

Codes and Standards Enhancement (CASE) Initiative For PY2008: Title 20 Standards Development

Title:

Analysis of Standards Options for Televisions
Revised Proposal

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1 Introduction

The Pacific Gas and Electric Company (PG&E) Codes and Standards Enhancement (CASE) Initiative Project seeks to address energy efficiency opportunities through development of new and updated Title 20 standards. Individual reports document information and data helpful to the California Energy Commission (CEC) and other stakeholders in the development of these new and updated standards. The objective of this project is to develop CASE Reports that provide comprehensive technical, economic, market, and infrastructure information on each of the potential appliance standards.

A full CASE report titled “Analysis of Standards Options for Televisions” was previously submitted by PG&E to the CEC on April 2, 2008 as part of Docket Number 07-AAER-3 for the 2008 Rulemaking on Appliance Efficiency Standards. This report provides a revised standards proposal that supersedes the recommendation in the previous CASE report.

The potential California statewide energy savings for the revised proposal are also presented along with source data and documentation. Additional material that provides

motivation and support for this revised proposal will be submitted to the CEC in subsequent versions of this report and/or as part of CEC workshop material.

2 Revised Proposal

2.1 Revised Proposal Language

The following is revised proposed language for Section 1605.3 of the Title 20 Appliance Efficiency Regulations.

Section 1605.3 State Standards for Non-Federally-Regulated Appliances.

(x) TVs, TV Combination Units, Television Monitors, and Component Television Units

TVs, TV Combination Units, Television Monitors, and Component Television Units shall not exceed the maximum On Mode power consumption (P_{MAX}) found from the equations in Table X below. The maximum On Mode power consumption is expressed as watts rounded to the nearest whole number. In the following equations, A is the viewable screen area of the product, found by multiplying the display width by the display height. Equations are provided in standard units (inches²). The Tier 1 levels are effective January 1, 2011 and the Tier 2 level is effective January 1, 2013.

Table X. Standards for TVs, TV Combination Units, Television Monitors, and Component Television Units

Native Vertical Resolution	Maximum On Mode Power Consumption (A expressed in inches ²)	
	Tier 1: Effective January 1, 2011	Tier 2: Effective January 1, 2013
≤480 native vertical resolution (i.e., Non-High Definition TVs)	$P_{MAX} = 0.12 * A + 25$	$P_{MAX} = 0.12 * A + 25$
>480 native vertical resolution (i.e., High Definition and Full Definition TVs)	$P_{MAX} = 0.20 * A + 32$	$P_{MAX} = 0.12 * A + 25$

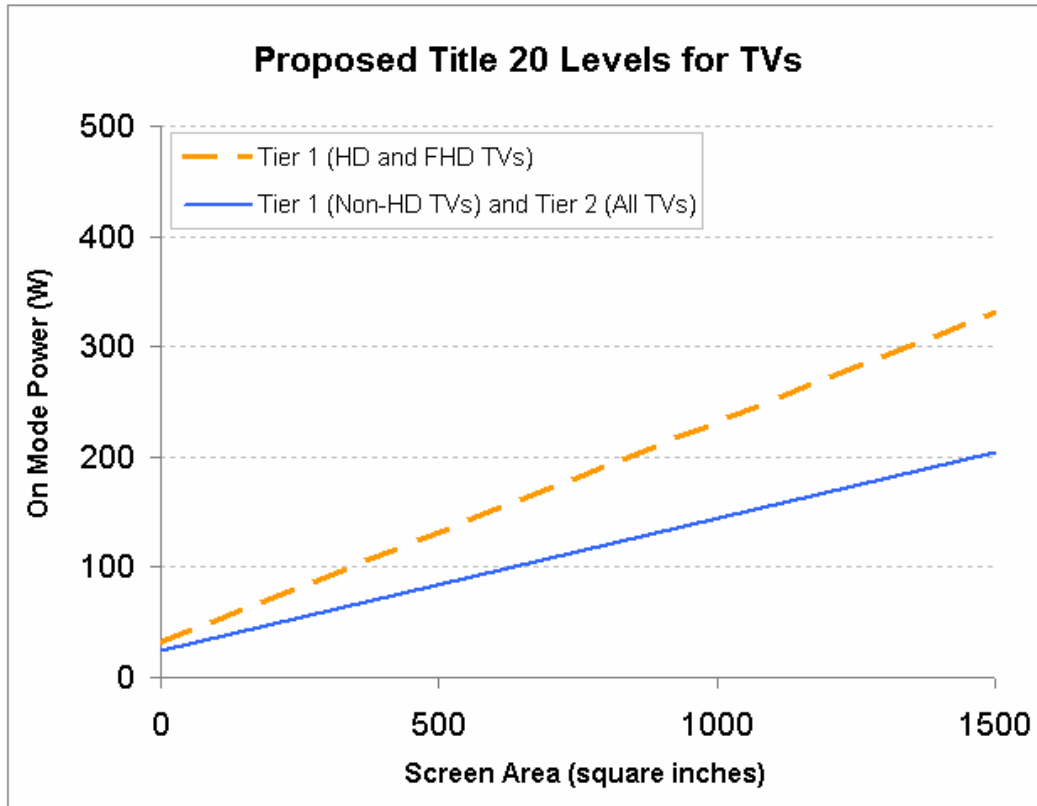
2.2 Additional Changes to Proposal Language

With the exception of the changes in the previous section (Section 2.1 Revised Proposal Language), there are no additional changes to the recommendations presented in Section 8 (“Recommendations”) of PG&E’s April 2, 2008 CASE report. Therefore, we continue to recommend that the Commission utilize the same definitions and test procedure as the Final Version 3.0 Energy Star specification for TVs. This includes adopting Energy Star’s guidelines for testing and certifying TVs with Automatic Brightness Control and its guidance for testing TVs at factory default settings.

2.3 Graphical Representation for Revised Proposal Language

Figure 1 shows the graphical representation for the revised Tier 1 and Tier 2 levels as presented in Section 2.1. The lines represent the respective maximum On Mode power levels permissible for Tier 1 and Tier 2.

Figure 1. Revised Proposed Title 20 Levels for TVs



3 Statewide Savings from Revised Proposal

Table 1 shows the estimated potential California statewide energy savings for the revised proposal. Incremental savings are showing for Tier 1 (i.e., Tier 1 minus baseline) and Tier 2 (i.e., Tier 2 minus Tier 1), as well as the combined Tier 1 and 2 savings. The detailed source data and documentation used to develop these estimates are provided in Appendix A. It should be noted that these savings estimates do not account for natural market improvements over time in the “non-standards” baseline, but neither do they account for the expected corresponding shipment weighted average efficiency improvements of the TVs that do qualify under the proposed standards.

Table 1. Potential California Statewide Energy Savings for Standards Proposal

Scenario	For First-Year Sales (Tier 1: 2011) (Tier 2: 2013)		After Entire Stock Turnover	
	Coincident		Coincident	
	Peak Demand Reduction (MW)	Annual Energy Savings (GWh/yr)	Peak Demand Reduction (MW)	Annual Energy Savings (GWh/yr)
Tier 1 (incremental)	33	349	362	3,831
Tier 2 (incremental)	23	243	253	2,684
Tier 1 and 2 (combined)	56	593	615	6,516

Appendix A: Source Data and Documentation for Savings Estimates

A1. TV Dataset

New TV power data has been used to inform the analysis since submitting the April 2008 CASE report. Figure 2 provides a summary of the TV data used for the April 2008 CASE report and for the subsequent analysis.

Figure 2. TV Dataset Summary

Dataset	Number of TVs	
Energy Star	175	} Dataset used for April 2008 CASE report
CEC PIER (tested at default settings)	70	
<i>subtotal</i>	245	
CEC PIER (tested at other screen settings)	50	} Additional datasets used to inform analysis after April 2008 CASE report
Energy Star (removed TVs)	114	
CNET	94	
EICTA (Europe)	102	
MTP (Europe)	157	
<i>subtotal</i>	517	
Grand Total	762	

All the datasets are different; therefore, careful consideration during analysis is used to accommodate for different variables, including but not limited to: technologies represented (e.g., LCD, Plasma, rear projection, CRT), screen sizes, test procedure used, TV screen settings during test, TV manufacture date, and resolution type. All attempts are made to represent what is available on the market now and in the near future.

The following provides a brief description for each dataset:

- **Energy Star data set:** Energy Star recently finalized an updated TV specification (Version 3.0) that includes active mode power levels and will become effective November 1, 2008. Energy Star used a TV dataset provided by the Consumer Electronics Association (CEA) to help inform its stakeholder revision process (Energy Star, 2008).
- **CEC PIER data set:** Ecos Consulting and Imaging Science Foundation (ISF) tested numerous TVs as a part of ongoing research for the CEC's PIER Program.
- **MTP data set:** This data set was used by the Market Transformation Programme (MTP), which supports UK Government policy on sustainable products. It was used as the basis for a paper developed by Hans-Paul Siderius (SenterNovem) and Robert Harrison (MTP) titled “An Energy Efficiency Index for Televisions” (February 12, 2007).

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- **EICTA data set:** This data set was used as the basis for a paper developed by Hans-Paul Siderius (SenterNovem) and Robert Harrison (MTP), titled “Televisions: the Impact of HD ready and Full HD on On-Mode Power” (March 4, 2008). The EICTA was formed in 1999 as the European Information & Communications Technology Industry Association by the consolidation of the two former European federations of the information and telecommunications industries.
- **CNET data set:** CNET test results can be found at: (http://reviews.cnet.com/4520-6475_7-6400401-3.html?tag=nav). CNET did not use the IEC 62087 test procedure; however an industry contact familiar with the IEC test method estimates the CNET test procedure would be within 10% of the IEC test procedure for plasma TVs and 3% for LCDs. If the CNET test result was different it would be likely be higher. PG&E is sponsoring additional TVs using the IEC 62087 test method to confirm these estimates.

Table 2 provides a summary of the sample set used for statewide savings analysis presented in this report. The analysis focuses on the two dominant TV technologies: LCD and Plasma. As shown in a future section (see Box 2), LCD and Plasma TVs are projected to have an over 97 percent combined market share in the year 2011; therefore, a reasonable statewide savings estimate can be developed by focusing on these two technologies. In an effort to keep the dataset current, TVs with an estimated manufacture date of 2007 or later are used for the analysis.¹

Table 2. TVs used for revised proposal savings analysis

Technology	Sample Size
LCD	288
Plasma	99
<i>Total</i>	<i>387</i>

Note: sample set includes TVs with an estimated year of manufacture/availability in 2007 or later. Includes TVs tested using IEC 62087 test procedure (Energy Star, CEC PIER, EICTA and MTP). Specific TV models may be represented more than once in the dataset but it is impossible to distinguish how many unique models there are since the majority of the combined dataset is masked.

A2. TV Shipment Estimates

Box 1 provides estimated TV shipment data for North America, U.S., and California in the years 2006 to 2012.

¹ The complete annotated dataset will be provided separately to the CEC in Microsoft Excel[®] format and is available to interested stakeholders upon request.

Box 1. TV Shipment Estimates

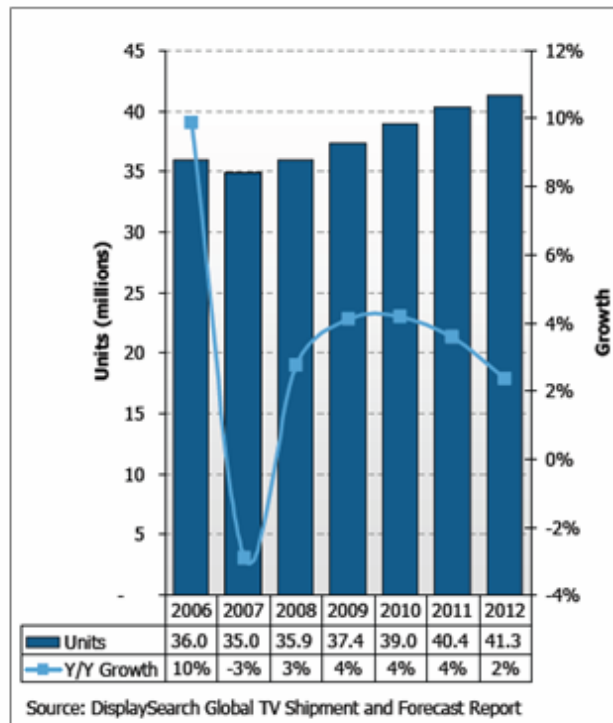
Estimated TV shipments (millions)				
North				
Year	America	U.S.	CA	Y/Y Growth
2006	36.0	32.0	3.9	
2007	35.0	31.2	3.8	-3%
2008	35.9	32.0	3.9	3%
2009	37.4	33.3	4.0	4%
2010	39.0	34.7	4.2	4%
2011	40.4	36.0	4.4	3%
2012	41.3	36.8	4.5	2%

Note: Source for North America is DisplaySearch 2007. DisplaySearch estimates that U.S. is 89% of North American market. California estimate is 12.1% of U.S. value based on U.S. Census Bureau, 2007 Population Estimates.

Source: DisplaySearch 2007. "DisplaySearch Global TV Shipment and Forecast Report". As presented in Paul Gagnon's (Director of North America TV Market Research) presentation titled "TV Market Review and Outlook: Realities and Opportunities" given at the 10th Annual DisplaySearch US FPD Conference in La Jolla, CA, March 10-13, 2008.

Excerpts from presentation: Units are for North America

Note: DisplaySearch contact said U.S. shipments are roughly 89% of North American shipments



A3. Market Share Data

Box 2 provides estimated market share data North American TV shipments, based on projections from DisplaySearch, a leading TV market research firm. DisplaySearch estimates that LCD market share is rapidly growing and will flatten at just below 90% in 2009 to 2012. During the same time period, plasma displays panels (PDP) are showing a market staying relatively flat at roughly 10-11%. CRT and RPTV market share is minimal and declining. OLED TVs are entering the market but small percentage.

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Box 2. Market Share Data

Estimated TV Market Share by Technology

TV Technology	Estimated Market Share
LCD	88.2%
Plasma	10.5%
RPTV	0.5%
CRT	0.8%

Source: DisplaySearch 2007 (projection for 2009; includes slight modifications to percentages so total equals 100%)

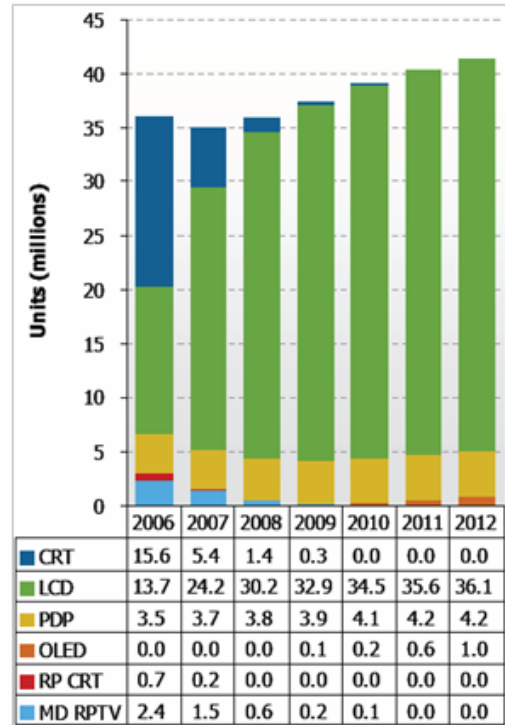
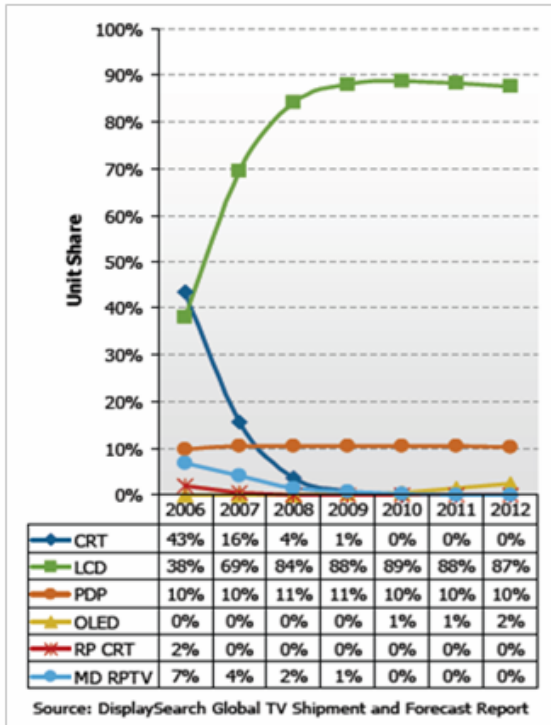
Estimated LCD and Plasma distribution in 2011

	NA Units	Percent of LCD/Plasma total
LCD	35.6	89%
Plasma	4.2	11%
Total	39.8	100%

Source: DisplaySearch 2007 (North American projection for 2011)

Source: DisplaySearch 2007. "DisplaySearch Global TV Shipment and Forecast Report". As presented in Paul Gagnon's (Director of North America TV Market Research) presentation titled "TV Market Review and Outlook: Realities and Opportunities" given at the 10th Annual DisplaySearch US FPD Conference in La Jolla, CA, March 10-13, 2008.

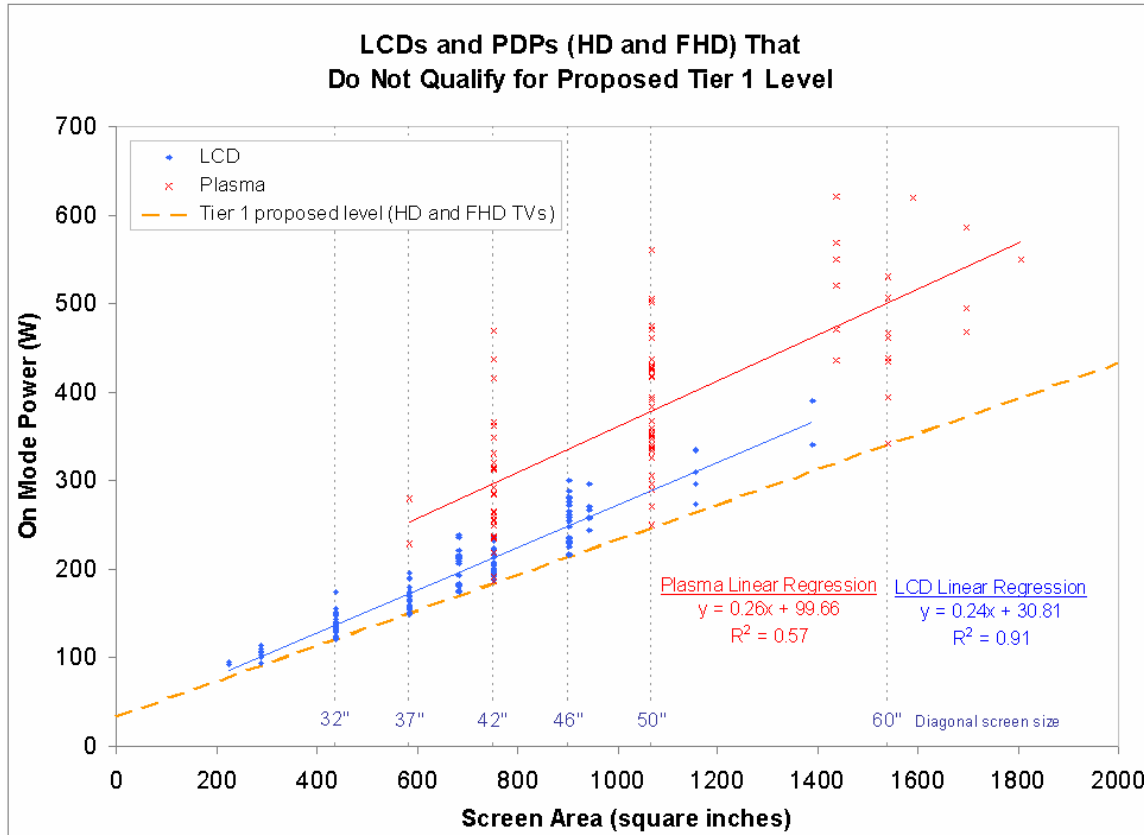
Excerpt from presentation:



A4. On Mode Power Analysis

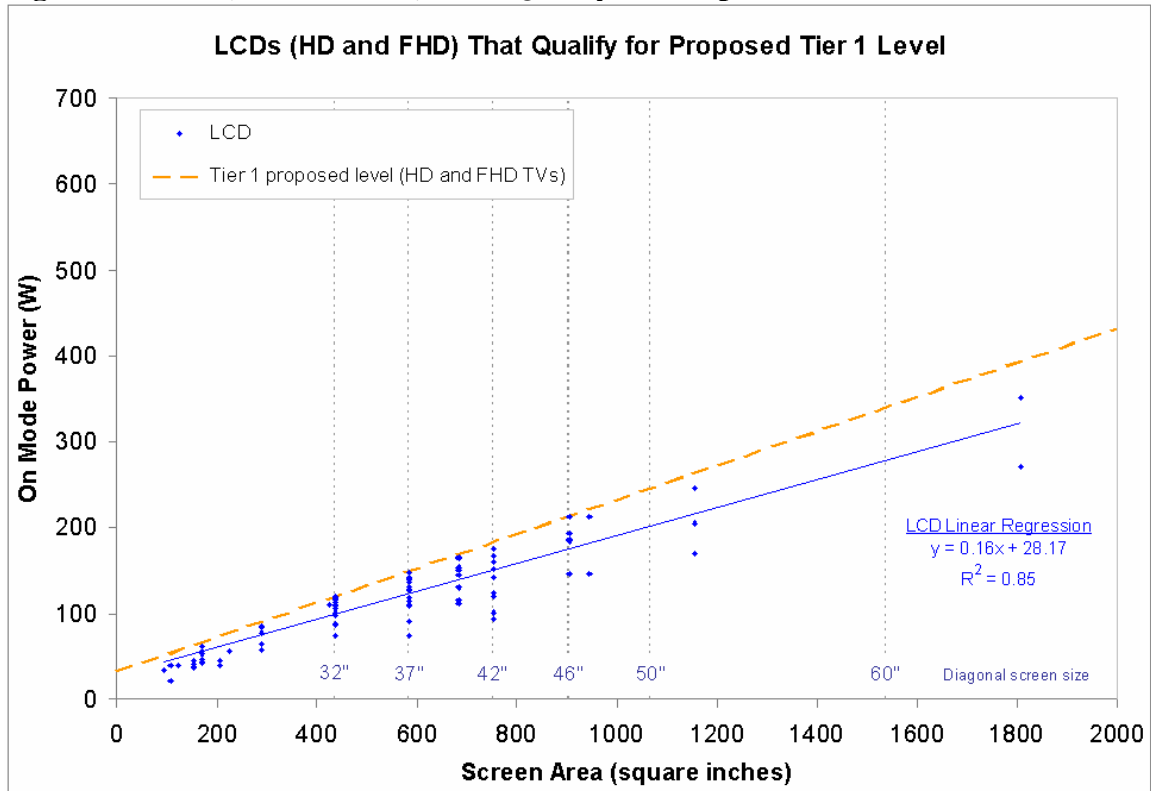
Figure 3 plots the LCD and PDP (HD and FHD) TVs that *do not* qualify for the proposed Tier 1 level. The dataset used is described in Section A1. Figure 4 plots the LCD TVs that *do* meet the qualifying level. Both figures show the linear regression for each sample set—these are used for the savings analysis discussed in the next sections.²

Figure 3. LCDs and PDPs (HD and FHD) That Do Not Qualify for Proposed Tier 1 Level



² Plasma TVs are not plotted on in Figure 3 because there are not enough data points in the current dataset to provide useful results for calculating overall savings. Note, this is not necessarily indicative performance for all plasma TVs on the market today or in the near future. Subsequent reports and/or presentation will be provided to the CEC showing that the leading plasma manufacturers all have plasma TVs on the market today that can meet proposed Title 20 level by simply adjusting the “out-of-the-box” screen settings.

Figure 4. LCDs (HD and FHD) That Qualify for Proposed Tier 1 Level



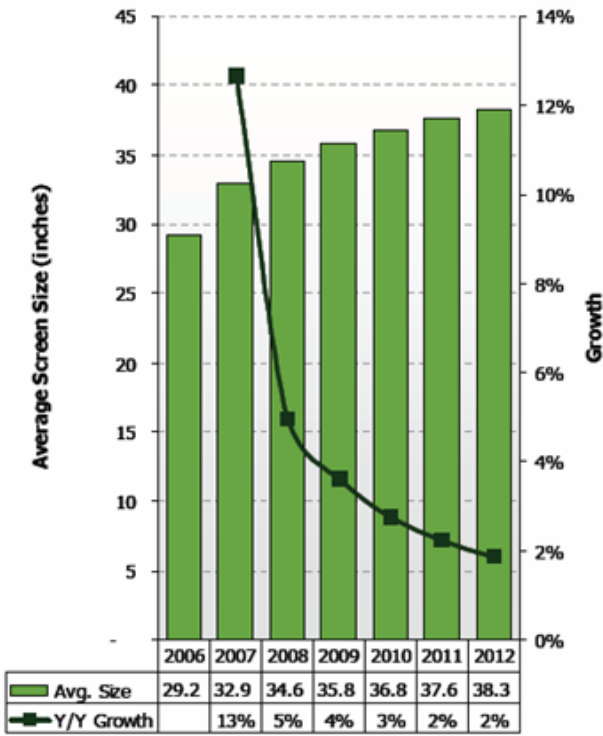
A5. TV Average Screen Size

Box 3 provides the estimated Average Screen Size for North American TV Shipments. The average screen size is expected to increase from 29.2 inches in 2006 to 38.3 inches in 2012.

Box 3. Average Screen Size for North American TV Shipments

Source: DisplaySearch 2007. "DisplaySearch Global TV Shipment and Forecast Report". As presented in Paul Gagnon's (Director of North America TV Market Research) presentation titled "TV Market Review and Outlook: Realities and Opportunities" given at the 10th Annual DisplaySearch US FPD Conference in La Jolla, CA, March 10-13, 2008.

Excerpt from presentation:



Source: DisplaySearch Global TV Shipment and Forecast Report

A6. On Mode Power for Base Case and Proposed Levels per TV

Table 3 shows the On Mode power estimates for base case TVs (e.g., TVs that do not meet Tier 1 requirements), Tier 1, and Tier 2. Data from previous sections A4 and A5 are used to inform the results.

Table 3. On Mode Power for Base Case and Proposed Levels per TV

Level	Reference equation {A = screen area (in ²); P = On mode power}	Reference Screen Size		On Mode Power (W)
		Diagonal (in)	Area (in ²)	
Base case				
LCD ¹	$P = 0.24A + 30.81$	37.6	604.1	175.8
Plasma ²	$P = 0.26A + 99.66$	50.0	1068.3	377.4
Qualifies for Tier 1				
LCD ³	$P = 0.16A + 28.17$	37.6	604.1	124.8
Plasma ⁴	$P = 0.20*A + 32$	50.0	1068.3	245.7
Qualifies for Tier 2				
LCD ⁵	$P = 0.12*A + 25$	39.1	652.1	103.3
Plasma ⁶	$P = 0.12*A + 25$	50.0	1068.3	153.2

Notes:

1/reference equation based on analysis of LCDs in PG&E TV dataset (2008) that don't qualify for Tier 1 level. Reference screen size based on 2011 projection in DisplaySearch 2007

2/reference equation based on analysis of PDPs in PG&E TV dataset (2008) that don't qualify for Tier 1 level. Reference screen size based on average plasma screen size in PG&E TV dataset (2008)

3/reference equation based on analysis of LCDs in PG&E TV dataset (2008) that qualify for Tier 1 level. Reference screen size based on 2011 projection in DisplaySearch 2007

4/reference equation based proposed Tier 1 level. Reference screen size based on average plasma screen size in PG&E TV dataset (2008)

5/reference equation based proposed Tier 1 level. Reference screen size is estimated for 2013 based on DisplaySearch 2007 projection for 2012 (38.3 in.) and Y/Y growth (2%)

6/reference equation based proposed Tier 1 level. Reference screen size based on average plasma screen size in PG&E TV dataset (2008)

A7. Operating Hours, Demand Reduction, and Energy Savings per TV

Table 4 provides the estimated annual operating hours in active mode. Table 5 summarizes the key data shown previously in Table 3 and shows per unit demand reduction for each Tier. The data in Table 4 and 5 are used to calculate the energy savings in Table 6.

Table 4. Estimated Annual Operating Hours in Active Mode

End-Use Sector	Estimated percent end-use application	Annual Operating Hours in Active Mode
Residential	99%	1882
Commercial/Professional	1%	4380
Weighted Average		1907

Notes: Residential operating hours based on Roth and McKenney (2007; Table 5.55); Commercial operating hours assumes 12 hrs/day; Commercial percentage is based on PG&E assessment of its commercial customers.

Table 5. On Mode Demand Reduction per TV

	Average On Mode Power (W)			On Mode Demand Reduction (W)		
	Base Case	Tier 1	Tier 2	Tier 1 (Base minus Tier 1)	Tier 2 Incremental (Tier 1 minus Tier 2)	Tier 1 & 2
LCD	175.8	124.8	103.3	51.0	21.6	72.5
Plasma	377.4	245.7	153.2	131.8	92.5	224.2

Table 6. Energy Savings per TV

	Unit Energy Consumption (kWh/yr)			Unit Energy Savings (kWh/yr)		
	Base Case	Tier 1	Tier 2	Tier 1 (Base minus Tier 1)	Tier 2 Incremental (Tier 1 minus Tier 2)	Tier 1 & 2
LCD	335.2	238.0	196.9	97.2	41.1	138.3
Plasma	719.7	468.4	292.1	251.3	176.3	427.6

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A8. Assumptions for Calculating Statewide Savings

Tables 7, 8, 9, and 10 show the detailed values, assumptions and sources used for estimating statewide energy savings and coincident demand reduction.

Table 7. Assumptions for Calculating Statewide Savings

Title 20 Level	Year	CA sales (M) ¹	Unit Percentage ²		Units (M) ³		Per Unit Savings for Tier 1 (kWh/yr) ⁴		Per Unit Incremental Savings for Tier 2 (kWh/yr) ⁴		Assumed % of units to claim incremental Tier 1 savings ⁵		Assumed % of units to claim incremental Tier 2 savings ⁶	
			LCD	PDP	LCD	PDP	LCD	PDP	LCD	PDP	LCD	PDP	LCD	PDP
Tier 1	2011	4.36	88%	10%	3.8	0.4	97.2	251.3			66%	95%	0%	0%
Tier 1	2012	4.45	87%	10%	3.9	0.4	97.2	251.3			66%	95%	0%	0%
Tier 2	2013	4.55	87%	10%	4.0	0.5	97.2	251.3	41.1	176.3	66%	95%	100%	100%
Tier 2	2014	4.65	87%	10%	4.0	0.5	97.2	251.3	41.1	176.3	66%	95%	100%	100%
Tier 2	2015	4.75	87%	10%	4.1	0.5	97.2	251.3	41.1	176.3	66%	95%	100%	100%
Tier 2	2016	4.86	87%	10%	4.2	0.5	97.2	251.3	41.1	176.3	66%	95%	100%	100%
Tier 2	2017	4.96	87%	10%	4.3	0.5	97.2	251.3	41.1	176.3	66%	95%	100%	100%
Tier 2	2018	5.07	87%	10%	4.4	0.5	97.2	251.3	41.1	176.3	66%	95%	100%	100%
Tier 2	2019	5.18	87%	10%	4.5	0.5	97.2	251.3	41.1	176.3	66%	95%	100%	100%
Tier 2	2020	5.29	87%	10%	4.6	0.5	97.2	251.3	41.1	176.3	66%	95%	100%	100%
Tier 2	2021	5.41	87%	10%	4.7	0.5	97.2	251.3	41.1	176.3	66%	95%	100%	100%
Tier 2	2022	5.53	87%	10%	4.8	0.6	97.2	251.3	41.1	176.3	66%	95%	100%	100%

Notes

1/Source for CA sales is DisplaySearch 2007; assumes a 2% annual growth per DisplaySearch estimate for 2012.

2/Source is DisplaySearch 2007

3/Calculated

4/Previous presented in report

5/LCD percentage is based on the percentage of LCDs in the PG&E dataset that did not qualify for Tier 1 level; PDP percent is an estimate. Does not account for natural market adoption of higher efficiency models

6/Assume 100% for Tier 2 incremental savings. Does not account for natural market adoption of higher efficiency models.

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Table 8. Estimated California Statewide Energy Savings

Title 20 Level	Year	1st yr incremental savings from Tier 1 (GWh/yr)			1st yr incremental savings from Tier 2 (GWh/yr)			1st yr incremental savings from Tier 1&2 (GWh/yr)		
		LCD	PDP	Total	LCD	PDP	Total	LCD	PDP	Total
Tier 1	2011	245	104	349				245	104	349
Tier 1	2012	248	106	354				248	106	354
Tier 2	2013	253	109	362	163	80	243	416	189	605
Tier 2	2014	259	111	370	166	82	248	425	193	618
Tier 2	2015	265	113	378	170	84	254	435	197	632
Tier 2	2016	270	116	386	174	86	259	444	202	646
Tier 2	2017	276	118	395	178	87	265	454	206	660
Tier 2	2018	282	121	403	181	89	271	464	210	674
Tier 2	2019	288	124	412	185	91	277	474	215	689
Tier 2	2020	295	126	421	189	93	283	484	220	704
Tier 2	2021				194	95	289	194	95	289
Tier 2	2022				198	97	295	198	97	295
Savings after stock turnover (GWh/yr) ---->										6,516

Note: Values reflect savings to TVs in PG&E's dataset (2008) and does not fully account for natural market adoption of higher efficiency models. Savings based on an estimated useful life of 10 years (see April 2008 CASE report)

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Table 9. Assumptions for Calculating Statewide Peak Demand Reduction

Title 20 Level	Year	CA sales (M) ¹		Unit Percentage ²		Units (M) ³		Per Unit Incremental Reductions for Tier 1 (W) ⁴		Per Unit Incremental Reduction for Tier 2 (W) ⁴		Assumed % of units to claim incremental Tier 1 savings ⁵		Assumed % of units to claim incremental Tier 2 savings ⁶		Peak Hour Load Share
		LCD	PDP	LCD	PDP	LCD	PDP	LCD	PDP	LCD	PDP	LCD	PDP	LCD	PDP	
Tier 1	2011	4.36		88%	10%	3.8	0.4	51.0	131.8			66%	95%	0%	0%	18%
Tier 1	2012	4.45		87%	10%	3.9	0.4	51.0	131.8			66%	95%	0%	0%	18%
Tier 2	2013	4.55		87%	10%	4.0	0.5	51.0	131.8	21.6	92.5	66%	95%	100%	100%	18%
Tier 2	2014	4.65		87%	10%	4.0	0.5	51.0	131.8	21.6	92.5	66%	95%	100%	100%	18%
Tier 2	2015	4.75		87%	10%	4.1	0.5	51.0	131.8	21.6	92.5	66%	95%	100%	100%	18%
Tier 2	2016	4.86		87%	10%	4.2	0.5	51.0	131.8	21.6	92.5	66%	95%	100%	100%	18%
Tier 2	2017	4.96		87%	10%	4.3	0.5	51.0	131.8	21.6	92.5	66%	95%	100%	100%	18%
Tier 2	2018	5.07		87%	10%	4.4	0.5	51.0	131.8	21.6	92.5	66%	95%	100%	100%	18%
Tier 2	2019	5.18		87%	10%	4.5	0.5	51.0	131.8	21.6	92.5	66%	95%	100%	100%	18%
Tier 2	2020	5.29		87%	10%	4.6	0.5	51.0	131.8	21.6	92.5	66%	95%	100%	100%	18%
Tier 2	2021	5.41		87%	10%	4.7	0.5	51.0	131.8	21.6	92.5	66%	95%	100%	100%	18%
Tier 2	2022	5.53		87%	10%	4.8	0.6	51.0	131.8	21.6	92.5	66%	95%	100%	100%	18%

Notes

1/Source for CA sales is DisplaySearch 2007; assumes a 2% annual growth per DisplaySearch estimate for 2012.

2/Source is DisplaySearch 2007

3/Calculated

4/Previous presented in report

5/LCD percentage is based on the percentage of LCDs in the PG&E dataset that did not qualify for Tier 1 level; PDP percent is an estimate. Does not account for natural market adoption of higher efficiency models

6/Assume 100% for Tier 2 incremental savings. Does not account for natural market adoption of higher efficiency models.

7/Assumed based on Nielsen Media Research (2008) TV tuning stats during peak periods in 3Q07.

Table 10. Estimated California Statewide Energy Savings

Title 20 Level	Year	1st yr incremental coincident peak demand reduction from Tier 1 (MW)			1st yr incremental coincident peak demand reduction from Tier 2 (MW)			1st yr incremental coincident peak demand reduction from Tier 1&2 (MW)			
		LCD	PDP	Total	LCD	PDP	Total	LCD	PDP	Total	
Tier 1	2011	23	10	33				23	10	33	
Tier 1	2012	23	10	33				23	10	33	
Tier 2	2013	24	10	34	15	8	23	39	18	57	
Tier 2	2014	24	10	35	16	8	23	40	18	58	
Tier 2	2015	25	11	36	16	8	24	41	19	60	
Tier 2	2016	26	11	36	16	8	24	42	19	61	
Tier 2	2017	26	11	37	17	8	25	43	19	62	
Tier 2	2018	27	11	38	17	8	26	44	20	64	
Tier 2	2019	27	12	39	17	9	26	45	20	65	
Tier 2	2020	28	12	40	18	9	27	46	21	66	
Tier 2	2021				18	9	27	18	9	27	
Tier 2	2022				19	9	28	19	9	28	
<i>Coincident peak demand reduction after stock turnover (MW) ----></i>									615		

Note: Values reflect savings to TVs in PG&E's dataset (2008) and does not fully account for natural market adoption of higher efficiency models. Savings based on an estimated useful life of 10 years (see April 2008 CASE report)