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DISTRIBUTED SOLAR INITIATIVE FOR ORPHANED WELL SITES

The RenuWell project will reduce the high up-front costs of renewable energy development by utilizing disturbed land and existing infrastructure such as access roads, graded well pads and electrical infrastructure. It will also reduce the high overhead costs associated with smaller-scale networked projects and enable a rapid transition to a cost-competitive distributed system where generation capacity is closer to the energy consumer.

END-OF-LIFE (EOL) SOLAR PV FACILITY DECOMMISSIONING REPORT

The intent of this report is to evaluate the processes and associated costs required to decommission a typical 500 KW ground mounted photovoltaic solar facility within the Municipal District of Taber, Alberta. Our goal is to apply sustainable solutions to either recycle or repurpose all materials into a circular economy with 0% of materials being disposed of in landfill. This assessment does not include reclamation of existing roadways, pads, or transmission lines. The cost values are based on early 2020 rates and may fluctuate with market value of good & services as the facility reaches it's EOL in 20-25 years. The information in this report is to be used as a benchmark for indicative costing. RENUWELL Energy Solutions and SUNSET Renewable Asset Management Inc. will re-evaluate processes and economics for each project when the time comes for decommissioning at EOL or Early Loss of materials.

ESTIMATED QUANTITIES – 500 KW SOLAR FACILITY

Electrical – Inverters, Electrical Cable

Racking – Fixed Tilt, 2x12 Rack Single Post, Galvanized Steel

PV Modules – 1400 Units x 360 Watt

Foundations – Ballast, Driven, Helical, or Ground Screw



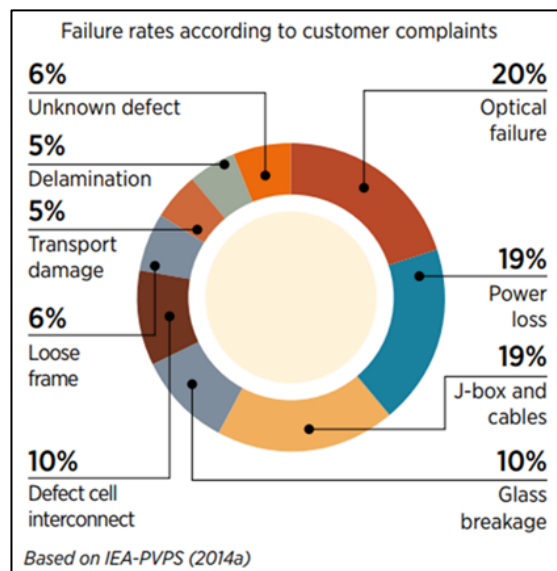
SUSTAINABILITY

When applying sustainable decommissioning of renewable energy systems towards the United Nations Sustainable Development Goals (SDGs), our efforts fulfill several boxes (3/4/5/6/7/8/9/10/11/12/13/14/15/17).

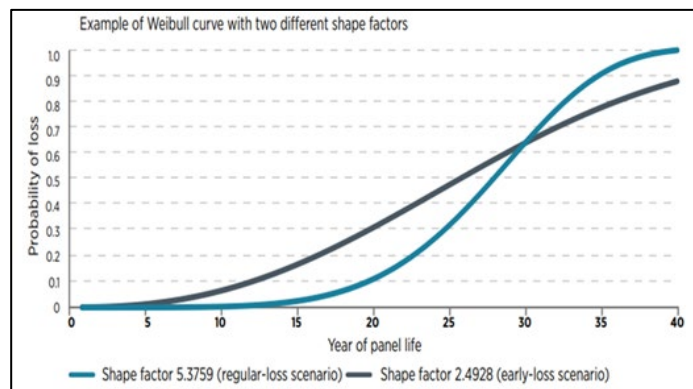


Ideally, any useful material are repurposed at their EOL to secondary agricultural, residential, or industrial markets where high output modules are not required. Modules, metals, cables, and inverters that are damaged or deemed unsafe through third party inspection or testing will be processed at a SUNSET facility.

Raw materials will be reintroduced into the circular economy leaving a carbon footprint of below net 0. This is achieved by introducing the used material into a new product, reducing the need for mining, trucking, processing, etc.



Note that early loss of modules or equipment may be experienced over the lifespan of the project. Regular inspection and maintenance will be required.



REFERENCE DRAWINGS

Typical Fixed Tilt Table Outlay

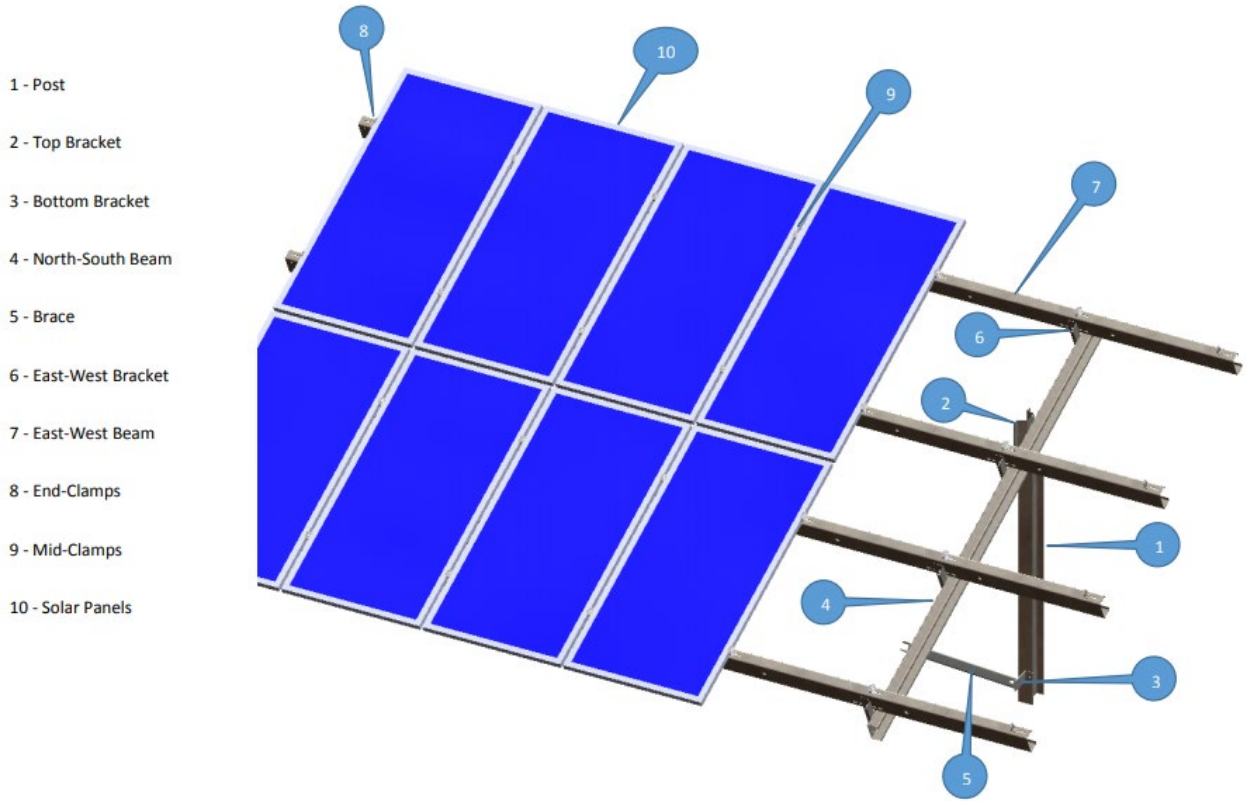
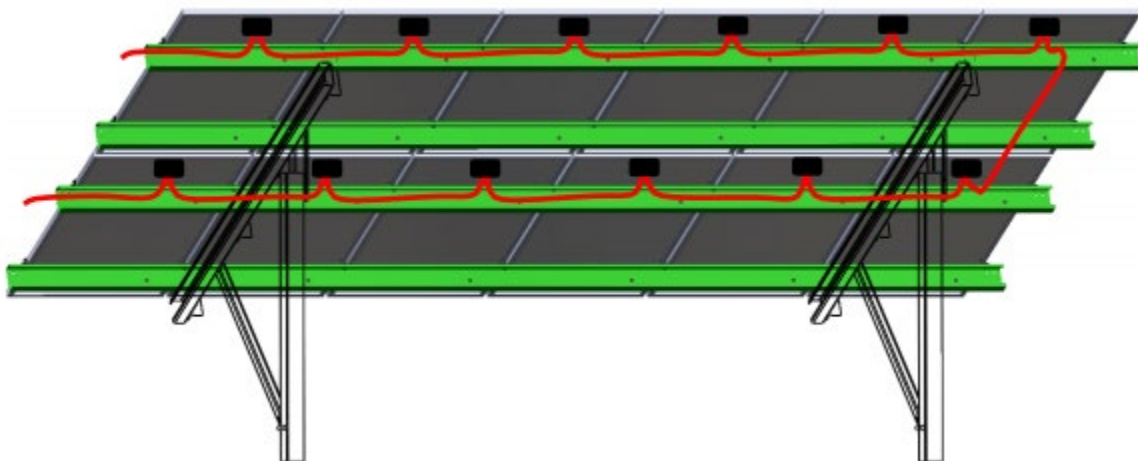
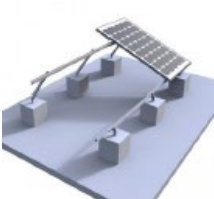


Table Back View



FOUNDATION EXAMPLES



BALLAST



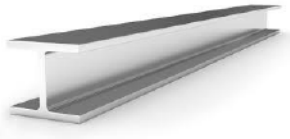
GROUND SCREW



HELICAL PILE



DRIVEN PILES



DECONSTRUCTION PROCESS

PPE REQUIRED:

Hard Hat, Gloves, CSA Approved Steel Toed High-Top Boots, Safety Glasses, Hearing Protection, High Visibility Vest

****WARNING****

****Ensure System is De-energized and locked out before dismantling system****

Cable Disassembly – 100 hours

- Unplug module leads
- Wrap in a knot
- Secure with clear tape to the module backing sheet

Hardware Removal – 150 Hours

- Undo fasteners holding modules to the purlins
- Put hardware into storage containers to be reused or recycled

(note: ensure modules are not subject to wind. If so, complete hardware removal and module packaging simultaneously)

Module Packaging (Reuse) – 400 Hours

- Record module specifications/serial number off of backside label
- Remove modules and stack on wooden pallet (20 modules per pallet)
- Wrap with shrink wrap to secure bundle
- Wrap serial number identification sheet into last wrap so it's visible.

Module Packaging (Recycling) – 200 Hours

- Record module serial number on backside label
- Remove modules and place into transport bins for recycling

Racking Deconstruction – 200 Hours

- Secure table with excavator thumb
- Using cutting torches or cut saw slice top brackets/lower brackets
- Cut to length for bins
- Put racking into transport bins for recycling

Foundation Extraction – Ballast - 200 Hours

- Move ballast foundations to deconstruction area using excavator & sling
- Break concrete apart using hydraulic impact breaker
- Steel pile from concrete base
- Load concrete into truck to be used for recycled aggregate
- Load steel piles into bins to be recycled into raw material

Foundation Extraction – Helical Pile/Ground Screws – 300 Hours

- Using excavator w. rotary head place and secure drive can on top of pile
- Reverse rotate and apply upward pressure to raise pile out of the ground
- Shake dirt off of helix
- Lay pile onto ground
- Remove connector pins and uncouple drive can
- Load piles into bins for removal to be recycled into raw material
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Foundation Extraction – Driven pile – 200 Hours

- Using Excavator w. vibratory back hammer apply upward pressure while vibrating loose the friction bond of pile to soil
- Lay pile onto ground
- Unclamp hammer
- Load piles into bins for removal to be recycled into raw material.

Transportation Logistics – Per/KM within MD of Taber

- Modules for reuse to be trucked using 43 ft flatbed transport truck
- Module for recycling to use 40 ft roll off bin
- Inverters/Cable to be shipped using tandem axel dually dump bed
- Racking, Piles, and Hardware to be shipped in 40 ft roll off bin

ECONOMIC EVALUATION

Electrical Removal – **-\$6,500**

2 Technicians

100 hours of technician time @ \$70.00/hour = **-\$7,000**

Value of Recycled Cable – **+\$500**

Value of Recycled Inverters – = \$0

Hardware Removal – **-\$12,000**

2 Technicians

150 hours of technician time @ \$70.00/hour = **-\$10,500**

Value of Recyclable Material - \$0.75/lb x 2000 = **-\$1,500**

Module Removal (Reuse) – **+\$2,100**

3 Technicians, 1 skid steer

400 hours of technician time @ \$70.00/hour = **-\$28,000**

Skid Steer Daily Rate - \$250/day – 20 days = **-\$5,000**

Wooden Pallet – 70 pallets x \$20/pallet = **-\$1,400**

Shrink Wrap – 5 x 500 sqft rolls x \$200/roll = **-\$1,000**

Transportation - \$1500/truck x 3 = **-\$4,500**

Resale value of used modules - \$30.00/module = **+\$42,000**

Module Removal (Recycling)- **-\$52,000**

2 technicians, 1 skid steer

200 hours of technician time @ \$70.00/hour = **-\$14,000**

Skid Steer Daily Rate - \$250/day x 10 days = **-\$2,500**

Transportation - \$750/40 cuyd Bin x 10 = **-\$7,500**

Cost of Processing Modules - \$20/module = **-\$28,000**

Racking Deconstruction – **+\$7,000**

1 Technician, 1 Operator

200 hours of technician time @ \$70/hour = **-\$14,000**

Excavator with thumb @ \$1500/day x 10 days = **-\$15,000**

Value of Scrap Material - +\$0.75/lb x 58000 lbs = **+\$43,500**

Transportation - \$750/40cuyd bin x 10 = **-\$7,500**

Foundation Extraction – 175 Ballasts - -\$50,850

1 Technician, 1 Operator

200 hours of technician time @ \$70/hour = -\$2,100

Excavator w. Hydraulic Rock Breaker @ \$1750/day x 10 = -\$17,500

Skid Steer Daily Rate - \$250/day x 15 = -\$3,750

Cost of Aggregate Removal - -\$100/ Cubic Yard = -\$17,500

Value of Scrap Metal - +\$0.75/lb x 17500lbs = +\$5,000

Transportation - \$750/40cuyd bin x 20 = -\$15,000

Foundation Extraction – 175 Helical/Ground Screws - -\$20,688

1 Technician, 2 Operators

300 hours of technician time @ \$70/hour = -\$21,000

Excavator w. Rotary Head @ \$1750/day x 10 = -\$17,500

Skid Steer Daily Rate - \$250/day x 15 = -\$3,750

Value of Scrap Metal - +\$0.75/lb x 43750lbs = +\$32,812

Transportation - \$750/40cuyd bin x 15 = -\$11,250

Foundation Extraction – 175 Driven Piles - -\$15,250

1 Technician, 1 Operator

200 hours of technician time @ \$70/hour = -\$14,000

Excavator w. Vibratory Extractor @ \$1750/day x 10 = -\$17,500

Skid Steer Daily Rate - \$250/day x 10 = -\$2,500

Value of Scrap Metal - +\$0.75/lb x 35000 = +26,250

Transportation - \$750/40cuyd bin x 10 = -\$7,500

Transportation Logistics – -\$15,000

Equipment Mob/Demobilization – (excavator/skid steer/accessories) = -\$5,000

Crew Mobilization – \$200/day x 50 days avg = -\$10,000

DECOMMISSIONING COST SUMMARY

Item	Labour (Technicians)	Equipment	Time (hrs)	Total Cost
Electrical Removal	2	N/A	100	\$6,500
Hardware Removal	2	N/A	150	\$12,000
Module Reuse	2	Skid Steer	400	\$2,100
Module Recycling	2	Skid Steer	300	\$52,000
Racking Deconstruction	2	Excavator/Skid Steer	200	\$7,000
Ballast Foundation	3	Excavator/Skid Steer	200	\$50,850
Helical/Ground Screw	3	Excavator/Skid Steer	300	\$20,688
Driven Pile	3	Excavator/Skid Steer	200	\$15,250
Transportation	3	Excavator/Skid Steer	N/A	\$15,000

TOTAL DECOMMISSIONING COSTS FOR A 500KW SOLAR PV SYSTEM (TAX NOT INCLUDED)

	Ballast	Helical/Screw	Driven
Module Reuse	\$75,250	\$45,088	\$39,650
Module Recycle	\$129,350	\$99,188	\$93,750

CONTACT INFORMATION

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Where possible and applicable, please accompany comments and feedback with supporting data.