Solar Array Types and Considerations for New Jersey Farmers

This information sheet covers several solar array design types, some of which are more mainstream and already used for utility scale installation, while others are still in the experimental stage or chosen for more specific, limited scale use. **Farmers and solar project installers should be in close communication on all key design aspects to ensure that farming operations can continue effectively for dual-use farming+solar ("agrivoltaics") purposes**. The descriptions included below should be one of the starting points for in-depth design discussions when planning dual-use projects.

Fixed-tilt installations:

The most common type of installation of solar panels is a ground-level "Fixed-tilt" array (Figure 1). Typically, the rows run **East to West** and are tilted permanently toward the South to improve annual electricity production. Fixed panels are often just a few feet off the soil surface and do not allow for agricultural production underneath, although in some instances they may be high enough to allow for small animals to graze beneath. These systems are the simplest to install and have no moving parts. Fixed-tilt systems typically allow little room for agricultural operations between the rows.

Figure 1: Fixed-tilt array, looking West, at the Rutgers University Livingston Campus, Piscataway, NJ.
Image © Rutgers Agrivoltaics Program.

Single-axis tracking installations:

Another common type of installation is a "Single-axis tracking" array (Figure 2). Typically, the post rows run **North to South** and are motorized to allow the rows of panels to aim more directly at the sun's motion through the day and achieve greater electricity production. Single-axis tracking arrays usually produce more electricity annually compared to fixed-tilt systems and have more uniform ground-level light illumination, depending on their specific post height, panel dimensions, row spacing and other geometric factors.

Figure 2: Single-axis tracking array, looking North, at the Rutgers Agricultural Research and Extension Center, Bridgeton, NJ.
Image © Rutgers Agrivoltaics Program.

Vertical bifacial installations:

A less common type of installation is the "Vertical bifacial" configuration (Figure 3). Typically, the rows run **North to South** and are fixed in place with the morning sunlight shining more on the East side and the afternoon sunlight shining on the West side. This design uses modules that are "bifacial" – meaning that the individual silicon wafers are visible from both front and the back sides and light can enter the wafers from either side. The front side of each panel can generate more electricity, with the back side typically generating between 70% to 95% when compared to the front under the same light conditions.

Figure 3: Vertical bifacial array, looking North, at the Rutgers University Animal Farm on Cook Campus, New Brunswick, NJ. Image © Rutgers Agrivoltaics Program.

Dual-axis tracking installations:

Another less common type of installation is a "Dual-axis tracking" array (Figure 4). These trackers have two different motor-driven angular adjustments that allow the modules to point exactly toward the sun's position throughout the day and throughout the seasons to achieve maximum electricity production. A disadvantage is that this system is more complex and may require more maintenance.

Figure 4: Dual-axis tracking array. Image credit: https://www.solarcentex.com/dual-axis-trackers/; no endorsement implied.

Raised array installations:

A third less common type of installation is any array type that is intentionally raised higher above the crop (Figure 5). These installations can have fixed tilt or tracker functionality but are raised high enough so that clearance below the panels is not an issue for farming production practices or equipment. This type of array is often chosen for perennial crop production (i.e., grapes, small fruit trees). A disadvantage is that these installations can be expensive and more challenging to service. The additional height of the structure will also incur a higher wind load and may therefore require stronger supports.

Figure 5: Raised single-axis tracking array. Image credit: https://sunagri.fr/en/solar-panels-help-french-winemaker-hold-off-climate-change/; no endorsement implied.

Discussion:

As noted in this information sheet, farmers and solar developers should closely work together and collaboratively on agrivoltaic designs to ensure that the arrays are built in such a way that they cause minimal impact on farming practices. This communication should start as early as possible during the design process to guarantee that farmland will remain in productive operation after a new agrivoltaics array is installed. General design considerations that might apply to any of the described array types are listed below.

General design considerations:

- How much power is the array intended to produce?
- Will the array be connected to the local utility grid? Will the generated electricity be mainly used on-site, or will it mostly be exported to the grid?
- For fixed-tilt arrays: Can the array be installed with a tilt oriented due South? If not, what deviation from due South is needed?
- For tracking and vertical arrays: What is the most convenient row orientation and does this orientation deviate from the typical North-South orientation?
- What is the desired row spacing and does that spacing allow for sufficient horizontal clearance for farming equipment to pass between the rows?
- It is critically important to match the array installation with the size of the current farming equipment (e.g., tractor dimensions, dimensions of tractor implements, width of harvesting equipment, etc.)
- What is the clearance height for the lower and higher edges of the array?
- For elevated agrivoltaic systems: Does the array allow for sufficient vertical clearance height for all farming equipment?
- Can the land under/near the array be easily accessed with farming equipment?
- What is the arrangement and placement of posts supporting the array and how would that arrangement impact agricultural operations?
- How much shading is caused by the array and how does this shading vary below and between the panel rows? How will this shading impact agricultural production?
- For tracking arrays, what is the range of tracking motion and can this range be adjusted occasionally by the farmer to allow better access for farming equipment?
- Is the property designated for a dual-use system large enough to allow adequate space for farming equipment to turn around at the end of the rows (headland)?
- Does the property designated for a dual-use system require deer fencing?
- Do the rows of vertical panels need to serve as fencing? Will the vertical panels require additional (electric) fencing to prevent farm animal contact/damage?
- Are the anchoring arrangements for the posts consistent with farming operations (e.g., posts pounded into the ground as opposed to post installed with a concrete footer)? Would farming operations need to be adjusted in order to work around the posts?
- Does the design allow for the land to return to normal agricultural operation after the end of the useful life of the agrivoltaic system?