Green Lands Blue Waters

GAINING GROUND

Solar Grazing Fact Sheet

Sheep grazing under solar panels. Credit: University of Minnesota

What is Agrivoltaics or Solar Grazing?

Agrivoltaics combines solar energy and agriculture production on one site.

Solar grazing, a type of agrivoltaics, is the grazing of livestock at a solar energy production site; both underneath and around the solar panels.

- Solar grazing requires a contract for vegetation management between the livestock producer (solar grazier) and the solar site owner or the Operations and Maintenance (O&M) company for the solar site.
- The solar grazier is providing a vegetation management service and the solar site owner or manager is paying the grazier to perform that service.
- Solar grazing is targeted or prescribed grazing; meaning the grazing livestock are controlled in a way to accomplish vegetation management primarily.
- Sheep are the most common livestock for solar grazing, as they have a broad palate and are relatively unlikely to damage panels or equipment. Some sites are set up to allow cattle grazing. Poultry can be kept under certain conditions as well.

Parties Involved

A challenging part of solar grazing is the sheer number of entities involved, and the flow of influence and dollars between them. In most cases, the solar grazier is contracting with the O&M entity.

Landowner: owns the land where the solar site will be located. Leases the land to the solar site developer or utility company for 20+ years.

Solar site developer: designs the solar site, helps to negotiate land leases, secures permits, interconnection agreements with utility companies, and financing.

> In some cases, sites may be established by one developer and then sold to other entities. The decision of whether to employ solar grazing may shift as this happens.

Utility company: purchases and distributes energy from the solar site. Utility companies may also purchase the solar project from the developer or build, own, and operate the solar site.

Operations and Maintenance: keeps the solar site running by conducting inspections, cleaning and repair. Monitors system performance and safety standards.
Asset manager: solar plant manager who works for the project owner or an asset management firm representing investors. Oversees business, financial and administrative elements of solar project and coordinates with the O&M company.
Solar grazier: maintains vegetation to specified conditions for the solar site and contracts with the O&M company usually.

Determining if Solar Grazing is a Good Fit

Solar grazing arrangements offer land access without the direct cash cost of purchase or lease payments - in fact, money flows to the grazier, instead of to the landowner! Most sites are also surrounded by robust permanent fence, ensuring a secure operation. This makes solar sites attractive opportunities for expansion of a flock or herd or a reduction in feed costs.
However, there are other non-cash 'costs' that must be accounted for. A major one is adherence to strict standards of vegetation management, including maximum allowable plant heights. The grazier may have to adjust stocking rates throughout the season to balance available forage, or may have to provide mechanical control if grazing alone does not suffice. Liability insurance will be required and at a level far above most farm policies.

Aerial photo of cows near solar panels. Credit: University of Minnesota

Cattle grazing under solar panels. Credit: University of Minnesota

The most recent solar census from the American Solar Grazing Association (ASGA) reports average season-long contract rates of $300-500/ac for Midwest locations.

Consensus from conversations with experienced solar graziers suggests that solar grazing is suited to expand a successful livestock operation by adding grazing land at no direct cash cost. However, the contract payments are often not so great that the service is a major income source. The most recent solar census from the American Solar Grazing Association (ASGA) reports average season-long contract rates of $300-500/ac for Midwest locations. While being paid to graze, instead of paying to lease a pasture, is tempting - graziers must balance that against the cost of daily trips to the site, mowing or string trimming excess vegetation, hauling animals to/from the site, insurance, and hauling water.

Practitioners generally agree that livestock production is the primary income generating enterprise, not grazing services. Since solar grazing necessitates owning (or having access to) lots of animals and equipment, and necessitates the capacity to execute a grazing plan, it may not be suitable as a 'startup' option for an aspiring farmer. However, for those with some experience and existing herds, it may allow expansion of an enterprise without the tremendous cost of purchasing (or leasing) grazing land.

Determining if Solar Grazing is a Good Fit

Solar graziers must have or find access to the following physical or tangible infrastructure, as well as business and managerial capabilities:

- Land and livestock
  - Sufficient animals to appropriately stock sites and the ability to stock/destock as needed – for instance, having more animals on-site during spring and fall flushes, but fewer during the heat of summer. In addition, graziers must match the classes of livestock to the vegetation species and forage quality, or may need to provide supplemental feed.
  - Alternative housing and feed is required when a site runs out of vegetation due to drought; a site does not allow livestock to overwinter; or lambing is not allowed on-site.

- Time, labor, and knowledge
  - Knowledge and capability to develop and adapt grazing plans.
  - Time to execute the plan, including fence construction, water hauling, and animal management – but also the time involved in travel to and from the site (or to multiple sites across a region) on a near-daily basis.
  - Time, labor, or connections with subcontractors to provide mechanical vegetation control if and when needed.

- Equipment and supplies
  - Portable fencing and handling systems.
  - Ability to haul water, as it may not always be available on-site.
  - Sufficient trailer capacity to transport animals, or relationships with haulers to move animals to/from sites.
  - Ownership or access to mowers, string trimmers, and other equipment as needed to maintain vegetation height below contract limits; or the ability to subcontract this work.

- Business, legal, and safety requirements
  - Compliance with solar site safety requirements: expect to purchase and wear PPE (personal protective equipment, such as a hard hat, safety goggles, and reflective vests) while on-site.
  - Insurance requirements vary across sites and states, but discussions among graziers suggest that umbrella liability coverage from $2-10 million is common.

There are entities that help connect aspiring graziers to solar companies seeking service. They may provide contract negotiation, insurance coverage, general guidance, and many other services.

- Communication skills – solar grazing requires producers to:
  - Work with people outside agriculture entirely and others accessing the site.
  - Share with the site owners, solar developers, O&M companies and the public about livestock production under solar panels.

Grazing Plan Considerations

Developing a grazing plan for solar sites involves adherence to the terms and limitations of the vegetation management contract and considering the size, configuration and vegetation (quantity and quality) at a site.

Site characteristics

- Solar sites may be just a few acres or a few thousand. In the Upper Midwest and particularly Minnesota, most sites are under 10 megawatts (MW). Generally, each MW requires 5-8 acres of panels. Leading edges of panels average 4 ft in height.

One megawatt can power 400-1000 homes/year

- Vegetation quantity and quality may be highly variable, especially shortly after establishment. Developers who intend to graze livestock will hopefully select species that provide ample forage of acceptable quality, but graziers should be prepared to supplement feed or reduce stocking rate, or to bring in animals with lower nutrient demands (such as wethers, dry ewes, steers or dry cows) to best match the available vegetation.
- Water may not be available on site. Graziers should be prepared to transport water from another source.

Cows grazing under solar panels. Credit: University of Minnesota

Research at the University of Minnesota and Colorado State University has demonstrated the ability to graze cattle under and between solar panels without damaging the panels. However, cattle grazing is not yet common practice in the solar grazing industry.

Safety considerations for livestock

- Any dangling or hanging wires or cables represent a strangulation risk, and animals could get caught in brackets, racking, or other components.
- There is a potential risk of stray voltage, though to date no issues have been reported.
- Exposed wires may be chewed on by livestock, a risk to them and a potential cost for the grazier if damage occurs. Particularly any exposed copper elements pose a risk of copper toxicity to sheep.
- Livestock handling and safety
    - Guardian animals may or may not be allowed.
    - Animals on a site for months may need to be rounded up for deworming, shearing, or other regular maintenance; as well as rounded up for loading.
    - Solar sites will have variable trailer access and turnaround space.

The American Solar Grazing Association (ASGA) offers training for solar graziers to meet specific certification standards.

Contract Components and Requirements

Contracts most likely will come from the O&M entity, but ASGA has developed a template contract with sections that graziers might want to have added. Any contract should include the following:

- **Statement of Work**: describes the location, acreage, and description of the site; as well as the allowable method(s) of vegetation control, vegetation management standard, and any milestones or timelines that the grazier agrees to.
- **Payment for services**: including timing/frequency, method, and amount of payment.
- **Length of contract**: start and end dates of the contract, including renewal terms and conditions (is it automatic unless a party cancels? Or does it automatically expire unless a party takes action to continue?)
- **Early termination of contract**: describes conditions when the contract can be terminated early, both with and without cause, by the site owner/O&M or the grazier; also how early termination affects payments.
- **Other items** that should be considered and included in a contract:
  - Limitations on allowable chemicals, either herbicides to control unwanted vegetation, or chemical dewormers for livestock.
  - Site access, including whether parties must inform the other when visitors are coming, limits to who may access the site, and so on.
  - Whether or not subcontractors are allowed (most often for mechanical vegetation control).
  - Responsibility for maintaining perimeter fence, signage, and access security.
  - Expectations of animal care, particularly when ill or injured animals must be removed vs when they can remain on-site; may include stipulations about the frequency of visits from grazier.

Solar Grazing Resources

- American Farmland Trust solar resources
- American Solar Grazing Association (ASGA)
  - Solar Grazing Census
  - Site design standards
  - Solar grazing contract template
- Colorado State University Agrivoltaics Research
- RE+
- Rutgers Agrivoltaics Program
- Solar Farm Summit
- United Agrivoltaics & other 'middlemen' / contract negotiators
- University of Minnesota Agrivoltaics Research
- University of Wisconsin Extension forage recommendations for solar grazing

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Attributions and Acknowledgements

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Green Lands Blue Waters supports the transition to multi-functional agricultural systems in the Upper Mississippi River Basin based on farming with Continuous Living Cover (CLC) - keeping plant cover on the soil and living roots in the ground year-round. The value of perennial crops and other CLC systems can be measured in yields, farm profits, and rural economic opportunities; but also as reduced risk, improved outlook for long-term productivity from the soil, more wildlife, cleaner water, and resiliency in the face of a changing climate.