



Remanufacturing

by

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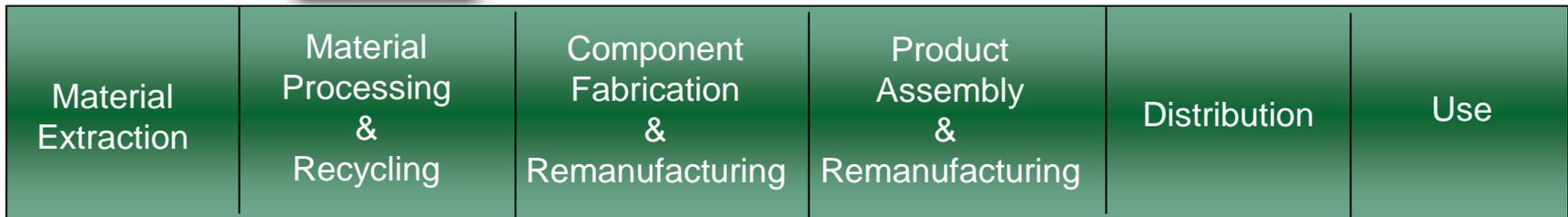
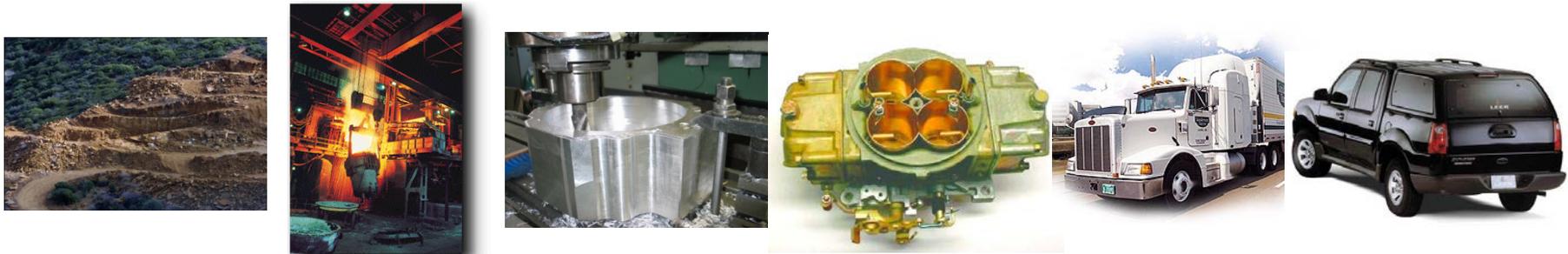
September 25, 2014

Overview Presentation Agenda

- What is Remanufacturing
- Remanufacturing Industry
- Benefits of Remanufacturing
- Corporate Examples
- Overview of Golisano Institute for Sustainability

What is Remanufacturing?

Remanufacturing is an industrial process by which retired or non-functional products are returned to “like-new” or “better than new” condition. This enables sustainable production and consumption.



Recycling



Remanufacturing



Refurbishing

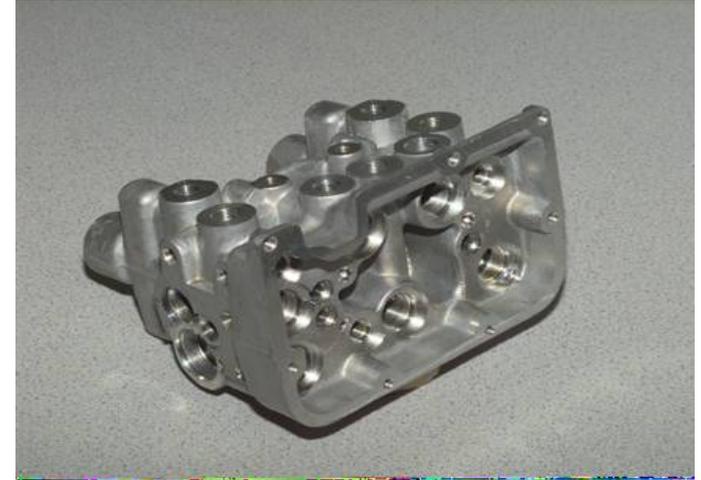
Refurbishing is a process where the product is inspected to identify repair needs, repaired, and restored aesthetically but not fully disassembled to recertify all components.

- Other Similar Terms
 - Restored
 - Rebuilt
 - Reconditioned
 - Factory Recertified



Recycling

Recycling is a disposition process where products are dismantled or processed to reclaim the material content, but not the value added features.



Remanufacturing Industry

Industry Characteristics



History of U.S. Remanufacturing

- The origins of the U.S. remanufacturing industry go back to the 1920's and 1930's, with the emergence of mass production and standardization in American industry.
 - Economic and resource constraints of the Depression era also served as a stimulus for remanufacturing.
- Henry Ford established first remanufacturing facility in 1932 for automobile engines
- 1940's automotive parts remanufacturing
- 1979 - 83 First remanufacturing study conducted (MIT)

History of U.S. Remanufacturing

- World War II was a major source of growth for remanufacturing, as a scarcity of raw materials such as steel drove the need to reuse durable goods, including automotive and truck parts.
- In the last 50 years, advances in technology and manufacturing have greatly expanded the scope of the remanufacturing industry to sectors such as:
 - Medical equipment - Photocopiers - Toner and ink cartridges
 - Electric motors - Office Furniture - Cell phones
- Growth in the remanufacturing industry has also resulted from the increased awareness of the need for environmental preservation.
 - In the 1970's, solid waste disposal, energy and natural resource conservation became important issues

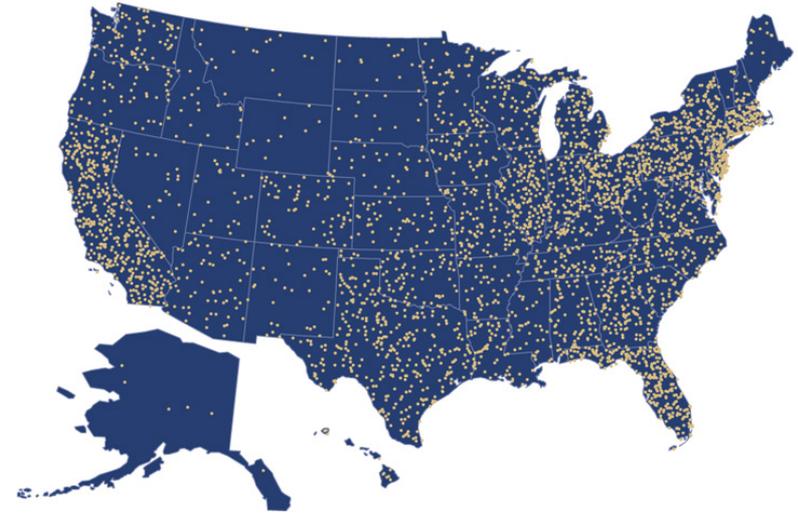
Remanufacturing Firms, Industry Sales and Employment*

Sector	Total Number of Firms	Total Sales (Millions)	Total Employment
Automotive	50,538	\$36,546	337,571
Compressors	155	\$249	2,878
Electrical Apparatus	13,231	\$4,633	47,280
Machinery	120	\$434	3,155
Office Furniture	720	\$1,663	12,148
Tires	1,390	\$4,308	27,907
Toner Cartridges	6,501	\$2,475	31,872
Valves	410	\$589	4,577
Other	250	\$2,009	14,372
Total	73,315	\$52,906	481,760

*"The Remanufacturing Industry: Hidden Giant", Robert Lund

Remanufacturing Industry

- Recent Trends
 - Higher technology found in products
 - Increased awareness among OEMs
 - Caterpillar
 - Xerox
 - Delphi
 - Hewlett Packard
 - Consolidation of smaller remanufacturers in recent years
 - Additional growth in consumer goods



U.S. Remanufacturing Industry:

- 73,000 Estimated Total Firms
- \$53 Billion in Annual Sales
- 480,000 Direct Total Employment
- \$2.9 Million average annual company sales
- 24 Employees per company on average

Source: The Remanufacturing Industry; Hidden Giant, Lund, 1996

Benefits of Remanufacturing

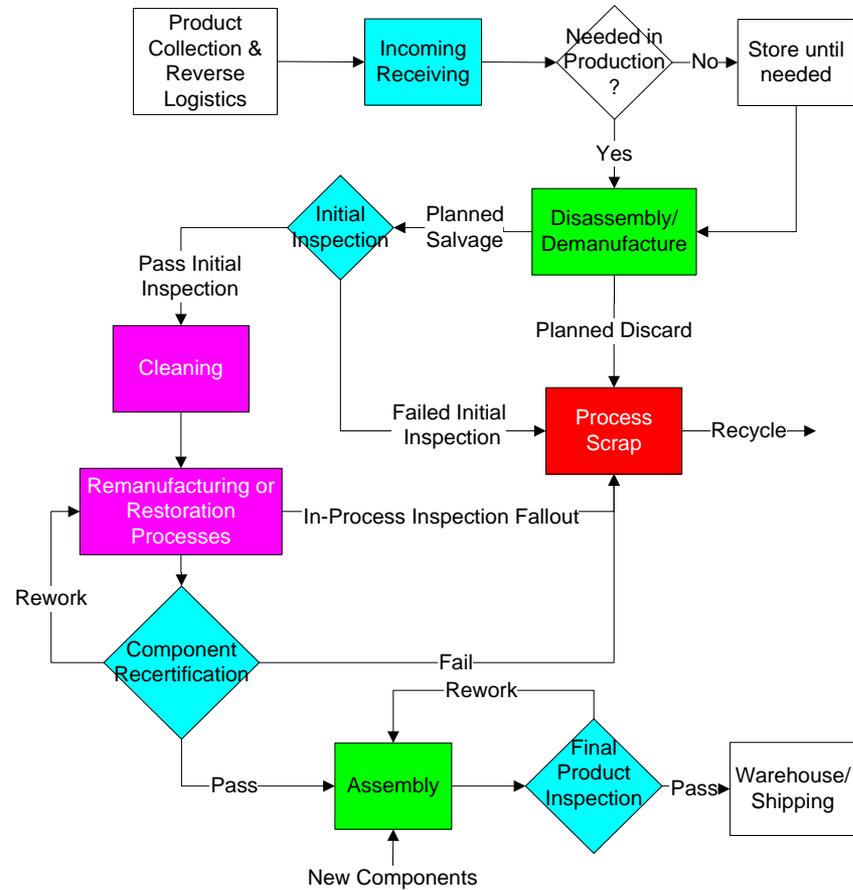
Contribution to the
Triple Bottom Line

Remanufacturing Process

Process steps required to bring product back to a “like-new” condition.

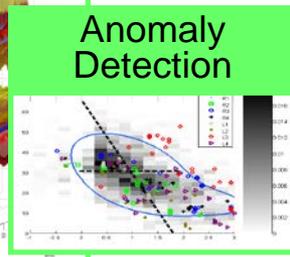
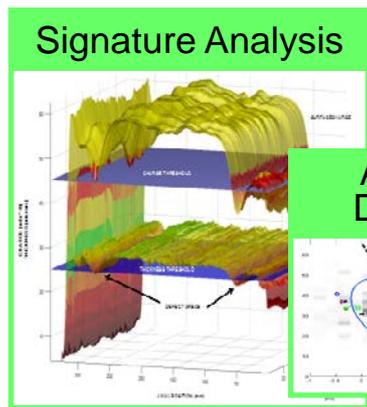
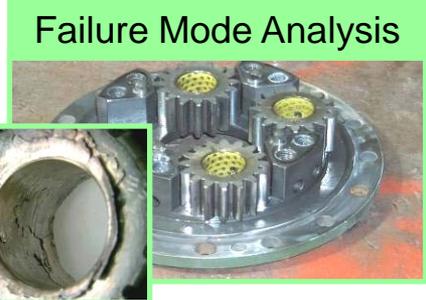
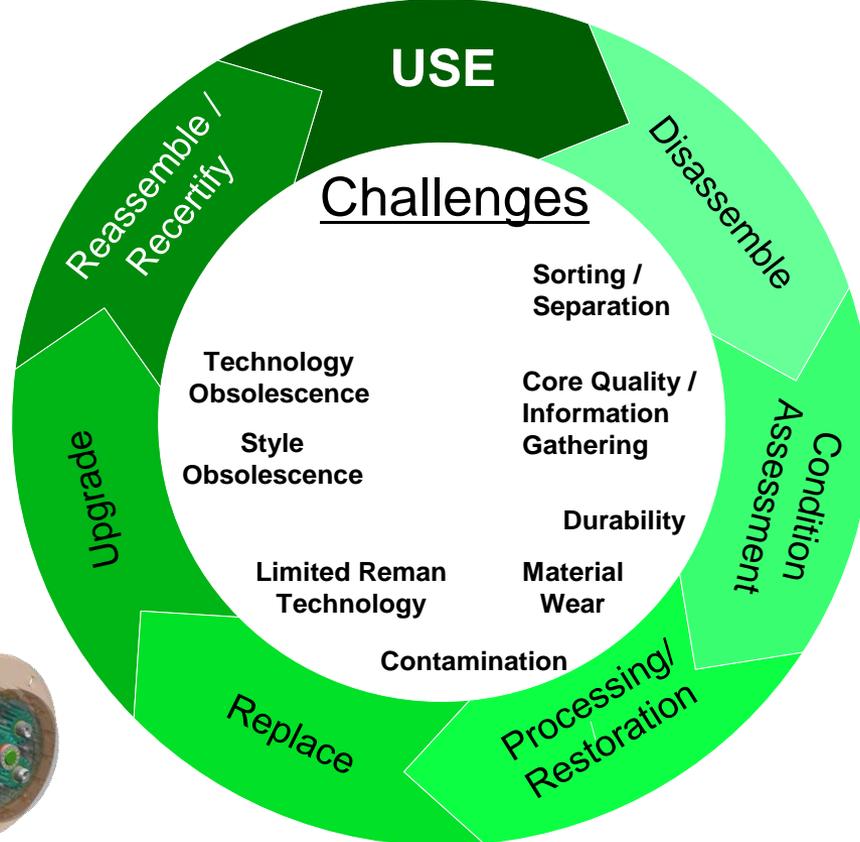
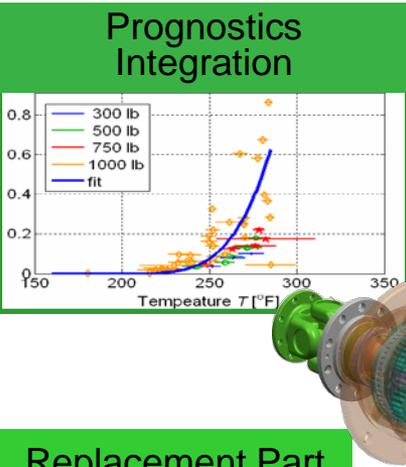
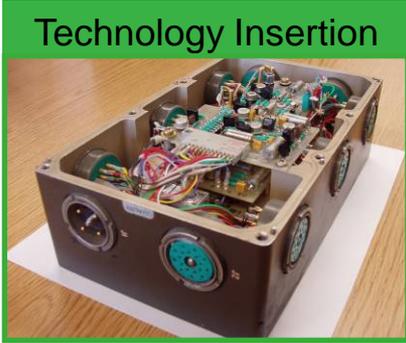
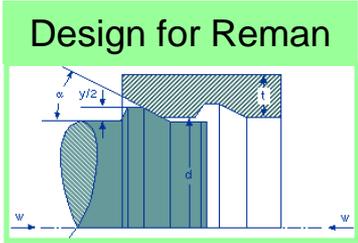
- Inspection
- Disassembly
- Cleaning
- Restoration / Replace
- Re-assembly
- Qualify

Generic Reman Process

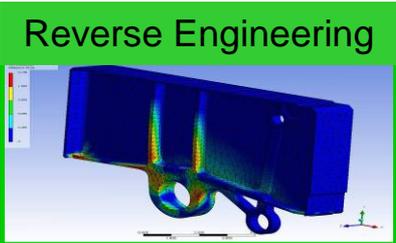


Enabling Sustainable Reman Processes and Technology

Lean Remanufacturing



Replacement Part Qualification



The Benefits of Remanufacturing

Asset Management



Extend product life

Reduce product obsolescence through life-cycle management, end-of-life disposition strategies for components and technology refresh options for remanufactured products

Economic



Lower costs for raw materials or components

Lower life cycle costs, higher margin

Remanufactured products can provide cost savings of 20% to 60% compared to the cost of new

Energy



Greater energy utilization

Energy savings through recapture of “embedded energy” in products at end-of-life

Environment



Waste reduction

Emissions reductions

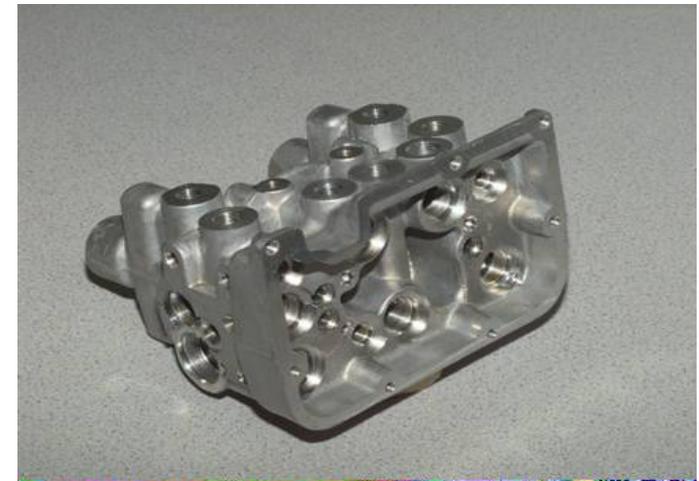
Reduced material use, preserve natural resources

Reduced process chemicals, solvents and hazardous materials

The Benefits of Remanufacturing

Approximately 85% of the energy expended in the manufacture of an original product is preserved in the remanufactured product.

- Recycling Reclaims
 - Material
- Remanufacturing Reclaims
 - Material
 - Energy from Casting, Machining, etc.
 - Labor from original processes
 - Capital
 - Function/Design Intent



Corporate Examples

Leading the Way

Xerox Corporation



- Corporate Goal: Waste Free Products and Manufacturing
 - Products designed to include easily removable subassemblies and more durable parts
 - Xerox takes back used equipment.
 - 70-90% of the parts by weight are remanufactured. Up to 60% of the parts are common with previous models.
 - Designed to be upgraded
-
- Since 1991, more than 2.8 million copiers, printers, and multifunction systems have been remanufactured while diverting almost two billion pounds of potential waste from landfills. (111 million pounds in 2006 alone)
 - Xerox saves **several hundred million dollars** per year by designing parts for remanufacture and recycling.

*http://www.xerox.com/downloads/usa/en/x/Xerox_Global_Citizenship_Report_2007.pdf.

Caterpillar

- Results of Innovative electric drive train (D7E):
 - 35-70% lower undercarriage operating cost
 - 60% fewer moving drive train parts
 - 25% more material moved per gallon of fuel used
 - 50% Better steering performance
 - Less fluids used.
- Remanufacturing
 - D7E was designed to be Remanufactured
 - After one full life, the Cat Certified Rebuild program can tap a second full life from major structures and components - <http://www.cat.com/D7E>
 - Cat uses an extensive dealer network and centralized remanufacturing facilities to service major markets



According to the results of a life cycle assessment, a Cat Certified Rebuild machine delivers the same high level of quality and performance as a new Cat machine, reusing 85 to 95 percent of the materials while consuming 50 to 60 percent less energy.

Source: <http://www.cat.com/sd2009>

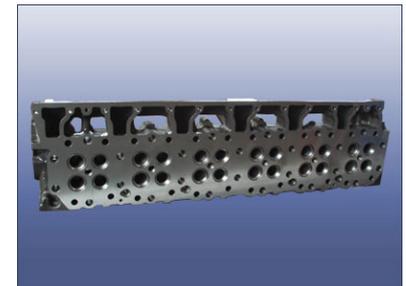
Caterpillar Corporation

- Sustainability metrics associated with remanufacturing individual assemblies

Cylinder Head*	Reman vs. New
GHG	61% Less
Water Use	93% Less
Energy Use	86% Less
Safety	82% Advantage
Material Use	>99% Less
Landfill Space	>99% Less



Cat 3412 engine



Cat 3412 head

Cardone Industries

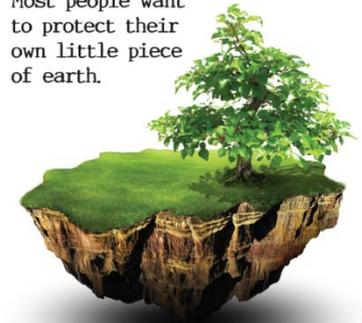
Corporate Goal: Zero discharge for environmental waste

- Largest family owned automotive remanufacturer in the world
- Employs 4,200 people in Philadelphia, PA
- Remanufactures over 43 different product lines

In 2009 Cardone Industries had the following impacts relating to the remanufacturing automotive components:

- **60,198 tons of discarded or non-usable auto parts were remanufactured**
- Cardone recycled disposable items in enormous quantities.
 - **8,517 tons of scrap metal were recycled.**
 - **53,456 gallons of waste oil was recycled into furnace fuel.**
 - **10,764 gallons of hydraulic fluids were recovered for reuse.**
 - **28 tons of electronic boards, PC monitors & telecommunications equipment recycled.**
 - 6,789 tons of cardboard were recycled into new paper products.
 - 2,514 tons of municipal trash were recycled into electrical energy.
 - 712 tons of wood skids were sent to a recycler and reused.
 - 191 tons of used stretch wrap were baled and recycled.
 - 8,739 gallons of alkaline washer bath was recycled.
 - 28,570 gallons of stoddard solvent recycled.

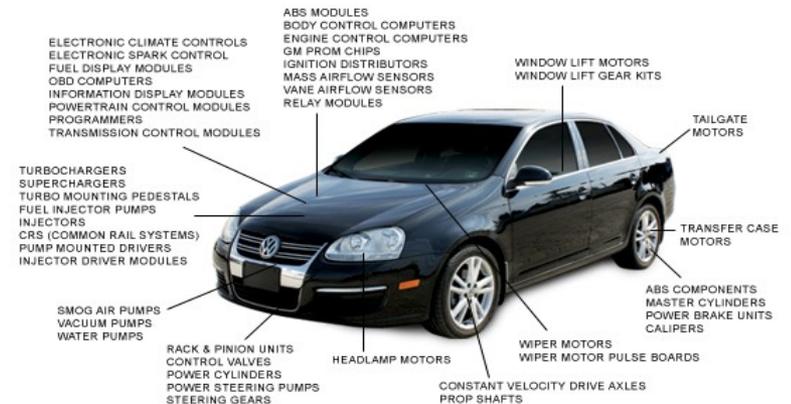
Most people want to protect their own little piece of earth.



We're all about preserving the whole thing.

CARDONE has been operating in an environmentally conscious manner since we first opened our doors in 1978. Nearly 40 years later, our business has grown but our ecological footprint has remained small. In 2009, 41 CARDONE remanufactured parts have over 14,000 tons of waste out of scope parts. Our choice to partner with CARDONE makes a difference that counts.

Partnering with CARDONE is not only good for your business. It's good for the planet.



Eastman Kodak Company One Time Use Cameras (OTUC)

Corporate Goal: Improve the environmental attributes of KODAK products throughout their life cycle

- Kodak Film Products Group achieved \$1.968 Billion in revenue of which OTUC are a significant contributor
- Since 1990, the total number of OTUC collected reached 1.2 billion
- In 2007, alone, Kodak collected 120 million single-use cameras
- Since 1990, 800 million Kodak OTUC have been remanufactured and the balance sent back to other manufacturers
- **Approaching 100%** of Kodak OTUC manufactured from recycled bodies and/or parts.



Overview of GIS



Addressing the Key Sustainable Development Issues of Our Time



Energy for Sustainable Development



Industrial Development



Air Pollution / Atmosphere



Climate Change



We propose three laws of sustainable business through:

1. Minimize material and energy resources needed to satisfy product function and consumer demand
2. Maximize usage of expended resources
3. Minimize or eliminate the adverse impacts of waste and emissions



Our Proposed Solution: *Innovation*

Innovation is the *transformation of knowledge,*

internally or externally generated, into new products, processes, services or business models.



Innovation is not simply invention.



The Golisano Institute for Sustainability



- International in Scope
- Leading Academic Programs
- Cutting Edge Research
- Community Outreach
- Industrial Applications & Technology Transfer
- Promote Innovative Campus Wide Sustainability Initiatives



Focus: The creation of goods and services using processes and systems that are:

- non-polluting
- conserving of energy and natural resources
- economically viable
- safe and healthful for workers, communities, and consumers

RIT-GIS Research Centers

Research Focus: Development of technologies for improved life-cycle engineering and sustainable product systems



Sustainable System Research Center

Sustainable Design
Asset Recycle Management
Reverse Logistics

Center for Sustainable Energy Systems (Fuel Cell - Bio-Fuels)

Life Cycle Engineering
Reliability/durability
Production

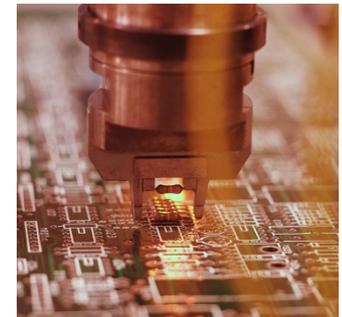


National Center for Remanufacturing and Resource Recovery

Clean Technologies
Intelligent Testing & Diagnostics
Design for Remanufacturing
Logistics and Policy

Systems Modernization & Sustainment Center

Material Aging
Life Cycle Engineering and Decision Systems
Asset Health Management



Examples of Research Sponsors

DETROIT DIESEL CORPORATION



BOSCH



NYSERDA



BAUSCH & LOMB



Gleason Corporation

Golisano Institute for Sustainability at RIT

The First of Its Kind

- Sustainability is not just the responsibility of corporations and governments.
- Universities have a unique role in developing a better world through continuous commitment to community, workforce, families, and students.
- Universities can have a significant impact on the quality of life for current and future generations.
- By extending its reach, RIT has enhanced its ability to disseminate its work and to engage a broader, global community in its educational and research endeavors. This international perspective has helped to enhance the relevance of the work at RIT to communities around the globe.



Sustainability Institute @ RIT
The Living Laboratory

GIS - Strategic Importance to RIT

“Through the Sustainability Institute at RIT, we will be the first technological university in the nation to provide a full spectrum of career-focused and interdisciplinary programs that will equip the first generation of professionals with the vision and know-how to deliver on the promise of sustainability.”



***RIT President
William W. Destler***

“The Golisano Institute for Sustainability is a natural extension for us. It expands our initiatives in education, research and technology transfer that build upon some of RIT’s strongest academic programs and the internationally respected research of the Center for Integrated Manufacturing Studies.”

GIS R&D Centers



Pollution Prevention Institute

Clean Technologies Implementation
Testing Green Product Assessment
Recycling Process Improvement



National Center for Remanufacturing & Resource Recovery

Design for Remanufacturing
Remanufacturing Processes
Reman. Logistics & Policy



Center for Sustainable Production

Sustainable Design
Asset Recycle Management



Systems Modernization & Sustainment Center

Asset Health Management
Life Cycle Engineering
Reliability/Durability



Center for Sustainable Energy Systems

Fuel Cell Technology
Bio-Fuels Technology
Manufacturing of SES



NanoPower Research Laboratory

Development & Characterization of Nanomaterials for Energy Conversion & Storage

GIS - Center for Integrated Manufacturing Studies



- RIT faculty, engineers, technicians, training professionals, support personnel, and co-op students



- 170,000 square-feet of laboratories, manufacturing pilot cells, training facilities, and offices



- 6 manufacturing bays

- 21 specialized laboratories



- 10-room, 400-seat training facility

