Cost of Reclaiming Land Currently Used for Solar Panels Back to Farmland

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Introduction

Across North Carolina, many farmers have leased their farmland to *solar* developers *so that the land can be covered with solar panels* (Fig. 1). *Farmland is highly valued by the solar developer because it is usually flat which makes panel installation easier and less expensive*. Eventually the solar panels at these sites will deteriorate and fail requiring either the replacement or retirement of the *solar power* facility. Most solar panels manufactured have a projected lifespan of between 20 and 25 years. Several sites in North Carolina have already been operational for 8 to 10 years and are already approaching half their expected lifespan. In the coming years, as solar sites across North Carolina are retired or decommissioned, the cost of returning the land to crop production will have to be considered. This paper seeks to review some of these costs with the goal of preparing landowners for this eventuality.

Figure 1. Solar panels on a site that was originally farmland in eastern North Carolina.

The Costs of Reclaiming Solar Facilities

There are **three main areas** that must be addressed in returning solar facilities back to productive agricultural activities. First, there is the cost of the removal of equipment including the solar panels, the support structure, wiring, concreate stands, inverters, poles, fencing, and buffer vegetation. The second step is mitigation of any heavy meal or herbicide residues. Finally, there are the costs of restoring the soil properties that are essential to supporting crop productivity. Each of these areas involves the expenditure of time and money in order to restore the site to farmland.

Cost of Removing Solar Equipment From a Site

Estimates *for* removing the solar panels and related equipment from a site vary widely. While the cost of removing and recycling solar photovoltaic modules (PV modules) has been studied and the overall costs of decommissioning a solar facility have been estimated based on construction costs, these figures are a closely guarded secret within the solar industry. The reason for this is that most studies have shown that in 15 to 20 years as a number of solar facilities are retired the cost of recycling PV modules and decommissioning a site will be substantial (McDonald and Pearce, 2010). Since investors are less likely to invest in a technology that has the risk of substantial future costs the decommissioning costs are often hidden or ignored. *A good estimate of these decommissioning costs can be found in a report funded by the National Science Foundation entitled DECOMMISSINING "US" POWER PLANTS – Decisions, Costs, and Key Issues by Daniel Raimi of Resources for the Future.*

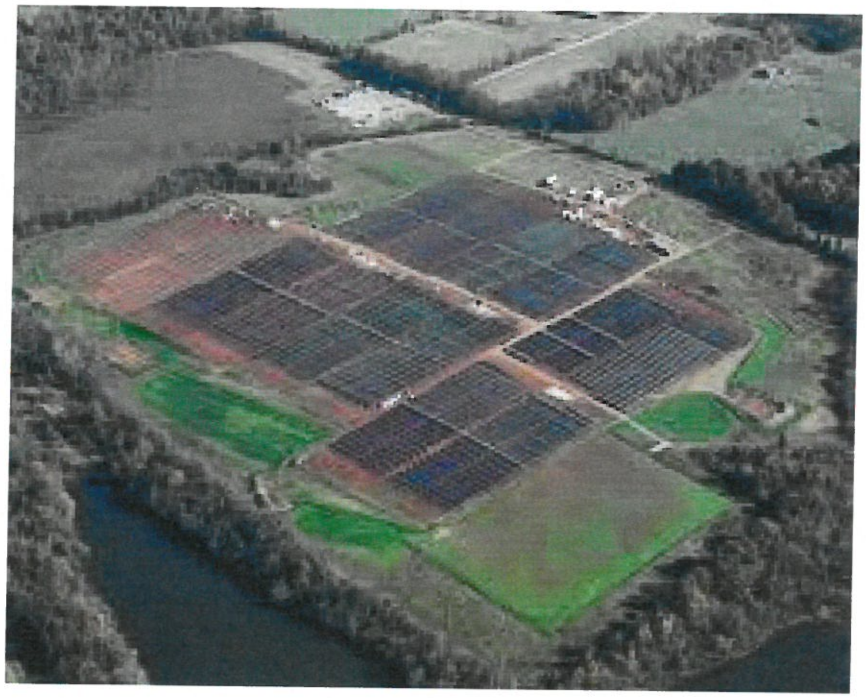

Figure 2. Thirty-acre solar facility in western North Carolina.

Cost of Mitigation of Heavy Metals or Herbicide Residues

The costs of mitigation of potential residues either from heavy metals such a zinc from the support structures, cadmium from decaying panels, or from the use of herbicides to sterilize the soil is largely unknown. This is due to the fact that it is not clear if any of these residues will be present at the time of decommissioning. Most engineers and construction specialists acknowledge that there is a potential for zinc contamination from the galvanized metal support structures that are placed through the landscape. However, the potential for zinc residues from these types of structures when used across a large landscape has not been studied. Residues from galvanized roofing in the immediate vicinity of the building structure have been shown to reach over 600 ppm in as little as 10 years and costs of mitigation of toxic levels of zinc in the soil can exceed $1,500 an acre.

Similar observations can be made about cadmium. Environmental Protection Agency tests have shown that the Cadmium in Cadmium-Telluride panels is stable under severe conditions but whether these tests are suitable simulations of field conditions is still to be determined. Cadmium is highly toxic to plants and would require removing large amounts of soil to waste sites. This would be extremely expensive. Most likely any Cadmium contamination would render a site unusable for agricultural production.

Mitigation of strong herbicides used under the panels to sterilize the soil and prevent weed growth would be less costly to achieve. This could be done by deep tillage to mix the sterilized soil with soil deeper in the soil profile that had not been touched by the herbicide. The cost of deep tillage would average between $30 and $50 an acre.

Cost of Restoring Soil Properties for Profitable Crop Production

The costs associated with restoring soil properties suitable for profitable crop production are the easiest to estimate with some certainty. The **first issue** to be addressed would be the issue of soil compaction. If properly managed, the vegetation under the solar PV modules should help reduce the amount of soil compaction from frequent mowing between the panels. However, the use of heavy equipment to remove the panels and the support structures will result in a great deal of soil compaction despite the benefits of the ground cover. To reduce compaction, a grower would have to use a ripper or other deep tillage tool at a cost of $30 to $50 an acre. This would also have the benefit of mitigation of any herbicide residues (see above). However, despite the use of deep tillage, research has shown that it will take from 3 to 5 years of cropping to reach the full yield potential of a site once the soil has been compacted (Soane and Ouwerkerk, 1994). Yield losses of 20 to 40% were commonly found in situations where soil compaction has occurred due to trafficking with heavy equipment. These yield losses will need to be considered as part of the cost of restoring the site.

The **second issue** that must be addressed is soil pH and nutrient levels. Under natural conditions of weather and rainfall, soil pH on North Carolina soils declines over time. This is due to frequent rainfall events that leach calcium and magnesium from the soil profile. In the 20 to 25 years of *solar* operation, the soil under a solar facility will see declines in pH from 6.0 (the level associated with productive agricultural soils) to as low as 4.5 depending on rainfall and any nitrogen fertilizer that is applied to the grass under the solar panels. To restore the site, lime will need to be applied at rates ranging from 1 to 2.5 tons per acre. At a cost for lime and spreading of $65 a ton, this operation must be considered as essential to the restoration of a solar site. Depending on the soil and how the site has been maintained, other nutrients such as sulfur, magnesium, nitrogen, and manganese may be lacking and will need to be applied prior to growing the first crop. This could add another $50 to $100 per acre in fertilizer costs.

Conclusions

The overall cost of returning a solar facility back to farmland must include a consideration of all three issues:

- *removal of equipment,*
- *mitigation of contamination, and*
- *restoring soil properties.*

This report focuses on the latter two, since the decommissioning costs are largely indeterminate at this time. A reasonable estimate of the per acre current costs of mitigation of contamination and restoring soil properties to farmland is shown below.

Reclamation Issue	Cost per acre
Mitigation of Zinc	$ 1,500
Mitigation of Herbicide and Compaction	$ 50
Application of Lime	$ 130
Fertilizer Cost	$ 100
Total Cost (excluding Equipment Decommissioning)	$ 1,780

To date, most of the attention at the end of a Solar Farm's life has focused on Equipment Removal and Decommissioning. This report adds another dimension to the "end-of-life equation," namely the activities and costs involved in returning the land to its original agricultural purpose. This latter function has here-to-fore been largely ignored.

Of course, if other contamination is found or other issues such as the need to install new ditches or drainage structures are discovered then these costs could be substantially higher or the site may no longer be suitable for agricultural production. Clearly, no grower could afford to decommission a site on his own. The cost of equipment removal alone would be greater than any potential gain from returning it to agricultural production. Therefore, it is essential that the solar operator be held responsible *for the entire process.* However, in some cases even when the cost of mitigation and restoration of soil properties is covered by the solar operator additional factors such as the loss of agricultural markets and suppliers of seed and fertilizer will make it difficult for the farmer to return the land to its original use.

References

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