

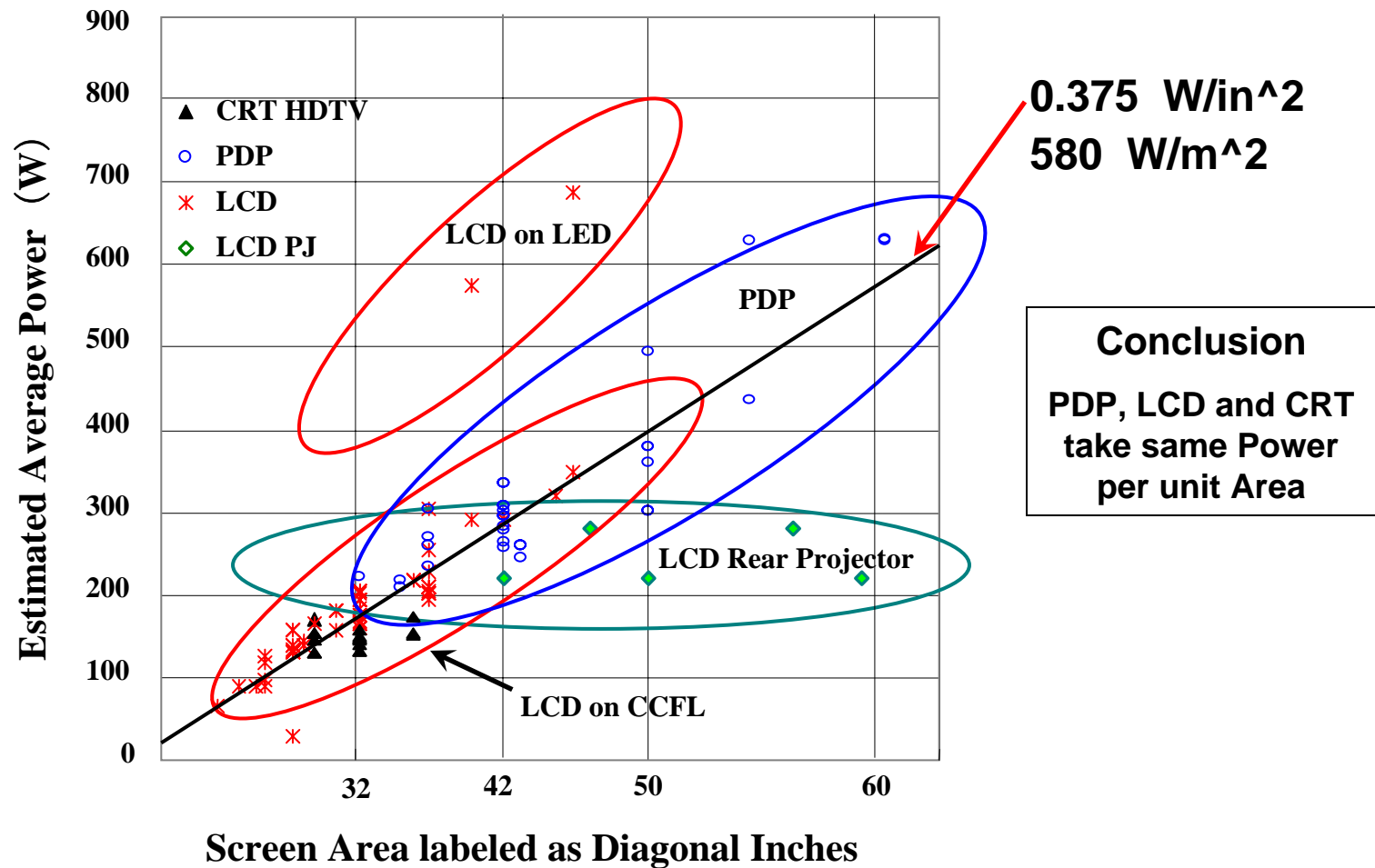
Test Method and Metric Ideas – a Technologist's Views

Dr. Larry F. Weber

Larry F. Weber

- 35 Years in Flat-Panel Displays
- Fellow of the Society for Information Display (SID)
- Fellow of the IEEE
- President-Elect of SID
- Technical Advisor for Flat-Panels to IEC
- Now very actively Retired

TV Set Power Comparison

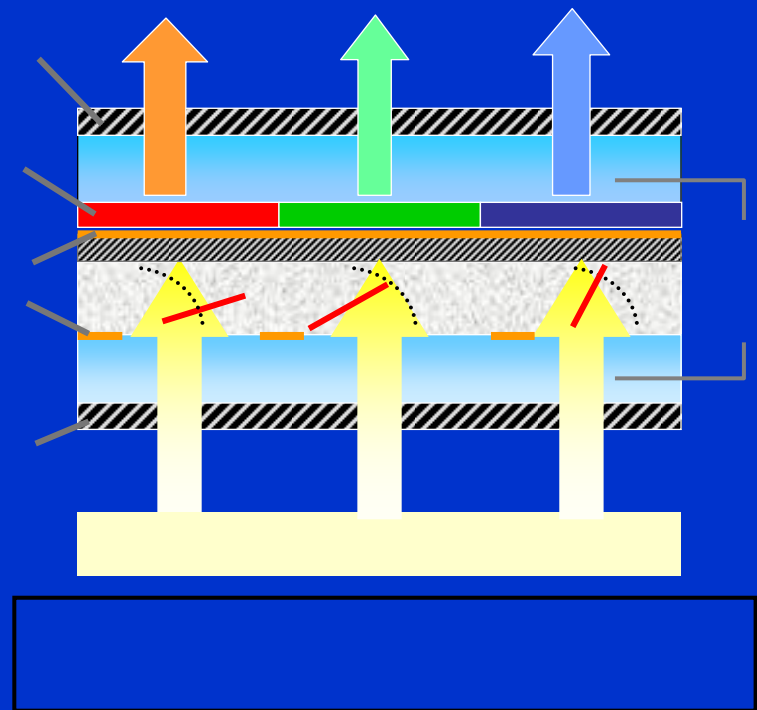
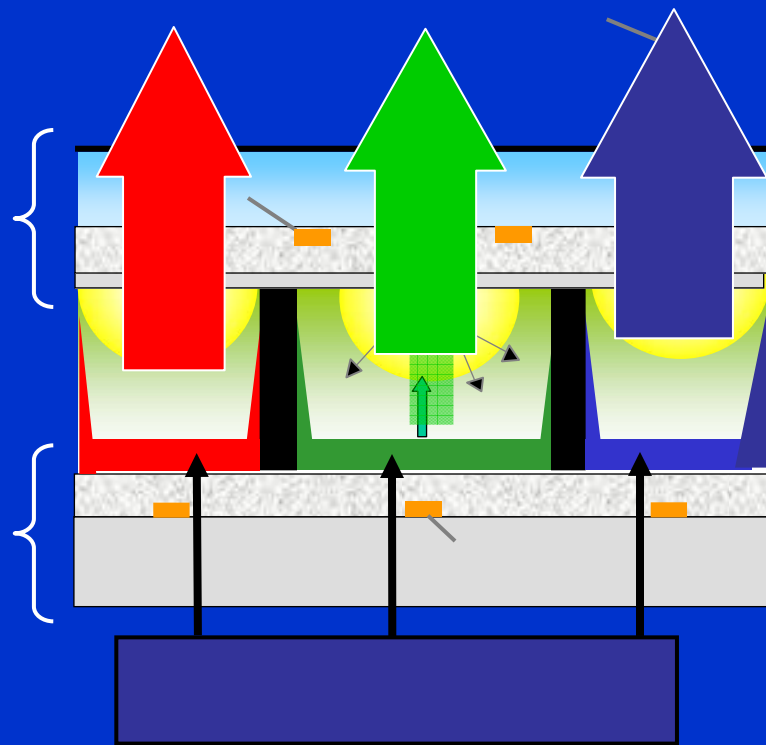


Data from Green Purchasing Network (Japan), 2005 www.gpn.jp/English/

Flat Panel TV Light Emission Structures

Plasma

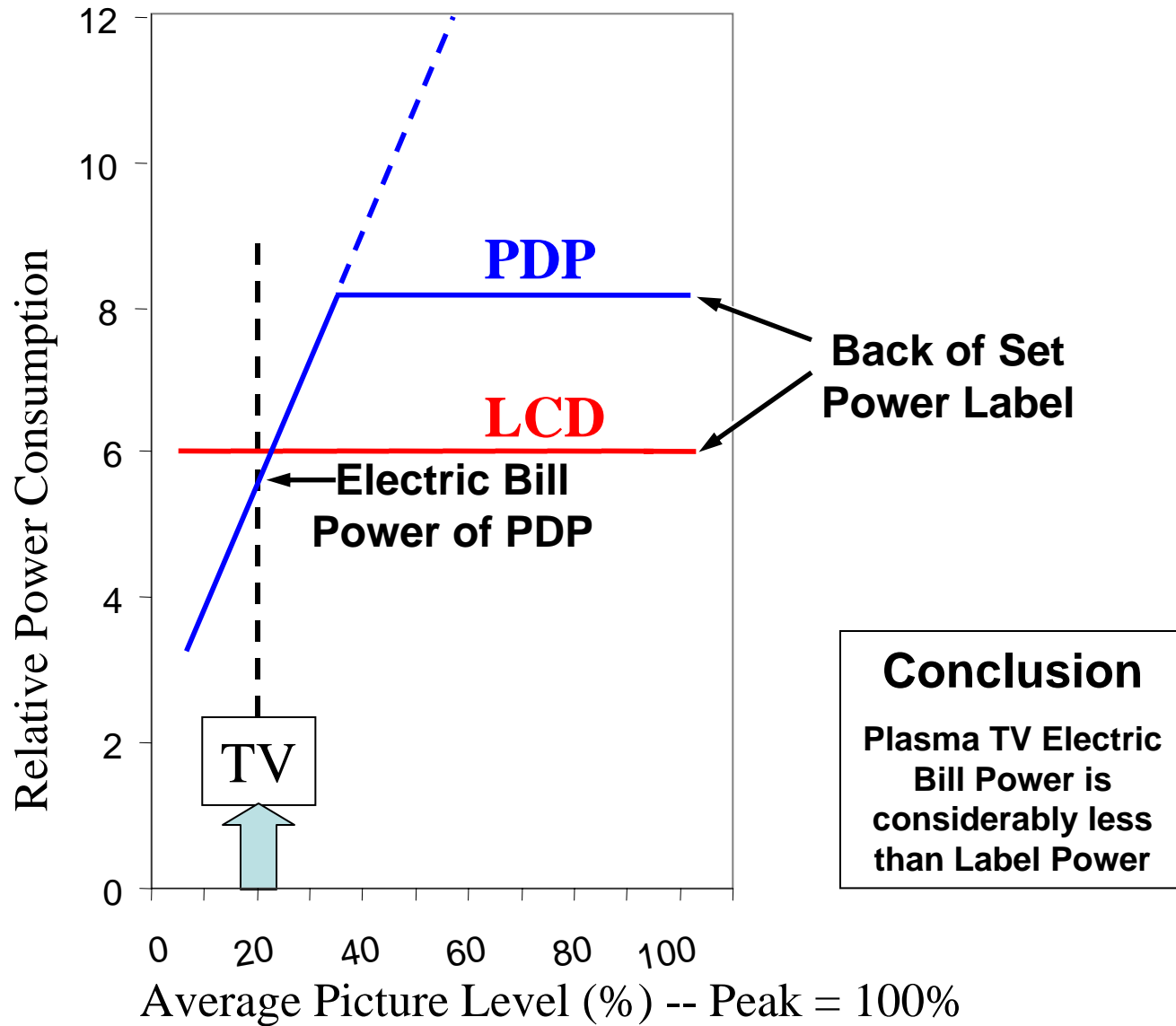
LCD



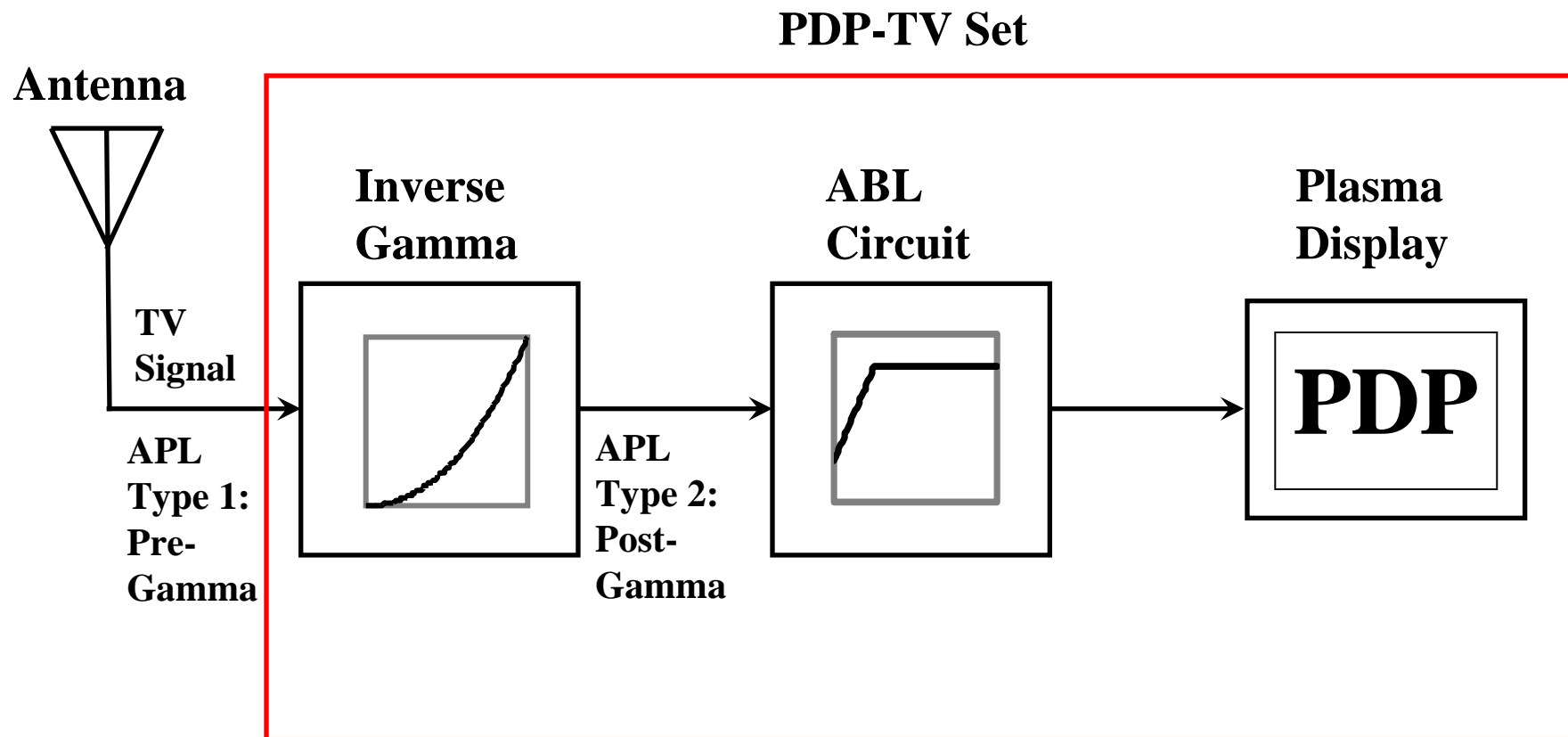
Average Pixel Level (APL)

- APL has major impact on TV power usage
- **APL Type 1 (Pre-Gamma) Definition:**
 - APL is the time average of the video signal input voltage to the TV set, which is usually expressed as a percentage of the *full white signal level voltage*.
- **APL Type 2 (Post-Gamma) Definition:**
 - APL is the time average of the average luminance of all pixels in the TV set, which is usually expressed as a percentage of the *peak white luminance level*.

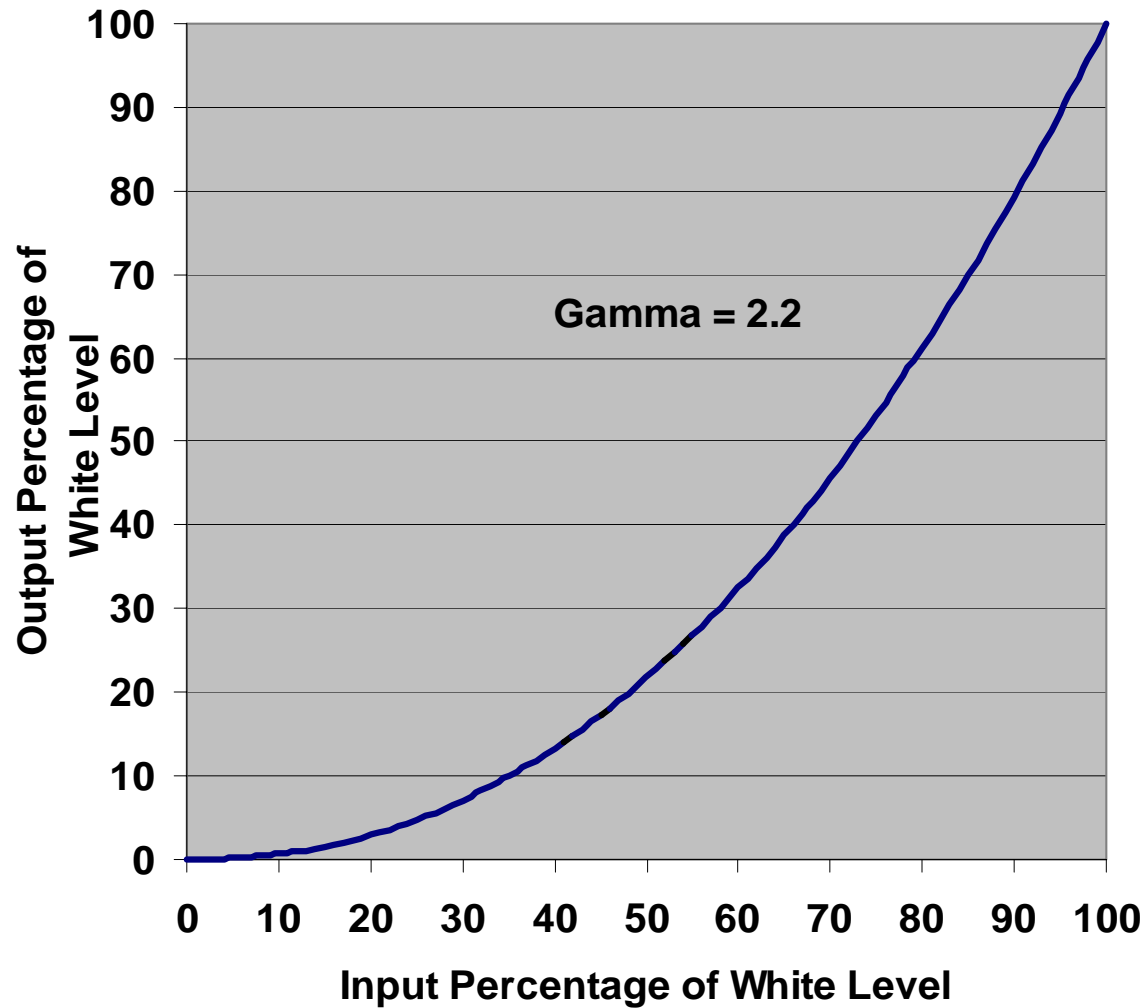
Power Consumption Dependence on APL



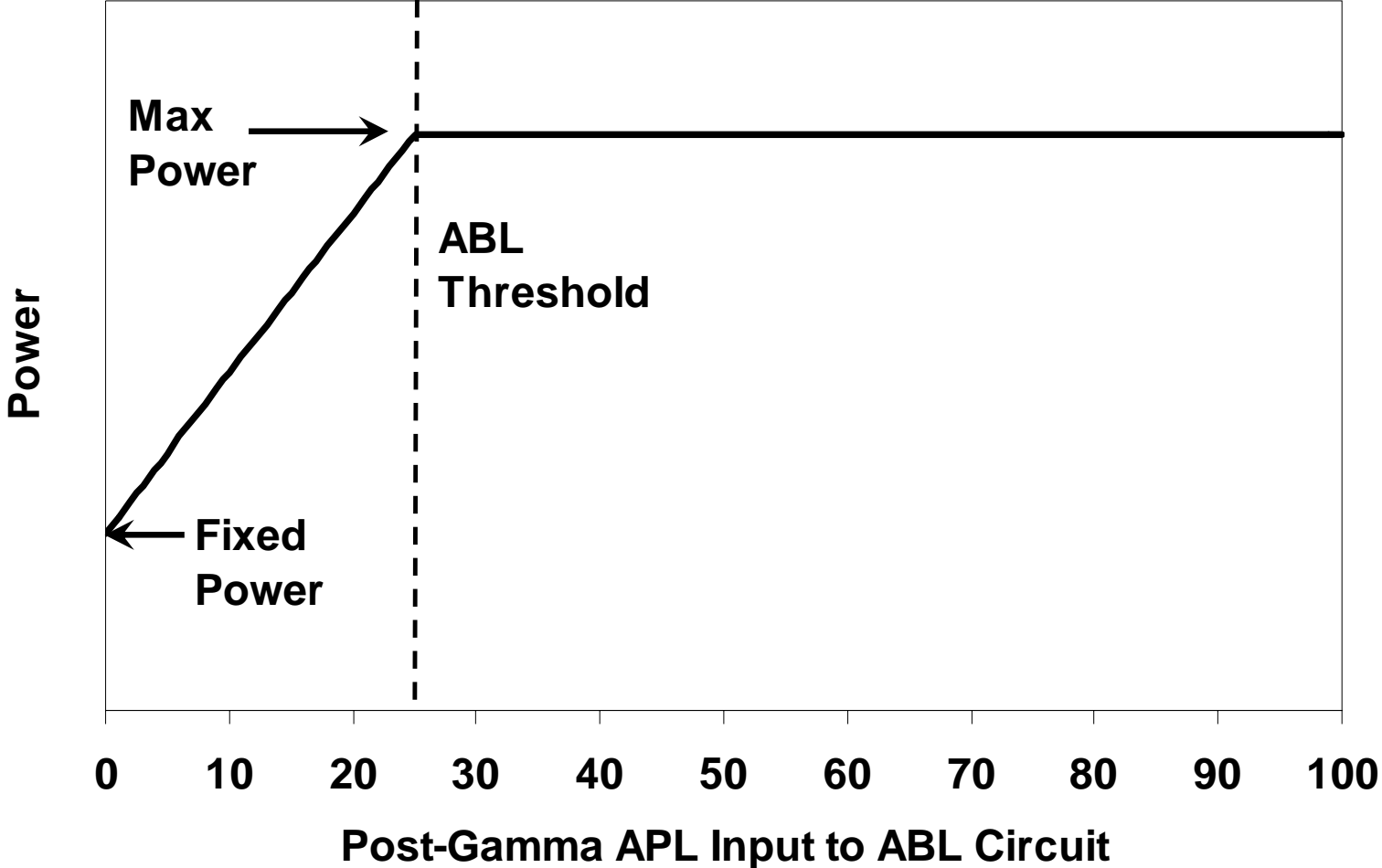
Power Model for Plasma Display TV Set



Inverse Gamma Function



Plasma TV Power Characteristic



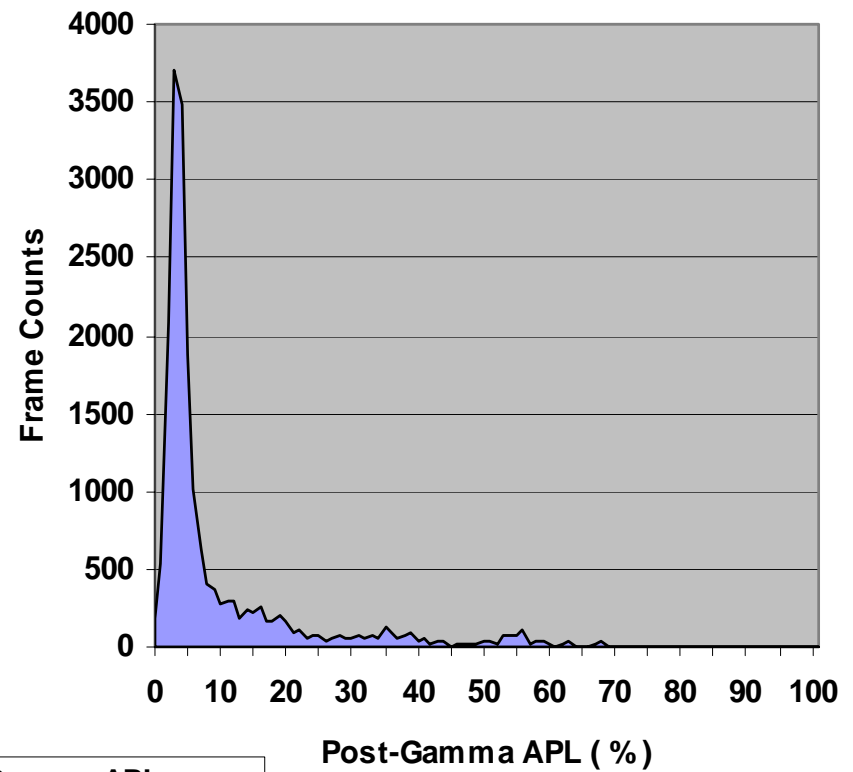
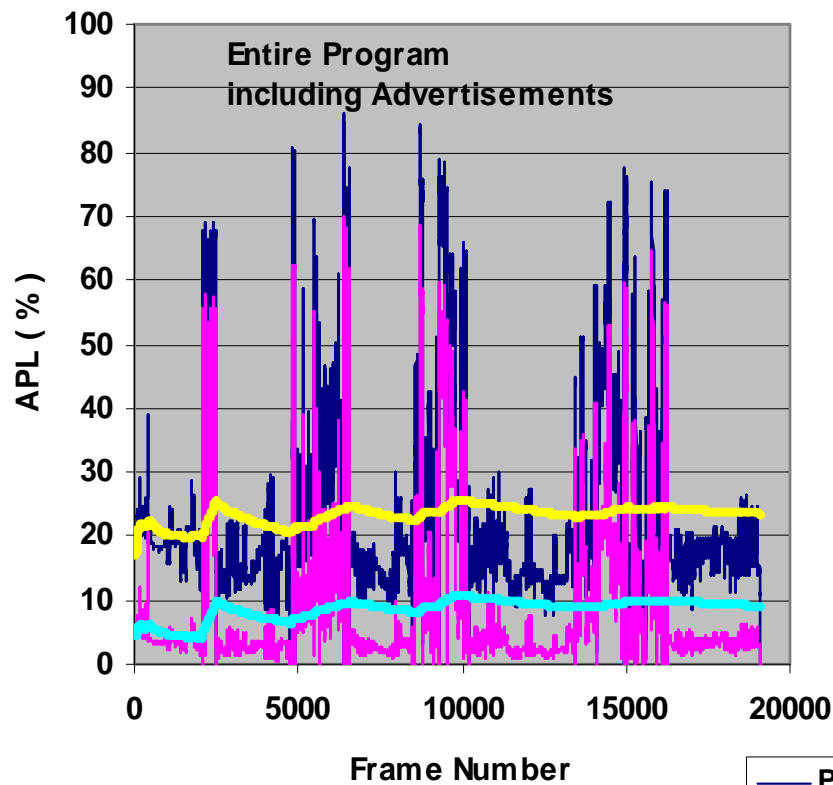
APL Measurements

- Built simple APL Meter
 - Laptop computer with frame grabber card
 - Custom software for math manipulations
- Measured with live TV programs and disks
- Logged APL for each frame
- Plotted with Excel spreadsheet

APL of Popular TV Program

The Young and the Restless Soap Opera

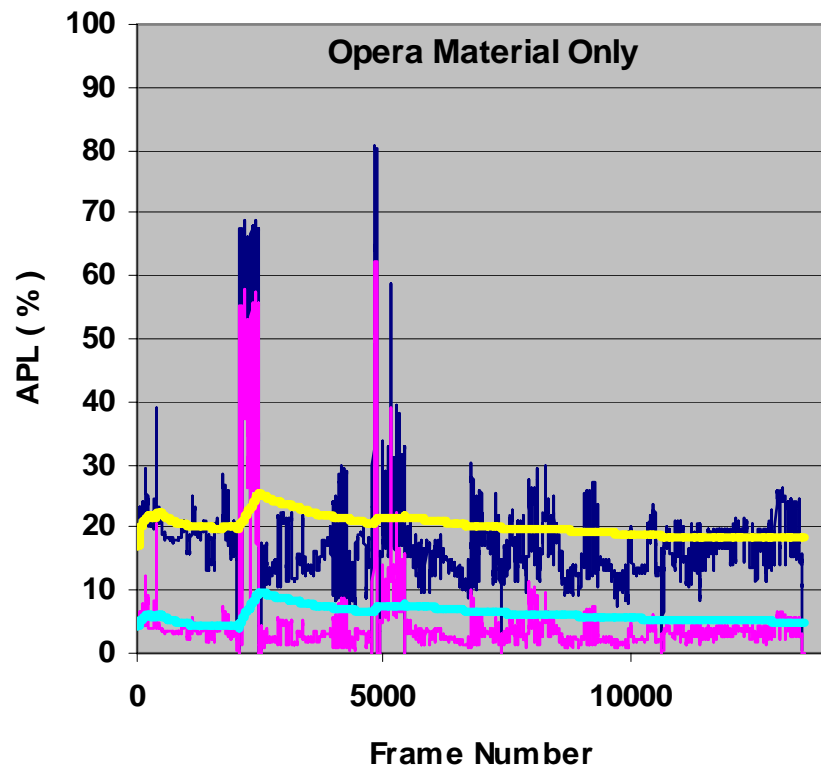
The Young and the Restless Soap Opera



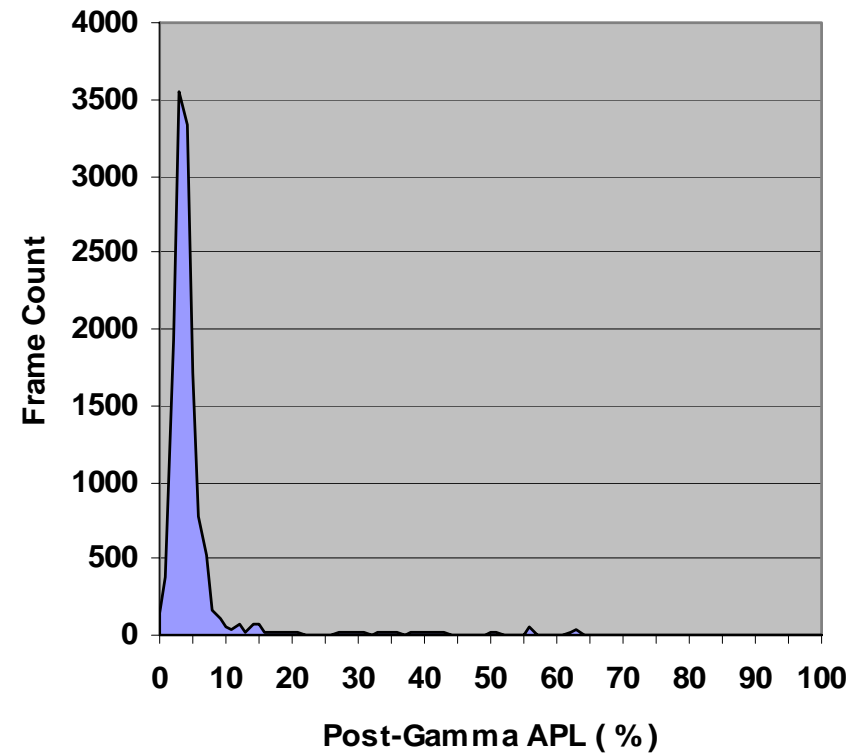
- Pre-Gamma APL
- Post-Gamma APL
- Mean Pre-Gamma APL
- Mean Post-Gamma APL

Soap Opera Program Only

The Young and the Restless Soap Opera

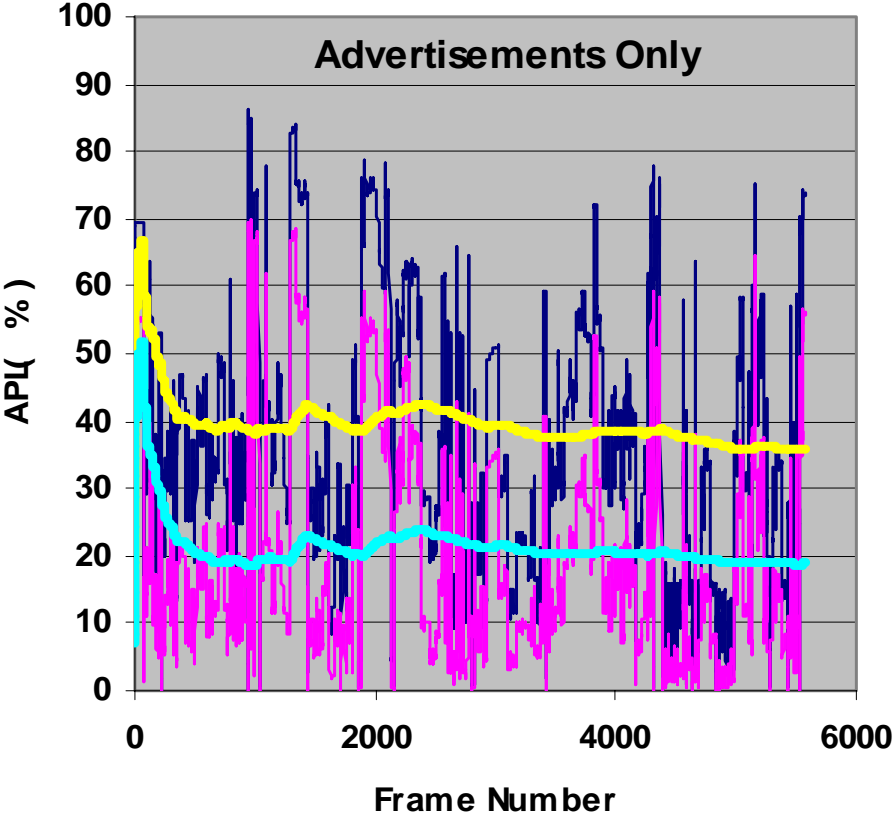


The Young and the Restless Soap Opera

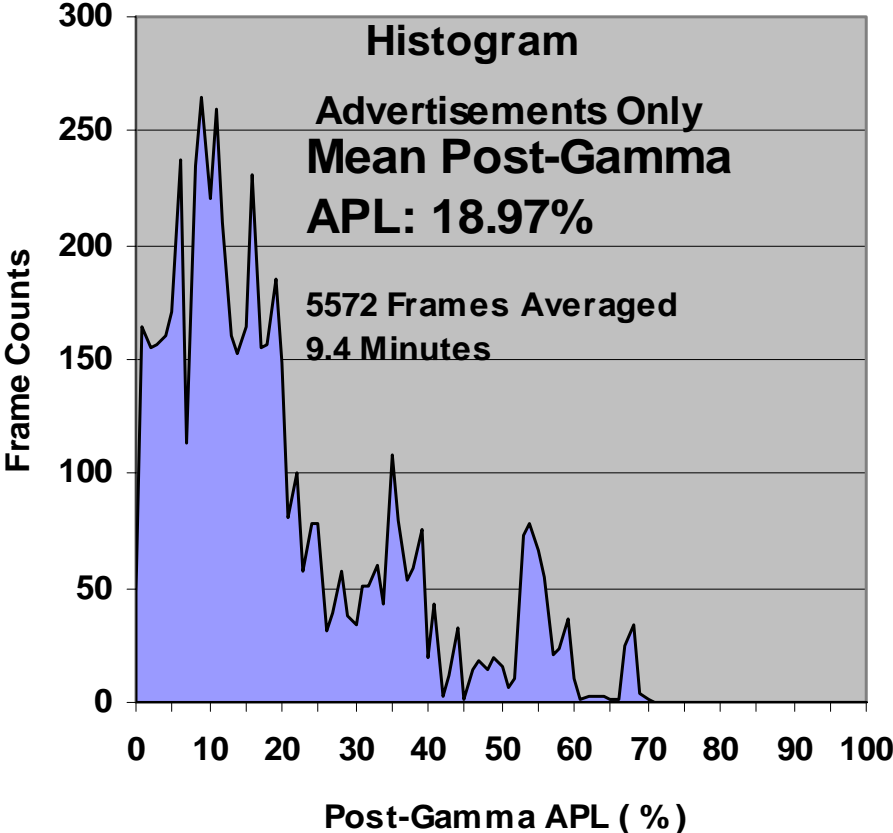


Soap Opera Advertisements Only

The Young and the Restless Soap Opera

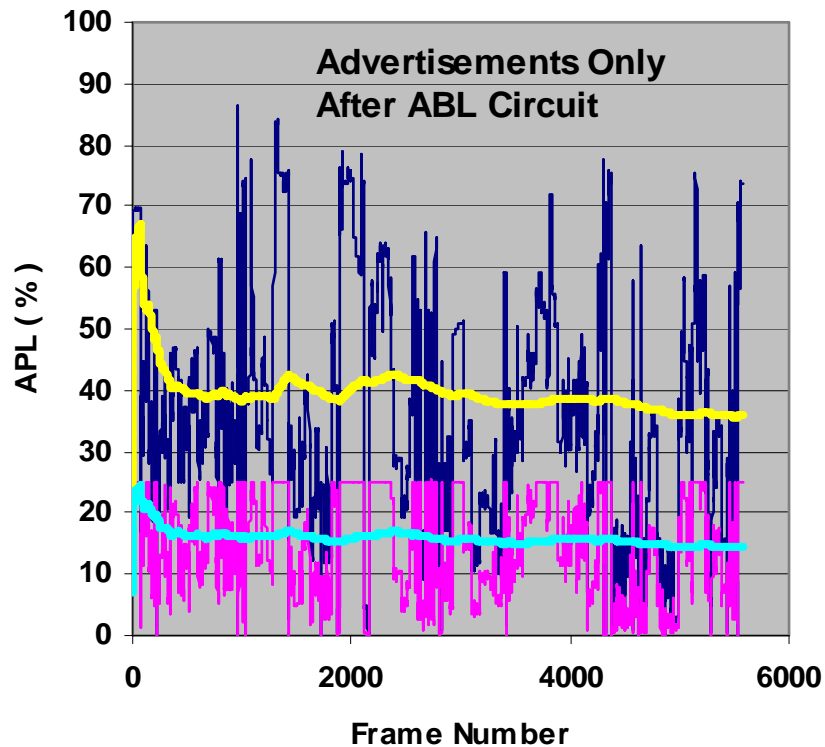


The Young and the Restless Soap Opera

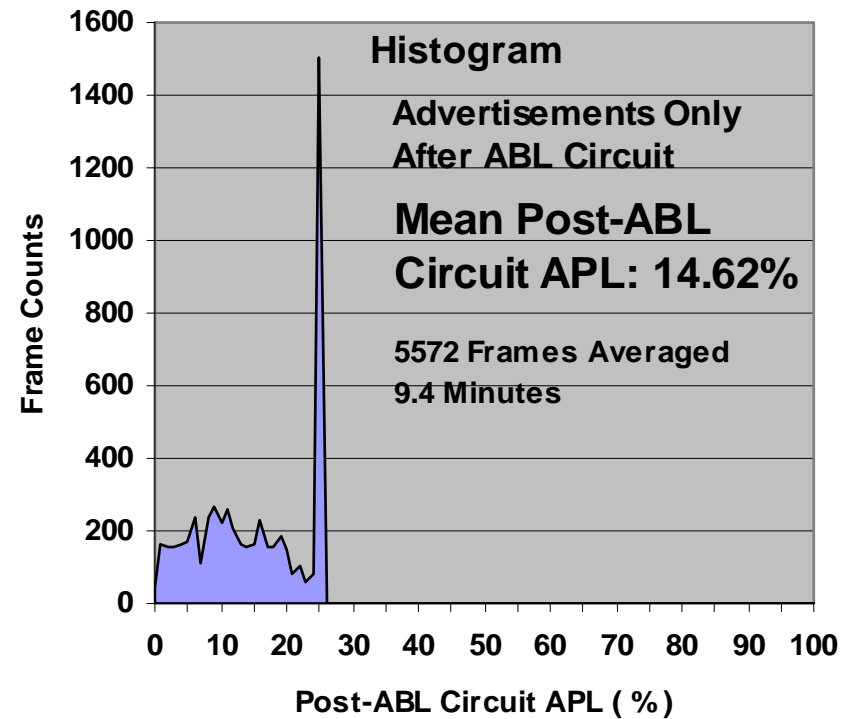


Soap Opera Advertisements After Automatic Brightness Limiting Circuit

The Young and the Restless Soap Opera



The Young and the Restless Soap Opera

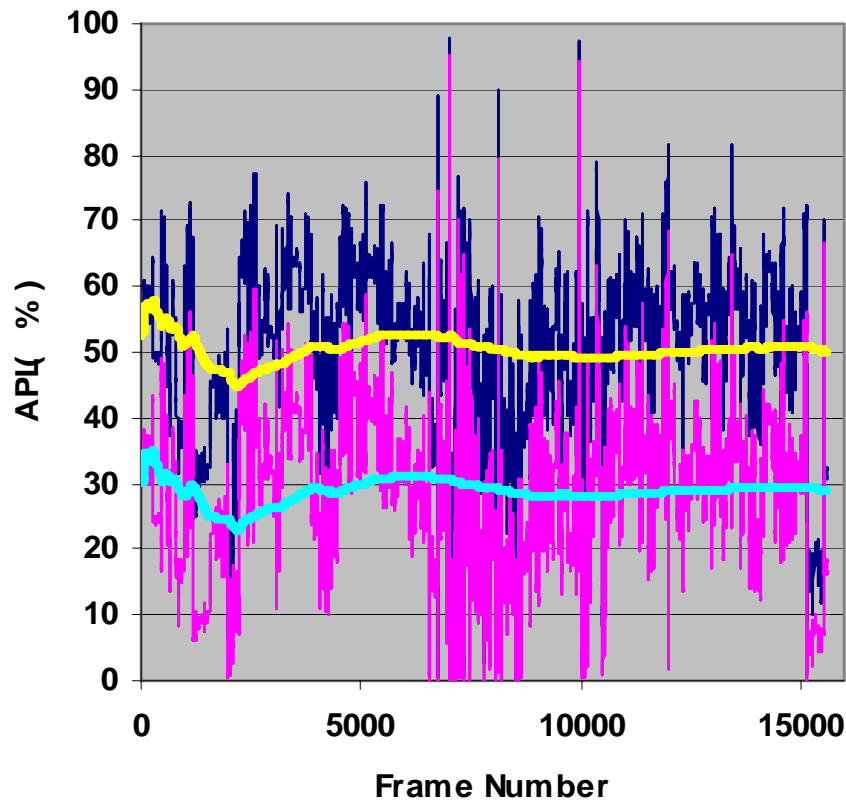


Low Budget Animation

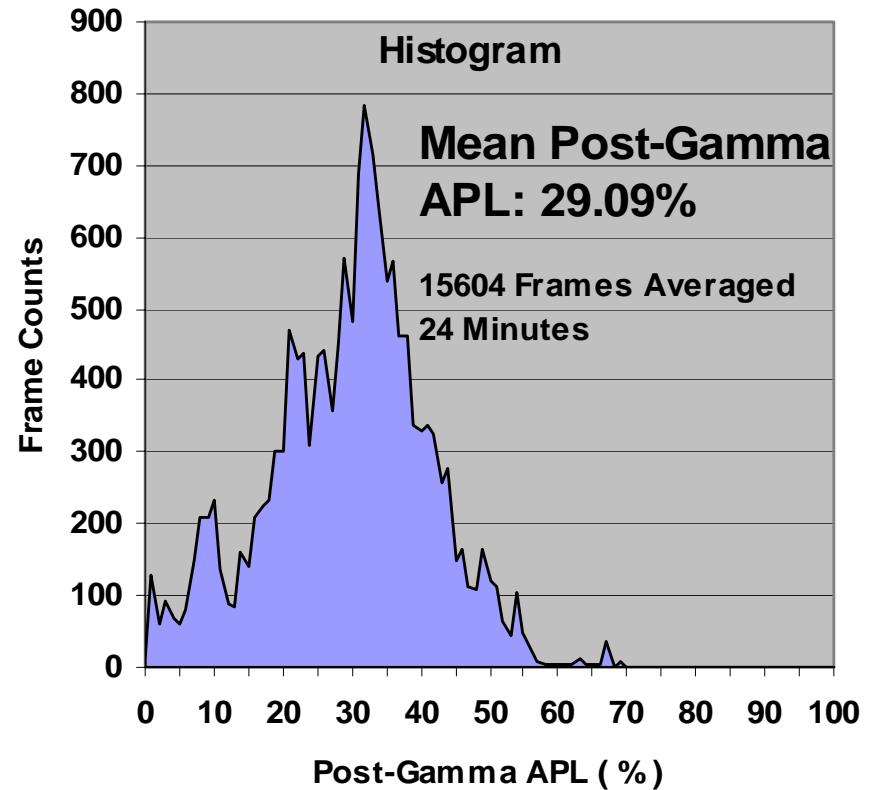


Low Budget Animation

Rug Rats Low Budget Animation

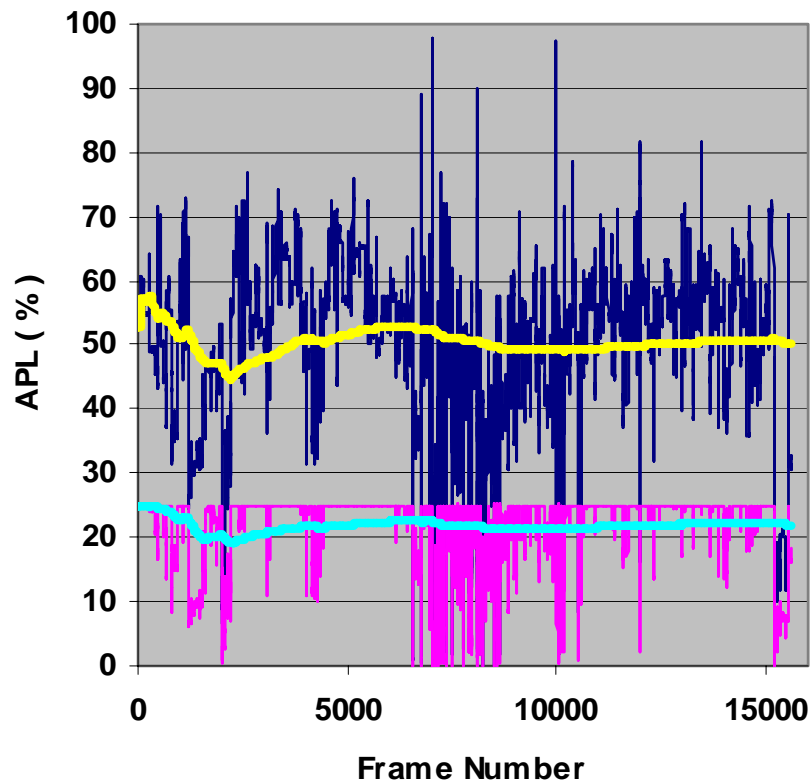


Rug Rats Low Budget Animation

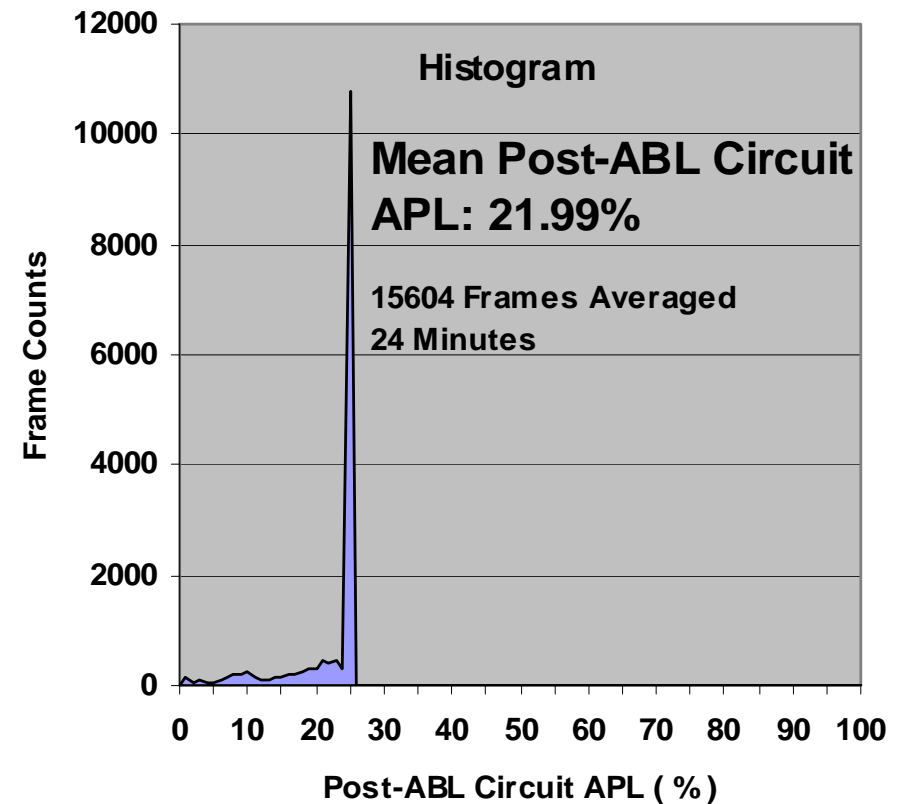


Automatic Brightness Limiting Circuit Reduces Power by 24%

Rug Rats Low Budget Animation



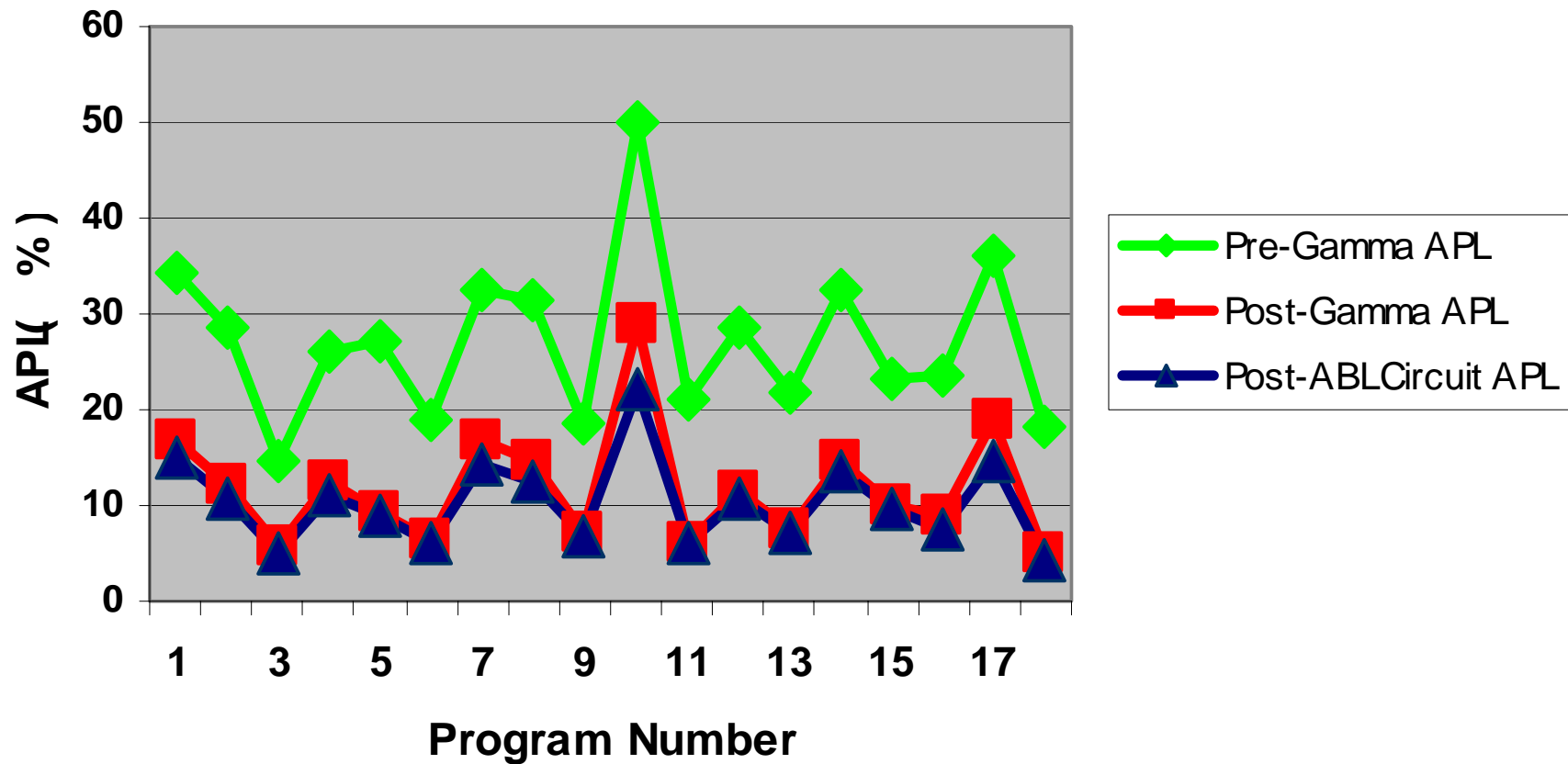
Rug Rats Low Budget Animation



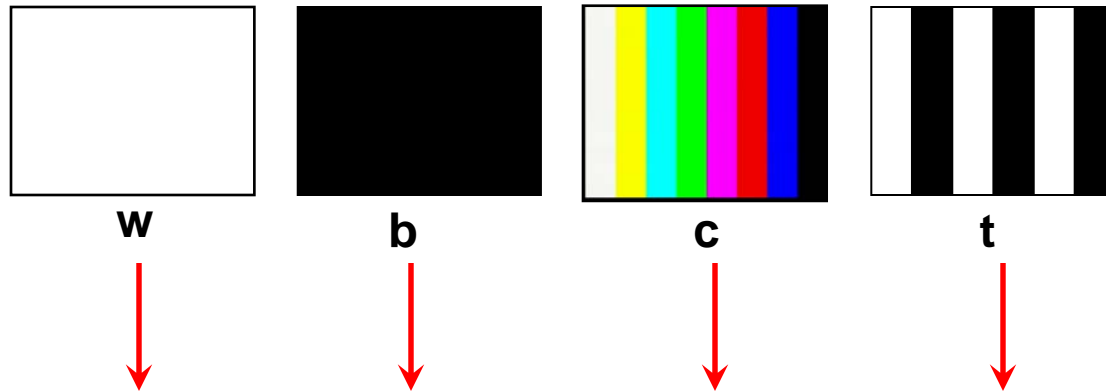
Summary of Measurements

	Program Title	Type	Pre- Gamma APL	Post- Gamma APL	Post- ABL APL	Minutes	Frames
1	Baseball	Sports	34.30	16.74	15.01	24.2	15627
2	Charlie's Angels 2000	Movie	28.51	12.02	10.81	97.8	55725
3	Deadwood (Drama Western)	Movie	14.49	5.78	5.13	53.5	33184
4	Educating Miss Bunny	Adult	26.00	12.34	10.97	30.0	10400
5	Finding Nemo	Animation Movie	27.00	9.44	9.09	100.3	56554
6	Jay Leno	Talk Show	19.03	6.51	6.05	11.5	6500
7	Life Stories: Families in Crisis (Docu Drama)	Movie	32.62	16.85	14.26	45.0	10700
8	Noon News	News	31.40	14.54	12.60	29.0	18528
9	Real Time with Bill Maher	Comedy Talk Show	18.56	7.12	6.77	60.0	29368
10	Rug Rats	Budget Animation	50.17	29.09	21.99	24.0	15604
11	Shakespeare in Love	Movie	20.93	6.09	6.08	123.0	66975
12	Sports Highlights on Sports Network	Sports	28.56	11.48	10.66	28.9	19040
13	The Dreamers (Drama)	Movie	21.79	7.64	7.09	115.0	44854
14	The Price is Right	Game Show	32.60	14.62	13.62	25.0	15868
15	The Winslow Boy (Historical Drama)	Movie	23.24	10.00	9.80	105.0	26543
16	The Young and the Restless Entire Program	Soap Opera	23.50	9.07	7.34	30.0	19095
17	The Young and the Restless Ads Only	Soap Opera	35.93	18.97	14.62	9.4	5572
18	The Young and the Restless Opera Only	Soap Opera	18.37	4.99	4.34	20.6	13524

Summary of Measured APL



JEITA Proposed TV Set Power Measurement Method



$$P_o = 0.167 \times P_w + 0.167 \times P_b + 0.333 \times P_c + 0.333 \times P_t$$

where:

P_o is the output power value that is used for the final power calculations,

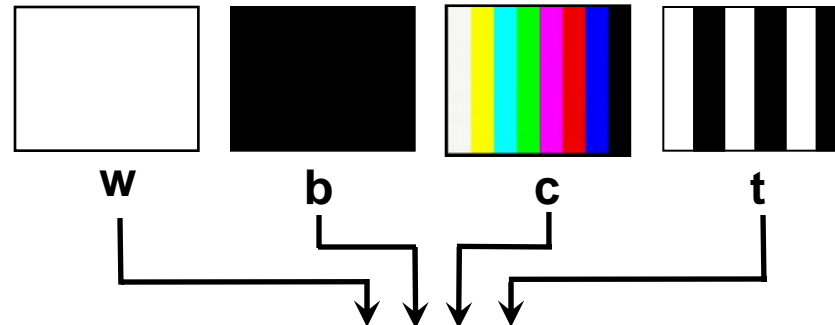
P_w is the measured power of the 100% white pattern,

P_b is the measured power of the full black pattern,

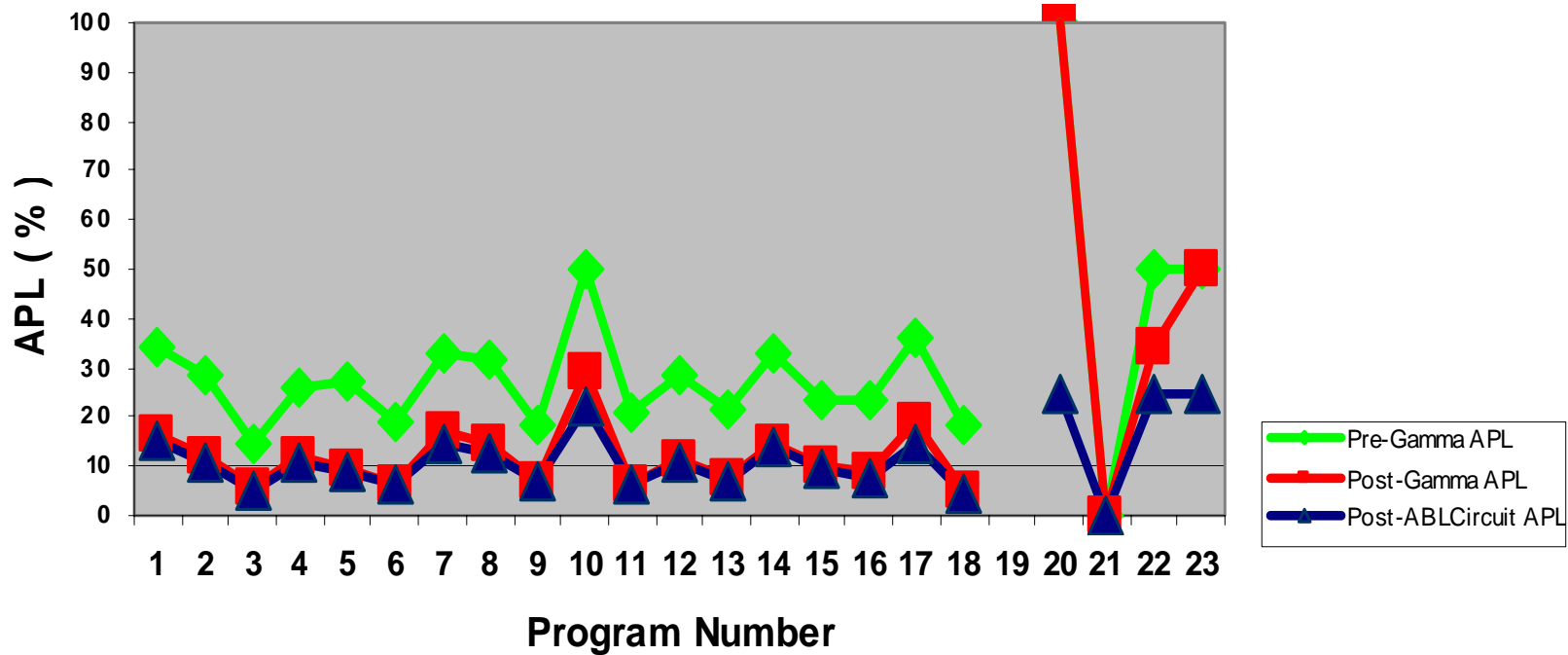
P_c is the measured power of the color bar pattern,

P_t is the measured power of the white and black bar pattern.

JEITA Proposal APL Comparison



Summary of Measured APL



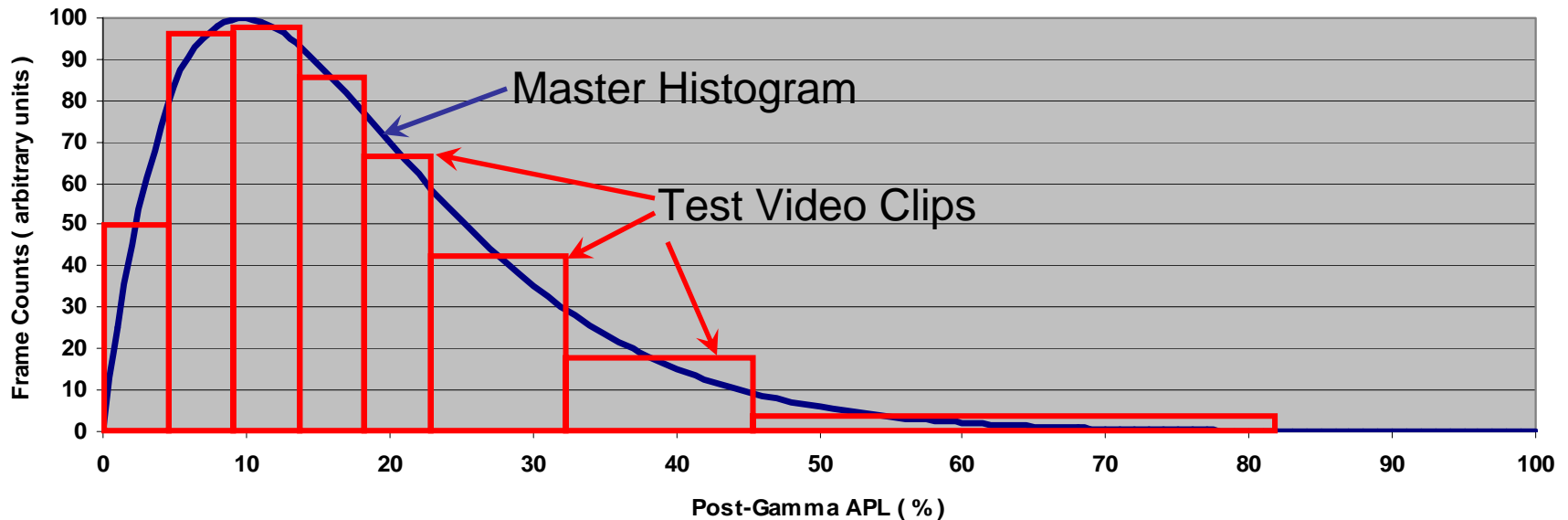
Proposed New Test Method

- Preserve simplicity of JEITA TV Set test
 - Run test images and measure power
- Modify test images
 - Images must represent real TV signals
- Use special test video disk (tape) for images
 - Must be chosen very carefully in order to be truly representative of real TV signals

Special Test Video Disk

- Measure APL Histograms of many popular TV programs
 - Big job that will take a few months
- Prepare Master Histogram of all TV programs
 - Weight individual program histograms by Nielsen ratings
 - Master Histogram will represent average TV usage
- Prepare Test Video Disk with various video clips
 - Histogram of final disk will be same as Master Histogram

Master Histogram



$$P_o = W_1 \times P_1 + W_2 \times P_2 + W_3 \times P_3 + W_4 \times P_4 + \dots + W_n \times P_n \quad (3)$$

Where:

P_o is the output power value that is used for the final power calculations,
 $P_1, P_2, P_3, \dots, P_n$ are the powers that are measured with the various test images,
 $W_1, W_2, W_3, \dots, W_n$ are fixed numbers or Weights defined by the test method.

**TVs Will Continue to Reduce
Power by Natural Market Forces**

All TV Technologies Will Reduce Power in the Future



IMID'

2005

International

Meeting on

Information

Display

July 19-23, 2005
Convention & Exhibition Center(COEX)
Seoul, Korea

Wed. / July 20

IMID '05

09:00-09:20 Room 301 (Auditorium)
Opening Ceremony

Chair : *K. W. Whang, Seoul National University*

Welcoming Remarks

*S. W. Lee, Conference Chair
Samsung Electronics, Korea*

09:20-10:40 Room 301 (Auditorium)
Keynote Address

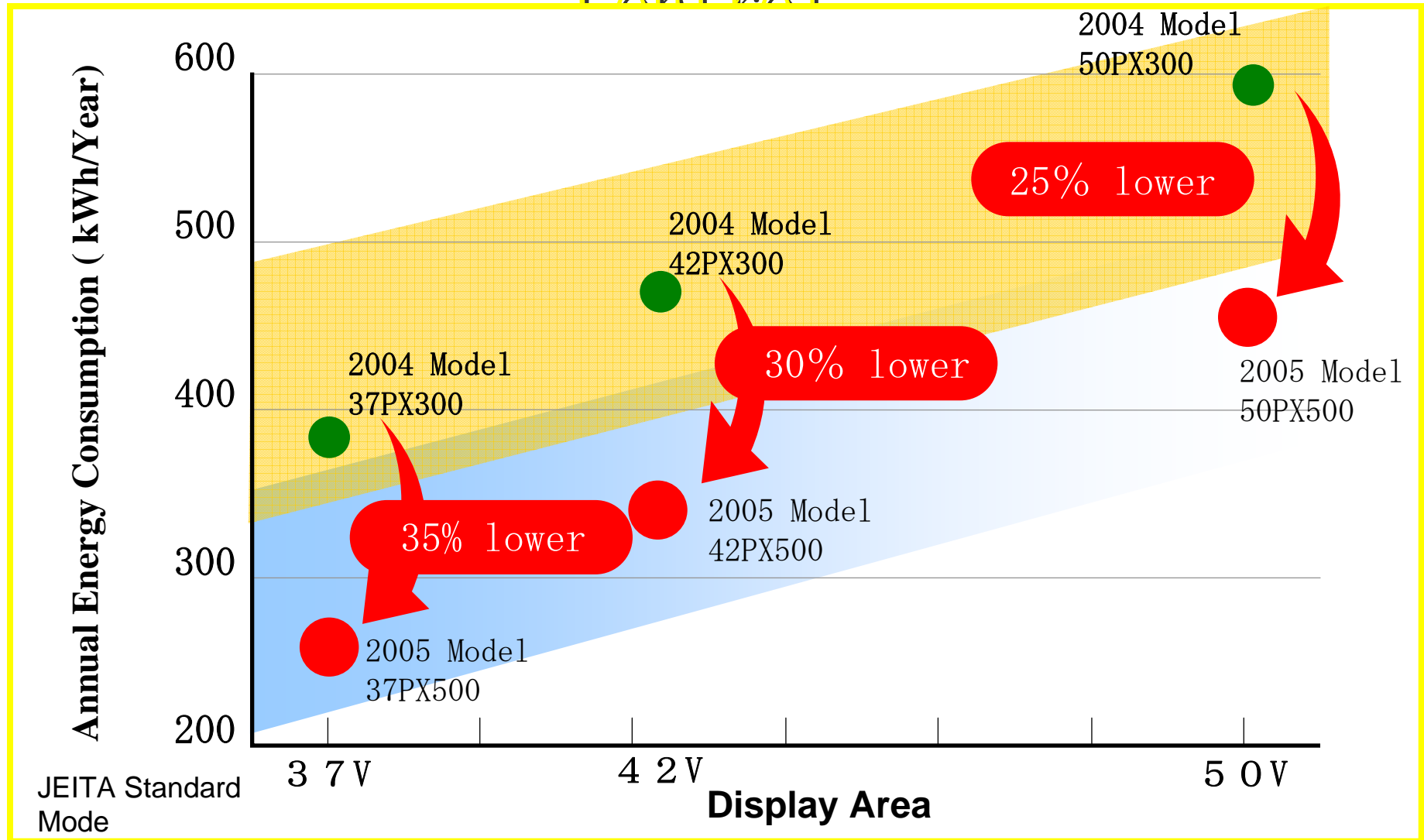
The Race for TVs with Higher Luminous Efficiency

*L. Weber
SID Chairman, USA*

2005 Panasonic Viera Energy Saving Plasma TV

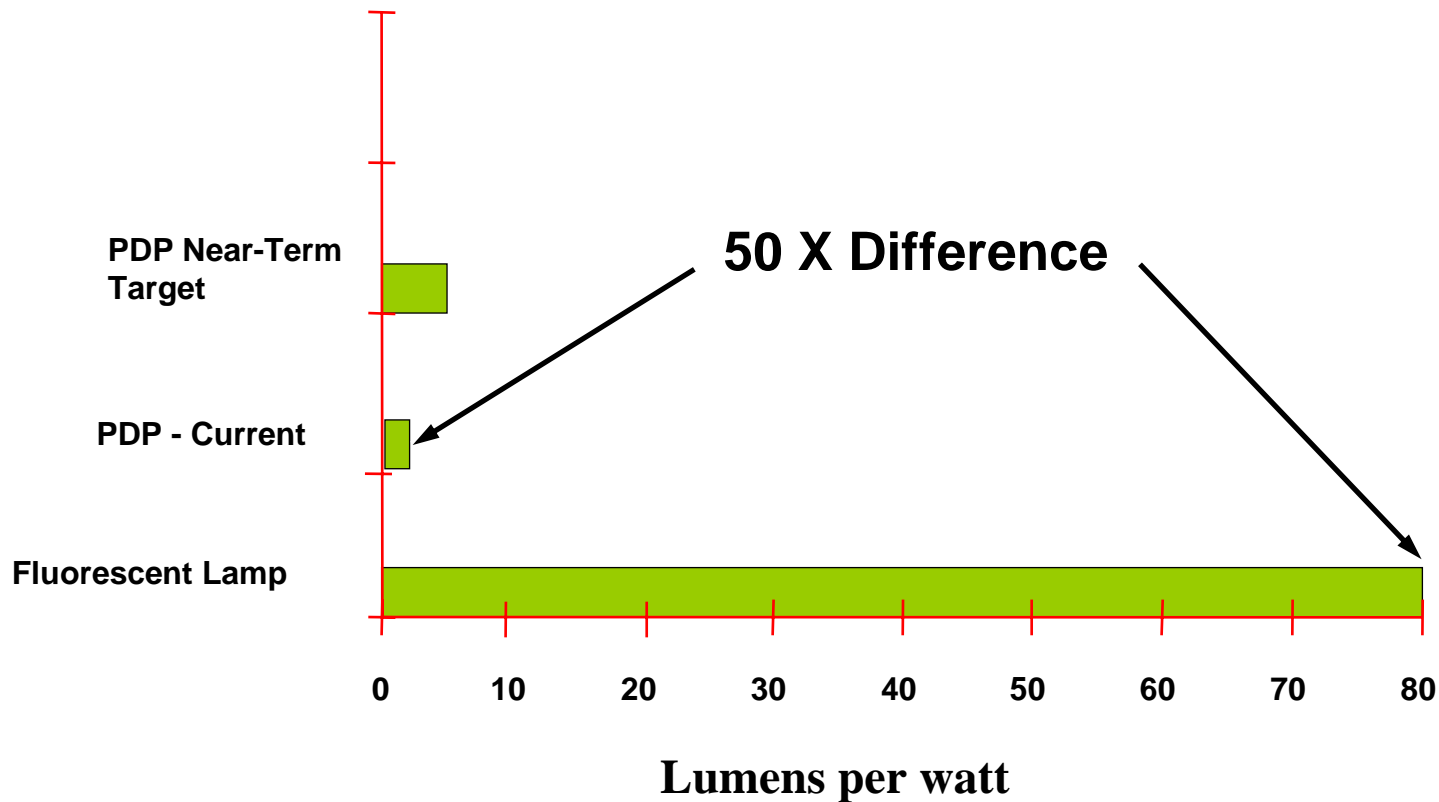
High Efficiency Panel & Better Power

Control



PDP Luminous Efficiency Comparison with Fluorescent Lamp

Luminous Efficiency



International Electrotechnical Commission



The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes international standards for all electrical, electronic and related technologies.

IEC Measurement Method Activity

- Plasma Display Group (IEC TC110 WG4)
 - New Project: “Measuring Method of Plasma-TV Module Energy Consumption”
- LCD Group (IEC TC110 WG2)
 - Will work jointly with Plasma Group to develop joint standard for all flat-panel modules
- Modules Technical Committee (IEC TC110) and TV Set Technical Committee (IEC TC100)
 - Now exploring forming a joint working group for “Measuring Methods of TV Set Energy Consumption”