Circular Economies and Second Life Products: At the Crossroads of Circularity & Safety

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Introductions

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Navigating Turbulence

We offer services designed to help organizations innovate safely, harness information ecosystem securely, and create more sustainable products, businesses and experiences.

Testing

Certification

Auditing

Advisory

Digital applications

Inspection

Verification

Analytics and intelligence

Learning and development

UL's Global Footprint

14,000+

EMPLOYEES

UL operates in more than

143

COUNTRIES

and across more than

20

INDUSTRIES

88%

of U.S. BUILT ENVIRONMENT AUTHORITIES trust and accept the UL Mark

UL *has supported* **125 YEARS OF INNOVATION** from electricity to nanotechnology

UL reaches more than

2 BILLION

GLOBAL CONSUMERS

annually with safety messages

Delivering safety, security and sustainability

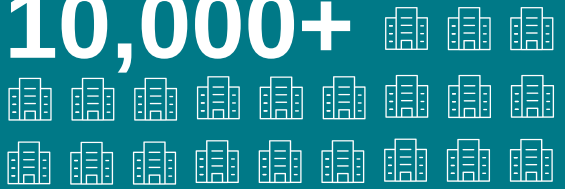
UL MARKS APPEAR on more than

22 BILLION

products *globally*

UL software is used by

10,000+



ORGANIZATIONS *in*

OVER 10 INDUSTRIES

UL'S SUSTAINABILITY CERTIFICATIONS are referenced in

900+

sustainable product specifications or purchasing guidelines around the globe

What is the circular economy?

Circularity: Decoupling natural resource use and environmental impacts from economic growth.

Based on three principles:

- Design out waste and pollution
- Keep products and materials in use
- Regenerate natural systems

Source: Ellen MacArthur Foundation

Why Circularity? The Risks

Regulatory measures are rising:

EU Green Deal policies, Circular Economy Action Plan

China circularity commitments

In the U.S., state and municipal level sustainability commitments, zero-waste requirements, bans on “single use” materials, carbon reduction goals

Resource constraints and supply chain resilience:

E.g., concrete: while the raw materials are generally abundant and found locally worldwide, some materials such as natural sand and lime stone suffer local scarcity

Source: Circular Economy, World Business Council for Sustainable Development. Scaling the Circular Built Environment: pathways for business and government.

Why Circularity? The Opportunities

Financial incentives:

Circular opportunities globally estimated to be as much as $700 billion annually on material savings

Global issuance of green bonds rose to $600 billion in 2018

Growth in green public procurement initiatives

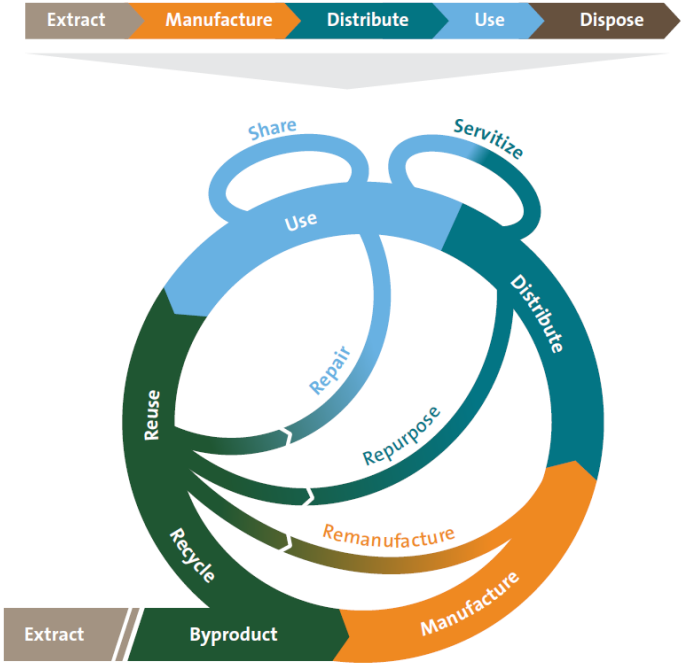
Consumers are demanding new models, “Smart / Sustainable Cities” require it:

Millennials choosing to access products without burden of ownership of housing and cars, for instance, giving rise to new circularity-infused business models like the “sharing economy”

Pandemic note: some analysts say this crisis spells the end of the sharing economy, while others point new areas where circularity concepts are at work, e.g., in finding ways to use sterilization agents commonly found in hospitals to decontaminate used N95/FFP2 masks for prolonged reuse

The Circular Economy: A Company View

An approach to “bending” our linear Take-Make-Waste economy away from landfills into circular flows of materials that become feedstocks for other processes.



This graphic is adapted from Building Services Design Consulting Engineer

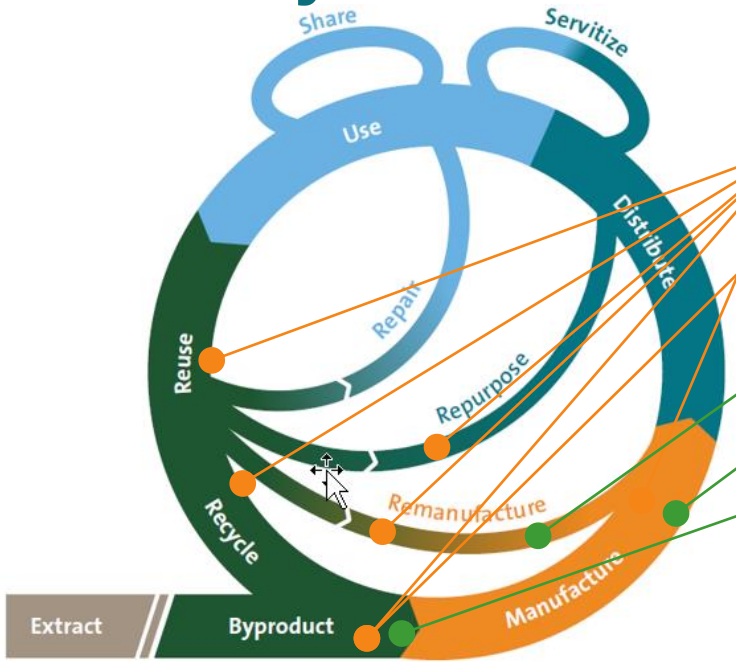
Circular Economy Business Models

Five main business models

CIRCULAR SUPPLY CHAIN	Using fully renewable, recyclable or biodegradable materials
RECOVERY AND RECYCLING	Ensuring that everything that used to be waste is revived for other uses
PRODUCT LIFE EXTENSION	Maintaining and improving products through repairs, upgrades, remarketing
SHARING PLATFORM	Eliminating wasted capacity by renting, sharing, swapping idle goods
PRODUCT AS A SERVICE	Retaining product ownership (and materials) only selling product utility

Source: Circular Advantage: Innovative Business Models and Technologies to Create Value without Limits to Growth, Accenture. https://www.accenture.com/t20150523t053139__w__/us-en/_acnmedia/accenture/conversion-assets/dotcom/documents/global/pdf/strategy_6/accenture-circular-advantage-innovative-business-models-technologies-value-growth.pdf

Sample UL's Standards for the Circular Economy



This graphic is adapted from Building Services Design Consulting Engineer

FACILITY- OR SITE-LEVEL:

- Zero Waste to Landfill / Waste Diversion (UL ECVP 2799)
- Byproduct Synergy (UL ECVP 2990)

PRODUCT-LEVEL:

- Certified rebuilt and remanufactured (UL safety certifications)
- Recyclability (UL ECVP 2789)
- Recycled Content (UL ECVP 2809)

PRODUCT-SITE-COMPANY-LEVEL:

ANSI/CAN/UL 3600 Standard for Measuring and Reporting Circular Economy Aspects of Products, Sites and Organizations

Remanufacturing Process Flow

"Remanufacturing is an industrial process that restores used products to a like-new or better-than-new condition, thereby recovering the value and reducing the environmental impact of the product. Remanufacturing therefore reduces the need to source virgin materials to produce a new product as well as reducing energy and emission required to produce new products. To do this, end-of-life products are systematically disassembled, cleaned and inspected for wear. Damaged components are restored or replaced, feature upgrades can be incorporated, and the product is reassembled and **requalified**."

Source: Golisano Institute for Sustainability, Rochester Institute of Technology, Technology Roadmap for Remanufacturing in the Circular Economy. 2017. https://www.rit.edu/sustainabilityinstitute/public/Reman_Roadmap_2017.pdf

UL Rebuilt Products Program

Energy and Power
(samples)

- Stationary Fuel Cell Power Systems
- Uninterruptible Power Supplies for Use in Health Care Facilities
- Electric Vehicle Battery Packs
- Electric Vehicle Charging System Equipment – Component

Hazardous Location
(samples)

- Generators for Use in Hazardous Locations
- Laboratory Equipment for Use in Hazardous Locations
- Radio Devices for Use in Hazardous Locations

Other
(samples)

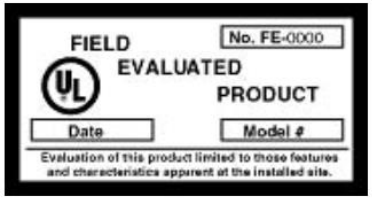
- Patient-monitoring Equipment
- Ultrasound Equipment
- Pumpers, Fire Department
- Power Supplies for Use with Audio/Video, Information and Communication Technology Equipment
- Amusement and Gaming Machines
- Power Supplies, Data-processing Equipment, Electronic – Component
- Office Furnishings
- Household Burglar Alarm System Units
- Cleaning Machines, Motor Operated
- Household Cooking Appliances
- Vacuum Cleaning Machines and Blower Cleaners

UL's Position Statement on Field Modification or Rebuilt Equipment

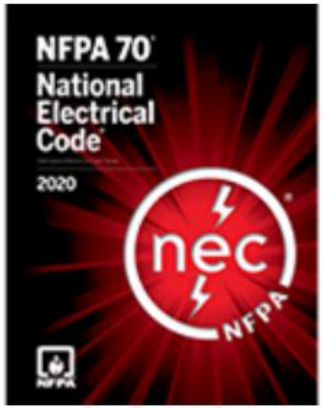
"An authorized use of the UL Mark is the manufacturer's declaration that a product was manufactured in accordance with the applicable certification requirements, and was in compliance with those requirements when it was shipped from the factory.

When a product bearing a UL Mark is modified or rebuilt (including being refurbished, remanufactured, reconditioned or renovated) after it leaves the factory where the UL Mark was applied, *UL does not know if the product continues to meet the applicable requirements unless the modification or rebuilding has been specifically investigated by UL*."

Evidence:



Code Requirements



National Fire Protection Association (NFPA)

110.21(A)(2) Reconditioned Equipment.

Reconditioned equipment shall be marked with the name, trademark, or other descriptive marking by which the organization responsible for reconditioning the electrical equipment can be identified, along with the date of the reconditioning.

Reconditioned equipment shall be identified as “reconditioned” and the original listing mark removed. Approval of the reconditioned equipment shall not be based solely on the equipment's original listing.

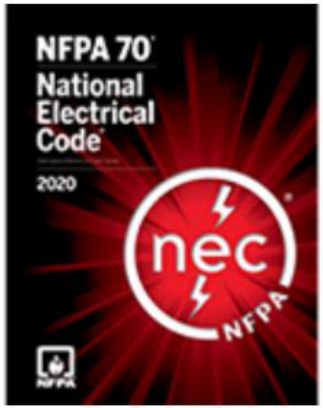
Exception: In industrial occupancies, where conditions of maintenance and supervision ensure that only qualified persons service the equipment, the markings indicated in 110.21(A)(2) shall not be required for equipment that is reconditioned by the owner or operator as part of a regular equipment maintenance program.

Informational Note No. 1: Industry standards are available for application of reconditioned and refurbished equipment.

Informational Note No. 2: The term reconditioned may be interchangeable with the terms rebuilt, refurbished, or remanufactured.

Informational Note No. 3: The original listing mark may include the mark of the certifying body and not the entire equipment label.

Exclusions



210.15

Reconditioned equipment.

The following shall not be reconditioned:

1) Equipment that provides ground-fault circuit-interrupter protection for personnel
2) Equipment that provides arc-fault circuit-interrupter protection
3) Equipment that provides ground-fault protection of equipment

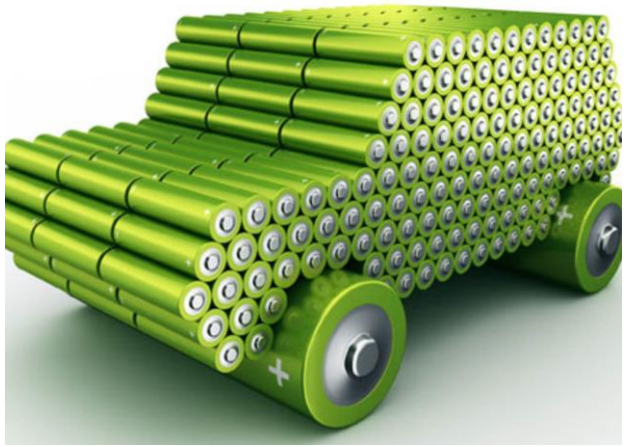
Example: Wind Turbines

UL 4134, Standard for Safety for Lifetime Extension of Wind Turbines

- Published in 2018
- Addresses rules and procedures for the life time extension of wind turbines (LTE) – that is, the process to obtain risk by relating severity to confidence level on accuracy for the failure mode
- Typical lifespan: ~20 years
- By 2020, ~41% of the currently installed capacity in Germany will be over 15 years old, 44% in Spain, and 57% in Denmark
- LTE employs a science-based approach to establish agreement about allowing these large assets to be used beyond the original lifetime.

Source: Lifetime extension of onshore wind turbines: A review covering Germany, Spain, Denmark, and the UK; Lisa Zieglerab, Elena Gonzalezc, Tim Rubert, Ursula Smolkaa, Julio J. Meleroc.

Example: Electric Vehicle Batteries



UL 1974, US and Canadian National Standard for Safety for Evaluation for Repurposing Batteries

- Published in 2018
- Designed to support safe and reliable repurposing of EV batteries for other uses
- Typical lifespan: ~5 years
- The battery is the single most expensive part of an EV – up to as much as half the cost in some vehicles
- Global demand for batteries that in energy storage systems that strengthen the electric grid and support more use of renewables – as well as in new applications like 5G base stations – is growing. But making sure the batteries are safe – especially from major safety hazards like thermal runaway for lithium batteries – is essential for sustainable use of these repurposed EV batteries.

What's Next: Urgent Circular / Safety Issues

UL Assistance Evaluating Water-Damaged Equipment and *Flood Immersed Electrical Wiring and Equipment (TIC services)*

- Hurricane and Tornado window & door testing – Windstorm rated building assemblies assist in providing protection high velocity winds and windborne debris resulting from hurricane and tornado force winds.
- Lightning Protection – Adding a lightning protection system to a building increases protection from physical damage and reduces the possibility of fire.
- Field evaluations for water-damaged equipment.

UL 2809, 5th Edition, Normative Ref in UL 3600

The latest edition of UL's recycled content program covers both pre-consumer (post-industrial) and post-consumer sources, and may be used to validate the percentage of recycled for many source materials (e.g., conventional scrap, ocean-bound plastic, biomass), processed through different technologies (i.e., mechanical recycling and advanced recycling) and using different accounting methods (i.e., segregated material flows, credit account of mass balance allocation).

Now includes procedures to validate the percent of product that is refurbished.

Conclusion

The circularity and sustainability benefits of remanufacturing and other product life extension methods are clear; the opportunities to extend these practices into a wider variety of built environment and consumer products are the next frontiers.

Capturing the value inherent in remanufacturing and product life extension adoption requires action on multiple fronts, all of which could benefit from evidence based research, standards, and verification services to enable safe scaling:

- Regulatory
- Collection and reverse logistics infrastructure
- Technological
- Market

Conclusion informed by: Nabil Nasr. Remanufacturing in the Circular Economy: Operations, Engineering and Logistics. 2019.

Q&A

Circularity / Sustainability-Related Resources

UL's 2019 Sustainability Report: https://sustainabilityreport.ul.com/

Magazines, company case studies, customer profiles, blogs, white papers, press releases, webinars:

- On the Mark – The Lithium-Ion Battery Issue: https://www.ul.com/news/mark-lithium-ion-battery-issue
- On the Mark – The Sustainability Issue: https://www.ul.com/news/mark-sustainability-issue
- UL issues first certification for repurposed EV batteries to 4R Energy: https://www.ul.com/news/ul-issues-world%27s-first-certification-repurposed-ev-batteries-4r-energy
- Paths to circularity: https://legacy-uploads.ul.com/wp-content/uploads/sites/2/2019/03/UL_Circularity_Infographic_FINAL_190314.pdf
- Waste diversion webinar with Walmart: https://ul.wistia.com/medias/m2nbom4tlw
- Apple announcement in China: http://www.apple.com/newsroom//2016/08/apple-announces-environmental-progress-in-china.html
- Mass balance accounting of recycled content through chemical recycling – co-project white paper published by Ellen MacArthur Foundation: https://www.ul.com/news/mass-balance-new-approach-calculating-recycled-content

Circular Economy

- **UL Circular Economy Page: http://circular.ul.com/circular-economy/p/1**
- **UL Waste Diversion / Zero Waste page: http://circular.ul.com/zwtl/p/1**

UL Circularity Related Standards (Sampling) (https://www.shopulstandards.com/Catalog.aspx)

- UL 4134, Standard for Safety for Lifetime Extension of Wind Turbines
- UL 1974 - ANSI/CAN/UL Standard for Evaluation for Repurposing Batteries / Norme sur les évaluation pour la transformation des batteries
- UL 87 - Standard for Power-Operated Dispensing Devices for Petroleum Products
- UL ECVP 2799 - Environmental Claim Validation Procedure for Zero Waste to Landfill
- UL ECVP 2809 - Environmental Claim Validation Procedure for Recycled Content
- UL ECVP 2990 - Environmental Claim Validation Procedure (ECVP) for By-Product Synergy (in short, one company's waste product is another company's raw material input)
- UL 3600 - Outline of Investigation for Measuring and Reporting Circular Economy Aspects of Products, Sites and Organizations

UL SPOT Database: https://spot.ul.com/

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