

# MANAGEMENT OF PHOTOVOLTAIC PANELS AT END OF LIFE: PROCESSES FOR THE RECOVERY OF VALUABLE MATERIALS

**Innovations and Benefits** - The actually available technologies for materials recovery from photovoltaic (PV) waste are energetically expensive and with a high environmental impact.

ENEA carries out activities to develop innovative and environmentally sustainable methods to recover valuable materials deriving from PV plants at the end of their life. Our goals are to optimize the global economy of the production process of new panels from recycled materials and to obtain benefits in the reduction pollution and protection of the environment. The correct management of PV waste allows the minimization of the volume and quantity of materials sent to landfill, the recovery and recycling of useful and exploitable materials (glass, aluminium, silver, copper, semiconductors, etc.), the reduction in consumption of raw materials and energy and then the positive closing of the energy balance of the complete life cycle of a PV module.

**Use** - Development of methodologies for the materials recovery to be introduced into eco-sustainable processes for the production of photovoltaic modules and electronic components.

Photovoltaic module production companies, electronic waste disposal / material recovery companies.

**Applications and ongoing Activities** - The ongoing activity is focused on the delamination of c-Si PV panels through thermal/physical treatments with reduced environmental and energy impact for the recovery of high-value components: Si, Ag, Cu, Al.

In particular, the goal is:

- to optimize, to simplify and to reduce the energy consumption of the separation techniques of the materials contained in the panel structure;
- to minimize the release into the environment of hazardous elements (metals and toxic organic substances) deriving from recovery treatments.



Tubular furnaces for the thermal treatment in flow of the PV modules



Gas chromatograph-FID / TCD for gaseous emissions analyses



Microwave digester for mineralization of samples containing metals



AA spectrophotometer for metals analysis in ashes, organic residues and gaseous emissions deriving from thermal treatment

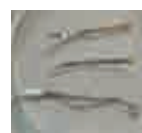


Typical disused PV panel subjected to thermal treatment

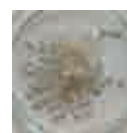
Recovered materials



Silicon



Metal electrodes



Glass

