



GET TO THE ROOT OF HIGHER YIELDS

Introduction to SUL4R-PLUS' Sustainability


SUL4R-PLUS

Turning this



Into this





To make this

And this.



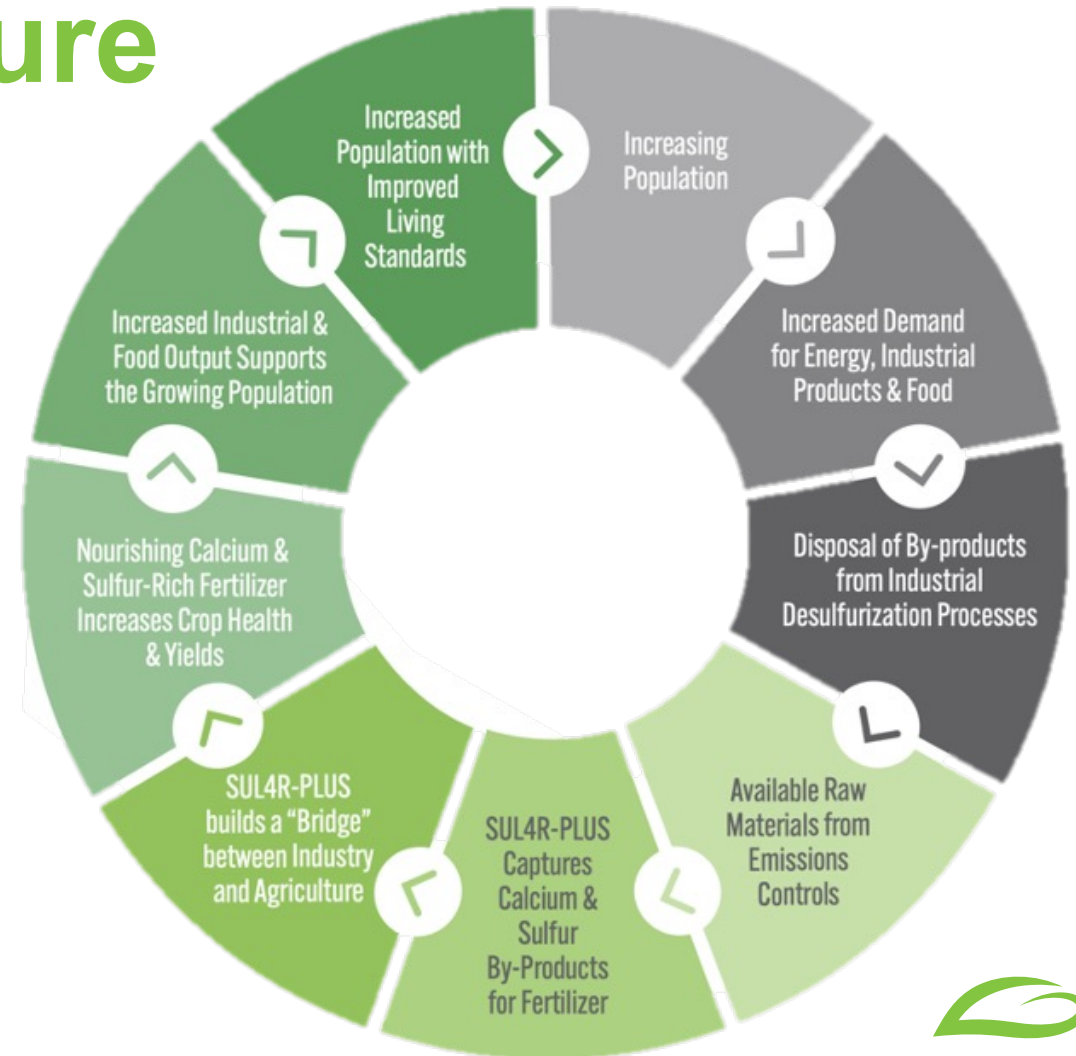
The Circular Economy: Industry and Agriculture

As the global population increases, so does the demand for power, industrial products, and food.

The environmental control processes of several of these vital power production and industrial processes result in various by-products.

SUL4R-PLUS leverages two of these by-products to produce a patented fertilizer product which increases the quantity & quality of food production in an economic & environmentally responsible way.

This beneficial use of under-utilized by-products to increase domestic food production creates a sustainability loop.



All Encompassing Approach to Sustainability

SUL4R-PLUS fertilizer's sustainability footprint is further enhanced in that its production process is 'low carbon' when compared to alternatives such as synthetically manufactured ammonium sulfate. Also, the increased nitrogen utilization seen in most crops associated with using SUL4R-PLUS fertilizer serves to help reduce the environmental and climate impacts inherent in traditional nitrogen fertilizer product production, application, and use. To summarize:





1

The sourcing (“upcycling”) of SUL4R-PLUS’ raw materials allows SUL4R-PLUS’s users avoid environmental, emissions, and climate impacts created through the mining and processing of new raw materials.



2

The patented SUL4R-PLUS production process consumes significantly less energy when compared to the production process of nitrogen fertilizers and synthetic ammonium sulfate, resulting in a much lower carbon footprint.



3

Although SUL4R-PLUS' fertilizer does not contain nitrogen, it will enhance the nitrogen utilization of most crops, which reduces CO₂e emissions that occur at the field level with nitrogen fertilizers through leaching and volatilization.



4

Each 100k metric tons (MT) of SUL4R-PLUS production provides an opportunity to displace nearly 200,000 MT of carbon dioxide equivalent (CO₂e) greenhouse gas (GHG) emissions annually; a savings of 4 million tons of CO₂e GHG emissions over 20 years.

SUL4R-PLUS Reduces GHG emissions production in two primary ways

1. Production is less energy intensive than synthetic AS production by 1.2 MT CO₂e/t of fertilizer produced.
2. Use of SUL4R-PLUS has shown an increase in nitrogen use efficiency in crops, which reduces usage of nitrogen-based fertilizers and the associated impact stemming from them (leaching and volatilization of soil, lowered water quality, etc.)

The study in *Reference 1* below indicates that the typical synthetic ammonium sulfate fertilizer production process produces the equivalent of 1.36 MT CO₂e per ton of fertilizer produced. The current SUL4R-PLUS production process uses approximately 89 KWH/MT of electricity and 2.25 MMbtu/MT of natural gas, producing the equivalent of 0.16 MT CO₂e/MT of SUL4R-PLUS produced. Future SUL4R-PLUS production plant design enhancements are projected to lower that to < 0.10 MT CO₂e/MT produced. The study in *Reference 2* below indicates that the emissions associated with application, direct N₂O in soil, indirect N₂O from volatilization, and indirect N₂O from leaching are approximately 6.15 MT CO₂e/ton of nitrogen fertilizer (urea).

Emissions comparison between nitrogen fertilizer and SUL4R-LUS fertilizer

	Nitrogen Fertilizer as Ammonium Sulfate Tons CO ₂ e/ton fertilizer	SUL4R-PLUS Fertilizer Tons CO ₂ e/ton fertilizer	Displacement Ratio %	Total Reduction Tons CO ₂ e/ton fertilizer
Production (based on synthetic ammonium sulfate)	1.36	0.16 ¹	100	1.2
Use/Field	6.15	0	15	0.92
Total	7.51	0.16	-	2.12

¹ Forecast to be under .10 on future production



The use of SUL4R-PLUS fertilizer creates the opportunity to displace 1.2 MT of CO₂e per ton of fertilizer produced, and an additional 6.15 MT of CO₂e per ton of nitrogen fertilizer displaced by the increased nutrient uptake efficiency associated with use of SUL4R-PLUS. Assuming a displacement ratio of 15%, each metric ton of SUL4R-PLUS Fertilizer displaces 0.92 MT of CO₂e, for a total of 2.12 MT CO₂e per ton of SUL4R-PLUS fertilizer. Per 100,000 tons per year of SUL4R-PLUS fertilizer production, SUL4R-PLUS fertilizer displaces over 200,000 MT of CO₂e annually – the equivalent amount of carbon sequestered by nearly 3.33 million tree seedlings grown for 10 years.

References:

1. Oak Ridge National Laboratory, Martin Marietta: “Energy in Synthetic Fertilizers and Pesticides: Revisited” Authors: Mahadev G. Bhat, Burton C. English, Anthony F. Turhollow, Hezron O. Nyangito
2. Menegat, S., Ledo, A. & Tirado, R. “Greenhouse gas emissions from global production and use of nitrogen synthetic fertilizers in agriculture.” Sci Rep 12, 14490 (2022) <https://doi.org/10.1038/s41598-022-18773-w>



Thank you

