Energy · Quality · Controllability℠

Sustainability and Resilience in Lighting

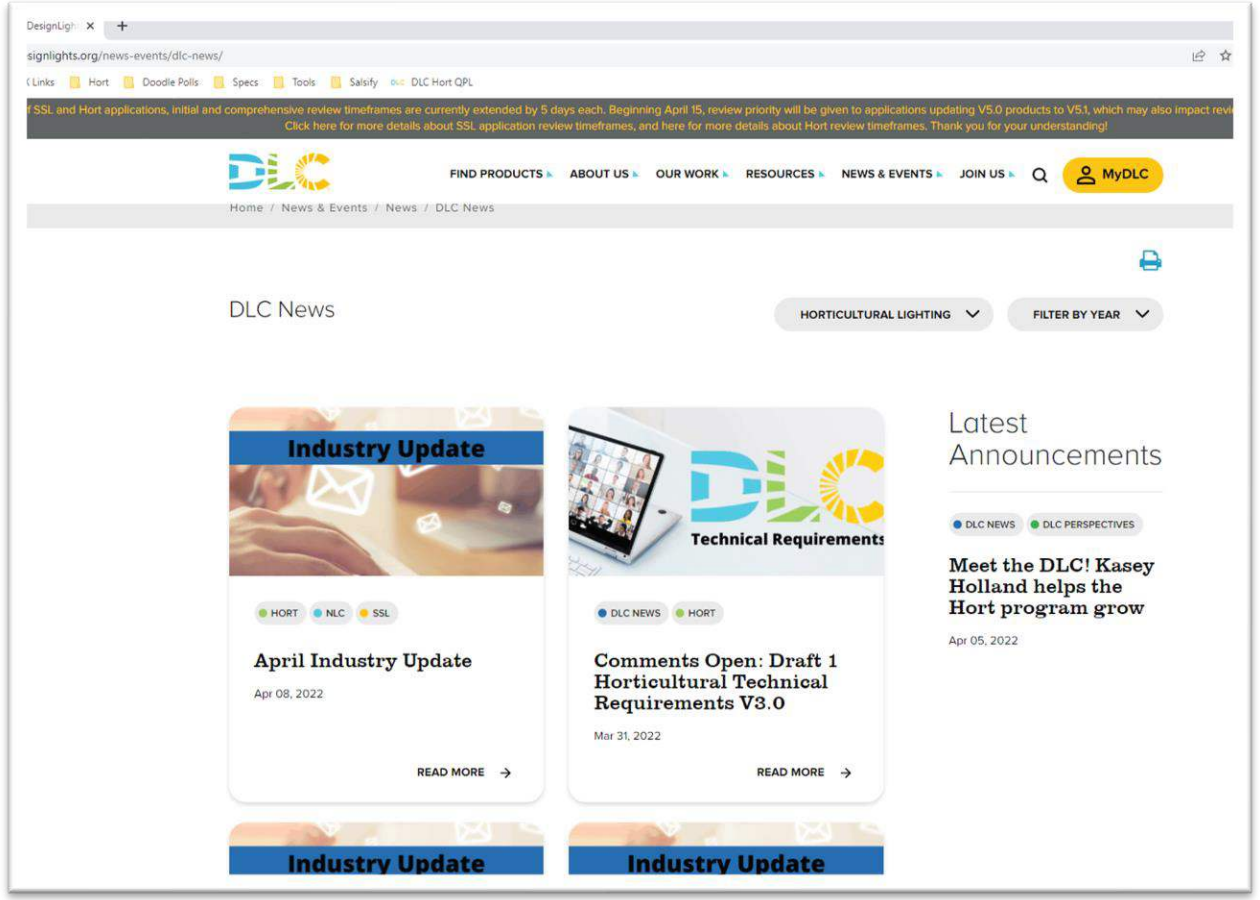
August 27th, 2025

designlights.org

Welcome!

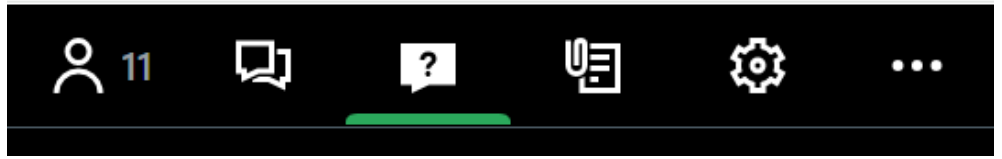
- **Slides and recorded webinar will be posted** on the *DLC News & Events* page at https://designlights.org shortly after today's presentation

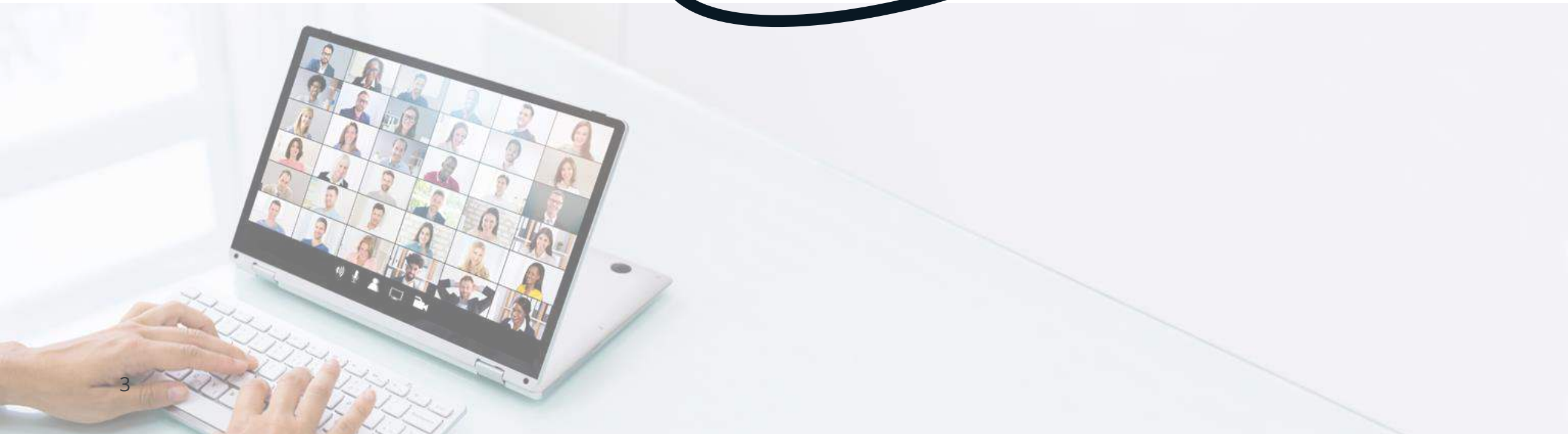
- All attendees are automatically muted



Webinar Orientation

- **Questions will be held until the end during a live Q&A**
  - **Use the Question pane (not Chat) to submit for Q&A**





The DesignLights Consortium is an independent, nonprofit organization providing decision makers with data and resources on quality lighting, controls, and integrated building systems to reduce energy, carbon, and light pollution.

Presenters

Adrian Martin
DLC

Alexandra Christiana
HMFH Architects

Scott Roos
IES Sustainable Ltg Committee

Andrew G. Harper
California Lighting Technology Center

Sustainability and Solar Luminaires in SSL V6.0

Sustainability Overview

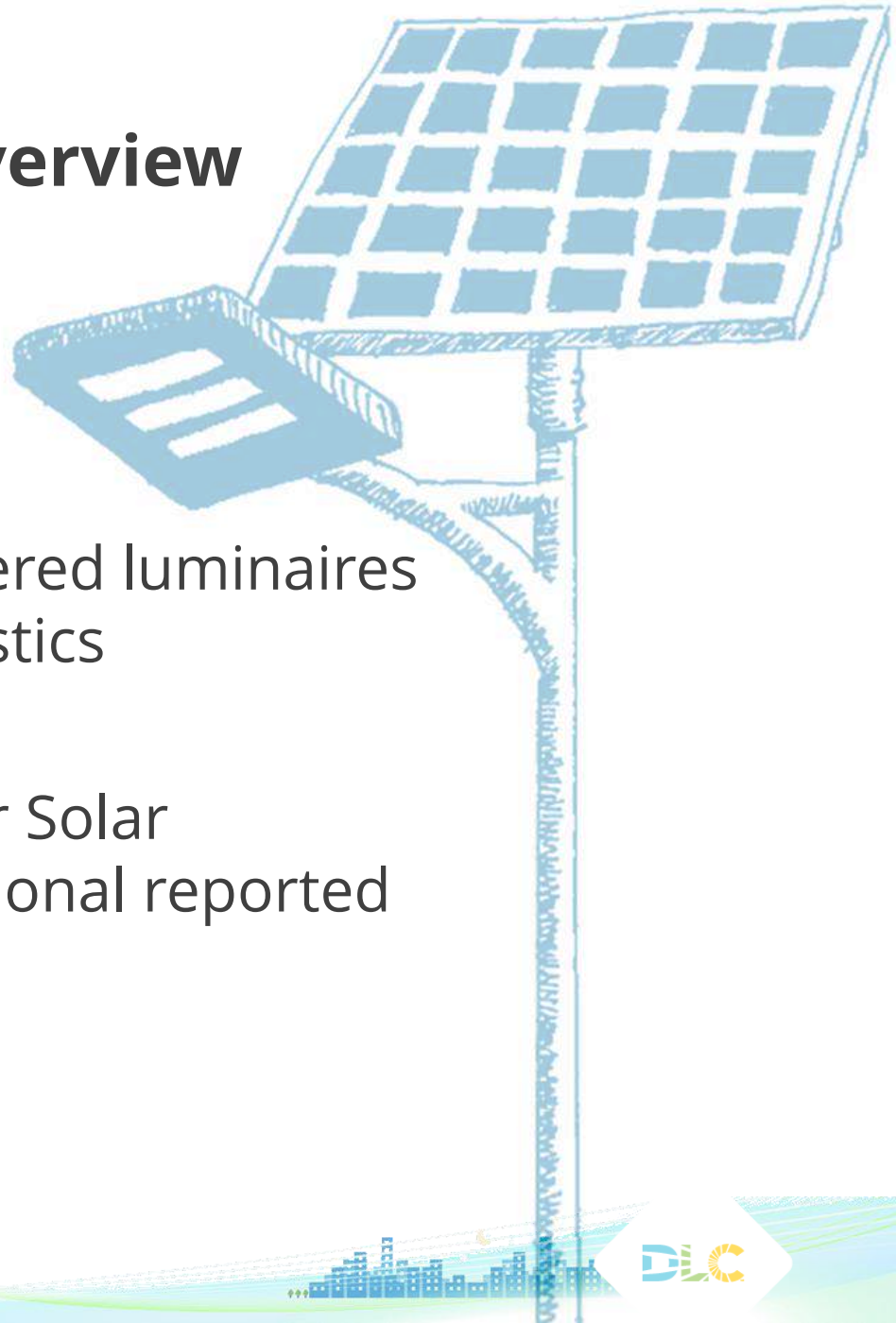
Goals

Promote lighting sustainability efforts and encourage lifecycle reporting

Requirement

Optional reporting of third party verified certifications

Solar Powered Outdoor Luminaires Overview



Goals

Support adoption of solar powered luminaires and reporting of key characteristics

Requirement

Introduce Category for Outdoor Solar Powered Luminaires with additional reported characteristics

Integrating Sustainability Into your Workflow

Alexandra Christiana
HMFH Architects

Why is this so important?

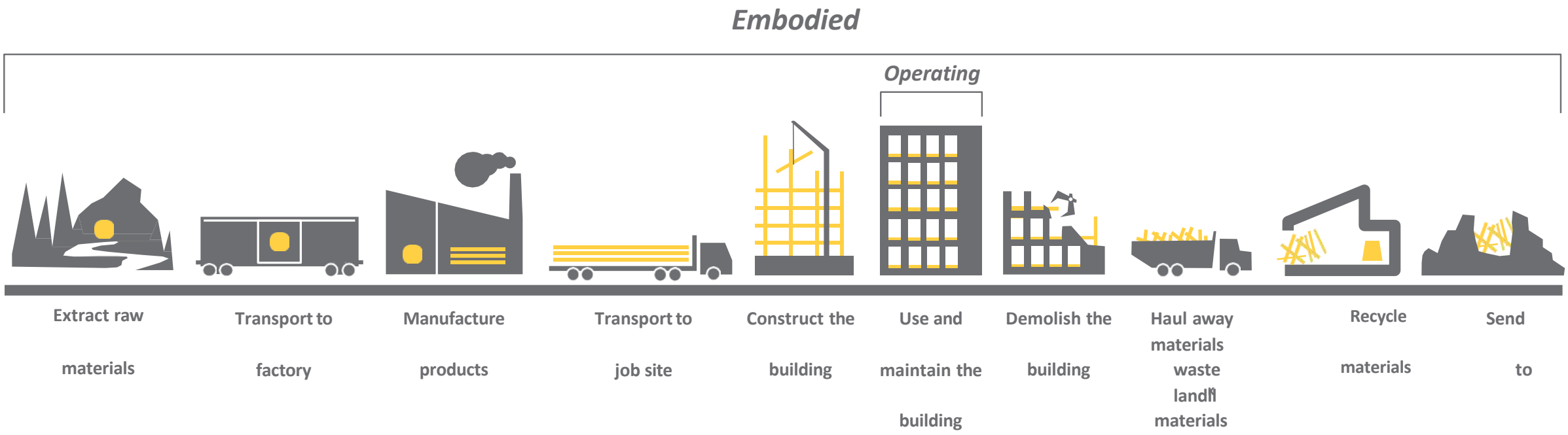
People spend

86.7%

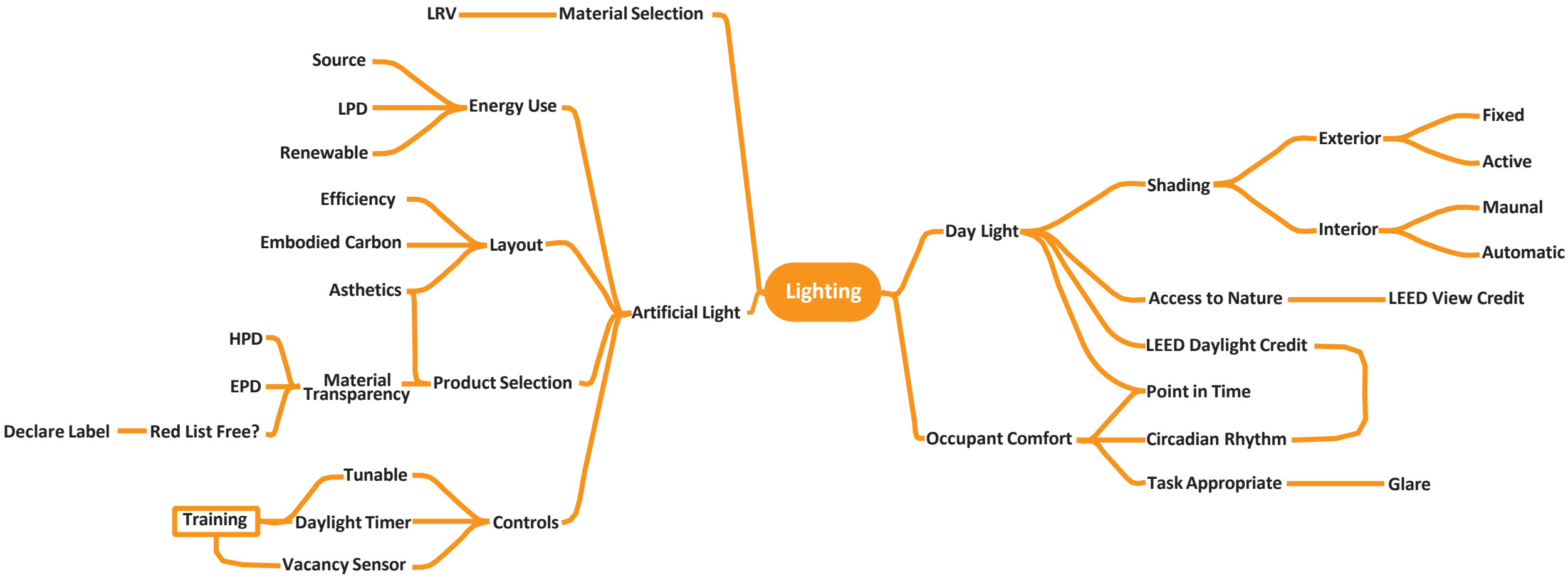
of their time indoors.

The National Human Activity Pattern Survey (NHAPS): A Resource for Assessing Exposure to Environmental Pollutants, by Neil E. Klepeis and others, and published by the Lawrence Berkeley National Laboratory in 2001.

Thinking Beyond Building Occupants



Synergies and Opportunities



Frame the Conversation

what is

SUSTAINABILITY

SOCIAL
SUSTAINABILITY
health & well-being
place
connectivity

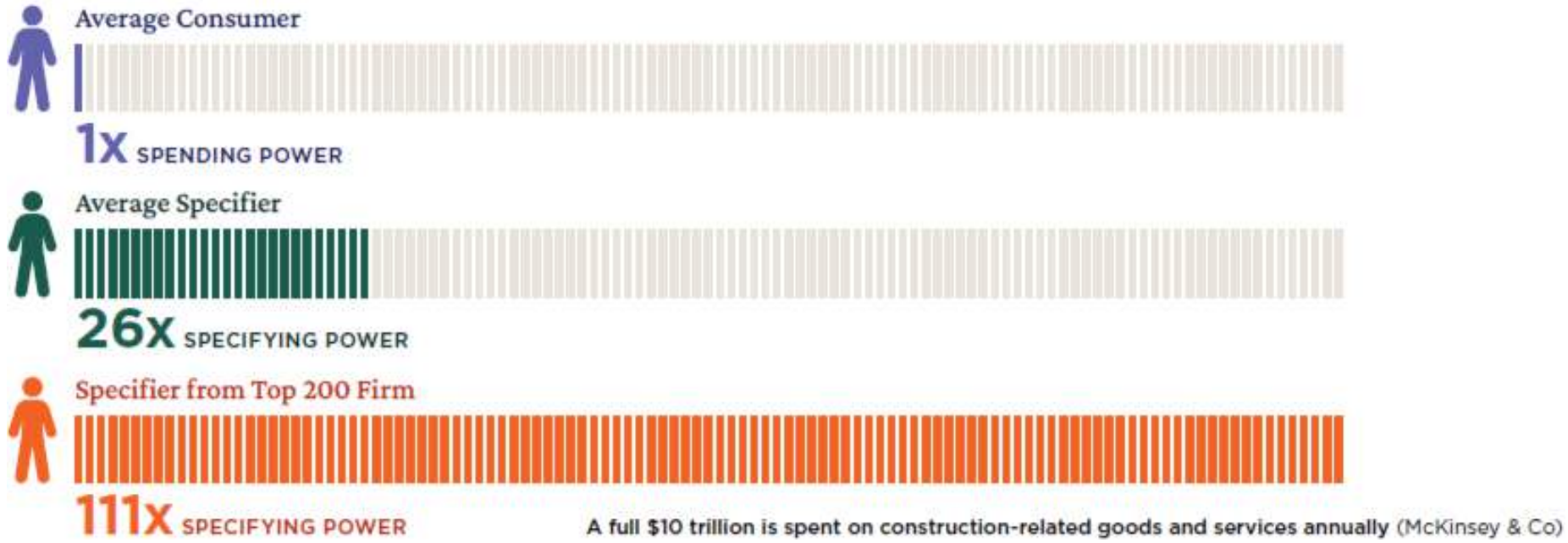
ECONOMIC
SUSTAINABILITY
prosperity
living infrastructure
resource regeneration

ENVIRONMENTAL
SUSTAINABILITY
resource regeneration
living infrastructure
health & wellbeing

EDUCATIONAL
SUSTAINABILITY
connectivity
living infrastructure
prosperity
health & wellbeing

Focus the Conversation

The Power of Specification

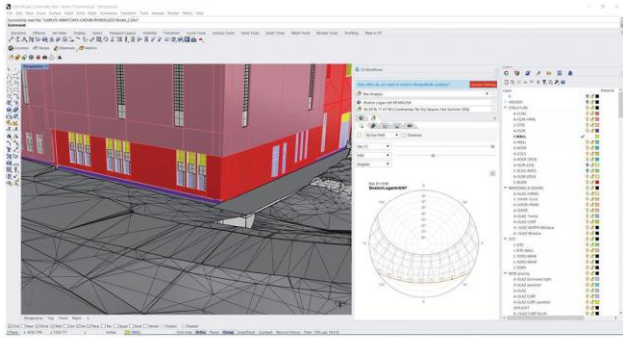


Workflow Integration

HM
FH

CLIMATE STUDIO: HMFH WORKFLOW

DRAFT



HMFH ARCHITECTS

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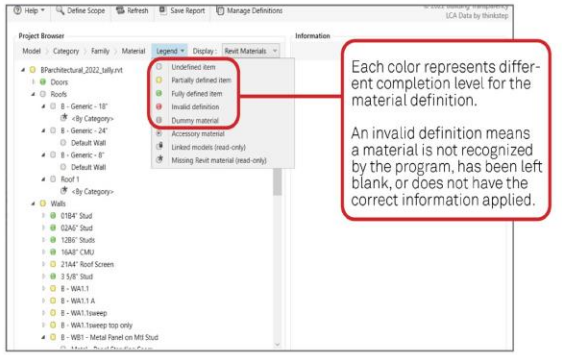
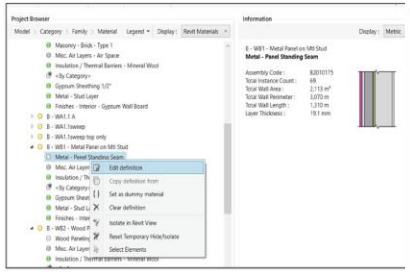
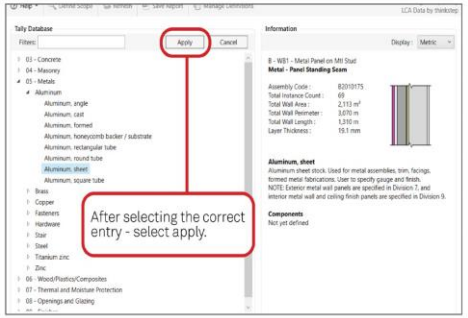
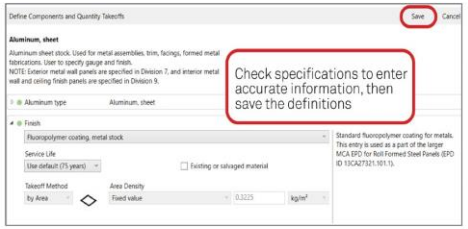
Defining Materials in Tally



Right Click to Edit Definition



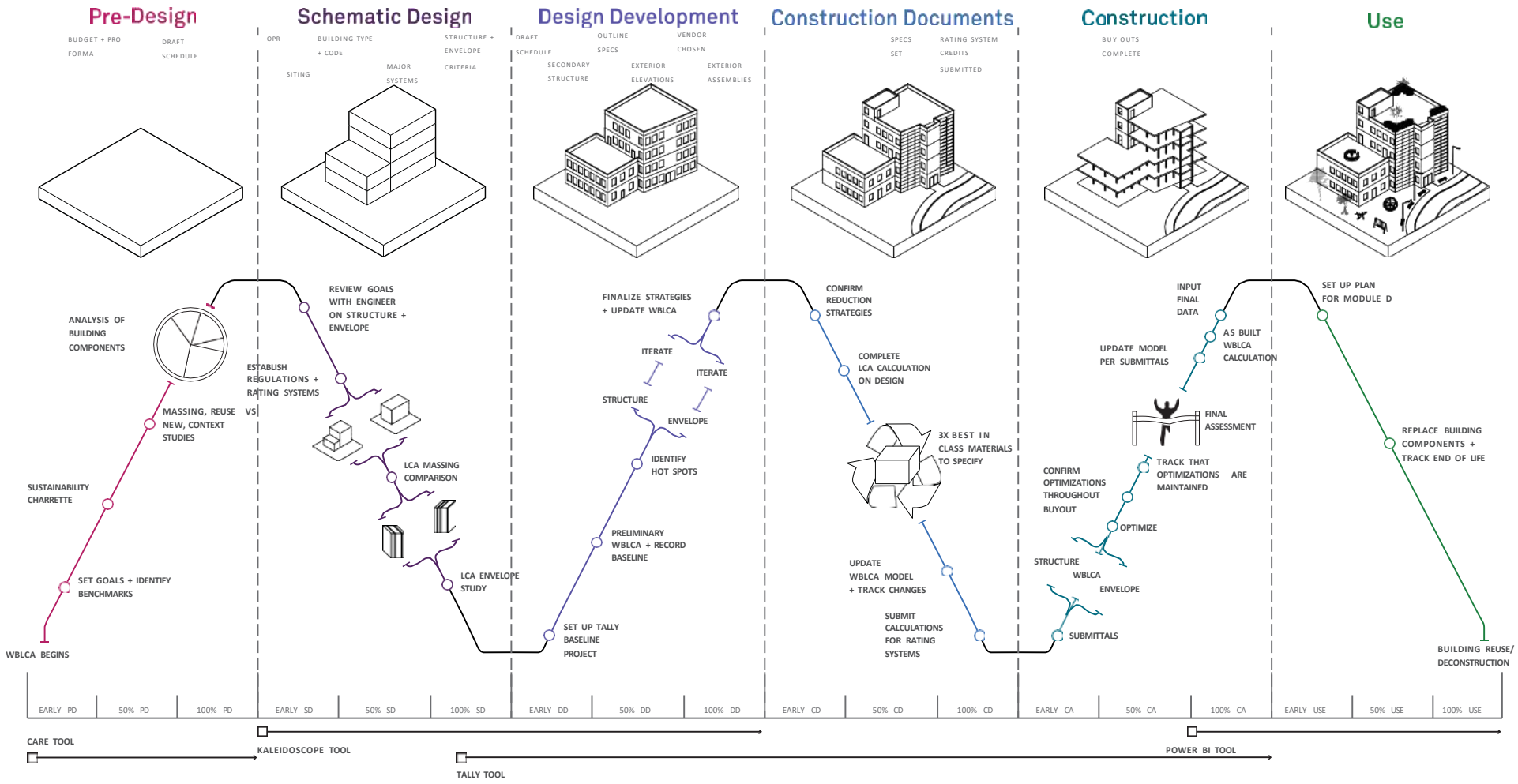




ARCHITECTS

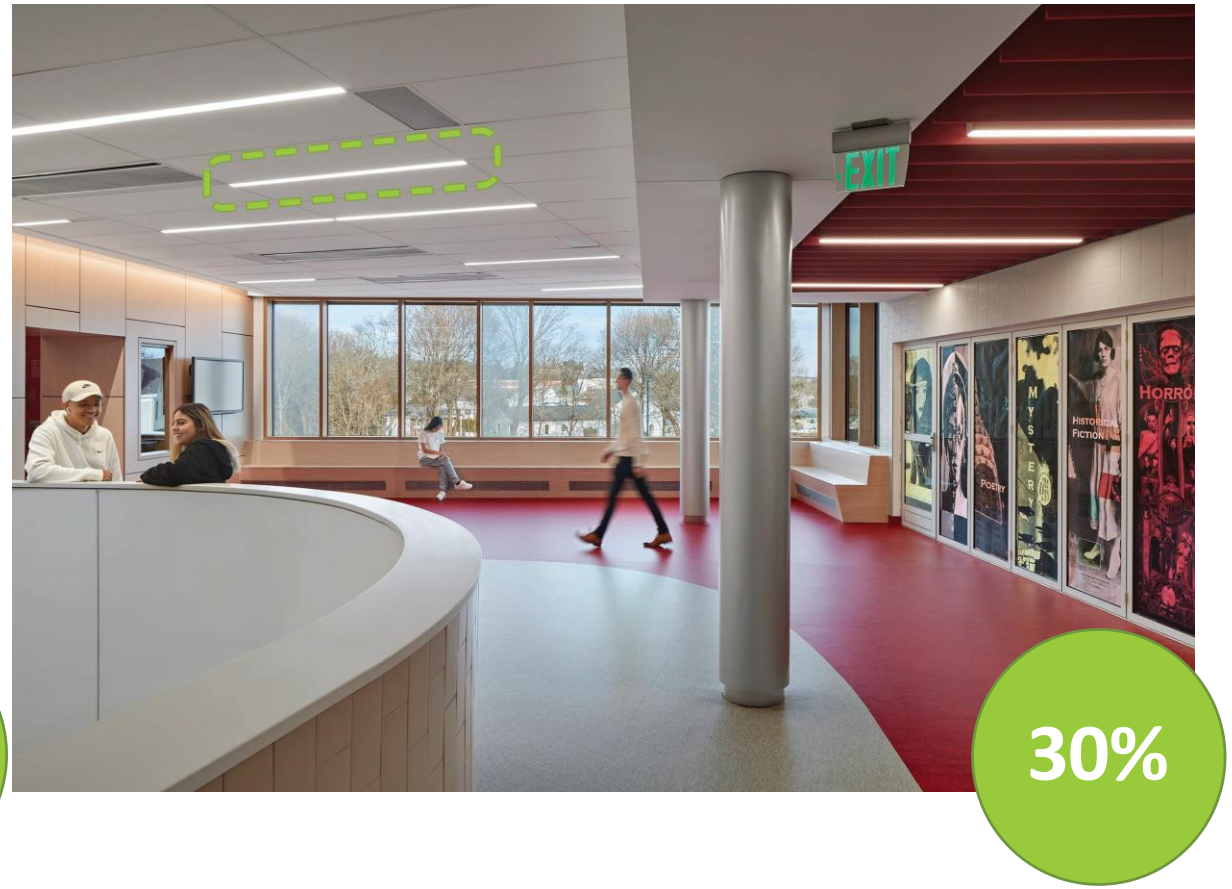
Workflow Integration

Carbon Conscious Design Workflow



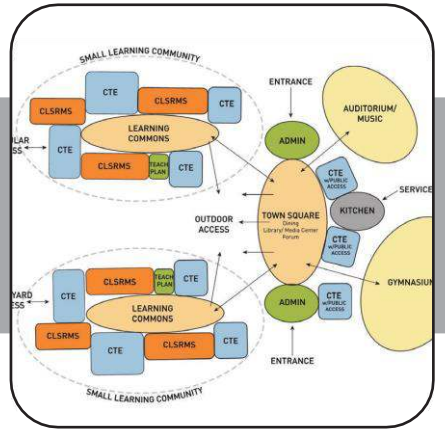
Goal Setting | **Right-sizing** | **X vs Y Systems** | **X vs Y Products** | **Reduction Realized** | **Paying it Forward**

Make one impactful change



Maintaining Sustainability Goals

PRE-DESIGN



DESIGN

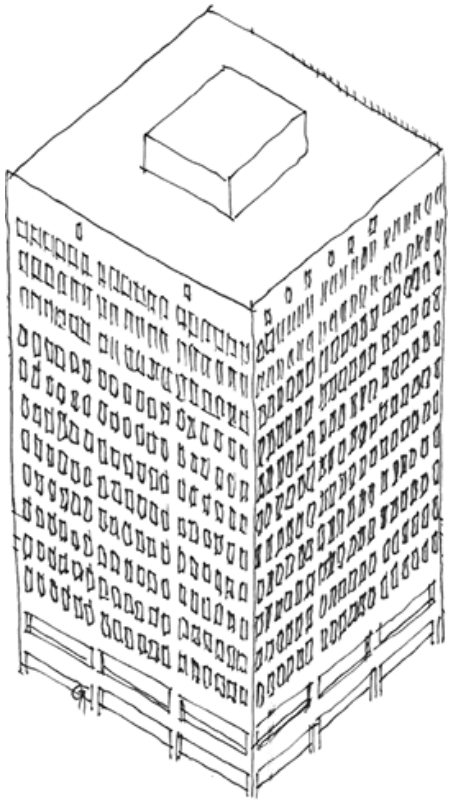
GOAL SETTING

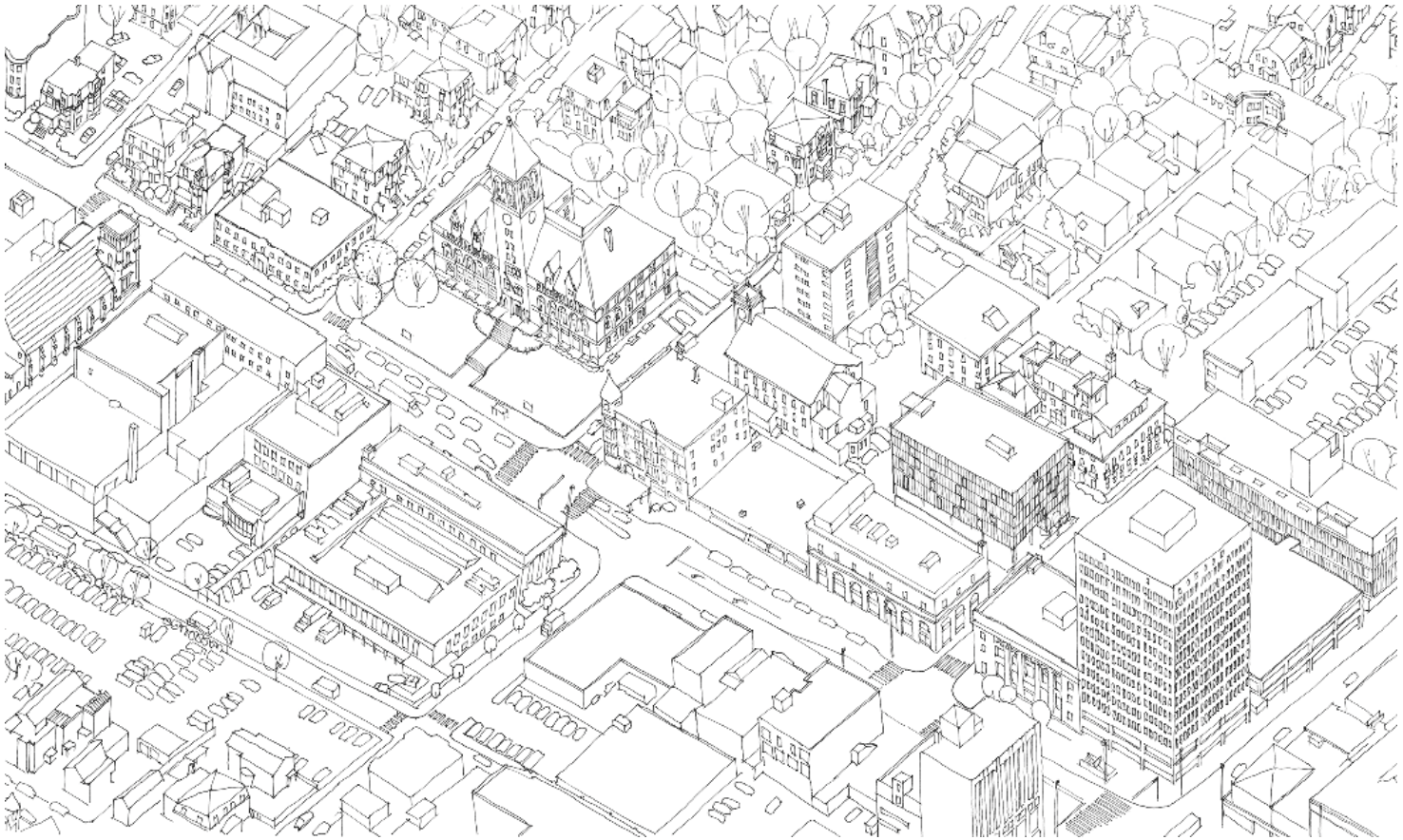
CONSTRUCTION

OCCUPANCY

Closing the Loop

ADVOCACY





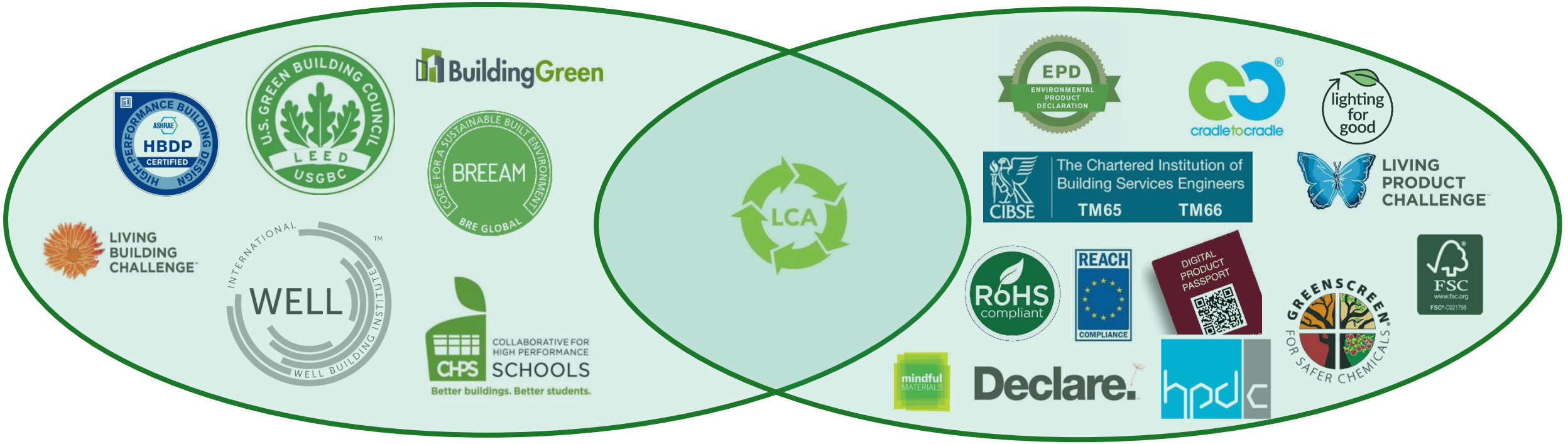
On the Horizon

LEED v5

Luminaire Sustainability Metrics

Scott Roos
IES Sustainable Lighting Committee

Rating Systems, Certification, Labels & Declarations



Whole Building **Product Level**

Key Rating Systems, Certifications, Labels & Declarations

	Human Health	Climate Health	Ecosystem Health	Social Health & Equity	Circular Economy
Whole Building					
Living Building Challenge (LBC)	✓	✓	✓	✓	✓
LEED	✓	✓	✓		✓
WELL	✓			✓	
Product Level					
Declare Labels	✓				
Health Product Declarations (HPD)	✓				
RoHS	✓				
Environmental Product Declarations		✓	✓		
TM65 Embodied Carbon Estimation		✓			
TM66 Circular Economy Assessment					✓
Corporate Sustainability Reports		✓	✓	✓	✓

Material, Sourcing, and Ingredient Disclosures

	Human Health	Climate Health	Ecosystem Health	Social Health & Equity	Circular Economy
Product Level					
Declare Labels	✓				
Health Product Declarations (HPD)	✓				
RoHS	✓				
Environmental Product Declarations		✓	✓		
TM65 Embodied Carbon Estimation		✓			
TM66 Circular Economy Assessment					✓
Corporate Sustainability Reports		✓	✓	✓	✓

Health Product Declarations (HPDs) & Declare Labels

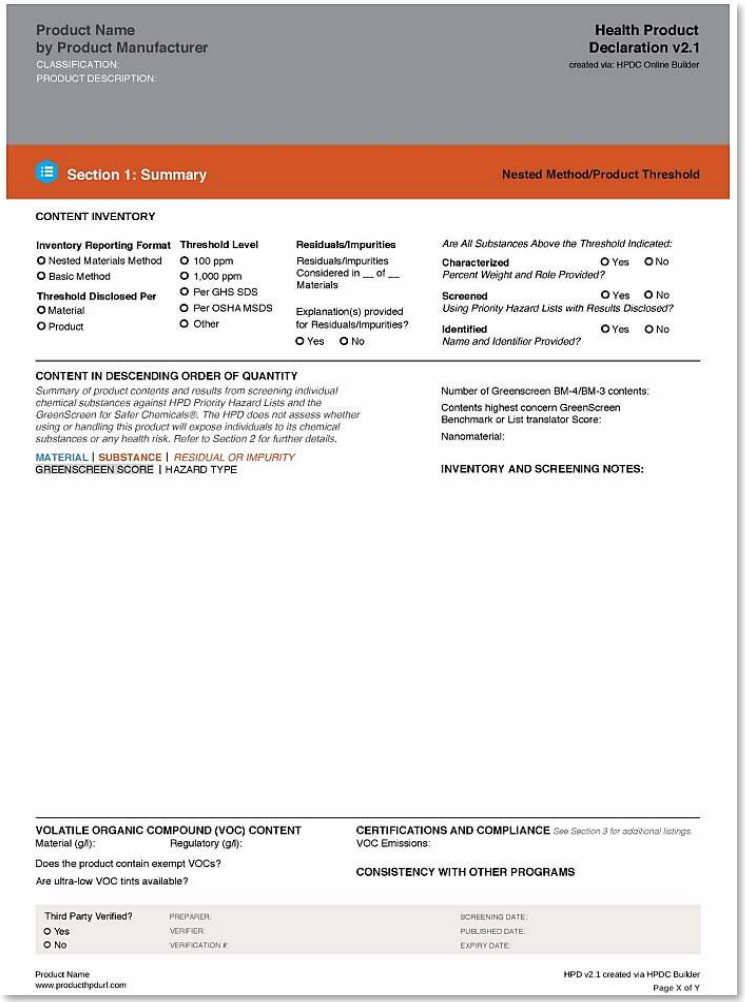
Standardized methods for Materials Transparency

Benefits

- Disclose detailed chemical ingredients of all the components in a luminaire w/ optional 3rd party verification
- Flag toxic ingredients with known human health impacts

Limitations

- Generally exclude electronics
- Supply chains not able to capture all additives in plastics and paints
- Inconsistent accuracy/completeness, even with 3rd party verification
- Susceptible to Greenwashing
  - Labels for components or partial luminaires
  - "Red List Free" luminaire not meaningful



Product Name
by Product Manufacturer
CLASSIFICATION:
PRODUCT DESCRIPTION:

Health Product Declaration v2.1
created via: HPDC Online Builder

Section 1: Summary — Nested Method/Product Threshold

CONTENT INVENTORY

Inventory Reporting Format
O Nested Materials Method
O Basic Method

Threshold Disclosed Per
O Material
O Product

Threshold Level
O 100 ppm
O 1,000 ppm
O Per GHS SDS
O Per OSHA MSDS
O Other

Residuals/Impurities
Residuals/Impurities Considered in __ of __ Materials

Explanation(s) provided for Residuals/Impurities?
O Yes O No

Are All Substances Above the Threshold Indicated:
Characterized — Percent Weight and Role Provided? O Yes O No
Screened — Using Priority Hazard Lists with Results Disclosed? O Yes O No
Identified — Name and Identifier Provided? O Yes O No

CONTENT IN DESCENDING ORDER OF QUANTITY

Summary of product contents and results from screening individual chemical substances against HPD Priority Hazard Lists and the GreenScreen for Safer Chemicals®. The HPD does not assess whether using or handling this product will expose individuals to its chemical substances or any health risk. Refer to Section 2 for further details.

MATERIAL | SUBSTANCE | RESIDUAL OR IMPURITY
GREENSCREEN SCORE | HAZARD TYPE

Number of Greenscreen BM-4/BM-3 contents:
Contents highest concern GreenScreen Benchmark or List translator Score:
Nanomaterial:

INVENTORY AND SCREENING NOTES:

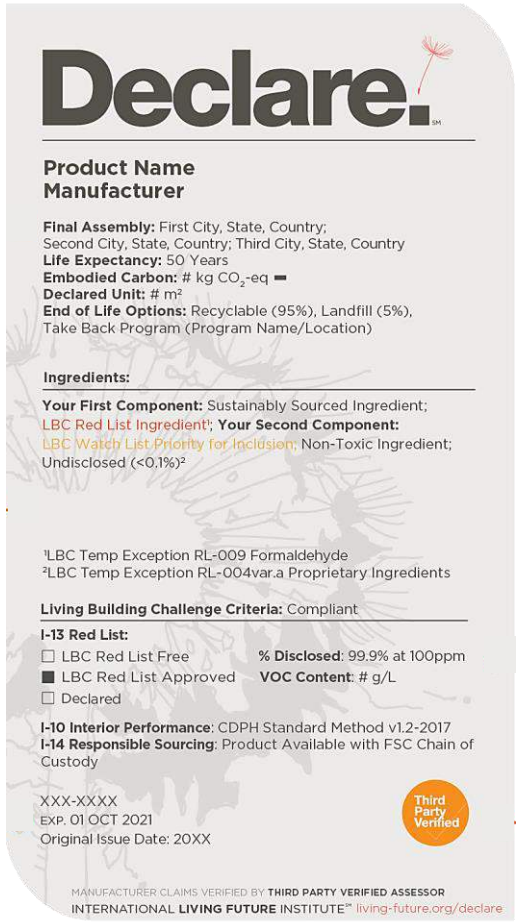
VOLATILE ORGANIC COMPOUND (VOC) CONTENT
Material (g/l): Regulatory (g/l):
Does the product contain exempt VOCs?
Are ultra-low VOC tints available?

CERTIFICATIONS AND COMPLIANCE See Section 3 for additional listings.
VOC Emissions:

CONSISTENCY WITH OTHER PROGRAMS

Third Party Verified?
O Yes
O No
PREPARER:
VERIFIER:
VERIFICATION #:
SCREENING DATE:
PUBLISHED DATE:
EXPIRY DATE:

Product Name
www.producthpdurl.com
HPD v2.1 created via HPDC Builder
Page X of Y



Declare.

Product Name
Manufacturer

Final Assembly: First City, State, Country; Second City, State, Country; Third City, State, Country
Life Expectancy: 50 Years
Embodied Carbon: # kg CO_2-eq
Declared Unit: # m²
End of Life Options: Recyclable (95%), Landfill (5%), Take Back Program (Program Name/Location)

Ingredients:

Your First Component: Sustainably Sourced Ingredient; LBC Red List Ingredient[1]; **Your Second Component:** LBC Watch List Priority for Inclusion; Non-Toxic Ingredient; Undisclosed (<0.1%)[2]

[1]LBC Temp Exception RL-009 Formaldehyde
[2]LBC Temp Exception RL-004var.a Proprietary Ingredients

Living Building Challenge Criteria: Compliant

I-13 Red List:
☐ LBC Red List Free
■ LBC Red List Approved
☐ Declared

% Disclosed: 99.9% at 100ppm
VOC Content: # g/L

I-10 Interior Performance: CDPH Standard Method v1.2-2017
I-14 Responsible Sourcing: Product Available with FSC Chain of Custody

XXX-XXXX
EXP. 01 OCT 2021
Original Issue Date: 20XX

Third Party Verified

MANUFACTURER CLAIMS VERIFIED BY THIRD PARTY VERIFIED ASSESSOR
INTERNATIONAL LIVING FUTURE INSTITUTE™ living-future.org/declare

RoHS

Restrictions on Hazardous Substances

Benefits

- Restricts the use of 10 common hazardous substances based on the current state of the art for electronics manufacturing
- Most drivers and many electronic components sold into North America are RoHS
    - Mandatory requirement for electrical & electronic products sold into the EU

Limitations

- NA Luminaire manufacturers not consistent in if & how they identify RoHS compliant components
- Unlike in the EU, in NA complete luminaires are generally not certified to be RoHS compliant

- **Cadmium (Cd)**: < 100 ppm
- **Lead (Pb)**: < 1000 ppm
- **Mercury (Hg)**: < 1000 ppm
- **Hexavalent Chromium: (Cr VI)** < 1000 ppm
- **Polybrominated Biphenyls (PBB):** < 1000 ppm
- **Polybrominated Diphenyl Ethers (PBDE)**: < 1000 ppm
- **Bis(2-Ethylhexyl) phthalate (DEHP)**: < 1000 ppm
- **Benzyl butyl phthalate (BBP)**: < 1000 ppm
- **Dibutyl phthalate (DBP)**: < 1000 ppm
- **Diisobutyl phthalate (DIBP)**: < 1000 ppm

Comprehensive Environmental Life Cycle Assessment

	Human Health	Climate Health	Ecosystem Health	Social Health & Equity	Circular Economy
Product Level					
Declare Labels					
Health Product Declarations (HPD)					
RoHS					
Environmental Product Declarations					
TM65 Embodied Carbon Estimation					
TM66 Circular Economy Assessment					
Corporate Sustainability Reports					

Environmental Product Declaration (EPD)

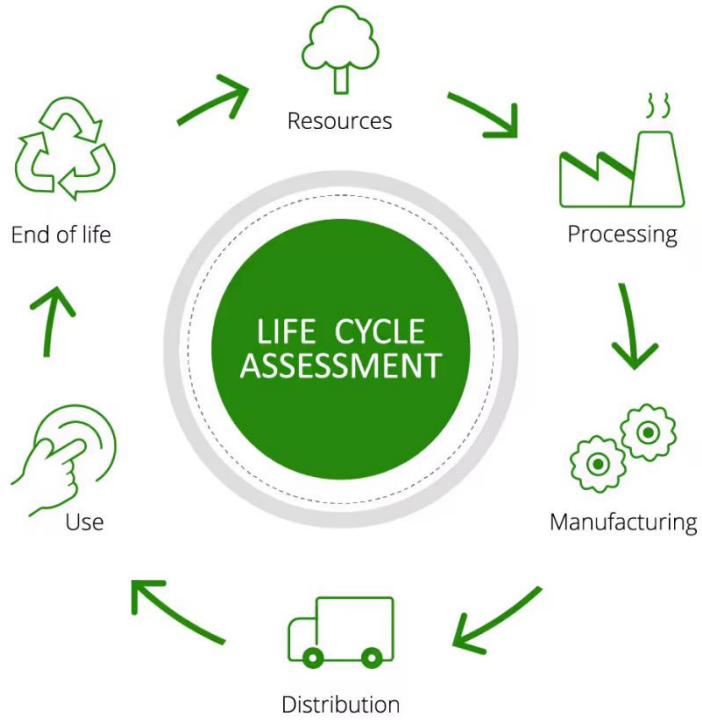
Public facing summary report of an LCA

Benefits

- Comprehensive; covers impacts to air, water & soil
- Scientifically sound, regulated by open ISO standards
- Luminaire EPDs can contribute to a whole building LCA
- Product Specific & Industry Wide EPDs accepted by LEED
- Instructive for Manufacturers to find hot spots

Limitations

- Difficult/costly for complex electrical products
- Efforts to simplify/lower cost may reduce accuracy
- Difficult to read & interpret
- Not comparable
  - Differing data sources, assumptions, software, chosen stages & ongoing standardization activities
- Questionable cost/benefit for luminaires
  - ~90% of impact from operating energy…already more accurately being quantified on a project specific basis



ATMOSPHERE			WATER		EARTH	
Global Warming Potential refers to long-term changes in global weather patterns that are caused by increased concentrations of greenhouse gases in the atmosphere.	**Ozone Depletion Potential** is the destruction of the stratospheric ozone layer, which shields the earth from ultraviolet radiation that's harmful to life, caused by human-made air pollution.	**Photochemical Ozone Creation Potential** happens when sunlight reacts with hydrocarbons, nitrogen oxides, and volatile organic compounds, to produce air pollution known as smog.	**Acidification Potential** is the result of human-made emissions and refers to the decrease in pH and increase in acidity of oceans, lakes, rivers, and streams – polluting groundwater and harming aquatic life.	**Eutrophication Potential** occurs when excessive nutrients cause increased algae growth in lakes, blocking the underwater penetration of sunlight needed to produce oxygen and resulting in the loss of aquatic life.	**Depletion of Abiotic Resources (Elements)** refers to the reduction of available non-renewable resources, such as metals, that are found on the periodic table of elements, due to human activity.	**Depletion of Abiotic Resources (Fossil Fuels)** refers to the decreasing availability of non-renewable carbon-based compounds, such as oil and coal, due to human activity.

Embodied Carbon Estimation

	Human Health	Climate Health	Ecosystem Health	Social Health & Equity	Circular Economy
Product Level					
Declare Labels	✓				
Health Product Declarations (HPD)	✓				
RoHS	✓				
Environmental Product Declarations		✓	✓		
TM65 Embodied Carbon Estimation		✓			
TM66 Circular Economy Assessment					✓
Corporate Sustainability Reports		✓	✓	✓	✓

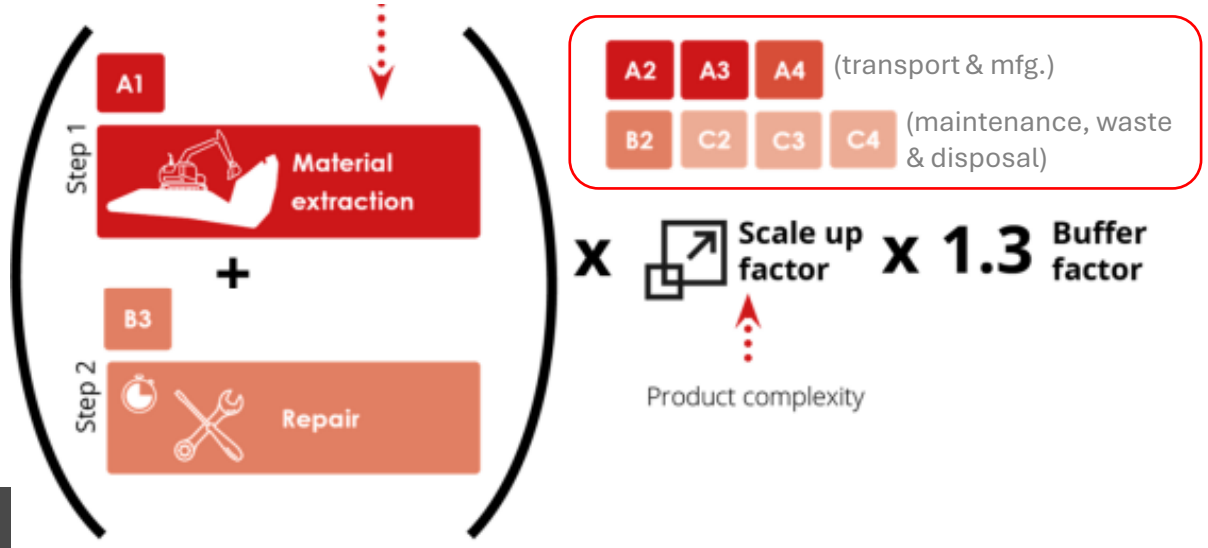
TM65 Embodied Carbon Calculation Methodology

CHARTERED INSTITUTION OF BUILDING SERVICES ENGINEERS

Basic formula to estimate embodied carbon

Benefits

- Simple/quick calculation
- No cost to manufacturer
- Standardized CO2/lb. material emission factors drives consistency
- Single number result
  - Easily understood
  - Readily comparable
- Optional 3rd party verification



TM65-Tool-BEAMA-webinar-Carl-Collins

Limitations

- Only CO2 Embodied Carbon emissions
- Theoretically less accurate than an EPD
  - Current model overstates CO2 by ~30% vs. EPDs
  - Opportunity for model refinement?
- Not recognized by sustainable building certifications

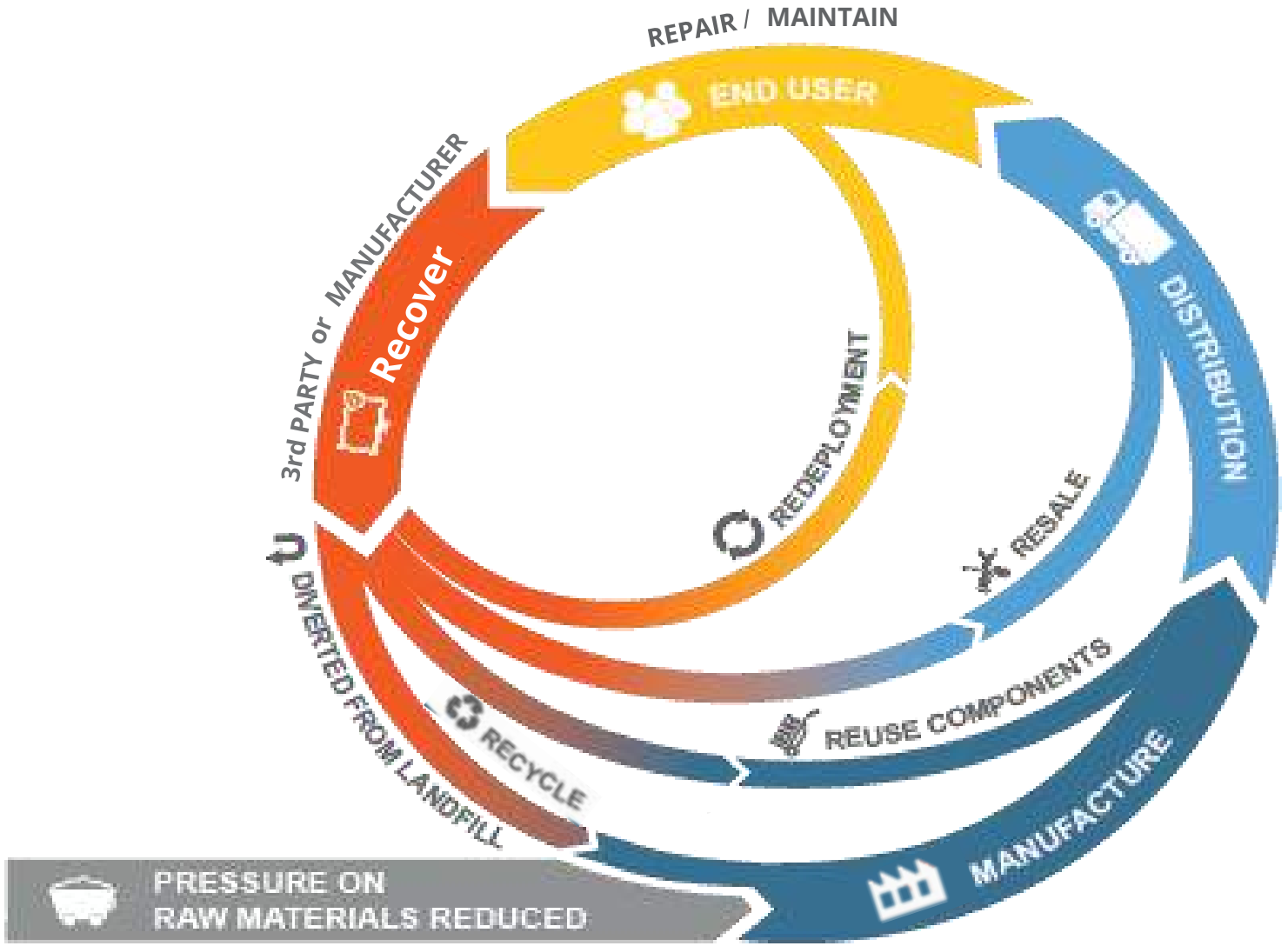
Circular Economy Assessment

	Human Health	Climate Health	Ecosystem Health	Social Health & Equity	Circular Economy
Product Level					
Declare Labels	✓				
Health Product Declarations (HPD)	✓				
RoHS	✓				
Life Cycle Assessments/EPDs		✓	✓		
TM65 Embodied Carbon Estimation		✓			
TM66 Circular Economy Assessment					✓
Corporate Sustainability Reports		✓	✓	✓	✓

Lighting Industry is primarily a Linear Economy

RAW MATERIALS → MANUFACTURE → DISTRIBUTION → END USER → INCINERATION or LANDFILL

Aspirational Lighting Industry Circular Economy



TM66 Circular Economy Assessment Methodology

Excel based questionnaire to assess wholistic support of circular economy

Benefits

- Assesses circularity based on 78 attributes
- Evidence supported survey responses w/ optional 3rd party verification
- Addresses high impact areas for embodied carbon reduction
- One-time Excel download <$100
- Highly instructive during development to drive improved outcomes
- Provides great insights and basis for specifiers and manufacturers to engage in discussion

Limitations

- Survey answers and evidence subject to interpretation and a learning curve
- Not recognized by sustainable building certifications

Result

Category	Points Scored	Maximum possible points	Assessment
Product design	21.0	35.0	2.4
Manufacturing	10.9	11.0	3.9
Materials	5.0	16.0	1.3
Ecosystem	15.0	22.0	2.7
Overall performance	51.9	84.0	2.6

Product Design

- Adaptability
- Upgradeability
- Use in second life
- Modularity
- Durability
- Material/BOM simplification vs. “typical”
- Assembly techniques
- Design for remanufacture
- Controls Obsolescence
- Performance Certifications
- Circularity Design Competence

Manufacturing

- Manufacturing Complexity Weighting
- Supply Chain Engagement
- In-house closed loop manufacturing
- Social Responsibility

Materials

- Reduction of virgin materials
- Plastics identified for recyclability
- Biodegradable materials
- Innovative sustainable materials
- Biodegradable packaging

Ecosystem for Product Reuse

- Systems & Resources
- Reusable packaging
- On-Site upgradability
- Accurate photometry accessible
- Component supplier commitment
- Warranty
- Manufacture Competence & buy-in

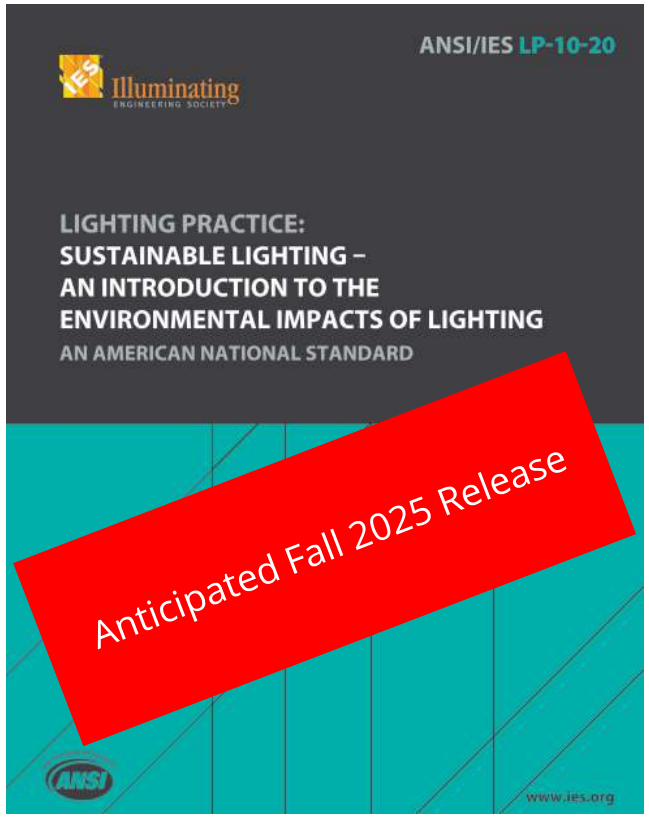
Two upcoming resources on sustainability!

Industry Life Cycle Assessment of Five Average Luminaires

Report Summarizing results of Green Light Alliance LCA Incubator Study

- Comprehensive LCAs of Downlights, Cylinders, Linear, Troffers & Post Tops based on data from 28 luminaire manufacturers
- Extremely informative
  - Relative environmental impact of the different luminaire types
  - Identifies highest areas of environmental impact
  - Guidance for manufacturers and specifiers on how to make the biggest reductions
- Industry Wide EPDs (IW EPD) will be available for participating manufacturers' products

IES LP-10: Sustainable Lighting



- Substantiative update
- Comprehensive review of how applied lighting & luminaires impact sustainability
- Recommendations to guide lighting design & manufacturing improvements
- Objective review of available metrics
- Informational, less prescriptive
- Significant resource guide

Sustainable Lighting – An Introduction to the Environmental Impacts of Lighting – The IES Webstore

Resilient, Efficient & Adaptable Lighting (REAL)

Andrew G. Harper
California Lighting Technology Center

Challenges with Conventional Exterior Lighting

Nighttime Energy & Emissions: Continuous grid draw drives operating costs and carbon output

Outdated Infrastructure & Safety: Failing poles, wiring and controls increase hazards and maintenance burdens

Beyond Efficiency – Resilience Gap:

Vulnerable to outages; little capability to operate during grid failures of PSPS

Sponsor: California Energy Commission (CEC) from Jun 2021 – Mar 2026

Scope and Scale:

- Product development with industry partners
- Large field deployment of over 200 solar + battery + LED luminaires at 8 locations

Key Partners: TRC, CEA, University of Utah, DLC, Community Partners and Industry Partners

The REAL Innovation

Hybrid Power Source: Each REAL luminaire uses a hybrid solar + grid power system.

Resilient: Can operate without grid power indefinitely depending on solar production

Battery Energy Storage: utilizes a high capacity battery sized to power luminaires for up to a night

High Efficiency LED Luminaires: high efficacy, low glare, improved light quality

Circadian Friendly: Biologically appropriate spectrum and distribution.

REAL Luminaires – Signify SolarForm

All in One (AIO): Battery, panel and LED luminaire integrated into a single unit

- 37.4W LED, 200W solar, 960Wh SIO2 Battery

Bollard: vertical side-mounted solar panels with internal battery

- 6W LED, 12W solar, 198Wh LiFePO4 Battery

Non-Integrated: Larger panel and battery bank mounted at pole top, luminaire positioned below

- 37.4W/54.8W LED, 200W/325W solar, 960Wh SIO2 Battey

Demonstration Sites

Hanford: Apartment complex, 16 REAL luminaires installed

Orosi: Apartment complex, 17 REAL luminaires installed

Visalia: Apartment complex, 25 luminaires installed

San Joaquin: Main street lighting, 18 REAL luminaires installed

Chula Vista: SDG&E Park, 20 REAL luminaires installed

Moreno Valley: Adrienne Mitchell Park, 25 luminaires installed

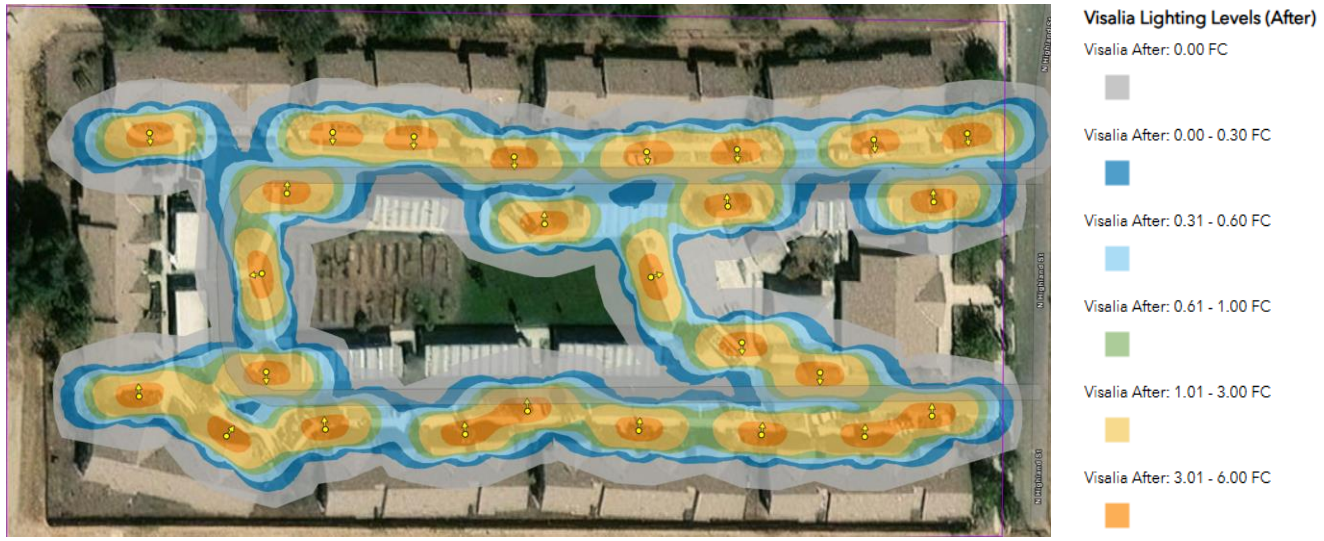
Pomona: Kiwanis Park, 27 luminaires installed

West Sacramento: Apartment complex, 59 luminaires pending install

M&V – Data Collection

- **AC/DC Power metering**
  - AC Power into pole, DC power in/out of battery
- **Site illuminance measurements**
- **Illuminance modeling**
- **Pre and post install photos/luminance mapping**

Performance Highlights & Preliminary Results



Lighting levels at Visalia REAL installation site

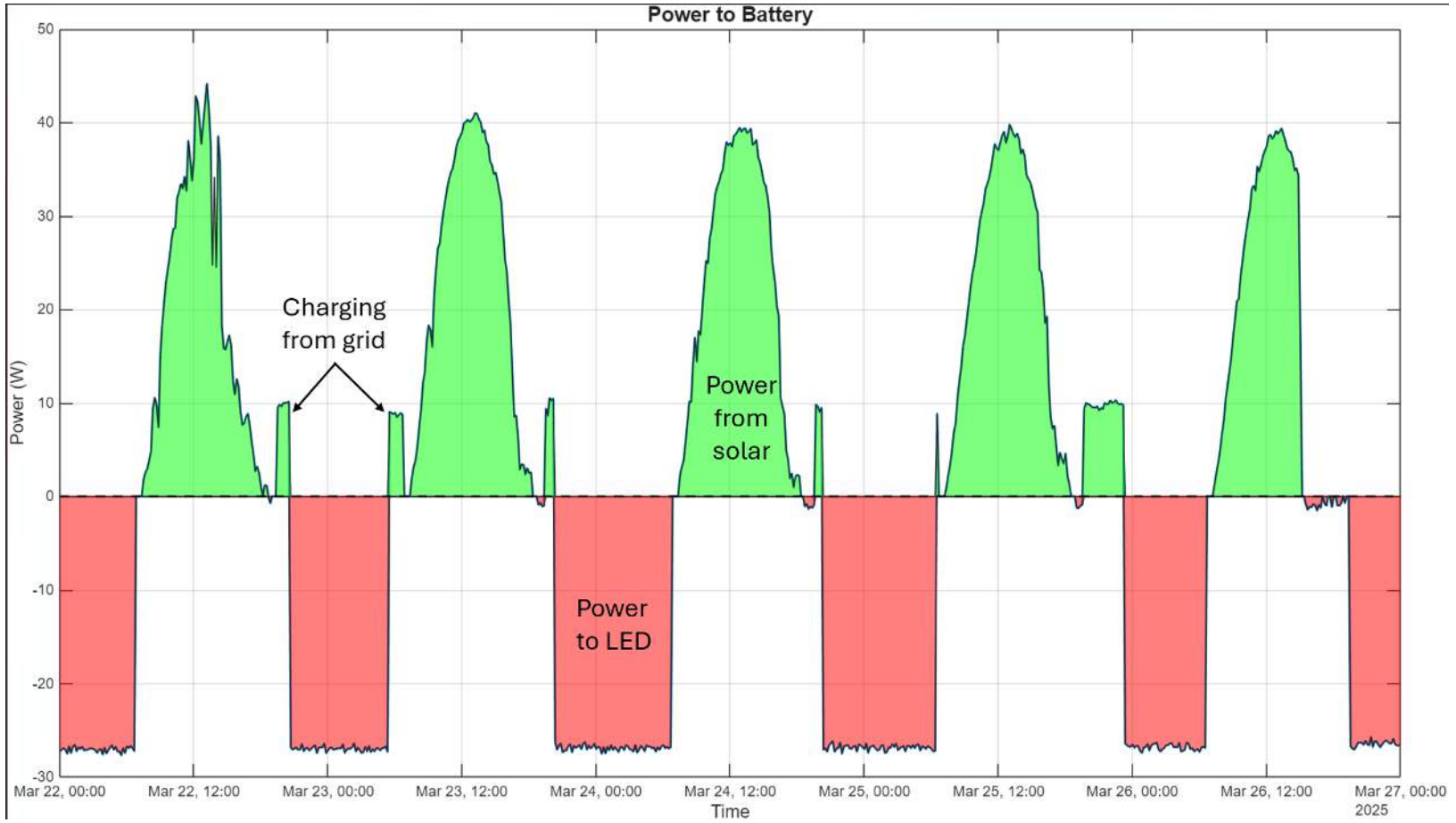
Off Grid Success: All luminaires across demonstration sites operated on battery power for 95%+ of nighttime hours

Energy Savings: 95-100% energy reduction for data collection period March – July 2025

Battery & Charging Performance: Consistent full overnight operation with reliable solar charging across spring and summer seasons

Lighting Quality Feedback: Positive occupant and site manager ratings for light level, distribution and visual comfort

REAL Performance



Next Steps

Complete REAL install at last remaining location – West Sacramento

Continue **data collection** across all sites through end of grant period

Analyze full dataset to estimate statewide impact: energy savings, GHG reduction and resilience potential

Q&A