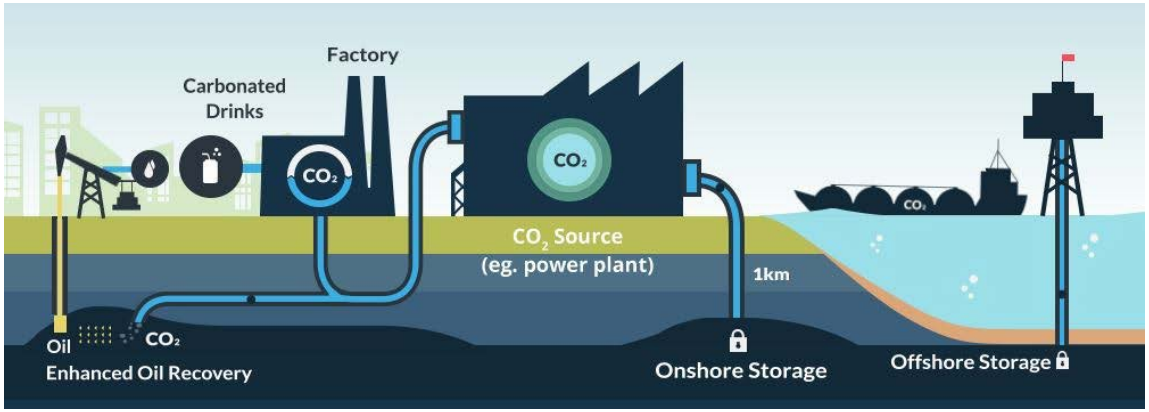

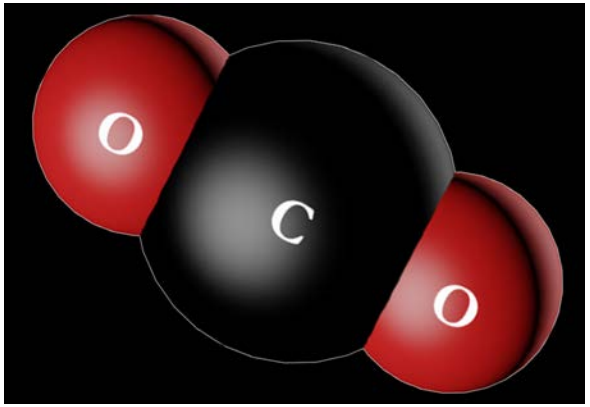

Carbon Capture and Storage in a Chemical Corridor

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Assistant Professor
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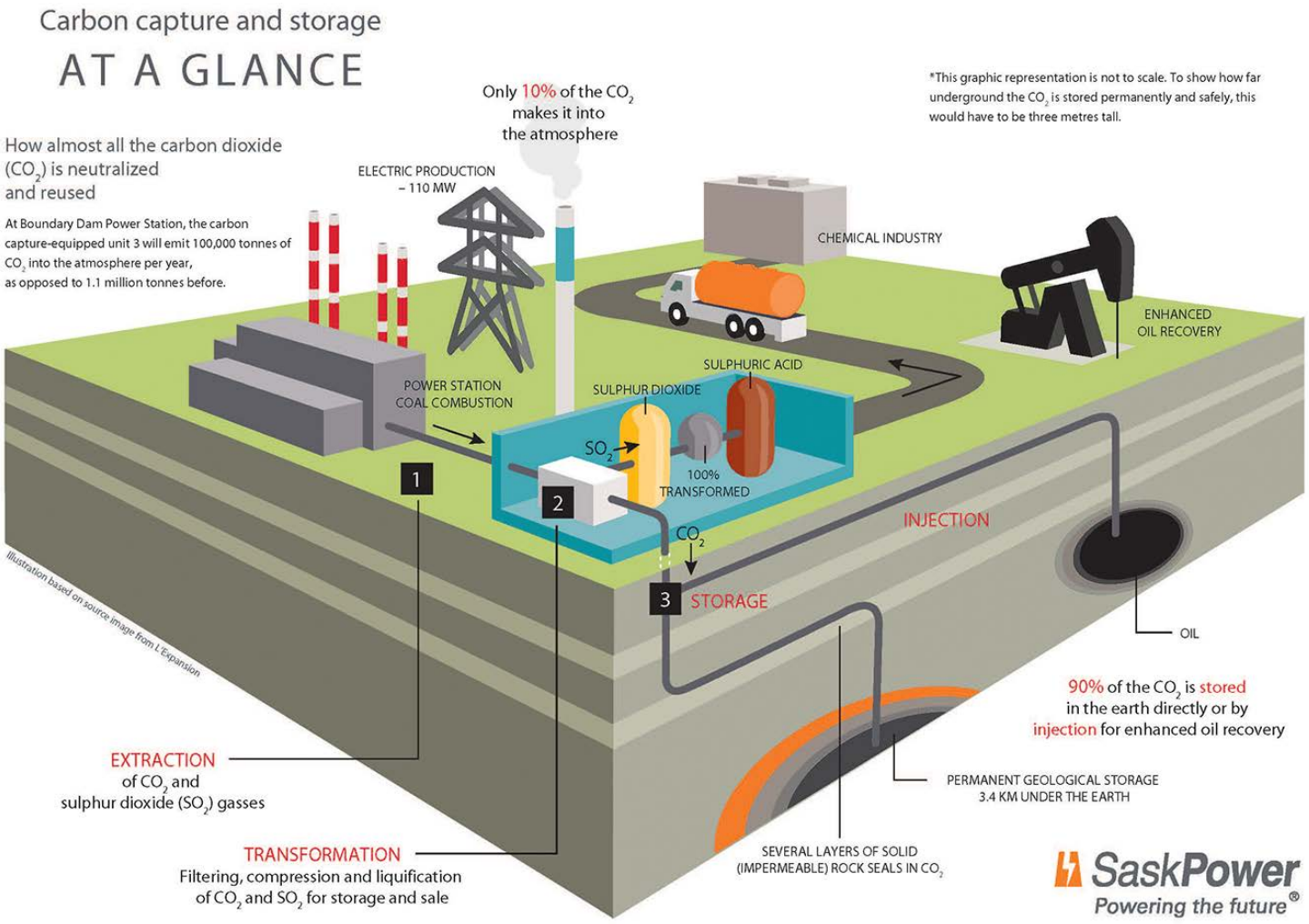
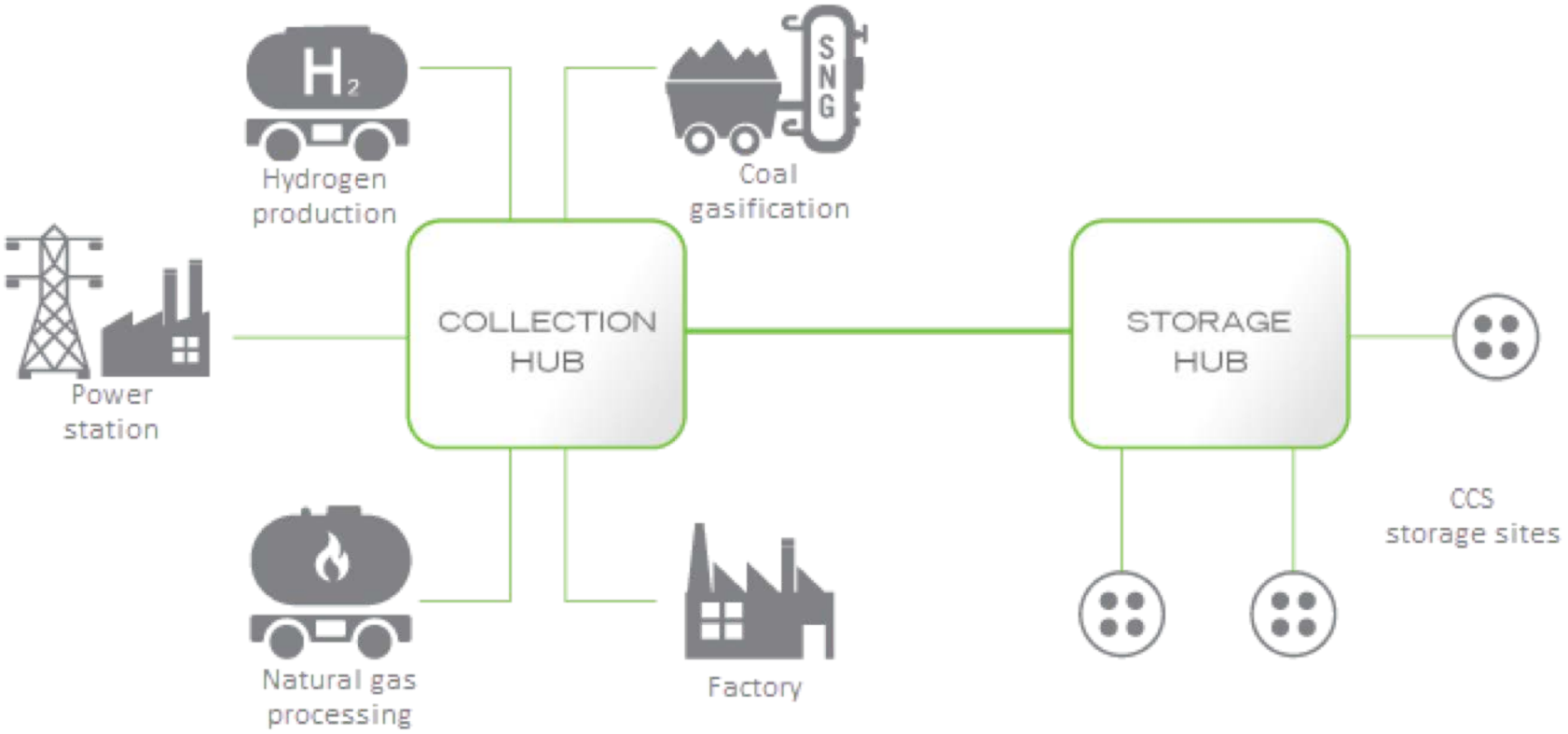
David E. Dismukes
Professor and Executive Director
Center for Energy Studies
Louisiana State University

What is CCS?


Carbon capture and storage
AT A GLANCE
How almost all the carbon dioxide (CO_2) is neutralized and reused
At Boundary Dam Power Station, the carbon capture-equipped unit 3 will emit 100,000 tonnes of CO_2 into the atmosphere per year, as opposed to 1.1 million tonnes before.
Only 10% of the CO_2 makes it into the atmosphere
*This graphic representation is not to scale. To show how far underground the CO_2 is stored permanently and safely, this would have to be three metres tall.
ELECTRIC PRODUCTION – 110 MW
CHEMICAL INDUSTRY
ENHANCED OIL RECOVERY
POWER STATION COAL COMBUSTION
SULPHURIC ACID
SULPHUR DIOXIDE
SO_2
100% TRANSFORMED
1
2
3
CO_2
INJECTION
STORAGE
OIL
Illustration based on source image from L'Expansion
90% of the CO_2 is stored in the earth directly or by injection for enhanced oil recovery
EXTRACTION of CO_2 and sulphur dioxide (SO_2) gasses
TRANSFORMATION Filtering, compression and liquification of CO_2 and SO_2 for storage and sale
PERMANENT GEOLOGICAL STORAGE 3.4 KM UNDER THE EARTH
SEVERAL LAYERS OF SOLID (IMPERMEABLE) ROCK SEALS IN CO_2
SaskPower
Powering the future®

Kemper County Facility

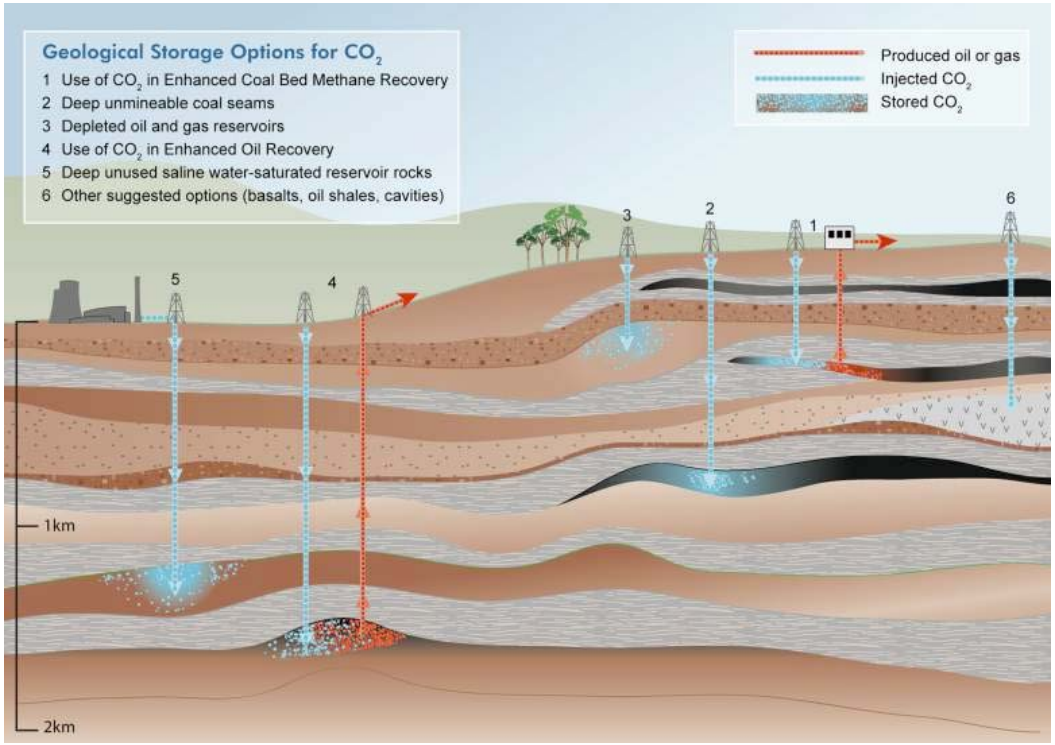
CCS has variable ***sources*** and sinks



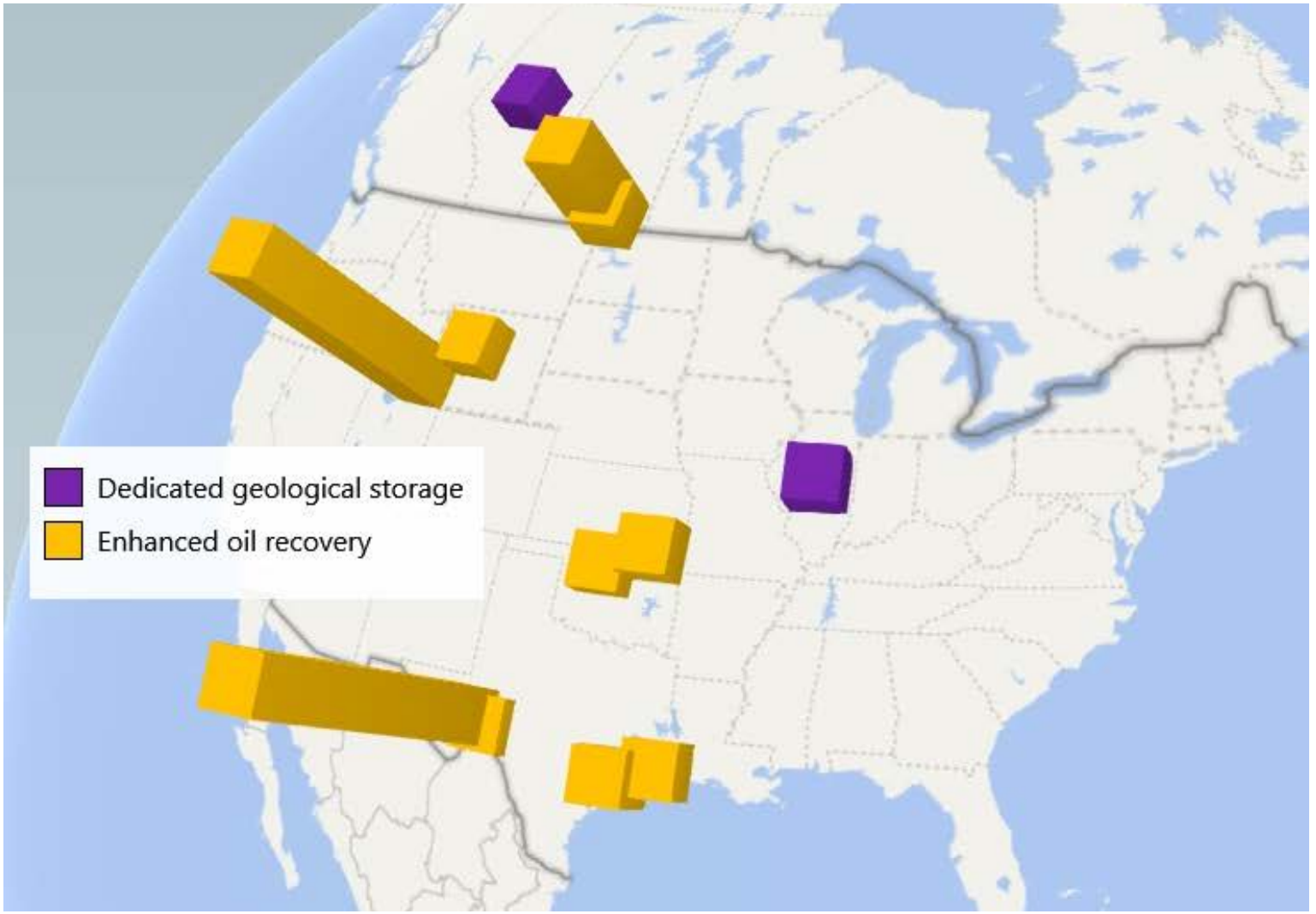
CCS has variable sources and ***sinks***

Major Sinks:

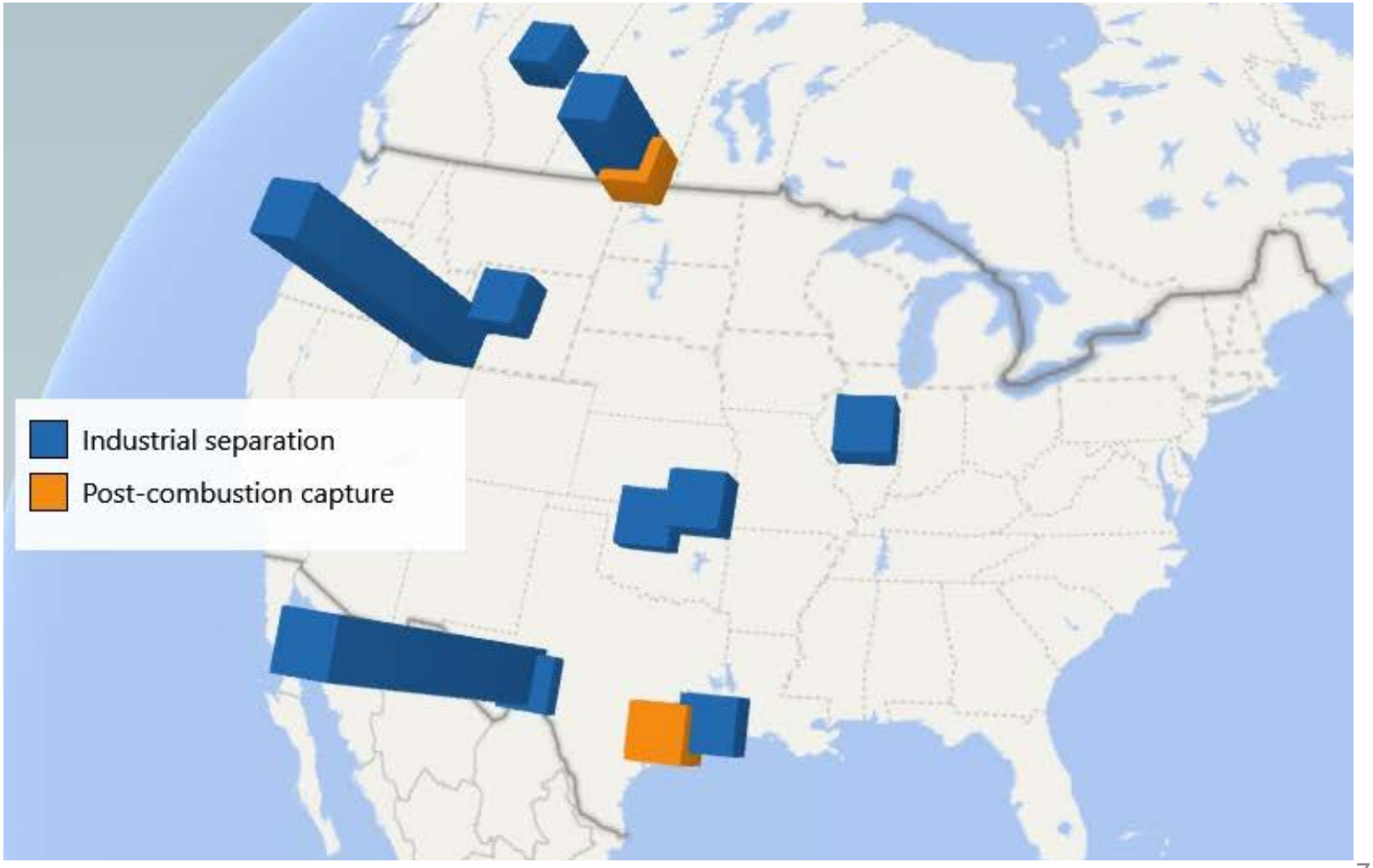
1. **Saline aquifer storage**
2. **Enhanced Oil Recovery**



Saline storage versus EOR

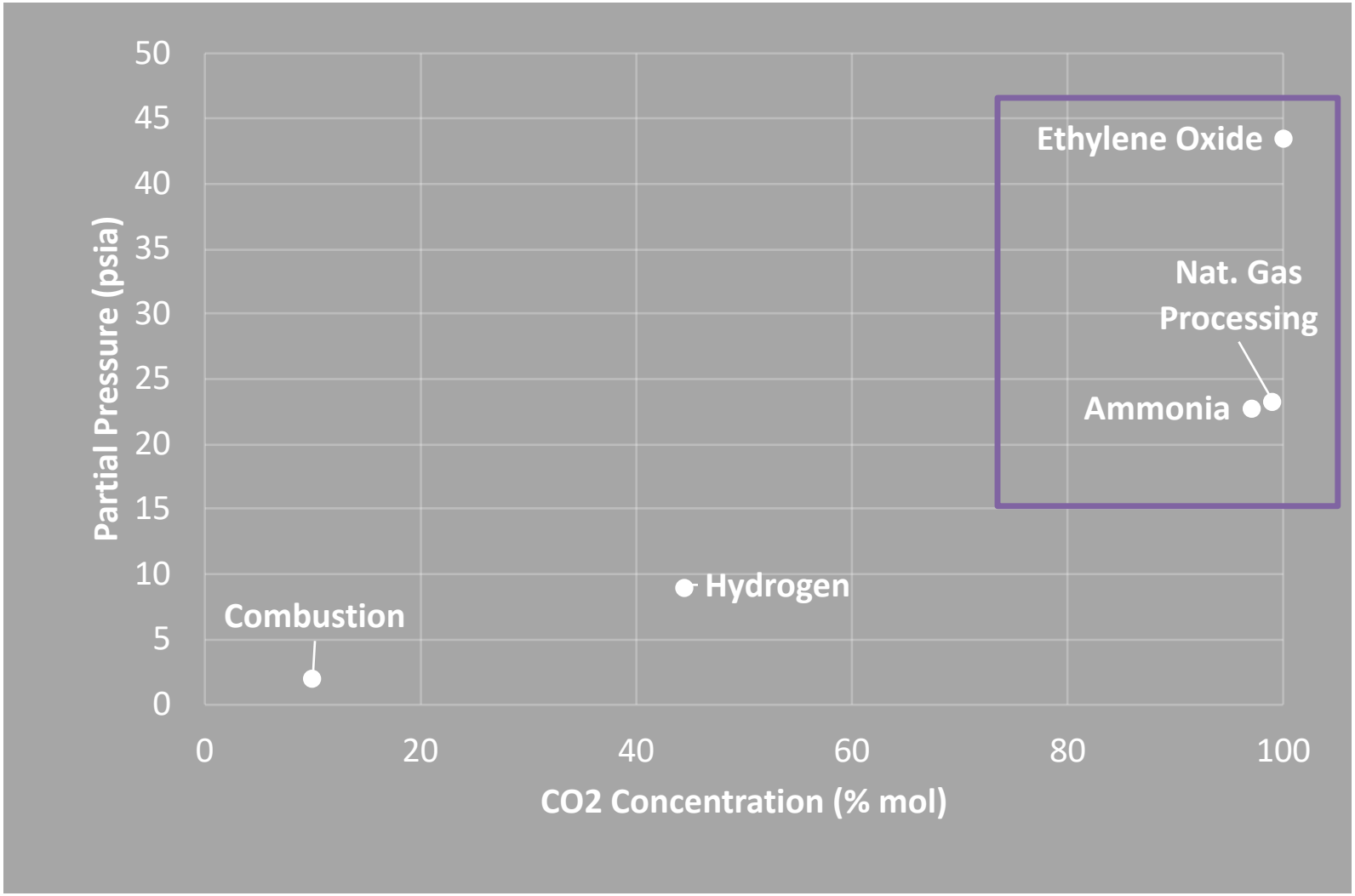


Industrial sources versus combustion sources

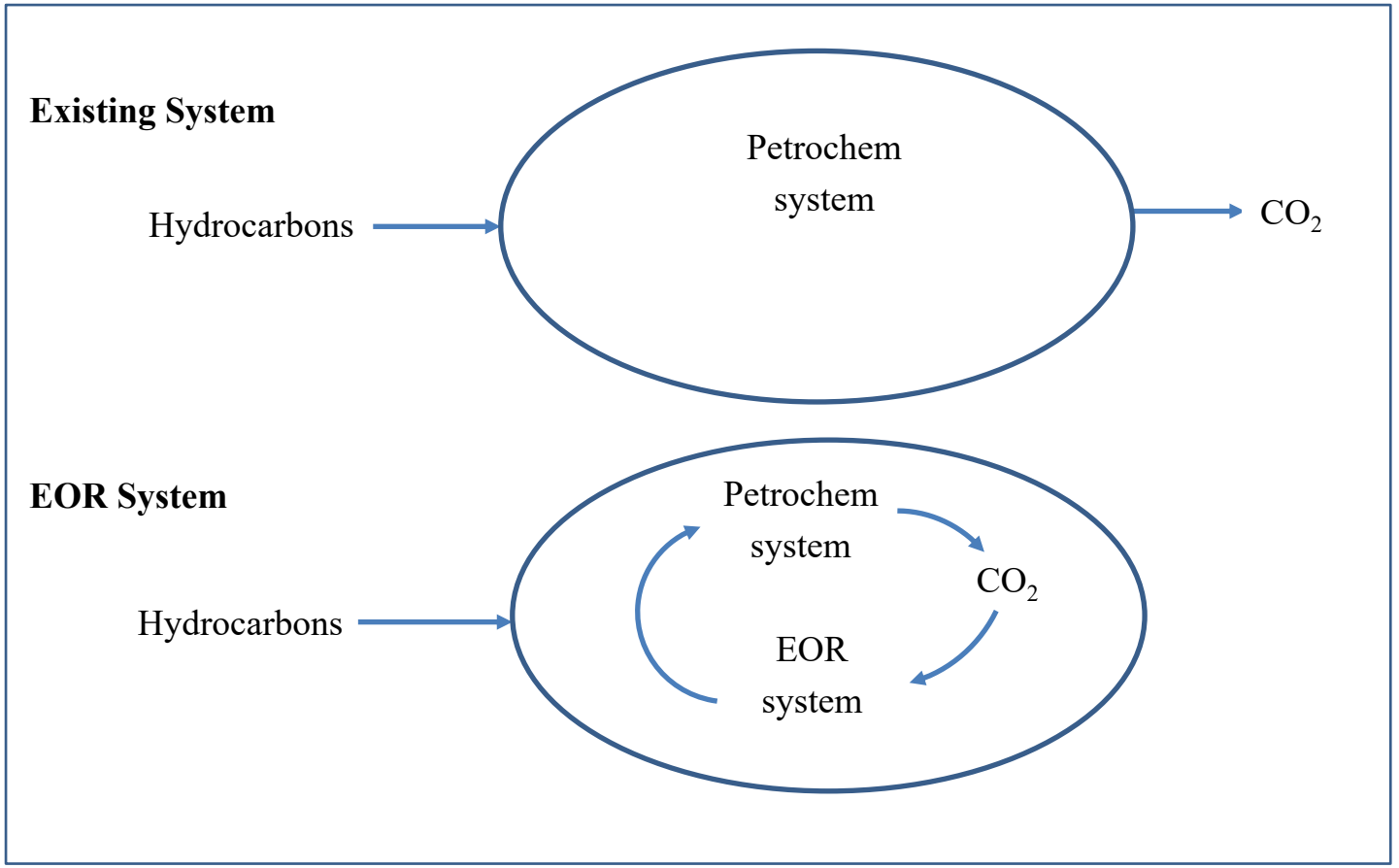


- As of 2018…
  - Most CCS operations are industrial
  - Most CCS operations are EOR
  - All CCS operations are either industrial or EOR – no operating combustion-based saline storage systems
- Why?

Why Industrial Capture?



EOR can create an industrial ecosystem



Why EOR?

- CCS will always require energy & $$$
- Two main sources of $$$:
  - Tax credits
  - EOR

5,563 views | Feb 15, 2018, 08:30am

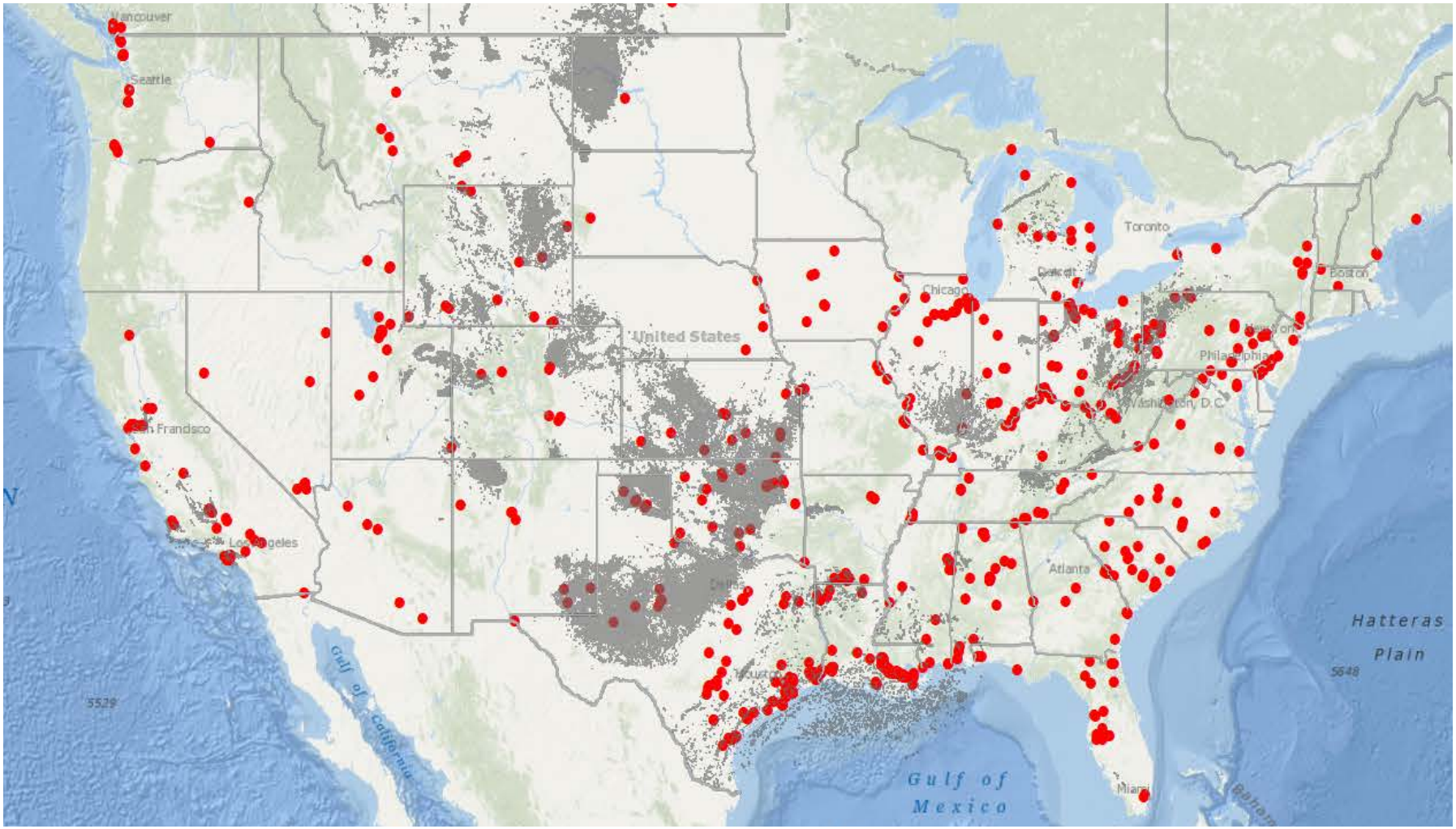
Tax Credit May Rev Up Carbon Capture And Sequestration Technology

Ken Silverstein Contributor

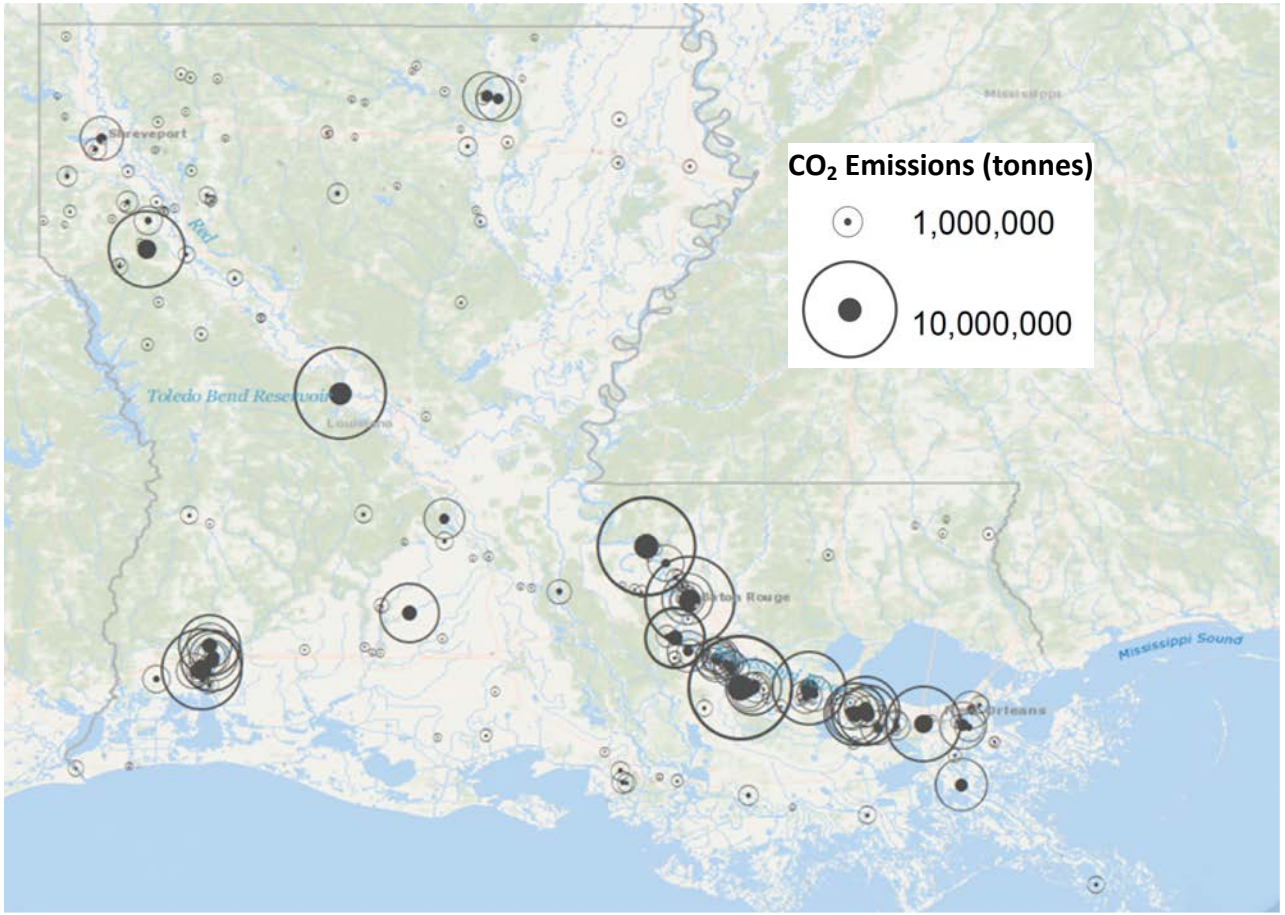
Energy

I write about the global energy business.

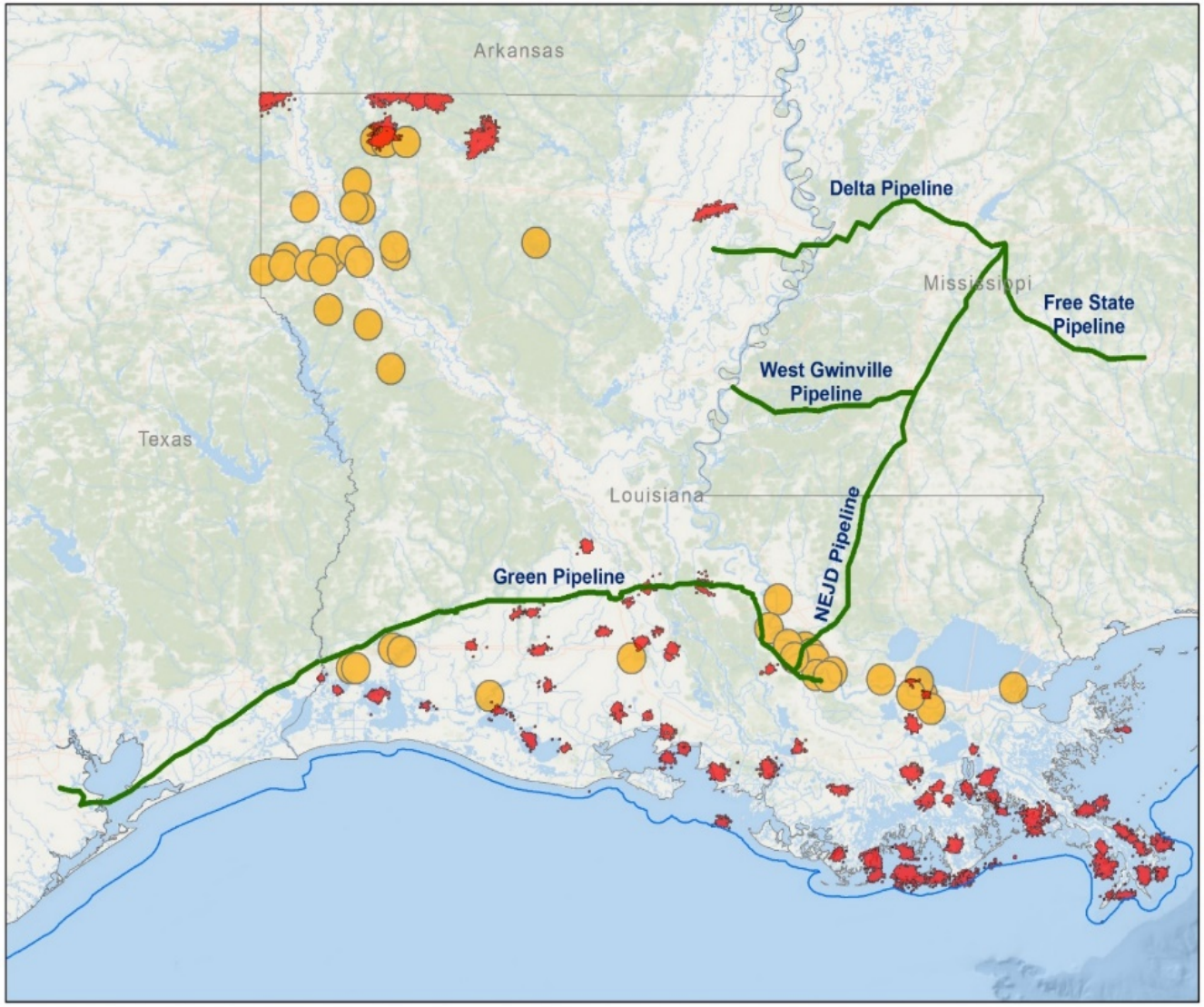
High-purity Industrial emissions and potential EOR fields



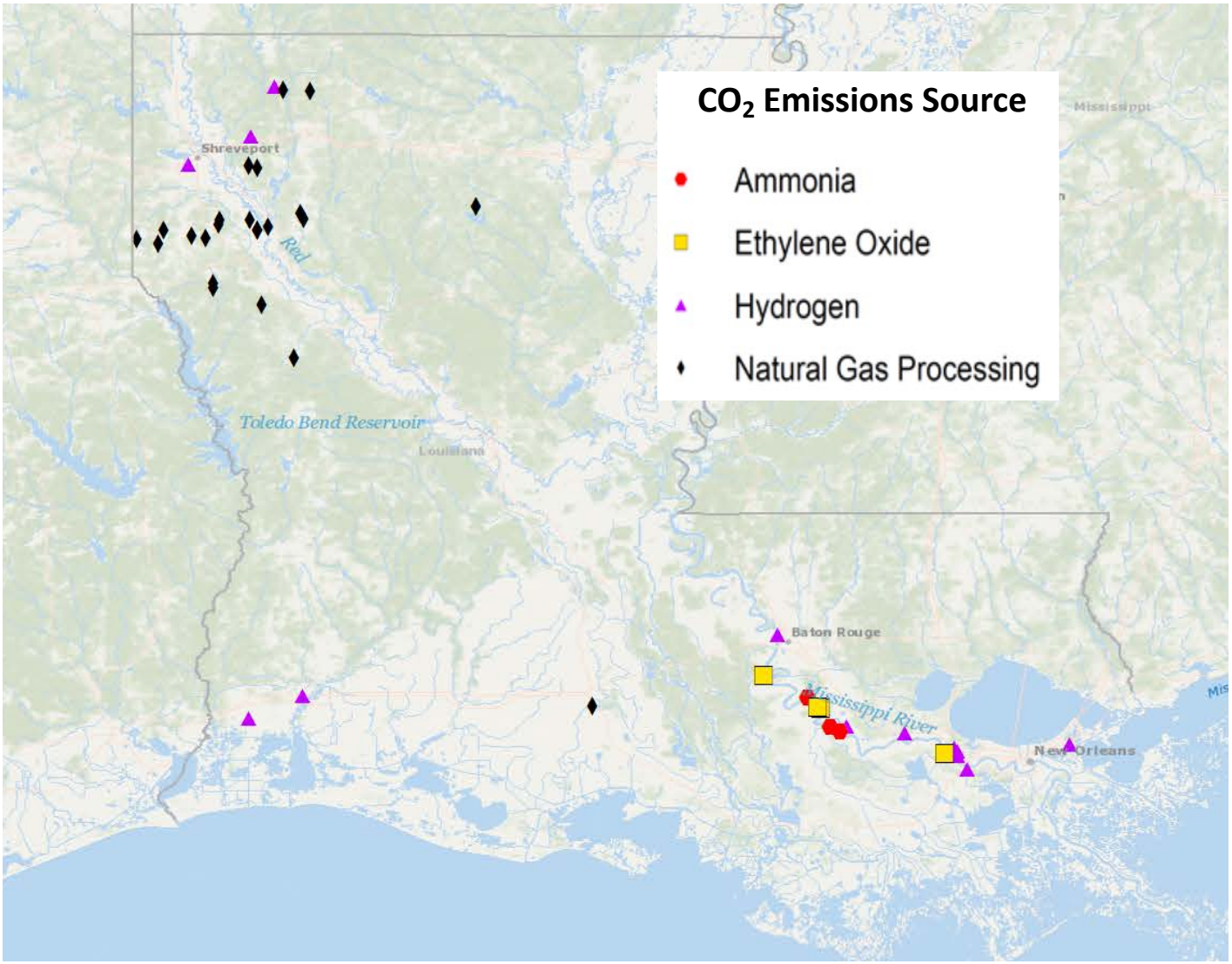
CO_2 Sources in Louisiana



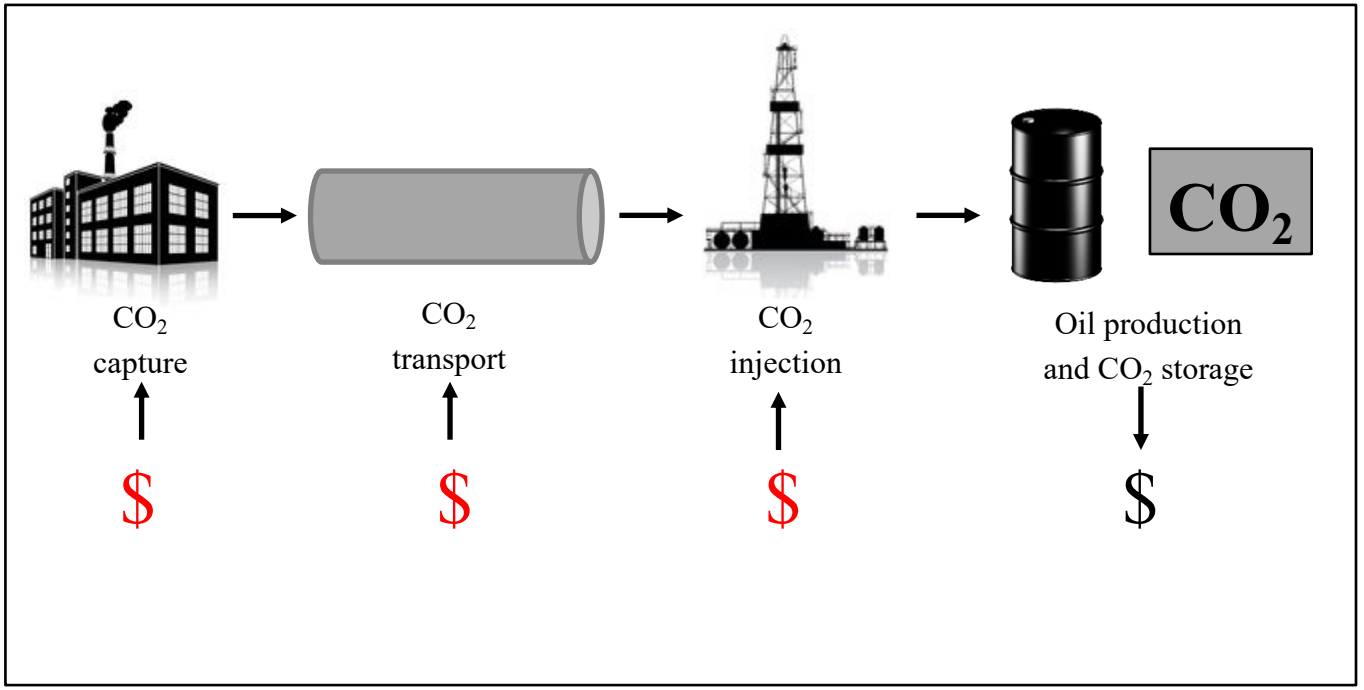
High Purity CO_2 Sources in Louisiana



High Purity CO_2 Sources in Louisiana

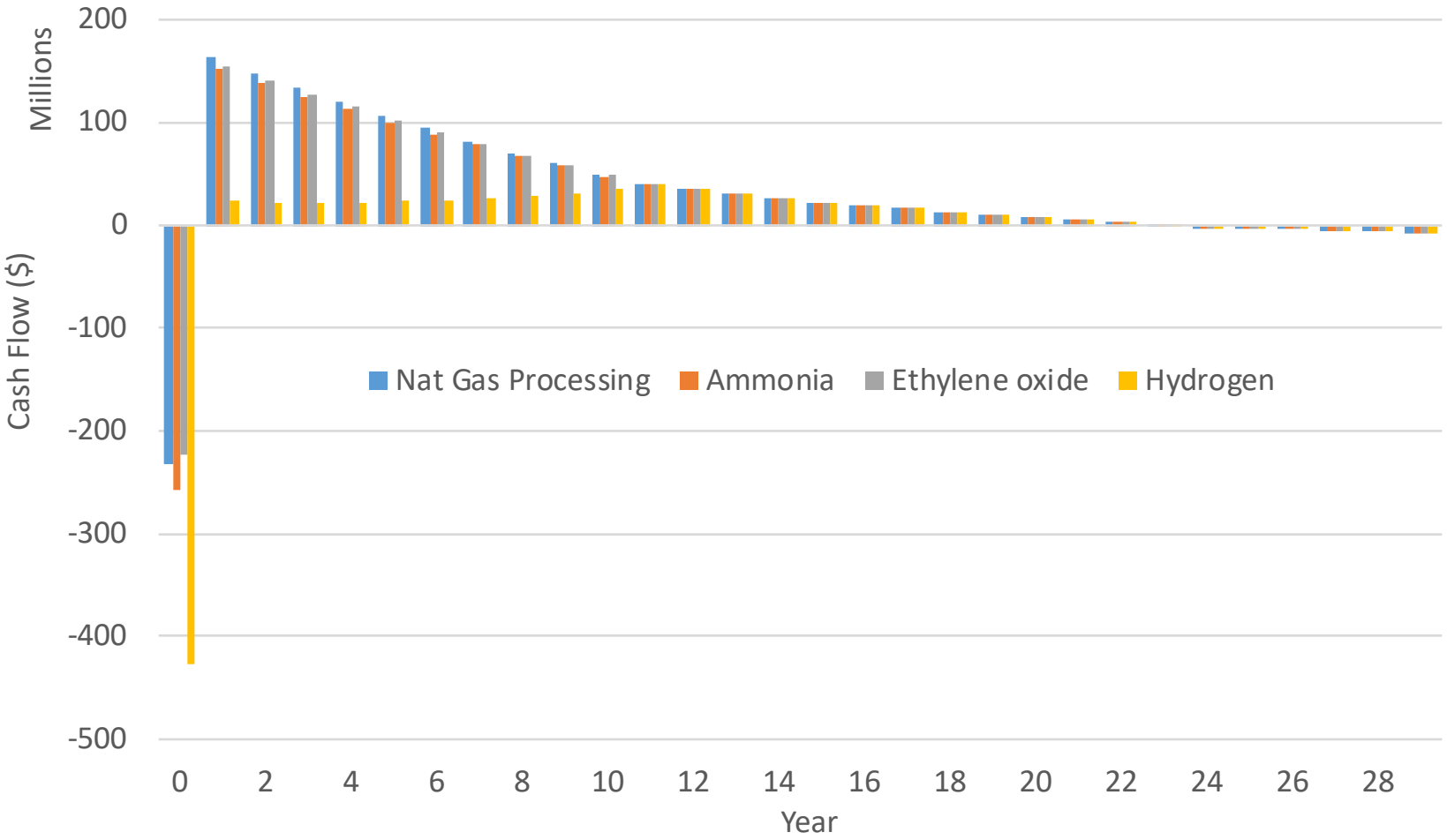


Cash flow model of CCS-EOR in Louisiana



Assumes a $35/tonne tax credit as in 45Q

Cash flow model of CCS-EOR in Louisiana

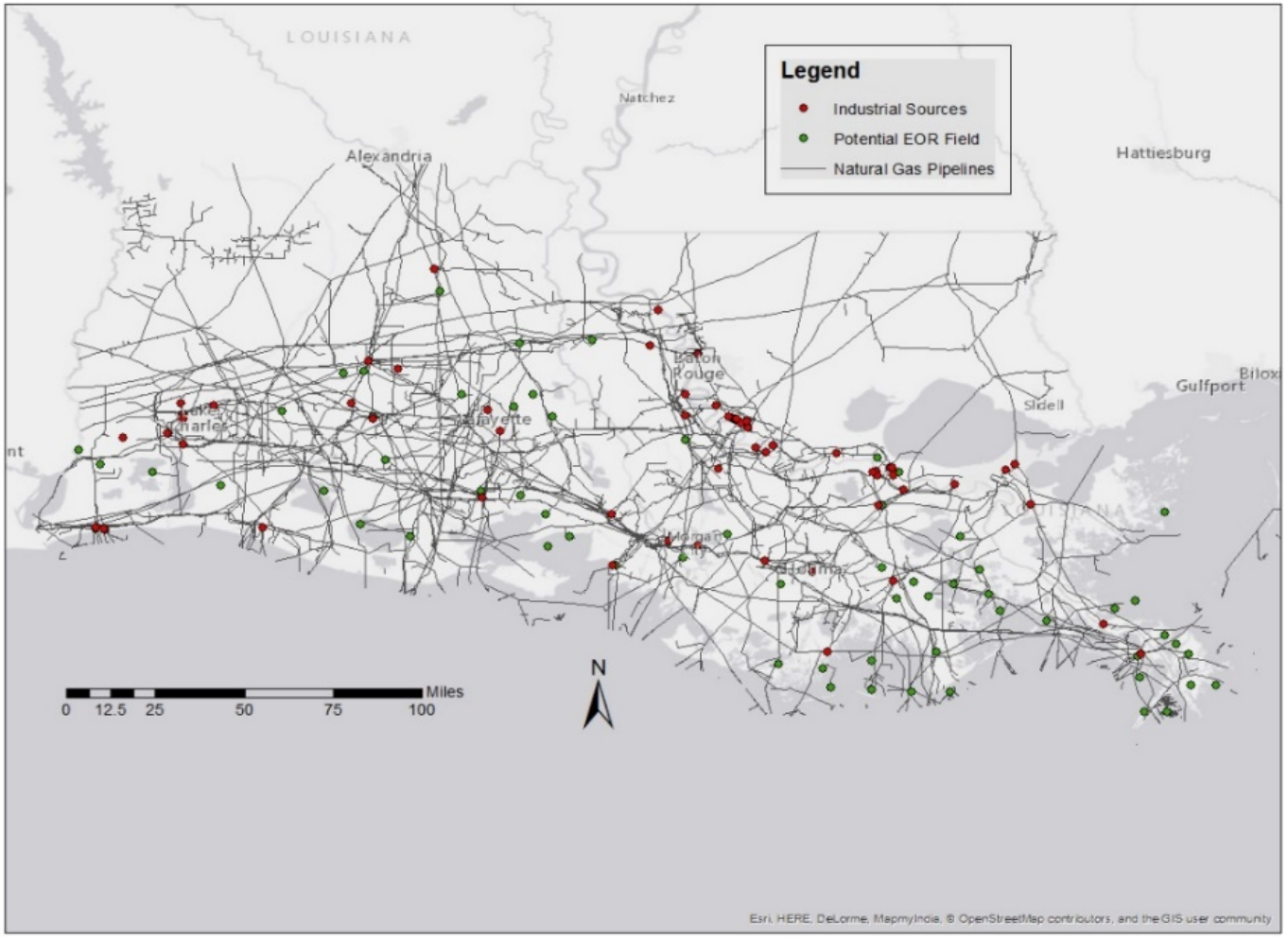


Cash flow model of CCS-EOR in Louisiana

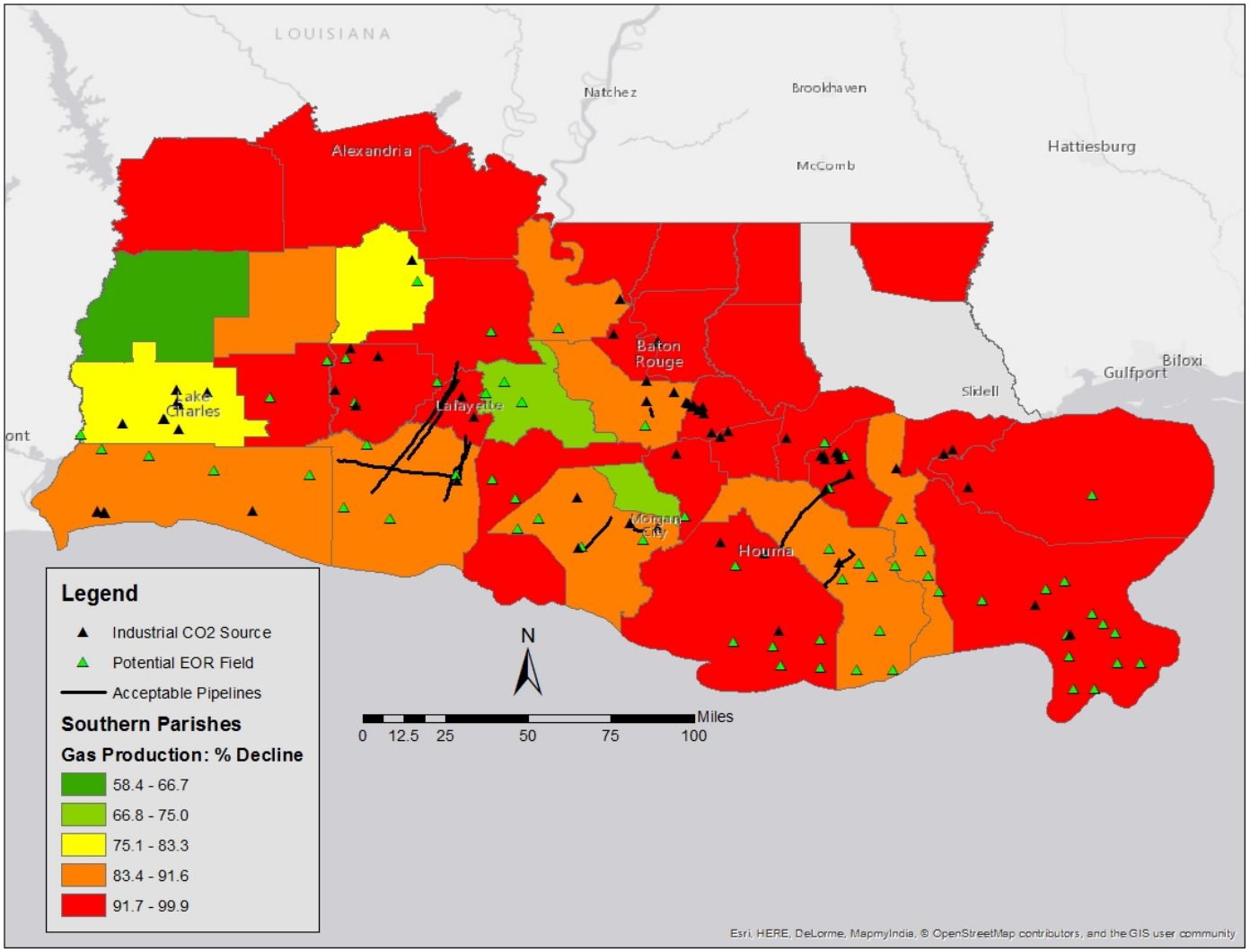
			NPV (million $)	
Field	OOIP (million bbls)	Depth (ft)	50 miles	100 miles
Paradis	206	11,000	453	428
Avery Island	155	9,000	320	291
Bayou Sale	290	14,000	684	651
Delhi	334	3,135	824	789
Hackberry West	166	7,360	349	324
Lake Pelto	32	13,200	8	-10
Clovelly	17	11,900	-27	-45
Erath	28	8,695	8	-10

	Net Present Value ($)			
Oil Price ($/bbl)	Nat Gas Processing	Ammonia	Ethylene oxide	Hydrogen
30	283	221	266	-446
50	515	453	497	-214
70	747	685	729	18

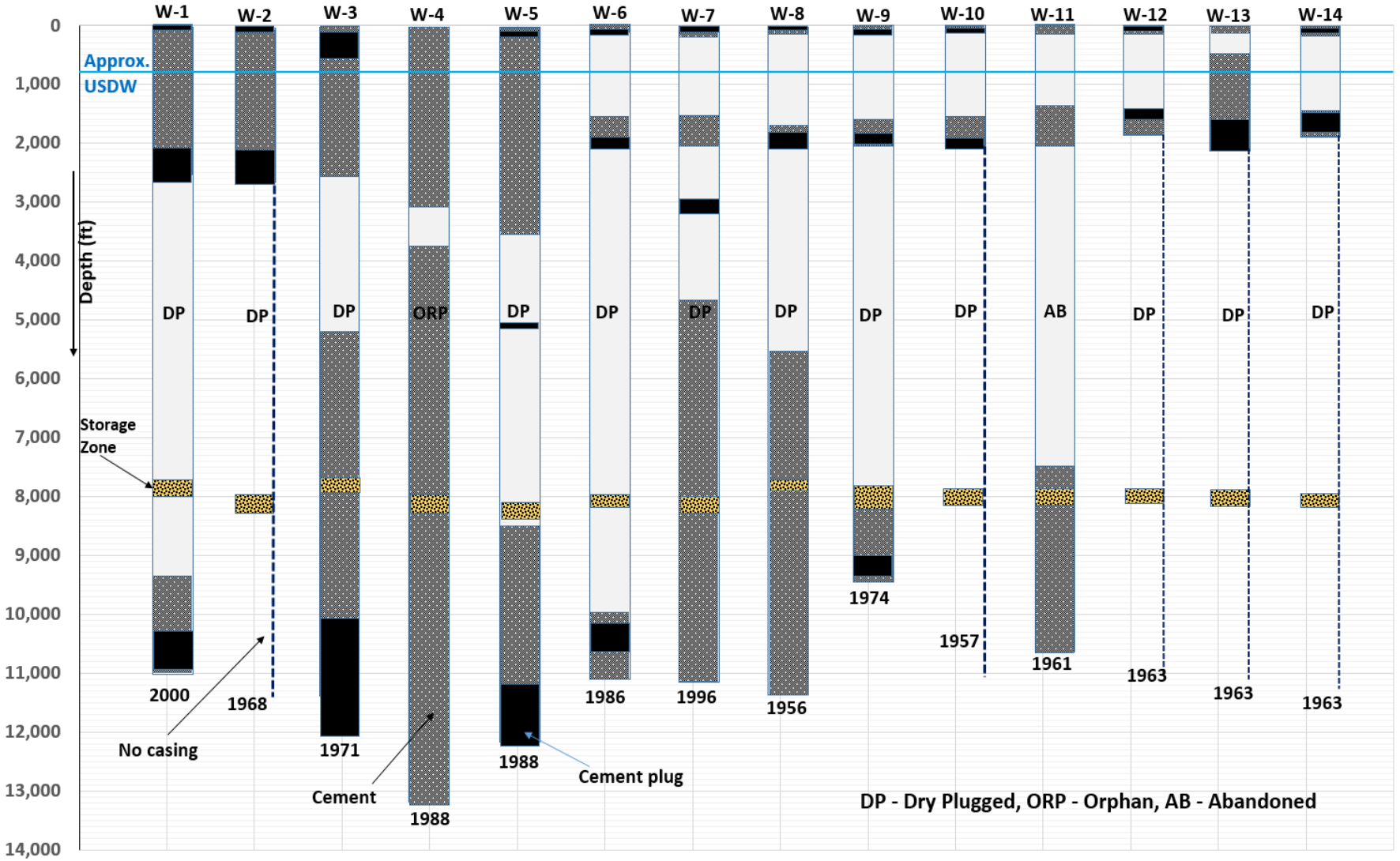
Transportation: Can we reuse existing lines?



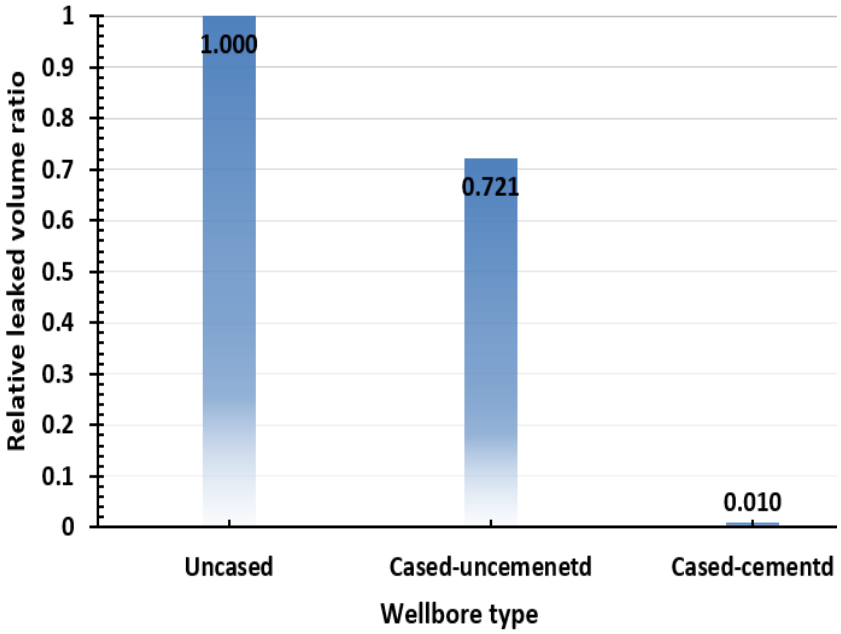
Transportation: Can we reuse existing lines?

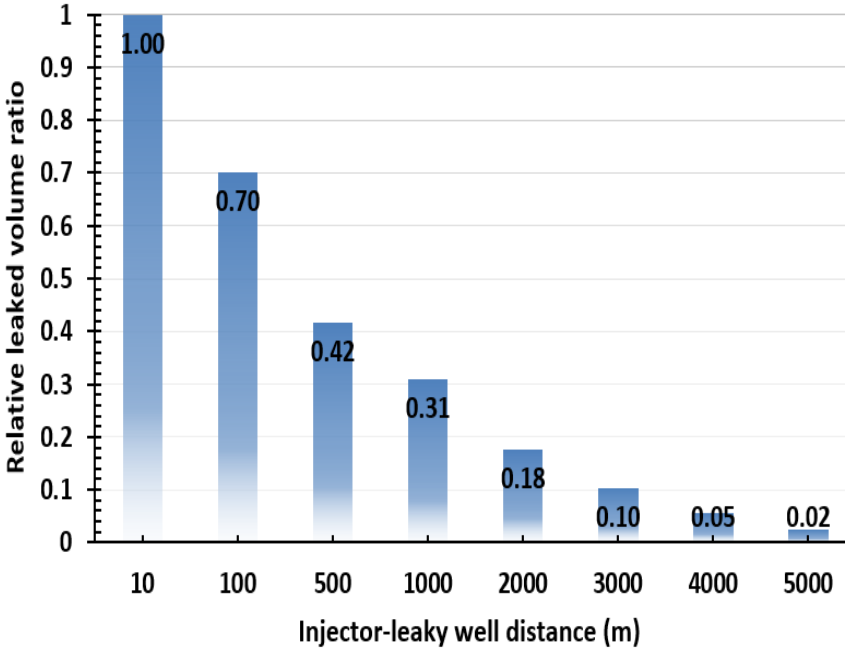


What About Leakage?

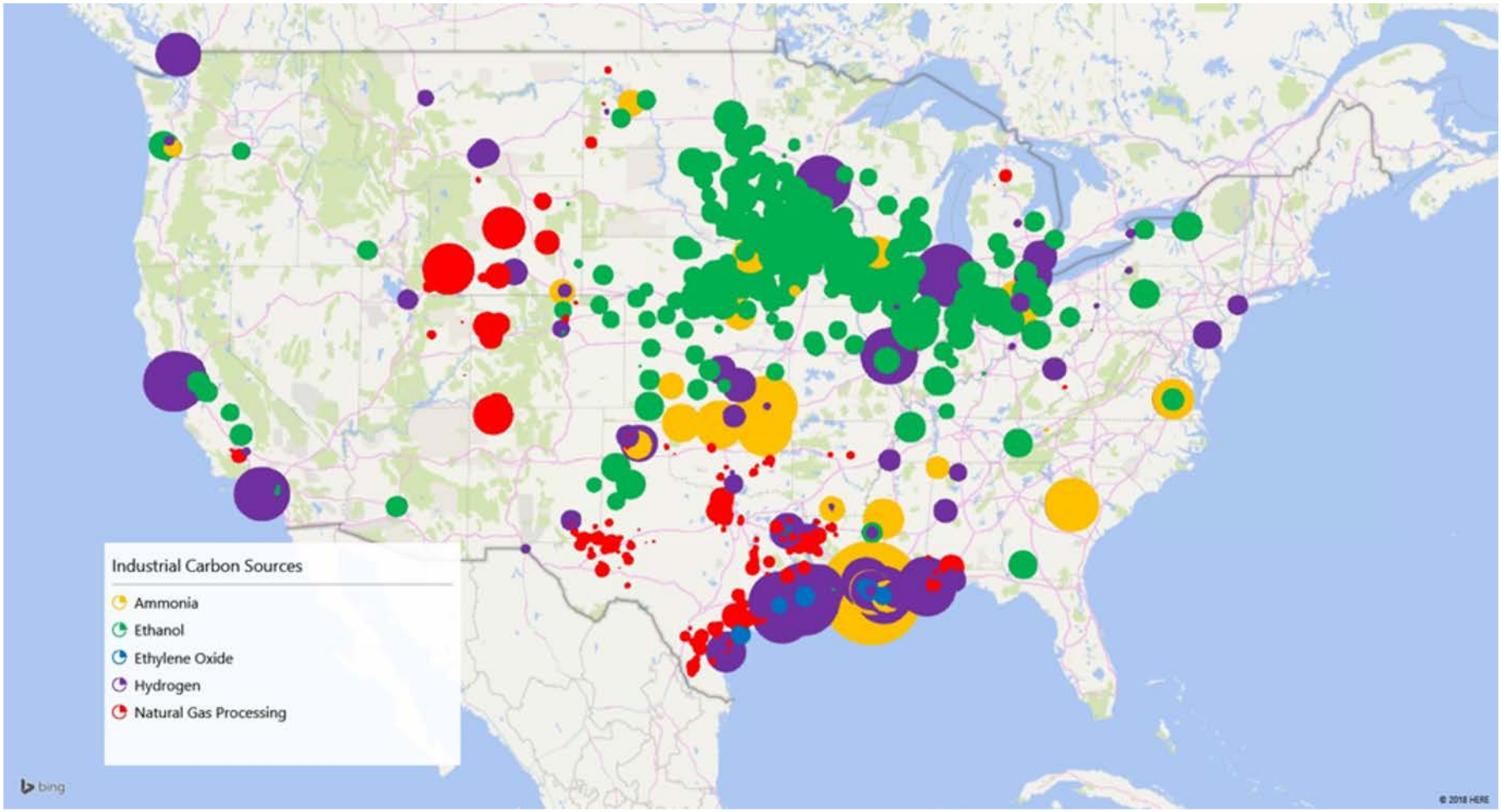


Model Results from NETL's NRAP model

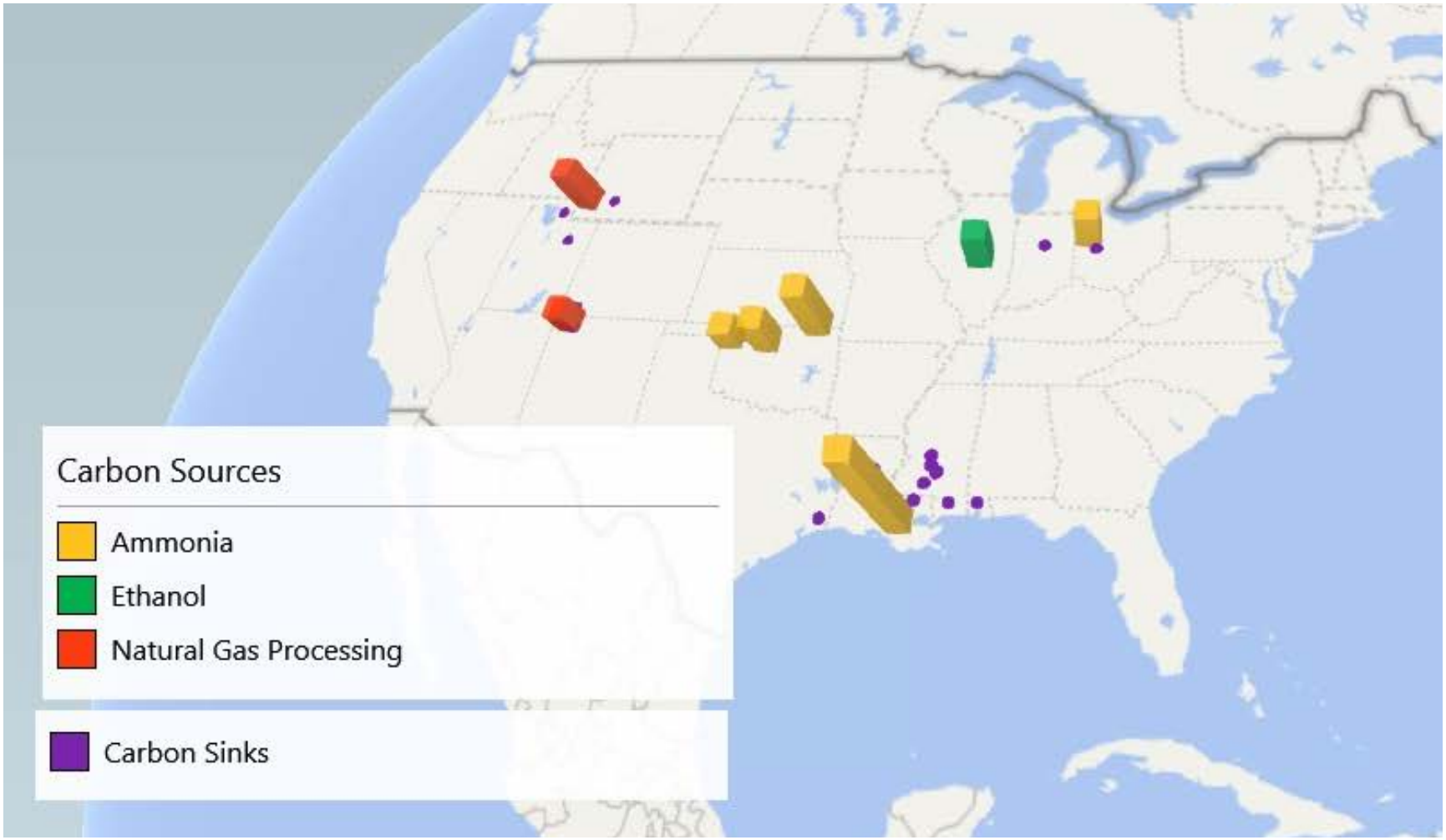




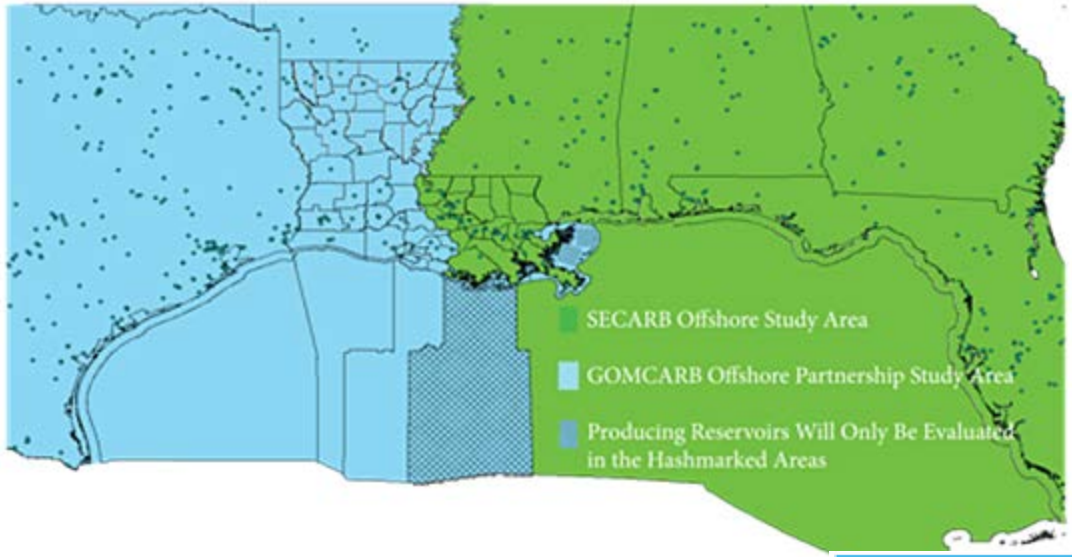
All potential high-purity industrial emissions sources in the US

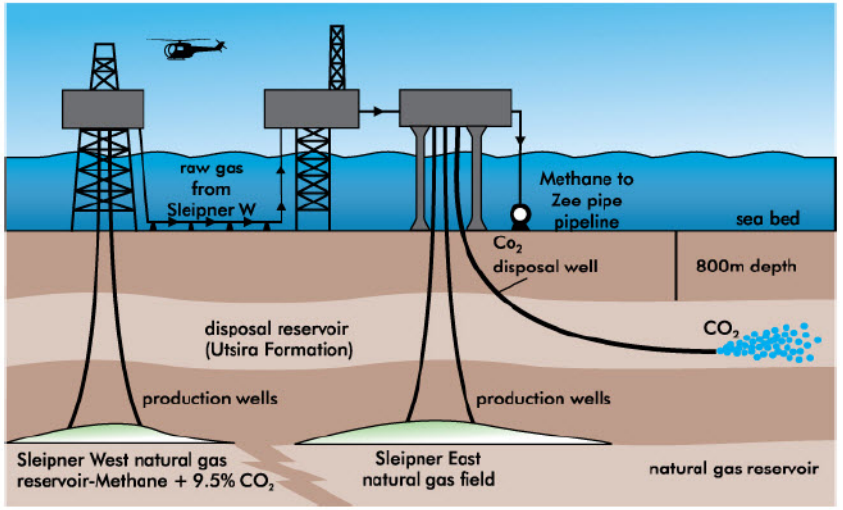


Potential Industrial CCS Systems in the US



What's Next?


SECARB Offshore Study Area
GOMCARB Offshore Partnership Study Area
Producing Reservoirs Will Only Be Evaluated in the Hashmarked Areas


raw gas from Sleipner W
Methane to Zee pipe pipeline
sea bed
Co_2 disposal well
800m depth
disposal reservoir (Utsira Formation)
CO_2
production wells
production wells
Sleipner West natural gas reservoir-Methane + 9.5% CO_2
Sleipner East natural gas field
natural gas reservoir

Conclusions

- Wide variety of CCS system configurations
- Even with 45Q, EOR is likely more cost effective that storage for most systems
- Constraints are associated with “small” scale
  - Suggests that alternative system configurations may be useful (i.e. cooperation is needed!)

Thank You!

David Dismukes
Mehdi Zeidouni
Richard Hughes
Michael Layne
Brian Harder
Kimberly Sams-Gray
Brian Hill
Jerry Hill
Juan Lorenzo
Chacko John