RELIABILITY FACTORS FOR SALVAGE VALUE OF PHOTOVOLTAICS

Joseph McCabe, P.E.

ABSTRACT

As photovoltaic (PV) system prices become less expensive, the salvage value can be increasingly important in life cycle economic calculations. This poster examines data from historic utility salvage sales and reliability perspectives. From 2005 to 2010, large volume PV modules sold at salvage for a variety of pricing dependent upon strength of glass, amount of easily recycled aluminum, industry reduced average selling price (ASP) of new modules and expectations for future energy production. Reliability of product, both real and perceived, are important factors in resale valuations.

Photo 1: 2006 Stacked single crystal silicon salvage sales PV panels.

LARGE SCALE SALVAGE SALES

The Sacramento Municipal Utility District (SMUD) has been re-selling salvaged PV equipment since 2005. The table presented includes the technology based dollar per nameplate watt prices. Over 0.9 megawatts of nameplate modules were sold during this period.

Winning bids ranged from $0.04 to $1.26 / watt. The table shows minimum, maximum, average $/watt winning price for individual lots and approximate nameplate wattage sold that year. Modules sold included tandem amorphous silicon (a-Si), single crystal (Single) and polycrystal (Poly) PV. Model numbers included: Solarex MST 43 and MSX 60, Shell SQ 75/80, Solec SP-102 and SQ-80, and Siemens M55's. Some modules had been panelized, as shown in Photo 1.

Winning Bids from 6 Years of Surplus Photovoltaic Sales at SMUD

	2005		2006		2007		2008		2009		2010	
Bid Lot	Type	Price Per watt	Type	Price Per watt	Type	Price Per watt	Type	Price Per watt	Type	Price Per watt	Type	Price Per watt
1	a-Si	$0.46	a-Si	$0.46	Single	$0.78	a-Si	$0.53	a-Si	$0.07	a-Si	$0.09
2	a-Si	$0.46	a-Si	$0.31	Single	$0.66	a-Si	$0.50	a-Si	$0.06	a-Si	$0.13
3	a-Si	$0.46	a-Si	$0.20	Single	$0.77	a-Si	$0.97	a-Si	$0.04	a-Si	$0.07
4	Poly	$0.98	a-Si	$0.22	Single	$0.82	Poly	$0.44	a-Si	$0.06	Poly	$0.23
5	Poly	$0.75	a-Si	$0.24	Single	$0.73	Poly	$1.15	a-Si	$0.04	Single	$0.13
6	Single	$0.51	Single	$0.66	Single	$0.82	Single	$0.54	a-Si	$0.04	Single	$0.13
7	Single	$0.51	Single	$1.04	Single	$0.72	Single	$0.83	Poly	$0.17	Single	$0.18
8	Single	$0.61	Single	$1.26	Single	$0.48	Single	$0.88	Poly	$0.48	Single	$0.19
9	Single	$0.61	Single	$0.77	Single	$0.66	Single	$0.76	Poly	$0.24	Single	$0.33
10	Single	$0.61	Single	$0.77	Single	$0.82	Single	$0.88	Poly	$0.29	Single	$0.04
11			Single	$0.92	Single	$0.78	Single	$0.91	Poly	$0.21	Single	$0.24
12					Single	$0.82	Single	$0.72	Poly	$0.17		
13					Single	$0.52	Single	$0.56	Poly	$0.23		
14							Single	$0.72	Single	$0.25		
15							Single	$0.65	Single	$0.24		
16									Single	$0.17		
17									Single	$0.30		
18									Single	$0.16		
Min		$0.46		$0.20		$0.48		$0.44		$0.04		$0.04
Max		$0.98		$1.26		$0.82		$1.15		$0.48		$0.33
Total kW		150		69		177		136		212		160

Table 1: 2005 – 2010 Salvage Values for various technologies; 0.9 MW total original capacity. .

RESALE MARKETS

Used or salvaged modules are bought and sold in a number of ways. In some cases, they can be installed into non-incentivized systems like off grid markets. Or they might be showing up in resale channels like on E-Bay, Craigslist or classified section of Home Power Magazine.

It is possible individual modules are being sold into existing systems where a component has broken. All modules in a system should perform at exactly the same level, thus avoiding miss match conditions that reduce overall system performance. Similar to a fine china dinner set that has a broken plate; specific modules have a high replacement value, even if they are a used module. If an existing PV system has a problem with an individual module, replacing that module could have a very high system level value.

Used modules could be sold into a wholesale green power generator; however a tax credit for the installation would not be allowable because the PV materials are not new.

Scrap markets can utilize crystalline cells, as well as the aluminum frames, thus non-working crystalline modules can have an attractive scrap value. Various PV recycling programs have begun around the world including PVCycle headquarted in Phoenix Arizona with additional collection points in Tucson Arizona and San Jose CA.

ENERGY and GLASS

Most PV technologies lose 1% per year in performance consistent with typical 20 year, 80% power warranties. A module with an original standard test condition (STC) power output rating of 100 watts will probably be producing 90 watts at STC after ten years, 80 watts after 20 years. Used modules can be tested for their performance using a max power point current / voltage meter, correcting for module temperature and actual solar radiation normalized to the STC conditions of 1,000 watts per square meter and 25 degrees centigrade cell temperature.

It is important to note that the SMUD salvage sales illustrates a-Si on breakable float glass has considerable less salvage value than single or poly silicon technologies using tempered glass. CdTe might have similar issues with removability and transportability of the more fragile glass compared with tempered glass of crystalline PV. Even tempered glass is subject to breakage during decommissioning, removal transportation and storage activities. If flexible PV like United Solar or other newer flexible PV players in the market were designed for removability, it is possible the salvage value would be even higher than glass based PV.

Visual factors including browning of EVA was an important factor for resale, with large amounts of browning, as shown in the 15 year old single crystals cells of Photo 2, reducing the resale value dramatically.

PHOTOS OF SALVAGED PV MODULES

Photo 2 & 3: 1995 Solec SP-102's piled up in 2010, EVA discoloration

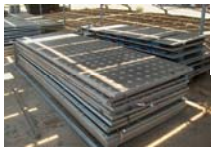

Photo 4 & 5: Bid of panelized single crystalline modules.

Photo 6: Panorama of poorly handled float glass a-Si for bid 2005.

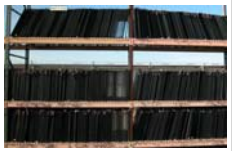

Photo 7 & 8: Well stacked float glass a-Si for bid in 2009.

Photo 9 & 10: Broken tempered glass and j-boxes w/wires in 2009.

Photo 11 & 12: Nicely handled salvaged PV modules in 2010.

PHOTOS OF SALVAGED PV MODULES

Photo 12: Well cared for and stacked modules obtain best resale bid price.

CONCLUSION

There is a healthy resale market for PV modules that should be recognized in project level economic calculations. As systems costs become lower and lower, salvage value have more significant ramifications. Functioning modules will have a revenue value based on life/performance expectations with the additional shipping and handling costs in comparison to other alternative to electric generation costs. The fragility due to glass used in PV modules has important resale value ramifications. Non-glass modules should have greater resale values because of no potential breakage during removal, and resale. There will continue to be a healthy used PV module market for years to come.

ACKNOWLEDGMENTS / REFERENCES

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