



Design for Recycling[®]: History, Challenges, Opportunities

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- ISRI
- Recycling
- Design for Recycling®
- Closing Thoughts



Manufacturers
Processors
Industrial Consumers

Brokers & Traders
Equipment/Services

\$117 Billion Industry Produced >130 Million Metric Tons of Recycled Materials

Our Mission

To promote safe, economically sustainable & environmentally responsible recycling through networking, advocacy & education.

- Workplace Safety
- Responsible Recycling
- Education, Training & Networking
- Specifications
- Design for Recycling®
- Market Intelligence
- Awareness
- Advocacy
- COVID-19 Resources

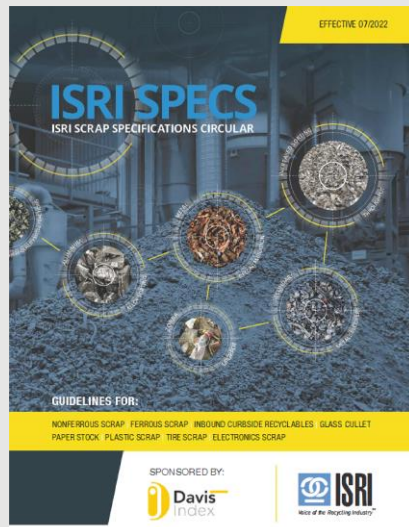
- Sufficient material value
- Sufficient material available for recycling
- Cost-effective recycling technologies
- Efficient material logistics
- Markets for recycled material
- Favorable policies, laws, and regulations

- Recycling should be driven by market forces.
- Recyclable materials and recycled materials should move as freely as primary materials.
- Policies or legislation to support markets for difficult-to-recycle items and materials may be appropriate and should provide support temporarily until markets mature.
- Manufacturers should consider end of use and recycling when designing and manufacturing products, consistent with ISRI's Design for Recycling® principles.

Recycling is a Materials Business Driven by Demand

It doesn't matter how much recyclable material is collected and processed, if there is no market on the other end to utilize the recycled material, the recyclables will not move ... and recycling has not occurred.

Material manufacturers will only purchase recycled material if it meets quality requirements.



ISRI's Specifications play a key role:

- Provide the global standard for consistency & quality
- Reflect tolerances allowed by manufacturers
- Offer common language

Role of ISRI's Specifications

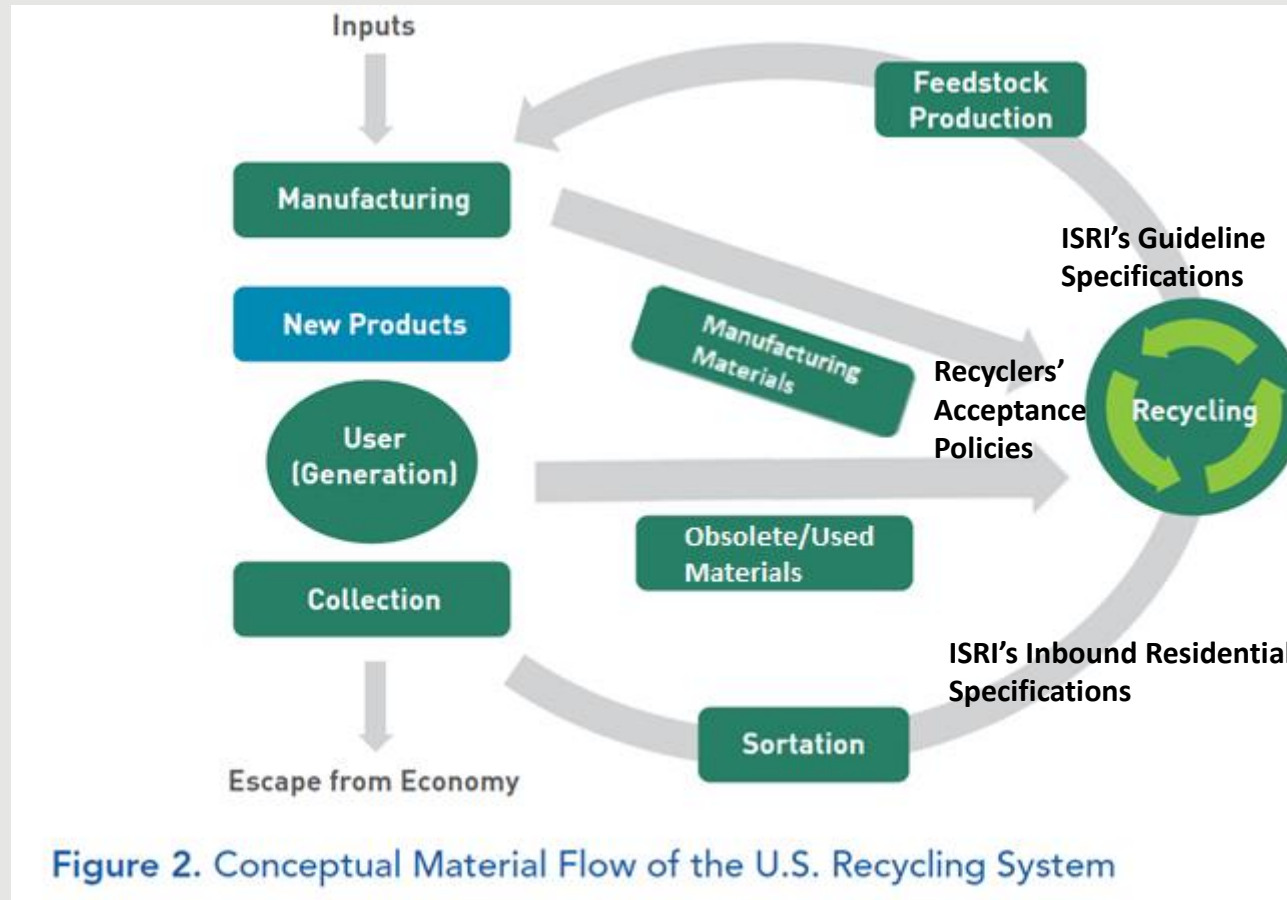


Figure adapted from EPA's "National Recycling Strategy: Part One of a Series on Building a Circular Economy for All" (November 15, 2021) to include manufacturing materials

ISRI's Design for Recycling® principles seek to increase sustainability of consumer durables by:

- Eliminating or reducing use of hazardous substances and material impediments to the recycling process
- Maximizing use of recycled materials
- Maximizing yield of recyclable materials at end of life
- Working with manufacturers, government, and other stakeholders to achieve above goals

An ISIS issue paper
dealing with potential hazardous wastes
and potentially nonrecyclable materials.

Design for Recycling

To date, the approach to the hazardous waste problem has been to

Hazardous Materials

Americans are being subjected to un-

Institute of Scrap Iron and Steel. *Phoenix Quarterly*. 1986, 18(1), 8-10.



Design for Recycling® Award




Design Challenges to Recycling: Materials View

- Container (ex. liner)
 - 47% steel (rim and bottom)
 - 40% paper (wall)
 - 13% HDPE (lid)
- Do all three recyclable materials get recycled?
- Recycling and environmental trade-offs between material design choices
- Closer to Circular Economy view



Design Challenges to Recycling: Impacts View

- Focus on impacts may result in different design choices.
- Landfill disposal is an impact.
- Recycling is not an impact, but it does affect landfill disposal.
- Closer to Sustainable Materials Management view

FORMAT	FOSSIL FUEL CONSUMPTION (MJ-EQUIV)	GHG EMISSIONS (KG-CO ² EQUIV)	WATER CONSUMPTION (L)	PRODUCT-TO-PACKAGE RATIO (%)	PKG LANDFILLED ((G)/1 000 KG COFFEE)
STAND-UP FLEXIBLE POUCH 	6,654	353	1011	96:4	40,294
PLASTIC (HDPE) CANISTER 	41,130 (+518%)	1678 (+376%)	3,164 (+213%)	83:17	142,063 (+252%)
STEEL CAN 	36,809 (+453%)	2763 (+683%)	17,238 (+1605%)	67:33	163,122 (+304%)

Source: Flexible Packaging Association. "Life Cycle Assessment Coffee Packaging Case Study"

The REMADE Institute

(www.remadeinstitute.org)

- **Reduced EModied-Energy And Decreased Emissions Institute for Sustainable Materials Manufacturing**
- A Manufacturing USA® Institute funded by Department of Energy
- \$140M/5-Year Public-Private Partnership in 1:1 Match
- Goal: To drive down the cost of technologies essential to reuse, recycle and remanufacture materials
- Four Material Types: Metals; Electronics; Polymers; and Fibers
- Five Focus Nodes
 - Systems Analysis & Integration
 - **Design for Re-X (includes Design for Recycling®)**
 - Materials Optimization
 - Remanufacturing
 - Recycling/Recovery
- Membership is open to for-profit companies, non-profit organizations, and academia.
 - ISRI is a Founding REMADE Affiliate Member and member of Strategic Advisory Committee.

- Development of an Industrially Relevant RE-SOLAR Design Framework / Design for RE-Solar
 - To provide “a design framework of high-efficiency modules that can be economically recycled, recovered, remanufactured, and/or reused.”
- Material and Vehicle Design for High-Value Recycling of Aluminum and Steel Automotive Sheet
 - “To increase automotive sheet metal EOL (post-consumer) recycled content”
- Analysis and Design for Sustainable Circularity of Barrier Film in Sheet Molding Composites
 - To “develop 1) data and models about alternatives for recycling, reusing, or replacing the current nylon-based SMC barrier film, and 2) an approach, database, and software for the design of sustainable and circular networks of this barrier film”
- Building Re-X (BREX)
 - To “develop a set of open access EOL databases for construction materials and create open-access BREX process models to enable EOL constraints to be incorporated into building design and materials selection”
- Quantification of Financial and Environmental Benefits Tradeoffs in Multi-Generational Product Family Development Considering Re-X Performances
 - “To develop fundamental models and new design tools with capabilities of generating and comparing design for Re-X alternatives considering economic profitability and environmental impact savings”

- ISRI's highest award to recognize outstanding products designed with recycling in mind
- Design for Recycling® Award criteria:
 - Contain the maximum amount of materials that are recyclable.
 - Be easily recycled through current or newly designed recycling processes and procedures.
 - Be cost effective to recycle, whereby the cost to recycle does not exceed the value of its recycled materials.
 - Be free of hazardous materials that are not recyclable or impede the recycling process.
 - Minimizes the time and cost involved to recycle the product.
 - Reduce the use of raw materials by including recycled materials and/or components.
 - Have a net gain in the overall recyclability of the product while reducing the overall negative impact on the environment.
- Award applicants and recipients are not required to be members of ISRI.
- More information and the application are available at www.isri.org/dfr.

Design for Recycling® Award History

Year	Company	Product	Year	Company	Product
2022	Sonoco Alloyd	EnviroSense® PaperBlister™ Packaging	2014	Dell, Inc.	Dell Latitude 10 and XPS 10 tablets; Latitude E7240 laptop
2021	Cascade Engineering	EcoCart™	2012	Cascades Fine Papers Group	100% Recycled and Recyclable Ream Wrapper for its fine paper
2020	Lexmark	Lexmark Toner Cartridges	2011	Wind Simplicity	Windancer™ small wind turbine
2019	Nestlé Waters North America	Nestlé® Pure Life® 700ml Bottle	2010	Coca-Cola Recycling Company	PlantBottle
2018	Dell, Inc.	The Latitude 5590 Laptop and 5285 2-in-1	2009	The Herman Miller Company	Cradle-to-Cradle products
2017	EcoStrate SFS, Inc.	100% recycled-plastic products	2007	U.S. EPA	Design for the Environment Program
2016	Samsung	2016 Curved Full HD TV (UN55K6250)	2006	Hewlett Packard	Products with lower hazards, simpler design and disassembly
2015	LG Electronics, Inc.	4K ULTRA HD OLED and LED TVs			

2023 Design for Recycling® Award Timeline

Date	Activity
September 19, 2022	Initial call for submissions
February 17, 2023	Deadline for submissions
March 10, 2023	Request for additional information deadline
March 13 - 17, 2023	Application review
March 20, 2023	Notification to applicants
April 17 - 20, 2023	Traditional award date for ISRI2023 Convention and Exposition in Nashville
See www.isri.org/dfr for details.	

- Successful recycling requires material value, scale, recycling technologies, logistics, markets, and policy/regulation to work together.
- ISRI originally developed Design for Recycling® principles to address consumer durables that used hazardous materials and/or nonrecyclable materials.
- Use of Design for Recycling® principles can remove barriers and impediments to product recycling at end-of-life via better, more-sustainable design choices.
- Challenges and opportunities for Design for Recycling® exist.
- ISRI's Design for Recycling® Award seeks to recognize outstanding products designed with recycling in mind and their manufacturers.
- Apply for the 2023 Design for Recycling® Award by February 17, 2023 at www.isri.org/dfr.

Thank you!

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