Svante

NETL Carbon Management and Oil & Gas Research Project Review Meeting

Integrated CCUS Projects and FEED Studies

LafargeHolcim CO_2MENT Colorado Project – FE0031942

August 3, 2021

Claude Letourneau, President & CEO – Svante, Inc.
Deborah Jelen, Executive Director – Electricore, Inc.

LafargeHolcim

CO2ment Project- Florence, Colorado

LafargeHolcim

Project Overview

Project Funding:

- Total Funding: $1,930,524
- Federal Funding: $1,500,000
- Cost Share Funding: $430,524 (22%)

Award Period: 10/1/2020 through 3/31/2022

Project Participants:

- Prime: Electricore, Inc.
- Technology: Svante, Inc.
- Engineer: Kiewit Engineering Group Inc (Kiewit)
- Cost Share: LafargeHolcim, Total, Oxy Low Carbon Ventures (OLCV)

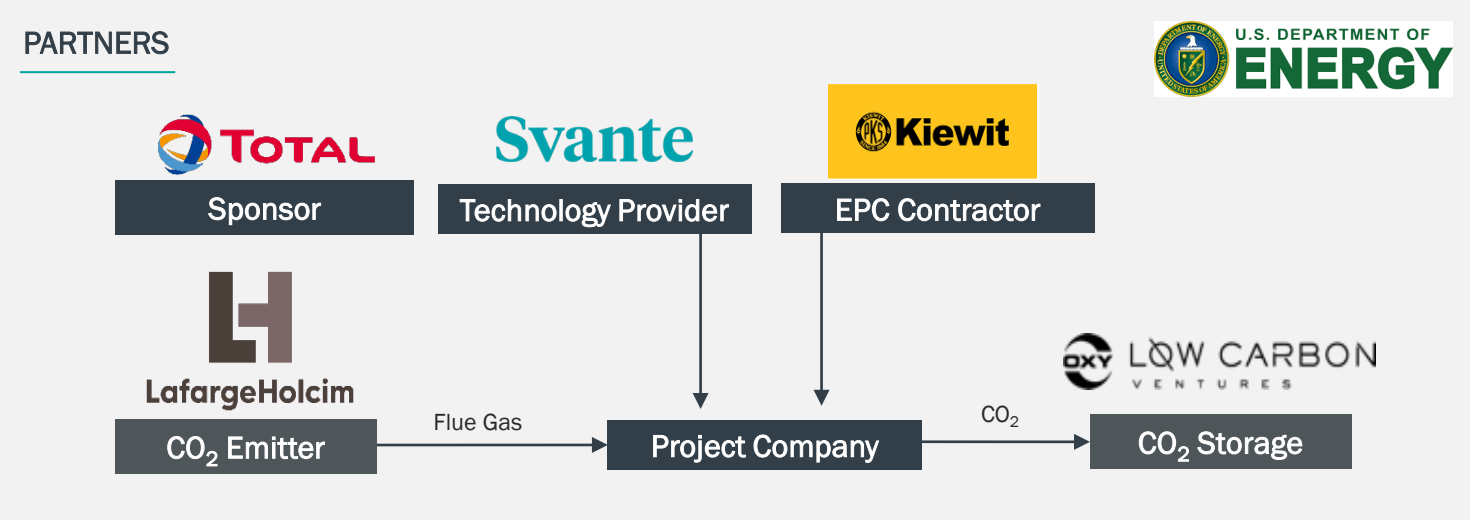
DOE-NETL Team:

- Project Manager: Mr. Carl Laird
- Contracting Officer: Ms. Kelly Haught
- Contracting Specialist: Mr. W. Ryan Simmons

Overall Objective:

The objective of this project is to accelerate the implementation of an 1.5 million tonnes per year (TPY), and first-of-a-kind (FOAK) Svante VeloxoTherm™ carbon capture plant by completing the pre-front-end engineering design (pre-FEED) of a fit-for-purpose design at an existing cement plant.

Organizational Structure of the Project Consortium

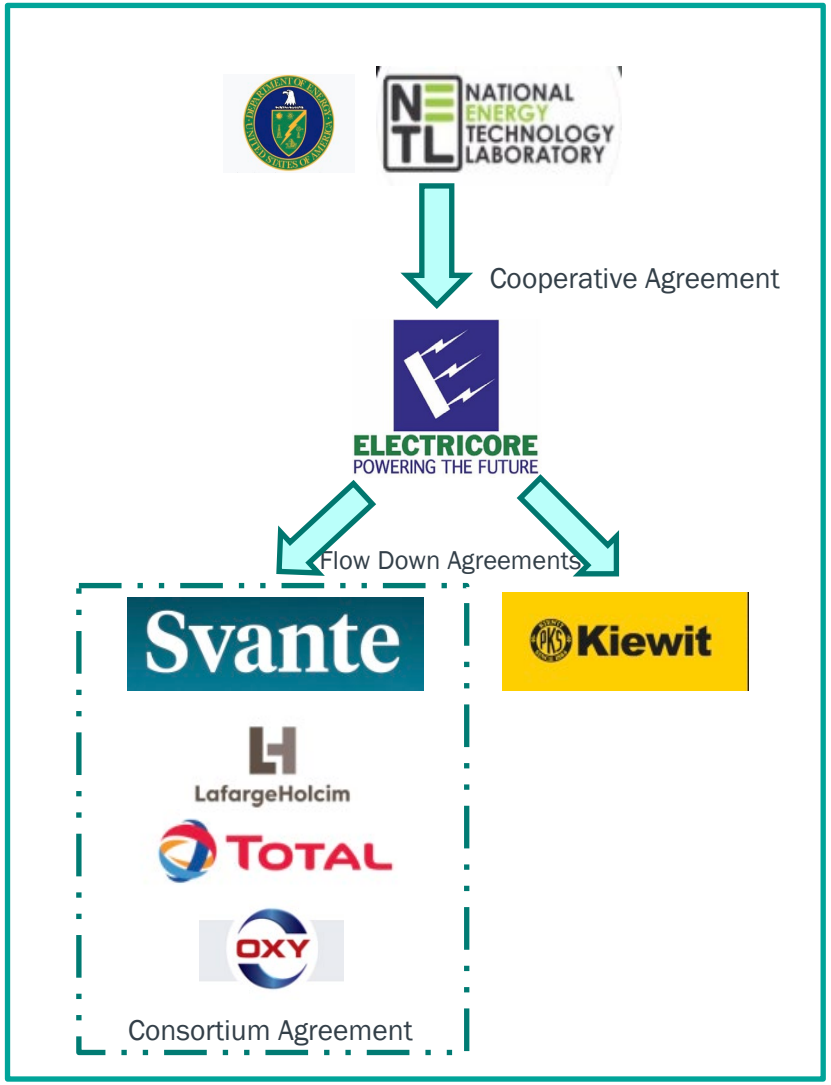


Pre-Feasibility Study of
First Commercial Scale Svante Capture Plant
for CO_2 storage from cement plant

45Q Tax Credits – 50 $/tonne

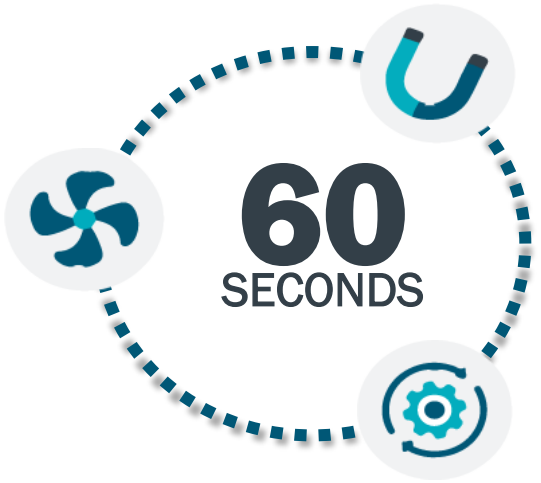
Capacity: 1.5 million tonnes per year

Florence, CO, USA



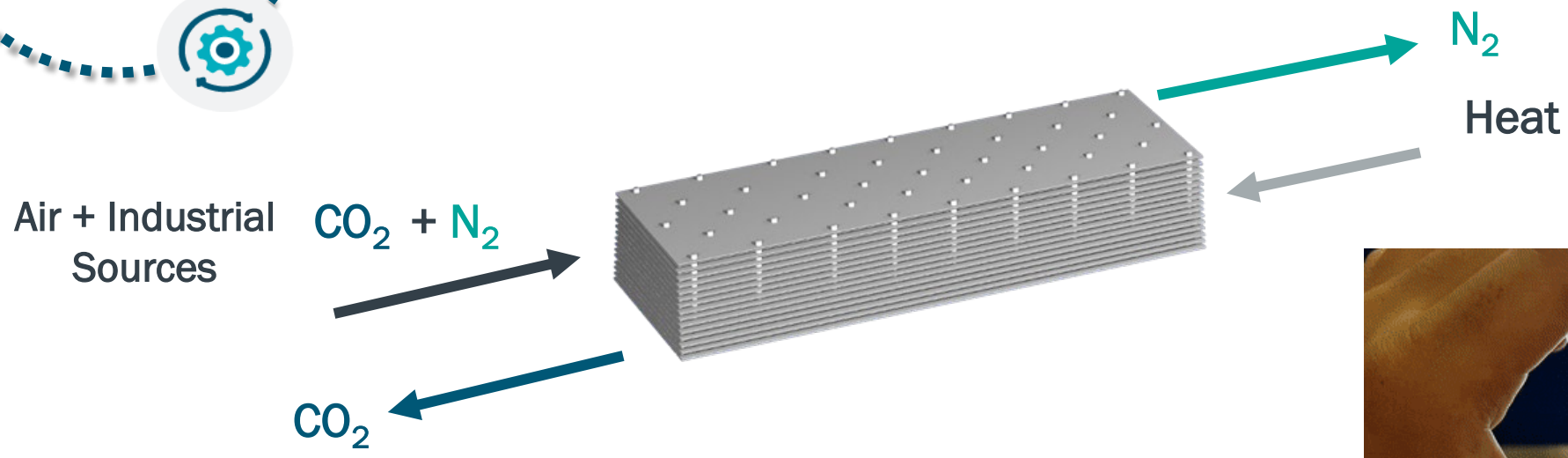
Svante Carbon Capture Technology

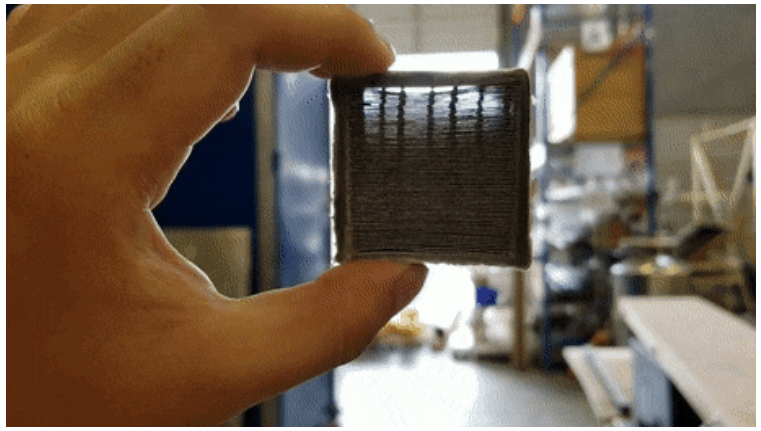
(Rapid Cycle Thermal Swing Adsorption (RC-TSA), VeloxoTherm™)



Engineered CO_2 filter

Structured Adsorbents with low pressure drops, fast mass transfer, high surface area, enable Rapid Cycling TSA process (RC-TSA)





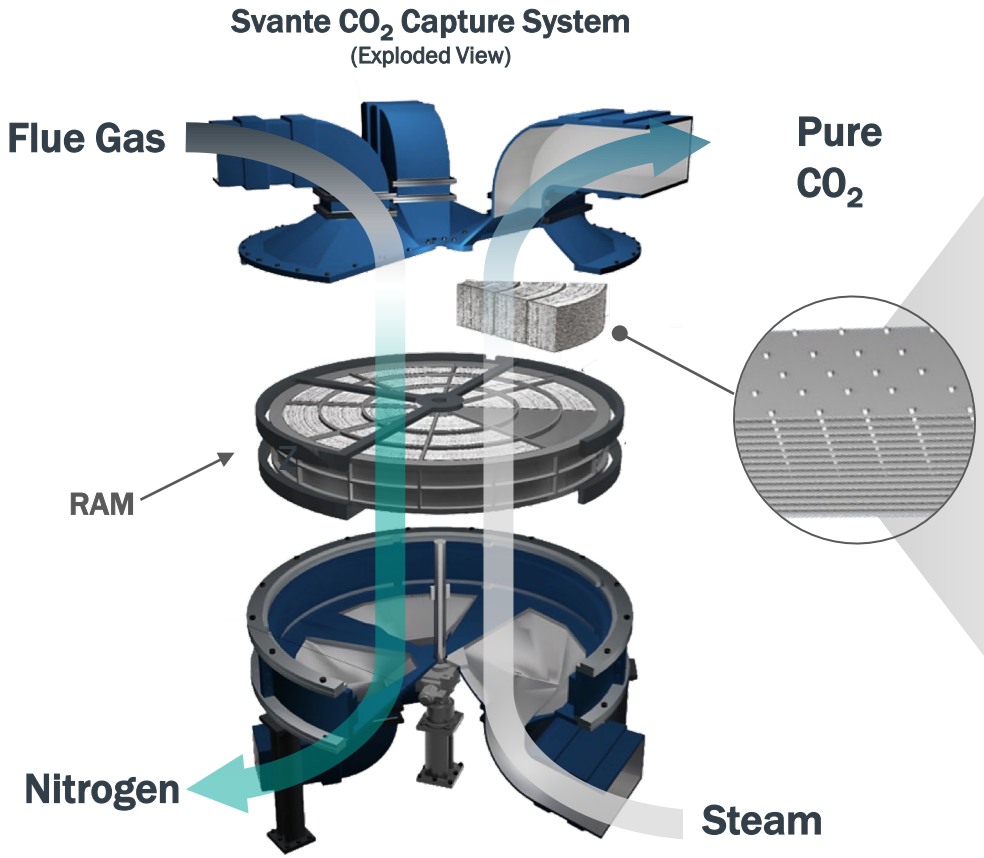
Sorbent materials can be customized for desired application (Amine-doped Silica, polymer or MOF)

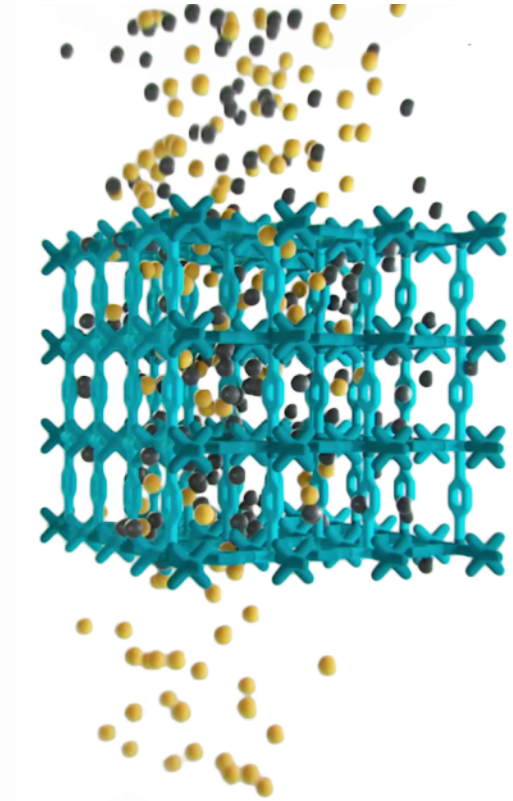
Svante's Technology – Rotary Adsorption Machine

Powerful Nano-Filter
high capacity for CO_2 capture

Fast Heat Transfer
large productivity and small footprint

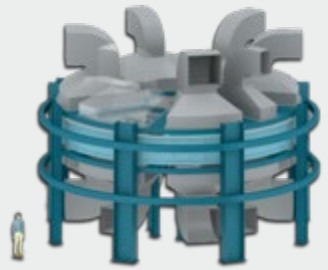
Low Pressure Drop
low operating cost



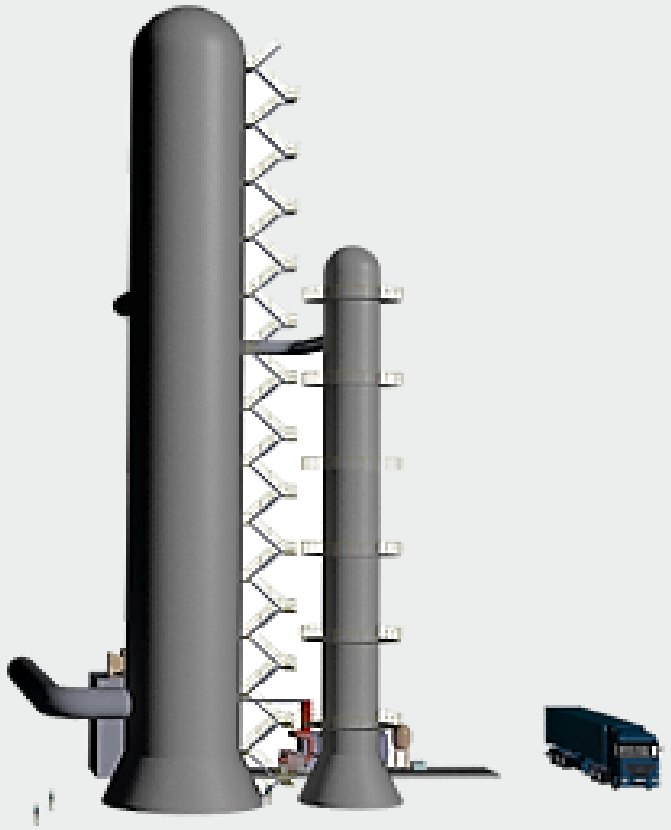


Svante's Technology – Capital Advantage

- High capital cost is currently a barrier to widespread **deployment of carbon capture**
- Svante's solid sorbent technology is industrial scale, **low CAPEX** solution ready to enable the market today
- By replacing large chemical solvent towers (conventional approach) with a single piece of compact equipment, Svante's technology **enables a 50% reduction in capital costs compared** to first generation approaches



Svante Technology

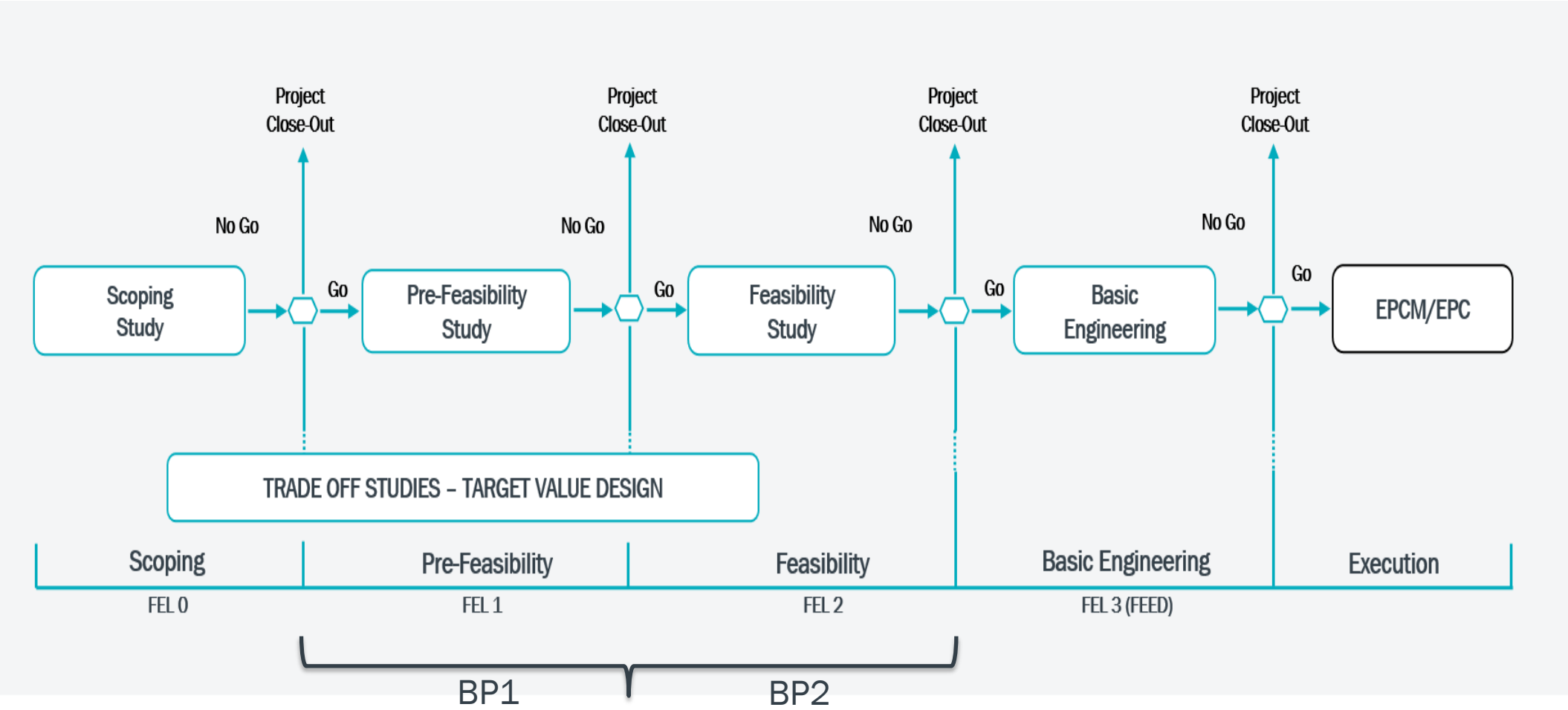


Conventional Approach

Flue Gas Sources and Composition

Flue Gas Sources				
Flue Gas Source	**Unit**	**LH Cement Plant Exhaust TP-1**	**Natural Gas Steam Boiler**	**Combined Flue Gas Feed**
Flue Gas CO_2 Concentration	%v/v dry	12.95	10.15	12.26
Total CO_2 in Flue Gas	TPD	4189	1086	5275
CO_2 Capture Recovery	%	90	90	90
CO_2 Captured	TPD	3722	977	4750
Capture Plant Design Capacity	TPD			4750
Composition				
Carbon Dioxide	%v/v	10.64	8.5	10.12
Water	%v/v	17.84	16.24	17.45
Nitrogen	%v/v	65.09	72.06	66.80
Oxygen	%v/v	6.43	3.2	5.64
SO_2 (max 100ppmv)	ppmv	40-50		40-50
NOx (NO_2 1-2ppmv)	ppmw	200-300		200-300

Stage Gate Process Definition

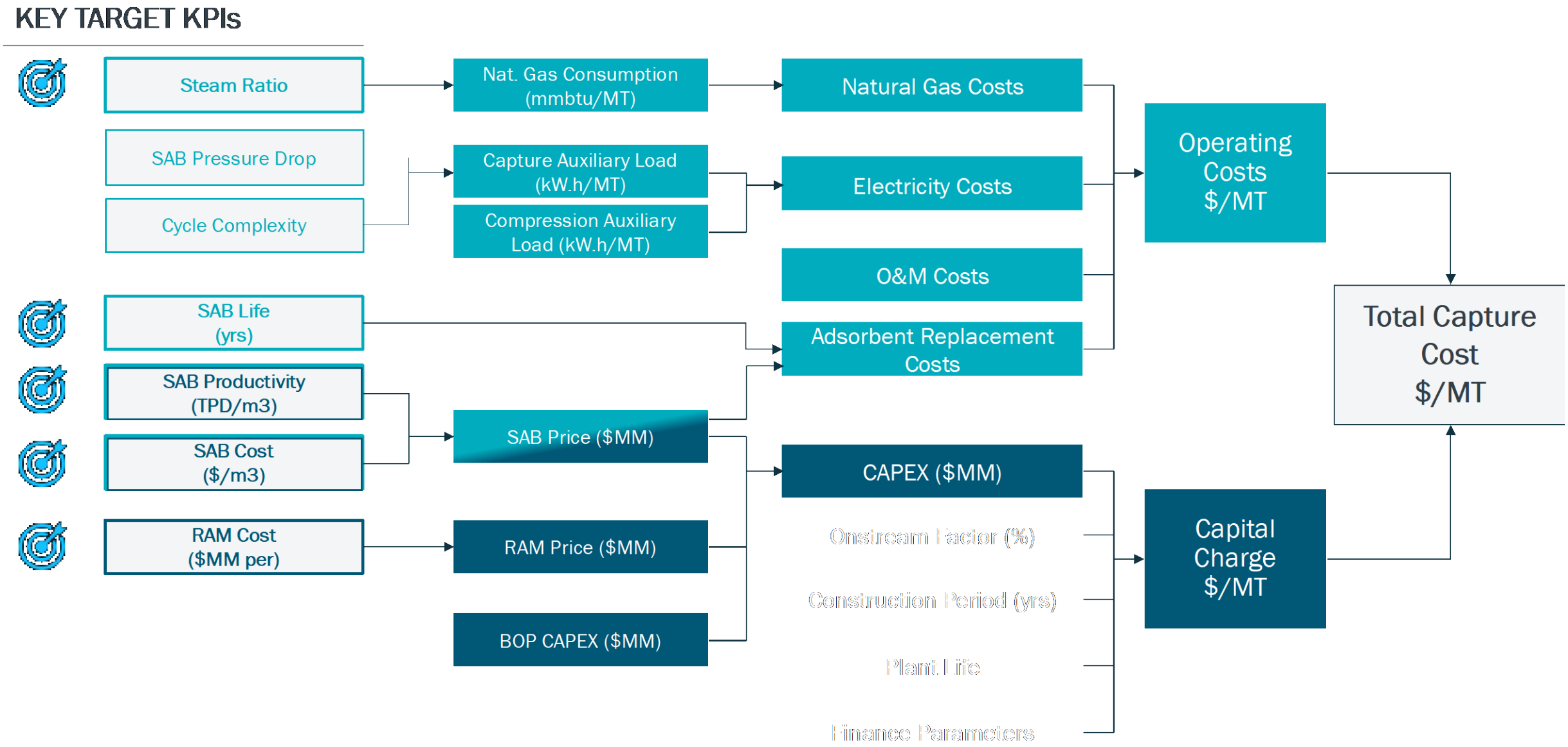


Scope of work under
current US DOE Contract

LafargeHolcim Colorado FEL 1 Prefeasibility Report

- FEL 1 Completed in BP1
- 4,750 TPD CO_2 (incl. steam generation)
- Net-Zero Index: 0.85
- Capture and Compression TOC $344MM
- Pipeline Connection $97MM
- Solar Renewable PPA
- Operating Cash Cost: 28$/tonne CO_2
- FEL 2 Stage in progress (BP2)

Mapping Technology and Product KPIs to Capture Cost



Capital Cost Estimate

Summary of Class IV Capital Cost Estimates for Option 2					
Direct Costs	**PEC**	**Material**	**Labor**	**Subcontract**	**Total Direct Costs (MM)**
Svante CO_2 Capture Process RAM & Adsorbent Beds	-	-	-	$ 43.168	$ 43.168
Svante CO_2 Capture Process BOP (Flue Gas Cooling & HMO)	$ 24.304	$ 11.794	$ 21.198	-	$ 57.296
CO_2 Compression	$ 22.935	$ 3.523	$ 7.827		$ 34.285
Utilities:					
Utilities - Steam Generation	$ 13.513	$ 1.629	$ 3.410	-	$ 18.552
Utilities - Cooling & Water Treatment	$ 12.286	$ 4.081	$ 6.760	-	$ 23.128
Stack & Tie-in	$ 4.800	$ 1.584	$ 3.114	-	$ 9.498
Site Specific Infrastructure	-	$ 24.000	$ 15.000		$ 39.000
Total Direct Installed Cost (BEC)					**$ 224.926**

Project Indirects	**Cost**
Engineering, EPC & Home Office	$ 37.22
Freight Allowance	$ 5.66
Process & Project Contingencies	$ 59.44
Total Project Indirects	**$ 102.31**
Total Plant Cost (TPC)	**$ 327.23**

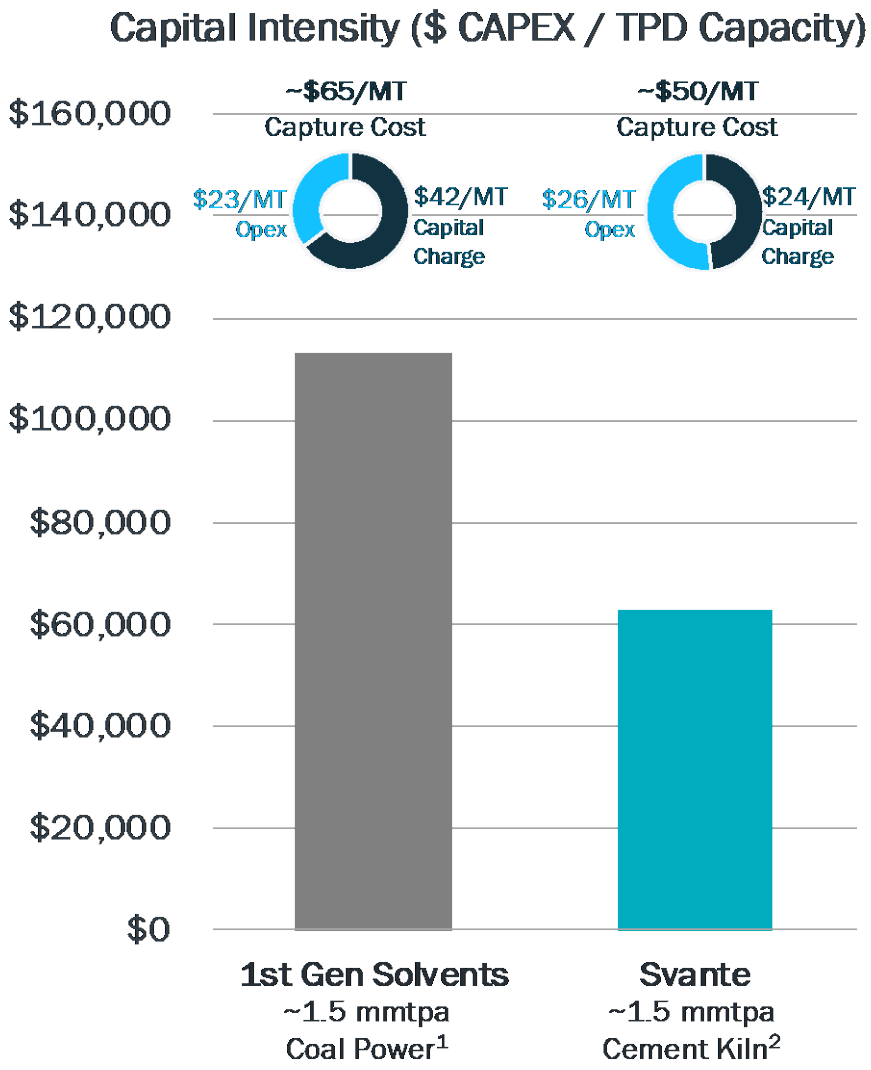
Owners Costs	**Cost**
Commissioning or Start-Up Costs	$ 6.748
Inventory Capital/Spare Parts	$ 1.636
Financing Costs	$ 8.835
Total Owners Costs	**$ 17.219**
Total Overnight Cost (TOC)	**$ 344.453**

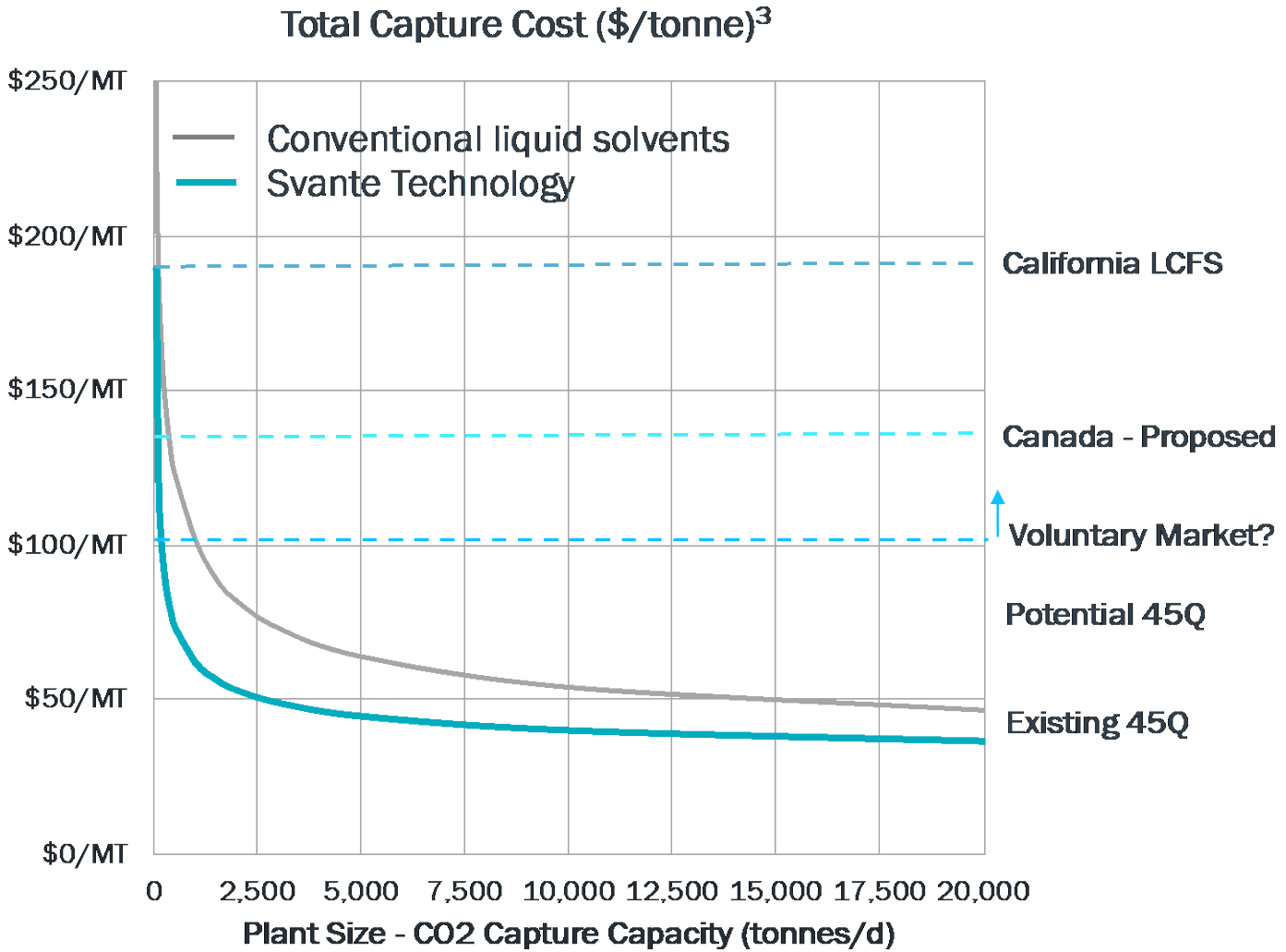
Svante Original Equipment Package is 12.5 % of Total Overnight Cost

Capital Intensity

	$/TPD
Baseline Plant:	59,560
Site Specific Infrastructure:	12,860
Total Carbon Capture Plant:	*72,420*

Estimating Capture Cost Scale Effects





1. Cost data source - "W.A. Parish Post Combustion CO_2 Capture and Sequestration Project" Final Public Design Report, DE-FE0003311, Petra Nova Parish Holdings LLC, capture cost estimate by Svante
2. Svante Techno-Economic Analysis (AACE Class IV)
3. Svante estimates

Project Milestones

	Task	Milestone Description	Planned Completion Date	Verification method
✓	1.0	Kick-Off Meeting	10/30/2020	Presentation File
✓	1.1	Updated Project Management Plan	10/30/2020	Submitted PMP
✓	1.2	Technology Maturation Plan	12/31/2020	Submitted TMP
✓	2.0	Phase 1 – Pre-feasibility Report	04/30/2021	Submitted Pre-feasibility Report
	3.8	FEL2 Level Safety Review (Proposed)	01/31/2022	Submitted Safety Review (Proposed)
	4.0	Phase 2 – Feasibility Report	06/30/2022	Submitted Feasibility Report
	4.4	Commercial Site Approval	06/30/2022	Submitted Commercial Site Agreement Letter
	5.1	Technology Environment, Health and Safety (EH&S) Risk Assessment	06/30/2022	Submitted EH&S
	5.2	Techno-Economic Analysis	04/30/2022	Submitted TEA
	5.3	State-Point Data Table	04/30/2022	Submitted State-Point Table

CCUS Project Challenges

Location, Location, Location

Long Life Emitter and Off-Taker

CCUS project needs guaranteed flue gas >20yrs

CO_2 storage or utilization has to be guaranteed >20 yrs

CO_2 Pipeline

Transportation to storage or utilization

Public opposition to pipelines in general

Costs ranging from $1.5 to $4.0 MM/mile

Large Cooling Load

Flue gas and compression cooling required

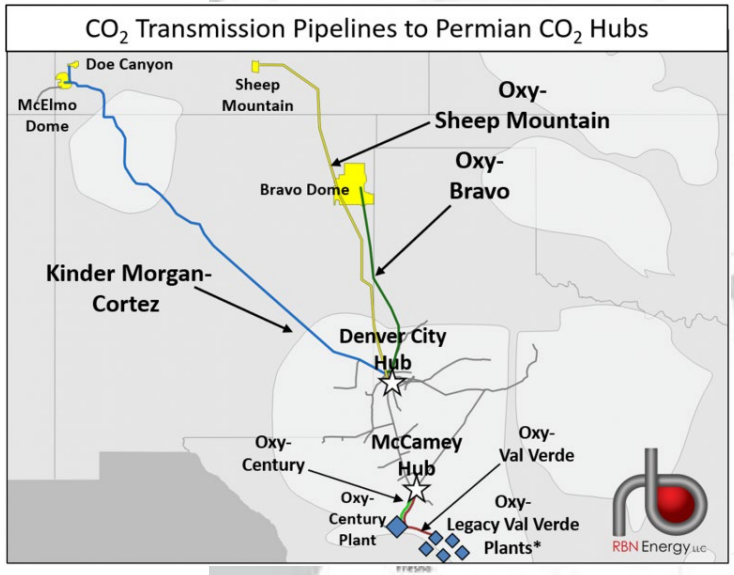
If water is not available then aerial cooling only way – expensive and large footprint

Contaminants

Many industrial flue gases such as cement contains SOx, NOx, and particulates that poison active capture materials

Conventional scrubbing adds costs and risk

Building a Major CO_2 Hub in Colorado



Sheep Mountain Natural Reservoir CO_2 Hub in Colorado

CCUS Project Challenges

A new Business Model

Complex Business Structure

Specialty expertise required

Numerous entities involved

Contract overhead high

CO_2 Storage Risk and Liability

Who takes liability?

Public opposition like Europe?

Slow permitting and development

Government Involvement

Slower implementation

Subject to change

High overhead effort

Economics

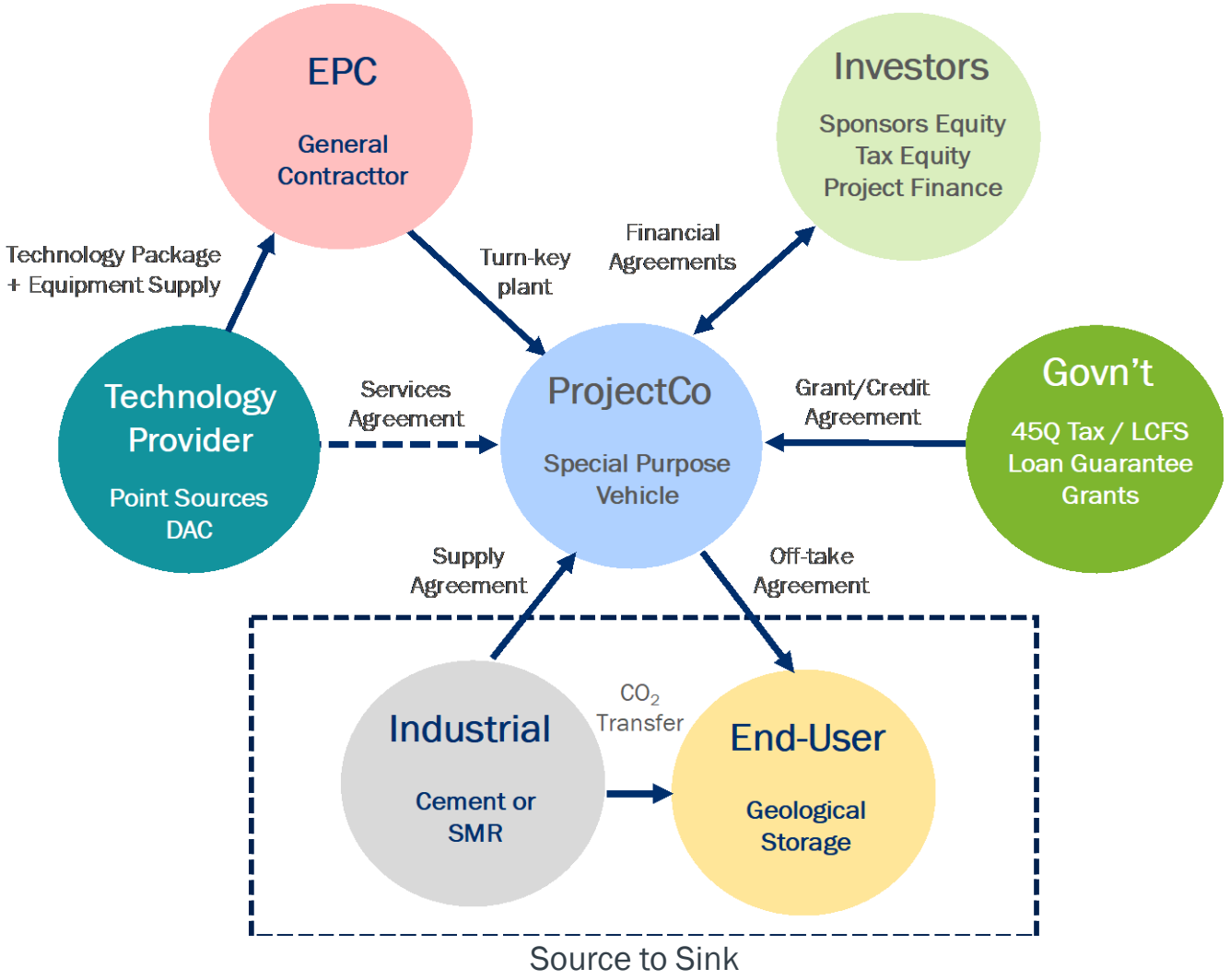
45Q+ Revenue
$50 to 85 USD/tonne

$50 USD/tonne
Capture and Compression

$25-30 USD/tonne
Sequestration

Cost of capital
8-10% IRR

Carbon Capture as-a-Service



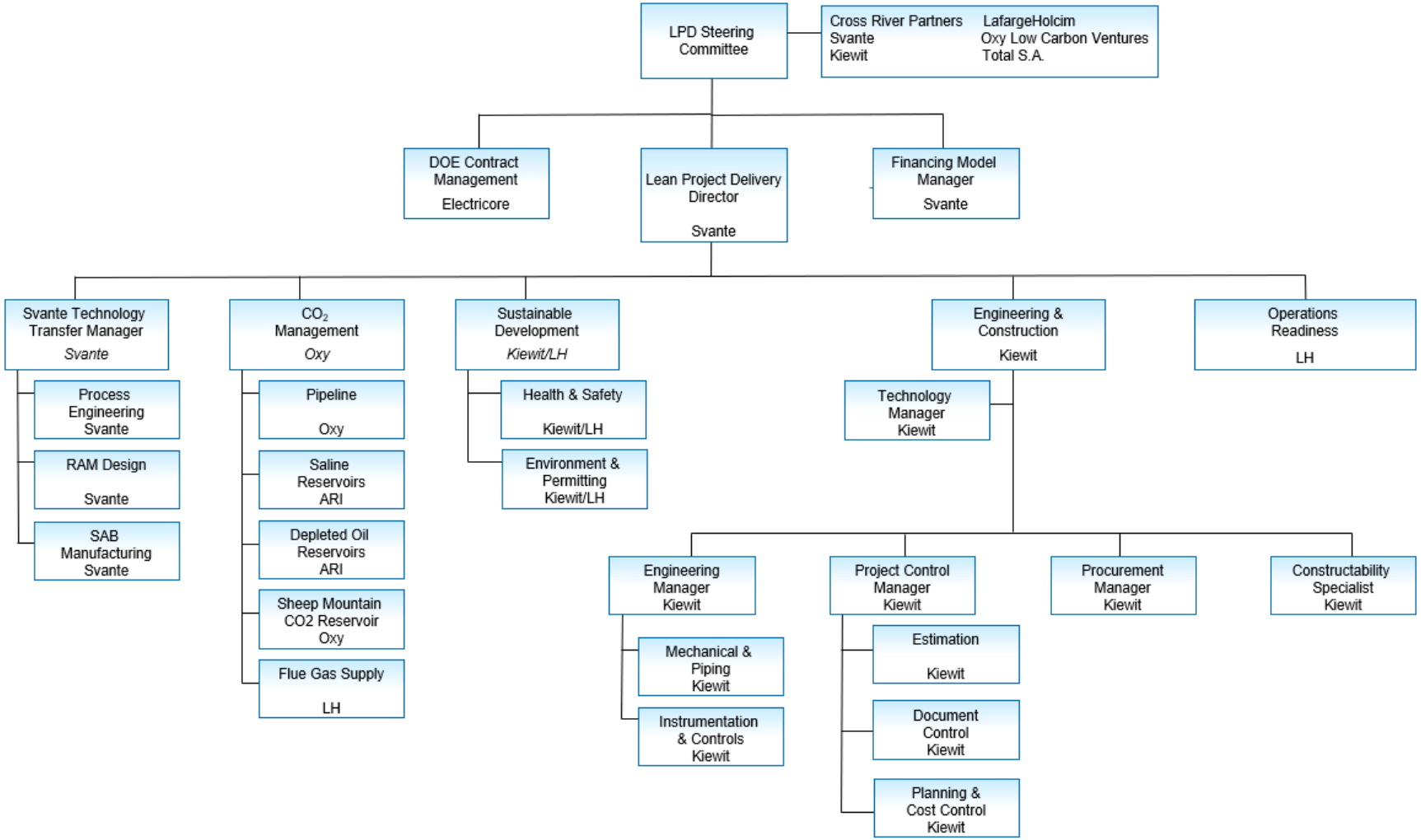
Key Drivers

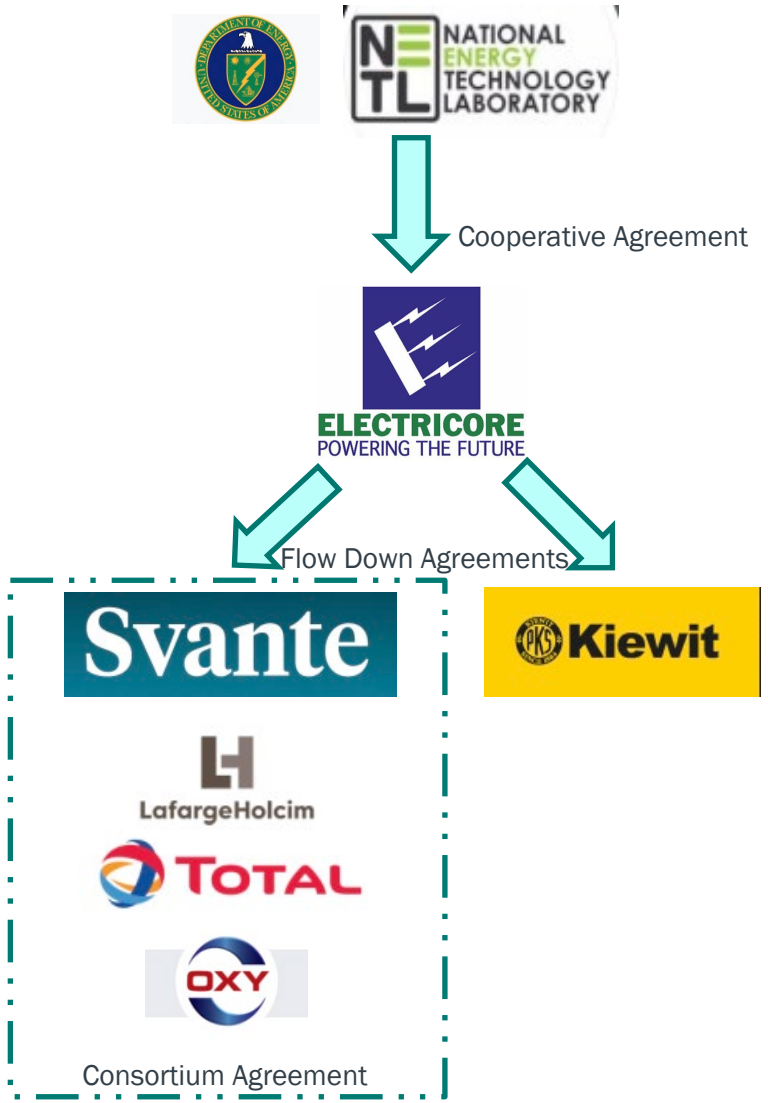
- 45Q Tax Credits
- LCFS
- Price on Carbon (50+ $US/tonne)
- Voluntary Carbon Markets
- Border Carbon Adjustments (BCA)

Project Finance

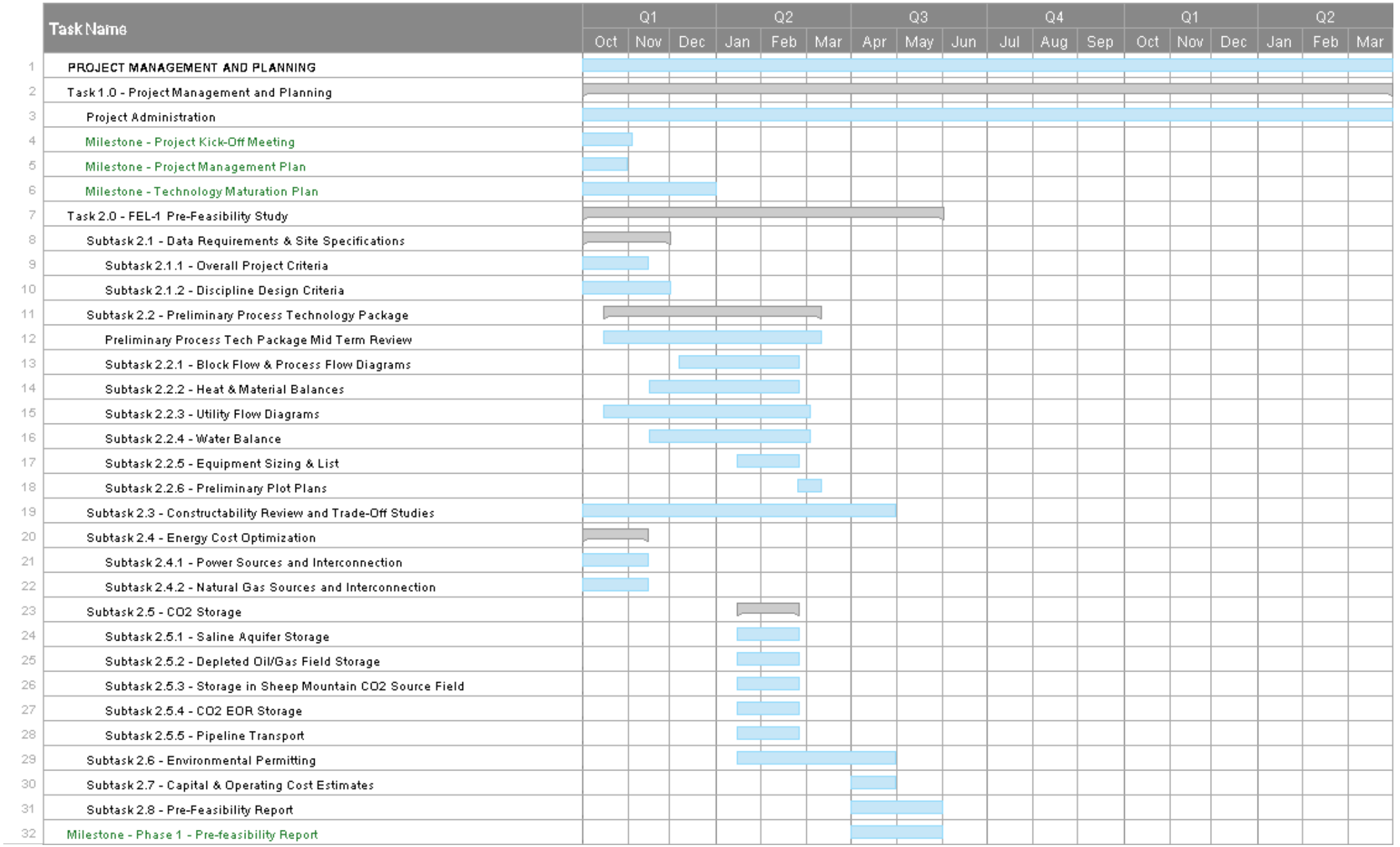
- Similar structure as renewables deployment
- Complex Risk Management Framework:
  - New technology deployment
  - CO_2 ownership liabilities (Cradle to Grave)
  - Multi-party arrangements

Appendix A – Organization Chart





Appendix B – Gantt Chart



Appendix B – Gantt Chart Page 2

Svante

	Task Name	Q3			Q4			Q1			Q2			Q3		
		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
33	Task 3.0 - FEL-2 Feasibility Study															
34	Subtask 3.1- Design Criteria															
35	Subtask 3.2 - Process Inside Battery Limit															
36	Subtask 3.3 - Outside Battery Limi															
37	Subtask 3.4 - General Arrangements															
38	Subtask 3.5 - CO2 Storage Assessment of High Grade Prospects															
39	Subtask 3.5.1 - Saline Aquifer Storage															
40	Subtask 3.5.2 - Depleted Oil/Gas Field Storage															
41	Subtask 3.5.3 - Storage in Sheep Mountain CO2 Source Field															
42	Subtask 3.5.4 - CO2 EOR Storage															
43	Subtask 3.6 - Environmental Permitting															
44	Subtask 3.7 - Capital & Operating Cost Estimates															
45	Subtask 3.8 - Safety Review (Proposed)															
46	Milestone - FEL2 Level Safety Review (Proposed)															
47	Task 4.0 - Engineering Design Report															
48	Subtask 4.1 - Inside Balance of Plant															
49	Subtask 4.2 - Outside Balance of Plant															
50	Subtask 4.3 - Field Cost Analysis															
51	Subtask 4.4 - Commercial Site Approval															
52	Milestone - Phase 2 Feasibility Report															
53	Milestone - Commercial Site Approval Letter															
54	Task 5.0 - Technology Assessment															
55	Subtask 5.1 - EH&S Risk Assessment															
56	Subtask 5.2 - TEA															
57	Subtask 5.3 - State-Point Data Table															
58	Milestone - EH&S Risk Report															
59	Milestone - TEA															
60	Milestone - State Point Data Table															