

Designers Lighting Forum

Decarbonization in Lighting - the Hotspots

Speakers

Leela Shanker,	Founder, Life Cycle Assessment Incubator, GreenLight Alliance and Sustainability Director, Design Lab, WAP
James Salazar,	Life Cycle Assessment Expert Analyst, Athena Sustainable Materials Institute and WAP Sustainability
William Paddock,	Co-Founder and Managing Director WAP Sustainability

Tuesday March 20



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Learning Objectives

At the end of this course, participants will be able to:

1. Outline current status of metrics and approaches to measuring the carbon footprint of luminaires and lighting strategies
2. Outline relative carbon impact of 5 key architectural luminaires
3. Understand practical issues in using life cycle assessment data to set decarbonization targets for lighting
4. Compare decarbonization initiatives progressing in other construction disciplines internationally



Abstract:

In New York City, 2024 marks the introduction of financial penalties under Local Law 97 for exceeding building CO2 emission limits; providing legislative and commercial imperatives for carbon footprint measurement. How does lighting contribute to achieving decarbonization goals of governments and corporate entities under legislation and “Net Zero” challenges set by construction partners in other disciplines, such as Architecture 2030 and MEP2040? This session presents the first results of the Life Cycle Assessment Incubator of the GreenLight Alliance and IALD, an industry-led pilot to develop a consistent framework for measuring embodied and operational carbon of five key architectural luminaires.



OVERVIEW

Part I	Current Commercial Context	[15 min]
Part II	Lighting Metrics	[10 min]
Part III	Industry EPD results	[15 min]
Part IV	Future Directions	[5 min]
Part V	Q&A	[15 min]



James bio pic

James Salazar
LCA Analyst,
Athena and WAP Sustainability

Leela bio pic

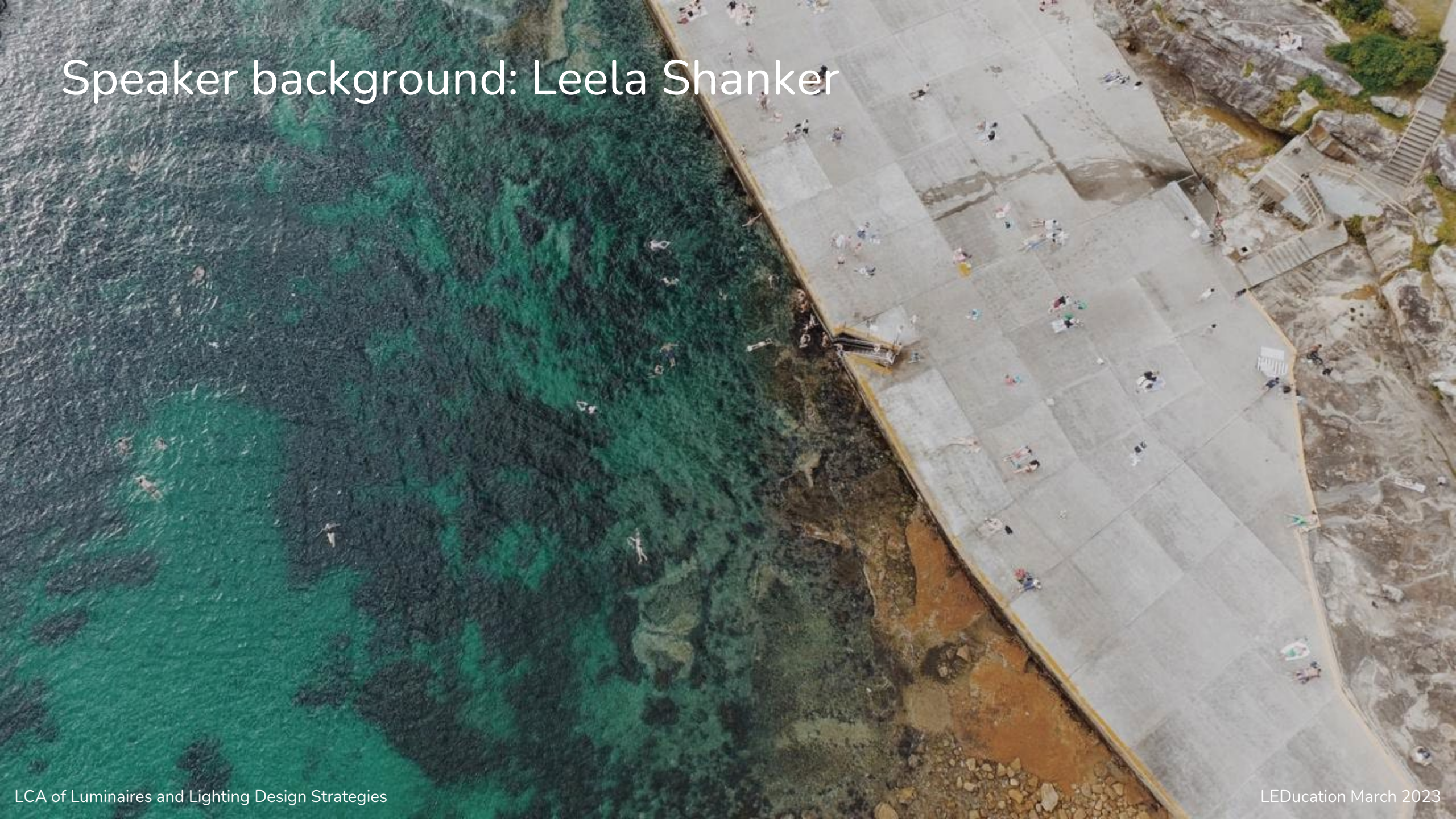
Leela Shanker
Founder, LCA Incubator,
GreenLight Alliance and
Design Lab, WAP Sustainability

Will bio pic

William Paddock,
Co-Founder and Managing Director
WAP Sustainability



Speaker background: Leela Shanker



Speaker background: James Salazar

[update image]

Speaker background: William Paddock

[update image]



Part I Current Context

Part II Lighting Metrics

Part III Industry EPD results

Part IV Future Directions

Part V Q&A

SECTION CONTENT OVERVIEW

Legislation

- Federal, State, Local Decarbonization legislation developments
- New York 2024 introduction of Local Law 97 financial penalties
- types of buildings/ owners

Industry Moves

- Other disciplines - New York industry association developments - AIA Committee on the Environment and Decarbonization Subcommittee, Carbon Leadership Forum NY Chapter

Commercial

- Corporate Net Zero protocols - LendLease introduced 2023 Scope 3 Emissions protocol and are reviewing procurement policies





<https://ukgbc.org/news/scaling-climate-change-mitigation-where-do-net-zero-buildings-fit-in/>





OFFICE OF THE FEDERAL CHIEF SUSTAINABILITY OFFICER
COUNCIL ON ENVIRONMENTAL QUALITY



Net-Zero Emissions Buildings by 2045, including a 50% reduction by 2032

Why focus on reducing emissions from buildings?

In the United States, residential and commercial buildings represent [35 percent of carbon dioxide emissions](#). Commercial and government buildings [cost \\$190 billion](#) to power each year. With eighty percent of all existing U.S. buildings expected to remain in service in 2050, electrifying existing buildings is essential to achieving President Biden's climate goals.

<https://www.sustainability.gov/buyclean/>



leducation.org

NOTE:

Leela and Will compare California
with Massachusetts and NYSERDA /
NY STATE developments



<https://www.dgs.ca.gov/PD/Resources/Page-Content/Procurement-Division-Resources-List-Folder/Buy-Clean-California-Act>





§ 28-320.6 Penalties. An owner of a covered building who has submitted a report pursuant to section 28-320.3.7 which indicates that such building has exceeded its annual building emissions limit shall be liable for a civil penalty of not more than an amount equal to the difference between the building emissions limit for such year and the reported building emissions for such year, multiplied by \$268.

https://www.nyc.gov/assets/buildings/local_laws/l197of2019.pdf



Financial Penalty
= xkgCO2 x \$268



Will to add operational carbon footprint owner
example data

§ 28-320.6 Penalties. An owner of a covered building who has submitted a report pursuant to section 28-320.3.7 which indicates that such building has exceeded its annual building emissions limit shall be liable for a civil penalty of not more than an amount equal to the difference between the building emissions limit for such year and the reported building emissions for such year, multiplied by \$268.

https://www.nyc.gov/assets/buildings/local_laws/ll97of2019.pdf





<https://www.lendlease.com/us/sustainability/climate-and-environment/>



What does this mean for lighting?

- **Procurement impact**
 - federal gvt and corporate targets creating demand
 - Lighting designers with defined sustainability performance criteria
- **Penalty avoidance**
 - role in avoiding building owner penalties (compare lighting industry EPDs in section 3 x \$286)



Part I

Current Context

Part II

Lighting Metrics

Part III

Industry EPD results

Part IV

Future Directions

Part V

Q&A

Performance Criteria

Quantitative thresholds 2024: Examples from MEP firms inhouse lighting teams

- Sustainability Performance Criteria:
 - consider for all new projects (Atelier 10, New York and London projects)
- Sustainability Performance Criteria:
 - top 3 luminaire types by budget covered by EPDs and preference for products with EPD reporting (Borealis Lighting Studio, Arvest workspace project)
- Lighting Key Performance Indicators:
 - 30% of all fixture schedule types covered by Environmental Reporting (Burro Happold in house target)



PROJECT
CASE STUDY:
ARVEST

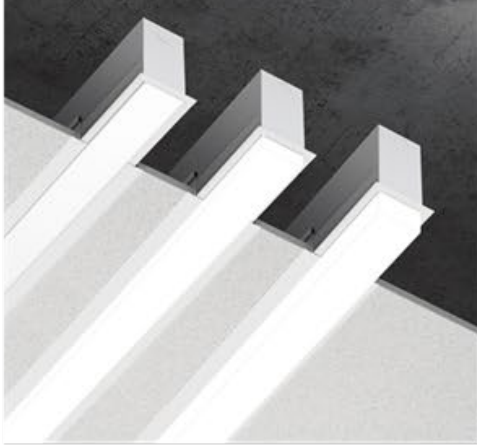


100% Architectural Performance Luminaires and
48% of decorative luminaires covered by
suppliers with EPDs

PROJECT CASE STUDY: ARVEST

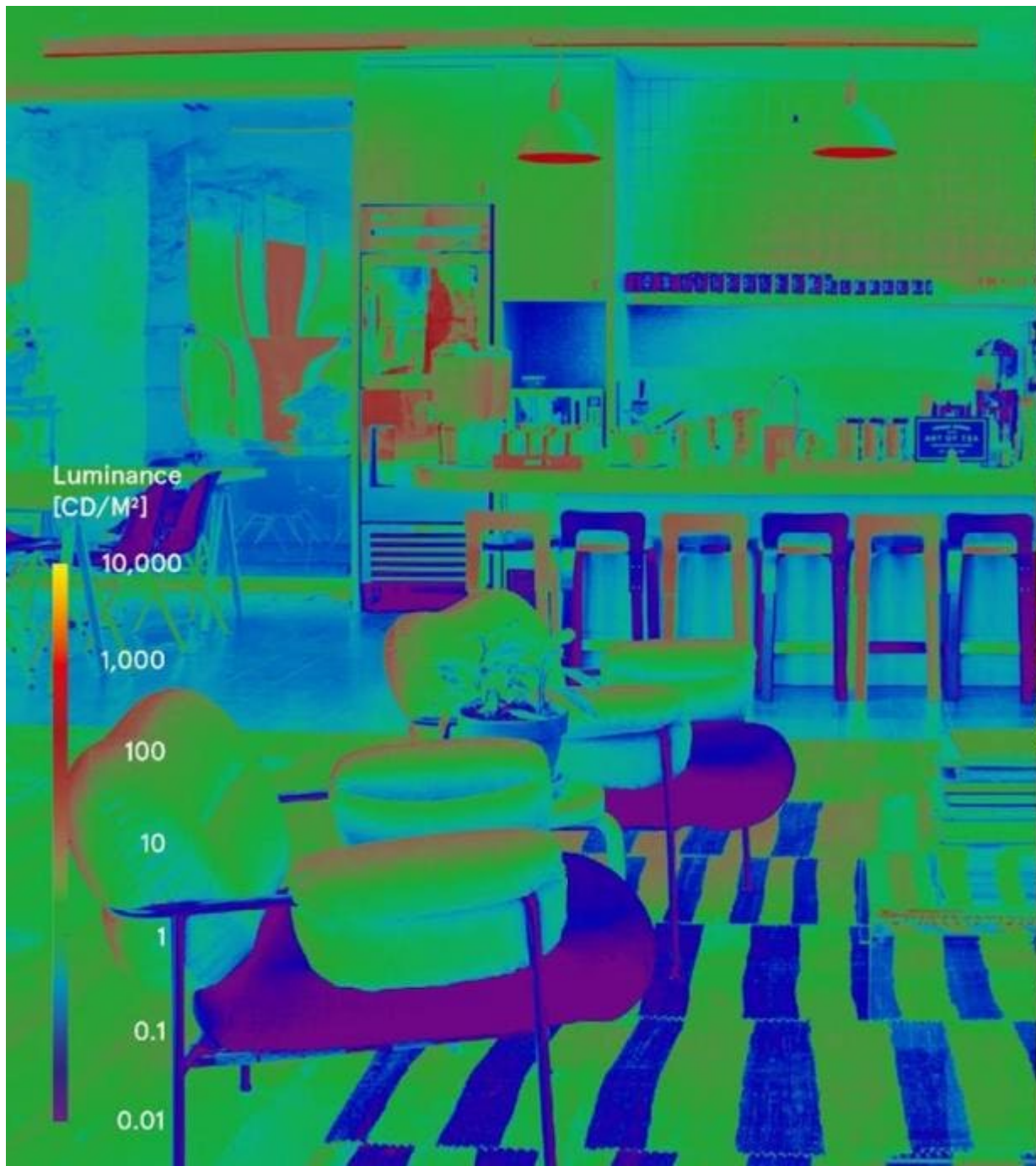


Considering new material palettes



Wallwasher (left)
Mycomaterial
marbled texture
from mycelium
strain (below)





Performance Criteria

Quantitative thresholds 2024: Examples from lighting design firms

- Circular economy targets:
 - TM66 ratings - example of Nulty setting 2 star rating
- Embodied Carbon targets
 - TM65 : Lighting framework clarified
 - free tool results compared to EPD results



Lumens per watt
(Minimum Efficiency
Performance levels)
120lm/W

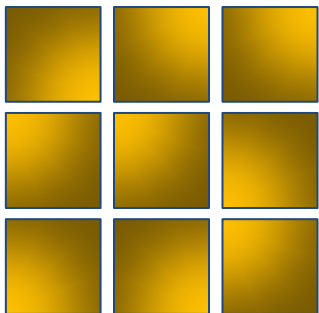


<https://assets.publishing.service.gov.uk/media/63d3c39c8fa8f51881c99e6c/new-ecodesign-requirements-for-lighting-products.pdf>



Carbon Intensity

Carbon Intensity
(CO₂/ m² or sf)



UK Net Zero Carbon Buildings Standard



UK Net Zero Carbon Building Standard Embodied Carbon Performance Levels

Next Steps

Embodied Carbon performance levels

Please do complete the technical testing **consultation** giving feedback on the embodied carbon performance levels.

If you feel that the performance levels shown are too high/low due to your experience, we would encourage you to share the data from your own projects (see below).

Embodied carbon further data

The NZCBS is also currently actively seeking further Embodied Carbon data, particularly:

- for the **Retail, Data Centre, Hotels, and Sports and Leisure** sectors
- for projects with high-quality data for **Modules A-C**.
- where the assessment has been completed for **all elements**, not only structure.

Higher education, Healthcare, and Science and Technology sectors were also relatively low in data and more would be welcomed.

This data should be uploaded to the **BECD** at <https://beta.becd.co.uk>.

Refit data

If you have **embodied carbon refit data** from UK-based projects in either the **Office, Retail** or **Hotel** sectors, please get in touch by emailing TG1b@NZCbuildings.co.uk.

6. Embodied Carbon Performance Levels

580
kgCO₂e/m² GIA
A1-A5 mean carbon
footprint across all
sectors

499
Total number of projects
used to determine new-
build performance
levels

56%
Proportion of A1-A5
emissions due to
structure

“
A huge thank you to all those companies that have submitted embodied carbon data to develop our understanding of embodied carbon emissions in the UK.
”

*Will Arnold,
Chair of Embodied Carbon Task Group*

36



Lighting Application data gap

New Build Data Overview and Quality



6. Embodied Carbon Performance Levels

Sector	Offices	Homes*	Commercial residential	Logistics & warehouses	Healthcare	Schools	Higher education	Culture & entertainment	Science & technology	Retail	Data centres	Sports & leisure	Hotels	
Number of projects	72	238*	78	20	10	94	10	33	16	1	1	3	0	
Mean GIA of projects (m ²)	105,000	5,900*	186,000	159,000	500	2,900	12,300	900	48,000	N/A	N/A	N/A	N/A	
Quality of upfront embodied carbon data (A1-A5)	Substructure (1)	Good	Good, but not split by element	Good	Good	Good	Good	Good, but not split by element	Good, but not split by element	Good	N/A	N/A	N/A	N/A
	Superstructure (2.1-2.4)	Good		Good	Good	Good	Good			Good	N/A	N/A	N/A	N/A
	Facade (2.5-2.6)	Good		Good	Good	ND	Good	ND	ND	ND	N/A	N/A	N/A	N/A
	Cat A fitout (2.7-3)	Good		Good	Good	ND	ND	ND	ND	ND	N/A	N/A	N/A	N/A
	FF&E (4)	Good		Good	Good	ND	ND	ND	ND	ND	N/A	N/A	N/A	N/A
MEP (5)	Good		Good	Good	ND	Only 2 projects	ND	ND	ND	N/A	N/A	N/A	N/A	
Quality of in-use embodied carbon data (B1-C4)	Poor quality	Poor quality	Good	Good	ND	Poor quality	ND	ND	ND	N/A	N/A	N/A	N/A	

ND = no data. For A1-A5 elements, this was then backfilled with average figures (facade taken from Offices sector, all other elements from the Commercial Residential sector)

*note: 31 projects were Future Homes Hub submissions, analysing single-family homes. This sub-sector will be considered separately when setting limits.

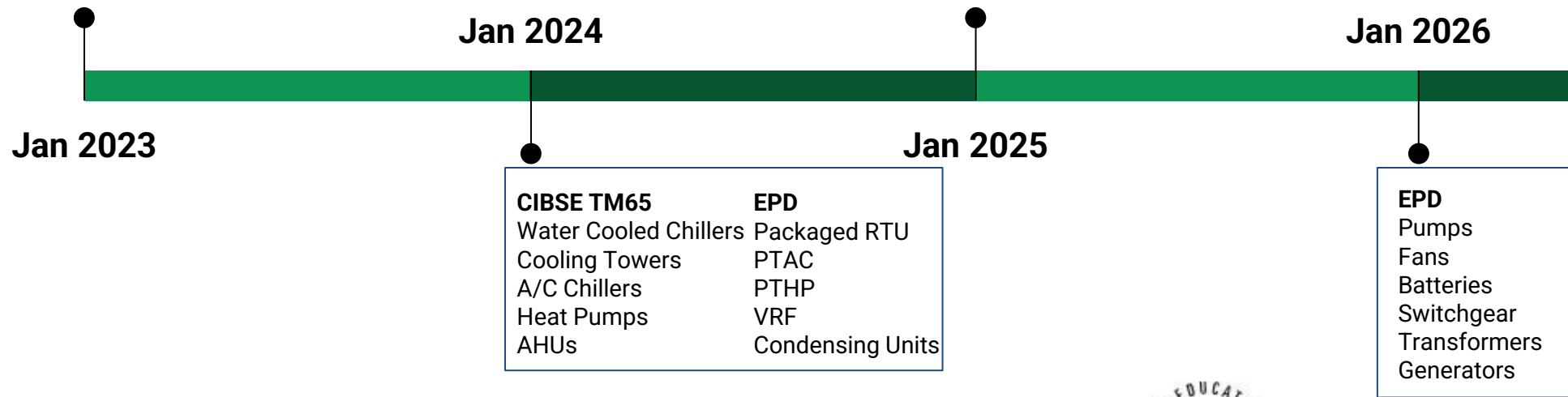


Lighting Application targets to be specified



CIBSE TM65
Packaged RTU
PTAC
PTHP
VRF
Condensing Units

CIBSE TM65	EPD
Pumps	Water Cooled
Fans	Chillers
Batteries	Cooling Towers
Switchgear	A/C Chillers
Transformers	Heat Pumps
Generators	AHUs



CIBSE TM65	EPD
Water Cooled Chillers	Packaged RTU
Cooling Towers	PTAC
A/C Chillers	PTHP
Heat Pumps	VRF
AHUs	Condensing Units

EPD
Pumps
Fans
Batteries
Switchgear
Transformers
Generators

https://docs.google.com/presentation/d/13TvigB8R5Kp0SiaSVnABTZmHqjZSoB9po81sezdSe0/edit#slide=id.g115c7076a48_0_122



Upfront v Lifetime impact

OPERATIONAL v EMBODIED IMPACT

Figure 27. Materials selection and implementation affects the carbon footprint of a building over its life cycle



Building Materials, Embodied and Operational Carbon
Projected Impact of Embodied Carbon relative to Operational Carbon 2020-2050

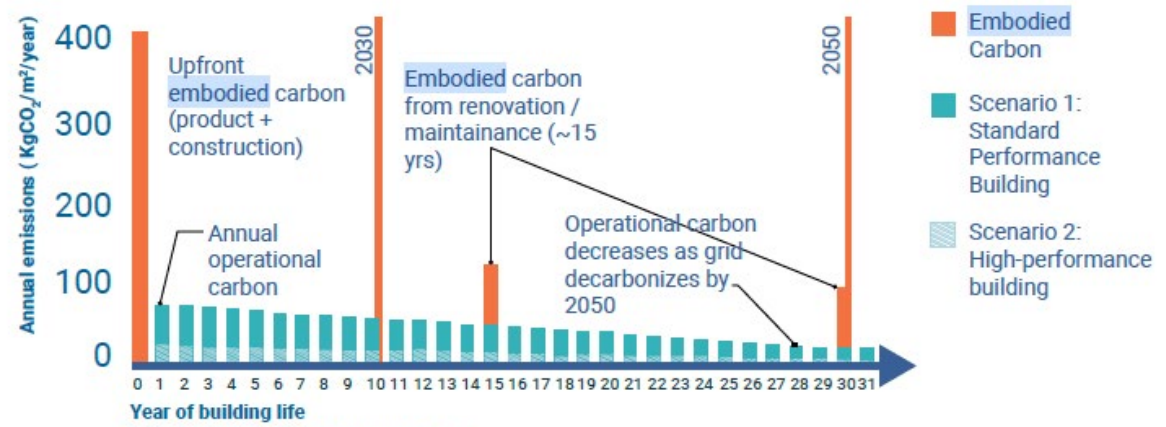


Fig : Adapted from Carbon Leadership Forum
Sources: Embodied Carbon Benchmark Study and CBECS

Source: Adapted by authors from Carbon Leadership Forum (2022) and data from Embodied Carbon Benchmark Study and Commercial Buildings Energy Consumption Survey (CBECS 2022).



Part I Current Context

Part II Lighting Metrics

Part III Industry EPD
results

Part IV Future
Directions

Part V Q&A

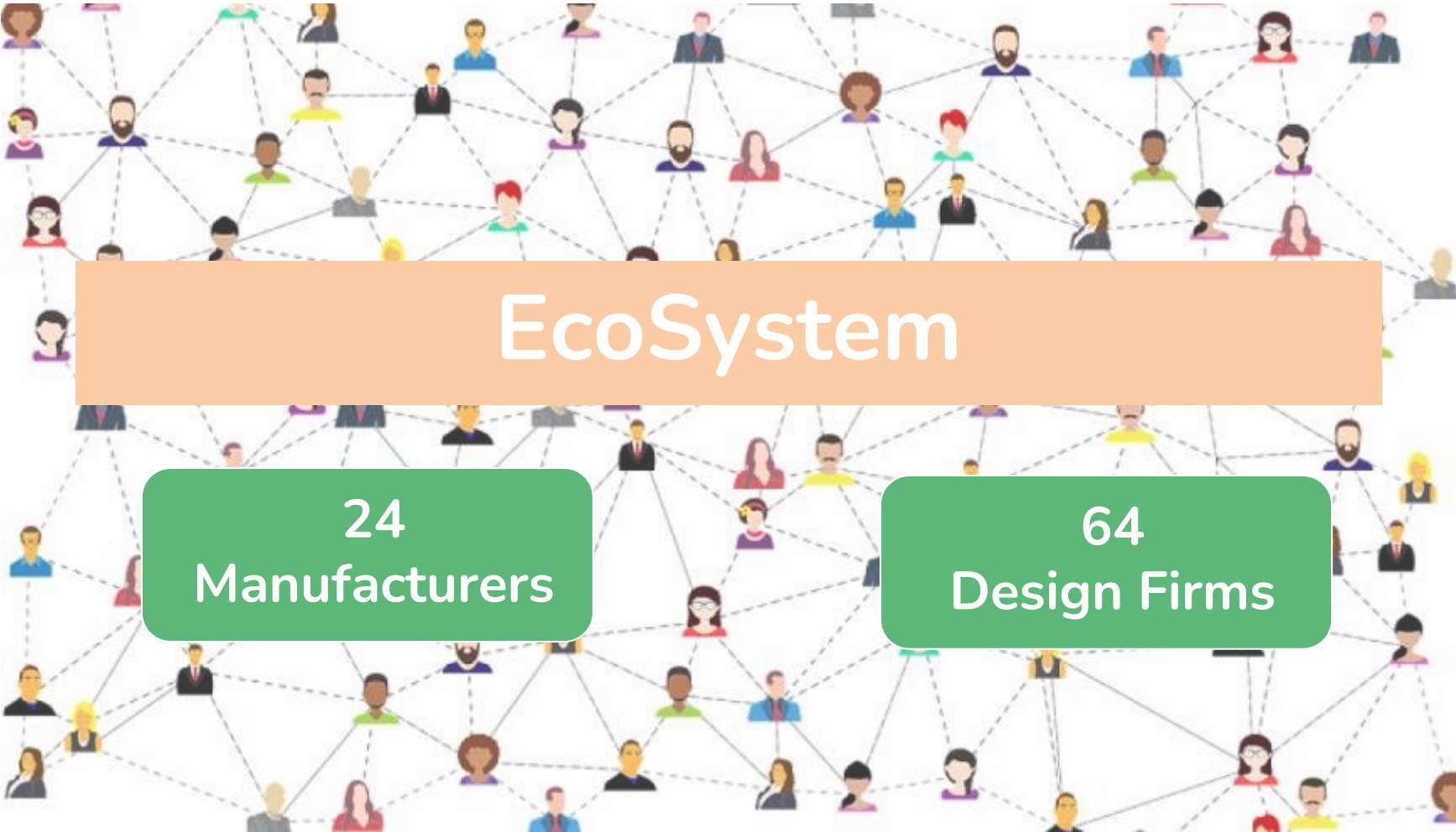
SECTION OVERVIEW

- 5 product categories
- GWP
- assumptions
- hotspots
- areas of interpretation
- further research



LCA Incubator

Industry Progress



LCA Incubator

Industry Progress



LCA Incubator






Industry Progress



LCA Incubator

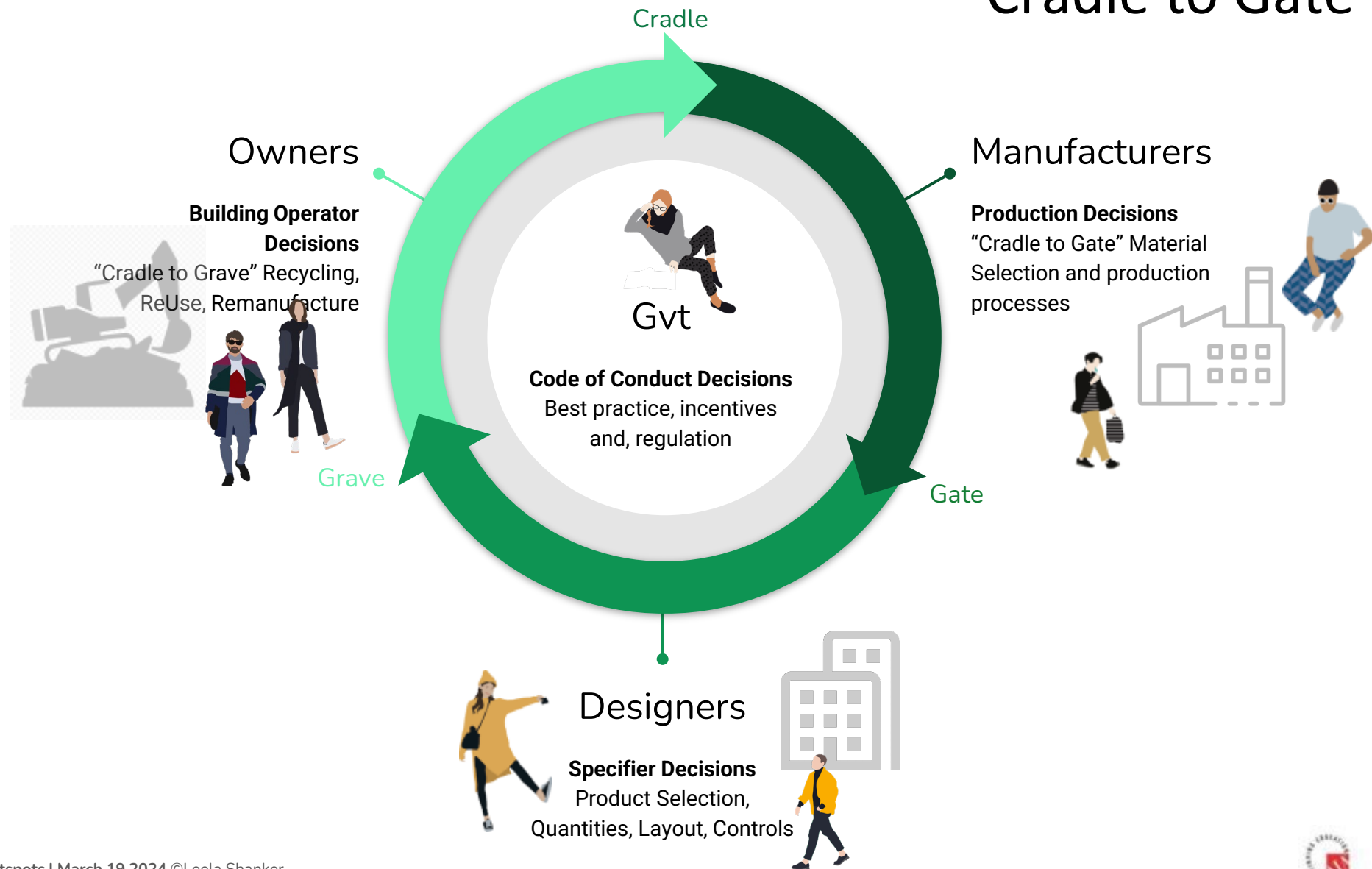
Global Representation



PERFORMANCE CRITERIA	PRODUCT				
	Downlight	Cylinder	Linear	Troffer	Post Top
					
Mounting	Recessed	Pendant	Pendant	Recessed	Pole-mounted
Key dimensions (diameter, length and/ or width)	3" / 100mm ø	3" / 100mm ø	4' / 1200mm L 2" or 4" / 50mm or 100mm W	2' x 2' / 600mm x 600mm	12' / 3.5m pole
Optics	60°	60°	90° direct batwing indirect	diffuse ambient	Type II, full cut off
Lumens	1500 LM	1500 LM	D: 375 LM per foot I: 700 LM per foot	3500 LM	2500+ LM'
CCT	3000K	3000K	3000K	3000K	3000K
CRI	90	90	90	90	80
Accessories	None	None	None	None	Glare Control TBA



Life Cycle Impact Cradle to Gate v Grave



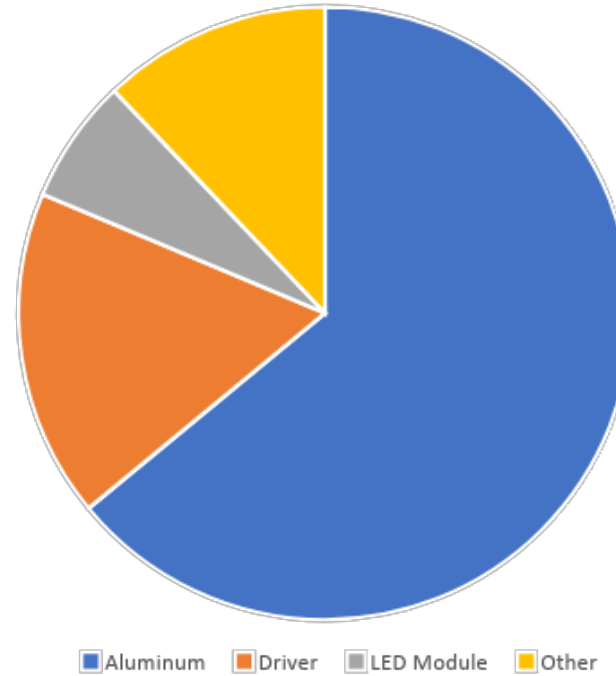
[add Cradle to Gate v
Cradle to Grave analysis]

PRODUCT
Linear

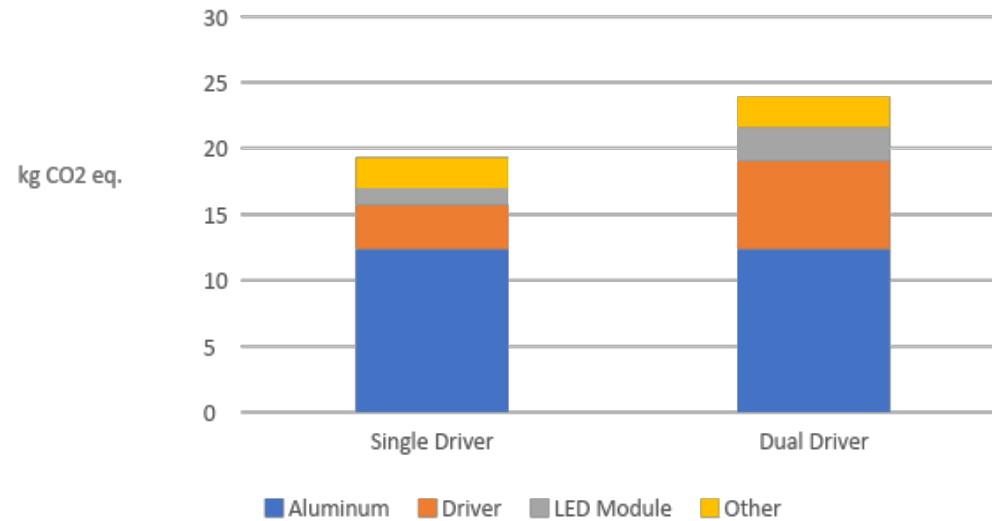
Pendant
4' / 1200mm L 2" or 4" / 50mm or 100mm W 90° direct batwing indirect
D: 375 LM per foot I: 700 LM per foot 3000K
90
None



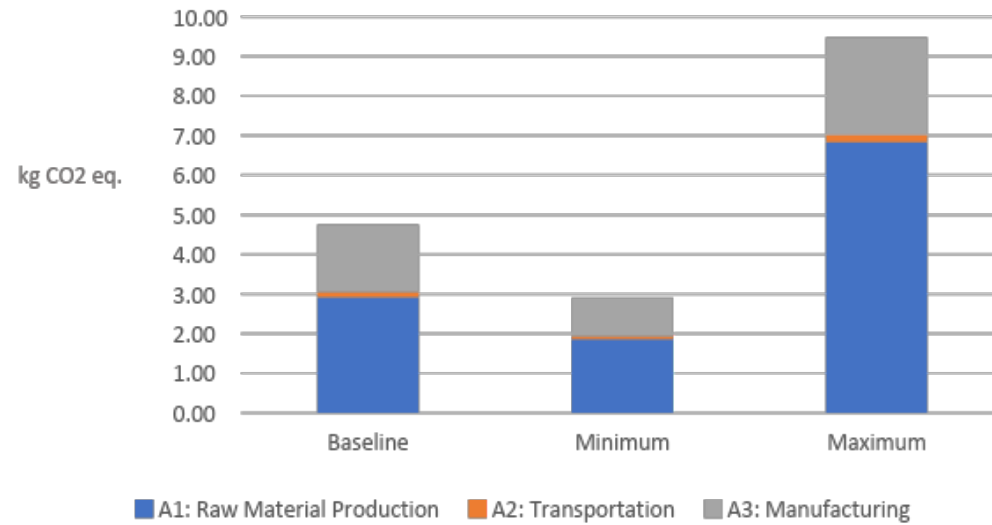
Linear Baseline Declared Unit - Contribution to GWP

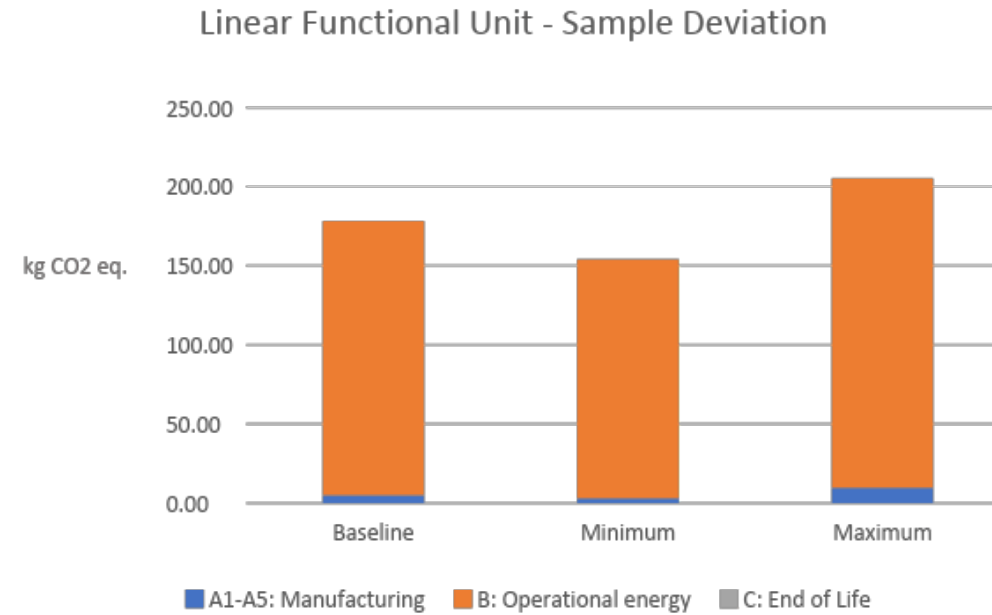


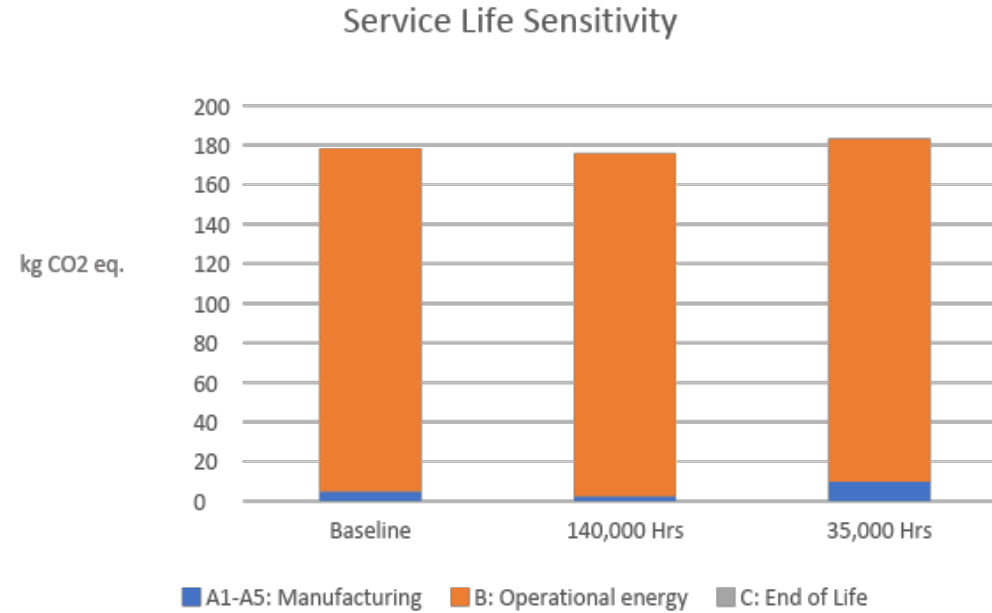
Linear Declared Unit - Single vs. Dual Driver/LED

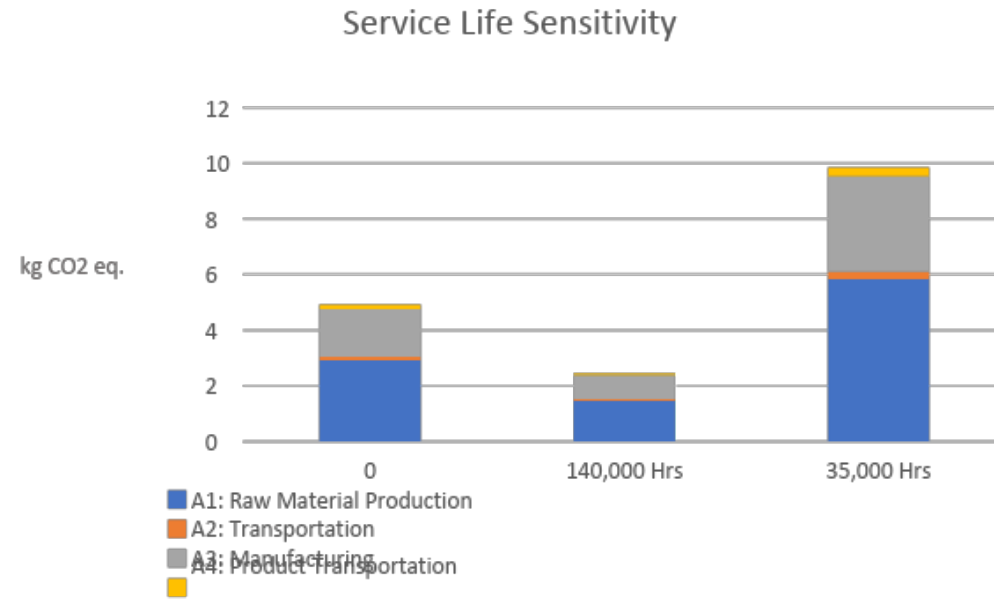


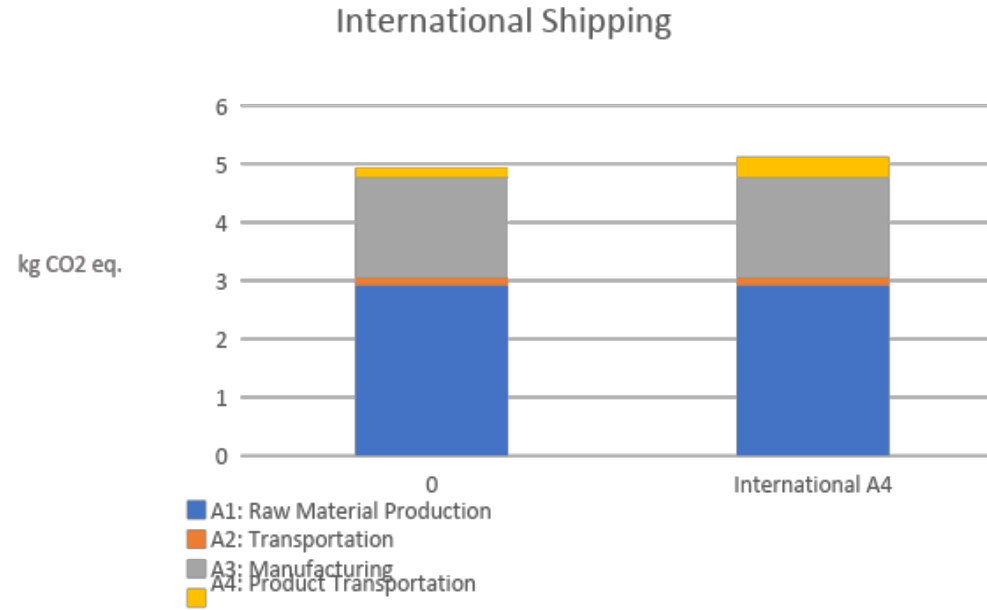
Linear Declared Unit - Sample Deviation

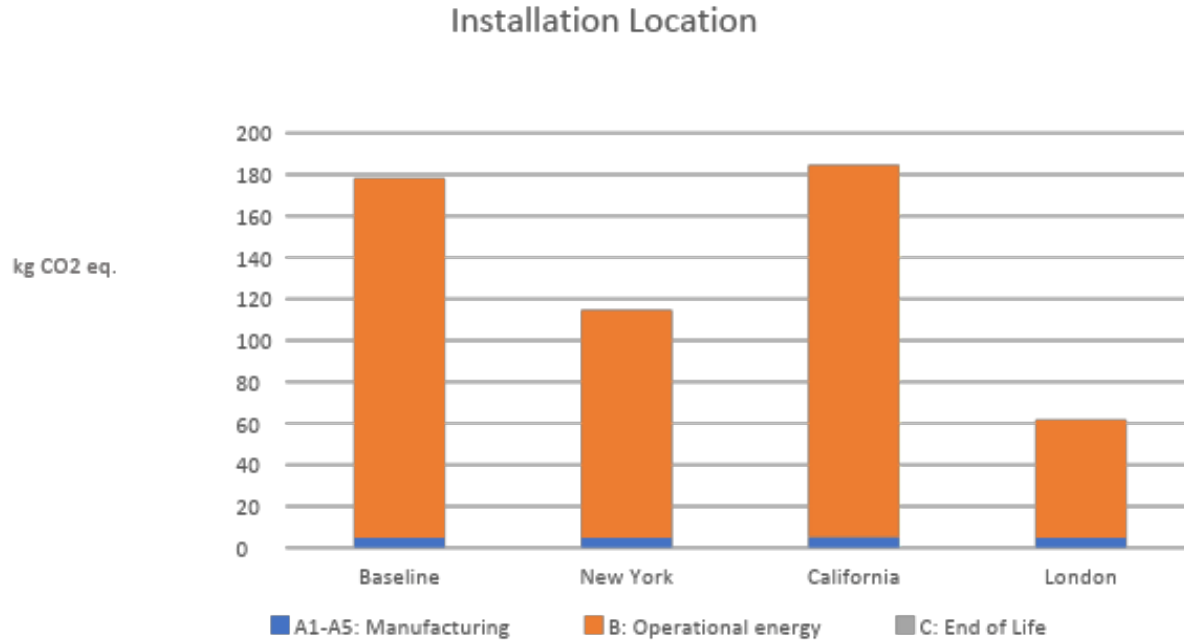


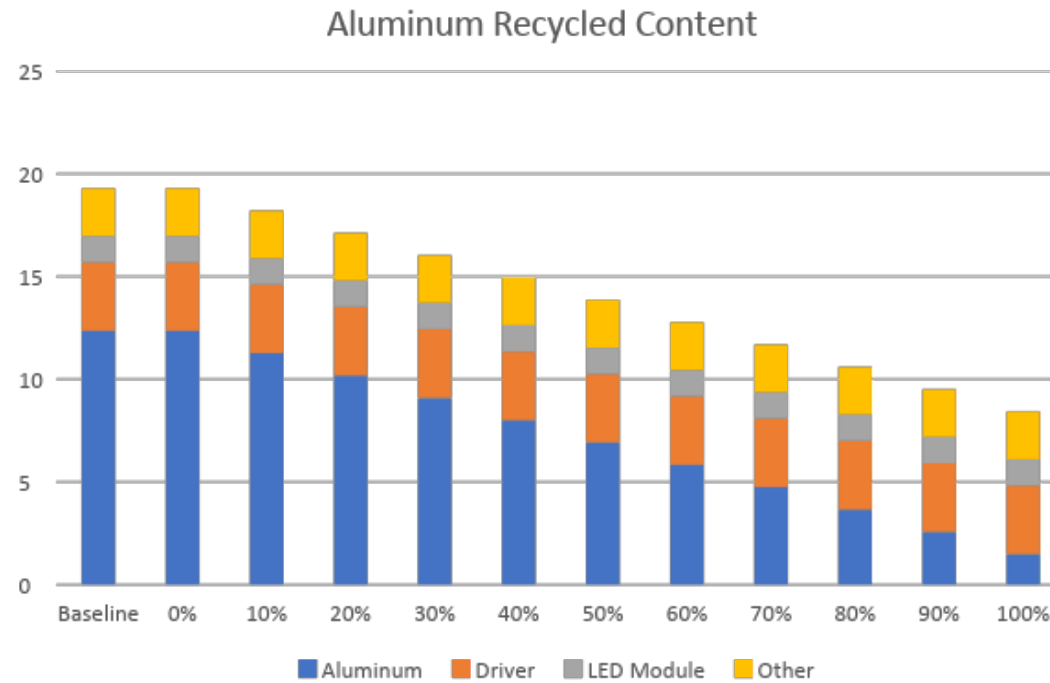


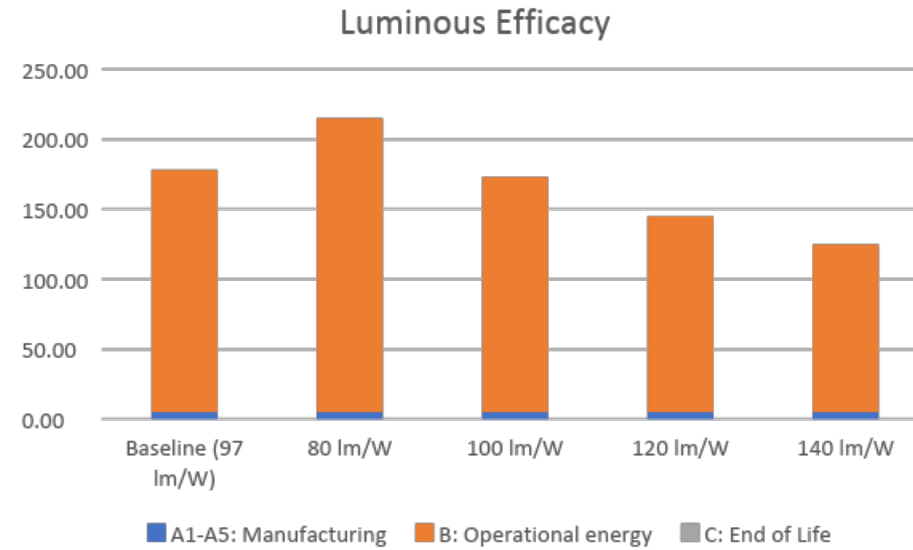




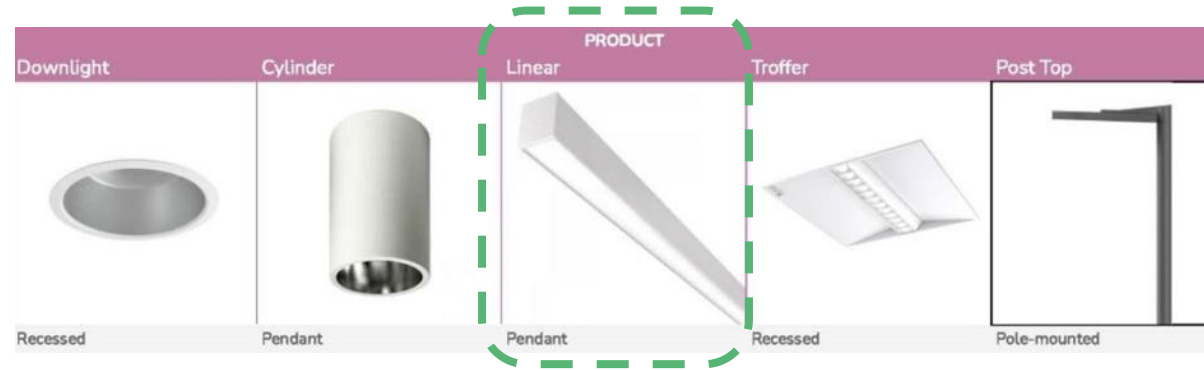








Key Findings: Linear



Assumptions:

Impact:

- Highest impact material: xxxxxx xxxxxxxxxxxx
- Highest impact manufacturing process:
- Highest impact production phase:
- GWP

Notes:

Further Study:

Assumptions

- Installation - what is included?
- Drivers - dual or single circuit?
- Use phase presentation?
- Lifetime capped at 70,000?
- Manufacturer reporting
- Grids - Global average? US Average, London, LA, NYC, Paris, Copenhagen, Shanghai / Taiwan, Dubai, Venezuela, Capetown, Melbourne,
- Normalised functional unit and product specific



PEP ecopassport® program

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Agreement for using PEP PSR in standardization

P.E.P. Association fully supports the transposition of the PSR rules developed by Association PEP into standards at national, European and international level.

For this reason, Association PEP wishes to clarify that the use of the PEP ecopassport® program PSRs for transposition into standards at national, European, and international level is not subject to approval by the PEP General Secretariat. Nevertheless, in case of use, PEP has to be informed to have an overview of the standard development at national, european or international level.

Consequently, all PSRs produced by the PEP ecopassport® program will be made available after publication to all interested formal SDOs (such as IEC, ISO, CEN, CENELEC and their national equivalents) as input for their EPD standardization efforts (including possible reference as a Publicly Available Specification (PAS)).

[List of PSR available](#)






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contacts | links | legal | site map

E.g. Lighting
PSR 14 for
Luminaires and
TM65 LA for
local addenda



5 Key Luminaire Categories

	PRODUCT				
	Downlight	Cylinder	Linear	Troffer	Post Top
					
	Recessed	Pendant	Pendant	Recessed	Pole-mounted
weight (kg)	1.2	1.8	2.8	4	15
GWP (kgCO2)	0.2	0.4	1	2	2
Hotspot	Driver LED	Driver LED	Driver LED Aluminum housing	Driver LED Aluminum housing	Driver LED Aluminum housing



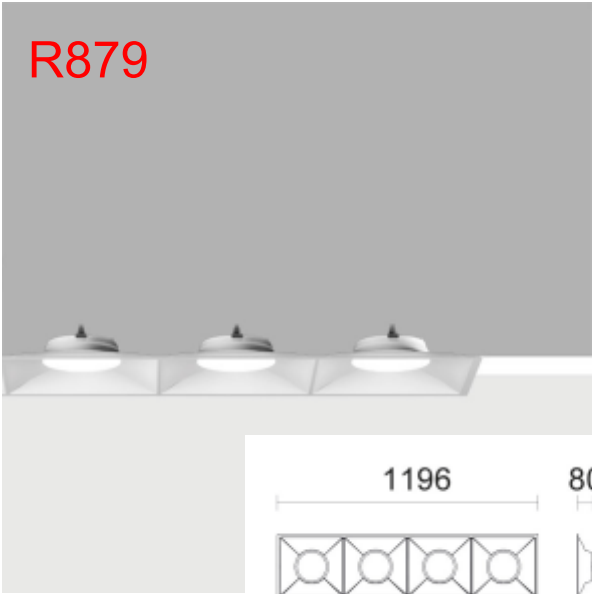
GreenLight Alliance



GreenLight Alliance

Homogenous Families

● James and Alana: Can we use the same industry average EPD for 2", 3" and 4" profile products?



USE PHASE SCENARIOS

Energy Grids

James and Alana to show relative impact based on grid mix



Underlying assumptions:

- Transport
- 3500 hours Annual operating hours
- Maintenance of drivers and LEDs

● LA, NYC, London, Paris, Dubai, Shanghai, Copenhagen



Next Steps:

01 Clarification of Assumptions

As a result of discussion

05 Phase 2 contributors

Cost and contact for people wanting to add their data to the industry average

02 Additional Industry EPDs Other Categories

LED tape, ++? - Cost

03 Product Specific EPDs

Proposed model - Cost and number

04 Industry Organisations

IES, IALD, CIBSE, Lighting Europe, MEP2040

05 Roundtables

™-65vEPD, ROI, Designer Layouts, Preferred Supplier Lists

Part I Current Context

Part II Lighting Metrics

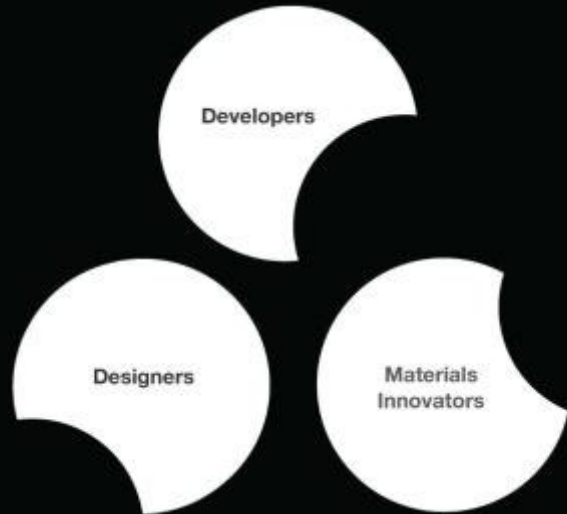
Part III
results Industry EPD

Part IV Future
Directions

Part V Q&A

1. MARKET DISCONNECT

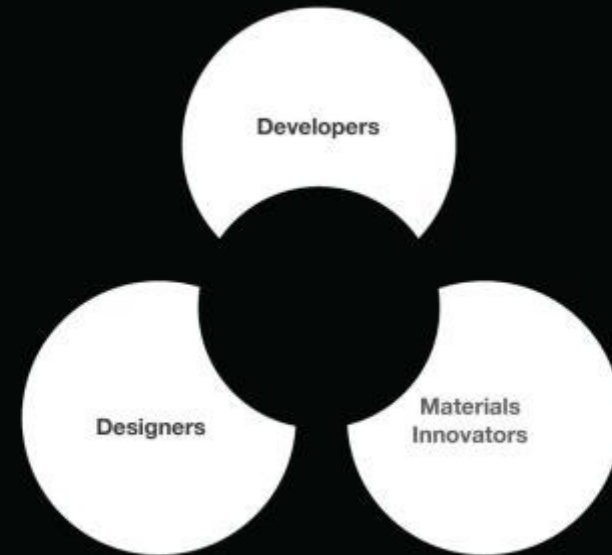
Pioneering designers, owners and product innovators ready to evolve legacy construction practices cannot find each other to collaborate on projects that accelerate adoption of sustainable design practices. Manufacturers have expressed their need to find designers and projects to cover their proposed significant reporting costs to pursue EPDs on all products. Developers such as Lendlease have requested preferred supplier lists and specifications drafting to protect procurement policies and achieve their net zero goals. Designers have sought templates to save time on sustainable product specifications and the need to find clients who support time and effort spent on innovation.



OPPORTUNITY:

Design applications grow the ecosystem and demand for its services

Connecting strategic partners from design, product manufacturing and property grows the ecosystem of early adopter sustainability champions across all sectors. Creating collaborative opportunities to test new strategies and materials moves construction into the next phase of development following measurement: optimization.



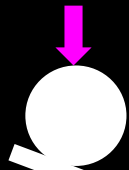
2. MARKET IMBALANCE

In the absence of legislative requirement for material transparency and life cycle assessment reporting, demand for LCA work is driven by the corporate sector. Individual firms committed to the creation of data (manufacturers) and application of data (designers) are responsible for incentive-based market demand, despite the lack of ambitious targets set by industry associations or green building frameworks.

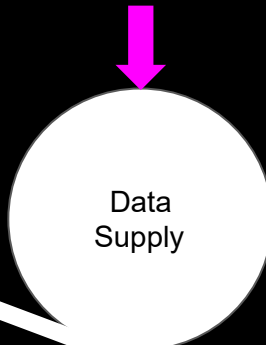
Demand for data (including analytics, reports, standards for measurement and industry mapping) continues to grow as manufacturer awareness has increased, even for complex interior products such as lighting and MEP items.

While supply of data is growing, without designer education to increase literacy in this new sustainability language, their ability to specify responsible products with material impact disclosure or adopt new reporting frameworks will be limited.

Designer Demand



Manufacturer Demand



OPPORTUNITY:

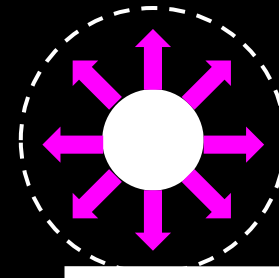
*Designer demand for data drives
Manufacturer supply*

By engaging the design sector, the source of demand for “feedstock” data from suppliers can increase.

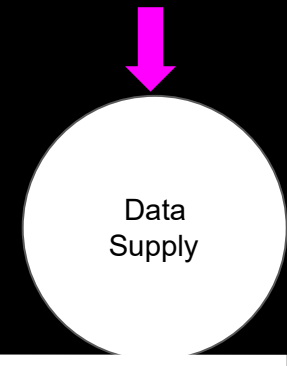
Designers have requested educational resources, preferred supplier lists, and opportunities to apply new strategies and materials on projects. By serving designers and consultant engineers, manufacturers can support owner and architect clients who have projects pursuing LEED certification.

Design firm - manufacturer partnerships will accelerate uptake of existing reports and test applied strategies utilising this data.

Grow Designer Demand



Manufacturer Demand



3. MARKET RESISTANCE

Misinformation and delay tactics by incumbent players is preventing the market from gaining critical mass with respect to standards setting and reporting. As a result, even willing, early adopters may be delaying engaging in life cycle assessment despite the economies of scale accessible through larger “package deals” with multiple firms committed upfront.

“Sustainability” as a design tool



“Sustainability” as a compliance burden

OPPORTUNITY:

Positioning sustainability as a design tool drives demand by reframing as innovation opportunity

Reframing sustainability work as a business design tool rather than a compliance exercise offers a more positive lens through which to approach this new scope of work.

Business development benefit:

Positioning this scope of work as synonymous with design leadership and critical enquiry reinforces the value of investment a company (manufacturer or design) gains from the investment.

Inhouse culture and team building

benefit: Elevating design and innovation validates resonates with in-house experts who want to grow and challenge the status quo.

Practical implications

- Industry EPDs on projects (number of credits)
- Case studies e.g. Arvest 100% arch performance and 48% decorative

Industry Code

Industry Partners

DESIGN PARTNERSHIPS - bringing it to life!!!



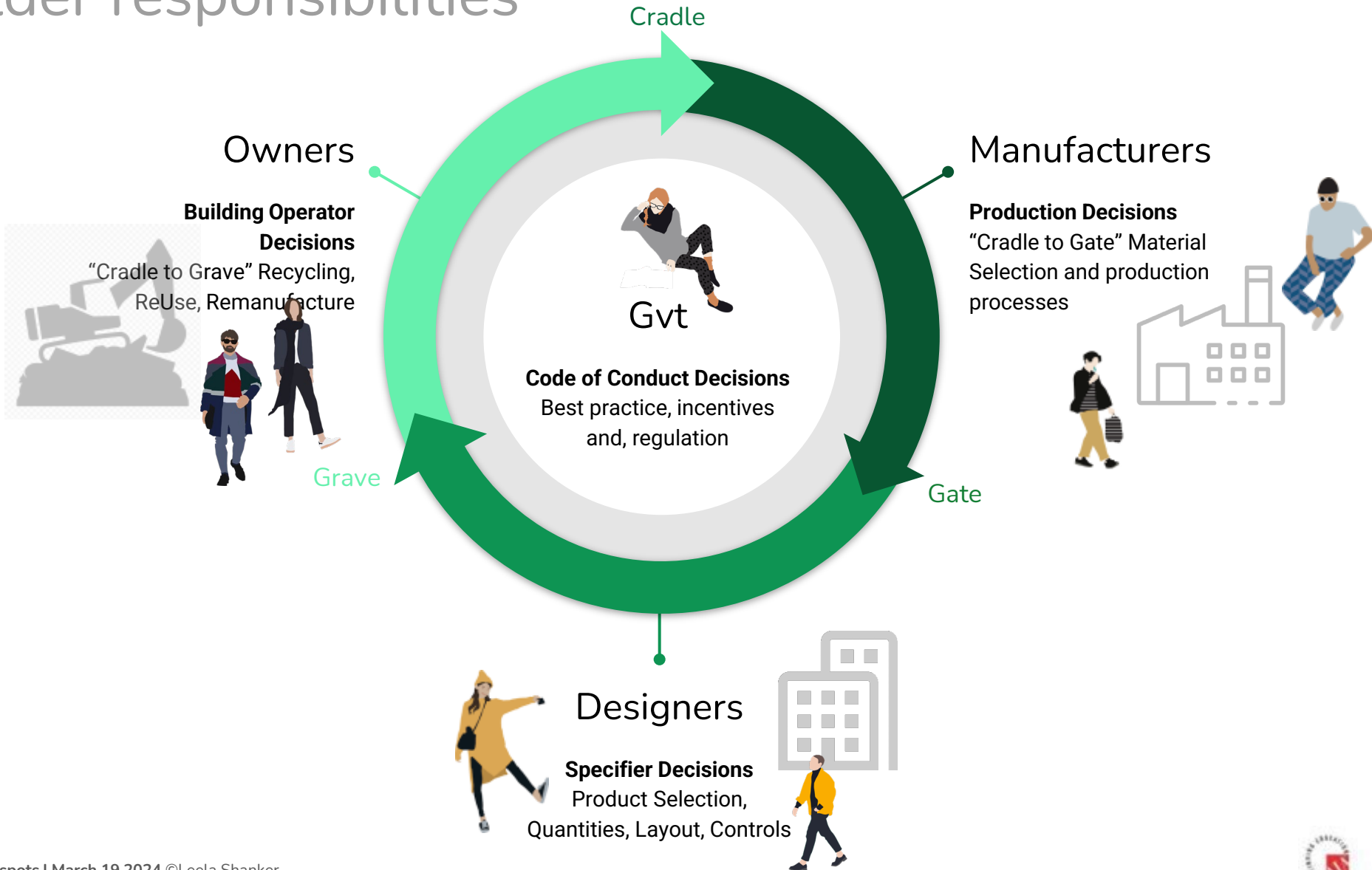
Conclusions:

- 01 LEED credits
Can include variation of 10%?
- 02 Cradle to Gate v Cradle to Grave

xxxxx
- 03 ROI
Proposed model
- 04 TBC
IES, IALD, CIBSE, Lighting Europe

Life Cycle Impact

Stakeholder responsibilities



Part I	Current Context
Part II	Lighting Metrics
Part III	Industry EPD results
Part IV	Future Directions
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Contacts

This concludes The American Institute of Architects Continuing
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