



AGRISoma

Sustainable Energy Founded in Agriculture

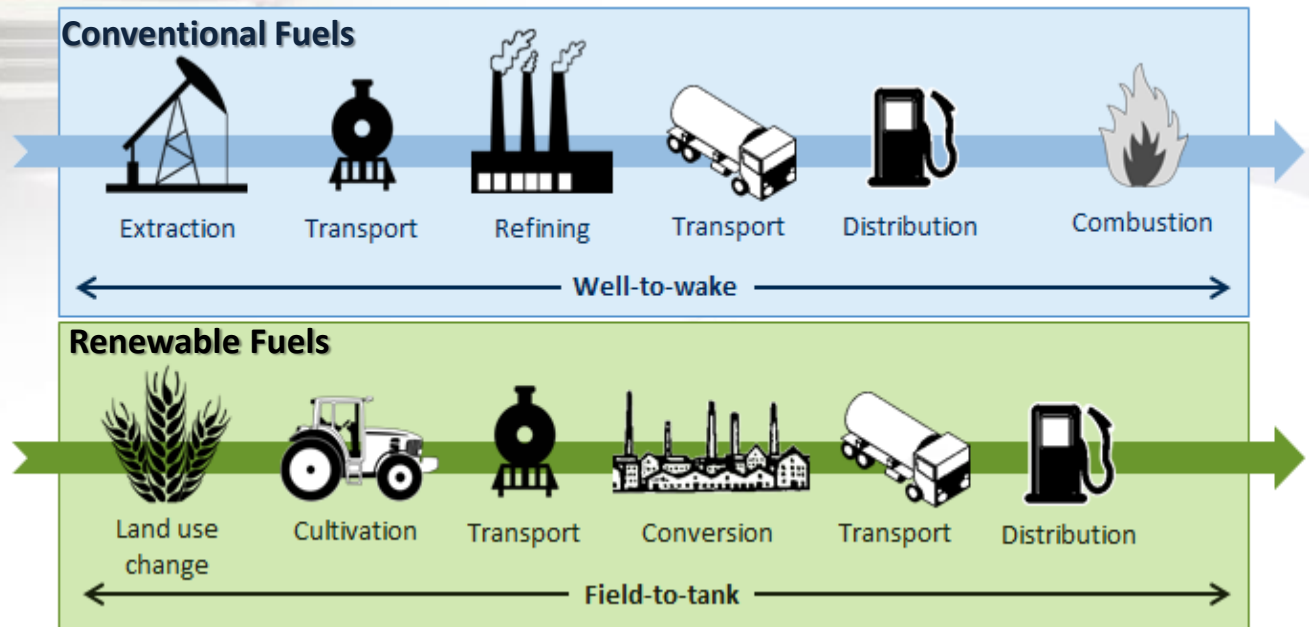
Carinata LCA Production Review 2016 Southeast USA Crop

Jeff Klingenberg, Agrisoma



Life Cycle Analysis (LCA) Models

- Provide a complete GHG emission analysis through production, transportation, and consumption of a fuel.



Biomass Yield, Oil and Carbon Capture



Carinata



Camelina

	Seed yield, lb/acre	Oil, gal per acre	Biomass, lb/acre	Lb biomass per gallon of oil	MT of carbon sequestered per acre at 40% carbon content ¹	Equivalent gasoline emissions offset by Carbon Sequestered (gallons) ²	Total CO ₂ equivalents captured, biomass & fuel, MT CO ₂ e per acre of cultivation
<div>A110 Agrisoma Carinata</div>	2943	150	15977	107	3.25	1226	13.4
<div>CO 46 Camelina commercial line</div>	944	40	3536	88	0.72	271	3.0

¹ Journal of Environmental Protection, 2010, 1, 73-84, doi:10.4236/jep.2010.12010 Published Online June 2010


² As per EPA GHG calculator <http://www2.epa.gov/energy/greenhouse-gas-equivalencies-calculator>, 1T Carbon X 3.66 is 3.66 T of CO₂ e

X MT of carbon produced X 103 gallons per CO₂ e. Also 1 gallon of Petro diesel = 22.38 lbs of CO₂ e, 1 gallon on biodiesel reduces CO₂ e by the same

LCA Models

- Regulations for sustainable fuels set GHG emission savings target against an incumbent fuel.
- LCA models are the tools for quantifying the GHG savings and demonstrating compliance with the regulation requirements.

Regulation	LCA Model
EU Renewable Energy Directive	RSB GHG Lifecycle calculator Biograce GHG Tool GREET Model GHGenius Model ISCC GHG Calculation Methodology
California LCFS	CA-GREET 2.0 Tier 1 and Tier 2
ICAO	GREET Model Biograce

- 
- Cultivation can represent a significant part of the emissions.

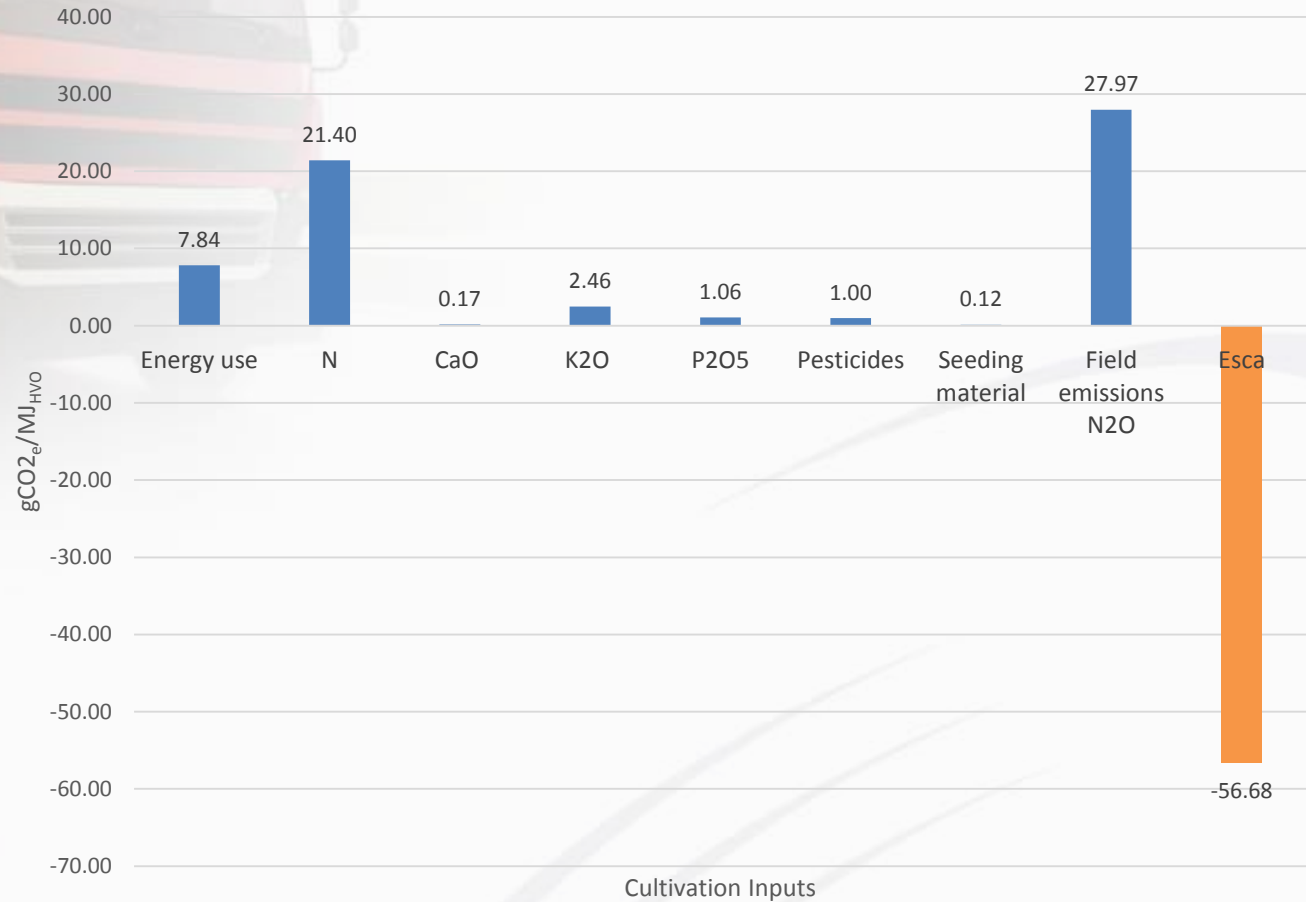
Key Inputs

- Fertilizer use
 - g of Nitrogen
 - g of P_2O_5
 - g of K_2O
 - g of $CaCO_3$
- Pesticide use
 - g of Herbicide
 - g of Insecticide
- Mechanical work
 - Energy consumed

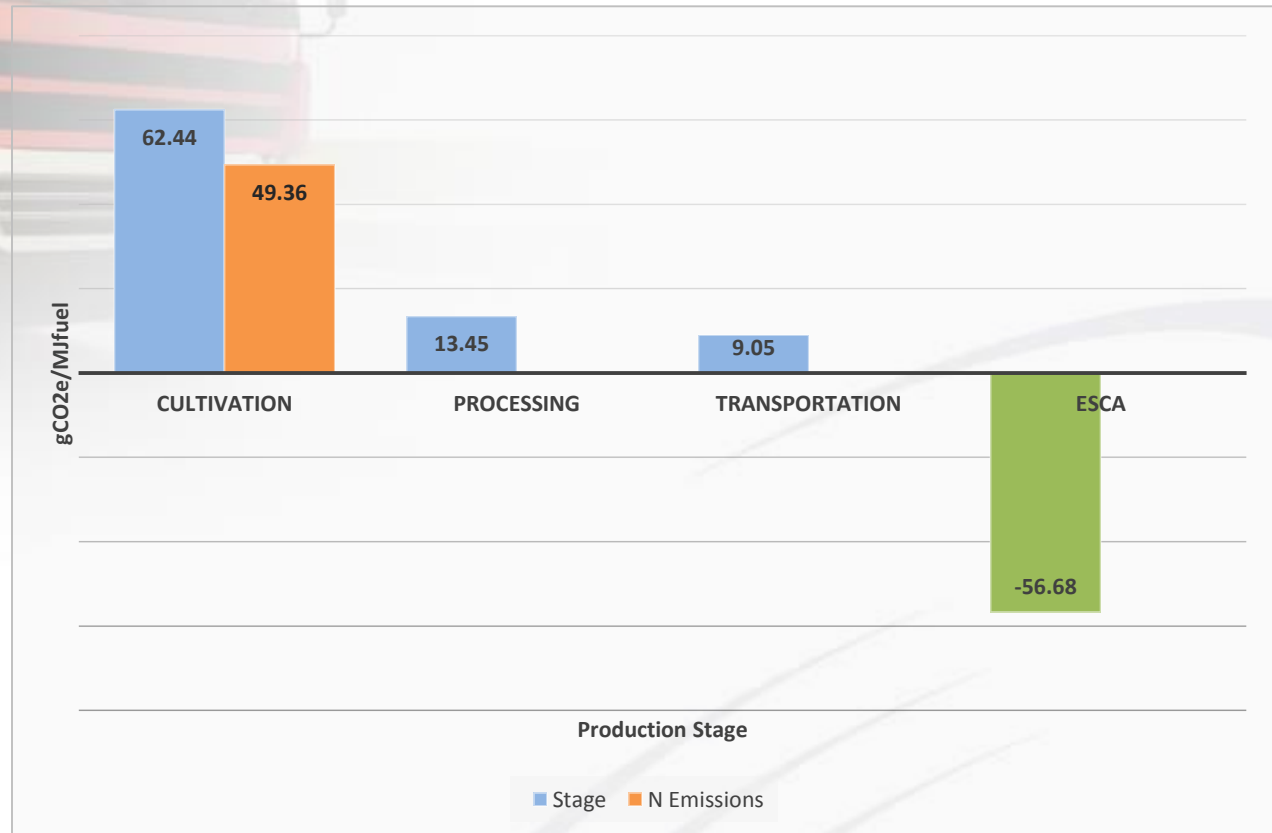
- Cultivation emissions can be offset by positive changes in soil carbon. Models for soil carbon:
 - EPIC
 - CENTURY



SE 2015/2016 Cultivation Emissions-BioGrace Model



SE 2015/2016 LCA Snapshot – Cultivation to Off-taker



AGRISOMA

Sustainable Energy Founded in Agriculture

Continuing LCA Research Trial Types

Nitrogen Use Efficiency

- Variable N treatment rates on Carinata including fallow and or traditional cover crop
- Single crop rotation over lay on each of the Carinata trt plots.
- Single management program on the rotation crop
- Multiple locations required for single rotation event

Crop Rotation Systems

- Involves traditional multiple summer crop species in rotation with Carinata, and other winter crop options
- Management at trial location based on recommendations for each crop type
- Minimum of 4 – 5 year trial



AGRISoma

Sustainable Energy Founded in Agriculture