be addressed? It is possible that sequestration sites would be "exclusive use" areas depending on liability issues that may be presented.

(3) A proposed procedure for ensuring that any geological carbon sequestration activities on public land--

> *(A) provide for public review and comment from all interested persons; and*
>
> *(B) protect the quality of natural and cultural resources of the public land overlaying a geological sequestration site.*

The BLM's Resource Management Plans (RMP) form the basis for every action and approved use on the public lands, including 258 million acres of surface lands and 700 million acres of mineral estate. Land use planning emphasizes a collaborative environment in which local, state, and tribal governments, the public, user groups, and industry work with the BLM to identify appropriate multiple uses of the public lands.

Where sequestration activities are proposed, plan amendments will be needed to identify the suitability of public lands within the planning area, analyze environmental impacts as a part of the NEPA process, protect or mitigate damage to other surface or subsurface resources whether natural or cultural, and provide for public review and comment. The existing planning process can be used to engage the various publics when contemplating CO_2 sequestration activities.

(4) A description of the status of Federal leasehold or Federal mineral estate liability issues related to the geological subsurface trespass of or caused by carbon dioxide stored in public land, including any relevant experience from enhanced oil recovery using carbon dioxide on public land.

It is unclear as to how liability will be determined and mediated. The question of liability will potentially involve the impacts, both surface and subsurface, on other resource estate, takings, geophysical trespass, use trespass, access, damages or degradation, economic loss, prior rights,

and eminent domain reconciliation. In establishing any leasing arrangements, the long time horizons involved in geologic sequestration of carbon may require further analysis of appropriate risk and cost sharing mechanisms. Sequestration sites will require design and monitoring so as to accommodate stable and safe storage for thousands of years. Liability is further complicated by the fact that sequestered CO_2 may contain contaminants such as hydrogen sulfide, oxides of sulfur and nitrogen, carbon monoxide, mercury, and others, and sequestration activities may liberate contaminants from the reservoirs at depth.

On split estate lands or lands where the surface is managed by another agency, ownership or administrative responsibility of the pore space where the carbon would be stored greatly complicates liability and property issues. In addition, impacts to other mineral interests need to be evaluated as the long-term nature of sequestration could foreclose future options for extraction and using future technologies.

Use of EOR in areas of historic production must be done carefully. A full inventory of existing boreholes must be conducted; any such existing boreholes must be evaluated for their ability to hold the pressures associated with EOR and reengineered as necessary. Failure of such existing infrastructure could lead to a significant release of CO_2, possibly posing a hazard to human health and safety and causing other environmental impacts. There is also potential for intrusion of CO_2 or other fluids into any freshwater aquifers that may be present. Again, in both of these instances, careful evaluation and remediation of existing boreholes and locating and plugging any abandoned or orphaned wells should prevent such problems.

(5) Recommendations for additional legislation that may be required to ensure that public land management and leasing laws are adequate to accommodate the long-term geological sequestration of carbon dioxide.

As noted at the beginning of this report, while the long-term nature of the stewardship commitments for these facilities, particularly the monitoring, verification, and remediation of sites presents challenges, current public land management and leasing laws may be adequate to authorize sequestration projects. For example, under FLPMA, the BLM has the authority to issue long-term leases. Legislative recommendations will follow under separate cover.

(6) An identification of the legal and regulatory issues specific to carbon dioxide sequestration on land in cases in which title to mineral resources is held by the United States but title to the surface estate is not held by the United States.

Where ownership of the surface and mineral estates is split, ownership of the pore space is an issue that determines which statutory and regulatory authorities can be used to authorize geologic sequestration activities.

Precedent established by court rulings has given rise to the American rule which holds that subsurface pore space is the property of the surface owner. However, some court cases appear to support the mineral estate owner as the owner of the subsurface pore space. Various state governments are considering action to establish the American rule as state law; Wyoming already has done so. The Interior Board of Land Appeals has also adopted the American rule in several cases. The procedures that could be followed are outlined below for split estate situations where only the minerals are federally owned, or where only the surface is federally owned.

1. Where the mineral estate is Federal but not the surface, CO_2 injection for the purpose of enhanced oil and/or natural gas recovery will be managed under the status quo procedures established under the MLA, as amended, usually under the aegis of unitization for secondary recovery. However, once enhanced recovery operations cease, any continued injection of CO_2 for sequestration purposes would no longer be a Federal undertaking if the American rule is followed. The BLM or other surface management agencies may participate in the EPA's permitting process for conversion of the injection wells from Class II to the newly proposed Class VI under the Safe Drinking Water Act's UIC program. Wells drilled solely for the purpose of sequestration would only be subject to Federal regulation under the EPA's UIC program if the American rule is applied. The operator would be liable to the Federal Government for any damages to its mineral estate caused by injection activities.

2. Where the surface is federally owned but the mineral estate is not, surface operations and drilling of CO_2 injection wells for either enhanced recovery or sequestration could be authorized through a lease or permit under the Section 302(b) of the FLPMA. The BLM or other surface management agency is authorized to charge rentals for the use of the surface for injection wells and other facilities and, if the American rule is applied, fees for the storage of the CO_2. The same issues would present complications as discussed above.

(7)(A) An identification of the issues specific to the issuance of pipeline rights-of-way on public land under the Mineral Leasing Act (30 U.S.C. 181 et seq.) or the Federal Land Policy and Management Act of 1976 (43 U.S.C. 1701 et seq.) for natural or anthropogenic carbon dioxide.

The BLM does not anticipate any issues related to the issuance of pipeline rights-of-way under the MLA or the FLPMA for natural or anthropogenic CO_2. Existing policy and guidance are adequate to address rights-of-way issuance under either Act.

(B) Recommendations for additional legislation that may be required to clarify the appropriate framework for issuing rights-of-way for carbon dioxide pipelines on public land.

The BLM does not anticipate that any additional legislation is required.

Section 714(d):

Compliance With Safe Drinking Water Act- The Secretary shall ensure that all recommendations developed under this section are in compliance with all Federal environmental laws, including the Safe Drinking Water Act (42 U.S.C. 300f et seq.) and regulations under that Act.

The BLM anticipates that all sequestration activities on public lands will be subject to regulation under the UIC program implemented by the EPA or state agencies that have received primary enforcement authority or primacy from EPA under the program. The proposed regulations published by the EPA on July 25, 2008, when finalized, would create a new Class VI well category under the existing UIC program with new Federal requirements to allow for permitting of the injection of CO_2 for the purpose of geological carbon sequestration. Primacy states would adopt these minimum requirements or could impose more stringent state standards than the Federal regulations in order to gain or retain primacy approval from EPA for their Class VI well program. The BLM as a land manager would fully cooperate with the EPA or state UIC permitting process and with the EPA or state monitoring and enforcement activities.

Conclusions:

Geologic sequestration of CO_2 appears to be technically feasible on the lands administered by the BLM given their location, extent, geologic character, and prior mineral resource use, e.g., oil and gas development and production. Further, management of geologic carbon sequestration appears to be administratively feasible within the BLM's multiple-use mandate.

However, essential questions and unknowns remain for regulatory and public policy resolution:

1. How will CO_2 be classified, with its many-faceted nature: a waste, a resource, an engineering tool for hydrocarbon recovery, a threat to human health and safety, and a source of potential impact to the quality of the human and natural environments?

2. How will geologic carbon sequestration be managed under split estate or multiple-resource ownership and what governs ownership and associated liability issues?

3. Where resource development or conservation conflicts emerge, what is the relative priority of geologic carbon sequestration?

4. How will liability be assigned and managed over the requisite time scales? What role will the BLM play in assigning liability or assuming liability and at what point in time?

5. How will land use plans and associated NEPA documents be modified or amended in a timely manner to accommodate geologic carbon sequestration? Note: It has taken over 10 years to

update most of the current RMPs in the Western U.S. to accommodate increased energy development.

6. What special technical workforce capabilities will be required by Federal agencies involved in the authorization of sequestration activities on public lands?

7. What types of other multiple uses are compatible with long-term storage of CO_2 and the potential liability it presents? Will these lands become single use?

8. Finally, the decision to geologically sequester CO_2 and associated impurities represents a potential irreversible commitment of public land resources in a given area for timeframes beyond the BLM's experience.

Recommendations:

1. Regulatory:

A. While gaps are likely to exist as we work, to the maximum extent practicable, Federal agencies should within current authorities, be able to address many of the issues that arise.

B. Retain enough regulatory flexibility to be responsive to unique site and project characteristics while allowing for adaptive management by the Federal agencies involved. Amend regulations on an as-needed basis as experience is gained in managing carbon sequestration activities on the public lands.

2. Policy:

A. Reconcile Federal and state agency procedures for granting rights-of-way related to pipeline and other infrastructure for CO_2 transmission, processing, and storage; reconcile agency views on whether proposed sequestration projects would address near- or long-term geologic sequestration needs; improve coordination among agencies that administer contiguous tracts of land when responding to applications for a right-of-way across their respective jurisdictions; and improve coordination among agencies regarding the appropriate geographic locations of energy transmission corridors or rights-of-way on Federal lands and the potential to include the transmission of CO_2.

B. Continue to invest in ongoing research to better characterize sequestration reservoirs and develop an understanding of the long-term behavior of CO_2 and other greenhouse gases in the subsurface; this will better inform future regulatory and rulemaking actions.

C. Continue to invest in research to develop improved monitoring, modeling, measurement, inspection and verification technology, techniques, protocols, and procedures specific to geologic carbon sequestration.

D. Continue to invest in research to develop remediation techniques to be applied upon detection of storage facility seal failure.

E. Continue to invest in research to develop an increased understanding of the environmental effects of geologic carbon sequestration and impact on other resources, including the subsurface biosphere.

F. Assess and analyze the future technical workforce needs and capabilities of Federal land management agencies in the areas of pre-injection geological and environmental assessment, regulatory approval, monitoring, measurement and verification, abandonment approval, and post-abandonment stewardship.

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