About DCA

- Manufacturing Consulting firm
  - Focus on Discrete/Fabricated “Article” Manufacturers
  - Based in San Francisco, CA
- Main Focus: Strategies/Tactics for Compliance with Product-Targeted Environmental Regulations & Customer/Market Requirements
  - Substance Restriction/Disclosure Compliance, Circular Economy, Recycling, Green Claims, Energy Use, Conflict Minerals, Carbon/GHG, NGOs/Retailers
  - Worldwide scope
  - A&D, Industrial and Commercial, Consumer, Medical, Apparel, Agriculture, Construction, etc.
- Visit DCA.LLC

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Mike's Background

- 20 years in manufacturing companies, in product development and quality/reliability roles:

- 20 years in consultancies

- Co-Moderator: ANSI Chemicals Network
- Initial Member of California EPA DTSC Green Ribbon Science Panel: 2009-2013
- Member of American Chemical Society Green Chemistry Institute Advisory Board: 2014-current

Electronics & The EU's Circular Economy

DESIGN CHAIN ASSOCIATES

May 26, 2021
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What's the (Electronics) Problem?

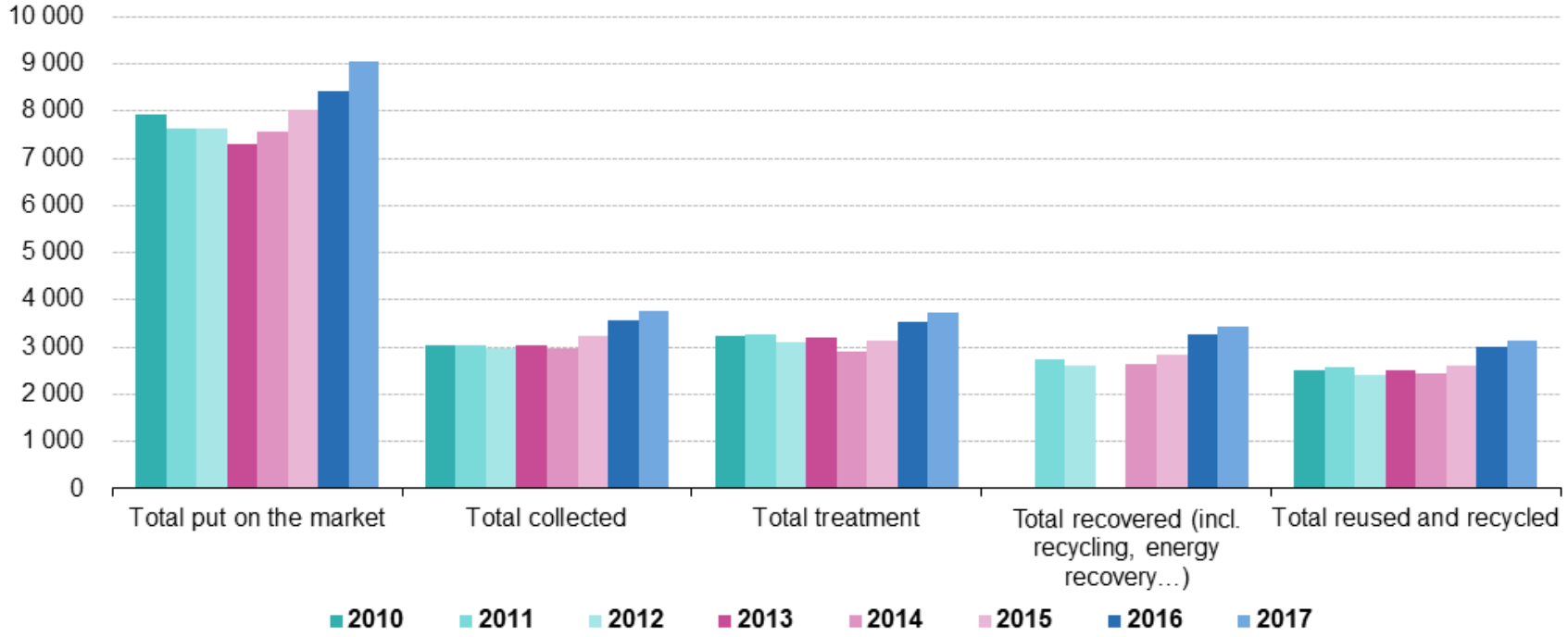
- 2% Annual Growth rate of EEE waste stream
- <40% of e-waste is recycled in the EU
  - <18% is recycled in the rest of the world
- More electronics are finding their way into more product categories than ever before
- Materials for electronics require extraordinary processing and introduce many new substances and materials to the market
  - Implications of toxicity in many applications is unknown
  - Regulations often don't keep up
- People want to repair broken products they own but it can be too expensive or challenging

© Peter Varga | Dreamstime.com

But but but what about WEEE?

- Didn't really solve the problem…

Electrical and electronic equipment (EEE) put on the market and waste EEE collected and treated, EU-27, 2010–2017
(thousand tonnes)



Note: 2010, 2016 and 2017 data, as well as 2011 data for reused and recycled EEE waste: Eurostat estimates
Source: Eurostat (online data code: env_waselee)

eurostat

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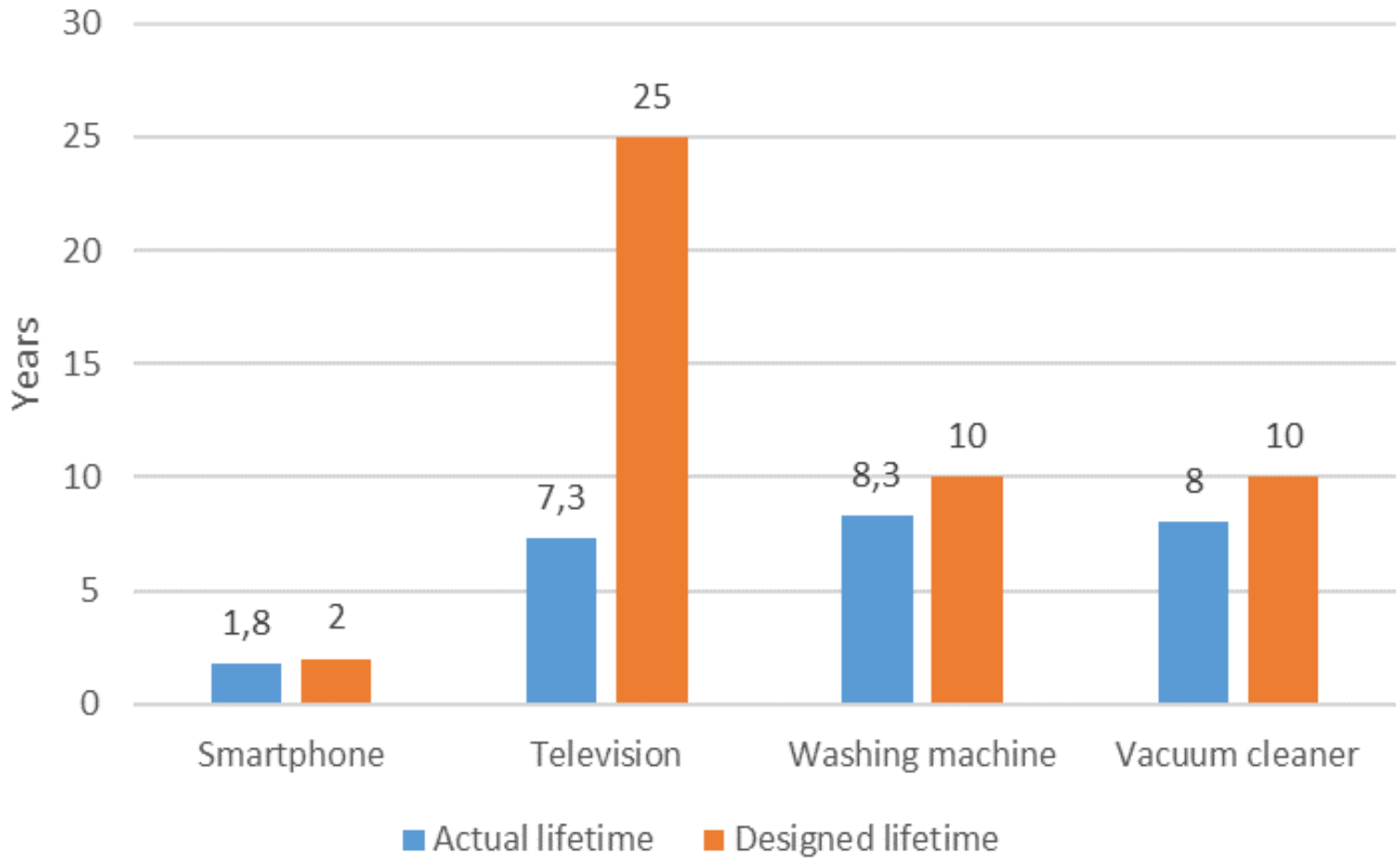
Electronics Use Patterns Accelerate Obsolescence



Eionet Report - ETC/WMGE 2020/3: “Electronic products and obsolescence in a circular economy”

Lower Cost => Why Repair?

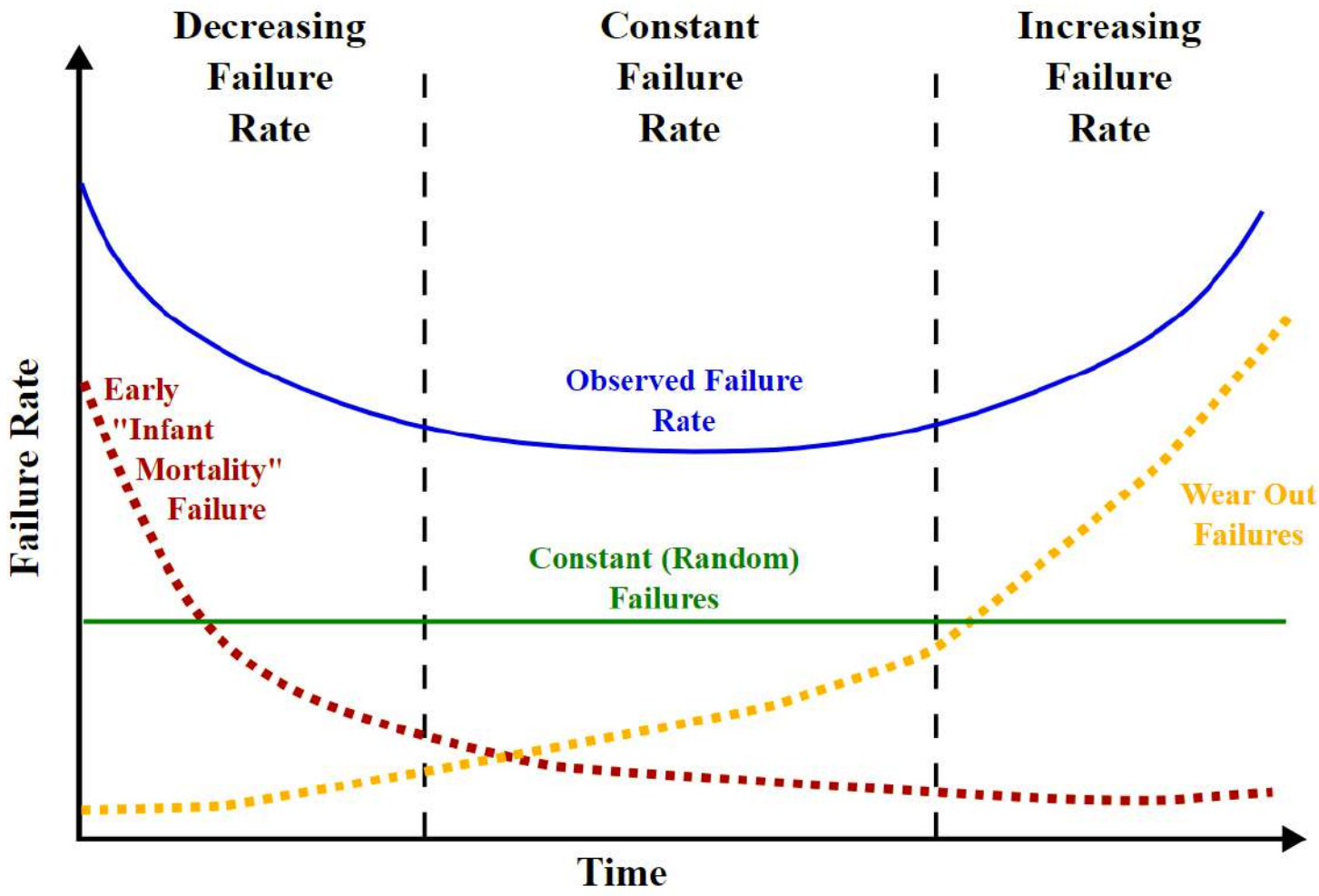
"Purchasing a new washing machine, for example, cost 59 working hours work in 2004 but dropped to just 39 hours in 2014 (CECED, 2017). This has led to electrical and electronic equipment becoming outdated more rapidly and, as such, less desirable to repair."

"… extending the lifetime of all washing machines, smartphones, laptops and vacuum cleaners in the EU by one year would lead to annual savings of around 4 million tonnes of carbon dioxide by 2030"

Eionet Report - ETC/WMGE 2020/3: "Electronic products and obsolescence in a circular economy"

Reliability Bathtub Curve

- Failure of electronic components and products tend to follow the “bathtub curve”
- Products are designed to have a given life and average failure rate, or “Mean Time Between Failures”
- Design decisions can extend or pull in the “wear out” stage

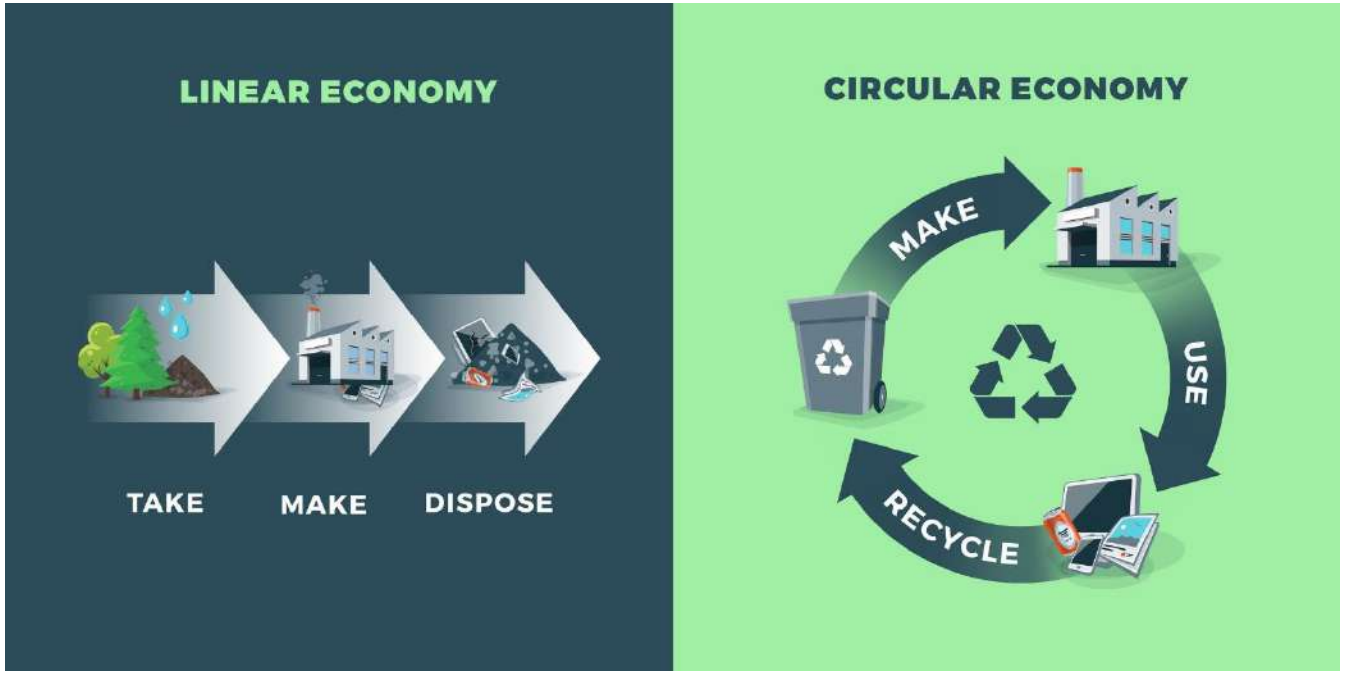


The Current Approach is Not Sustainable

Photo © Geoff Arrowsmith - Dreamstime.com

2014: Towards a circular economy: A zero waste programme for Europe

- Competition for finite/scarce resources is increasing
- Pressure on resources is causing greater environmental degradation and fragility
- Current economy is a “linear model based on the assumption that resources are abundant, available, easy to source and cheap to dispose of”
- Deliver on the Europe 2020 Strategy for “Sustainable growth: promoting a more resource efficient, greener and more competitive economy”
  - “decouple economic growth from the use of resources, support the shift towards a low carbon economy, increase the use of renewable energy sources, modernise our transport sector and promote energy efficiency”



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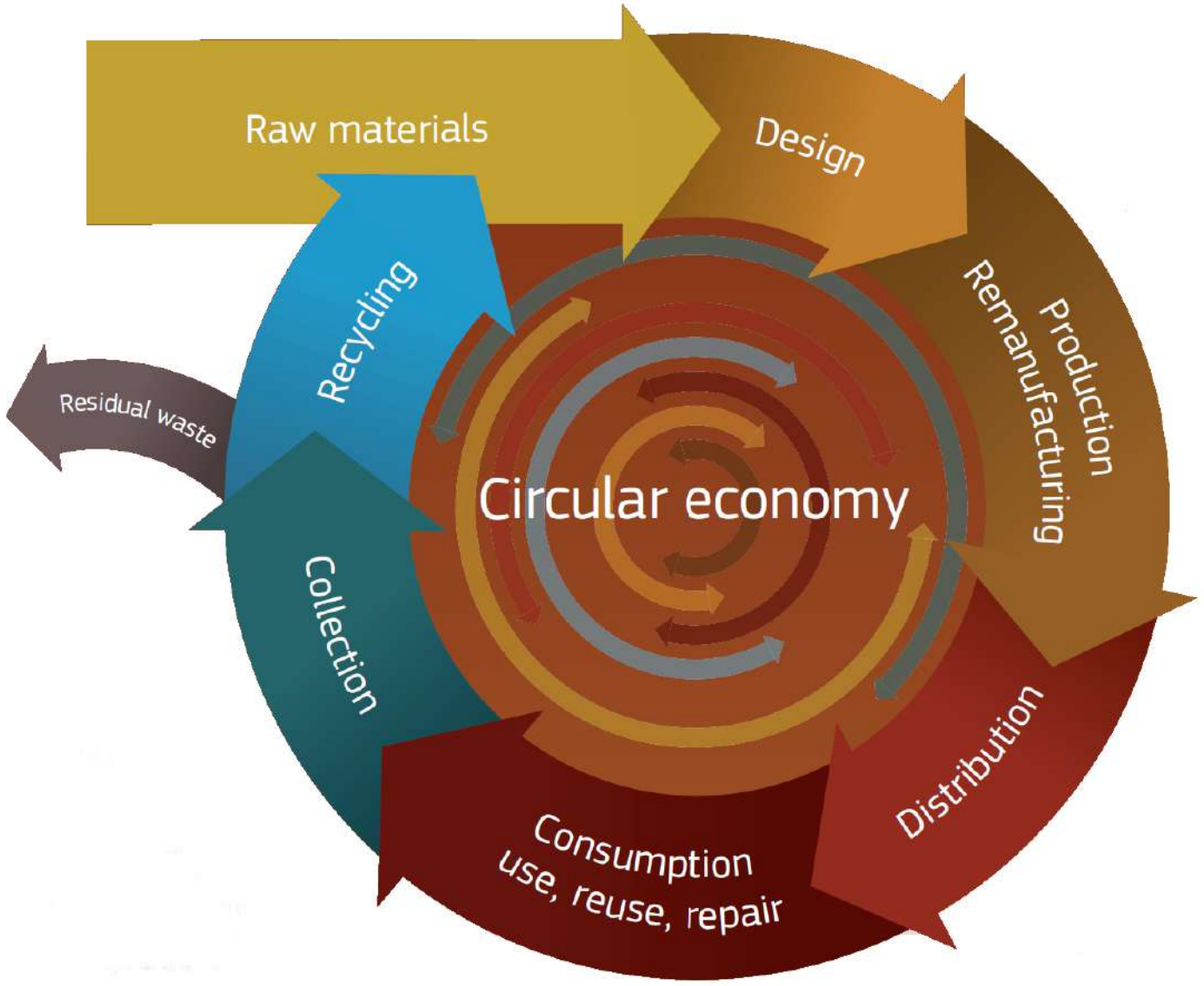
2015: The EU's Circular Economy Diagram



- Implication: full systemic change and innovation in
  - Technologies
  - Organisation
  - Society
  - finance methods and
  - policies

EU 2018: Behavioural Study on Consumers' Engagement in the Circular Economy

- 64% of consumers do repair products
- 90% have ***no experience*** renting/leasing or buying second hand products
- Rationale: consumers lack
  - information on product durability and reparability
  - lack of sufficiently developed markets (e.g. for second hand products, renting, leasing or sharing services etc.)
- Interest in product durability and reparability was generally higher for large and expensive products (and associated with perception of product quality)

https://ec.europa.eu/info/live-work-travel-eu/consumers/sustainable-consumption_en

Recommendations from the 2018 Report

1. Build the Market: strengthen pro-environmental attitudes and awareness
2. Make Repair Easier
3. Create financial incentives for reparability and durability
4. Make durability and reparability information available at the point of sale
5. Strengthened enforcement of legislation requiring the provision of accurate information to consumers

2020: Circular Economy Action Plan for Electronics & ICT

- regulatory measures for electronics and ICT including **mobile phones, tablets and laptops** under the Ecodesign Directive so that devices are designed for energy efficiency and durability, reparability, upgradability, maintenance, reuse and recycling. The upcoming Ecodesign Working Plan will set out further details on this. **Printers and consumables such as cartridges** will also be covered unless the sector reaches an ambitious voluntary agreement within the next six months;
- focus on electronics and ICT as a **priority sector for implementing the 'right to repair',** including a right to update obsolete software;
- regulatory measures on **chargers for mobile phones and similar devices,** including the **introduction of a common charger,** improving the durability of charging cables, and incentives to decouple the purchase of chargers from the purchase of new devices;
- improving the collection and treatment of waste electrical and electronic equipment[22] including by exploring options for **an EU-wide take back scheme to return or sell back old mobile phones, tablets and chargers;**
- review of EU rules on **restrictions of hazardous substances in electrical and electronic equipment[23]** and provide guidance to improve coherence with relevant legislation, including REACH[24] and Ecodesign.

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Coming in Q4: EU Circular Electronics Initiative

- Goal: address shortcomings in
  - durability
  - circular design
  - hazardous/harmful substances
  - recycled content
  - reparability
  - access to spare parts
  - upgradability
  - **e-waste prevention**
  - collection, reuse and recycling
- Will also address
  - integration of issues linked to early obsolescence including product obsolescence caused by software changes;
  - harmonisation and improvement of recycling infrastructure for waste electrical and electronic equipment in the EU
  - a mandatory certification scheme for recyclers of electronics waste to guarantee efficient material recovery and environmental protection

Worldwide Product Environmental Regulations – Trend

Laying the Circularity Groundwork in the EU

1. Waste Framework Directive
   - End-of-life management/recycling
   - Better information on toxics use
2. Energy-related Products Directive
   - Prioritize longer lifetimes in new product design
3. Supporting Standards
   - EN 45550 to EN 45559
4. EU Energy Label
   - Help decision-making by consumers

❖ And MORE

Focus on

- Resource efficiency
- Products are designed for ease of recycling, reuse, disassembly and remanufacturing
- Measurability

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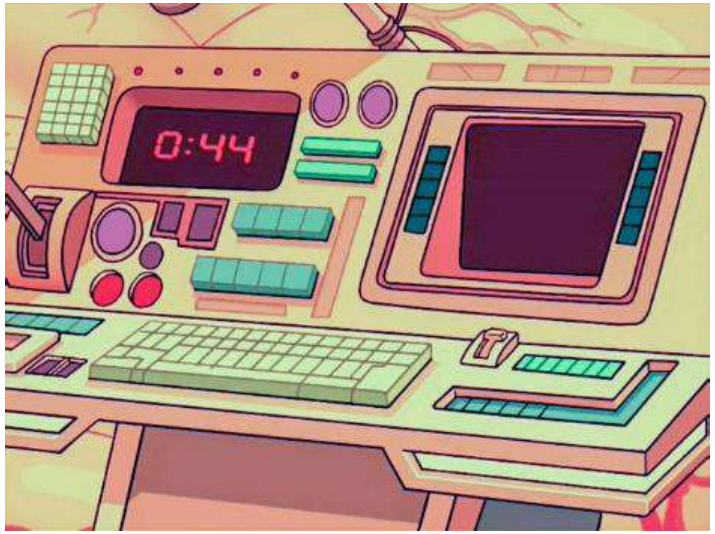
Waste Framework Directive

- Directive 2008/98/EC
- Includes the WEEE Directive
  - Article 1 – goal is “reducing overall impacts of resource use and improving the efficiency of such use in accordance with Articles 1 and 4 of Directive 2008/98/EC, thereby contributing to sustainable development.”
- Includes the requirement for the SCIP Database
  - Identify where SVHCs are used
  - To target future regulatory actions



EcoDesign: Expanded Scope

- From 2005 to 2018: energy consumption & efficiency during the use phase
- *Ecodesign Working Plan 2016-2019* identified the intent to include circularity aspects in new and revised implementing measures
  - "such as resource efficiency, reparability, recyclability and durability"
- Implementing Measure circularity requirements may include:

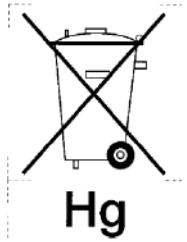
Material efficiency	Specific functionality requirements	Marking - internal & External
Data protection	Resource efficiency	Ban on HFRs in display enclosures
Firmware availability	Reparability	Spares and software availability
Cobalt in batteries	Reusability	Reliability/durability
Neodymium in HDDs	Design for dismantling / recycling / recovery	Repair info/availability

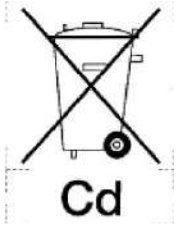
New Draft Battery Regulation (not another Directive)

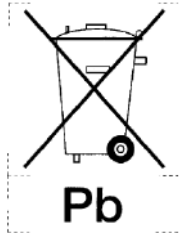
- 130 pages + 28 pages of annexes! 

- “addresses **three groups of highly interlinked problems**”
  1. the lack of framework conditions providing incentives to invest in production capacity for sustainable batteries
  2. sub-optimal functioning of recycling markets and insufficiently closed material loops
  3. social and environmental risks not otherwise covered by EU environmental law

Some New EU Battery Regulation Aspects







- New Additional Requirements include
  - CE-related obligations
  - Electrochemical performance
  - Durability
  - Amount of cobalt, lead, lithium or nickel contained
  - Recycled content requirements
  - Extensive labeling requirements
  - Internal battery management system containing data on the parameters for determining the state of health and expected lifetime, accessible by the user
  - Lot-by-lot testing
  - An electronic record (“battery passport”)
  - Detailed material composition information (available “only to accredited remanufacturers, second-life operators and recyclers”)
  - Supply Chain Due Diligence obligations
    - Only required for rechargeable industrial batteries and electric-vehicle batteries with internal storage and a capacity above 2 kWh

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Relevant CENELEC/CEN/ETSI Standards

Reference	Date	Title
CLC/TR 45550:2020	2020-12-04	Definitions related to material efficiency
EN 45554:2020	2020-02-21	General methods for the assessment of the ability to repair, reuse and upgrade energy-related products
EN 45558:2019	2019-03-01	General method to declare the use of critical raw materials in energy-related products
EN 45555:2019	2019-11-27	General methods for assessing the recyclability and recoverability of energy-related products
EN 45552:2020	2020-03-11	General method for the assessment of the durability of energy-related products
EN 45557:2020	2020-04-29	General method for assessing the proportion of recycled material content in energy-related products
EN 45556:2019	2019-06-07	General method for assessing the proportion of reused components in energy-related products
EN 45559:2019	2019-03-01	Methods for providing information relating to material efficiency aspects of energy-related products
EN 45553:2020	2020-07-10	General method for the assessment of the ability to remanufacture energy-related products

CEN/CLC/JTC 10 *Energy-related products - Material Efficiency Aspects for Ecodesign*

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Member State Approach – France's Repairability Index

- Series of Regulations Define
  - Documentation availability
  - Ease of disassembly
  - Tools required
  - Spare parts availability
    - For how long…

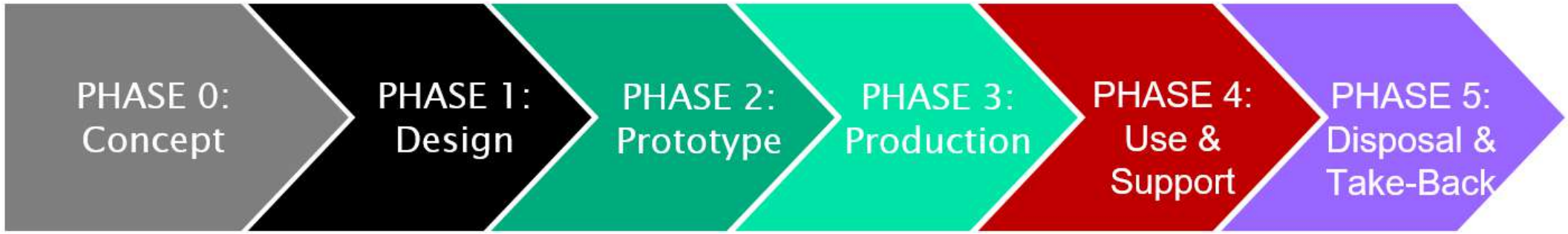
Front-Loading Washing Machines
Smartphones
Laptops
Televisions
Lawnmowers

France TV Repairability Index: Documentation Criteria

	Column B				Column C			
	Repairers				Consumers			
	Years of availability				Years of availability			
	0 to 6	7 to 8	9 to 10	11 or more	0 to 6	7 to 8	9 to 10	11 or more
Documentation type	Number of points				Number of points			
Unambiguous product identification	0	7	9	11	0	7	9	11
Disassembly diagram or exploded view	0	7	9	11	0	7	9	11
Wiring and connection diagrams	0	7	9	11	0	7	9	11
Electronic boards diagrams	0	7	9	11	0	7	9	11
List of required repair and test equipment	0	7	9	11	0	7	9	11
Repair instruction technical manual	0	7	9	11	0	7	9	11
Error and diagnostic codes	0	7	9	11	0	7	9	11
Component and diagnostic information	0	7	9	11	0	7	9	11
Software instructions (including reset)	0	7	9	11	0	7	9	11
Access to incidents reported and recorded in the equipment	0	7	9	11	0	7	9	11
Technical bulletins	0	7	9	11	0	7	9	11
Specific supervision of self-repair (recommended operations, safety and repair instructions, possible repercussions on the warranty)					0	7	9	11
Information on access to professional repairers					0	7	9	11
Failure detection and required actions (general public approach)					0	7	9	11
Tips for use and maintenance					0	7	9	11

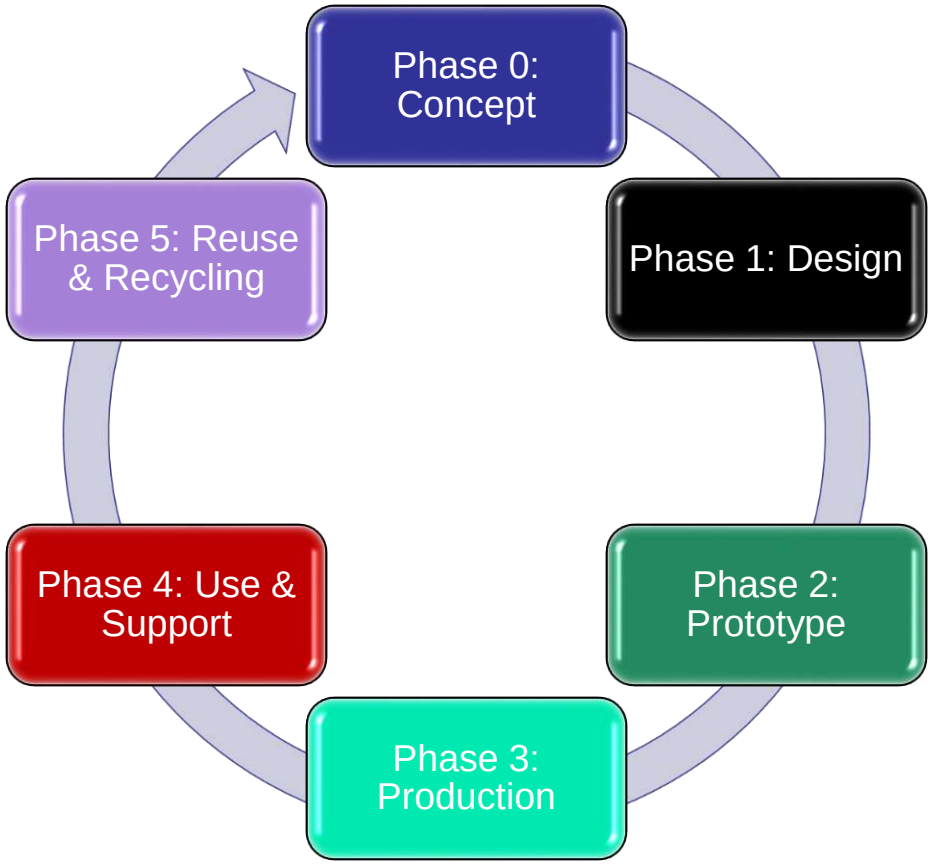
A Product Development Approach

Products: Linear Product Lifecycle Management vs. Circular Lifecycle



A Revised Product Lifecycle Management Process

- Manufacturers must revise their approach to product development to support – and derive profits from – market demands for
  - Reuse
  - Repair
  - Recycling



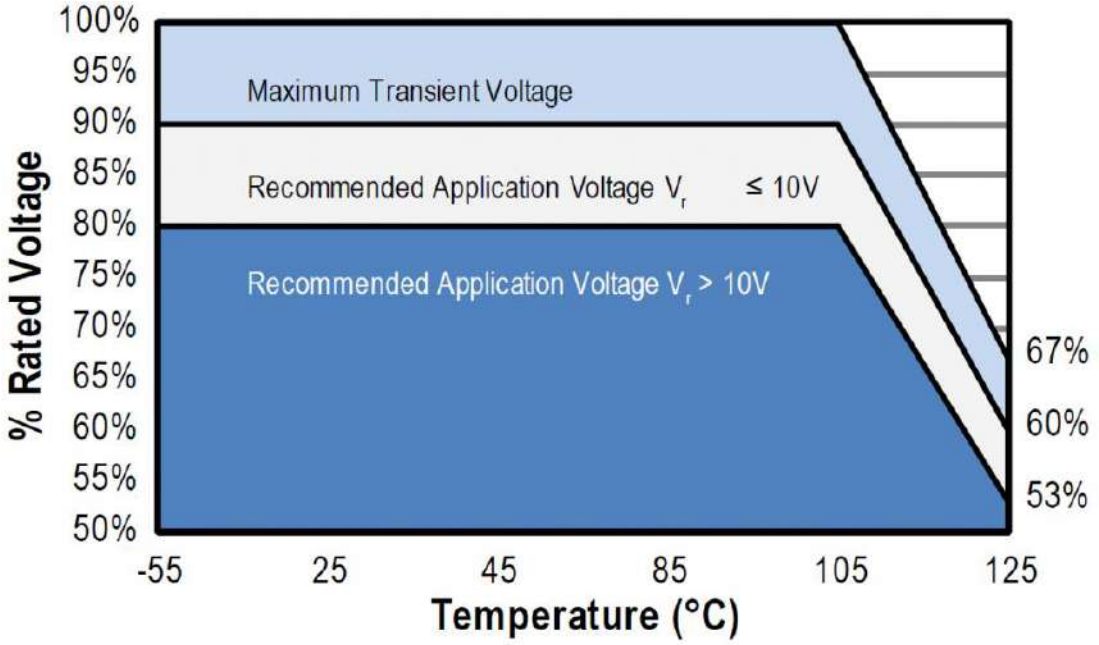
M. Kirschner, Adv. Sustainable Syst. 2021, 2100046

Implications for the Electronics Industry

- Design for Reuse – at all levels
- Design for Repair
- Design for Recycling
  - Separable materials, based on mechanical – or chemical – recycling compatibility
  - Elimination of toxic substances – enables material reuse across product sectors

Design For Reuse

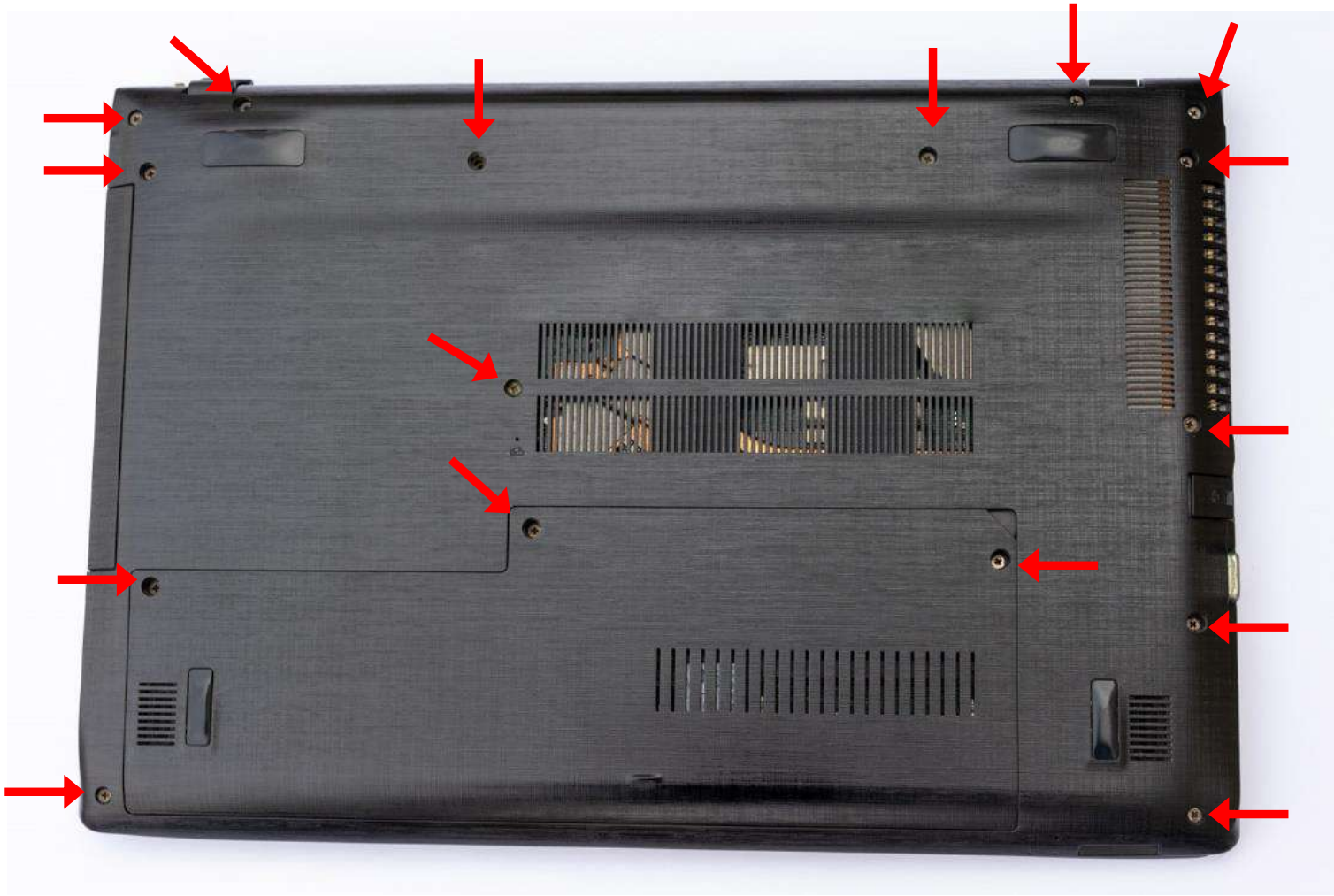
- Updateable
  - More modular
- More reparable
  - Modularity helps with this
- Extended Product Lifetime
  - More durable
  - More reliable
- Cannibalizes Products
  - Requires new business approach



Kemet polymer electrolytic cap Voltage derating curve from https://ec.kemet.com/faq/

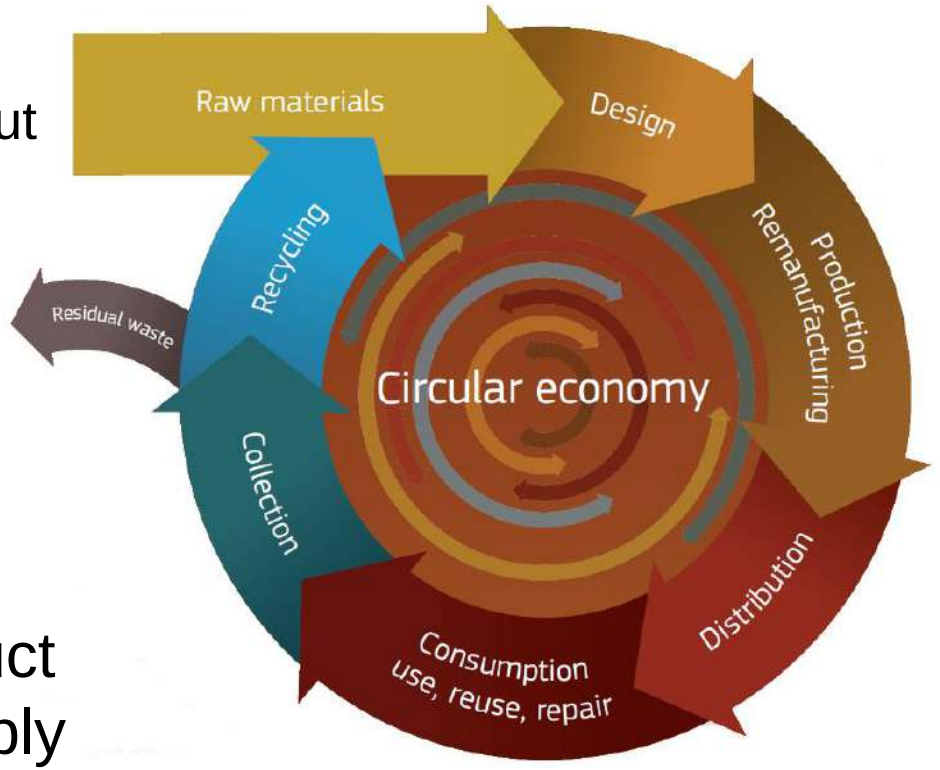
Consumer Products and Reparability

- Repair Cafés in the EU
  - Cost-Effective (no cost)
  - Dependent on the kindness (and skills) of your neighbors
- Reparability is often not prioritized in today's product design
  - Adhesives
  - Many fasteners (look at the bottom of your laptop!)
  - Repair is not cost effective
- Improved separability aids in recyclability



Key Takeaways

- Circular Electronics Initiative will be an important step
  - Will they give industry enough time to execute without either cutting it short or allowing it to drag on?
- EU's approach is broad and seems comprehensive
  - The electronics industry's response is, so far, limited
    - Individual company actions
    - Nascent Circular Electronics Partnership
- Significant changes to business models, product lifecycle management processes, and the supply chain will be required



Questions?

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Appendix

Read My Columns

- TTI MarketEYE (bi-monthly)
  - https://www.tti.com/content/ttiinc/en/resources/marketeye/Contributors/marketEYE-kirschner.html

- EE Times (monthly)
  - https://www.eetimes.com/author/michael-kirschner/