PVNAVIGATOR, LLC

Brownfields Uplift ...Developing Utility-Scale PV Solar Facilities on Closed Landfills

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Presentation at:

BACK IN BUSINESS: RESOURCES FOR REDEVELOPMENT & LAND RECYCLING
RIVERSIDE, CA

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![Center for Creative Land Recycling Logo]
PVNavigator, LLC is an Operating Unit of Project Navigator, Ltd.

PVNavigator, LLC Develops, Owns and Operates PV Power Installations on Landfills and Brownfield Sites

- Distributed PV power developments
- MW-scale (2-5 MW, optimum)
- Reuse of environmentally impacted land
- Fixed-tilt PV systems
- Geotechnical & Interconnect
- Feasibility studies
- Permitting & engineering
- EPC management
- Regulatory interface & relationships
- Project financing

714-388-1809 | Los Angeles • New York • Houston
The Los Angeles Basin has 1,000’s of Acres of Closed Landfill Space & Brownfield Sites. This Acreage Can be Repurposed into MW-Scale Solar Power Installations.

From Worthless To Worthwhile

Our Niche: MW-Scale, PV Solar Developments on Closed Landfill Caps

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Landfill Owners Receive Revenue via a Long-term Land Lease.
Many Large Scale (300 MW and up) Solar Facilities Are Planned for the U.S. Southwest, However They Face Permitting, Financing, and Interconnect Challenges.

Less so for Urban Located Landfill or Brownfield Sites.
Landfill Sites are Excellent PV Power Platforms. Flat Acreage, Close to Load and Interconnect, Putting Otherwise Unusable Acreage Back to Use. Projects are Technically Straightforward but Administratively Complex.

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.”

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

The sun gives off about 400 trillion watts of power.

Landfill Gas-to-Power
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.
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)

Site Candidates: According to U.S. EPA, There is No Shortage of Brownfield and Landfill Site Acreage Which Could be Suitable for Renewable Energy. (Much more at www.epa.gov/re-powering)

Source: https://www.epa.gov/re-powering
Drilling Down to the Los Angeles Basin and Inland Empire...Landfills and Brownfield Sites are Abundant.

Legend
- Landfill Sites
- Brownfield Sites

- Appropriate Geographic Location
- Land Control (Title or Long-Term Lease)
- Environmentally Impacted Land (Restricted Future Use)
- Nearby Interconnection Point
- Who Will be the Power Oftaker? (PPA with Utility or Behind the Meter?)
- Project Financing • External • Internal
- Green Corporate Goals
- State-Mandated Renewable Portfolio Standards

Applicability of Your Site to Host a PV Solar Installation
Tip 2: Can Development Logistics be Parallel Tracked to Optimize Time and Project Spend.

**STEP 1**
Letter of intent with site owner...most likely the audience in today’s session in Riverside

**STEP 2**
PVNavigator performs a detailed project economic analysis + *starts an Interconnect Feasibility Study*

**STEP 3**
$ Deal Structuring: 
- **Landowner:** Straight land leasing to “some form of participation” in facilities 
- **Financing:** Debt v’s equity

**STEP 4**
Power purchase agreement negotiations with off-taker...e.g. So Cal Edison (SCE)

**STEP 5**
Project financing

**STEP 6**
Complete agreements and environmental studies (e.g. Post Closure Permit Update, and CEQA)

**STEP 7**
- Design / Build

**STEP 8**
- Start up and long term operations
- Synergize with landfill operations
Stages in PV Solar Power Installation Development: The Development Pathway Viewed from an Industrial Landowners’ Perspective. ...or... *What’s in the Deal for the Industrial Landowner?* (Hand Out Provided)

Overview: Where Project Cash Flow Occurs and How an Industrial Landowner Can Participate

1. All project development fees are paid by PVN (from feasibility to design to construction. No development costs need be incurred by landowner).

2. In the simplest business model, landowner receives revenue from a land lease for 25 to 30 years. If site is in a remediation OM&M phase, lease revenues can offset OM&M costs.

3. More innovative (complex?) PV development financial arrangements are possible which can include components such as:
   a. landowner receives a fraction of power sales revenue (replacing lease);
   b. power can be sold to a landowner’s “facility” at a “project-economic” rate; or
   c. landowner could co-invest in the PV facility, if consistent with the entity’s power purchase needs and sustainability goals.

Key Metrics:
- Concept to operations in ~2 years
- PVN pays for all project development costs
- PVN’s construction costs will be about $2.5M/MW (4 acres of installation)
- Landowner can receive lease fees, or more innovatively participate (see below)
- PV facility lifetime is 25 to 30 years
- PVN remotely monitors the facility, augmented by monthly onsite inspections
- PPA with power offtaker sets power sales rates, and escalator
- Landowner sustainable project credit
- PVN's evolution from the landfill EPC services world insures that PV installation will be "cap-compatible"

1. Should be performed in a consulting, “bed-side manner” with landowners, where PV project feasibility (FS) is generally discussed and assessed. All very conceptual at this stage.

Big Q: who would be the power offtaker?

2. Landowner buys into a “PV-vision”, and via an option agreement b/t landowner and PVN, grants interim site control to PVN to push forward on a PV plan. Any power offtaker will require site control for interconnect FS purposes. No cost to landowner.

3. Above tasks are the meat and potatoes of PVN’s PV planning and project feasibility studies. Interaction at this stage occurs with power purchaser, and environmental and permitting agencies. All work is performed by PVN at PVN’s cost in role of developer.

4. The above tasks move the job from concept and proven economic feasibility through detailed engineering, procurement and PV installation construction, into final start up and power sales (under the terms of the early negotiated PPA). All the above work is performed by PVN (and selected) EPC resources at PVN’s cost.

* Can be in form of an “option agreement” between landowner and PVN Navigator, LLC, or a longer term land lease. Option would convert to a land lease once the scope and economics of the proposed project are better defined, such as at the execution of a PPA. PVN can supply a model option agreement, on request.

** Civil engineer and EPC contractor can be the one company.
“Riverside now gets two megawatts of its power supply from the sun, and a planned city project could nearly double the amount of available solar power with a year.”

“The city’s public utility is moving ahead with a project to build a solar array on the closed Tequesquite Landfill just south of Mount Rubidoux.”
Solar Project Deal Structuring: Multiple Stakeholders with Different Interests Must Be Aligned

Site Owner
- Lease revenue

Power Offtaker
- Ok cents/kWh

Regulatory Agency
- Continued compliance
- CEQA

Financing
- IRR
PVNavigator, LLC First Piloted the Landfill-Based PV Power Concept at the Operating Industries, Inc. (OII) Landfill in Monterey Park, CA.

Funding was Supplied by the California Energy Commission. PVN’s Pilot Study Ran for 2 Years under the watchful eyes of CEC, U.S. EPA and the Landfill’s Responsible Parties.
Today PVNavigator, LLC is Starting Construction of a 3MW PV Solar Power Installation on the County of San Bernardino’s Milliken Landfill in Ontario, CA.
The Solar Construction Vendor Market is Vibrant...More than 20 Entities Participated in PVN’s Bid Walk in Jan, 2016

San Bernardino County Will Receive Revenue via a 20+ Year Lease.
PVNavigator, LLC Has Also Optioned Space on the County of San Bernardino’s Big Bear Landfill to Develop a 3MW Installation.

Power Sales will be to Bear Valley Electric Services.
PVNavigator, LLC’s Big Bear Landfill PV Installation will be Located on the Landfill Cap and on Adjacent Acreage within the Landfill Facility.
PVNavigator, LLC is Also Active on the East Coast.
PVNavigator, LLC’s PV Solar Development at the Owens Corning Landfill, NJ.

Who
- A development Team anchored by PV Navigator, Ltd. (PVN) as the project integrator.
- PVN specializes in developing small scale distributed solar facilities on landfill sites.
- Design capabilities by Miller Brothers, NJ, and solar modules from SunPower.
- Permitting and environmental tasks to be performed by PVN.

What
- A 3.1 MW PV Solar Development.
- Fixed Tilt, Rack Mounted, Self Ballasting.
- Occupies 12 acres of landfill top deck areas.
- Racks are specifically designed for landfill cap installations.
- No long-term cap damage.

When
- All permitting and design completed by end of 2015.
- System installed and operational by December 2016.

How
- PVN and the Township of Gloucester enter into a Land Lease Agreement which includes ability to use the landfill top deck for 20 years.
- Project will be financed via a combination of debt and equity.
- PVN has excellent fund raising track record with major East and West Coast renewable energy funds.

The PV solar systems will not penetrate or damage the existing cap.

Develop a 3.1 MW photovoltaic solar array from approximately 1,034 SunPods, fixed tilt, rack mounted arrays.
Many Resources Exist, e.g.; “EPA’s Best Practices for Siting PV Solar on Landfills”.

Inquiries Welcomed on How to Develop a Solar Power Installation on Your Brownfield Site.

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PV Solar Facilities on Closed Landfills...

Thanks for Your Attention...Questions?

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