

# Closing the Loop: Sustainable Approaches to Total PV Recycling

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**An Integrated Mechanical, Physical, and Chemical/Electrochemical Technique for EOL solar modules recovery, with a focus on minimizing emissions and reducing the use of hazardous chemicals.**

## Technology Summary and Key Features:

- Efficiently recovers all valuable materials from EOL solar modules, including aluminum, polymers, glass, silicon, silver, tin and copper,.
- Utilizes fractional softening and melting for the separation of polymers from the solar wafer, achieving over 97% polymer recovery and a glass recovery rate of over 98%.
- Employs rapid molten alkali etching to recover silicon with a recovery rate of over 97% from the solders.
- Applies simple oxidation and solvent washing processes to fully recover copper wires.
- Incorporates electrodeposition to achieve a recovery rate of over 90% for metals (silver and tin).

## Technology Impact:

Helping the U.S. to Achieve Key Objectives in Solar Recovery:

- An environmental sustainability & circular Economy Contribution,
- Resource Efficiency and Reduction of E-Waste,
- Cost-Effectiveness.

Proposed Technology	Common methods
✓ Aluminum (100%)	✓ Aluminum (95-98%)
✓ Polymers (>97 %)	✗ Polymers
✓ Glass (>98 %)	✓ Glass (80-90%)
✓ Silicon (>97 %)	✓ Silicon (85-90%)
✓ Copper (100 %)	✗ Copper
✓ Ag and Sn (> 90%)	✗ Ag and Sn

