The Circular Economy and IOT

What is the IoT

The **Internet of Things** (**IoT**) is the network of physical devices, vehicles, home appliances, and other items embedded with electronics, software, sensors, actuators, and connectivity which enables these things to connect and exchange data, creating opportunities for more direct integration of the physical world into computer-based systems, resulting in efficiency improvements, economic benefits, and reduced human exertions

Source Wikipedia

Applications

Consumer Applications

- Smart Home
- RFID

Enterprise Applications

- Infrastructure applications
- Manufacturing
- Agriculture
- Energy management
- Environmental monitoring
- Building and home automation
- Metropolitan scale deployments

Other Applications

- Medical and healthcare
- Elder care
- Transportation

Prevalence

Gartner, Inc. forecasts that 8.4 billion connected things will be in use worldwide in 2017, up 31 percent from 2016, and will reach 20.4 billion by 2020. Total spending on endpoints and services will reach almost $2 trillion in 2017

Regionally, Greater China, North America and Western Europe are driving the use of connected things and the three regions together will represent 67 percent of the overall IoT installed base in 2017

Industry Distribution

Table 1: IoT Units Installed Base by Category (Millions of Units)

Category	2016	2017	2018	2020
Consumer	3,963.00	5,244.30	7,036.30	12,863.00
Business: Cross-Industry	1,102.10	1,501.00	2,132.60	4,381.40
Business: Vertical-Specific	1,316.60	1,635.40	2,027.70	3,171.00
Grand Total	6,381.80	8,380.60	11,196.60	20,415.40

Source: Gartner (January 2017)

ITAD & Refurbisher's Role

Refurbished electronics extends equipment life and allows for multiple users to benefit from each refurbished piece of equipment

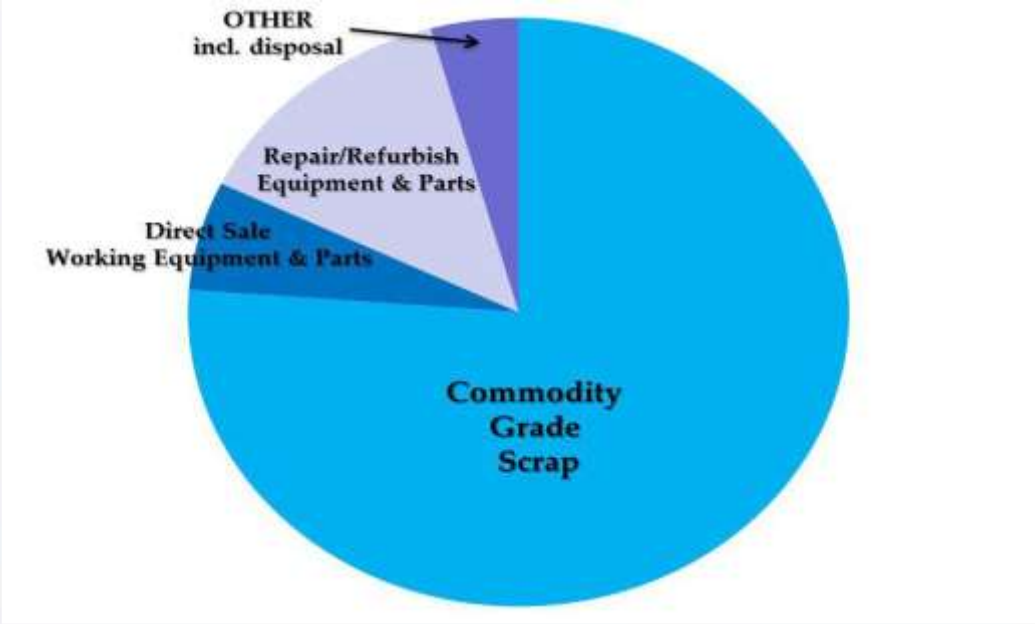
Keeping equipment in circulation requires fewer new pieces of equipment to be manufactured to meet the needs of the populace

ITAD equipment often flows from businesses to schools to citizens domestic or foreign

Up to 70% of energy the equipment will consume is often used to manufacture it in the first place so multiple users lower lifecycle energy costs

What Happens to Used Electronics

- › 70% recycled into specification grade commodity scrap (e.g., scrap steel, Al, Cu, etc.)
- 10% resold as functioning equipment & components for direct resale
- ‹ 18% is resold as equipment & components for further repair and refurbishment



Source: IDC Survey: Inside the Electronics Industry (2011)

Refurbishing

Prior to returning equipment to commerce the ITAD company will perform a series of steps to verify properly functionality

- Test for functionality
- Repair problems
- Sanitize data and maybe reimage hard drives
- Increase RAM (if needed)
- Return to Commerce

Repairing / Refurbishing Apple Laptops, USA

Refurbished iMacs for Resale, USA

Repair Center Ghana, Africa

Retail Store Front Ghana, Africa

Parts Harvesting

Many ITAD and escrap recyclers are now participating in parts harvesting for reuse and repair

Has become more prevalent since Precious Metals (PMs) have come down in price and manufacturers reduced the amount of PMs used in manufacturing process

Competition has driven down recycling profits but opened doors to expanded parts markets

Pulling Parts, USA

Ready for Powder Coating, Mexico

Attention to Detail is Important, Mexico

Tablet & Cell Phone Parts Harvesting

Tablets & Cell Phones contain many reusable parts that can have secondary lives in IoT products

Batteries can be stacked to create e-bike or electric car battery kits

Cameras can be used in refrigerators to review date on milk jugs for reordering or security cameras to watch neighborhood (kids)

Bluetooth chips can be used many places

Multitude of secondary uses for cell phone parts

Production Destruction for Parts Harvest, USA

Multi- Story Cell Phone Parts Market Shenzhen, China

Processors from Cable TV Boxes, Laptops, Computers & Servers

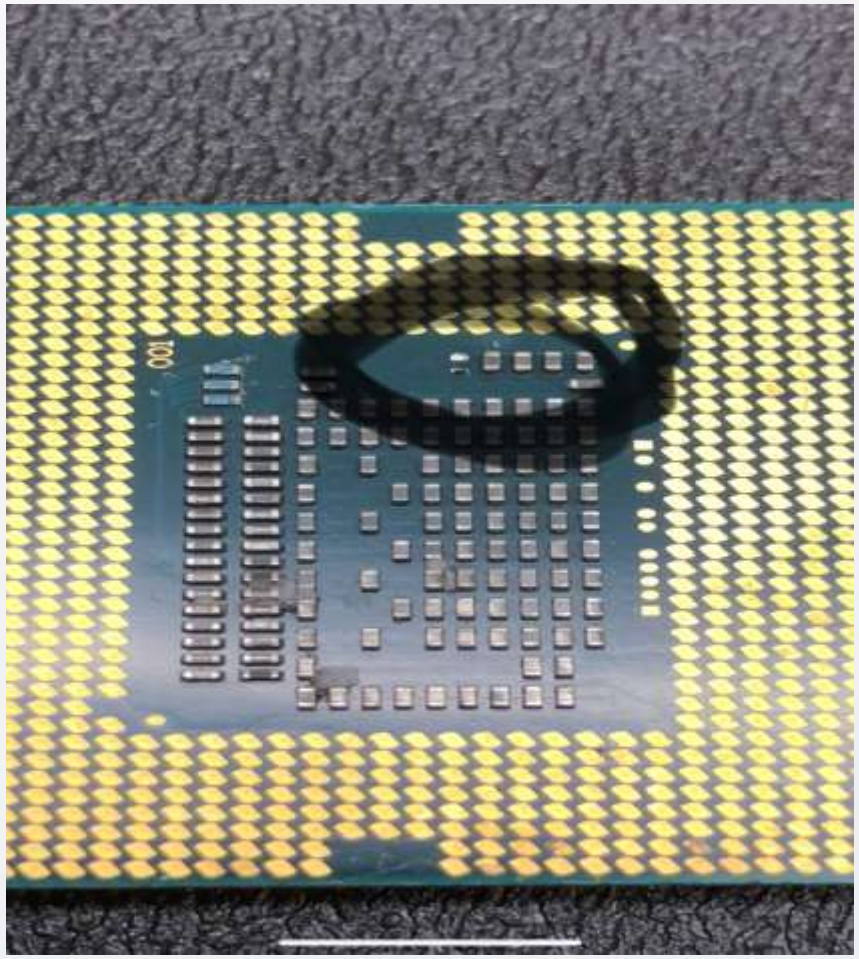
ITAD and escrap recyclers have pulled processor chips for reuse but now many are surface mounted on boards

Surface mounted chips are now being pulled and re-balled for reuse in a variety of products needing processing power at a huge fraction of initial cost

Many are older and have only had reuse opportunities since the explosion of IoT

Broken capacitors are being replaced to repair functionality and extend life

Processor with Missing Capacitors



Memory

Similarly, memory has always been reused when properly functioning and in its current configuration

Now individual chips from non-functioning sticks of RAM are being harvested for chip reuse into a wide ranging group of products

Often there is a need for older RAM that is not of current performance specification but chips can still be harvested at prices multiple of scrap

Repurposing Li Ion Batteries

In ITAD and escrap recycling arenas Li Ion 18650 3.7 V batteries are common items

They are in most laptops with removable batteries

Are present in many Cable TV / Internet Modems that have battery backup for 911 calling

Are easily removed without damage and safely stored / transported

Market for Li Ion Batteries

Many ITAD and escrap companies regularly sell laptop and modem batteries to battery refurbishers and recyclers

Recyclers are increasingly sorting for reuse to increase profits from incoming products

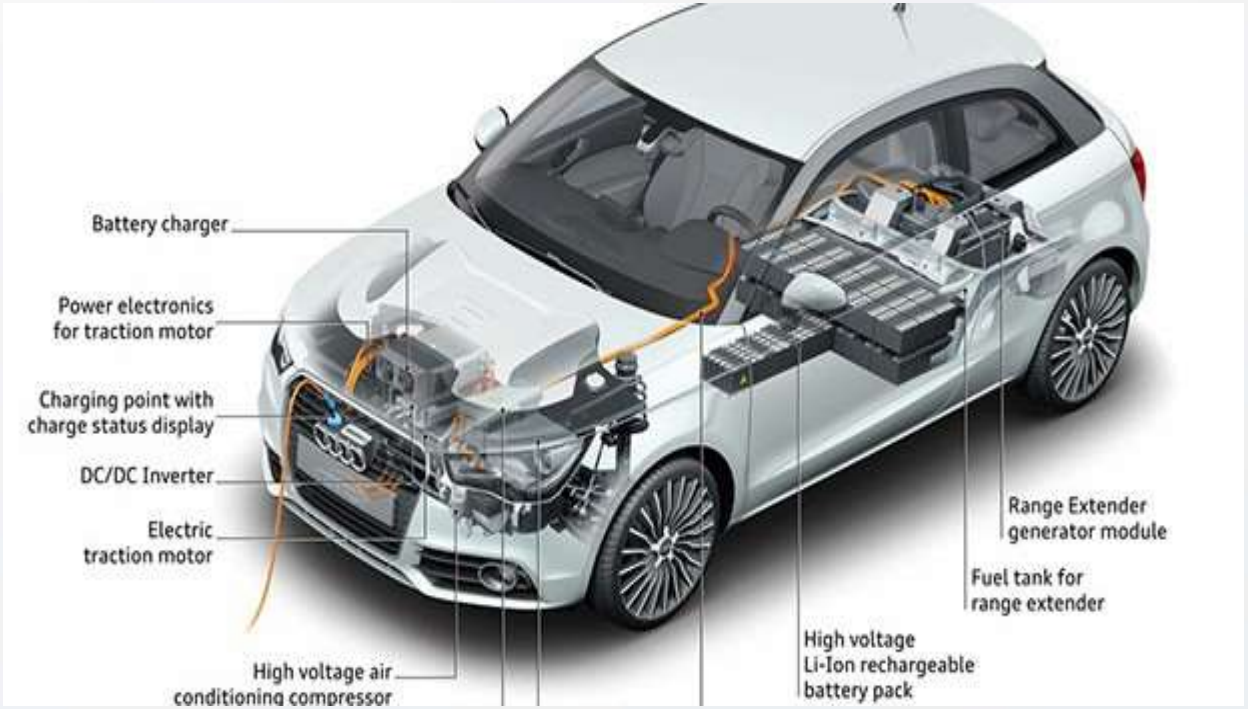
Laptop Batteries are easily refurbished and the value of a working laptop battery is many multiples of recycling the same battery

Markets are widespread in USA, east coast, mid-west and west coast at a minimum

Inside a Laptop Battery, 18650 Cells

18650 Cells Stacked for Electric Car

Driverless Electric Auto



In Conclusion

Reused, Repaired and Repurposed equipment fosters the integration and expansion of IoT at a lower cost than new equipment

Reuse as intended fosters a circular economy and limits the environmental and economic costs to society as a whole

The circular economy can help bridge the digital divide by providing technology to underserved markets at reasonable prices

A vast network of markets and companies are already in place and ready to expand as IoT grows

Reputable companies are working hard to make sure the markets function to protect the environment at all stages in the process

Joe Clayton

ARCOA Group

1301 Broadway Blvd NE

Albuquerque, NM 87102

jclayton@thinkarcoa.com

Office 505.369.1959 x 301

Cell 919.619.4856