

## NC-213 PROGRESS REPORT FOR 2024

### Title

Assessment and Approaches for Achieving Net-Zero Carbon Emissions for Grain Drying, Handling and Storage Operations

### Investigators

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### Outputs/Research Updates

Grain drying, handling, and storage operations utilize significant amounts of energy which releases greenhouse gases into the environment. The development of energy efficient operations systems, as well as the identification and implementation of net-zero carbon emission technology, could make a positive impact on the environment. Quantifying current greenhouse gas emissions from post-harvest operations is important to assess possible mitigation solutions. The specific objectives of this projects are:

1. Quantify the scale and assess the challenge for achieving net-zero carbon emissions for on- and off-farm grain handling, drying and storage operations.
2. Identify approaches and evaluate their potential for achieving net-zero carbon emissions for on- and off-farm grain handling, drying and storage operations.

### Outcomes/Impacts/Deliverables and updates of studies continued in 2024

Data were collected from two grain elevators with storage capacities of 7 million and 2.85 million bushels, respectively. The electric energy usage and total motor sizes (2700 HP and 1250 HP) were analyzed assuming one handling cycle to calculate greenhouse gas emissions per bushel of corn. Life Cycle Assessment (LCA) results showed greenhouse gas emissions of 138 gCO<sub>2</sub>eq/bushel for the larger facility and 109 gCO<sub>2</sub>eq/bushel for the smaller facility. When comparing these emissions to potential renewable electric energy alternatives, solar energy reduced emissions to 19 gCO<sub>2</sub>eq/bushel for the larger facility and 15 gCO<sub>2</sub>eq/bushel for the smaller facility. Wind energy offered even greater reductions, reducing emissions to 5 gCO<sub>2</sub>eq/bushel and 4 gCO<sub>2</sub>eq/bushel, respectively. The analysis suggests that electricity generated from renewable solar or wind sources could reduce greenhouse gas emissions by 86-96% for grain handling facilities.

A case study in the ISU FMGSC Grain Center was started during the fall 2024 harvest to better understand electric energy and natural gas consumption in a more controlled setting. Total storage capacity is 220,000 bu and installed electric motor size capacity is about 525 HP. Energy use data was collected during a corn drying test in a high-temperature mixed-flow dryer and a medium-temperature batch stir-drying bin. Additional data on moisture reconditioning and aeration cooling is being gathered in four 44,000-bushel bins, with parameters such as moisture content, temperature, and quality factors recorded. The findings will be analyzed to determine the potential for greenhouse gas emissions reduction using

LCA and to develop strategies for achieving net-zero carbon emissions in grain handling, drying, and storage operations of the ISU FMGSC Grain Center.

## **Publications**

### ***Oral/Poster Presentations:***

- Advanced Grain Elevator Operations Management Short Course, Grain & Feed Association of Illinois (GFAI), Bloomington, Illinois, June 17-21, 2024. (Sabbir: 1 lecture; 2 hands-on sessions)
- Sabbir, A.S.M.Y.B., Maier, D.E., and Rosentrater, K. Estimating Environmental Impacts of a Grain Elevator by using Life Cycle Assessment. ASABE 2024 Annual International Meeting, Anaheim, CA, July 28-31, 2024. (presenter)
- Advanced Grain Elevator Operations Management Short Course, Agribusiness Association of Iowa (AAI), Ames, Iowa, August 5-9, 2024. (Sabbir: 1 lecture; 2 hands-on sessions)

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