BUILDING TECHNOLOGIES PROGRAM

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Television Sets Test Procedure NOPR Public Meeting

Department of Energy

Energy Efficiency and Renewable Energy

March 22, 2012

Welcome, Introduction & Opening Remarks

- Introductions
- Role of the Facilitator
- Ground Rules (norms)
  - Listen as an ally
  - Use short, succinct statements/keep to the point
  - Hold sidebar conversations outside the room
  - Focus on issues, not personalities
  - One person speak at a time (raise hand to be recognized; state your name for the record)
  - Set cell phones to silent/vibrate
- Housekeeping Items

Listening Via the Webcast

- The Department is broadcasting this meeting live over the Internet.
- DOE is providing the webcast to accommodate stakeholders that are unable to attend the public meeting in person.
- The web broadcast allows stakeholders to listen in and view the slides.
- All stakeholders are encouraged to submit written comments after the public meeting.

Purpose of the Public Meeting

- To present DOE's proposed test procedure for Television Sets.
- To answer questions about DOE's proposed approach.
- To seek comment & input from participants on DOE's proposed testing.
- To discuss the NOPR published in the Federal Register which:
  - Gives notice of the public meeting and availability of the NOPR document.
  - Describes the proposed TV test procedure.

Request for Comment Format

Issue Box - In the test procedure NOPR for Television Sets, DOE welcomes comment. Throughout this presentation, specific issues will be raised for discussion on slides such as this, with identifying numbers corresponding to those in the test procedure NOPR document. In addition, DOE has added questions that are not in the NOPR document. These questions are identified by a letter.

DOE Requests Feedback

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In all correspondence, please refer to the Television Set Test Procedure
Docket Number EERE-2010-BT-TP-0026 and
Regulatory Identification Number (RIN) RIN 1904-AC29

Federal eRulemaking Portal: http://www.regulations.gov

Email: Televisions-2010-TP-0026@ee.doe.gov

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Comment period closes 04/03/2012

At this time DOE welcomes opening remarks on the test procedure NOPR for Television Sets

Public Meeting Agenda

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

1. Rulemaking History & Timelines
2. Summary of NOPR
3. Definitions/Scope
4. Testing Conditions and Instrumentation
5. Luminance Test
6. On , Standby & Off Modes
7. Energy Efficiency Metric(s)

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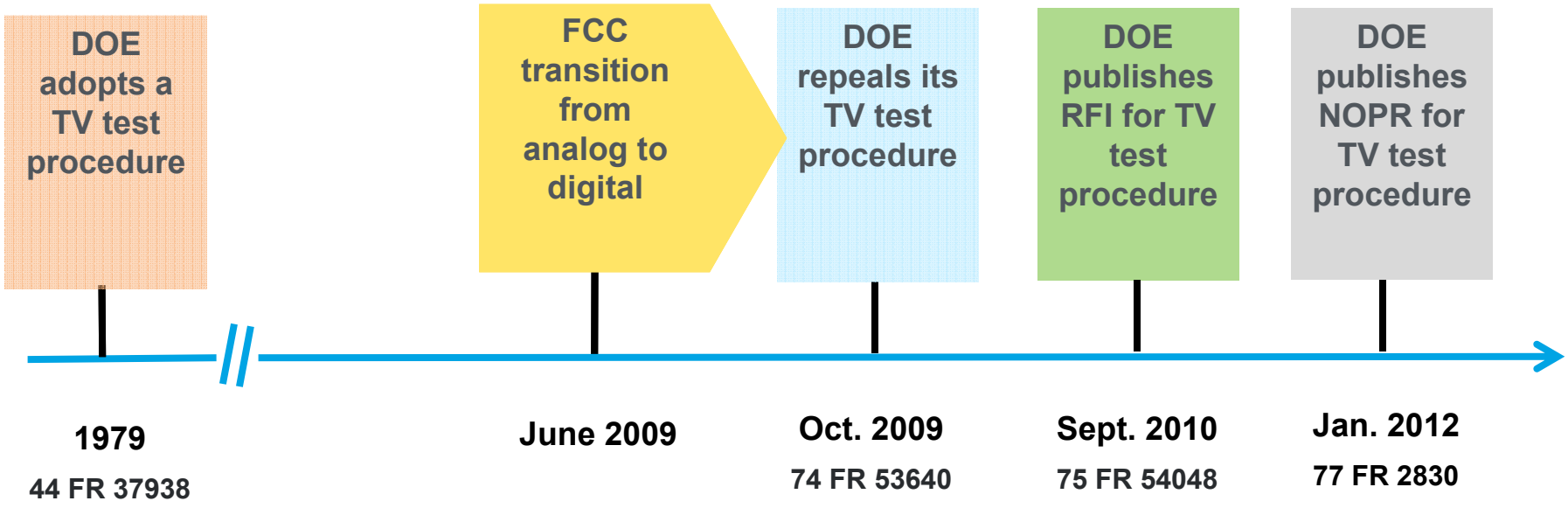
TV Regulatory History



Background and Overview

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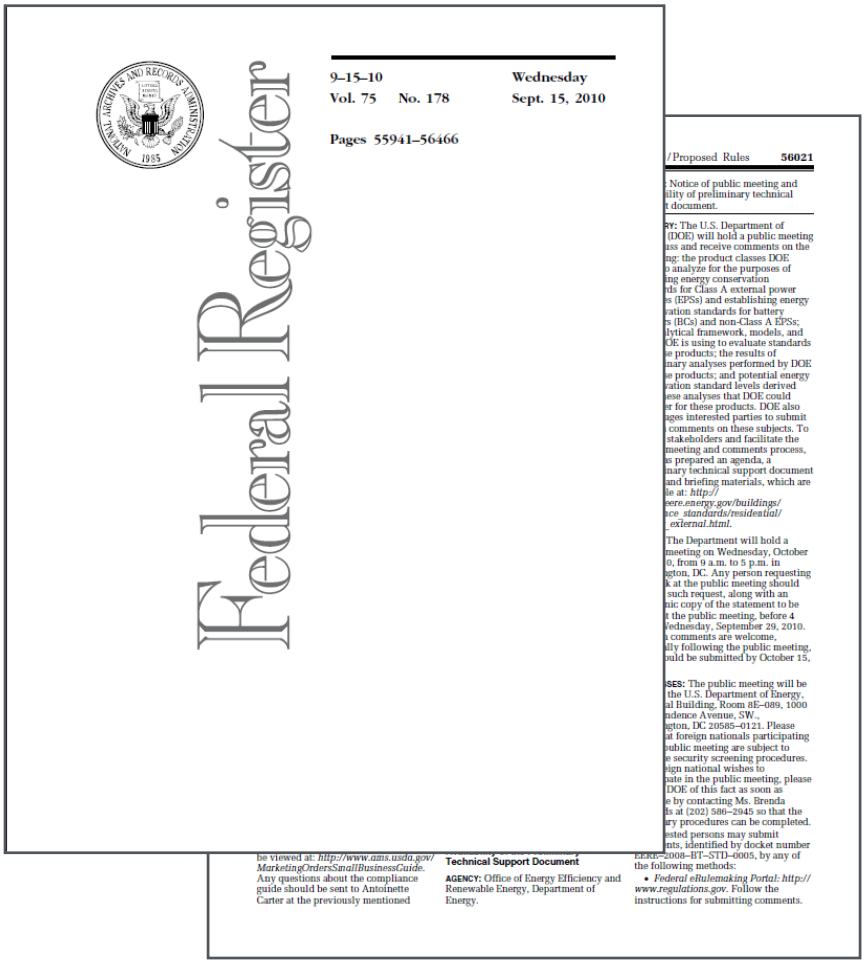
Notice of Public Meeting and Notice of Proposed Rulemaking



Federal Register

9–15–10 Vol. 75 No. 178 Wednesday Sept. 15, 2010

Pages 55941–56466

/Proposed Rules 56021

Technical Support Document

AGENCY: Office of Energy Efficiency and Renewable Energy, Department of Energy.

- Test procedures are codified in Title 10 of the Code of Federal Regulations (CFR), Part 430, Subpart B.
- Once published, the DOE TV test procedure final rule will be in Appendix H.
- NOPR published on January 19, 2012 at 77 FR 2830.
- Supporting material can be downloaded from the TV webpage
  - <http://www1.eere.energy.gov/buildings/appliance_standards/residential/tv_sets.html>

Test Procedure Rulemaking Process

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Preliminary Stage

- Request for Information published 9/3/2010

NOPR

- NOPR published 1/19/2012
- NOPR Public Meeting 3/22/2012

Final Rule

- Final Rule publication anticipated by the end of FY 2012

Effective Date and Compliance Date

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If adopted, test procedure becomes effective 30 days after the publication of the final rule

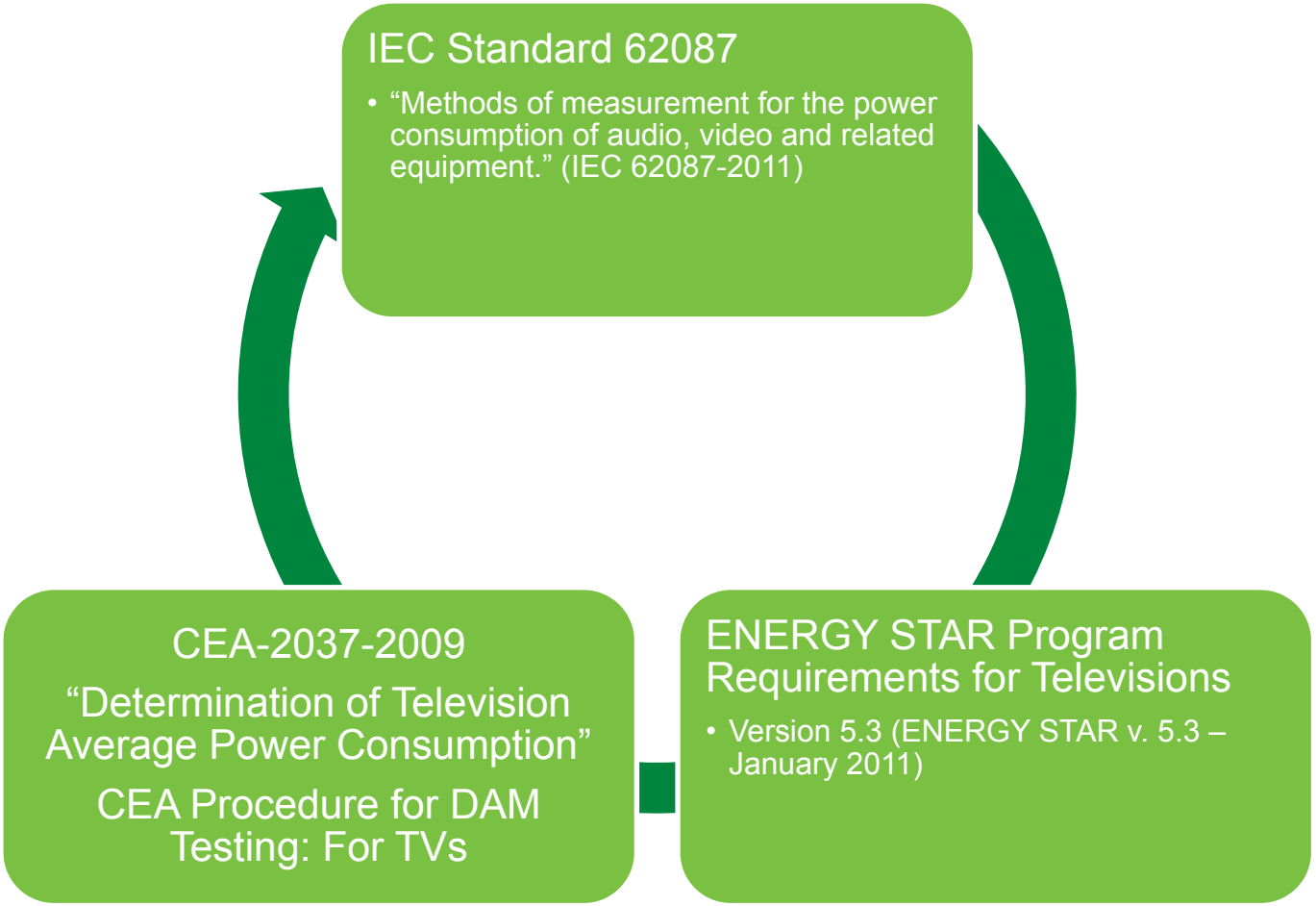
All energy use representations made 180 days after the test procedure final rule is published must be according to the new test procedure

DOE's test procedure is developed for but not limited to:

- Potential DOE Standard
- Federal Trade Commission
- Environmental Protection Agency
- States (Preempted)

Existing TV Test Procedures

DOE evaluated existing TV test procedures to use as a basis for its test procedure.



Public Meeting Agenda

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Summary of NOPR

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The test procedure consists of four major steps.

Luminance test

- Home picture setting
- Retail picture setting

On mode test (ABC Enabled by Default)

Perform in Home Picture Setting at ambient light levels of 10,50,100, and 300 lux

On mode test (ABC Disabled/NA by Default)

If ABC sensor is not enabled by default perform only once

Standby mode test

- Standby-Passive
- Standby-Active, High

Off Mode Test

- Only applicable to TVs that cannot be turned on by remote.
- Must possess an additional switch that puts the unit into a lower power state

Summary of NOPR

Supporting data available on the DOE website

- Television Test Procedure Comparison Chart
- Video Signal of Test Patterns Comparison Table
- Room Illuminance Measurements During TV Viewing: Pilot Study
- Round Robin Test Program Final Report for Televisions
- Television Energy and Luminance Test Data Set

Summary of NOPR

Raw data supporting the NOPR can be found on the DOE website

Television Energy and Luminance Test Data Set

- Television Luminance
- Television Luminance Stabilization Period
- Television Power
- Television Internet Standby
- Television 9-point Video Signal Comparison
- Television On Mode Automatic Brightness Control
- Television Download Acquisition Mode
- Television 3D Mode

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Test Procedure Scope

DOE's proposed scope includes:

- Television sets of 15 inches and above which are sold with a tuner.

TV Definitions (cont.)

DOE has modified (or updated) 1979 test procedure definitions

- Old Definitions
  - Television Set
  - Color Television Set
  - Monochrome Television Set

- Proposed Definition
  - Television Set: A product designed to be
    - Powered primarily by mains power
    - Having a diagonal screen size of fifteen inches or larger
    - That is manufactured with a TV tuner, and
    - That is capable of displaying dynamic visual information from wired or wireless sources

Definitions

- DOE proposed definitions harmonize with:

IEC 62087 – 2011 definitions	ENERGY STAR v. 5.3 definitions
• Additional Functions • Off Mode • Standby-Passive Mode • Standby-Active, High Mode • Standby-Active, Low Mode	• Download Acquisition Mode • Luminance • On Mode • TV Combination Unit

- DOE developed definitions for:
  - Home Picture Setting
  - Retail Picture Setting

Issue 1 - DOE seeks comments from interested parties on the proposed scope of this rulemaking, as well as the definition of TVs. Specifically, DOE would like comments on including both TVs and displays greater than 15 inches which are sold with a TV tuner.

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Accuracy and Precision of Measurement Equipment

DOE is proposing input and voltage frequency requirements for all tests

- Power supply providing voltage of 115 V at 60 Hz
- Total harmonic distortion within 5%
- Power factor measurement
- Uncertainty requirements no greater than 2% at a 95% confidence level

Light Measurement Device (LMD) Specifications

- DOE proposes to allow the use of both contact and distance luminance meters.

- DOE proposes to set specifications for the LMDs to ensure results are similar for both meters.
  - *Accuracy of ± 2 percent (± 2 digits) of the digitally displayed value and repeatability within 0.4 percent (± 2 digits) value.*
  - *Acceptance angle of 3 degrees or less.*

Issue 2 - DOE seeks comments from interested parties on the LMD equipment specifications proposed in this NOPR.

Test should be conducted under standardized settings

- Dark Room Conditions
  - Room illuminance shall not exceed 1.0 lux while in dark room conditions
- Ambient Temperature and Humidity
  - Temperature: 23°C +/- 5°C
  - Relative Humidity: 20% - 80%
- Signal Source and Generation
  - Dynamic video content from IEC 62087-2011

Issue 3 - DOE seeks comments from interested parties on the signal source and generation specified in this NOPR.

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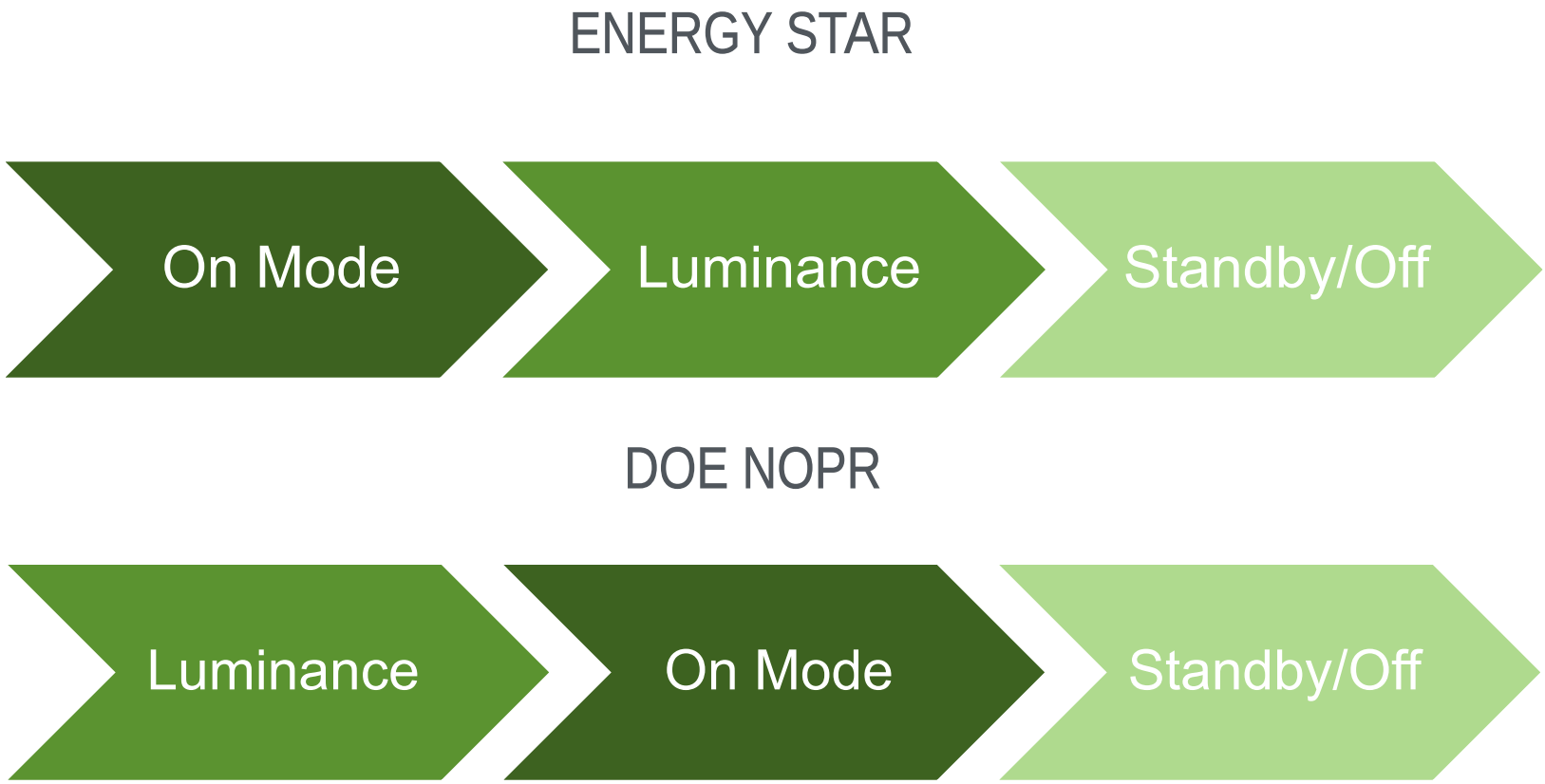
DOE NOPR proposes revising testing order from that specified in ENERGY STAR v. 5.3



DOE NOPR proposes testing in two picture settings

- A luminance test has been included to allow for other policy makers to use in their specifications to prevent overly dim home picture settings, including:
  - Energy Star
  - California Energy Commission
- The luminance test will be conducted in both home and retail picture settings to determine a ratio.
- The on mode power consumption test will only be conducted in the home picture setting.

Luminance Test

- Home Picture Setting

  Definition - the picture setting which is recommended by the manufacturer from the initial set up menu or the mode that the television comes shipped in if no setting is recommended.

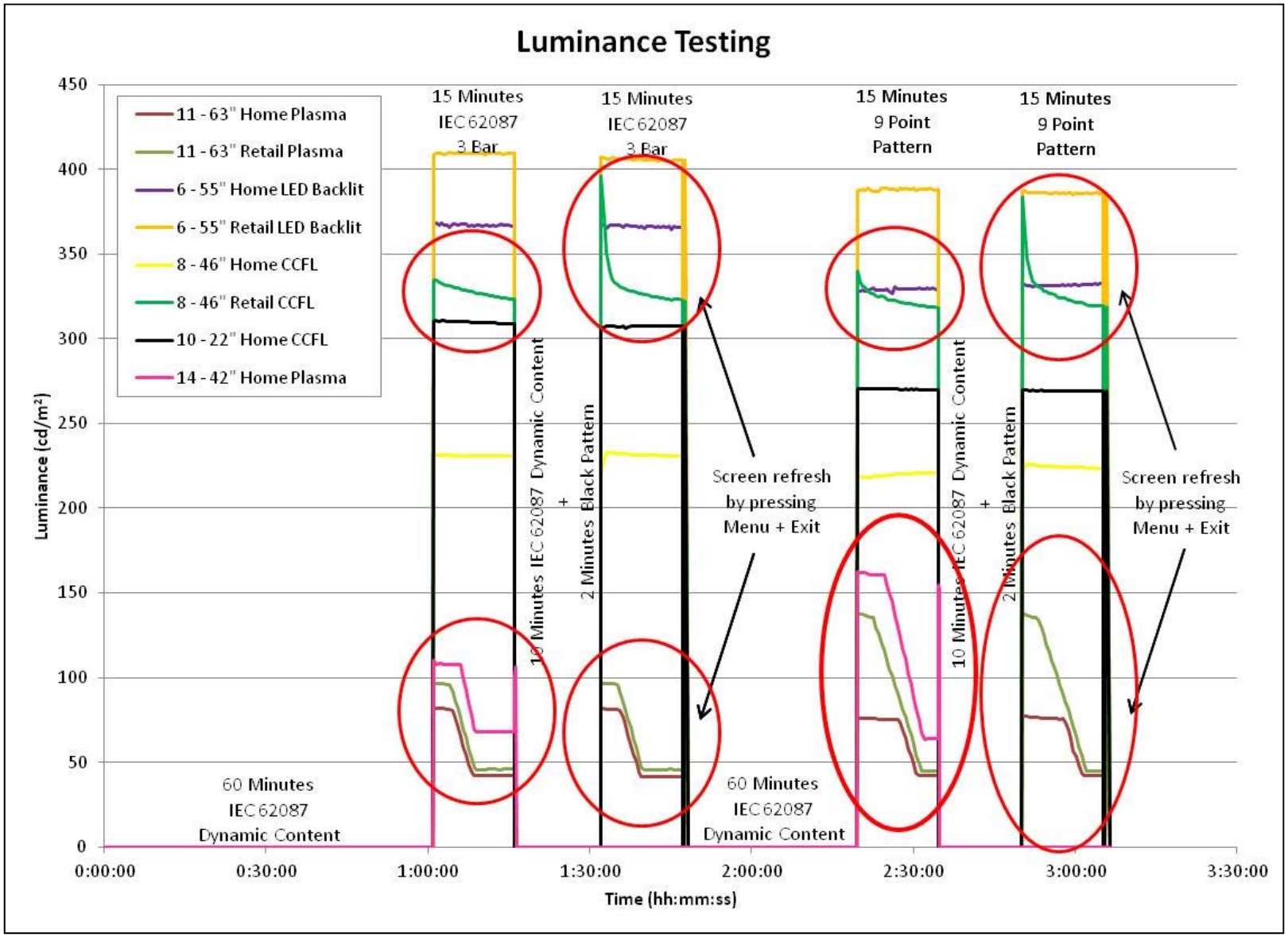
- Retail Picture Setting

  Definition - the preset picture setting in which the TV produces the highest luminance during the on mode conditions.

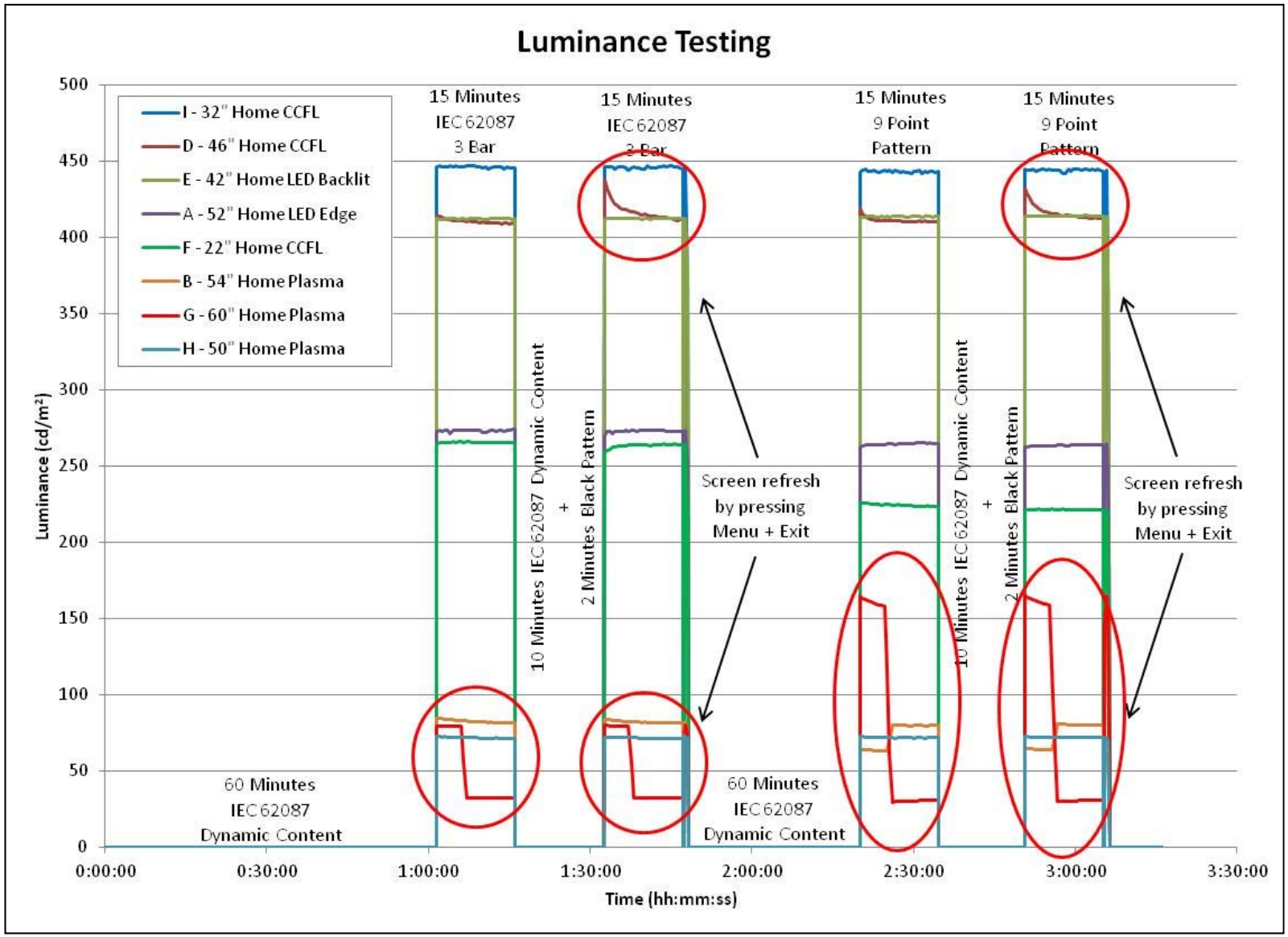
- Easy-to-Access Picture Settings
  - DOE is currently considering testing these settings

Issue 4 - DOE seeks comments from interested parties on its proposal to conduct luminance tests in home picture setting and retail picture setting. For testing on mode energy consumption, DOE seeks comment on its proposal to test in home picture setting, along with its consideration to test on mode in both the highest and lowest energy consuming picture settings (or brightest or dimmest), or all picture settings.

Luminance Test

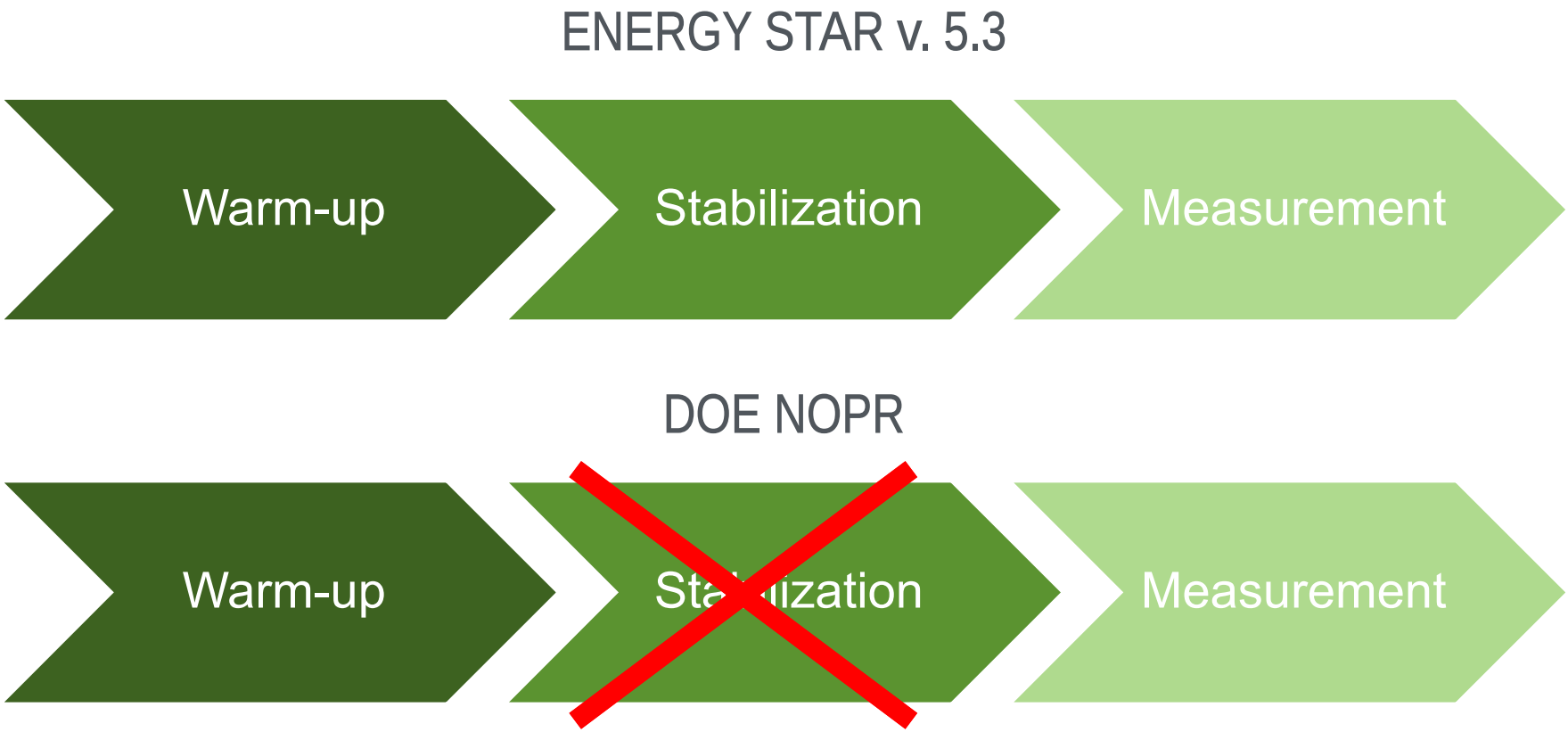


Luminance Test



Luminance Test

DOE NOPR proposes that TVs are warmed-up but not stabilized to ensure consistency in luminance and to prevent power limiting



Luminance Test

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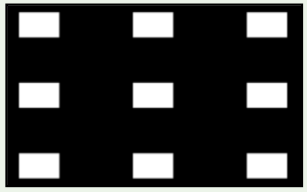
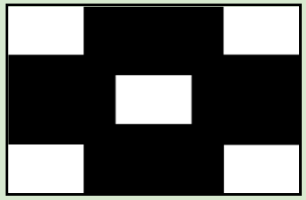
	Video Signal	Sample Image	Average Picture Level (APL)	Usage
DOE NOPR	**3-Bar Video Signal**		**50%**	• **Default video signal for display industry** • **Initially developed for use with CRT displays**
DOE's Considerations	9-Point Video Signal		17%	• Chinese TV Test Procedure • ISO/IEC Test Procedure for front projectors
DOE's Considerations	DOE 5-Point Video Signal		34%	• Developed by DOE as part of this proposed test procedure
DOE's Considerations	Dynamic Video Signal		~34%	• In development by IEC

Luminance Test

3-Bar Video Signal (50% APL)

Advantages

- Already referenced by ENERGY STAR, CEC, and IEC
- Pattern widely available on DVD or Blu-ray test discs

Limitations

- APL higher than typical TV program content
- No reference point for vertical centering
- Static pattern – not representative of dynamic video typical of TV program content
- Results in quick automatic brightness limiting for plasmas due to the amount of white on the screen

Luminance Test

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9-Point Video Signal (17% APL)

Advantages

- Results in less automatic brightness limiting for plasmas than the 3 bar
- White target in the middle of screen which allows for centering

Limitations

- May disproportionately disadvantage plasma TVs
- APL lower than typical TV program content
- Static pattern – not representative of dynamic video typical of TV program content
- Results in automatic brightness limiting for some plasmas

Luminance Test

DOE 5-Point Video Signal (34% APL)

Advantages

- APL of typical broadcast content
- White target is in the middle of screen which allows for centering
- Similar in appearance to an available VESA 5-point pattern (RT01BN)

Limitations

- Static pattern – not representative of dynamic video typical of TV program content
- Results in automatic brightness limiting for some plasmas

Luminance Test

Dynamic Video Signal (~34% APL)

Advantages

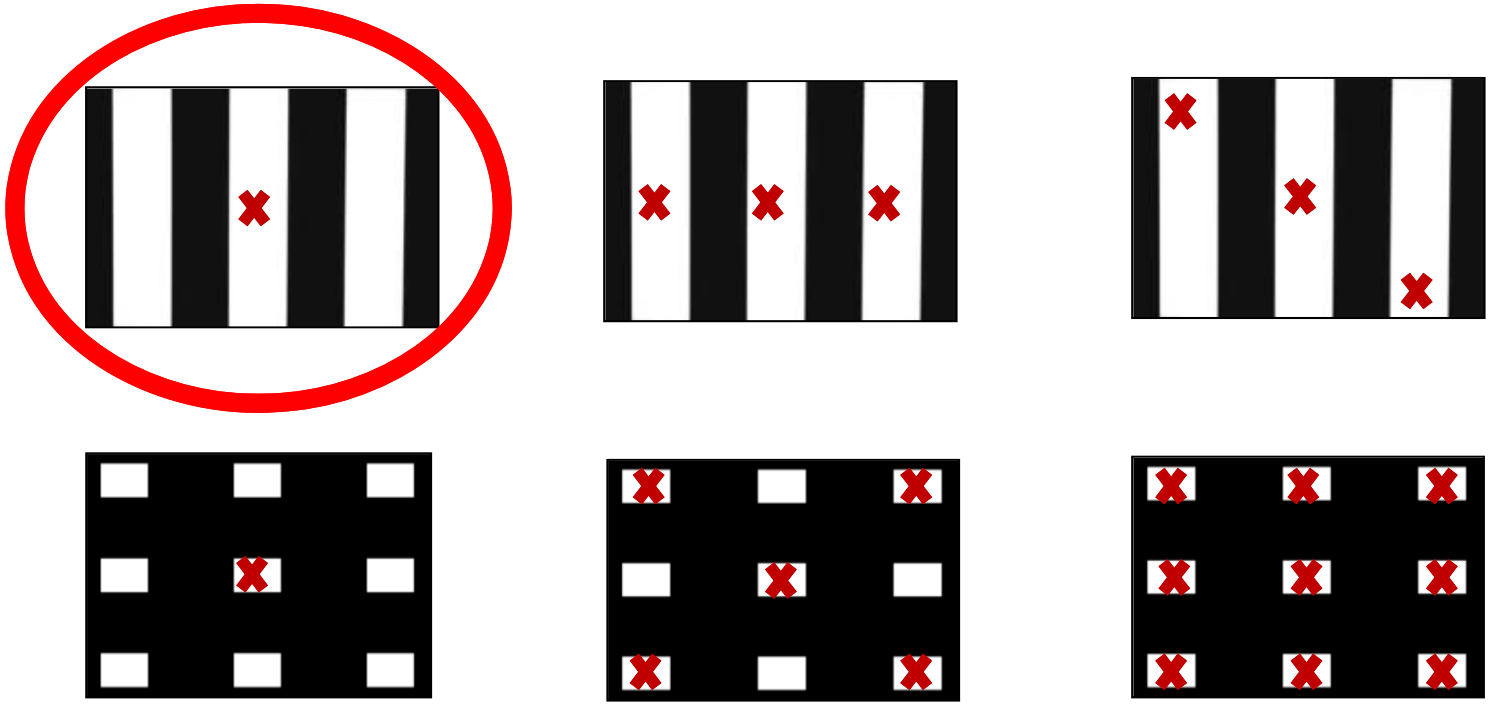
- APL of typical broadcast content
- Not a static image – representative of dynamic video typical of TV program content (reduces ABL issue)
- Pattern under consideration by IEC

Limitations

- Pattern not yet finalized by IEC
- Measurement procedure yet to be determined

Luminance Test

DOE considered single and multiple measurements



- DOE is proposing to take a single luminance measurement perpendicular to the center of the screen

Luminance Test

Issue 5 – DOE seeks comments from interested parties on its proposed method of luminance testing. DOE also seeks comments on its proposal to include a luminance ratio.

Issue 6 - DOE seeks comments on the proposed method of taking the luminance measurement immediately after displaying the three bar video signal.

Issue 7 - DOE seeks comments from interested parties on its proposal to use the three bar video signal for luminance testing. DOE further seeks comments on any of the additional video signals that it considered.

Issue A - DOE seeks comments on aligning with the IEC language that outlines a 1 hour off mode period prior to a 1 hour warm-up time and a 3 hour maximum on-mode duration.

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On Mode Tests

There are two methods for testing on mode energy consumption depending on initial as shipped settings

ABC Enabled (by default)

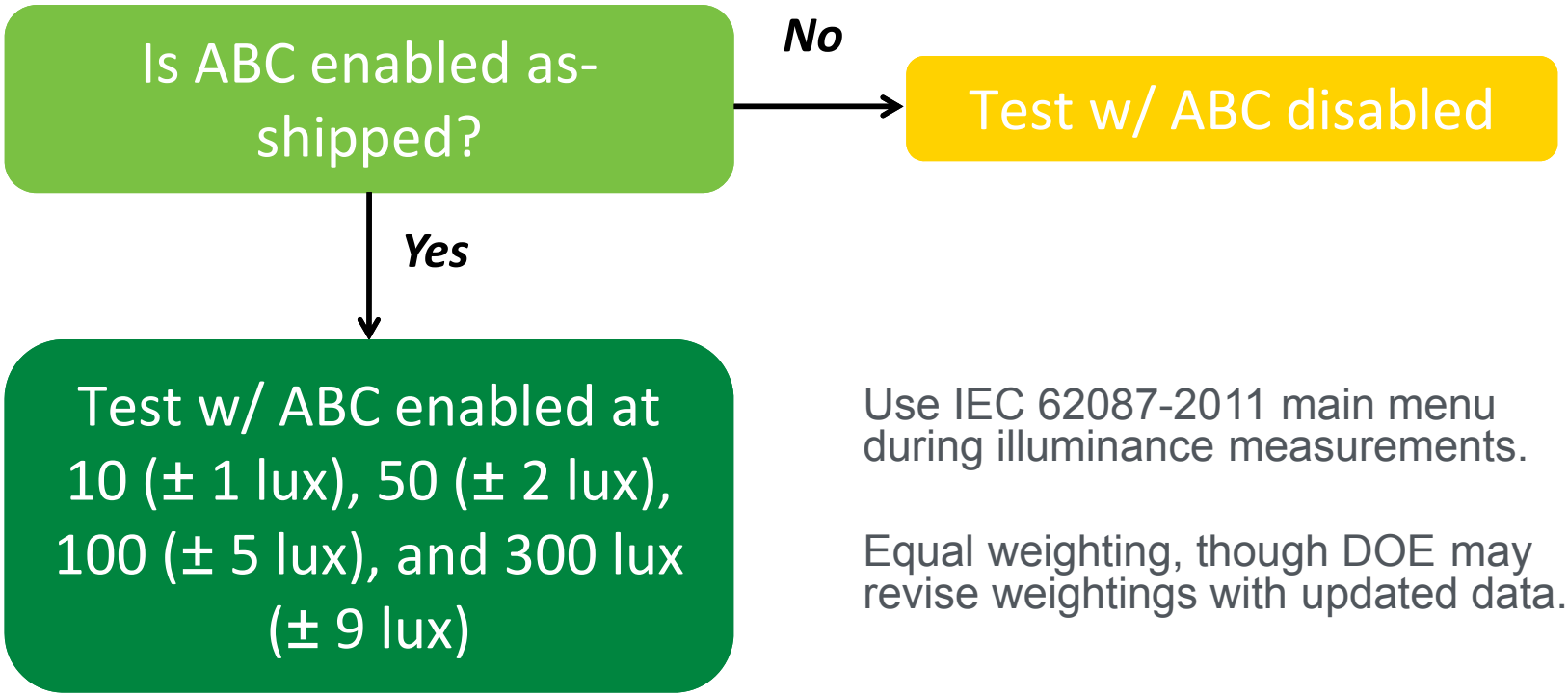
- Room illuminance levels
- Method for creating illuminance levels

ABC Disabled (by default or N/A)

- Tested in home mode

On Mode Tests

If ABC is disabled by default, the TV should be tested in the home picture setting otherwise multiple room illuminance are to be tested.



Use IEC 62087-2011 main menu during illuminance measurements.

Equal weighting, though DOE may revise weightings with updated data.

On Mode Tests (ABC Enabled)

Different methods can be used for creating room illuminance levels

Direct light

Diffused light

DOE proposes to shine light directly at the ABC sensor. DOE considered alternatives such as a diffuse light source, but determined that such alternatives would not be easily repeatable.

On Mode Tests (ABC Enabled)

Different types of lighting can be used as a light source

Incandescent

Compact Fluorescent

Light-Emitting Diode

DOE proposes to use a halogen incandescent light source. This light source has a continuous spectral distribution, and DOE believes it is sufficient for creating a repeatable lighting condition.

On Mode Tests (ABC Enabled)

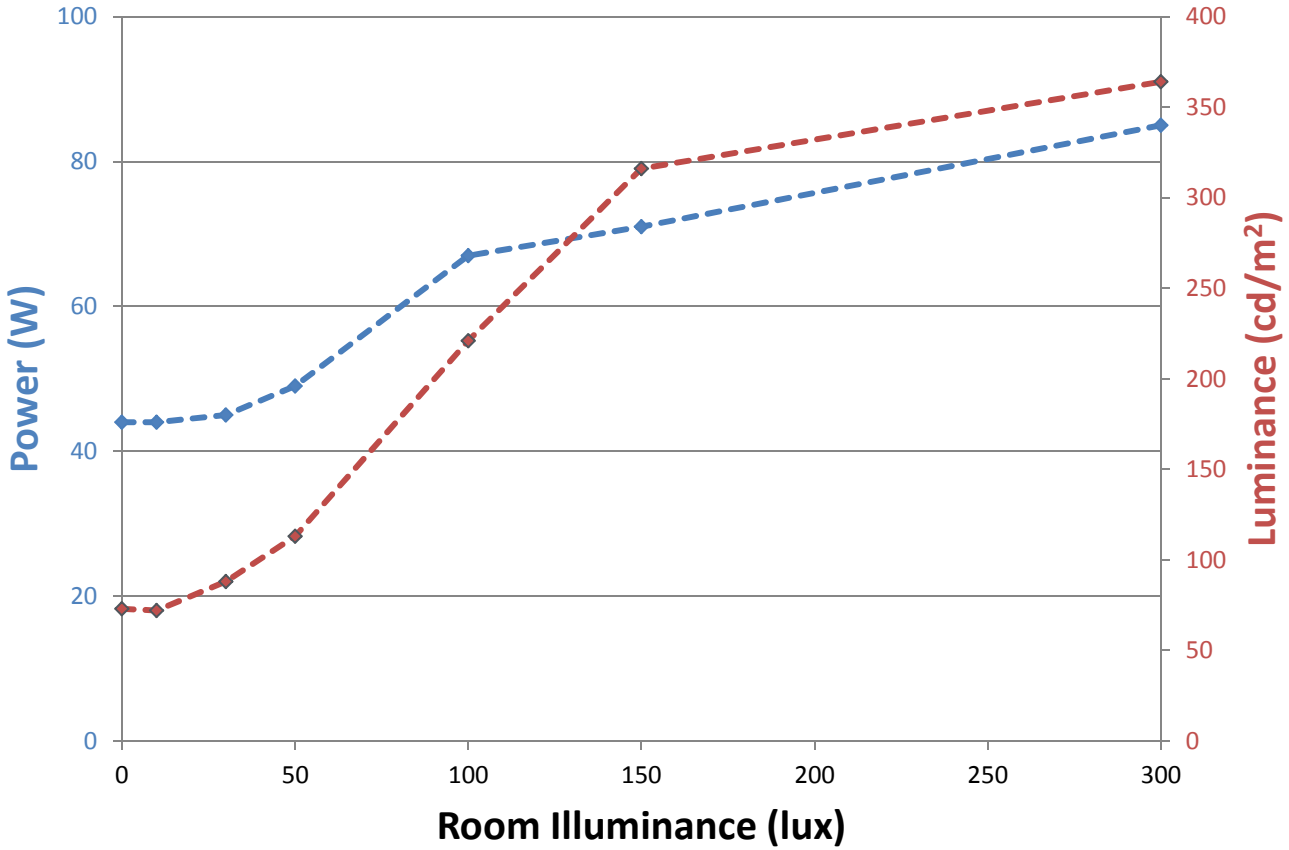
Issue 9 - DOE seeks comments from interested parties on the method for creating room illuminance levels including both the direct light method, that it proposed in this NOPR, and the diffused light method, considered in this NOPR. DOE also seeks comments from interested parties on setting a color temperature range and a potential warm up period associated with other light sources in that range.

Testing TVs with ABC Enabled

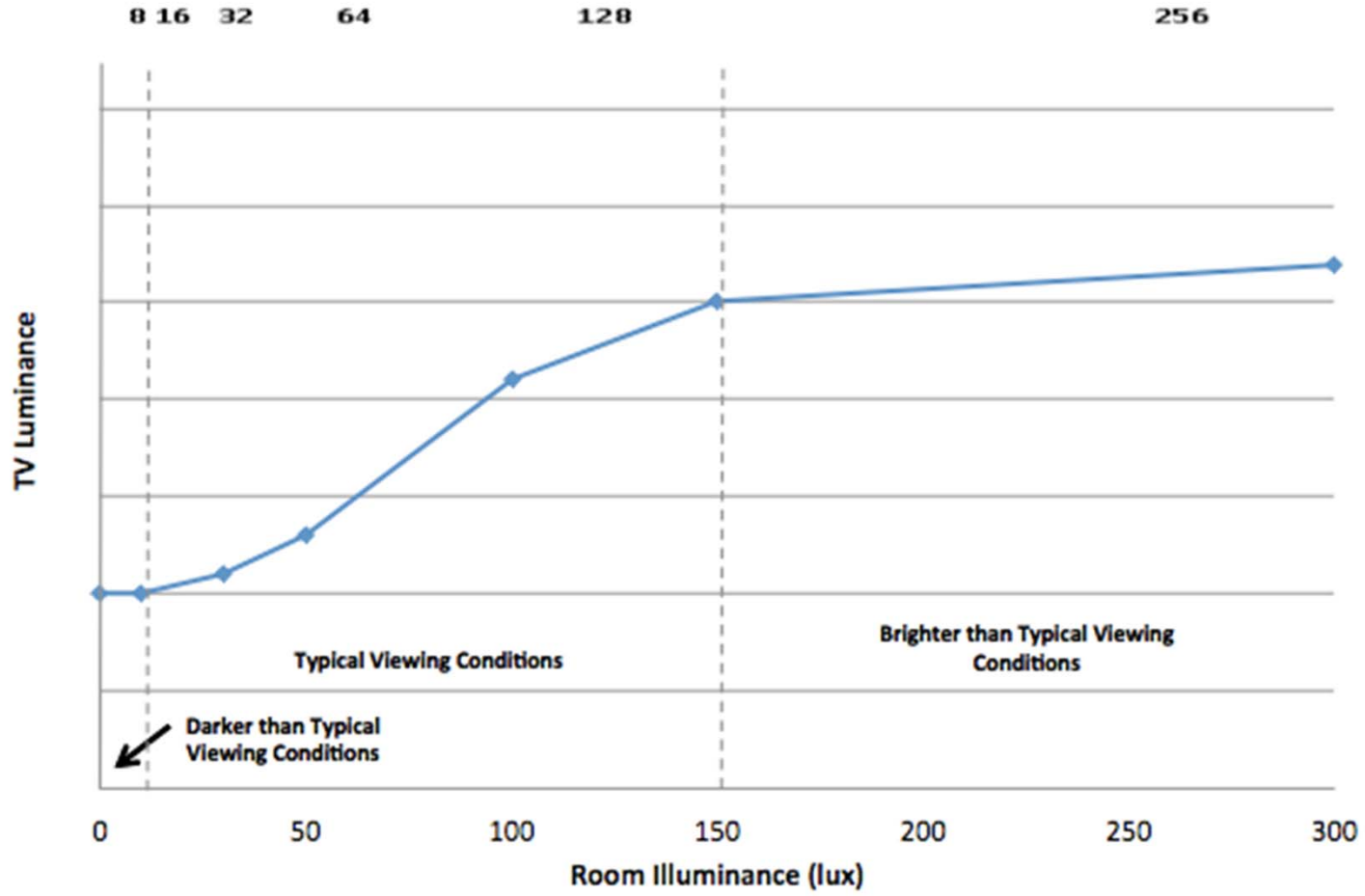
- IEC 62087-2011 and ENERGY STAR v5.3 currently require TVs with ABC enabled by default to be tested differently than those without ABC enabled by default.
- DOE requested comment on testing TVs with ABC enabled in RFI. (75 FR 54048)
- Interested parties generally in support of adopting a test procedure for TVs with ABC enabled by default.
- Comments submitted urged adoption of a repeatable and representative test procedure.
- DOE is therefore proposing to incorporate a test procedure for TVs with ABC enabled by default.

Automatic Brightness Control

- Screen luminance (cd/m^2) is adjusted based on ambient room illuminance (lux).
- Clear relationship between TV luminance and power.



Theoretical ABC Response



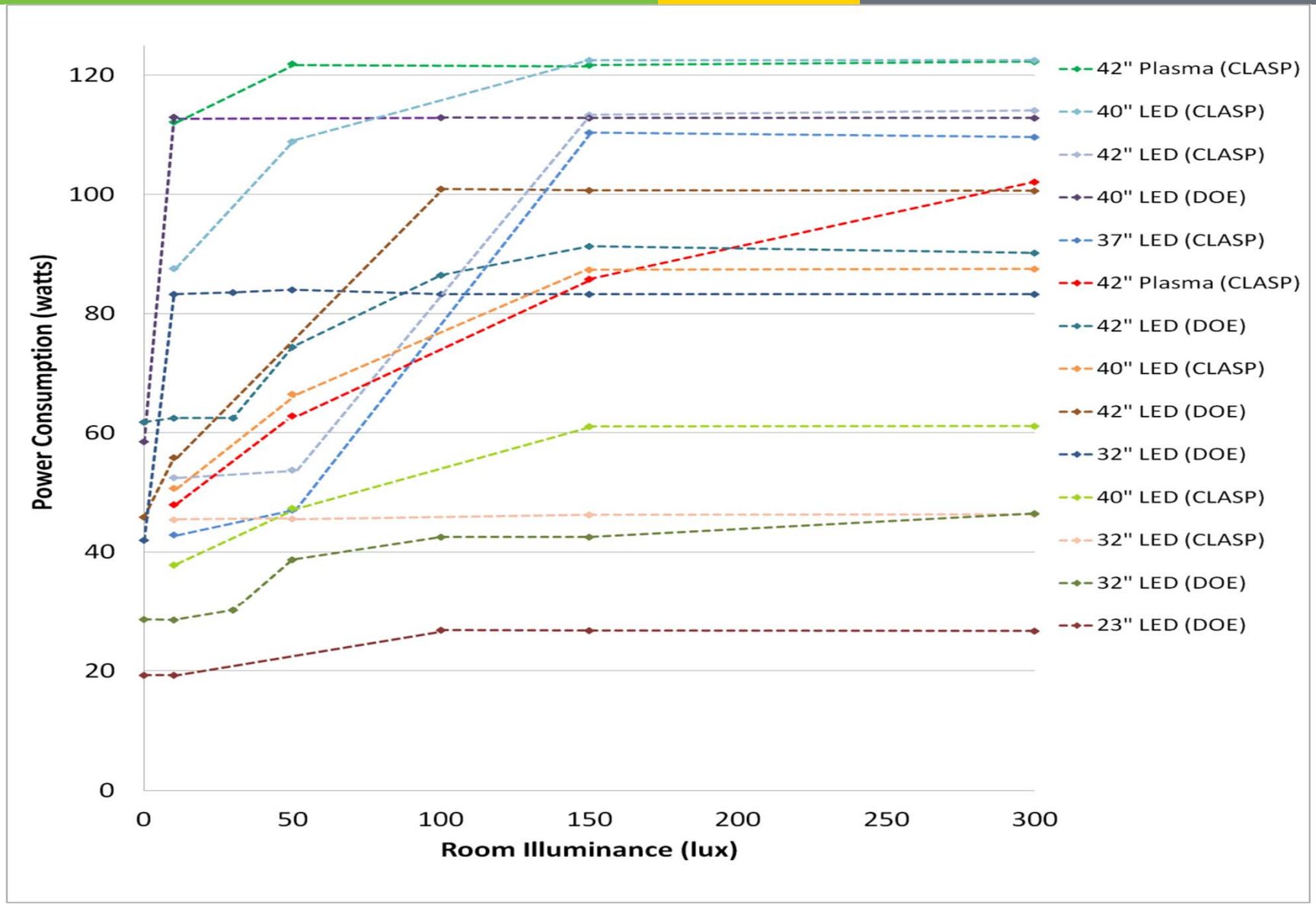
TV luminance levels can be based on Imaging Science Foundation's recommended brightness levels, and average consumer preferences as derived in Masumoto et al., 2011, *Appropriate Luminance of LCD-TV Screens under Actual Viewing Conditions at Home*, Journal of the Society for Information Display, Volume 19, Issue 11, pp. 813-820.

Testing TVs with ABC Enabled

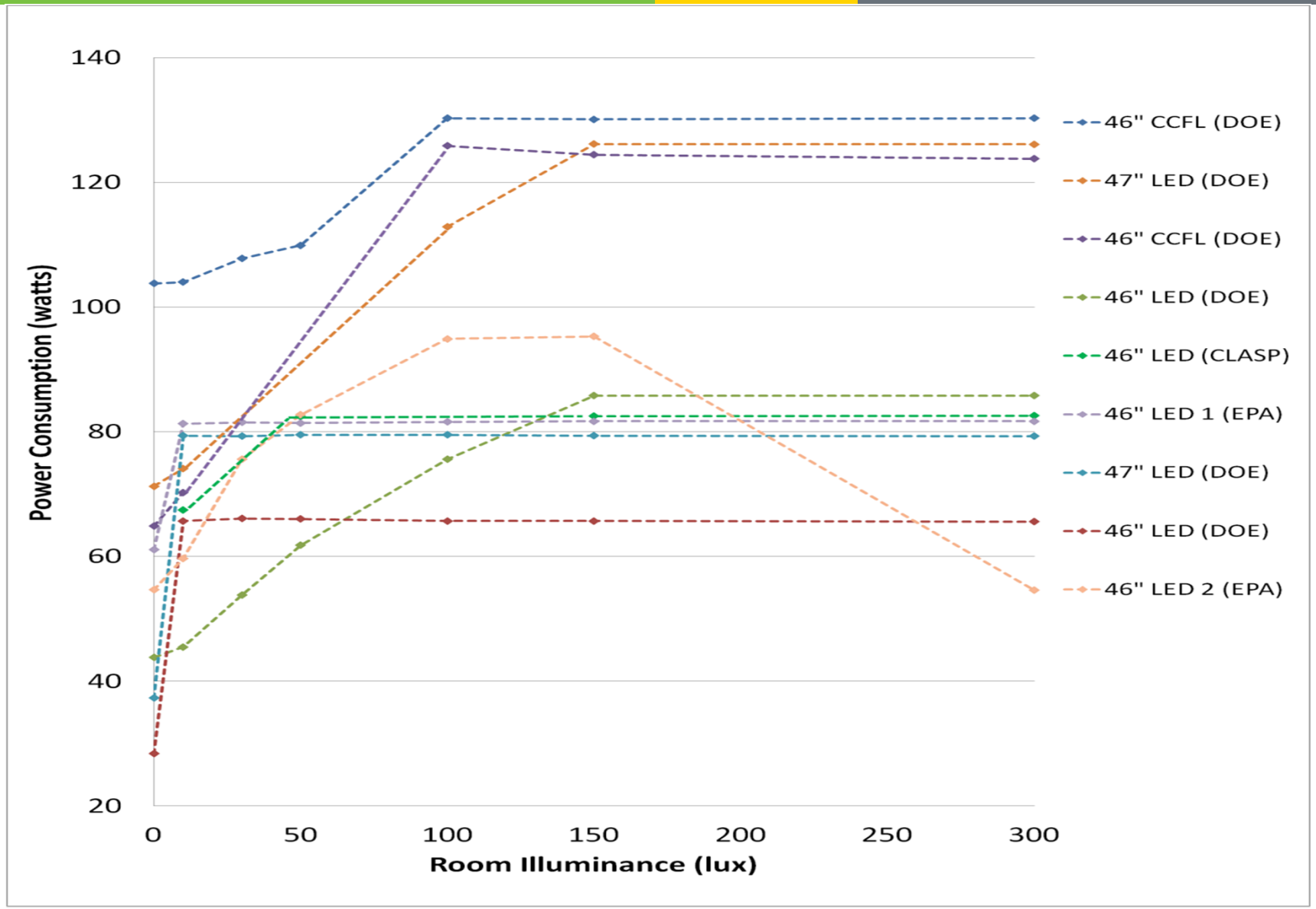
- IEC 62087-2011 and ENERGY STAR v5.3 currently require ABC testing at 0 lux and greater than 300 lux.
- A recent study* demonstrated that ABC is often implemented in a manner that does not take full advantage of potential energy savings.
- TV luminance at 0 lux is sometimes very dim.
- Some TVs implement ABC using a gradual response curve, others utilize a step function.
- Measurements at only 0 lux and greater than 300 lux may result in reported energy consumption values that are not representative of actual use.
- Actual room illuminance in homes is uncertain, though recent studies have provided preliminary results.

* Calwell, C., Mercier, C., & Foster-Porter, S., 2010, *Assessment of Options for Improving Energy Efficiency Test Procedures for Display*.
http://www.efficientproducts.org/%5Creports%5Ctvs%5CEcos_Display%20Test%20Procedure%20Report_FINAL.pdf

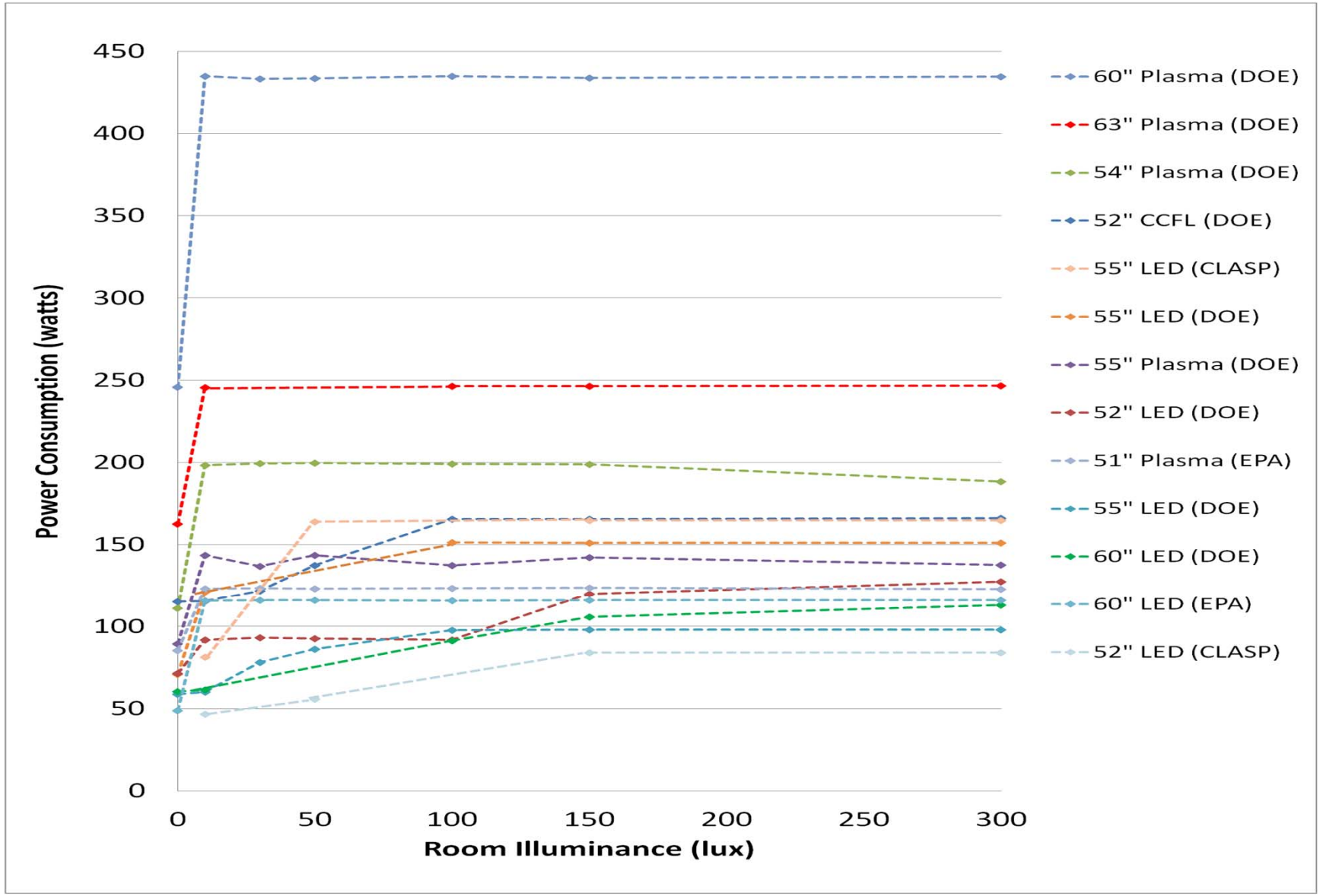
ABC Testing: 23”-42”



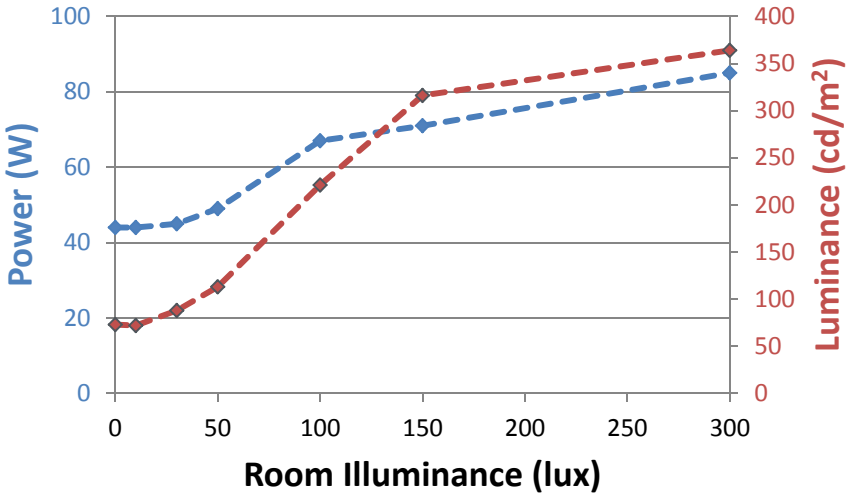
ABC Testing: 46”-47”

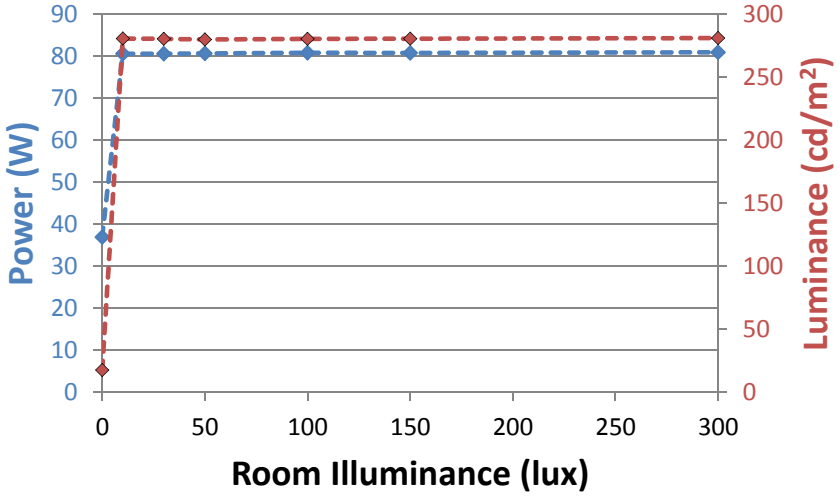


ABC Testing: 51”+



Summary of ABC Approaches





- Significant power savings possible when ABC response curve is gradual instead of step-wise.
- 100 lux does not represent ABC sensor saturation (maximum luminance) for all TVs.
- 300 lux does generally represent ABC sensor saturation (maximum luminance), with some exceptions.
- Luminance at 0 lux is sometimes very dim.

Summary of ABC Testing

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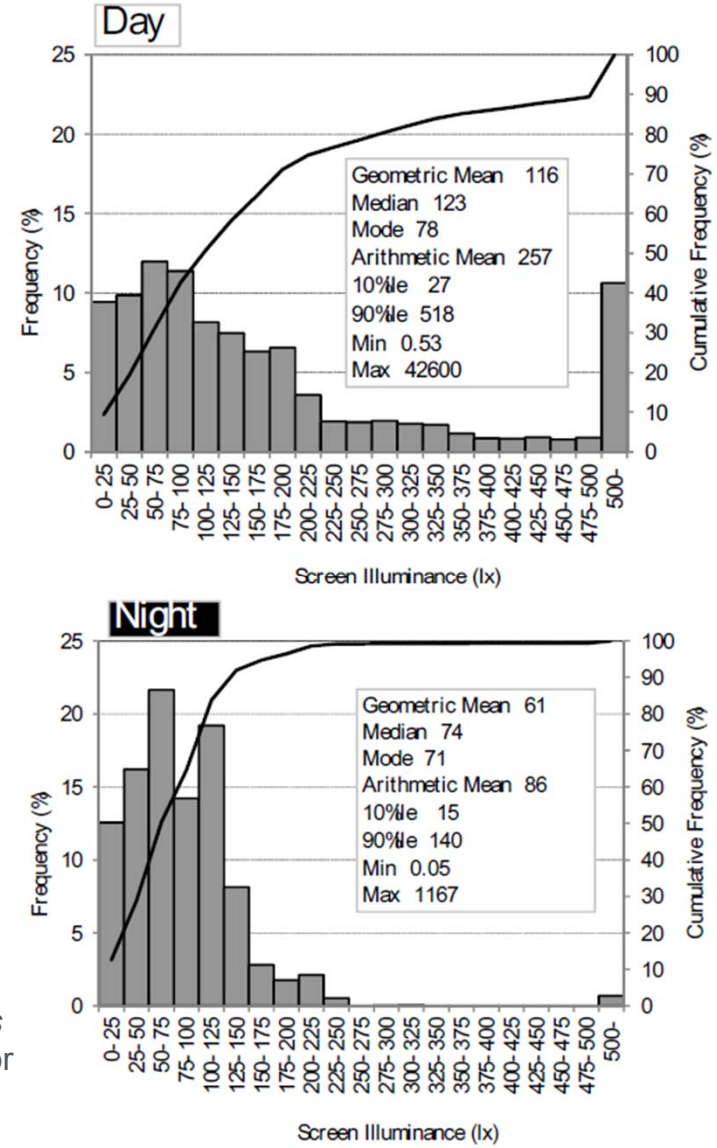
ID	Year	Size/Tech	Power (W)							Luminance (cd/m2)						
			0 lux	10 lux	30 lux	50 lux	100 lux	150 lux	300 lux	0 lux	10 lux	30 lux	50 lux	100 lux	150 lux	300 lux
DOE 1	2010	23" LED	19	19	-	-	27	27	27	-	-	-	-	-	-	-
DOE 2	2010	32" LED	42	83	84	84	83	83	83	41	297	296	296	297	298	299
DOE 3	2010	32" LED	29	29	30	39	43	43	47	128	128	142	203	238	247	259
DOE 4	2010	40" LED	59	113	-	-	113	113	113	-	-	-	-	-	-	-
DOE 5	2010	42" LED	62	63	63	74	87	91	90	94	98	130	159	231	248	234
DOE 6	2010	42" LED	46	56	-	-	101	101	101	-	-	-	-	-	-	-
DOE 7	2010	46" CCFL	104	104	108	110	130	130	130	232	234	241	247	283	300	299
DOE 8	2010	46" LED	28	66	66	66	66	66	66	29	236	236	236	236	236	236
DOE 9	2011	46" LED	44	46	54	62	76	86	86	73	72	88	113	221	316	364
DOE 10	2010	46" CCFL	65	70	-	-	126	124	124	-	-	-	-	-	-	-
DOE 11	2011	47" LED	37	79	79	80	80	79	79	18	286	282	283	285	284	284
DOE 12	2010	47" LED	71	74	-	-	113	126	126	-	-	-	-	-	-	-
DOE 13	2010	52" CCFL	115	116	122	137	166	166	166	165	169	187	227	301	301	302
DOE 14	2010	52" LED	71	92	93	93	92	120	128	93	267	266	266	267	267	267
DOE 15	2010	54" Plasma	111	198	199	200	199	199	188	23	79	80	80	79	79	79
DOE 16	2011	55" Plasma	89	144	137	144	137	142	138	27	64	64	63	64	63	63
DOE 17	2010	55" LED	59	60	78	86	98	98	98	92	92	152	188	236	236	237
DOE 18	2010	55" LED	71	121	-	-	151	151	151	-	-	-	-	-	-	-
DOE 19	2010	60" Plasma	246	435	433	433	435	434	435	68	75	80	81	80	80	80
DOE 20	2010	60" LED	60	61	-	-	91	106	113	-	-	-	-	-	-	-
DOE 21	2010	63" Plasma	163	246	-	-	246	247	247	-	-	-	-	-	-	-
ES 1	2011	46" LED 1	61	81	82	81	82	82	82	158	278	278	278	278	278	277
ES 2	2011	60" LED	49	116	116	116	116	116	116	116	407	408	407	407	408	409
ES 3	2011	46" LED 2	55	60	76	83	95	95	55	95	155	233	269	302	302	94
ES 4	2011	51" Plasma	85	123	123	123	123	124	123	38	63	63	63	63	63	63
CLASP 1	2010	42" Plasma	-	48	-	63	-	86	102	-	29	-	42	-	111	172
CLASP 2	2010	42" Plasma	-	112	-	122	-	122	122	-	78	-	79	-	79	79
CLASP 3	2010	46" LED	-	67	-	82	-	83	83	-	194	-	275	-	278	279
CLASP 4	2010	40" LED		88	-	109	-	123	123	-	126	-	177	-	202	205
CLASP 5	2010	55" LED	-	81	-	164	-	165	165	-	49	-	426	-	427	427
CLASP 6	2010	42" LED	-	52	-	54	-	113	114	-	38	-	44	-	326	326
CLASP 7	2010	37" LED	-	43	-	47	-	110	110	-	56	-	122	-	528	528
CLASP 8	2010	40" LED		38	-	47	-	61	61	-	68	-	130	-	207	208
CLASP 9	2010	40" LED	-	51	-	67	-	87	88	-	92	-	143	-	277	278
CLASP 10	2010	52" LED	-	47	-	56	-	84	84	-	82	-	123	-	217	218
CLASP 11	2010	32" LED	-	45	-	46	-	46	46	-	120	-	120	-	121	194

Room Illuminance in Homes

- Prior to 2011, very limited data on representative room illuminance values found in homes.
- 2011 Japanese study found that most common range was 50-75 lux, with 50%+ of measurements at 100 lux or less.
- Not necessarily indicative of U.S. homes, however.



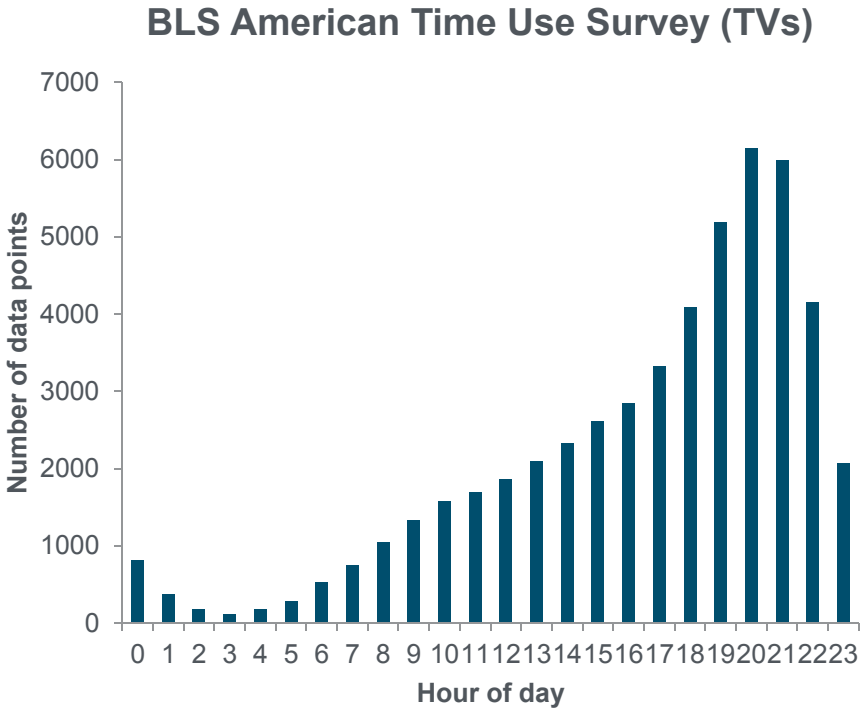
Masumoto et al., 2011, *Appropriate Luminance of LCD-TV Screens under Actual Viewing Conditions at Home*, Journal of the Society for Information Display, Volume 19, Issue 11, pp. 813-820.

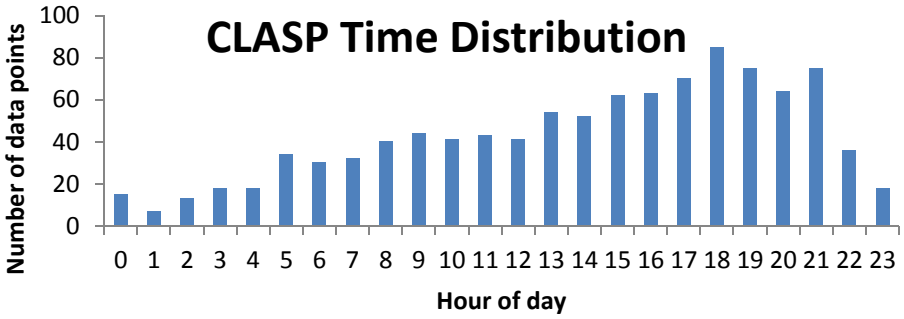
Room Illuminance in Homes

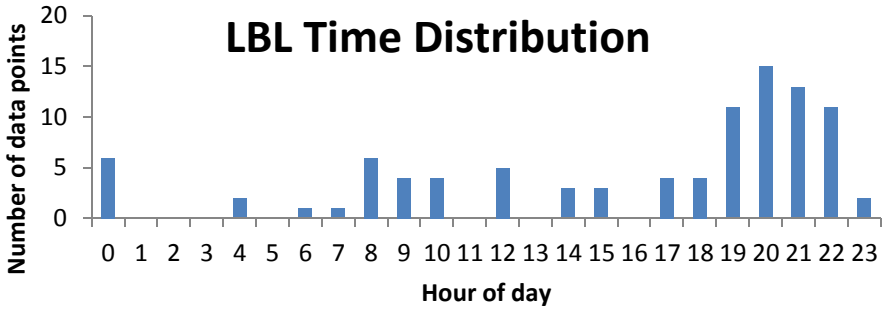
Recent U.S. Studies

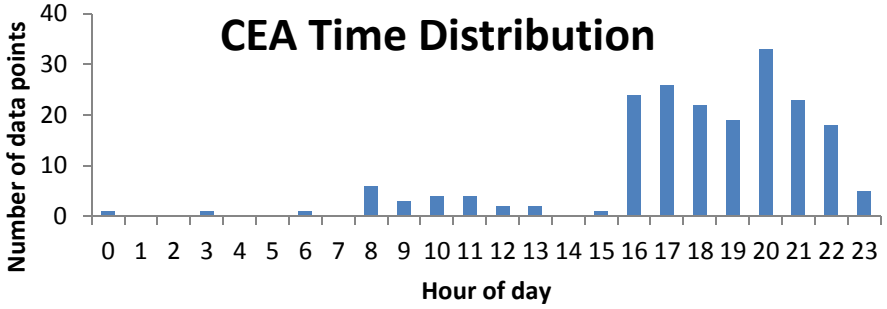
	Number of Homes	Locations	Dates	Measurement Method
LBNL	9 (pilot)	CA and CO	May-June 2011	Simultaneous metering of TV power and room illuminance at 10-minute intervals, over 1-2 weeks
CLASP	60	CA and DC	Oct.-Nov. 2011	Simultaneous metering of TV power and room illuminance at 5-minute intervals, over 1-2 weeks
CEA/CEDIA	234 (35 excluded)	Various (majority in CA)	Sept.-Dec. 2011	One-time spot measurement of room illuminance with room arranged as if watching TV

TV Viewing Time Distributions

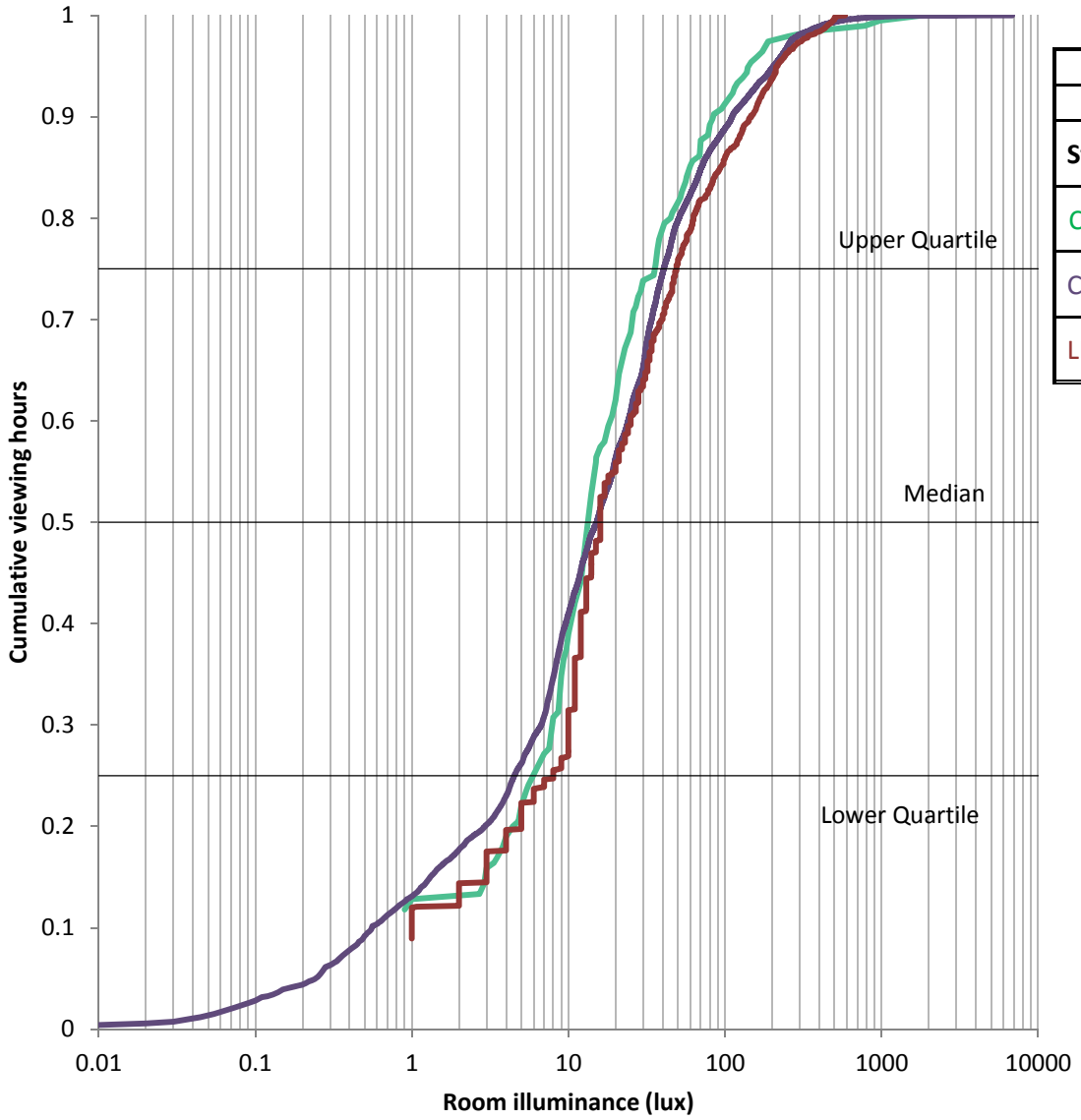








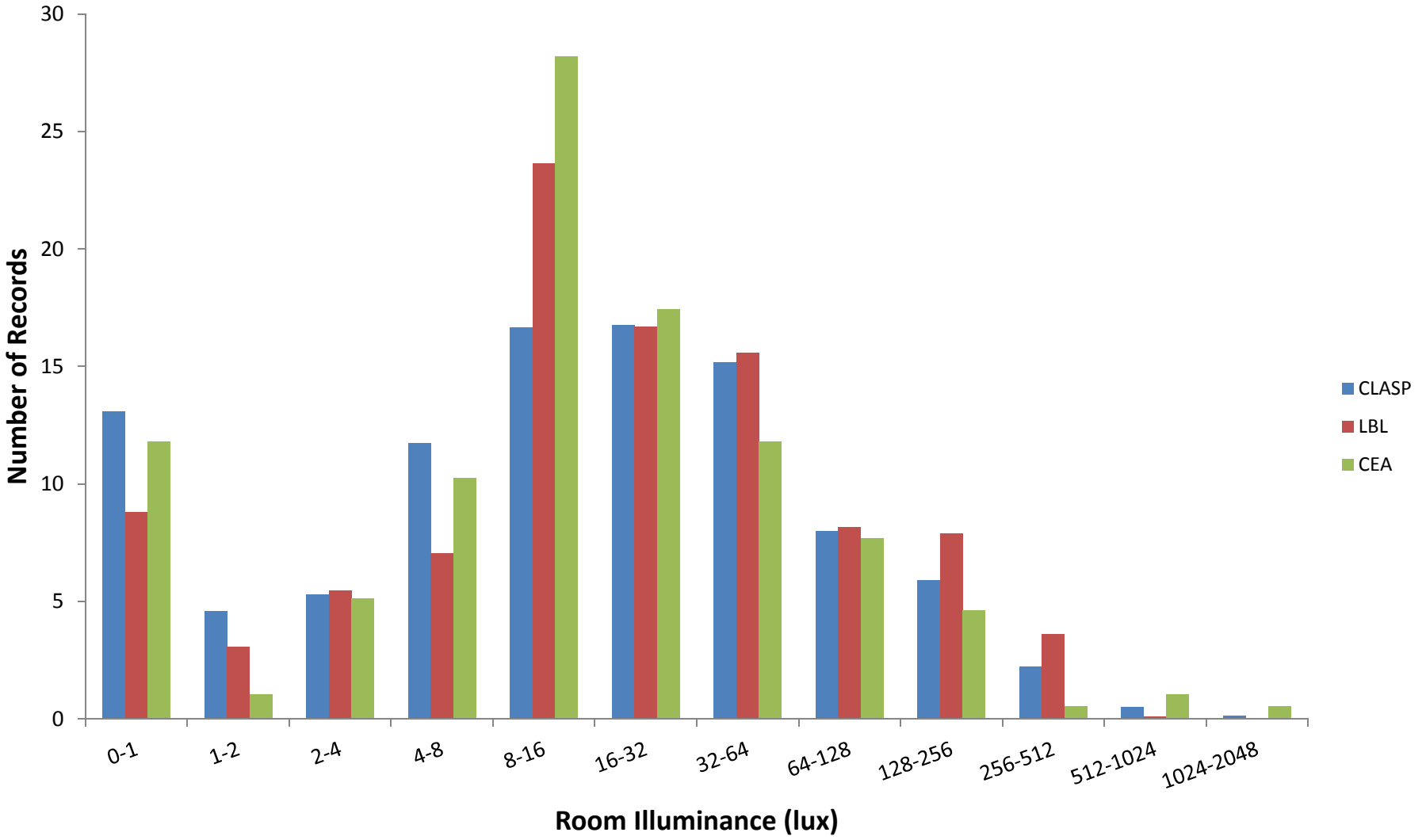
Room Illuminance in Homes



	Cumulative viewing hours (%)						
	12.5	**25**	**37.5**	**50**	**62.5**	**75**	**87.5**
Study	***Room illuminance (lux)***						
CEA	1.0	5.9	9.7	13.3	20.2	35.6	69.9
CLASP	0.9	4.5	8.8	15.1	26.4	40.6	87.4
LBL	2	8	12	16	28	49	119.5

CEA
CLASP
LBL
Lower Quartile
Median
Upper Quartile

Room Illuminance in Homes



Summary of Room Illuminance Studies

- 0 lux is an extreme condition (occurring less than 0.2% in CLASP data) and allows for artificial behavior during testing.
- 300 lux is extreme condition occurring less than 5% of the time, though does generally correspond to maximum TV luminance.

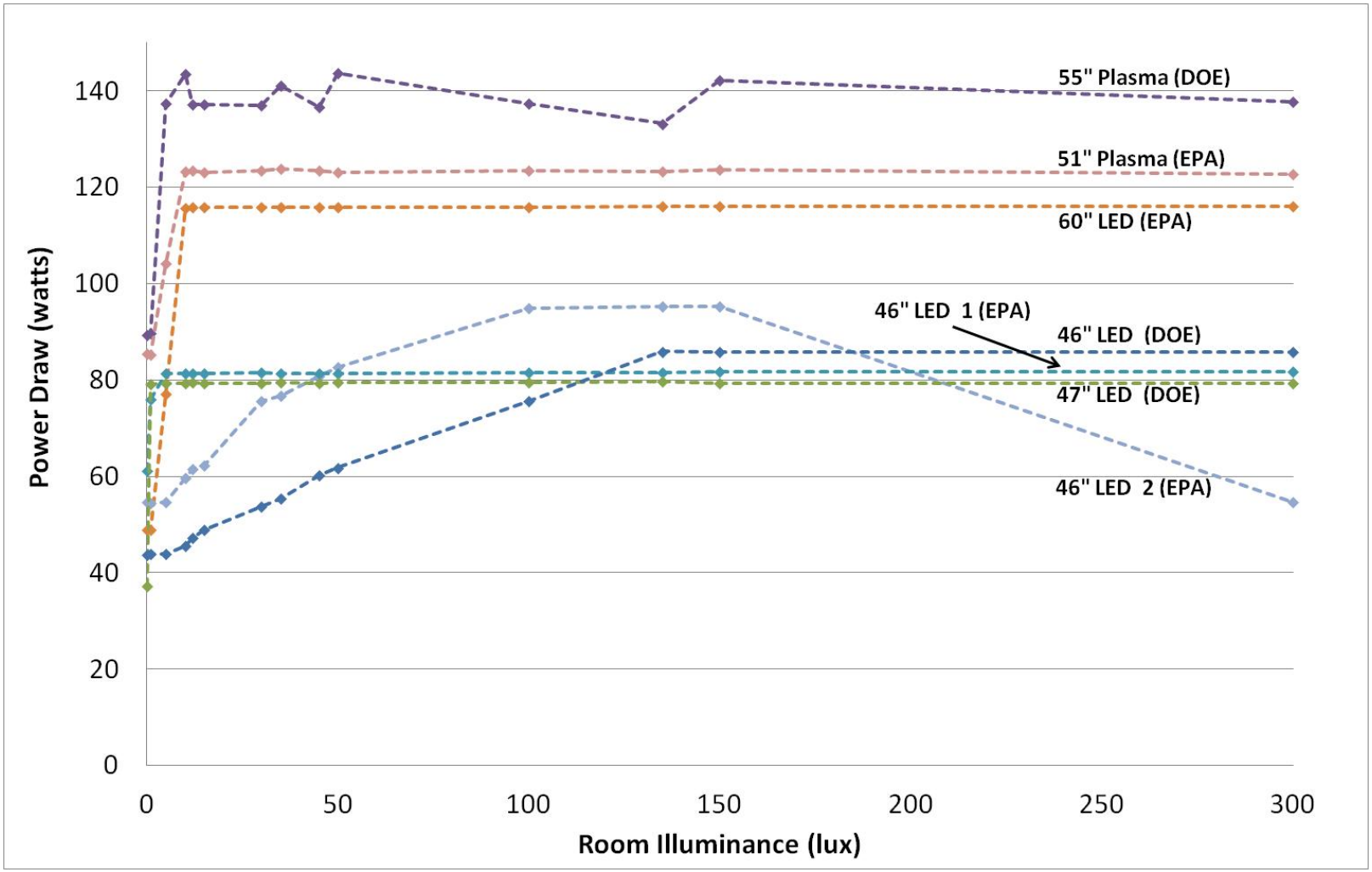
- The peak of the distribution occurs between 10-15 lux.
- Over 30% of data in all 3 studies are at or below 10 lux.
- Over 75% of data in all 3 studies are at or below 50 lux.
- Over 85% of data in all 3 studies are at or below 100 lux

- Future home illuminance studies should include a representative household sample, and span a range of dates during the year. Weekends and weekdays must be appropriately sampled.

On Mode Tests (ABC Enabled)

- Some stakeholders have suggested 0/12/35/300 lux as measurement points, in comments to ENERGY STAR.
- Some stakeholders have suggested keeping 0/300 lux, with a third measurement point near 10 lux, in comments to ENERGY STAR.
- CLASP recommends three measurement points between 10 and 100. This is consistent with DOE's proposed levels of 10/50/100/300 lux.
- If one picks the 25th, 50th, and 75th percentiles from in-home studies, then the illuminance values are 5/15/45 lux. Extending logarithmically adds 135 lux, which would approx. represent saturation.
- If one picks the 12th, 37th, 62nd, and 87th percentiles from in-home studies, then the illuminance values are 1/10/30/100 lux. Extending to 300 lux would represent saturation.

Updated ABC Testing on 2011 Models



Represents 6 major manufacturers, covering 65% of total TV sales.

Updated ABC Testing on 2011 Models

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Power Calculation Method	46" LED (DOE)	47" LED (DOE)	55" Plasma (DOE)	46" LED 1 (EPA)	60" LED (EPA)	46" LED 2 (EPA)	51" Plasma (EPA)
ENERGY STAR (0, 300 – 45%/55%)	-	-	-	-	-	-	-
10, 50, 100, 300	0%	31%	21%	13%	35%	34%	16%
0, 12, 35, 300	-13%	14%	9%	5%	16%	13%	7%
0, 10, 300	-13%	8%	6%	3%	9%	3%	4%
5, 15, 45, 135	-11%	32%	17%	12%	24%	34%	12%
1, 10, 30, 100, 300	-9%	31%	11%	11%	19%	24%	9%

Updated ABC Testing on 2011 Models

	46" LED (DOE)	47" LED (DOE)	55" Plasma (DOE)	46" LED 1 (EPA)	60" LED (EPA)	46" LED 2 (EPA)	51" Plasma (EPA)
Power @ 1 lux (W)	43.9	79.2	89.8	76.0	48.9	54.5	85.3
Power @ 5 lux (W)	43.9	79.3	137.3	81.3	77.1	54.6	104.2
Power @ 10 lux (W)	45.5	79.4	143.5	81.3	115.7	59.7	123.2
Power @ 12 lux (W)	47.2	79.5	137.2	81.4	115.9	61.6	123.5
Power @ 15 lux (W)	48.9	79.4	137.2	81.3	115.9	62.2	123.1
Power @ 30 lux (W)	53.8	79.3	137.0	81.5	115.9	75.6	123.4
Power @ 35 lux (W)	55.4	79.5	141.1	81.3	115.8	76.8	123.8
Power @ 45 lux (W)	60.2	79.4	136.6	81.3	115.9	80.8	123.5
Power @ 50 lux (W)	61.8	79.5	143.7	81.4	115.9	82.7	123.1
Power @ 100 lux (W)	75.6	79.5	137.3	81.6	115.8	94.9	123.4
Power @ 135 lux (W)	85.9	79.7	133.2	81.6	116.1	95.2	123.2
Power @ 150 lux (W)	85.8	79.4	142.2	81.7	116.0	95.3	123.7
Power @ 300 lux (W)	85.8	79.3	137.7	81.7	116.0	54.6	122.8

On Mode Tests (ABC Enabled)

Issue 8 - DOE seeks comments from interested parties on whether there should be a limit to the reduction in display luminance achieved from ABC, and how a minimally acceptable display luminance value should be established. DOE also seeks comment from interested parties on its proposal to test TVs shipped with ABC enabled at room illuminance levels of 10, 50, 100, and 300 lux and their respected tolerances. DOE additionally welcomes comments on how these outputs should be weighted and combined.

3D Overview

- a **Energy impacts of 3D TV**
- b **3D TV market**
- c **Possible routes for test procedure development**

Preliminary Conclusions on 3D

DOE did not propose including a 3D test procedure in its NOPR

- DOE explored two alternatives for including 3D in its test procedure in the future.

a Energy impacts of 3D TV

b 3D TV market

c Possible routes for test procedure development

Power impacts of 3D TV - Overview

- TVs in 3D mode can consume a considerable power premium when compared to 2D mode.
  - DOE data: power consumption ranges from **negative** 21.5% to **positive** 86%
    - Average increase of positive 39%
  - CLASP data: increase in power consumption of 32%

- There is considerable variation in the power premium.

Units Tested

- 5 different types of 3D TVs tested
- 2 Types of Blu-ray players both capable of 2D to 3D conversion
- Technologies ranging from:
  - Plasma
  - Full Array/Backlit LED-LCD
  - Edgelit LED-LCD
  - Rear Projection DLP

Tests performed

- Each test displayed the same 10 minute segment of *Cloudy With a Chance of Meatballs* (Chapter 5 of Blu-ray version)
- Power Consumption Tests performed:
  - 3D Blu-ray version
  - 2D DVD version
  - 2D-3D conversion performed by 2 different Blu-ray players
  - 2D-3D conversion performed by TV (2 of 5 units)

Home Picture Setting

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TV	Converter	Home					
		3D version (Watts)	Settings	2D to 3D (Watts)	Settings	2D (Watts)	Settings
TV A 52" LED Edgelit 1080p – Active 3D	BD Player 1	135.0	Cinema	134.8	Cinema	132.3	Cinema
	BD Player 2	135.6	Cinema	135.6	Cinema	93.4	Standard
TV B 54" Plasma 1080p – Active 3D	BD Player 1	312.3	Cinema	312.9	Cinema	169.7	Cinema
	BD Player 2	311.7	Cinema	314.7	Cinema	167.5	Cinema
TV C 75" DLP 1080p – Active 3D	BD Player 1	88.2	Brilliant	89.1	Brilliant	112.4	Brilliant
	BD Player 2	88.7	Brilliant	91.6	Brilliant	110.2	Brilliant
TV 1 40" LED Backlit 1080p – Active 3D	BD Player 2	138.36	Standard	138.43	Standard	111.1	Standard
	BD Player 1	138.54	Standard	**	Standard	112.14	Standard
	TV Conversion	138.36	Standard	138.14	Standard	111.1	Standard
TV 11 63" Plasma 1080p – Active 3D	BD Player 2	364.8	Standard	365.7	Standard	210.48	Standard
	BD Player 1	364.8	Standard	366.9	Standard	213.66	Standard
	TV Conversion	364.8	Standard	367.6	Standard	210.48	Standard

N/A – Test is not applicable for TV

* - TV required an external adapter to produce 3D content, adapter consumed 5.6 watts which was included in this measurement

** - This configuration of TV, player, and disc, does not perform the requested test.

Power Consumption Analysis

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TV	Converter	Percent Difference Home (3D/2D to 3D)	Percent Difference Retail (3D/2D to 3D)	Percent Increase from 2D to 3D (Home)	Percent Increase from 2D to 3D (Retail)
TV A 52" LED Edgelit 1080p – Active 3D	BD Player 1	0.09%	0.10%	2.04%	1.95%
	BD Player 2	0.00%	0.10%	45.20%	-13.46%
TV B 54" Plasma 1080p – Active 3D	BD Player 1	-0.20%	-0.17%	83.98%	0.34%
	BD Player 2	-0.96%	2.87%	86.04%	0.17%
TV C 75" DLP 1080p – Active 3D	BD Player 1	-1.01%	0.05%	-21.47%	-13.99%
	BD Player 2	-3.31%	-1.60%	-19.51%	-13.63%
TV 1 40" LED Backlit 1080p – Active 3D	BD Player 2	-0.05%	N/A	24.58%	N/A
	BD Player 1	N/A	N/A	23.54%	N/A
	TV Conversion	0.16%	N/A	24.58%	N/A
TV 11 63" Plasma 1080p – Active 3D	BD Player 2	-0.25%	N/A	73.32%	N/A
	BD Player 1	-0.58%	N/A	70.74%	N/A
	TV Conversion	-0.77%	N/A	73.32%	N/A

N/A – Test is not applicable for TV

Preliminary Observations

- Little difference in how the TV displays 3D content (whether via Blu-ray, converted Blu-ray, or converted by the TV)
- Difference in energy consumption between 3D and 2D modes – significant and variable
- Some difficultly with different manufacturers' products interacting (company X's Blu-ray player working with company Y's TV)

a Energy impacts of 3D TV

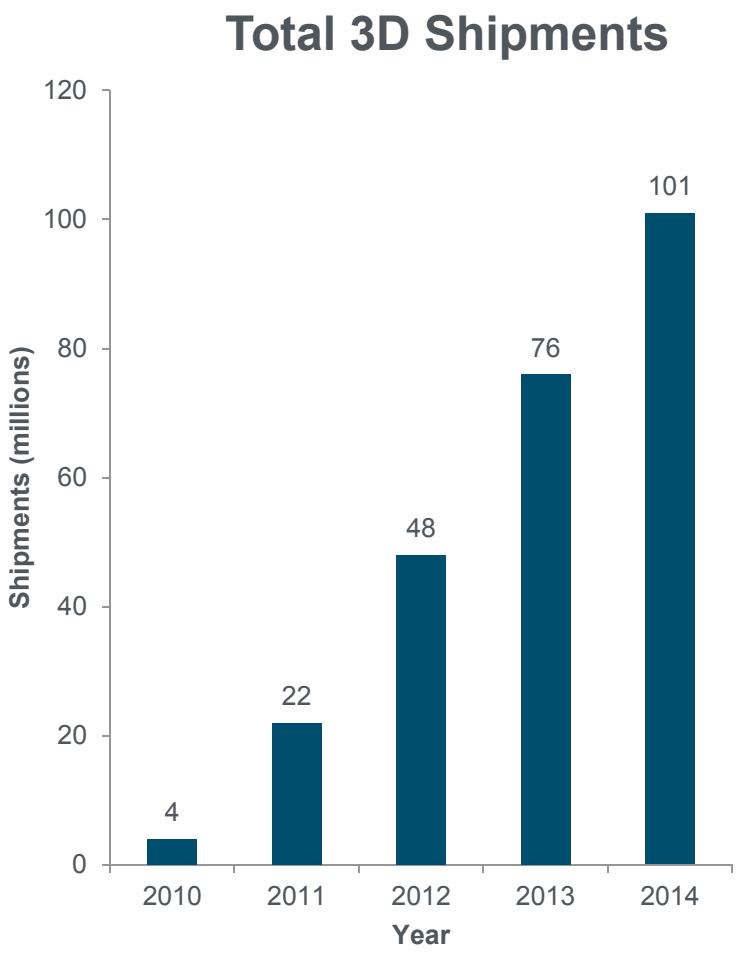
b 3D TV market

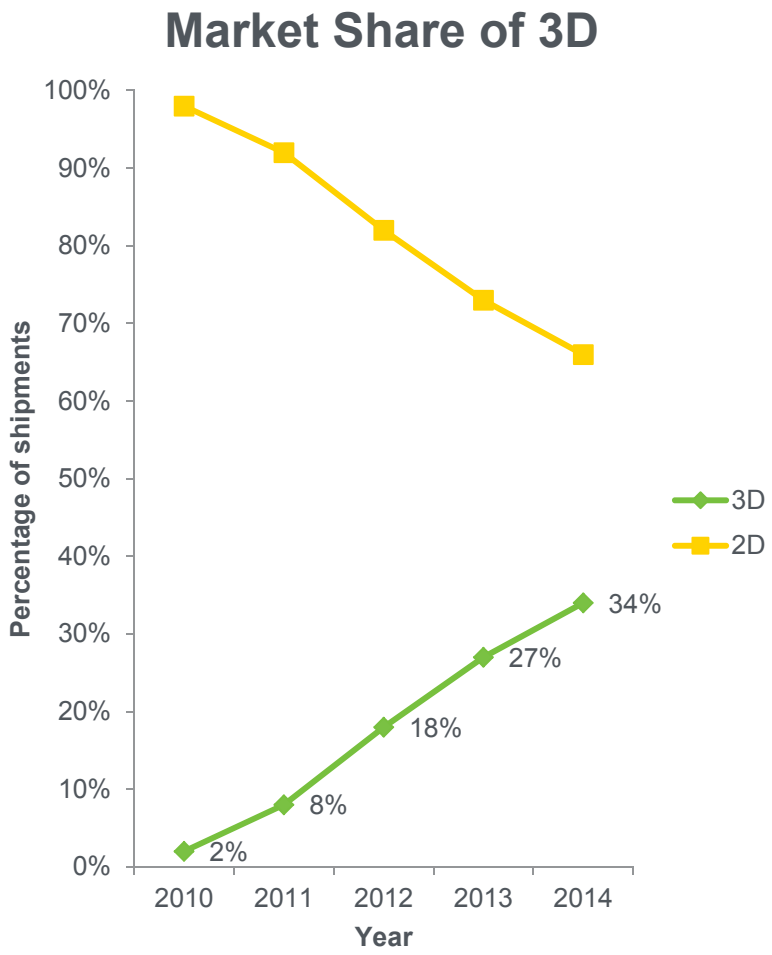
c Possible routes for test procedure development

3D TV Market Overview

- Currently ~20% of TV sales are 3D capable
- This is increasing, particularly for the larger sizes (40”+) ~45%
- Sales of larger sizes TV => increasingly larger market share
- Barriers to adoption of 3D TV are decreasing

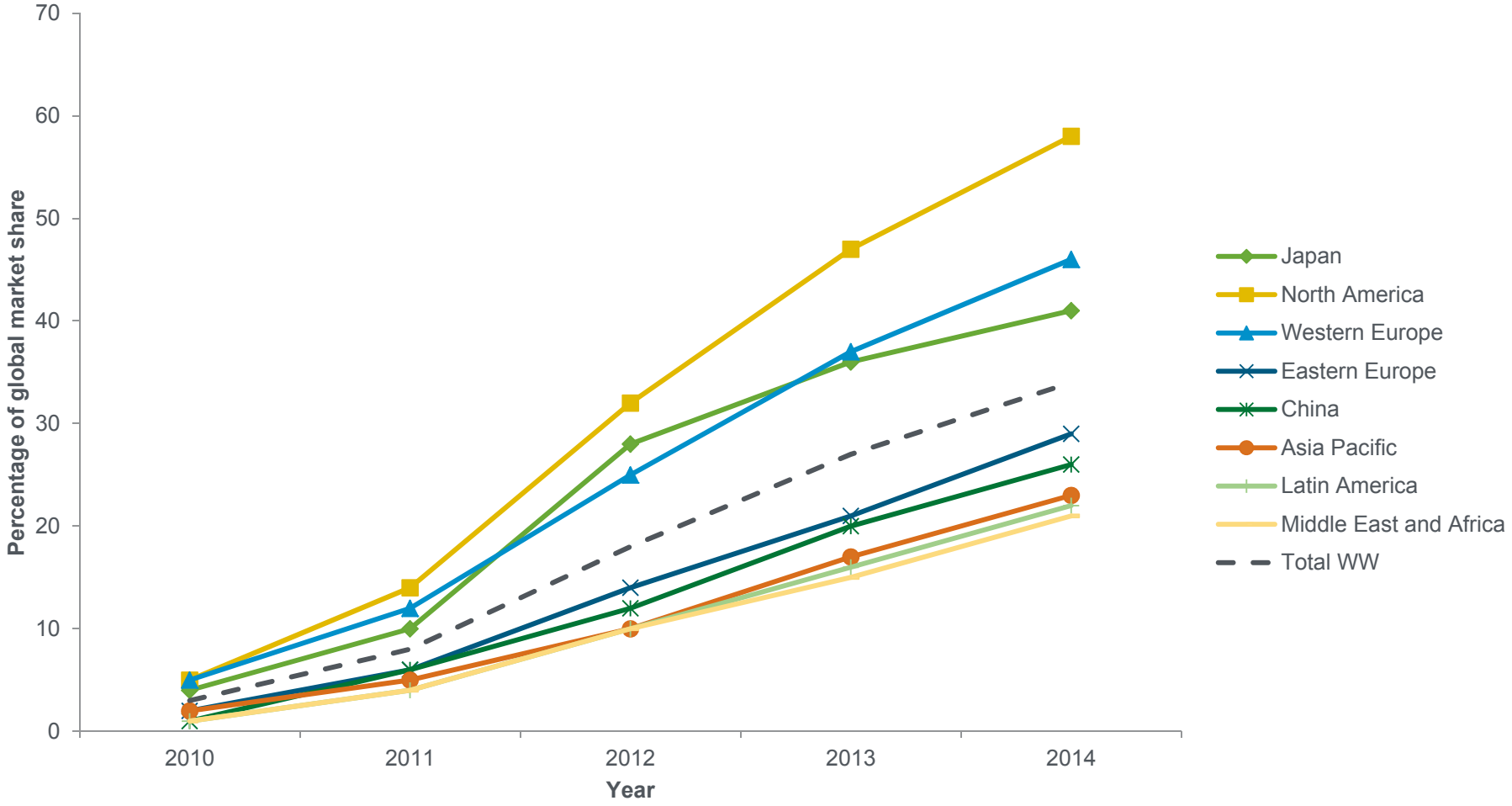
3D Global Shipments Forecast





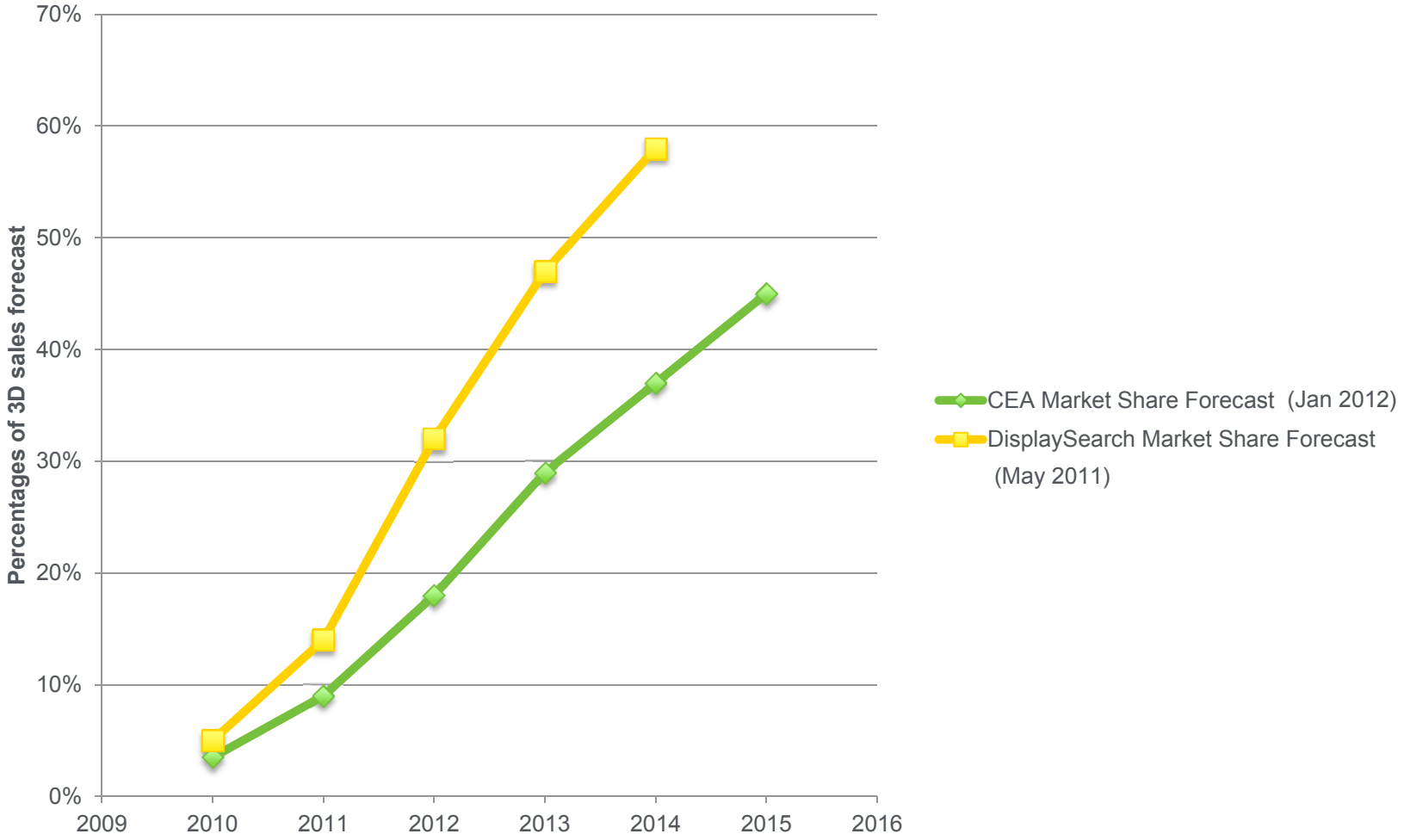
Source: Paul Gagnon (DisplaySearch) (2011*). 3D TV: Can it still be a Game Changer*, 3rd Annual SID DisplaySearch Business Conference, Los Angeles CA.

Forecasted 3D Share of Global Market



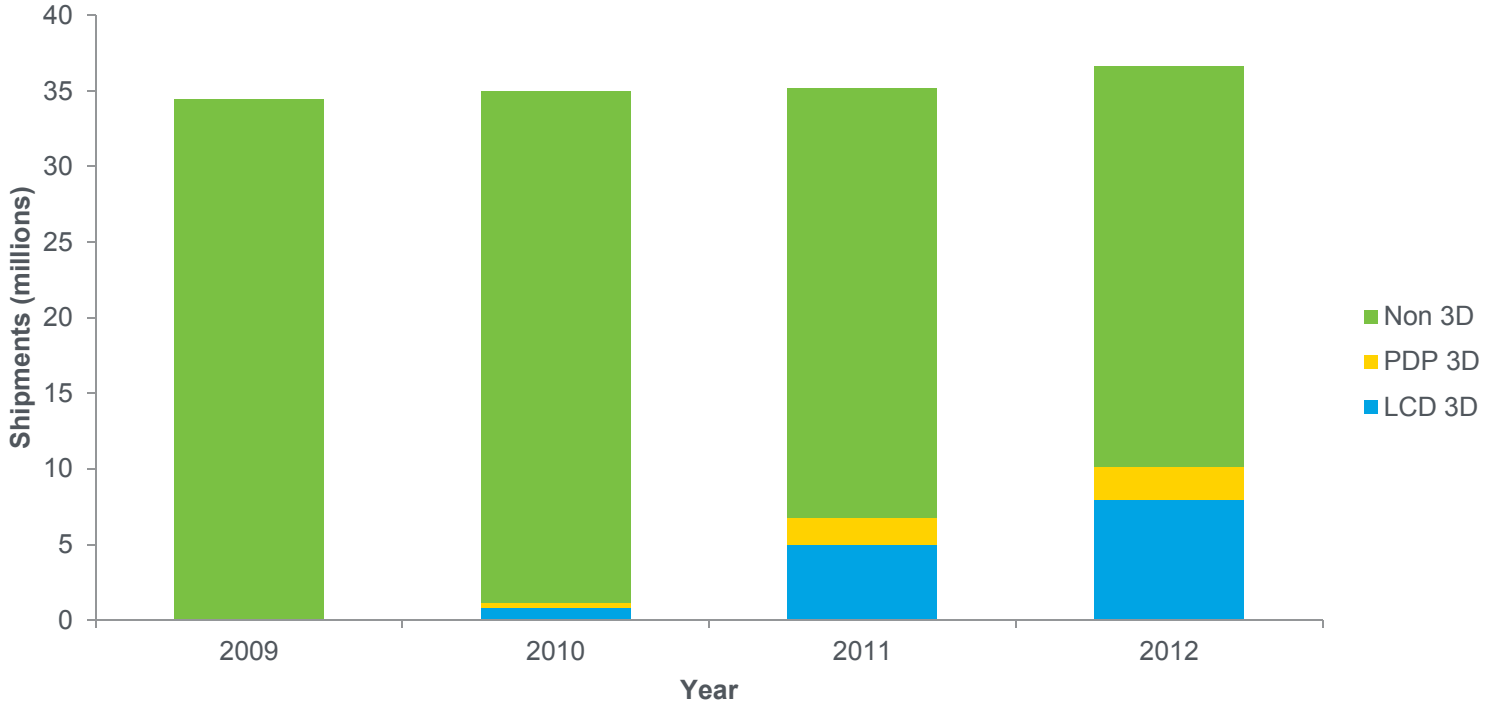
Source: Paul Gagnon (DisplaySearch) (May 2011*). 3D TV: Can it still be a Game Changer*, 3rd Annual SID DisplaySearch Business Conference, Los Angeles CA.

CEA – USA forecast of 3D capable TVs



Sources: DisplaySearch: Paul Gagnon (DisplaySearch) (May 2011*). 3D TV: Can it still be a Game Changer*, 3rd Annual SID DisplaySearch Business Conference, Los Angeles CA.
CEA: CEA's U.S. Industry Forecast, Jan 2012 Edition

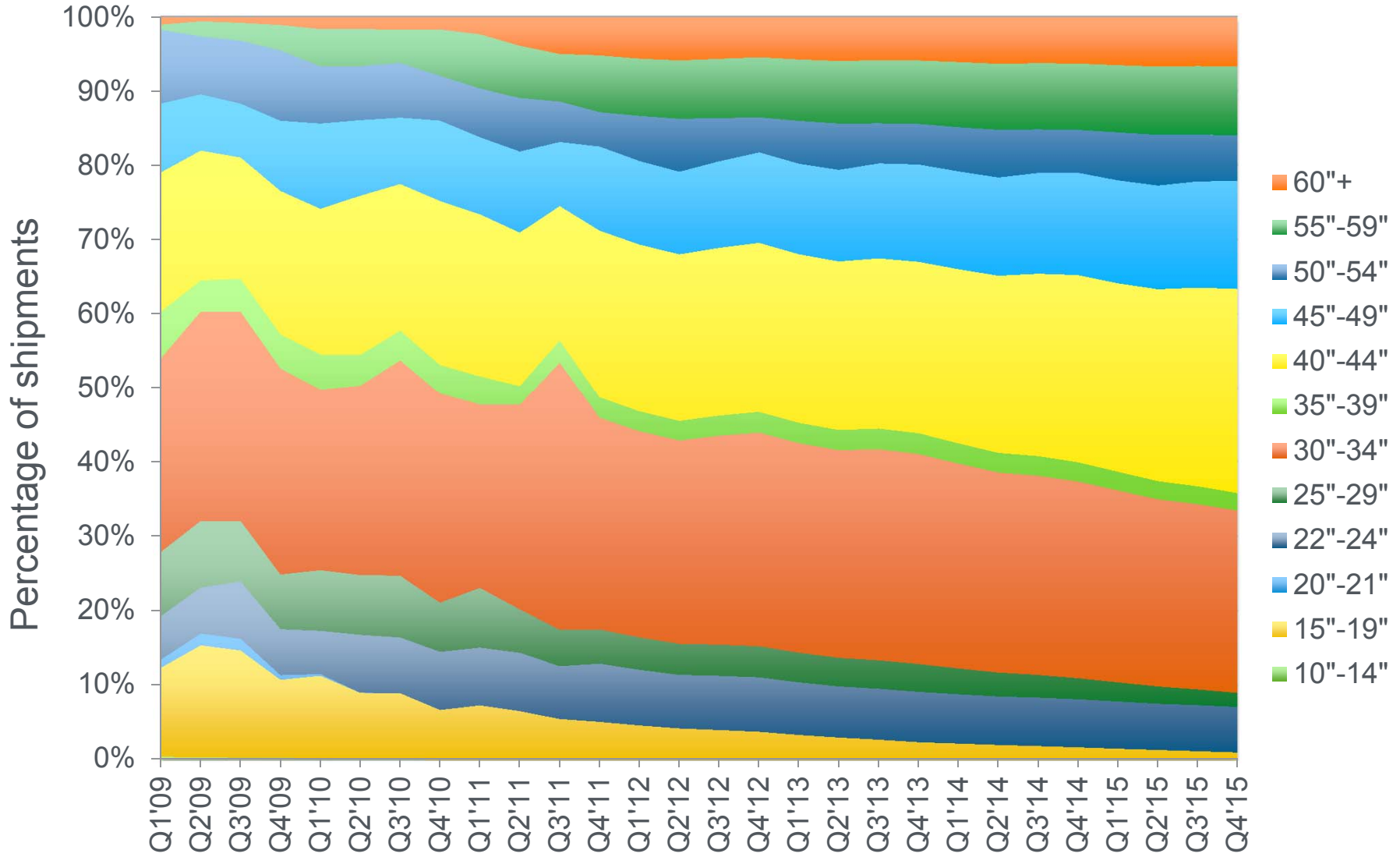
U.S. Market Data from SID Conference



	2010	2011	2012
Total 3D (millions)	1.1	6.7	10.1
Total Share 3D (%)	3.1	19	28
% of 3D 40+"	7	34	45

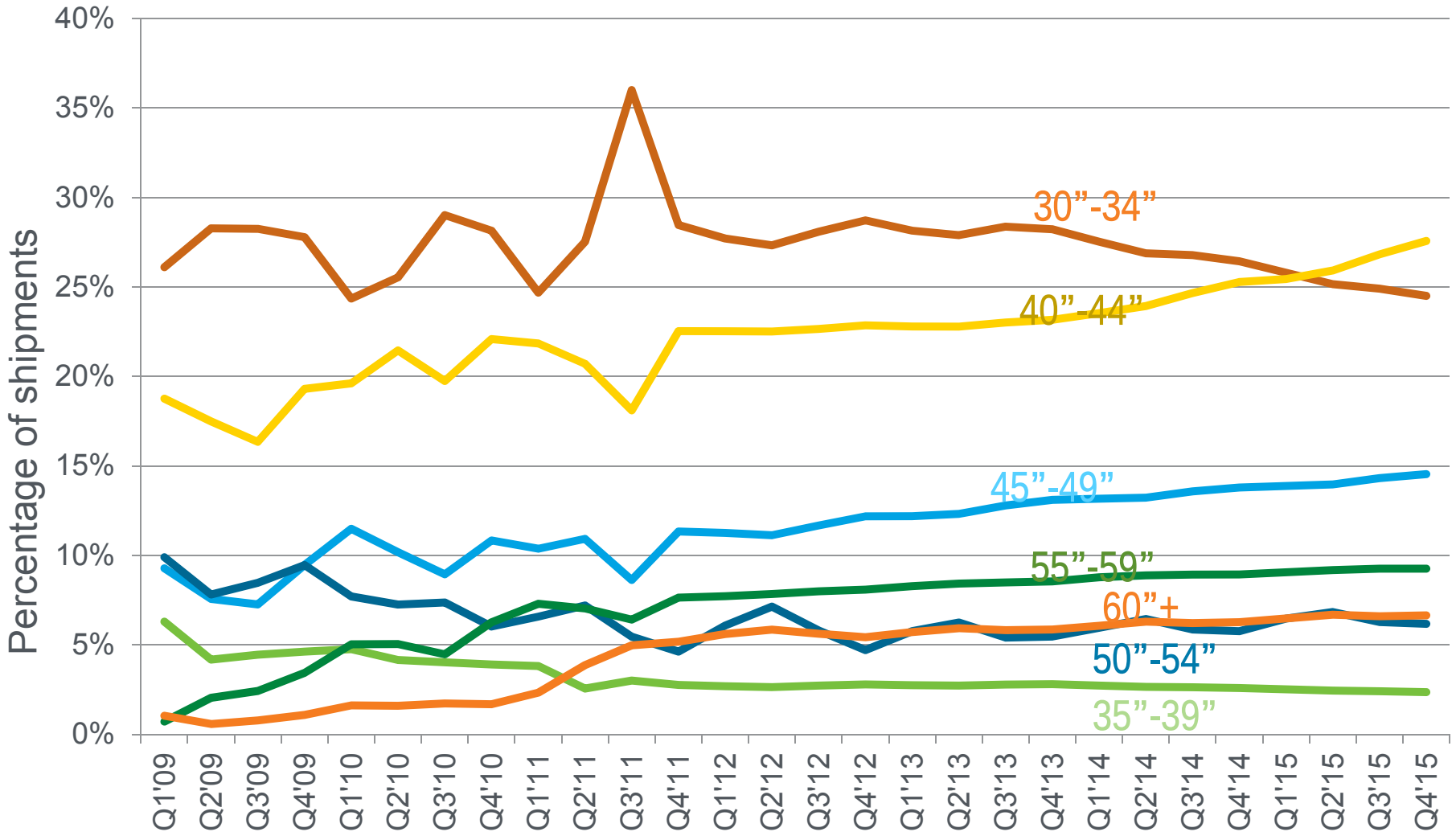
Source: Mike Abary (Sony) (2011). Sony's 3D Ecosystem – from lens-to-living room, 3rd Annual SID DisplaySearch Business Conference, Los Angeles CA.

U.S. Shipments – increasing size



Source: DisplaySearch, Quarterly Advanced Global TV, Shipment and Forecast Report (Frame Rate + LED)

U.S. Shipments – size movement towards 40”+



Source: DisplaySearch, Quarterly Advanced Global TV, Shipment and Forecast Report (Frame Rate + LED)

Changing Barriers to Greater 3D Adoption: Cost

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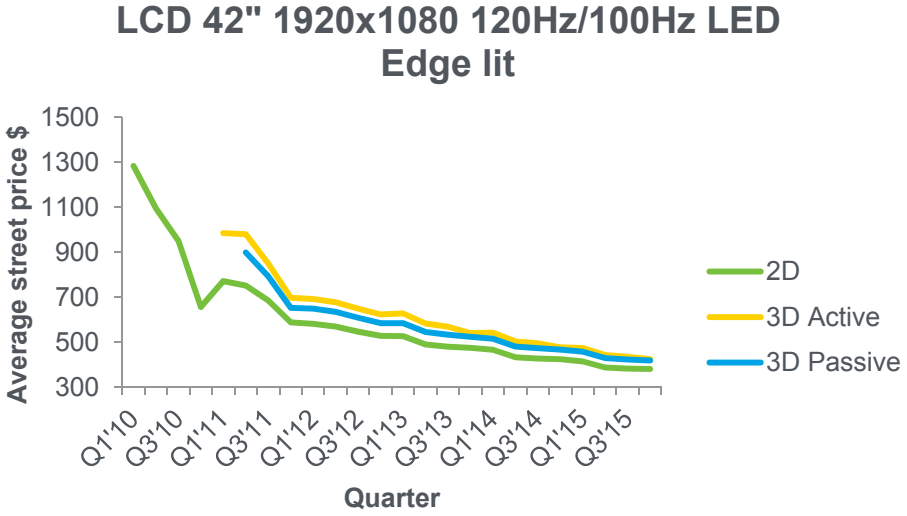

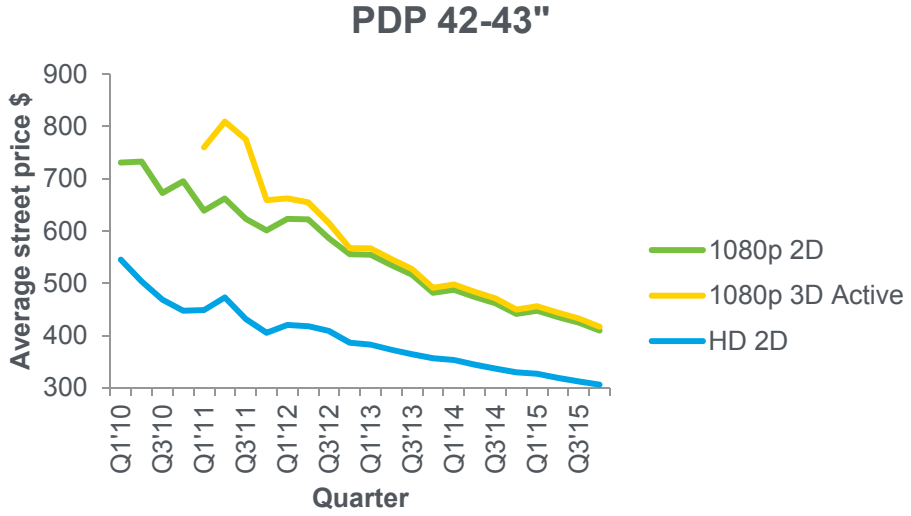

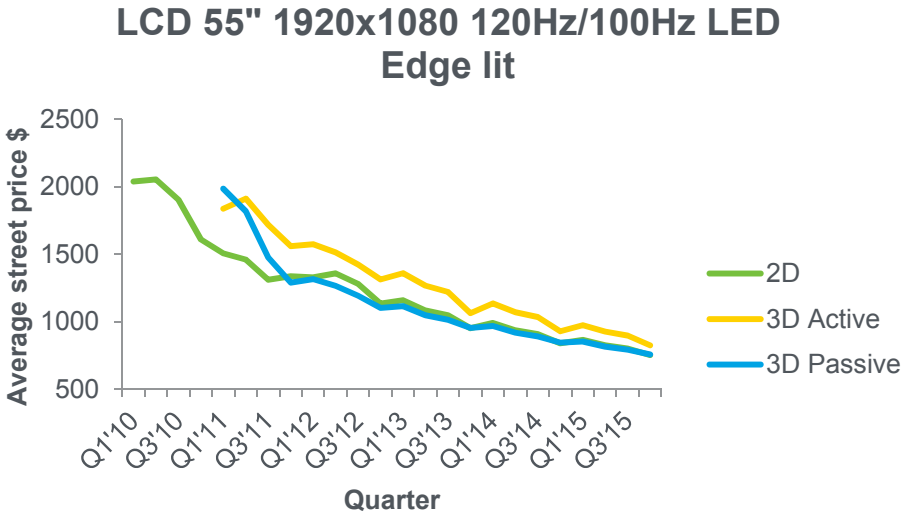

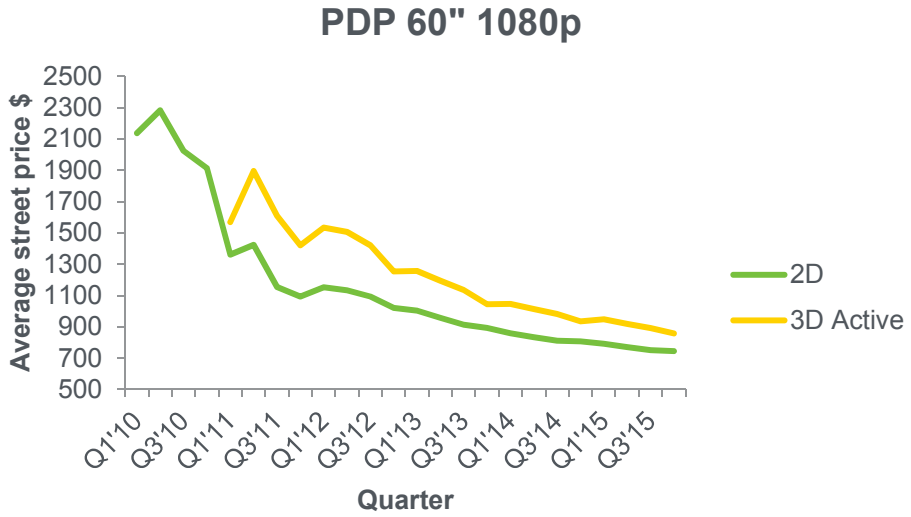

Source: Display Search (2011). *Quarterly TV Cost and Price Forecast Model Report*

Changing Barriers to Greater 3D Adoption: Content

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Sony survey found 50% of consumers don't want 3D due to lack of content

ESPN survey found 70% of consumers don't want 3D due to lack of content.

Sony released 9 3D titles by mid-2011, 45-50 released in total market.

ESPN project 6 million Blu-ray disc shipments in 2011
AND 100 3D channels worldwide by 2015

ESPN looking into new camera technology allowing 3D from single camera could add live coverage. ESPN also committed to creating new content.

Motorola believes that the key to increasing content is seamless delivery of 3D material via STBs.

Sony Comments from Mike Abary (Sony) (2011). Sony's 3D Ecosystem – from lens-to-living room, 3rd Annual SID DisplaySearch Business Conference, Los Angeles CA.
ESPN Comments from: Bryan Burns (ESPN) (2011). Watch for clues, 3rd Annual SID DisplaySearch Business Conference, Los Angeles CA.
Motorola Comments from: Faisal Ishtiaq (Motorola) (2011). Delivering 3D TV to the Home, 3rd Annual SID DisplaySearch Business Conference, Los Angeles CA

Changing Barriers to Greater 3D Adoption: Content

- 9 US channels show 3D content (5 with 24/7 3D programming)
  - ESPN 3D; 3net; Verizon FIOS 3D; Yes Network; DirecTV Cinema 3D; DirecTV n3D; Wealth TV; Xfinity 3D; and Starz 3D.

- Current mix of channels should give "U.S. consumers with 3D TV sets something new to watch virtually every day of the week"

- Over 90 + titles available on Amazon's website (2010 or newer from major studios)

http://www.3dtvguide.org/3d-tv-channels.html
http://www.stereoscopynews.com/hotnews/history/tv-channels-a-experiments/1279-two-new-3d-tv-channels.html

3D usage data

- DOE is not aware of any data on usage of 3D mode
- Challenge to incorporate into a single-metric duty cycle
- Request for data

a Energy impacts of 3D TV

b 3D TV market

c Possible routes for test procedure development

USA – Two 3D options

In its test procedure NOPR, DOE considered 2 options for testing 3D power consumption:

- Creating a 3D version of the current 2D IEC 62087 test clip
- Using 2D to 3D Blu-ray players to convert the clip

USA – Two 3D options (option 1)

Option 1: Creating a 3D version of the current 2D IEC 62087 test clip.

- DOE has IEC rights to convert the test clip (except for rights to the CEA section).
- Although IEC has the rights to use the CEA sections to make a 3D test clip – it does not have the rights to transfer the CEA's rights to a third party.
- DOE - 2 choices:
  - Wait for IEC test clip (not in time for this TP).
  - Develop test clip itself by cutting out CEA portions of the test clip (could adding portions in to make sure that APL is same).

USA – Two 3D options (option 2)

Option 2: Using 2D to 3D Blu-ray players to convert the clip

- Initial testing yielded positive results
- However, early equipment, occasional mismatch
- Not yet tested with IEC 62087 test clip

International

- IEC has full rights to develop a 3D TV test clip based on IEC 62087 test clip.
- CEA 3D Discovery Group investigating 3D technologies and issues with measurement of 3D energy consumption.
- Europe and Australia are interested in 3D test clip – ideally prefer it to be through international organization like IEC.

Preliminary Conclusions on 3D

- DOE did not propose including a 3D test procedure in its NOPR.
- DOE explored two alternatives for including 3D in its test procedure in the future.

Issue 10 – DOE seeks comments from interested parties on 3D testing. DOE specifically seeks comment on its two methods under consideration for a future rulemaking which include converting the 2D IEC dynamic broadcast-content video signal to 3D using a real time converting Blu-ray player or creating a 3D version of the IEC dynamic broadcast-content video signal. DOE also seeks comments on how it can best work with the IEC and interested parties to promote the development of a 3D test procedure.

Issue B – DOE requests any available data on usage of 3D mode.

Public Meeting Agenda

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

1. Rulemaking History & Timelines
2. Summary of NOPR
3. Definitions/Scope
4. Testing Conditions and Instrumentation
5. Luminance Test
6. On , Standby & Off Modes
7. Energy Efficiency Metric(s)

Additional Functions and Power Saving Technologies

- DOE NOPR proposes that TVs be tested with additional functions off

- Current power saving technologies
  - Presence sensors
  - Automatic shut-off
  - Display power management systems

Issue C – DOE welcomes interested party information regarding power saving technologies.

DOE NOPR proposes testing in the following modes:

Standby-Passive Mode

Definition: the mode in which the TV 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 (which incorporates the DAM mode test)

Definition: the mode in which the TV 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 with an external signal, and is exchanging/receiving data with/from an external source.

DOE considered testing in the following modes:

Standby-Active, Low Mode

Definition: the mode in which the TV 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.

DOE also considered testing with an internet connection.

Issue 11 – DOE seeks comments from interested parties on its consideration of testing the internet as part of on mode; standby-active, high mode; and standby-active, low mode.

Standby Modes (cont.)

DOE conducted testing on TVs when connected to the internet while in standby mode.

Standby-passive mode

- No Connections
- Connected to HDMI Only

Standby-active, low mode

- Connected to Cable
- Connected to Ethernet
- Connected to Wireless

Standby Modes (cont.)

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	Standby-passive No connections (Watts)	Standby-passive HDMI only (Watts)	Standby-active, low Cable (Watts)	Standby-active, low Ethernet (Watts)	Standby-active, low Wireless (Watts)
40" LED Backlit	0.10	0.06	0.05	0.10	N/A
15" CCFL	0.62	0.61	0.83	N/A	N/A
23" LED Edgelit	0.47	0.46	N/A	N/A	N/A
22" CCFL	0.11	0.11	0.11	N/A	N/A
19" LED Edgelit	0.54	0.54	0.54	N/A	N/A
55" LED Backlit	0.07	0.07	0.07	0.07	N/A
47" LED Edgelit	0.82	0.86	0.83	0.82	0.82
46" CCFL	0.14	0.14	0.14	N/A	N/A
42" LED Backlit	0.20	0.20	0.21	N/A	N/A
22" CCFL	0.64	0.63	0.63	N/A	N/A
63" Plasma	0.11	0.11	0.11	0.11	N/A
42" Plasma	0.39	0.38	0.38	N/A	N/A
23" LED Backlit	0.16	0.16	N/A	N/A	N/A
60" LED Edgelit	0.16	0.16	0.16	0.16	N/A

DOE NOPR proposes using the CEA test for Download Acquisition Mode (DAM)

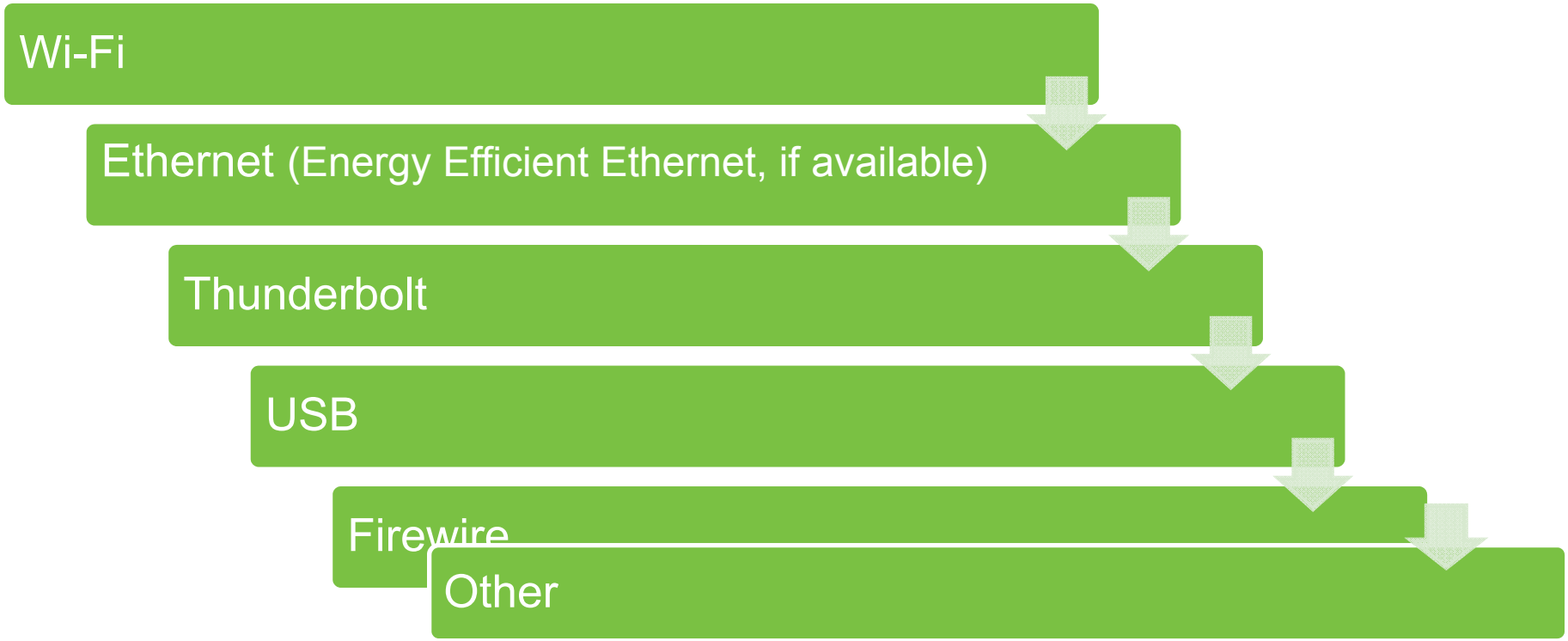
Download Acquisition Mode

Definition: 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.

Issue D – DOE seeks comments from interested parties on the proposed CEA DAM test procedure.

Standby-Active, High Mode

DOE NOPR proposes to test according to the CEA test for DAM using a hierarchy of input formats



Issue 14 – DOE seeks comments from interested parties on the hierarchy of input formats required to connect the TV to a video source.

Off Mode

Definition: the mode where the TV 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.

DOE NOPR proposes testing in off mode.

Issue 12 – DOE seeks comments from interested parties on testing standby and off mode of TVs according to the procedure outlined in the NOPR.

Public Meeting Agenda

1. Rulemaking History & Timelines
2. Summary of NOPR
3. Definitions/Scope
4. Testing Conditions and Instrumentation
5. Luminance Test
6. On , Standby & Off Modes
7. Energy Efficiency Metric(s)

Energy Efficiency Metric

Multiple Outputs			
Luminance Ratio	On Mode Power	Standby Mode Power	Off Mode Power

- DOE NOPR proposes multiple tests that produce unique outputs.
- DOE is considering a single metric that combines these outputs to represent the overall energy efficiency of a TV.

Issue 13 – DOE seeks comments from interested parties on the alternative approach of using a single metric for calculating annual energy consumption. DOE also seeks comment on its preliminary decision not to take into account the possibility that consumers may switch between preset picture settings.

Energy Efficiency Metric (Single Metric)

Annualized Energy Consumption Metric

$$AEC_{metric} = ((P_{on} * H_{on} + P_{standby\text{-}passive} * H_{standby\text{-}passive} + P_{off} * H_{off} + DEC_{DAM})/1000) * 365$$

On Power Metric (ABC Enabled)

$$P_{on} = P_{10} * W_{10} + P_{50} * W_{50} + P_{100} * W_{100} + P_{300} * W_{300}$$

Annualized Energy Consumption Metric (Hour weightings)

$$H_{on} = 7$$

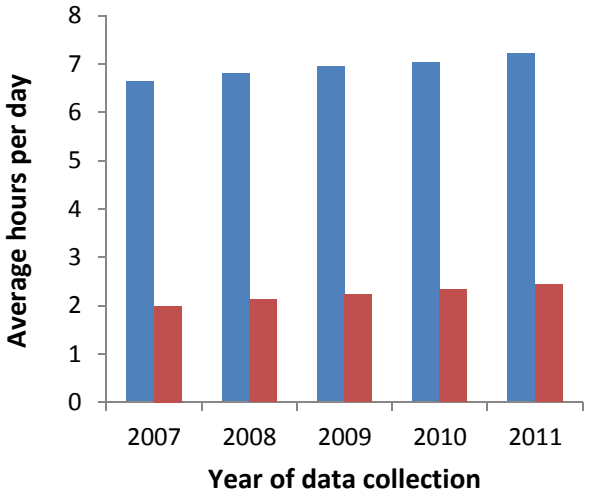
$$H_{standby\text{-}passive} = 17$$

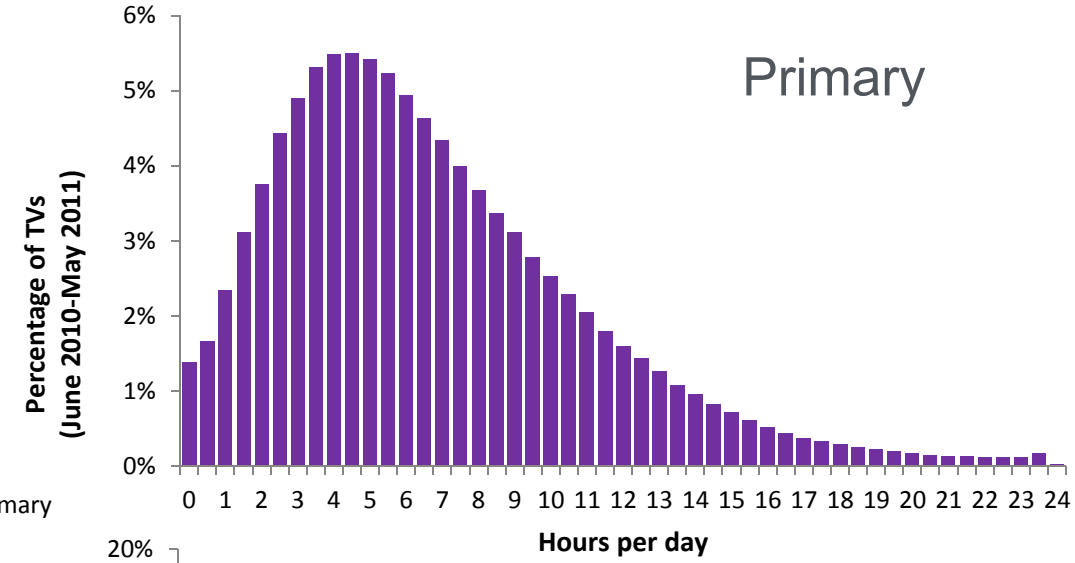
$$H_{off} = 0$$

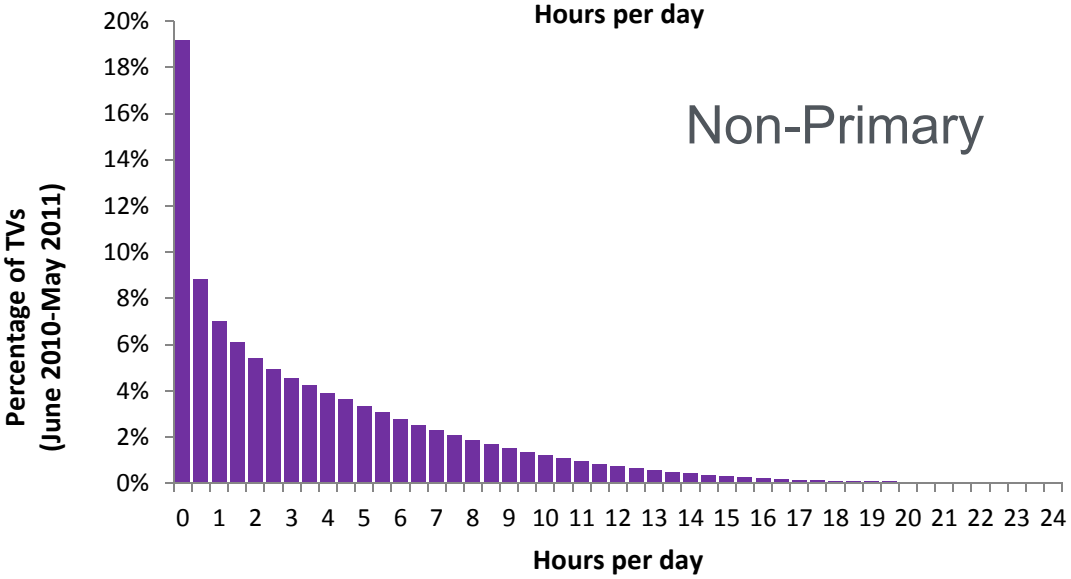
TV Usage Analysis: Data

- Monthly set-level viewing statistics from May 2007 to May 2011, from The Nielsen Company.
- Representative cross-section of U.S. households.
- Over 20,000 participating households in May 2011.
- Viewing hours are obtained from metering devices on each TV in a participating household.
- Meters also attached to peripheral devices (e.g., DVD players, game consoles).
- Statistics include TV use from broadcast, recorded media, games, etc.

TV Usage Analysis: Results







TV Usage Analysis: Results

- For the last full year of data (June 2010-May 2011) the average daily usage for primary TVs was 7 hours. This is a robust finding.
- This value is in agreement with the CLASP room illuminance study (average was 6.9 hours across 60 homes).
- This value has been steadily rising in the past several years.

TV Usage Analysis: Results

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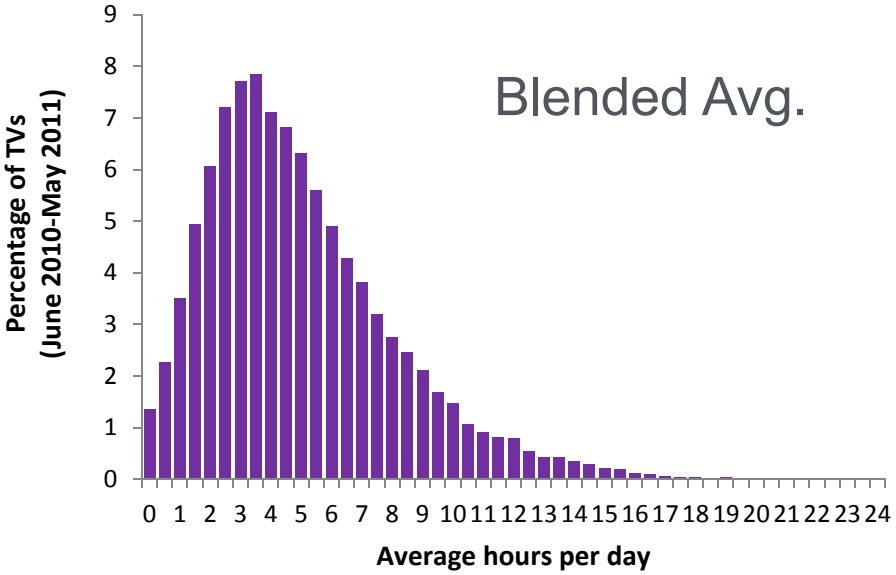
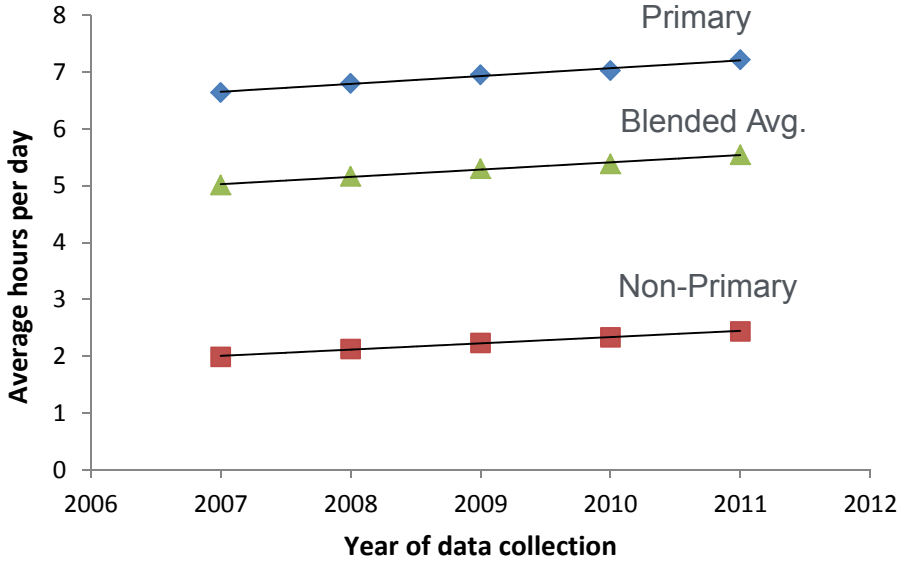
- Not all new TVs are necessarily primary TVs, however.
- In 2011, approx. 65% of the newest TVs in Nielsen households are primary TV, up from 55% in 2007.
- Insufficient data to do detailed analysis on shipments, however. In addition, there is likely a screen size dependence.
- Assuming 65% primary and 35% non-primary results in average daily usage of 5.5 hours, but this is an approximation only.





TV Usage Analysis

Issue E – DOE welcomes comments from interested parties on the analysis used to determine average on-mode hours per day, and the assumption to base these hours on those measured for primary TVs. DOE welcomes any data from interested parties on the percentage of new shipments that become primary TVs, including any dependence on screen size.

Thank you

DOE Requests Feedback

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In all correspondence, please refer to the Television Set Test Procedure
Docket Number EERE-2010-BT-TP-0026 and
Regulatory Identification Number (RIN) RIN 1904-AC29

Federal eRulemaking Portal: http://www.regulations.gov

Email: Televisions-2010-TP-0026@ee.doe.gov

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Comment period closes 04/03/2012

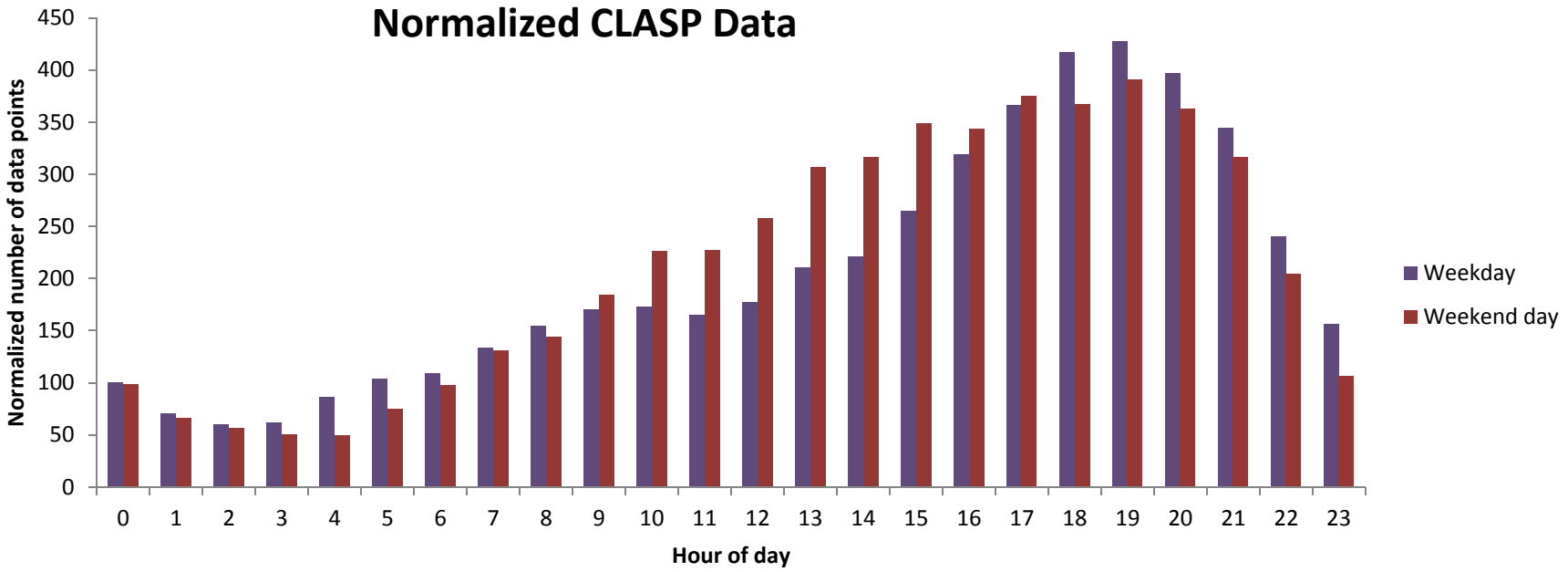
Relevant URLs

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

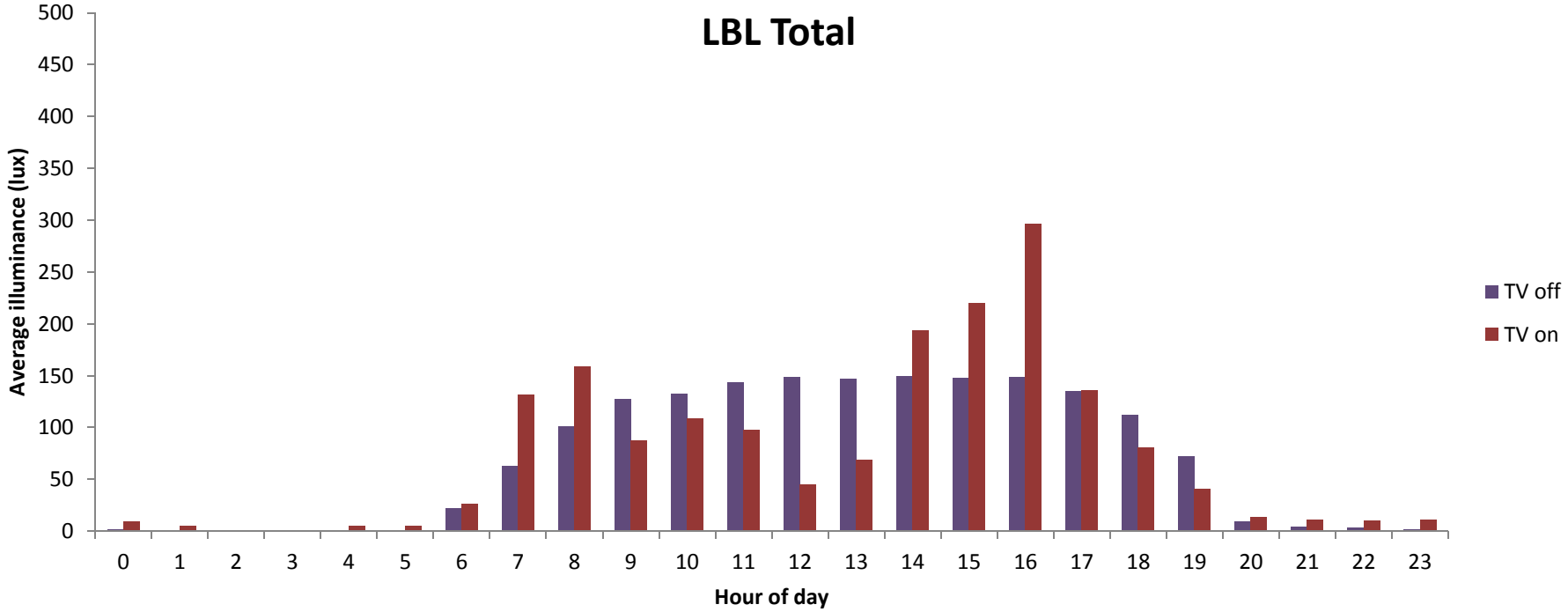
- DOE Appliance Standards
  - http://www1.eere.energy.gov/buildings/appliance_standards/
- DOE Television Sets
  - http://www1.eere.energy.gov/buildings/appliance_standards/residential/tv_sets.html
- DOE Television Sets NOPR
  - http://www1.eere.energy.gov/buildings/appliance_standards/pdfs/television_test_procedure_notice_of_proposed_rulemaking.pdf

Backup slides

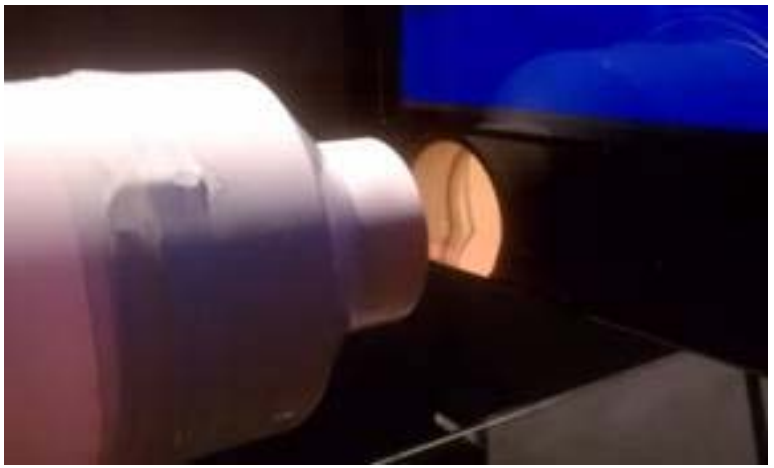
Weekday vs. Weekend



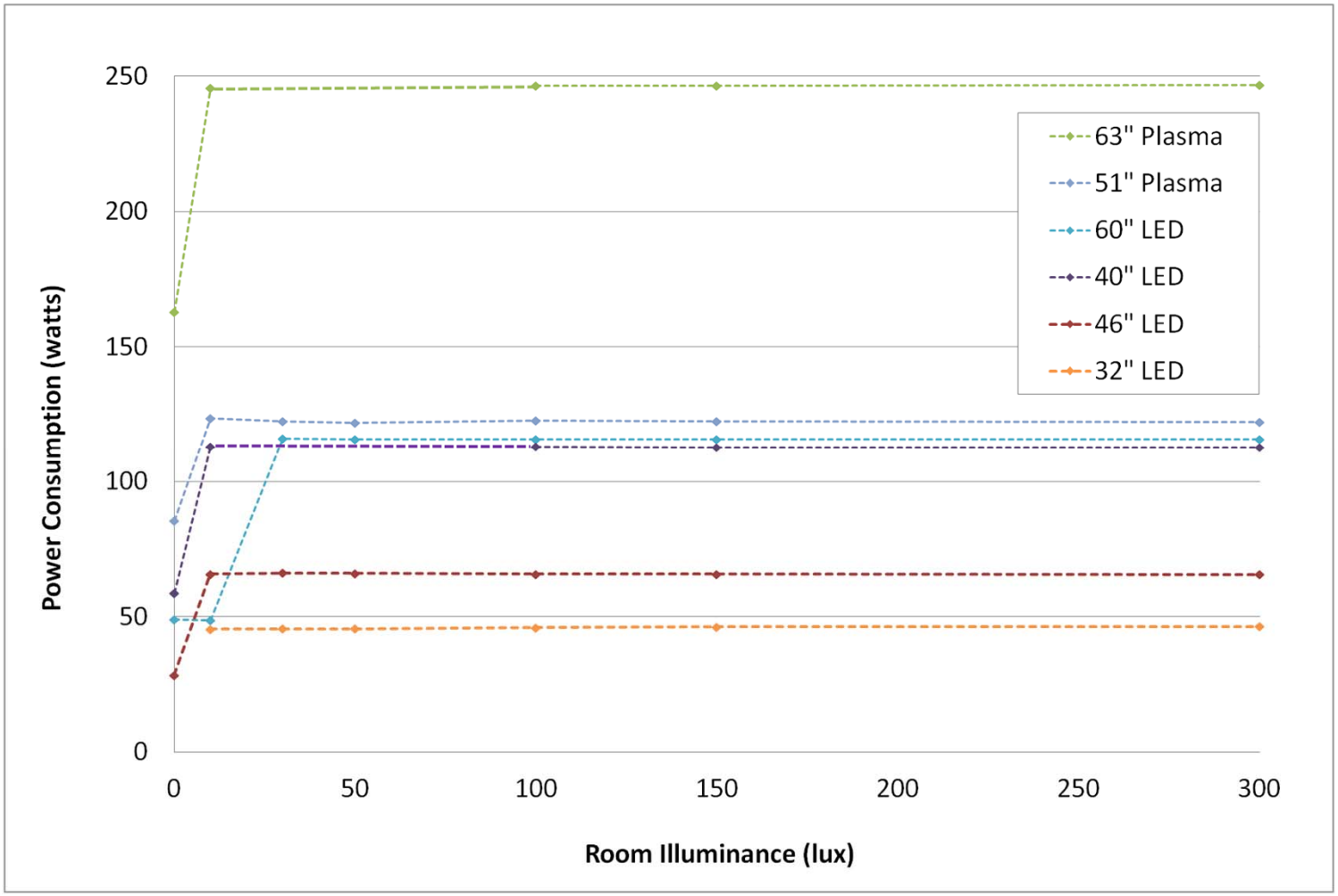
TV On vs. TV Off



ABC Testing

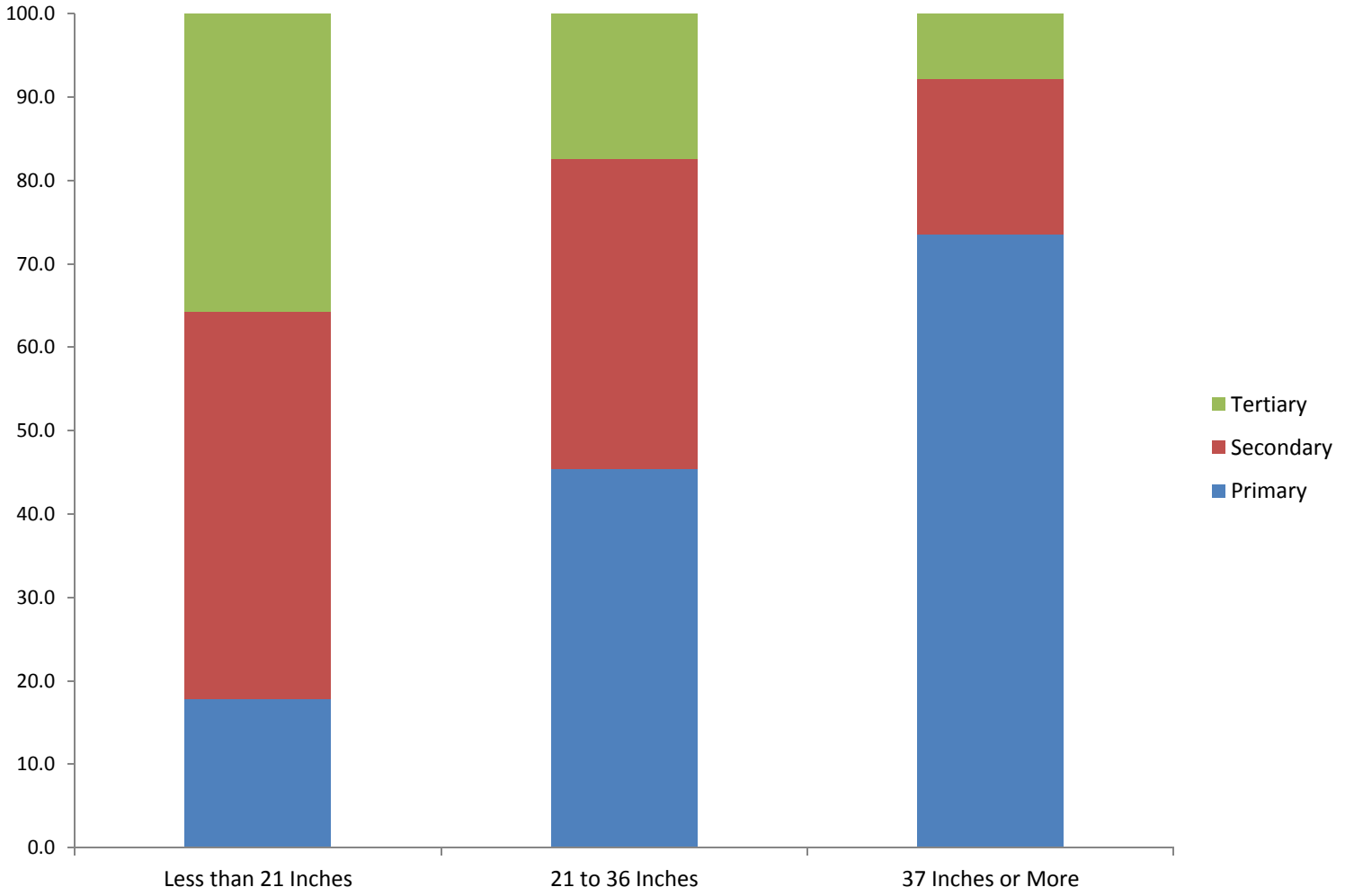


ABC Testing



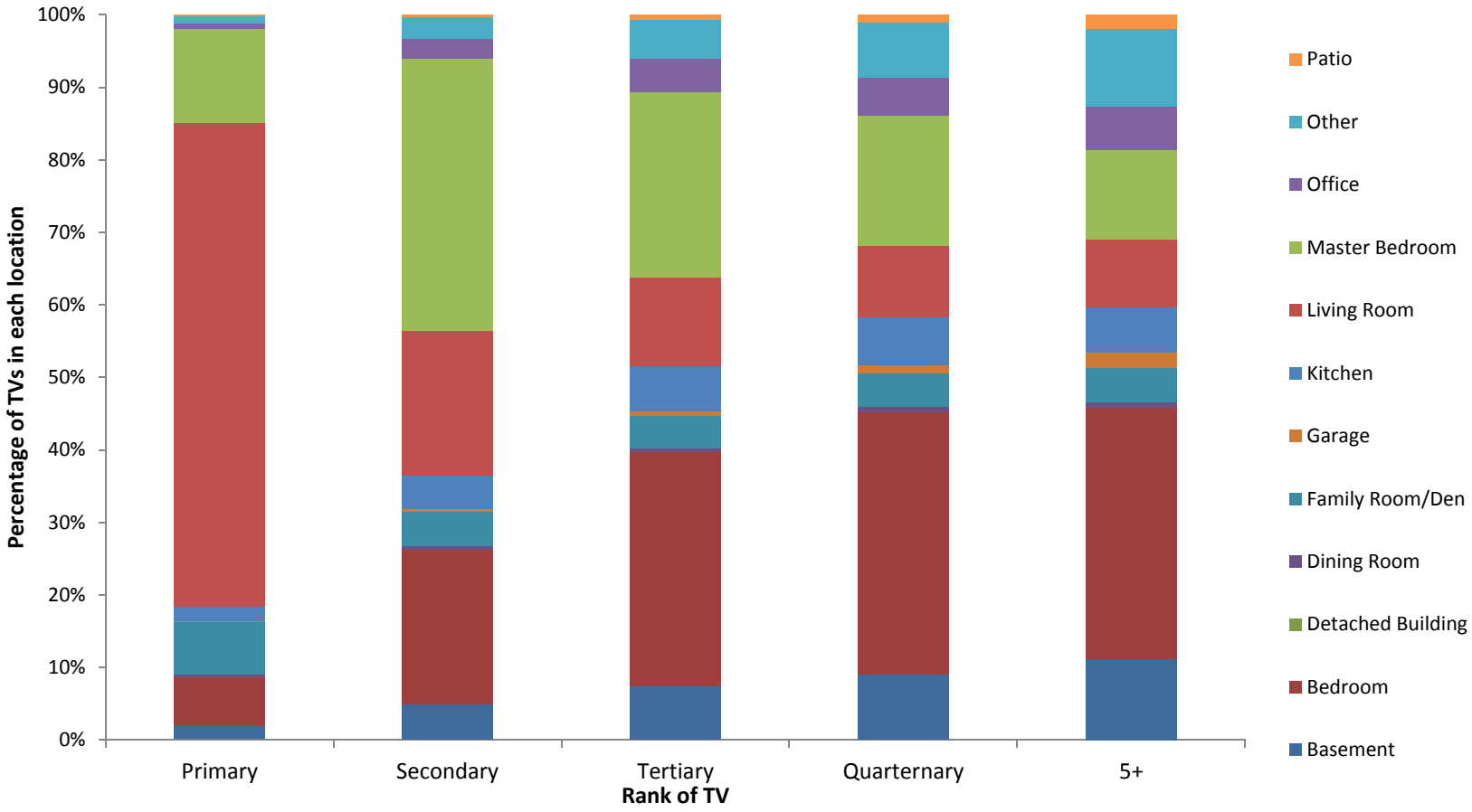
ABC response curves for a single manufacturer, in a given model year.

Screen Sizes



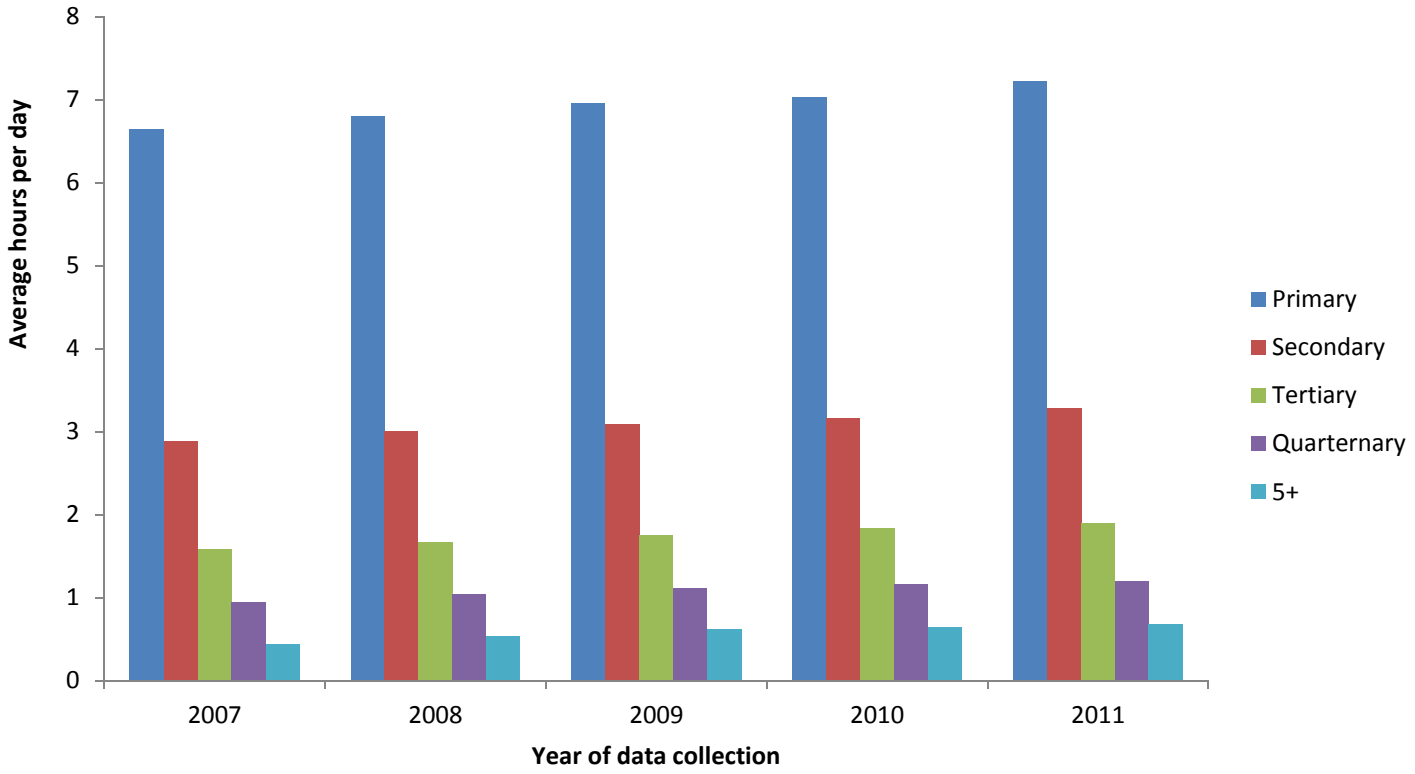
RECS 2009

TV Location



The Nielsen Company, 2011

Primary vs. Non-Primary



The Nielsen Company, 2011

TV Usage Analysis: Comparison to RECS

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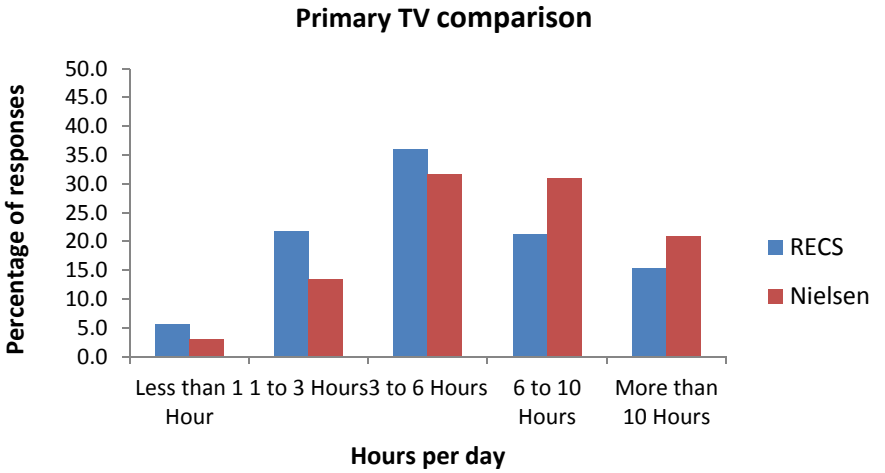
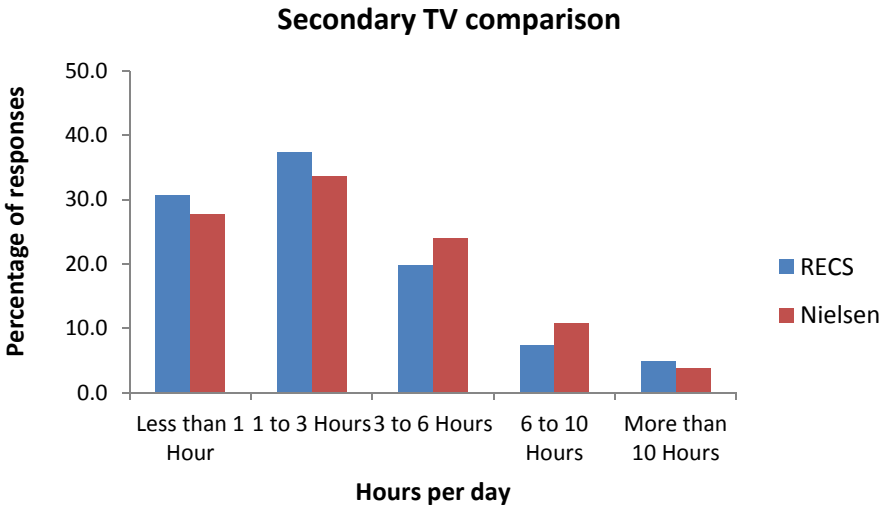
- Issues when using surveys:
  - Social desirability bias
  - Requires estimating "typical"
  - TV watching is low intensity activity
  - Multitasking
- Nielsen is considered more representative.

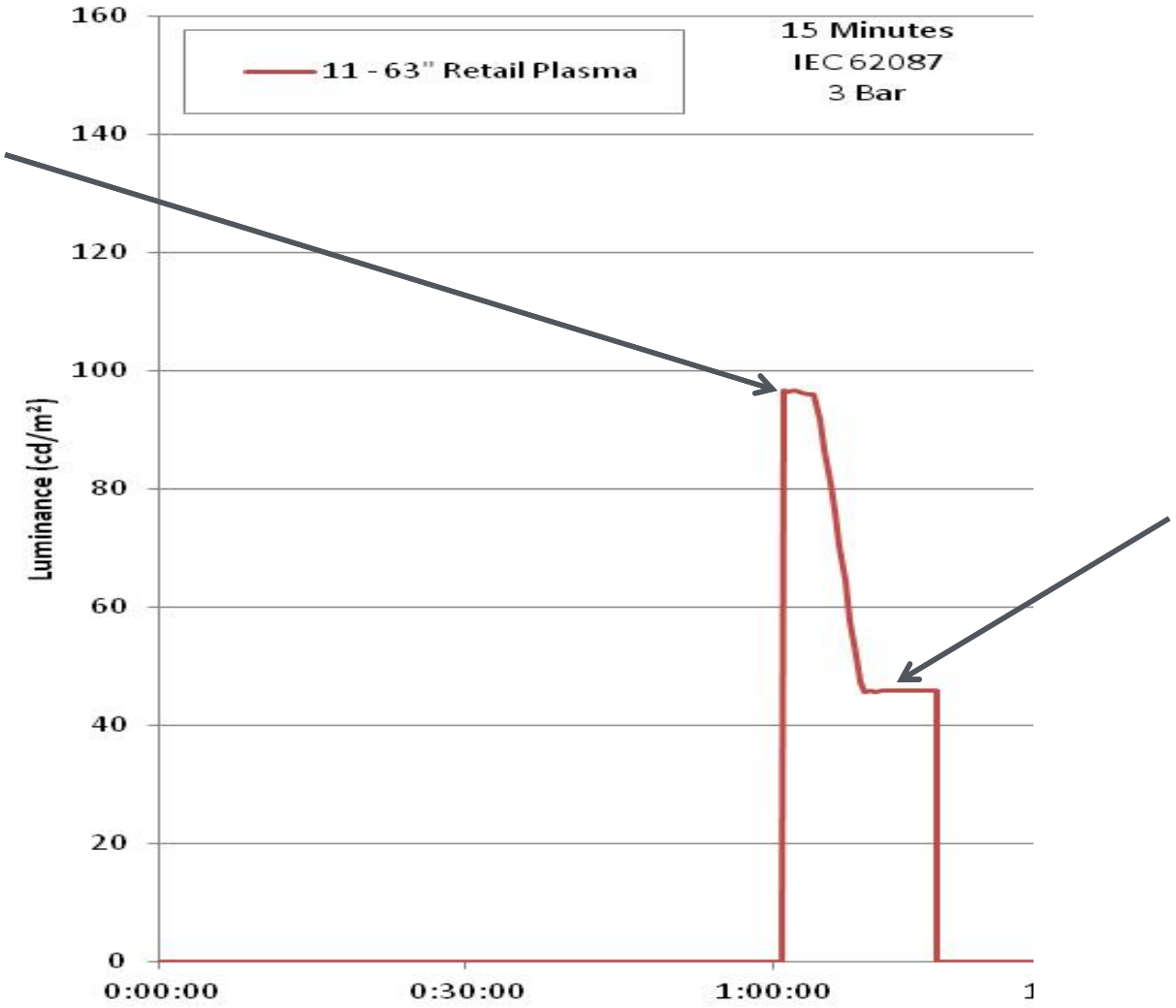
Pettee, K. K., S. A. Ham, et al. (2009). "The reliability of a survey question on television viewing and associations with health risk factors in US adults." Obesity **17**(3): 487-493.





Luminance Test

Measurement without stabilization period.



Measurement after 10 minute warm-up period.

Summary of NOPR

Raw data supporting the NOPR can be found on the DOE website

Television Energy and Luminance Test Data Set

- Television Luminance
- Television Luminance Stabilization Period
- Television Power
- Television Internet Standby
- Television 9-point Video Signal Comparison
- Television On Mode Automatic Brightness Control
- Television Download Acquisition Mode
- Television 3D Mode

Measuring Luminance

- Measuring screen luminance of 200 nits
  - If LMD displays “200.0” then 2% will be:
    - ± (2/100) * 200 = ± 4 nits
  - The least significant digit is 0.1 nits, therefore:
    - ± 2 digits = ± 0.2 nits
  - Total accuracy must be within:
    - ± 4 nits ± 0.2 nits = ± 4.2 nits

Television Definition

- Television set (also referred to as "TV"): A product designed to be powered primarily by mains power having a diagonal screen size of fifteen inches or larger that is manufactured with a TV tuner, and that is capable of displaying dynamic visual information from wired or wireless sources including but not limited to:
-
  - (1) Broadcast and similar services for terrestrial, cable, satellite, and/or broadband transmission of analog and/or digital signals; and/or
  - (2) Display-specific data connections, such as VGA, DVI, HDMI, DisplayPort, used typically for a computer or workstation that is not physically attached to the display; and/or
  - (3) Media storage devices such as a USB flash drive, memory card, or a DVD; and/or
  - (4) Network connections, usually using Internet Protocol, typically carried over Ethernet or WiFi.