

BUILDINGENERGY NYC

Beyond Operational Energy: Demystifying MEP Embodied Carbon

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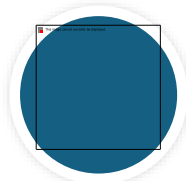
Northeast Sustainable Energy Association (NESEA) | October 15, 2026

Definitions

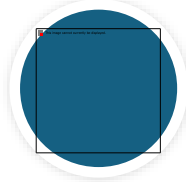
- LCA: Assessment of the environmental impacts associated with the life cycle (or a subset of life cycle stages) of a product or process, in accordance with ISO 14040/44
- Whole Building LCA: evaluates the total environmental impact of an entire building across all life stages, from raw material extraction to final demolition and disposal
- EPD: a product level summary of the output of the LCA in a public facing document, in accordance with ISO 14025: Type III label, third party verified, and internationally recognized.
- Embodied Carbon: Summary of the output of the LCA in a public facing document, in accordance with ISO 14025: Type III label, third party verified, and internationally recognized.

Methodologies for Quantifying Embodied Carbon

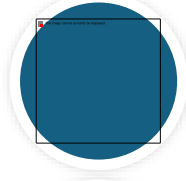
“Lite LCA”: TM65 Methodology



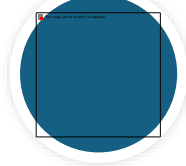
Standardized, high level LCA



Embodied carbon, MEP Products

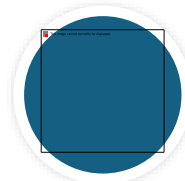


Analyze at any time

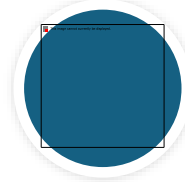


Available now from ASHRAE and CIBSE

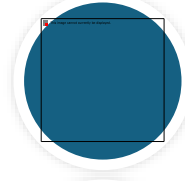
LCA/Environmental Product Declarations



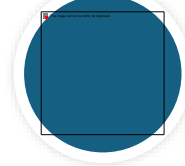
Required third-party verification



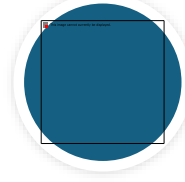
Any building product, full LCA



Must be updated every 5 years



Follows ISO standards



High degree of trust for external reporting

Why do we care?

Wymer Hall – 100,000 ft²
University of Illinois
Urbana-Champaign

MEP 2040 Beginner's Guide to
MEP Embodied Carbon v2



401,265 kg of MEP



27% of the total
day 1 embodied
carbon!!!!

Signatory MEP firms

THANK YOU for being part of this work.

www.mep2040.org



MEP 2040
Committing to Zero

83

Supporting organizations



Download Beginner's Guide
to MEP Embodied Carbon,
V2



Download Whole Life
Carbon Pilot Findings & Gap
Analysis

MEP WHOLE LIFE CARBON PILOT - EMBODIED CARBON (A1-A3) BY CATEGORY

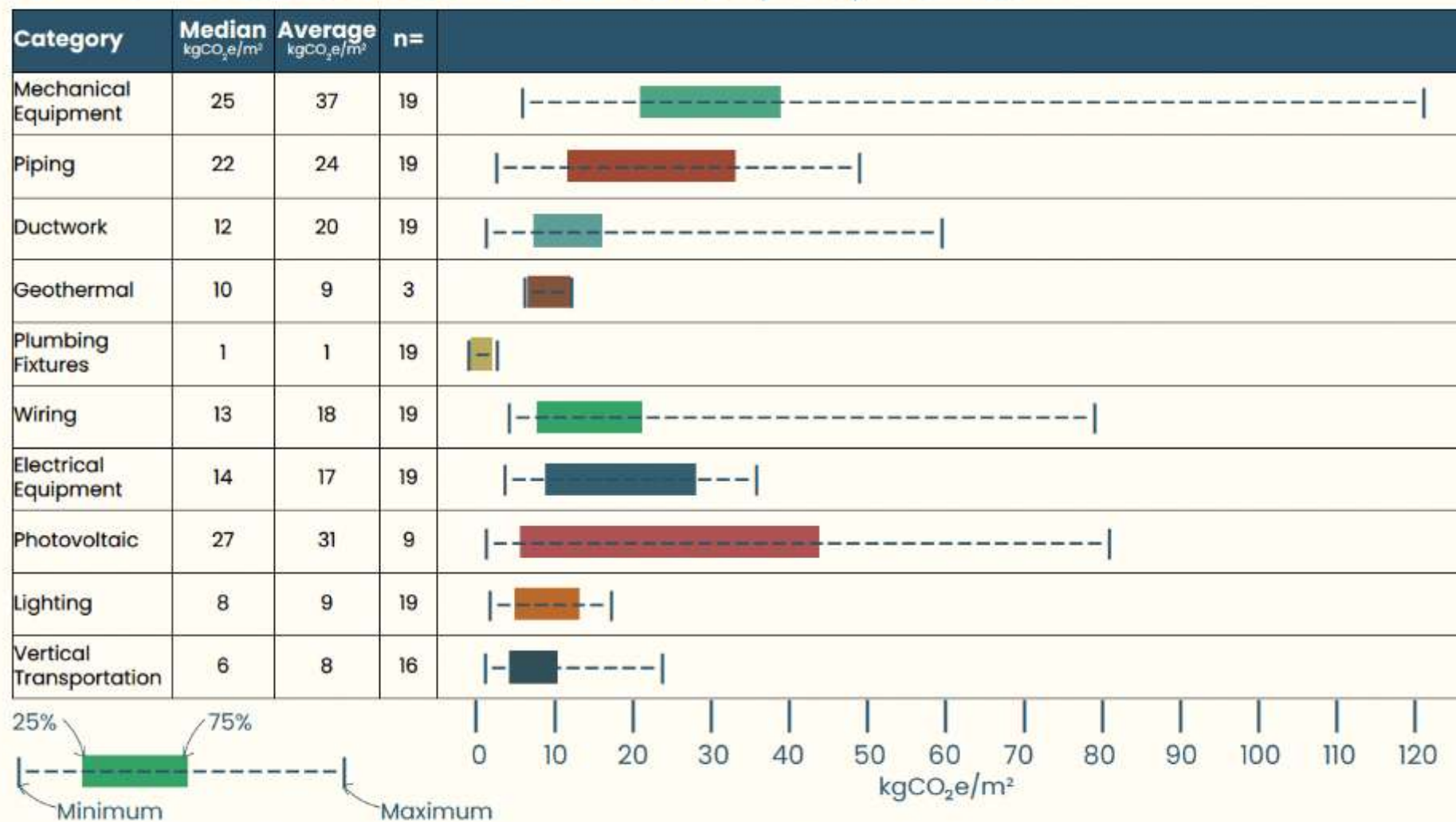


Figure 3. MEP 2040 Whole Life Carbon Pilot Embodied Carbon (A1-A3) by Category. Box and whisker plot showing cradle-to-gate LCA results for each category from the MEP Whole Life Carbon Pilot.

MEP WHOLE LIFE CARBON PILOT - RESULTS BY LCA STAGE

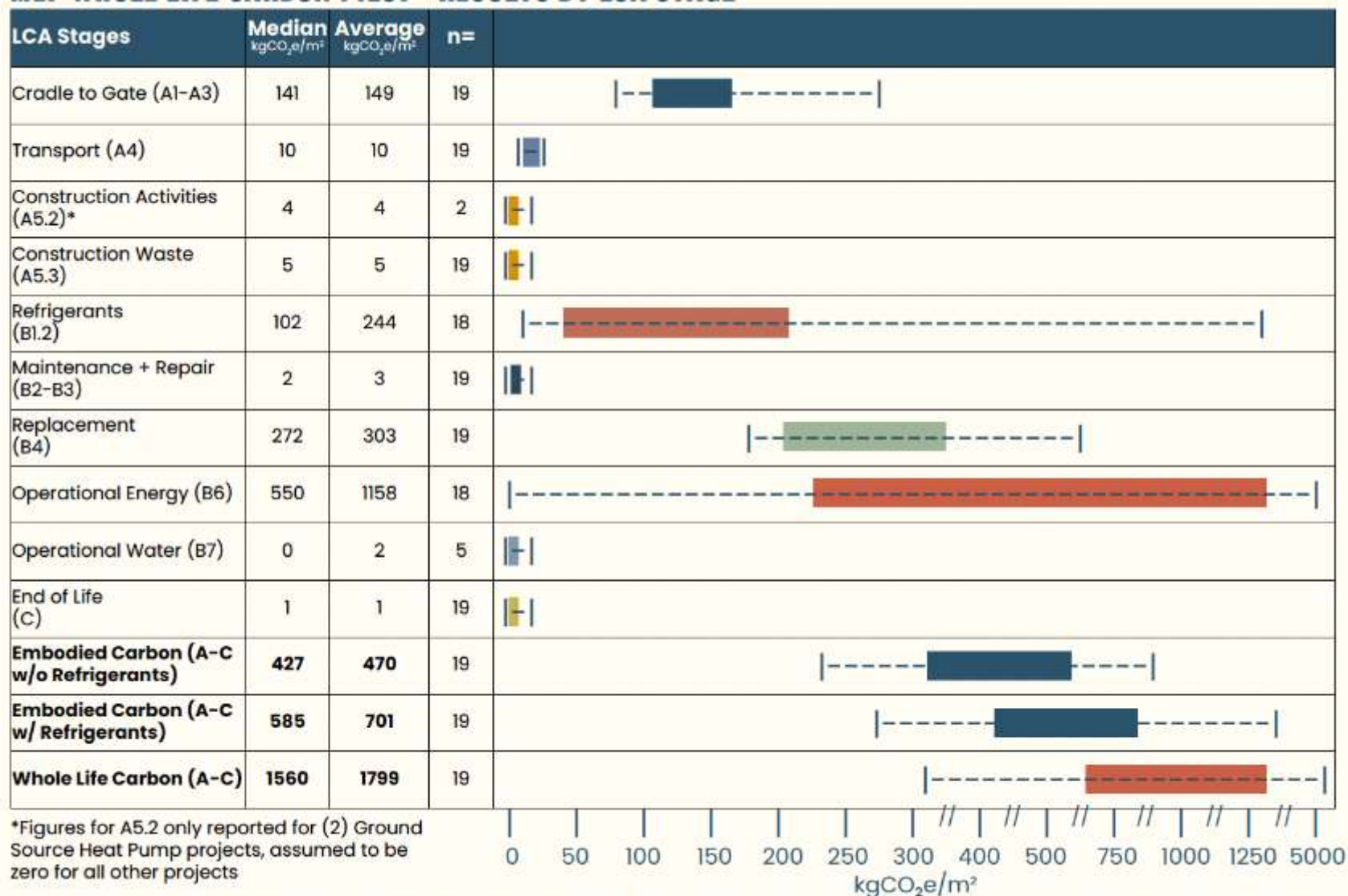
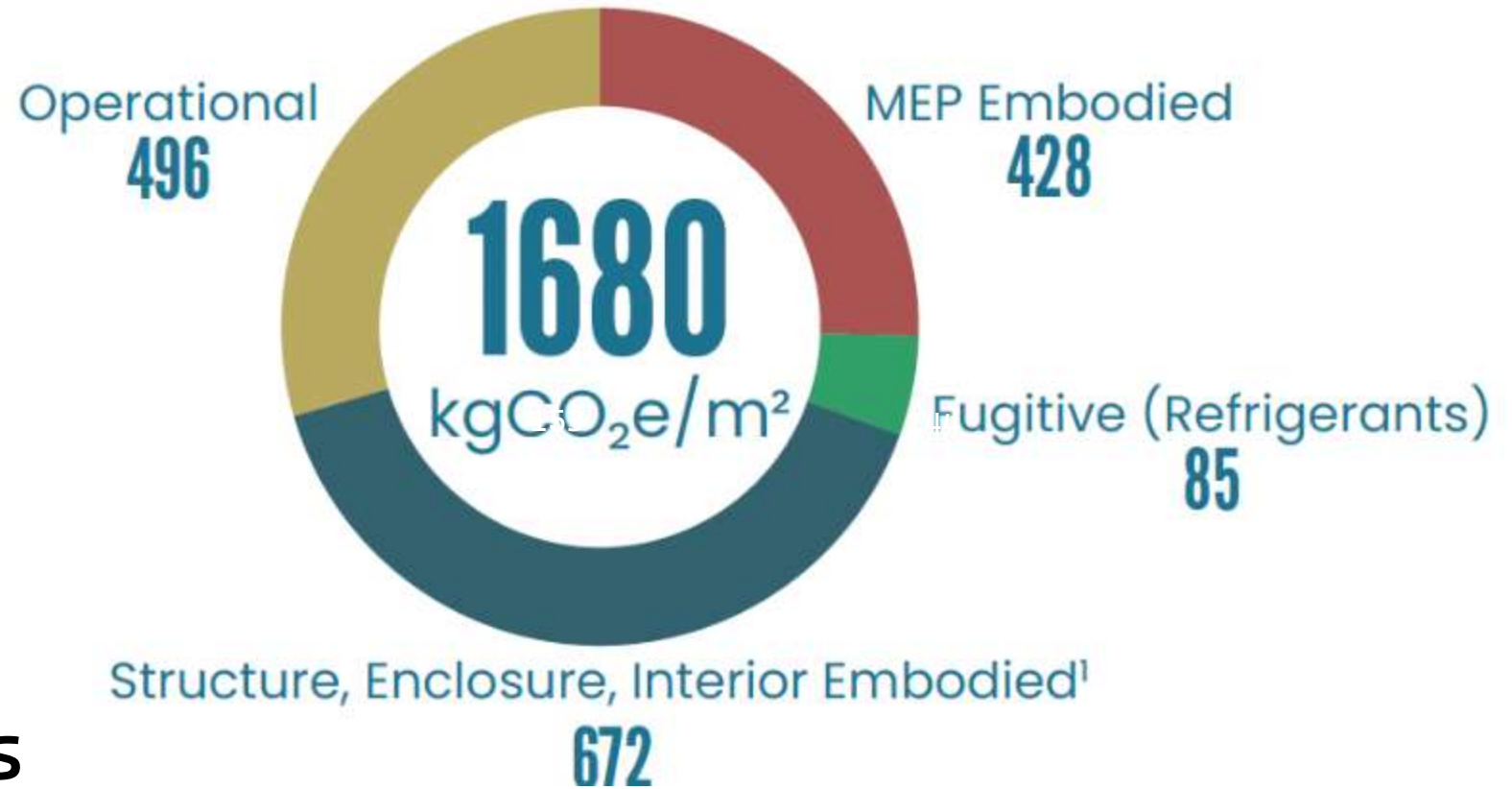


Figure 4. MEP 2040 Whole Life Carbon Pilot - Results by LCA Stage. Box and whisker plot showing stage-by-stage LCA results from the MEP Whole Life Carbon Pilot.

WHOLE BUILDING WHOLE LIFE CARBON (A-C)¹

Pilot Medians by Scope kgCO₂e/m²



19 Projects



Date: [Date]
Re: Request for MEP Equipment Availability with Next-Generation, Low/No GWP Refrigerants

Dear [MEP Equipment Manufacturer Leader],

[MEP2040 Signatory Firm Name Here] is part of the new MEP 2040 Challenge (<http://mep2040.org>) and we are seeking to reduce the refrigerant-based global warming potential (GWP) of our designs. Did you know that typical refrigerants, like R410A, can be up to an average of 75% of the embodied carbon emissions related to HVAC systems? As manufacturers, you hold the key to taking this impact to zero by working toward an equipment solution that uses next-generation, natural refrigerants.

With this in mind, we are asking MEP equipment manufacturers to develop a timeline, work plan, and ultimately product availability that will allow designers to start specifying next-generation refrigerant equipment well before 2024 for chillers and 2025 for the rest of HVAC. This goal is in alignment with the twelve states that have adopted the former EPA SNAP 21 rules and the AIM Act, which provides for a national phasedown of Hydrofluorocarbons in refrigerants by 85 percent—the outcome of which anticipates an avoidance of 0.5 degrees Celsius of global warming by 2100.

Call to Action: Sustainable Refrigerants for MEP Systems

Template for a letter MEP design firms can use to request low-GWP refrigerants in MEP systems.

[DOWNLOAD TEMPLATE](#)



Date: [Date]
Re: Request for Material Weight Data to Support Embodied Carbon Calculations

Dear [Contractor],

[MEP2040 Signatory Firm Name Here] is part of the new MEP 2040 Challenge (<http://mep2040.org>) and is looking for ways to estimate the amount of carbon emissions that are embodied in the materials of the systems and equipment that we design.

MEP 2040 has undertaken the development of a library of mechanical, electrical, and plumbing (MEP) embodied carbon-related data for MEP materials and equipment at the schematic design level. The intent is to evaluate the data before a system is fully designed, but we are able to produce a narrative and some block loads, and turn them over to our contracting partners to develop a rough budget estimate of the cost.

Call for Action: Subcontractor Take-off Data

Template for a letter MEP design firms can use to ask subcontractors to help quantify BOM material lists for common building types, and help populate a database with the information to allow informed design decisions to design for a lower embodied carbon future.

[DOWNLOAD TEMPLATE](#)



Date: [Date]
Re: Request for MEP Equipment Product Transparency

Dear [MEP Equipment Manufacturer Leader],

[MEP2040 Signatory Firm Name Here] is part of the new MEP 2040 Challenge (<http://mep2040.org>) and we are looking for ways to understand the amount of global warming potential of individual products. More commonly, you may have heard this concept referred to as 'embodied carbon'.

Primarily, MEP 2040 is seeking to increase transparency on the global warming potential (GWP) of mechanical, electrical and plumbing (MEP) products. This will allow us to understand, not only the great work that your organization has done on minimizing operational carbon in the built environment, but also what are the key drivers within the industry that influence the development of your products. This data will help us put together the total carbon "picture", taking into account the operational carbon savings for high efficiency equipment and the embodied carbon contribution of the same equipment.

Call to Action: MEP Equipment Product Transparency

Template for a letter that MEP design firms can use in requesting EPDs from manufacturers to promote MEP equipment product transparency.

[DOWNLOAD TEMPLATE](#)



LEED BD+C: New Construction • v5 - LEED v5

Multi-Attribute Mechanical and Electrical and Plumbing Products

Project Priority Credit

MRpc185 | Possible 2 Points

Priority credit type: Pilot credits

[Language](#)[Guide](#)[Addenda](#)[Resources and tips](#)[Forum](#)[↩ All credits](#)

Intent

To support the procurement and installation of Mechanical, Electrical and Plumbing (MEP) products and materials that have sustainability information available and have optimized their products across multiple criteria areas. To reward project teams for selecting products that have environmentally, economically, and socially preferable impacts.

Requirements

This credit builds upon *MRc4: Building Product Selection and Procurement* by including products not eligible in the credit. This credit follows the guidelines and resources available for *MRc4: Building Product Selection and Procurement* with the following additions.

How is embodied carbon data being asked for and addressed?

- Need an EPD or LCA
- Need Data, EPD, LCA, PCF, TM65
- Scope 1, 2, and 3 GHG of suppliers
- SBTi

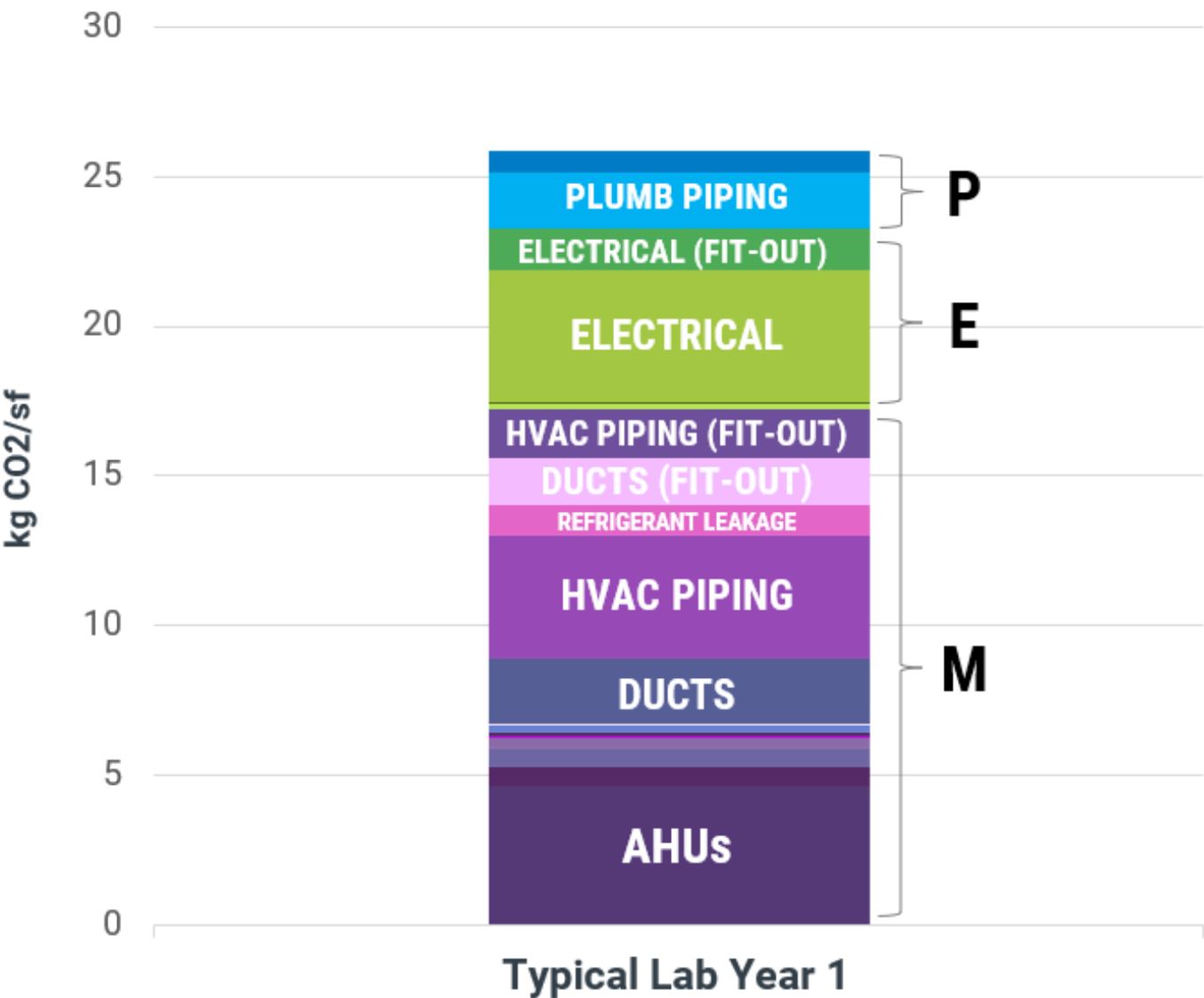
The best I've seen it:

Ask and Give Time

KEY DRIVERS

- Plumbing Piping (Fit-Out)
- Plumbing Piping (Core)
- Fire Pump
- Electrical (Fit-Out)
- Electrical (Core)
- Fuel Oil Tank
- Switchgear
- Mechanical Piping (Fit-Out)
- Ducts (Fit-Out)
- Refrigerant Leakage
- Mechanical Piping (Core)
- Ducts (Core)
- VRF
- Water Cooled Condensing Unit
- VFD
- Heat Exchanger
- Fans
- Diesel Generator
- Pump
- Condensing Boiler
- Centrifugual Chiller
- AHUs

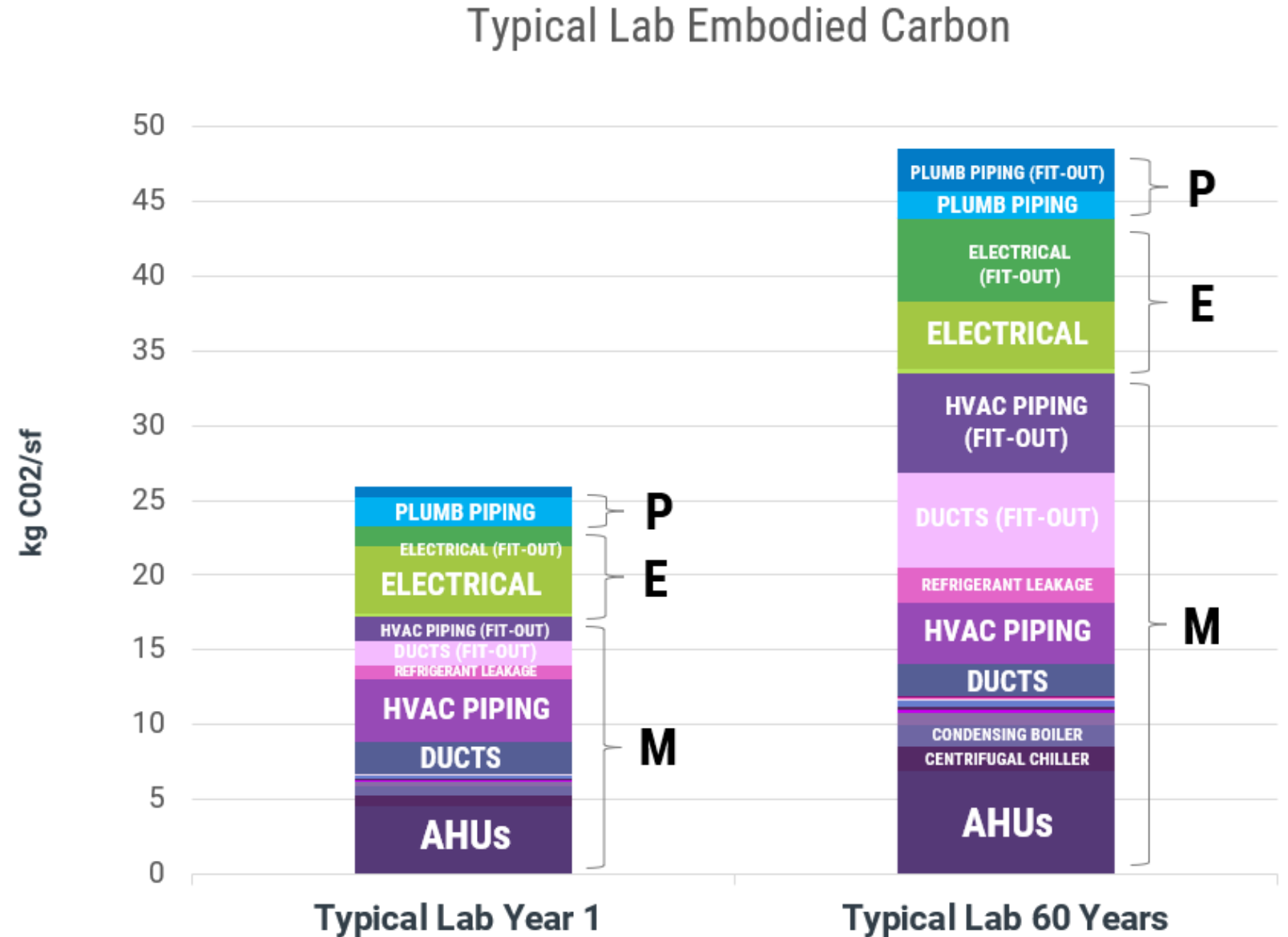
Typical Lab Embodied Carbon



Note: no credit taken for end-of-life recycling of material for MEP systems

YEAR 1 VS. YEAR 60

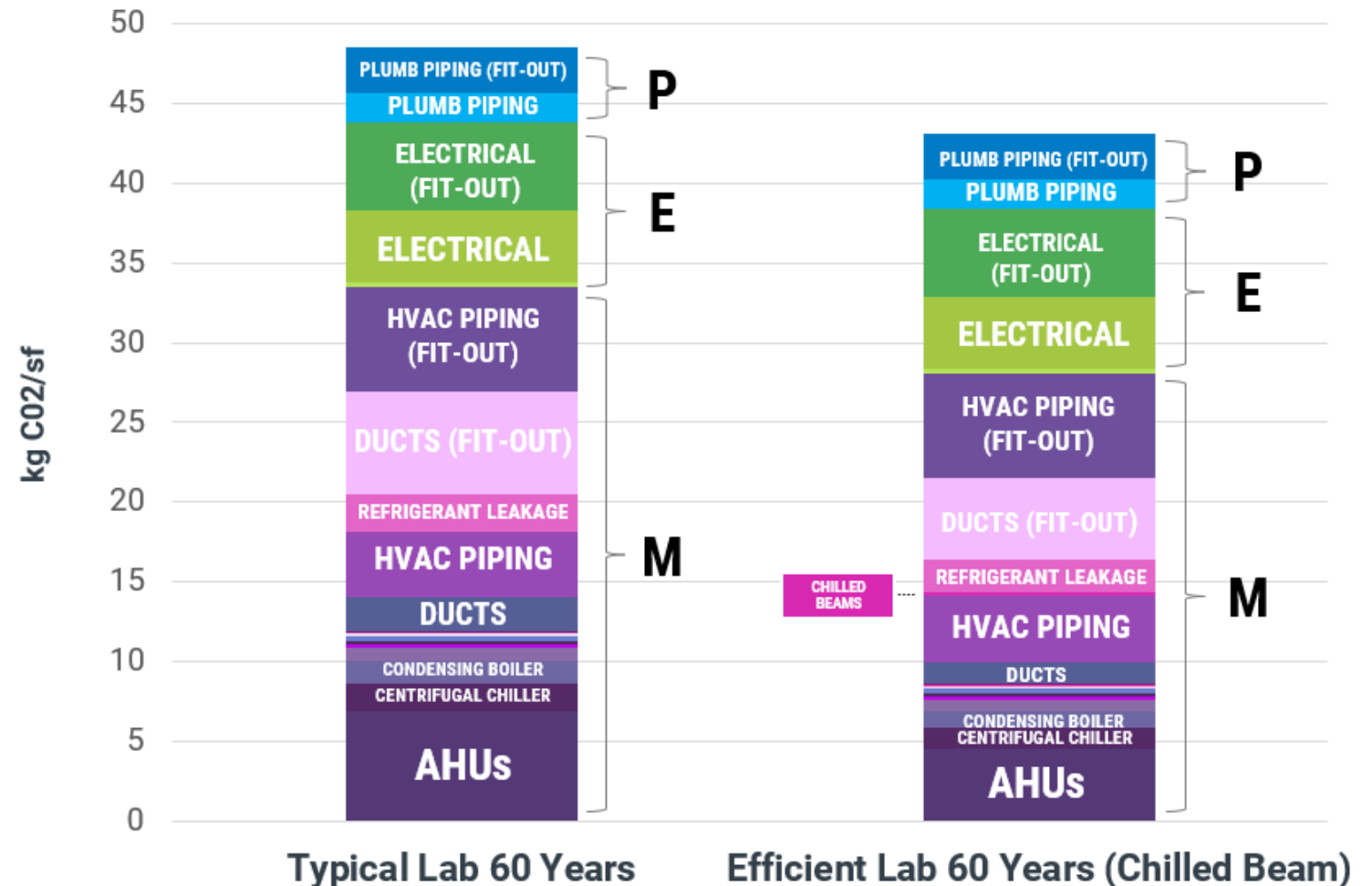
- Equipment replacement is a critical component for MEP



HIGH-PERFORMANCE LAB

- Design choices like chilled beams can lead to reductions
- Reduced embodied carbon in manufacturing is the only path to zero for MEP systems

Typical vs. Efficient Lab Embodied Carbon

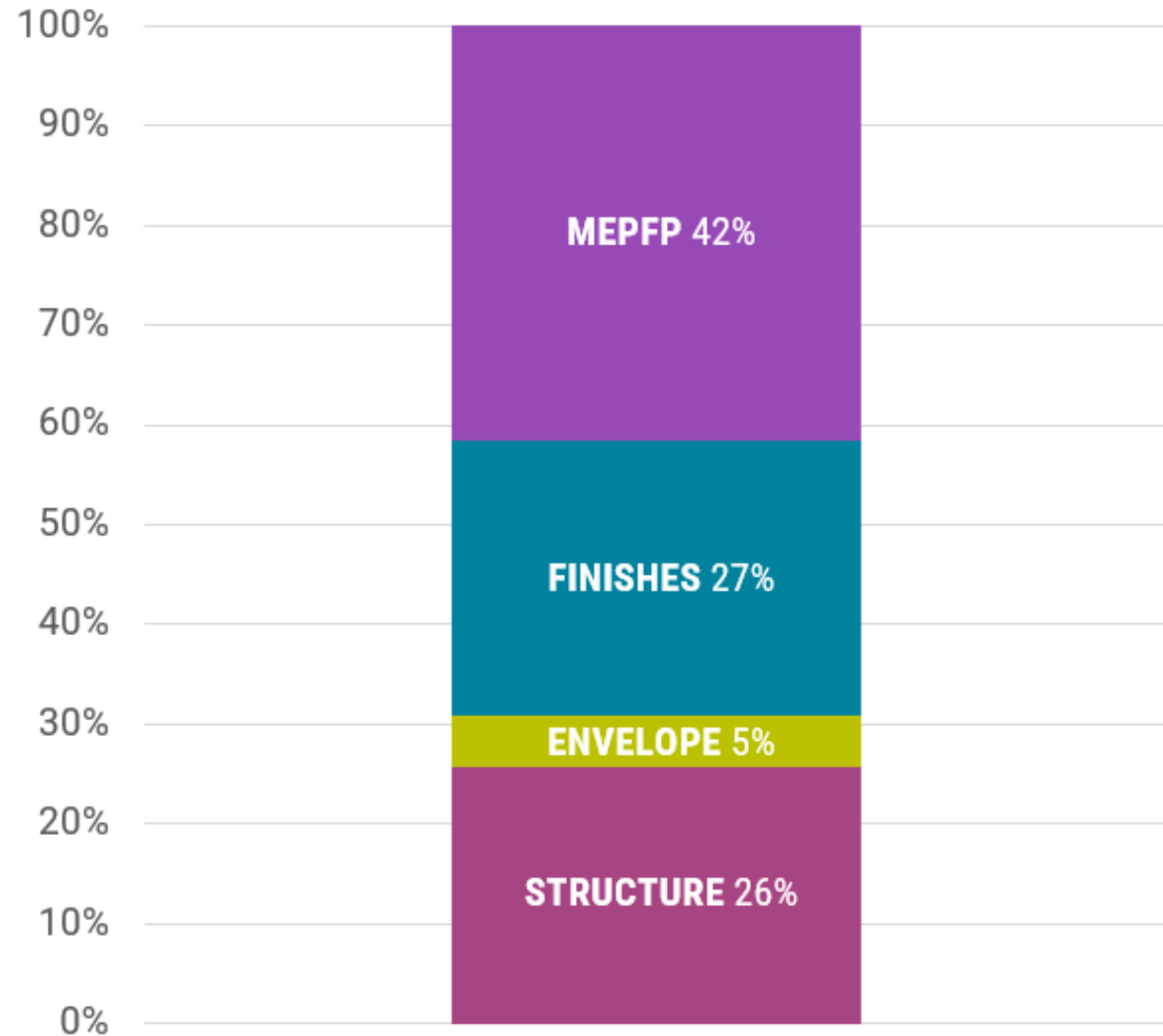


Note: no credit taken for end-of-life recycling of material for MEP systems.

YEAR 1 VS. YEAR 60

- MEP systems are a large portion of life-cycle embodied carbon, especially in MEP intensive buildings like labs

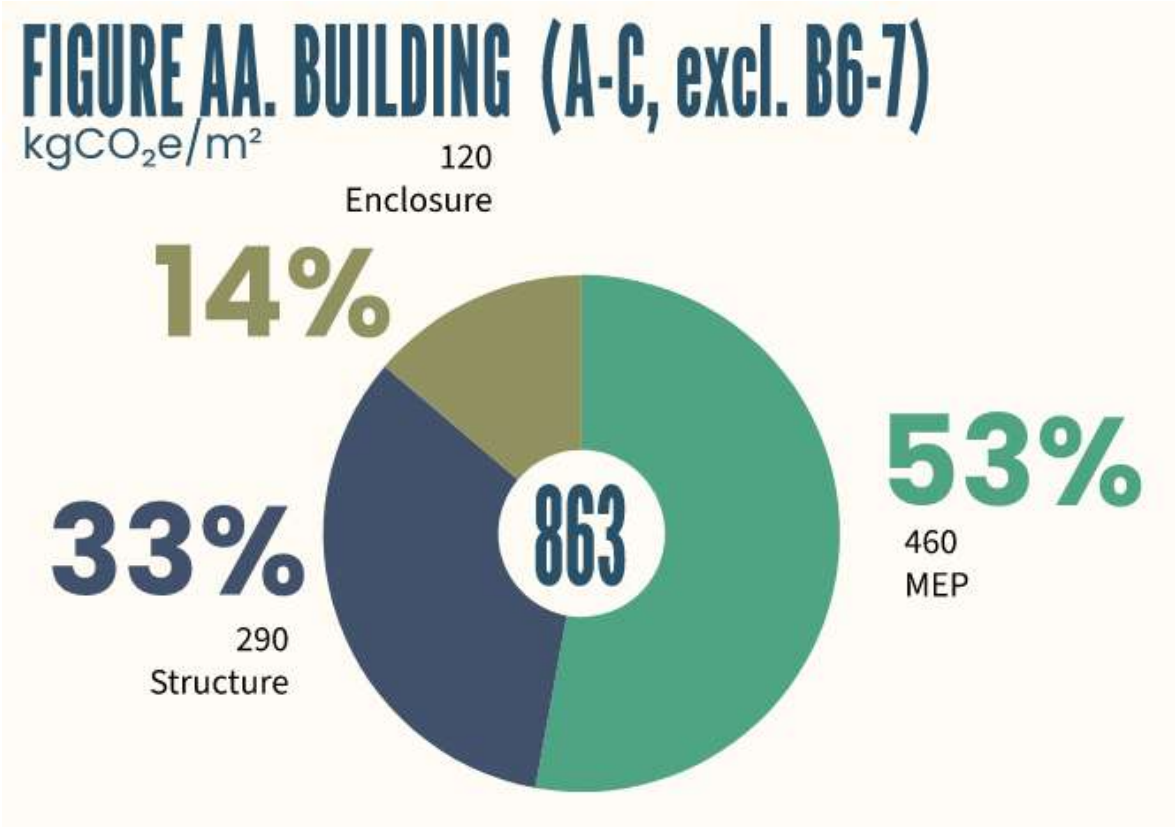
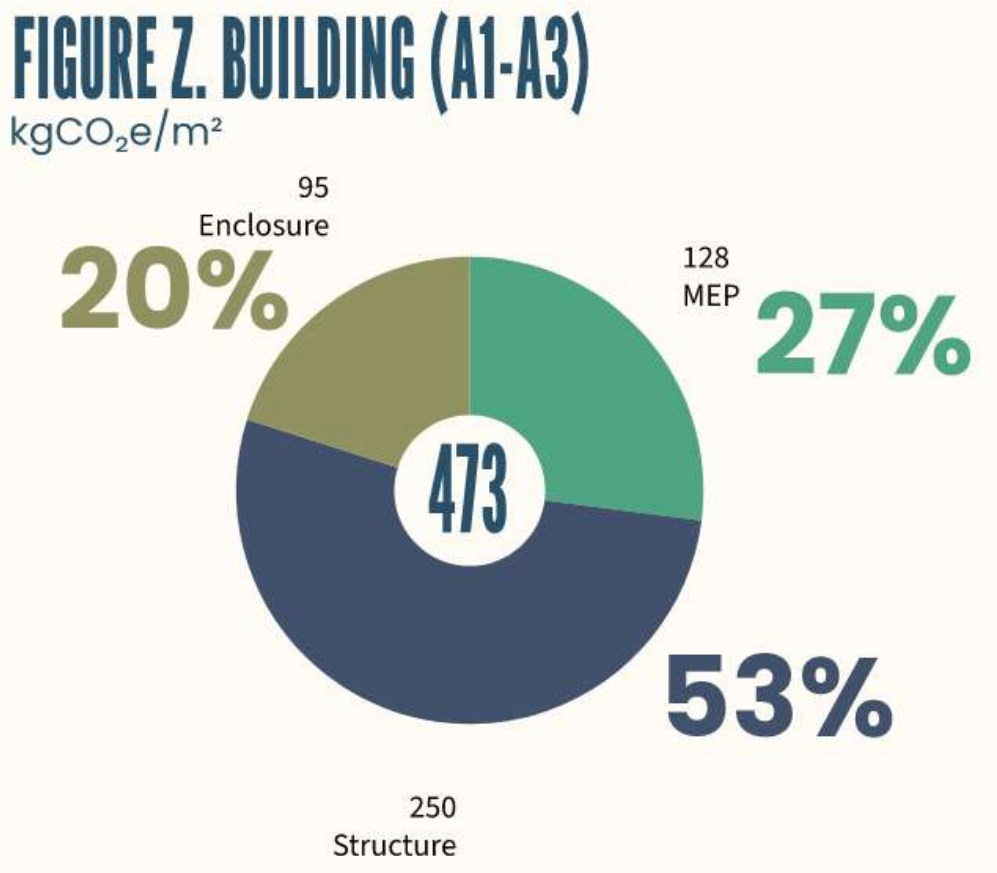
Typical Lab Embodied Carbon Breakdown



Typical Lab Embodied Carbon (60 Years)

Note: no credit taken for end-of-life recycling of material for MEP systems.

MEP 2040 DATA



Source: The Beginner's Guide to MEP Embodied Carbon v2

Operational vs. Embodied Carbon | Lab and Office Buildings

FIGURE 3.8: MEP WHOLE LIFE CARBON (A-C)

kgCO₂e/m²

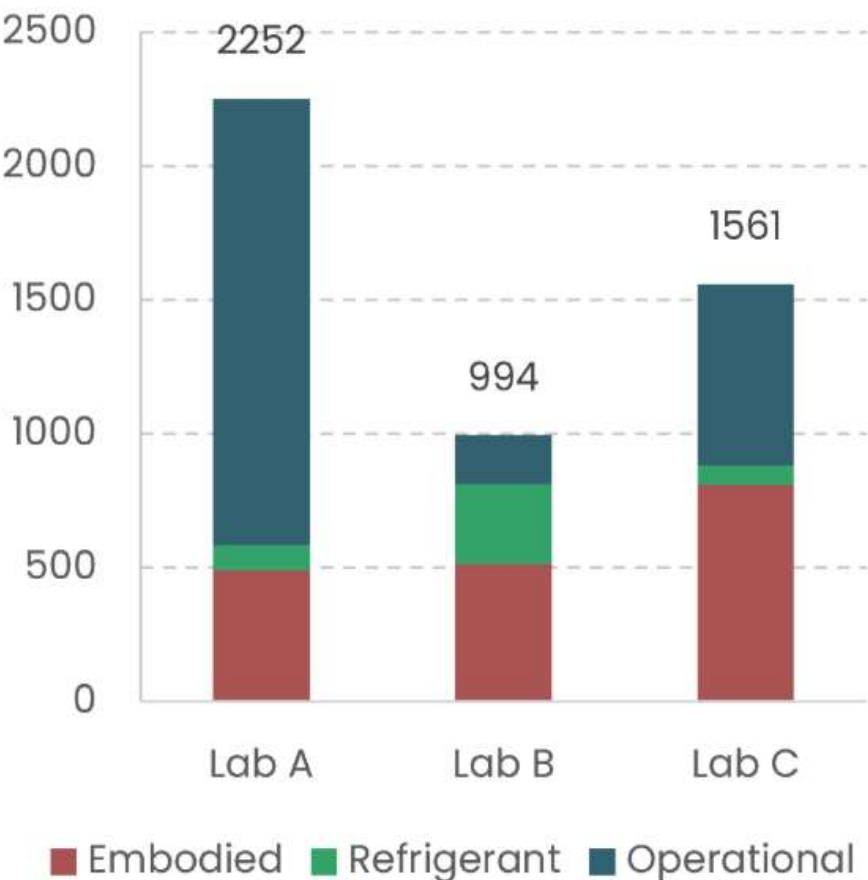
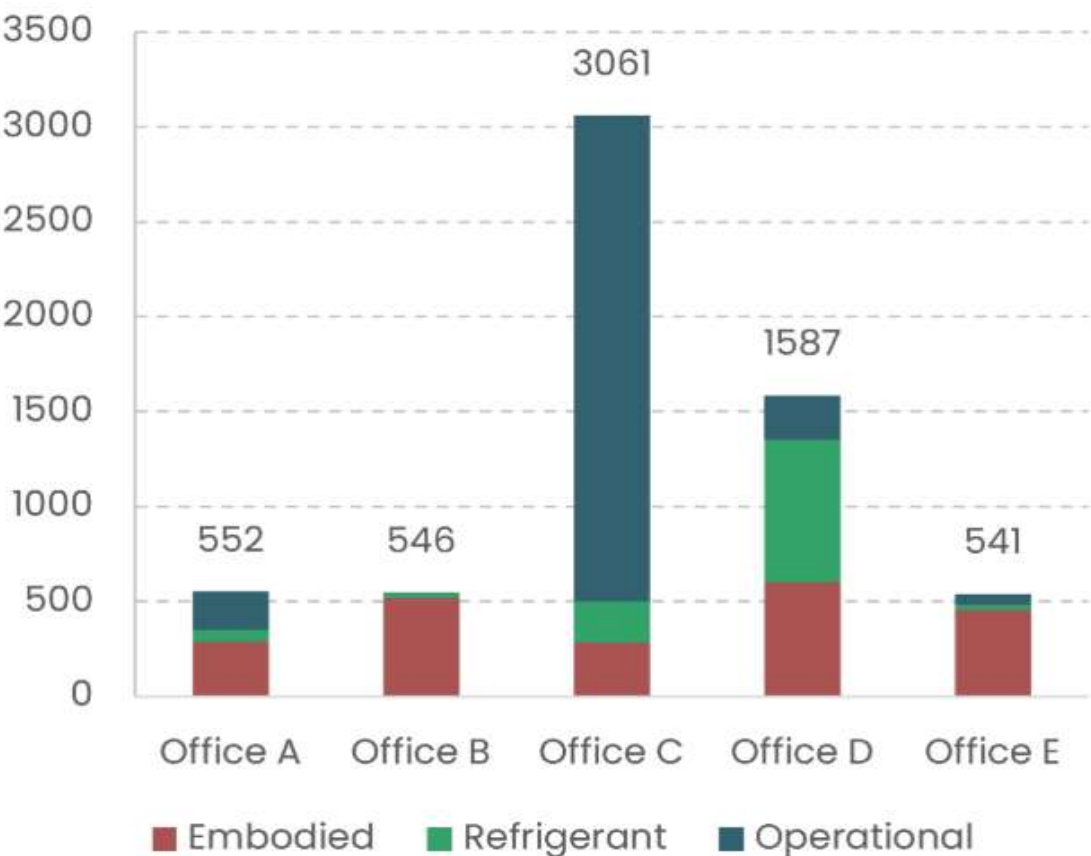


FIGURE 3.5: MEP WHOLE LIFE CARBON (A-E)

kgCO₂e/m²



I2SL Best Practices Guide: Embodied Carbon in Laboratory Buildings

Coming soon!



International Institute for
Sustainable Laboratories

Dedicated to advancing sustainable laboratories globally.

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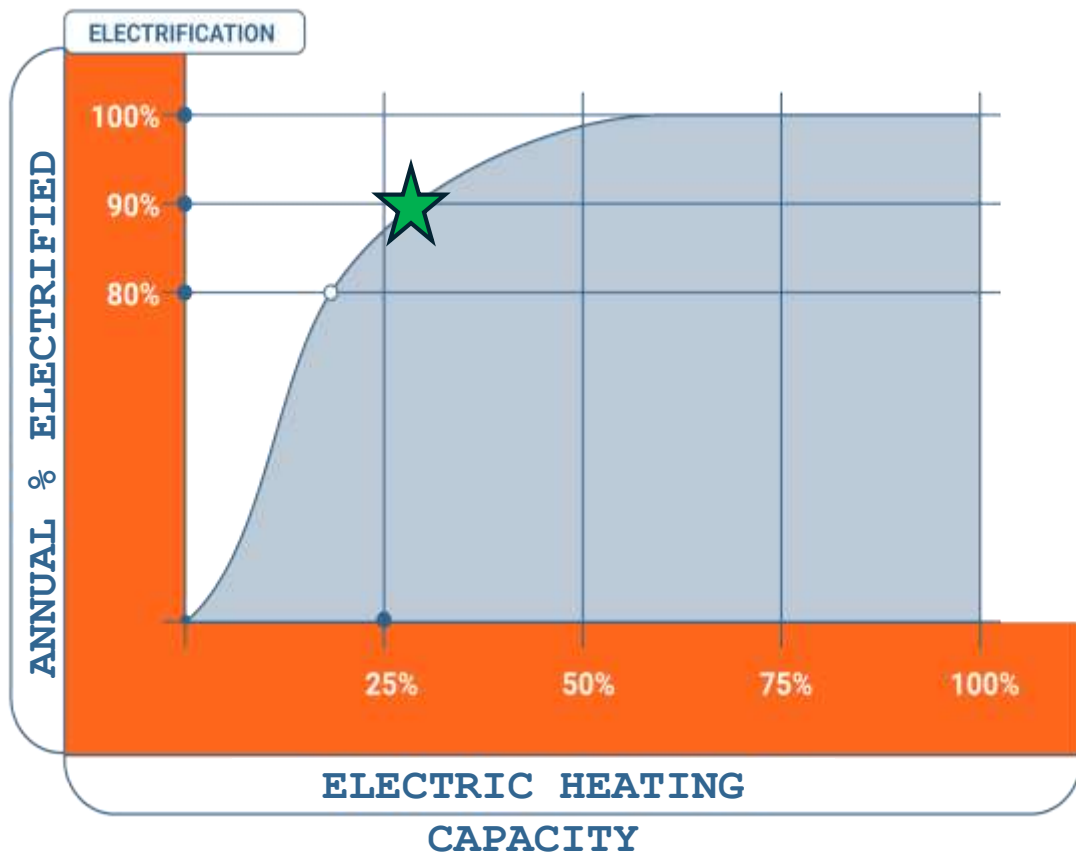
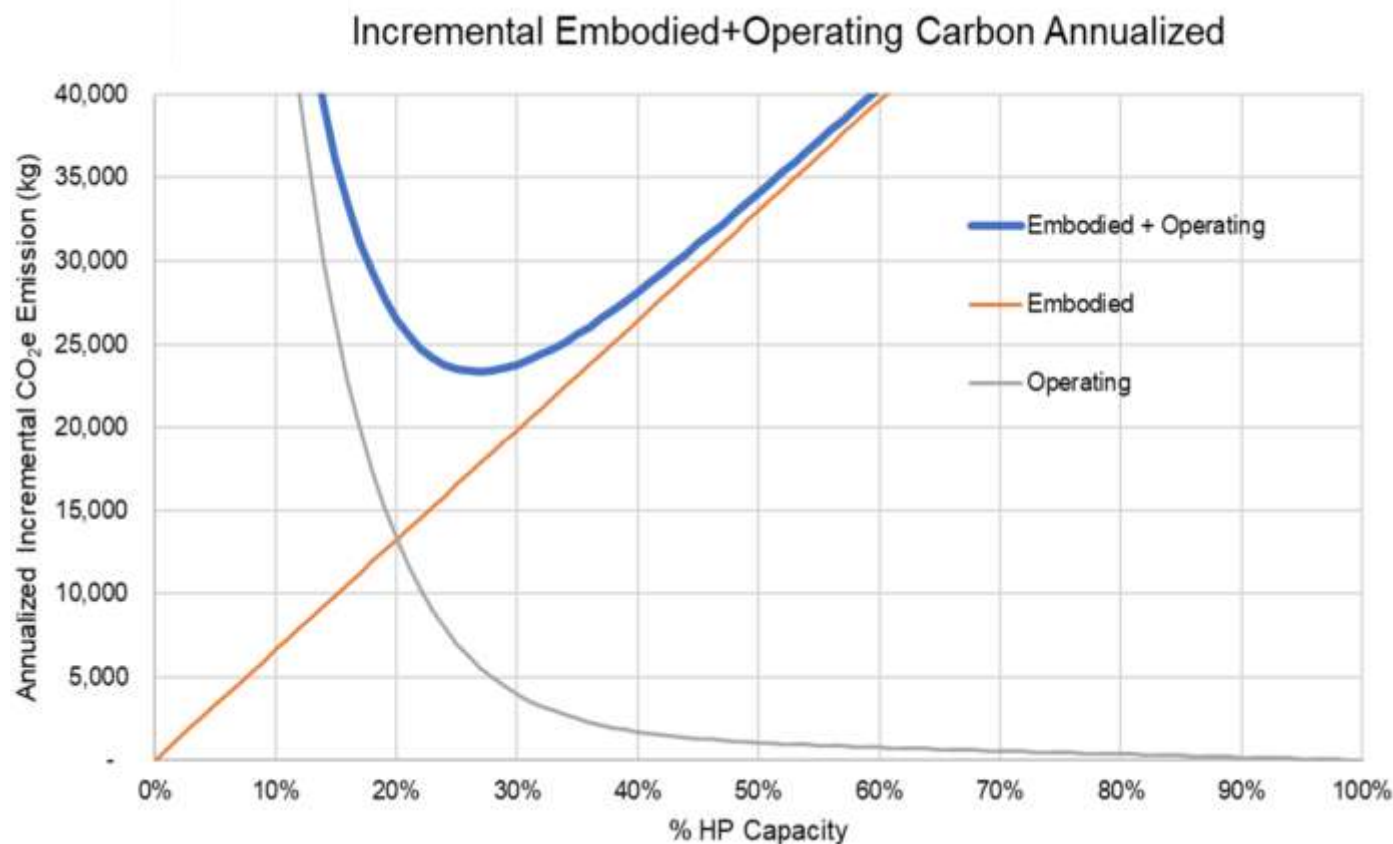
I2SL Best Practices

Best Practice Guides and Technical Bulletins provide information on the design, construction, and operation of specific technologies that contribute to energy efficiency and sustainability in laboratories. The guides include information from actual implementation of these technologies in various laboratory facilities by highlighting quantifiable performance goals and possible methods to achieve them.



How Do We Reduce MEP Embodied Carbon? | Hybrid System Design

- Is more electrification always better?



Reducing MEP Embodied Carbon | Design Implications

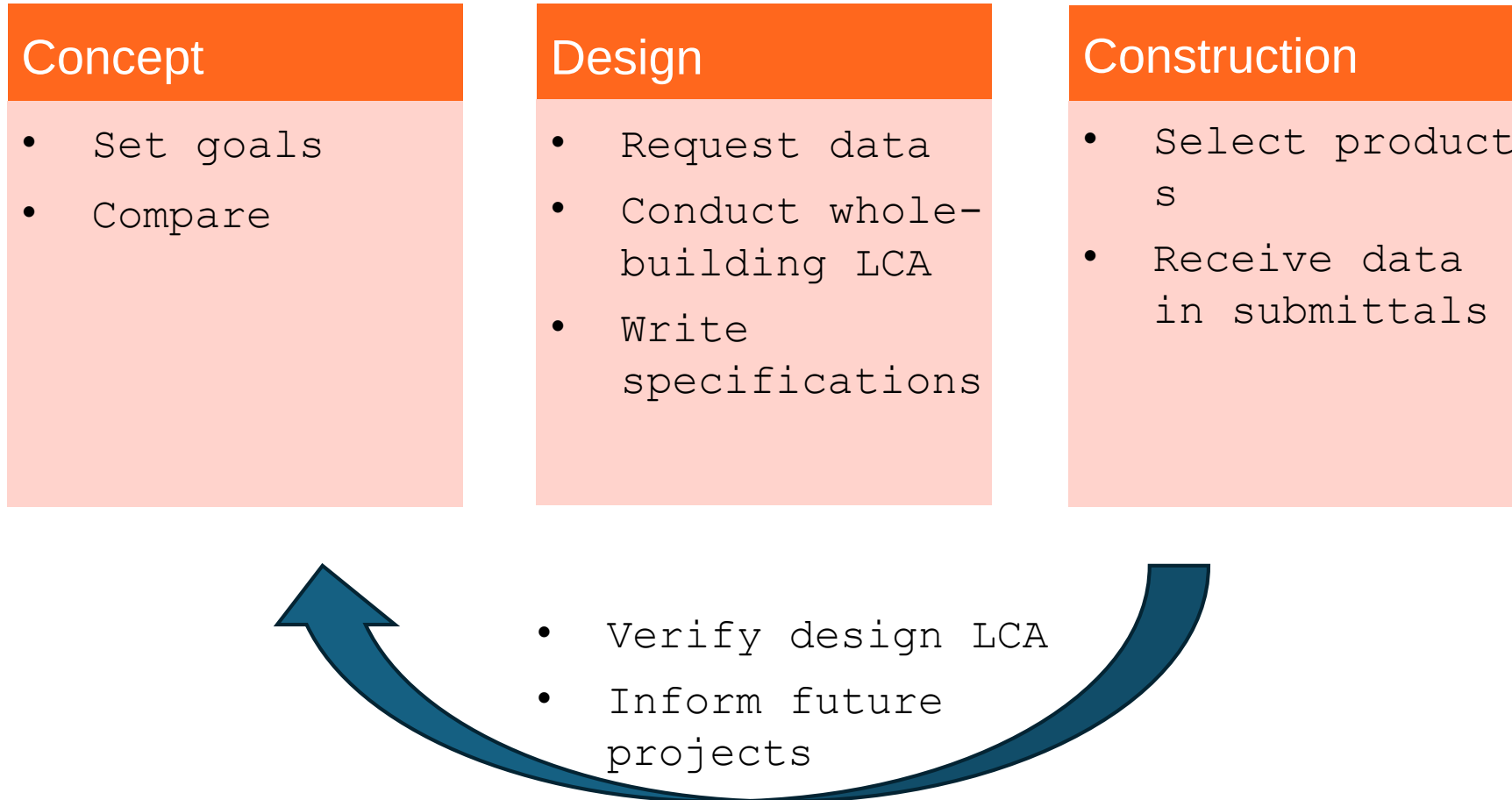
Strategies to consider:

- Right-sizing
- Peak load reductions
- System selection
 - e.g. centralized vs. decentralized
- Distribution efficiency
- Longevity

Lots of trade-offs -> Do the analysis!

Need better data for analysis -> Request EPDs!

PROJECT CYCLE OF EMBODIED CARBON ANALYSIS



PREFERENCE OF EMBODIED CARBON DATA

1

Product-Specific, Facility Specific EPD

2

Product-Specific EPD

3

Industry Average EPD

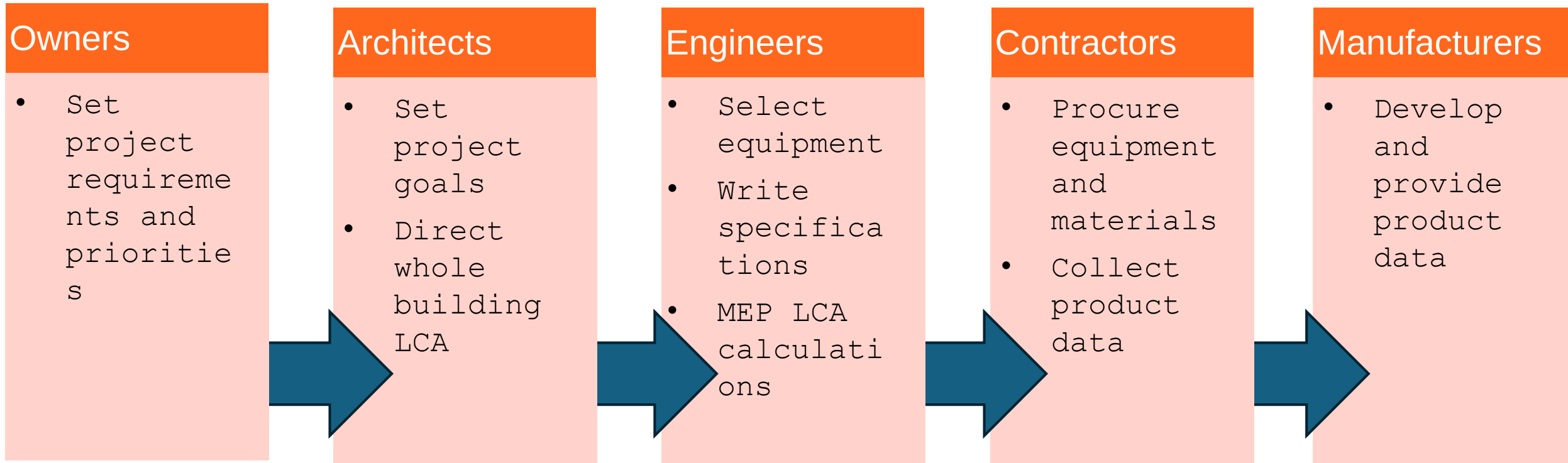
4

TM65 Mid-Level Calculation

5

TM65 Basic Calculation

PROJECT ROLES



Case Study | Lighting EPDs

- Large campus project
- Lighting design team added EPD requirement into project spec
- Reached out to manufacturers during Design Development
- Successfully got EPDs for lighting fixtures across the project
- Now repeating for other projects currently in design



Can this be replicated across other areas of MEP?

Getting EPDs | MEP Considerations

Challenges:

- Large, complex, and specialized equipment
- Limited number of suppliers and models

Opportunity:

- Close relationships between designers and equipment vendors



Addressing Embodied Carbon | Balancing Project Needs

Entry Strategy: Low Project Impact

- Avoiding impacts to project cost or major design decisions
- Design for efficiency, request EPDs, conduct whole-building LCA

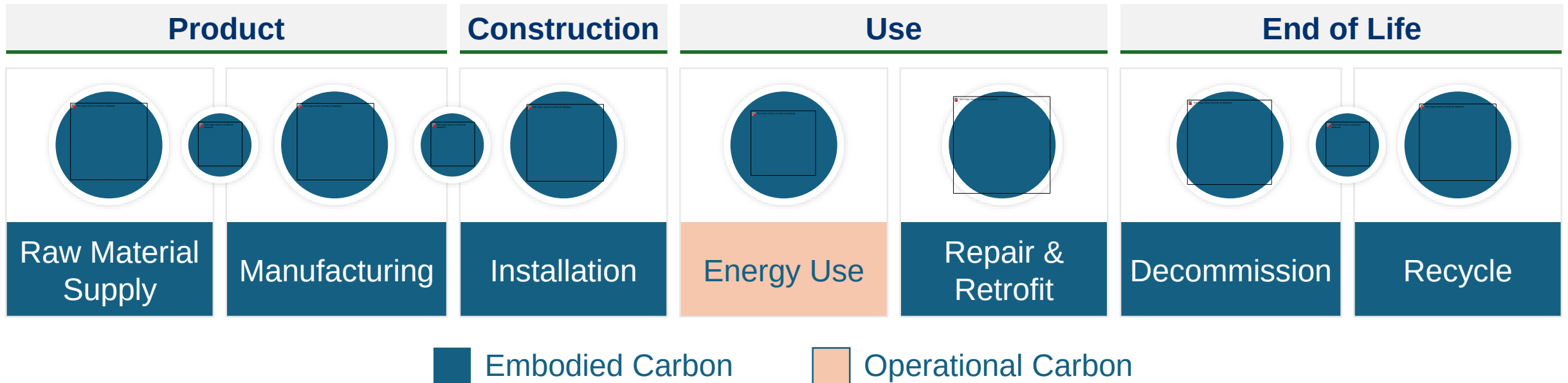
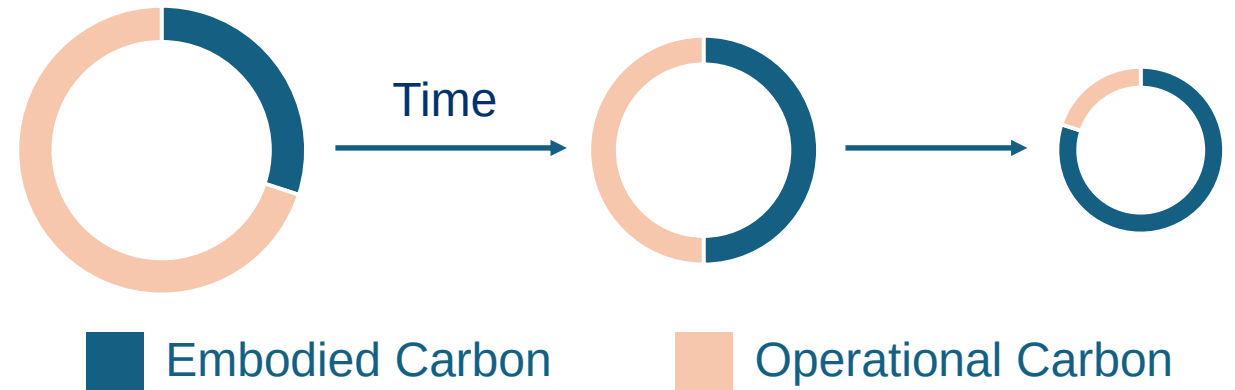
Looking Forward: Embodied Carbon as a Priority

- We invest in operational carbon strategies – why not embodied carbon?
- Project requirements for EPDs or demonstrated embodied carbon reductions
- New LEED v5 pilot credit (MRpc185) is an example

• Carbon Emissions Across the Product & Building Life Cycle

Greater share of emissions will come from embodied carbon over time as buildings decarbonize and operating carbon falls and approaches zero.

Some buildings/organizations already operating net zero — embodied carbon is the only piece of the pie left to decarbonize.



What is Life Cycle Assessment (LCA)?

Resource

S

End of
Life

Use

Life Cycle
Assessment

Processi
ng

Manufacturi
ng

Distribu
tion

Quantitative approach to evaluate environmental impacts, benefits and tradeoffs across the product life cycle.

An LCA will measure the **environmental footprint** of a product across one or many impact categories.

What is an Environmental Product Declaration (EPD)?



**Chiller
Environmental
Product
Declaration**

An EPD is a **third-party-verified report summarizing a product's environmental footprint** across its life cycle **based on an LCA study**.

It must be produced in line with "rules" for the product category (**PCRs**) to ensure compliance with the **ISO standards**

What does Life Cycle Assessment (LCA) Actually Look Like?

Embodied Carbon Disclosure: Ascend® Air-to-Water Heat Pump

TM65 North American Methodology, ASHRAE® and CIBSE 2024

Last Updated: October 2024; contact your account manager with questions. Please do not distribute without permission.

Results			
Life Cycle Stage	Results per unit (kg CO2-eq)	Results per kg product weight (kg CO2-eq)	Notes
A1. Material Extraction	23,041	4.32	Material emission factors sourced from TM65:2021 table 2.1 and TM65NA:2024 table 2.1. Greater than 95% of material composition accounted for. Assumed steel for any weight unaccounted for in raw material composition.
A2. Transport to Factory	4,641	0.87	Used TM65NA:2024 assumption of 8,000 km transport to factory, per table 2.5. Transport emission factors from TM65NA: 2024 table 2.4.
A3. Manufacturing	5,500	1.03	Electricity Carbon Factor for RMPA eGRID region from TM65NA:2024 table 2.6. Gas carbon factors from TM65NA:2024 table 2.10. As per TM65NA:2024 table 2.5, assumed 4 rounds of manufacturing.
A4. Transport to Site	1,530	0.28	Calculation based on avg. transport distance to customer sites over past 3 years. Transport emission factors from TM65NA: 2024 table 2.4.
B1. Use (Refrigerant Leakage During Product Life)	109,253	20.48	Refrigerant GWP from TM65NA:2023 table 2.3. Used AR6 value. Annual leak rate calculations use industry-assumed values per TM65NA:2024 table 2.2. Actual values will differ based factors such as maintenance and unit configuration.
B3. Repair	3,823	0.68	TM65:2021 assumption, Table 4.6, value is 10% of A1-A4 + 10% of C3-C4
C1. Deconstruction (Refrigerant Leak at End of Product Life)	18,205	3.41	Refrigerant GWP from TM65NA:2023 table 2.3. Used AR6 value. End of life leak rate calculations use industry-assumed values per TM65NA:2024 table 2.2, actual values will vary based on recovery practices.
C2. End of Life Transport	77	0.01	Per TM65NA:2024 Table 2.8, assumed transport of 100 km by truck. Transport emission factors from TM65NA: 2024 table 2.4.
C3. Waste Processing	1,375	0.26	Per TM65:2021 Table 4.7, assumed processing energy use equal to one round of manufacturing energy use from A3. Manufacturing.
C4. Disposal	66	0.01	Assumed 85% of metals in product recycled, other materials sent to landfill. Sourced landfill emission factor from TM65NA:2024 table 2.13.
Embodied carbon without refrigerant leakage			
A1-C4 (excluding B1, C1)	39,855	7.47	
A1-C4 with buffer factor (excluding B1, C1)	51,811	9.71	1.3 buffer factor per TM65:2021
Refrigerant leakage only			
B1 + C1	127,462		
Total Embodied Carbon			
All life cycle stages, without buffer factor	167,317		
All life cycle stages, with buffer factor	179,273		

Product Details

Model: Ascend® Air-to-Water Heat Pump ACX

Unit Selected for Analysis: 180 tons

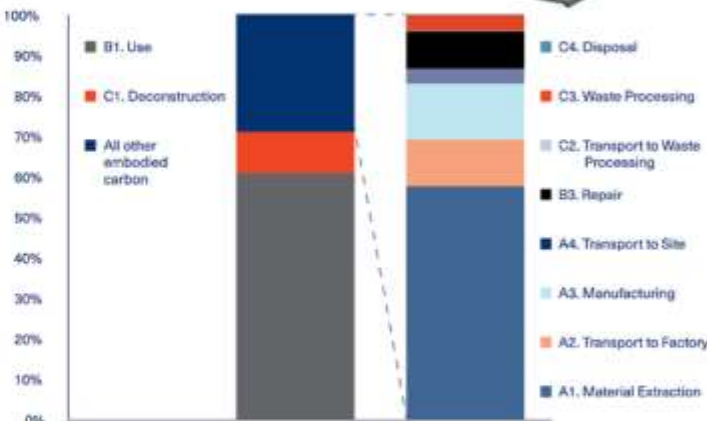
Unit Weight (shipping weight unless otherwise specified): 5,334 kg

Size Range: 140-230 tons

Refrigerant & Charge: R-454B, 171 kg; GWP = 531 (AR6)

Manufacturing Location: Pueblo, CO

Modeled Product Lifetime: 20 years



Other Data, Details, Notes

TM65 Complexity Category: Category 3: High Complexity

Estimated refrigerant leakage; values prescribed by TM65 North American Methodology (2024), Table 2.2

- Annual leak rate: 6%
- End of life recovery rate: 80%

Repair and replacement rate per TM65: 10%

This calculation was performed for a selected unit configuration and size. It is reasonable to assume that the per-kg product weight results can be extrapolated to all sizes in the model range, using each unit's respective shipping weight, given similarities in raw materials, manufacturing, supply chain, and end of life. However, *it is recommended to perform bespoke refrigerant leakage calculations for each different size using the refrigerant charge amounts listed in the product manual.*



Trane – by Trane Technologies (NYSE: TT), a global climate innovator – creates comfortable, energy efficient indoor environments through a broad portfolio of heating, ventilating and air conditioning systems and controls, services, parts and supply. For more information, please visit trane.com or tranetechnologies.com.

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AC-SLB010-EN
11/06/2024

What About An Environmental Product Declaration (EPD) ?

 Product Environmental Profile - PEP EcoPassport. Document in compliance with ISO 14025: 2006 "Environmental labels and declarations. Type III environmental declarations."	
Company	Trane Technologies
Contact Information	TraneCommercialEPD@trane technologies.com
Registration Number	TRNE-10013-V01.01-EN

Company Description

Trane Technologies[®] is a world leader in heating and cooling systems, services, and solutions. Together with our brands, Trane[®] and Thermo King[®], we bring efficient and sustainable climate innovations to buildings, homes, and transportation.

Trane helps customers succeed by providing innovative solutions that optimize indoor environments through a broad portfolio of energy-efficient heating, ventilating, and air-conditioning systems, buildings, contracting and energy services, parts support, and advanced controls for homes and commercial buildings.

Trane serves engineers, contractors, and building owners on all continents and in an array of markets including education, healthcare, government, industrial/ manufacturing, data centers, lodging, retail, and commercial real estate. With more than 900 U.S. patents to date, Trane creates comfortable and energy-efficient environments around the world.

Trane systems and services have a reputation for reliability, high quality, and advanced innovation; and are available through a powerful distribution network. Trane employees and distributors are respected industry-wide for their skills and performance in designing, manufacturing, marketing, and supporting commercial and residential systems.

Product Information	
Reference Product	Ascend™ Air-to-Water Heat Pumps Model ACX
Product Description	Meeting the demands of modern building decarbonization and operational efficiency requires more than just high performance—it calls for innovative, flexible technologies designed to adapt to real-world challenges. The Trane® Ascend™ Air-to-Water Heat Pump Chiller (ACX) leads the way with a suite of exclusive features: thermal energy storage integration, dual electronic expansion valves, and Symbio® 800 equipment controller with active hot water reset, all purpose-built to maximize energy savings and comfort.
	Built on Trane's proven Ascend platform and available in capacities from 80 to 230 tons, ACX incorporates advanced vapor injection compressors (80–120 ton models) for powerful heating—even in extreme cold. The waterside reversing valve enables counter-current flow in both heating and cooling mode, allowing for additional heating capacity and improved efficiency in heating mode, enhancing year-round flexibility. With low-GWP R-454B refrigerant and all-electric operation, the ACX aligns with sustainability goals and evolving energy regulations.
	Operate More Efficiently Addressing the challenge of high energy costs, the Trane® Ascend™ model ACX, as a heat pump, delivers <u>three-times more energy efficient</u> than other forms of electric heating. This significant energy savings reduces operational costs and ensures compliance with stringent energy regulations, making it an economical and sustainable choice for large commercial buildings.
	Low GWP R-454B Refrigerant Tackling the environmental impact challenge, the Trane® Ascend™ model ACX utilizes low GWP R-454B refrigerant to minimize direct emissions. As an all-electric heat pump, it supports your building's decarbonization journey, helping you meet sustainability goals and comply with evolving environmental regulations, thus contributing to a greener future.
Functional Unit	Vapor Injection Technology for Low Ambient Heating Solving the challenge of reliable heating in cold climates, the advanced vapor injection technology in the Ascend™ ACX 80-120T models allows for efficient heating even in ambient temperatures as low as -15°F (-1.25°C). As a heat pump, it ensures consistent performance and comfort in colder climates, eliminating the need for oversized units and reducing operational costs, providing a dependable solution for extreme weather conditions.
	Specifications • Capacity range: 80-230 tons • Refrigerant: R-454B • Compressor Design: Scroll with variable volume ratio (140-230T), vapor injection scroll (80-120T) • Controls: Symbio® 800
Declared Unit	To produce heating or cooling thanks to air-to-water heating of 314 kW according to the appropriate usage scenario and during the 22-year lifetime of the product. <i>Note: the mathematical relationship between the functional and declared unit is such that the declared unit divided by its capacity in kW equals the functional unit.</i>
Other Products Covered	List of other products covered in this PEP is presented in the section which concerned the extrapolation rules.
Reference Lifetime*	22 Years

*Reference lifetime was defined as 22 years by the Product Category Rules which governed this analysis.

What About An Environmental Product Declaration (EPD) ?

Technical Characteristics	
Data Point	Ascend™ Air-Cooled Heat Pump Models ACE
Product Category	Heat pump
Chiller Technology	Air-to-water
Reversible or non-reversible	Reversible
Heating Capacity*	80.3 tons 314 kW
ODP*	3.68 kW/kW
Cooling Capacity*	85.3 tons 300 kW
IPV*	17.8 BTU/W-hr 5.71 kW/kW
Refrigerant Used	R-454B
Refill Threshold**	0%

*Capacity and ODP/IPV at AHRI 550/590 conditions.

**Refill threshold denotes the ratio of refrigerant (expressed as a %) at which a refill back up to the original charge takes place. For the Product Category Rules, the refill threshold is considered 50% by default.

Constituent Materials >> Total weight of the reference product: 3,402 kg					
Plastics as % of weight		Metals as % of weight		Others as % of weight	
Product only: 3,402 kg					
Nylon	1.9%	Steel	57.0%	Refrigerant	2.5%
Various Plastics	1.1%	Copper	10.1%	Electronic Components	4.3%
		Cast Iron	4.6%	Various Other	2.0%
		Aluminum	9.2%		
		Other metals	7.2%		
Packaging only: 0 kg					
	0%		0%		0%
Total plastics	3.0%	Total metals	88.2%	Total others	8.8%

Life Cycle Stages	
Manufacturing	The manufacturing stage includes the production of raw and intermediate materials, as well as transportation to the manufacturer's last logistic platform for Ascend™ Heat pump. The final assembly of the product is carried out at Trane's plant in Pueblo, CO, USA. As a member of Steel Zero, Trane has pledged to procure, specify or stock 50% net-zero steel by 2030 and 100% net-zero steel by 2050. The main process steps for production include cutting, rolling, machining, brazing, welding, painting, sub- and final assemblies, and end-of-the-line testing.
Distribution	The transport from Trane's manufacturing facility to the customer was considered. The distance was calculated using averages for all shipped orders in 2024.
Installation	The installation stage includes diesel consumed by machinery used to move and place the product during installation.
Use	The use stage is conducted in alignment with the PSR, which models energy use of this air-to-water heat pump associated with comfort heating applications over its 22-year lifetime. The conditions outlined AHRI Standard 550/590 were used to set product capacity and efficiency. Refrigerant leak and electricity usage are considered in this stage. Default refrigerant leak amounts from the PSR were used.
End of Life	The end-of-life stage includes transportation to the end-of-life facility of the disposal of product. End of life fates were modeled by material for the region where they are being disposed, in this case the United States.
Benefits and loads beyond the system boundaries	Throughout the life cycle of the product, net loads and benefits beyond system boundaries are included.

Data Quality and Software	
Geographical Representativeness	The geographical scope of this PEP across all life cycle stages (manufacturing, distribution, installation, customer use, and end of life) is North America (United States and Canada). Overall geographical representativeness is considered good.
Temporal Representativeness	Primary data was collected from 2024. Secondary data refers to the Ecoinvent database published in 2023. The temporal coverage for each secondary process used in the LCA model is specified in the documentation section of individual Ecoinvent datasets.
Technological Representativeness	Overall technology representativeness is considered good.
Software and Database Used	Sima Pro desktop 9.6.0.3 Ecoinvent Database Version 3.10

Energy Model Used	
Manufacturing	Manufacturing electricity considers the eGRID specific region from which the product is being manufactured in Ecoinvent's datasets (market for electricity, medium voltage [US WTECC]).
Distribution	No energy consumption occurs during the distribution stage.
Installation	No energy consumption occurs during the installation stage.
Use	Use stage electricity is modeled using an average North American grid mix dataset (market group for electricity, medium voltage [NNA]).
End of Life	No energy consumption occurs during the end-of-life stage.
Benefits and loads beyond the system boundaries	End of life benefits consider average North American electricity (market group for electricity, medium voltage [NNA]).

Environmental Impacts

EN 15804 + A2 Environmental Impact Indicators, per kW corresponding to the functional unit										
		Total Life Cycle Impact (Excluding Module 0)	Manufacturing A1-A3	Distribution A4	Installation A5	Use B1	Maintenance B2	Operational Energy Use B6	End of Life C2-C4	Module 0
Climate change - total	GWP	6.20E+01	kg CO2 eq	9.75E+01	2.21E+00	1.77E-01	1.86E-01	8.79E-01	6.06E+03	1.80E+01
Climate change - fossil fuels	GWPf	6.14E+01	kg CO2 eq	9.68E+01	2.21E+00	1.77E-01	1.86E-01	8.78E-01	6.02E+03	1.62E+01
Climate change - biogenic	GWPb	1.94E+01	kg CO2 eq	8.36E-01	2.58E-04	3.11E-05	0.10E+00	1.82E-04	3.69E+01	1.80E+00
Climate change - land use and land use transformation	GWP ₄	1.85E+01	kg CO2 eq	-2.06E-01	6.17E-05	6.10E-06	0.00E+00	1.00E-01	1.83E+01	2.51E-04
Ozone depletion	ODP	2.41E-04	kg CFC-11 eq	2.09E-04	2.91E-06	3.72E-09	0.10E+00	1.89E-08	1.21E-03	2.51E-08
Acidification	AP	1.73E+01	moles of H+ eq	1.43E+00	5.80E-03	7.75E-04	0.10E+00	1.45E-03	1.59E+01	4.87E-03
Eutrophication, freshwater	EpF	4.25E-01	kg P eq	1.13E-01	5.40E-06	6.43E-07	0.10E+00	2.40E-06	4.15E-01	5.44E-05
Eutrophication, marine aquatic	EpM	2.53E+00	kg of N eq	1.32E-01	2.29E-03	2.87E-04	9.20E+00	1.38E-03	2.39E+00	5.83E-03
Eutrophication, terrestrial	EpL	1.80E+01	moles of N eq	1.59E+00	2.79E-02	3.14E-03	0.10E+00	1.53E-02	2.70E+01	1.70E-02
Photochemical ozone formation	POCP	1.17E+01	kg NMVOC eq	5.34E-01	8.66E-03	1.94E-03	0.00E+00	1.88E-03	1.11E+01	6.43E-03
Abiotic resource depletion - elements	ADPe	2.38E-02	kg Sb eq	2.25E-02	1.29E-07	1.58E-08	0.10E+00	5.70E-08	1.01E-04	3.12E-06
Abiotic resource depletion - fossil fuels	ADPf	1.16E+05	MJ	1.18E+05	2.91E+01	8.85E+06	9.00E+08	1.18E+03	1.15E+05	1.81E+03
Water use	WU	1.50E+03	m3 world eq	9.25E+01	2.68E-02	3.32E-03	0.00E+00	1.13E-02	1.47E+03	-4.08E-01

Note: characterization factors use the -L/+1 biogenic carbon storage assessment methodology

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Please fill out an evaluation for this session



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