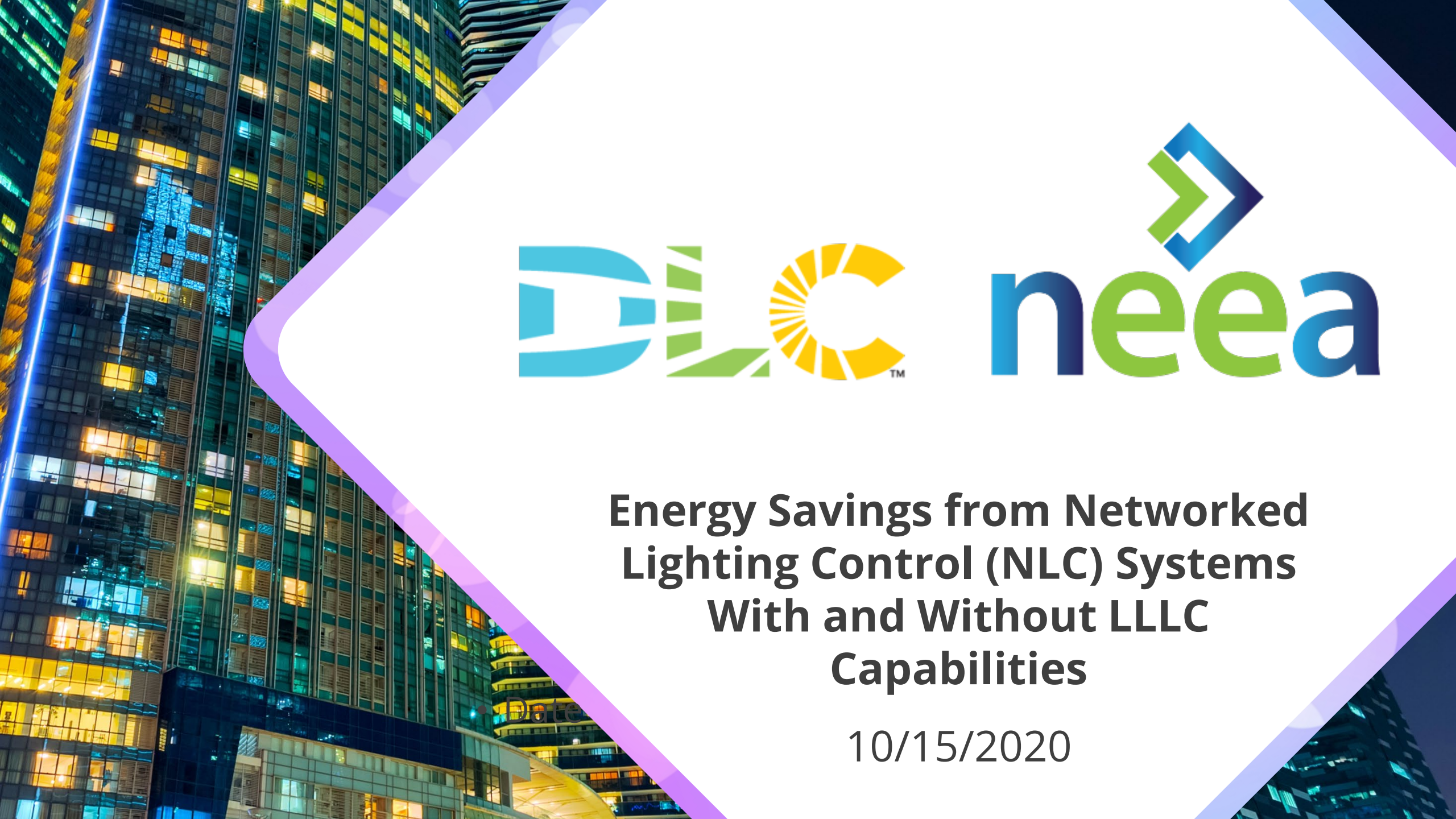

Energy Savings from Networked Lighting Control (NLC) Systems With and Without LLLC Capabilities

Date

10/15/2020

Speakers

Bagwat Mohan
DLC

Yao-Jung Wen, PhD, LC
Energy Solutions

Chris Wolgamott CEM, CDSM
NEEA

Agenda

- Introduction
- Methodology and Results
- Findings and Recommendations
- Efficiency Programs' Use of this Data
- Q&A

Webinar Logistics

- All attendees on mute
- Ask questions as we go using Question feature of webinar
- If you experience any technical issues, use Chat feature to let us know
- Presentation and recorded webinar will be posted to the DLC website

Thank you to Data Contributors

RAB LIGHTING

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nedap

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enlighted

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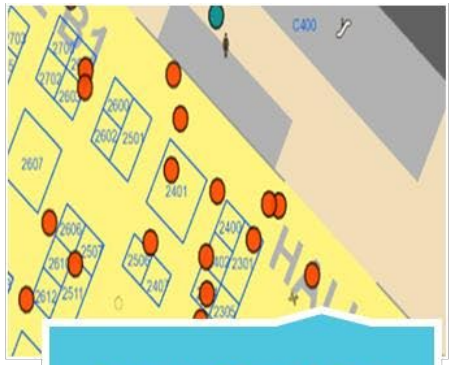
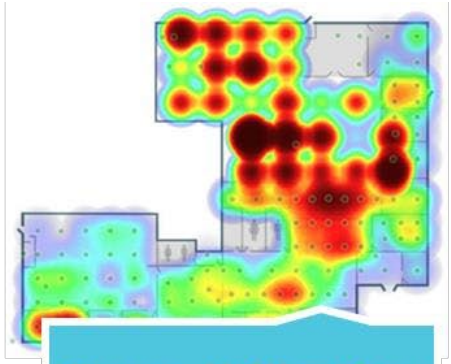
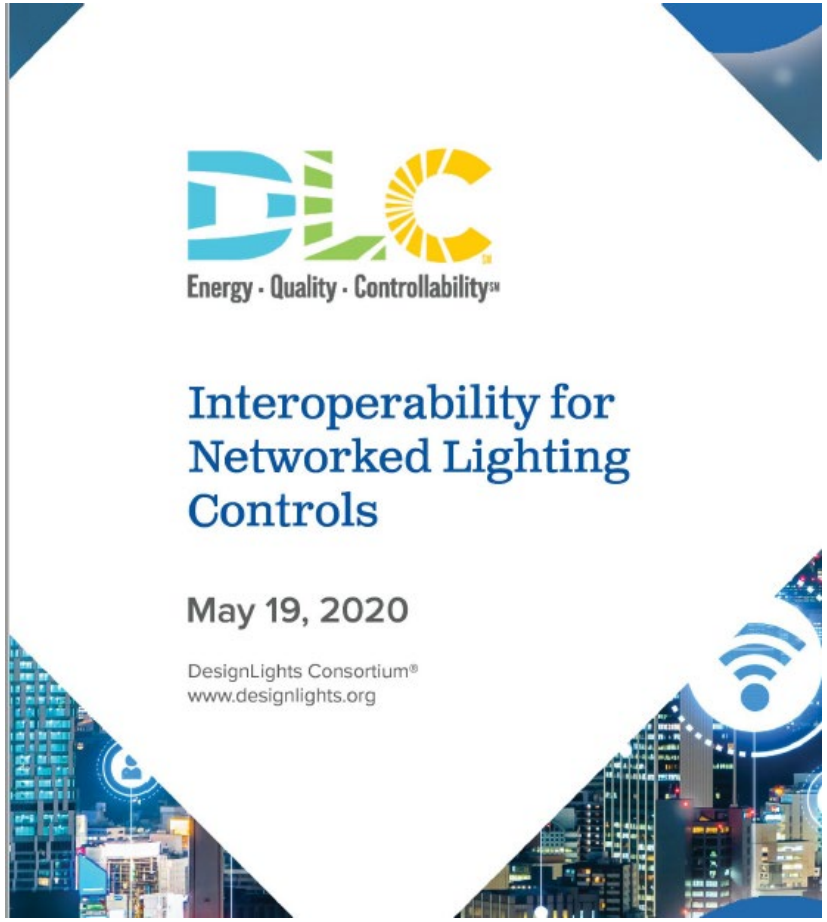
Introduction

Networked Lighting Controls Provide Significant Additional Energy Savings and Non-Energy Benefits





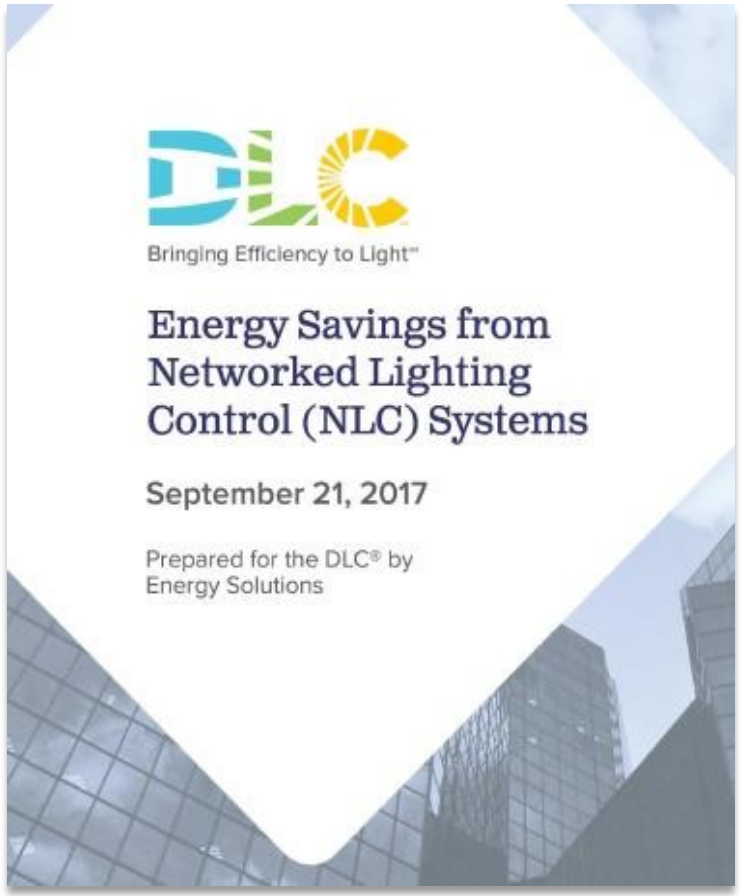
DLC Interoperability Report published in May 2020



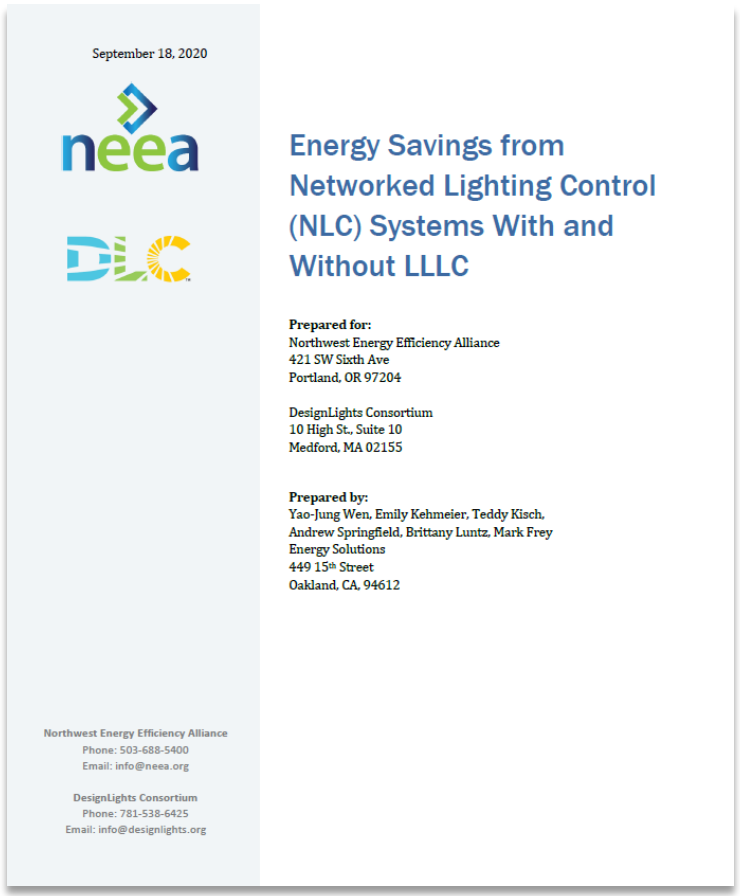
- Identified three critical use cases of NLCs to accelerate market adoption:
  - Energy Monitoring
  - Demand Response
  - External Systems Integration
- Capture the untapped energy savings

This Report Builds upon the 2017 NLC Savings Study

2017



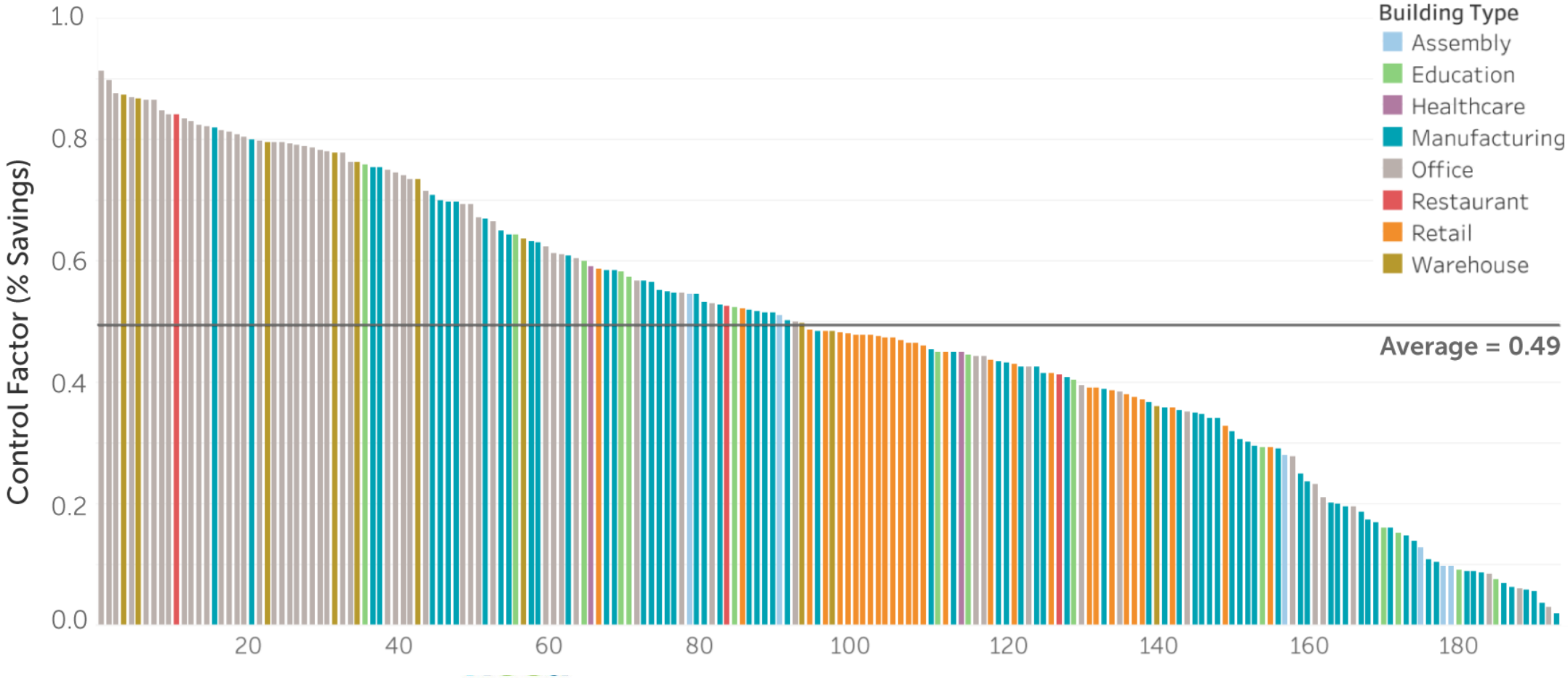
2020



- Augmented sample size (114 to 194)
- Increased manufacturer diversity (5 to 12)
- Added 1 building type (Healthcare)
- Analyzed the effect of high-end trim vs other control strategies
- Analyzed the effect of LLLC

Consistent with 2017 Findings, NLCs Provide Significant Savings

Average savings: 49%

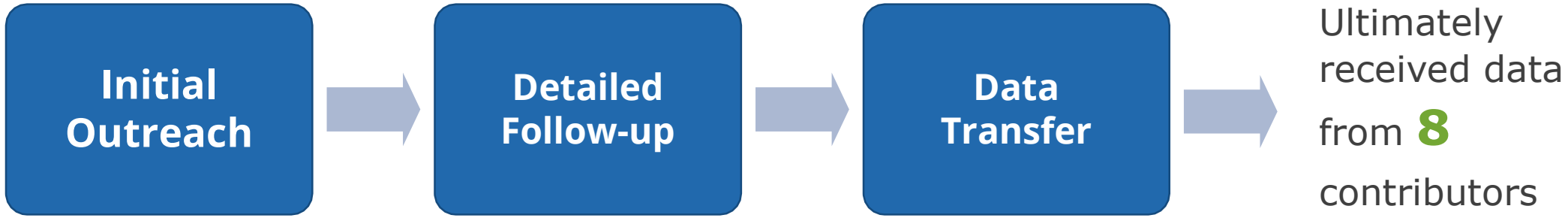


Methodology & Results

Methodology:
Outreach & Data Collection

Outreach and Data Collection

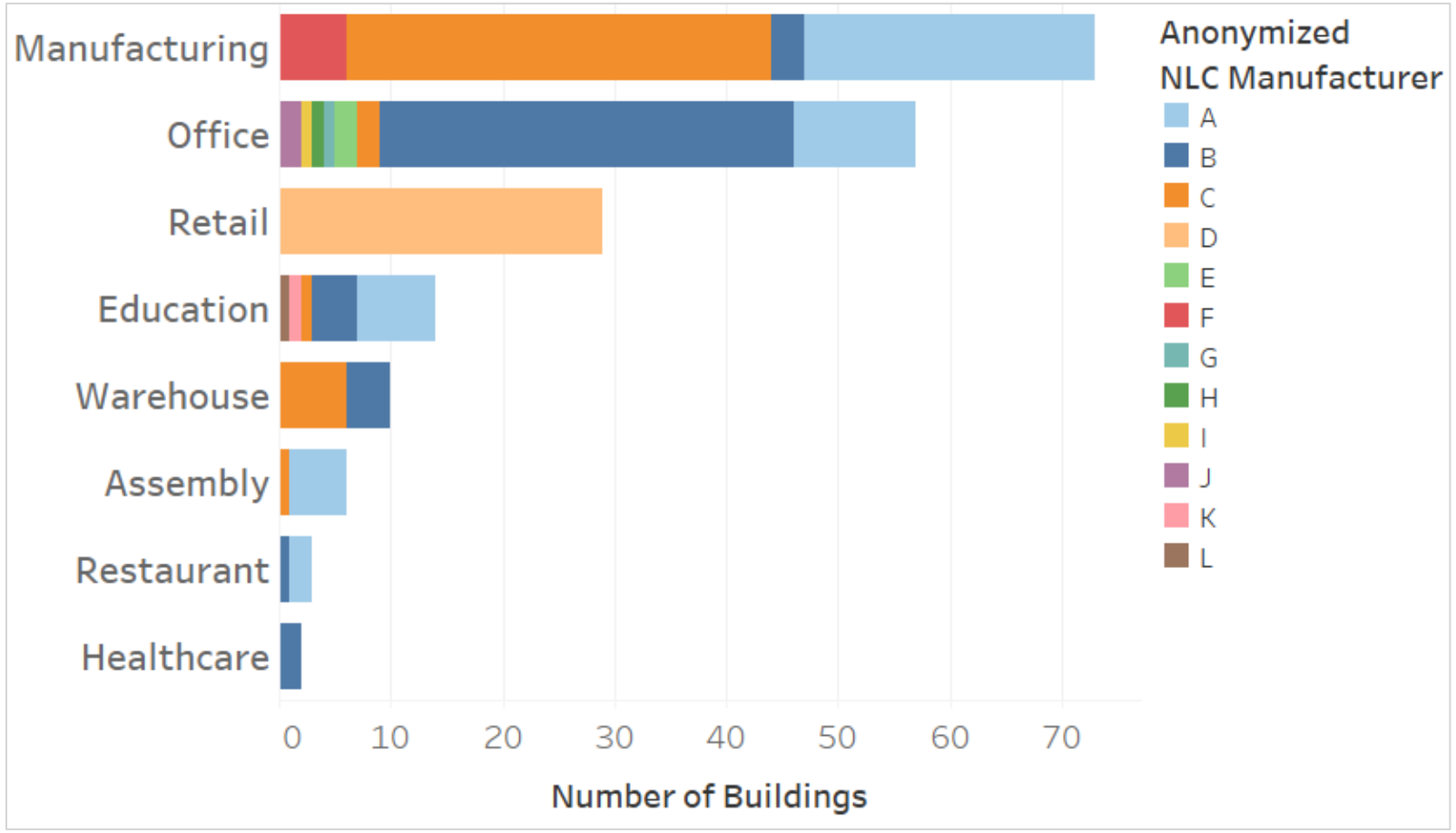
Conducted outreach to 38 organizations –
manufacturers, utilities, research orgs, and end customers



Greatest challenges:

- Lack of access to data
- Lack of data

Summary of Data Collected

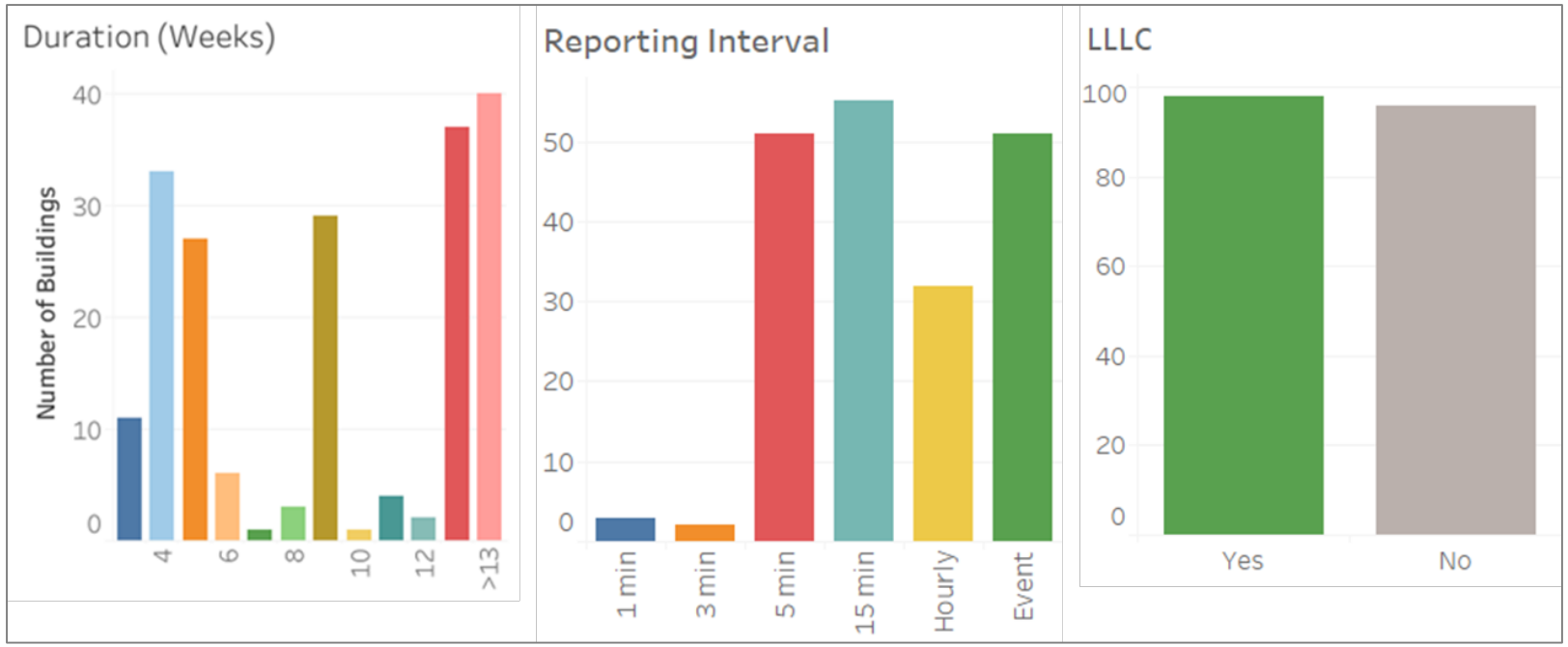


194 buildings

8 building types

12 manufacturers

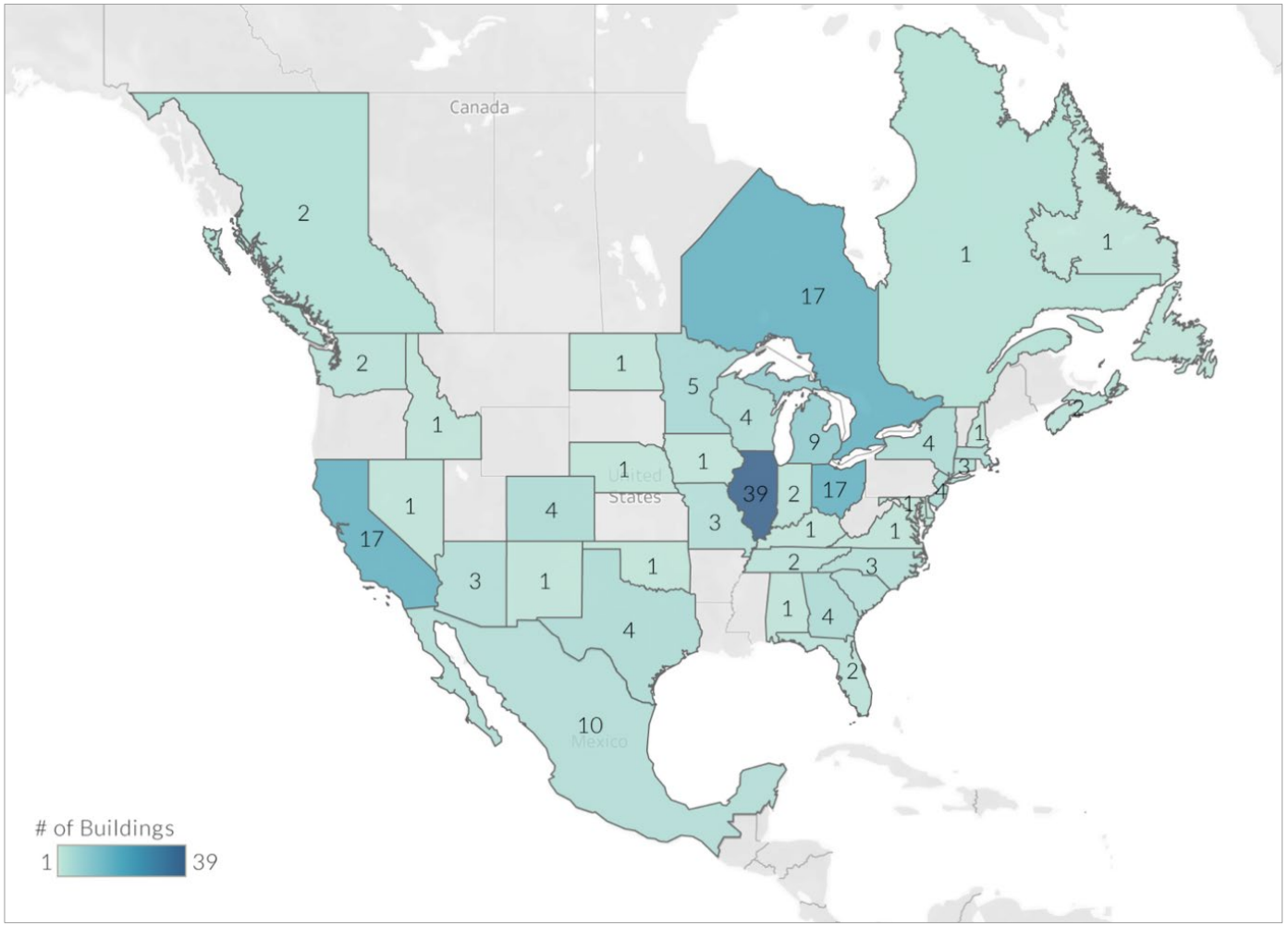
Summary of Data Attributes



9 weeks average reporting duration

50/50 spread between NLCs with and without LLLC

Geographic Distribution of Datasets

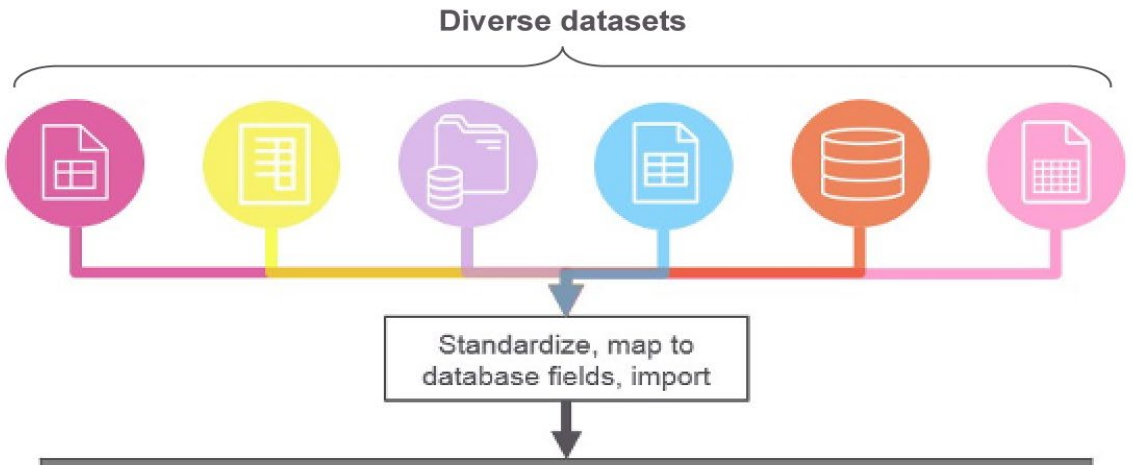


35 U.S. states

5 Canadian provinces

& Mexico

Data Normalization and Database Architecture



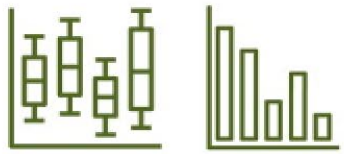
Standardize, map to database fields, import

DATABASE

	Fixture-level	Zone-level	Building-level
Time Series Data	- Average power - Dimming level - Claimed savings …	- Average power - Dimming level - Claimed savings - Inferred baseline …	- Average power - Claimed savings …
Static Attributes	- Fixture, zone, and building ID - Space type - Rated power …	- Zone ID and building ID - Space type - Rated power …	- Building ID - Location - Building type - Reported baseline …

OUTPUTS

- Savings estimates
- Custom queries



8 data contributors

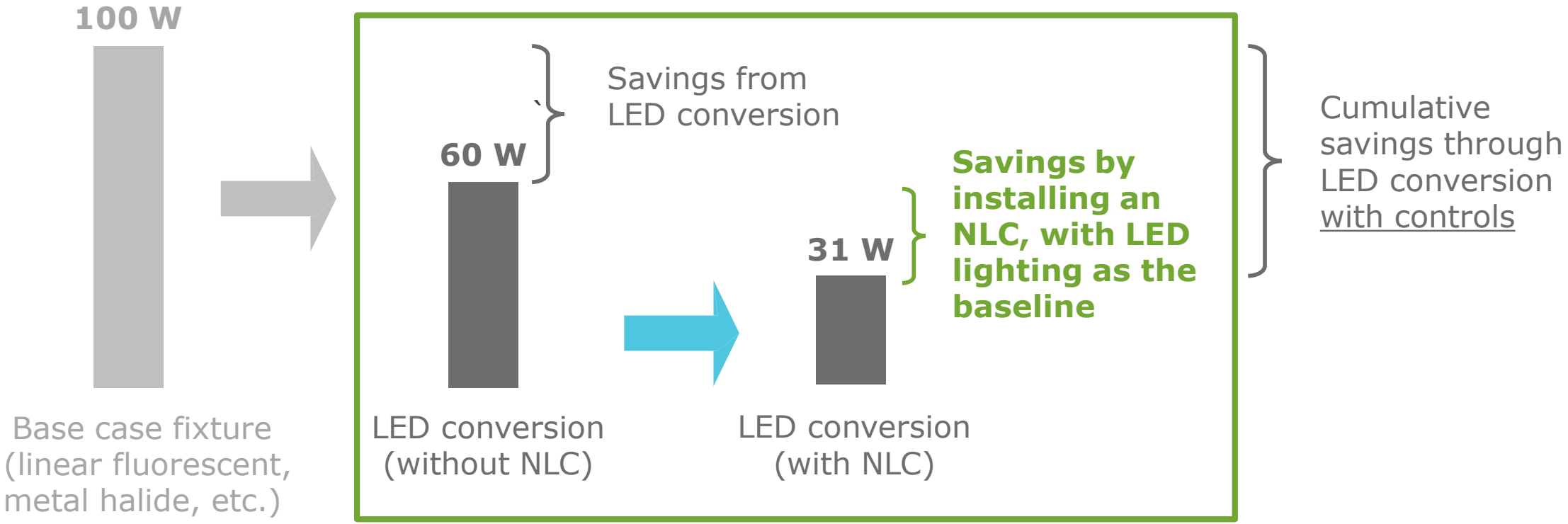
9 unique data formats

18 sub-formats

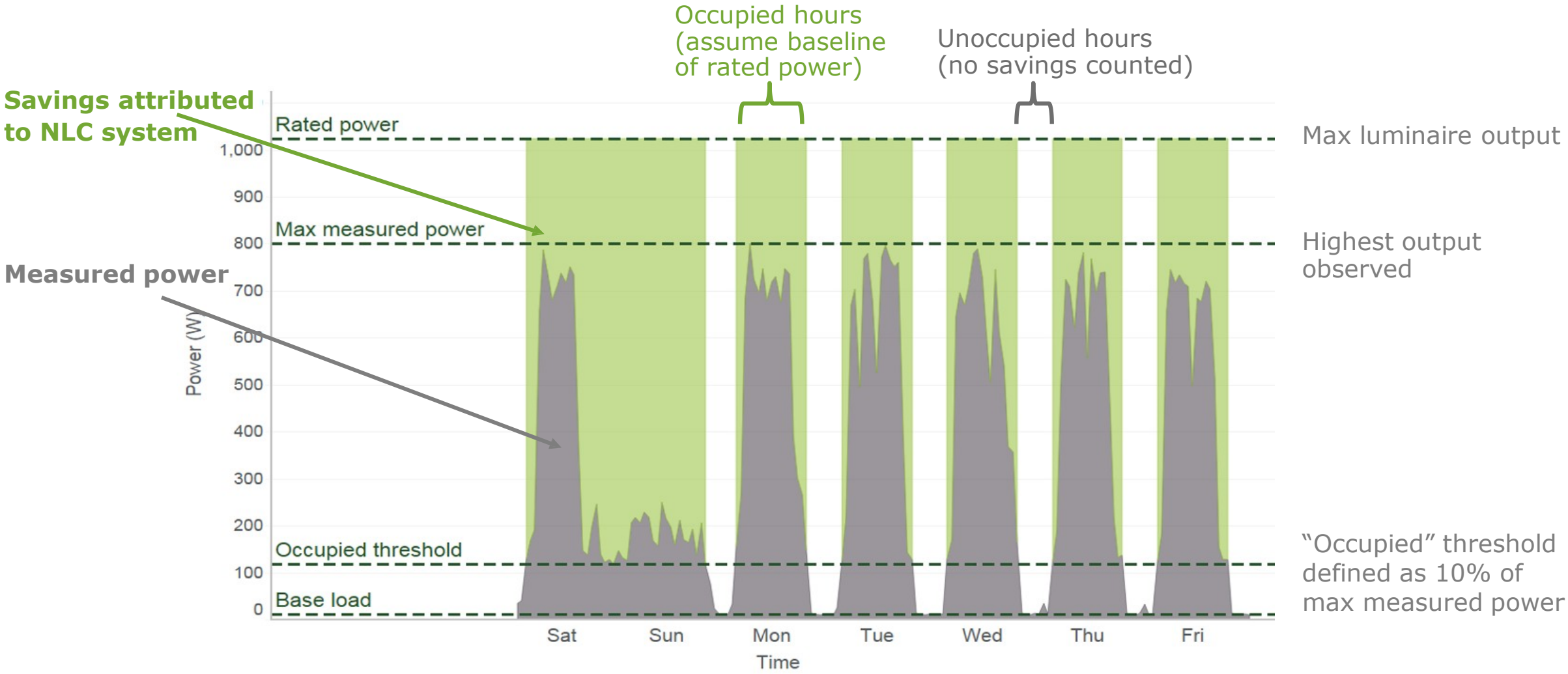
Methods:
Energy Savings Calculation

Baselining and Savings Calculation

The values in this report represent % savings of installing NLC system with existing LED Luminaires



Inferred Baseline Methodology



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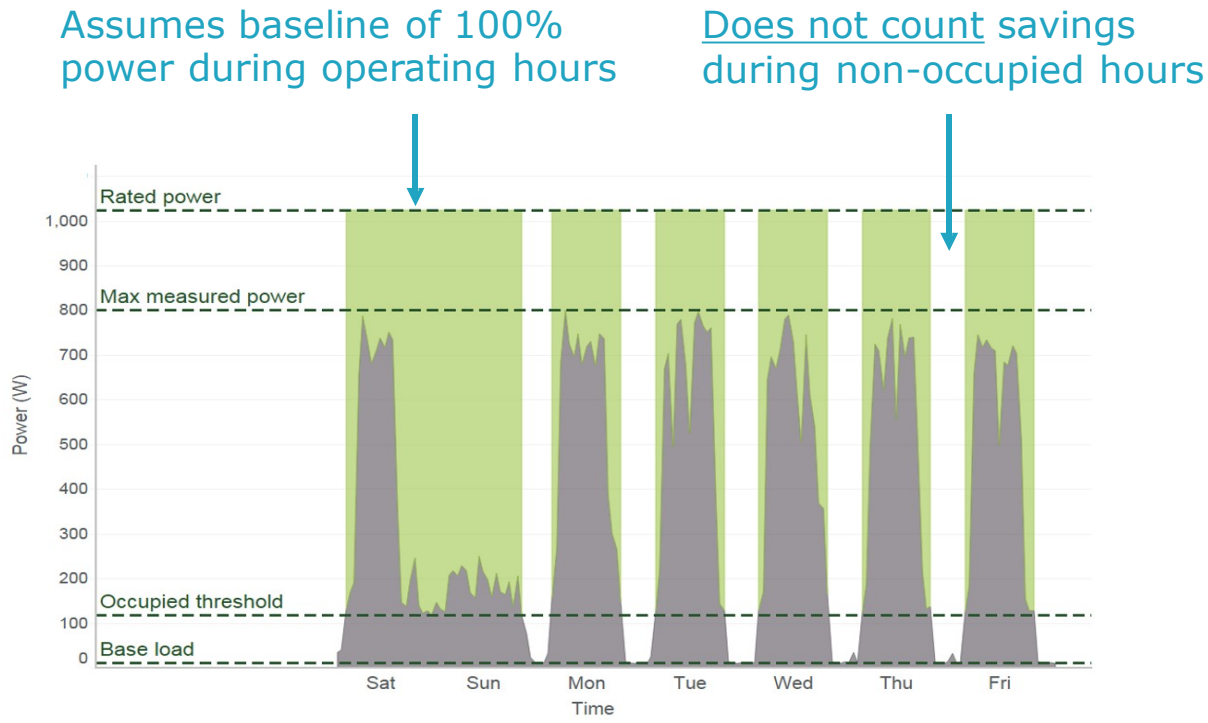
Sample zone within a building

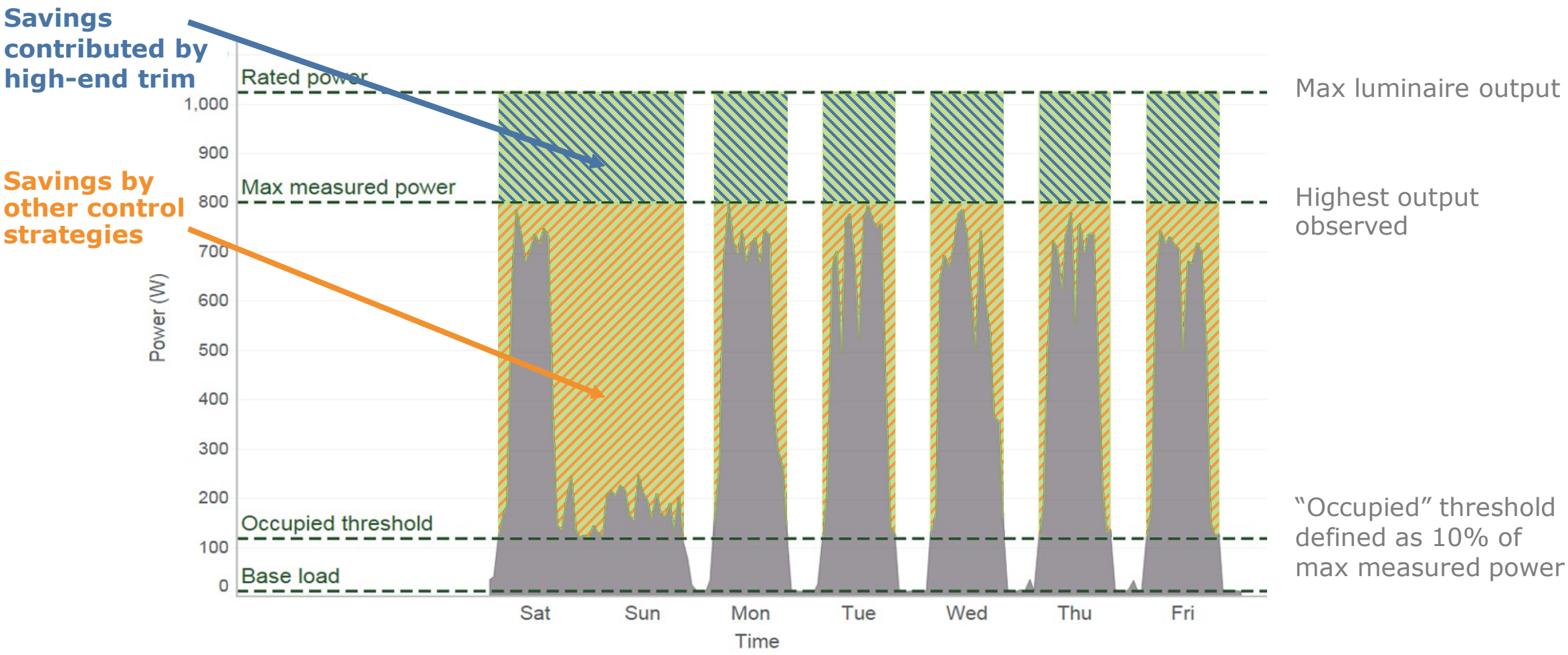
Rationale and Caveats



- Consistent with the methodology used in the 2017 study
  - Unobtrusive and inexpensive
  - Scalable and reproducible
  - Project-specific and highly granular
  - Reviewed and endorsed by NLC and EM&V experts

- Caveats
  - Assumes 100% power during operating hours → does not account for pre-existing controls
  - Assumes basic scheduling control exists → Does not count any energy savings during non-occupied hours

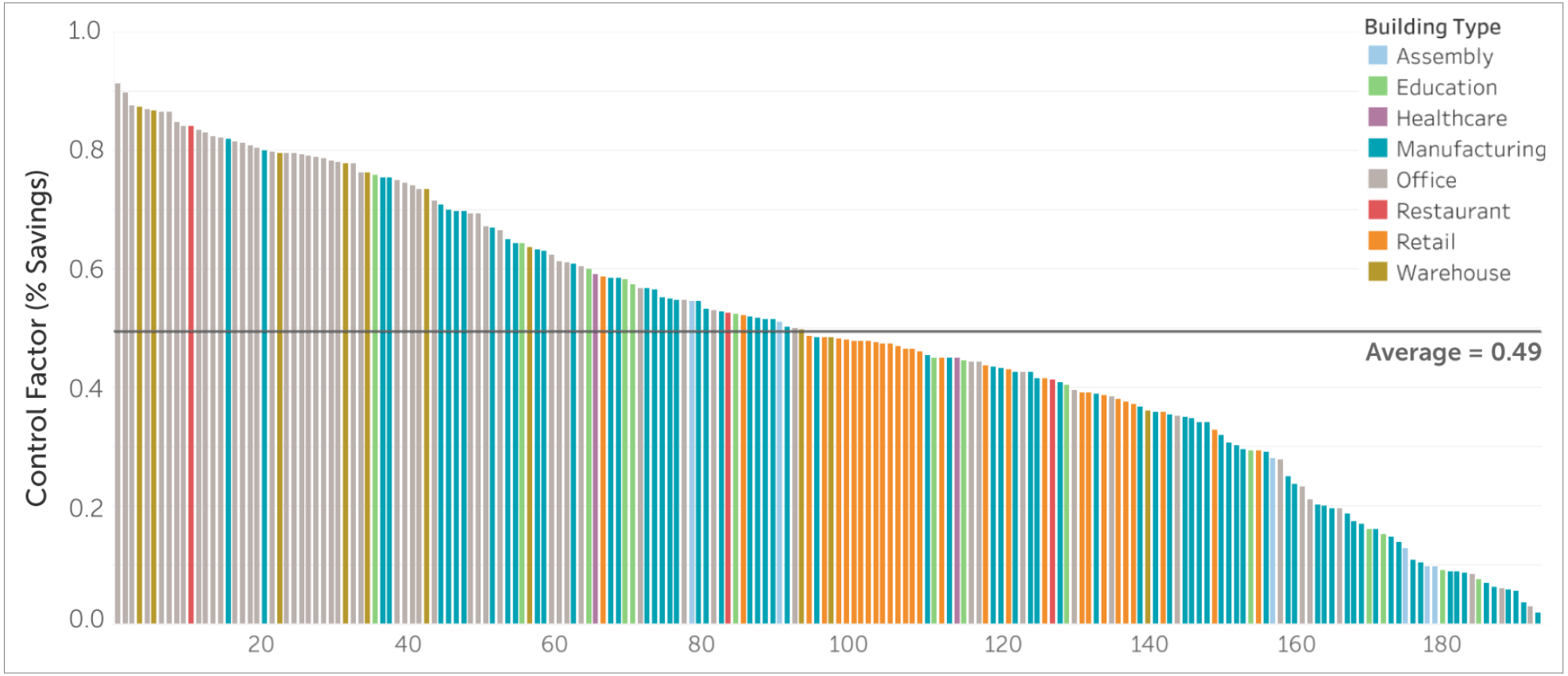
Savings Attribution



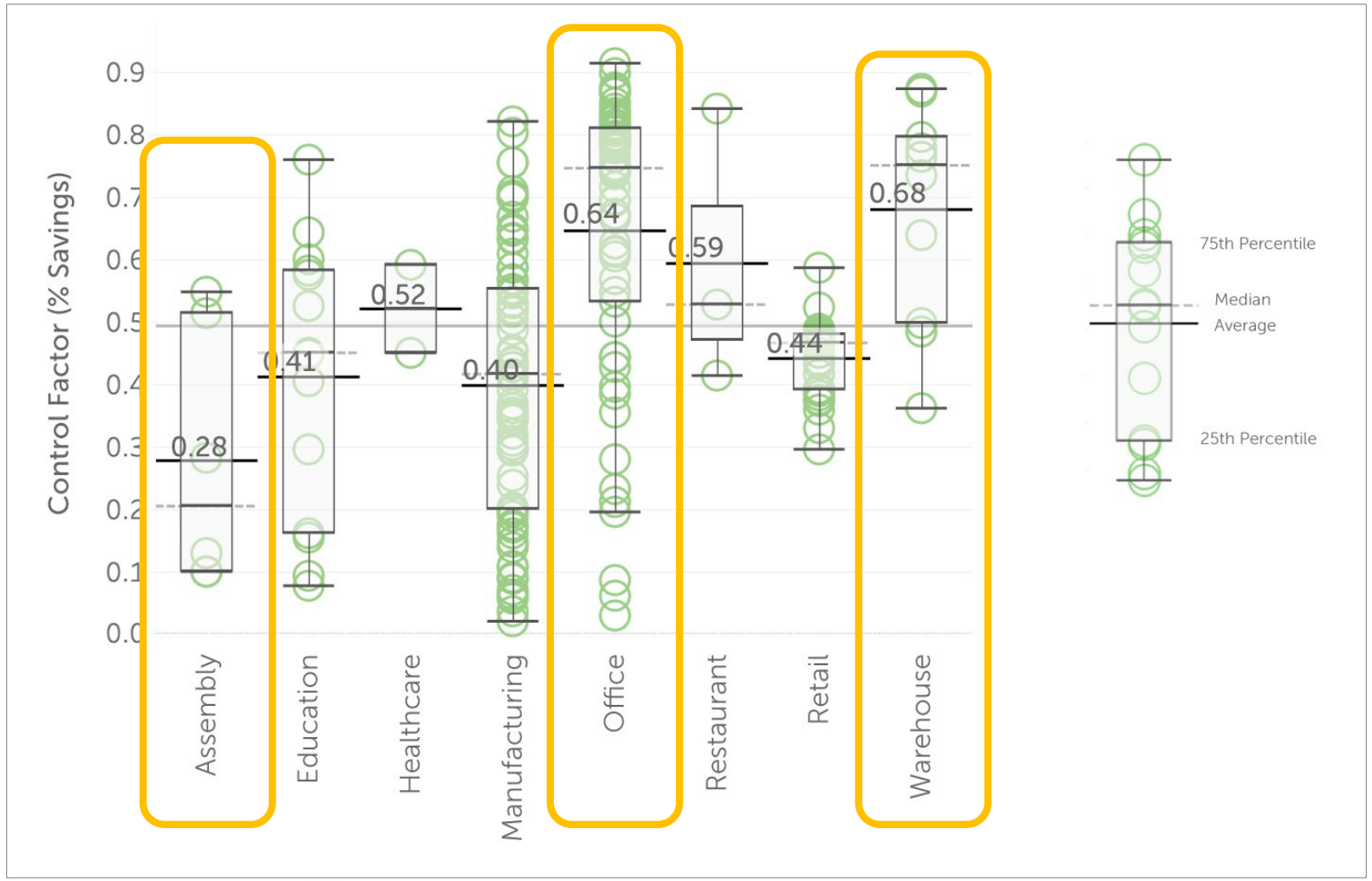
Results

Distribution of NLC Savings

Average control factor is 0.49 (49% savings)

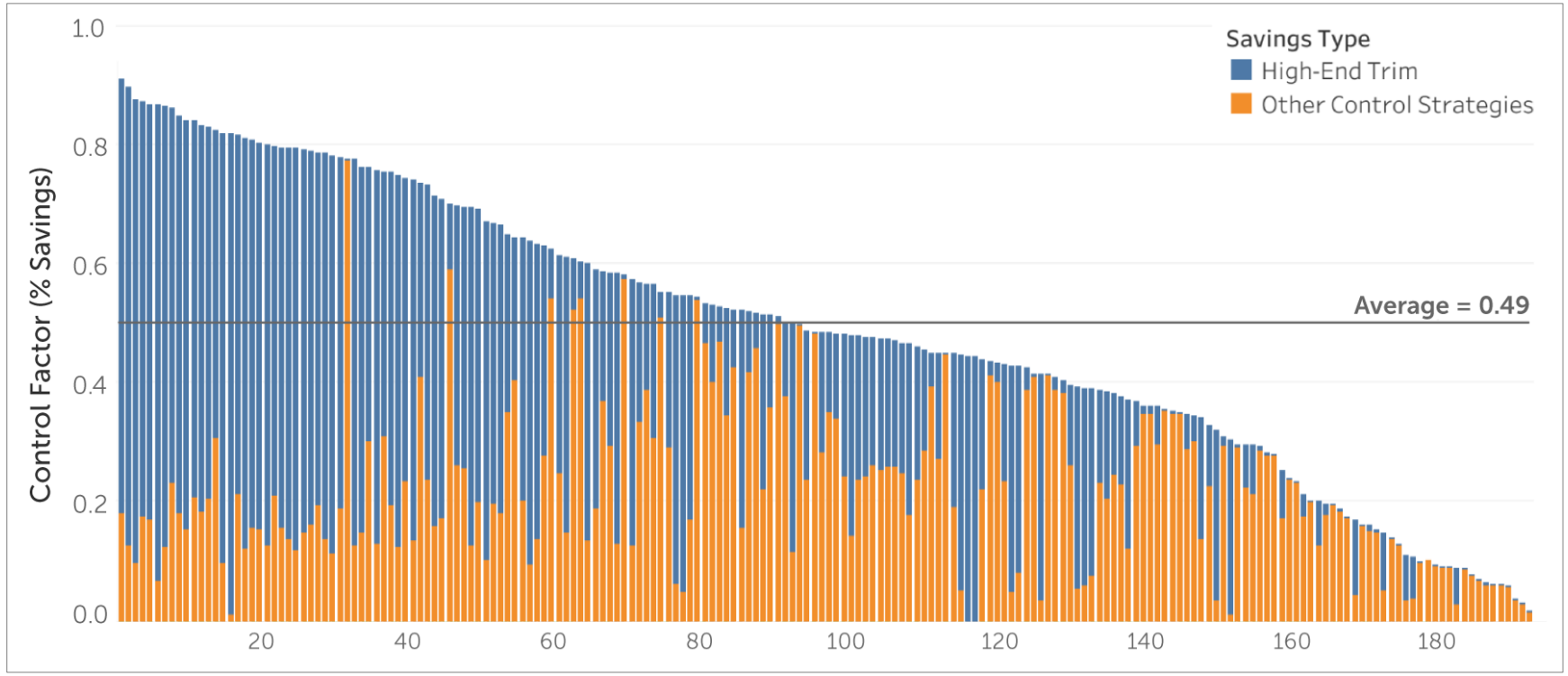


Distribution of NLC savings across all buildings



Control Strategies Savings Attribution

Average control factor attributed to **high-end trim** is **0.27**
Average control factor attributed to **other controls combined** is **0.32***



* Control factors for other control strategies are in comparison to an inferred baseline with savings from high-end trim removed.

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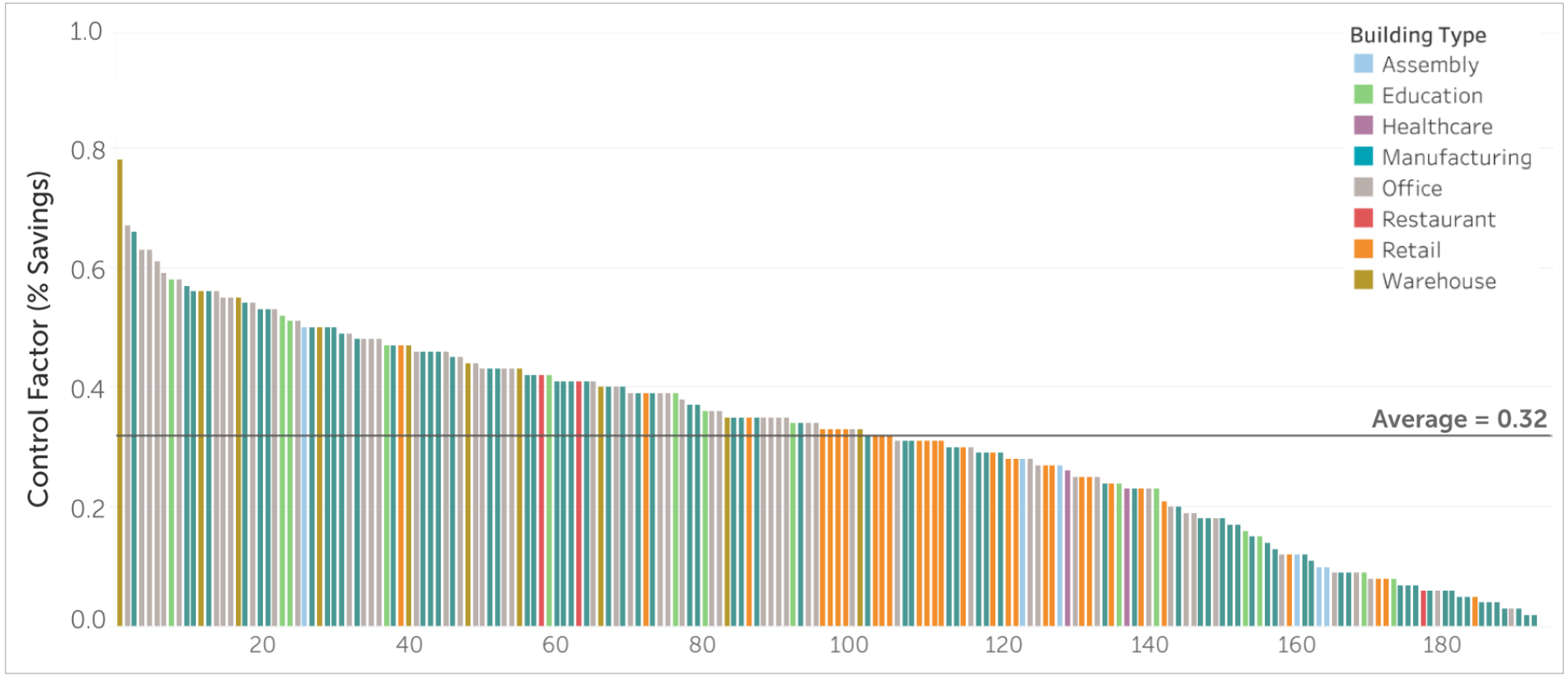
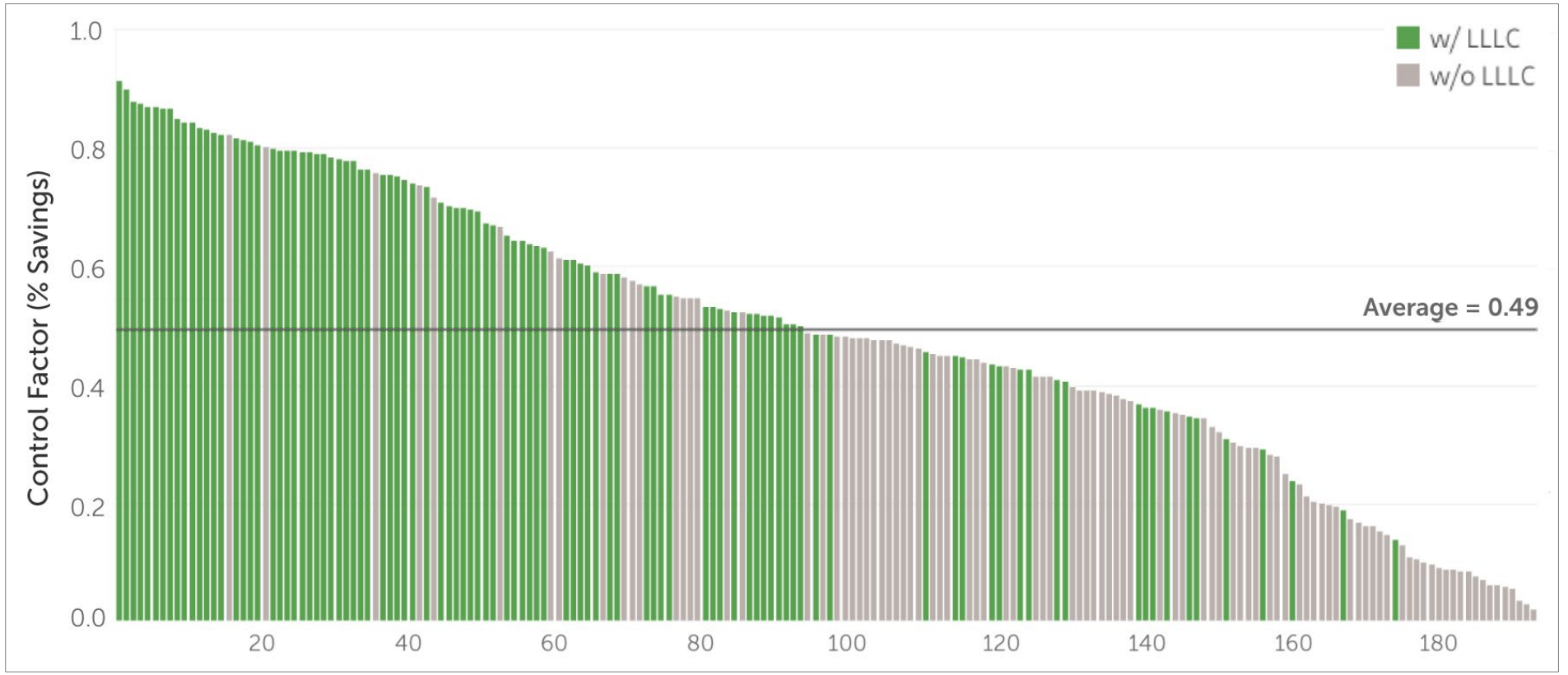
Savings from Controls other than High-End Trim

Equal savings opportunities across all building types



Savings for NLCs w/ LLLC

Average control factor for NLCs w/ **LLLC** is **0.63**



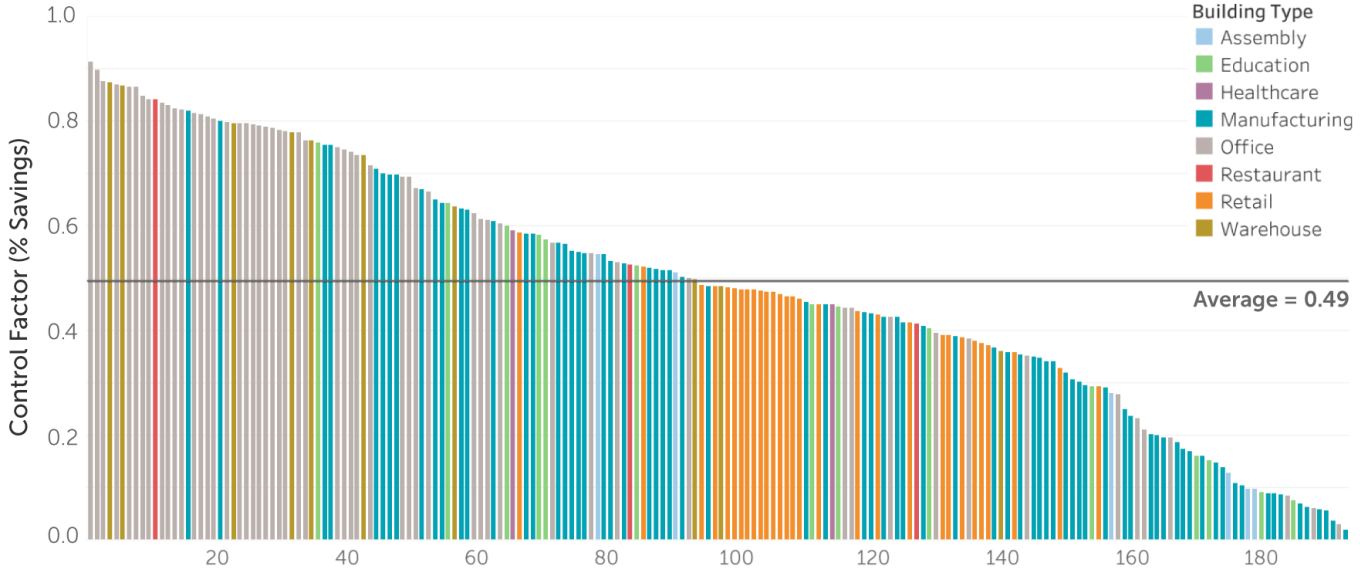
Findings & Recommendations

Key Findings & Recommendations

Finding #1: Average energy savings in this study was 49%.

- Site-specific variation is the largest driver of savings
  - Which control strategies are used and the settings for those strategies
  - Site characteristics, occupancy, user behavior

Recommendation #1: Efficiency programs can use 49% as the best portfolio-level estimate.



Finding #2: NLC systems with LLLC showed overall higher savings.

- Additional study needed to confirm correlation
- Need to control for potential confounding variables

Recommendation #2: Based on this dataset, it may be worthwhile to explore programs around LLLC for greater average energy savings.

LLLC Presence	Total Buildings	Control Factor (% Savings)			
		Average	25th–75th Percentile	High-End Trim Contributions	Other Control Strategies
NLCs w/ LLLC	98	0.63	0.50 - 0.79	0.37	0.41
NLCs w/o LLLC	96	0.35	0.17 - 0.48	0.17	0.22
All NLCs	194	0.49	0.35 - 0.69	0.27	0.32

Note: The numbers provided in this table is meant to provide a high-level overview of average savings trends. Additional study is needed to control for potentially confounding variables, and thus at this time does not imply that LLLC is universally superior and applicable to all building types.

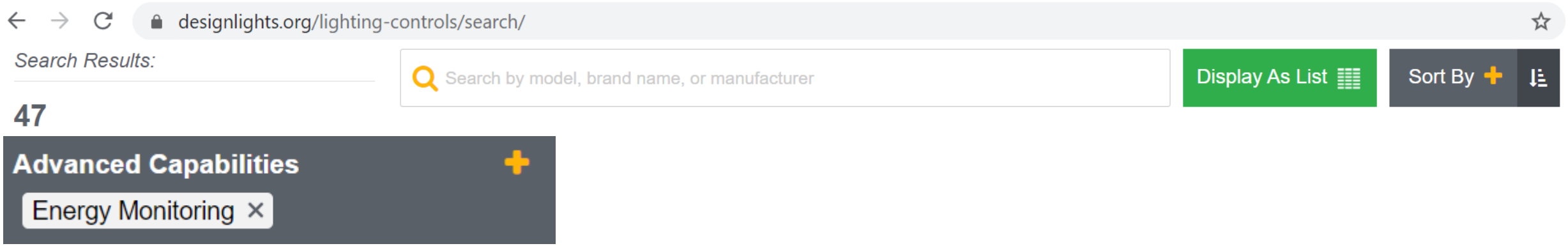
Additional Findings & Recommendations

Finding #3: Access to NLC data varies from manufacturer to manufacturer.

- Central location of data in the cloud vs locally in each system
- Contractual access agreements vs need to get approval case-by-case

Recommendation #3: Efficiency programs should drive the sharing of NLC data

- Goal for efficiency programs: Require energy reporting for NLC incentives
- Evaluate savings at each installation
- Consider a clause in participation agreement to require data sharing

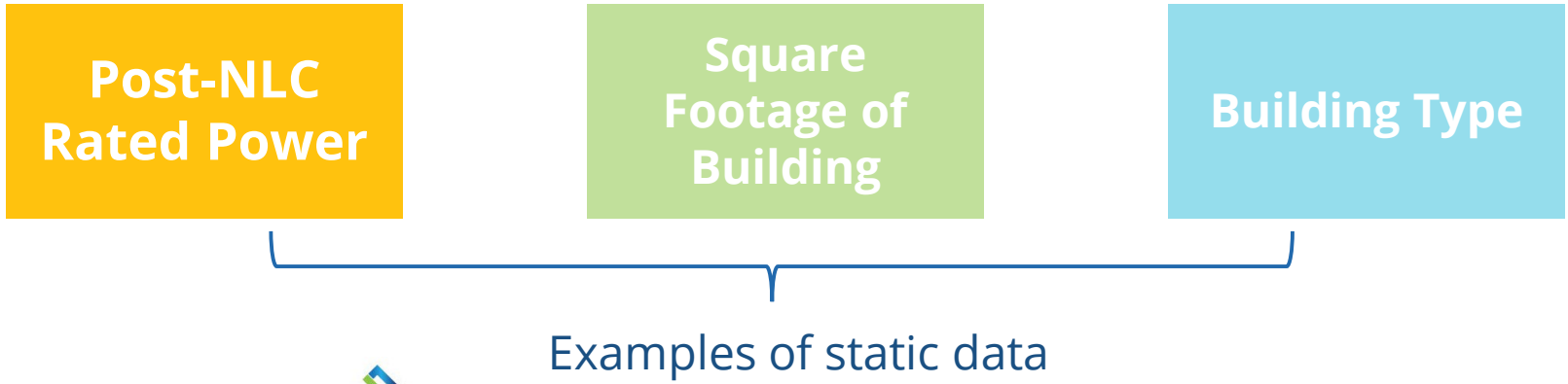


Finding #4: Collection of static data more error-prone.

- Time-series data is directly exported
- Static data are entered into the system during startup, and open to human error.

Recommendation #4: Static data should be reviewed carefully by the person/entity that facilitates the transfer of data.

- Critical in ensuring the accuracy of savings calculations
- Best time to verify is at the completion of the installation



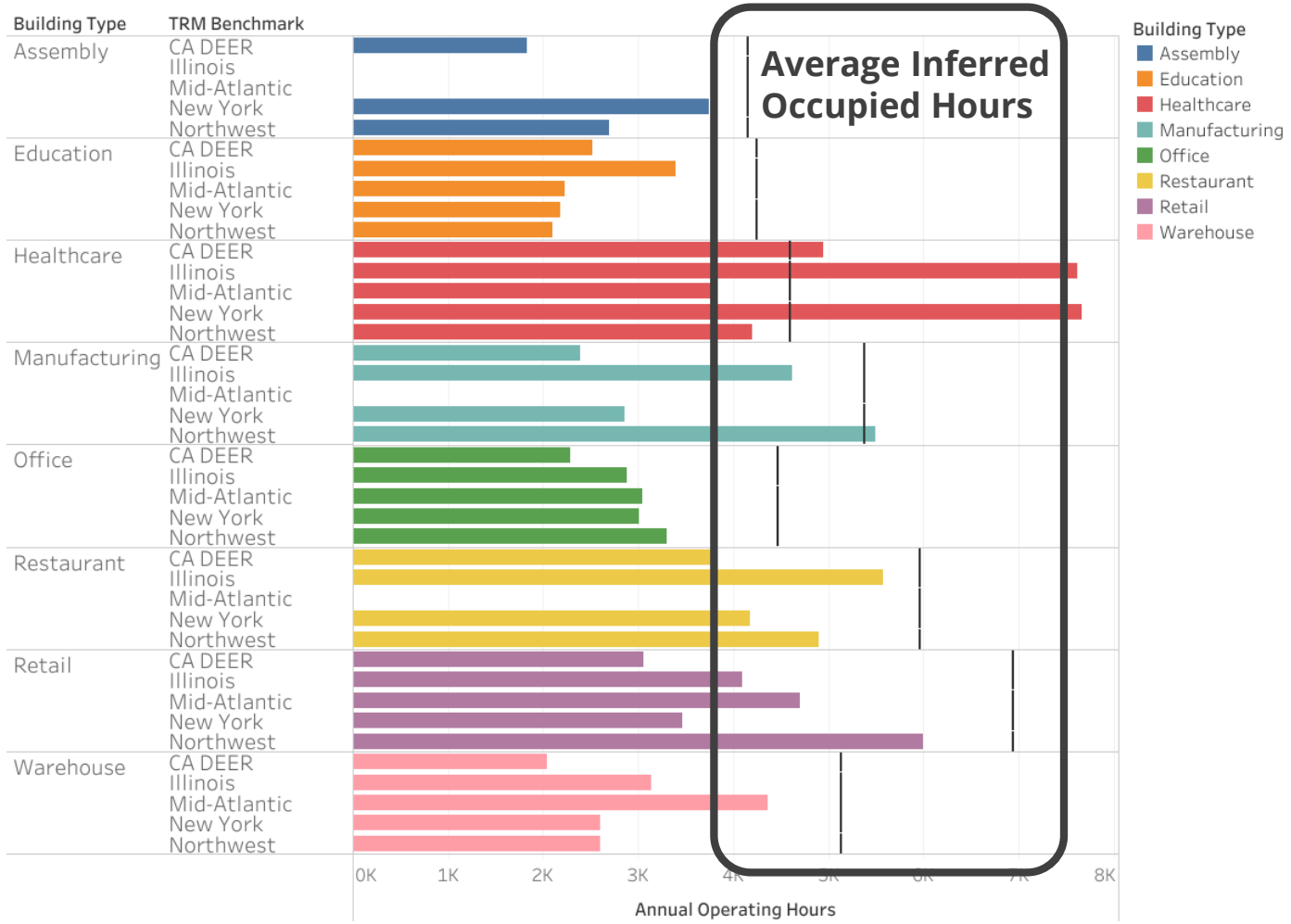
Finding #5: The size of energy data files grows rapidly with data granularity.

- Fixture-level data, for example, had the largest file sizes

Recommendation #5: Standardize reporting guidelines for the efficiency program use case.

- Large size datasets will not be scalable for EE programs - need to strike balance between accuracy and scalability
- Program administrators should work together to standardize a reporting format including:
  - Spatial and temporal granularity
  - Duration
- The DLC is supporting progress on Recommendations #4 and #5 through the NEMA ANSI C137 committee

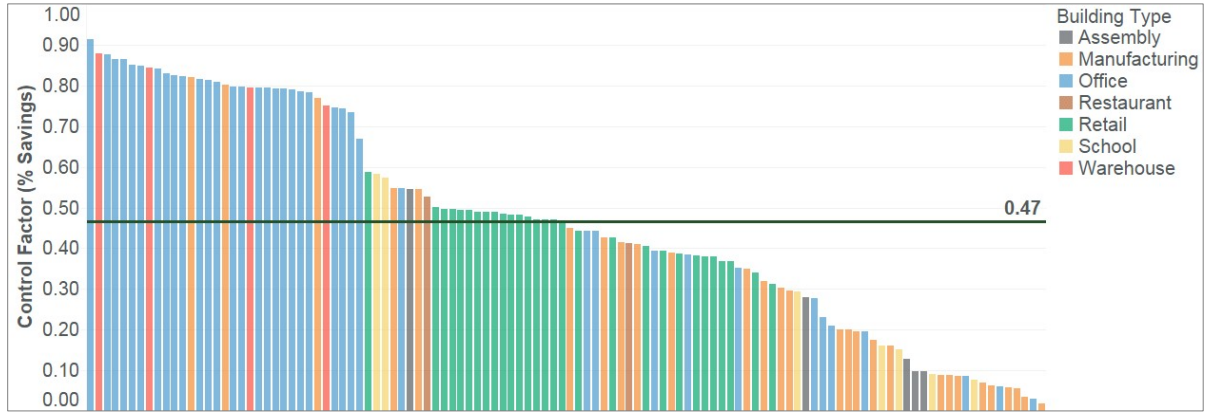
Finding #6: Operating hours generally longer than expected

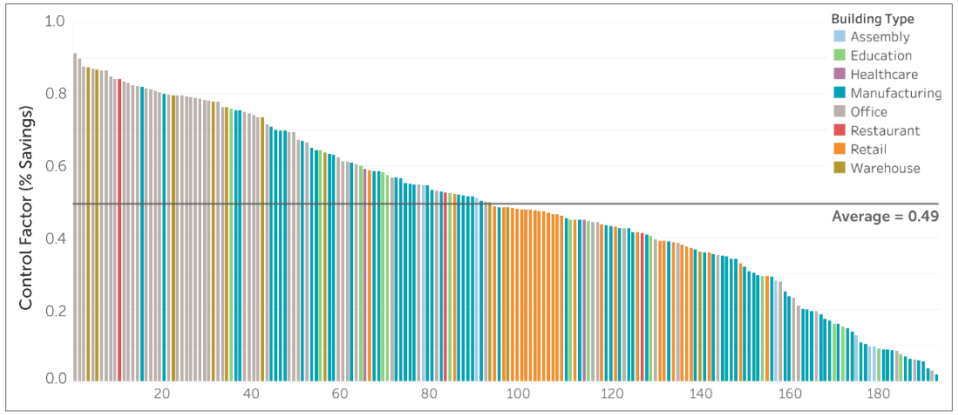


This study could serve as additional data points for the TRMs to calibrate the deemed operating hours

Efficiency Programs' Use of This Data

Average Energy Savings Consistent with 2017 Report





2017: **47%** savings

2020: **49%** savings

Opportunity for efficiency programs to update cost-effectiveness and for RTFs to update regional calculators

Different Average Savings Estimates for Systems with & without LLLC

LLLC Presence	Total Buildings	Control Factor (% Savings)			
		Average	25th–75th Percentile	High-End Trim Contributions	Other Control Strategies
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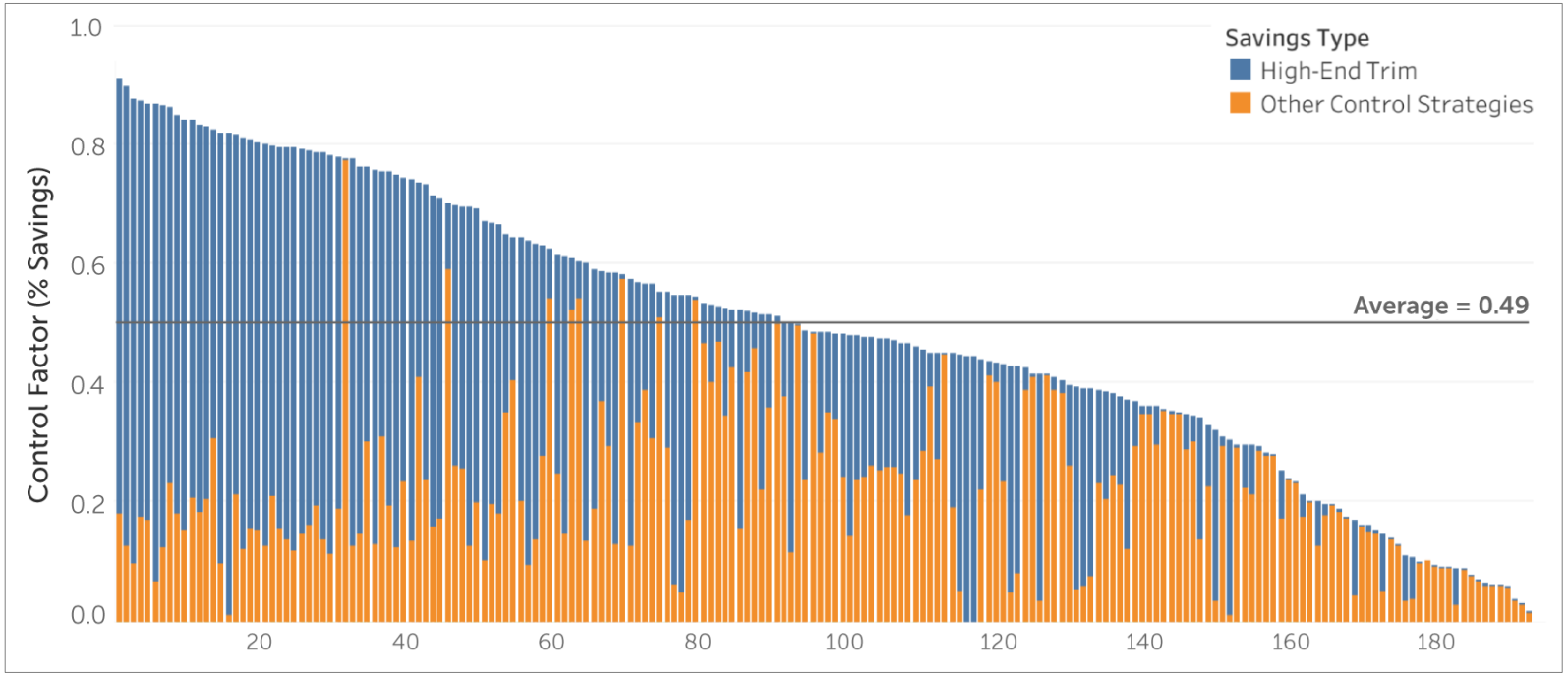
Note: The numbers provided in this table is meant to provide a high-level overview of average savings trends. Additional study is needed to control for potentially confounding variables, and thus at this time does not imply that LLLC is universally superior and applicable to all building types.

Opportunity to offer different incentives for NLCs with LLLC, or otherwise push the sales of NLCs with LLLC.

Better Differentiation between Control Strategies in all NLCs



Average control factor attributed to **high-end trim** is **0.27**
Average control factor attributed to **other controls combined** is **0.32**

Opportunity to differentiate incentives for particular control strategies.

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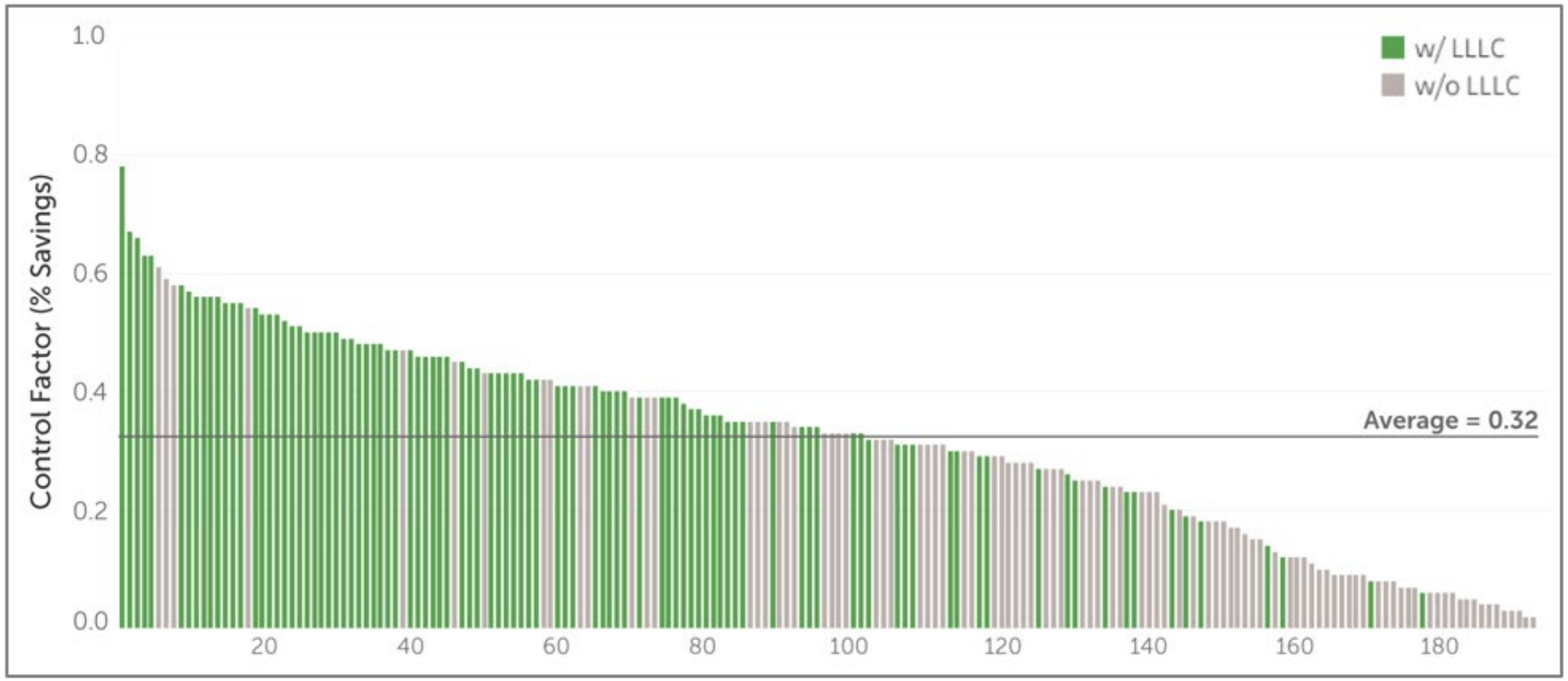
Differentiation between Control Strategies w/LLLC



Systems w/ LLLC average control factor attributed to **high-end trim** is **0.37**
Systems w/LLLC average control factor attributed to **other controls combined** is **0.41**

Opportunity to differentiate incentives for particular control strategies.

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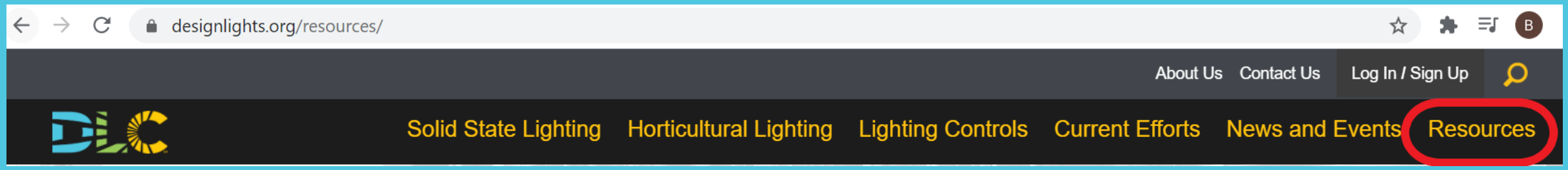
Report and Webinar Recording available

- Full report and recording available on DLC website: https://www.designlights.org/resources/



Time for Questions

Thank You For Attending

Bagwat Mohan
Sr. Technical Operations Analyst, DLC
bmohan@designlights.org

Chris Wolgamott CEM, CDSM
Sr. Product Manager, NEEA
CWolgamott@neea.org

Yao-Jung Wen, PhD, LC
Sr. Engineer, Energy Solutions

Levin Nock, PhD
Sr. Technical Manager, DLC
lnock@designlights.org

Anne Curran
Sr. Program Manager, NEEA
acurran@neea.org

Teddy Kisch, LC
Sr. Manager, Energy Solutions