OVERVIEW OF SOLAR DECOMMISSIONING

Overall re-use and recycling process and regulatory approach discussion

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THE MARVEL OF A SOLAR MODULE

- When the engineers designed todays solar panels they were planning on a service life of 20+ years in some extreme environments. The materials they chose were needed to provide a water / weather proof environment for the solar cell to rest within while getting a good view of the sun.
 - I want to commend those engineers because the materials are doing their job quite well.
 - The solar panels may not look like a difficult challenge to recycle. Looks are quite deceiving.



FAILURE MODES - THOUGH MOST ARE NOT IMMEDIATE

The following is a brief list of solar module failure modes and some ways to potentially identify them.



























DECOMMISSIONING COST. ASSURANCE

- We typically see the the costs of decommissioning being required in many localities to be assured at the end of the project life.
- The most effective way to do this is the require a developer to put together a closure plan or decommissioning plan that describes all the steps required to close / decommissioning to the minimum requirements of the rules (if any) or the land owner. More on the requirements seen later...
- The plan then should have an independent estimate from someone who does that sort of work in order to set aside the appropriate funding for the closure.
- The money to fund the closure then needs to be set aside in a manner that ensures it is available when the time comes – look at the closure finding for hazardous waste facilities in federal law for great examples on how to assure funding

COMMON ISSUES IN FUNDING CLOSURE PLANS

We clearly understand that solar modules may be recycled and reused for 25+ years, though the value diminishes typically over the first 10 years. As the labor and transportation to reuse modules that are over 10 years old, in our experience leaves little to no value in the modules. Sometimes the cost of removal exceeds the value of the modules.

Solar modules that are cracked or have burn marks clearly have no value.

PRIMARY COMPONENTS OF SOLAR FARM

Component	
component	
Solar Modules (approximate)	
Tracking System (combined 2 and 3-string trackers)	
Steel Piles	
Inverter Stations with Foundations	
Electrical Cables and Conduits	
Perimeter Fencing	
Access Roads (approximate)	
Project Substation	

Quantity	Unit of Measure
418,975	Each
	Tracker
5,587	
67,632	Each
49	Each
59,755	Linear Foot (estimated)
58,600	Linear Foot
48,800	Linear Foot
1	Each



DECOMMISSIONING EXPENSES

- the estimates.
- **Project decommissioning will incur costs associated with disposal of**

Expenses associated with decommissioning the Project will be dependent on labor costs at the time of decommissioning. For the purposes of this report approximate 2019-2020 average market values were used to estimate labor expenses. Fluctuation and inflation of the labor costs were not factored into

components not sold for salvage, including materials which will be disposed of at a licensed facility, as required. Decommissioning costs also include backfilling, grading and restoration of the proposed Project site.

Activity	Unit	Quantity	Cost per Unit	Total
Overhead and management	Lump Sum			
(includes estimated				
permitting required)		1	\$720,000.00	\$720,0
Public road repair	Lump Sum	1	\$202,000.00	\$202,0
Solar modules; disassembly	Each	418,975	\$3.75	\$1,571,1
and removal				
Tracking System	Each			
disassembly and removal				
(equivalent 3- string trackers)		5,587	\$620.00	\$3,463,9
Steel pile/post removal	Each	67,044	\$9.50	\$636,9
Remove buried cable	Linear Feet	59,755	\$0.40	\$23,9
Inverter stations	Each	49	\$1,100.00	\$53,9
Inverter steel pile removal	Each	588	\$9.50	\$5,5
Access road excavation and	Lump Sum	1	\$154,240.00	\$154,2
removal				
Perimeter fence removal	Linear Feet	58,600	\$2.80	\$164,0
Topsoil replacement for	Lump Sum	1	\$715,500.00	\$715,5
roads and rehabilitation of				
site				
Project substation	Each	1	\$300,000	\$300,0
Total estimated	\$8,012,222			
decommissioning cost				



DECOMMISSIONING SALVAGE VALUE – NOT GOOD EXAMPLE

			Salvage Price per Unit	Total Salvage Price per Item		
ltem	Unit of Measurement	Quantity per Unit			Number of Items	Total
Panels - Silicon	Pounds per Panel	2.2	\$0.40	\$0.88	418,975	\$368,6
Panels - Aluminum	Pounds per Panel	3.5	\$0.40	\$1.40	418,975	\$586,5
	Pounds per Panel					
Panels - Glass		32.6	\$0.05	\$1.63	418,975	\$682,9
Medium Voltage Collection Cabling	Pounds per 1,000 feet	833	\$0.19	\$158.27	59.7	\$9,4
Tracking System and Posts	Metric tons per MW[AC]	50	\$253	\$12,650	152.5	\$1,929,1
Substation \$3,626,766	Each	1	\$50,000	\$50,000	1	\$50,0



SUMARY

- value.
- **30% upon installation.**
- example plan.

Projects will try and off set closure expenses feeling that the panels have

The current value will diminish typically to zero in 10 years and much like a car

Recycling scrap values are hard to obtain from a solar panel as the materials are very difficult to separate in order to obtain scrap values shown in this

OTHER ISSUES FOR REGUALTORS TO CONSIDER

- During construction and operations solar modules fail and must be treated as a waste.
- There are not specific regulation for solar modules so they end up in strange places. We have seen them in typical places like landfills and transfer stations but in automobile shredders and metal recycling yards.
- Solar modules, especially the older ones should be tested like any other waste stream prior to management as a waste or for recycling
- We have sampled over 200 models of solar modules and found many to meet the definition of a hazardous waste by TCLP analysis. This means they then need specific treatment Good example of how to use the federal hazardous secondary materials rule...
- Need to set a regulatory structure to improve recycling in an organized manner, such as universal waste rules did to organize recycling of batteries, lightbulbs, and aerosol cans

