

**TELEVISION USAGE ANALYSIS:
ENERGY EFFICIENCY PROGRAM FOR CONSUMER
PRODUCTS:**

Television Sets

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TELEVISION USAGE ANALYSIS

TABLE OF CONTENTS

1.1	INTRODUCTION	2
1.1.1	Modes of Use Considered.....	2
1.2	FORMULA FOR CALCULATING TV ANNUAL ENERGY USE.....	3
1.3	TELEVISION SET USAGE PROFILES	4
1.3.1	Nielsen TV Set Level Viewing Data	4
1.3.2	Residential Energy Consumption Survey	5
1.3.3	Ranking of TVs Within a Household.....	7
1.3.4	Distribution of TV Viewing Time	8
1.4	FINAL RESULTS	12

LIST OF TABLES

Table 1.3.1	Nielsen Data set	5
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LIST OF FIGURES

Figure 1.3.1	Comparison between RECS and Nielsen viewing hours data for 2009.....	7
Figure 1.3.2	Percentage of TVs in each location, by their rank	7
Figure 1.3.3	TV ranking by screen size from RECS 2009.....	8
Figure 1.3.4	Average Usage by Rank of TV	9
Figure 1.3.5	Distribution of Primary TV viewing hours	10
Figure 1.3.6	Distribution of non-primary TV viewing hours.....	10
Figure 1.3.7	Distribution of blended average hours per day	12
Figure 1.4.1	Adjusted Average Hours of Use of New TVs	13

TELEVISION USAGE ANALYSIS

1.1 INTRODUCTION

The purpose of this television usage analysis is to establish the range of annual TV usage in U.S. homes. This document describes the methodology that was used to determine the hours per day a TV is in on mode.

DOE used data collected by The Nielsen Company (Nielsen) between May 2007 and May 2011 from up to 21,000 households in each month as a basis for estimating the annual usage of TVs. The data set includes use of the TV for viewing live broadcasts as well as for displaying information from external devices such as DVD players and games consoles. It also includes demographic information from participating households.

Section 1.1.1 defines the different modes of use of TVs. Section 1.3 describes the method DOE used to derive usage profiles from the Nielsen data set. Section 1.4 presents final results.

1.1.1 Modes of Use Considered

DOE has defined various modes of use for TVs in its Test Procedure Notice of Proposed Rule (NOPR; 77 FR 2830) which are:

On Mode: On mode is the power mode in which the product is connected to a mains power source, has been activated, and is providing one or more of its principal functions.

Standby passive: Standby-passive mode is the mode in which the appliance is connected to a power source, produces neither sound nor picture but can be switched into another mode with the remote control unit or an internal signal.

Standby-active, high mode: The appliance is connected to a power source, produces neither sound nor picture but can be switched into another mode with the remote control unit or an internal signal and can additionally be switched into another mode with an external signal and is exchanging/ receiving data with/ from an external source.

Download Acquisition Mode: Download acquisition mode is the power mode in which the product is connected to a mains power source, produces neither sound nor picture, and is actively downloading data. Data downloads may include channel listing information for use by an electronic programming guide, TV setup data, channel map updates, firmware updates, monitoring for emergency messaging/ communications or other network communications.

Standby-active, low mode: The appliance is connected to a power source, produces neither sound nor picture but can be switched into another mode with the remote control unit or an internal signal and can additionally be switched into another mode with an external signal.

Off Mode: is the mode where the appliance is connected to a power source, produces neither sound nor picture and cannot be switched into any other mode with the remote control unit, an external or internal signal.

Unplugged: Unplugged simply means the television set is disconnected from mains power. No energy is consumed in this state.

DOE has adopted the definitions for off mode and the various standby modes from IEC 62087-2011¹, while download acquisition mode and on mode are defined in accordance with the ENERGY STAR V5.3 test procedure². In its test procedure, DOE requires testing to be performed in all the modes except for *standby-active, low*, although it incorporates the definition to be consistent with other test procedures.

In consideration of typical TV usage, DOE considered only two modes, on mode and standby passive. DOE believes this reflects the most common usage of TVs in U.S. households, where it is uncommon for the TV to be off or unplugged. This method is the same as that used by the Federal Trade Commission for determining the numbers on the EnergyGuide Label, as well as the ENERGY STAR method for determining annual energy use. Download acquisition mode (as defined) is currently only active in 7% of TVs and declining. TVs are increasingly equipped with Ethernet connections for downloading data, which would use a negligible amount of energy. Therefore it was not considered representative of current TV usage and was not included in the analysis.

1.2 FORMULA FOR CALCULATING TV ANNUAL ENERGY USE

Television energy consumption is the sum of energy consumed in on mode, standby mode, and off mode, as well as a download acquisition mode (DAM) applicable to some TVs. In its Notice of Proposed Rulemaking (77 FR 2830), DOE defined the annual energy consumption (AEC, expressed in kWh/yr) equation as follows:

$$AEC = \left(\frac{P_{on} \times H_{on} + P_{standby} \times H_{standby} + P_{off} \times H_{off} + DEC_{DAM}}{1000} \right) \times 365$$

Where

<i>AEC</i>	= Annual Energy Consumption
<i>P_{on}</i>	= Power use in on mode (in W)
<i>P_{standby}</i>	= Power use in standby-passive mode (in W)
<i>P_{off}</i>	= Power use in off mode (in W)
<i>H_{on}</i>	= number of hours per day spent in on mode
<i>H_{standby}</i>	= number of hours per day spent in standby-passive mode
<i>H_{off}</i>	= number of hours per day spent in off mode
<i>DEC_{DAM}</i>	= daily energy consumption in DAM, if applicable.

The following sections describe the analysis used to derive H_{on} .

1.3 TELEVISION SET USAGE PROFILES

The data analysis described in this section is used to profile the use of an average TV in an average U.S. household for the 12-month period from June 2010 to May 2011, as this is the most recent full year of data available. This section describes the data set, and why it was chosen over other data sets. It then explains how the data were analyzed.

1.3.1 Nielsen TV Set Level Viewing Data

DOE used monthly TV set-level viewing statistics from May 2007 to May 2011, obtained from Nielsen, to determine usage profiles. The data were collected from a representative cross-section of U.S. households in each month. The number of households participating in the survey has grown from month to month, increasing from 12,750 in May 2007 to 20,950 in May 2011.^a

The data fields received from Nielsen are described in Table 1.3.1. Demographic and geographic information about participating households are included in the data, along with TV usage data.

Although the Nielsen data are organized in ‘months’, the time period of data collection was not necessarily a calendar month. The variation from month to month was due to the specific days when technicians went to the household to install and collect the devices. Variations within a month were also seen, due to TVs that were either not plugged in during installation, being used at a later time during the collection period or vice versa. To obtain the true time for which a TV was used, the total minutes were divided by the number of days installed to convert the value to minutes per day, and then divided by 60 to obtain the hours per day.

^a Nielsen data are collected by placing a metering device on each television within a participating household. The device begins collecting data when the TV is turned on until it is switched into standby mode, or turned off. Any peripheral devices such as DVD players or games consoles are also connected to the meter and each of these will be allocated a code so that the meter can identify which device the TV is receiving input from. If an additional device is connected to the TV during the installation period the data will be received as an error with Nielsen. If errors are recorded for more than 75% of on-time for 3 out of 7 consecutive days, and each day has more than 60 minutes of on time, Nielsen will contact the participating household to identify the issue (i.e. whether they have added a new device). Error readings can also occur if the meter has accidentally become disconnected from a device. Where audio devices are located at a TV site, the installer will ask the participant whether they use the TV for audio only as well.

Table 1.3.1 Nielsen Data set

TUNER_HOUSEHOLD_ID	Unique identifier for each household
TUNER_ID	Unique ID for each TV within a household. Every TV in a household was recorded in the survey, whether connected to a power supply or not. But our dataset has filtered out any data relating to TVs that are not used during the survey, which is why numbers are not consecutive.
STATE_DESC	State
COUNTY_DESC	County
SET_BRAND_DESC	Brand of the TV
TUNER_MODEL_YEAR	Estimated year of TV model manufacture, based on sticker on TV set or if not available guess/ask consumer
LOCATION_DESC	Room in the house TV is located
DAYS_INSTALLED	Includes full 24 hour days (from 6am to 6am) that data was collected. Meters often installed a few days before data collection begins
HUT Live Viewing	Total number of minutes TV was used to view live broadcast including video on demand
DVD Playback	Total number of minutes TV was used to watch a DVD
DVR Playback	Total number of minutes TV was used to watch DVR
VCR Playback	Total number of minutes TV was used to watch VCR
Video Games	Total number of minutes TV was used to play video games
Income Amount	<i>Question is phrased as: Please include income from all current household members.</i> The data collected reflects all incomes within the household. The income ranges included on the sheet we show the household members are in \$5,000 increments. The reporting systems expect 1 income value; therefore, the values provided by EDW reflect the mid-point of that range. For example, an EDW income value of 43 means the household income range of \$40,000 to \$44, 999.

1.3.2 Residential Energy Consumption Survey

DOE typically uses the Energy Information Administration’s Residential Energy Consumption Survey (RECS)³ data to determine usage profiles. The 2009 RECS recorded information on television set usage by asking participants “How many hours is the television turned on each day?” with answers available in the following 5 bins: less than 1 hour, 1 to 3 hours, 3 to 6 hours, 6 to 10 hours, more than 10 hours. The question was asked separately for ‘primary’, ‘secondary’ and ‘tertiary’ television sets.

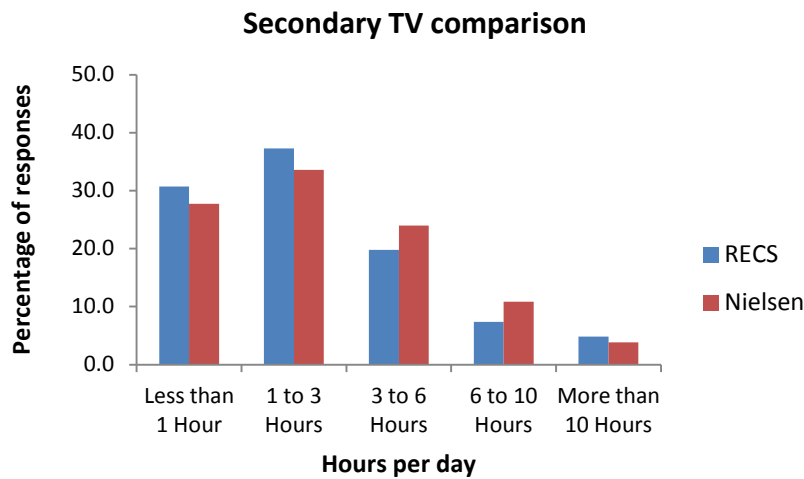
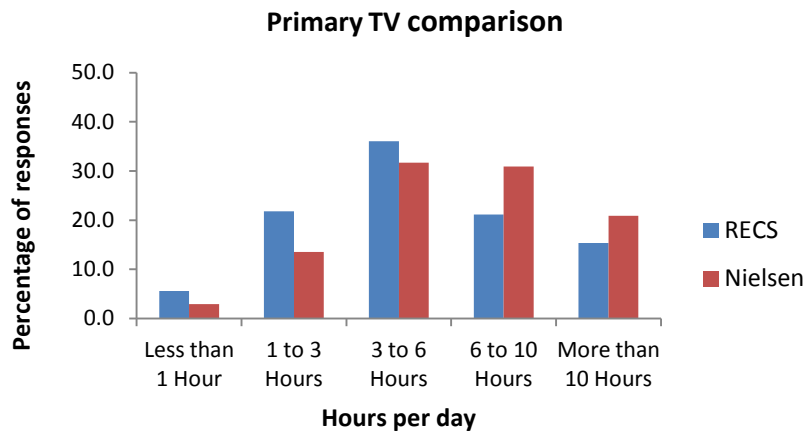
DOE compared the responses in RECS to the recorded Nielsen data as shown in Figure 1.3.1. On average, the RECS viewing hours are lower than those recorded by Nielsen. DOE acknowledges that there are several common limitations to asking survey participants to recall the amount of time they spend in an activity, compared to taking automated measurements⁴. Some of these include:

- (i) social desirability bias, i.e. the desire to present oneself in a way that is viewed favorably by others. The face to face interview format of some RECS data collection would be a likely contributor to this effect;

(ii) Asking a participant to identify how many hours watched in a typical week, means they will first need to identify what they consider a typical week, and then identify the number of hours, which is more complicated than for example asking how many hours of TV they watched yesterday;

(iii) Lower intensity activities are more difficult to recall than higher intensity activities, although due to the structure of television programming into timeslots, this is usually easier than other lower intensity activities;

(iv) Multitasking can also lead to confounded responses as many people will have the television on while they are performing another activity, and may not recall this as television on time. Therefore the RECS data are not considered as reliable as that recorded by Nielsen. RECS data were still used, however, to estimate the number of TVs currently in use in the U.S. and the number of TVs per household.



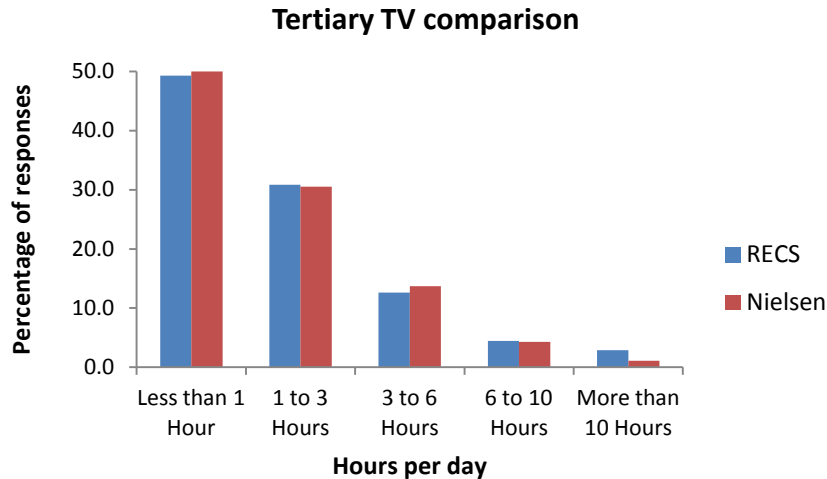


Figure 1.3.1 Comparison between RECS and Nielsen viewing hours data for 2009

1.3.3 Ranking of TVs Within a Household

In the Nielsen data set, DOE assigned a ranking to each TV within a household, based on the hours per day for which the TV was used (i.e. primary, secondary, tertiary, etc.). This method was chosen in favor of assigning a ranking based on the location of the TV, since room location and ranking are not perfectly correlated. For example Figure 1.3.2 shows the percentage of TVs in each location separated by their rank. While the majority of primary TVs are located in a living room, there are still a significant number of households using bedrooms, family room/dens and even basements as their primary viewing location.

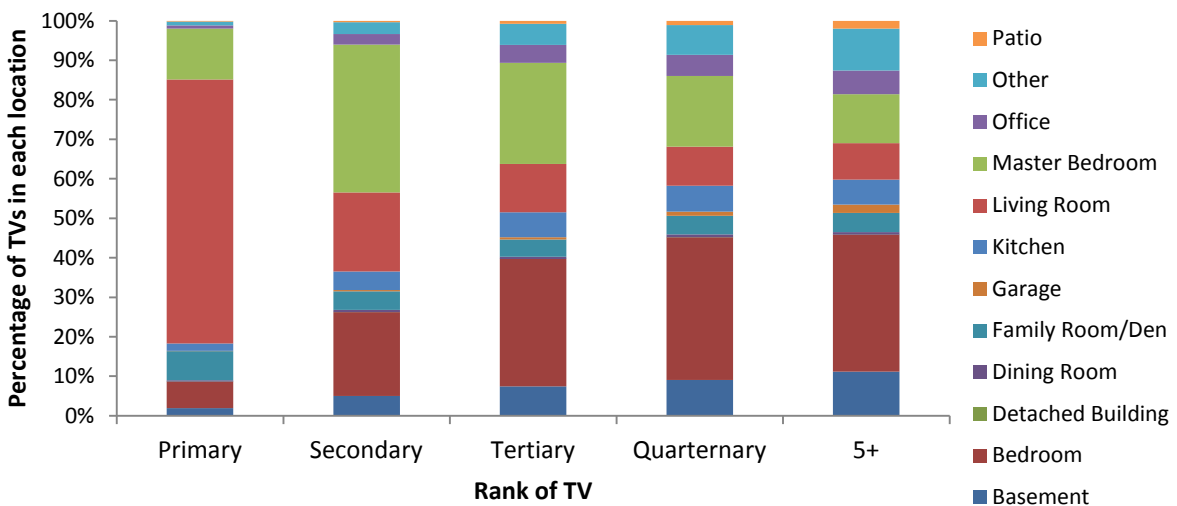


Figure 1.3.2 Percentage of TVs in each location, by their rank

DOE also considered ranking TVs based on the screen size. Information relating viewing hours to screen size was not available in the Nielsen data set, but available in RECS. RECS

asked participants if their TVs were ‘large screen’ in the 2001 survey. However there is no definition of large in the survey questions. DOE contacted the EIA for clarification, and EIA explained that there was no record of what constituted ‘large screen’ during the 2001 survey or the subsequent 2005 survey which asked the same question. The EIA acknowledged that this had been an issue and rephrased the question in the 2009 survey, asking participants for the diagonal screen size within one of four bins. In Figure 1.3.3 below, based on the 2009 survey, it can be seen that more than 75 % of TVs with screen size greater than 37 inches are primary. However, these limited data were not considered sufficient to be able to project forward the rank of TVs as a function of screen size.

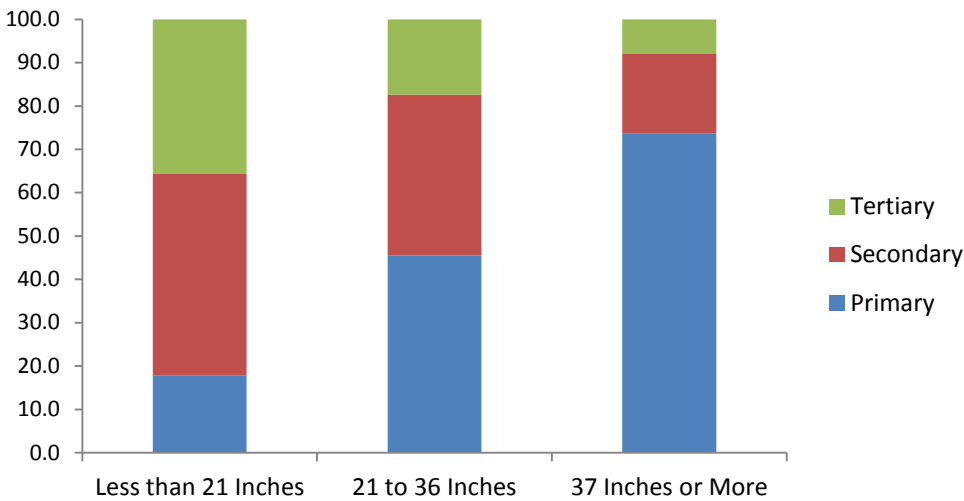


Figure 1.3.3 TV ranking by screen size from RECS 2009

1.3.4 Distribution of TV Viewing Time

DOE calculated the average viewing time of a TV for each year of the survey, as a total over all TVs, as well as separately for primary, secondary etc. As can be seen in Figure 1.3.4, the time difference between primary and secondary TV viewing hours was significant, while going from secondary to tertiary was less so. The data were therefore split into primary and non-primary for the rest of the analysis.

The distributions of viewing hours for primary and non-primary TVs are shown in Figure 1.3.5 and Figure 1.3.6. These distributions are for the last full year in the data set (June 2010-May 2011). The distribution for primary TVs is a stretched normal distribution, whereas the distribution for non-primary TVs is more skewed, peaking at the 0-30 minute bin. Secondary TVs, tertiary TVs, and so on have similar distributions peaked at the 0-30 minute bin, providing further justification for considering them as a group.

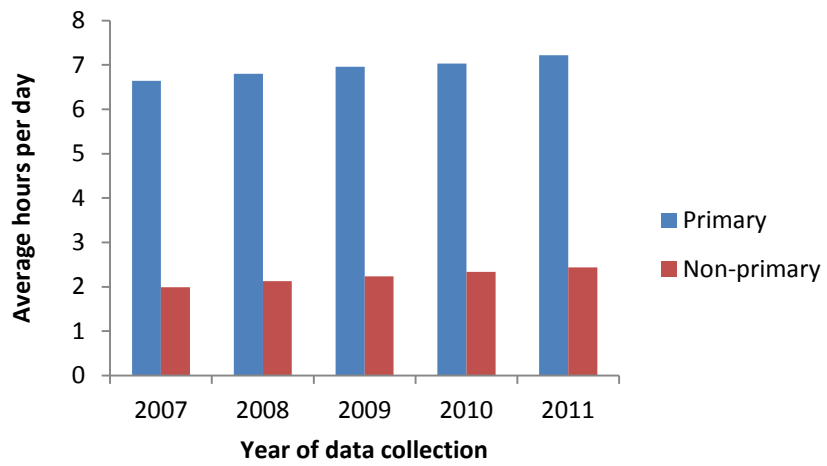
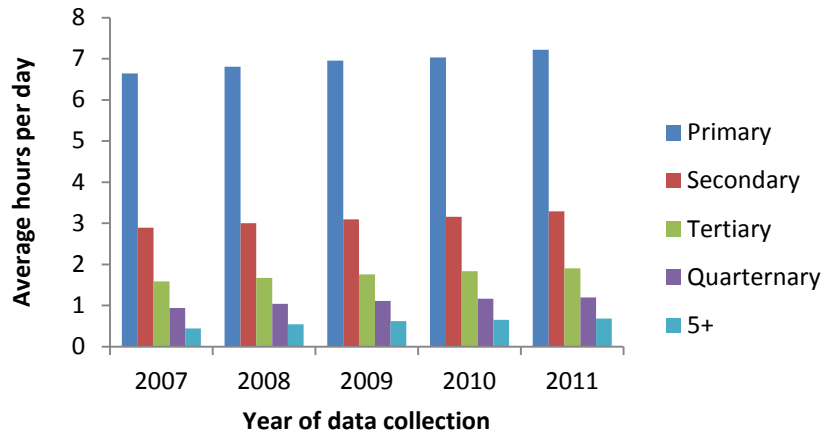


Figure 1.3.4 Average Usage by Rank of TV

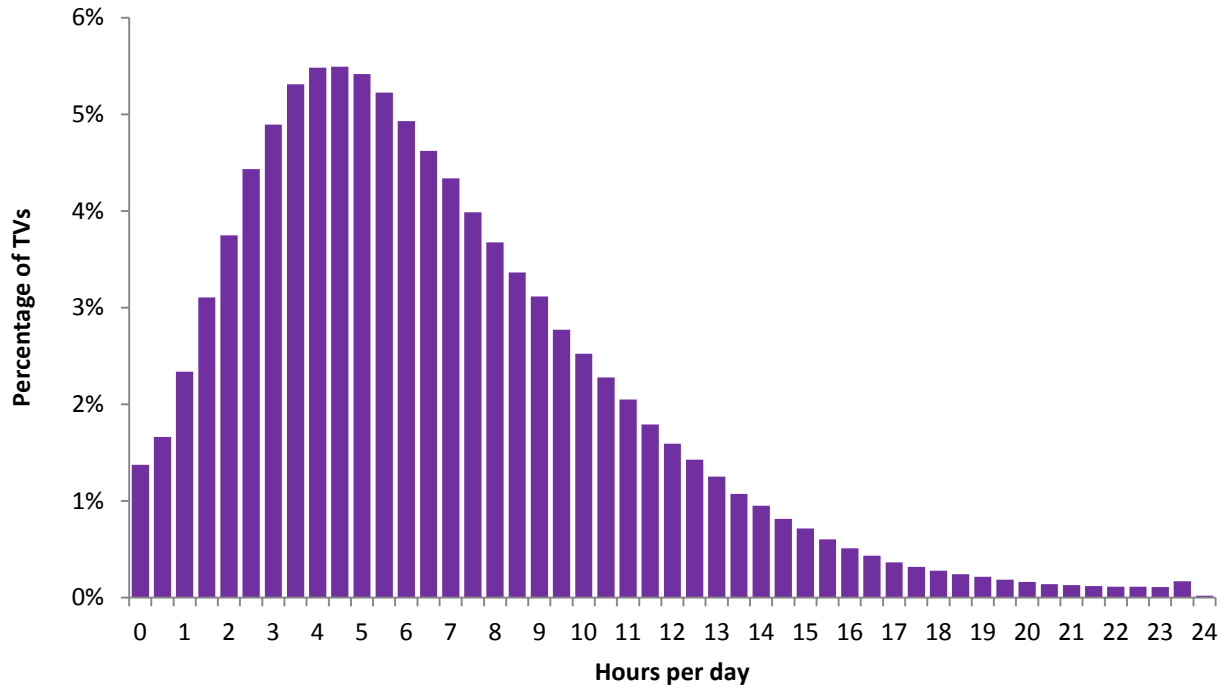


Figure 1.3.5 Distribution of Primary TV viewing hours

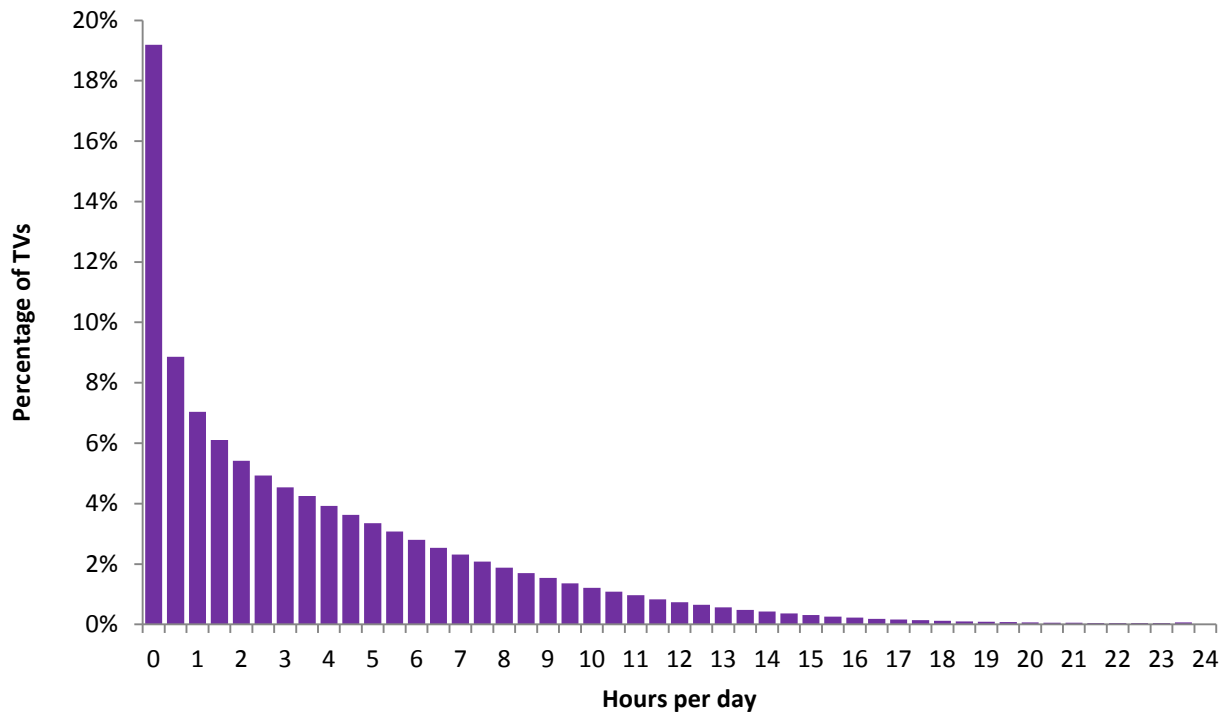


Figure 1.3.6 Distribution of non-primary TV viewing hours

Estimating total energy consumption using the average usage over all TVs would significantly underestimate usage if a TV was purchased as a primary TV. Estimating total energy consumption based on the average usage of a primary TV would, however, significantly overestimate the use of a TV purchased as a non-primary TV. DOE therefore estimated the probability that a TV would be used as a primary TV in its year of purchase.

To do this, DOE used the Nielsen data to estimate the percentage of households for which the newest TV was also the primary TV. This approximately represents households whose latest TV purchase was intended to become a primary TV. The analysis was done for May of each year, as this was the only month present for all 5 years. The percentage of households using their newest TV as a primary rose from 55% in May 2007 to 60% in May 2008. However, this rate of increase slowed down after this, with a percentage increase from 2010 to 2011 of less than 1%. DOE therefore estimates the probability of a future TV purchase being used as a primary TV to remain similar to 2010 and 2011, rather than the earlier years in the Nielsen data. Given that the percentage of households using their newest TV as a primary TV is relatively steady, using data on the stock is representative of new shipments. DOE therefore assigned a probability of 65% for a new TV being used as a primary TV, and 35% for a new TV being used as a non-primary TV.

DOE then determined a blended usage profile of TVs, based on the above assumed probabilities, in their first year of purchase. The resulting distribution of viewing hours per day is shown in Figure 1.3.7. It is a stretched normal distribution similar to the one seen for primary TVs, with slightly reduced peak hours per day.

It should be noted that this probability is likely to be a strong function of screen size. Larger TVs are more likely to be used as a primary TV than smaller TVs. Unfortunately, the Nielsen dataset does not include screen size. DOE could not find another suitable dataset that includes both screen size and the age of TVs found in homes. Nor could DOE find any data on whether new shipments of TVs are used as primary TVs, as a function of size. Therefore, DOE did not assign different probabilities based on screen size.

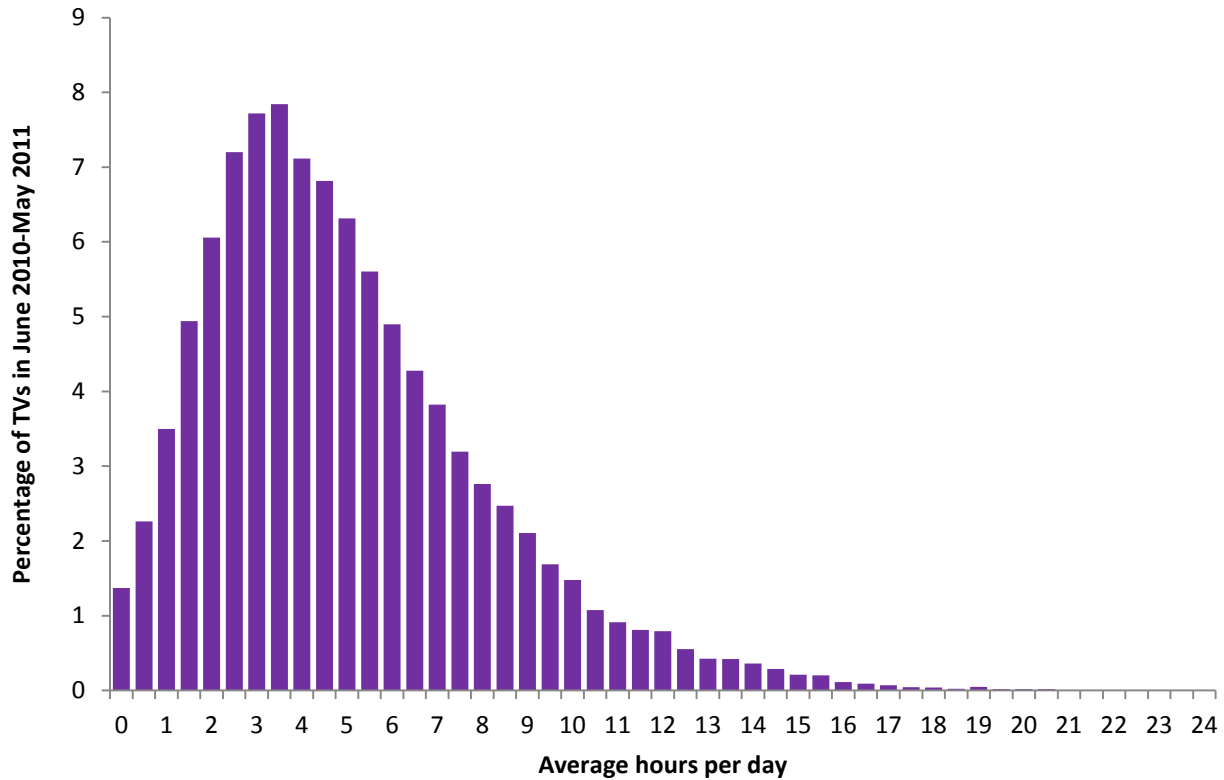


Figure 1.3.7 Distribution of blended average hours per day

1.4 FINAL RESULTS

The recent historical trend indicates that the average hours of use has been increasing significantly over just a few years. The historical data are well fit by a logarithmic regression (using only a simple 2-parameter regression, given the small number of points). The probability that a TV would be used as a primary or non-primary TV (discussed above in section 1.3.4) was then applied to the data set to produce a blended average. The resulting historical trends are shown in Figure 1.3.8. The average for primary TVs is slightly greater than 7 hours per day, the average for non-primary TVs is less than 2.5 hours per day, and the blended average is 5.5 hours per day.

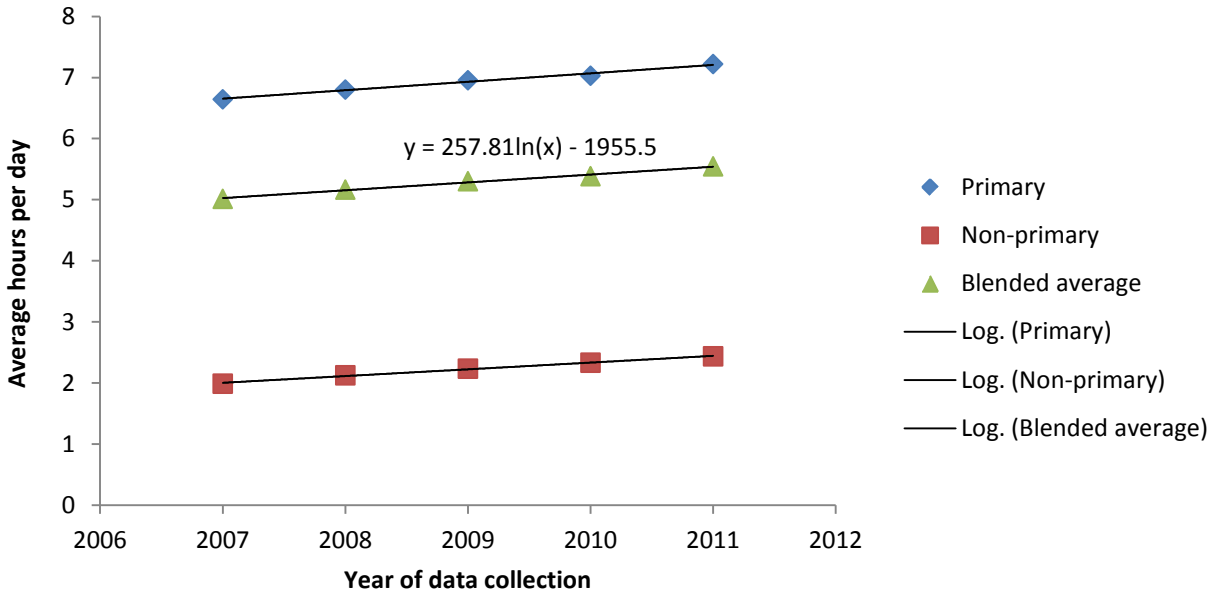


Figure 1.4.1 Adjusted Average Hours of Use of New TVs

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