

# Developing Utility Scale PV Solar Installations on Closed Landfills

*Facilitation Slides for "Rethinking Renewable Energy on Brownfields Sites" Session*

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SUNLIGHT + LANDFILLS = POWER

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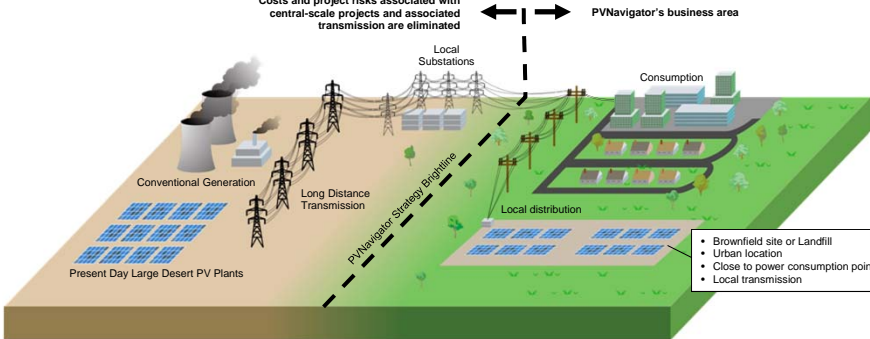
## 1 – 10 MW, Small-Scale, Distributed, PV Solar Facilities Can Rapidly Deliver Power to Meet Utilities' RPS Standards or Generate Renewable Energy Credits (SRECs).

**PV Navigator, L.L.C.'s business model is centered around the following drivers:**

- **Speed to marketplace** ahead of larger central-scale projects
- Availability of **urban landfill or Brownfield sites** which can host the panels
- **Availability of funding** for small plants
- Location of sites by **existing distribution or local load**

- **Project cost avoidance** via use of Brownfield sites and the need for new transmission lines
- **Minimizing permitting requirements** via development on State or Federal superfund sites
- **RPS regulatory drivers** for green power purchase
  - e.g., in CA, 20% renewable power by 2010, and 33% by 2020

Costs and project risks associated with central-scale projects and associated transmission are eliminated



Legend:

- Brownfield site or Landfill
- Urban location
- Close to power consumption point
- Local transmission

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## According to U.S. EPA, There is No Shortage of Brownfield and Landfill Site Acreage Which Could be Suitable for Renewable Energy.



- Over 400,000 identified Brownfield sites in the United States
- 16 million acres are available for development of renewable energy
- That's enough land to generate approximately 3,175,000 MW
- (For reference, the Hoover Dam generates about 2,000 MW)

## A Landfill Site is a Good PV Development Candidate if Certain Screening Criteria are Met.



## Landfill Sites are Excellent Platforms for PV Solar Facilities. Flat Acreage, Close to Load and Interconnect, Putting Otherwise Unusable Acreage Back to Use. *Projects are Technically Straightforward but Administratively Complex.*

**Photovoltaic Cell Detailed cross-section**

Glass covering  
Transparent adhesive  
Anti-reflection coating

Electric Current

Not to scale

**PV Solar Power**

A photovoltaic (or PV) cell is a specially treated wafer of silicon, sandwiched between two thin contact plates. The top contact is positively charged and the back contact is negatively charged, making it a semiconductor.

- The n-type semiconductor has an abundance of electrons, giving it a negative charge, while the p-type semiconductor is positively charged.
- Electron movement at the p-n junction produces an electric field that allows only electrons to flow from the p-type layer to the n-type layer.
- When sunlight hits the solar cell, its energy knocks electrons loose from the atoms in the semiconductor.
- When the electrons hit the electrical field, they're shuttled to the top contact plate and become a usable electric current.
- PV panels are mounted in racking systems specially designed to accommodate landfill-specific requirements such as "no cap damage" and "waste settlement."

The sun gives off about 400 trillion watts of power

A typical racking module is 10ft. By 20ft, and generates 2.5kW. This translates to about 1MW from every 3-5 acres.

**Solar Power to the Grid**

Excess energy from the solar array is fed into the power grid. It helps provide extra electricity to the community, especially during peak daytime hours.

**Landfill Gas-to-Power**

Perforated Gas Pipe

Methane and Carbon Dioxide

Landfill gas (LFG) migrates to waste prism extraction wells and the associated collection systems. The LFG is conveyed via a network of pipes to feed a power generation plant.

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A UNIT OF **PROJECT NORTSTAR, LLC**

## Case Study: PV Navigator, LLC Entered into an Agreement in 2011 to Develop a 6 MW PV Solar Installation on the Southern Ocean Landfill (SOLF), New Jersey with Power Sales to Atlantic City Electric.

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## Key Design Criteria are Minimal Settlement & The Continued Need for Cap Functionality.

**Design considerations include eliminating cap penetration, continued functionality of the ET cap, storm water management, wind design and insuring protectiveness during an earthquake event.**

**Design of PV Array will take into consideration:**

1. **Settlement**
  - Total
  - Differential
2. **Panel placement on cap**
  - Spread footings
  - Anchors
3. **Continued performance of evapotranspirative (ET) cap**
  - Infiltration minimization
  - Vegetative growth
4. **Stormwater management**
  - No standing water
  - Runoff management
5. **Other**

The diagram illustrates a cross-section of a landfill cap with a PV array. Key features include:
 

- 1 Settlement monument:** A vertical marker to monitor ground movement.
- 2 SunPods solar array with adjustable footing:** The PV panels are mounted on adjustable footings.
- 3 ET moncover:** An evapotranspirative cover layer with vegetation on top.
- 4 Drainage swale:** A channel for collecting and managing runoff.
- Electrical lines in above-ground, lightweight, flexible steel conduit:** Power lines for the solar array.

**Types of footings for rigid glass solar panels:**

- SunPods adjustable footing
- Pre-cast concrete footing
- Ballasted racking

**Landfill ET cap designs:**

Vegetation	Vegetation
2 to 4 inch thick geotextile layer	2 to 4 in. thick geotextile layer
Evapotranspiration Layer	Evapotranspiration Layer
Solid Waste	Solid Waste
Geotextile-based Liner (Barrier layer)	Geotextile-based Liner (Barrier layer)
Standard Subtitle D Cover	Evapotranspiration Cover (Anti-Region)

**Swale cross-section design:** A detailed view of the drainage swale showing its profile and connection to the cap.

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