

Consumer Electronics in 2020: Ownership, Usage, and Energy Consumption amid COVID-19

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ABSTRACT

Consumer electronics are among the most dynamic building end uses. Device ownership, power draw characteristics, and usage patterns can all change rapidly due to frequent innovation, short product cycles, and shifts in user behavior. We characterized the energy use, ownership, and power draw of consumer electronic devices in 2020, based on bottom-up models and drawing upon field-monitoring studies, power databases and field measurements. To estimate usage and ownership, we fielded online surveys for televisions, video-game consoles, computers and monitors, smart speakers, and home security cameras. We estimate that 3.3 billion devices consumed 176 TWh in 2020, or about 12% of residential sector and 4.5% of total U.S. electricity consumption. This represents a 23% increase in consumption relative to 2017, apparently driven by higher usage during the COVID-19 pandemic. Televisions (54 TWh), computers and monitors (45 TWh), and set-top boxes (18 TWh) continue to account for a majority of total consumption. Newly-studied categories consumed relatively less energy: robot vacuums (0.4 TWh), smart speakers (1.7 TWh), home security cameras (3.7 TWh), uninterruptible power supplies (1.2 TWh), and virtual reality headsets (0.2 TWh).

Introduction

This paper shares findings from a comprehensive study of U.S. consumer electronics (CE) energy use in 2020 (Urban, Roth, and Olano 2021). The study, the fifth of its kind (Roth and McKenny 2007, Urban, Tiefenbeck, and Roth 2011; Urban, et al. 2014; Urban, et al. 2017), provides an in-depth characterization of the ownership, power draw, and usage of electronics, providing energy policymakers and industry stakeholders with current information. Regular evaluations of CE energy consumption is crucial, as consumer electronic devices have shorter product cycles, new device categories can quickly gain large market share, and user behaviors can shift. This can lead to rapid changes in the energy consumption of individual CE categories. To keep pace with this dynamic situation, we perform a periodic “energy census” of consumer electronics in the U.S. The final report is public and available for download on the Consumer Technology Association (CTA) website. Given space constraints, this paper will focus on key results, new device categories, and noteworthy trends. The final report goes into far greater detail on methods, results, and modeling decisions used for individual device categories.

Methods

Device Category Selection

In consultation with CTA, we selected priority devices to study in the most depth. Priority was given to devices with historically high total annual energy consumption (AEC),

higher uncertainty in preliminary estimates, and/or new devices that have gained market traction but have not yet been well characterized. We updated estimates for the lower-priority devices were updated mainly by revising estimates of installed base figures, assuming power draw and usage characteristics were unchanged since the 2017 study unless we found more recent studies of power draw by mode.

Energy Modeling Approach

We used a bottom-up modeling approach to evaluate consumer electronic device energy consumption, Figure 1. For each device category studied, we first developed estimates for the typical average power draw (W) and usage (hours per year) for relevant power modes. Multiplying power and usage by mode yields the component unit energy consumption (UEC in kWh per year) values, and the sum of UEC over all modes equals the total device UEC. Finally, the product of the total device UEC and the installed base (in millions of units) equals the annual electricity consumption (AEC in TWh).

Mode	Power Watts	Usage hours/year	Unit Energy Consumption kWh/year	Installed Base million units	Annual Energy Consumption TWh
Active	P _{active}	× T _{active}	= UEC _{active}	× IB	= AEC
Sleep	P _{sleep}	× T _{sleep}	= UEC _{sleep}		
Off	P _{off}	× T _{off}	= UEC _{off}		
			Σ = UEC _{total}		

Figure 1. Illustrative method for calculating device-level Unit and Annual Energy Consumption.

To estimate the modeling inputs for installed based, power draw, and usage for each device category, we drew upon field-monitoring studies, power databases device power measurements, CTA market research, and industry input, and fielded an ownership and usage survey. We discuss the components of the UEC and AEC estimates below.

Installed base. The installed base represents the total number of devices in U.S. homes that were plugged in within the past month. This definition excludes devices that were *owned* but not *plugged in*, so values may differ from ownership figures published elsewhere. Installed base estimates came from market research studies, most commonly the ownership and sales reports published by CTA Market Research (2016-2020), the Consumer Electronics Usage Survey (see next subsection), and, to a lesser extent, ownership and sales data from other sources. For most devices, the installed base estimates have the lowest uncertainty of any AEC component.

Power draw by mode. All consumer electronics have at least two basic operating modes – *on* and *off* – and most have other modes such as *idle*, *standby*, *sleep*, *hibernate*, or *charging*. Within a specific power mode, device power draw can vary appreciably due to changes in operation such as variable processor utilization, display brightness, or audio signal. For each device category, we identified the most relevant power modes and developed estimates for the average power draw of its installed base in each mode, attempting to reflect real-world usage conditions as accurately as possible.

We relied on several sources to estimate power draw by mode, including: energy consumption characterization studies, field measurement campaigns, product power draw and

energy consumption databases (ENERGY STAR 2021, California Energy Commission 2021, Energy Efficiency Voluntary Agreements 2021), measurements performed by CTA member companies, and targeted measurements performed by Fraunhofer USA.

Usage by mode. For most device categories, the average annual time spent in different power modes is the most challenging to estimate accurately. While long-term field studies of demographically-representative populations would provide the best data, these are challenging to implement and expensive to administer. Instead, we relied on the Consumer Electronics (CE) Usage Survey, data from prior field measurement campaigns, and data from prior energy consumption characterization studies.

The CE Usage Survey responses served as inputs into more refined models used to assess computer, monitor, television, and video game console usage. We posed more questions for computers and video game consoles because they have substantial AEC values that depend strongly on usage behaviors and power management settings.

Consumer Electronics Usage Survey

To develop refined estimates of the installed base, device characteristics, and user behavior, we worked with CTA Market Research to organize an online survey of demographically representative households, hereafter the CE Usage Survey. This survey addressed priority device categories including televisions, computers, monitors, video game consoles and some newer device categories, including smart speakers, security cameras, robot vacuums, and virtual reality headsets. For each category, we asked respondents how many units had been plugged in at their home within the past month.

We also designed usage questions to elicit how many hours a device spends in different power modes. For simple devices, we asked direct questions about usage frequency and duration. For more complex devices, like computers and monitors, we posed additional questions to identify likely power management settings. We then inferred user behaviors and device states from the survey to model devices' energy consumption. For some devices, like televisions, we asked detailed questions about the device itself, such as approximate screen size and display type. This is important because past CE studies found that use can correlate with features affecting energy consumption, including screen size and display type. We also added questions to determine how the COVID-19 pandemic may have affected television and computer usage.

We used multiple survey fields to model the energy consumption of particular devices in households, with household demographic weightings applied by the company fielding the surveys to estimate the average UEC of each device type across the population. The final report contains further details, including question wording and device-specific modeling methods (Urban, Roth, and Olano 2021).

In contrast to prior studies, this fielded surveys online instead of by telephone. This allowed for a raw sample about twice as large as prior surveys ($n=2,006$), while also allowing us to present images that could help respondents to provide more accurate information about specific kinds of products. Unfortunately, we found that a significant portion of the online surveys responses appeared highly irregular and likely invalid. This was more frequent and severe than in prior phone surveys. To minimize invalid responses, the survey vendor used two kinds of filters. First, validation questions within the survey served to exclude possible robots or respondents who weren't paying attention. Second, they excluded "speeders" or respondents whose total survey duration was less than 30% of the median.

Nevertheless, during the initial data review, we found that a portion of the responses were highly irregular (e.g., owning six of every type of video game console; having more than four external monitors on every computer and laptop). Spurious responses were often correlated across many questions and device categories. To address this, we developed a basic scoring method to flag potentially invalid data. We worked with the survey vendor to exclude suspicious responses (17.5%) from the base survey set and re-weighted the remaining responses. This filtering approach brought the summary results more in-line with expectation and past results.

Energy Consumption Results

Overall Energy Trends

We estimate that 3.3 billion CE devices consumed about 176 TWh in 2020, equal to about 12% of residential sector and 4.5% of total U.S. electricity consumption. Powering these devices costs about \$23 billion annually. For the average household, this is about 1,465 kWh or \$190 per year.

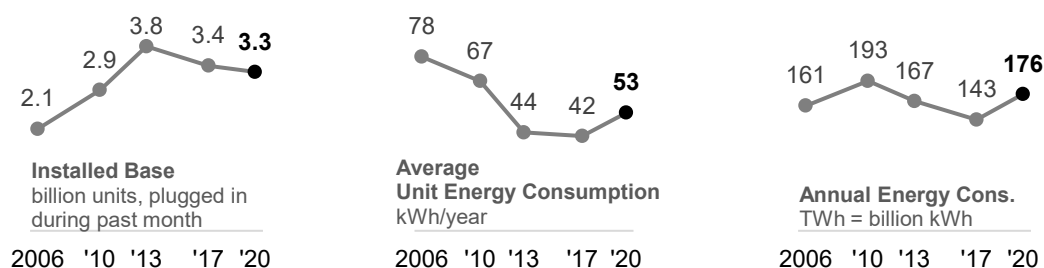


Figure 2. Recent trends in consumer electronics installed base and energy consumption.

While total consumer electronics energy use had been trending downward since 2010, the 2020 energy total exceeded that of 2017 by 23%. Results of the CE Usage Survey suggest that significantly higher usage, very likely related to the COVID-19 pandemic, accounted a large portion of this increase. Active and idle modes accounted for the vast majority (85%) of the energy consumed by the devices studied in depth.

Device-Level Consumption

The estimated energy use breakdown by device category is shown in Table 1 and Figure 3. Three categories account for just over half the total energy consumption: televisions (30%), desktop computers (15%), and set-top boxes (10%). The *other devices* studied in less detail account for about 35% of the total number of units but only about 15% of the total energy consumption, with audio devices accounting for over half of “other” devices’ AEC. Altogether, the devices studied in depth account for the vast majority of the total AEC.

Table 1. Energy use estimates for consumer electronics in U.S. homes in 2020.

Device	Units (mill.)	Power (W)				Usage (hours/year)				UEC (kWh/yr)	AEC (TWh)
		Active	Idle	Sleep	Off	Active	Idle	Sleep	Off		
Computer, Desktops	79	73	49	2.5	1.1	2,310	3,190	1,500	1,760	331	26.1
Computer, Portables	123	19	9.1	0.7	0.3	2,145	2,805	1,950	1,860	69	8.5
Computer Monitors	123	25	-	0.6	0.4	3,385	-	3,450	1,925	86	10.8
Network Gateways	105	13.5	-	-	1.3	8,760	-	-	-	118	12.4
Network Local Equip.	38	6.5	-	-	1.0	8,760	-	-	-	57	2.2
Robot Vacuums	14	27	0.2	-	3.0	80	66	-	8,614	28	0.4
Security Cameras	117	3.6	-	-	-	8,760	-	-	-	31	3.7
Set-top Boxes, Subscription	171	11	-	9.5	-	5,110	-	3,650	-	89	15.2
Set-top Boxes, Digital Stream	93	2.8	-	1.7	-	1,925	-	6,835	-	17	1.6
Set-top Boxes, Standalone	2	33	-	30	-	4,200	-	4,560	-	275	0.6
Set-top Boxes, Over-the-Air	16	6.5	-	0.8	-	3,940	-	4,820	-	29	0.5
Smart Speakers	76	3.0	2.5	-	-	732	8,028	-	-	22	1.7
Televisions	285	81	-	-	2.3	2,120	-	-	6,640	188	53.5
Uninterruptible Power Supplies	5	26	-	-	-	8,760	-	-	-	224	1.2
Video Game, Major Consoles	109	67	47	-	3.4	905	350	-	7,505	103	11.2
Video Game, VR Headset	11	12	-	-	1.8	560	-	-	8,200	22	0.2
Video Game, Retro Game	4	-	-	-	0.0	240	-	-	8,520	0.7	0.0
Video Game, Portable	49	-	-	-	-	-	-	-	-	4.3	0.2
Other Devices, Portable	1,058	-	-	-	-	-	-	-	-	3.5	3.7
Other Devices, Non-Portable	904	-	-	-	-	-	-	-	-	25	22.8
TOTAL	3,334	-	-	-	-	-	-	-	-	53	176

Notes: Top three energy-consuming devices highlighted.

Power modes in this table are approximate. See Urban, Roth, and Olano (2021) for more detail.

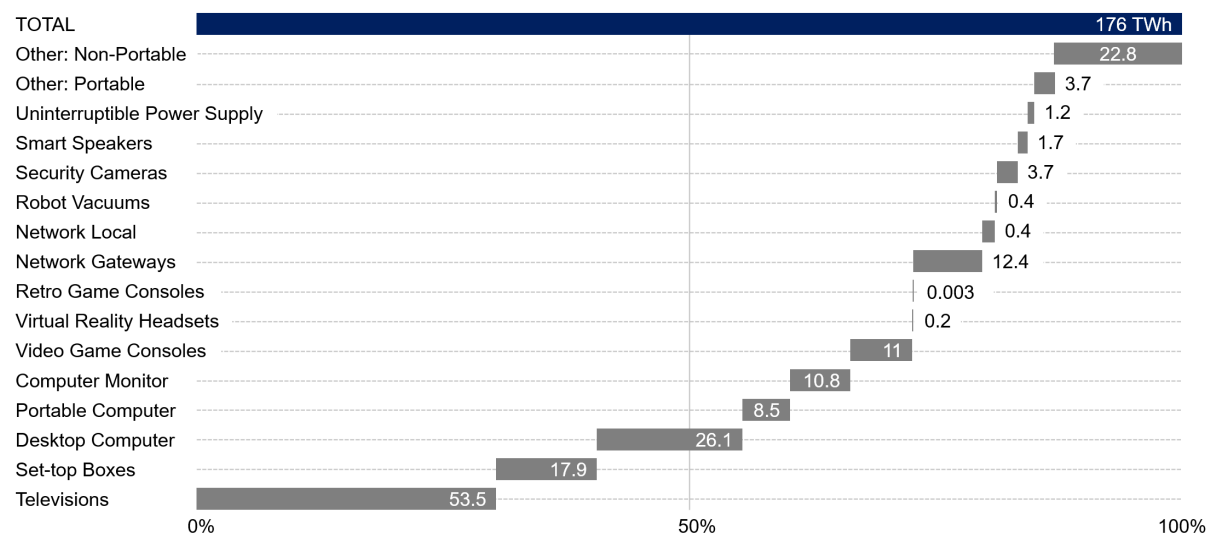


Figure 3. Energy use estimates by device type in U.S. homes in 2020.

COVID-19 led to higher energy usage for major devices

While it is not always possible to directly attribute top-level changes in energy consumption to a single factor, 2020 was clearly a special case. During the COVID-19 pandemic, people spent far more time at home for school, work, and recreation, and we found this behavior was directly linked to the increased usage estimates for 2020. Whether these usage trends will continue to increase, remain stable, or revert to prior levels will be the subject of future studies.

To assess these potential impacts, we included COVID-19 specific survey questions for televisions and computers, asking respondents to estimate by how much their daily usage has increased or decreased per day. The results agree with and explain most of the increased usage. For instance, the average daily television active mode usage (i.e., the total number of hours a TV is on) increased by nearly 50% from 2017 to 2020, going from 3.9 to 5.8 hours per day per TV. This increase is consistent with the self-reported COVID-19 impact of +1.5 hours per day per TV. Similarly, the active use of computers was also higher than in 2017. Our models estimate that the average desktop and laptop were used for 5.7 and 5.5 hours, respectively, about 30% higher than in 2017. Responders indicated an average increase of +1.5 hours per day per computer due to the pandemic.

For these device categories, active-mode power draw is substantially higher than standby or off-mode, so higher active (and idle) usage translates directly into higher UEC and AEC values. The same is true of computer monitors, as their use is directly influenced by computer usage. Finally, video game consoles usage was about 20% higher than in 2017. Although we did not field COVID-19 specific questions for this category, we expect that, too, was likely strongly influenced by the pandemic as well.

In sum, the increased time spent at home and the resulting increase in usage explains much of the total energy increase observed across categories.

A Closer Look at Major Device Categories

This section looks at the findings for several major device categories that were studied in depth since 2013. Table 2 shows recent trends for Installed Base, Unit Energy Consumption (UEC), and Annual Energy Consumption (AEC).

Table 2. Trends in U.S. ownership and energy consumption for selected devices.

Device \ Year	Installed Base millions			Avg. Unit Energy Consumption kWh/yr			Annual Energy Consumption TWh		
	2013	'17	'20	2013	'17	'20	2013	'17	'20
Televisions	301	284	285	166	123	188	50	35	53.5
Set-top Boxes, Subscription ¹	239	228	171	123	107	89	29	25	15.2
Video Game, Major Consoles	128	105	109	88	79	103	11	8.3	11.2
Computer, Desktops	88	72	79	186	246	331	16	18	26.1
Computer, Portables	93	122	123	51	42	69	4.7	5.1	8.5
Monitors	97	101	123	58	80	86	5.7	8.1	10.8
Network Gateways	113	93	105	58	107	118	6.6	9.5	12.4
Network Local Equip.	94	39	38	59	52	57	5.5	2.0	2.2

¹ Includes DVR, Non-DVR, Thin client, and Cable DTAs. STB values in the '17 column are actually for 2016. *Source:* Based on (Urban, et al. 2014; Urban, et al. 2017, and Urban, Roth, and Olano 2021)

Television energy consumption up about 50% amid higher usage

Televisions remain the most owned and highest-consuming category. The 2020 installed base remained relatively flat at around 285 million units vs. 284 million units in 2017. In that time, UEC and AEC increased by about 53% to 188 kWh/yr and 54 TWh, respectively.

This energy increase reversed a major downward trend that started after 2010, when TV energy consumption peaked around 65 TWh. From 2010 until 2020, Cathode Ray Tube (CRT) displays steadily left the installed base, while modern LCD and LED TVs took their place. As of 2020 we estimate the transition away from CRTs is nearly complete, i.e., the 2020 CE Usage Survey found that only 6% of TVs were identified as CRTs.

Relative to 2017, on-mode power estimates increased slightly from 77 to 81 W. This increase was partly because of a power-adjustment factor that we applied to account for differences in as-tested vs. real-world screen brightness. User preferences and brightness settings can influence TV power draw appreciably, yet the prevalence of different brightness settings is not well characterized.

Off-mode power estimates also increased from about 1.0 to 2.3 W, due to considerations about networked and active standby modes of smart, network-enabled TVs, particularly those that allow for instant-on or screen-casting capabilities. Some models can use 10 W or more in these active standby modes, while others use much less (see Horowitz et al. 2019). Unfortunately, the prevalence and use of these active modes is not well understood.

As discussed earlier, TVs experienced a 50% increase in on-mode usage, going from 1,410 to 2,120 hours per year, primarily driven by the COVID-19 pandemic and additional time spent at home. This was the main driver behind the category's energy increase. It remains to be seen if this increased usage trend will continue or if usage will eventually return to pre-pandemic levels.

Computers and Monitors

Computers and their monitors consumed an estimated 45 TWh in 2020, with computers accounting for 80% of the total. This represents an increase of nearly 50% since 2017, driven almost entirely by higher active usage during the pandemic. Secondary effects included decreases in on-mode power and slight-to-moderate increases in the installed base of desktops and external monitors.

Desktop and portable computers¹ and their external monitors all consumed more energy in 2020, primarily because of higher active mode usage. Users reported an average active usage of about 5.5-6.2 hours per day per computer,² or 32-51% higher than pre-pandemic levels.

More than most categories, computer and monitor usage depends also on device power management (PM) settings and behaviors. To evaluate these factors, we included targeted survey questions to determine devices' likely PM status that fed into energy models (Table 3). These models account for transitions between power modes during typical daily usage to estimate the total time spent in each mode.

¹ Including laptops and Chromebooks, but excluding tablets and smartphones.

² The range reflects values for different computer types.

Table 3. Usage survey responses for computers and monitors.

Survey Question	Desktop		Portable
	Tower	All-in-One	
<i>Active Usage Yesterday? (h/day)</i>	5.7	6.2	5.5
Before 5PM	3.4	3.7	3.1
After 5PM	2.4	2.5	2.4
<i>Owner-Reported Change in Usage Due to Pandemic (h/day)</i>	+1.4	+2.1	+1.6
Percent Change	+32%	+51%	+41%
<i>First Use State?</i>			
PC On & Display On	19%	24%	14%
PC On & Display Off	29%	33%	20%
PC Sleep	18%	18%	34%
PC Off / Hibernate	34%	25%	32%
<i>Power Management Status?</i>			
No Power Management	23%	29%	19%
Display Sleep Only	37%	38%	32%
PC Sleep (implies display sleep)	25%	21%	29%
PC Off / Hibernate	15%	13%	20%

Notes: Active usage values are as-reported by owners and differ from those used in the energy models. Modeled active usage depends on other factors like power management settings and behaviors. *Source:* (Urban, Roth, and Olano 2021).

Monitor energy use increased by about 20% from 2017 reaching almost 11 TWh. Three factors drove this change. First, the installed base increased by about 22% to 123 million units. Second, time spent in active mode increased by about 38% to about 9.2 hours per day. And, third, the average active-mode power draw declined by nearly 20% to 25 W. The average sleep- and off mode power-draw also declined slightly, at 0.6 and 0.4 W, respectively. As with televisions, CRT monitors have largely disappeared from the installed base, i.e., we estimate that LCD monitors comprise about 93% of the installed base, driving the decline in active-mode power draw.

Video Game Consoles

Major video game consoles consumed an estimated 11 TWh or 103 kWh per year per unit, in 2020. Since 2017, we estimate that major console consumption increased by about 20%, almost entirely due to higher active usage. Estimated active usage across several modes increased by 60% relative to 2017, to around 2.5 hours per day. We expect – but cannot demonstrate – that this reflects increased usage of consoles for streaming video playback and more time spent at home during the pandemic. In contrast, the total installed base and average power draw by mode were relatively unchanged from 2017 estimates.

Other related devices, including Virtual Reality (VR) headsets, portable games, and retro game devices, consumed far less energy, approximately 0.4 TWh. We estimate that about 11 million VR headsets consumed about 0.2 TWh (UEC = 22 kWh) in 2020.

Retro game consoles are reissued standalone clones of discontinued legacy consoles, like the NES Classic, Sony PlayStation Classic, or SEGA Genesis Mini. These generally use relatively little power, about 3 W in active mode. While CTA estimates indicate ownership of

about 45 million units, our CE Usage survey found that only a small fraction (10%) were plugged in recently. Consequently, we estimate their energy use to be exceedingly small at around 1 kWh per year and well below 0.01 TWh in total AEC.

Set-Top Boxes and Small Network Equipment

A major portion of Set-Top Box and Small Network Equipment industry stakeholders have signed onto voluntary agreements (VAs) to improve the energy efficiency of these devices. As part of these voluntary agreements, the industry provides data that characterizes the energy consumption of devices procured and sold. This information is then published in annual reports, which we use to study these devices.

Subscription set-top box energy use estimates have declined by almost half from 2013 to 2020, when they used about 15 TWh. This decrease occurred mainly for two reasons. First, the installed base shrunk by about 13%, with non-DVR boxes disappearing at the fastest rate. Second, the average UEC has also declined because newer boxes draw less power. The average DVR set-top box shipped in 2016 uses about 24 W in active mode, compared with 17 W for those shipped in 2020. Although some set-top boxes can enter a sleep mode, we estimate that this currently has a relatively small impact on average UEC and overall AEC.

Small network equipment energy use estimates have increased in recent years, with a total AEC of 14.5 TWh in 2020. Gateway devices, including Integrated Access Devices (IADs) and broadband modems, drew an average 13.5 W. We assumed that they are always on, with a UEC of 118 kWh in 2020, about 16% more than in 2017.

Newly-Studied Device Categories

The 2020 study included several device categories that we studied in depth for the first time. This section reviews the key findings.

Smart Speakers

Smart speakers or virtual assistant speakers have grown rapidly in recent years. Devices like the Amazon Echo, Google Nest Hub, and Apple HomePod can recognize and respond to voice commands, stream audio, and control other smart home devices. Smart speakers maintain a wireless network connection while waiting for commands and may include a built-in display. We estimate smart speakers consumed about 1.7 TWh per year or 22 kWh/yr per unit in 2020.

The CE Usage Survey found a 36% household penetration, with 1.8 units per owner household, implying 76 million units installed in 2020. The typical power draw of smart speakers is relatively low: 2.5 W in standby and 3.0 W in active mode. We asked survey respondents about smart speaker usage, finding that they spent an average of about 107 minutes playing music and 4.4 voice commands per day, or about two hours of active time per day. Consequently, the standby mode accounted for most of the UEC.

Security Cameras

Home security cameras include dedicated indoor/outdoor cameras for home video monitoring, typically USB or battery-powered. We also developed preliminary estimates for

smart video doorbells and baby monitors. Together, we found these devices consumed 3.7 TWh or 31 kWh per unit in 2020.

The CE Usage Survey found that 24% of households had at least one security camera, with an average 2.9 units per owner household, implying 85 million units. The installed base of baby monitors (22 million) and smart doorbells (11 million) was appreciably smaller.

For indoor/outdoor security cameras, we estimated typical continuous power draw values in the 3-5 W range, based on common models, or about 37 kWh per unit. Baby monitors were treated similarly, except that some were assumed to be audio-only with an average UEC of 24 kWh. Smart doorbells, in contrast, are typically battery powered and can go months between charges, yielding a very low estimated UEC of <1 kWh.

Robot Vacuums

Robot vacuums perform autonomous floor cleaning tasks in the home. In between cleaning missions, and sometimes during missions, the robot returns to a powered base station to recharge its batteries and/or empty its dirt payload. The vacuum system connects to a wireless home network to send and receive commands.

We estimate there were about 14 million robot vacuums in service in 2020 based on cumulative sales figures from 2016-2020 (CTA). We estimate robot vacuums consume about 0.4 TWh or 28 kWh/yr per unit in 2020. Based on aggregated user data shared by U.S. market leader, we estimate the average unit performs 141 missions per year (iRobot 2020). Each mission is associated with 28 minutes of charging and 34 minutes cleaning. The vast majority of robot vacuum energy consumption occurs in standby mode, when the robot is docked with the charging station awaiting commands. Thus, the UEC varies to a limited extent on the frequency or duration of usage. An example measured power profile for a cleaning mission is shown in Figure 4.

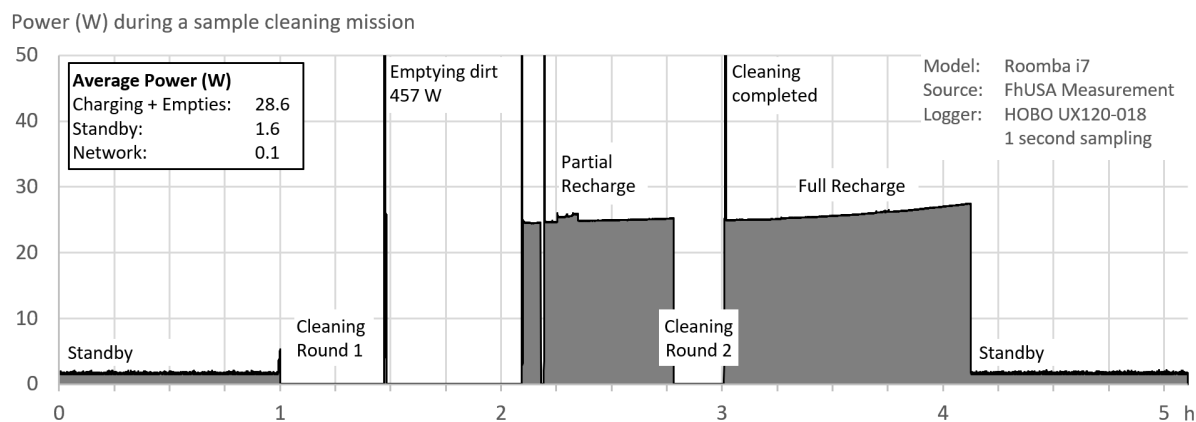


Figure 4. Measured power draw for a sample robot vacuum cleaning mission.

Uninterruptible Power Supplies

Uninterruptible Power Supplies (UPS) can provide temporary battery backup power, surge protection, and power conditioning for critical electronic devices. During normal operation, the connected devices are powered from the electric grid and the battery remains charged. When grid power is interrupted, control circuitry rapidly detects the outage and

automatically diverts to battery power. The rapid switch provides continuous operation until the batteries are depleted, typically minutes or hours depending on the load and UPS capacity.

We estimate that around 5 million UPS devices in homes consume up to 1.2 TWh or 224 kWh/yr per unit in 2020. This is likely an upper-bound estimate, as it was based in part on data from commercial use cases, where duty cycling and loads may be higher than in residential applications.

The analysis was based largely on data from a U.S. Department of Energy rulemaking from 2016. To estimate the 2020 installed base, we assumed that prior residential shipment sale trends continued into 2020 and applied a first-in-first-out model to the stock over typical device lifetimes for different UPS typologies. Three kinds of UPS were considered: Voltage and Frequency Dependent (UEC 75 kWh/yr), Voltage Independent (124 kWh/yr), and Voltage and Frequency Independent (804 kWh/yr), and their UEC estimated reflected typical device loading and efficiency levels from the DOE rulemaking and ENERGY STAR standard levels and historical market share data.

Conclusions

This paper summarizes results from a comprehensive study that evaluated the ownership, power draw, usage, and energy consumption characteristics of U.S. consumer electronics in 2020. We offer the following conclusions:

1. U.S. Consumer Electronics consumed about 176 TWh (\$23 billion) in 2020, equal to about 4.5% and 12% of total U.S. and residential electricity consumption, respectively. Per-household consumption was about 1,465 kWh per year (\$193).
2. Total consumer electronics energy consumption increased by about 24% relative to 2017. This was primarily driven by a 50% increase in active-mode usage in major categories, foremost televisions and computers, as people spent more time at home during the COVID-19 pandemic. The future of CE energy consumption will depend greatly on whether the higher active-mode usage found in 2020 persists.
3. Set-top box energy consumption has decreased by almost 40% since 2016, reflecting appreciable reductions in the UEC of more energy-intensive DVR and non-DVR STBs and the installed base of all STBs except cable DTAs.
4. Newly studied device categories include robot vacuums (28 kWh/yr and 0.4 TWh), smart speakers (22 kWh/yr and 1.7 TWh), home security cameras (31 kWh/yr and 3.7 TWh), uninterruptible power supplies (224 kWh/yr and 1.2 TWh), and virtual reality headsets (22 kWh/yr and 0.2 TWh). Together, these represent 4% of total CE energy consumption.
5. The highest-consuming categories include televisions (188 kWh/yr and 53.5 TWh), desktop computers (331 kWh/yr and 26.1 TWh), and subscription set-top boxes (89 kWh/yr and 15.2 TWh). Together, these three device categories represent more than half of the consumer electronics energy total.
6. Less efficient CRT displays have largely left the installed base.

Acknowledgements

The authors would like to thank the project sponsors at the Consumer Technology Association (CTA)[®], and especially Douglas Johnson, Vice President of Emerging Technology, for leading the project at CTA. In addition, we thank Richard Kowalski, Director of Industry

Analysis and Business Intelligence at CTA, for providing market data and consultations on installed base estimates. We also thank Paul Gagnon with Omdia for providing computer monitor data and Hans-Paul Siderius of the Netherlands Enterprise Agency for sharing power draw data for a wide range of products, and Stefanie Slayback, Senior Manager at ENGINE Insights, for collaborating on the Consumer Electronics Usage Survey.

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