

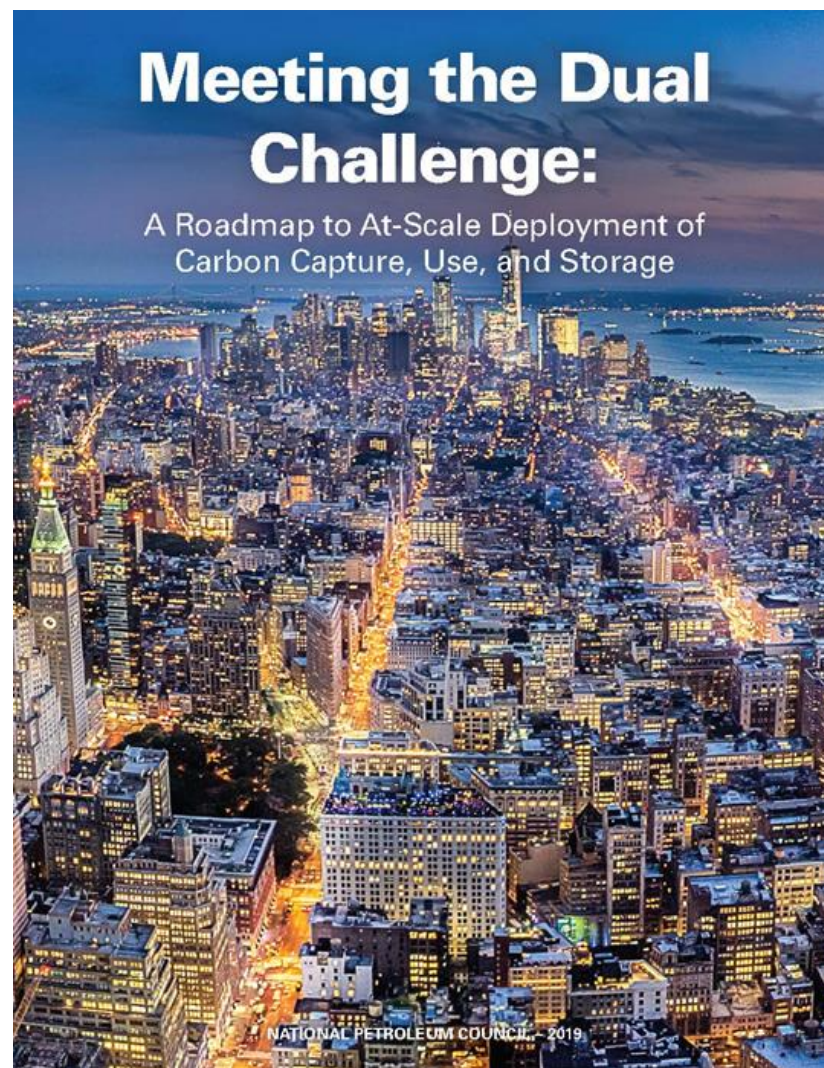
National Petroleum Council

***Meeting the Dual Challenge:  
A Roadmap to At-Scale Deployment of  
Carbon Capture, Use, and Storage***

***<https://dualchallenge.npc.org>***

US DOE/USEA CCUS Roadshow  
January 28, 2020

Nigel Jenvey, Gaffney-Cline



# In September 2017

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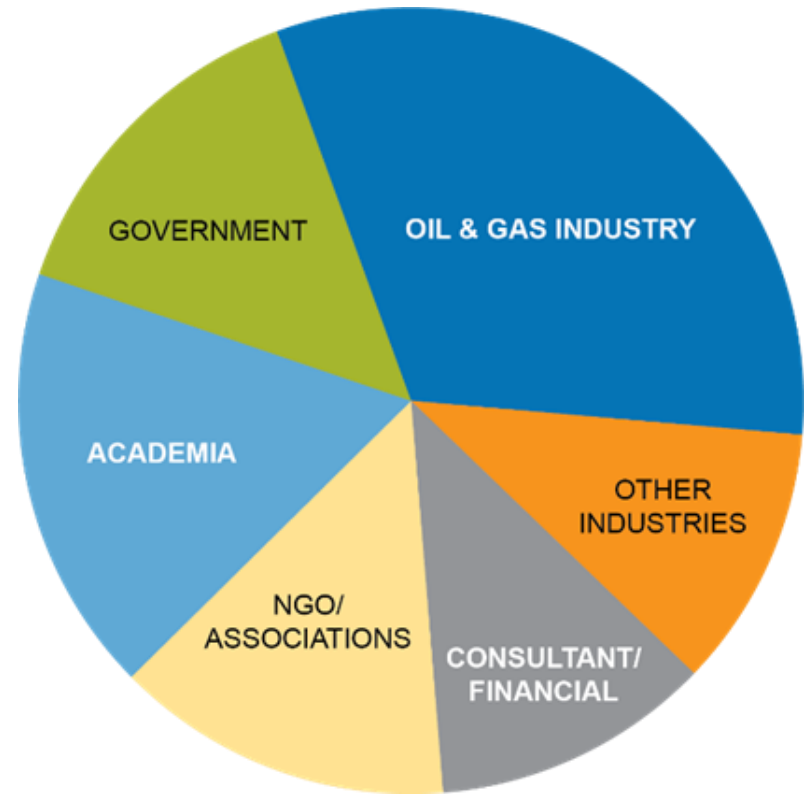
The Secretary of Energy requested the NPC conduct a study to define the potential pathways for integrating CCUS at scale into the energy and industrial marketplace.

The Secretary asked the Council five key questions:

1. What are **U.S. and global future energy demand outlooks**, and the environmental benefits from the application of CCUS technologies?
2. What **R&D, technology, infrastructure, and economic barriers** must be overcome to deploy CCUS at scale?
3. How should **success be defined**?
4. What actions can be taken to **establish a framework that guides public policy and stimulates private-sector investment** to advance the deployment of CCUS?
5. What **regulatory, legal, liability or other issues should be addressed** to progress CCUS investment and to enable the U.S. to be global technology leaders?

# Study participation

- The overall study team was composed of **over 300 participants** from **more than 110 different organizations** and includes **17 international members**.
- National Coal Council participation is represented through overlap of 21 organizations.



# CCUS deployment at scale

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## Will mean:

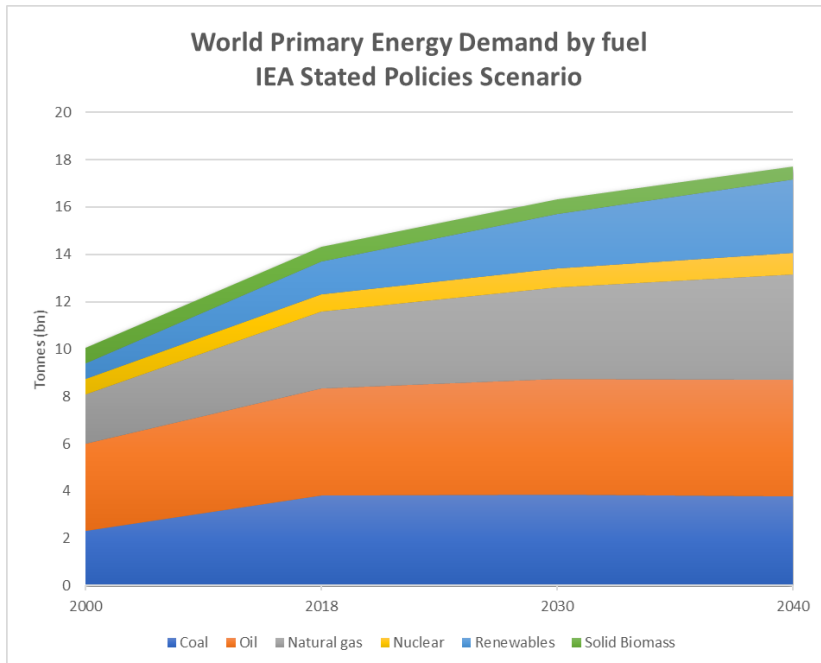
- Moving from 25 to **500 Million tonnes per annum** of CCUS capacity
- Infrastructure buildout equivalent of **13 million barrels per day** capacity
- Incremental investment of **\$680 billion**
- Support for **236,000 U.S. jobs** and **GDP of \$21 billion** annually

## Will require:

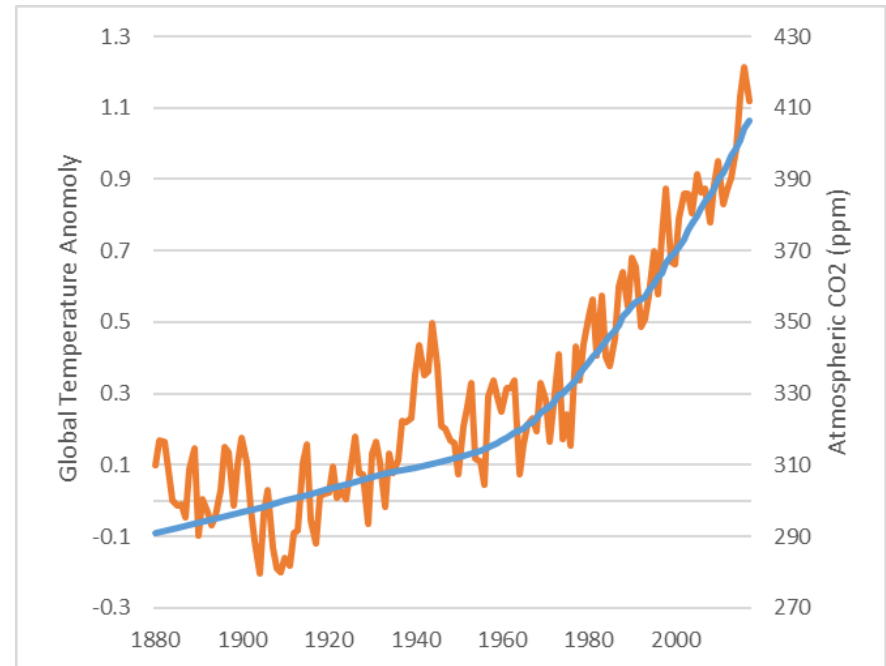
- Improved **policies, incentives, regulations** and **legislation**
- Broad-based **innovation** and **technology** development
- Strong **collaboration** between **industry** and **government**
- Increased **understanding** and **confidence** in CCUS

# Understanding the dual challenge

The world faces a dual challenge of providing affordable, reliable energy while addressing the risks of climate change.



Over the next two decades, global population and GDP growth will drive continued increase in global energy demand



At the same time, the need to address rising carbon dioxide (CO<sub>2</sub>) emissions continues to grow

# CCUS cost assessment: methodology

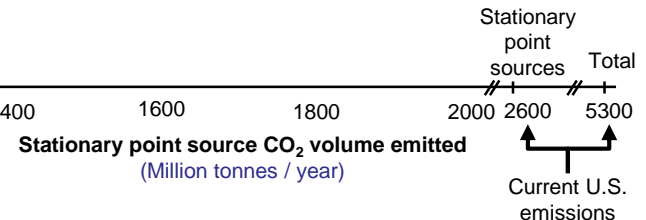
## U.S. CCUS Costs by Point Source

(\$ / tonne of CO<sub>2</sub>)  
280

260  
240  
220  
200  
180  
160  
140  
120  
100  
80  
60  
40  
20  
0

Assessed the costs to capture, transport and store 850 point sources of emissions comprising 80% (~2Gt) of all U.S. stationary sources:

- Cost to capture, transport, and store one tonne of CO<sub>2</sub> plotted against the volume of CO<sub>2</sub> abatement possible
- Source, industry, and location specific
- Costs and performance based on N<sup>th</sup> of a kind technology currently available and deployed
- Transparent assumptions, leveraging existing studies combined with industry experience
- Identifies level of value (incentives, revenue, etc.) necessary to enable deployment based on the following financial assumptions:
  - Asset Life 20 years
  - IRR 12%
  - Equity Financing 100%
  - Inflation Rate 2.5%
  - Federal Tax Rate 21%



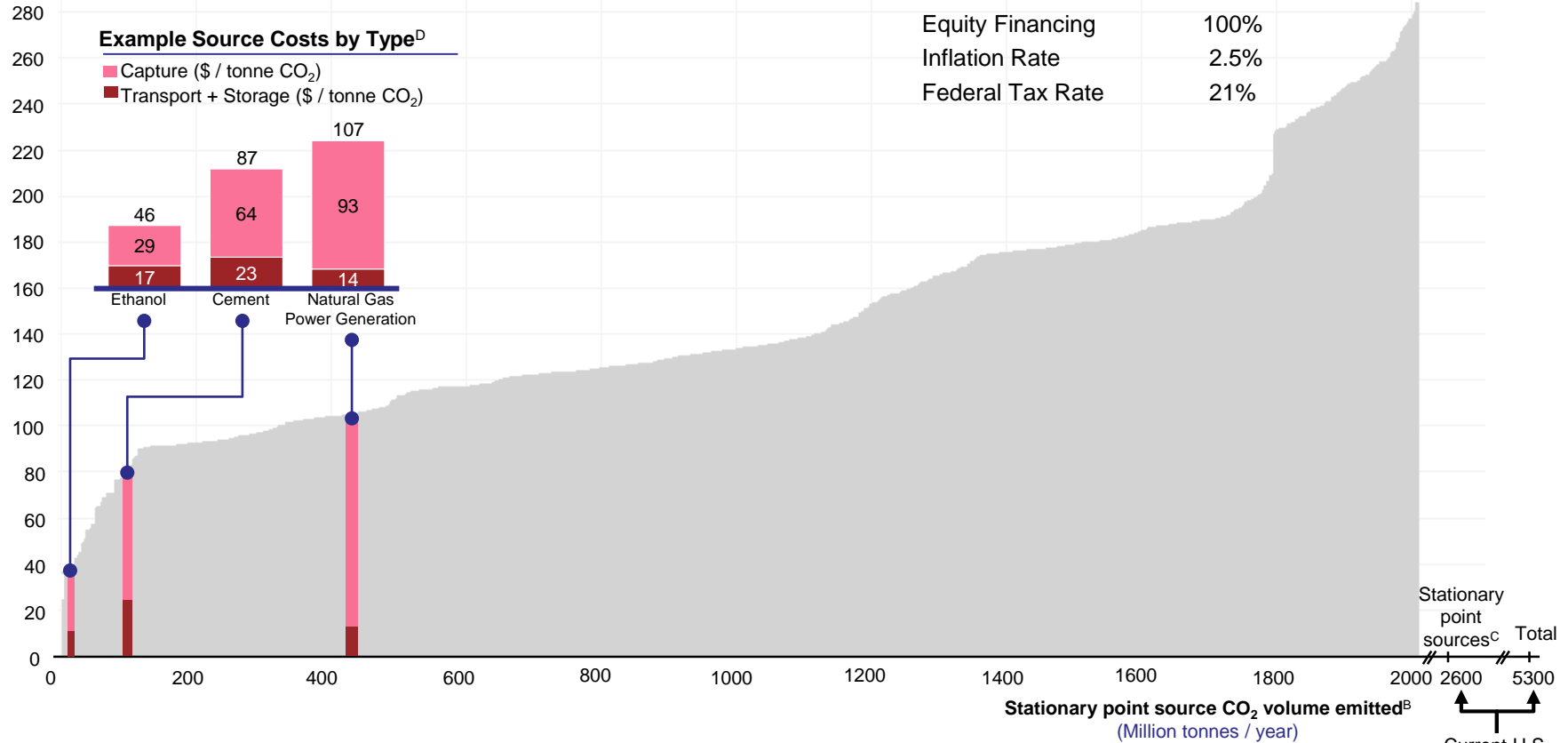
# CCUS cost assessment: methodology

## Financial Assumptions

Asset Life	20 year
IRR	12%
Equity Financing	100%
Inflation Rate	2.5%
Federal Tax Rate	21%

## U.S. CCUS Costs by Point Source<sup>A</sup>

(\$ / tonne of CO<sub>2</sub>)



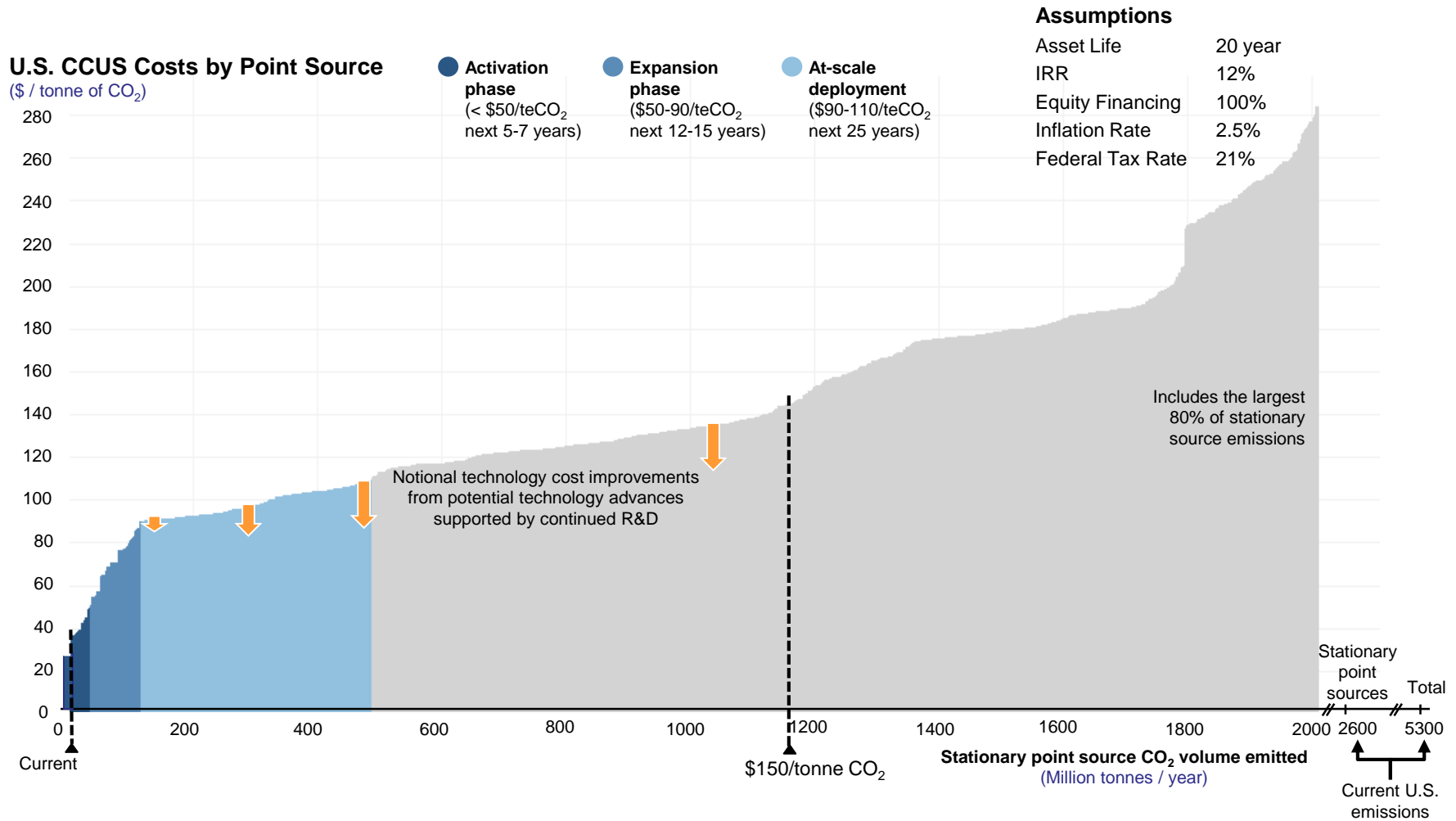
A Includes project capture costs, transportation costs to defined use or storage location, and use/storage costs; does not include direct air capture

B This curve is built from bars that each represent an individual point source with a width corresponding to the total CO<sub>2</sub> emitted from that individual source

C Total point sources include ~600 MTPA of point sources emissions without characterized CCUS costs

D Widths of bars are illustrative and not indicative of volumes associated with each source

# CCUS cost assessment: phases of deployment





# CCUS cost assessment: public online tool

To provide a useful public resource and ensure transparency of the work, a cost assessment tool will be hosted by Gaffney, Cline & Associates and will be available in late January/early February.

- Registration page [www.gaffney-cline-focus.com/npc-ccus-cost-assessment-tool](http://www.gaffney-cline-focus.com/npc-ccus-cost-assessment-tool)

**Gaffney, Cline & Associates**

6th December 2014

**More Insight**

- GCCA Oil & Gas Monitor
- Africa
- Latin America
- North America
- Asia/Pacific & China
- Europe
- Middle East
- Russia & Caspian

**Business of Energy**

- Jackson
- Midstream & Downstream
- Oil & LNG
- West oil Events
- Project Experience Brochures
- Tarboro Business
- GCCA Oil & Gas Monitor, 2019 active
- US Oil & Gas Monitor, 2017 active
- US Oil & Gas Monitor, 2019 active
- US Oil & Gas Monitor, 2015 active
- Recouptment

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Email Address:

### Request Access

Evaluate different economic scenarios using our CO2 Capture Cost Calculator tools, and sign up to our newsletter (you can unsubscribe at any time)

First Name \*

Last Name \*

Email \*

Mobile/Cell Phone

Office Phone

Organization / Company

Organization Type \*

Select

Which NPC Cost Assessment tools are you interested in? \*

Online Cost Calculator

Downloadable Cash Flow Spreadsheet

Preferred Communication Methods

E-mail

Telephone

Yes, please keep me informed of topics and innovations transforming my industry, including special event invitations, surveys, newsletters, product and service offerings, and any product announcements.

Please check your spam filter if you do not receive a confirmatory e-mail.

### Capture Cost Model: Dashboard

Purpose: to obtain cost to capture one tonne of CO<sub>2</sub> per year.

Cell Color Coding:

Project inputs		Debt inputs	
Capacity	276,216 t/yr	Debt portion (% of Total CapEx)	50%
Utilization rate	85%	Debt interest rate	5%
Operation duration	20 years	Debt financing method	from start of operations (Project)
Capacity cost	79.85 USD/annual toe	Debt repayment (years)	15
CapEx duration	3 years		
Total CapEx	22 MM USD		
CapEx Schedule - Year 1	20% of Total CapEx		
CapEx Schedule - Year 2	50% of Total CapEx		
CapEx Schedule - Year 3	30% of Total CapEx		
CapEx Schedule - Year 4	0% of Total CapEx		
CapEx Schedule - Year 5	0% of Total CapEx		
Total CapEx %	100%		
OpEx, Energy, annual			
Electricity usage	0.10 MWh/capthured		
Electricity price	50.00 USD/MWh		
Gas usage	0.0 MMBtu/capthured		
Gas price	3.50 USD/MMBtu		
OpEx, Non-Energy, annual	6% of Total CapEx		

Tax and Macroeconomic Inputs	
Tax	21%
Depreciation years (MACRS)	7
Inflation	2.5%
Net operating loss carryforward	no

Rate of Return	
Incentive inflation	0
OpEx inflation	1
CapEx inflation	0
IRR	12.0%

