

#### McLindon Geosciences, LLC



# Why South Louisiana Geology is so good for Carbon Dioxide Sequestration

February 15, 2023



















#### Sources and Sinks



Sources: EPA, NETL



#### US vs LA – CO2 Emissions Sources







## LA – CO2 Industrial Emissions Sources



LSU CES



#### LA – Top 10 CO2 Emitters

#### my / LOUISIANA INDUSTRIAL DECARBONIZATION AND LOW-CARBON ANNOUNCEMENTS (2020-2022)

#### **REDUCED-CARBON MATERIALS**

- Arg Fuel (St. Charles Parish), January 15, 2021
- Louisiana Green Fuels Renewable Diesel (Caldwell Parish), April 23, 2021
- Chalmette Refining Renewable Diesel (St. Bernard Parish), June 24, 2021 .
- Delta Biofuel (Iberia Parish), June 28, 2021 .
- Renewable Energy Group (Ascension Parish), October 13, 2021
- Diamond Green Diesel Expansion (St. Charles Parish), October 21, 2021
- Origin Materials (Ascension Parish), February 18, 2022
- Arbor Renewable Gas (West Baton Rouge Parish), June 14, 2022 .
- Grön Fuels (West Baton Rouge Parish), December 2, 2022

#### ELECTRIC VEHICLE SUPPLY CHAINS

- · Syrah Technologies Graphite and Active Anode Material Processing (Concordia Parish), February 15, 2022
- Koura Lithium Hexafluorophosphate (Iberville Parish), October 19, 2022

#### HYDROGEN AND AMMONIA

- Grön Fuels Green Hydrogen (West Baton Rouge Parish), November 10, 2020
- CF Industries Green Ammonia (Ascension Parish), April 21, 2021
- Air Products Blue Hydrogen (Ascension Parish), October 14, 2021 .
- CF Industries Carbon Capture (Ascension Parish) August 5, 2022 .
- CF Industries Blue Ammonia (Ascension Parish), August 17, 2022
- · Plug Power and Olin Corp Green Hydrogen Joint Venture (Iberville Parish), October 19, 2022

Phillips 66 - Alliance Refinery

Motiva Enterprises - Convent Refinery

NOLA.com



4,766,415

3,529,020

3,924,963

2,881,974

2,589,605

2,840,750

2,111,565

2.083,624

36,373,695

4,699,447

3,440,424

3,949,417

2,789,131

2,509,828

2,784,974

1,962,580

2,257,249

36,027,490

4,629,084

3,887,900

3,778,079

2,837,285

2,777,647

2,671,132

2,570,326

2,358,841

38,007,508

4,658,391

3,982,608

4.014.786

2,857,844

2,514,636

2,891,554

2,790,463

2,357,948

39,958,331

35	,523,902	36,586,988	
Source:	EPA,	2018c.	

4,346,027

3,961,999

3.934.015

2,069,376

2,384,289

2,988,160

2,163,263

2,031,251

4,561,286

3,498,212

3,918,742

2,794,800

2,747,273

3,050,713

2,403,978

1,975,545

Petroleum and Coal Products

Chemical Manufacturing

Chemical Manufacturing

LSU CES



## Subsurface Injection in Louisiana

	Injection Well Class Types	Wells in Louisiana
Class I	Industrial (Hazardous & Non-Hazardous) or Municipal Waste	34
Class II	Oil and Gas Related (SWD, EOR, Storage)	3425
Class III	Solution Mining (Caverns)	81
*Class IV*	Hazardous Waste above or into the USDW *banned*	0
Class V	Wells not covered under the remaining classifications	1030
Class VI	Carbon Sequestration	o so far

LA DNR



## Storage, Injection & EOR





## Mosaic - Class I Wastewater Injection Well





Company Name and Address: MOGAIC FERTILIZER, LLC 7280 LA MWY 44 UNCLE SAM, LA 075200							
	Weil 001 Perf-Top: 6424	Serial Num Bottom	974237 6633				
Month I Number of days any injection socurred	87 / 31	08 / 31	09 / 30				
iolune of Month	1028251	1141978	1071063				
Cumulative Total (Life of Well)	61116670	62258650	63329809				
Average Daily (When injecting)	34138	36838	35815				
Maxmum Daty	35509	36859	36860				
Minamum Daily (When injecting)	18798	36379	20681				
Burtace Injection Pressure (psl)							
Average (When injecting)	956	782	846				
Maxmum	1034	848	1015				
Annular Pressure							
Average (When Pressured)	1171	1050	1078				
theorem.	1278	5148	1202				
Minimum (at any time)	873	819	792				
Injection Rate (gent)	6.5 - C						
Average (When Injecting)	996	1074	1044				
Maximum	1100	1098	1101				



#### Mosaic - Class I Wastewater Injection Well





#### CHEMICAL CHARACTERIZATION DATA FOR THE WASTE STREAM MOSAIC FERTILIZER, LLC UNCLE SAM PLANT

Waste Stream Components	Sample Date 4/30/2009	Sample Date 12/15/2010	Health Based Limit	Laboratory Detect Limit
METALS				
Antimony	NA	0.118	0.005	
Arsenic	1.90	1.45	0.050	
Barium	0.159	0.054	2.0	
Berylium	NA	<0.003	0.004	
Cadmium	0.730	0.849	0.005	
Chromium	2.13	2.4	0.1	
Copper	NA	<.005	NA	
Lead	0.131	0.080		0.001
Mercury	88000.0	<0.0002	0.002	
Nickel	NA	2.62		0.001
Selenium	<0.013	<0.013	0.050	
Silver	<0.001	<0.001	0.18	
Thallum	NA	<0.006	0.002	0.000
Vanadium	NA	4.57		0.004
Zinc	NA	9.19	11.0	
INORGANICS				
Sulfate	5,310	NA		
Phosphorous	8,525	NA		
Nitrate	<2.0	<2.0	-	
Fluoride	2.070	2.562	4.0	
Ammonia	28.3	NA		
Chloride	27.8	NA		
TDS	31,440	30.055		
TSS	64.1	17.6		
Uranium	7.64	NA		
Radium-226 (pCi/L)	2.52 (+/- 0.26)	NA		
Radium-228 (pCi/L)	42.6 (+/-0.283)	NA		
pH (s.u.)	1.69	1.96		
Specific Gravity (g/mL)	1.0232	1.0248		
Viscosity	1.181 (60F)	NA		



#### Diamond – Class II Saltwater Injection



ſ	INJECTION PRESSURE		ANNULUS PRESSURE (PSI)		INJECTION RATE (GALLONS PER MINUTE)		VOLUME INJECTED	
ľ	AVERAGE	MAXIMUM	MINIMUM	MAXIMUM	AVERAGE	MAXIMUM	BBL	MCF
JAN	0	0	0	0	0	0	0	N/A
FEB	320	760	0	0	9	15	11,693	N/A
MAR	529	700	0	0	12	14	17,887	N/A
APR	81	630	0	0	4	13	5,572	N/A
MAY	80	90	0	0	6	11	8,759	N/A
JUN	71	130	0	0	4	10	5,264	N/A
	121	130	0	0	6	19	8,434	N/A
AUG	159	230	0	0	7	14	10,337	N/A
SED	164	200	0	0	6	13	6,816	N/A
OCT	116	250	0	0	4	10	5,394	N/A
NOV	202	310	0	0	7	12	10,016	N/A
NOV	292	220	0	0	2	12	2,422	N/A
DEC	79	330		I		TOTAL	92,594	N/A





#### CCS Project Life Cycle



























# Progradational Model













#### Lower Miocene Deltas







## Middle Miocene Transgressive Deltas







## Middle Miocene Regressive Deltas





## Upper Miocene Deltas







### Modern Delta Deposits





#### Modern Delta Deposits





# Progradational Model












































#### Present





### Sea Level Cycles







### Sea Level Cycles





LGS



### Sea Level Cycles





BOEM



#### Holocene sea level rise



- Eustatic sea-level change from ICE-5G(VM2) model (Peltier & Fairbanks 2006)
- Eustatic sea-level reconstruction from ocean cores (Waelbroeck et al. 2002)
- Error estimate for eustatic sea-level reconstruction from ocean cores



### 15,000 Years Ago







#### Present









#### Sea Level Cycles and Deltaic Deposition



BOEM























































### Middle Miocene Sediment Deposition

























### LA – CCS Activity





# Pore Space Rights Operating Agreement w/ LA DNR





### Upper Miocene Subsurface Structure Map





## Cross Section – Injection and Confining Zones





### Upper Miocene Delta Deposits





# Aquifer and Seal Quality




#### Evaluation Model Construction





## Evaluation Model Construction – Subsurface Grids





#### Oxy Injection Well Locations

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## Model Construction - Injection Well Locations





















## Model Construction - Multiple Injection Zones





#### Area of Review





# CCS Project Types





# Higher Dip Fault Trap





## Components of a Fault







#### Recent Report



Source | Enverus Energy Transition Research

The seven risk factors for CO2 storage, injection and containment reviewed throughout the report published by Enverus Intelligence Research (EIR).



# Thank - you

# Questions ?

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