

# Valuing Advanced LED Lighting Features

## Using NEBs & Other Approaches to Value Hard-to-Measure "Next Generation" Features of Energy Efficiency Measures

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**Need:** Pacific Northwest National Laboratory (PNNL) needed results for modeling future demand for advanced LED features being researched.

**Purpose:** To monetize the value potential purchasers place on new features being researched for: Commercial Lights, Residential Sockets, and Street / Roadway Lighting

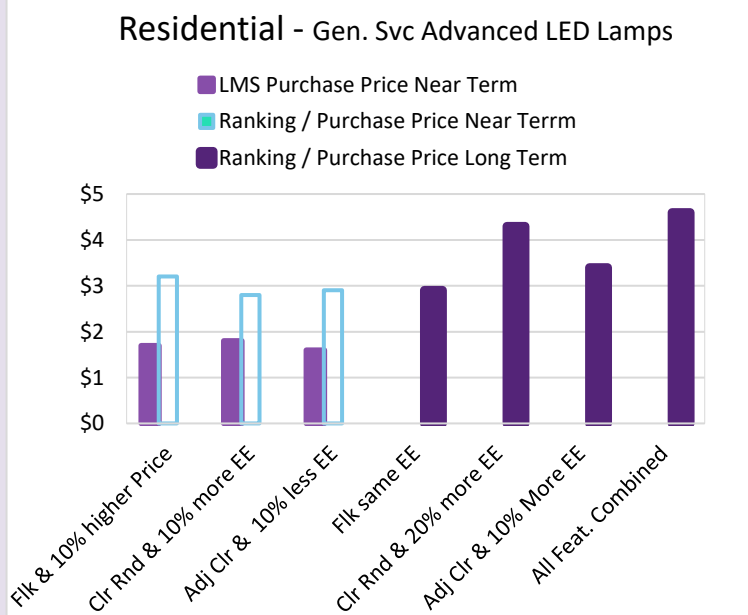
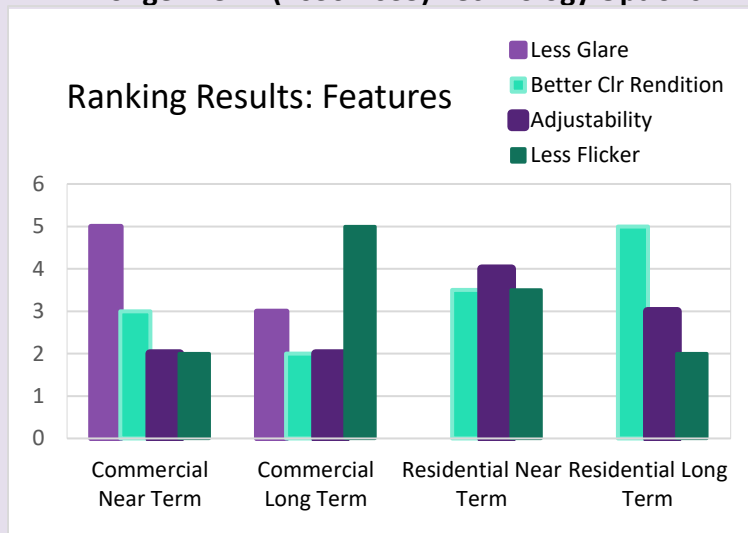
**Research:** SERA developed individual price inputs for Navigant lighting forecasting / market share model.

### Key Features of Lighting Technologies Studied

(EE is Energy Efficiency)

	Feature	Near term, vs. baseline	Longer Term vs. baseline
Com?	Glare	15% lower EE, no price change	No EE or price changes
	Flicker	10% price increase, no EE change	No change in price or EE
	Color	10% better EE, no price change	20% better EE, no price change
	Adjustable	10% lower EE, no price change	10% better EE, no price change
Resid?	Flicker	10% price increase, no EE change	No change in price or EE
	Color	10% better EE, no price change	20% better EE, no price change
	Adjustable	10% lower EE, no price change	10% better EE, no price change
PW	Color	No change in EE or price	10% better EE, no price change

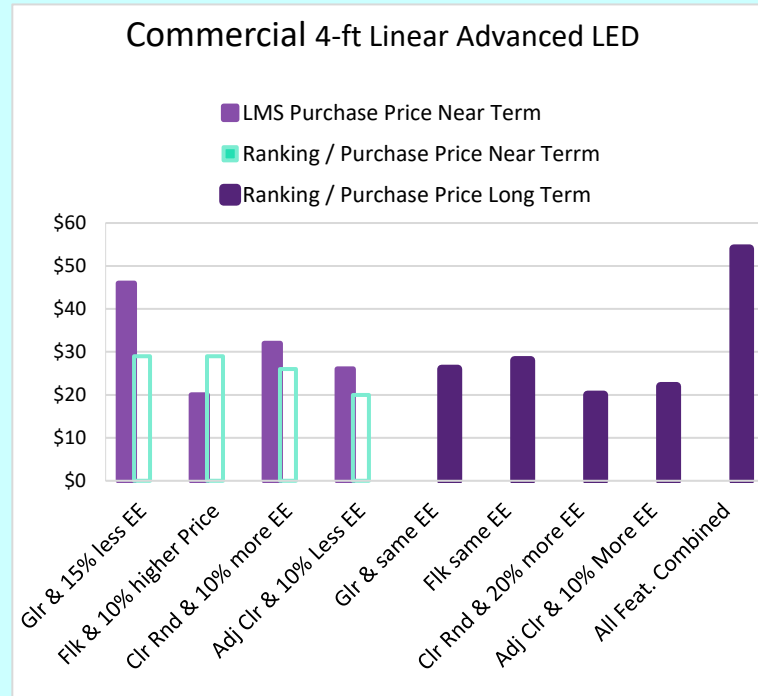
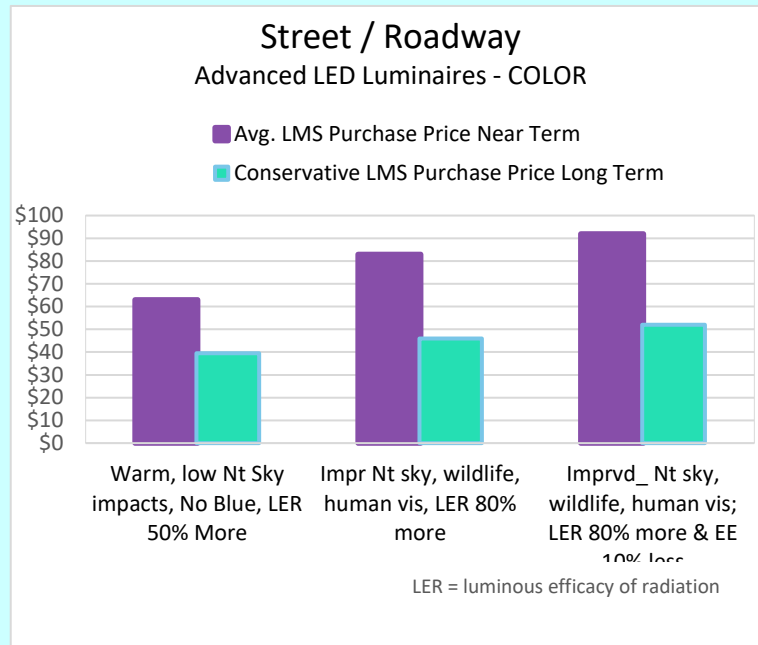
### Results of the Near Term (2020-2025) and Longer-Term (2030-2035) Technology Options



### Quantifying "hard to measure" (HTM) and Non- Energy Benefits (NEBs)

- Non-energy benefits / impacts (NEBs)– Specialized labeled-magnitude scaling (LMS) – associates multipliers with 5-point scale from "much more valuable" to "much less valuable".
- Ranking – Rank options; value top two and bottom
- Willingness to pay (WTP) – Value WTP for feature

Also asked: valuations for multiple features included in one lamp. Valued as annual stream, and one-time price effect using sector-specific discount rates and measure EULs.



### This work reached several conclusions.

- **Useful Approach-** Both LMS & ranking / valuation approaches provided relatively – but not perfectly – logical / consistent results.
- **Positive Value** - The advanced LED features appear to have positive value to the relevant sectors / purchasers for all features studied.
- **Monetary Estimates** – Responses to questions that were not directly monetary were used to develop monetary estimates. The monetary results can be used for research or scenario purposes, in market projection models.
- **Hierarchy of Value** - These monetized estimates indicated a tentative hierarchy of value for various features.
- **Additivity:** Value from Multiple Features are not Fully Additive - The sum of the values from each of the individual features exceeds the value respondents assign to a luminaire with all of the features combined.
- **Lessons Learned / Next Steps:** Refine scale & terminology; apply to features without tradeoffs; split surveys / reduce length.

## Background / Design

**OBJECTIVES:** Develop statistically-defensible estimates of the (dollar) value of Advanced LED Lighting Features

*improved glare, flicker, color rendition, adjustable intensity & color temperature*

... To use in developing near- and longer-term projections from a lighting sales / market share model.

**Outputs:** Incremental dollar value for individual (and combined) features by sector – annual stream and first cost dollars.

### Sectors and Features of Interest

Feature	Com'l 4' Linear	Resid. Lamps	Street / Roadway
Glare	√		
Flicker	√	√	
Color Rendition	√	√	√
Adjustability (intens & color)	√	√	

### Sources of Benefits:

- Occupant satisfaction / comfort
- Productivity
- Fewer tenant calls
- Animal protection, human safety
- Sleep, daily rhythms
- Other

### Survey Sample Sizes (purchasers, specifiers, users)

Sector / Respondent Group	Source / Administration Method to Web survey	Number of Responses
Commercial – Lighting Designers	Purchased sample/ emails; emailed link	184
Commercial – Business Owners	Purchased panel survey responses, statistically representative nationwide	400
Commercial – Business Owner Follow-up sample	Purchased panel survey responses, statistically representative nationwide	104
Residential – Builders	Purchased sample / emails; emailed link	104
Residential – Households	Purchased panel survey responses, statistically representative nationwide	400
Street/roadway – Public Works and Utilities	Purchased sample / emails; emailed link	79

*Used web survey; easier for rankings and relative / comparisons.*

## Measurement Methods

### Drill-down on Measurement Methods

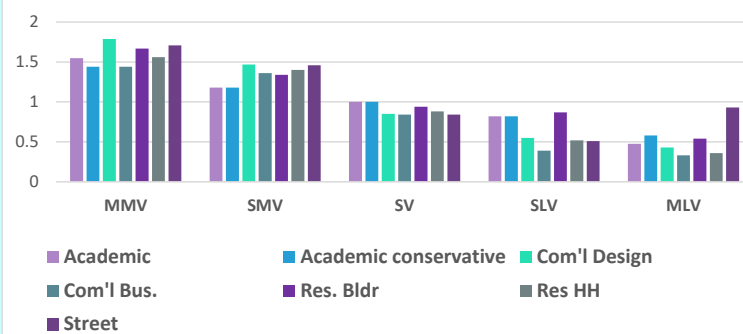
Monetizing “less glare”, “better color rendition”...

Respondents have trouble answering in dollar amounts. Instead, we focused on “relative” approaches. Used multiple approaches to bound / triangulate the values.

#### 1) Labeled Magnitude Scaling / LMS:

- SERA used adapted LMS approach to monetize comfort and other impacts from energy efficiency programs.
- Derived from academic “taste” measurement literature.
- Relies on comparative phrases that link to “numeric multipliers” that are quite consistent between populations (see graph below)
- Specialized questions structured so respondents state whether “comfort” is more or less valuable (on a 5- or 7-point scale) than something with known dollar value (e.g. specific lower energy efficiency, changed purchase price...). Easier to answer than dollar or quantitative value.
- Value is calculated using known value times selected phrase ← → numeric multiplier.
- Did not use for features without tradeoffs.

Project Population Multiplier Values compared to Academic Values



#### 2) Ranking paired with valuations (WTP, %)

- Approach used for long term options with all positive features.
- Asked respondents to rank list of options (glare, color rendition, etc.) from most- to least- preferred (including base case).
  - 1) Ask WTP for 1<sup>st</sup> and Last ranked options (not base).
  - 2) Ask percentage extra willing to pay for 1<sup>st</sup> choice relative to base case.
- Used regressions to calculate dollar estimates from responses.