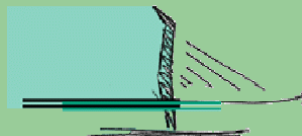


# Liability and compensation for damage resulting from CO<sub>2</sub> storage sites

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Workshop: managing long-term liability for geological storage of CO<sub>2</sub>

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# Structure

- 1 Law and economics and the nature of risk
- 2 Economic efficiency and liability rules for geological storage
- 3 Options for compensation & roles for government

# 1. Law and economics and the nature of risk

- Introduction
- CCS: miracle solution for climate change?
- Legislation in many legal systems
- Adequate liability and compensation framework considered adequate for development
- Legal rules developed in *inter alia* US, Australia, EU
- How can adequate liability and compensation scheme be developed still:
  - stimulating socially desirable activities (CCS)?
  - given positive externalities
  - providing incentives for risk mitigation to stake holders?

# 1. Law and economics and the nature of risk

## 1. What is CCS?

- Capturing CO<sub>2</sub> from plants
- Transportation
- Sequestration (injection underground)
- Offshore and onshore
- IPCC 99% of injected CO<sub>2</sub> remains underground for over 100 years (p 90-99%)

*“Observations from engineered and natural analogues as well as models suggest that the fraction retained in appropriately selected and managed geological reservoirs is very likely to exceed 99% over 100 years and is likely to exceed 99% over 1,000 years.*

*For well-selected, designed and managed geological storage sites, the vast majority of the CO<sub>2</sub> will gradually be immobilised by various trapping mechanisms and, in that case, could be retained for up to millions of years. Because of these mechanisms, storage could become more secure over longer timeframes.”*

Result:

- Proper storage crucial
- Selection, design and management as well

## 2. Advantages

- BAU?
- Reliance on coal? Clean coal?
- Great potential to prevent CO<sub>2</sub>
- Hence contributing to mitigation

### 3. Barriers and limits

- Only few (pilot) projects
- Commercialisation?
- “Moving CCS from hype to pipe”?
- Barrier: carbon pricing
- Barrier 2: lacking regulatory framework, lacking incentives for long-term investment

## 4. Potential risks

### 4.1. Nomenclature of risks

- Dependent upon project cycle
- Risk assessment possible?
- Local versus global risks
- Short-term versus long-term risks
  - global CO<sub>2</sub> emissions
  - affecting water aquifers
  - seismic risks
  - personal injury
  - environmental risks



## 4.2. Risks limited

- IPPC: “small in magnitude and distant in time”
- Risks diminish over time
- Condition: proper site selection and monitoring
- Experiments confirm: low risk

## 5. Potential damage

Corresponding to risk categories, hence:

- Atmospheric releases
- Impacts on water resources
- Geological impacts
- Human health impacts
- Ecological impacts
- Damage is calculable, but potentially catastrophic: low  $p$ , high  $D$

## 6. CCS project life cycle

CAPTURE

TRANSPORT

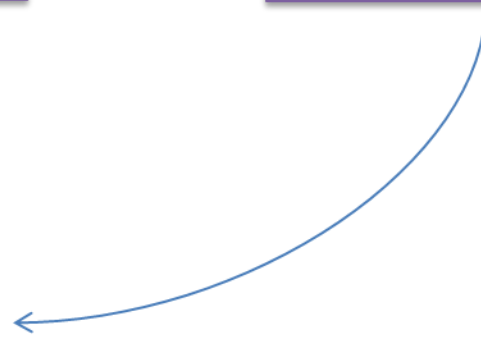
SEQUESTRATION

Siting/design

Injection/operation

Closure/post-closure  
monitoring

Long-term stewardship



## 7. Uncertainties

- Capturing CO<sub>2</sub>
- Risk assessment
- Uncertainty higher in post-closure phase, given long-term
- But risks can be modelled

## 8. Stakeholders

- Energy industry
- Government
- Civil society

## 9. First movers

- Incentive structure necessary to stimulate first movers?
- Shared public-private liability regime?
- Financial cap for first movers?
- Debated!
- Symbolic value?

## 10. Summary

- Large potential benefits
- Green house gas mitigation
- Cost effective alternative to cutting emissions
- Risk manageable
- But long-term post-storage monitoring needed
- Beyond traditional concept of liability
- Hence: role of government for long –term stewardship
- Providing incentives to CCS development?
- Avoid fear of long-tail liability

## 2. Economic efficiency and liability rules for geological storage

### 1. Goals and limits of liability rules

- Victim compensation versus deterrence
- Economic perspective: remedying market failure, prevention is better than cure
- Preventing externalisation of costs
- Correct pricing of risky activities
- Adelman/Duncan: distinction various phases CCS life cycle + regulation
- Balance positive and negative externalities
- Avoid “crushing” liability
- Other mechanisms than liability rules also important for :
  - prevention
  - compensation



## 2. Strict liability versus negligence

- Unilateral accident situation: both provide incentives for care, only SL for optimal activity level
- Bilateral accident situation:
  - strict liability optimal care and activity level for injurer
  - negligence optimal care and activity level for victim
- If injurers activity more important: SL
- Other argument: information asymmetry
- Also in CCS legal doctrine
- But: important to control insolvency risk!

### 3. Force majeure

- Only excuse if beyond operators influence
- Natural disaster and CCS
- Only excuse if totally unpredictable

#### 4. Attribution of liability

- Channelling of liability, following oil and nuclear?
- Probably inefficient

## 5. Joint and several liability

- If all actors solvent: incentives for mutual monitoring
- Subsequent recourse
- Increasing access to justice
- In case of insolvency: inefficiency
- Endanger insurability

## 6. Causation

- Causal uncertainty with CCS?
- If so, how to solve?
- Threshold liability (all or nothing)
- Proportional liability
- Shifting risk of proving causation: crushing liability

## 7. Long tail risk: limit in time?

- Starting point: different phases of CCS project
- Exclusion for long-term stewardship?
- Long-term liability discounted against present value
- No deterrent effect
- But debated issue
- EU Directive

## 8. Remedies: limit in amount?

- Financial cap on liability?
- Nuclear/oil?
- Opinions divided: needed for industry versus wrong signal to public
- SL should be unlimited to provide efficient incentives
- Cap may lead to underdeterrence
- Would constitute implicit subsidy
- In starting phase...?

## 9. Regulation?

- Information advantage
- Insolvency risk
- Threat of a liability suit
- Importance of regulation for CCS
- But: public or private regulation?
- Supplementary role of liability rules
- Hence: effect of regulation:
  - breach of regulation: liability
  - compliance with regulation: no excuse



## 10. Combinations

- No liability for long-tail risk
- No financial limit on liability
- Contradictory?
- Only liability when positive effects on incentives for prevention
- But: smart mix of liability rules and regulation, hence
- (Only) supplementary effect of liability rules
- What about compensation?

### 3. Options for compensation & roles for government

#### 1. General questions

- Why compensate?
- Economic role?
- Task of welfare state?
- Distribution, but cost effectiveness
- Principles of fair and efficient compensation:
- Exposing risk creators to costs
- Proportionality, so:
- Risk differentiation
- Perverse effects to be avoided

## 2. Insurance

### 2.1. Demand for insurance for CCS related risks?

- Related to attitude to risk
- First party versus third party insurance

### 2.2. Supply of insurance cover

- Barriers to market entry
- Legal and factual uncertainty
- Insurer ambiguity
- Predictability of CCS related risk

### 2.3. Capacity

- Potential high damage
- Co-insurance
- Reinsurance
- Pooling by injurers

### 2.4. Curing moral hazard and adverse selection

- Exposing insured to risk
- Risk differentiation
- Specialisation of insurers
- Differentiating CCS related risks

## 2.5. Insurability of CCS?

- Depends upon CCS life cycle
- Insurer ambiguity
- Risk differentiation possible?
- Probably only for short-term risk (injection and operation)
- Hence: needs to look for alternatives

### 3. Alternative compensation mechanisms

#### 3.1. Self-insurance and captives

- Theory
- Evaluation

#### 3.2. Risk sharing agreements

- Theory: mutual monitoring
- Possibility of risk sharing without actuarial fair information
- Many examples:
  - voluntary risk sharing (P&I clubs)
  - and statutorily mandated (Price Anderson)
- Risk sharing for CCS?

### 3.3. Guarantees and deposits

- Theory
- Evaluation

## 4. The role of government in facilitating compensation

### 4.1. Compulsory financial guarantees

- Theory
- For CCS?

### 4.2. Direct compensation by the government?

- Advantages
- Disadvantages
- For CCS?



### 4.3. Compensation fund

- Funds versus insurance
- For CCS?

### 4.4. Reinsurer of last resort

- Theory
- Examples
- For CCS?

## 5. Summary

- Mandatory financial security, but flexibility (local regulators)
- Post-closure monitoring: compensation fund with risk dependent premiums (only if risk sharing between operators is not feasible)
- Reinsurer of last resort: only if serious capacity problems