

Our Systematic Approach is Your Guide



All successful decarbonization efforts, clean fuel projects and sustainability programs must incorporate the following six items into their strategies:

1. **Training/education:** Regulations, technologies, and marketplace
2. **Carbon life-cycle analysis (LCA)**
3. **Regulatory, political engagement / strategic internal policies**
4. **Asset development:** Assess risks, redirect capital, monetize carbon
5. **Compliance management:** Making the carbon claim
6. **Third-party verification** of the claim

The Way to Net-Zero Ethanol

In a world demanding net-zero, the way forward for ethanol is to take advantage of its carbon sinks

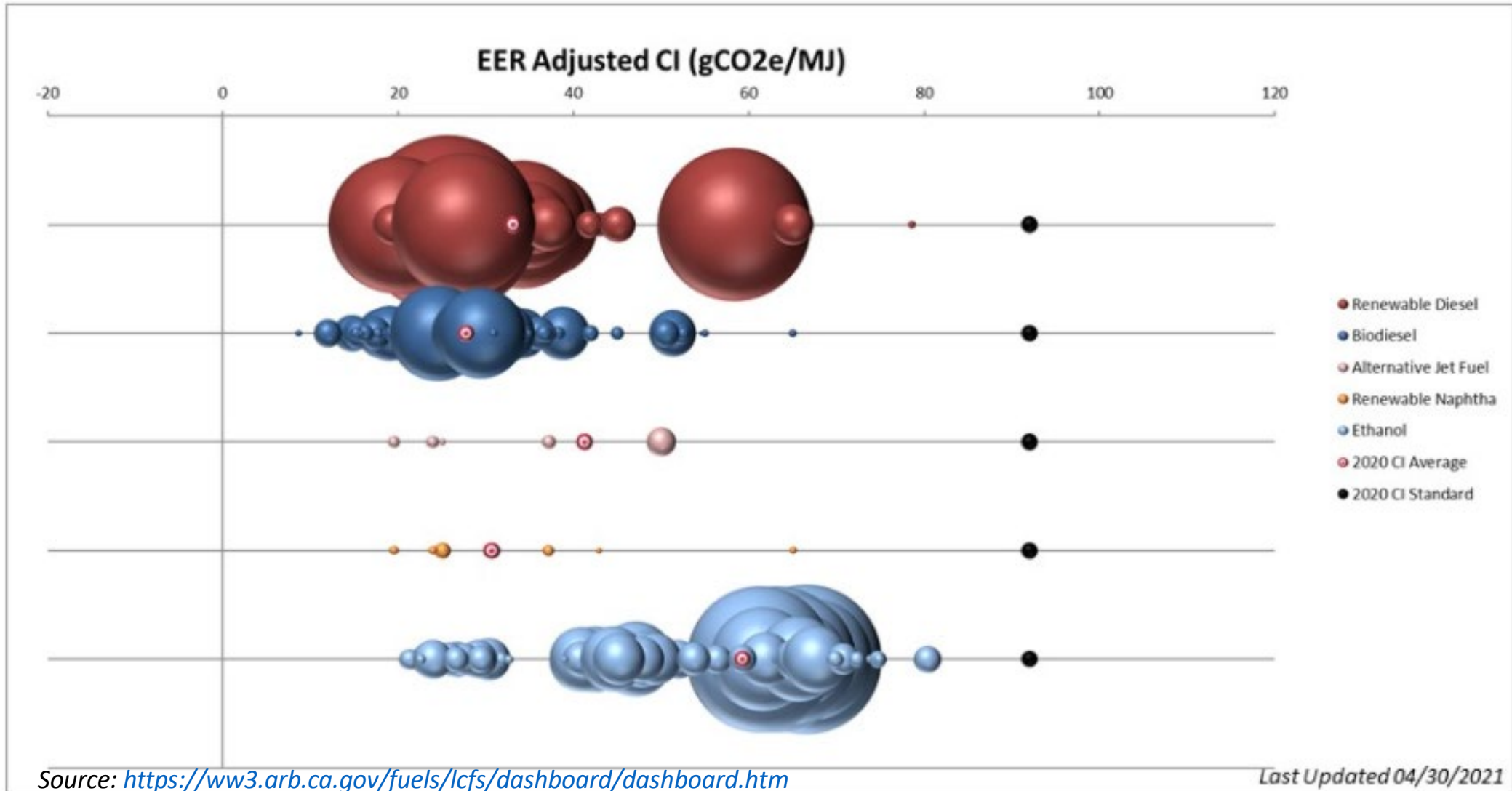
1. Sustainable agriculture
2. Soil carbon sequestration
3. Carbon capture and sequestration
4. Solar, wind, and biomass based heat and electricity
5. Kernel fiber

<https://tinyurl.com/nzethanol>



Volume-Weighted Sales into California

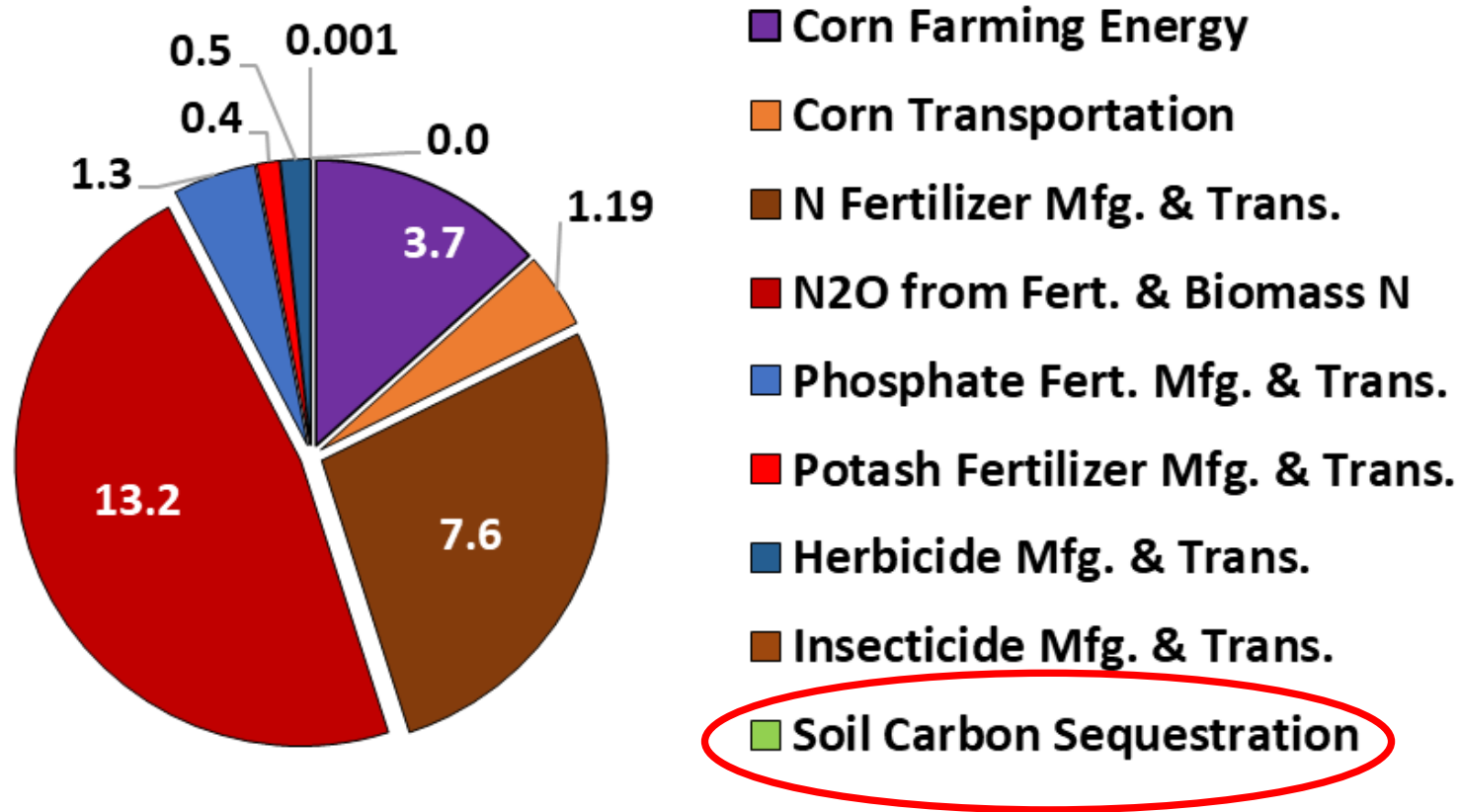
2020 Volume-weighted Average Carbon Intensity by Fuel Type for Liquid Fuels



Pathways to Net-Zero Ethanol

Market Readiness	Low-CI Inputs	Sustainable Management Practices by Corn Growers	Renewable Process Energy	Carbon Capture and Storage by Ethanol Producers
Currently Available	Corn starch, kernel fiber	No till, cover crops, soil carbon sequestration	Biomass, RNG, wind, solar, CHP including both electric and process heat demand	Carbon capture and sequestration, enhanced oil recovery including pipeline, truck, rail
Emerging		Biochar, low-CI fertilizer	Pyrolysis, H ₂	

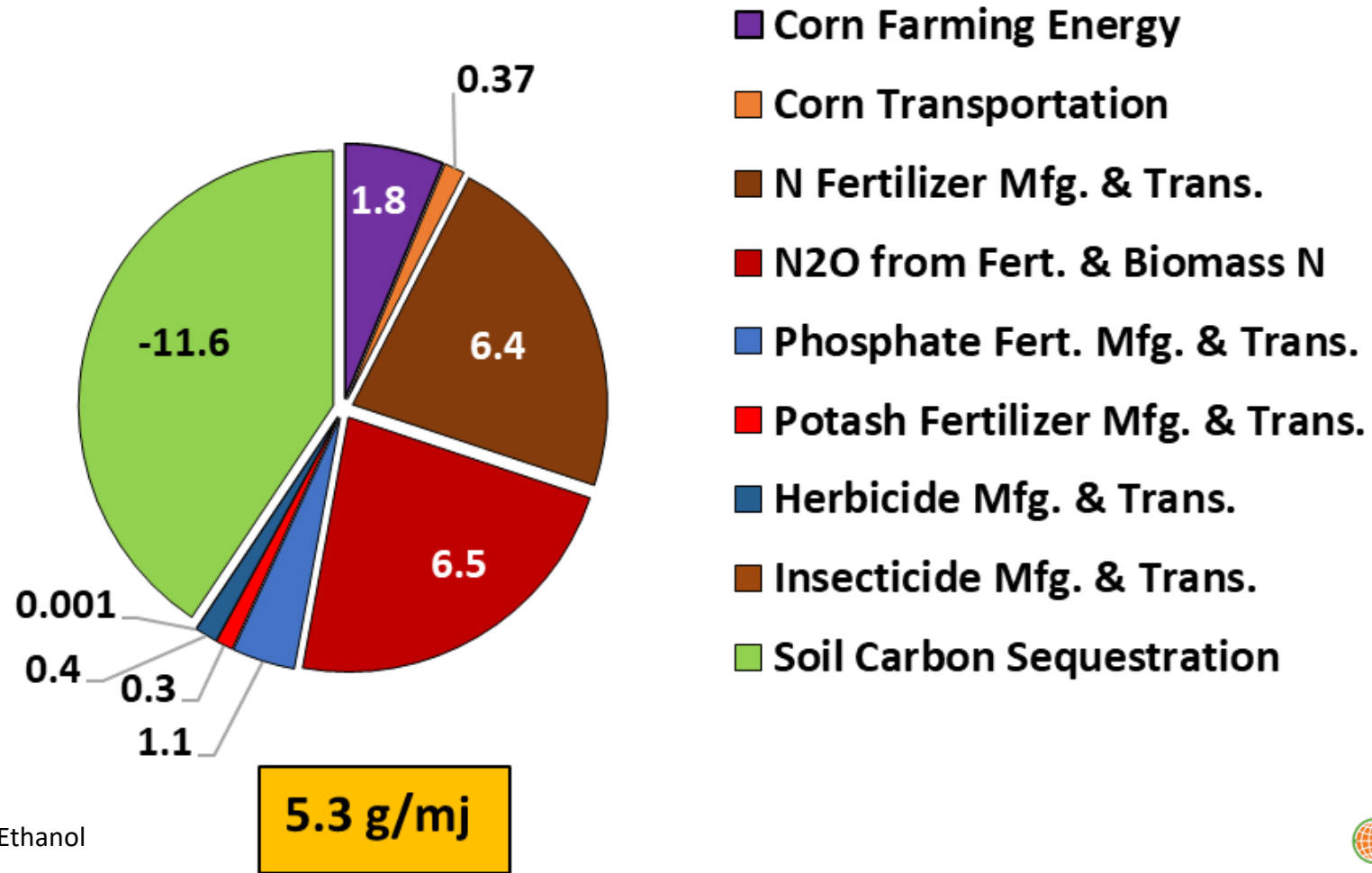
U.S. Midwest Average



29.3 g/mj

Lake County, South Dakota Average

(with optimized low-carbon corn production practices)



Site-Specific Supply Chain Solutions

	Site Specific	GREET Default (g CO ₂ e/MJ)
Region-Specific GHG includes SOC	-	U.S. Midwest Average
Yield Bushel per acre	-	178.4
Fertilizer Nitrogen/ Phosphate/ Potash	-	158/75/60
Tillage	-	Conventional
Cover Crop	-	None

Ethanol Feedstock CI	Site Specific	GREET Default (g CO ₂ e/MJ)
w/o Soil Organic Carbon (SOC)	-	28.1
SOC	-	0.8
w/ SOC	-	29.0

Site-Specific Supply Chain Solutions

	Site Specific	GREET Default
Region-Specific GHG includes SOC	Muscatine, Iowa	U.S. Midwest Average
Yield Bushel per acre	220	178.4
Fertilizer Use 4 R's & Manure	40/0/0	158/75/60
Tillage	No Till	Conventional
Cover Crop	Cereal Rye	None

Ethanol Feedstock CI	Site Specific	GREET Default (g CO ₂ e/MJ)
w/o Soil Organic Carbon (SOC)	11.4	28.1
SOC	-23.0	-28.4 SOC Using CCLUB Default
w/ SOC	-11.6	-0.2

16.7 CI w/o SOC or 40.6 w/ SOC

Site-Specific Phase-In Plan

The future is now - Phase 1

- Let's move forward with what we agree on now
- Models have emission factors at known values with buffer included
- Areas of disagreement come in phase 2

Site-Specific Practice	Phase 1 Emissions	Phase 2 Sequestration	Total CI Reduction
Field / Farm-specific Yield	4.7 less	-0.1 more	4.6
Fertilizer Practice Change (4R's)	4.4 less	0.0 less	4.4
Fertilizer Form	7.0 less	7.2 less	14.2
Tillage	0.3 less	3.5 less	3.8
Cover Crops	0.0 less	13.6 less	13.6
Total CI Reduced / Phase	16.4 Pts	24.2 Pts	40.6 Pts

Monetization of 200 Bushel Corn per Acre

Emissions	Soil Organic Carbon
16.4 gCO ₂ e/MJ	24.2 gCO ₂ e/MJ
<i>X \$0.01 per gallon</i>	
\$16.40 per gallon	\$24.20 per gallon
\$0.4838 per bushel	\$0.7139 per bushel
<i>X 200 bushels per acre</i>	
\$96.76 per acre	\$142.78 per acre
Total: \$239.54 per acre	



Creating sustainable solutions for a better tomorrow