



Session 1: Adaptive regulation

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Resolving the Legal and Regulatory Challenges to Geologic Sequestration of CO₂—A CCSReg Project Workshop

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Regulation plays a role in four different aspects of geologic sequestration

Siting	Projects must be sited in appropriate locations—from both technical and sociopolitical standpoints.
Design, construction, and operation	projects must be designed, constructed, and operated to protect human health and the environment (both locally and globally).
Closure and post-closure	Projects must be closed and then, maintained, and monitored as it is deemed necessary.
Abnormal circumstances	In the case that there are adverse impacts from a project, regulation ensures that these impacts are remediated or mitigated appropriately.

Knowledge base for geologic sequestration

Knowledge base for geologic sequestration is continually growing due to:

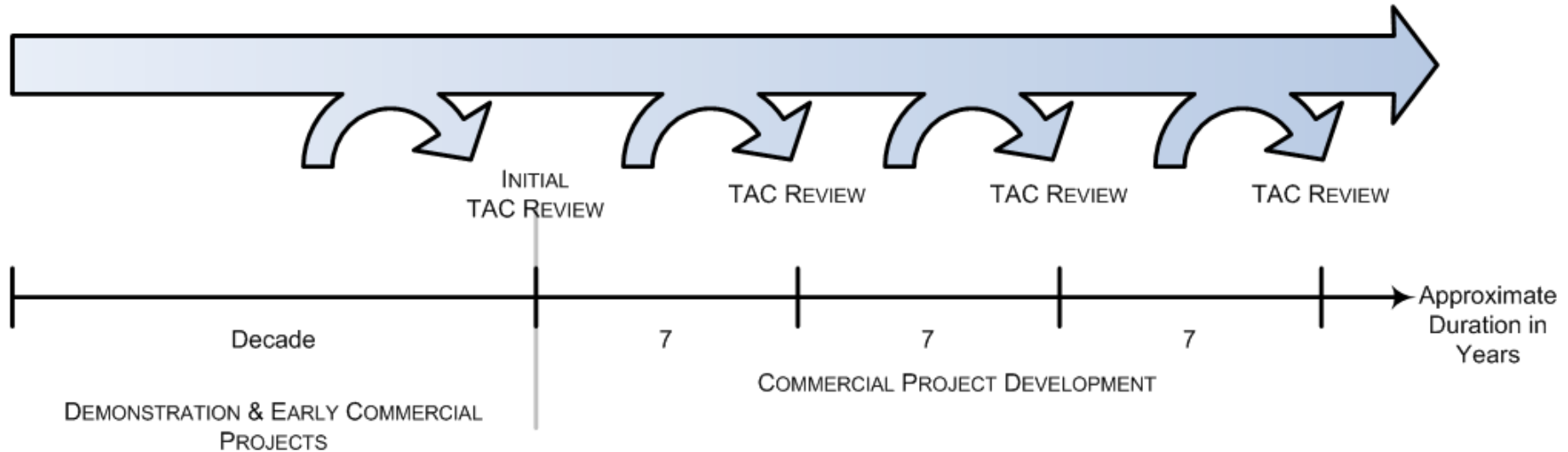
1. research studies—both lab- and pilot-scale activities—on CO₂ injection and trapping mechanisms
2. studies of natural analogs, such as Mammoth Mountain, CA; Lateral caldera, Italy; and numerous CO₂ "domes"
3. studies of industrial analogs, such as CO₂-flood EOR, natural gas storage, acid-gas injection, and disposal of other wastes and
4. studies of the 3 operating sequestration projects of a reasonably large scale (i.e., millions of tons per year).

However, **today we inject only 3-4 Mt/y in 3 saline aquifer sequestration projects.**

Adaptive Regulation: Adapting regulation to the "reality on the ground" through a planned process

Ample evidence exists to suggest that "geological storage operations can be conducted without presenting any greater risks for health and the local environment than similar operations in the oil and gas industry, when carried out at **high-quality and well-characterized sites.**" (IPCC, 2005)

Recommendation: "Two-stage" regulation of geologic sequestration



Existing regulations for permitting (i.e., EPA UIC Class V, GS-specific state rules)
Indemnification of operators from liability as necessary—with eventual goal of merging these projects into a long-term framework.

Projects will be governed by a regulatory framework and rules that are:

1. performance based, and
2. revised at fixed intervals (if not sooner) through a planned review process that will allow the accumulated weight of GS project experience (both in the US and elsewhere) to shape the regulation.

Making the transition between the first and second stages

We recommend that an expert **Technical Advisory Committee** (TAC) of the National Research Council (NRC) be convened by the EPA. Per Sec. 202(b), this committee will review:

the available accumulated data and experience from operational [GS] projects in the U.S. and elsewhere, and publish a summary of its findings together with recommendations, based on those findings, as to:

- (1) how regulations and standards for permitting and operating a carbon dioxide geologic sequestration facility should best be shaped to provide reasonable protection to health, safety and the environment;
- (2) the feasibility of adaptive strategies and performance-based standards that improve the effectiveness of GS operations with no loss of protection to health, safety and the environment; and,
- (3) research needed to provide the foundation for improving standards in the future.

Performance based regulation of geologic sequestration

Regulations should be, to the extent practicable, **performance based**. Per Sec. 201(b):

In general, the objective of performance-based standards is to provide a greater degree of flexibility and cost-effectiveness in achieving the safe operation of a GS project.

Specifically, performance based standards should specify to what standard of performance projects will be held, rather than how the projects should design specific components of the system.

Planned adaptation during commercial operation

During commercial operation, a review by the TAC is triggered every seven years. Per Sec. 202(c), during review the TAC will:

- (1) update and evaluate the cumulative experience from all geologic sequestration facilities operating in the U.S. or elsewhere;
- (2) publish a summary of its findings along with recommendations for any changes in GS regulations it believes are needed; and ,
- (3) identify research to provide the foundation for improving the formulation of standards in the future.

Flexibility and adaptation at the project level

Each sequestration project will be different, and develop in ways which are unexpected, *a priori*.

Consistent with the objective of safe operation, the regulatory program should allow the regulator and site operator to modify details of the site monitoring plan, injection operations, and other regulated activities on the basis of the accumulated evidence as injection proceeds.

A gap in our proposal: how will operating projects deal with the changing regulatory frameworks?

1. Projects can be required to comply with the revised regulations, regardless of the change.
2. Projects can be grandfathered, such that each project is subject to the rules at the time of licensing across all regulated categories.
3. Project permits can be modified by the EPA (or designate) on a case-by-case basis to include changes that are required for protection of human health and the environment.
4. Projects can be required to comply with the revised regulations, unless they have applied for and received a permit modification allowing the deviation.

Questions for discussion

- Does an adaptive approach make sense, *prima facie*?
- Is an adaptive approach, as we have described it, practicable? If not, is there another adaptive approach that is?
- Is the trigger for the review appropriate? Should we use a metric other than time?