ENERGY FACTS

Better Viewing, Lower Energy Bills, and Less Pollution: Improving the Efficiency of Television Set-Top Boxes

More than 80 percent of U.S. homes subscribe to some form of pay television service. Transforming those signals into shows, movies, and sports on the screen currently depends on approximately 160 million set-top boxes, nearly all of which are owned and installed by the cable, satellite, phone, or other service provider. NRDC and Ecos partnered to better understand how much energy these devices use and what energy savings opportunities exist. What we found was startling: In 2010, set-top boxes in the United States consumed approximately 27 billion kilowatt-hours of electricity, which is equivalent to the annual output of nine average (500 MW) coal-fired power plants. The electricity required to operate all U.S. boxes is equal to the annual household electricity consumption of the entire state of Maryland, results in 16 million metric tons of carbon dioxide (CO_2) emissions, and costs households more than $3 billion each year. Fortunately, there is great potential for improving the efficiency and reducing the cost of operating these electronics relied upon by so many viewers.

Key Findings

- There are approximately 160 million set-top boxes installed in U.S. homes. Almost all of these boxes are owned and installed by the service provider (e.g. Comcast, Time Warner, Cox Communications, DISH Network, DirecTV, Verizon and AT&T, etc).
- Today's set-top boxes operate at near full power even when the consumer is neither watching nor recording a show. As a nation, we spend $2 billion each year to power these boxes when they are not being actively used.
- Digital Video Recorders (DVRs) are growing in popularity and frequently replace set-top boxes without recording capability. DVRs typically use around 40 percent more energy per year than their non-DVR counterparts.
- Better designed pay-TV set-top boxes could reduce the energy use of the installed base of boxes by 30 percent to 50 percent by 2020. The big opportunities include: a) shifting to whole-home solutions that include a main box connected to the primary TV with either TVs specially-designed to access the video content stored on the main box or low-power thin client boxes that serve the same function, and b) having the boxes automatically power down to much lower power levels when not in use (e.g. in the middle of the night, or while users are at work).

NRDC
THE EARTH'S BEST DEFENSE

For more information, please contact:

Noah Horowitz
nhorowitz@nrdc.org
switchboard.nrdc.org/blogs/nhorowitz/

www.nrdc.org/policy
www.facebook.com/nrdc.org
www.twitter.com/nrdc

ENERGY USE OF SET-TOP BOXES AND OTHER APPLIANCES

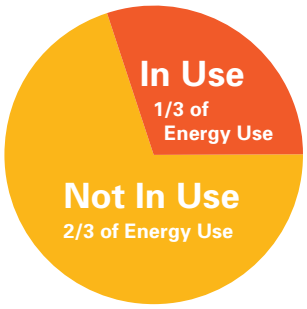
Pay-TV service providers control set-top box installation, configuration, software updates, repair, refurbishment, retirement, and resale. The consumer, who pays the electric bill, has little choice about what box the service provider installs and how much energy it uses. The average new cable high-definition digital video recorder (HD-DVR) consumes more than half the energy of an average new refrigerator and more than an average new flat-panel television. Even more troubling, when not displaying or recording video content, U.S. boxes draw nearly as much power as they do when in use. Because set-top boxes are not in use most of the time, two-thirds of total energy consumption—or the equivalent annual energy output of six power plants (500 MW)—occurs when the boxes are not in use. Innovation to reduce power consumption when not in active use—such as has occurred with mobile phones, which also work on a subscriber basis and require secure connections—is sorely needed in set-top boxes.

WHAT WE TESTED AND HOW

In 2010, NRDC and Ecos investigated the energy consumption of set-top boxes in three applications: (1) 58 pay-TV boxes deployed in the United States over the past two years, (2) a few pay-TV boxes in Europe, and (3) a few emerging video streaming boxes like AppleTV. The results support the following findings:

- U.S. set-top boxes continue to use almost as much power when not in use as they do when in use. However, leading European service providers have begun to solve this problem in their newest boxes.
- Pay-TV set-top box national energy consumption has held steady as efficiency gains at the component level have been offset by the increased energy consumption of advanced features.
- Satellite HD-DVRs in this study drew slightly more power than their cable counterparts, but this may change over time. Internet Protocol TV (IPTV), which is rapidly gaining market share compared to cable and satellite, enables the use of lower-power boxes. The most efficient U.S. HD-DVRs tested were AT&T's IPTV boxes, drawing approximately 18 watts when operating (On mode) and 12 watts in light sleep state. European IPTV HD-DVRs demonstrated impressively low On mode power levels of less than 10 watts.

Nearly Two-Thirds of Annual U.S. Set-Top Box Energy Use Occurs When Viewers are Not Watching or Recording Content



RESULTS IN...

Electricity Consumption:
3 Power Plants (500 MW each)

Emissions:
5 Million Metric Tons CO_2/year

Cost to Consumers:
$1 Billion/year

RESULTS IN...

Electricity Consumption:
6 Power Plants (500 MW each)

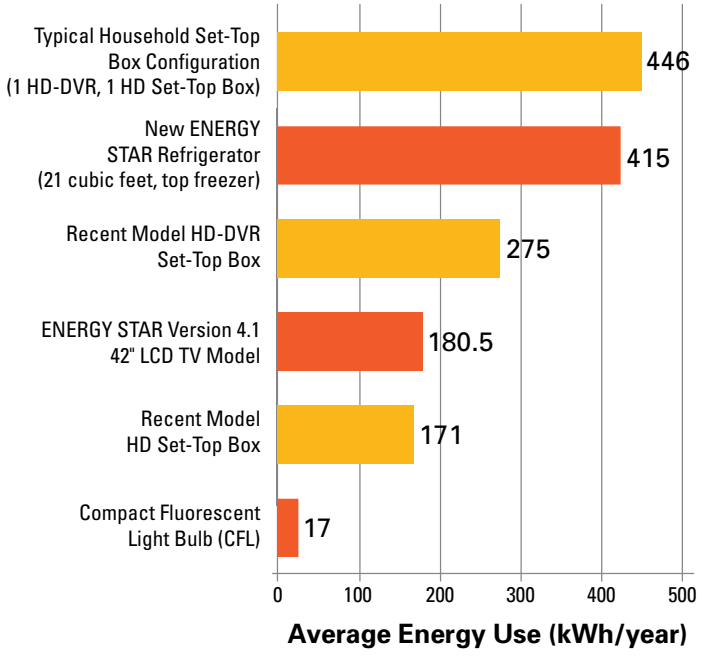
Emissions:
11 Million Metric Tons CO_2/year

Cost to Consumers:
$2 Billion/year

In Use = watching or recording a show

Not In Use = not watching or recording a show

Energy Use of Set-Top Boxes and Other Appliances

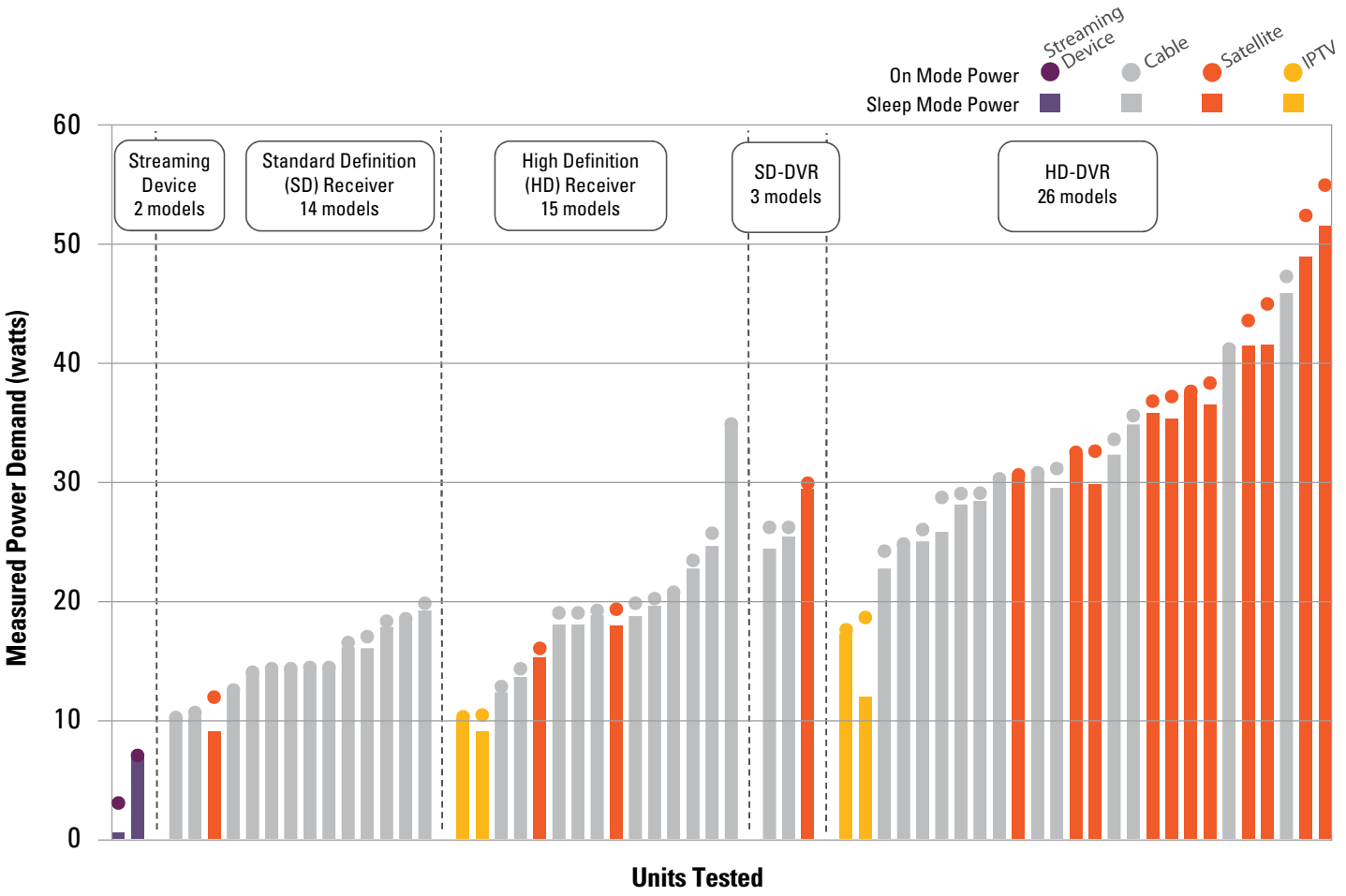


- Consumers are increasingly getting their video content from a variety of new broadband video streaming services, including Netflix, AppleTV, and the most recently introduced GoogleTV. Consumers can access these services via Internet-enabled TVs, video game consoles, Blu-ray players, or dedicated set-top boxes. The data below include two of these video streaming devices, the most efficient of which was AppleTV, which drew just 3 watts in On mode and less than 1 watt in Sleep mode. Today, many people use these streaming devices in addition to their pay-TV box. Tomorrow, this streaming capability is likely to be integrated into TVs. These TVs will be able to stream video from sources such as Netflix, Hulu, and locally stored content on the home's DVR. We do not expect these low-power streaming devices to replace the central DVR in the near future. However, the highly efficient architecture of these streaming devices may pave the way toward more efficient pay-TV boxes.

A BETTER VIEWING EXPERIENCE USING LESS ENERGY

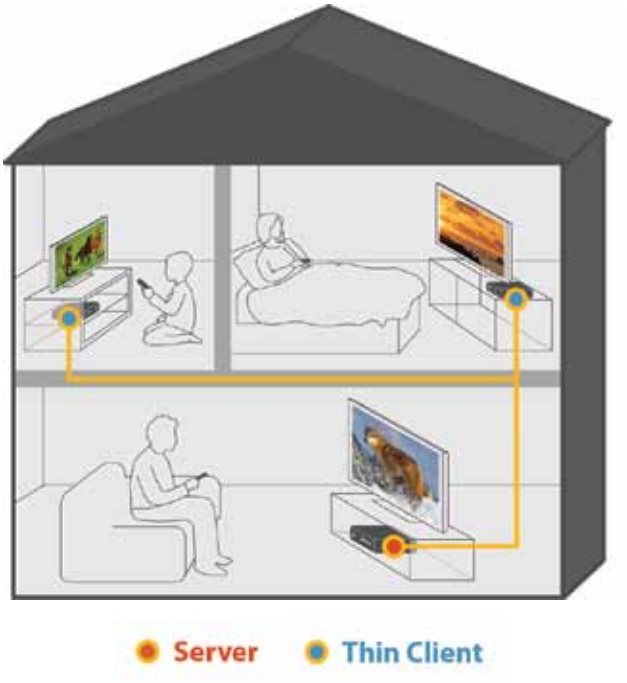
U.S. television viewers prefer to watch what they want, when they want, where they want. In their initial response to this customer desire, service providers offered promotions that included free installation of multiple DVRs (up to four) in each home. Since 2007, the percentage of boxes manufactured with DVR capability has grown from 10 percent to 35 percent and the equivalent total annual energy consumption of installed boxes has grown from six to nine power plants (500 MW). Fortunately, the industry is moving toward more efficient multi-room solutions with the potential to provide consumers with better options for accessing live television and recorded content while requiring significantly less energy. For example, multi-room technologies enable consumers to schedule recordings once on a central DVR and to view these recordings from any TV in the home.

NRDC'S 2010 Survey of Energy Consumed by U.S. Set-Top Boxes



While today's multi-room solutions use less power than multiple DVR deployments, service providers are working with other industry players to bring even more efficient pay-TV equipment to U.S. homes, as explained in the tables below. By comparing today's and tomorrow's multi-room solutions for the average U.S. home with three TVs, the tables below show total home energy calculations for two multi-room scenarios: one depicting the energy use of today's typical multi-room set-top box configuration (Scenario A) and the other a more energy efficient multi-room configuration that uses low-power thin-client boxes now in development and low-power sleep states (Scenario B). Note that multi-room technology is new to the pay-TV market and, therefore, the On mode hour estimates of these scenarios are based on limited test data for viewing habits. Scenario A includes one HD-DVR that draws just more than 30 watts around the clock, consuming 275 kilowatt-hours of electricity each year, and two HD-receiver boxes that both consume approximately 171 kilowatt-hours of electricity each year. This results in a total annual energy consumption of 617 kilowatt-hours. If all pay-TV subscribers in the United States chose this configuration, we would need the equivalent of 20 500 MW power plants to run our set-top boxes—double today's need.

Example of Multi-Room U.S. Set-Top Boxes



Today's Multi-Room Set-Top Box Configuration – Scenario A: 3 TVs, 1 HD-DVR, 2 HD-Receivers

	On Mode			Light Sleep			Deep Sleep			Total Energy Consumption
	watts	hours	kWh/yr	watts	hours	kWh/yr	watts	hours	kWh/yr	kWh/yr
HD-DVR	32	9	105	31	15	170	–	–	–	275
HD-Client	20	3	22	19	21	149	–	–	–	171
HD-Client	20	3	22	19	21	149	–	–	–	171
TOTAL			149			468			–	617

Energy Efficient Future Multi-Room Set-Top Box Configuration – Scenario B: 3 TVs, 1 HD-DVR, 2 Clients

	On Mode			Light Sleep			Deep Sleep			Total Energy Consumption
	watts	hours	kWh/yr	watts	hours	kWh/yr	watts	hours	kWh/yr	kWh/yr
HD-DVR	23	9	76	14	7	36	1	8	3	115
HD-Thin Client	8	3	9	3	21	23	–	–	–	32
HD-Thin Client	8	3	9	3	21	23	–	–	–	32
TOTAL			94			82			3	179

Scenario B shows a path to getting the same features and functionality for customers while consuming 70 percent less energy than Scenario A. The industry has made notable progress over the past few years reducing On mode power levels within each device class (e.g. HD-DVR). Reducing On mode power levels of both the HD-DVR and clients in Scenario A reduces overall energy consumption by approximately 10 percent.

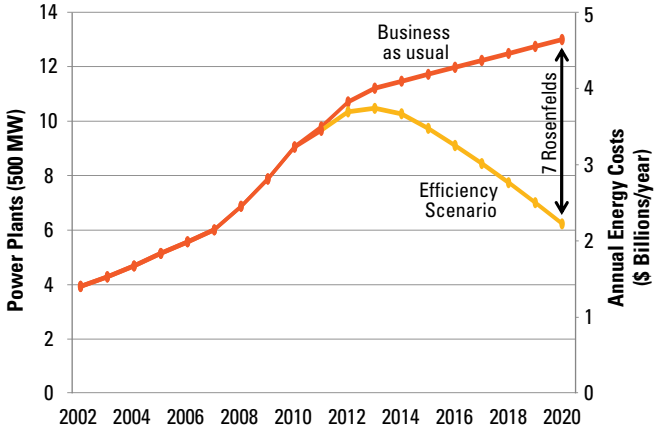
Improved power management provides another energy savings opportunity. Best-in-class power management schemes include both light and deep sleep states. Adding power management to the boxes in Scenario B reduces energy consumption by an additional 60 percent compared to Scenario A.

Overall, by implementing multi-room technology with low-power thin-client boxes, reducing On mode power levels, and employing power management solutions, Scenario B shows a reduction in energy consumption of approximately 70 percent when compared to Scenario A. Moreover, service providers are promoting standards to eliminate the need for thin-client boxes, instead using specially-designed TVs as clients. This would reduce the energy consumption of Scenario B by an additional 18 to 54 kilowatt-hours each year.

ACHIEVABLE EFFICIENCY IMPROVEMENTS CAN SAVE CUSTOMERS BILLIONS OF DOLLARS

NRDC's investigation and modeling of the energy consumption of pay-TV set-top boxes under business-as-usual and more energy-efficient scenarios revealed a startling fact: unless the industry deploys more energy efficient designs, the electric bill to power these devices will increase by a staggering $3.5 billion per year by 2020. Fortunately, development and deployment of energy-saving technologies and practices has the potential by 2020 to save as much energy as is generated by seven large (500 MW) power plants.

U.S. Pay-TV Set-Top Boxes Total Energy Consumption Scenarios



Sky Broadcasting Saves Energy with Light Sleep and Deep Sleep States

Sky Broadcasting in Europe offers one of the best examples of an energy efficient set-top box. Their highly featured HD-DVR draws 23 watts in On mode and 13 watts when the user puts the box into light sleep state by pressing the power button on the remote. In light sleep, the box does not output or record video, but remains connected to the network and able to resume full functionality almost instantly.

In addition, Sky set-top boxes default to a less than 1 watt deep sleep state each evening at 11:00 pm. In this state, Sky's boxes wake for a brief period every half hour to check for new program recording requests entered by subscribers using smart phones. If there is no scheduled activity, the box will automatically return to deep sleep state. Sky's customers experience a 90-second wake time when they press the power button to wake from deep sleep state, and they may disable this deep sleep feature if they choose.

RECOMMENDATIONS FOR IMPROVING CUSTOMER EXPERIENCES AND REDUCING ENERGY CONSUMPTION

Product Improvements and Deployment

Meeting Energy Star Requirements
Manufacturers are strongly encouraged to design products that meet or surpass ENERGY STAR Version 4.0 requirements as soon as possible.

Employing Automatic Low-Power States
Future products should automatically enter a low power state when the user is neither watching nor recording or downloading a show, and should wake up in a sufficiently short period of time to prevent customer dissatisfaction.

Replacing Outdated and Inefficient Set-Top Boxes
Service providers should accelerate deployment of new energy-efficient set-top boxes and make any needed changes in their "upstream" equipment to ensure the energy saving features are successfully utilized. Service providers are encouraged to shift to multi-room solutions that require only one main box and employ much lower power boxes (thin clients) to view content on other televisions in the home.

Spurring Technological Innovation
Service providers should work with their supply chain and industry groups to accelerate adoption of standards that enable:

- Multi-room clients to achieve deep sleep with short wake time
- Connected consumer electronics devices such as the television, set-top box, and DVD player to share power state information in support of more effective power management
- Data connections should operate at lower power levels when not in use
- Service providers to wake set-top boxes from deep sleep remotely over the network

Additional Policy Opportunities to Boost Efficiency

Providing Incentives at the Utility Level
Electric utilities should consider providing financial incentives to encourage the development and deployment of energy efficient set-top boxes.

Consider Regulatory Policies to Increase Set-Top Box Energy Efficiency
Policy makers should consider establishing minimum energy efficiency standards for set-top boxes at the state or national level, or via an industry-led voluntary agreement similar to those established in Europe.

Connecting Policies with FCC Planning
The energy efficiency community should ensure efficiency requirements are incorporated into the Federal Communications Commission's (FCC) National Broadband Plan implementation that is looking at creating a retail market for set-top boxes across different service providers.

Bringing Efficiency to Local Markets
As a means to drive demand for more efficient set-top boxes, local cable regulators should consider adding efficiency requirements to their franchise agreements. A simple means to do this is to require deployment of boxes that meet ENERGY STAR Version 4.0 or better.

Pursuing Efficiency Upstream
Policy makers and utilities should consider co-funding comprehensive, system-level efficiency studies to better understand the data center and network energy requirements of video-on-demand.

The research performed to prepare this report was funded by a grant to NRDC from the U.S. Environmental Protection Agency.

Research and analysis was conducted by Gregg Hardy, Jeffrey Swofford, and Tyler Dillavou of Ecos (ecosconsulting.com).

The views and findings expressed herein are solely those of the authors and do not necessarily reflect those of the EPA. For more information contact Project Manager Noah Horowitz at nhorowitz@nrdc.org.

NRDC