

# U.S. Soybeans, Soybean Meal, and Soy Oil

## Life Cycle Assessment Fact Sheet



### United Soybean Board and the National Oilseed Processors Association Sustainability

Soybeans are a major commodity crop. Global production went from less than 50 million tons in the year 1970 to 161 million tons in the year 2000 and over 350 million tons in the year 2020. The U.S. is the second largest producer and second largest exporter of soybeans, and soybeans comprise about 90% of U.S. oilseed production in the agricultural sector.

The United Soybean Board (USB) and National Oilseed Processors Association (NOPA) partnered together initially in 2010 to complete a similar analysis to ascertain the environmental impacts of soybeans, soybean meal, crude soy oil, and refined soy oil. In 2015, a second analysis was performed. In the 2015 study, NOPA members reviewed the 2010 LCA dataset and updated certain values to reflect a weighted average value. NOPA members concluded that this revision to the dataset was required to better represent the actual operating conditions necessary for soybean processing.

### Key Findings

Based on 2020 - 2021 harvesting yields reported by soybean farmers and 2021 operations data provided by soybean processors and soy oil refiners, the global warming potential (GWP) profile has decreased considerably for all evaluated U.S. soy commodities. This is compared to previous findings presented in the 2015 and 2010 life cycle assessment studies which were prepared by different LCA practitioners on behalf of USB and NOPA.\* Since 2015, the U.S. soy commodities saw GWP reductions of 19% per kg U.S. soybeans, 6% per kg U.S. soybean meal, 22% per kg U.S. crude soy oil, and 8% per kg U.S. refined soy oil from co-located processing facilities and refineries.

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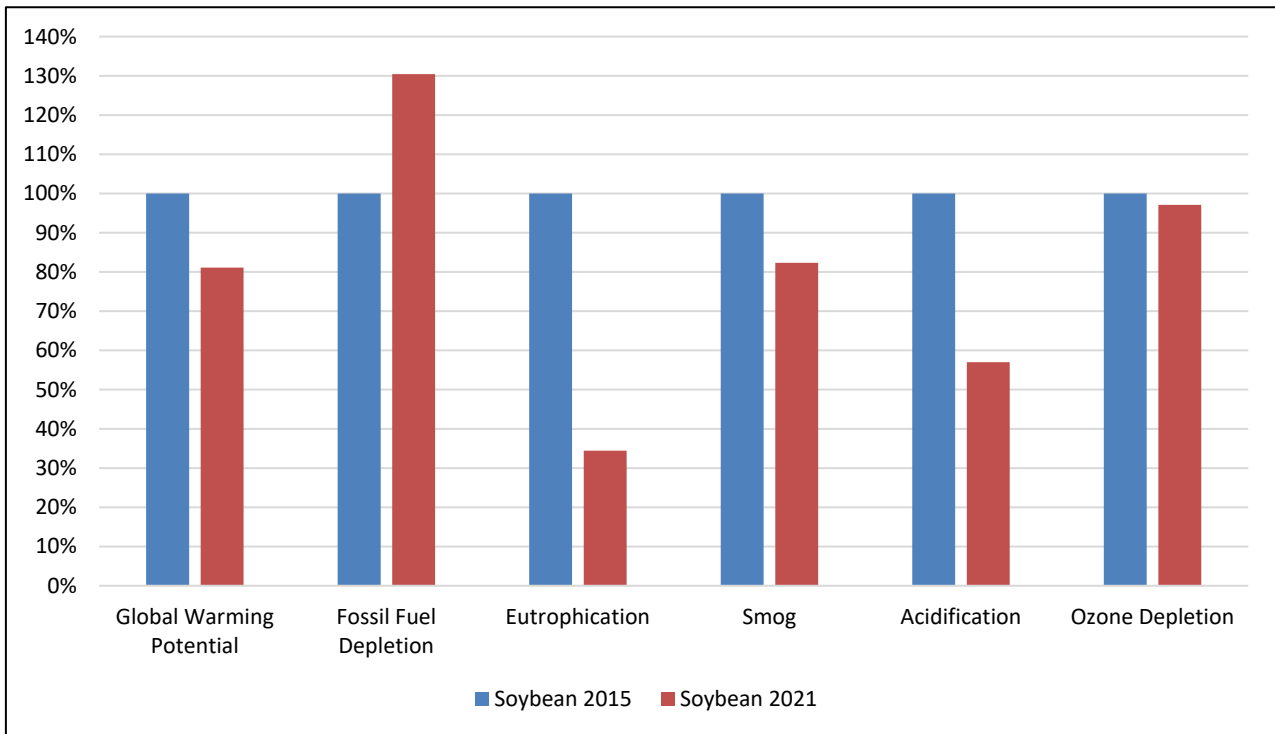
\* The 2015 LCA study relied on NOPA member data for 50 processing plants based on previously reported data used for the 2010 study. In preparing the processing operations data used for the 2015 study, NOPA members reviewed the 2010 dataset and elected to revise only the electricity use input value. As such, the 2015 dataset reported the weighted average value instead of the upper bound value which was used for the 2010 study. This change was made so that the input value better reflected typical operating conditions at a soybean processing plant.

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### Soybean Products Comparison (2015 vs. 2021)

The analysis below is focused on evaluating the environmental impact differences between this life cycle assessment study and the one completed in 2015. Impact categories for comparison were limited to what was reported in the 2015 study, so the only impact categories evaluated in this section were TRACI impacts. The figure below presents a comparison of 2021 data as a percentage change from 2015 data.



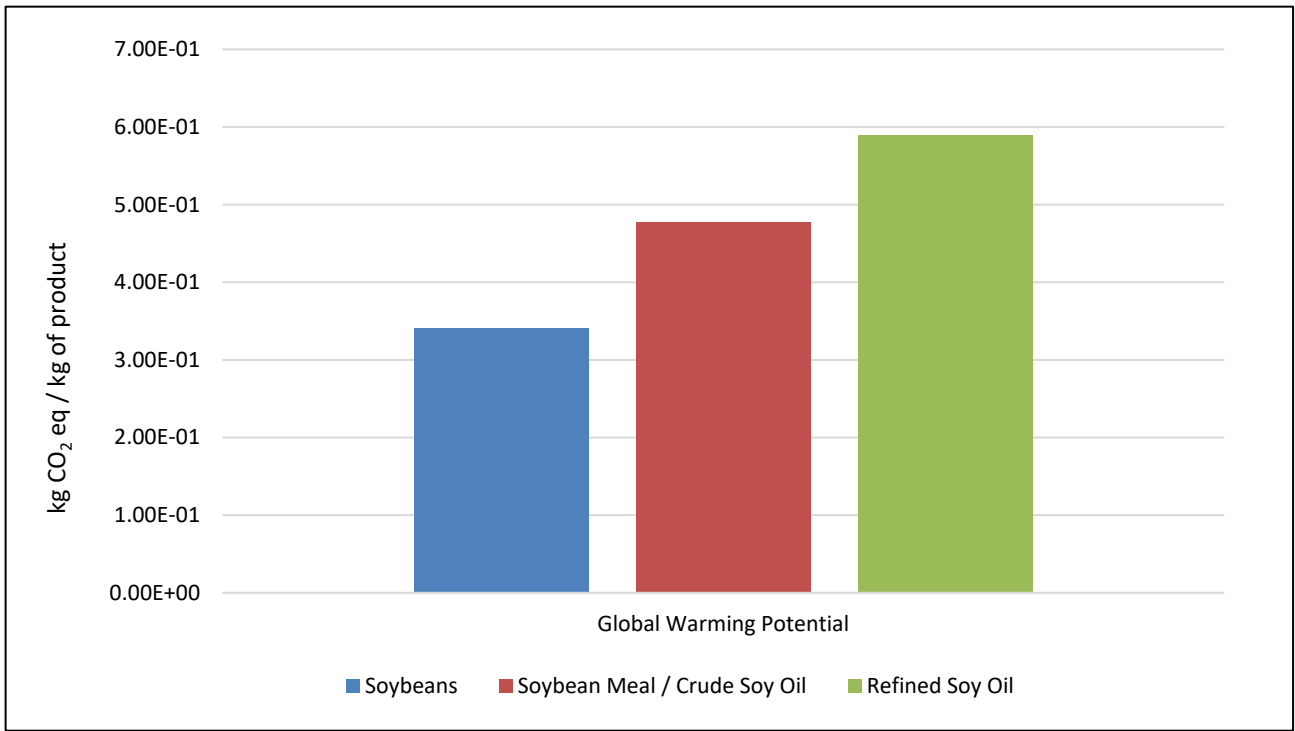
Impact Category	Unit	Soybeans		Crude Soy Oil		Soy Meal		Refined Soy Oil	
		2015	2021	2015	2021	2015	2021	2015	2021
Global Warming Potential	kg CO <sub>2</sub> eq	4.20E-01	3.41E-01	6.10E-01	4.78E-01	5.10E-01	4.78E-01	6.40E-01	5.89E-01
Fossil Fuel Depletion	MJ surplus	3.20E-01	4.17E-01	5.20E-01	6.57E-01	4.40E-01	6.57E-01	5.50E-01	8.39E-01
Eutrophication	kg N eq	1.10E-02	3.79E-03	1.20E-02	3.99E-03	1.00E-02	3.99E-03	1.20E-02	4.12E-03
Smog	kg O <sub>3</sub> eq	2.50E-02	2.06E-02	3.40E-02	2.70E-02	2.90E-02	2.70E-02	3.60E-02	3.69E-02
Acidification	kg SO <sub>2</sub> eq	3.50E-03	2.00E-03	4.70E-03	2.55E-03	4.00E-03	2.55E-03	5.00E-03	3.22E-03
Ozone Depletion	kg CFC-11 eq	3.20E-08	3.11E-08	4.40E-08	4.00E-08	3.70E-08	4.00E-08	4.80E-08	4.48E-08

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### Global Warming Potential Comparison: Soybeans, Soybean Meal / Crude Soy Oil, and Refined Soy Oil

The comparison below demonstrates the total global warming potential of soybeans, soybean meal / crude soy oil, and refined soy oil. The primary driver of global warming potential is field operations for soybeans (38.6%) which accounts for field level emissions, including dinitrogen monoxide and phosphorus. The impact of soybean cultivation is the primary driver for soybean meal / crude soy oil (73.7%) and for refined soy oil (61.2%).



Impact Category	Unit	Soybeans	Soybean Meal / Crude Soy Oil	Refined Soy Oil
Global Warming Potential	kg CO <sub>2</sub> eq	3.41E-01	4.78E-01	5.89E-01

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### Project Scope

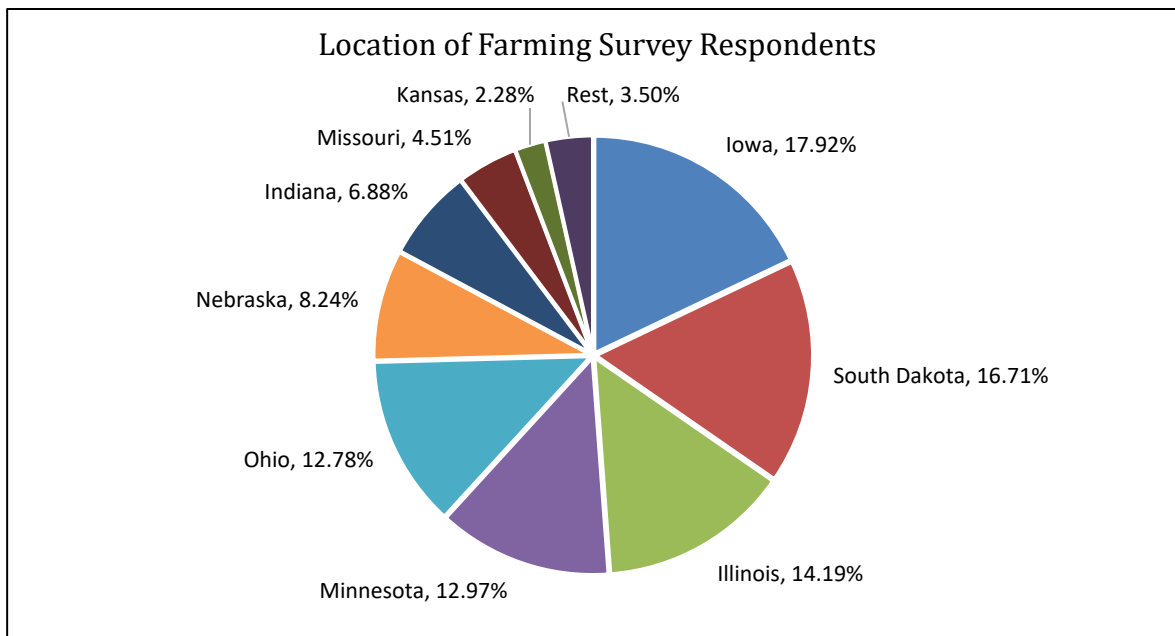
**System Boundary:** Cradle to Gate

**Geographic Boundary:** Soybean cultivation data reflect 454 farms across 16 states. Soybean meal, crude soy oil, and refined soy oil data reflect 52 U.S. soybean processing plants and 27 co-located soy oil refineries operating across 18 states. Farming survey respondents are demonstrated below.

**Functional Unit:** 1 kg of soybeans, 1 kg of soybean meal, 1 kg of crude soy oil, 1 kg of refined soy oil

**LCA Software:** SimaPro v9.2.0.2

**Impact Assessment:** TRACI 2.1 with Global Warming Potential and Cumulative Energy Demand using IPCC AR5 and ReCiPe used for Land Use and Water Consumption



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