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New Results & Uses for Measure-Based NEBs/NEIs: Smart Thermostats & NextGen LED Bulbs

IEPEC 11/2022

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TOPICS

1. Intro
2. Thermostat NEIs
   - Existing Values
   - Wifi & Smart Values
3. Advanced LEDs
   - Methods
   - Results by Type
4. Summary / Conclusions

ABOUT SERA

- *Economics Research / Consulting*
- *NEBs, EULs, Evaluation Oversight*
- *Methods, Best Practices, HTM*

Background

NEBs/NEIs - PROGRAM-BASED VS. MEASURE-BASED

- Net NEBs – positive &negative effects beyond energy savings from measures / interventions
- Measure vs. program-based
  - Sampling, unbundling
- Causality
  - Measure characteristics vs. savings-based
- Transferability / flexibility
- Units ($, %, period)

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Thermostats

USED COMPREHENSIVE SERA LITERATURE DATABASE – "NEB-It"

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1,800

1,200

765

500

>44,000

COMPREHENSIVE LITERATURE REVIEW – TO "NEB-It" DATABASE

SERA "NEB-It" Database

>1,800 NEB studies reviewed, 1200 detail, US &International; program &measure-based

~765+ priority studies; 500+ entered

>44,000+ NEBs and *NEB Inputs data*

160 NEBs, >260 matched measures w/NEBs

Sortable: program, type, state, year, target

Sources, data method, scores, reliability

Automatic updates (CPI, state)

➔Comparisons, Statistics, Patterns, Gaps

SERA "NEB-It" Model- with Adjustment Features

Inputs–measures, mix, location, sector

Client data - %, rates, horizon, etc.

Primary &Secondary Calculations

Select In/Out NEBs (>160 NEBs)

➔NEBs by category &measure &both

➔ Value &multiplier &ratios

SERA NEB-It | Sectors | Initiative | Measures | Region | All Existing Lit & Inputs | NEB & Measure Results

Source / Citation: Skumatz Economic Research Associates (SERA)

NON-WIFI PROGRAMMABLE THERMOSTAT NEI RESULTS

- Literature survey using NEB-It database – found studies largely programmable, pre-wifi / smart
- Results of review:
  - Property Manager: maintenance &tenant complaints largest;
    - 1.05 multiplier
  - Single Family: temperature stress-related / comfort, work
- Used to refine list of NEBs for new study

Source: Skumatz Economic Research Associates (SERA) Research

WIFI & SMART THERMOSTAT NEBs / NEIs

- New SERA Research - Not utility-based study (CT, MA, NH)
- Survey:
  - Multi-purpose, at-large surveys, screener, 369 responses, web, cleaning
- LMS & incidence
- List from literature

Source: Skumatz Economic Research Associates (SERA) Study, 2021

WIFI & SMART THERMOSTAT NEBs/NEIs

NEI	$/hh/yr	% savings
Comfort	11.52	26
Asthma	1.74	4
Cold symptoms	3.18	7
Missed time from work	9.54	22
Missed time from School	11.97	27
Noise from inside home	6.08	14
Installation / ease of operation	9.49	22
Aesthetics	9.43	21
Safety	9.17	21
Doing good for environment	11.06	25
Total	$83.18/yr	189%

- Only include NEBs relevant to use
- Other units in paper
  - Pos &neg, savings
  - Experiencing effect
- Breakdown of findings by other units

Source: Skumatz Economic Research Associates (SERA) Study, 2021

SUMMARY: WIFI NEBs

- Barriers (high negative NEBs):
  - Comfort – ability to control / override / get immediate response
  - Noise – equipment cycling
  - Aesthetics – visible, lighting up
- High values: Comfort, illness
- Considerations: separability? Comparisons
- Comparison to programmables

Source: Skumatz Economic Research Associates (SERA) Study, 2021

Advanced LEDs – Using NEBs Methods to Estimate the Dollar Value of Advanced Lighting Features

SECTORS AND FEATURES OF INTEREST

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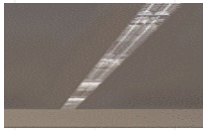


Feature	Commercial 4' Linear	Residential Lamps	Street/ Roadway
Glare	√		
Flicker	√	√	
Color Rendition	√	√	√*
Adjustability (intens. & color)	√	√	
Survey responses	184+400+104	104+400	79




Methods

- LMS
- Ranking & value

Streetlighting - Color, warmer, no blue, human visibility, wildlife, night sky, 50% higher LER/80% LER/ 10% EE

Near- and longer-term variations in the technologies; Price and EE variations compared to baseline

Sources of benefits: occupant comfort, productivity, tenant calls, comfort, daily rhythm/sleep, human safety, animal protection, other

Source: Skumatz, et al, 2019, "Study of the Value of Advanced LED Lighting Features",, included as Appendix B in Ledbetter, et.al. "Energy Saving Opportunity from Advanced LED Research, October 2019.

SIMPLIFIED RESULTS

	Combined Features Added Value compared to base price
Commercial	16-29%
Residential	12-33%
Public Works	12-28%

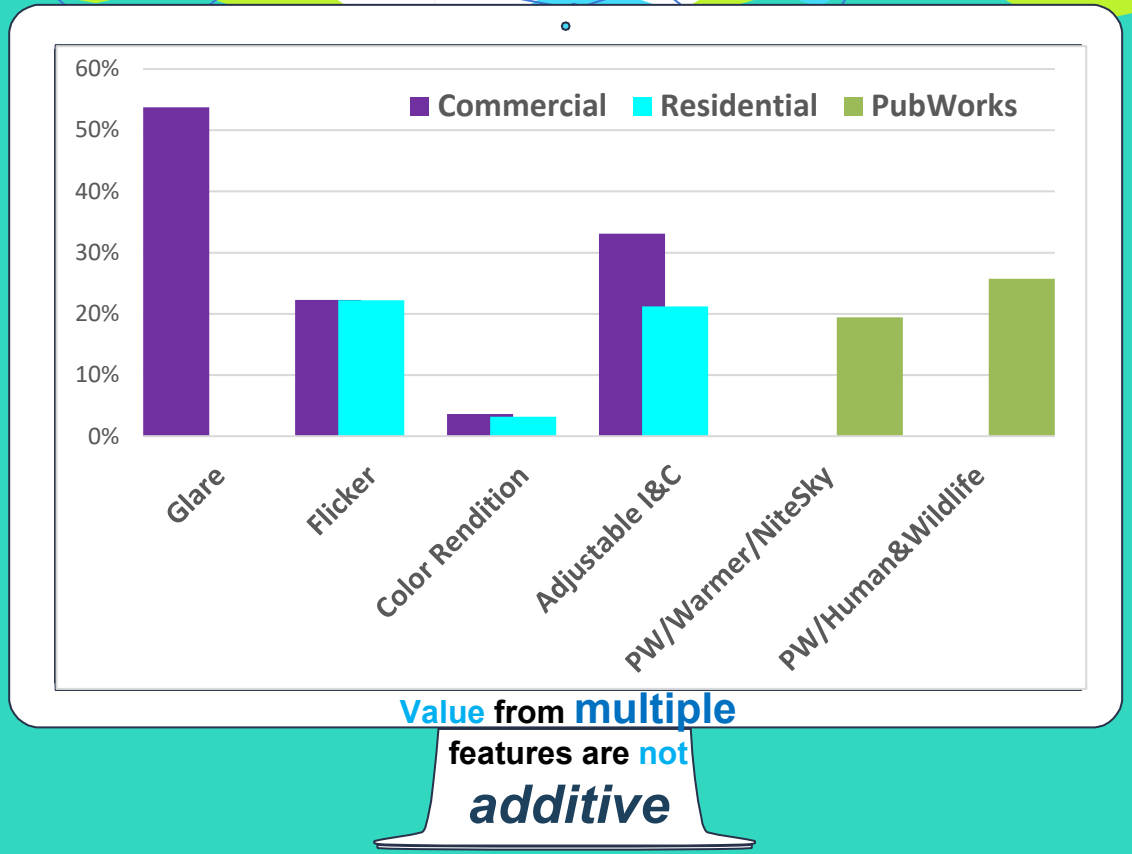
Source: Skumatz, et al, 2019, “Study of the Value of Advanced LED Lighting Features”,, included as Appendix B in Ledbetter, et.al. “Energy Saving Opportunity from Advanced LED Research, October 2019.

Feature Rankings / Relative Premiums

(extracting EE/Price components)

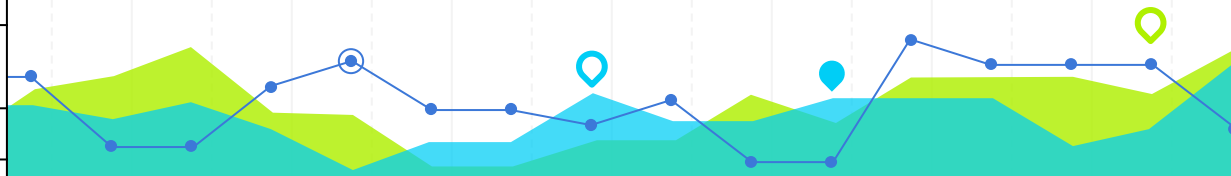
Uses:

- R&D-rank
- ROI – WIP vs. cost
- Pricing – value-related



Source: Skumatz / SERA Research 2020

FACTORS AFFECTING TRANSFERABILITY MORE	
Measures included / Mix	Economic, H&S, Water, Participant effects
Savings-dependent	Payment-related, hardship, other bills, some H&S
Participant targets	Payment-related, hardship, H&S
Housing type	Payment-related, noise
Climate zone & Geog area	Comfort, Payment-related, Economic
Fuel Type	Safety, Comfort
Time of Day	Emissions effects peak/off-peak
FACTORS AFFECTING TRANSFERABILITY LESS	
Measure-invariant NEBs	Payment-related (savings); Emissions*



Best Practices in NEB Study Analysis &Reporting

BMP RECOMMENDATIONS FOR METHODS & REPORTING – AN APPEAL!

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3 key topics to remember / include – Triple Net, Values for Recipients, and Normalizing Program Data

- **Care with baselines – net net net**
  - Don't forget triple net
    - Net of positive &negative
    - Net of NTG
    - Net of standard equipment efficiency / baselines
- **Measure-based best**
  - Report for those RECEIVING, not just program-wide
  - Matrix results NEBsxMeasure
  - Consistent units
- **Normalization factors important - Include in report**
  - Program savings (kWh, Th &$), measures in program, # installed, target participants, fuels
  - NEB perspective (tests)
  - Results by business type, target
  - State assumptions (discount rates, horizons for PV, baselines
  - Copies of instruments
  - More in paper

Source: Skumatz / SERA Research 2020

Summary & Conclusions

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SUMMARY / CONCLUSIONS

- 25 years of research in NEBs, database
- New smart / wifi NEBs values
  - up to ~1.9x savings ($83) depending on which NEBs.
  - Info on highest values (comfort, school, operation, enviro)
  - Info on negatives (control, noise, aesthetics)
- LED / advanced features
  - Measurable with R&D, ROI, Price implications
  - C&I: Glare & Dim
  - Res: Flicker & Dim
  - PW: Night sky, safety
- Best practices
  - Net 3, normalization, units $&%
  - Measure-based, value for recipients
  - Program documentation

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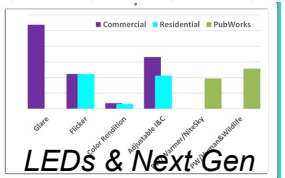
SERA NEBs research continues…



LEDs & Next Gen


IoT – Res & Coml

Smart T-stats

THANKS!

Questions?

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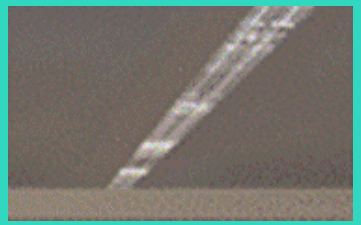
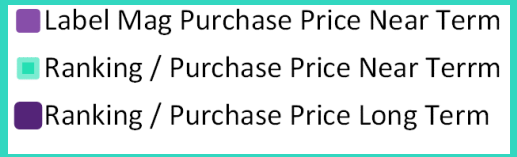
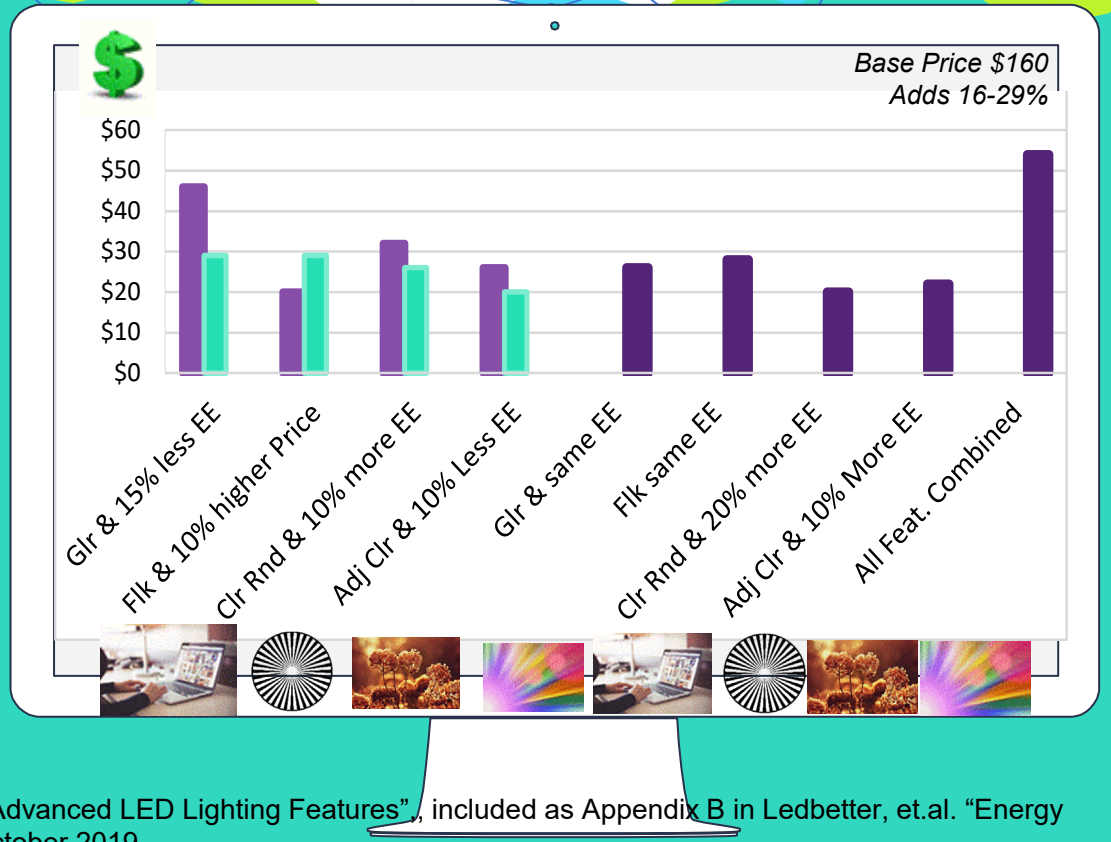
Valuing Hard-to-Measure (HTM) Effects For Decision-Making for 26 years…

All things NEBs



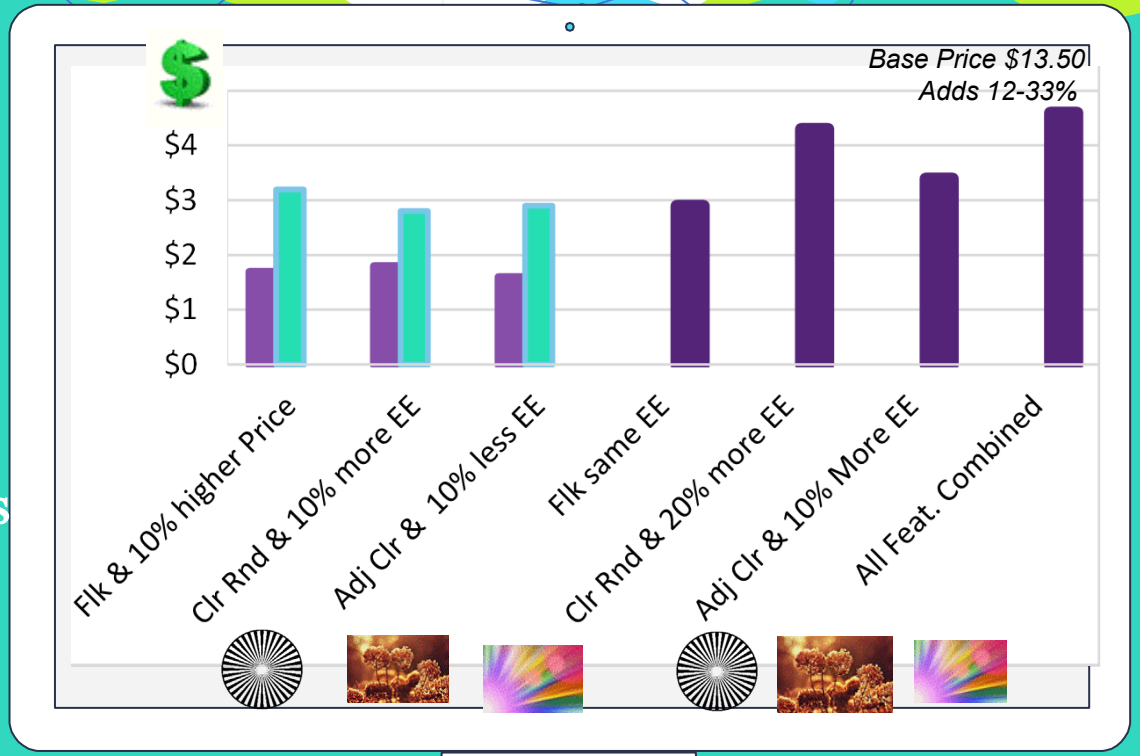
Commercial 4-ft Linear Advanced LED





Source: Skumatz, et al, 2019, "Study of the Value of Advanced LED Lighting Features", included as Appendix B in Ledbetter, et.al. "Energy Saving Opportunity from Advanced LED Research, October 2019.

Residential – General Service Advanced LED Lamps



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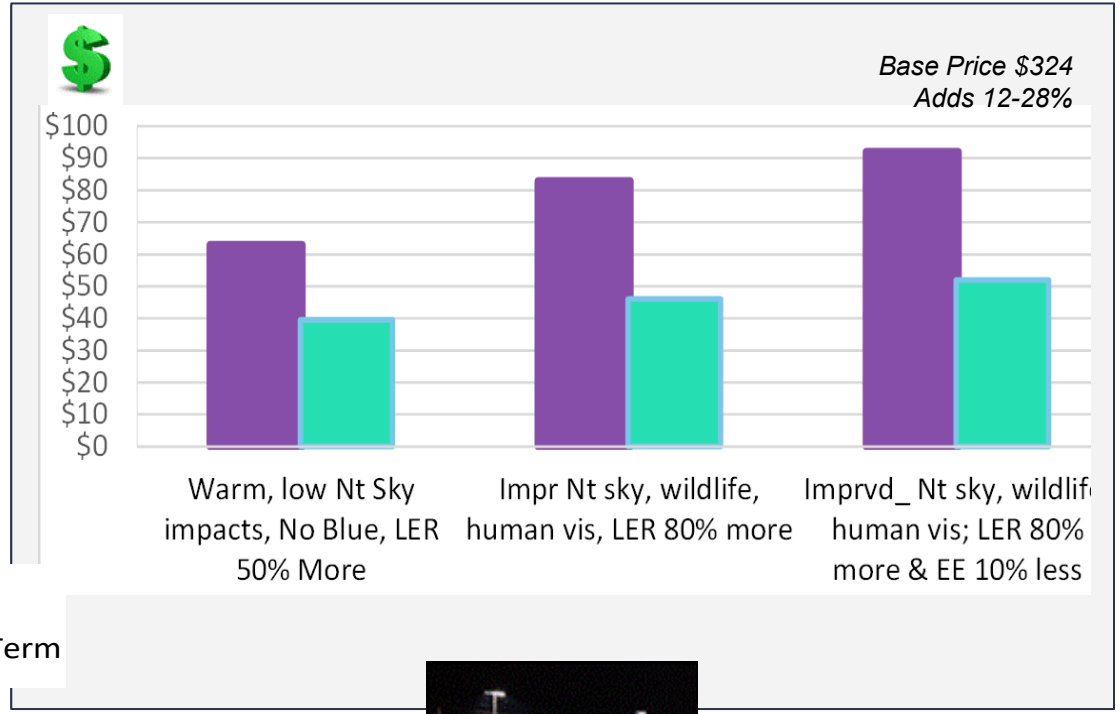
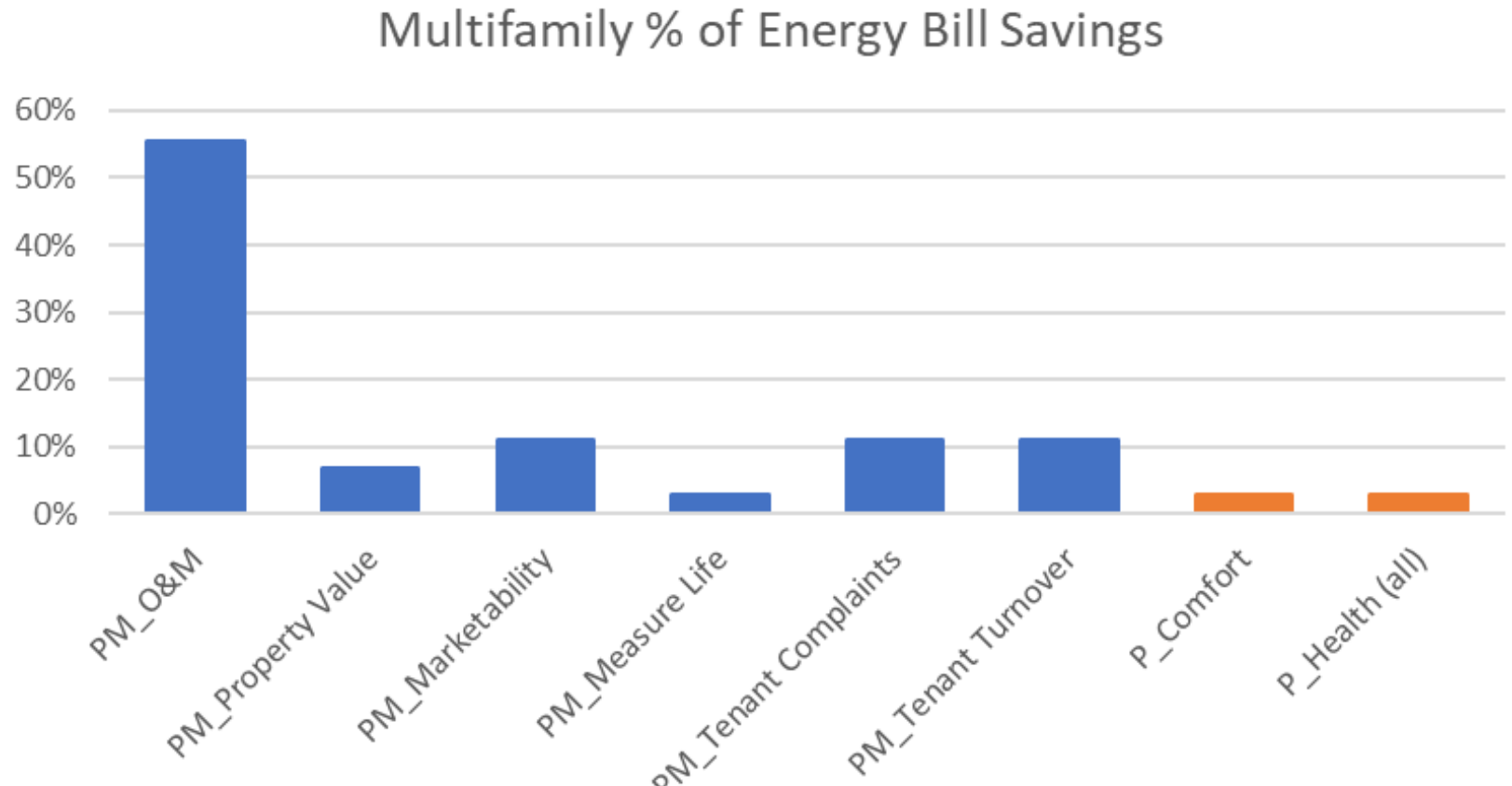
Street / Roadway

Advanced LED Luminaires COLOR



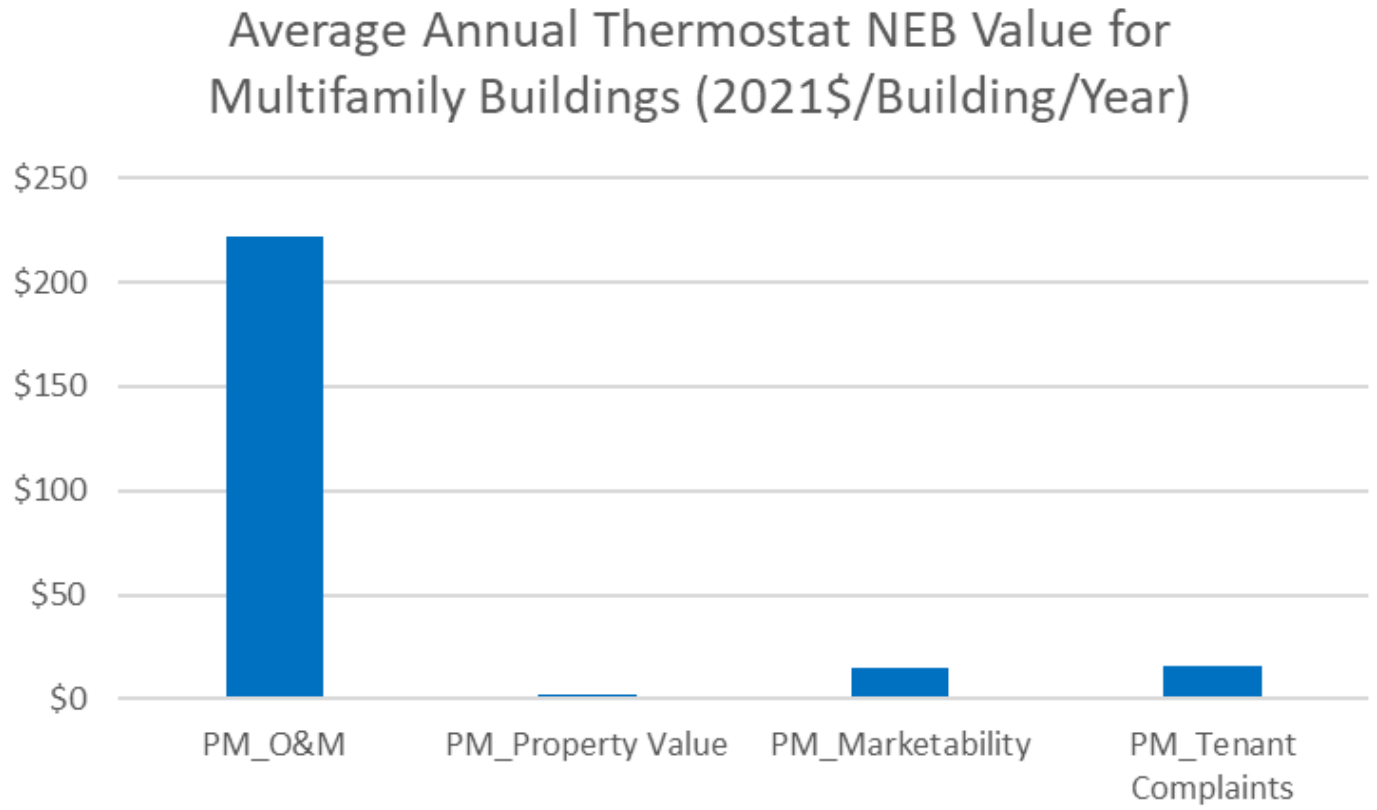
Source: Skumatz, et al, 2019, "Study of the Value of Advanced LED Lighting Features",, included as Appendix B in Ledbetter, et.al. "Energy Saving Opportunity from Advanced LED Research, October 2019.

NON-WIFI PROGRAMMABLE NEIs – MF (%)



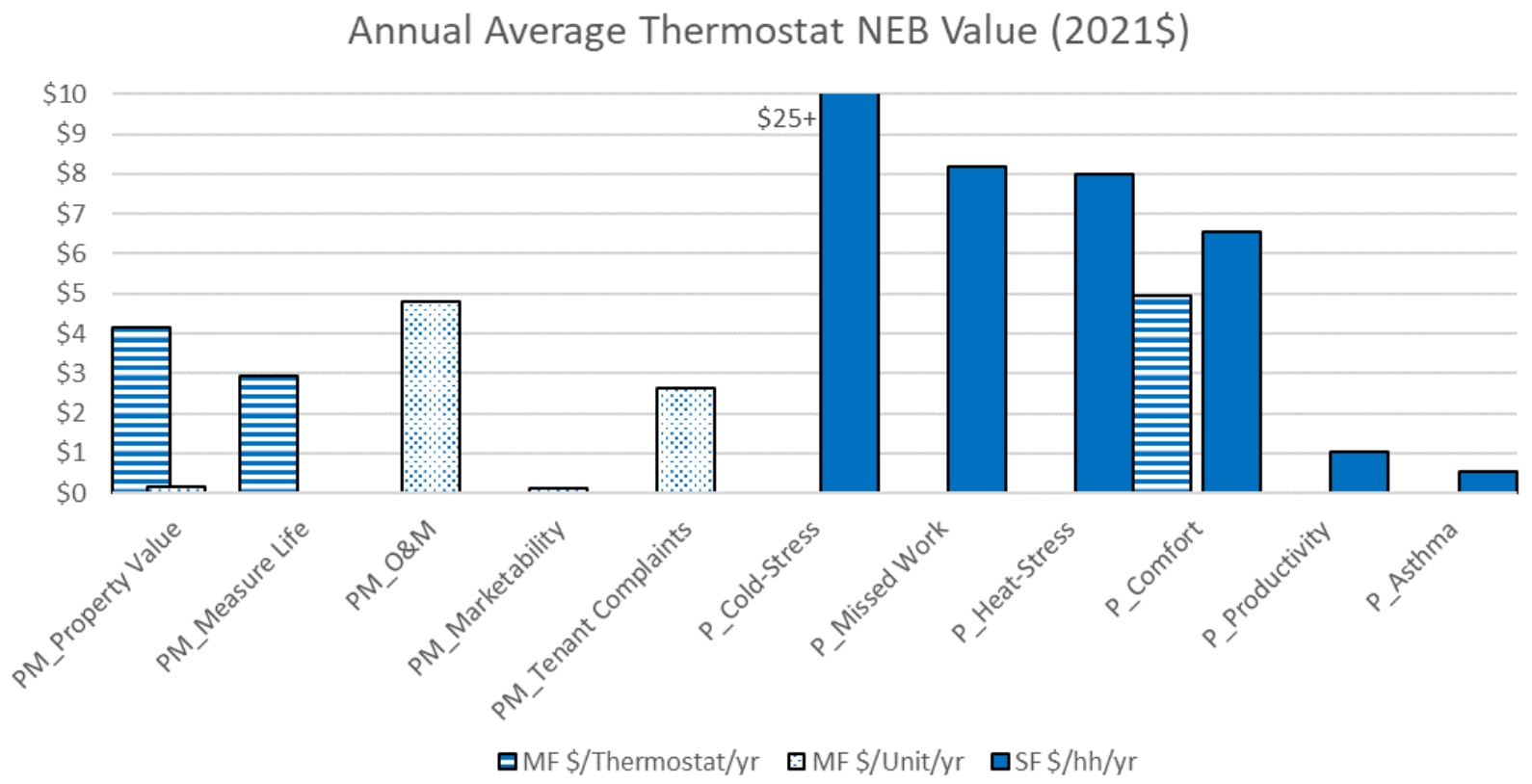
Source: Skumatz Economic Research Associates "SERA NEB-It database"

NON-WIFI PROGRAMMABLE VALUES – MF ($)



Source: Skumatz Economic Research Associates "SERA NEB-It database"

NON-WIFI PROGRAMMABLE VALUES – MF ($)



Source: Skumatz Economic Research Associates "SERA NEB-It database"

NEBs / NEIs, USES

Net NEBs = Positive & negative effects beyond energy savings from measures / interventions

- Utility, Participant, Societal Perspectives
- Best Measurement Practices (BMPs)
- Hundreds of research studies since 1990s
- Different applications have different NEB requirements / standards – C/B most demanding
- Repeated lit reviews over and over…
- NEBs/NEIs**

PROJECT OBJECTIVES

Dollar Value of Advanced Lighting Features

Near, longer term

For lighting sales / market share model projections

Client

US DOE and Pacific Northwest National Labs (PNNL)

Method

Non-energy impacts / benefits

COMPLICATED MEASURES / FEATURE BUNDLES & SURVEY COUNTS

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Key Features of Lighting Technologies Studied

(EE is Energy Efficiency)

	Feature	Near term, vs. baseline	Longer Term, vs. baseline
Commercial	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
PW 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
	Color	No change in EE or price	10% better EE, no price change

Technologies consist of multiple elements & tradeoffs, esp. near-term

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

Streetlighting - Color, warmer, no blue, human visibility, wildlife, night sky; 50% higher LER/80% LER/ 10% EE

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