Salvage Values Determines Reliability of Used Photovoltaics

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**ABSTRACT**

Tracking salvage values can help to represent the reliability of a particular technology, the manufacturer and model of PV modules. There exists a secondary market for used modules and new modules from bankrupt companies. This presentation examines data from historic utility salvage sales and a bankruptcy auction. Reliability perspectives are presented. From 2005 to 2012, large volume of used PV modules sold at salvage for a variety of pricing dependent upon age, 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.

**RESALE MARKETS**

Used modules are bought and sold in a number of ways. They can be installed into non-incentitized systems like off grid markets. They are often sold in resale channels like on E-Bay, Craigslist of classified section of Home Power Magazine.

Individual modules could be sold into existing systems where a component has broken. If an existing PV system has a problem with an individual module, replacing that module could have a very high system level value.

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 are available around the world including a PV ReCycling.

**ENERGY, GLASS**

The Sacramento Municipal Utility District (SMUD) has been re-selling salvaged PV equipment since 2005. Table 1 presents includes the technology based dollar per nameplate watt prices.

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 polycrystalline (Poly) PV. Model numbers included: Solarwax PST 43 and MSX 60, Shell SQ 75/80; Solar SP 102 and SQ-80, and Siemens M5Ss. Some modules had been paneled, as shown in Photo 1. Graph 1 shows these trends overlap.

New Abound Solar CdTe Modules sold between $0.77 and $0.38/watt during the 2012 bankruptcy auction (see Photo 2 & 3). Graph 1 shows these trends overlap.

**PHOTOS OF SALVAGED PV MODULES**


Photo 5 & 6: Well stacked float glass a-Si for bid in 2009.

Photo 7: Well cared for and stacked modules obtain best salvage price.

Photo 8: Panorama of poorly handled float glass a-Si for bid 2005.

**Change over time of average/technology salvage prices**

Graph 1: Trends for salvage sales, 2005 to 2012.

In 2011 we examined the 144 Solec SP-102’s 24 volt modules shown in photo #4 for the actual resale value. Operating modules produced approximately 85 watts in full sun, consistent with a 1%/year degradation. Performance was field measured with a 100 watt variable resistor providing voltage open circuit, short circuit current and a good approximation of voltage and current at max power in full sunlight. Good modules with junction boxes sold on a roadside in Grass Valley CA (see Photo 9) for between $30 and $50 each. Modules without junction boxes sold in bulk for $20 each. Approximately 15% of the modules were discarded because of glass breakage (see Photo 10), delamination, serious browning of EVA (see Photo 5), obvious burn marks on interconnections or damaged backsheets. Angle aluminum used to panelize the modules was salvaged at a high value. The time needed to transport, warehouse, clean, examine, sort, inventory, and sell the surplus modules considerably reduced the value of the salvage operation. Ideally modules would be taken out of service with immediate installation in a new location.

**CONCLUSION**

There is a healthy resale market for PV modules that should be recognized in project level economic calculations. The salvage price is a market reflection of the reliability. 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. Live auction might provide higher salvage values as in the Abound Solar experience. There exists a healthy used PV module market. Safety and performance standards for used modules will become more important as salvaged modules show up in greater numbers in future years. Recycling is an important industry issue.

**PHOTOS OF SALVAGED PV MODULES**

Photo 9 & 10: Selling PV in CA, Broken and good quality modules.

**TRENDS FOR SALVAGE SALES, 2005 TO 2012**

Graph 1: Trends for salvage sales, 2005 to 2012.

2011 Salvage Operation

In 2011 we examined the 144 Solec SP-102’s 24 volt modules shown in photo #4 for the actual resale value. Operating modules produced approximately 85 watts in full sun, consistent with a 1%/year degradation. Performance was field measured with a 100 watt variable resistor providing voltage open circuit, short circuit current and a good approximation of voltage and current at max power in full sunlight. Good modules with junction boxes sold on a roadside in Grass Valley CA (see Photo 9) for between $30 and $50 each. Modules without junction boxes sold in bulk for $20 each. Approximately 15% of the modules were discarded because of glass breakage (see Photo 10), delamination, serious browning of EVA (see Photo 5), obvious burn marks on interconnections or damaged backsheets. Angle aluminum used to panelize the modules was salvaged at a high value. The time needed to transport, warehouse, clean, examine, sort, inventory, and sell the surplus modules considerably reduced the value of the salvage operation. Ideally modules would be taken out of service with immediate installation in a new location.

2010

In 2010, EVA (see Photo 5), obvious burn marks on interconnections or damaged backsheets. Angle aluminum used to panelize the modules was salvaged at a high value. The time needed to transport, warehouse, clean, examine, sort, inventory, and sell the surplus modules considerably reduced the value of the salvage operation. Ideally modules would be taken out of service with immediate installation in a new location.

2009

In 2009, EVA (see Photo 5), obvious burn marks on interconnections or damaged backsheets. Angle aluminum used to panelize the modules was salvaged at a high value. The time needed to transport, warehouse, clean, examine, sort, inventory, and sell the surplus modules considerably reduced the value of the salvage operation. Ideally modules would be taken out of service with immediate installation in a new location.

2008

In 2008, EVA (see Photo 5), obvious burn marks on interconnections or damaged backsheets. Angle aluminum used to panelize the modules was salvaged at a high value. The time needed to transport, warehouse, clean, examine, sort, inventory, and sell the surplus modules considerably reduced the value of the salvage operation. Ideally modules would be taken out of service with immediate installation in a new location.

2007

In 2007, EVA (see Photo 5), obvious burn marks on interconnections or damaged backsheets. Angle aluminum used to panelize the modules was salvaged at a high value. The time needed to transport, warehouse, clean, examine, sort, inventory, and sell the surplus modules considerably reduced the value of the salvage operation. Ideally modules would be taken out of service with immediate installation in a new location.

2006

In 2006, EVA (see Photo 5), obvious burn marks on interconnections or damaged backsheets. Angle aluminum used to panelize the modules was salvaged at a high value. The time needed to transport, warehouse, clean, examine, sort, inventory, and sell the surplus modules considerably reduced the value of the salvage operation. Ideally modules would be taken out of service with immediate installation in a new location.

2005

In 2005, EVA (see Photo 5), obvious burn marks on interconnections or damaged backsheets. Angle aluminum used to panelize the modules was salvaged at a high value. The time needed to transport, warehouse, clean, examine, sort, inventory, and sell the surplus modules considerably reduced the value of the salvage operation. Ideally modules would be taken out of service with immediate installation in a new location.

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PVX2010_wohlgemuth.pdf

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