Solar Generation System on a Landfill Case Study – An Australian First

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ARENA

Australian Government

Australian Renewable Energy Agency

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ENERGY

Who are we?

- Joule Energy is a new, wholly owned subsidiary of LMS Energy – a partnership combining over 35 years of landfill gas, renewable energy generation and carbon abatement experience
- Joule's core focus is on the development of photo voltaic power generation systems on and adjacent to landfills across Australia
- This involves installation, operation, maintenance and repair of solar generation systems and the production and supply of electricity

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Solar on Landfill

Opportunity

- Landfills have very little utility once capped due to issues of land settlement and landfill gas.
- Therefore they are ideal locations for solar development.
- Solar generation systems on landfills, and adjacent buffer zones provide an economically viable reuse for sites that may have significant clean-up costs and little potential for commercial or residential development.

Benefits

- Reduce post closure maintenance costs.
- Utilize land that has minimal commercial value
- Turn landfill into a 'renewable energy park'
- Supports council environmental policies

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Challenges

Installing a solar generation system on a capped landfill presents a series of unique and difficult challenges –

- Hazardous Environment (Explosive gas levels)
- Landfill Gas System
- Land Settlement/Subsidence
- Final Cap Integrity
- Environmental Regulations

All of these challenges have implications on the design of the solar system

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Wollert Landfill Project

In partnership with ARENA, Joule designed and implemented the first solar generation system on an Australian landfill – an ambitious solar project in Wollert, Victoria.

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- VIDEO

https://arena.gov.au/blog/solarpowertip/

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Wollert Landfill Project

Project Details

Address: 55 Bridge Inn Road, Wollert, Victoria
Description: Ground Mounted Array Situated on Landfill Cap
Capacity: 100KW
Annual Production: 140 MWh's
Footprint: 2000m2
Age of Waste: >10 years
Project Partners: ARENA, Hanson's, IT Power

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Technical Specifications

Mounting Methods: (The system uses three different mounting technologies)
1) Single module ballast mounting – 65.5KW facing north with 15% tilt
2) Multi module ballast mounting – 28.6KW facing north with 35% tilt
3) Micro pile mounting - 5.76KW facing north at 35% tilt.
Racking: Schletter PvMax3
Inverters: 3 ABB string inverters (27.6KW)
Solar PV Panels: 384 Tindo Karra modules (260KW)
SCADA: Aurora Vision Plant Portfolio Manager

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Project Aim

The Wollert project sought to demonstrate engineering options to deal with the challenges of:

1) Land settlement/subsidence on landfill surfaces
2) Maintaining the integrity of the cap

The project achieved this aim by testing and comparing three approaches to mounting the PV frames.

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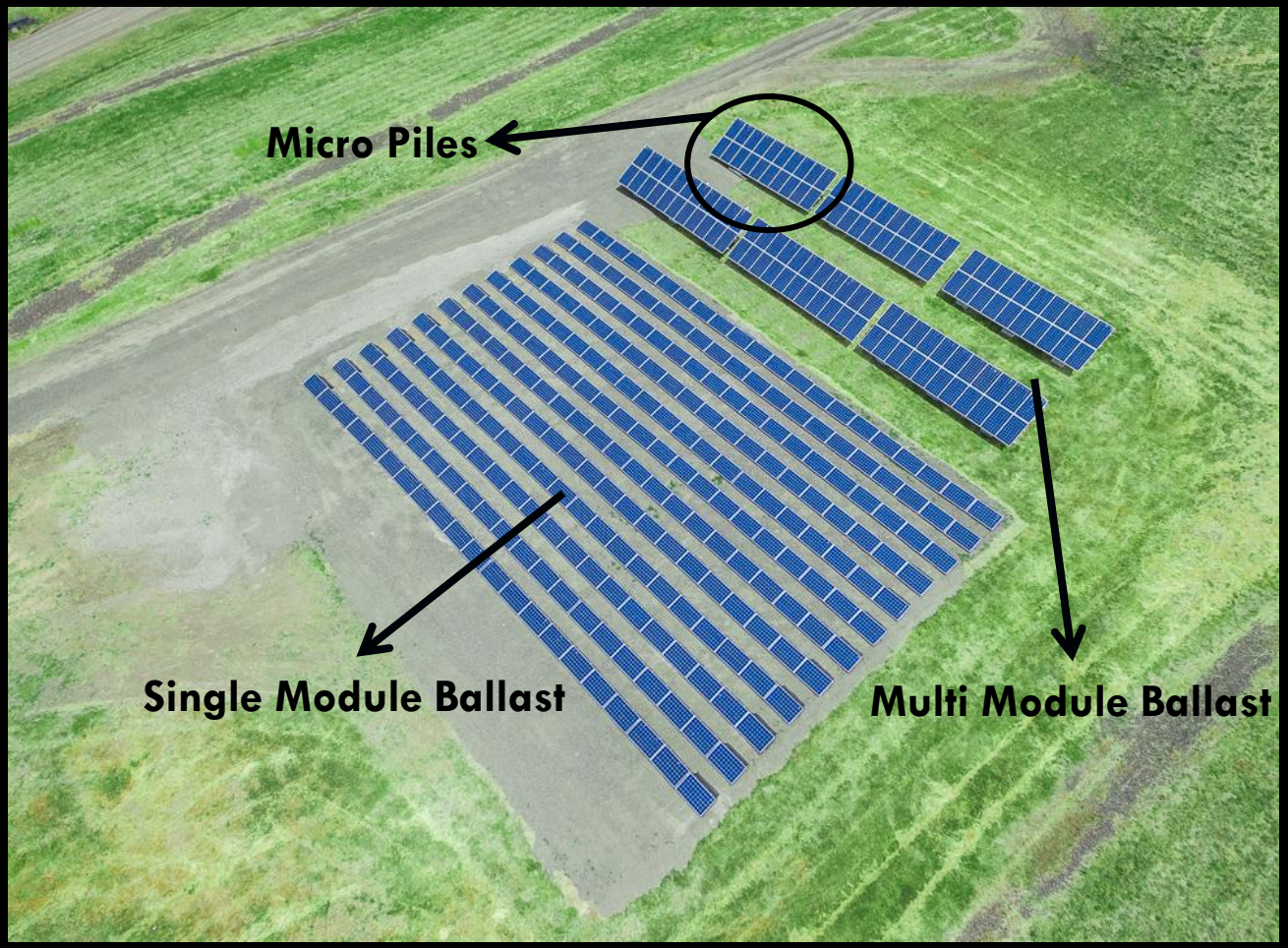

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Single Module Ballast Mounting (Renusol Consuls)

Benefits:

- Versatile (easily movable)
- Doesn't penetrate the cap
- Flexible with significant subsidence
- Low material cost

Negatives:

- High labour costs
- Requires extensive civil works (gravel)
- Not suitable for large installations
- On-going maintenance costs
- Cables not easily accessible
- Optimum tilt angle not achieved

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Multi Module Ballast Mounting (Precast Concrete)

Benefits:

- Optimum tilt angle achieved
- Doesn't penetrate the cap
- Quick installation (once blocks are in place)
- Wiring is accessible
- Provides support for mounting electronics

Negatives:

- High material costs
- Relatively inflexible
- Civil works and extra fill required if substantial subsidence occurs
- Places heavy load on cap

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Micro Pile Mounting (Surefoot)

Benefits:

- Optimum tilt angle achieved
- Easy installation
- Cheap material costs
- Wiring is accessible

Negatives:

- Penetrates the cap
- Inflexible
- Not suitable for landfills where substantial subsidence is expected
- Unable to mount electronics

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Comparison of Mountings

	Singe Module Ballast	Multi Module Ballast	Micro Pile
Cost	Medium	High	Medium
Flexible	Yes	Moderately	No
Subsidence Adaptability	High	Medium	Low
Cap Penetration	No	No	Yes
Optimum Tilt Angle	No	Yes	Yes
Wiring Accessibility	Low	High	High
Ease of Installation	Difficult	Average	Easy
Support for Mounting Electronics	No	Yes	No

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Practical Implications

Single Module Ballast (Renusol Consuls)

- Suitable for small-medium scale installations where substantial subsidence is expected

Multi Module Ballast (Precast Concrete)

- Suitable for medium-large scale installations where moderate subsidence is expected and the weight bearing capacity of the soil is high

Micro Pile (Surefoot)

- Suitable for small-large scale installations where little subsidence is expected and landfill gas levels are minimal

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Other Lessons Learnt

1) Landfill Gas

- Entire system must meet strict safety standards due to the explosive nature of landfill gas
- Trenches and conduits create gas pathways
- Gas build-up can occur in electrical equipment creating an explosive risk
- Critical to engage contractors with landfill experience

Gas Ventilation Cage

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Other Lessons Learnt

2) Protecting the Cap

- Levelling must be additive rather than subtractive
- Penetrations of the cap require approval from the EPA
- Each penetration becomes a new testing point for gas emissions
- Penetrations of impermeable layer of the cap should be avoided
- Bentonite clay must be used to seal any penetrations

Bentonite added to top of micro pile posts

- Cables should run above ground or at a shallow depth
- Final cover vegetation should be maintained where possible

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Other Lessons Learnt

3) Land Settlement

- Significant settlement occurs within 5 years of final capping
- Short spans are preferred for the PV array mounting structure (Prevents overstressing and allows the shorter blocks to move independently from one another)
- Spread out the weight of the array where possible
- Use framework footings which have built in adjustment to allow parts of the array that sink over time to be lifted

40mm of adjustment

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Other Lessons Learnt

4) Vermin

- Landfills attract a variety of vermin
- Extra protection needed for exposed wiring and cabling
- Bird spikes added to the top of arrays to minimize bird droppings

5) Landfill Gas System

- Landfills generally have substantial gas infrastructure onsite
- Hence it is critical to engage the landfill gas contractor and identify the landfill gas infrastructure
- This allows the solar system to be designed in a way that does not interfere or damage the landfill gas infrastructure
- Disturbance of this infrastructure can have serious environmental consequences
- The system must also be designed in a way which allows flexibility in the event that further landfill gas infrastructure is installed

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Summary

- Landfills present unique and difficult challenges compared to virgin ground solar installations
- The most important aspect is ensuring the landfill remains compliant with environmental regulations now and in the future (solar is a secondary objective)
- Recently capped landfills are unsuitable for installations due to the substantial amount of settlement that occurs within the first 5 years
- The type of mounting preferred depends on site specifics
- The integrity of the landfill cap is paramount and penetrations of the impermeable layer of the cap should be avoided at all times
- Landfill gas is a dangerous explosive risk which must be considered at all stages of the project
- Engagement with landfill gas contractor is essential

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Thankyou

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