

VOLVO

LIFE CYCLE ASSESSMENT FOR BUSES

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Extensive experience in electromobility and sustainable transport solutions.

Previously City Mobility Director at Volvo Buses, closely co-operating with cities, authorities and operators.

Representing Volvo Buses in international committees within industry organisations, such as UITP and ACEA.

M. Sc. Civil Engineering Chalmers University of Technology



Maria Wallenius Henriksson

**Volvo Buses Corporation, Environmental and
Substance Compliance manager**

*More than 20 years of experience of Life Cycle
Assessment (LCA), polymer materials and
Substances of Very High Concern (SVHC)*

*Ph D in polymer synthesis in 1992 from Chalmers
University of Technology*



Agenda

- Introduction
- Value of LCA in bus tenders
- Ambitions in bus businesses/industry
- Assessing the environmental impact of a bus
- Summary

The Volvo Group

- ~ 100,000 employees
- 140 nationalities
- 12 brands, 190 markets
- Production facilities in 18 countries
- Trucks, buses, construction equipment,
- Power solutions for marine and industrial applications,
- Financing and services
- Worldwide service networks and dealerships
- Global supplier of Electrified Buses & Trucks



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Agenda

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Value of LCA in bus tenders

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Ambitions in bus business/industry

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Assessing the environmental impact of a bus

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Summary

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Value of LCA in bus tenders

Learning curve

We need to reduce
fuel consumption

Electric buses have
zero tailpipe
emissions

All electricity
production has a
carbon footprint

The vehicle's entire
lifecycle has an
environmental
impact

\$\$\$
2005

TTW
2010

WTW
2015

LCA
2020

Sustainability focus in tenders

- PTA/PTO create evaluation methods; questionnaires
- Lack of standardised evaluation formats make scoring complicated
- 1-to-1 comparison of LCA reports requires identical scope and prerequisites



Climate

Greenhouse gas emissions are one of the biggest threats to the planet.

This is what we will do to reduce greenhouse gas emissions.



Resources

The planet's resources are finite.

This is what we will do to improve efficiency and take a step change on circularity.



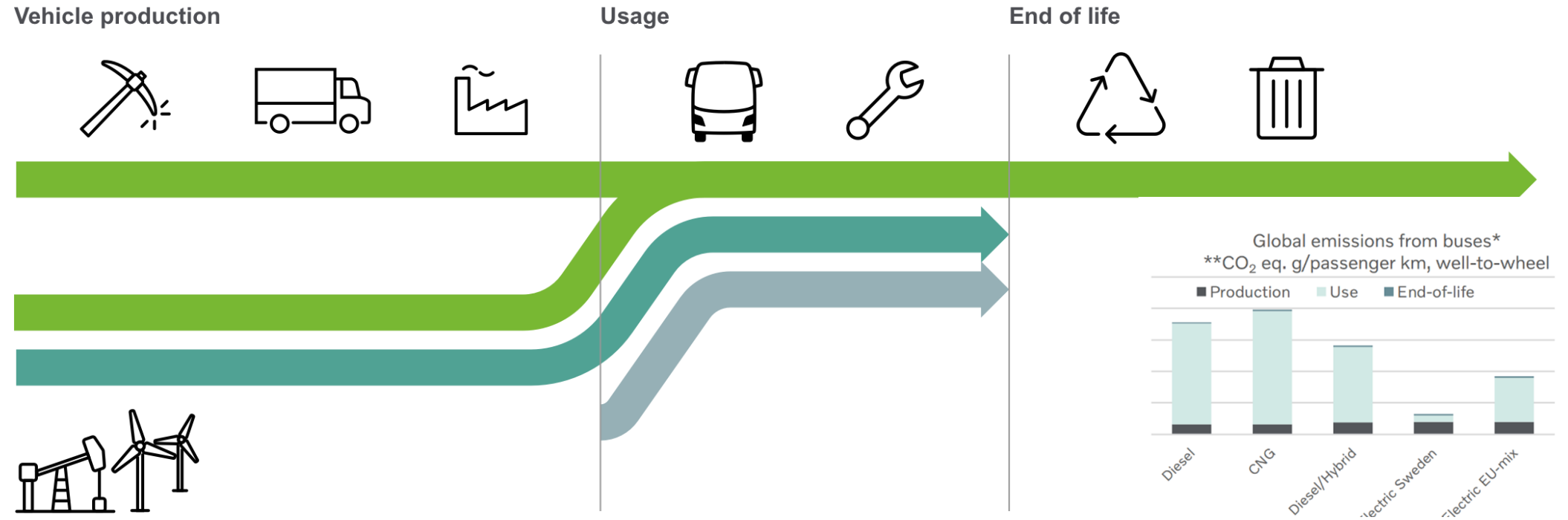
People

We are a human centric company.

This is what we do to deliver safety, respect human rights and use our full potential.

Ambitions in bus business/industry

How LCA supports in understanding the environmental impact of electric buses



Energy production

LCA

Life Cycle Assessment

Total environmental impact,
cradle to grave

WTW

Well-To-Wheel

Impact from energy production
and emissions in operation.

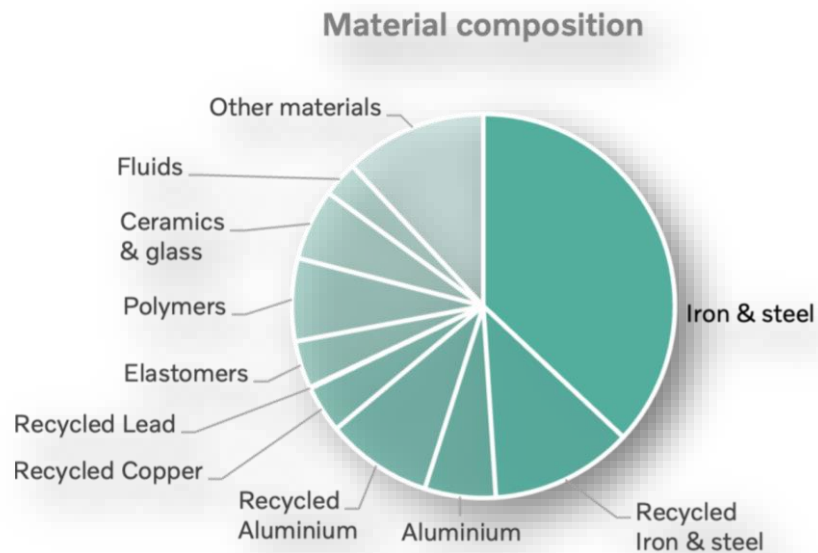
TTW

Tank-To-Wheel

Impact from emissions in
operation.

Environmental Declaration / Environmental Product Declaration

- Environmental impact in all product life phases
- Depletion of natural resources
- Material composition
- Recycleability / Recoverability rate according to ISO 22628

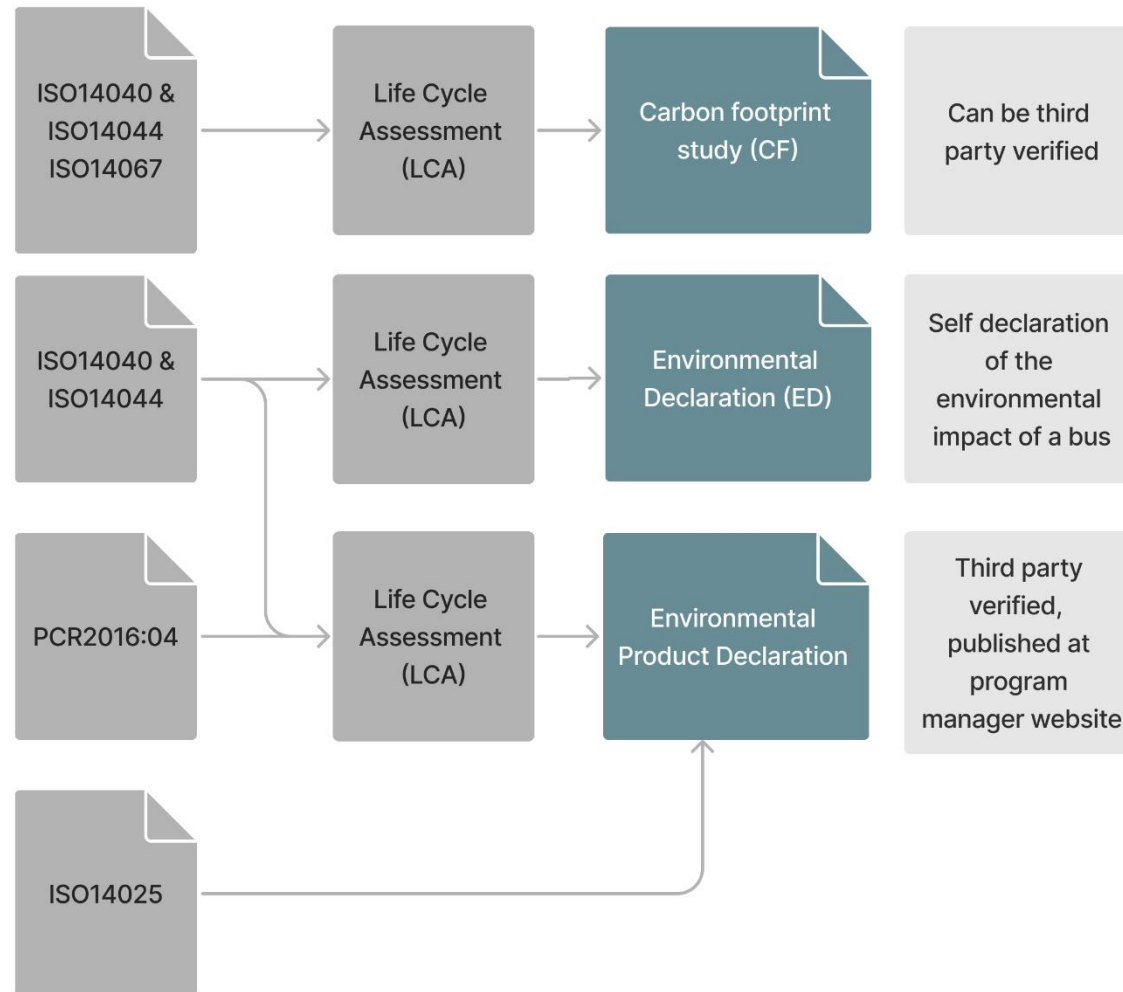


Emissions/pkm	Production	Use incl maintenance		End-of-life	Total	
		SE	EU		SE	EU
Electricity mix		SE	EU		SE	EU
CO ₂ , [grams]	0.78	0.42	4.19	-0.16	1.03	4.81
VOC. [milligrams]	1.71	0.51	7.67	-0.42	1.80	8.96
NOx. [milligrams]	1.80	0.97	6.66	-0.32	2.44	8.14
SOx. [milligrams]	2.14	0.53	7.53	-0.40	2.27	9.27
PM. [micrograms]	213.91	33.57	229.99	-46.16	201.32	397.74

*High-level example of LCA results with regards to two specific electric mixes
For a 12 m generic electric city bus*

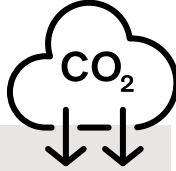
Assessing the environmental impact of a bus

LCA is the core of environmental declarations



There are several methods...

- Definitions



Carbon Footprint (CF)

- The total greenhouse gas emissions caused by a product, service, etc expressed as carbon dioxide equivalent (CO₂e)
- Is used for Science-Based Targets calculations of Scope 1, 2 and 3



Environmental Product Declaration (EPD)

- Type III declaration that quantifies environmental information on the life cycle of a product or service
- Purpose is to enable comparisons between products fulfilling the same function



Product Environmental Footprint (PEF)

- European framework initiative (2013/179/EU)
- A multi-criteria measure of the environmental performance of a product or service throughout its life cycle.
- Purpose is to reduce the environmental impact

What are the differences between methodologies?

- Carbon footprint (CF)

- Standards

- ISO14040/44
- ISO14067

- 1 default impact category

- Climate change factors

- Fossil CO₂=1
- Any methane=25
- Nitrous oxide=298

- Environmental Product Declaration (EPD)

- Standards

- ISO14040/44
- PCR2016:04 for buses
- ISO14025

- 7 default impact categories

- Climate change factors

- Fossil CO₂=1
- Any methane=28
- Nitrous oxide=265

- Product Environmental Footprint (PEF)

- Standards and guidelines

- PEF framework
- ISO14040/44
- PEFCR (not yet for bus)

- 16 default impact categories

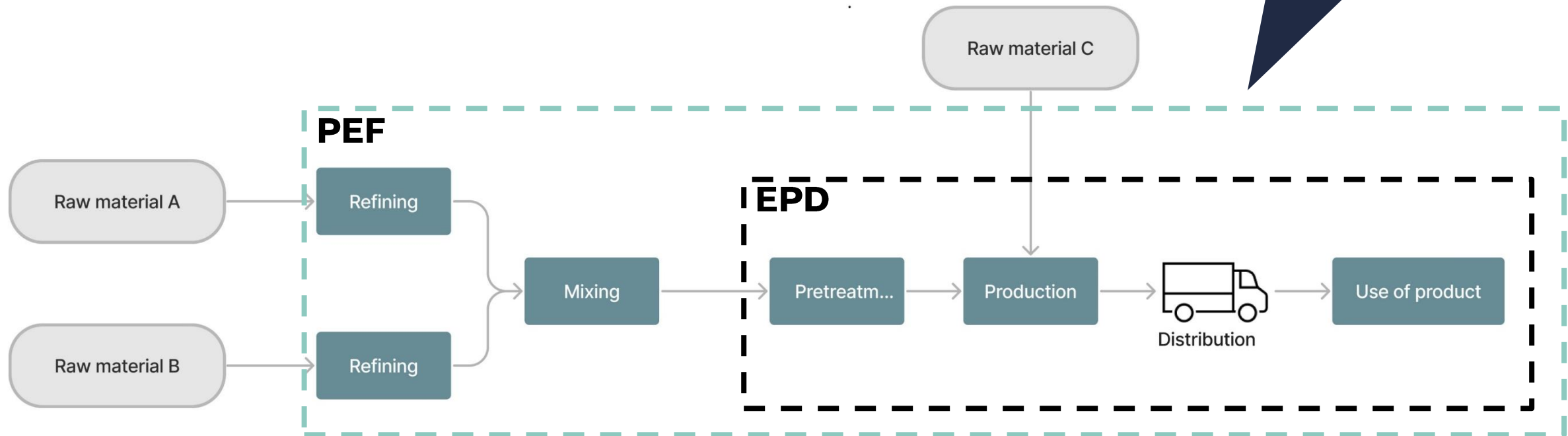
- Climate change factors

- Fossil CO₂=1
- Fossil methane=36.8
- Biogenic methane=34
- Nitrous oxide=298

Another thing that is different...

- System boundaries

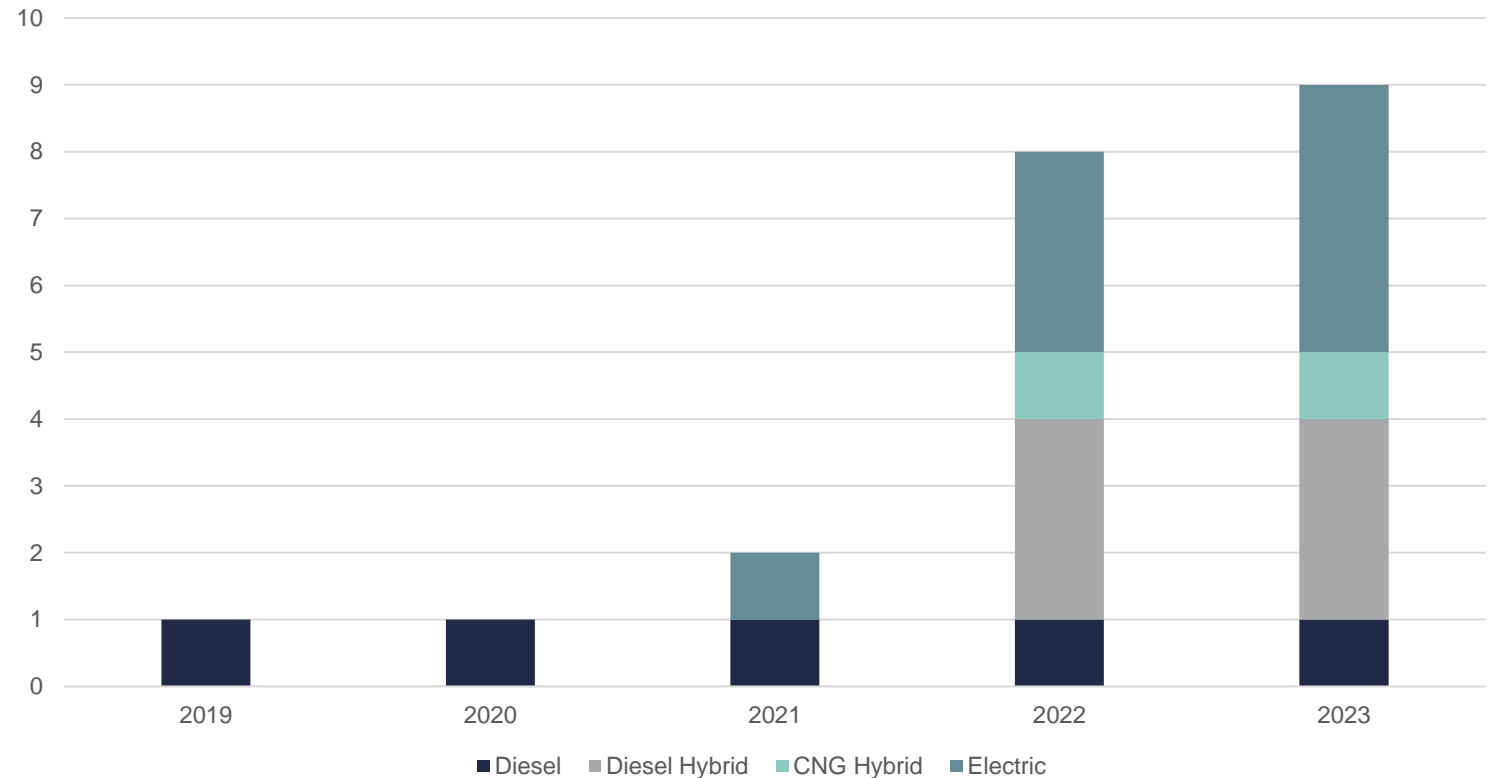
Results from EPD vs
PEF will not be
comparable!



Today, is EPD becoming the accepted way to report environmental performance?

- ✓ Comparability of basic data possible, due to Product Category Rules (PCR) for buses
- ✓ Third party review

Tomorrow, will PEF become the accepted method?



(More info at <https://portal.environdec.com/>)

This means that...

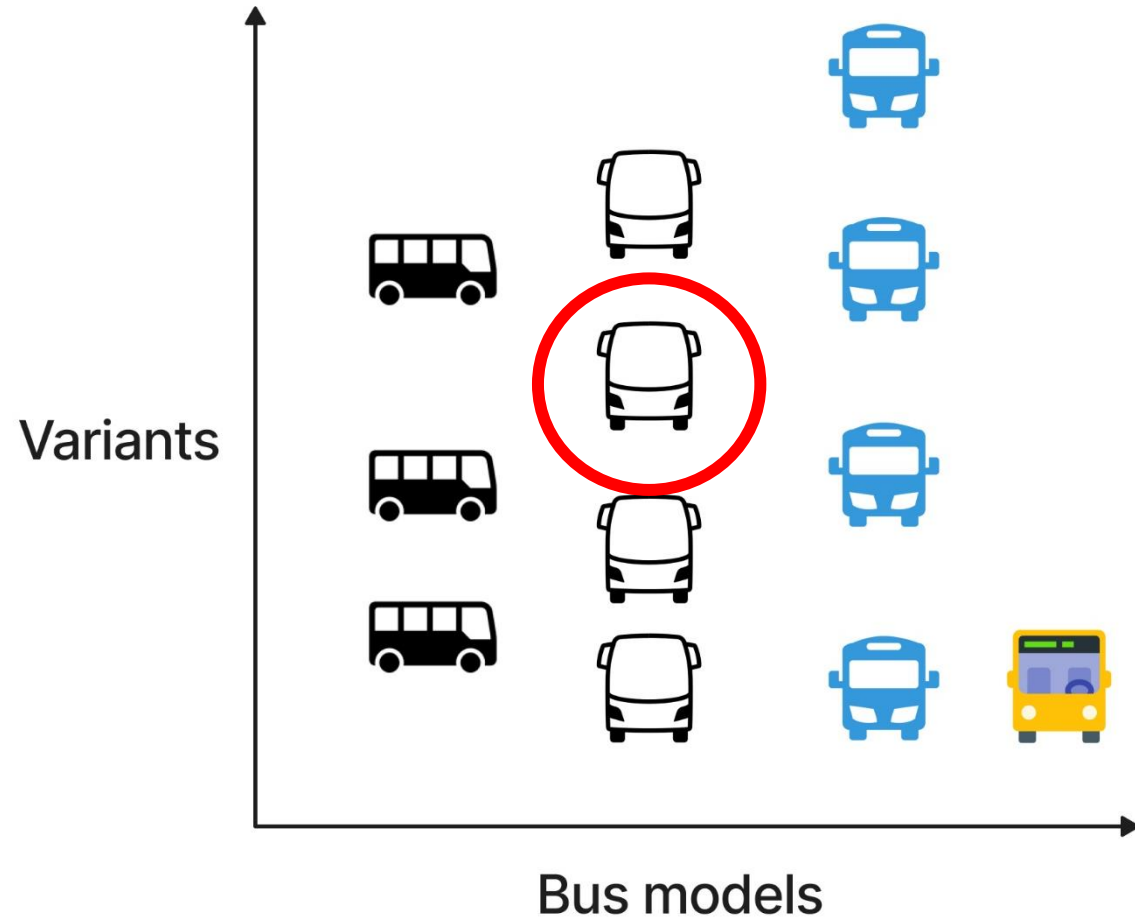
- ✗ Product Environmental Footprint (PEF) data for e. g. for batteries cannot be mixed with Environmental Product Declaration (EPD) data for a bus
- ✗ Carbon footprint (CF) data cannot be mixed with EPD data



EPD

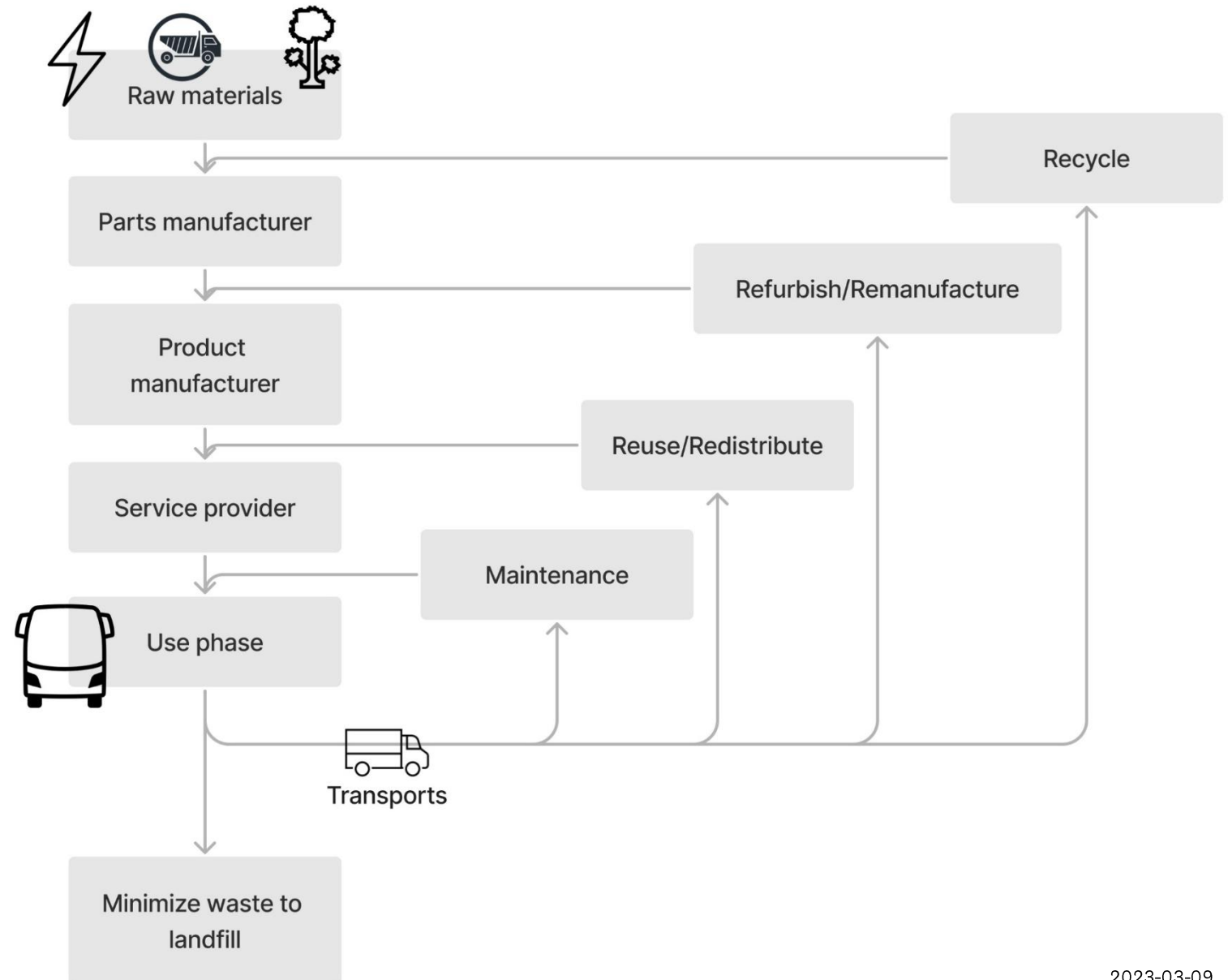
How to choose object for LCA?

- Representative bus out of many variants
- You also need
 - Material content of all parts, incl chemical products like dried paint and glues, lubricants, etc
 - Production data
 - Preventive maintenance
 - Use phase based on max passengers



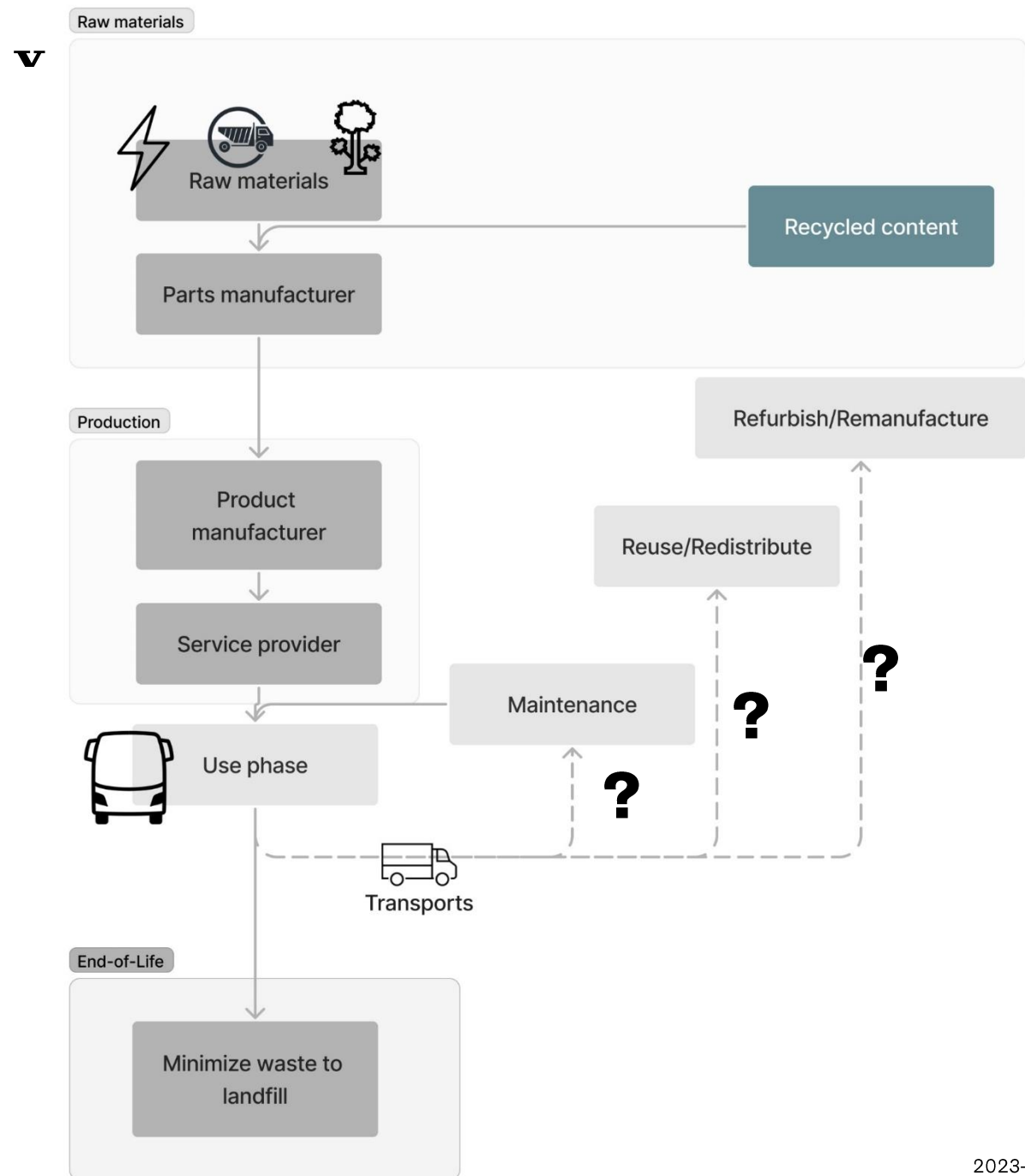
Life cycle of a bus

- Flows need to be mapped
 - Use of energy
 - Use of resources
 - Use of water
 - Emissions to air and water
 - Waste
 - Transports



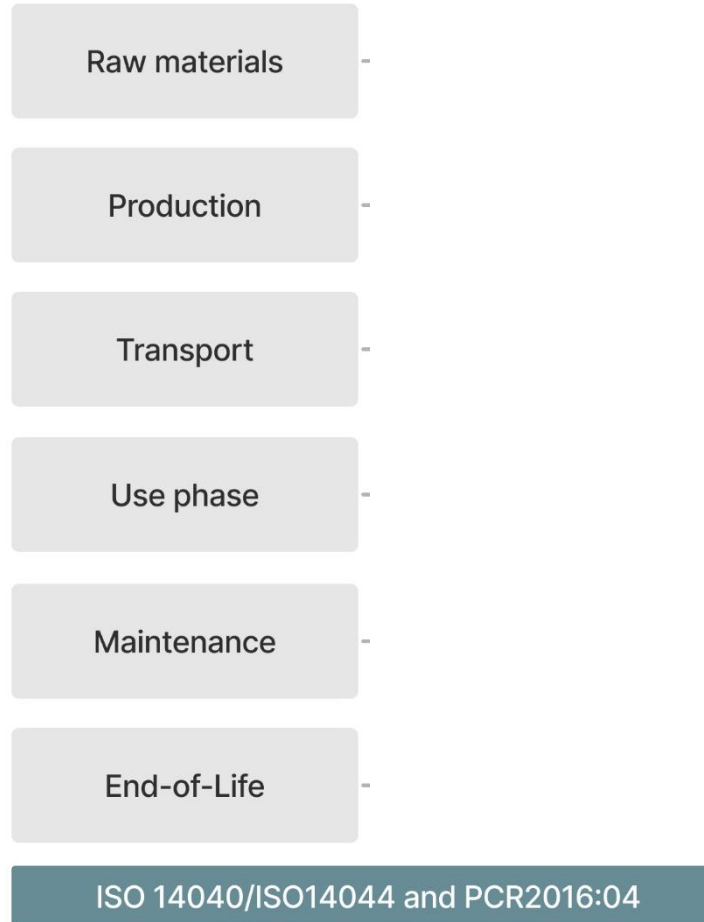
Need to simplify...

- Group into phases of the life cycle
- Cut circular flows
- Collect information for each phase on
 - Used resources
 - Consumption of fuel and electricity
 - Emissions to air, water and land



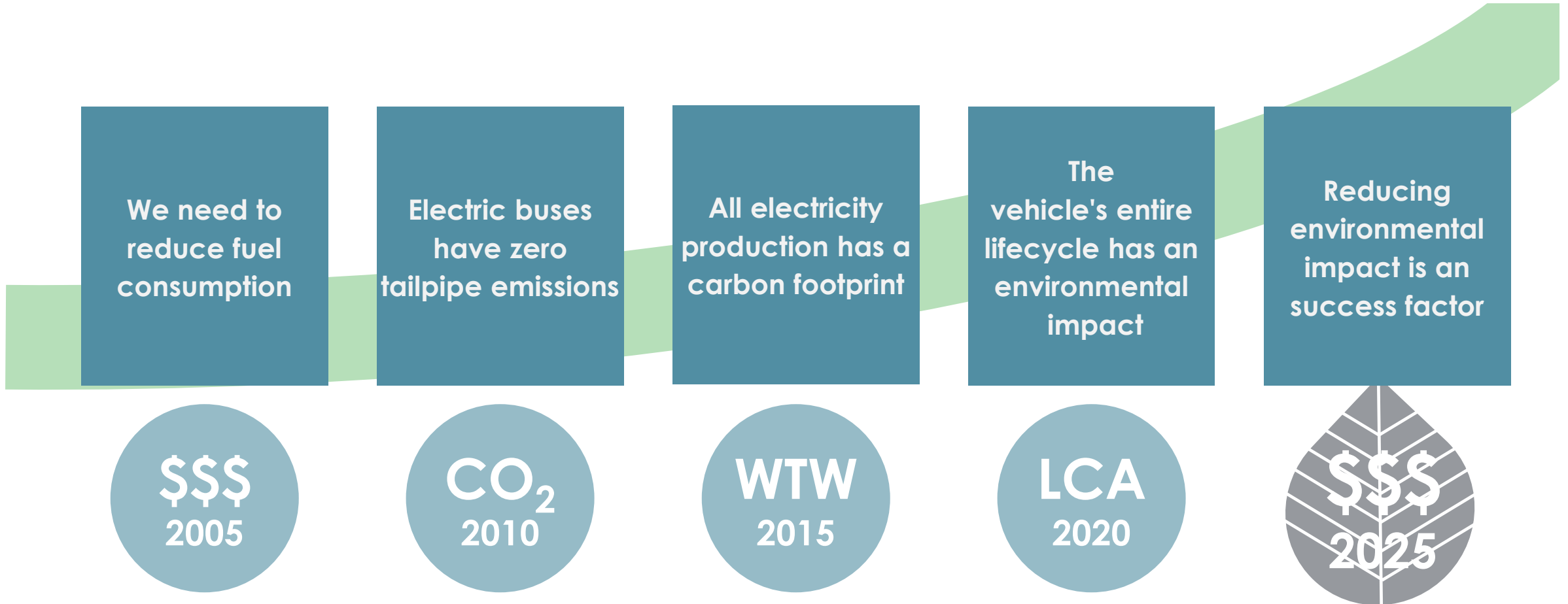
Prepare EPD

- Collect information
- Make environmental impact assessment according to PCR2016:04
- Third party review of LCA
- Publish EPD



Summary

Next phase in the learning curve



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THANK YOU