Characterisation of European CO2 storage

Storage feasibility workflow

Rob Arts

Kick-off meeting

Stakeholder Workshop

September 24, 2013

Stakeholder workshop, September 24 2013

Site Characterisation

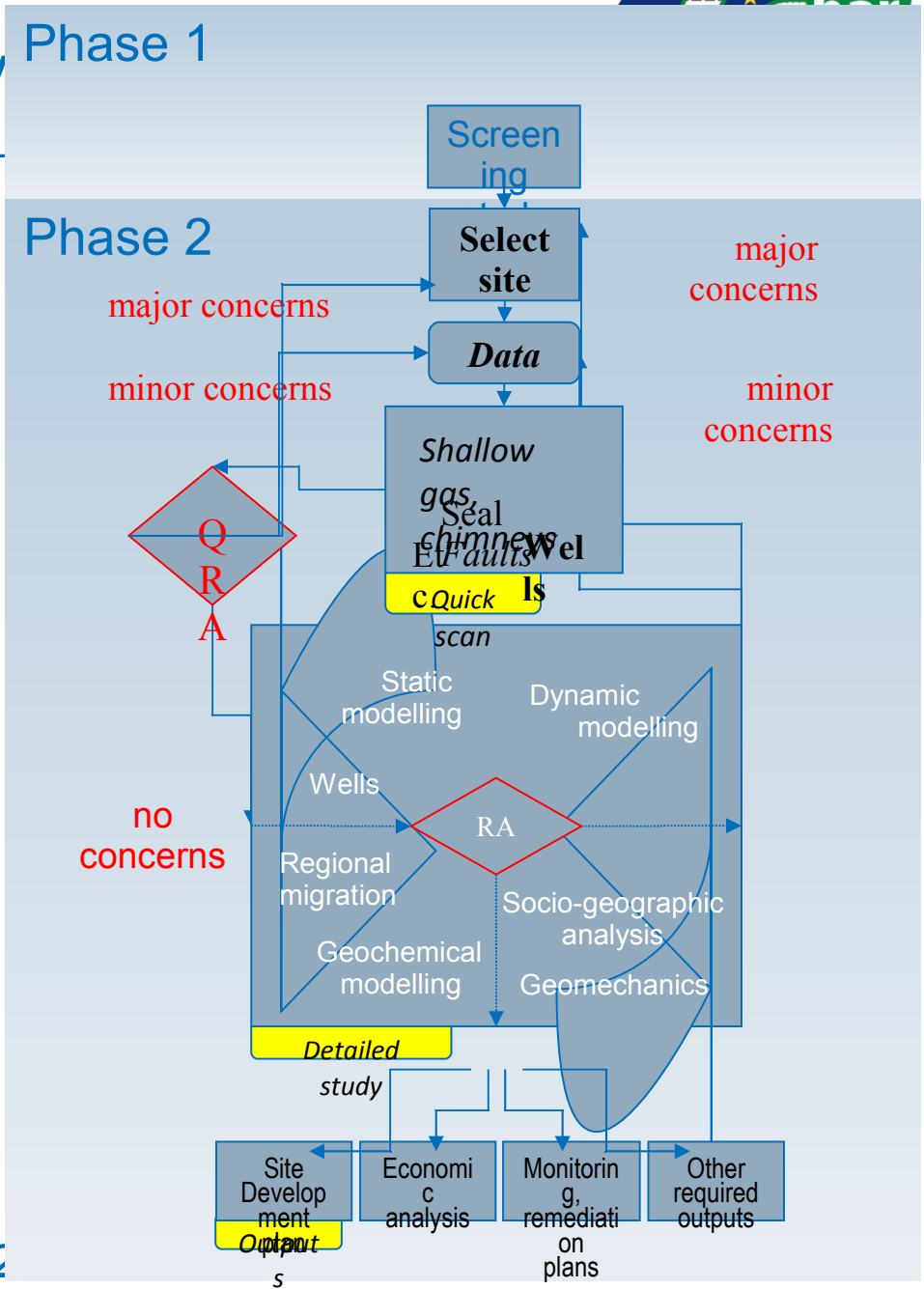
- **Multidisciplinary approach**
  - Geology, geophysics, geochemistry, geomechanics, …
- **Many links between expertises**
  - Example: reservoir engineering & geomechanics, through pressure
  - Storage risks often fully defined only by combining multiple expertise areas
  - Storage Directive aspects also addressed by combining results from several disciplines
- **Clarify links**
  - To render site characterisation work more efficient and effective

SiteChar workflow

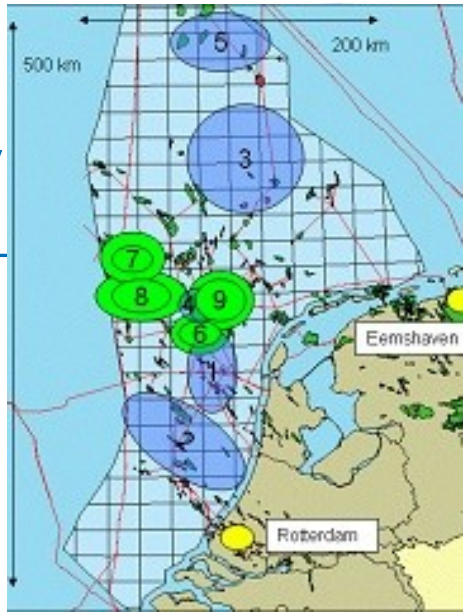
- **Risk driven**
  - **Site characterisation is about understanding the risks of storing CO2 at specific site**
  - **Risks mitigated through**
    - **Injection strategy**
    - **Site design**
    - **Monitoring plan**
    - **Contingency (corrective) measures plan**
  - **Residual risks**
    - **After all mitigation measures**
    - **Thresholds defined by operator, competent authority**
  - **Key Performance Indicators**
    - **Monitored during operation**
    - **Trigger additional monitoring, corrective measures**

Site characterisation study

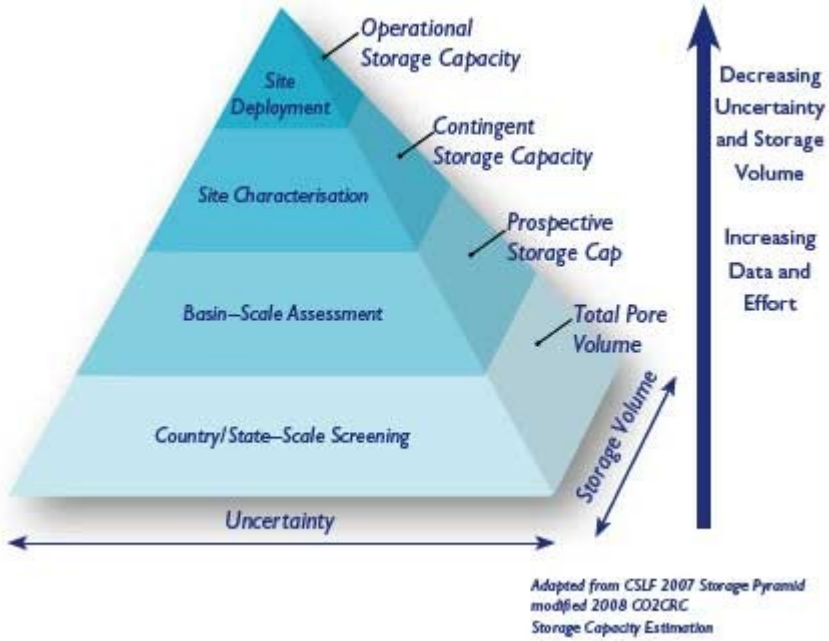
- **Site characterisation workflow**
  - **Aligned with EU Storage Directive**
  - **Tested and improved in five site studies in the SiteChar project**



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**



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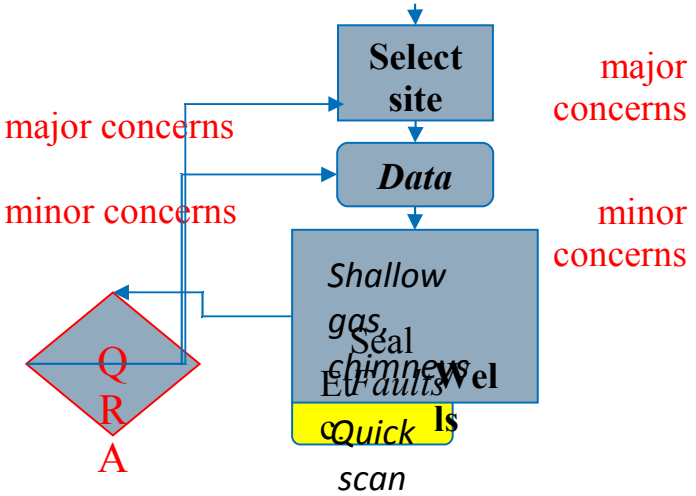
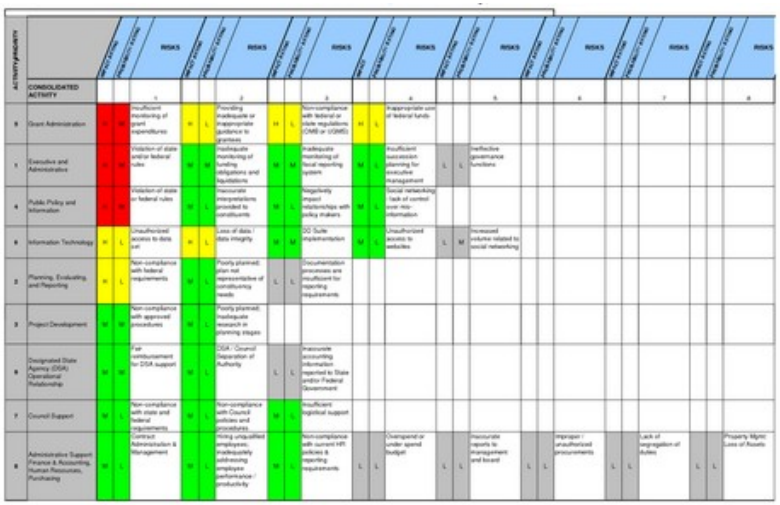
Workflow elements: detailed study

- **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**
     - **Input: results from quick analysis**
     - **Output: first version of ranked risk matrix**

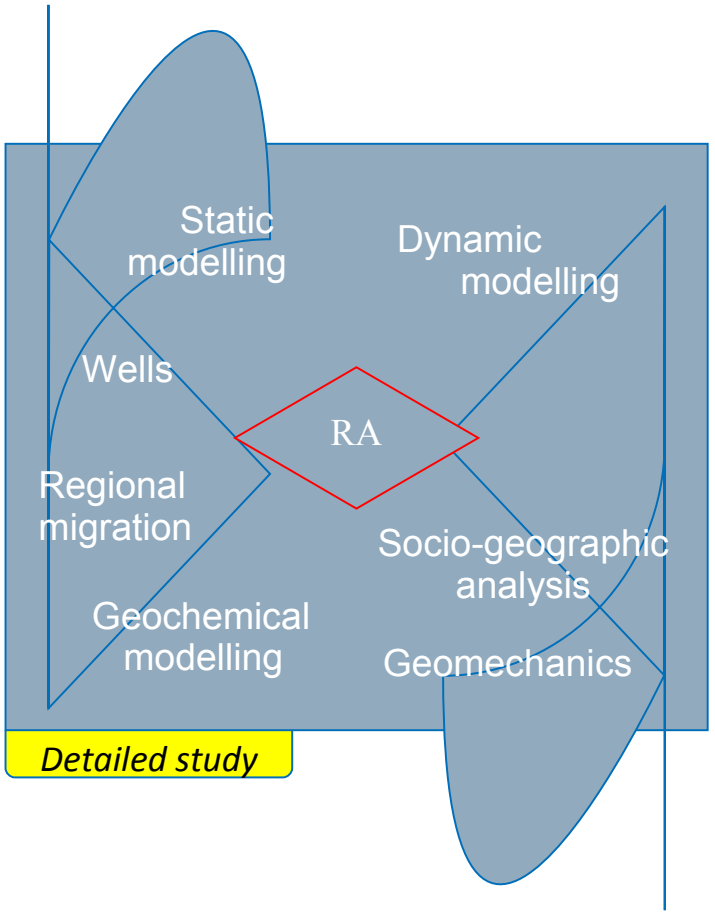




Example of ranked risk matrix

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 low	Low	Medium	High	Very high
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
	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*)**
  - **Location of legacy wells and risk when in contact with CO2, location of current production wells (*well integrity*)**
  - **Impact of potential large-scale migration if CO2 plume migrates out of reservoir (*migration analysis*)**
  - **History match leads to updates to static model (*reservoir engineering*)**
- **Iterative approach is required to find optimum solution**

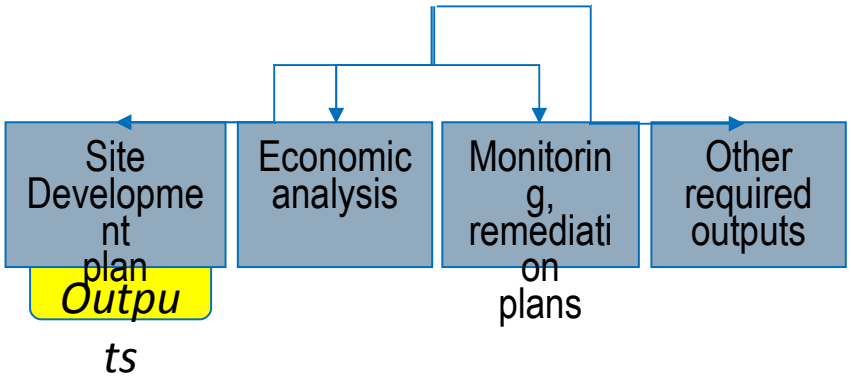
** List is of course incomplete!*

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 write permit application**
    - **Site development plan**
    - **Monitoring plan**
    - **Corrective measures plan**
    - **Environmental impact assessment (*outside focus of SiteChar*)**
    - **Economic analysis (cost of project)**



Conclusion

- **SiteChar workflow**
  - Describes tasks, flow of work to address EU Storage Directive
  - Highlights dependencies among various disciplines in site characterisation team

- **Key findings**
  - 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

SiteChar Workflow

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