GLOBAL CCS INSTITUTE

Carbon Sequestration Leadership Forum
www.cslforum.org

PROJECT INTEGRATION

Working group update

CSLF Edmonton - 19 May 2011

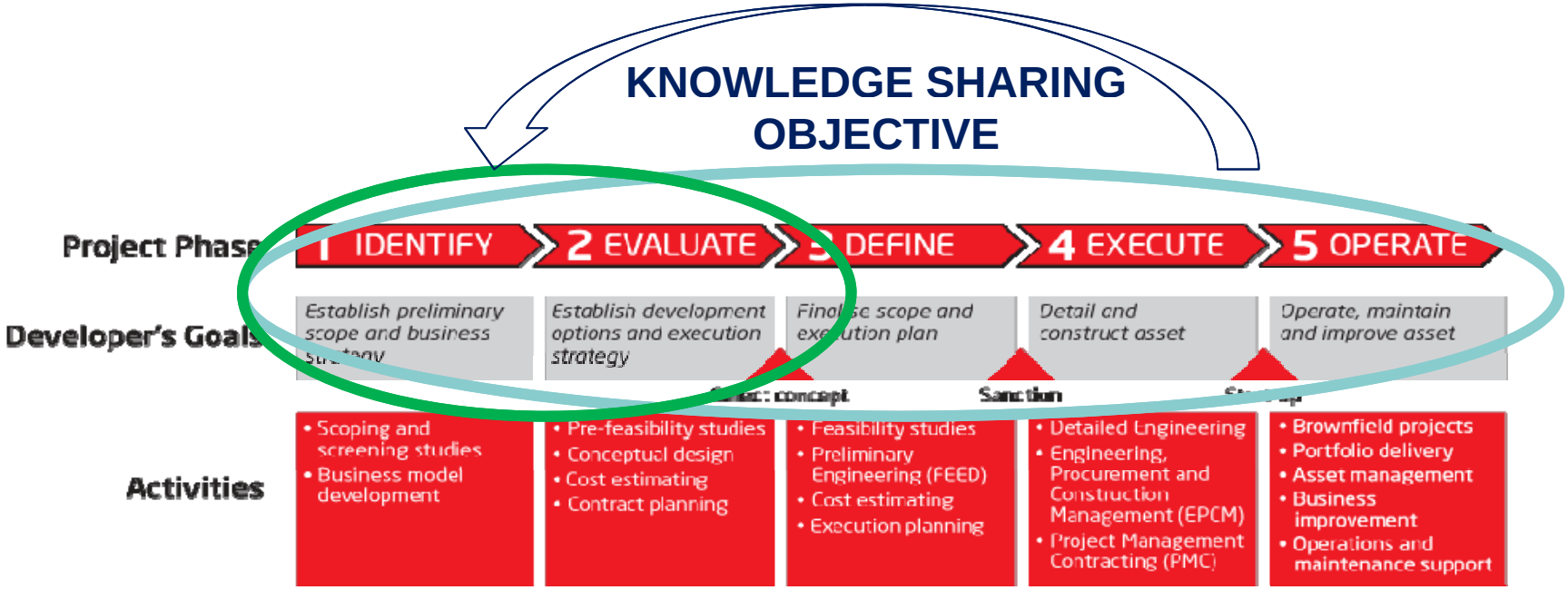
CONTENTS

BACKGROUND - THEMATIC GROUPS

- Discussions held in margins of GHGT-10 with Members - ~70 attendees
- Presentations on 4 themes identified from projects
  - Hub Development Challenges
  - Managing Impacts of CO_2 storage on groundwater
  - Storage learning from EOR operations
  - **Project Integration Challenges**
- Themes accepted as being appropriate and useful
- Implementation of the Thematic Groups **is one of the key actions for the Global CCS Institute in 2011/2012**

OBJECTIVE - PROJECT INTEGRATION WG

- Address the need for whole of CCS project integration of risk management and dependencies
- To inform the proponents and prospective funders of early stage project proposals, to enable them to incorporate key learnings from prior projects into their plans and schedules



SCOPE – PROJECT INTEGRATION WG
(CIRCULATED TO WG MEMBERS Q1 2011)

Subsequent Steps

1. Collect high level project development schedules (incl. resources) – presented primarily as Gantt charts
2. Describe scope of stages, key tasks and decisions points in CCS projects
3. Identification of project inter-dependencies critical paths and timing determinants
4. Comparison of project staging and commentary on key challenges and risk management
5. Key learnings regarding project integration and their application to new projects, including preparation of guidance schedules, tasks and resourcing descriptions

*** work in progress**

SCOPE – PROJECT INTEGRATION WG

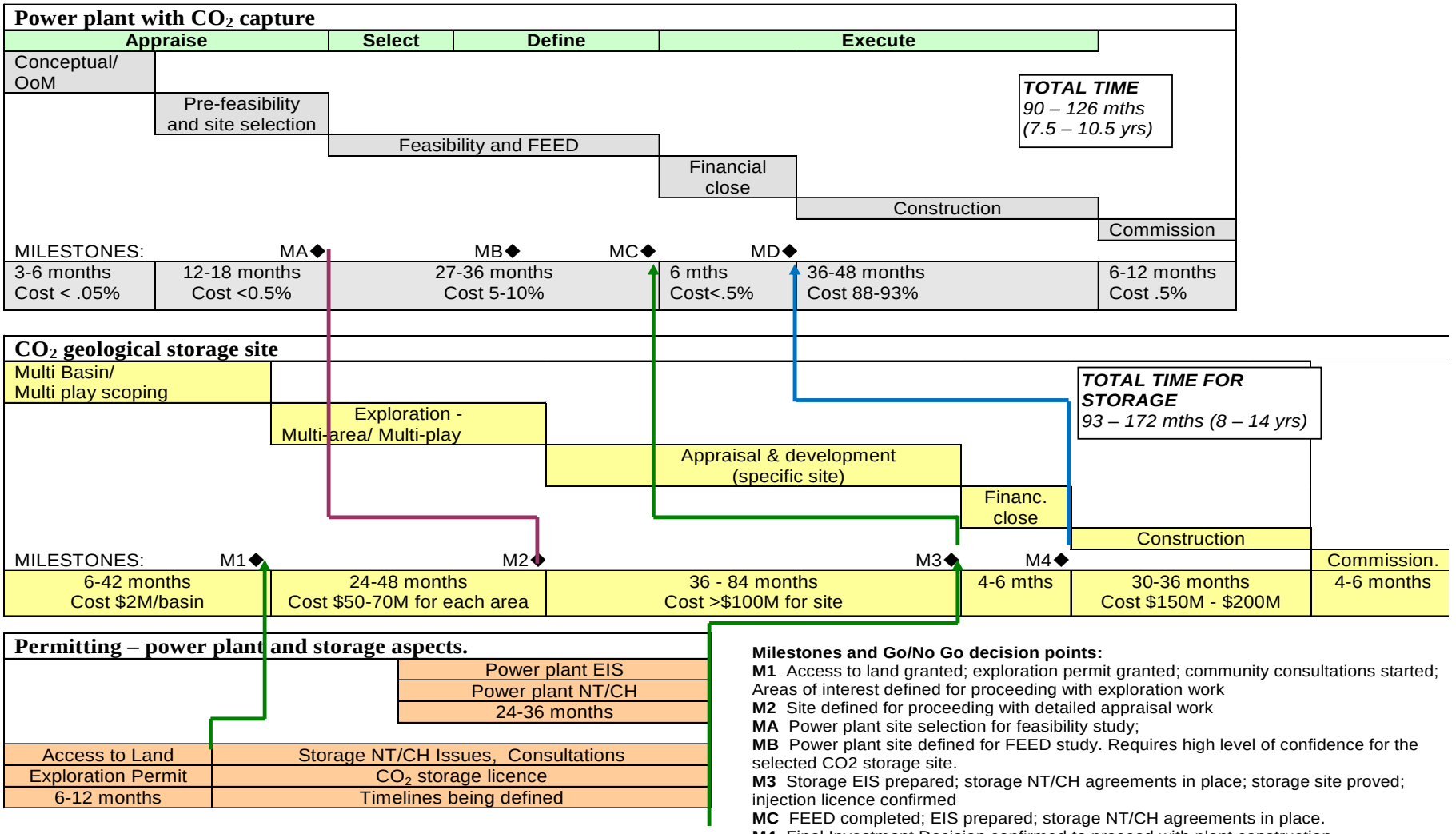
WG Members Feedback

- Include information from projects that have failed and key decisions not made in their project development cycle
- Careful handling of proprietary data from projects
- Accommodate for context specific issues when developing "generic" project development guidelines
- The development of project development software might be too ambitious for this WG – and it was noted that most projects will use their own software (to which the WG can provide valuable input)
- Make sure the work is not duplicating the activities undertaken by the EU CCS Project Demonstration Network (or any other project network for that matter)

PROGRESS MADE – PROJECT INTEGRATION WG

GANTT CHARTS COLLECTED FROM PROJECTS

Indicative project timeline – Power plant with CO_2 capture and storage



Milestones and Go/No Go decision points:

M1 Access to land granted; exploration permit granted; community consultations started; Areas of interest defined for proceeding with exploration work

M2 Site defined for proceeding with detailed appraisal work

MA Power plant site selection for feasibility study;

MB Power plant site defined for FEED study. Requires high level of confidence for the selected CO2 storage site.

M3 Storage EIS prepared; storage NT/CH agreements in place; storage site proved; injection licence confirmed

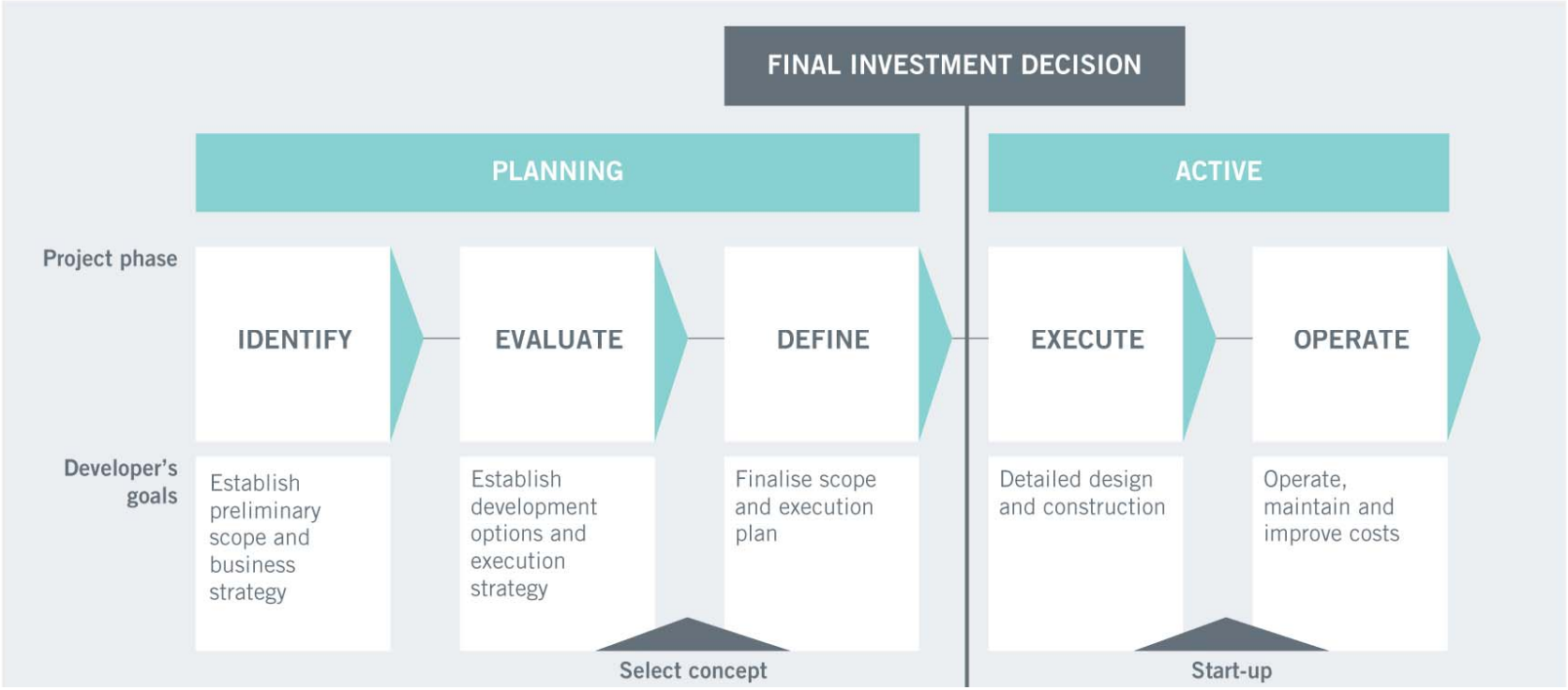
MC FEED completed; EIS prepared; storage NT/CH agreements in place.

M4 Final Investment Decision confirmed to proceed with plant construction

MD: Final Investment Decision confirmed to proceed with storage site construction

PROGRESS MADE – PROJECT INTEGRATION

BASED ON GANTT CHARTS "GENERIC" TASKS HAVE BEEN IDENTIFIED FOR EACH STAGE OF THE PROJECT LIFECYCLE



PROGRESS MADE – PROJECT INTEGRATION WG
KEY PROJECT TASKS ARE DOCUMENTED ON "OPENCCS" ACCORDING TO THE PROJECT LIFECYCLE

- OpenCCS is a collaborative area for building and sharing methodologies, best practices and lessons learned regarding CCS Project Development
- OpenCCS is structured as a "project development guide" and consists of three layers (see following slides)
- Initially it is not an open editing model:
  - Parsons Brinckerhoff has been contracted to support the development of content for OpenCCS
  - As the content develops, controls are in place to lock down aspects of content of OpenCCS and provide it with maturity ratings
  - Experts are sought to review content that is currently hosted behind a firewall

OPENCCS STRUCTURE - 3 FRAMES TO SHOW GRANULARITY IN PROJECT DEVELOPMENT

- Level 1 frame provides the main structure for OpenCCS; i.e. the generic project development guide.
- Level 2 frame describes around 20 activities necessary in a certain of development phase of the project, e.g.:

Activity	*Description (Define Phase – Capture Plan)*
Site Selection	*Undertake selected site survey* *Undertake topographical survey* *Soil investigation* *Identify sensitive receptors (noise / visual impacts)* *Negotiate and finalise site leasehold, ready for execution*
Capital / Operating Costs	*Estimate order of magnitude costs of the capture plant (both capital (+/-10-15% accuracy) and operating (+/-5-10% accuracy)*

- Level 3 frame lists the key tasks and outcomes in detail and references are made to existing work in this area and attention is paid to possible bottlenecks in relation to this particular aspect of the project.

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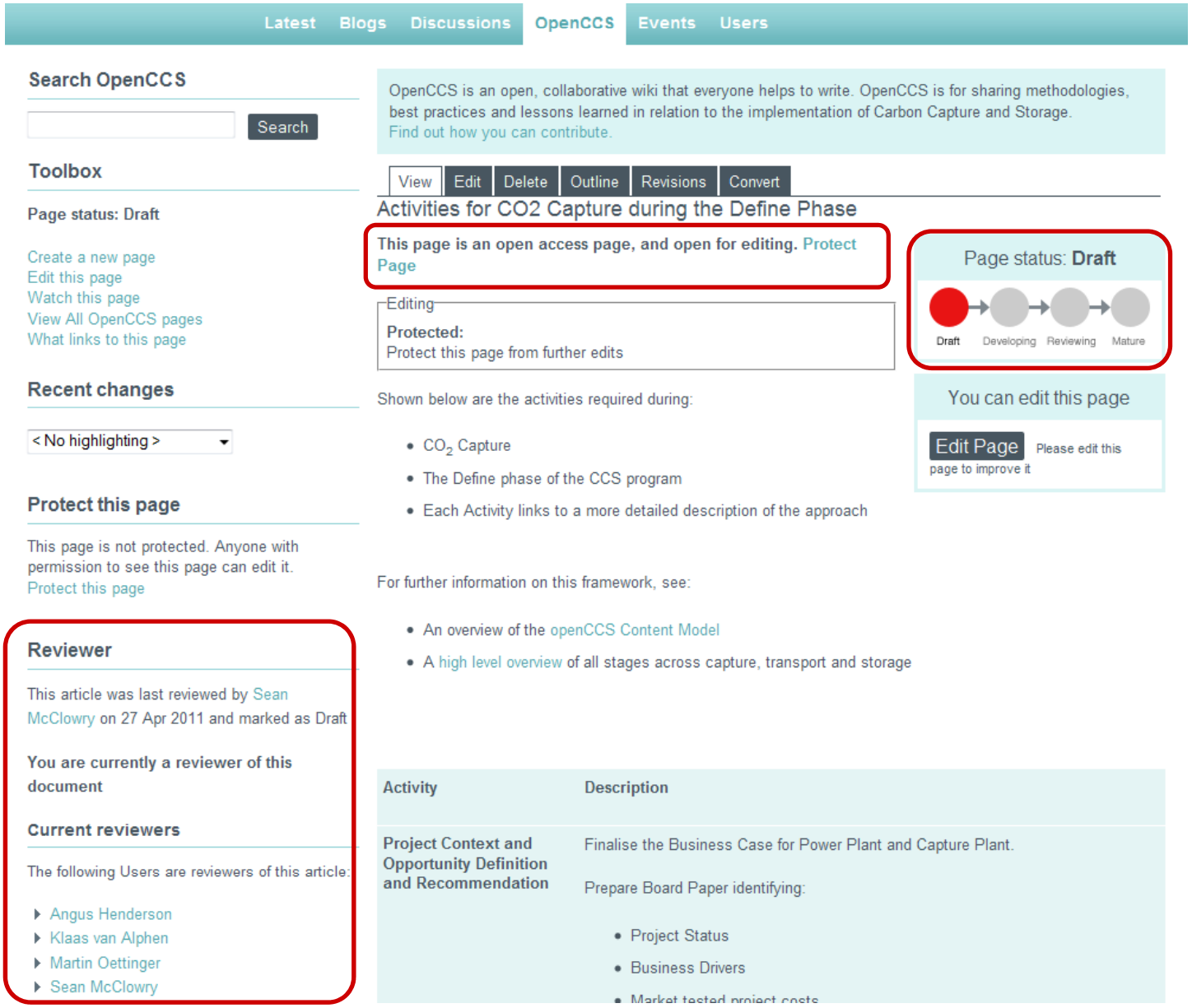
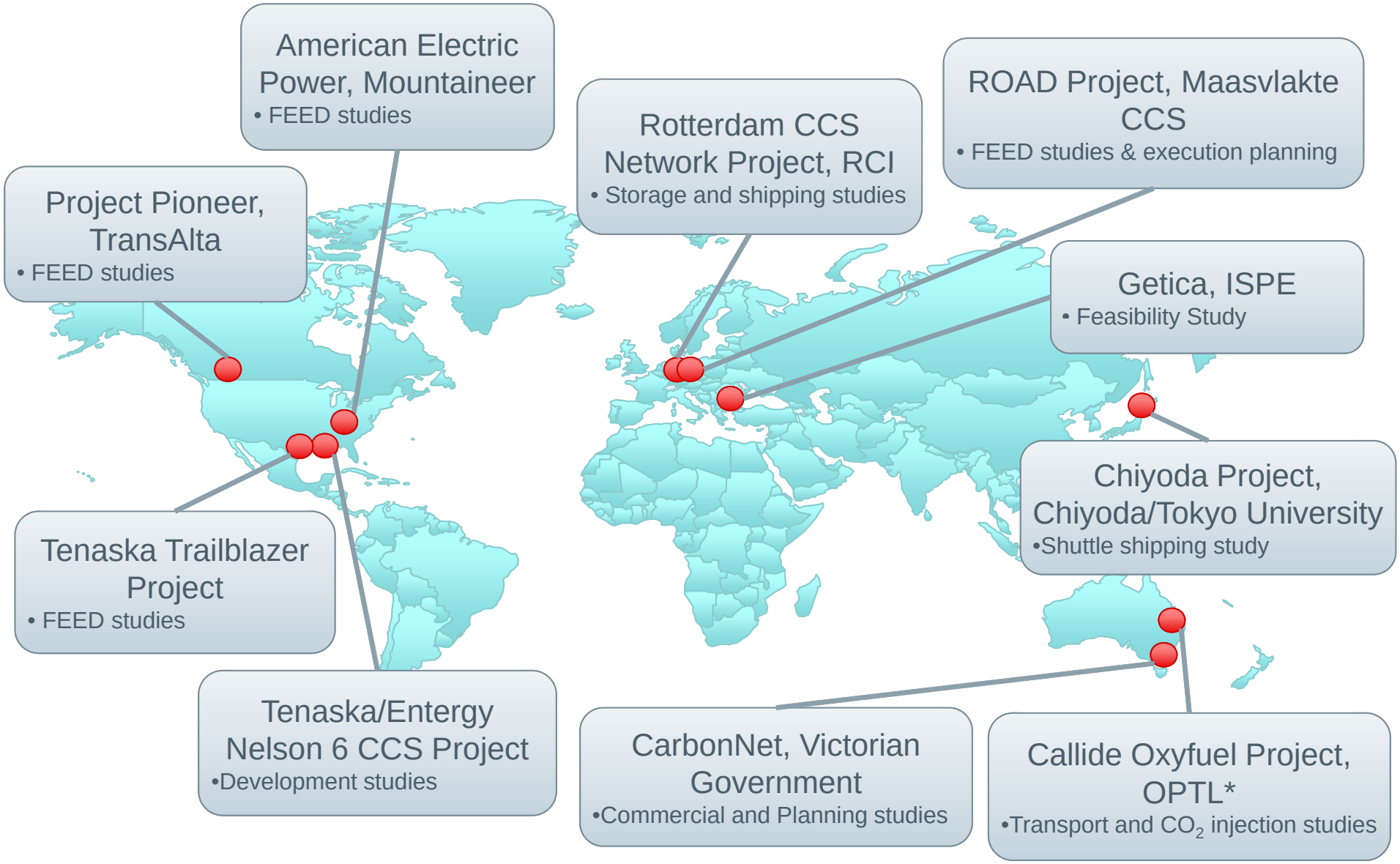
OpenCCS structure – Level 1 data: An Example

Areas	1. Identify Stage	2. Evaluate Stage	3. Define Stage	4. Execute Stage	5. Operate Stage	6. Closure Stage
General Approach	Consider high-level options Short list options for further study "What could it be?"	Examine short-listed options and sub-options Establish if any fatal flaws Select one best option for taking forward "What should it be?"	Examine selected option and provide further definition to allow investment decision to be made Demonstrate the technical and economic viability of the project; "What will it be?" Be capable of being audited by third parties (i.e. peer reviewers, banks	Undertake remaining (detailed) design Build organisation to commission and manage asset Undertake construction activities Undertake commissioning	Operate the asset within regulatory compliance requirements, for the operating life of the asset	Decommission asset to regulatory compliance requirements Rehabilitate site for future defined use Build organisation and provide resources for post-closure
Specifics for Capture	**Concept Studies** • Identify potential of the new or expanded business • Consider new-build or retrofit for capture • Consider saline reservoir or EOR or other for storage/beneficial reuse • Document general features of the project • Estimate order of magnitude costs of the project (both capital (+/- 30-35% accuracy) and operating (+/- 15-20% accuracy))	**Prefeasibility Studies** Consider different capture technologies Consider different EPC contractors Consider different process, location and project configuration options Consider different capacities for the project Assess the likely technical and economic viability of the project Recommend the preferred option and size for final study Estimate costs of the project (both capital (+/- 20-25% accuracy) and operating (+/- 10-15% accuracy))	**Feasibility Studies** Undertake front end engineering design (FEED) studies, clearly recommending one processing, location and project configuration, and prevent the need to be materially varied after project commitment Estimate costs of the project (both capital (+/- 10-15% accuracy) and operating (+/- 5-10%; closer to 5% accuracy)) Select construction contractor and delivery approach (i.e. EPC) Obtain all required regulatory approvals Provide the basis for making an investment decision, and make final investment decision for construction of capture facility	**Project Execution** Complete the design detail for building the carbon capture asset Build the organisation and systems to manage the carbon capture asset Build the carbon capture asset • On time • On budget • To scope and quality Commission the carbon capture asset to operating state	**Asset Operation** Ramp-up operation of the carbon capture asset to ascertain true performance Modify the carbon capture asset (as necessary) to achieve required performance Operate the carbon capture asset to achieve required performance over asset life Maintain the carbon capture asset to achieve required asset life Modify the carbon capture asset to comply with legislated regulatory changes Modify the carbon capture asset to realise identified opportunities	**Asset Decommissioning** Operation of asset (i.e. power plant with capture) ceased Modify the asset (as necessary) to achieve required decommissioned state • On time • On budget • To scope and quality Asset sites decommissioned and rehabilitated to required condition Establish organisation for post-closure stage (as necessary)
Specifics for Transport	**Concept Studies** Consider pipeline or other CO2 transport options Consider existing or new transport route Consider single or multi-user transport route Estimate order of magnitude costs of the project (both capital (+/- 30-35% accuracy) and operating (+/- 15-20% accuracy))	**Prefeasibility Studies** Consider different transport routes Recommend the preferred transport route and capacity for final study Estimate costs of the project (both capital (+/- 20-25% accuracy) and operating (+/- 10-15% accuracy))	**Feasibility Studies** Undertake front end engineering design (FEED) studies, clearly recommending one transport route Estimate costs (both capital (+/- 10-15% accuracy) and operating (+/- 5-10%; closer to 5% accuracy)) Select construction contractor and delivery approach (i.e. EPC) Obtain all required regulatory approvals Make final investment decision for construction of transport facilities	**Project Execution** Complete the design detail for building the transport asset Build the organisation and systems to manage the transport asset Build the transport asset • On time • On budget • To scope and quality Commission the transport asset to operating state	**Asset Operation** Operate the transport asset to achieve required performance over asset life Maintain the transport asset to achieve required asset life Modify the transport asset to comply with legislated regulatory changes Modify the transport asset to realise identified opportunities	**Asset Decommissioning** Operation of asset (i.e. pipeline) ceased Modify the asset (as necessary) to achieve required decommissioned state • On time • On budget • To scope and quality Asset sites decommissioned and rehabilitated to required condition Establish organisation for post-closure stage (as necessary)
Specifics for Storage	**Site Screening Studies** Define screening basis Develop screening plan Review available data and identify potential sites Estimate capacity and level of uncertainty Shortlist storage sites	**Site Assessment Studies** Obtain exploration permit Define selection basis and develop selection plan Acquire data, test, analyse, rank risks Select site and engineering concept	**Site Selection Studies** Specify performance targets Prepare CO2 storage development plan Evaluate compliance with regulations and qualification goal Obtain storage permit	**Design and (Initial) Construct** Select construction contractor and delivery approach for (initial) storage assets (i.e. EPC) Complete the design detail for building the (initial) storage assets (i.e. wells, feeder piping) Build the organisation and systems to manage the storage assets Build the (initial) storage assets • On time • On budget • To scope and quality Commission the (initial) storage assets to operating state	**Operate (Remaining Construct)** Operate the storage assets to achieve required performance over asset life Develop plan for permit review/re-qualification Reassess risks Adjust performance targets Adjust CO2 storage development plan Storage permit renewal Complete the design detail for building the (remaining) storage assets (i.e. wells, feeder piping) Select construction contractor and delivery approach for (remaining) storage assets (i.e. EPC)	**Close** Assess if conditions for site closure have been met Define closure basis Develop closure plan Update storage performance forecast and environmental impact assessment Obtain certificate of fitness for closure Initiate decommissioning Transfer of responsibility for site

OPENCCS STRUCTURE



INFORMATION SOURCES – PROJECT INTEGRATION



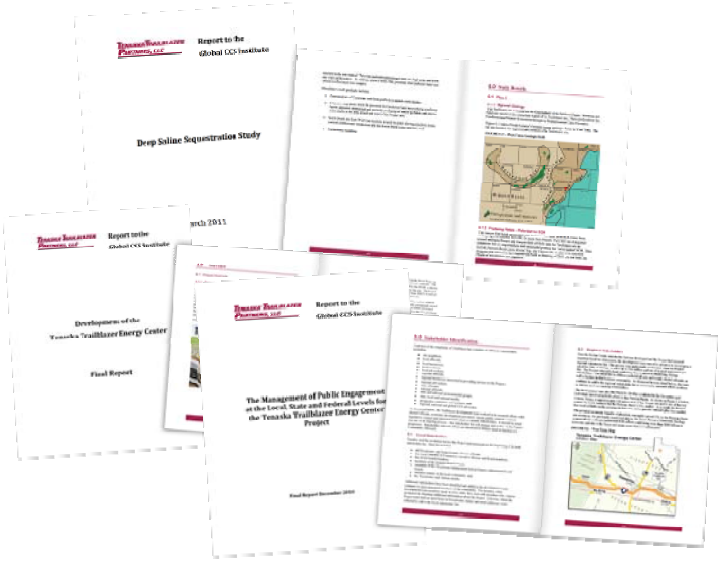
* Letter of Intent

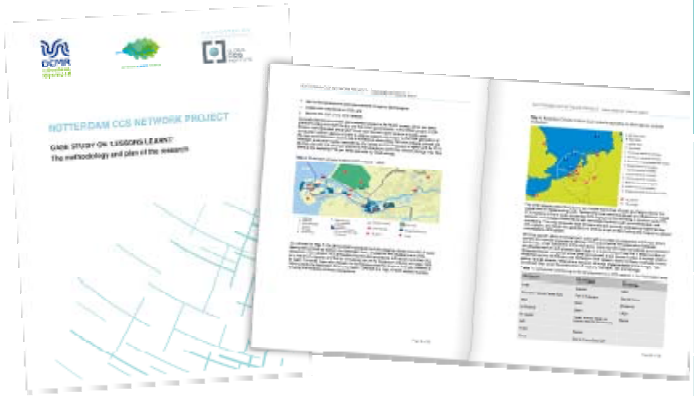
KNOWLEDGE TOPICS COVERED

	Feasibility/FEED			Case Studies			
Project	**Capture**	**Transport/ Infrastructure**	**Storage and MMV**	**Finance and Commercial**	**Policy, Legal and Regulation**	**Public Engagement**	**Risk and Environment**
Rotterdam CCS Network Project		✓	✓	✓	✓	✓	✓
Romanian CCS Demo Plant	✓	✓	✓	✓	✓		
Trailblazer Energy Center	✓		✓	✓	✓	✓	
Nelson 6 CCS Project (Phase 1)	✓			✓	✓	✓	
TransAlta Pioneer	✓	✓	✓	✓	✓	✓	✓
AEP Mountaineer	✓		✓	✓			
Chiyoda Project		✓					
ROAD Project	✓			✓	✓	✓	✓

INFORMATION SOURCES – PROJECT INTEGRATION EXAMPLES OF REPORTS FROM PROJECTS

Knowledge products – Trailblazer Tenaska
Development History of the Project
CO_2 Technology Evaluation, Methodology and Criteria
Public Engagement activities
Report on Steam Turbine Sizing
Carbon Capture Plant Layout Integration with a New Coal Fired Power Generating Facility
Deep Saline Sequestration Study





Knowledge products – Rotterdam CCS Network Project
Detailed technical and cost reports for 3-4 storage sites in Dutch sector North Sea
Historic Case Study on the Rotterdam CCS network
Methodology report on the Independent Storage Assessment

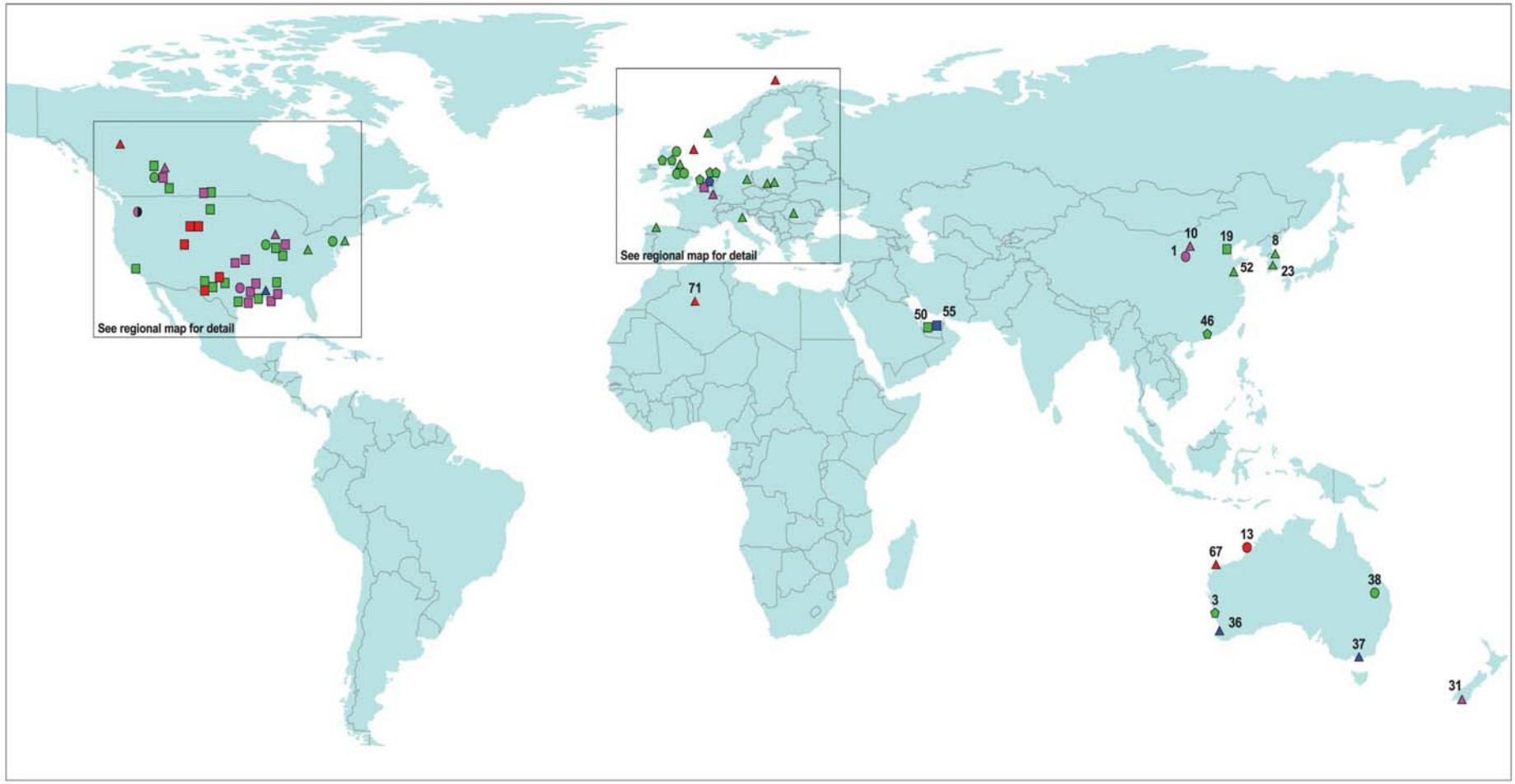
INFORMATION SOURCES – PROJECT INTEGRATION EXAMPLES OF UPCOMING REPORTS FROM N-A

Knowledge products – Project Pioneer (Transalta)
Report on the Regulatory gaps for implementing CCS
Case Study on the socio - economic impact of an integrated CCS Project
Special report on the Construction execution strategy for the Project
New developments in MMV technology
Non confidential version of FEED study report of the integrated project

Knowledge products – Mountaineer Project (A.E.P)
CO_2 Compression report
Report on CCS integration issues
The business case – financial modelling and local impacts of CCS
Non confidential version of FEED study report of the integrated project

Knowledge products – Tenaska Trailblazer
Building a Consortium to Develop a New Pulverised Coal Plant with Post-combustion Capture
Bridging the commercial gap for CCS (ERCOT base load power and EOR market factors)
Financing a new pulverized coal plant with CCS.
Non confidential version of FEED study report

INFORMATION SOURCES–PROJECT INTEGRATION PROJECT SURVEY WORK



SUMMARY & NEXT STEPS – PROJECT INTEGRATION

Progress has been made with regard to data gathering, but WG Member involvement is required in the next steps

Next Steps

1. Review and improve project related content on OpenCCS
2. Identification of project inter-dependencies critical paths and timing determinants
3. Comparison of project staging and commentary on key challenges and risk management
4. Summary of key learnings and application to new projects
5. The first work program could result in a “special report”:
    a) Key technical integration issues; or
    b) Key interdependencies in project schedules and risk mitigation strategies

SUMMARY & NEXT STEPS – PROJECT INTEGRATION

Next Steps – Timing

1. A password and user manual for OpenCCS will be send to the WG Members – Q2 2011
2. A chair will be appointed to convene a face to face Working Group Meeting (Dr Klaas van Alphen will perform a secretariat role) – Q2 2011
3. A Working Group Meeting with Technical Group Members and Interested Project Proponents will be organized to discuss results and refine the work scope with regard to the preparation of specific reports – Q3-Q4 of 2011
4. Technical Group Members will be kept informed regarding the agenda setting process for the meeting – Q3 -2011