

Landfills

Turning Your Landfill Into a Solar Power Factory: New Technologies Provide More Opportunities

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LANDFILL ENERGY PROJECTS ARE STARTING TO ENTER A NEW ERA WHERE in addition to producing energy from captured methane, they now also can produce energy from solar panel systems. Driven by new regulations mandating renewable energy sources, and in areas with higher power costs, older closed landfills with large unobstructed grassed areas are being considered. In addition, operating landfills that are planned to be capped can produce significant energy as well as a result of breakthroughs in liner and solar panel technology. There are around a dozen operational landfill solar projects in the U.S., and many more in the planning stage.

Landfill Caps

Landfills that have been closed and capped use a traditional rack-mounted, solar panel system (Figure 1). Typically, the panels are installed on metal frames that are “secured” to the landfill. Special care is needed to design the attachment so that the integrity of the landfill cap is not compromised and the panels do not slide. Drainage patterns on the landfill can be altered and

modifications must be made to maintain the soil and grass cap in areas around the panels. High wind loads that can result in uplift on the panels and should be addressed with supplemental anchor systems.

The other technology, the flexible solar panel, is laminated to a thermoplastic geomembrane that is used as an exposed cap (Figure 2). Exposed geomembrane caps (or EGCs) have been around for decades with a spotty record. However, the most recent projects use a new material, polyolefin, which is being offered with a 20-year manufacturer’s warranty. This material has a good record with the commercial roofing industry where it has been used for many years with the same laminated solar panel.

However, every State has their own regulations for EGCs, with some considering them experimental and subject to replacement with a conventional soil cap if they experience significant decay before the end of the closure period (30 years under Federal rules). The EGCs have some other challenges to address including increased runoff and uplift of the geomembrane. The flexible panel also does not generate as much power per unit area as the rack mounted system. Both types of systems have been installed in the U.S.

Figure 1: Rack mounted solar photovoltaic panels on landfill.
Photo courtesy of Pfister Energy, Hawthorne, NJ, www.pfisterenergy.com



Compatibility Issues

Landfill compatibility issues do arise when considering a solar panel project. An experienced landfill consultant can assist with addressing basic to more complex issues including:

- Feasibility studies, both economic and technical
- Cap integrity and attachment assessments
- Geotechnical/settlement effects on panels
- Maintaining existing engineering controls
- Regulatory permitting
- Full design and construction oversight

Usually, only the southern facing slopes of a landfill are used for solar panels. However, some panels can be placed on the southeast and southwest corners and still be effective. On closed, flat top landfills, rack panels can be placed across the entire area, if they face south. The angle (or tilt) of the panel at the sun is critical to effective power output and should ideally match the latitude of where the site is located. It turns out that for most landfills a 3:1 side slope is not that far off from the ideal tilt angle.

The major components of a typical solar system are shown in (Figure 3, page 54). A solar panel converts sunlight to direct current (DC) and that



Figure 2: Exposed geomembrane landfill cap with laminated solar photovoltaic panels provides power to serve 224 homes. Photo courtesy of Carlisle Energy Services, Carlisle, PA, www.carlisleenergy.com.

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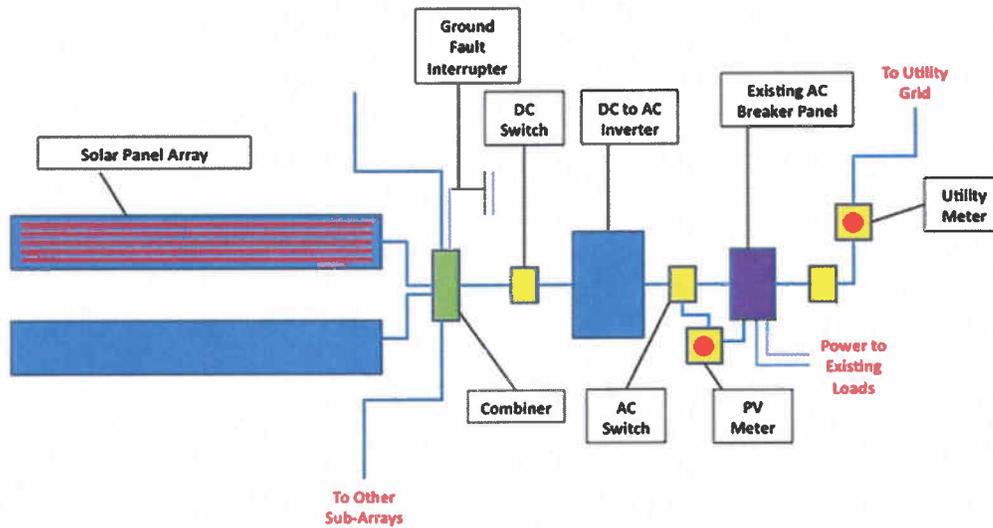


Figure 3: Typical grid-tied solar photovoltaic system. Image courtesy of SCS Engineers.

current is converted to alternating current (AC) in a device called an inverter. That AC current can then be channeled into the utility grid, or used to power onsite loads. Depending on the power output of a solar system, several inverters may be necessary. Manufacturers of solar panels are able to assist you with determining the correct size and number of inverters. Most experienced electrical engineering consultants can provide all of the other aspects to complete the “electrical-side” of actual design projects.

How much power can a system produce? A 1,000 kilowatt laminated panel system on approximately 10 acres of EGC in the south can produce power to meet the needs of roughly 160 average homes. Of course, home power consumption varies widely, and although a landfill system will not furnish power directly to homes, this number which could be higher or lower, is used by companies to promote the equivalent renewable energy benefit of the system.

Cost Considerations

The most recent Department of Energy study indicates that the 2011 installed cost of a rack-type solar panel system (i.e., panels, inverters and wiring) for a typical installation that one might see on a landfill was about \$5 per watt. If the system is rated to produce 1,000 kilowatts (i.e., a 1-megawatt system), that cost alone is \$5 million. There are other major costs including the specialized attachments, drainage modifications and connection to the utility grid, among others. However, the capital cost of an EGC with a modest, initial solar PV system is similar to the cost of a standard Subtitle D cover, in the range of \$150,000 per acre. One other possible advantage of the EGC and laminated panel system may be the opportunity to gain the revenue from waste disposal in the airspace that would have been formerly occupied by the 2-foot thick soil cap.

Combinations of federal, state and utility incentive programs are usually necessary to make the economic payback of a system work. A long-term agreement with a utility, typically for 20 years (i.e., power purchase agreements, PPAs) is usually necessary to obtain financing. States with renewable portfolio standards (RPS) often enable the electric utility to offer more attractive pricing and a market for renewable energy credits. A few areas with feed-in tariffs

provide guaranteed rates, which are significantly higher than retail prices for up to 20 years. The federal investment tax credit, which is 30 percent of the installed cost, is also still available through 2016.

Conclusions

Recent advancements in solar panel technology have opened up their use in applications on landfills of different configurations that were previously not actively considered. Although the use on landfills has its challenges, these are now well understood, and appropriate engineering controls can be included to maintain the integrity of the landfill operating systems, the final cap and the solar panels.

However, the biggest challenge to the increased development of solar panel systems still remains putting together a viable funding package. This requires the combined resources of the local utility, municipal government, federal and State agencies, and private investors. As they say, “success begets success”, and hopefully this holds true for the solar landfill sector of the industry. As more success stories unfold, we expect to see more organizations looking into putting an underused resource, their landfill, to work for them and the environment. | WA

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