# Cattlevoltaics: The Emerging Practice of Cattle Grazing on Solar Farms

## Introduction: A New Frontier for Ranchers and Solar Developers

Across rural America, cattle ranchers face mounting economic pressures. Beef prices fluctuate unpredictably, land costs continue to rise and input expenses from feed to fuel strain already thin profit margins. At the same time, solar energy is expanding rapidly across agricultural landscapes, raising concerns about land use conflicts between food and energy production.

But what if cattle ranching and solar energy could work together instead of competing? A small but growing number of operations across the U.S. are proving this is possible through cattlevoltaics, or the practice of grazing cattle on solar farms. While agrivoltaics broadly refers to any agricultural activity co-located with solar energy production, cattlevoltaics specifically involves beef or dairy cattle grazing beneath or around solar panels.

This brief examines the current state of cattlevoltaics in the U.S., what research tells us about benefits and challenges, and what this emerging practice means for ranchers, solar developers and rural communities.

## Understanding Agrivoltaics: The Bigger Picture

Agrivoltaics, defined by the U.S. Department of Energy as "agricultural production, such as crop or livestock production or pollinator habitats, underneath solar panels or adjacent to solar panels," has grown dramatically in recent years. As of October 2024, the American Solar Grazing Association's census documented approximately 113,050 sheep grazing across 129,000 acres at over 500 solar sites nationwide, representing roughly 18 to 26 gigawatts of solar capacity.

The National Renewable Energy Laboratory's agrivoltaics database identified 617 agrivoltaic projects across the U.S., with livestock grazing accounting for 248 of these sites. However, the livestock breakdown reveals a striking disparity: **237 sites graze sheep, while only eight documented sites graze cattle.**

Why the overwhelming dominance of sheep? Size and maneuverability. Sheep, typically weighing 100 to 200 pounds, easily navigate beneath standard solar panels mounted two to four feet above ground.

## Why Cattlevoltaics Matters for the Beef Industry

The U.S. beef industry generated approximately $112 billion in cattle and calf cash receipts in 2024, but cattle ranchers face significant economic challenges:

**Volatile market prices:** Cattle prices can fluctuate dramatically based on feed costs, drought conditions, disease outbreaks, and market demand. Profit margins for cattle operations are often razor-thin, with many ranchers operating at break-even or losses during market downturns.

**Rising input costs:** Land, feed, fuel, veterinary care and labor costs continue to climb. Operating expenses for cattle ranching operations have increased significantly over the past decade while prices received by producers have not kept pace.

**Land access challenges:** For ranchers who don't own enough grazing land, leasing additional pasture adds substantial fixed costs. Competition for agricultural land from urban development and other uses drives lease prices higher.



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**Climate and heat stress:** Heat stress costs the U.S. livestock industry an estimated $1.69 to $2.36 billion annually, with dairy operations alone losing more than $900 million per year to reduced productivity during extreme heat events.

**The cattlevoltaics value proposition:** For landowners, leasing pastureland to a solar developer offers stable, predictable payments while continuing to graze cattle on the land. In some cases, ranchers can receive additional contracted fees from the developer for vegetation management services. This could mean three revenue streams from leasing, vegetation management, and cattle that may make the difference between remaining profitable or not.

For solar developers, cattle grazing represents a cost-effective vegetation management solution that eliminates or substantially reduces mechanical mowing and herbicide expenses while potentially improving community acceptance. Research shows that 81.8% of survey respondents were more likely to support solar development in their community if it integrated agricultural production.

## Current Cattlevoltaics Operations in the United States

Based on NREL's InSPIRE agrivoltaics database and additional research, the following operations represent the documented cattle-solar landscape in the U.S. so far:

**Burgundy Brook Farm & Douglas Oak Street (Massachusetts):** Two 2023 to 2024 installations totaling 5.9 MWdc across 32 acres using bifacial PV with single-axis tracking. Both integrate cattle grazing, hay production and pollinator habitat.

**Grafton Solar (Massachusetts):** A 3.7 MWdc across 12 acres (2016) is one of the earliest documented cattle-solar operations. This site includes cattle grazing and vegetable crops such as squash and lettuce, showing the potential for diversified production.

**University of Minnesota (UNM) Morris:** The nation's most comprehensive cattle-solar research program. Starting in 2018, UMN installed 530 kW across its 275-cow dairy operation with panels elevated eight feet.

**Rutgers University (New Jersey):** Part of a $7.4 million, three-site research program featuring 378 vertical bifacial solar panels (Sunzaun system). It was the first such installation in New Jersey. Research began with forage crops in April 2024 continued with beef cattle grazing in September 2024, studying grazing strategies, hay harvesting, and animal behavior. Its partners include Delaware State University, American Farmland Trust and NREL.

**Silicon Ranch CattleTracker:** A DOE-funded 39-month research program developing patented GPS tracking technology where panels automatically tilt horizontal when cattle approach. The test site at SR Christiana Solar Farm (four+ MW/20 acres) has three partners including Colorado State University, Quanterra Systems and White Oak Pastures. Chief Technology Officer, Nick de Vries, told Inside Climate News "the challenges with introducing cattle to solar farms can be solved" through heavier gauge structures and smart systems.

**Additional research sites:** Northern Great Plains Research Laboratory (North Dakota), J Bar L Ranch (Montana) and Tiffany Cattle Feedlot (Kansas) represent smaller-scale research installations testing cattle-solar compatibility across different climates and operation types.

## Research Findings: Benefits and Impacts on Cattle

Peer-reviewed research and ongoing field studies identify several key advantages for cattle grazing on solar farms.



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The most significant benefit is heat abatement during summer months. University of Minnesota research by Sharpe, Heins, et al. (2021) studied 24 crossbred dairy cows during summer grazing:

- Cows in the shade of solar panels maintained body temperatures 0.5°F lower than cows that were not in the shade
- Afternoon respiration rates were 66.4 breaths/minute (shade) vs 78.3 breaths/minute without shade

Supporting Brazilian research documented skin temperature reductions of 10.8°F for Holstein heifers under solar panels and increased lying and ruminating behavior during high solar irradiance.

Given that heat stress costs the U.S. livestock industry billions annually, these thermal benefits represent real economic value through maintained productivity during extreme heat events.

### Infrastructure Requirements and Challenges

Cornell University dairy forage systems specialist Joe Lawrence noted, "Depending on if it's a dairy or beef cow, it could weigh 1,500 or 2,000 pounds. The main challenge is protecting the [solar] equipment from the animals." Research and operational sites have identified these specific requirements:

- Panel height with 7-12 feet clearance (vs 2-4 feet for sheep)
- Heavier gauge materials to withstand rubbing from 1,400 to 2,000 lb. animals
- Livestock-appropriate perimeter and interior fencing systems
- Adequate water access for cattle (10 to 20 gallons per day per animal)

The University of Minnesota's five years of research has found that with proper design considerations, panel damage has "not been a problem" in their cattle operations.

### Research Findings: Benefits and Impacts on Grazing Land

Beyond cattle welfare, research documents significant positive impacts on soil health and pasture quality. A comprehensive study by the American Solar Grazing Association (2022-2023) examined 28 northeastern solar grazing sites and found the following:

- Higher soil organic matter in grazed sites compared to non-grazed sites
- More neutral pH levels that support optimal plant growth
- Improved soil structure through natural fertilization from manure
- Enhanced carbon sequestration potential

Like sheep, as cattle graze, they naturally fertilize the soil, trample organic matter back into the earth, and through hoof action, provide beneficial soil aeration. This creates a regenerative cycle that can improve degraded soils over time.

### Operational Benefits for Solar Sites

Solar site vegetation management typically relies on mechanical mowing or herbicide application. Cattle grazing offers multiple benefits:

- Eliminates or reduces mechanical mowing costs and herbicide use
- Provides regular on-site monitoring (farmers checking cattle)
- Reduces fire risk from unmanaged vegetation
- Some insurers offer premium reductions for managed grazing sites

While research demonstrates biological and agronomic benefits, the infrastructure requirements for cattlevoltaics present real economic challenges.

### Higher Upfront Costs

Standard solar installations feature two-to-four-foot panel clearance and standard gauge materials. Cattle-compatible installations generally require:

- Increased panel mounting height of seven to 12 feet clearance, requiring more materials and engineering
- Heavier gauge structural components to withstand animal pressure
- Livestock-appropriate fencing systems
- Water infrastructure such as storage, distribution and reliable access points

According to industry sources, these modifications can add significant costs to solar installations, though specific percentages vary by site conditions and design choices. Despite added costs, solar developers are actively pursuing cattle integration.

### Conclusion: Early Days with Significant Potential

Cattlevoltaics remains in its infancy in the U.S. With only eight documented cattle operations in the NREL database compared to 237 sheep operations and most cattle projects being recent research installations, we are witnessing the beginning of what could become a significant agricultural practice.

The research to date demonstrates clear benefits, but real challenges exist. Even so, both the solar industry and agricultural research institutions are taking cattlevoltaics seriously. For cattle ranchers facing economic uncertainty, cattlevoltaics offers a potential path to financial stability through income diversification. For solar developers seeking community acceptance and reduced operating costs, cattle grazing provides a proven vegetation management approach with significant co-benefits. For rural communities concerned about agricultural land preservation, this practice demonstrates that food and energy production do not need to compete.

The next several years of research, technological development and on-the-ground operational experience will determine whether cattlevoltaics moves from niche practice to mainstream agricultural activity. The foundation is promising, and the potential is substantial. Given the large U.S. cattle industry and the rapid expansion of solar energy development in rural areas, cattle integration represents the next logical growth phase for agrivoltaics.

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