

Introduction to Carbon Capture, EOR, and Storage

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Carbon Capture for EOR in Kansas Meeting
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CO₂ conversions, scales and “green” oil

Units/volumes

- 6.6 pounds of CO₂ co-produced for every gallon of ethanol
- 1 tonne (metric ton) = 1.1 tons
- 1 ton CO₂ 17.2 mcf
- 1 tonne CO₂ 19 mcf
- 1 million tonnes 19 bcf

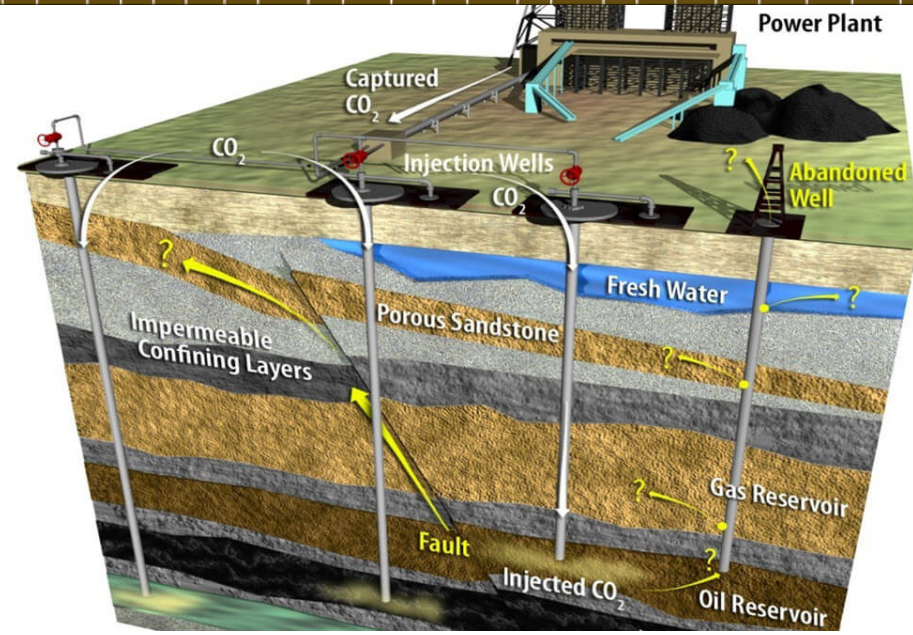
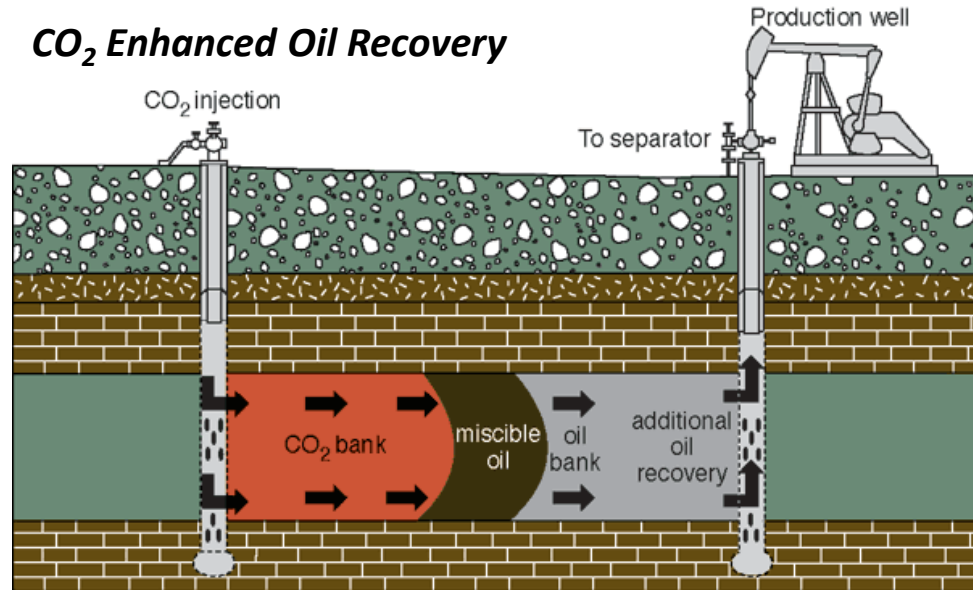
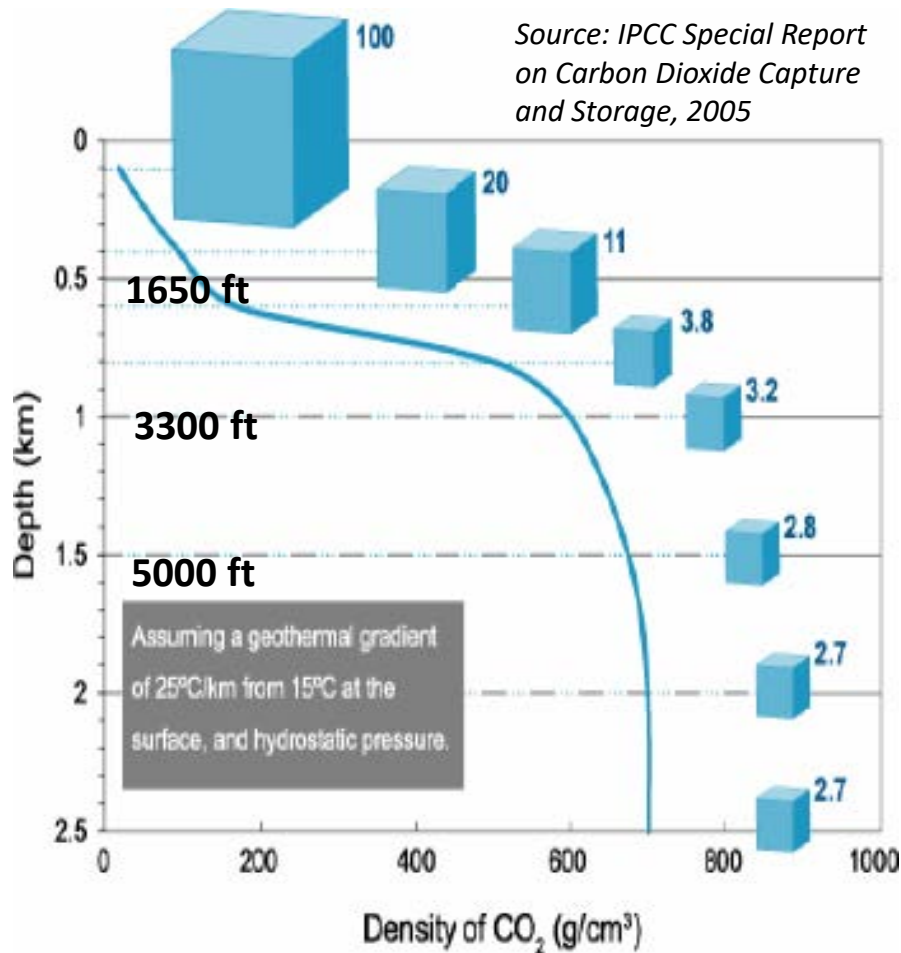
CO₂ production at varying scales

- An average human exhales 5.6 mcf CO₂/yr, 0.26 tonnes/yr
- Small Ethanol plant (55mgy) – 8.3 mmcfd, 0.17 million tonnes/yr
- Large Ethanol plant (313mgy) – 50 mmcfd, 0.94 million tonnes/yr
- Coffeyville fertilizer plant – 40 mmcfd, 0.8 million tonnes/yr
- Jeffrey Energy Center – 650 mmcfd, 12.5 million tonnes/yr

How “green” is anthropogenic CO₂ EOR?

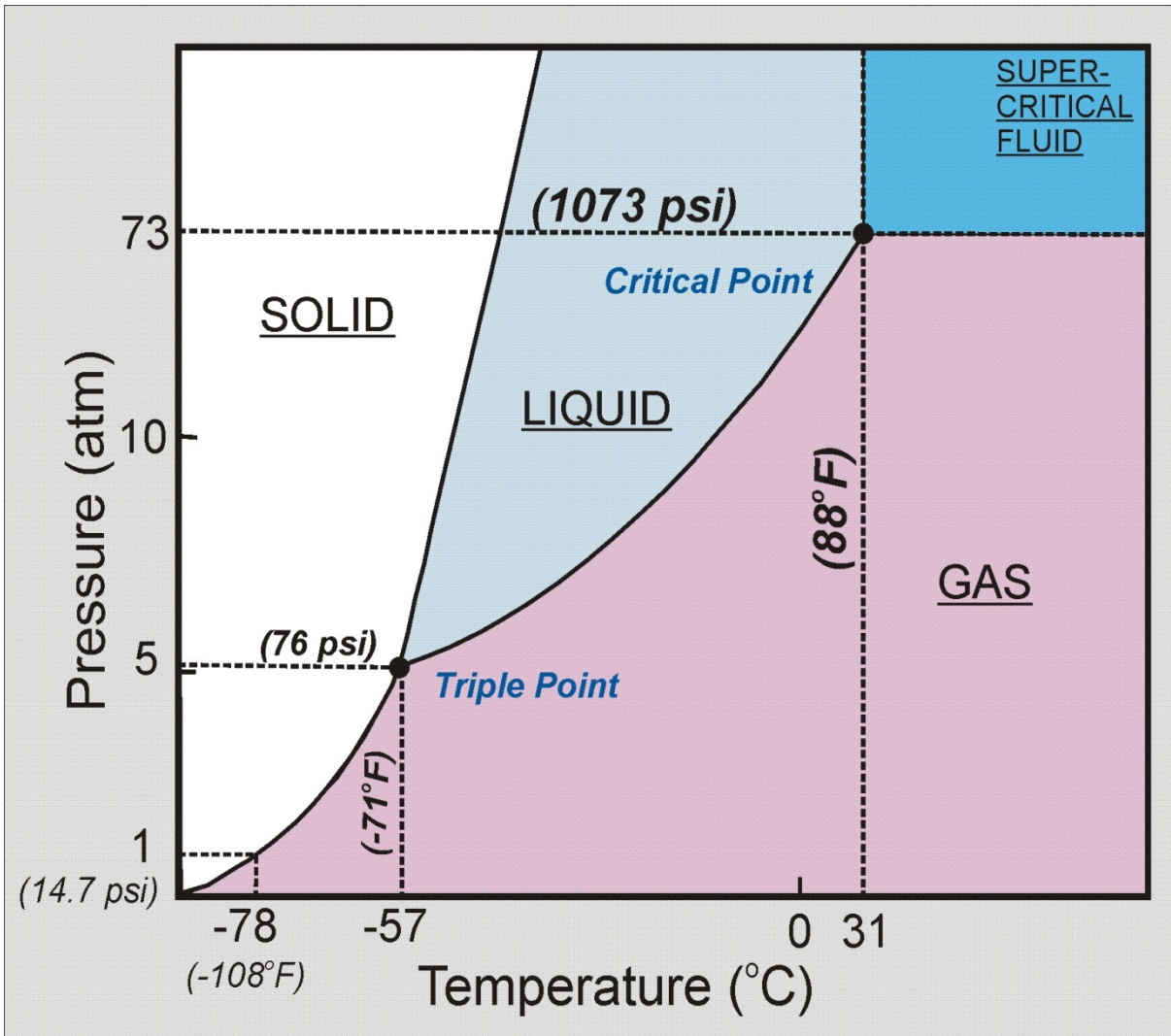
- Combustion of 1 barrel of oil yields 8 mcf CO₂
- For every barrel of oil produced ~8 mcf CO₂ is permanently left in the reservoir
- Stores as much as is released upon combustion

Carbon Capture, Utilization and Storage in Concept



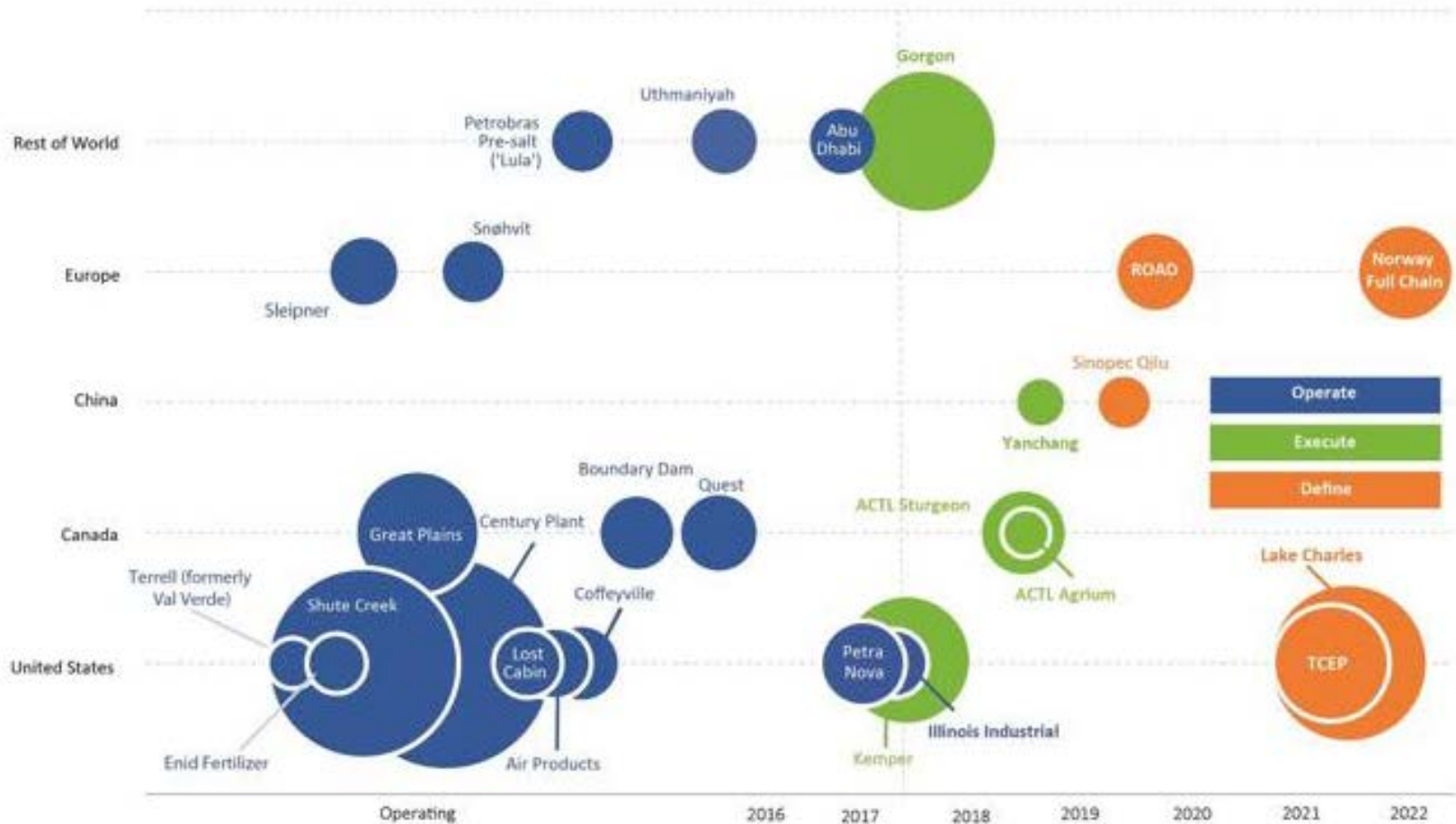
CO₂ EOR and Geologic Storage - Operational Conditions

CO₂ Phase Diagram



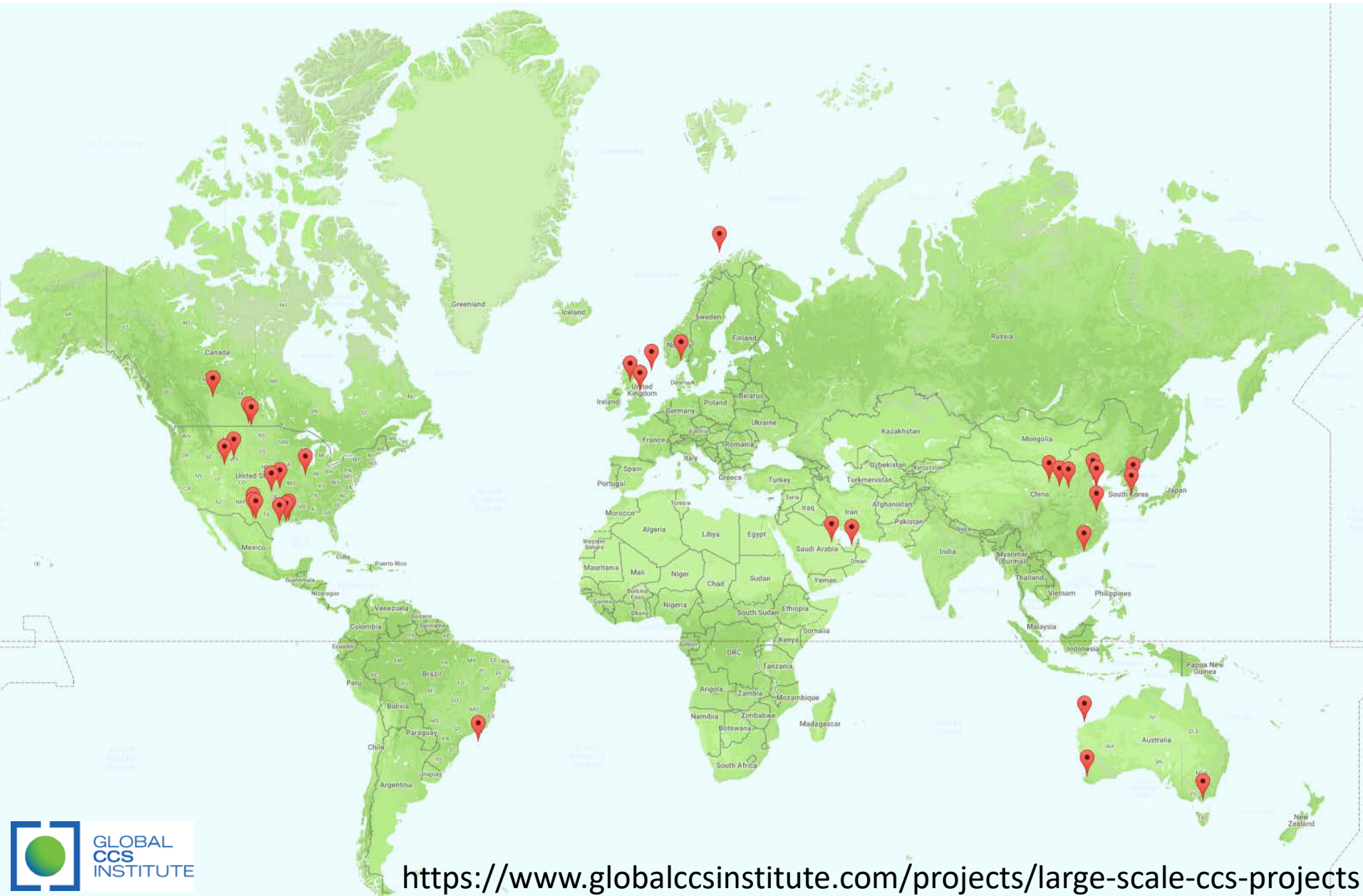
- Miscible floods must operate at greater than supercritical (1073 psi) and MMP (>1200 psi)
 - Fraction of light components in oil needs to be high (high API)
 - CO₂ reduces the viscosity of oil
- Kansas reservoirs ambient properties range: 400 psi and 85F at 1000 ft and 1600 psi and 125 F at 6000 ft.

Operating and Planned Commercial Scale CCUS Projects (2017)



○ = 1Mtpa of CO₂ (area of circles proportional to capacity)

CCUS Project Locations



What about Kansas?

From the Midwest Governor's Association and ARI (2009)

- Kansas holds > **750 million barrels** of technical CO₂-EOR potential.
- Kansas has the largest oil resources in the MGA region.

Basin	EOR potential (Mil bbl)	Net CO ₂ Demand (MMT)	Direct Jobs Created
Illinois/Indiana	500	160 – 250	1,550 – 3,100
Ohio	500	190 – 300	1,550 – 3,100
Michigan	250	80 – 130	800 – 1,800
Kansas	750	240 – 370	2,300 – 4,600
TOTALS	2,000	670 – 1,050	6,200 – 12,400

Byrnes et al., 1999 (Kansas Geological Survey)
250 to 1,000 million barrels

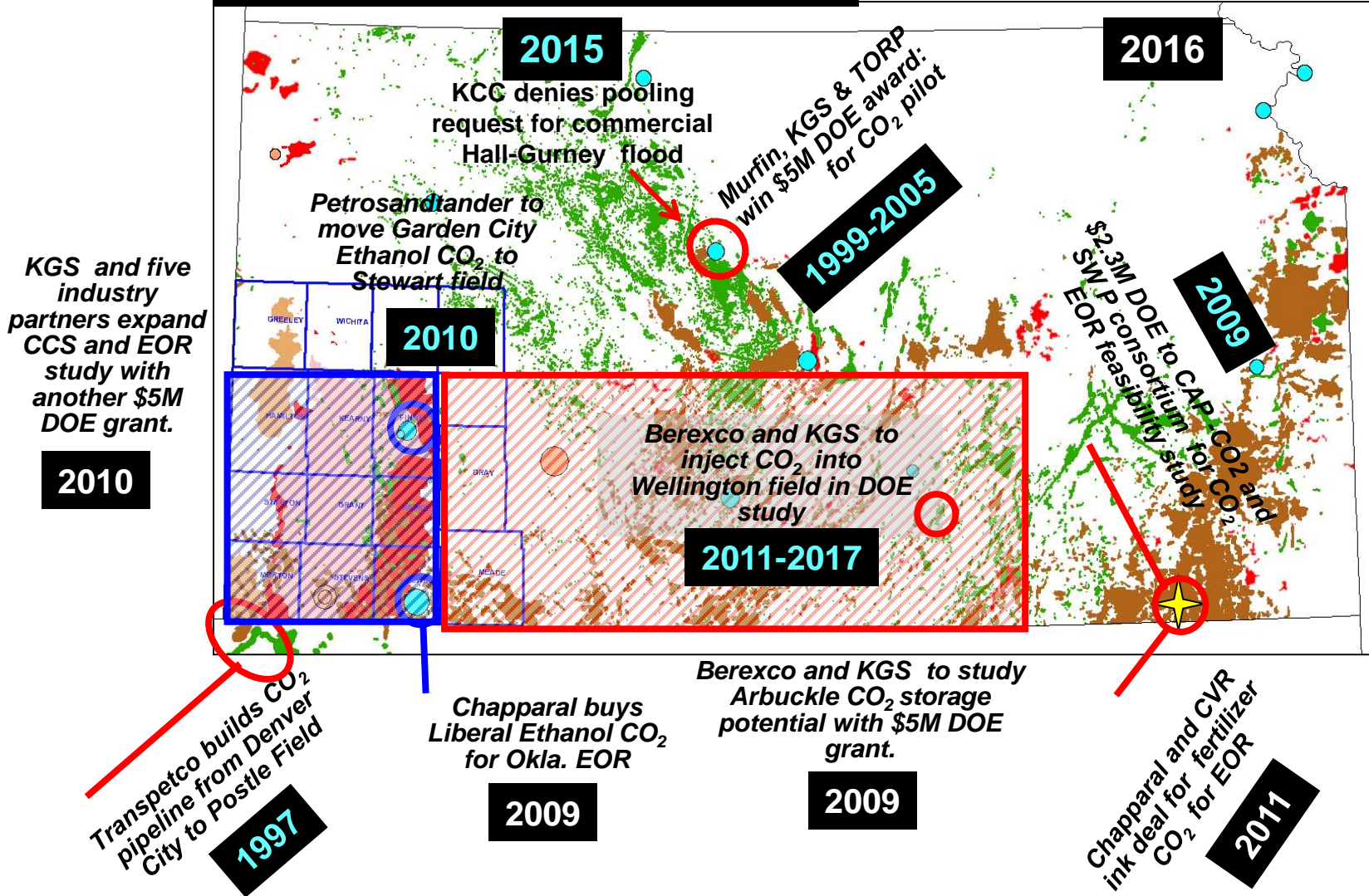
**Main challenge – capturing CO₂ and providing
infrastructure for transportation**

CO₂ EOR and Storage in Kansas

Kansas Ethanol Plants (2008)

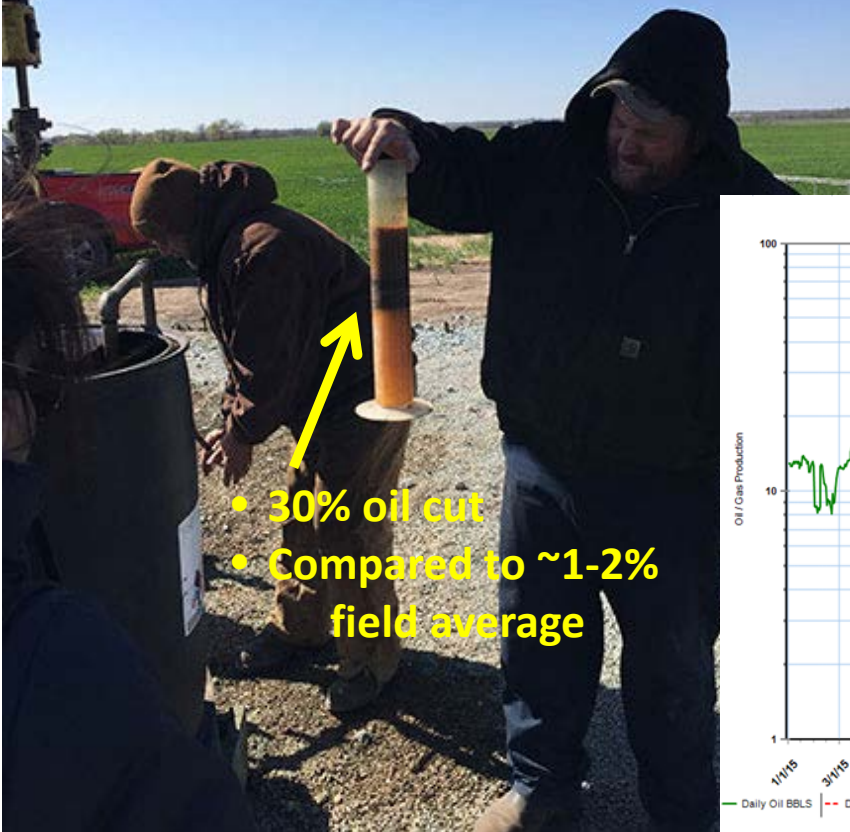
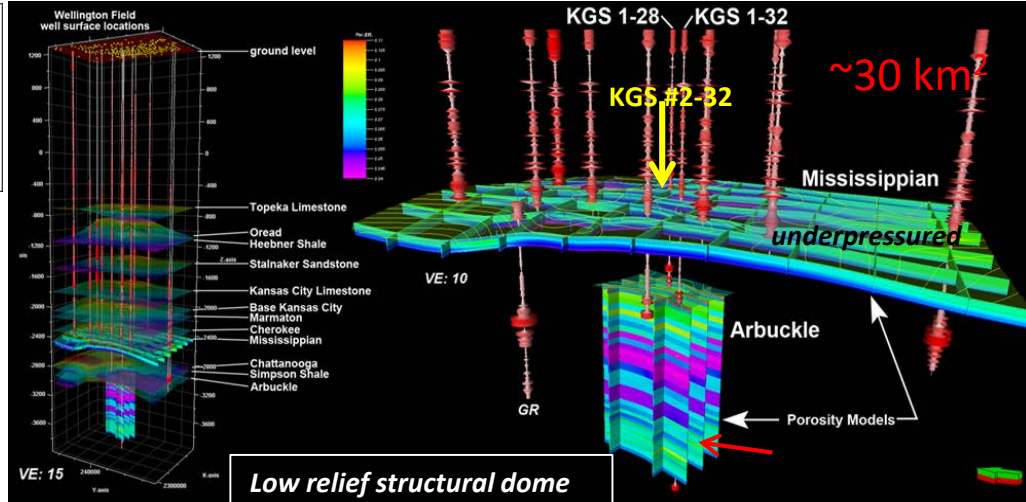
Blue – active, Tan - planned

KGS and industry partners land \$1.5M for Phase I in DOE CarbonSAFE program

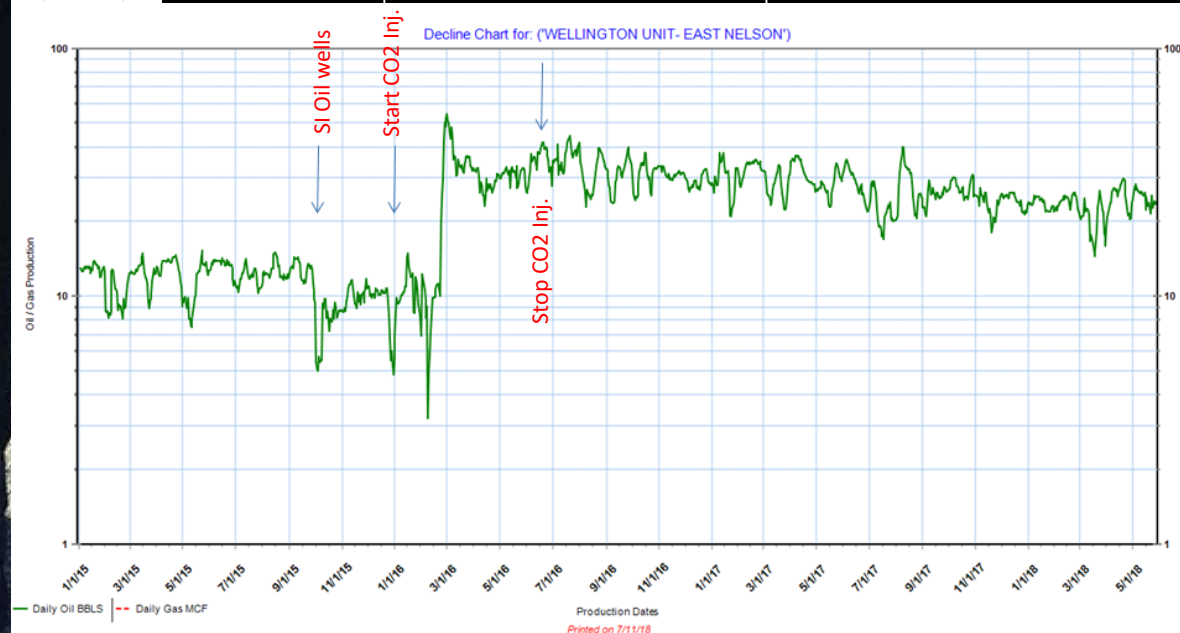


Wellington CO₂ EOR

20k tonnes of CO₂ -> Incremental Oil Production ~16,000 bbl oil as of 6/1/2018



- 30% oil cut
- Compared to ~1-2% field average



Highlights of past quarter: 45Q specifics

45Q specifics*

Enacted 2/9/2018 as part of a Federal budget bill

- Restricted to projects that begin construction before February 9, 2025 (seven years after enactment date).
- Can be claimed for a 12-year period beginning the day the equipment is placed in service
- Credits can be claimed by the capture facility but can be transferred to the storage facility, but not directly by the transporter
- 2017 tax credits are \$12.83/tonne for EOR and \$22.66/tonne for saline storage.
- Credit from 2018 through 2026 is a linear interpolation from 2017 credit values increasing to \$35 for EOR and \$50 for saline storage in 2026, plus an annual adjustment for inflation.
- Credit is \$35 for EOR and \$50 for saline storage from 2026 on.
- Adjusted annually for inflation after 2026.
- Injected into a qualified EOR project or in a secure geologic storage

* Sources: NEORI (Kurt Walzer), CLATF, State CO2 EOR Workgroup (Brad Crabtree), and S. 1535 document

Credits (no inflation)

	EOR	Saline
2017	\$12.83	\$22.66
2018	\$15.29	\$25.70
2019	\$17.76	\$28.74
2020	\$20.22	\$31.77
2021	\$22.68	\$34.81
2022	\$25.15	\$37.85
2023	\$27.61	\$40.89
2024	\$30.07	\$43.92
2025	\$32.54	\$46.96
2026 - 2035	\$35.00	\$50.00

Questions?

