

# CCS Project Risk Management

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| Very Low | Low   | Medium | High   | Very High |   |
|----------|-------|--------|--------|-----------|---|
| 0-5%     | 5-20% | 20-30% | 30-40% | 40-100%   |   |
| 5        | 10    | 15     | 20     | 25        | 5 |
|          |       | 12     | 16     | 20        | 4 |
|          |       | 9      | 12     | 15        | 3 |
|          |       | 6      | 8      | 10        | 2 |



# Project Risk: Definition

## Possible Deviations from Objectives

### Mission of Risk Management

To Suppress Possible Unfavourable Deviations (Threats)

To Enhance Possible Favourable Deviations (Opportunities)

| Very Low | Low   | Medium | High   | Very High |
|----------|-------|--------|--------|-----------|
| 0-5%     | 6-20% | 20-30% | 30-40% | 40-100%   |
| 9        | 12    | 15     | 3      |           |
| 6        | 8     | 10     | 2      |           |



# Key Questions

## Possible Deviations from CCS Objectives

**Question #1: What Are Typical CCS Project Objectives?**

**Question #2: Where Deviations Might Come from?**



# Typical CCS Project Objectives & Baselines

| CCS Objective              | CCS Baseline   |
|----------------------------|--|
| <b>System Capacity</b>     | <i>Amount of CO<sub>2</sub> Captured, Transported, Stored &amp; Sold</i>   |
| <b>Incremental Oil</b>     | <i>Incremental Oil Produced Due to CO<sub>2</sub>-EOR (if applicable)</i>  |
| <b>CapEx</b>               | <i>Approved Capital Expenditure Budget</i>                                 |
| <b>OpEx</b>                | <i>Net Present Value of Approved Operating Budget</i>                      |
| <b>Profitability</b>       | <i>Approved Level of Profitability</i>                                     |
| <b>Schedule</b>            | <i>Approved Project Completion Date</i>                                    |
| <b>Environmental</b>       | <i>No Negative Environmental Impact</i>                                    |
| <b>Health &amp; Safety</b> | <i>No H&amp;S Impact on Workers and General Public</i>                     |
| <b>Reputation</b>          | <i>Reputational Benefits; No Negative Impacts on Stakeholder Relations</i> |

**Lesson Learned #1: The Better CCS Objectives and Baselines Developed, the Smaller Room for Risks**



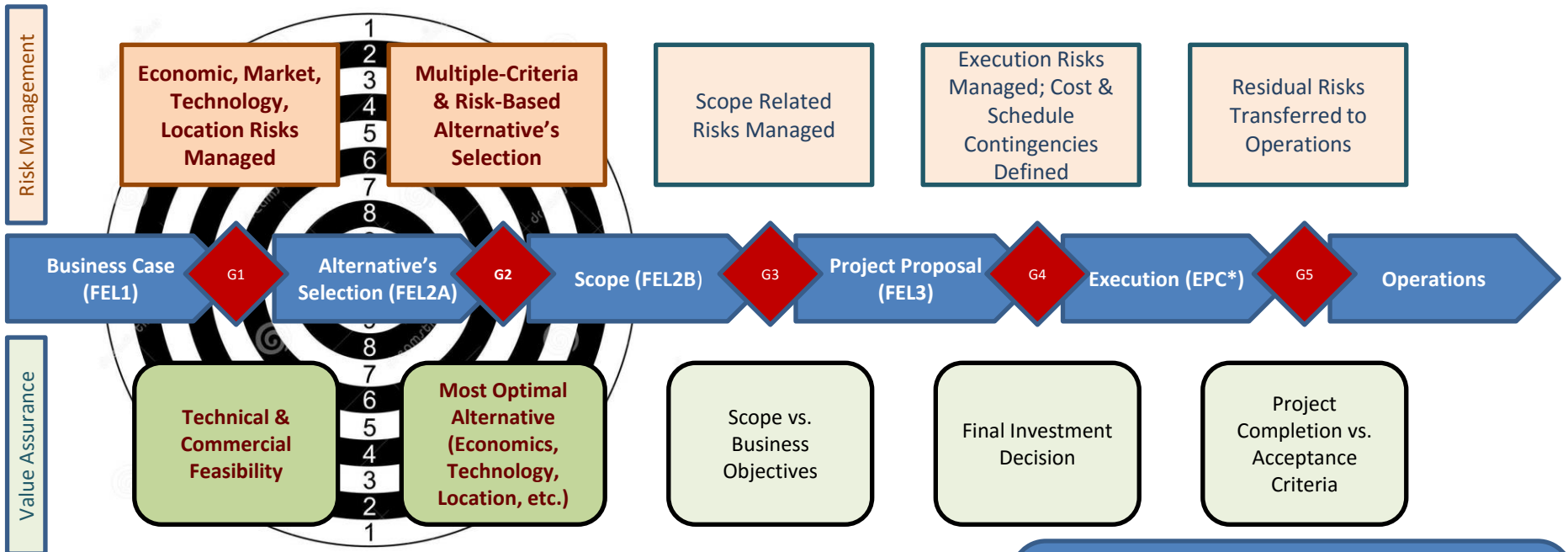
# Risk Breakdown Structure: Where Risks Might Come from?

| RBS Category                               | RBS Sub-Category  |
|--|---|
| <b>Regulatory &amp; Stakeholders</b>       | <i>Applicable Regulations</i><br><i>Approval Process &amp; Permits</i><br><i>General Public</i>   |
| <b>Organizational</b>                      | <i>Adopted Project Development Procedures</i><br><i>Project Team Structure &amp; Skills</i>   |
| <b>Economics &amp; Agreements</b>          | <i>Commodity Market and Sales Agreements</i><br><i>Incremental Oil (CO<sub>2</sub>-EOR)</i><br><i>Infrastructure in Place</i><br><i>Funding, Grants and Investments</i><br><i>Taxes and Credits</i><br><i>Profitability &amp; Phasing</i><br><i>Acceptance Criteria</i> |
| <b>Project Development &amp; Execution</b> | <i>Front End Loading</i><br><i>Reservoir Characterization &amp; Source – Sink Match</i><br><i>EPC* of Capture, Transportation &amp; Storage</i><br><i>Capture – Transportation - Storage Integration</i><br><i>Commissioning &amp; Start-up</i>                         |
| <b>Operations</b>                          | <i>Capture Operations</i><br><i>Transportation</i><br><i>Injectivity &amp; Accepted Capacity</i><br><i>CO<sub>2</sub>-EOR</i><br><i>Measurement, Monitoring, Verification (MMV)</i><br><i>Seismic/ Tectonic &amp; Cap Rock Integrity</i><br><i>Asset Integrity</i>      |

\*EPC = Engineering, Procurement, Construction



# Risk Management vs. Front End Loading (FEL)



**Lesson Learned #3: Business Case (FEL1) and Alternative's Selection (FEL2A) Phases Are Most Critical Phases for Success of a CCS Project**

**Rule #1: Project Moves to a Next Phase only When Objectives of a Previous Phase Met**

**Lesson Learned #2: Violating FEL Logic Is a Major Organizational Risk**

*\*EPC=Engineering, Procurement, Construction*

# Crucial Importance of Business Case (FEL1) Phase

## Goal: Development of a CCS Project Business Model that Marries

- Monetary and Non-Monetary Benefits of Project Owners as For-Profit Organizations and Good Corporate Citizens

**with**

- Smart Application of Carrots & Sticks

### CCS Project Owner's Benefits

- CCS Leadership
- Reputational Benefits
- Technology Licensing
  - Incremental Oil
- Overall Profitability

**Equilibrium**

### CCS Carrots & Sticks

- Grants
- Credits
- Taxes
- Standards & Regulations
- Infrastructure in Place
- CO<sub>2</sub> Market in Place

**Lesson Learned #4: Most of CCS Project Failures Stem from Mismatch of the Benefits and Carrots & Sticks (Pull vs. Push Mismatch)**

# Crucial Importance of Alternative's Selection (FEL2A) Phase

## Goal: Selection of a Project Alternative that Meets Two Criteria

- Most Optimal Economics, Geology, Technology, Location, etc. (Multiple Criteria Decision Analysis (MCDA\*))
- Lowest Project Uncertainty & Risk Exposure\*\*

**Lesson Learned #5: It Is Much Easier to Manage Risks of a CCS Project Alternative That Is Least Risky First Place**

\* J. Choptiany, R. Pelot, J. Brydie, W. Gunter, *An MCDA Risk Assessment Framework for Carbon Capture and Storage*, Int. J. Decision Support Systems, vol. 1, No. 4, 2015

\*\* Yuri Raydugin, *Project Risk Management: Essential Methods for Project Teams and Decision Makers* (2013), New York: John Wiley & Sons Inc.





# Conclusion

Although Managing CCS Technical and Project Execution Risks Is Important

**Mutual Understanding and Exploitation of Industry's and Government's Drivers Are Most Crucial (Pull vs. Push Equilibrium)**

## Role of CCS Risk Management:

- Assist with Finding the Equilibrium as an Objective
- Manage Deviations from The Equilibrium
- Ensure Successful CCS Project Execution