

# Commitment Admissibility Under Subsurface Ignorance

## A Decision-Governance Framework for Irreversible Exploration Decisions

Subsurface exploration often proceeds under a structural contradiction.

The system being evaluated cannot be fully understood from a distance, but the act of verification may disturb the system, require support infrastructure, and begin to create commitment.

This is true on the Moon. It is also true in geothermal development, carbon storage, offshore infrastructure, critical minerals, seabed systems, and other physical environments where access is limited, evidence is indirect, and reversal is costly.

The central question is not whether action is useful. The question is whether a proposed commitment is admissible under the evidence available at the decision point.

A project can be technically feasible and still be inadmissible. A resource can be plausible and still be insufficient as an architecture anchor. A site can be promising and still be premature as a commitment.

Commitment admissibility governs this boundary.

### 1. The General Problem.

1. Many frontier and subsurface decisions are made before the underlying state is fully known.
2. This is unavoidable.
3. But the problem becomes dangerous when decisions harden faster than knowledge improves.
4. In these settings, evidence often arrives through indirect signals. Remote sensing, geophysical surveys, seismic response, thermal data, orbital observations, electromagnetic data, sampling, geotechnical investigation, and prior analogs can all constrain interpretation. But they may still leave multiple plausible realities in play.
5. Those plausible realities may not matter equally.
6. Some support the proposed commitment.
7. Others invalidate it.
8. Others create failure modes that cannot be recovered once the commitment has been made.

9. The decision problem is therefore not ordinary uncertainty. It is uncertainty with decision-changing power.
10. Commitment admissibility asks whether the proposed action survives the plausible states still consistent with the evidence.
11. If it does, the action may proceed within defined bounds.
12. If it does not, the action must defer or be refused.

### 2. The Governing Distinction

Most development systems ask:

#### 2.1. Can this be done?

Commitment admissibility asks:

#### 2.2. Should this be allowed to proceed now, given what remains unresolved and what the action would make difficult to reverse?

1. That distinction matters because feasibility and permission are not the same.
2. A technically plausible action may still be inadmissible if it fixes a site, creates access dependency, commits capital, disturbs the evidence base, narrows future options, or forces later decisions to inherit unresolved assumptions.
3. The relevant question is not whether uncertainty exists.
4. The relevant question is whether unresolved uncertainty still has the power to change the decision.

### 3. Core Concepts

#### 3.1. Commitment

1. A commitment is an action that makes future alternatives harder, more costly, or less legitimate to pursue.
2. Commitment may be physical, financial, operational, institutional, or architectural.
3. It can occur before construction is complete.

4. It can begin through site control, queue entry, drilling, corridor formation, infrastructure placement, capital release, permitting sequence, repeated access, or public reliance on a preferred interpretation.

### 3.2. Admissibility

1. Admissibility is the permission boundary before commitment.
2. It determines whether a proposed action may proceed under the evidence and assumptions available at the decision point.
3. Admissibility is not a prediction of success.
4. It is a judgment about whether the action is defensible across plausible states.

### 3.3. Subsurface Ignorance

1. Subsurface ignorance exists when the evidence permits multiple materially different interpretations of the physical system.
2. The term does not mean absence of knowledge.
3. It means the remaining uncertainty still matters to the decision.

### 3.4. Irreversibility

1. Irreversibility occurs when reversal exceeds practical capacity.
2. It may be caused by cost, time, access limits, physical disturbance, institutional lock-in, capital commitments, contractual obligations, environmental change, or loss of future measurement conditions.
3. Irreversibility is not always absolute.
4. It is defined relative to the action, the environment, and the capacity to recover.

## 4. Ignorance Dominance

1. Ignorance dominates a commitment when three conditions hold.
2. First, multiple plausible states remain consistent with the evidence.
3. Second, those states produce materially different outcomes for the proposed action.
4. Third, at least one plausible state would make the commitment fail, become stranded, destroy value, or create non-recoverable consequences.
5. When ignorance dominates, the commitment is not admissible.

6. This is true even if the opportunity is attractive.
7. This is true even if one interpretation supports action.
8. This is true even if delay is inconvenient.
9. The burden is not to eliminate all uncertainty.
10. The burden is to reduce the uncertainty that still controls the decision.

## 5. Decision Test

A proposed commitment should pass through the following decision test.

### 5.1. Step 1: Define the Commitment

1. What action is being considered?
2. What does it authorize?
3. What will become harder to reverse if it proceeds?
4. Examples include drilling, injection, excavation, site hardening, corridor formation, landing zone preparation, interconnection entry, fixed infrastructure placement, capital escalation, or long-term dependency on a resource assumption.

### 5.2. Step 2: Identify the Plausible State Set

1. What materially different physical states remain consistent with current evidence?
2. This may include different resource distributions, mechanical conditions, reservoir behaviors, seabed states, volatile configurations, fault structures, containment conditions, ground response, or access constraints.
3. The point is not to list every possible state.
4. The point is to identify the states that could change the decision.

### 5.3. Step 3: Test Outcome Sensitivity

1. Would the decision change across plausible states?
2. If the action is robust across the plausible set, it may be admissible.
3. If one plausible state supports action and another invalidates it, the decision is unstable.
4. Decision instability requires Defer or Refuse.

### 5.4. Step 4: Identify the Irreversible Threshold

1. Where does the action cross from investigation into commitment?
2. The threshold may be physical, financial, operational, architectural, environmental, legal, or institutional.
3. The threshold is crossed when reversal becomes impractical, or when the system begins to inherit the action as a future constraint.

### 5.5. Step 5: Evaluate Measurement Before Commitment

1. Can the decision-dominant uncertainty be reduced before crossing the threshold?
2. If yes, the action should defer to measurement.
3. If no, the decision must determine whether bounded verification is possible, or whether the commitment must be refused.

### 5.6. Step 6: Issue the Determination

1. The output is not a score.
2. The output is a decision.

#### Proceed

The action is admissible. It survives the plausible states relevant to the commitment.

#### Defer

The action is not yet admissible. Additional measurement, bounded verification, or sequencing change is required.

#### Refuse

The action is inadmissible. The uncertainty is decision-dominant, or the action would cross an irreversible threshold without sufficient evidence.

## 6. Commitment Integrity

1. Admissibility governs whether a commitment may begin.
2. Integrity governs whether it may continue.
3. A commitment that was admissible at entry may lose integrity if new evidence alters the state space, assumptions expire, dependencies accumulate, the environment changes, or the action begins to exceed its original bounds.

4. This matters because irreversible systems do not fail only at the initial decision point.
5. They often fail through gradual drift.
6. A bounded investigation becomes a preferred site.
7. A preferred site becomes a corridor.
8. A corridor becomes infrastructure.
9. Infrastructure becomes dependency.
10. Dependency becomes lock-in.
11. Commitment integrity prevents a valid beginning from becoming an unmanaged escalation.

## Integrity Outputs

### Maintain

The commitment remains within its admissible bounds.

### Constrain

The commitment may continue only under narrowed scope or added conditions.

### Re-evaluate

New evidence or changed structure requires reassessment.

### Terminate

The commitment no longer satisfies its governing assumptions or admissible bounds.

## 7. Cross-Domain Application

The lunar case is severe, but it is not unique.

The same structure appears wherever indirect evidence, limited access, disturbance, and path dependence interact.

### 7.1. Lunar ISRU and Surface Infrastructure

Volatile signals may support exploration but may not yet justify site hardening, power placement, excavation, or infrastructure dependency.

### 7.2. Geothermal Development

1. Temperature, permeability, stress state, reservoir connectivity, and drilling risk may remain uncertain until the project approaches irreversible capital and subsurface intervention.
2. The decision is not simply whether a geothermal system may exist.

3. It is whether drilling is admissible under the unresolved state of the reservoir.

### 7.3. Carbon Storage

1. Storage capacity, injectivity, caprock integrity, fault behavior, pressure evolution, and plume migration may remain uncertain before injection begins.
2. The decision is not only whether storage is technically possible.
3. It is whether injection should be allowed to proceed before containment uncertainty is reduced.

### 7.4. Offshore and Seabed Infrastructure

1. Seabed conditions, cable routes, sediment behavior, geohazards, foundation conditions, and marine access can create early lock-in.
2. The decision is not only whether infrastructure can be engineered.
3. It is whether the corridor or site should be fixed before the seabed state is sufficiently understood.

### 7.5. Critical Minerals and Subsurface Resources

1. Geophysical and geochemical signals may indicate prospectivity while leaving geometry, grade continuity, extractability, access, permitting exposure, and infrastructure dependency unresolved.
2. The decision is not only whether the target is promising.
3. It is whether capital, land, access, or development commitments should harden around the interpretation.

## 8. What the Framework Produces

1. Commitment admissibility produces decision products tied to real commitment thresholds.
2. It does not produce generic feasibility commentary.
3. It does not optimize projects.
4. It does not replace engineering, science, or execution teams.
5. It determines whether a proposed action is admissible before it becomes difficult to reverse.
6. Typical outputs include:

### 8.1. Decision Exposure Review

Identifies where a proposed action begins to create irreversible exposure.

### 8.2. Pre-Commitment Admissibility Screen

Determines whether the next step should Proceed, Defer, or be Refused.

### 8.3. Commitment Integrity Determination

Evaluates whether an existing commitment remains valid as evidence, assumptions, or dependencies change.

### 8.4. Minimum Evidence Determination

Defines what evidence is required before a commitment-bearing action may proceed.

## 9. Final Statement

1. The governing problem in subsurface exploration is not uncertainty alone.
2. It is the release of commitment authority before uncertainty has lost decision-changing power.
3. Commitment admissibility exists to prevent that failure.
4. It separates what can be built from what should be allowed.
5. It separates resource promise from infrastructure permission.
6. It separates investigation from lock-in.
7. A decision is admissible only when the evidence is sufficient for the burden of the action being authorized.
8. Where that burden is not met, the correct outcome is not momentum.
9. It is Defer or Refuse.