Responses to Issues Raised on CEC's Proposed Standards for Metal Halide Luminaires

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Issues With Requirement for Use of Pulse Metal Halide Lamps

- Definition of vertical operation – change ok
- Exempt “universal” position lamps
  - New issue just raised
  - Would create a loophole as these lamps can be used in vertical and horizontal positions
  - Are 150 W universal lamps on the market so possible to develop PMH universal lamps

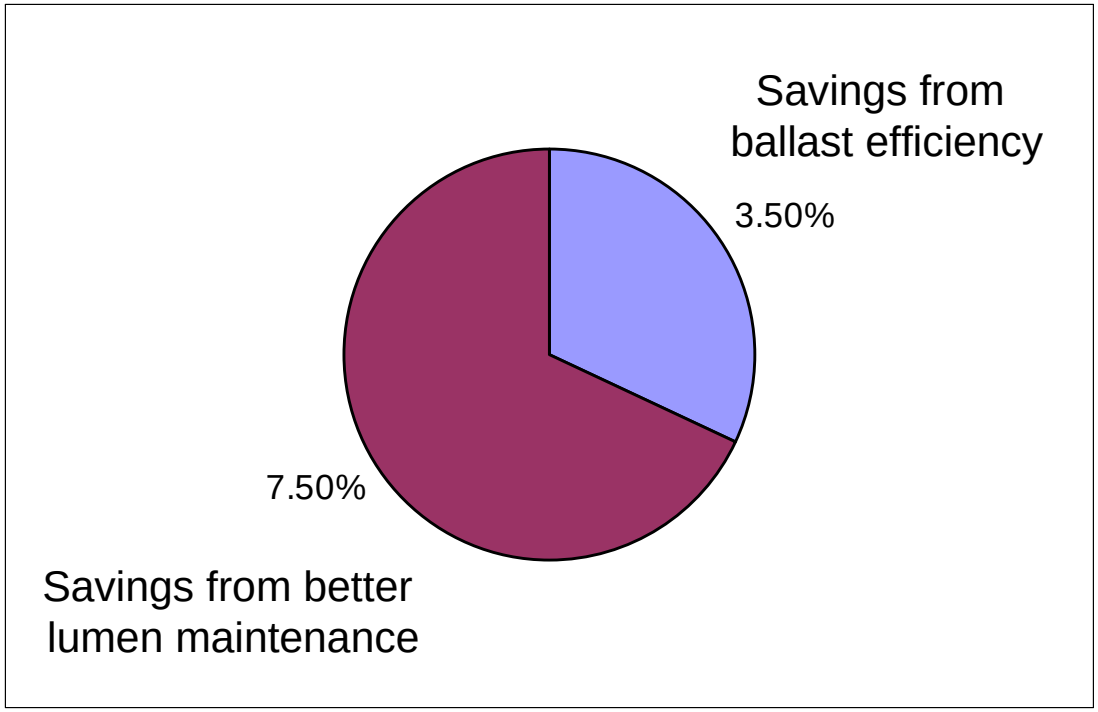
PMH Issues (2)

- Delay effective date to 2009 for 201-500 W
  - This appears to call for delay to tier 1 standard too
  - AZ, OR and WA all call for 2008
  - California should align with neighboring states; will be difficult for them to change
  - Delay electronic ballast standard to 2009 so testing can concentrate on PMH for 2008

Ballast Efficiency Proposal

- Intent – require electronic ballasts or their equivalents due to:
  - Better lumen maintenance, allowing lower wattage lamps
  - Modest increase in ballast efficiency
- Performance approach allows flexibility but in this case has some downsides
  - Allows reactor ballasts
  - Data of uneven quality: testing and test procedure issues

Savings with CEC Proposal



Numbers from Advance comments.

Options
That Have Been Suggested

- Proposal in 45-day language
- Modified proposal to allow lower efficiencies for dimming, quick restrike and use of very high efficacy lamps
- Require use of electronic ballasts but no specific efficiency requirements
- Proposal in 45-day language with exemptions for dimming, quick restrike, or very high efficacy lamps
- Regulate ballast efficiency to eliminate worst magnetic ballasts
- Lamp/ballast system efficacy

Points of Agreement

- Savings available in lamp, in ballast and in system
- Improved lumen maintenance can be source of significant savings
- Some but not all electronic ballasts have improved lumen maintenance
- Pulse-start standard achieves some but not all of available lamp efficiency savings

Points of Agreement (2)

- Ceramic MH lamps generally more efficient than quartz
  - Significant savings at low wattages
  - Middle wattages now being heavily researched
- Dimming and quick restrike can result in additional savings
- Lamps with high scotopic lumens can be used to reduce light levels, saving energy
  - Not all lighting designers convinced

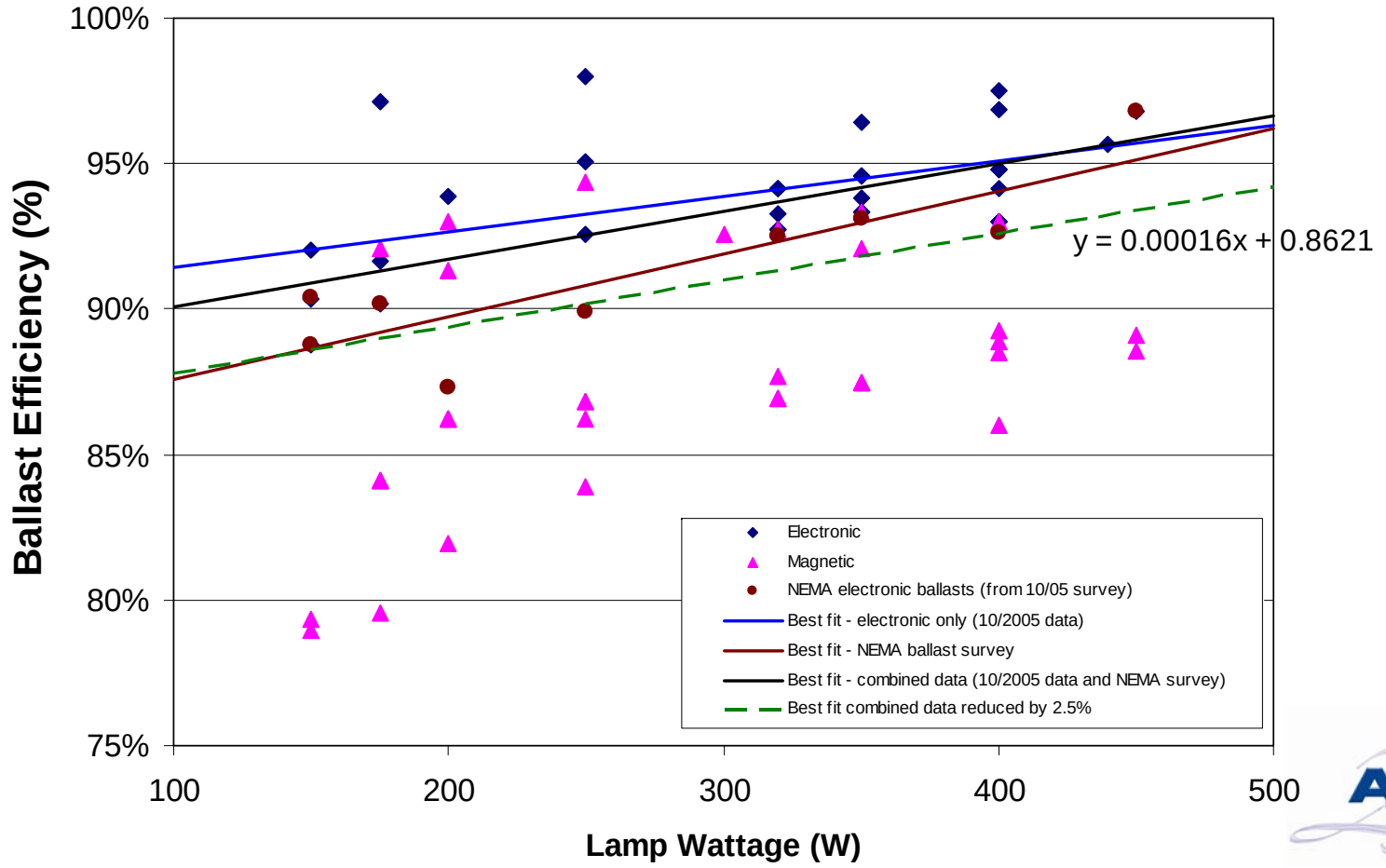
Points of Agreement (3)

- Presently no ANSI standard for electronic HID ballasts
- ANSI has been moving slowly
- CEC proceeding has caused ANSI to accelerate its work
- ANSI standard for low frequency ballasts well along and will be completed fairly soon
- Work on high frequency standard just starting

Points of Agreement (4)

- Electronic ballasts will predominate in the future
- Some lamp manufacturers are certifying their lamps for use with specific electronic ballasts
- Curve provided by ACEEE/PG&E is driven by least efficient electronic ballasts, higher efficiency points have little impact
  - Most of these data points come from NEMA

Derivation of Proposed Standard



Key Points of Disagreement

- Which option to use
- Cost of electronic ballasts
- When should a standard take effect

- Discuss each of these in subsequent slides

Other Points of Disagreement

- Request to exempt outdoor fixtures
  - Been debated for more than a year -- exemptions in 45-day language adequately address
  - To be exempted need to be rated for wet locations *and* have high temperature ballast
- Should we exempt all CMH lamps?
  - We expect some inexpensive low-quality CMH lamps to come out of China soon
  - Any special treatment for CMH should have an efficacy requirement

NEMA Proposals

- Regulate mean lumens/W using rated data (Advance proposal)
  - But this only attempts to capture 3.5% savings
  - And if efficient lamps are replaced with inefficient lamps, savings could be less
- Set a ballast efficiency requirement that eliminates the worst magnetic ballasts
  - But only saves roughly 1% (depending on where line drawn)

Modification of 45-Day Proposal

- Reduce efficiency required by 45-day language by the following factors where applicable:
  - .02 credit for linear dimming
  - .01 credit for quick restrike
  - .04 credit if very high efficacy lamps packaged with fixture
- We estimate this will save ~9%

Expressing Proposal in Regulations

- Ballast efficiency must be greater than or equal to: .00016*W + .86 – Adj
- W= lamp watts
- Adj = .01 for quick restrike
  .02 for dimming
  .04 for high efficacy lamps
  .07 for all three
  Other combinations also allowed

Example

- For a 320 W fixture with dimming, quick restrike and high efficacy lamps, required efficiency is:

  .911 base efficiency

  - .020 for dimming

  - .010 for hot restrike

  - .040 for very efficient lamps

  = .0841 required efficiency

Definitions

- Dimming ballasts -- use no more than 55% of full power when the ballast is dimmed to 50% of full lamp lumens.
- Quick restrike capability – lamps relight within 1 minute after being switched off and then on.
- Very efficient lamps -- fixtures packaged with lamps and ballasts that provide at least 95 mean lumens per watt.

Rationales for Adjustment Factors

- Dimming and quick restrike based on efficiency penalty for these features per discussions with manufacturers
- Very high efficacy lamps gives half credit for efficacy improvement; savings derated since when lamp burns out may be replaced with conventional lamp

Derivation of Very High Efficacy Lumens Per Watt

From Walerczyk, Generic Best Practice Lighting Report, 1/06

NON-FLUORESCENT LAMP EFFICACY TABLE

lamp family	lamp type	lamp wattage	catalog mean lumens	ballast type	ballast factor	system mean lumens	system watts	mean lumens / system watt
MH	quartz PS	450	39,000	elect	1.00	39,000	470	**83**
	ceramic PS	400	41,000	elect	1.00	41,000	417	**98**
	ceramic PS	400	32,000	mag	1.00	32,000	458	**70**
	quartz PS	400	34,200	elect	1.00	34,200	417	**82**
	quartz PS	400	30,000	mag	1.00	30,000	458	**66**
	standard	400	23,600	mag	1.00	23,600	458	**52**
	ceramic PS	250	25,200	elect	1.00	25,200	265	**95**
	ceramic PS	250	19,200	mag	1.00	19,200	288	**67**
	quartz PS	250	21,100	elect	1.00	21,100	265	**80**
	quartz PS	250	17,900	mag	1.00	17,900	288	**62**
	standard	250	13,600	mag	1.00	13,600	288	**47**
	quartz PS	100	6,000	elect	1.00	6,000	112	**54**
	cer. PS PAR20	39	1,600	elect	1.00	1,600	44	**36**
MV	standard	400	18,000	mag	1.00	18,000	455	**40**
HPS	standard	400	45,000	mag	1.00	45,000	465	**97**
LPS	standard	180	30,000	mag	1.00	30,000	231	**130**
incan - descent	HIR PAR38	100	2,200	none		2,200	100	**22**
	HIR PAR38	60	1,100	none		1,100	60	**18**
	H PAR38	60	830	none		830	60	**14**
	BR40	65	680	none		680	65	**10**
	2-ended quartz	300	5,800	none		5,800	300	**19**
	A19	60	880	none		880	60	**15**
LED	white light	about slightly better than most incandescents						**? 20 ?**

footnotes

Green - good. Yellow - caution. Red - bad, but sometimes necessary. HPS and LPS haves no color, because with low CRI and low scotopic/scotopic ratio, not really that good.

HID maintains light output hot to cold, unlike fluorescent which can drop off significantly.

Since HID lamps need a ballast to work, ballasting is included.

Some higher mean lumens are listed with EBs. To be conservative same lumens could be listed with electronic & magnetic.

These numbers are based on composite lamps and ballasts. Specific calculations should be done with specific lamps & ballasts.

MH = metal halide. HPS = high pressure sodium. MV = mercury vapor. LPS = low pressure sodium. PS = pulse start. R = reflector. HIR = halogen infrared. H = halogen. BR = reflector. EB = electronic ballast. Mag = magnetic ballast.

Prepared by Stan Walerczyk of Lighting Wizards on 9/27/05. www.lightingwizards.com

Alternative: Just Require Electronic Ballasts

- No efficiency requirement for now; maybe add in future
- Would allow all electronic ballasts including low frequency
  - More products eligible
  - Can use forthcoming ANSI standard for low frequency while waiting for high frequency standard
- Captures some efficiency improvement plus often improves lumen maintenance
- Estimate approximately ~9% savings

Electronic Ballast Costs

- Advance correct that an incremental cost of $100 is common today.
- Can sometimes obtain incremental costs as low as $50 today with large orders.
- As availability and sales increase, due in part to new CEC standards, $50 cost should become the norm and $30 is very possible

Electronic Ballast Economics

- Advance economic analysis only considered ballast efficiency savings and not improvements in lumen maintenance
- If latter included, savings are $198 (per CASE), costs are $100 (per Advance) and net savings are $98.

Effective Date

- 45 day language proposes:
  - 2008 for 150-200 W
  - 2009 for 201-500 W
- We propose to use 2009 for all wattages (150-500 W) in order to permit:
  - Completion of PMH testing in 2008
  - Enough time to complete ANSI low-frequency standard and hopefully the high-frequency standard

Other Option

- 45-day language equation but exemptions for linear dimming, quick restrike or very-high efficacy lamps
  - Estimate roughly 7% savings
- With this option or with requirement for electronic ballasts, likely to add efficiency requirements in future

Our Preferences
(in order of preference)

1. Electronic ballast requirement (simple)
2. 45-day language with Adj factor
3. 45-day language with 3 exemptions (lower savings)

- Savings from other options too small to merit serious consideration
- By adopting one of these 3 options keep pressure on ANSI and manufacturers to address outstanding issues; other options wouldn't