



Characterisation of European CO₂ storage

The SiteChar workflow to answer the requirement of characterization

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Objectives

- **To describe how the elements of the EU Storage Directive can be addressed**
- **To clarify the links between the areas of expertise required for a thorough site characterisation**
- **To provide the basis for an efficient and focused site characterisation**

Challenges

■ Site characterisation:

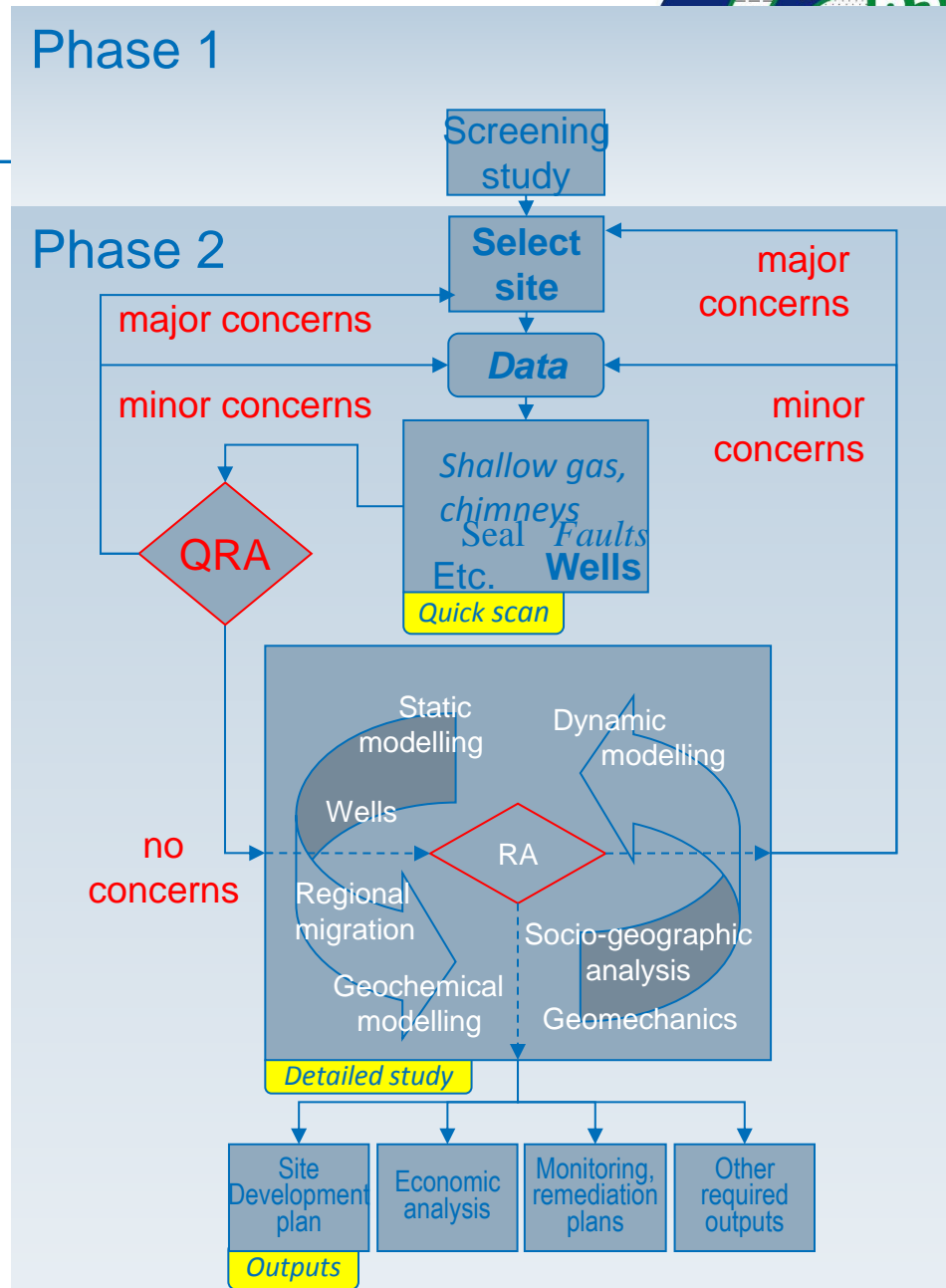
- Iterative by nature
- Multi-disciplinary team
- Many links between disciplines
- Product / result is permit application

■ The SiteChar workflow:

- Describes iterations in site characterisation
- Clarifies links between areas of expertise
- Provides clarification of site characterisation in addition to existing documents – CO2Qualstore, CSA-Z741, DNV-RP

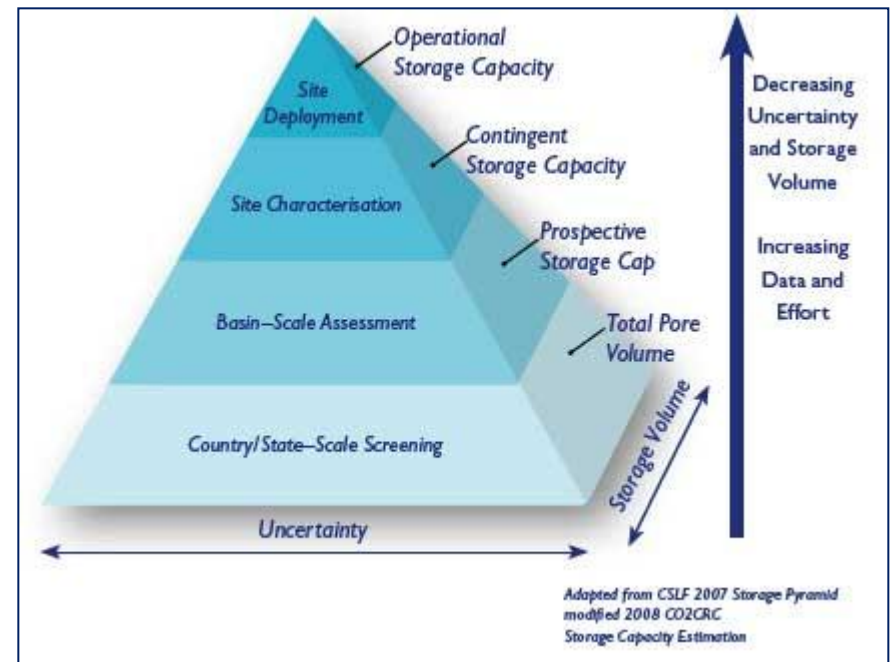
Site characterisation study

- **Site characterisation workflow**
 - Aligned with EU Storage Directive
 - Tested and improved in five site studies in the SiteChar project



Workflow elements: screening study

- **Regional screening study**
 - High-level screening of potential sites
 - Limited site data
 - Criteria: (example list)
 - Total storage capacity
 - Injection rate
 - Distance
 - Availability
 - Surface use

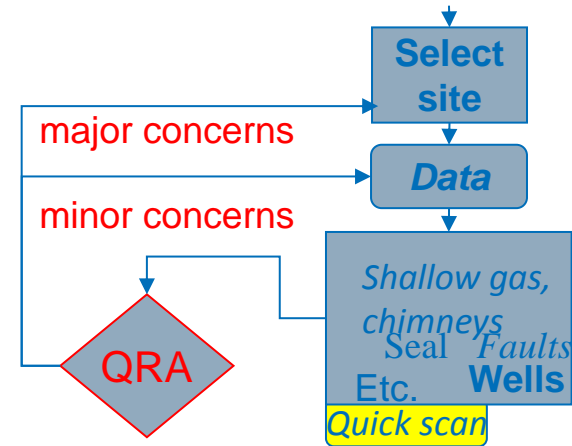


Workflow elements: detailed study

■ Preparation

1. **Collect all available data**
2. **Quick analysis of data**
 - **Experts to define risks and potential show stoppers**
3. **Qualitative risk analysis**
 - **All expertises**
 - **Not necessarily integrated yet**
 - **May lead to collecting new data**
 - **Input: results from quick analysis**
 - **Output: first version of ranked risk matrix**

... can take a long time and a sizable budget!



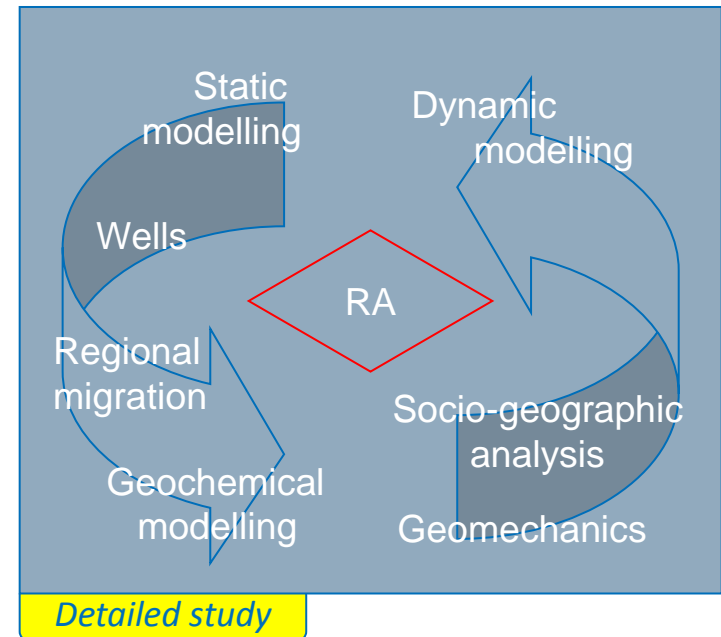
Activity/Activity	Risks															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
CONSOLIDATED ACTIVITY																
1. Grant Administration																
2. Executive and Administrative																
3. Public Policy and Information																
4. Information Technology																
5. Planning, Evaluation, and Reporting																
6. Project Development																
7. Designated State Agency (DSA) Operational Relationship																
8. Council Support																
9. Administrative Support (Personnel & Resources, Contract Resources, Purchasing)																

Example of ranked risk matrix

Workflow elements: detailed study

■ Detailed study

- Static model building, geomechanical analysis, dynamic (injection and flow) modelling, etc.
- Focus is on most important risks
- Links / interfaces and feedback loops between disciplines
- Work towards permit deliverables
 - *Site characterisation is not a study of site geology, of reservoir behaviour, of large-scale flow...*
 - *Site characterisation is a study to produce input for a permit application.*



Workflow elements: detailed study

- Risk matrix focuses the site characterisation work
 - Highest risks most emphasis
 - Define severity and probability more precisely
 - Risk mitigation options
 - E.g., injection scenario definition
 - Continuous risk assessment
 - New risks may be found

Probability	Very high	0	0	0	0	0
	High	0	2	4	2	0
	Medium	0	4	18	8	0
	Low	0	3	20	13	0
	Very low	0	0	4	1	0
		Very low	Low	Medium	High	Very high
Severity						

Example of risk matrix

Example of links between areas of expertise



- **Injection, plume migration***
 - Pressure limits due to reservoir and cap rock strength; fault reactivation (*geomechanics*)
 - Near-well pressures, CO₂ migration and pressure distribution in reservoir, number and location of wells required to reach target rate (*reservoir engineering*)
 - History match leads to updates to static model (*reservoir engineering*)
- **Iterative approach is required**

* *List is of course incomplete!*

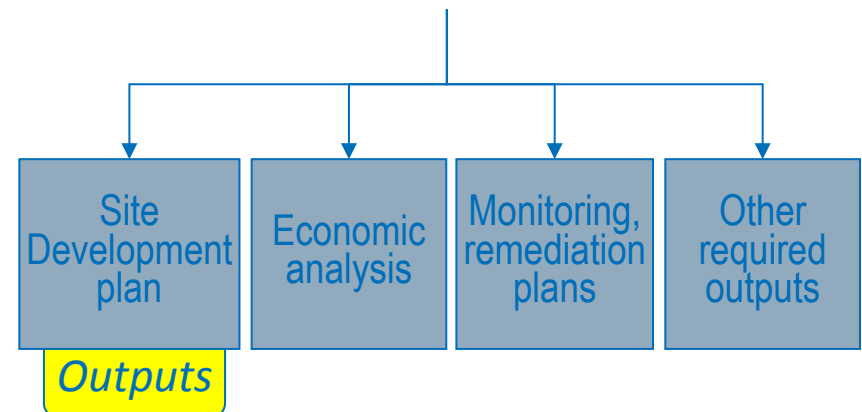
Workflow elements: detailed study

- **Risk assessment: a continuous process**
 - Improved understanding of risks through detailed study
 - Identification of new risks
 - Mitigation of risks through site design and monitoring

- **Close, regular contact with Competent Authority**
 - Improve CA's understanding of site and the CCS project
 - Ensure site performance meets CA standards
 - Important especially for early CCS projects

Workflow elements: detailed study

- **When all risks sufficiently characterised**
 - **Use results to quantify risks and write permit application**
 - **Site development plan**
 - **Monitoring plan**
 - **Corrective measures plan**
 - **Environmental impact assessment (*outside focus of SiteChar*)**
 - **Economic analysis (cost of project)**



Key learnings from the SiteChar experience



- Site characterisation is risk based; **it is of key importance to continuously update the risk matrix during the site characterisation**
- **Regular contact with the competent authority is strongly recommended**
- **The characterisation team should be aware of the links between the areas of expertise and the iterative nature of the work**

Remaining issues/Challenges

First of all:

- To use the workflow in pre-competitive storage appraisal – focused, efficient

Also:

- To update the workflow with the feedback from *many* site characterisations
- To update the workflow when EU Storage Directive is updated

SiteChar Workflow

- **The workflow is available at**
<http://www.sitechar-co2.eu/FileDownload.aspx?IdFile=605&From=Publications>

**EUROPEAN COMMISSION
DG RESEARCH**
SEVENTH FRAMEWORK PROGRAMME
THEME 5 - Energy
ENERGY 2010.5.2-1: CCS - storage site characterisation
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Site characterisation workflow

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