

**VOLUNTARY AGREEMENT
FOR ONGOING IMPROVEMENT TO THE ENERGY EFFICIENCY OF SET-TOP BOXES**

Amended and Restated: January 1, 2018

This document sets out a Voluntary Agreement between the undersigned Signatories to continue improvements in the energy efficiency of Set-Top Boxes used in the distribution of digital video signals. The Annexes 1-9 attached hereto form part of the Voluntary Agreement.

1. Purpose

- 1.1. The purpose of this Voluntary Agreement is to continue improvements in the energy efficiency of Set-Top Boxes used in the delivery of services by Service Providers, thereby further reducing potential environmental impact and increasing benefits to consumers. Fostering device and service functionality while encouraging innovation and competition by Service Providers and Manufacturers are equally important objectives of this Voluntary Agreement.
- 1.2. Energy efficiency improvements will be pursued provided that such improvements do not jeopardize the intended uses and functionalities of Set-Top Boxes; that they preserve or enhance the customer experience; and that they are sufficiently flexible to adapt to technological options and market competition, to improve functionality, to offer service enhancements, and to foster rapid innovation.
- 1.3. This Voluntary Agreement is intended to be a complete and adequate substitute for all Federal and State legislative and regulatory solutions for the energy efficiency of Set-Top Boxes. The Signatories agree that this agreement is the preferred means for addressing the energy consumption of complex, networked, digital video service set-top boxes that are generally owned by the Service Provider and integrated with distribution networks, but deployed within the premises of customers.
- 1.4. The Signatories agree that energy efficiency measures should not create undue burdens or competitive disadvantages for Service Providers compared with other means of distributing video programming and other programming services.

2. Equipment Covered

- 2.1. This Voluntary Agreement covers only new Set-Top Boxes, as defined in Annex 1, ordered and placed into service in the United States by a Service Provider after the Effective Date. There is no retroactive effect on equipment that is deployed or in inventory prior to the Effective Date, nor is there any requirement to retire or change existing equipment or to change existing equipment that is returned to the Service Provider and refurbished, repaired, and/or upgraded, and then redeployed
- 2.2. The Signatories will consider modifications to the definition of Set-Top Box in Annex 1 in the event that a new type of Service Provider-supplied equipment that uses a customer's electricity to deliver residential multichannel video services represents a materially significant amount of energy use.

3. Service Provider Signatory Commitments for Set-Top Boxes

- 3.1. Service Providers, through their purchasing, will support and encourage the development of new Set-Top Boxes designed to minimize energy consumption as specified below while achieving the operational specifications, preserving their intended uses and functionalities, permitting ongoing innovation, preserving and enhancing the customer experience, and complying with existing applicable regulation.

- 3.2. Ninety percent (90%) of all new Set-Top Boxes that a Service Provider Purchases after December 31, 2016 shall meet the Tier 2 efficiency levels.
 - 3.2.1. A Service Provider shall also comply with such specific energy efficiency provisions as are set forth in the Annex specifically accepted by the Service Provider.
- 3.3. Ninety percent (90%) of all new Set-Top Boxes that a Service Provider Purchases after December 31, 2019 shall meet the Tier 3 efficiency levels.
- 3.4. Service Providers will support:
 - 3.4.1. reasonable steps to monitor the effectiveness of this Voluntary Agreement through the procedure described in Section 11;
 - 3.4.2. periodic review of the Voluntary Agreement to consider amendment to the Voluntary Agreement through the procedure described in Section 12; and
 - 3.4.3. reasonable steps to inform consumers about the general energy consumption characteristics and performance of Set-Top Boxes, as described in Section 8.5.

4. Long-Term Energy Savings

- 4.1. Upon the Energy Advocates' request, each Service Provider agrees to annually review trends in the following areas in private, confidential individual discussions with the Advocates: (1) the deployment and functionalities of apps that enable consumers to access the Service Provider's video content without the use of a Service Provider-supplied Set-Top Box on TVs, through Internet-connected devices that may be connected to TVs, and on other display devices; (2) Set-Top Box power management and component improvements; and (3) low-power architectures. Nothing in this section requires a Service Provider to disclose confidential, commercially-sensitive information, and any such information disclosed is subject to the Confidentiality Agreement between the Parties.
- 4.2. By the third quarter of 2019, the Service Providers will begin discussions with the Energy Advocate Signatories and Vendor Signatories to develop proposed Tier 4 efficiency levels. To prepare for these discussions, in addition to the discussions described in Section 4.1, the four largest Service Provider Signatories individually will continue to engage with the Energy Advocates, the Manufacturer Signatories, component suppliers and software developers to explore approaches to further improve the energy efficiency of Set-Top Boxes in all power states, with a special emphasis on efficiencies in standby power, while preserving a good consumer experience.
- 4.3. In addition to improving the energy efficiency of Set-Top Boxes, the Service Providers are enabling consumers to use their video apps to receive video programming services without a Service Provider-supplied set-top box. The Service Providers will annually report information regarding the availability and usage of such apps pursuant to Section 8 of the Agreement. Each Service Provider is encouraged to continue to develop, deploy and support video apps for widely available and popular customer-owned and managed devices (e.g., Smart TVs and streaming devices). Each Service Provider is making these apps attractive and widely available to consumers. The prevalence of app usage may depend on consumer demand, technology, the terms on which third party platform owners make their platforms available, and other factors that may change over time.

5. Signatories to the Voluntary Agreement

- 5.1. Service Providers may become Signatories by signing Annex 7, Part A.

- 5.2. Equipment Manufacturers and other vendors may become Vendor Signatories to the Voluntary Agreement by signing Annex 7, Part B. Each such Vendor Signatory endorses the purposes of the Voluntary Agreement and agrees to its commitments set out herein.
- 5.3. The Energy Advocates are the Natural Resources Defense Council and the American Council for an Energy-Efficient Economy,¹ which became Signatories to the Voluntary Agreement as indicated in Annex 7, Part C.
- 5.4. Each Signatory commits only to the areas which are under its individual control and responsibility.
- 5.5. Qualified additional parties may become Signatories upon the approval of the Steering Committee, which shall not be unreasonably withheld.

6. Vendor Signatory Commitments for Set-Top Boxes

- 6.1. Vendor Signatories will use reasonable efforts to design and manufacture equipment, software and services to enable improved Set-Top Box energy efficiency while meeting the Service Providers' functional and operational specifications.

7. Test Method

- 7.1. Set-Top Boxes shall be tested in the currently installed configuration using the applicable test methodologies and procedures referenced in Annex 2 (Program Requirements) and Annex 6 (New Features Process).
- 7.2. Set-top Boxes shall be tested using qualified vendor laboratories, Service Provider laboratories, or other facilities that are pre-approved as test facilities by the Steering Committee. Cable Television Laboratories, Inc. and its subsidiaries ("CableLabs") and the Cable Operators' test facilities operating under CableLabs' guidance are specifically approved as test facilities for these purposes.
- 7.3. The Signatories agree that Vendors and Service Providers are constantly innovating their products in response to developments in service concepts and technologies, competition, and consumer demand. In order to foster the benefits of such innovative and competitive markets, the New Features Process set forth in Annex 6 may be invoked by the Service Provider for Set-Top Boxes with new features/functions which consume significant power that are not covered by the applicable Tier allowances.
- 7.4. The Signatories agree that consumers and stakeholders are best served by the consistent use of the same test method to measure the energy use of Set-Top Boxes, and will use best efforts to discourage any Federal or State authority from initiating any proceeding to consider the adoption of any mandatory test method for Set-Top Boxes.

8. Reporting

¹The Appliance Standards Awareness Project (ASAP) is housed within the American Council for an Energy-Efficient Economy (ACEEE). Under ACEEE's auspices, ASAP was a signatory to Amendment 1 of the Voluntary Agreement. ASAP focuses on regulatory standards and was not involved in the development of Amendment 2 of the Voluntary Agreement, but supports its objectives and the role of ACEEE and the Natural Resources Defense Council (both ASAP Steering Committee members) in the Voluntary Agreement. ASAP is not required to separately perform proactive Energy Advocate obligations that are performed by ACEEE, but it will not engage in actions with respect to Set-Top Boxes that are inconsistent with the Energy Advocates' commitments established by the Agreement.

- 8.1. Each Service Provider shall prepare a confidential annual report by April 1 of each year containing the data for the prior Reporting Period during which it was a Signatory and submit the report to the Independent Administrator as set forth below.
 - 8.1.1. The information in the Service Providers' annual reports shall include:
 - 8.1.1.1. For each Set-Top Box model Purchased during the Reporting Period, all information necessary to calculate maximum or reported TEC, including:
 - 8.1.1.1.1. Modal power use (e.g., on, sleep, deep sleep) and TEC;
 - 8.1.1.1.2. A feature set description sufficient to calculate the applicable allowances; and
 - 8.1.1.1.3. Details on calculating TEC and implementation of sleep states, including the number of hours deep sleep was set for at deployment.
 - 8.1.1.2. Different configurations of a model should be reported separately if energy use varies by configuration.
 - 8.1.1.3. Procurement information (total units Purchased by Category and units Purchased compliant with applicable Tier requirements by Category) with an attestation that the volumes reported reflect units Purchased during the Reporting Period.
 - 8.1.1.4. The weighted TEC for each Category.
 - 8.1.1.5. A table identifying the platforms (e.g., specific Smart TV manufacturers, streaming devices, and operating systems) supported by the video apps of each Service Provider, which will indicate whether each app supports linear, on-demand, and/or recording, and the number of unique customer owned and managed devices that have accessed the provider's video services via apps during a representative portion of the Reporting Period.
 - 8.1.2. Service Providers are encouraged towards early adoption of Tier 3 commitments. To that end, annual reports for the 2018 and 2019 Reporting Periods will include the percentage of Set-Top Box purchases that meet Tier 3 levels.
 - 8.1.3. The information in the annual report shall include the number of residential multichannel video subscribers served during the Reporting Period, with an indication of the "as of" date.
 - 8.1.4. Service Providers are invited to report information to the Independent Administrator that can help to describe trends and progress in improving the energy efficiency of Set-Top Boxes and promoting apps as an alternative means of access to a Service Provider's video services.
 - 8.1.5. Service Providers shall provide an annual report for the 2021 Reporting Period by April 1, 2022, notwithstanding any expiration of the Voluntary Agreement.
 - 8.1.6. A recommended reporting template shall be approved by the Steering Committee and posted on a website maintained by the Steering Committee.
- 8.2. By April 1 of each year, NCTA and the Consumer Technology Association (CTA) shall provide the Independent Administrator with the estimated total number of U.S. residential multichannel video subscribers served by all Service Providers (including those outside of the Voluntary Agreement) during the Reporting Period. By May 1 of each year, NCTA and CTA shall provide information to the Independent Administrator on progress with respect to non-procurement commitments for inclusion in the annual report. NCTA and CTA shall provide this information for the 2021 Reporting Period notwithstanding any expiration of the Voluntary Agreement.

- 8.3. A Reporting Period covers a single calendar year. When a new Service Provider Signatory is making its first report, it may provide data either for the entire prior calendar year (effectively backdating its commitment to the January 1 preceding its signature) or provide a report covering only the period beginning with its signature.
- 8.4. All reporting arrangements shall protect the confidentiality of commercially sensitive information. The Independent Administrator must sign a confidentiality agreement in relation to any confidential information supplied by the Signatories.
- 8.5. Service Providers shall provide their subscribers and potential customers with reasonable access to energy efficiency information about the Set-Top Boxes subject to this Voluntary Agreement. For any new Service Provider Signatories, this commitment will become effective six months after signature. The energy efficiency information that the Service Provider shall make available under this section shall include:
 - 8.5.1. For each model of Set-Top Box Purchased after the later of January 1, 2014 or the date the Service Provider signed the Voluntary Agreement:
 - 8.5.1.1. Modal power use (e.g., on, sleep, deep sleep) and TEC; and
 - 8.5.1.2. A complete feature set description sufficient to calculate the applicable allowances.
 - 8.5.2. Different configurations of a model should be reported separately if energy use varies by configuration.
 - 8.5.3. This information need not be updated for software and/or configuration changes unless changes significantly affect energy use.
 - 8.5.4. This information shall be made publicly available for each such model as such models are made available to the Service Provider's subscribers.
 - 8.5.5. The information need not include confidential or commercially sensitive information, such as features that have not been publicly announced.
 - 8.5.6. The Independent Administrator shall at least annually verify that the information required by this Section 8.5 is posted and is readily accessible to consumers. If the Independent Administrator is not able to verify that the Service Provider is in substantial compliance with its commitment, it shall request a report from the Service Provider demonstrating substantial compliance. If the Independent Administrator finds that there has been insufficient improvement within 60 days of its request, it shall report that finding to the Steering Committee.
- 8.6. The Independent Administrator will aggregate and compile the confidential data submitted by Signatories and submit a report to the Steering Committee for each Reporting Period by May 31 of the following year. To preserve confidentiality, any such official report produced by the Independent Administrator in connection with the information supplied by any individual Signatory shall not refer to the performance of individual Signatories.
 - 8.6.1. The Independent Administrator will aggregate Service Provider reports of models/units/annual energy use and report aggregated TEC on a purchases weighted basis by Category, provided that aggregation must be sufficient so that no individual company's results can be deduced or reasonably approximated. Data may be averaged in the Independent Administrator report to the Steering Committee.
 - 8.6.2. The Independent Administrator will compile a table identifying the platforms supported by the video apps of each Service Provider, which will indicate whether each app supports linear, on-demand, and/or recording, and will aggregate the number of unique customer

- owned and managed devices that the Service Providers have reported accessed their video services via apps in their annual report.
- 8.6.3. Model-specific data may be made available to the Steering Committee, unless the model is specific to or predominantly used by a single Service Provider and has not been made available publicly.
 - 8.6.4. The Independent Administrator's report shall not include confidential or commercially sensitive information, such as shipping and volume reports and features that have not been publicly announced.
 - 8.6.5. The percentage of Set-Top Boxes Purchased in 2018 and 2019 that test at Tier 3 levels early shall be provided on a Service Provider-specific basis to the Energy Advocates but not included in the public annual report or shared with other Signatories.
 - 8.6.6. The Independent Administrator may report trends useful for power load planning, such as overall rate of change in plug load.
 - 8.6.7. The Report shall report efficiency gains under the Voluntary Agreement compared with the 2012 Base Case. Before the public annual report for the 2018 Reporting Period, the Signatories and the Independent Administrator will review available information and consider whether to make an adjustment to the Independent Administrator's estimate of the total number and distribution by Category of deployed Set-Top Boxes. The Signatories and the Independent Administrator will also periodically review the model used in the Annual Report for accounting for replacement of devices with new procurements.
 - 8.6.8. The Independent Administrator report should put data in context, such as the number of Thin Clients in lieu of fully-featured Set-Top Boxes and examples of implementations that permit viewing without a Set-Top Box.
 - 8.6.9. If the Independent Administrator finds substantial non-compliance in a Service Provider report, it shall provide notice to the Service Provider by May 1 and to the committee designated pursuant to Section 13.5.
 - 8.6.10. The Independent Administrator shall provide a report to the Steering Committee for the 2021 Reporting Period by May 31, 2022, notwithstanding any expiration of the Voluntary Agreement.
- 8.7. The Independent Administrator and Steering Committee shall publish a public annual report that will:
- 8.7.1. Identify participating members during the Reporting Period.
 - 8.7.2. Identify the aggregate number of video customers served by Service Provider Signatories compared with the number of U.S. residential multichannel video subscribers served by all Service Providers (including those outside of the Voluntary Agreement) during the Reporting Period.
 - 8.7.3. Report efficiency gains under the Voluntary Agreement compared with the 2012 Base Case.
 - 8.7.4. Report percentage of Set-Top Boxes that meet the Tier 2 and Tier 3 levels, which shall be provided only on an aggregate basis.
 - 8.7.5. Include a summary of the results of annual verification testing conducted pursuant to Section 9.3.

- 8.7.6. Present a table identifying the platforms supported by the video apps of each Service Provider, which will indicate whether each app supports linear, on-demand, and/or recording.
- 8.7.7. Report the aggregate the number of unique customer owned and managed devices that the Service Providers reported to have accessed their video services via apps during the Reporting Period.
- 8.7.8. Include a narrative of trends, such as overall progress under the Voluntary Agreement, overall rate of change in plug load, and contextual comments such as those identified in Section 8.6.8.
- 8.7.9. Include an Appendix of Set-Top Box models which Service Providers have Purchased during the Reporting Period including their model number, features, modal power use (e.g., on, sleep, deep sleep) and TEC. The information shall not include confidential or commercially sensitive information, such as shipping and volume reports and features that have not been publicly announced.
- 8.8. To preserve confidentiality, any such annual report produced by the Independent Administrator in connection with the information supplied by any individual Signatory shall not refer to the performance of individual Signatories or provide information from which an individual company's results can be deduced or reasonably approximated.
- 8.9. The Steering Committee shall make arrangements for the publication of an annual report for the 2021 Reporting Period by July 30, 2022, notwithstanding any expiration of the Voluntary Agreement.

9. Audit and Verification

- 9.1. Either the Independent Administrator or an independent auditor approved by the Steering Committee will conduct an audit of procurement figures reported by one Service Provider selected at random each year. The same Service Provider shall not be randomly selected two years in a row.
- 9.2. In addition, on request of the Steering Committee, the Independent Administrator shall instruct an independent auditor approved by the Steering Committee to conduct an audit of the information and test results supplied by any Service Provider's annual report,. Commercially sensitive information with respect to an individual Signatory, as designated by that Signatory, shall remain confidential both during and after the audit. Signatories agree to provide reasonable assistance to the auditor. The independent auditor must sign a confidentiality agreement in a form reasonably satisfactory to the Signatory. The Steering Committee shall bear the cost of such audit.
- 9.3. The Independent Administrator will randomly select one model from each Service Provider's annual report from each Category of Set-Top Boxes, if any, that meets the energy efficiency levels of the applicable Tier for verification testing. In consultation with the Energy Advocates and the committee established pursuant to Section 13.5, the Independent Administrator may in its discretion exclude from selection any model that was successfully tested pursuant to this section in the prior year. Verification testing shall be conducted in a third party laboratory approved by the Steering Committee or under a supervised Signatory testing program with an accredited observer approved by the Steering Committee. Cable Television Laboratories, Inc. and its subsidiaries ("CableLabs") and test facilities operating under CableLabs' supervision are specifically approved as test facilities for these purposes. Tests must be conducted using the test method set forth in Annex 6 and the applicable provisions of the Tier programs and the new features process, which require that Set-Top Boxes

are tested in their as-installed configuration on the Service Provider's network. The Steering Committee will adopt operating procedures that include automatic additional testing if a tested device does not meet prescribed levels. The Steering Committee may direct additional verification testing in accordance with Section 9.2 of the Voluntary Agreement. The testing obligations under this section shall begin in connection with the Service Provider's annual reports for 2018 submitted in 2019.

9.3.1. The cost of verification testing shall be borne by the Service Provider.

9.3.2. Issues identified during verification testing shall be submitted for discussion with the relevant Service Provider and/or by the Steering Committee. Substantial non-compliance identified from verification testing shall be submitted as a claim for resolution under Section 13.3 through 13.5.

10. Steering Committee

10.1. A Steering Committee is established as the coordinating and governing body of this Voluntary Agreement.

10.2. Each Service Provider with more than two million U.S. residential multichannel video subscribers as of its date of execution of this Voluntary Agreement, or which is one of the four largest Signatory telephone providers of U.S. residential multichannel video services, may nominate one person to represent it as a Member on the Steering Committee. Initial Service Provider Signatories shall maintain their Member seats on the Steering Committee notwithstanding any merger or consolidation of particular Service Provider Members.

10.3. The Vendor Signatories in Annex 7, Part B together may nominate no more than three persons to serve as Members of the Steering Committee. A representative of the Consumer Technology Association shall serve as one such Member. No Vendor Signatory may be represented twice.

10.4. A representative of NCTA shall serve as a Member.

10.5. The Energy Advocates together may nominate no more than two persons to serve as voting Members of the Steering Committee. The Energy Advocates may also nominate a third person as a non-voting participant of the Steering Committee representing an Energy Advocate who has not nominated a voting Member, with full rights to receive information, participate, and attend meetings as do Members but with no voting rights.

10.6. Signatories entitled to nominate a Member may appoint an alternate representative that may attend meetings and vote in the absence of that Member. A Signatory may replace its Member or alternative representative on notice.

10.7. The Steering Committee will elect a Chair from among its Members.

10.8. The Chair will be responsible for convening the Steering Committee meetings at least once each calendar year, and for running meetings of the Steering Committee.

10.9. At the request of any Signatory, the Chair may authorize any person to attend meetings of the Steering Committee as a non-voting observer.

10.10. Attendees at Steering Committee meetings shall sign a confidentiality agreement as a condition of attendance.

10.11. The Steering Committee may adopt rules of procedure and administration. At a minimum, such rules will provide that all Members will be provided with at least fifteen (15) days' prior written notice of meetings of the Steering Committee or any sub-committee or any other groups acting in accordance with this Voluntary Agreement, that an agenda will be circulated sufficiently before the meeting to be reviewed by counsel, that no substantive vote will occur unless the

subject of the vote was included in such prior notice, and that written minutes as to all topics of discussion be recorded, approved by all committee Members, and retained. In lieu of the above procedures, the Steering Committee may also vote in writing, or conduct a vote on less than fifteen days' notice, provided that all Members cast a vote and that the Committee's action is recorded in the book of minutes.

- 10.12. The Steering Committee may adopt rules for reporting, verification, and audit, which may be informed by existing ENERGY STAR procedures.
- 10.13. The Steering Committee may delegate any of its powers under the Voluntary Agreement to specific individuals or to sub-committees established by the Steering Committee.
- 10.14. The Steering Committee shall designate an Independent Administrator to be responsible for the collection and processing of information supplied directly or indirectly by Signatories and determining a Signatory's compliance with the Voluntary Agreement.
- 10.15. The costs of operating the Steering Committee shall be allocated in cost-recovery only annual dues set by the Steering Committee and assessed equally on each Commercial Signatory.
- 10.16. The Steering Committee will seek regular consultation and engagement with the official representatives of the Department of Energy, the Environmental Protection Agency, appropriate state regulatory authorities, and other stakeholders to provide updates regarding the implementation of this Agreement. Such meetings will include a representative from the Energy Advocates.

11. Annual Review of the Voluntary Agreement

- 11.1. At least once each calendar year the Steering Committee will meet to review the Voluntary Agreement in order to:
 - 11.1.1. evaluate the effectiveness of the Voluntary Agreement in achieving its purposes as identified in Section 1 above;
 - 11.1.2. create an annual report consistent with Section 8.7;
 - 11.1.3. evaluate current and future developments that may influence energy consumption with a view to agreeing upon a course of action and/or revising the Voluntary Agreement; and
 - 11.1.4. set future targets to increase energy efficiencies in accordance with the usual product development cycles.
- 11.2. Such discussions shall take place on a confidential basis.

12. Amendment of the Voluntary Agreement

- 12.1. The Voluntary Agreement may be amended in accordance with Section 11 and in accordance with the procedure set out in this Section 12.
- 12.2. The Members of the Steering Committee will negotiate in good faith when considering amendments to the Voluntary Agreement.
- 12.3. A proposed amendment will be adopted if (1) there is at least agreement of two-thirds of the Service Provider Members; (2) the two-thirds includes at least one Member of each of the three industry groups of Service Providers (cable, satellite, and telephone) covered by the Voluntary Agreement; and (3) there is agreement by a majority of all voting Members.
- 12.4. An industry-specific Annex may only be amended by agreement of two-thirds of the Service Provider Members covered by that specific Annex, after consultation with such Vendor

Member(s) as is appropriate for that industry-specific Annex. Service Providers not covered by a particular industry-specific Annex may not prevent amendment of that Annex.

- 12.5. Any Member may raise with the Steering Committee any concerns that an amendment to an industry-specific annex is inconsistent with the purpose of this Voluntary Agreement and may require further amendments to the Voluntary Agreement.
- 12.6. Once an amendment to the Voluntary Agreement has been adopted by the Steering Committee, the Voluntary Agreement will be amended with the newly adopted amendment taking effect on the next anniversary of the Effective Date or such other date as may be adopted with the amendment.

13. Non-Compliance and Dispute Resolution

- 13.1. Substantial compliance with the Voluntary Agreement shall be assessed by the Independent Administrator based upon data for the most recently completed Reporting Period on the basis of the information provided by each Signatory and data collected under the verification testing program.
- 13.2. In mitigation of any claims or concerns raised with respect to any Reporting Period and in evaluating substantial compliance with the Voluntary Agreement, a Service Provider shall be credited for alternative energy efficiency steps which the Service Provider demonstrates will provide net energy efficiency gains in the delivery of content that are superior to those required by the Voluntary Agreement. The Steering Committee shall adopt procedures for evaluating such alternative energy efficiency steps. The Steering Committee may authorize a committee to approve an alternative efficiency credit, but only if such committee includes at least one Energy Advocate Signatory that approves the request.
 - 13.2.1. If a Service Provider believes that it is likely to fall short of its procurement commitment, it shall promptly initiate confidential discussions with the Energy Advocates to report on progress and consider any appropriate mitigation measures in accordance with Section 13.2 of the Agreement.
- 13.3. The Steering Committee may raise a claim against a Signatory concerning compliance with the Voluntary Agreement.
- 13.4. The Steering Committee will establish dispute and compliance resolution procedures that provide notice of a claim to the Signatory, and shall endeavor in good faith to resolve the issue within three (3) months through consultation.
- 13.5. A Signatory that is found by the Independent Administrator not in substantial compliance with the Voluntary Agreement after being credited for alternative energy efficiency steps, if any, shall be provided a period of three (3) months from the date of its receipt of the notice described in Section 13.4 to provide a satisfactory remedial plan to the Steering Committee. The Steering Committee shall authorize a committee of Members to approve a remedial plan, but only if such committee includes at least one Energy Advocate Signatory that approves the plan. A Signatory that fails to do so and to fulfill its remedial plan may have its Signatory status terminated by the Steering Committee and its termination reported to such persons as the Chair may deem appropriate.
- 13.6. Involuntary termination pursuant to this Section constitutes the sole and complete remedy available to the Steering Committee, Signatories, Independent Administrator, auditor or any third party or other individuals or entities with respect to any alleged noncompliance with any term, provision or obligation of the Voluntary Agreement by a Signatory.

14. Termination

- 14.1. Any Commercial Signatory may elect to terminate its Signatory status by giving twenty-eight days' written notice to the Chair of the Steering Committee. Such termination shall immediately terminate all of that Signatory's rights and obligations under the Voluntary Agreement except that all confidentiality obligations arising from this Voluntary Agreement shall survive such termination.
- 14.2. The Chair will notify all Members of the Steering Committee and such other persons as the Chair may deem appropriate of the termination.
- 14.3. If Service Providers depart from the Voluntary Agreement and the remaining Service Provider Signatories serve fewer than 85% of the U.S. residential multichannel video subscribers served by Service Providers, then the Energy Advocates may, after no less than ninety days during which the Energy Advocates shall engage in good faith discussions with the Steering Committee to address their concerns, jointly terminate the Signatory status of all of the Energy Advocates and advocate for regulatory solutions. Such termination shall be indicated by giving twenty eight days' written notice, signed by all Energy Advocates, to the Chair of the Steering Committee. Such termination shall immediately terminate all of the Energy Advocates' rights and obligations under the Voluntary Agreement except that all confidentiality obligations shall survive such termination.
- 14.4. The Energy Advocates may also jointly terminate their Signatory status if industry commitments in the Voluntary Agreement are not being performed in good faith, or changes in the Voluntary Agreement are not faithful to the purposes of the Voluntary Agreement and consistent with the justified expectations of all Signatories. The Energy Advocates may terminate under this provision, after no less than ninety days during which the Energy Advocates shall engage in good faith discussions with the Steering Committee to address their concerns. Such termination shall be indicated by giving written notice, signed by all Energy Advocates, to the Chair of the Steering Committee. Such termination shall immediately terminate all of the Energy Advocates' rights and obligations under the Voluntary Agreement except that all confidentiality obligations arising from this Voluntary Agreement shall survive such termination.

15. Commitment to the Voluntary Agreement as an Alternative to Regulatory Approaches

- 15.1. Each Signatory will use its best efforts to promote the Voluntary Agreement as an effective alternative to any U.S. Federal and State energy regulation of Set-Top Boxes used by Service Providers, and will discourage initiation of new regulations or legislation covering Set-Top Box energy use by any Federal or State authority.
- 15.2. All commitments of Signatories are contingent on the continued absence of all U.S. Federal and State regulations covering energy use of Set-top Boxes used by Service Providers, unless otherwise mutually agreed by the Signatories.

16. Term

- 16.1. The initial term of this Voluntary Agreement began on January 1, 2013. Effective January 1, 2018, the Voluntary Agreement was extended for four (4) years, provided that the reporting commitments shall continue until the 2022 publication of the annual report for 2021.
- 16.2. The Voluntary Agreement may be renewed by mutual agreement.

17. Miscellaneous

- 17.1. Press. A Signatory may make public statements or issue press releases in relation to the Voluntary Agreement generally and its own compliance and/or engagement with the Voluntary Agreement. Except as expressly provided in this Voluntary Agreement, neither the Steering Committee nor any Signatory may make public statements or issue press releases making reference to another Signatory's compliance and/or engagement with the Voluntary Agreement

(directly or by inference), except for: (1) statements made with prior approval of that other Signatory; or (2) comparative product information; provided that no statements may make use of or reveal confidential information. A Signatory may make public statements or issue press releases in relation to the Voluntary Agreement provided that no public statement or press releases: (1) may reveal confidential information; (2) provide information from which the operations of an individual Signatory may be inferred; or (3) be used as a tool for negotiations or advocacy for Federal or State legislative and regulatory solutions, it being agreed that concerns with operations under the Voluntary Agreement or opportunities for change shall be directed to Steering Committee discussions. A Signatory may engage in press activities concerning Set-Top Box energy efficiency that do not include confidential information.

- 17.2. Force Majeure. If a Signatory is prevented or delayed in performance of its commitments hereunder as a result of circumstances beyond such Signatory's reasonable control, including, without limitation, Acts of God, war, terrorism, acts of the government, or failure of suppliers, subcontractors, or carriers, such failure or delay will not be deemed to constitute substantial noncompliance with this Voluntary Agreement, but such commitments will remain in full force and effect, and will be performed or satisfied as soon as reasonably practicable after the termination of the relevant circumstances causing such failure or delay.
- 17.3. Counterparts. This Voluntary Agreement may be executed in one or more counterparts, each of which when so executed and delivered shall be an original and all of which together shall constitute one and the same instrument. Signatures to this Voluntary Agreement may be delivered by facsimile, which, upon delivery, shall be deemed to be originals.
- 17.4. Legal Effect. The Voluntary Agreement sets out a course of action for the Signatories to improve the energy efficiency of Set-Top Boxes. The Voluntary Agreement is not a commercial agreement and does not in itself create any contractual relationship, partnership, joint venture or other agency relationship among the Signatories. Nothing in this Voluntary Agreement shall be deemed to create a third-party beneficiary relationship.
- 17.5. Notice. All communications to Signatories required by Section 14 of the Voluntary Agreement should be addressed and sent to the relevant contacts specified in Annex 9.

SCHEDULE OF ANNEXES

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ANNEX 2	TIER 2 AND TIER 3 PROGRAM REQUIREMENTS
ANNEX 3	CABLE INDUSTRY PROVISIONS
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ANNEX 1 – GENERAL DEFINITIONS

1. “Category” means the types of Set-Top Boxes specified in the definition thereof.
2. “Commercial Signatory” means any Signatory that is not an Energy Advocate.
3. “Effective Date” means January 1, 2013, except that as applied to a Signatory that signs the Voluntary Agreement after that date, it shall mean the date on which that party signs the Voluntary Agreement.
4. “End User” means a subscriber to content services provided by a Service Provider who uses a Set-Top Box provided by the Service Provider as part of the subscription.
5. “Energy Advocates” are the Natural Resources Defense Council and the American Council for an Energy-Efficient Economy.
6. “Equipment Manufacturer” means a company or other legal entity that is responsible for designing, developing and/or manufacturing a Set-Top Box for Purchase and deployment in the United States by a Service Provider, or components thereof, or software or conditional access techniques employed by such Set-Top Boxes.
7. “Federal” includes any part of the government of United States and any department, agency or instrument thereof.
8. “Independent Administrator” means the party designated by the Steering Committee who is tasked with, and responsible for, the collection and processing of information supplied directly or indirectly by Signatories pursuant to Section 8, and determining a Signatory’s compliance with the Voluntary Agreement in accordance with Section 13. The Steering Committee shall engage the services of an Independent Administrator upon terms and conditions that shall require undertakings of confidentiality from the Independent Administrator, and which shall also set out any requirements or applicable mechanisms for a process of appeal, should this ever be necessary.
9. “Member” means a Member of the Steering Committee.
10. “Purchase” means to accept delivery of a Set-Top Box for commercial deployment in the United States.
11. “Reporting Period” means the period within which the required information is to be submitted by a Signatory (which is generally a calendar year).
12. “Service Provider” means an entity that provides video (and possibly other) content to subscribers with whom it has an ongoing contractual relationship through a cable, satellite, or other managed distribution network provided by that entity. A Service Provider in the context of the Voluntary Agreement is one that supplies Set-Top Boxes to a residential End User.
13. “Set-Top Box” means a device (1) which is capable of receiving digital television services from a coaxial, hybrid fiber coaxial, or fiber-to-the-home distribution system, from satellites, or encapsulated in IP packets from managed IP distribution networks in order to decrypt or descramble these signals and to decode/decompress for delivery to residential consumer displays and/or recording devices, and/or one or more other Set-Top Boxes or Thin Clients in a residential multi-room architecture; and (2) that is Purchased and placed into service in the United States by a Service Provider for the first time on or after the Effective Date. The Set-Top Boxes subject to this Voluntary Agreement are limited to the following Categories of Set-Top Boxes supplied by Service Providers to residential End Users:
 - a. DVR. A Set-Top Box that enables recording and playback of video content from a hard disk drive or other integrated non-volatile storage.

- b. Non-DVR. A Set-Top Box that does not enable recording and playback of video content from a hard disk drive or other integrated non-volatile storage, and is not a Thin Client, Multi-Service Gateway, or DTA.
- c. Thin Client. A Set-Top Box that is designed to interface between another Set-Top Box and a TV (or other display device) over a home network and relies solely on the other Set-Top Box for access to digital video signals received from the network.
- d. Multi-Service Gateway. A device that is capable of joining multiple Service Provider delivery protocols that provisions video and at least one of voice or broadband services from a Service Provider.
- e. Cable Digital Transport Adapter (DTA). A minimally-configured unidirectional Set-Top Box without recording functionality that can receive and decode video content as delivered from a coaxial or hybrid fiber coaxial system using a Conditional Access System (CAS).

Set-Top Boxes subject to this Voluntary Agreement do not include any Set-Top Box that is Purchased for the first time before the Effective Date, including any such Set-Top Box that is returned to the Service Provider and refurbished, repaired, and/or upgraded, and then redeployed, or that is used in a “swap-for-failure” scenario after the Effective Date.

- 14. “Signatory” and “Signatories” mean those companies or organizations that sign this Voluntary Agreement as Service Providers, Vendor Signatories or Energy Advocates.
- 15. “State” includes the governments of the District of Columbia and any State, territory and insular possession of the United States and their political subdivisions; and any department, agency, or instrument thereof.
- 16. “Steering Committee” means the coordinating and governing body of this Voluntary Agreement.
- 17. “Tier 2” means the energy consumption targets designated in Section 3.2.
- 18. “Tier 3” means the energy consumption targets designated in Section 3.3.
- 19. “Typical Energy Consumption” or “TEC” refers to the method for evaluating energy efficiency through a calculation of expected energy consumption of a Set-Top Box over a one year period, expressed in units of kWh/year.
- 20. “Vendor Signatory” means the Equipment Manufacturers and other vendors that are Signatories pursuant to ANNEX 7, Part B Signing Forms.
- 21. “2012 Base Case” means the report of Set-Top Box energy consumption applicable to devices prior to the Voluntary Agreement, as identified in Annex 8.

ANNEX 2 - TIER 2 AND TIER 3 PROGRAM REQUIREMENTS

1. INTRODUCTION

This annex defines the base and additional feature energy allowances, allowance rules, and the Typical Energy Consumption (TEC) equation used to determine compliance with the Tier 2 and Tier 3 procurement commitments established by Sections 3.2 and 3.3 of the Voluntary Agreement.

1. COMPLIANCE NOTATION

As used in this document “shall” and “must” denote mandatory provisions. “Should” denotes a provision that is recommended but not mandatory. “May” denotes an item whose presence does not preclude compliance, and implementation of which is optional. “Optional” denotes items that may or may not be present in a compliant device.

2. DEFINITIONS

A) Set-Top Box (STB) Base Types:

- 1) Cable (CBL): A STB that can receive and decode video content as delivered from a Service Provider hybrid fiber coaxial distribution system using a Conditional Access System (CAS).
- 2) Satellite (SAT): A STB that can receive and decode video content as delivered from a Service Provider satellite network using a Conditional Access System (CAS).
- 3) Cable Digital Transport Adapter (DTA): A minimally-configured unidirectional STB without recording functionality that can receive and decode video content as delivered from a coaxial or hybrid fiber coaxial system using a Conditional Access System (CAS).
- 4) Internet Protocol (IP): A STB that can receive and decode video content encapsulated in IP packets from a Service Provider managed distribution network.
- 5) Thin Client (TC): A STB that can receive and decode video content solely over a Home Network Interface from another STB and does not include a Service Provider network interface.

B) Client: A device (e.g., STB, Thin Client STB, Smart TV, Mobile Phone, Tablet, PC, etc.) that can receive video content over a Home Network Interface.

C) Multi-Service Gateway (MSG): A STB that is capable of joining multiple Service Provider delivery protocols and/or that provisions a video service and at least one of voice or broadband services from a Service Provider.

D) Additional Functionality:

- 1) CableCARD (CC): The capability to decrypt premium video content and services and provide other network control functions via a plug-in Conditional Access module that complies with the ANSI/SCTE 28 HOST-POD Interface Standard.¹
- 2) Digital Video Recorder (DVR): A feature that enables recording and playback of video content from a hard disk drive (HDD) or other integrated non-volatile storage. A DVR often includes features such as: Play, Record, Pause, Fast Forward (FF), and Fast Rewind (FR). STBs that only support buffering or a Service Provider network-based DVR service are not eligible for the DVR feature allowance. The presence of a DVR feature does not mean the device is defined to be a STB.

¹ See <http://www.scte.org/standards>.

- 3) DOCSIS™: The capability to distribute data and video content over cable television infrastructure according to the following specifications²:
 - i) DOCSIS 2.0 (D2): DOCSIS 2.0 interface as defined by CableLabs® Data Over Cable Service Interface Specification.
 - ii) DOCSIS 3.0 (D3): DOCSIS 3.0 interface as defined by CableLabs® Data Over Cable Service Interface Specification.
- 4) High Definition (HD): The capability to transmit or display video signals with a minimum output resolution of 1280×720 pixels in progressive scan mode at minimum frame rate of 59.94 fps (abbreviated 720p60) or a minimum output resolution of 1920×1080 pixels in interlaced scan mode at 29.97 fps (abbreviated 1080i30).
- 5) Advanced Video Processing (AVP): The capability to decode video signals in accordance with standards H.264/MPEG 4 or SMPTE 421M.
- 6) Transcoding (XCD): Additional capability to translate (e.g., MPEG2 to H.264), transrate (e.g., HD bitrate to Mobile bitrate), transscale (e.g., HD resolution to Mobile resolution), transcrypt (e.g., CAS to DRM), or perform audio format conversions (e.g., AC-3 to AAC) in real-time.
- 7) Home Network Interface (HNI): the interface with external devices over a local area network (e.g., MoCA, HPNA, IEEE 802.3, IEEE 802.11, HomePlug AV) capable of transmitting video content.
- 8) WiFi HNI (WiFi HNI): A wireless HNI as specified by IEEE 802.11.
- 9) Multi-Input Multi-Output WiFi (MIMO WiFi): Functionality that supports more than one Spatial Stream³ for both send and receive.
- 10) Shared DVR (S-DVR): The capability to provide independent DVR video content to more than one Display Device and/or Client in a single-subscriber configuration.
- 11) Multi-Room (MR): The capability to provide independent live video content to more than two Display Devices and/or Clients in a single-subscriber configuration.
- 12) Multi-Stream (MS): The capability to receive multiple independent streams of video content for use with one or more Clients, one or more directly-connected Display Devices, a DVR, or picture-in-picture, etc., in a single-subscriber configuration.
- 13) Routing (RTG): The capability to determine the path along which network traffic should be forwarded.
- 14) Access Point (AP): The capability to provide wireless network IEEE 802.11 (Wi-Fi) connectivity to multiple clients.
- 15) Ultra High Definition – 4K (UHD-4): The capability to transmit or display video signals with a minimum output resolution of 3840×2160 pixels in progressive scan mode at minimum frame rate of 24 frames per second (“2160p24”).
- 16) High Efficiency Video Processing (HEVP): Video decoding providing compression efficiency significantly higher than H.264/AVC, for example HEVC (H.265).

² See <https://www.cablelabs.com/specs>.

³ Spatial multiplexing is a transmission technique in MIMO wireless communication used to transmit independent and separately-encoded data signals, so-called Spatial Streams, from each of the multiple transmit antennas. Therefore, the space dimension is reused, or multiplexed, more than one time. The number of receive antenna does not define the number of Spatial Streams. The common description “2 x N: 2” means 2 send streams x N antennas: 2 receive streams, where N will always be the same or larger as the largest number of streams.

17) Telephony: The ability to support analog telephone service through one or more RJ11 or RJ14 jacks.

E) Auto Power Down (APD): A STB feature that monitors parameters correlated with user activity or viewing. If the parameters collectively indicate that no user activity or viewing is occurring, the APD feature enables the STB to transition to a Sleep Mode or Off Mode.

F) Principal STB Functions: Functions necessary for selecting (i.e., the electronic program guide (EPG)), receiving, decoding, decompressing, or delivering live or recorded video content to a Display Device, local/remote recording device, or Client. Monitoring for user or network requests is not considered a Principal STB Function.

G) Operational Modes:

1) On Mode: The STB is connected to a power source. At least one Principal STB Function is activated and all Principal STB Functions are provisioned for use. The power consumption in ON Mode may vary based on specific use and configuration.

2) Sleep Mode: A range of reduced power states where the STB is connected to a power source and is not providing any Principal STB Function. The STB may transition to ON, Deep Sleep, or OFF Mode due to user action, internal signal, or external signal. The power consumed in this mode may vary based on specific use or configuration. If any Principal STB Function is activated while operating in this mode, the STB is assumed to transition to On Mode. The STB shall be able to transition from this mode to On Mode within 30 seconds.

3) Deep Sleep Mode: A range of reduced power states where the STB is connected to a power source and is not providing any Principal STB Function. Deep Sleep represents the lowest average power consumption state where Principal STB Functions can be re-activated without user action and without the transition time requirement of Sleep Mode. Deep Sleep Mode may be entered and exited on a user-configurable schedule.

4) Off Mode: The STB is connected to a power source, has been de-activated, and is not providing any function. The STB requires a user action to transition from this mode to ON or Sleep Mode.

H) Other Definitions:

1) Display Device (DD): A device (e.g., TV, computer monitor, or portable TV) that receives its content directly from a STB through a video interface (example: High-Definition Multimedia Interface (HDMI), Component Video, Composite Video, or S-Video), not through a HNI, and displays it for viewing.

2) Service Provider (SP): An entity that provides video (and possibly other) content to subscribers with whom it has an ongoing contractual relationship through a cable, satellite, or other managed distribution network provided by that entity.

3) Conditional Access System (CAS): The encryption, decryption, and authorization techniques employed to protect content from unauthorized viewing. CableCARD and Downloadable Conditional Access System (DCAS) are examples of Conditional Access technology.

3. QUALIFICATION CRITERIA

A) Significant Digits and Rounding

1) All measured and calculated power values shall be rounded as follows:

i) To the nearest 0.01 W for power measurements of 10 W or less.

ii) To the nearest 0.1 W for power measurements of greater than 10 W and up to 100 W.

- iii) To the nearest 1 W for power measurements of greater than 100 W.
- 2) All measured and calculated TEC values shall be rounded as follows:
 - i) To the nearest 0.01 kWh/year for values of 10 kWh/year or less.
 - ii) To the nearest 0.1 kWh/year for values of greater than 10 kWh/year and up to 100 kWh/year.
 - iii) To the nearest 1 kWh/year for values of greater than 100 kWh/year.
- B) General Qualification Criteria
 - 1) Device Operation Requirements:
 - i) Products may automatically exit Sleep Mode or Deep Sleep Mode on a regular schedule to perform maintenance activities. The total time spent performing maintenance activities shall not exceed an average of two hours in any 24-hour period. Maintenance activities may include, but are not limited to; software updates, electronic programming guide updates, HDD maintenance, and routine diagnostic operations.
 - ii) Products that automatically exit Sleep Mode or Deep Sleep Mode and have completed maintenance or other user-requested activities (e.g., user pre-scheduled recording) shall automatically return to Sleep Mode or Deep Sleep Mode in less than 15 minutes.
 - iii) Products that provide a default (no user opt-in) speculative recording function shall provide a user-accessible menu option to permit users to disable the functionality. Instructions for disabling speculative recording shall be made available to the user.
 - iv) Energy-related default settings shall persist until an end-user chooses to disable or modify the default settings.
 - v) Products represented as offering an APD feature shall meet the following requirements:
 - (1) STBs shall be deployed with APD enabled by default, with APD timing set to engage after a period of inactivity less than or equal to 4 hours.
 - (2) Otherwise, at time of installation the Service Provider shall enable APD timing to engage after a period of inactivity less than or equal to 4 hours. The Service Provider may vary these settings in order to provide a good customer experience but the average APD timeout period must be less than or equal to 4 hours.
 - (3) Products that provide an APD feature should provide a user-accessible menu option to permit users to modify or disable the functionality.
 - (4) Products that provide an APD feature shall not provide the ability to disable the APD functionality with a single-button press from the APD timeout notification screen such that the disabled APD state is persisted.
 - vi) Products represented as offering a Deep Sleep Mode shall meet the following criteria:
 - (1) STBs shall be deployed with automatic Deep Sleep Mode enabled by default.
 - (2) Otherwise, at time of installation the Service Provider shall enable automatic Deep Sleep Mode.
 - (3) Products that provide a Deep Sleep Mode should provide a user-accessible menu option to permit users to modify or disable the functionality.
 - (4) Products that provide a Deep Sleep feature shall not provide the ability to disable the Deep Sleep functionality with a single-button press from a timeout notification screen such that the disabled Deep Sleep state is persisted.

C) Maximum Typical Energy Consumption Calculation

- 1) Maximum TEC: The maximum TEC to qualify toward the procurement commitment of the Voluntary Agreement is the sum of the specified STB Base type allowance and the sum of all applicable Additional Functionality Allowances as defined in Equation 1.

Equation 1: Maximum TEC

$$TEC_{MAX} = TEC_{BASE} + \sum_1^i TEC_{ADDL_i}$$

Where:

TEC_{BASE} is the Base Type Allowance (kWh); and

TEC_{ADDL_i} is each applicable Additional Functionality Allowance (kWh).

- 2) Base Allowances shall be as specified in Table 1:

If a STB supports more than one base type definition then the topmost base type listed in Table 1 must be used to classify the device.

Table 1: Base Type TEC Allowances

Base Type (use Topmost if Multiple Apply)	Tier 2 Allowance (kWh/yr)	Tier 3 Allowance (kWh/yr)
Cable DTA (DTA)	25	40
Cable (CBL)	45	50
Satellite (SAT)	50	55
Internet Protocol (IP)	45	40
Thin Client (TC)	12	25

Note: The nominal increase in most base allowances from Tier 2 to Tier 3 in fact represents a significant reduction due to the incorporation of the Tier 2 allowances for the first Advanced Video Processing decoder (8 kWh/year) and High Definition (12 kWh/year) into the Tier 3 base allowance.

- 3) Additional Functionality Allowances shall be as specified in

- 4) Table 2, subject to the following usage rules:
- i) Each Additional Functionality Allowance shall be used at most **once per STB** unless otherwise specified.
 - ii) **DTA** base type shall only use the **HD, AVP, HNI, UHD-4, and HEVP** allowances, if applicable.
 - iii) **TC** base type shall only use the **HD, AVP, HNI, WiFi HNI, MoCA HNI, MIMO WiFi, UHD-4, HEVP, and RTG** allowances if applicable.
 - iv) For Tier 2, the **AVP** allowance shall be used for each decoder that is active during the On Mode test up to a maximum of two (2). For Tier 3, one **AVP** allowance shall be used only for a second decoder that is active during the On Mode test.
 - v) **CableCARD** allowance shall be used for each CableCARD up to a maximum of two (2).
 - vi) **DVR** allowance shall not be used with STB types that only support buffering or a Service Provider network-based “DVR” service and do not use a hard disk drive (HDD) or other integrated non-volatile storage.
 - vii) **DVR-TB** allowance may be applied to DVR STBs with a 3.5 inch hard disk drive with 1 terabyte (TB) of storage or greater, for each full TB of integrated storage up to a maximum of 2 TB, in addition to the **DVR** allowance.
 - viii) Either **DOCSIS 2.0 (D2)** allowance OR **DOCSIS 3.0 (D3)** allowance, but not both, shall be used if applicable.
 - ix) **DOCSIS 3.0 (D3)** allowance is applicable to all DOCSIS 3.0 configurations up to and including an eight downstream/four upstream configuration (8X4 mode).
 - x) Either **Shared DVR (S-DVR)** allowance OR **Multi-Room (MR)** allowance, but not both, shall be used if applicable.
 - xi) Either **Multi-Room (MR)** allowance OR **Home Network Interface (HNI)** allowance, but not both, shall be used if applicable.
 - xii) **MoCA HNI (M-HNI)** allowance and/or **WiFi HNI (W-HNI)** allowance are used in addition to the **MR** allowance or **HNI** allowance and shall only be used if the interface is providing video content during the qualification test (e.g., if a **MoCA HNI** and a **WiFi HNI** provide video content to Clients concurrently during the qualification test, then both allowances may be taken).
 - xiii) **MIMO WiFi HNI (MIMO)** allowance is additive to the **WiFi HNI (W-HNI)** allowance.
 - xiv) **Multi-Stream (MS)** allowance shall be used for devices receiving two (2) video content streams during the qualification test.
 - xv) **Multi-Stream Additional (MS-A)** allowance is used in addition to the **MS** allowance. One **MS-A** allowance shall be used for devices receiving greater than two (2) and, up to and including, eight (8) video streams, and two **MS-A** allowances apply to STBs with more than eight (8) and up to sixteen (16) streams.
 - xvi) **Transcoding Base (XCD)** allowance shall be used if the device includes a transcoding feature in addition to the basic video decoding required for directly connected Display Devices.
 - xvii) **Transcoding Additional (XCD-A)** allowance is additive to **Transcoding Base (XCD)** and shall be used once for each actively transcoded video stream during the qualification test.

- xviii) **Routing (RTG)** allowance is applicable if the device is providing IP routing functionality, forwarding IP data packets from one IP network to another as part of a high-speed data service or providing mesh networking functionality that extends Wi-Fi Internet access associated with a residential high speed data service. Routing of IP video packets that is not part of a high-speed data service is considered a new feature that does not have an energy allowance and is subject to the new feature allowance setting process set forth in Annex 10.
- xix) Either **Routing** OR the **Access Point** allowance, but not both, shall be used if applicable.
- xx) **UHD-4** can be taken once per STB, and can be taken in addition to the HD allowance.
- xxi) **HEVP** can be taken once per STB, and can be taken in addition to the AVP allowance.

Table 2: Additional Functionality TEC Allowance (TEC_{ADDL_i})

Additional Functionality	Descriptor	Tier 2 Allowance (kWh/year)	Tier 3 Allowance (kWh/year)
Advanced Video Processing (first active decoder)	AVP	8	0
Advanced Video Processing (second active decoder)	AVP	8	8
High Definition	HD	12	0
Multi-Stream (1 < received streams ≤ 2)	MS	8	8
Multi-Stream Additional (first MS-A allowance for 3-8 streams; second allowance for 9-16 streams) (max 2)	MS-A	8*	8*
Transcoding	XCD	13	13
Transcoding Additional (per tested stream transcoded)	XCD-A	5*	5*
CableCARD (per CableCARD, max 2)	CC	15*	15*
DOCSIS 2.0	D2	20	20
DOCSIS 3.0 (up to and including 8X4 mode)	D3	50	45
Digital Video Recorder	DVR	45	20
DVR 3.5” hard disk drive (per 1 TB storage, max 2)	DVR-TB	NA	15*
Shared DVR	S-DVR	20	20
Multi-Room	MR	40	25
Home Network Interface	HNI	10	10
MoCA HNI	M-HNI	12	12
WiFi HNI	W-HNI	15	0
MIMO WiFi HNI 2.4 (per spatial stream at 2.4 GHz)	MIMO-2.4	2*	0
MIMO WiFi HNI 5.0 (per spatial stream at 5 GHz)	MIMO-5	4*	0
Wi-Fi IEEE 802.11n radio at 2.4 GHz or at 5.0 GHz with a conducted output power less than 200 mW per chain (up to 2x2, i.e. 400 mW)	Wi-Fi (n) LP	NA	9*
Wi-Fi, IEEE 802.11ac radio at 5 GHz with a conducted output power less than 200 mW per chain (up to 2x2, i.e. 400 mW)	Wi-Fi (ac) LP	NA	19*
Additional allowance per RF chain above a 2x2 MIMO configuration (e.g., for 3x3 and 4x4) with a conducted output power less than 200 mW per chain	Wi-Fi above 2x2 LP	NA	3*
Wi-Fi IEEE 802.11n radio at 2.4 GHz or at 5.0 GHz with a conducted output power greater than or equal to 200 mW per chain (up to 2x2, i.e. 400 mW)	Wi-Fi (n) HP	NA	11*
Wi-Fi, IEEE 802.11ac radio at 5 GHz with a conducted output power greater than or equal to 200 mW per chain (up to 2x2, i.e. 400 mW)	Wi-Fi (ac) HP	NA	22*
Additional allowance per RF chain above a 2x2 MIMO configuration (e.g., for 3x3 and 4x4) with a conducted output power greater than 200 mW per chain	Wi-Fi above 2x2 HP	NA	9*
Routing	RTG	27	27
Access Point	AP	8	8
High Efficiency Video Processing	HEVP	10	10
Ultra High Definition – 4K	UHD-4	5	5
Telephony	TELE	4	4
* Indicates allowance may be used more than once			

D) **Measured Typical Energy Consumption Requirements:** The measured values derived from Section 4 below are used in combination with the TEC equation to calculate the $TEC_{MEASURED}$ value for the device.

- 1) Measured TEC ($TEC_{MEASURED}$) shall be less than or equal to the Maximum TEC (TEC_{MAX}), as calculated using Equation 1.
- 2) $TEC_{MEASURED}$ shall be calculated using Equation 2.

Equation 2: Measured TEC

$$TEC_{MEASURED} = 0.365[(T_{WATCH\ TV} \times P_{WATCH\ TV}) + (T_{SLEEP} \times P_{SLEEP}) + (T_{APD} \times P_{APD}) + (T_{DEEP\ SLEEP} \times P_{DEEP\ SLEEP})]$$

Note: The maximum value for $T_{DEEP\ SLEEP}$ is four (4) hours for the purposes of this program. To claim Deep Sleep the device must transition to and from Deep Sleep Mode automatically when in the as-deployed configuration.

Where:

- $T_{WATCH\ TV}$ is the time coefficient for On Mode, as determined per Table 3;
- $P_{WATCH\ TV}$ ($= P_{WATCH\ TV_n}$ *) is the measured power in On Mode (W);
- T_{SLEEP} is the time coefficient for Sleep Mode, as determined per Table 3;
- P_{SLEEP} is the measured power in Sleep Mode (W);
- T_{APD} is the time coefficient for APD, as determined per Table 3;
- P_{APD} ($= P_{APD_ON_to_SLEEP}$ *) is the measured power after an APD timeout (W);
- $T_{DEEP\ SLEEP}$ is the time operating in Deep Sleep Mode time (maximum of 4h); and
- $P_{DEEP\ SLEEP}$ ($= P_{SLEEP_SP_n}$ *) is the measured power in Deep Sleep Mode (W).

* $T_{APD_ON_to_SLEEP}$, $P_{APD_ON_to_SLEEP}$, $P_{SLEEP_SP_n}$, and $P_{WATCH\ TV_n}$ are test result parameters from ANSI/CTA-2043. $T_{APD_ON_to_SLEEP}$ is the STBs default APD timeout duration.

- 3) Operational Mode Durations for use with Equation 2 are specified in Table 3:

Table 3: Operational Mode Durations

APD Enabled by Default	Automatic Deep Sleep	$T_{WATCH\ TV}$ ($14 \geq T_{SLEEP} \geq 5$)	T_{SLEEP} ($10 \geq T_{SLEEP} \geq 6$)	T_{APD} ($9 \geq T_{APD} \geq 7$)	$T_{DEEP\ SLEEP}$ ($T_{DEEP\ SLEEP} \leq 4\ h$)
NO	NO	14	10	0	0
NO	YES	14	$10 - T_{DEEP\ SLEEP}$	0	$T_{DEEP\ SLEEP}$ as-deployed duration
YES	NO	$7 - \frac{4 - T_{APD_ON_to_SLEEP}}{2}$	10	$7 + \frac{4 - T_{APD_ON_to_SLEEP}}{2}$	0
YES	YES	$7 - \frac{4 - T_{APD_ON_to_SLEEP}}{2}$	$10 - T_{DEEP\ SLEEP}$	$7 + \frac{4 - T_{APD_ON_to_SLEEP}}{2}$	$T_{DEEP\ SLEEP}$ as-deployed duration

Note: Default APD timeout durations of less than 4h are given a 50% credit toward reduction of the T_{WATCH_TV} 7h duration. The 7h is the sum of 5h, accounting for the national average TV watching time, and 2h, assuming 50% of users shut off the TV but leave the STB on which causes APD to trigger after the default 4h duration resulting in the addition of 2h to national TV watching time per day. The reduction of the APD timeout results in a reduction in T_{WATCH_TV} .

4. TEST CRITERIA

A) Test Method:

The ANSI/CTA-2043: Set-top Box (STB) Power Measurement standard, as published in June 2013 by the Consumer Technology Association, will be used for all required power measurement values. The Steering Committee may approve the use of subsequent versions of ANSI-CTA-2043 or a successor standard, and modifications to the test method pursuant to Annex 10.

B) Number of Units Required for Testing:

- 1) A product configuration equivalent to that which is intended to be marketed is considered a Representative Model.
- 2) A single unit of each Representative Model shall be selected for testing. If the resulting $TEC_{MEASURED}$ is within 5% of the TEC_{MAX} requirement, two (2) additional units of the same Representative Model with an identical configuration shall be tested.
- 3) All tested units shall be less than or equal to the TEC_{MAX} for the device configuration to meet the requirements.

C) Configuration Testing Rules:

- 1) STBs offering more than one integrated Service Provider (SP) network interface option at time of installation may either be tested with each combination of SP network interface and each result reported under a different STB sub-model or the STB may be tested using the SP interface priority as specified in Table 4 and reported once under the primary model number. This table may not apply to TC STB types.

Table 4: Service Provider Network Interface Priority

Connection (Protocol)
1. Coax (QAM/DOCSIS)
2. Coax (SAT/MoCA)
3. Coax (QAM/MoCA)
4. Wi-Fi (802.11)
5. Coax (HPNA)
6. Ethernet (802.3)
7. Other

- 2) STBs offering more than one integrated HNI option at time of installation, but operating with only one HNI after installation, may either be tested with each SP network interface and each result reported under a different STB sub-model or the STB may be tested using the HNI connection priority as specified in Table 5 and reported once under the primary model number.

Table 5: HNI Priority

Connection (Protocol)
1. MIMO Wi-Fi HNI
2. Wi-Fi HNI
3. Coax (MoCA)
4. Coax (HPNA)
5. HomePlug AV
6. Ethernet (802.3)
7. Other

- 3) STBs offering concurrent operation of integrated HNIs at time of installation must be tested with the HNIs providing video content.
- 4) STBs offering more than one Display Device interface shall use the priority as specified in Table 6 for each Display Device.

Table 6: Display Device Interface Priority

Connection (Protocol)
1. HDMI/DVI
2. Component
3. S-Video
4. Composite
5. Coax
6. Other

- 5) STBs claiming the **Multi-Room (MR)** allowance must be tested with three (3) live video streams with at least one (1) Client (receiving live video) in addition to locally connected Display Devices, if supported. If three (3) live streams are not supported the MR allowance may not be used.
- 6) STBs claiming the **Shared DVR (S-DVR)** allowance must be tested with two (2) independent DVR video streams serving one of the following configurations:
 - i) One directly connected Display Device and one Client.
 - ii) Two directly connected Display Devices.
 - iii) Two Clients.
- 7) **Multi-Service Gateway STBs** must replace ANSI/CTA-2043 Section 8.1.12 Non-STB Features with the following new text:

8.1.12 Non-STB Features

Product features such as voice or data services that are not covered by a specific ANSI/CTA-2043 test procedure or a configuration directive from 8.1.14 should be configured in idle mode in accordance with ANSI/CTA-2049, if applicable.

- 8) STBs claiming an allowance for Ultra High Definition – 4K (**UHD-4**) must be tested with UHD content when performing the 8.2.2.1 ON (Watch TV) procedure.
- 9) Thin Clients claiming the **RTG** allowance must be tested with routing enabled.

D) Required Tests Results:

- 1) The minimum required ANSI/CTA-2043 tests, test parameters, and reported results are specified in Table 7. Parameters used in this section are defined in the ANSI/CTA-2043 standard.
- 2) Any deviations from Table 7 test parameters must be reported to the VA Independent Administrator when annual STB TEC results are reported.
- 3) ANSI/CTA-2043 Special Sleep Mode test is not required if the STB does not support a DEEP SLEEP Mode.

Table 7: ANSI/CTA-2043 Required Tests and Test Parameters

ANSI/CTA-2043 (Test Number: Test Name)	<u>Test Parameters</u>	<u>Reported Result</u>
On Mode		
8.2.2.1 ON (Watch TV)*	$T_{ON} \geq 5m$	$P_{WATCH\ TV_n}$ (n = DD + Clients)
Sleep Mode		
8.3.4 Sleep**	$T_{SLEEP} \geq 1h$ (Use ANSI/CTA-2043 Section 8.3.2 for Sleep determination method)	P_{SLEEP}
Special Sleep Mode		
8.3.4 Sleep (for Deep Sleep Mode)	$T_{SLEEP} \geq 1h$	$P_{SLEEP_SP_1}$
Power Mode Transitions		
8.5.1 APD initiated ON to Sleep	$T_{SLEEP_MAX} = 4.25h$	$P_{APD_ON_to_SLEEP}$ $T_{APD_ON_to_SLEEP}$
8.5.3 Reenter Sleep after RECORD	$T_{SLEEP_MAX} = 20m$	$T_{REC_to_Sleep}$
8.5.5 Sleep to ON	$T_{SLEEP_to_ON_WAIT} = 1m$	$T_{SLEEP_TO_ON}$

* ANSI/CTA-2043 On Mode test may be tested at the maximum configurations only and without the requirement to measure and record incremental Display Device and Client configuration power consumption, as is required in ANSI/CTA-2043 Section 8.2.2.1. Only the maximum Display Device and Client configurations power consumption must be reported.

** Assure no DEEP Sleep Mode is scheduled over the entire duration of the Sleep test.

ANNEX 3 - CABLE INDUSTRY PROVISIONS

1. Signatories

- 1.1. The detailed commitments set forth in this Cable Industry Annex have been subscribed to by Comcast Cable Communications, LLC; Cox Communications, Inc.; Charter Communications, Inc.; and Cablevision Systems Corp. (“Cable Operators”).

2. Power Scaling

- 2.1. The Cable Operators will continue to work with their suppliers to develop specifications for new model Set-Top Boxes that allow parts of the device to operate in a reduced power consumption mode while still functioning with cable system architectures and meeting consumer expectations for quick start-up time and the ability for the Set-Top Box to wake for periodic updates or record pre-scheduled shows.
- 2.2. If a new Set-Top Box that includes significantly-improved power management has been field tested and it successfully performs on a Cable Operator’s network, the embedded System-on-a-Chip supports all of a Cable Operator’s services, and utilization of that Set-Top Box is economically feasible, then the Cable Operator will begin deployment of Set-Top Boxes that include the new power management features in its ordinary set-top box replacement cycle.
- 2.3. In addition to or in lieu of the foregoing efforts in regards to traditional QAM Set-Top Boxes, a Cable Operator may pursue strategies to reduce the overall energy usage in typical homes through other means such as IP delivery or architectures that reduce the number of operator-supplied devices in the home.

ANNEX 4 - TELEPHONE INDUSTRY PROVISIONS

In addition to the energy efficiency commitments outlined in Section 3 (Service Provider Commitments for Set-Top Boxes), this Annex has been subscribed to by AT&T Services, Inc. (with respect to its U-verse services), CenturyTel Broadband Services, LLC d/b/a CenturyLink, Frontier Communications Corporation, and Verizon Communications, Inc.

The Service Providers adopting this annex commit that energy-efficient whole home architectures will be available to all new and existing subscribers. Whole-home architectures serve content to multiple remote or client devices within a consumer's home more efficiently than configurations involving multiple DVR Set-Top Boxes throughout the home.

ANNEX 5 - SATELLITE INDUSTRY PROVISIONS

In addition to the energy efficiency commitments outlined in Section 3 (Service Provider Commitments for Set-Top Boxes), this Annex has been subscribed to by AT&T Services, Inc. (with respect to its DIRECTV services) and DISH Network LLC.

1. At least 90% of new satellite Set-Top Boxes Purchased will include an “Automatic Power Down” (APD) feature with a default value of four hours or less.
2. Energy efficient Whole-Home Servers and Clients will be available to all new and existing subscribers.
3. The Satellite Service Providers will complete a joint study on the energy use of all additional residential premises equipment that they deploy to support their multichannel video service including low noise block downconverters, wi-fi range extenders, mesh networks, etc. and present a white paper to the first Steering Committee meeting that occurs after June 30, 2018. The satellite providers commit to engage with the Energy Advocates to discuss any significant and feasible energy savings opportunities identified in the white paper and to pursue any such opportunities that are compatible with their networks in support of all services and that can be implemented economically without adverse impact on customers.

ANNEX 6

NEW FEATURES PROCESS

1.0 Purposes

- 1.1 This new feature process is applicable to Tier 2 and Tier 3 Commitments.
- 1.2 This new feature process is intended to encourage innovation and competition by Service Providers and Vendor Signatories and also to encourage energy efficiency by design.
- 1.3 This new feature process is intended to provide a path for Service Providers and Vendor Signatories to innovate and add new features, including features with no assigned allowances and features that are in the early stages of design, without being treated as in violation of Voluntary Agreement energy allowances or procurement commitments. For example, during the initial Term of the Voluntary Agreement, this process was used to adopt new feature Tier 2 allowances for High Efficiency Video Processing, Ultra HD, and VOIP functionality included in a Set-Top Box.
- 1.4 This new feature process is intended to assure that most Set-Top Boxes remain under the procurement commitments of the Voluntary Agreement, with sufficient transparency for appropriate allowances to be established for new features.

2.0 Allowances

- 2.1 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 TEC, the Service Provider will set and report an appropriate initial allowance for the power consumption of that feature when it reports the device under the Voluntary Agreement.
- 2.2 The initial allowance will be reported within nine months of the initial deployment of such a Set-Top Box if the Service Provider expects that its percentage of procurement of such Set-Top Box will be sufficient to be reported in its next annual report.
- 2.3 The initial allowance will represent the Service Provider's best estimate of the amount of energy consumed by the new feature in that particular unit. All new features, associated initial allowances, and justifications for such allowance, will be submitted to the Independent Administrator together with other required testing data. The Independent Administrator shall inform the Steering Committee of the Service Provider created allowance for the new feature, except as otherwise provided in Section 3.4.
- 2.4 If the new feature is confidential and the Service Provider seeks an allowance, the Service Provider shall confidentially report the initial allowance, the basis for the allowance, and a written justification for its confidentiality to the Independent Administrator. The new feature may remain confidential until the feature is marketed or otherwise made public. The Service Provider shall inform the Independent Administrator within thirty days of marketing or otherwise making public a previously confidential new feature. In no case may a new feature remain confidential for purposes of this agreement, for longer than eighteen months from initial deployment. Once a new feature is reported as public information or the eighteen month period has elapsed, the Independent Administrator shall inform the Steering Committee of the Service Provider created allowance for the new feature. Annual reports should include the total energy

use of Set-Top Boxes that include confidential new features, but need not identify the new feature.

- 2.5 When the information is reported to the Steering Committee, the Steering Committee shall propose appropriate allowances and effective dates when the allowances would go into effect under the processes of Voluntary Agreement. Initial allowances set by the Steering Committee will reflect the Steering Committee's best estimates of the energy consumption required for systems incorporating the new feature to meet the levels of the applicable Tier. Initial allowances shall be set within six months of submission, and become effective at such time as is prescribed by the Steering Committee.
- 2.6 If a Service Provider includes in its report to the Independent Administrator a Set-Top Box that it has Purchased but has not yet deployed that includes a new feature with no allowance, and the presence of the feature causes the Set-Top Box to exceed the TEC, the Service Provider may report a provisional Service Provider created allowance until an initial allowance is submitted after deployment.
- 2.7 Allowance setting would be designed to not prejudice a variety of implementations. If a new feature is specific to one particular sector and its energy consumption when applied to other sectors is undetermined, it may be adopted as a sector annex amendment. The process for adopting a level for that feature will apply to other sectors when one of its Service Provider members submits an allowance for that feature to the Independent Administrator.
- 2.8 Allowances established by the Steering Committee for a new feature would be publicly reported as are other such allowances under the Voluntary Agreement.
- 2.9 The Steering Committee may adopt appropriate modifications to the test method and/or additional rules governing the applicability of new feature allowances.

ANNEX 7, Part A – SERVICE PROVIDER SIGNING FORMS

The undersigned Signatories agree to the Voluntary Agreement and ANNEX 3 – CABLE INDUSTRY PROVISIONS.

Bright House Networks, LLC

Signature: /s/ Jeff Chen
Name: Jeff Chen
Title: SVP, Advanced Technology
Date: November 30, 2012

Cablevision Systems Corp.

Signature: /s/ Yvette Kanouff
Name: Yvette Kanouff
Title: EVP – Corporate Engineering & Technology
Date: November 30, 2012

Charter Communications, Inc.

Signature: /s/ Jay Rolls
Name: Jay Rolls
Title: SVP & CTO
Date: November 29, 2012

Comcast Cable Communications, LLC

Signature: /s/ Tony Werner
Name: Tony Werner
Title: EVP & CTO
Date: November 30, 2012

Cox Communications, Inc.

Signature: /s/ Kevin T. Hart
Name: Kevin T. Hart
Title: Executive Vice President & Chief Technology Officer
Date: November 29, 2012

Time Warner Cable Inc.

Signature: /s/ Mike LaJoie
Name: Mike LaJoie
Title: Chief Technology Officer
Date: November 28, 2012

The undersigned Signatories agree to the Voluntary Agreement and ANNEX 4 – TELEPHONE INDUSTRY PROVISIONS.

AT&T Services, Inc.

Signature: /s/ Nolan Daines
Name: Nolan Daines
Title: SVP
Date: November 30, 2012

CenturyTel Broadband Services, LLC d/b/a CenturyLink

Signature: /s/ Matt Beal
Name: Matt Beal
Title: SVP Corporate Strategy/Product Development & CTO
Date: November 30, 2012

Frontier Communications Corporation

Signature: /s/ Steve Gable
Name: Steve Gable
Title: Executive Vice President and Chief Technology Officer
Date: October 11, 2017

Verizon Communications, Inc.

Signature: /s/ James J Gowen
Name: James J Gowen
Title: Vice President Supply Chain Operations / Chief Sustainability Officer
Date: November 30, 2012

The undersigned Signatories agree to the Voluntary Agreement and ANNEX 5 – SATELLITE INDUSTRY PROVISIONS.

DirecTV, LLC

Signature: /s/ Rômulo Pontual
Name: Rômulo Pontual
Title: EVP and CTO
Date: November 30, 2012

DISH Network LLC

Signature: /s/ Stanton Dodge
Name: Stanton Dodge
Title: EVP & General Counsel
Date: November 30, 2012

ANNEX 7, Part B – VENDOR SIGNING FORMS

The undersigned Signatories agree to the Voluntary Agreement.

ARRIS Group, Inc.

Signature: /s/ Lawrence A. Margolis
Name: Lawrence A. Margolis
Title: EVP and Chief Counsel
Date: November 28, 2012

Technicolor Connected Home USA LLC

Signature: /s/ Luis Martinez-Amago
Name: Luis Martinez-Amago
Title: President
Date: February 25, 2016

ANNEX 7, Part C – ENERGY ADVOCATE SIGNING FORMS

The undersigned Signatories agree to the Voluntary Agreement as Energy Advocates.

**American Council for an Energy-Efficient Economy and the
Appliance Standards Awareness Project**

Signature: /s/ Naomi Baum
Name: Naomi Baum
Title: Chief Operating Officer, ACEEE
Date: December 19, 2013

Natural Resources Defense Council

Signature: /s/ Noah Horowitz
Name: Noah Horowitz
Title: Senior Scientist and Director - NRDC Center for Energy Efficiency Standards
Date: December 19, 2013

ANNEX 8 – 2012 BASE CASE

2012 Base Case: estimated national energy consumption

	On			Sleep			UEC	Units	TEC	Power Plants	
	Watt s	Hour s	kWh/y r	Watt s	Hour s	kWh/y r	kWh/y r	Million s	TWhr/y r	Rosenfelds	
Cable	DVRs	33	14	169	31	10	113	282	27	7.5	2.5
	Receivers	16	14	83	15	10	56	139	57	7.9	2.6
	Clients	11	14	57	9	10	33	90	2	0.1	0.0
	DTAs	5	14	23	4	10	16	39	33	1.3	0.4
Sat.	DVRs	33	14	169	31	10	114	283	21	5.9	2.0
	Receivers	13	14	66	12	10	44	110	58	6.4	2.1
Tel.	DVRs	17	14	86	15	10	54	140	6	0.8	0.3
	Receivers	11	14	55	10	10	35	90	21	1.9	0.6
	U.S. Total			708			465		224	32	10.6