

Center Pivot Carbon Footprint Life Cycle Assessment

The Valmont® Irrigation business segment helps feed the world. Our solutions help growers around the world produce greater yields with fewer input resources. We engineer durable irrigation machines and connected crop management technology to enable maximum productivity and optimized water and energy efficiency. Our complete suite of precision ag technology solutions lets growers save time and reduce labor costs using the trusted systems in their field as a data hub. We utilize artificial intelligence and machine learning to alert growers of field-related water issues, pests and disease, representing the next step toward fully autonomous crop management.



Real Results in Real Fields

Valmont Sustainability

Valmont Industries recognizes that greenhouse (GHG) emissions impacts our climate. We believe that climate change is a serious issue that will require shared effort between government, business and the global community to address. As Valmont evolves and expands, we stay mindful of where our materials come from and how to extend their usefulness. Our tagline – Conserving Resources. Improving Life. – has a long history that all of us take to heart. At Valmont, we have been solving for sustainability from the start.

What is Life Cycle Assessment

Life cycle assessment (LCA) is an analytical tool used to comprehensively quantify and interpret the environmental impacts of the entire life cycle of a product. A LCA takes a deeper look at each stage of product's life, from raw material extraction to end of life management. In 2020, we partnered with Sustainable Solutions Corporation to conduct a cradle-to-grave LCA to better understand the environmental impacts associated with the life cycle of our Center Pivot products.

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Project scope

- **System Boundary:** Cradle to Grave
- **Geographic Boundary:** Nebraska*
- **Functional Unit:** 1 Center Pivot
- **Three power configurations:**
Grid Electricity, Solar, Diesel
- **Service Life:** 25 years
- **LCA Software:** GaBi v6.0
- **Impact Assessment:** TRACI 2.1

8000 Series Benefits:

- Valley® spans are independently field-tested to outperform other brands under all field conditions.
- Standard, low, high and ultra-high profiles available.
- Truss rod and angle design create a smooth crown that maintains even loading in the span.
- Polyurethane flange gaskets deliver longer, leak-free life.
- Truss angle placement and lengths provide even loading on uneven terrain.
- Exclusive Valley warranty - See your dealer for details.

8000 SERIES SPECIFICATIONS

Pivot point options	6 5/8" 8 5/8" 10"
Maximum machine length	2,800'
Pipe diameter options	6 5/8" 8 5/8" 10"
Span length options	115' - 225'
Overhang options	9' - 100'
Towable pivot point options	2-Wheel E-Z Tow 4-Wheel E-Z Tow Skid Tow
Booster pump options	2 HP, 5 HP, 7.5 HP
Tire size options	11.2-24 11R-22.5 Recap 14.9-24 16.9-24 11.2-38 12.4R-38 18.4-26
Crop clearance profile options	Low Standard High Ultra-high



* The study evaluated the impacts of a center pivot used to grow corn in Nebraska, assuming a 120 day growing period per year. The datasets used to model the impacts are representative of United States in terms of geographic and technical coverage. Results may be subject to change based on specific geographic regions.

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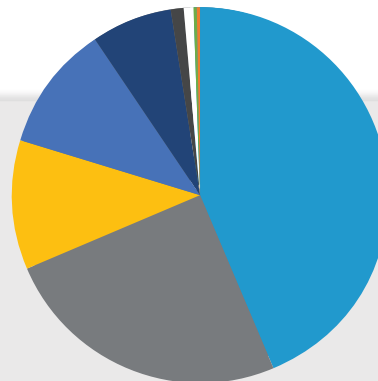
Why Choose a Valley Center Pivot

The Valley center pivot outperforms all other brands in independent tests. With years under our belt we have been trusted by more growers than any other brand. We custom engineered and designed to meet individual field needs. We have the longest machine life in the industry to keep you going longer than anyone else. With less leaching and fertilizer loss to help you maximize your profits without anything going to waste.

Electricity Grid Mix

The LCA results for our electric motor center pivot are representative of the average electricity grid mix in Nebraska (MROW). As such, the LCA results are subject to change based on the location the electric motor center pivots are used. To the right is a breakdown of the average mid-western US grid mix from 2019.

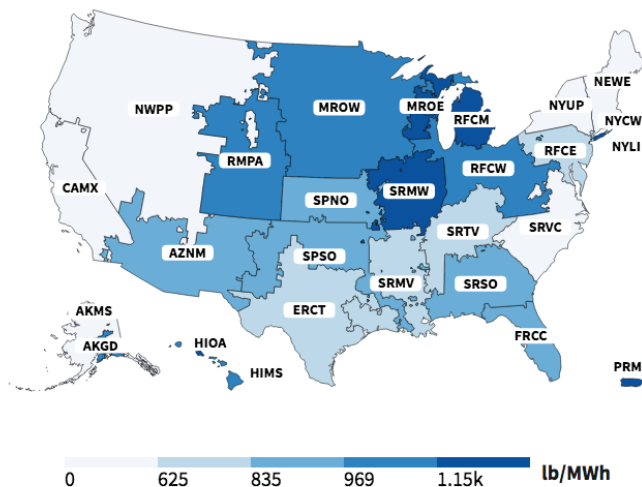
Average MROW Grid Mix



■ Coal 44% ■ Wind 25% ■ Gas 11% ■ Nuclear 11% ■ Hydro 7% ■ Biomass 1% ■ Solar 1% ■ Other 0.2% ■ Oil 0.1%

US EPA. (2019) eGRID Data Explorer.

CO₂ total output emission rate (lb/MWh) by eGRID subregion, 2019



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Life Cycle Assessment Results - Electric Grid Powered Motor

Global Warming (kg CO2 eq) – The methodology and science behind the Global Warming Potential calculation can be considered one of the most accepted Life Cycle Impact Analysis categories. Carbon dioxide and other greenhouse gases are emitted at every stage in the manufacturing process. These gases can trap heat close to the Earth, contributing to global warming.

Fossil Fuel Depletion (MJ surplus) – Maintaining fossil fuel resources for future generations is an essential part of sustainable development. This impact category measures the depletion of those resources in terms of megajoules (MJ). Fossil fuels are used as energy sources as well as raw materials for chemical productions.

Primary Energy Use (MJ) – The sum of all energy sources drawn directly from the earth, such as natural gas, oil, coal, biomass, or hydro power energy.

These impact categories were chosen based off of their relevance and general indication of the environmental impact of a product.

Global Warming:

98% of Global Warming Impact is from B1. Use - Grid Electric Motor

Cradle to Grave TRACI 2.1 - Electric Grid Powered Motor

Impact Category	Unit	A1. Raw Materials	A2. Raw Material Transport	A3. Manufacturing	A4. Distribution	B1. Use-Grid Electric Motor	C2. EOL Transport	C4. Disposal	Total
Global Warming	kg CO2 eq	35,000	2,070	3,070	1,410	2,090,000	192	136	2,130,000
Resources, Fossil Fuels	MJ surplus energy	34,100	3,650	13,000	2,490	955,000	268	268	1,010,000
Primary Energy Demand	MJ	551,000	28,200	125,000	19,300	36,800,000	2,620	2,290	37,500,000

Resources, Fossil Fuels:

95% of Resources, Fossil Fuels Impact is from B1. Use - Grid Electric Motor

Cradle to Grave CML Baseline v.3.06 - Electric Grid Powered Motor

Impact Category	Unit	A1. Raw Materials	A2. Raw Material Transport	A3. Manufacturing	A4. Distribution	B1. Use-Grid Electric Motor	C2. EOL Transport	C4. Disposal	Total
Global Warming	kg CO2 eq	35,000	2,070	3,140	1,410	2,000,000	193	137	2,040,000
Resources, Fossil Fuels	MJ surplus energy	468,000	26,100	102,000	17,800	5,080,000	2,420	2,080	5,700,000
Primary Energy Demand	MJ	517,000	26,300	115,000	18,000	12,200,000	2,450	2,470	12,800,000

Primary Energy Demand:

98% of Primary Energy Demand Impact is from B1. Use - Grid Electric Motor

The figure and tables above represent the cradle to grave life cycle impacts of our center pivots with electricity grid powered motors. Results from both the Tools for Reduction and Assessment of Chemicals and Other Environmental Impacts (TRACI) and Center for Environmental Studies (CML) impact assessment methodologies were included above. TRACI was developed by the US EPA and CML was developed by the Leiden University in the Netherlands. The impact assessment methodologies fulfill the same purpose of assisting with impact analysis in Life Cycle Assessments, but TRACI is commonly used in the US while CML is commonly used in Europe.

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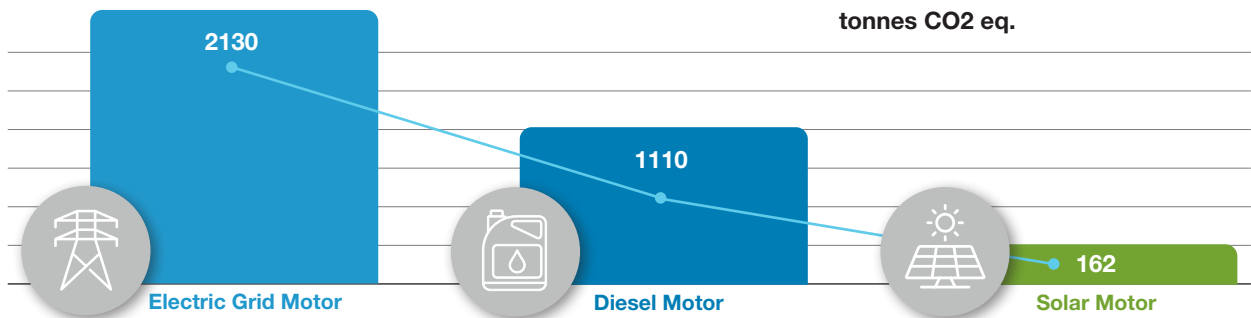
Key Findings

Our electric motor center pivots' cradle to grave global warming potential is 2,130 tonnes CO2 eq. over its 25 year lifetime. This represents the emissions of 15.5 homes' electricity use over 25 years. Diesel motor center pivots and solar powered pivots have global warming potentials of 1,110 and 162 tonnes CO2 eq. over their respective 25 year lifetimes. They represent the emissions of 8.05 and 1.18 homes' electricity use over 25 years.

Through the life cycle assessment, we identified that the use phase is the most impactful stage of our product's life cycle. These results assume that the growing season for corn is 120 days per year. These phase impacts can be reduced by **93%** when using solar powered motors as opposed to electric motors whose power is supplied by the grid.



Cradle to Grave TRACI 2.1 - Global Warming Potential (tonnes CO2 eq.)



Cradle to Grave TRACI 2.1 - Diesel Motor

Impact Category	Unit	A1. Raw Materials	A2. Raw Material Transport	A3. Manufacturing	A4. Distribution	B1. Use-Grid Electric Motor	C2. EOL Transport	C4. Disposal	Total
Global Warming	kg CO2 eq	35,000	2,070	3,070	1,410	1,060,000	192	136	1,100,000
Resources, Fossil Fuels	MJ surplus energy	34,100	3,650	13,000	2,490	2,030,000	341	268	2,090,000
Primary Energy Demand	MJ	551,000	28,200	125,000	19,300	15,700,000	2,620	2,470	16,400,000

Cradle to Grave TRACI 2.1 - Solar Motor

Impact Category	Unit	A1. Raw Materials	A2. Raw Material Transport	A3. Manufacturing	A4. Distribution	B1. Use-Grid Electric Motor	C2. EOL Transport	C4. Disposal	Total
Global Warming	kg CO2 eq	35,000	2,070	3,070	1,410	120,000	192	136	162,000
Resources, Fossil Fuels	MJ surplus energy	34,100	3,650	13,000	2,400	100,000	341	268	154,000
Primary Energy Demand	MJ	551,000	28,200	125,000	19,300	74,200,000	2620	2,470	74,900,000

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Center Pivots and Soil Management

Soil moisture can impact near-surface soil temperatures and the amount of carbon dioxide sequestered by land ecosystems.*

Research shows that sprinkler irrigation can increase the sequestration of carbon in arid and semi-arid regions when compared to non-irrigated or flood irrigated agricultural land. One study found that the highest increase in soil organic carbon (SOC), around 14.8%, was observed in irrigated semiarid sites from 0-10 centimeters of soil depth.*

However, more research needs to be conducted in this field. As there is no current standardized approach for soil sequestration accounting in life cycle assessment, the potential benefits of the center pivots on soil carbon sequestration was excluded from the study.

*Emde, David, et al. (2021). Soil Organic Carbon in Irrigated Agricultural Systems: A Meta-Analysis Caltech. (2021). Soil Moisture Drives Year-to-Year Change in Land Carbon Uptake

For 75 years, we have always been connected to the earth.
We began in irrigation, helping farmers grow more from their soil efficiently
while conserving the vital resource of fresh water.

Recyclability:

Our center pivots consist of 80% steel by weight. Steel is a highly recyclable material and can maintain its inherent properties proceeding the recycling process. The recycling rate for steel machinery is approximately 90% (World Steel Association). Therefore, approximately 72% of our product can be recycled at the end of its life.

