



## EPEAT Server Recyclability Rate Calculation

### Purpose

To establish an EPEAT Server Recyclability Rate for the following servers:

- PWKS\_AA25UTRT Series Servers.
- PWKS\_AA25UTRT Series Servers
- PW-GT20 Server
- PWB-411 Server
- PWB-421 Server

### Scope

The recyclability assessment applies to the following ACE Computers Server systems:

- PWKS\_AA25UTRT Series Servers.
- PWKS\_AA25UTRT Series Servers
- PW-GT20 Server
- PWB-411 Server
- PWB421 Server

### References

NSF/ANSI 426-2019 Environmental Leadership and Corporate Social Responsibility Assessment of Servers (Criterion 9.1.4)

IEC TR 62635

### Methodology

The methodology used to compile the recyclability rate calculation is based on the IEC TR62635 Standard. The calculation starts with the receipt of untreated waste equipment and ends when end-of-life status has been reached. Annex E of the IEC TR62635 Standard was used to break down the server parts into the following categories: parts for selective treatment, parts with single recyclable material, parts difficult to process, metal separation, and non-metal separation. These categories are based on the IEC TR62635 standard definition for each, which includes reference numbers 5.4.3 (Condition for Parts Selective



Treatment), 5.4.4 (Condition for Single Recyclable Materials), and 5.4.5 (Condition for Parts Difficult to Process). Under each category, each specific server part is broken into the mass, material, recycling rate, and recyclable mass. The sum of the recyclable masses divided by the total mass of the server (as a percentage) summarizes the overall recyclability rate for the server system.

### Recycling Technologies

To determine the recyclability rate of the server systems, ACE has analyzed the recycling streams needed to process all components of the server systems. The following recycling streams were identified through online research of publicly available information on common E-waste recycling practices:

- *Metal Smelting:* Applies to metals parts of the fans, screws, metal brackets, chassis metallic parts, and metals from cables.
- *Precious Metal Processor:* Applies to RAM, processor, circuit boards, heatsink, and server back plane.
- *Plastic Processor:* Applies to all plastic parts and plastics from cables.
- *Batteries:* All battery types are sent to a battery recycler.

### Assumptions

Based on the methodology above, the material of each part of the server was publicly researched online for percent recyclability and we collaborated with our 3<sup>rd</sup> party recycler to determine any other relevant recycling data. Below is a chart with materials, the recycling rate percentage, and the assumption made to determine the recycling rate percentage:

Material	Recycling Rate %	Assumption Information
PC+ABS (plastic)	10%	Online research of publicly available information indicates that PC and ABS are a Plastic No. 7 for recycling which indicates that it is composed of a variety of resins and has a low recyclability rate. Based on this information Ace has evaluated the recycling rate to be 10%.
PC (plastic)	10%	Online research of publicly available information indicates that PC is a Plastic No. 7 for recycling which indicates that it is composed of a variety of resins and

<b>Material</b>	<b>Recycling Rate %</b>	<b>Assumption Information</b>
		has a low recyclability rate. Based on this information Ace has evaluated the recycling rate to be 10%.
ABS PA-765A (plastic)	10%	Online research of publicly available information indicates that ABS plastics are a Plastic No. 7 for recycling which indicates that it is composed of a variety of resins and has a low recyclability rate. Based on this information Ace has evaluated the recycling rate to be 10%.
PC+ABS+25% GF (plastic)	10%	Online research of publicly available information indicates that PC and ABS are a Plastic No. 7 for recycling which indicates that it is composed of a variety of resins and has a low recyclability rate. Based on this information Ace has evaluated the recycling rate to be 10%.
Printed Circuit Boards (includes Processor, RAM, Riser Card, Motherboard, Expansion Card/Graphics Card)	100%	Online research of publicly available information and collaboration with our third-party recycler indicate that printed circuits boards have a high rate of recyclability. The process to recycle PCBs includes selectively dismantling the PCB, crushing it, then physically separation using magnetic or electrostatic methods to obtain various metal particles. The non-metallic fraction from waste PCBs can be used as additives to fillers to fabricate high-strength composites. Based on this information ACE has evaluated the recycling rate to be 100%.
Lithium Battery	60.5%	Online research of publicly available information indicates that the recycling process for lithium batteries can yield any where from 25% to 96% recyclability rates. Based on this information ACE has evaluated the recycling rate to be 60.5% but choosing the medium of the above listed range.
Nylon (Plastic)	10%	Online research of publicly available information indicates that nylon plastics are a Plastic No. 7 for recycling which indicates that it is composed of a variety of resins and has a low recyclability rate. Based on this information Ace has evaluated the recycling rate to be 10%.

<b>Material</b>	<b>Recycling Rate %</b>	<b>Assumption Information</b>
PBT (plastic)	10%	Online research of publicly available information indicates that PBT plastics are a Plastic No. 7 for recycling which indicates that it is composed of a variety of resins and has a low recyclability rate. Based on this information Ace has evaluated the recycling rate to be 10%.
POM (plastic)	100%	Online research of publicly available information indicates that POM plastics are 100% recyclable either as feedstock or mechanically. Based on this information ACE has evaluated the recycling rate to be 100%.
PMMA (plastic)	10%	Online research of publicly available information indicates that PBT plastics are a Plastic No. 7 for recycling which indicates that it is composed of a variety of resins and has a low recyclability rate. Based on this information Ace has evaluated the recycling rate to be 10%.
PVC (plastic)	10%	Online research of publicly available information indicates that PBT plastics are a Plastic No. 7 for recycling which indicates that it is composed of a variety of resins and has a low recyclability rate. Based on this information Ace has evaluated the recycling rate to be 10%.
PE (plastic)	10%	Online research of publicly available information indicates that PBT plastics are a Plastic No. 7 for recycling which indicates that it is composed of a variety of resins and has a low recyclability rate. Based on this information Ace has evaluated the recycling rate to be 10%.
PPHOX (m-PPE) (plastic)	10%	Online research of publicly available information indicates that m-PPE plastics are a Plastic No. 7 for recycling which indicates that it is composed of a variety of resins and has a low recyclability rate. Based on this information Ace has evaluated the recycling rate to be 10%.
PA66 (plastic)	10%	Online research of publicly available information indicates that PA66 plastics are a Plastic No. 7 for recycling which indicates that it is composed of a

<b>Material</b>	<b>Recycling Rate %</b>	<b>Assumption Information</b>
		variety of resins and has a low recyclability rate. Based on this information Ace has evaluated the recycling rate to be 10%.
PA9T	10%	PA9T is a PPA which is a subset of a thermoplastic, they are suitable for high temperature applications. Online research of publicly available information indicates that thermoplastics are 100% recyclable as they can be melted down and reused, but due to current industries, trends, costs, etc. they are not recycled with such efficiency, as such Ace has evaluated the recycling rate to be 40%.
PA46	10%	PA46 is a Polyimide with excellent high temperature and electrical resistance. Online research of publicly available information indicated a typically low recyclability rate. Based on this information Ace has evaluated the recycling rate to be 10%.
PA4T	10%	PA4T is a Polyimide with excellent high temperature and electrical resistance. Online research of publicly available information indicated a typically low recyclability rate. Based on this information Ace has evaluated the recycling rate to be 10%.
Wus Prepeg	10%	Online research of publicly available information indicates that Prepeg plastics (carbon fiber fabric infused with resin) typically have a low recyclability rate. Based on this information Ace has evaluated the recycling rate to be 10%.
Various Metals (includes Chassis Cover, Chassis, Back Plane, Metal Brackets, Screws)	100%	Online research of publicly available information indicates that metals that can be separated and are composed of a single metal material can be recycled at a rate of 100%. Based on this information Ace has evaluated the recycling rate to be 100%.
External and internal Cables	85%	Online research of publicly available information indicates that external and internal cables typically have a recyclability rate of 85%. Based on this information Ace has evaluated the recycling rate to be 85%.

<b>Material</b>	<b>Recycling Rate %</b>	<b>Assumption Information</b>
Power Supply Module	94%	Online research of publicly available information indicates that power supply modules, once dismantled typically yield a recycling rate of 94%. Based on this information Ace has evaluated the recycling rate to be 94%.
CPU Processors	5%	Online research of publicly available information indicates that CPUs typically yield a recycling rate of 5% as the CPU is chemically stripped for copper, silver, and gold with a low return rate. The remaining portions are then landfilled. Based on this information Ace has evaluated the recycling rate to be 5%.
Fans	85%	Online research of publicly available information indicates that Fans typically yield a recycling rate of 85% when all parts within the fan are separated. Based on this information Ace has evaluated the recycling rate to be 85%

## Results

The results of the Recyclability Rate Calculation are as follows:

### PWKS\_AA25UTRT Series Servers

Primary Parts	% Weight	Recyclability Rate
Chassis and Chassis Cover	60.85%	100%
Fans	5.00%	85%
Metal Brackets/Screws	1.37%	100%
RAM	3.33%	100%
Hard Drive	4.31%	98%
Riser Card	2.00%	100%
Plastics: PC, PC+ABS, PC+ABS+25%GF, Nylon, PBT, ABS, PMMA, PVC, PE, ABS PA-765A	1.10%	10%
Plastics: POM	0.07%	100%
Lithium Battery	0.02%	60.50%
Motherboard	3.75%	100%
Power Supply Module	11.39%	94%
CPU Processor	0.97%	5%
Internal/External Wires	1.84%	85%
Heat Sink	2.00%	100%
Back Plane	2.00%	100%

$$R_{cyc} = (15028.38g/16329g) \times 100\% = 92.03\%$$

Dimensions: 17.2"W x 3.5"H x 28.46"D

### PWKS\_AA15PWTR Series Servers

Primary Parts	% Weight	Recyclability Rate
Chassis and Chassis Cover	59.42%	100%
Fans	3.75%	85%
Metal Brackets/Screws	0.91%	100%
RAM	3.33%	100%
Hard Drive	4.31%	98%
Riser Card	2.00%	100%
Plastics: PC, PC+ABS, PC+ABS+25%GF, Nylon, PBT, ABS, PMMA, PVC, PE, ABS PA-765A	1.79%	10%
Plastics: POM	0.08%	100%
Lithium Battery	0.02%	60.50%
Motherboard	3.75%	100%
Power Supply Module	13.66%	94%
CPU Processor	0.97%	5%
Internal/External Wires	2.01%	85%
Heat Sink	2.00%	100%
Back Plane	2.00%	100%

$$R_{cyc} = (12,644.66g/13,607.54g) \times 100\% = 92.92\%$$

Dimensions: 23.5"W x 8.5"H x 33.7"D



### PW-GT20 Server

Primary Parts	% Weight	Recyclability Rate
Chassis and Chassis Cover	45.31%	100%
Fans	1.13%	85%
Metal Brackets/Screws	0.82%	100%
RAM	1.92%	100%
Hard Drive	25%	98%
Plastics: PC2865, PBT, PE, PVC, ABS PA-765A, PBT+PVC, Modified ABS/PBT, Nylon+PVC, PPHOX (m-PPE), PA66	4.59%	10%
Lithium Battery	0.016%	60.50%
Motherboard	3.71%	100%
Power Supply Module	11.28%	94%
CPU Processor	0.96%	5%
Internal/External Wires	1.66%	85%
Heat Sink	3.60%	100%

$$R_{cyc} = (16,830.69g/18,143.47g) \times 100\% = 92.76\%$$

Dimensions: 23.5"W x 8.5"H x 33.7"D

### PWB-411 Server

Primary Parts	% Weight	Recyclability Rate
PCBs (Motherboard, RAM, M.2, etc.)	36%	100%
Metals	57%	100%
Single Type Plastics	2%	10%
Multi Type Plastics (harder to process)	4%	10%
Coin Cell (Lithium Metal Battery)	0.07%	60.5%
CPU	1%	5%

$$R_{cyc} = (4345.96 \text{ g}/4103.38 \text{ g}) \times 100\% = 94.42\%$$

Dimensions: 7.6" W x 16.7"H x 20.68" D

### PWB-421 Server

Primary Parts	% Weight	Recyclability Rate
PCBs (Motherboard, RAM, M.2, etc.)	41%	100%
Metals	52%	100%
Single Type Plastics	2%	10%
Multi Type Plastics (harder to process)	4%	10%
Coin Cell (Lithium Metal Battery)	0.06%	60.5%
CPU	1%	5%

$$R_{cyc} = (4479.93.72\text{g}/4779.19\text{g}) \times 100\% = 93.63\%$$

Dimensions: 7.6" W x 16.7"H x 20.68" D



## **Treatment Operator Information**

In order to achieve the recycling rate in the Results section above, the components should be broken down to the most homogeneous level possible.

## **Special Transportation Considerations**

Lithium batteries are regulated as a hazardous material under the U.S. Department of Transportation's (DOT's) Hazardous Materials Regulations (HMR; 49 C.F.R., Parts 171-180). Lithium batteries must conform to all applicable HMR requirements when offered for transportation or transported by air, highway, rail, or water. Electronic devices containing batteries should be securely packed to prevent movement within the outer packaging or activation of the device. This includes placing the electronic device containing batteries in a rigid, strong outer packaging. Once the device is ready for shipping, additional paperwork or shipping labels may be required by the shipping carrier. Additional information regarding transporting lithium batteries is publicly available through the U.S. Department of Transportation's webpage (<https://www.phmsa.dot.gov/lithiumbatteries>).

## **Mitigating Environmental and Personnel Hazards**

Lithium batteries contain lithium compounds, nickel compounds, arsenic compounds, and dimethoxyethane, all of which are considered toxic materials. To prevent these toxic materials from being released into the environment, lithium-ion batteries should be separated from the electronic device and recycled at a certified battery electronics recycling facility upon end-of-life status.

Lithium batteries can cause personnel hazards if misused, mishandled, improperly stored, overcharged, or defective batteries can short circuit, overheat, and sometimes cause a fire. Most lithium batteries manufactured today contain a flammable electrolyte and have a higher energy density. They can overheat and ignite under certain conditions and, once ignited, can be difficult to extinguish. Although infrequent, a lithium battery is susceptible to thermal runaway which is a chain reaction leading to a violent release of its stored energy.

Lithium batteries and devices containing lithium batteries should be stored in well-ventilated, dry areas kept between 40 and 80 degrees Fahrenheit. They should be stored away for heat sources, direct sunlight, water, and explosive materials.



**Revision History Table:**

<b>Revision No.</b>	<b>Revision Date</b>	<b>Description</b>	<b>Approved By:</b>
1	9/10/2021	Initial Release	LH
2	9/16/2021	Added dimensions, information for special transportation considerations, information for mitigating environmental and personnel hazards	LH
3	10/04/2021	Added information for server PW-GT20, and PWKS_AA15PWTR server series	LH
4	3/15/2022	Added information for server PWB411 and PWB421	LH
5	7.5.2022	Minor Updates	AR
6	7.7.2022	Updated recyclability rate of PA9T to 10% for worst case and updated recyclability totals for PWB-421 to reflect the 10% change.	AR