e-Waste Responsible Recycling

PERRY JOHNSON REGISTRARS PJR

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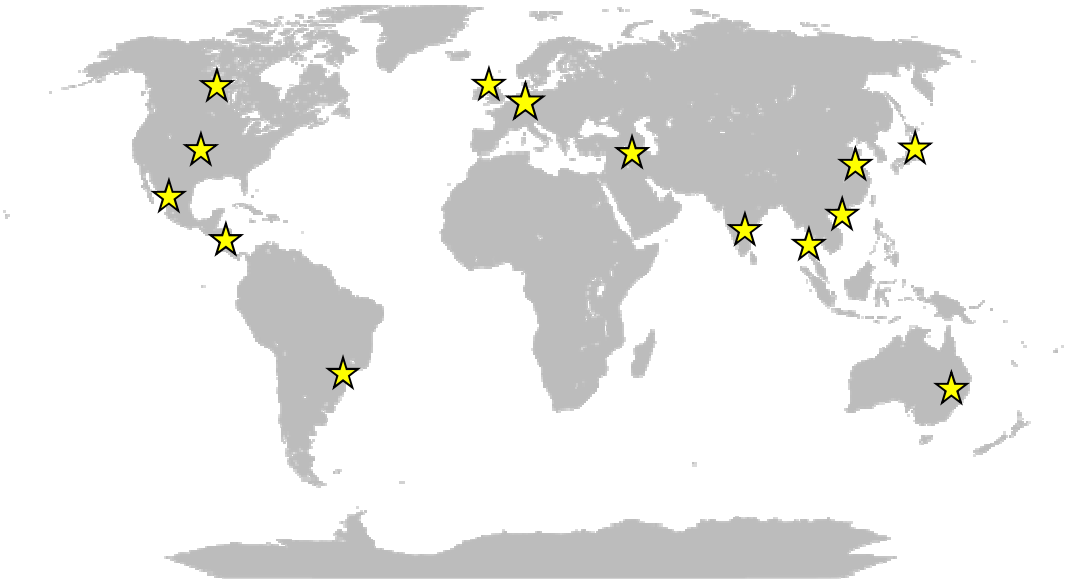
PJR is the #1 R2 Registrar in the World

Countries where PJR has certified companies to R2:

- Australia
- Canada
- Costa Rica
- Hong Kong
- Brazil
- India
- Japan
- Malaysia
- Mexico
- Thailand
- Singapore
- European Union
- United States



What is R2?

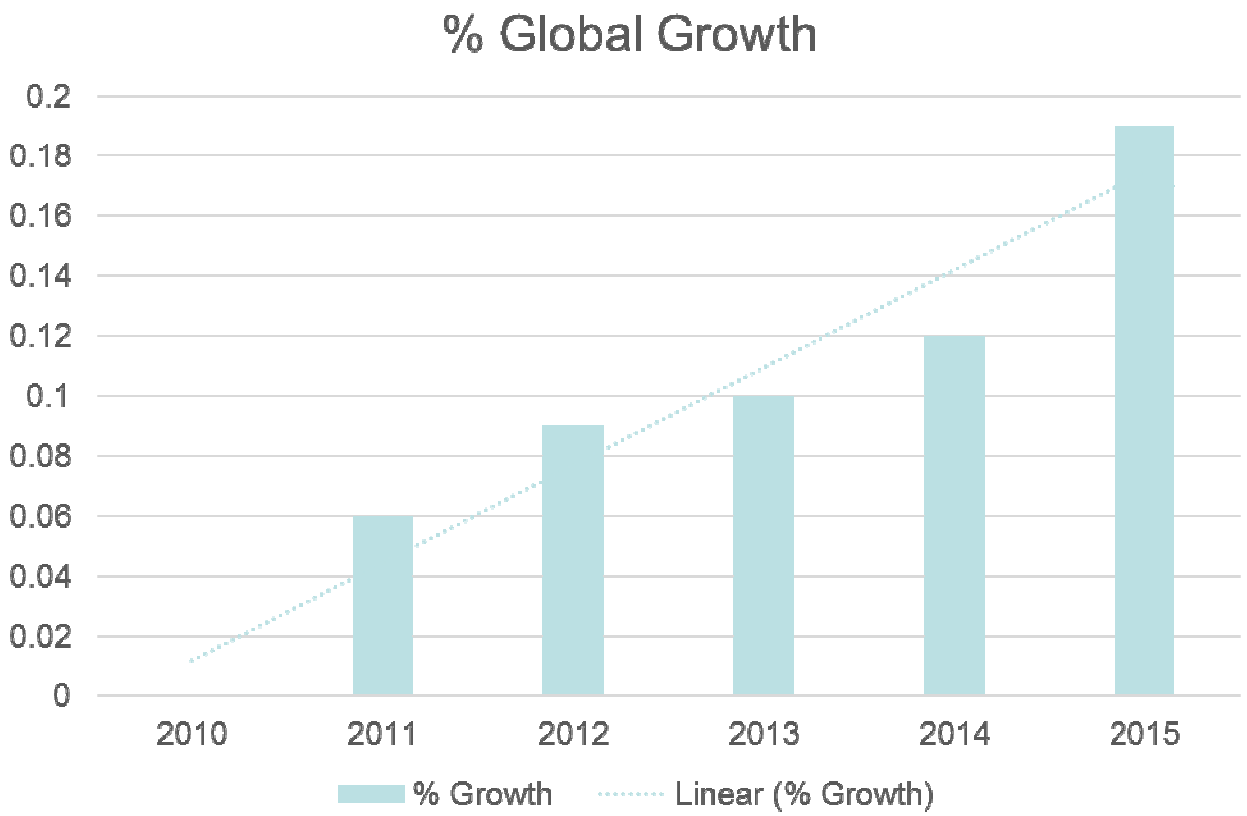
- R2 is the leading standard for electronics repair and recycling
- The R2 Standard provides a common set of processes, safety measures, and documentation requirements for businesses that repair and recycle used electronics.
- Who Can get certified?
  - e-Waste recyclers
  - e-Waste refurbishers
  - End-of-life processors of e-Waste (e.g. smelter, refiner, etc.)
  - Brokers

- **600 facilities are currently R2 certified in 21 countries, with more added every day.**

About R2:2013

- The initial R2 Standard was published in 2008 (R2:2008). It was later revised to the current standard, R2:2013, effective July 1, 2013.
- Developed for international use.
- R2:2013 is not intended to be an EH&S Management System by itself.
- R2:2013 requires a company to meet one of the following requirements:
  - Certification to ISO 14001 **and** OHSAS 18001; **OR**
  - Certification to the Recycling Industry Operating Standard (RIOS).

R2 Statistics

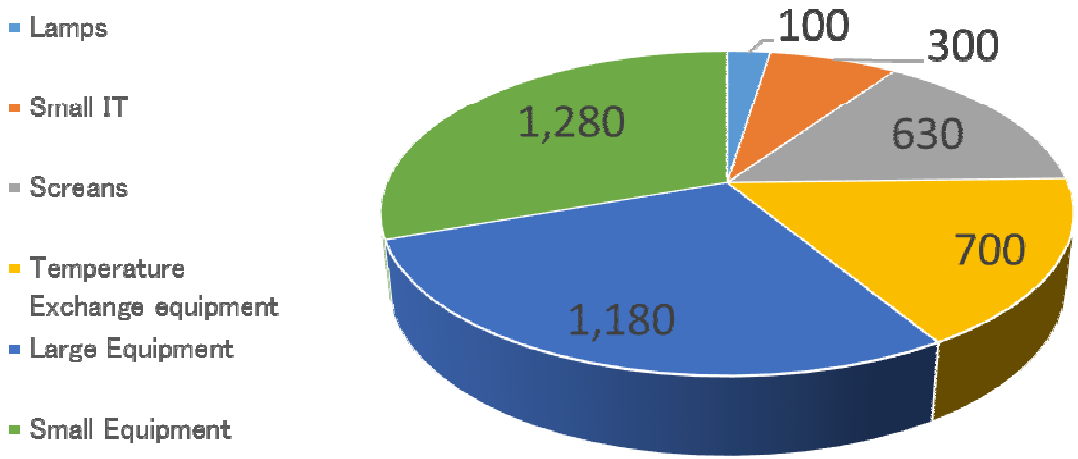


Worldwide disposal of e-waste

Source : THE GLOBAL E-WASTE MONITOR 2014

GLOBAL QUANTITY OF E-WASTE GENERATED			
Year	E-waste generated (Mt)	Population (billion)	E-waste generated (kg/inh.)
2010	33.8	6.8	5.0
2011	35.8	6.9	5.2
2012	37.8	6.9	5.4
2013	39.8	7.0	5.7
2014	41.8	7.1	5.9
2015	*43.8*	*7.2*	*6.1*
2016	*45.7*	*7.3*	*6.3*
2017	*47.8*	*7.4*	*6.5*
2018	*49.8*	*7.4*	*6.7*

Data 2015 onwards are forecasts



• Lamps. Typical equipment comprises straight fluorescent lamps, compact fluorescent lamps, fluorescent lamps, high intensity discharge lamps and LED lamps).

• Small IT and telecommunication equipment. Typical equipment comprises mobile phones, GPS, pocket calculators, routers, personal computers, printers, telephones).

• Screens, monitors. Typical equipment comprises televisions, monitors, laptops, notebooks, and tablets.

• Temperature exchange equipment. Also more commonly referred to as, cooling and freezing equipment. Typical equipment is refrigerators, freezers, air conditioners, heat pumps.

•Large equipment. Typical equipment comprises washing machines, clothes dryers, dish washing machines, electric stoves, large printing machines, copying equipment and photovoltaic panels.

• Small equipment. Typical equipment comprises vacuum cleaners, microwaves, ventilation equipment, toasters, electric kettles, electric shavers, scales, calculators, radio sets, video cameras, electrical and electronic toys, small electrical and electronic tools, small medical devices, small monitoring and control instruments).

Export of e-Waste

Benefits of Certification

- Key benefits of R2 certification:
  - Meet upstream vendor requirements
  - Instills confidence through certified third party review
  - Eliminate the improper disposal of hazardous electronic components
  - Demonstrates compliance with domestic and international laws
  - Enhance customer satisfaction

R2 Requirements

1. Environmental, Health and Safety Management System
2. Reuse, Recover … Hierarchy of Responsible Management Strategies
3. Legal Requirements
4. On-Site Environment, Health and Safety
5. Focus Materials
6. Reusable Equipment and Components
7. Tracking Throughput
8. Data Destruction
9. Storage
10. Security
11. Insurance, Closure Plan and Financial Responsibility
12. Transport
13. Documentation and Recordkeeping

Focus Materials

The following are considered “Focus Materials”:

- CRT vendors (Monitors, TVs, equipment).
- Battery vendors.
- Mercury Containing Device vendors (switches/relays, bulbs, laptops, LCD displays, TVs).
- PCBs vendors.
- Circuit Board vendors.
  - This includes materials such as keyboards, mice, cell phones, power supplies, etc. that contain a circuit board.

R2 Requirements

Environmental, Health & Safety Management System:

- Establish the Scope.
- Management review and internal audits, at least annually.
- EHS and data security objectives.
- List of activities and documents necessary to conform to R2.

"Reuse, Recover…"Hierarchy of Responsible Management Strategies:

- Develop policy for managing used and end-of-life electronics equipment.
- Policy must be based on the hierarchy of responsible management strategies: Reuse, Materials Recovery, Energy Recovery and Land Disposal.

R2 Requirements

Legal Requirements:

- Develop a legal compliance plan, including import/export requirements.
- Maintain Facility Compliance.
- Maintain import/export compliance.
- Compliance evaluation.

On-Site Environmental, Health & Safety:

- Adhere to good housekeeping standards.
- identify and assess EHS risks and implement controls.
- Conduct monitoring and sampling of EHS risks and controls.
- Designate qualified employee(s) to manage EHS.
- prepare, periodically test, and update an emergency plan.

R2 Requirements

R2 Focus Materials:

- Development and Adherence to an FM Management Plan.
- Removal of FMs.
- Processing, Recovery, and Treatment of FMs.
- Prohibition on Energy Recovery, Incineration, and Land Disposal of FMs.
- Selection and Ongoing Due Diligence of Downstream Vendors for FMs.
- Non-Focus Materials Requiring Specific Management.
  - Print Cartridges.

R2 Requirements

Reusable Equipment & Components:

1. Tested for Full Functions, R2/Ready for Reuse;
2. Tested for Key Functions, R2/Ready for Resale; and/or
3. Evaluated and Non-Function, R2/Ready for Repair.

- Use effective test methods (1 and 2)
- Written Quality Assurance Plan and Policy (1, 2, and 3)
- Disclose in writing any functions not working (2)
- Product Return Plan and Policy (1 and 2)
- No major cosmetic defects (1)
- Meet customer requirements (1, 2, and 3)
- Meet DSV due diligence requirements (3)

R2 Requirements

Tracking Throughput:

- Maintain records of tracking throughput for at least three years:
  - Commercial contracts, bills of lading, or other commercially-accepted documentation for all transfers of equipment, components, and materials.
  - An R2:2013 electronics recycler does not need to track non-FM's beyond the first tier downstream vendor.

R2 Requirements

Data Destruction:

- Sanitize, purge, or destroy data on hard drives and other data storage devices.
- Review and validate processes.
- Ensure quality controls are in place.
- Ensure security controls are in place.
- Outsourcing of data destruction

R2 Requirements

Storage of FM's, equipment, and components:

- Protected from the environments.
- Is in full legal compliance.
- Access controlled/security.
- Container labeling and storage area identification.

Facility Security:

- Consider equipment, sensitivity of media containing data, and customer needs.
- Consider and include necessary controls to secure electronic equipment upon acceptance of said equipment.

R2 Requirements

Insurance, Closure Plan and Financial Responsibility:

- Evaluate the risks and ensure adequate insurance or reserves to cover liabilities, including environmental pollution and worker health and safety.
- Develop a Closure plan that assures proper closure in case of abandonment.
- Ensure financial instrument is in place to properly close the facility:
  - Must be assigned to an independent party or corporate parent.
  - Shall cover reasonably foreseeable costs of processing remaining inventory, sampling for environmental contamination, and site remediation to restore premise to sellable condition.

R2 Requirements

Transportation:

- Comply with regulatory requirements
- Maintain adequate insurance coverage,
- maintain an acceptable vehicle and driver safety record during the previous 3 years.

Documentation and Recordkeeping:

- Maintain access at the certified facility to documents and records.

About e-Stewards

- Encompasses the globally recognized certification **ISO 14001** environmental management system.
- Prohibits all toxic waste from being disposed of in solid waste landfills and incinerators.
- Requires full compliance with existing international hazardous waste laws and treaties for exports and imports of electronics, and specifically prohibits the export of hazardous waste to developing countries.
- Requires extensive baseline protections for and monitoring of recycling workers in every country, including developed nations where toxic exposures are routinely taking place.
- Is written for international use.

e-Stewards Statistics

Hazardous Electronic Equipment (HEE)

- Asbestos
- Batteries
- Cathode Ray Tubes (CRT)
- Circuit Boards, lamps, switches or any other parts, materials, assemblies, housings, cables, and wires which contain any of the applicable substances in levels exceeding the indicated thresholds.
- Mercury: Circuit boards, lamps, switches, LCD displays, and other parts, components or assemblies containing intentional inputs of mercury.
- Polychlorinated Biphenyls (PCBs)
- Radioactive waste
- Selenium & arsenic (i.e. printer or copy drums)
- Any other material deemed hazardous waste

How e-Stewards is different

- Licensing fees vary between programs.
- Social accountability values within its Organization consistent with the principles of SA 8000 (certification is not required).
- At least every three years a risk assessment shall be conducted by an Occupational Environmental Health and Safety Professional(s).
- Increased requirements for downstream due diligence.
- Specific reuse thresholds for equipment (e.g. batteries).
- Tracking of electronic equipment requires material balance accounting.
- Annual Reporting requirements to e-Stewards.

Solar Panel Recycling

Companies That Recycle

- First Solar
  - Tempe, Arizona
  - "First Solar leads the industry with proven recycling solutions that fulfill solar's promise as a clean and sustainable renewable energy"

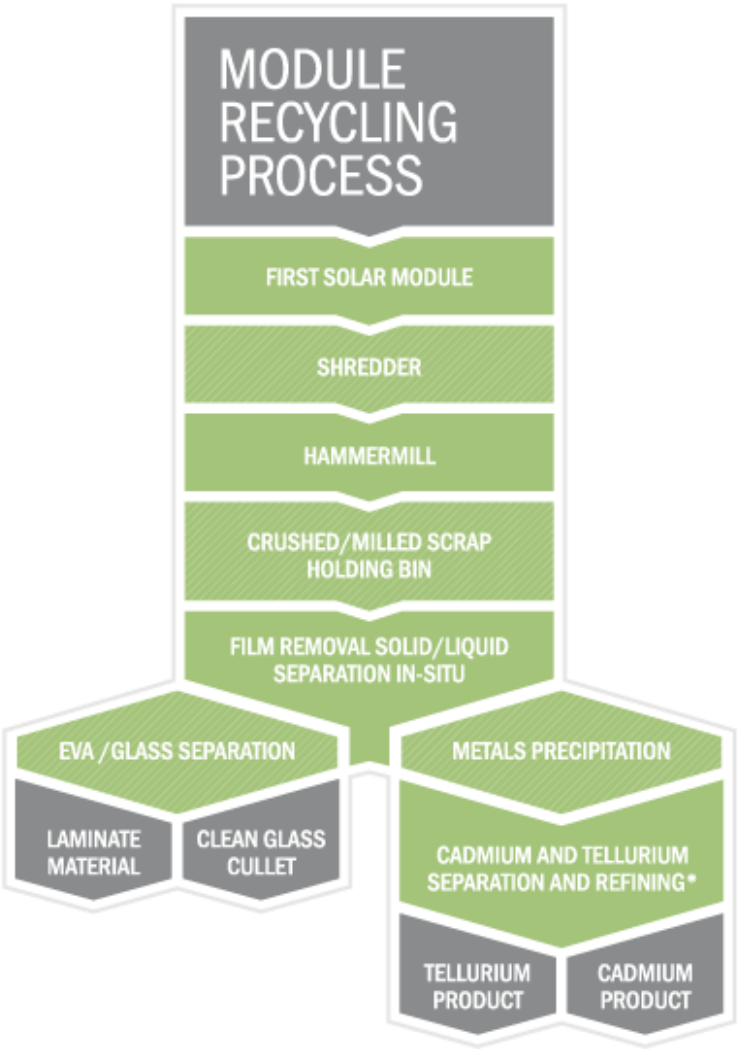
First Solar

- First Solar pioneered the first global and comprehensive recycling program in the PV industry in 2005

- Up to 90% of the semiconductor material can be reused in new modules and 90% of the glass can be reused in new glass products.

First Solar Process of Recycling

**Cadmium and tellurium separation and refining are conducted by a third-party.*



PV Cycle

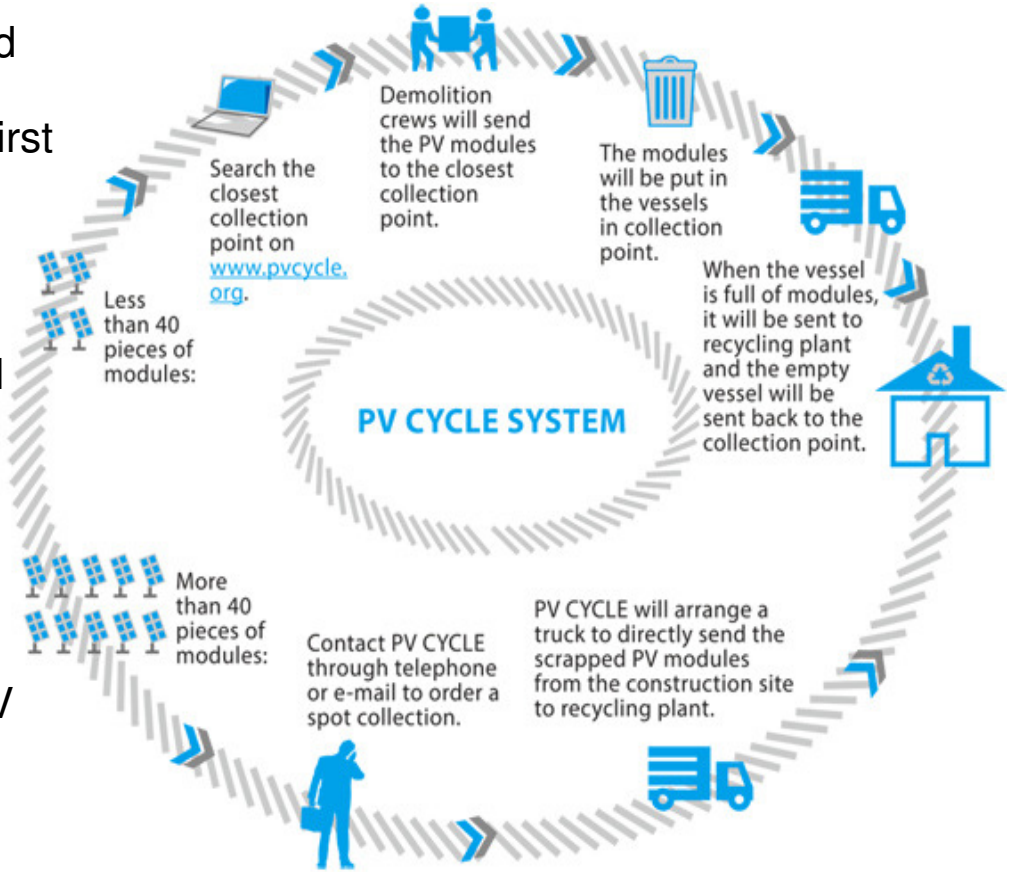
- USA Inc., Multiple USA Locations

- “The primary purpose of PV CYCLE is to promote sustainable lifecycle management in the PV industry, educate companies and communities about the benefits of sustainable waste management, and provide safe and sustainable options for discarded solar energy system products”

ASSOCIATION PV CYCLE

PV Cycle System

- The execution of all administrative and operative tasks is subcontracted to PV CYCLE Association aisbl, the world's first collective take-back and recycling scheme for PV modules.
- Waste holders with a dismantling need can benefit from a comprehensive decommissioning service for PV installations, covering dismantling by professionals and waste packaging.
- Our dismantling service is limited to PV projects.
- Offer a direct pick-up service for a variety of waste products, including PV modules, batteries, EEE or production scrap



Solar Energy Industries Association
Washington, DC

- "As the national trade association in the U.S., we represent all organizations that promote, manufacture, install and support the development of solar energy."

SEIA Solar Energy Industries Association®

SEIA

- SEIA members are currently engaged in developing collection and recycling processes for the solar industry, and are committed to guiding both state and federal regulations that support safe and effective collection and recycling models.
- Several SEIA members operate take-back and recycling programs or engage with suitable waste handlers and disposers for their products.
- End-of-life disposal of solar products in the US is governed by the Federal Resource Conservation and Recovery Act (RCRA), and state policies that govern waste

- **<u>Hazardous Materials in Solar Panels:</u>**

  Fabricating the panels requires caustic chemicals such as sodium hydroxide and hydrofluoric acid, and the process uses water as well as electricity, the production of which emits greenhouse gases.

  Silicon is used to make the vast majority of today's photovoltaic cells

  Other Chemicals Used:
  Cadmium Telluride
  Copper Indium Selenide
  Cadmium Indium Gallium (Di)selenide

Resources

- http://www.firstsolar.com/Technologies-and-Capabilities/Recycling-Services

  http://www.pvcycle.org/usa/

  http://www.pvsolarreport.com/seia-plan-recycling-solar-panels/

  http://www.seia.org/policy/environment/pv-recycling

  http://www.trinasolar.com/us/about-us/Sustainability.html

  http://news.nationalgeographic.com/news/energy/2014/11/141111-solar-panel-manufacturing-sustainability-ranking/

  http://classroom.synonym.com/toxic-chemicals-solar-panels-18393.html