

UNI-SOLAR®

COMPATIBLE POWER:

SOLAR GEOMEMBRANE COVERS
AND
LANDFILL GAS RECOVERY

13th Annual LMOP Conference and Project Expo

Baltimore, MD

12 January, 2010

1 Megawatt Landfill Remediation Project Malagrotta, Italy



Republic Services Tesson Landfill San Antonio, TX

UNI-SOLAR.

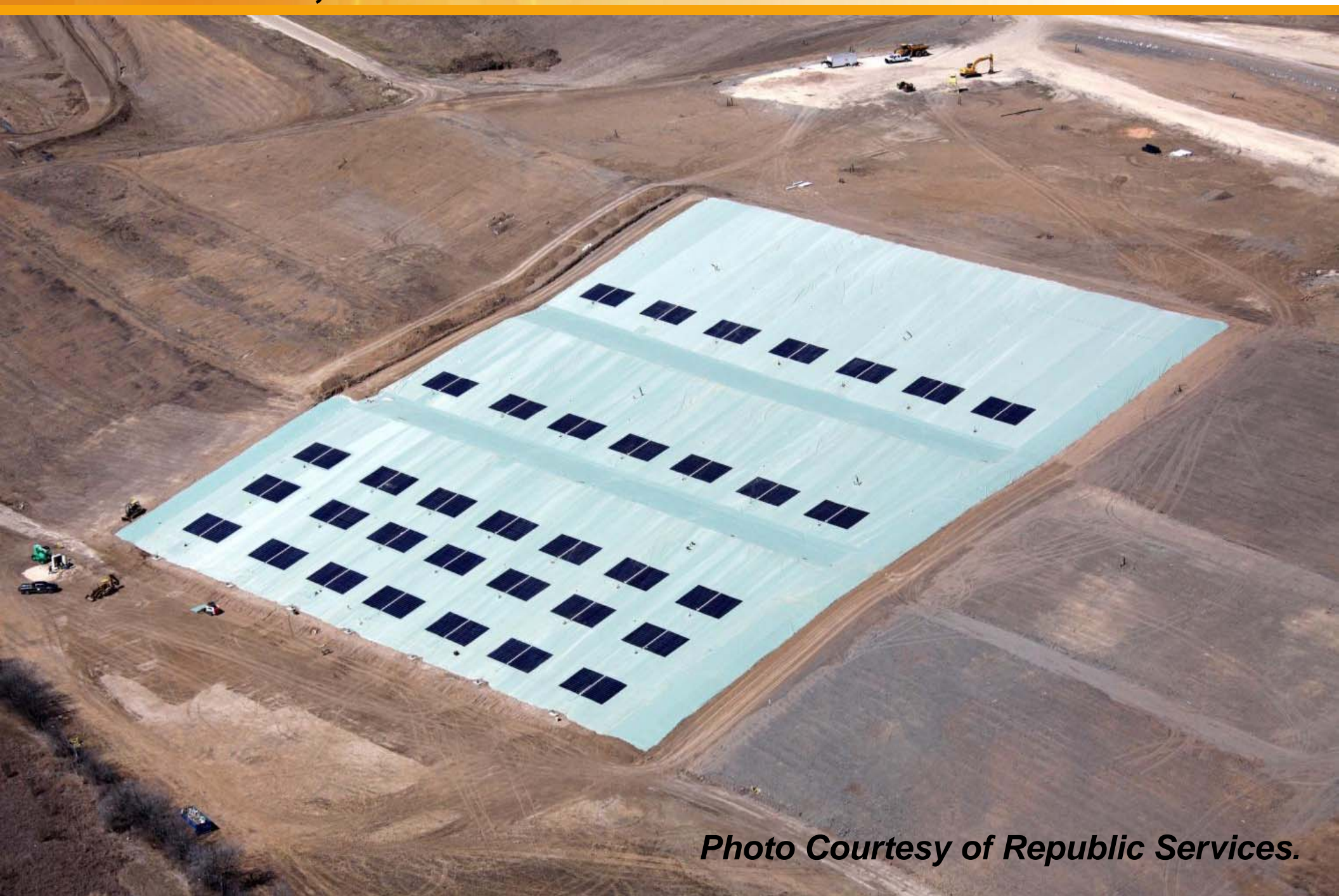


Photo Courtesy of Republic Services.

UNI-SOLAR Flexible [Non-Glass] Panels are the best fit for “active” waste sites

UNI-SOLAR.

Covers ‘new’ landfills, slopes, remediation sites

- BONDS TO GEOMEMBRANES
- NO RACKING, OR RIGID STRUCTURE
- ACCOMODATES DIFFERENTIAL SETTLEMENT



UNI-SOLAR Leader in Solar Membrane Solutions...

Proven Technology

- **Proven materials**
- **NREL & FSEC Tested**
- **25 years of experience**
- **Proven durability**
- **Unbreakable design**
- **High Quality USA**

Best Real World Performance

- **Higher Energy Yield**
- **High-temp performance**
- **Shadow tolerant**
- **Anti-glare surface**
- **Vandalism resistant**
- **Low cost of ownership**

Solar Membrane Solutions

- **TPO, EPDM, Mod-Bit**
- **Light weight: <1 lb/ft²**
- **No roof penetrations**
- **Wind-resistant**
- **Hail impact resistant**
- **Easy to install**

Leader in Solar Membrane Solutions

UNI-SOLAR PV Panels Never Contain and Never Produce Toxic Chemicals

UNI-SOLAR.



- World's largest manufacturer of flexible PV
- Produced in a clean, safe environment
- No toxic chemicals used in production
- Low-temperature manufacturing with very little silicon content = low energy consumption / emissions.
- No risk of chemicals leaching out into the environment after installation.
- Recyclable and landfill disposable

All our solar cells are proudly
MADE IN THE USA!



- Equivalent Subtitle D Cap alternative
- Enhanced community protection
- Improved methane capture
- Reduced gas emissions and air entrainment
- Leverage LFGTE utility interconnection
- Avoided costs

Photo Courtesy of Republic Services

Superior “Equivalent” Alternative Cap

UNI-SOLAR.

**Proven 60-mil scrim-reinforced
Thermoplastic Polyolefin (TPO)**

**Decades of superior performance
in extreme conditions**

25 year warranty on the UNI-SOLAR panels

Photo Courtesy of Republic Services

Exposed Geomembrane Solar Cap Compared to “Subtitle D” and “ET” Caps

Geomembrane Liner
(barrier layer)



**Exposed
Geomembrane Cover
(EGC)**



**Standard Subtitle D
Cover**



**Evapotranspiration
Cover
(Arid Regions)**

- ❑ Guaranteed revenue stream for >25 years
- ❑ Leadership in community sustainability efforts
- ❑ Lower installed cost when PV panels are factory-integrated with geomembrane e.g. Carlisle TPO
- ❑ O & M savings
- ❑ Potential tipping fees from extra “airspace”

- Avoided fuel emissions via reduction of structural fill
- Reduced methane escape / better containment
- Renewable solar energy generation



- ❑ Safer more efficient ongoing O & M
 - Integrity assurance
 - Efficient inspections, detection, repairs
 - Better access to LFG system
 - No vegetation failure, mowing
 - No soil cover failure, erosion, landslides

- ❑ Superior leachate control
 - Uniform low permeability containment
 - Clean water runoff
 - Needs larger storm water management system

Solar Cap Works with LFG System In Place

UNI-SOLAR.



Photos courtesy of Republic Services

“...[L]andfills with impermeable geomembrane covers and active gas controls are expected to have a collection system efficiency greater than 90%, based on the consistent reporting of near-zero surface emission measurements...

...Landfill cover systems incorporating a flexible membrane liner (FML) within the final cover system have negligible methane oxidation and the default oxidation rate for these types of covers is equal to zero.”

Direct Emissions from Municipal Solid Waste Landfilling

U.S.EPA, Climate Leaders; Sec.4.2, pp.13-14

How does >90% capture improve your LFGTE economics?

- Additional revenues?
- Run a larger plant? An extra plant?
- Monetize additional emissions reduction?

SIMILIAR TO LFGTE PROJECTS:

- What's the project capacity/yield of your site?
 - Access to electrical transmission lines?
- Who will buy/ own the solar energy asset?
- Who will buy the power?
 - At what price?
- Other incentives available to fund the project?

How many total acres will be capped?

Acres South-facing?

Acres of top-deck with assured positive drainage?

➤ Assume 150kW per acre DC capacity if using *UNI-SOLAR* integrated TPO by Carlisle



➤ ***UNI-SOLAR* can help you with the PV design and energy yield calculations for your site**

Landfill Owner

- Access to capital?
- Fund the solar with avoided costs?
- Can monetize the tax incentives?

Energy Project Developer or Utility

- Own the Solar / LFG Equipment but not the cap/closure system
- Access to capital?
- Can monetize the tax incentives?

“DIRECT TO THE GRID”

- “Wheel the power” to the wholesale market (usually lowest price option)
- Standard Offer or Negotiated Contract to the Utility
- Feed in Tariff [when they become available]

- Renewable Energy Credit (REC) Market
- Carbon Credit Market

“NET-METERING”

Feed directly into facility service meter

Offset retail electricity costs

Onsite electrical load

- LFG plant, etc.? Offices? Recycling plant?

“Over the fence” Power Purchase Agreement with nearby off-taker

- Water / Wastewater treatment plant
- Offices, industrial facilities, schools
- Extend existing LFGTE sales agreement?

- Scheduled Budget for closing / capping / remediating the site
- Federal Investment Tax Credit (30%) and MACRS
- PV Rebates and incentives (vary locally) www.dsireusa.org
- Power Purchase Agreement distributed generation contracts
- Utility Owned Generation for RPS requirements
- EPA redevelopment incentives for contaminated lands including grants, loans, bonds, etc. which vary by state.
- Strategic Environmental Research and Development Program (SERDP) www.serdp.org/
- DoE Solar America Initiative incentives for “brownfield” remediation
- ARRA funds to supplement eligible brownfields revolving loan fund (RLF) grants <http://www.epa.gov/brownfields/rlflst.htm>

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