



# 2021 Annual Report

## Voluntary Agreement for Ongoing Improvement to the Energy Efficiency of Set-Top Boxes

Prepared on behalf of the  
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## TABLE OF CONTENTS

Executive Summary.....	4
Overview of The Voluntary Agreement.....	8
Voluntary Agreement Objectives.....	8
Voluntary Agreement Signatories and Steering Committee.....	9
Service Provider Commitments.....	10
Independent Administrator and Auditor Role.....	10
New Feature Allowances.....	10
Increased Energy Efficiency of Set-Top Boxes.....	11
Report on Procurement Commitments.....	13
Impact on National Energy Consumption.....	14
Audit and Verification.....	18
Procurement Audit.....	18
Verification Testing.....	18
Progress on Other Energy-Efficiency Commitments.....	19
Consumer Access to Energy-Efficiency Information.....	19
Viewing Without Operator-Supplied Set-Top Boxes.....	19
Conclusion.....	23
Appendix A: Set-Top Boxes Purchased by Voluntary Agreement Signatories in 2021.....	24
Appendix B: Consumer Access To Set-Top Box Energy-Efficiency Information.....	28
Appendix C: 2021 Procurement Audit Report.....	29

## LIST OF TABLES

Table ES-1: Voluntary Agreement Energy Savings 2013-2021 .....	6
Table ES-2: Weighted Average Typical Energy Consumption (TEC) for Major Set-Top Box Categories.....	7
Table 1: Weighted Average Typical Energy Consumption for Major Set-Top Box Categories .....	11
Table 2: Set-Top Box Procurement by Set-Top Box Category in 2021.....	13
Table 3: Base Case – 2012 Estimated Energy Consumption .....	14
Table 4: Change in Subscribers from 2012-2021 .....	14
Table 5: Estimates of Total Deployed Units in the Market from 2013-2021 .....	15
Table 6: Total Signatory Set-Top Box Units Procured in 2014 and from 2018-2021 .....	15
Table 7: National Energy Consumption Calculation .....	16
Table 8: National Energy Consumption of Installed Set-Top Boxes 2012-2021 .....	17
Table 9: Platforms and Apps Used by Customers to View Content Without Set-Top Boxes .....	21
Table 10: Set-Top Boxes Procured by Voluntary Agreement Signatories in 2021 .....	25
Table 11: Set-Top Box Base Allowances.....	26
Table 12: Set-Top Box Feature Allowances .....	27
Table 13: Links for Consumer Access to Energy-Efficiency Information.....	28

## LIST OF FIGURES

Figure ES-1: Annual Energy Used by Set-Top Boxes .....	5
Figure ES-2: Annual Electricity Consumer Savings Under the Voluntary Agreement .....	6
Figure 1: Average Weighted TEC of Purchased Set-top Boxes by Year .....	12
Figure 2: Distribution of Current Inventory by Year of Procurement (Percentage of Units).....	16
Figure 3: Annual Energy Saved by the Voluntary Agreement Procurement Commitments.....	17

## EXECUTIVE SUMMARY

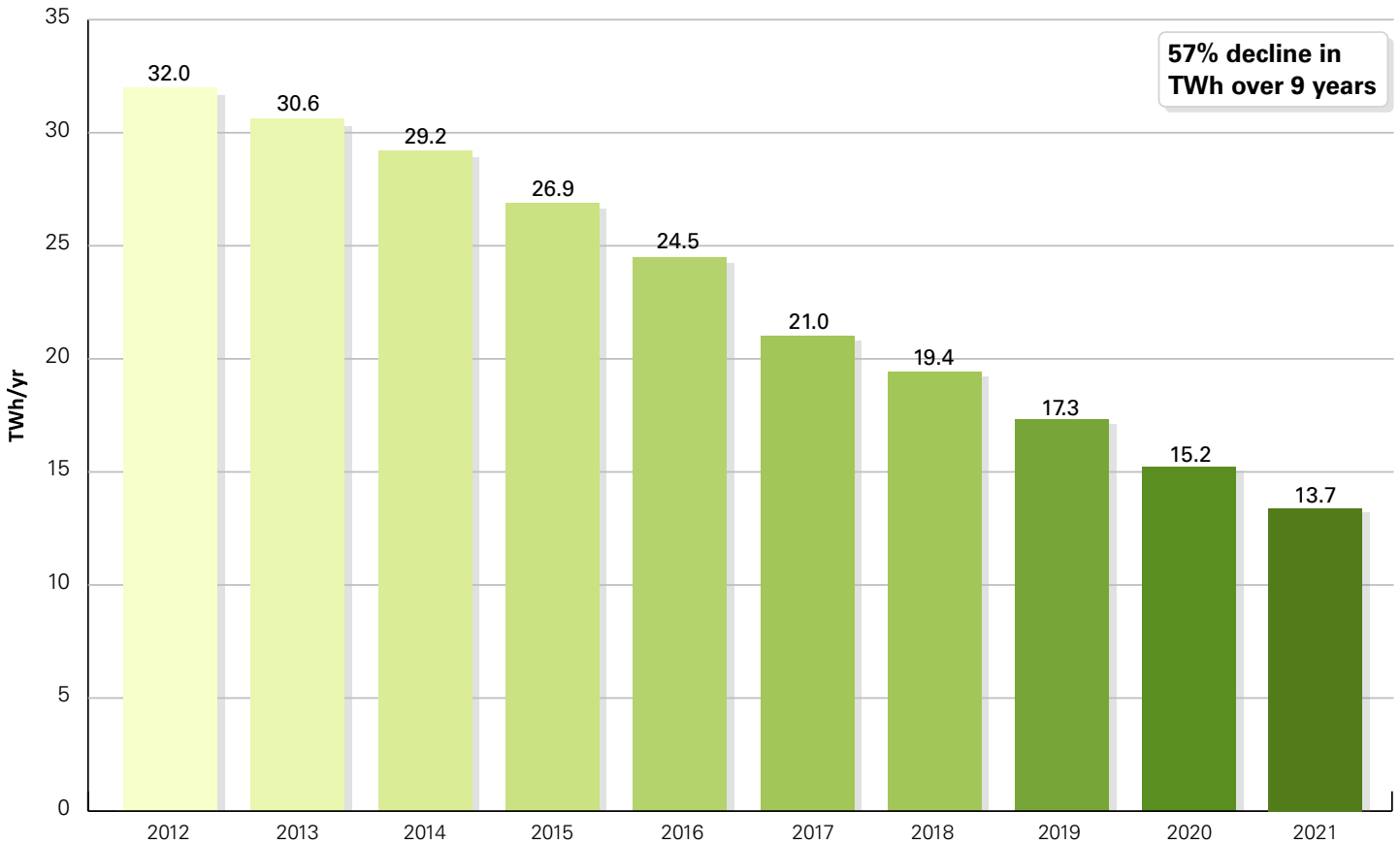
In 2012, the pay television industry, led by NCTA - The Internet & Television Association, the Consumer Technology Association, and CableLabs®, signed the [Voluntary Agreement for Ongoing Improvement to the Energy Efficiency of Set-Top Boxes](#) with the goal of increasing the energy efficiency of set-top boxes while protecting rapid innovation and timely introduction of new features. Signatories include major manufacturers of set-top boxes and the largest cable, satellite, and telco service providers, serving approximately 63.5 million U.S. video subscribers and accounting for nearly 95% of the traditional pay-television (pay-TV) market in 2021. In 2013, leading Energy Advocates joined with the pay-TV industry in an expanded version of the Voluntary Agreement. One of the requirements of the Voluntary Agreement is the publication of an annual report by D+R International (D+R), acting as Independent Administrator and Independent Auditor of the Agreement. This ninth annual report provides a summary of developments for the previous calendar year, 2021. Annual reports for the previous eight years and energy information for consumers and other stakeholders can be found at [www.energy-efficiency.us](http://www.energy-efficiency.us).

The primary commitment of the Agreement is that in each calendar year 90% of each service provider's new set-top box purchases meet prescribed energy-efficiency levels (that have become more rigorous every three years). In 2021, 97.4% of service providers' set-top box purchases met the applicable "Tier 3" levels,<sup>1</sup> and all but one of the service providers met the 90% commitment individually. In accordance with the terms of the Voluntary Agreement, a subcommittee that includes the Energy Advocates and the Independent Administrator have confirmed that this signatory has successfully implemented a remedial plan that has secured more than enough incremental energy savings to offset the additional energy used by the new devices associated with its missed procurement commitment.

National set-top box annual energy consumption has been reduced by nearly 60% under the Voluntary Agreement. As shown in Figure ES-1 below, total energy consumption of the industry's deployed set-top boxes has declined from 32 TWh in 2012 to 13.7 TWh in 2021, even as functionality and features of set-top boxes continue to increase. Independent of subscriber reductions and deployed stock estimates, the average weighted power usage of annual new set-top box purchases has fallen by 57% since 2013, from 122 kWh/year to less than 53 kWh/year.

<sup>1</sup> - As set forth below, this calculation is based on 2021 procurement data submitted to D+R by service providers and corroborated by the results of independent verification testing and by the procurement audit conducted by D+R.

**Figure ES-1: Annual Energy Used by Set-Top Boxes**



This 18.3 TWh reduction is more than the power generated by six typical 500-megawatt coal-run power plants in a year.<sup>2</sup> In 2021 alone, consumers saved more than \$2.5 billion<sup>3</sup> on their utility bills and 13 million metric tons of CO<sub>2</sub> emissions from power plants were avoided.<sup>4</sup> The following table and figure present the cumulative effect of these year-over-year declines during the nine years of the Voluntary Agreement, during which energy consumption has been reduced by an estimated 90.2 TWh, saving consumers almost \$12 billion and avoiding nearly 64 million metric tons of CO<sub>2</sub> emissions. The energy saved during this nine-year period is enough to power every home in California for nearly a year.<sup>5</sup>

2 - A common unit in measuring energy-efficiency savings is the “Rosenfeld” (3 terawatt hours per year), the same amount of electricity generated by a conventional 500-megawatt coal-run power plant each year. See <https://www.scientificamerican.com/article/rosenfeld-energy-savings>.

3 - This calculation is based on the national average residential energy cost of 13.72 cents per kWh for 2021. See U.S. Energy Information Administration, *Electric Power Monthly*, <https://www.eia.gov/outlooks/steo/report/electricity.cfm>.

4 - Emission reduction estimates in this report are based on the U.S. Environmental Protection Agency’s Greenhouse Gas Equivalencies Calculator, <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>.

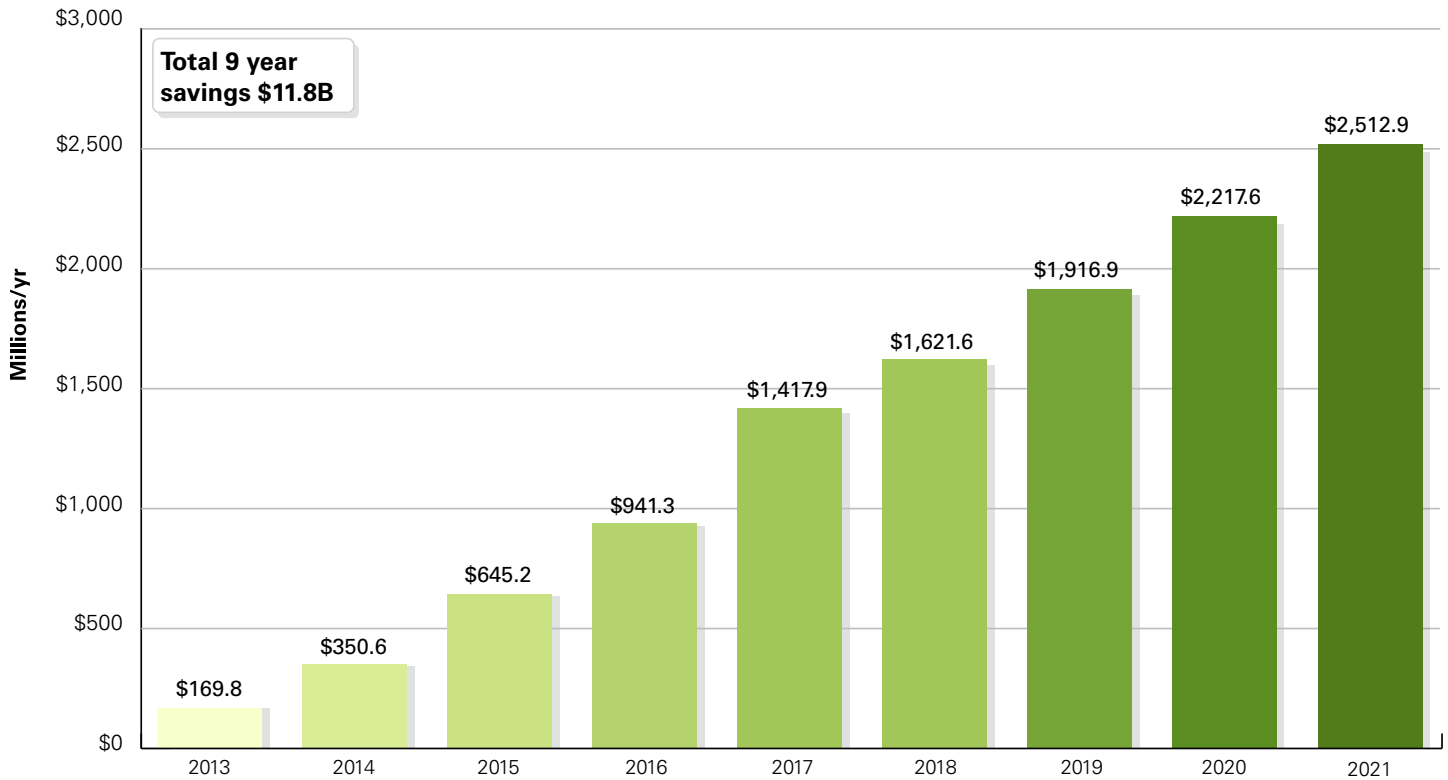
5 - EIA State Energy Data System (SEDS): 2020 (updates by energy source), Table F20, Electricity Consumption Estimates, 2020, Residential (December 17, 2021), [https://www.eia.gov/state/seds/sep\\_fuel/html/pdf/fuel\\_use\\_es.pdf](https://www.eia.gov/state/seds/sep_fuel/html/pdf/fuel_use_es.pdf).

**Table ES-1: Voluntary Agreement Energy Savings 2013-2021**

	2013	2014	2015	2016	2017	2018	2019	2020	2021	Lifetime of VA
Total National Energy Consumed (TWh/yr)	30.6	29.2	26.9	24.5	21.0	19.4	17.3	15.2	13.7	197.8
Total National Energy Saved (TWh/yr)	1.4	2.8	5.1	7.5	11.0	12.6	14.7	16.8	18.3	90.2
500 MW Power Plant Equivalents Saved (Rosenfelds) <sup>a</sup>	0.5	0.9	1.7	2.5	3.7	4.2	4.9	5.6	6.1	N/A
Electricity Costs Saved (Million\$/yr)	\$169.8	\$350.6	\$645.2	\$941.3	\$1,417.9	\$1,621.6	\$1,916.9	\$2,217.6	\$2,512.9	\$11,793.7
CO <sub>2</sub> Avoided (MMT)	1.0	2.0	3.6	5.3	7.8	8.9	10.4	11.9	13.0	63.8

<sup>a</sup>The electricity generated by a typical 500 MW power plant is measured in Rosenfelds, which represents annual electricity output. At the 2012 peak, set-top boxes used 10.6 Rosenfelds annually, and that figure declined to 4.6 Rosenfelds in 2021.

**Figure ES-2: Annual Electricity Consumer Savings Under the Voluntary Agreement**



After years of reports that have primarily addressed incremental changes from the prior year, this report emphasizes that the market for the purchase of new set-top boxes is fundamentally different than a decade ago when the Voluntary Agreement was adopted:

- The total number of deployed set-top boxes has declined by nearly one-third since 2012 as a result of subscriber losses and consumer adoption of streaming apps that enable viewing on Smart TVs, smartphones, tablets and other devices without set-top boxes.
- The signatories purchased more than 46 million set-top boxes in 2014, but, in 2021, new purchases declined to only 8 million units.

- More than 70% of all purchases in 2021 were IP Non-DVR set-top boxes, a category that was not defined when the Agreement began. The average weighted power usage of these new IP Non-DVR devices is only 36 kWh/year. By contrast, the primary concern of the Energy Advocates that led to the establishment of the Agreement were DVRs that at that time used an estimated 267 kWh/year.
- Purchases of DVRs have decreased significantly from 12.7 million in 2014 (27% of all purchases) to fewer than 760,000 in 2021 (only 9% of purchases) as service providers have shifted from deploying a DVR for each television, to whole-home DVR services that use one DVR per home or cloud DVR services that do not require the use of DVR set-top boxes at all.
- The percentage of U.S. televisions that are connected to a pay-TV set-top box has declined from 58% in 2016 down to 37% in 2021.<sup>6</sup>

Meanwhile, set-top boxes have not only become far fewer in number, but those that remain are much more energy efficient. Since 2012, energy usage of the three major categories of new set-top boxes has declined by 64% (Non-DVR), 47% (Thin Client), and 45% (DVR) as shown in Table ES-2 below.

**Table ES-2: Weighted Average Typical Energy Consumption (TEC) for Major Set-Top Box Categories**

Category	Weighted Average TEC (kWh/yr)		Percent Change in Weighted Average
	Pre-2013 Stock	2021 Purchases	Pre-2013 to 2021
DVR	267	146.5	-45%
Non-DVR	119	42.5	-64%
Thin Client	90	47.6	-47%

The Voluntary Agreement prescribes third-party verification testing of randomly selected set-top boxes from each service provider signatory in each reported category. This testing verification resumed in 2022 after a two-year pause due to the COVID-19 pandemic, though due to ongoing limitations on travel and lab access, testing was limited to models that had not been independently tested in previous years. The verification testing successfully confirmed that the energy use of each of the tested models is consistent with the levels reported by the signatories.

The signatories' performance in meeting their procurement commitments was also validated through D+R's review of procurement data of all signatories and D+R's successful detailed audit of one randomly selected party's records.

In 2021, the signatories unanimously amended the Voluntary Agreement and extended its term for an additional four years through 2025 with new, more rigorous Tier 4 energy levels that will become applicable to the 90% procurement commitment in 2023. The signatories have estimated that by the end of the extended term of the agreement, the total energy used by set-top boxes in the United States will be only one-third of the energy used by set-top boxes in 2012 when the agreement was initially signed. Approximately 86% of that reduction objective has been achieved as of the end of 2021. The Independent Administrator will continue to monitor these developments and publish these annual reports through the 2025 report, to be issued in 2026.

6 - Leichtman Research Group, *PayTV in the U.S. 2021* (October 26, 2021).

## OVERVIEW OF THE VOLUNTARY AGREEMENT

Cable, satellite, and telco service providers offer pay television to nearly 67.1 million U.S. households.<sup>7</sup> These services, historically, relied upon the use of customer-premises equipment, often referred to as set-top boxes, to make the services accessible to consumers' televisions. Each device contains hardware and software to receive television programming and related services from service providers and process it for home networks, display devices, and recording devices. The underlying delivery network and the types of service provided vary widely among service providers. As a result, set-top boxes operate as highly specialized components, and the devices change as the service providers introduce new services.

As with all electronic devices, set-top boxes must utilize power in order to operate. In aggregate, set-top boxes in the United States consumed an estimated 32 TWh of electricity in 2012, constituting 18% of residential consumer electronics electricity consumption and 2.2% of all residential electricity consumption.<sup>8</sup> To reduce the amount of energy consumed by set-top boxes while protecting rapid innovation and timely introduction of new features, the pay-TV industry crafted the [Voluntary Agreement for Ongoing Improvement to the Energy Efficiency of Set-Top Boxes](#). The Voluntary Agreement provides a framework for the pay-TV industry to deliver market-based energy-efficiency gains that keep pace with technological innovation. The signatories of the Voluntary Agreement represent all the major pay-TV service providers, equipment vendors, and related industry organizations in the United States. Combined, these companies reported providing multichannel video service to approximately 63.5 million American households in 2021, accounting for nearly 95% of the traditional live pay-TV market.

After extensive negotiations among the initial signatories and Energy Advocates, an expanded Voluntary Agreement was launched in 2013. The Natural Resources Defense Council (NRDC), the American Council for an Energy-Efficient Economy (ACEEE), the Appliance Standards Awareness Project (ASAP), the Consumer Technology Association (CTA), and NCTA - The Internet & Television Association announced this expansion in December 2013. The revised Voluntary Agreement included additional energy-efficiency commitments, coverage of whole-home multi-service gateway devices, expanded provisions for transparency and accountability, and participation by Energy Advocates in the Steering Committee for the Voluntary Agreement.

The parties have twice unanimously extended the Voluntary Agreement, with the latest amendment extending its commitments through 2025. The most recent amendment defines more rigorous Tier 4 energy levels that will take effect in 2023. The reductions in the new allowance levels are particularly significant for Internet Protocol (IP) Non-DVR set-top boxes, which represent more than 70% of purchases in 2021. The Tier 4 base allowance for IP set-top boxes is reduced by 62.5%, from 40 kWh/year to 15 kWh/year, and a number of allowances for additional functionalities was also reduced, as listed in Table 12.

This report covers the second year (2021) in which the Tier 3 levels were in effect.

### Voluntary Agreement Objectives

The primary objective of the Voluntary Agreement is to continue improvements in the energy efficiency of set-top boxes without jeopardizing their intended uses and functionalities. Further, energy-efficiency improvements are expected to preserve or enhance the customer experience and be sufficiently flexible to adapt to technological innovations and market competition, while also improving functionality, offering service enhancements, and fostering rapid innovation.

7 - This figure is based on data provided by NCTA and CTA and does not include customer counts for third-party streaming services.

8 - Bryan Urban; Victoria Shmakova; Brian Lim; Kurt Roth, Energy Consumption of Consumer Electronics in U.S. Homes in 2013, *Final Report to the Consumer Electronics Association (CEA)*, Fraunhofer USA Center for Sustainable Energy Systems (2014). This report estimated 31 TWh of use in 2013, which is consistent with the annual report's estimate of ongoing declines under the Voluntary Agreement since set-top boxes used 32 TWh in 2012.



The signatories originally estimated that consumers would save \$1.6 billion annually in energy costs once the benefits of the Tier 3 commitments were fully realized. In the second year of the Tier 3 energy levels, the signatories far exceeded this estimate, with more than \$2.5 billion in annual savings.<sup>9</sup> These 2021 energy savings exceed the power generated by six typical 500-megawatt coal-run power plants<sup>10</sup> annually and avoid 13 million metric tons of CO<sub>2</sub> emissions per year compared to the national set-top box energy use and related emissions from the base year of 2012.<sup>11</sup>

## Voluntary Agreement Signatories and Steering Committee

The current signatories and participants in the Voluntary Agreement are listed below. Each of these entities participates in the Steering Committee.

### Energy Advocates

- American Council for an Energy-Efficient Economy (ACEEE)
- Natural Resources Defense Council (NRDC)

### Cable Service Providers

- Altice USA
- Charter Communications (“Spectrum”)
- Comcast
- Cox Communications

### Satellite Service Providers

- AT&T/DIRECTV
- DISH Network

### Telco Service Providers

- AT&T
- Frontier
- Verizon

### Manufacturers

- CommScope
- Sagemcom
- Technicolor

### Other Organizations

- NCTA – The Internet & Television Association
- Consumer Technology Association (CTA)
- Cable Television Laboratories (CableLabs)

The composition of the Steering Committee allows the Voluntary Agreement to offer a multi-stakeholder approach, while permitting rapid adjustments as the technological landscape changes.

9 - U.S. Energy Information Administration, *supra*, note 3.

10 - Scientific American, *supra*, note 2.

11 - U.S. Environmental Protection Agency, *supra*, note 4.

The Voluntary Agreement obligates the Steering Committee to designate an Independent Administrator and publish an annual report. The Steering Committee designated D+R International, Ltd. as the Independent Administrator and Auditor in 2013, and D+R has continued in this role.

The Voluntary Agreement requires that the Steering Committee meet at least once annually. The Steering Committee convened on March 19, June 10, and July 29, 2021, and subcommittees also were active during the year.

Representatives of the signatories have continued to provide updates to state and federal regulators and other stakeholders regarding the ongoing execution of the Voluntary Agreement.

CTA and NCTA are required to provide the following two reports to the Independent Administrator, both of which were provided on time for this 2021 report:

- The estimated total number of U.S. residential multichannel video subscribers and the number served by service providers participating in the Voluntary Agreement during the reporting period (due by April 1 of each year); and
- Information on progress with respect to other energy-efficiency commitments (due by May 1 of each year).

## Service Provider Commitments

The primary service provider commitment is that at least 90% of its set-top box purchases will meet specified energy-efficiency levels. The original levels were replaced by Tier 2 levels for devices purchased after December 31, 2016, which were then replaced with Tier 3 energy levels for models procured after December 31, 2019. This is the second Annual Report in which the Tier 3 levels were in effect. Service providers also committed to public posting of energy-efficiency information for consumers. Additional information on other service provider commitments is outlined in [Progress on Other Efficiency Commitments](#), below.

## Independent Administrator and Auditor Role

The Voluntary Agreement obligates the Steering Committee to designate an Independent Administrator and an Independent Auditor. The Steering Committee designated D+R as the Independent Administrator and Auditor in 2013. D+R has continued in this role since its appointment. Under the Voluntary Agreement, the Independent Administrator must aggregate and compile confidential procurement data submitted by service providers and assess whether there is substantial compliance with the service provider commitments. If these commitments are not met, the Independent Administrator initiates a remediation process following the procedures set out in the Voluntary Agreement. The Independent Administrator is required to publish its findings in an annual report. The 2021 Annual Report is the ninth report published. D+R is also required to conduct a random audit of one service provider's procurement figures each year. The 2021 audit report is presented in Appendix C.

## New Feature Allowances

The Voluntary Agreement includes a process that enables new features to be deployed without advance notice or permission, so that companies can secure the competitive benefits of first-mover advantages and so that consumers are not delayed from accessing new features. At the same time, the process assures that such new features are promptly and transparently brought within the bounds of the Voluntary Agreement's commitments to energy efficiency.

If a service provider deploys a set-top box that includes a new feature with no allowance, and the presence of the feature causes the set-top box to exceed the allowable TEC, the new feature process permits the service provider to set and report an appropriate initial allowance based upon its best estimate of the amount of energy consumed by the new feature. No new feature allowances were submitted for the 2021 reporting period.

## INCREASED ENERGY EFFICIENCY OF SET-TOP BOXES

Table 1 demonstrates the progress made by the signatories in improving the energy efficiency of set-top boxes. Data from 2021 continues to follow the four previous year-over-year reductions in energy consumption of new devices. This trend is illustrated in Table 1 by the 64% drop from 2012 to 2021 in the weighted average TEC for Non-DVR units. As reported in the [Progress on Other Efficiency Commitments](#) section below, such Non-DVR devices are also replacing high-energy DVR devices in facilitating whole-home systems that provide content to multiple devices without the need for multiple set-top box units throughout the home.

**Table 1: Weighted Average Typical Energy Consumption of New Purchases for Major Set-Top Box Categories**

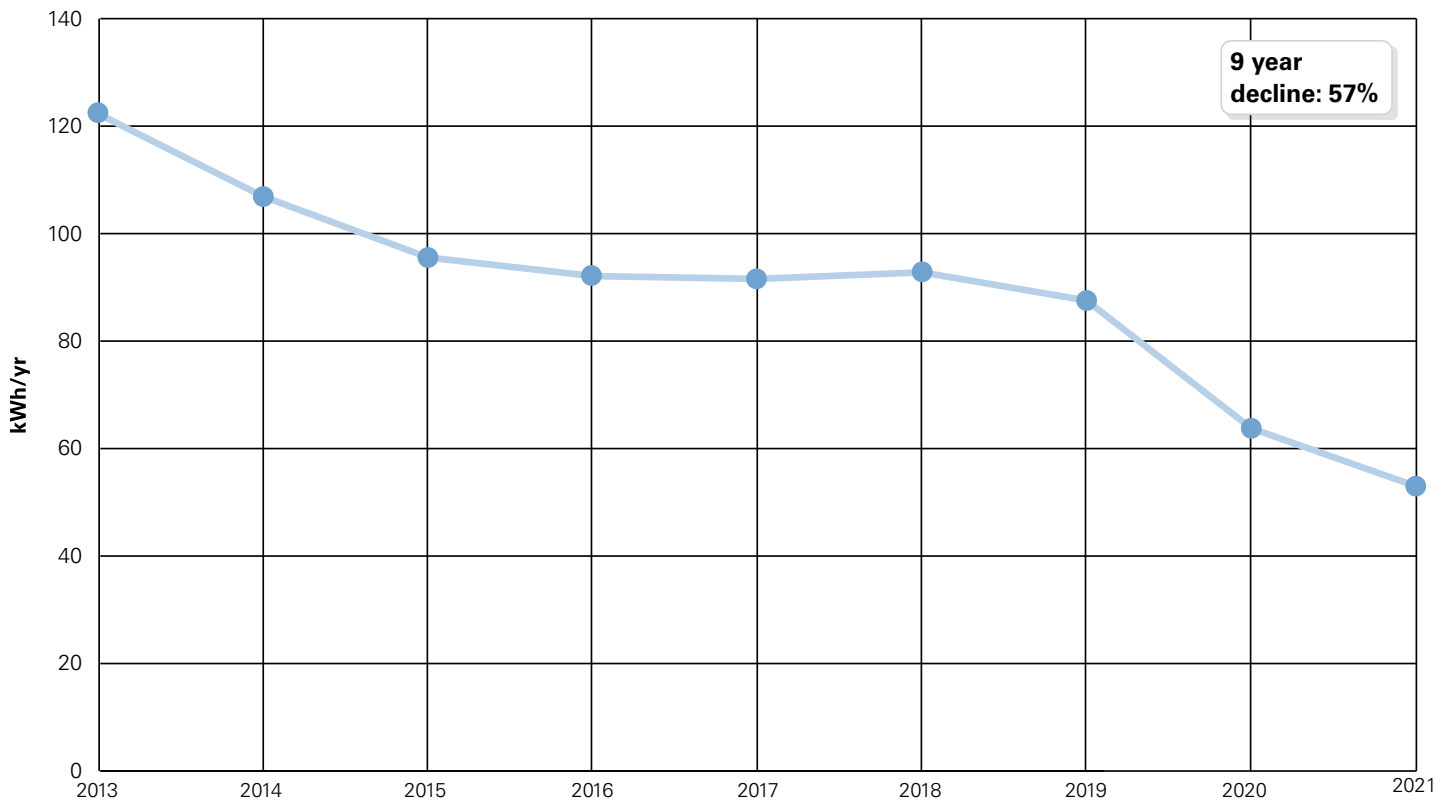
Category	Weighted Average TEC of New Purchases (kWh/yr)										Percent Change in Weighted Average 2012 to 2021
	Pre-VA	2013	2014	2015	2016	2017	2018	2019	2020	2021	
<b>DVR</b>	267	195.4	179.4	170.6	161.3	142.9	138.7	134.4	144.8	146.5	-45%
<b>Non-DVR</b>	119	108.6	103.3	92.6	85.6	90.8	91.8	74.1	49.0	42.5	-64%
<b>Thin Client</b>	90	51.4	50.0	49.1	46.9	44.3	45.4	45.4	48.0	47.6	-47%

Multi-Service Gateways were not purchased in 2021 and DTAs were purchased in small quantities by one service provider.

While there was a slight increase in average power in 2021 in the DVR category and only a marginal decline in the Thin Client category, both categories have declined by nearly 50% since the adoption of the Voluntary Agreement. Furthermore, purchases of set-top boxes in both of these categories are decreasing annually in favor of the more efficient Non-DVR models, particularly IP Non-DVRs which represent more than 90% of Non-DVR purchases and more than 70% of all purchases in 2021. That trend was the stated reason for the signatories' decision to focus on improvements to IP Non-DVRs in the Tier 4 allowances that will take effect in 2023. With the significant shift to the purchase of IP Non-DVRs, 96.1% of set-top box purchases reported in 2021 already met Tier 4 levels ahead of schedule.

Another indication of the progress of the Voluntary Agreement is the 57% decline in the average weighted TEC of aggregate set-top box purchases year-over-year, as shown in Figure 1 below. The 2021 drop of 13.5% represents the second largest year-over-year improvement for new set-top boxes purchased, after the largest annual decline to date in the prior year. The decline from more than 122 kWh/year for the first reported purchases in 2013 to just under 53 kWh/year corroborates the national energy consumption estimated savings of 57%, as this metric is independent of stock estimates and subscriber count adjustments.

**Figure 1: Weighted Average TEC of Purchased Set-top Boxes by Year**



## REPORT ON PROCUREMENT COMMITMENTS

Under the Voluntary Agreement, the service providers committed that 90% of set-top boxes they purchased after December 31, 2019, would meet the Tier 3 efficiency levels. This is the second year in which the Tier 3 procurement commitment has been evaluated, and the eighth year in which a procurement commitment is in force.

97.4% of all set-top boxes purchased by the service provider signatories in 2021 met the Tier 3 commitment levels. The total procurement figures for the reported categories of set-top boxes can be found in Table 2 below. IP Non-DVRs were added as a subset of the Non-DVR category in 2021 which is the first year this data has been collected.

**Table 2: Set-Top Box Procurement by Set-Top Box Category in 2021**

Category	Units Procured <sup>a</sup>
DVR	759,555
Non-DVR (Non-IP)	625,552
Non-DVR (IP)	5,819,170
Thin Client	923,849
DTA	48,240
<b>Total</b>	<b>8,176,366</b>

<sup>a</sup>In 2021, Multi-Service Gateway devices were not procured by any signatory.

The Voluntary Agreement prescribes that if a service provider signatory fails to meet a procurement commitment, it shall implement a remedial plan with new savings measures that offset the extra energy associated with the set-top boxes that caused it to miss its commitment. All but one of the service providers met the Voluntary Agreement procurement commitment in 2021. The remediation plan for that signatory (which was the same signatory that missed its commitment in 2020) was unanimously approved by a subcommittee that includes the Energy Advocates in May 2022. In June 2022, the subcommittee and the Independent Administrator confirmed that the signatory has successfully implemented a remedial plan that has secured more than enough incremental energy savings to offset the additional energy used by the new devices associated with its missed procurement commitments in 2020 and 2021 through the download of new more energy-efficient software to already-deployed set-top boxes.

## IMPACT ON NATIONAL ENERGY CONSUMPTION

In 2012, service providers began working with Energy Advocates to estimate the energy consumption of set-top boxes and the number of units installed in subscriber households. Using service provider and energy-efficiency advocate reports and data on product trends, the signatories developed the base case shown in Table 3, representing the market in 2012.

**Table 3: Base Case – 2012 Estimated Energy Consumption**

Segment	Category	TEC (kWh/yr)	Units (Millions)	National Energy Consumption (TWh/yr)	500 MW Power Plant Equivalents (Rosenfelds)
Cable	DVR	282	27	7.5	2.5
	Non-DVR	139	57	7.9	2.6
	Thin Client	90	2	0.1	0.0
	DTA	39	33	1.3	0.4
Satellite	DVR	283	21	5.9	2.0
	Non-DVR	110	58	6.4	2.1
Telco	DVR	140	6	0.8	0.3
	Non-DVR	90	21	1.9	0.6
<b>U.S. Total</b>		<b>-</b>	<b>225</b>	<b>32</b>	<b>10.6</b>

To gauge the Voluntary Agreement's impact on energy consumption at the national level, D+R estimates energy savings over the base case. The first step is to estimate changes in set-top box stock levels. Under the terms of the Voluntary Agreement, D+R does not collect a census of deployed legacy equipment. Instead, it has employed a model that assumes that newly purchased devices generally replace older (less energy-efficient) equipment from the same category rather than add to total deployed stock. However, the total deployed stock estimate is adjusted to account for changes in subscriber levels as shown in Table 4 below.

**Table 4: Change in Subscribers from 2012-2021**

Segment	Percent Change <sup>a</sup>									
	2012 to 2013	2013 to 2014	2014 to 2015	2015 to 2016	2016 to 2017	2017 to 2018	2018 to 2019	2019 to 2020	2020 to 2021	2012 to 2021
Cable	-4.5%	-0.3%	-0.5%	-1.7%	-3.7%	-2.2%	-1.3%	-4.1%	-6.4%	-22.3%
Satellite	1.0%	0.1%	-1.9%	3.0%	-9.2%	-7.5%	-11.6%	-11.9%	-13.5%	-42.3%
Telco	25.4%	8.2%	-0.9%	-20.9%	2.0%	-3.5%	-13.6%	-12.1%	-14.4%	-31.9%

<sup>a</sup>Based on data provided by the Steering Committee (for 2012) and service providers (for 2013-2021).

As a result of the changes in subscribership levels and replacement assumptions, D+R estimates total stock levels as shown in Table 5.

**Table 5: Estimates of Total Deployed Units in the Market from 2013-2021**

Category	Units <sup>a</sup>								
	2013	2014	2015	2016	2017	2018	2019	2020	2021
DVR	54,038,000	54,599,000	53,890,000	52,674,000	49,892,000	47,672,000	44,412,000	40,901,000	36,898,000
Non-DVR	130,344,000	122,650,000	112,668,000	96,327,000	92,563,000	89,139,000	83,572,000	77,440,000	80,206,000
Thin Client	10,561,000	20,299,000	28,774,000	39,784,000	34,958,000	32,447,000	28,625,000	25,208,000	21,797,000
DTA	31,633,000	31,543,000	31,396,000	30,866,000	29,722,000	29,074,000	28,683,000	27,494,000	15,718,000
<b>Total</b>	<b>226,576,000</b>	<b>229,092,000</b>	<b>226,727,000</b>	<b>219,651,000</b>	<b>207,135,000</b>	<b>198,331,000</b>	<b>185,293,000</b>	<b>171,043,000</b>	<b>154,619,000</b>

<sup>a</sup> Units are rounded for this table, but D+R did not round any figures when calculating the national footprint estimate.

For this year's report, D+R made a manual adjustment to account for the ongoing replacement of older DTAs with Non-DVRs. D+R's prior approach only replaced a DTA with a new DTA purchase, but DTA purchases have declined to very low levels in recent years. Based upon information obtained from the cable operator signatories, D+R reduced the estimate of deployed DTAs by an additional 10 million units and correspondingly restored 10 million Non-DVRs to the estimates.

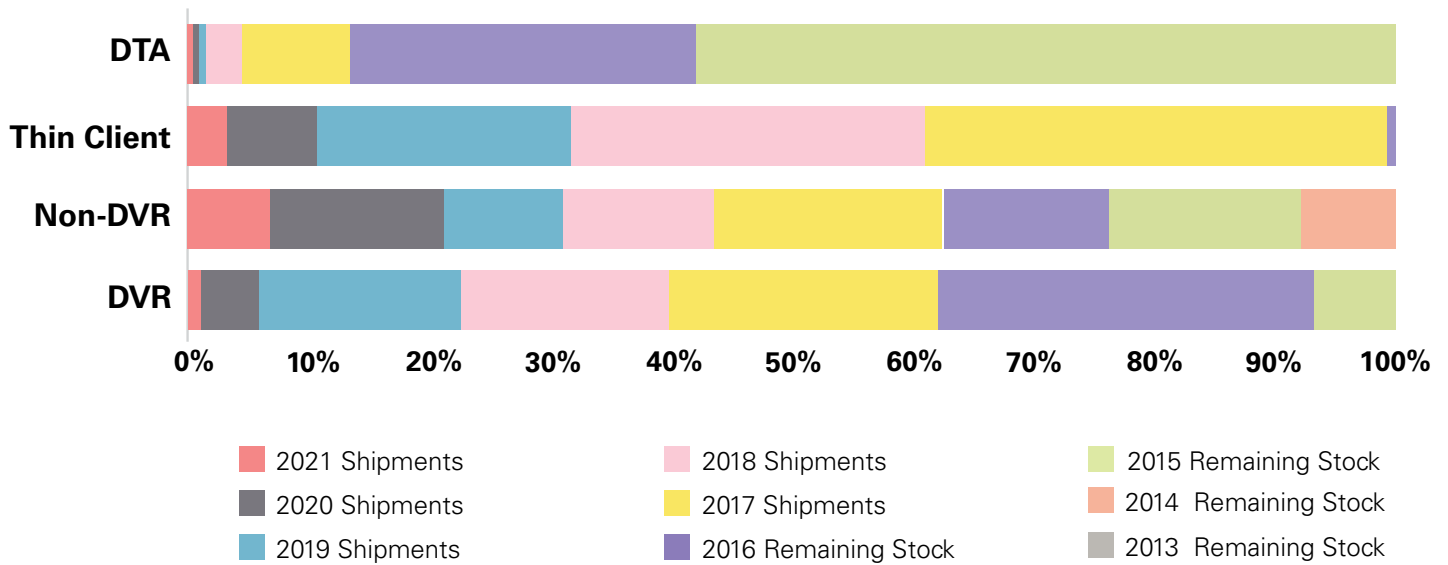
The next step in estimating national energy consumption is to account for products procured in 2021. The signatories purchased approximately 5.7 million fewer set-top boxes in 2021 than in 2020. The ongoing reduction over a period of years can largely be attributed to subscriber loss (more than 6.5 million subscribers since 2020 alone) and an increasing prevalence and usage of options for customers to watch programming without a set-top box, as discussed below. The decline in 2021 may also have been magnified by supply chain disruptions arising from the COVID-19 pandemic.

**Table 6: Total Signatory Set-Top Box Units Procured in 2014 and from 2019-2021**

Category	Total Units Procured				Percent Change
	2014	2019	2020	2021	2014 to 2021
DVR	12,710,777	5,848,219	1,719,840	759,555	-94%
Non-DVR	18,646,064	8,319,044	10,537,923	6,444,722	-65%
Thin Client	9,738,163	4,592,236	1,473,453	923,849	-91%
DTA	5,201,332	127,850	86,959	48,240	-99%
<b>Total</b>	<b>46,296,336</b>	<b>18,887,349</b>	<b>13,818,175</b>	<b>8,176,366</b>	<b>-82%</b>

D+R subtracts 2021 set-top box procurements from the total units listed in Table 6, using the new replacement assumptions described above. This methodology yields multiple sets of stock – one for each purchase year – each with its own weighted average TEC values. The remaining stock estimates for each of the purchase year sets are shown in Figure 2.

**Figure 2: Distribution of Current Inventory by Year of Procurement (Percentage of Units)**



Multiplying the number of units purchased each year that remained in the field at the end of 2021 and the average TEC for that category of device at the time of its purchase produces the estimated national energy consumption shown in Table 7. Table 8 displays the results of this calculation year-over-year for the lifetime of the Voluntary Agreement.

**Table 7: 2021 National Energy Consumption Calculation**

Category	Pre-VA (before 2013)	2013	2014	2015	2016	2017	2018	2019	2020	2021	2021 National Energy Consumption (TWh)*
DVR Purchases from Each Year Remaining in Field	0	0	0	2,778,045	11,219,933	8,268,205	6,304,346	5,848,219	1,719,840	759,555	
DVR TEC Average (kWh/yr)	267.0	195.4	179.4	170.6	161.3	142.9	138.7	134.4	144.8	146.5	5.5
Non-DVR Purchases from Each Year Remaining in Field	0	0	6,933,198	10,977,499	11,535,694	15,390,556	10,066,928	8,319,044	10,537,923	6,444,722	
Non-DVR TEC Average (kWh/yr)	119.0	108.6	103.3	92.6	85.6	90.8	91.8	74.1	49.0	42.5	6.4
Thin Client Purchases from Each Year Remaining in Field	0	0	0	0	203,462	8,287,414	6,316,550	4,592,236	1,473,453	923,849	
Thin Client TEC Average (kWh/yr)	90.0	51.4	50.0	49.1	46.9	44.3	45.4	45.4	48.0	47.6	1.0
DTA Purchases from Each Year Remaining in Field	0	0	0	8,857,536	4,831,980	1,337,930	427,480	127,850	86,959	48,240	
DTA TEC Average (kWh/yr)	39.0	57.6	49.3	46.5	49.9	54.9	55.8	51.2	51.4	54.9	0.8
<b>Total 2021 National Energy Consumption (TWh)</b>											<b>13.7</b>

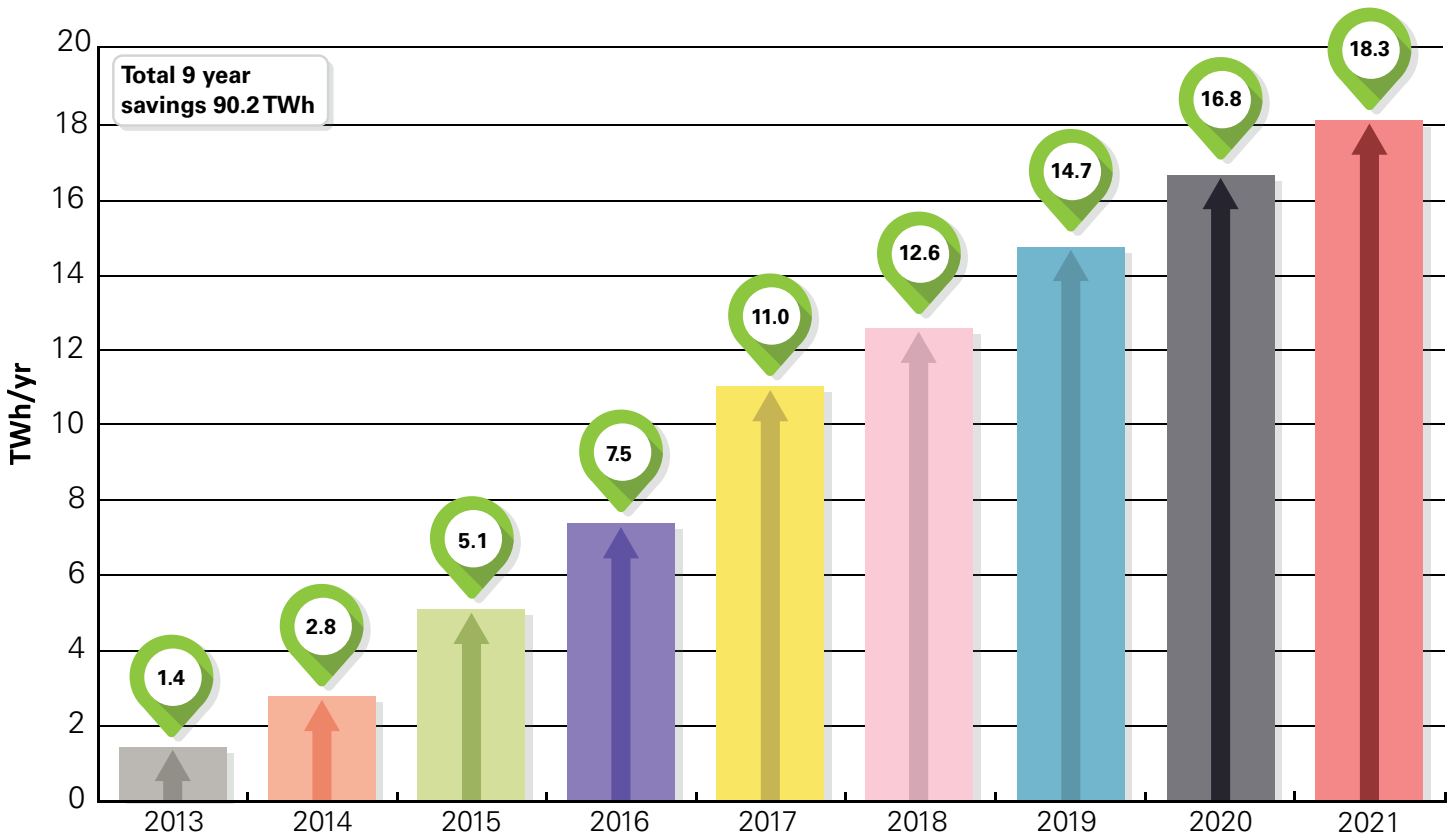


**Table 8: National Energy Consumption of Installed Set-Top Boxes 2012-2021**

	2012 (Pre-VA)	2013	2014	2015	2016	2017	2018	2019	2020	2021
Estimate of Total Deployed Units in the Market	225,000,000	226,576,000	229,092,000	226,727,000	219,651,000	207,135,000	198,331,000	185,293,000	171,043,000	154,619,000
National Energy Consumed (TWh/yr)	32.0	30.6	29.2	26.9	24.5	21.0	19.4	17.3	15.2	13.7
500 MW Power Plant Equivalents (Rosenfelds)	10.6	10.2	9.7	9.0	8.2	7.0	6.5	5.8	5.1	4.6
CO <sub>2</sub> Emitted (MMT)	22.6	21.6	20.6	19.0	17.3	14.9	13.7	12.2	10.7	9.7

These improvements in energy efficiency spurred by the Voluntary Agreement have had an increasingly significant role in reducing national energy consumption, and do not appear to be slowing down. Set-top box energy consumption decreased by a larger percentage in the past year (from 15.2 TWh to 13.7 TWh, or 10%) than in the first three years of the Voluntary Agreement (from 32 TWh to 29.2 TWh, or 8%). The overall 18.3 TWh reduction in usage in 2021 compared to 2012 represents consumer savings of more than \$2.5 billion<sup>12</sup> and avoidance of 13 million metric tons of CO<sub>2</sub> in 2021 alone.<sup>13</sup> As shown in Figure 3 below, during the nine years of the Voluntary Agreement, cumulative energy consumption has declined by an estimated 90.2 TWh, saving consumers approximately \$11.8 billion and avoiding nearly 64 million metric tons of CO<sub>2</sub> emissions.

**Figure 3: Annual Energy Saved by the Voluntary Agreement Procurement Commitments**



12 - U.S. Energy Information Administration, *supra*, note 3.

13 - U.S. Environmental Protection Agency, *supra*, note 4

## AUDIT AND VERIFICATION

### Procurement Audit

D+R is required to conduct an audit of one randomly-selected service provider's procurement figures each year. The audit report for the 2021 reporting year is presented in Appendix C. D+R determined that the data submitted by the service provider for the audit is consistent with the annual report submitted by that service provider.

### Verification Testing

The Voluntary Agreement prescribes third-party verification testing of models chosen by the Independent Administrator. This testing was scheduled to occur during the spring of 2020 and again in 2021, but had to be postponed due to restrictions on travel and lab access because of the COVID-19 pandemic. Testing resumed in 2022, but due to ongoing COVID-related restrictions, models that had previously been successfully independently verified were not required to be re-tested. As a result, a few service providers that did not introduce new models were not required to perform verification testing during the 2021 reporting cycle.

Every model tested measured within the applicable Tier 3 energy-efficiency levels, and 100% of the devices tested were at or below the values reported by the service providers. These results validate and support the findings in this report.

## PROGRESS ON OTHER ENERGY-EFFICIENCY COMMITMENTS

The Voluntary Agreement established other energy-efficiency commitments described below.

### Consumer Access to Energy-Efficiency Information

All service providers committed to provide subscribers and potential customers with reasonable access to energy-efficiency information for set-top boxes purchased since January 1, 2014. This information makes it easier for consumers to learn about energy-efficient set-top boxes and typical set-top box energy consumption. This information is posted on company websites from the links listed in Appendix B of this annual report and at [www.energy-efficiency.us](http://www.energy-efficiency.us), which offers a single site from which the public may conveniently link to each provider's information, the Independent Administrator's Annual Reports, the Voluntary Agreement, and related news and information. D+R again confirmed that this information is readily available to the public from the links listed in Appendix B of this report.

### Viewing Without Operator-Supplied Set-Top Boxes

All the service provider signatories are continuing to enable their customers to watch video programming without the use of operator-supplied set-top boxes through their support of apps. These apps can be used on hundreds of millions of consumer-owned Internet-connected devices, such as smartphones, tablets, personal computers, select Smart TVs, game consoles, and low-power streaming devices such as Apple TV, Roku, Google Chromecast, and Amazon Fire. Nearly all U.S. TV households have at least one of these devices.

Signatories reported that the number of unique customer-owned and managed devices used to access video services via apps remained at approximately 56 million in 2021, which represents an increase per subscriber since pay-TV subscriptions declined by 9%.

Table 9 lists the supported TV and other platforms and devices used by consumers to view each service provider's content using its app without operator-supplied set-top boxes in 2021. The table indicates whether the service provider's app on each platform supports access to linear (live TV) content, on demand content, and/or recording capability, which are among the features that help make apps an attractive alternative to a set-top box. There remain some differences in functionality and visibility between apps and set-top boxes that may encourage most customers to continue to use set-top boxes, but the service provider signatories are continuing to work to enhance the functionality of their apps such as through new support for cloud DVR offerings and investing in customer education and employee training to promote the use and awareness of apps.

App usage can replace or reduce demand for set-top boxes in a variety of ways. For example, the use of apps to view pay-TV and other video content on televisions can render a set-top box unnecessary for that television. New models of Samsung and LG Smart TVs, and many Smart TVs that use Roku, Android, or Amazon Fire operating systems can access select service provider apps without set-top boxes. More than three-quarters of American households now have at least one Smart TV, and Smart TVs now represent 57% of all televisions used in the United States.<sup>14</sup> Nearly all Smart TVs – 86% in a recent study – now are used to access at least some video directly without a set-top box or streaming device.<sup>15</sup>

14 - Hub Entertainment Research, Connected Home 2022 (March 2022).

15 - Leichtman Research Group, *Emerging Video Services 2021* (Aug. 31, 2021).

Streaming devices connected to a television also can eliminate the need and demand for a set-top box for that television. While the growth of streaming devices declined by 10% in 2021 as a majority of streaming customers turned to Smart TVs that embed that functionality,<sup>16</sup> millions of consumers still use these devices to watch streaming video on their televisions.<sup>17</sup>

App usage on other devices can replace set-top boxes as well. A majority (54%) of adults now watch video regularly on devices other than televisions, such as tablets, smartphones, and computers.<sup>15</sup> Use of these non-TV mobile devices inside the home reduces the demand for additional set-top boxes on additional rooms around the house.

D+R's prior reports speculated that energy usage in the network to support apps and cloud-based DVR services is less than the energy used in customer homes to power set-top boxes, but did not find data to substantiate that conclusion. The signatories of the Voluntary Agreement accordingly commissioned Saras Partners to perform an independent research study to estimate the incremental energy usage in service provider networks attributable to the delivery of streaming video services in order to enable comparisons with the energy used to deliver their video services via set-top boxes. The four largest service providers provided confidential network and energy information to Saras to enable an informed study of each relevant component parts of their platforms, and Saras supplemented that information with public sources. Saras' report found that the average incremental<sup>18</sup> energy usage in the network is only 3.6 kWh/year for streaming live TV and only 14.4 kWh/year for recorded video – substantially less than even the most efficient set-top boxes and DVRs. The continued decline in the number of pay-TV customers combined with the increase in use of these alternative options to access video has resulted in a sharp decrease in the percentage of U.S. televisions that are connected to a pay-TV set-top box, from 58% in 2016 down to 37% in 2021.<sup>17</sup> As a result of this decline and the significant improvement in the energy efficiency of the set-top boxes that remain in use, the relevance of the set-top box category to national energy policy has diminished since the adoption of the Voluntary Agreement.

The confluence of these changes results in fewer homes with set-top boxes and fewer set-top boxes per home in the homes that use them. The estimated number of deployed set-top boxes has declined by 31% from 2012 to 2021,<sup>19</sup> and there are projections of even steeper declines ahead.<sup>16</sup> These trends, when coupled with more energy-efficient devices, result in a lower energy footprint of set-top boxes.

16 - See Kagan Market Intelligence, *Cable, telco and DBS set-tops stream out of US homes in 2020 forecast* (July 22, 2020) (estimating as few as 100 million deployed set-top boxes in the United States by the end of 2024).

17 - Leichtman Research Group, *supra*, note 6. We assume that many of these TVs are still connected to a set-top box and/or streaming devices to access additional video content.

18 - The study excludes energy used by in the network and at the customer premises for other services or functions, such as Internet access service.

19 - As noted in Table 5, D&R estimates that there were approximately 155 million set-top boxes deployed at the end of 2021, down from an estimated 225 million in 2012.

**Table 9: Platforms and Apps Used by Customers to View Content Without Set-Top Boxes**

Service Provider	Platform	App Name	Live TV	On-Demand	DVR
			Yes/No		
Altice USA	Android	Altice USA One App	Yes	Yes	Yes
	Apple iOS	Altice USA One App	Yes	Yes	Yes
	Apple TV	Altice USA One App	Yes	Yes	Yes
	MAC	Altice USA One App	Yes	Yes	Yes
AT&T/DIRECTV	Amazon Fire TV	U-Verse, DIRECTV Stream, AT&T WatchTV	Yes	Yes	Yes
	Amazon Kindle Fire HD	DIRECTV, U-Verse	Yes	Yes	Yes
	Android	DIRECTV, U-Verse, DIRECTV Stream, AT&T WatchTV	Yes	Yes	Yes
	Android TV	DIRECTV Stream	Yes	Yes	Yes
	Apple iOS	DIRECTV, U-Verse, DIRECTV Stream, AT&T WatchTV	Yes	Yes	Yes
	Apple TV	DIRECTV Stream, AT&T WatchTV	Yes	Yes	Yes
	Google Chromecast	DIRECTV Stream, AT&T WatchTV	Yes	Yes	Yes
	MAC	DIRECTV, U-Verse, DIRECTV Stream, AT&T WatchTV	Yes	Yes	Yes
	PC	DIRECTV, U-Verse, DIRECTV Stream, AT&T WatchTV	Yes	Yes	Yes
	Roku	DIRECTV Stream	Yes	Yes	Yes
	Roku TV	DIRECTV Stream	Yes	Yes	Yes
	Samsung TV	DIRECTV Stream	Yes	Yes	Yes
	Sony Smart TV	DIRECTV Stream	Yes	Yes	Yes
Charter	Android	Spectrum TV	Yes	Yes	Yes
	Apple iOS	Spectrum TV	Yes	Yes	Yes
	Apple TV	Spectrum TV	Yes	Yes	Yes
	Google Chromecast	Spectrum TV	Yes	Yes	Yes
	MAC	Spectrum.net	Yes	Yes	Yes
	PC	Spectrum.net	Yes	Yes	Yes
	Roku	Spectrum TV	Yes	Yes	Yes
	Roku TV	Spectrum TV	Yes	Yes	Yes
	Samsung TV	Spectrum TV	Yes	Yes	Yes
	Xbox One	Spectrum TV	Yes	Yes	Yes
Comcast	Amazon Fire TV	Stream	Yes	Yes	Yes
	Amazon Kindle Fire HD	Stream	Yes	Yes	Yes
	Android	Stream	Yes	Yes	Yes
	Apple iOS	Stream	Yes	Yes	Yes
	Apple TV	Stream	Yes	Yes	Yes
	Google Chromecast	Stream	Yes	Yes	Yes
	LG TV	Stream	Yes	Yes	Yes
	MAC	Stream	Yes	Yes	Yes
	PC	Stream	Yes	Yes	Yes
	Roku	Stream	Yes	Yes	Yes
	Roku TV	Stream	Yes	Yes	Yes
	Samsung TV	Stream	Yes	Yes	Yes
Cox	Android	Contour	Yes	Yes	Yes
	Apple iOS	Contour	Yes	Yes	Yes
	MAC	Contour	Yes	Yes	Yes
	PC	Contour	Yes	Yes	Yes

**Table 9: Platforms and Apps Used by Customers to View Content Without Set-Top Boxes (cont.'d)**

Service Provider	Platform	App Name	Live TV	On-Demand	DVR
			Yes/No		
<b>DISH</b>	AirTV Mini	SlingTV	Yes	Yes	Yes
	AirTV Player (AndroidTV)	SlingTV	Yes	Yes	Yes
	Amazon Fire TV	SlingTV	Yes	Yes	Yes
	Android	DISH Anywhere	Yes	Yes	Yes
	Android	SlingTV	Yes	Yes	Yes
	AndroidTV	SlingTV	Yes	Yes	Yes
	Apple iOS	DISH Anywhere	Yes	Yes	Yes
	Apple TV	SlingTV	Yes	Yes	Yes
	Cox Contour Steam Player	SlingTV	Yes	Yes	Yes
	Evoca Scout	SlingTV	Yes	Yes	Yes
	Facebook Portal	SlingTV	Yes	Yes	Yes
	Fire OS	DISH Anywhere	Yes	Yes	Yes
	Google Chromecast	SlingTV	Yes	Yes	Yes
	Google Nest Hub	SlingTV	Yes	Yes	Yes
	Google TV	SlingTV	Yes	Yes	Yes
	LeEco (AndroidTV)	SlingTV	Yes	Yes	Yes
	LG TV	SlingTV	Yes	Yes	Yes
	MAC	DISHAnywhere.com (website)	Yes	Yes	Yes
	Oculus	SlingTV	Yes	Yes	Yes
	PC	DISHAnywhere.com (website)	Yes	Yes	Yes
	Roku	SlingTV	Yes	Yes	Yes
	Samsung TV	SlingTV	Yes	Yes	Yes
	TiVo Stream	SlingTV	Yes	Yes	Yes
	Vizio TV	SlingTV	Yes	Yes	Yes
	XBOX ONE	SlingTV	Yes	Yes	Yes
	Xfinity Flex	SlingTV	Yes	Yes	Yes
	Xfinity X1	SlingTV	Yes	Yes	Yes
	Xiaomi Mi (AndroidTV)	SlingTV	Yes	Yes	Yes
ZTE (Android)	SlingTV	Yes	Yes	Yes	
<b>Frontier</b>	Android	Frontier TV	Yes	Yes	Yes
	Apple iOS	Frontier TV	Yes	Yes	Yes
	MAC	Frontier TV	Yes	Yes	Yes
	PC	Frontier TV	Yes	Yes	Yes
<b>Verizon</b>	Amazon Fire TV	fios TV Home	Yes	Yes	Yes
	Android	fios Mobile	Yes	Yes	Yes
	Android TV	fios TV Home	Yes	Yes	Yes
	Apple iOS	fios Mobile	Yes	Yes	Yes
	MAC	tv.verizon.com	Yes	No	No
	PC	tv.verizon.com	Yes	Yes	No
<b>Number of unique, customer-owned and managed devices that have accessed video services via apps during Reporting Period</b>			<b>56,211,758</b>		

## CONCLUSION

In 2021, 97.4% of set-top boxes purchased by the signatories met the Tier 3 energy-efficiency levels of the Voluntary Agreement. All but one service provider met the 90% procurement commitment under the Agreement in the second year of Tier 3. The service provider that missed its 2021 procurement commitment has already successfully implemented a remedial plan that has secured more than enough incremental energy savings to offset the additional energy used by the new devices associated with its missed procurement commitment. All other commitments have been met.

As a result, the Voluntary Agreement reduced national energy consumption of set-top boxes from 32 TWh/year in 2012 to 13.7 TWh/year in 2021, a reduction of 57%, even as the functionality of set-top boxes increased. Under the Voluntary Agreement, consumers have saved \$11.8 billion and nearly 64 million metric tons of CO<sub>2</sub> emissions have been avoided. The savings have been confirmed year-by-year through an analysis of independent verification testing and procurement audits. Meanwhile, the total energy footprint of set-top boxes in customers' homes used to access traditional pay-TV services continues to decline as a result of improved energy efficiency, declining subscribership, and consumer use of apps as an alternative to set-top boxes.

## APPENDIX A: SET-TOP BOXES PURCHASED BY VOLUNTARY AGREEMENT SERVICE PROVIDER SIGNATORIES IN 2021

Table 10 lists the reported typical energy consumption (TEC) for each model of set-top box purchased by Service Provider signatories in 2021. These values are reported TEC, rather than calculated TEC. In the Voluntary Agreement, service providers have the option to publish a “reported TEC” that rounds up calculated TEC values for reporting purposes to account for production variances. Reported TEC figures in this Appendix are rounded up to the next one-tenth digit (e.g., 99.11 kWh/year would be rounded up to 99.2 kWh/year). Please note that the same model could have variances in TEC for several reasons, including differences in reported versus calculated TEC, enabling of different product features, and/or deployment of the device by service providers running different software. The Voluntary Agreement calculates the maximum allowable TEC for a product using the base-type allowances outlined in Table 11 and the feature allowances outlined in Table 12. Table 12 also includes descriptions of the features abbreviated in Table 11 in the “Claimed Allowances” column. The Voluntary Agreement sets forth rules for claiming feature allowances, so the column for claimed allowances lists only the features used when calculating the maximum allowable TEC for the specific product to qualify toward meeting the signatory’s commitment.

The template used to collect the information reported in this Appendix is posted at <https://www.energy-efficiency.us/library/pdf/Set-top-Box-Voluntary-Agreement-2021.pdf>. Procurement data submitted by service providers is subject to one random audit per year and the Steering Committee has the option to direct the Independent Administrator to conduct additional audits as necessary. An asterisk indicates models that have been evaluated through third-party verification testing in previous years under the Voluntary Agreement.



**Table 10: Set-Top Boxes Procured by Voluntary Agreement Service Provider Signatories in 2021**

Service Provider	Base Type	Primary Function	Brand	Model No.	Claimed Allowances	Reported Modal Power (W)		TEC (kWh/yr)	Meets Tier 3
						On	Sleep		
Altice USA	IP	Non-DVR	SDMC	DV8555*	HNI, WiFi (n) LP, WiFi (ac) LP, HEVP	2.70	1.56	22.0	Yes
Altice USA	IP	Non-DVR	Apple	A1842	HNI, WiFi (n) HP, WiFi (ac) HP, WiFi Addl HP, HEVP	4.14	0.36	24.0	Yes
Altice USA	IP	Non-DVR	Apple	A2169	HNI, WiFi (n) HP, WiFi (ac) HP, WiFi Addl HP, HEVP	2.43	1.57	20.0	Yes
AT&T/ DIRECTV	Satellite	DVR	DIRECTV	HR54-500*	APD, DVR, DVR-A, HNI, M-HNI, Multi-room, MS, MS-A	12.66	12.64	110.8	Yes
AT&T/ DIRECTV	Thin Client	Thin Client	DIRECTV	C61-500*	APD, HNI, M-HNI	5.43	4.22	40.1	Yes
AT&T/ DIRECTV	Thin Client	Thin Client	DIRECTV	C61W-400*	APD, HNI, WiFi (ac) LP, WiFi Addl LP(2)	6.53	5.03	47.9	Yes
AT&T/ DIRECTV	Thin Client	Thin Client	DIRECTV	C61W-700*	APD, HNI, WiFi (ac) LP, WiFi Addl LP(2)	6.56	5.22	49.2	Yes
AT&T/ DIRECTV	Satellite	DVR	DIRECTV	H44-500*	APD, DVR, DVR-A, HNI, M-HNI, Multi-room, MS, MS-A	10.37	9.37	84.7	Yes
AT&T/ DIRECTV	IP	Non-DVR	AT&T	C71KW-400	HNI, WiFi (ac) LP, WiFi Addl LP(2), HEVP, UHD-4	5.86	4.13	45.0	Yes
Charter	Cable	Non-DVR	ARRIS	110A	APD, D3 above 8x4(2), HEVP	12.74	11.81	110.0	Yes
Charter	Cable	DVR	ARRIS	210A	APD, DVR, D3 above 8x4(2), MS, MS-A, HEVP	16.24	15.09	135.0	Yes
Charter	Cable	Non-DVR	Humax	110H*	APD, D3 above 8x4(2), HEVP	12.95	12.33	113.0	Yes
Charter	Cable	DVR	Humax	210H*	APD, DVR, D3 above 8x4(2), MS, MS-A, HEVP	17.51	16.07	145.0	Yes
Charter	IP	Non-DVR	Apple	A1842	HNI, WiFi (n) HP, WiFi (ac) HP, WiFi Addl HP, HEVP	2.91	0.82	20.0	Yes
Comcast	Cable DTA	Cable DTA	Evolution	DMS2004UHDW*		6.27	6.27	60.0	No
Comcast	IP	Non-DVR	ARRIS	AX061AEI*	HNI, WiFi (n) LP, WiFi (ac) LP	4.65	3.71	40.0	Yes
Comcast	IP	Non-DVR	Technicolor	TX061AEI*	HNI, WiFi (n) LP, WiFi (ac) LP	4.06	3.30	35.0	Yes
Comcast	IP	Non-DVR	Sercomm	SCXI11AEI-BCO	HNI, WiFi (n) LP, WiFi (ac) LP	3.82	2.53	32.0	Yes
Comcast	IP	Non-DVR	Sercomm	SCXI11BEI-BCO*	HNI, WiFi (n) LP, WiFi (ac) LP	2.99	2.32	26.0	Yes
Cox	IP	Non-DVR	ARRIS	AX061AEI*	HNI, WiFi (n) LP, WiFi (ac) LP, HEVP	5.10	3.40	40.0	Yes
Cox	IP	Non-DVR	Sercomm	SCXI11AEI*	HNI, WiFi (n) LP, WiFi (ac) LP	3.81	2.49	32.0	Yes
DISH	Satellite	DVR	DISH	Hopper 3*	APD, Adv Video-A, DVR, DVR-A(2), M-HNI, Multi-room, MS, MS-A(2), XCD, XCD-A, WiFi (n) LP, HEVP, UHD-4	24.43	23.28	207.0	Yes
DISH	Thin Client	Thin Client	DISH	Wireless Joey*	APD, HNI, WiFi (ac) HP, WiFi Addl HP	7.60	7.15	64.0	No
DISH	Thin Client	Thin Client	DISH	Joey 3*	APD, HNI, M-HNI, HEVP	5.33	5.05	46.0	Yes
DISH	Satellite	Non-DVR	DISH	Wally*	APD, HEVP	8.10	7.80	70.0	No
DISH	Satellite	DVR	DISH	Hopper Duo*	APD, Adv Video-A, DVR, M-HNI, Multi-room, MS, WiFi (ac) LP, HEVP	14.33	13.94	124.0	Yes
DISH	Thin Client	Thin Client	DISH	Joey 4	APD, HNI, M-HNI, HEVP, UHD-4	6.40	5.90	53.0	Yes

**Table 10: Set-Top Boxes Procured by Voluntary Agreement Service Provider Signatories in 2021 (cont'd)**

Service Provider	Base Type	Primary Function	Brand	Model No.	Claimed Allowances	Reported Modal Power (W)		TEC (kWh/yr)	Meets Tier 3
						On	Sleep		
DISH	Thin Client	Thin Client	DISH	Wireless Joey 4*	APD, HNI, WiFi (ac) HP, WiFi Addl HP, HEVP, UHD-4	6.83	6.33	57.0	Yes
Verizon	Cable	DVR	CommScope	4100P2	APD, Adv Video-A, DVR, M-HNI, Multi-room, MS, MS-A, XCD, XCD-A, HEVP, UHD-4	19.70	15.50	147.0	Yes
Verizon	IP	Non-DVR	CommScope	4100*	APD, HNI, WiFi (ac) HP, WiFi Addl HP(2), HEVP, UHD-4	8.80	6.00	60.0	Yes

Table 11 presents the base allowances for set-top boxes under the current Tier 3 and the Tier 4 that will become applicable in 2023.

**Table 11: Set-Top Box Base Allowances**

Base Type (Use topmost if multiple apply)	Tier 3 Allowance (kWh/yr)	Tier 4 Allowance (kWh/yr)
DTA	40	40
Cable (CBL)	50	45
Satellite (SAT)	55	50
Internet Protocol (IP)	40	15
Thin Client (TC)	25	25

Table 12 sets forth the features listed for set-top boxes and outlines the feature allowances under the currently applicable Tier 3 and the Tier 4 that will apply beginning in 2023.

**Table 12: Set-Top Box Feature Allowances**

Set-Top Box Feature Allowances			
Feature	Description	Tier 3 TEC Allowance (kWh/yr)	Tier 4 TEC Allowance (kWh/yr)
<b>Adv Video-A</b>	Advanced Video Processing	8	8
<b>AP</b>	WiFi Access Point	8	8
<b>APD (hrs)</b>	Automatic Power Down (4 hrs)	-	-
<b>CableCARD</b>	CableCARD	15	10
<b>D3</b>	DOCSIS 3.0	45	40
<b>D3 above 8x4</b>	DOCSIS 3.0 above 8x4	11	11
<b>DVR</b>	Digital Video Recorder (DVR)	20	15
<b>DVR-A</b>	DVR Additional	15	10
<b>HEVP</b>	High Efficiency Video Processing	10	10
<b>HNI</b>	Home Network Interface	10	10
<b>M-HNI</b>	MoCA HNI	12	12
<b>MS</b>	Multi-stream	8	8
<b>MS-A</b>	Multi-stream Additional	8	8
<b>Multi-room</b>	Multi-room	25	20
<b>S-DVR</b>	Shared DVR	20	20
<b>UHD-4</b>	Ultra High Definition - 4K	5	5
<b>WiFi (ac) HP</b>	WiFi (ac) HP	22	20
<b>WiFi (ac) LP</b>	WiFi (ac) LP	19	16
<b>WiFi (n) HP</b>	WiFi (n) HP	11	10
<b>WiFi (n) LP</b>	WiFi (n) LP	9	9
<b>WiFi Addl HP</b>	WiFi above 2x2 HP	4	3
<b>WiFi Addl LP</b>	WiFi above 2x2 LP	3	3
<b>XCD</b>	Transcoding Base	13	13
<b>XCD-A</b>	Transcoding Additional	5	5

## APPENDIX B: CONSUMER ACCESS TO SET-TOP BOX ENERGY-EFFICIENCY INFORMATION

Set-top box energy information for consumers is available at [www.energy-efficiency.us](http://www.energy-efficiency.us), and for each service provider at the links below.

**Table 13: Links for Consumer Access to Energy-Efficiency Information**

Service Provider	Consumer Information Location
Altice USA	<a href="https://energy.cablelabs.com/alticeusa/">https://energy.cablelabs.com/alticeusa/</a>
AT&T/DIRECTV	<a href="https://www.directv.com/support/satellite/article/KM1071943/">https://www.directv.com/support/satellite/article/KM1071943/</a>
Charter	<a href="https://www.spectrum.net/support/tv/digital-receiver-energy-use/">https://www.spectrum.net/support/tv/digital-receiver-energy-use/</a>
Comcast	<a href="https://www.xfinity.com/support/cable-tv/set-top-box-energy-usage/">https://www.xfinity.com/support/cable-tv/set-top-box-energy-usage/</a>
Cox Communications	<a href="https://www.cox.com/residential/support/conserving-energy-with-your-digital-receiver.html">https://www.cox.com/residential/support/conserving-energy-with-your-digital-receiver.html</a>
DISH Network	<a href="https://www.mydish.com/support/energy-efficiency">https://www.mydish.com/support/energy-efficiency</a>
Frontier	<a href="https://frontier.com/~media/HelpCenter/Documents/tv/fiber-optic-tv/set-top-box-equipment-efficiency.ashx">https://frontier.com/~media/HelpCenter/Documents/tv/fiber-optic-tv/set-top-box-equipment-efficiency.ashx</a>
Verizon	<a href="https://www.verizon.com/support/residential/tv/equipment/stb-dvr">https://www.verizon.com/support/residential/tv/equipment/stb-dvr</a>

## APPENDIX C: 2021 PROCUREMENT AUDIT REPORT

In 2012, the pay-TV industry signed a Voluntary Agreement with the goal of increasing the energy efficiency of set-top boxes, while protecting rapid innovation and timely introduction of new features. Signatories of the Voluntary Agreement include major manufacturers of set-top boxes and the largest cable, satellite, and telco service providers and leading Energy Advocates.

The Voluntary Agreement requires the service providers to submit annual procurement data to an Independent Administrator, who collects and analyzes the data, then publishes the findings in an annual report. Data from the individual service providers are aggregated for publication in the annual report to protect this highly confidential information. To verify the accuracy of the reported procurement data, the Voluntary Agreement requires a random audit of one service provider each year. In accordance with the confidentiality requirements of the Voluntary Agreement, the name of the service provider is not published.

D+R conducted an audit of the 2021 procurement data, which was used to develop the findings published in the 2021 Annual Report. D+R randomly selected the service provider by creating an Excel spreadsheet and using the “random” function, after excluding the signatory that was successfully audited last year in accordance with the terms of the Voluntary Agreement.

D+R requested raw data from the selected service provider to verify the procurement data submitted, which included invoice data and specification sheets. D+R determined that the data submitted by the service provider for the audit is consistent with the annual report submitted by that service provider.

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