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## A Global Circular IT Hardware Industry

**Opportunity and Imperative** 





### Are Our Heads in the Clouds?



Computer Power consumption forecast to exceed global energy production in 2040 (Semiconductor Ind. Assoc., 2015)



2016 ewaste = 49m tons, growing to 57 million tons in 2021 (United Nations University)



"The future of electronics may depend on deep sea mining for minerals" (All About Circuits)



Datacenters powering Al could account for 10% of global electricity demands by 2025



CO2 emissions of digital increased by 450m tons since 2013 in OECD countries, while globally, overall CO2 emissions decreased by 250 tons over the same period. (Shift Project)



GHG of digital on track to go from 4% to 8% (UMass)

### **Data Center IT Growth is Explosive**

Servers Deployed, 2019-2023:

# 65 + (14\*4) = 121





### And... Data Center IT Growth Waste is Explosive

# Servers Deployed, 2019-2023: 65 + (14 \* 4) = 121 75

 $\rightarrow$  46M servers to be "EOL'ed" between 2019 and 2023





### What We are Doing Really Well

PUE

- Computational efficiency
- Utilization and power scaling
- Cooling, power efficiency
- Renewables



### **Renewable Progress**

The World's Largest Colo Buyers Demanded Green Power

**EQUINIX** INTERCONNECTIONS

**Connecting With Sustainable Purpose: Moving to 100% Renewable Energy & More** 

#### COMMERCIAL & INDUSTRIAL ENERGY

#### Google Officially Hits Its 100% Target Renewable Energy

#### **Facebook will power itself with 100% renewable energy by 2020**

Boden Type Data Center One: progress on the world's most efficient prototype data centre

Apple now globally powered by 100 percent renewable energy

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CIO JOURNAL

**Iron Mountain Pitches Renewable Energy to Data-Center Customers** 

Renewable sources can offer up to 30% in energy savings, according to the head of Iron Mountain's data-center operations



### But Are We Looking at the Whole Picture?

#### **Pre-Use**

#### Phase

CO2e and GHG from mining to manufacturing to deployment Embodied Energy/ Scope 3 emissions **Operational** 

#### Phase

Electricity to run IT equipment

Scope 1 emissions

**Post- Use Phase** Recycling and EOL Processes Embodied Energy / Scope 3 emissions

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Recycling and EOL Processes Embodied Energy / Scope 3 emissions



### **Model Approach and Assumptions**

- Lifecycle analysis of CO2e across Embodied Energy (pre- and post-use phases) and use phase impacts
- Mining -> materials -> components -> systems -> racks (and reverse)
- Compute equipment only
- OCP-style rack, bare bones x86 servers
- EU Datacenter
- Component manufacture in China
- Rack and server assembly in Czech Republic

- 50+ research papers
- 10+ expert interviews
- Thinkstep consulting/ GaBi/ Ecolnvent validation for key components
- ITRenew data
- Version 1.0
- Designed to drive collaboration
- Directionally robust



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### **Turns Out, This Stuff Matters**

#### **Pre-Use Phase**

# 76%

**Operational** 



Post

2%

#### If Embodied Matters So Much on the Surface, "Quantify a Mini System"

#### OBJECTIVES

 Compare a "business as usual case" to a circular economic model

#### APPROACH

- Hyperscaler uses 1 server for 3 years
- Downstreamers use server for 9 years
- Servers "normalized" by generation according to Moore's law
- Define single 9 year period for analysis



### What if We Could Enable a 2<sup>nd</sup> "Life"?







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### **TCO Impact of the Same System... Also Better**

#### SAME ASSUMPTIONS THROUGHOUT:

- Moore's law= 13%
- Depreciation 60/30/10
- \$/ kwh: .0752
- Busy/ average power ratio: 58%
- Busy watts/ server: 465 (270 avg)







### But Can I Really Run This Stuff This Long? Yes.

#### ECONOMIC LIFE ANALYSIS

- Moore's Law: 13% perf/watt/year over 10 year horizon
- PUE: 1.15
- \$/ kwh: .0752
- Busy/ average power ratio: 58%
- Busy watts/ server: 465 (270 avg)
- \$/ w/ yr facility cost: .4551
- Server capex: \$3,500

Useful Life = 9.2 years





### Won't I Need More Datacenters? No.

#### ASSUMPTIONS

- Moore's law: 13% perf/ watt/ yr
- 150K sq. ft DC
- 20% compute and storage growth / year
- 10 year time horizon

NEW EQUIPMENT, 3 YEAR DECOM

40%	48%	54%	50%	53%	53%	49%	55%	61%	69%
50% RECERTIFIED EQUIPMENT									
40%	49%	56%	58%	63%	63%	59%	64%	70%	74%

- If Moore's Law is double, still don't need
- If you start at 60% full, definitely need new DC... in the same year regardless
- If you grow at 25% instead, also need, diff is year  $9 \rightarrow 8$



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#### The Circular IT Hardware Industry Opportunity

WHAT IF...

Servers

Tonnes C02e

## 15 million $\rightarrow$ 10 million = 7.8 million

**Return trips from** San Francisco – Amsterdam

#### The Circular IT Hardware Industry Opportunity

WHAT IF...

Servers

Tonnes C02e

# 46 million $\rightarrow$ 31 million = 6.7 million

Cars' annual emissions

#### The Circular IT Hardware Industry Opportunity

WHAT IF...

### 46 million

Servers



Tonnes of waste

**2.2X** Trucks From Amsterdam

to Brussels

#### What Does This Look Like in Action?

### **Open is Essential, But Not Sufficient**



#### **Open is Essential, But Not Sufficient**

Design, engineering and product expertise, rigorous commitment to quality

> Market-making scale and diversity of downstream channels

Services and Products + a changed mindset and shared ethos across the ecosystem

e stack

Global operations and logistics footprint – time to market is critical

Automation and machine learning to fuel both customization and efficiency at

## Introducing SESAME, Hyperscale Technology for Everyone

THE FUNDAMENTAL ENABLER

- First of its kind, recertified, open integrated compute and storage systems
- Performance optimized
- Warrantied (3 and 6 years)
- Rack solutions for data centers globally
- New form factors for new use cases
- Availability of supply at scale, worldwide and consistent
- Quality on par with new (under industry average of 1.5%)
- Disruptive economics to enable adoption at scale

**Democratized Access, No Compromises, and Transformational TCO!** 



## Open. Together.

#### The Opportunity •

#### The Imperative



\$50B+

hyperscale TCO value recovery



\$10B+/yr

recent hardware market currently blocked \$

24% System TCO savings



24%

Net CO2e Savings



52% of global

population not online