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# Quality assessment of life cycle inventory data for composites

Moutik, B

Southern Counties Materials, Minerals & Mining Society

# Quality assessment of life cycle inventory data for Composites


**Chair: Prof. John Summerscales**

**Presenter: Badr Moutik**

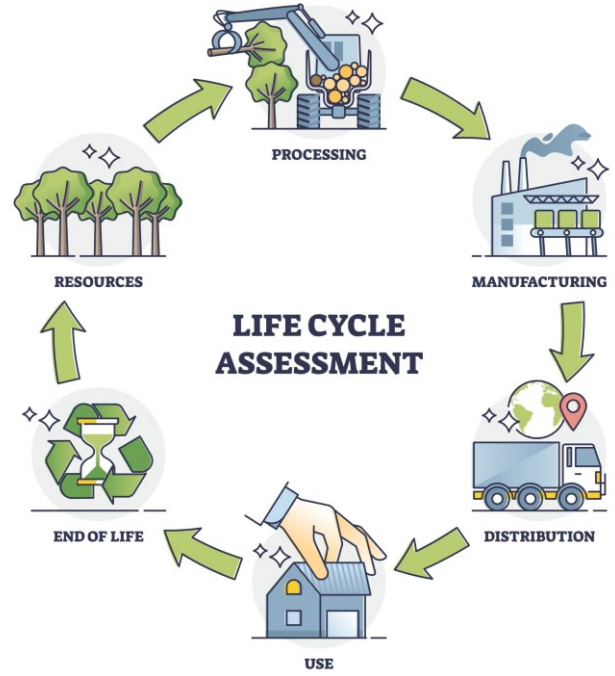
Jasper Graham-Jones, and Richard Pemberton

UNIVERSITY OF PLYMOUTH

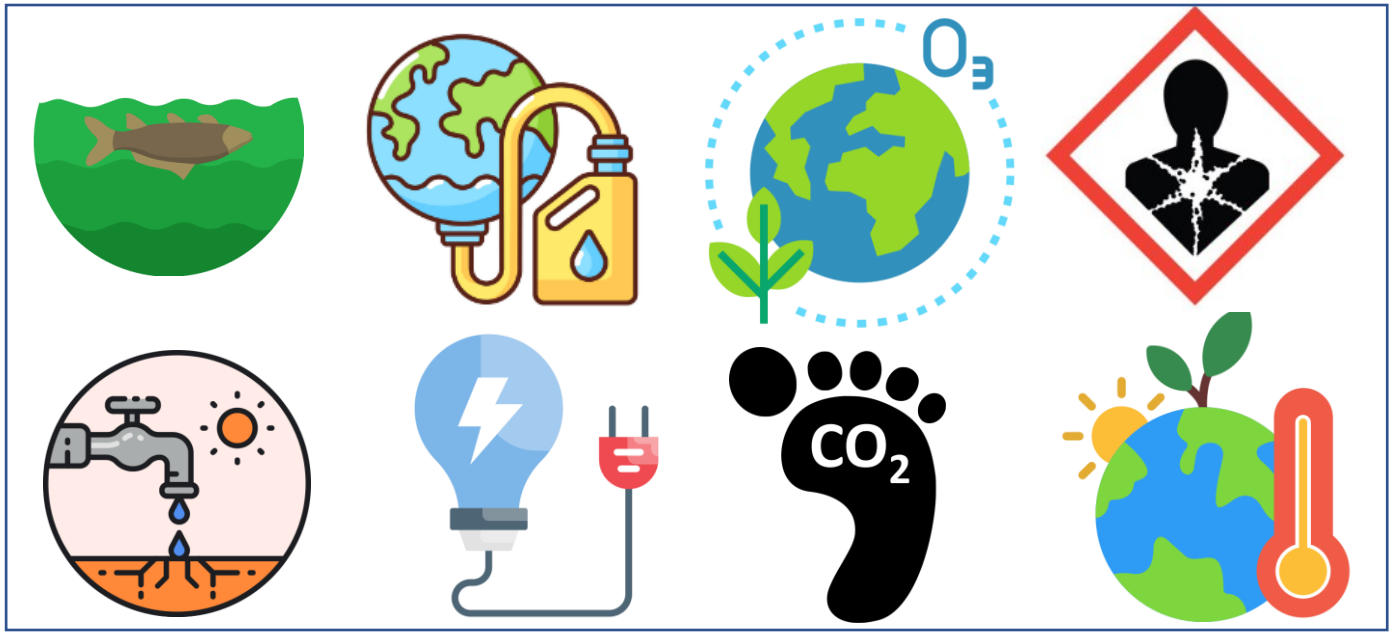
# WHAT IS LIFE CYCLE ASSESSMENT (LCA)?

**LCA** is the “compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle” *(ISO,2006)*

**Product Life Cycle**

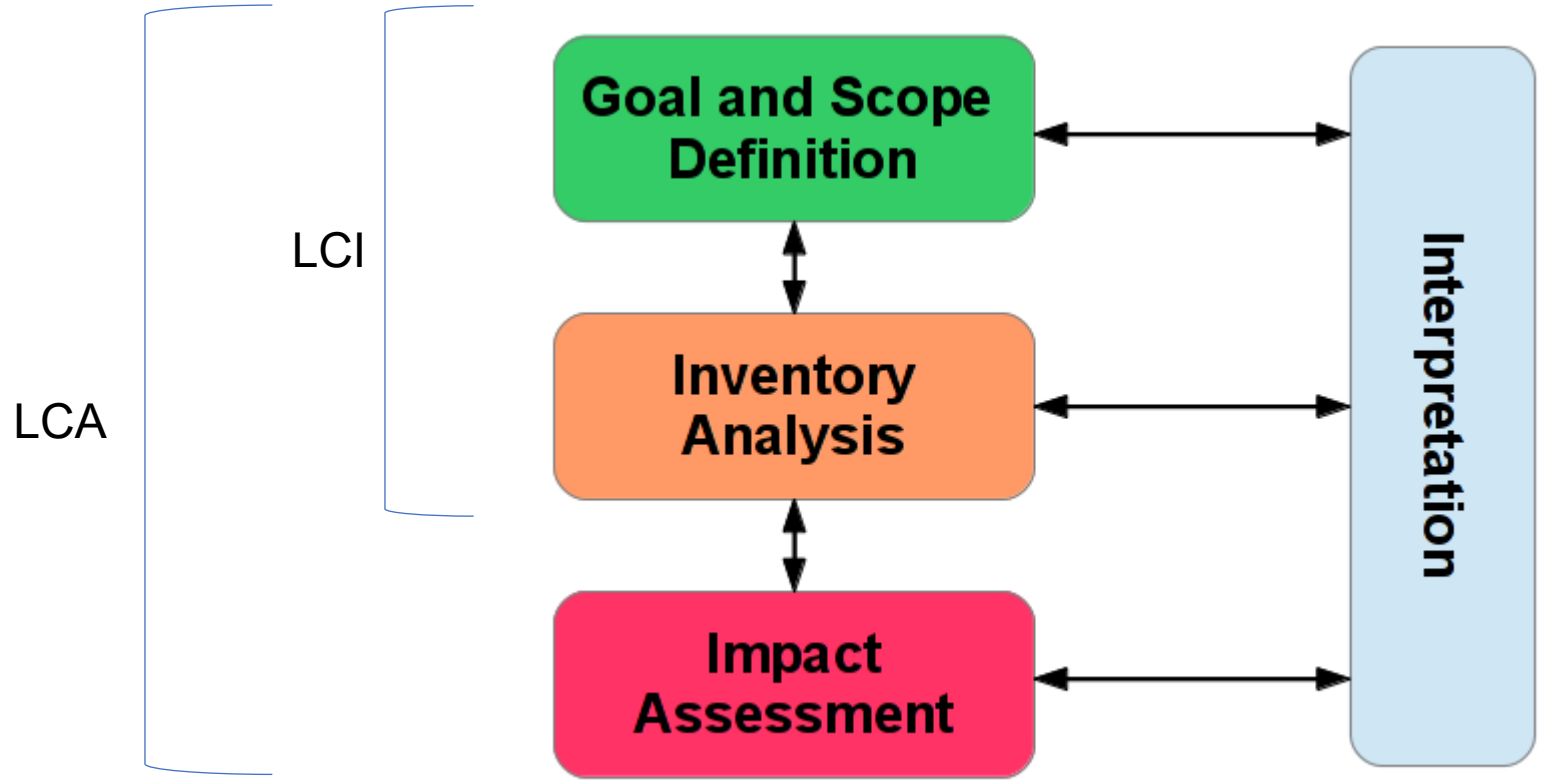



**Environmental impacts**

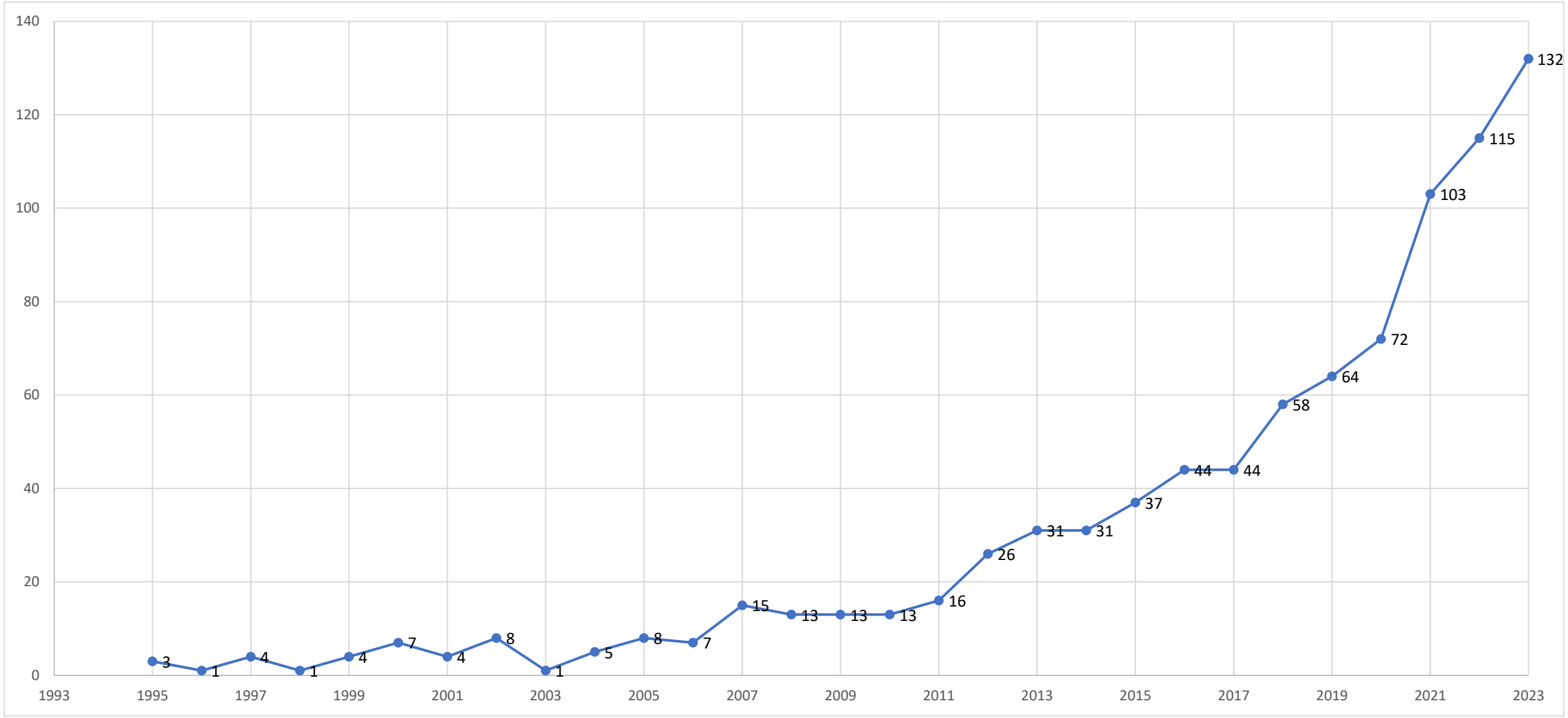


## LIFE CYCLE INVENTORY ANALYSIS (LCI)

**LCI** is a phase of life cycle assessment involving the compilation and quantification of inputs and outputs for a product throughout its life cycle *(ISO,2006)*



# BACKGROUND: EVOLUTIONARY TREND OF LCA RESEARCH PUBLICATIONS IN COMPOSITE



# BACKGROUND: REGULATORY CONTEXT: THE FRAMEWORKS SHAPING SUSTAINABILITY

EUROPEAN
COMMISSION

Brussels, 22.3.2023
COM(2023) 166 final

2023/0085 (COD)

Proposal for a

**DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL**

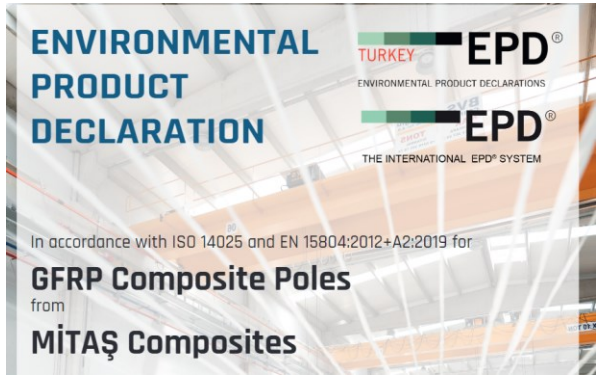
**on substantiation and communication of explicit environmental claims (Green Claims Directive)**



Green Claims Code - get

# BACKGROUND: ENVIRONMENTAL PRODUCT DECLARATIONS AND REPORTS

ecoinvent




ENVIRONMENTAL PRODUCT DECLARATION

subor®

In accordance with ISO 14025 and EN 15804:2012+A2:2019 for

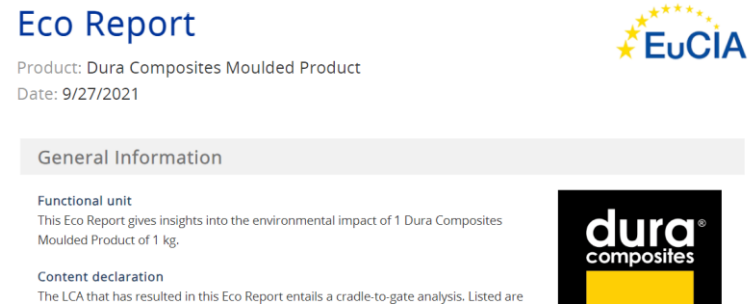
Glassfiber Reinforced Plastic (GRP) Pipes

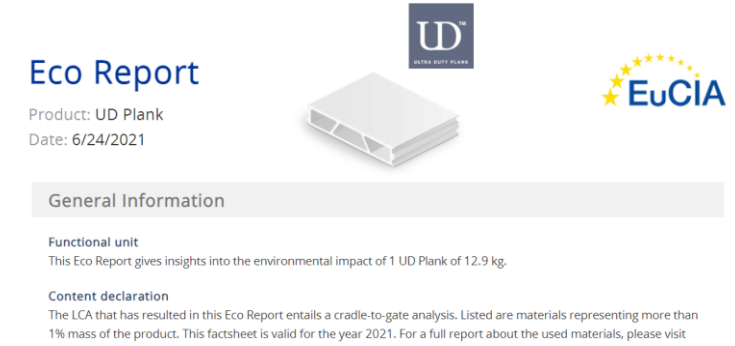
from Subor Boru San. ve Tic. A.Ş.

sphera®

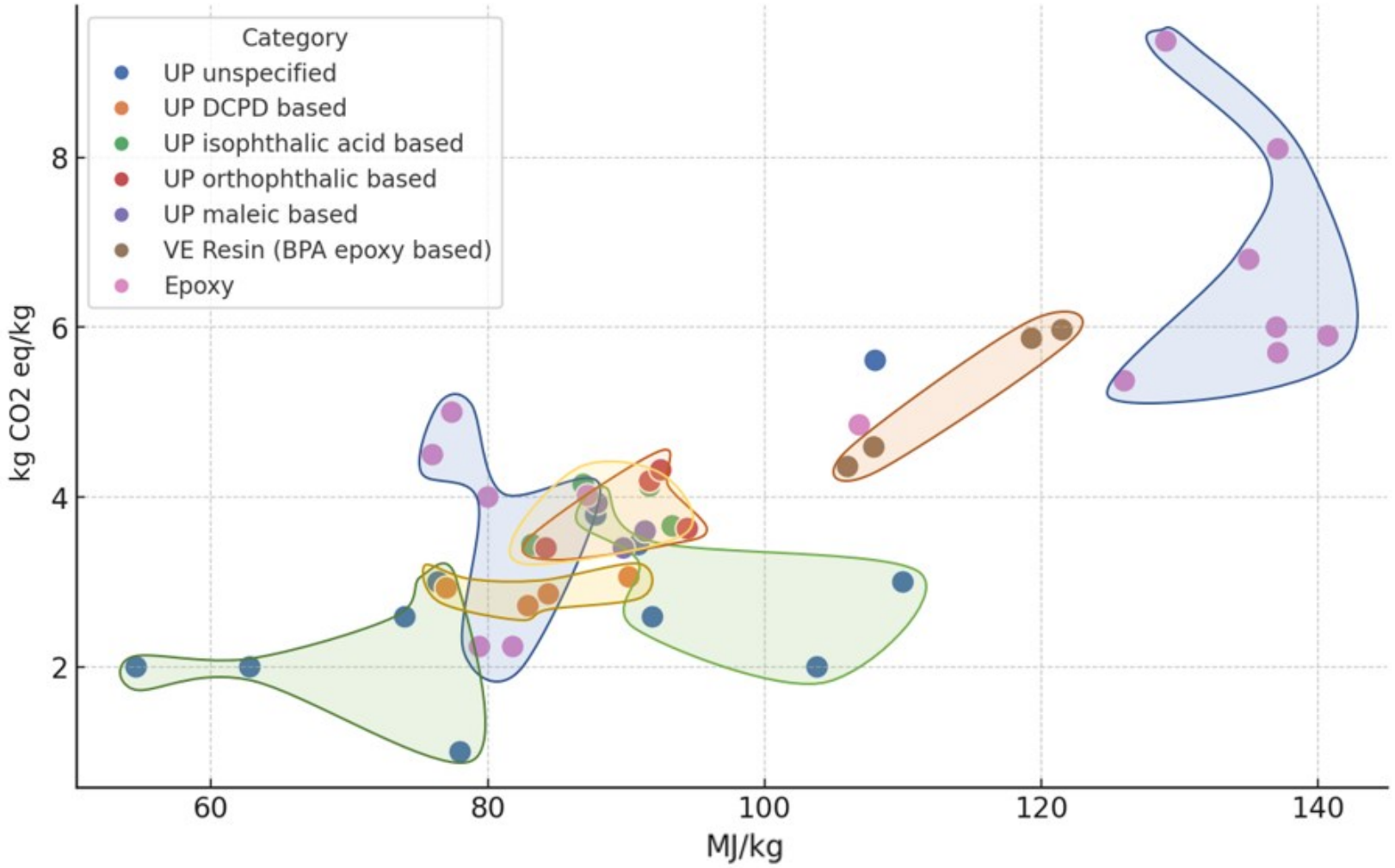


Eco Impact Calculator By EuCIA



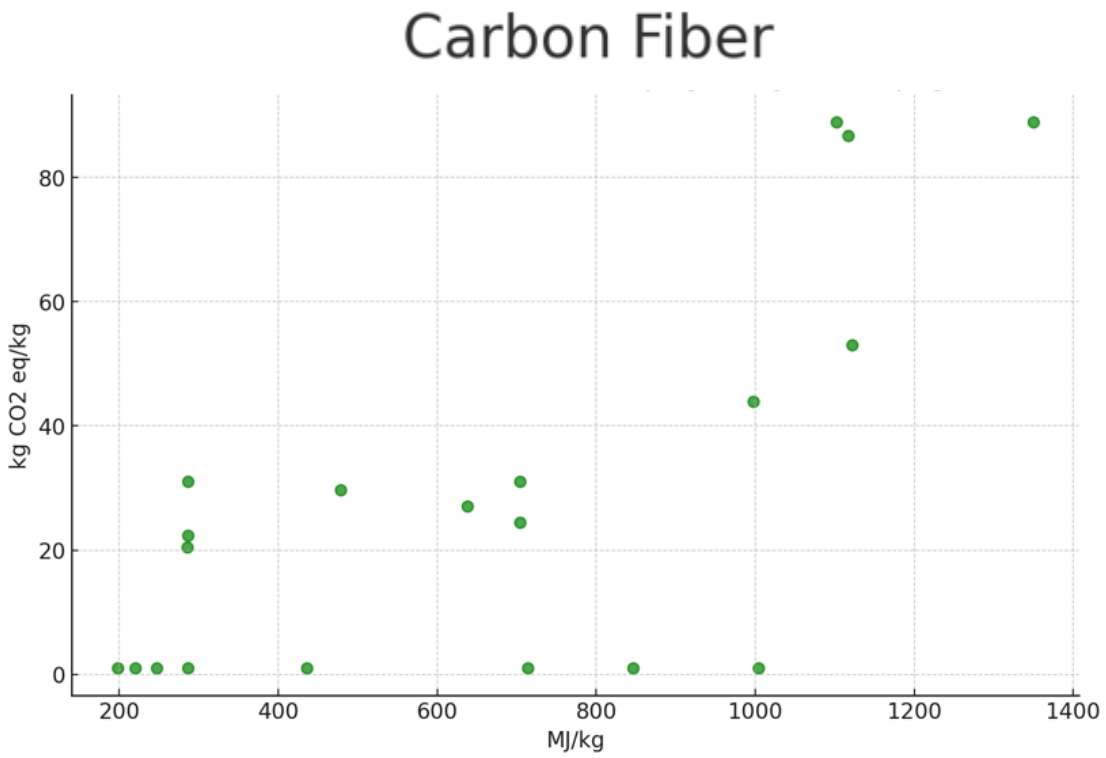



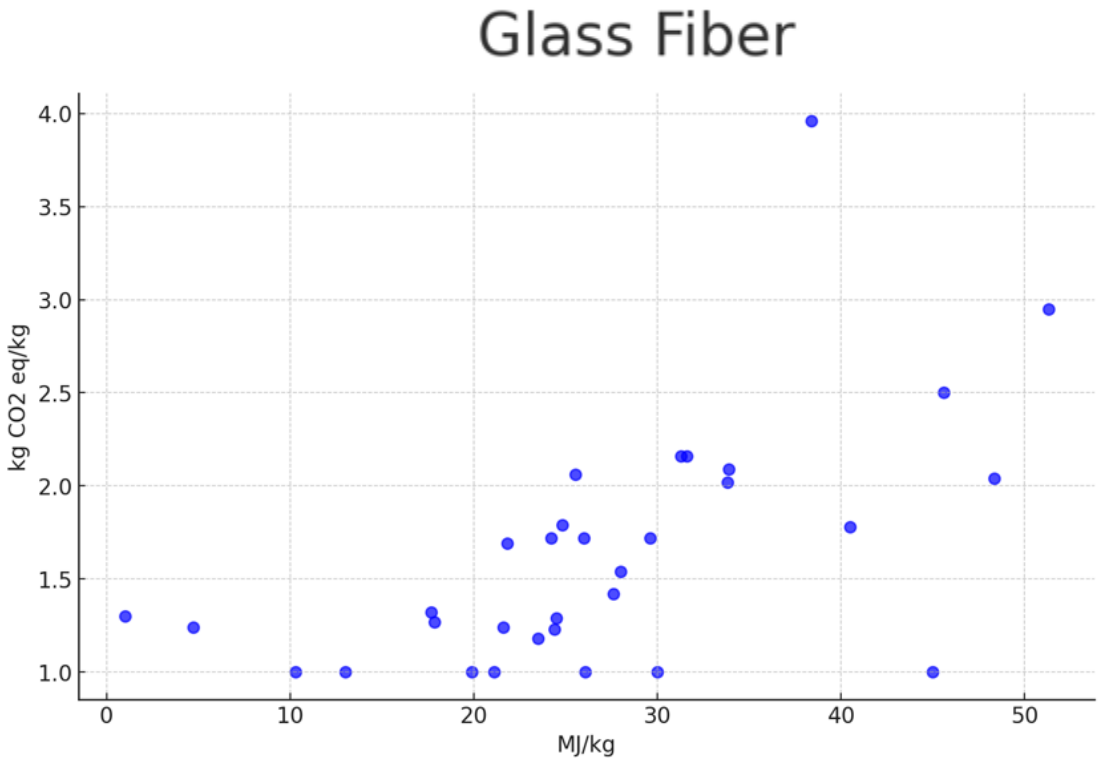
# BACKGROUND: LIFE CYCLE GHG EMISSIONS AND CUMULATIVE ENERGY DEMAND VALUES: RESINS




* GHG: Greenhouse gases emissions

# BACKGROUND: LIFE CYCLE GHG EMISSIONS AND CUMULATIVE ENERGY DEMAND: CARBON FIBER AND GLASS FIBER




Kg CO2 eq: One kg of CO2 equivalent – Global Warming Potential

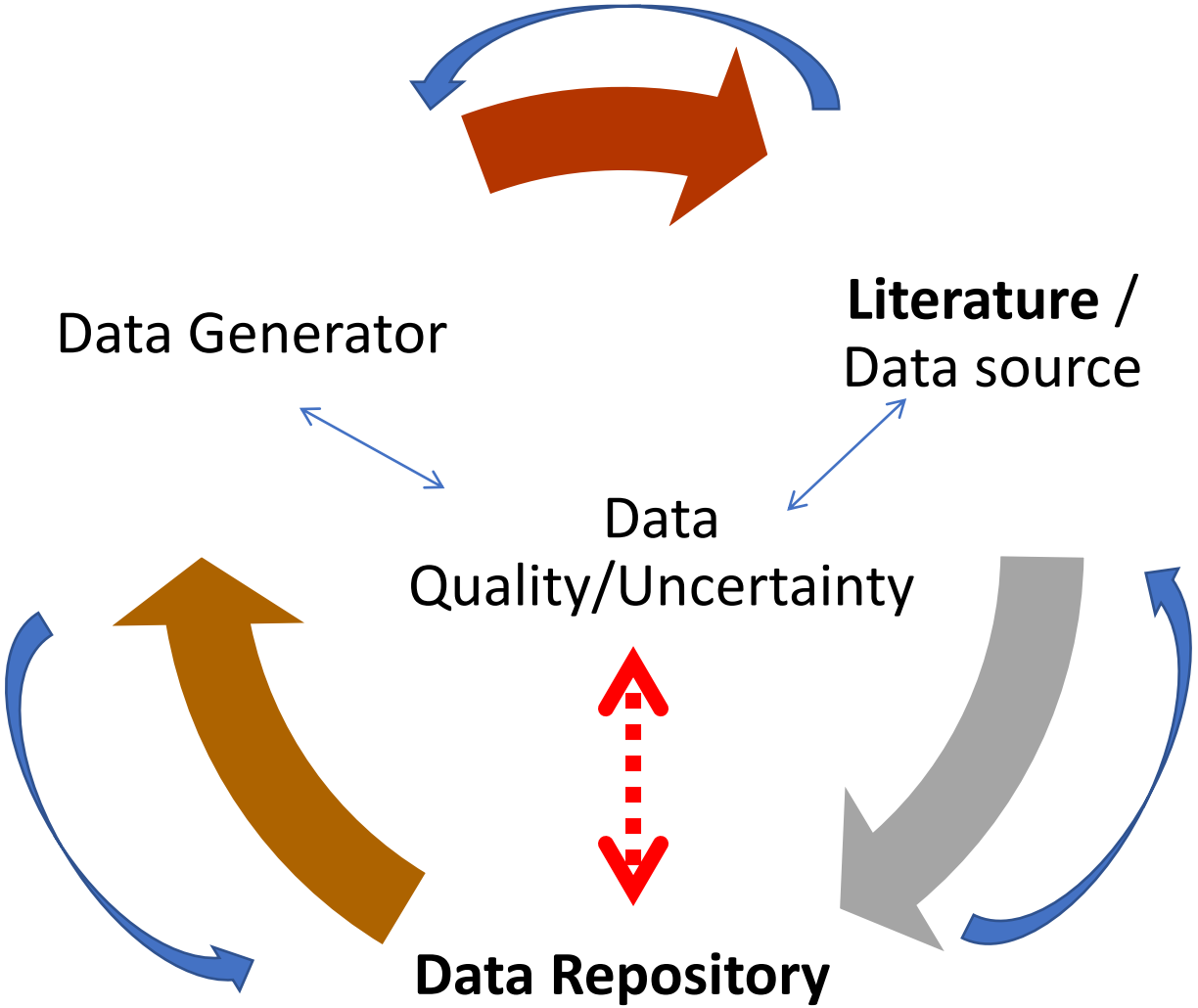
MJ: Megajoules – Cumulative Energy Demand

* The LCA data presented in this graph includes all moduli of glass-reinforced plastic (GRP) and carbon-reinforced plastic (CF) combined

# DATA QUALITY ASSESSMENT

“You can’t manage what you can’t measure.”

# LCA DATA LIFECYCLE



# Major LCI data sources

softwares

databases

sector platforms

literature

SimaPro

openLCA

thinkstep
GaBi

ecoinvent

JRC
EUROPEAN COMMISSION

FEDERAL
LCA
COMMONS

sphera

Eco Impact
Calculator
By EuCIA

MARINESHIFT360

Scopus

ELSEVIER

Springer

literature

# DATA QUALITY IN LCA


ISO 14040/44:2006

- "The characteristics of data that relate to their ability to satisfy **stated requirements**"

- "**Data Quality requirements** shall be specified to enable the **goal** and **scope** of the LCA to be **met**"

# LCA DATA QUALITY REQUIREMENTS

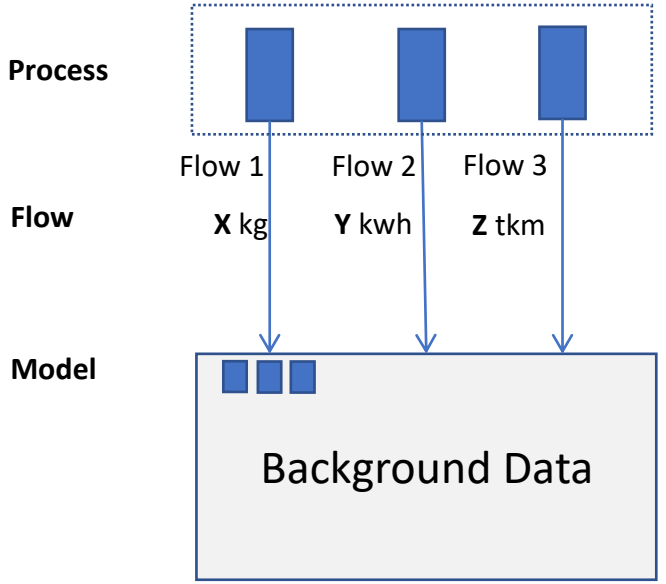
***"where a study is intended to be used in comparative assertions intended to be disclosed to the public, the [following] data quality requirements"*** **shall be addressed**, *(ISO,2006)*

| | | | |
|---|---|---|---|
| Time-related coverage | Geographical coverage | Technology coverage | Precision |
| Completeness | Representativeness | Consistency | Reproducibility |
| | Sources of the data | Uncertainty | |

# DATA QUALITY IN LCA

ISO 14040/44:2006

- Flexibility in determining the approach for addressing DQA-specific areas
- It does not specify to which component, or level, data quality analysis should be applied



# METHODOLOGIES FOR LCI DATA QUALITY ASSESSMENT (DQA)

ILCD handbook
International Reference Life Cycle Data System

General guide for Life Cycle Assessment
- Detailed guidance

First edition

JRC EUROPEAN COMMISSION

ies

European Commission

PEF/OEF

Product/Organisation Environmental Footprint

## Pedigree Matrix

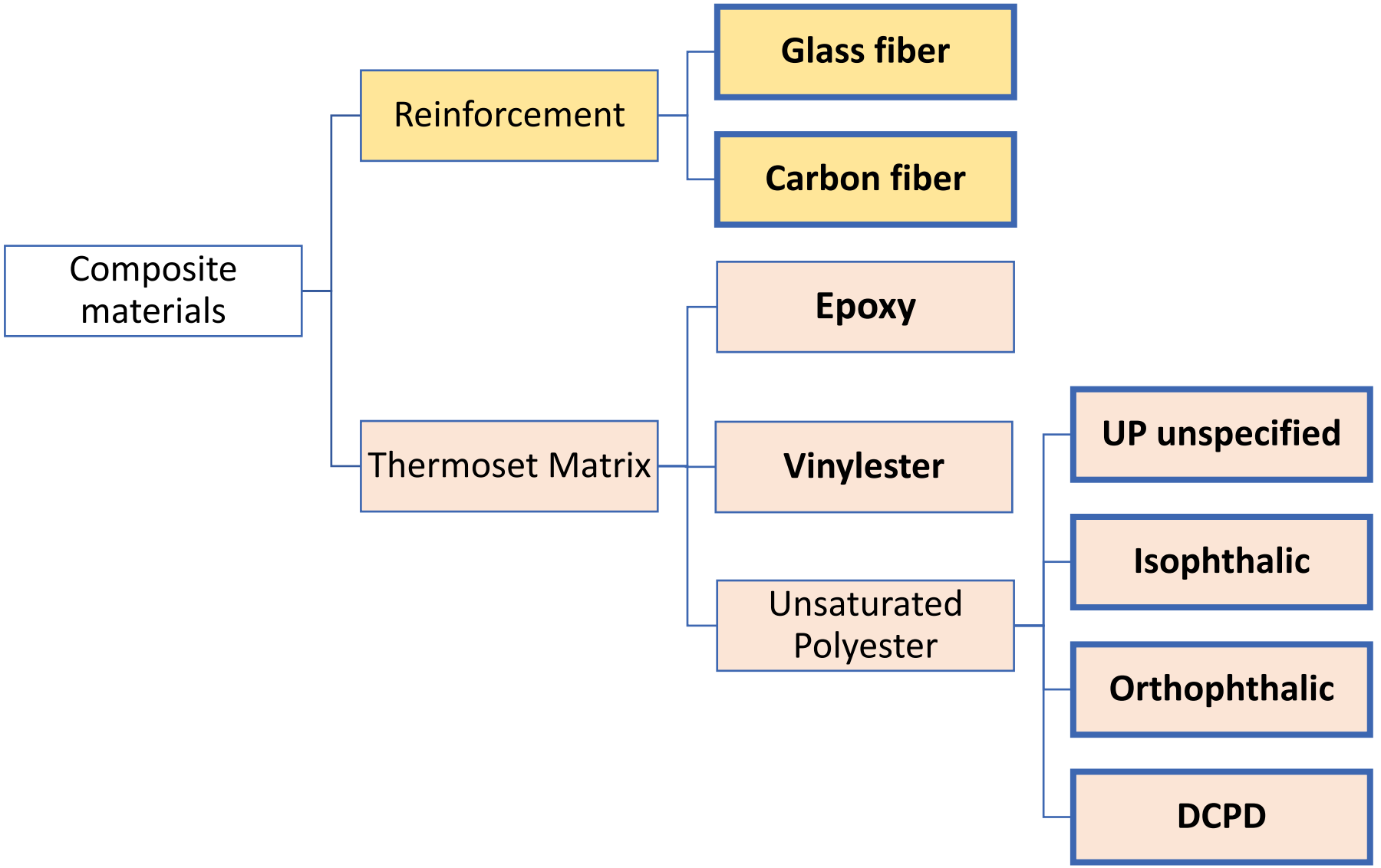
| Indicator score | 1 | 2 | 3 | 4 | 5 (default) |
|---|---|---|---|---|---|
| **Reliability** | Verified[3] data based on measurements[4] | Verified data partly based on assumptions *or* non-verified data based on measurements | Non-verified data partly based on qualified estimates | Qualified estimate (e.g. by industrial expert) | Non-qualified estimate |
| **Completeness** | Representative data from all sites relevant for the market considered, over an adequate period to even out normal fluctuations | Representative data from >50% of the sites relevant for the market considered, over an adequate period to even out normal fluctuations | Representative data from only some sites (<<50%) relevant for the market considered *or* >50% of sites but from shorter periods | Representative data from only one site relevant for the market considered *or* some sites but from shorter periods | Representativeness unknown or data from a small number of sites *and* from shorter periods |
| **Temporal correlation** | Less than 3 years of difference to the time period of the dataset | Less than 6 years of difference to the time period of the dataset | Less than 10 years of difference to the time period of the dataset | Less than 15 years of difference to the time period of the dataset | Age of data unknown or more than 15 years of difference to the time period of the dataset |
| **Geographical correlation** | Data from area under study | Average data from larger area in which the area under study is included | Data from area with similar production conditions | Data from area with slightly similar production conditions | Data from unknown *or* distinctly different area (North America instead of Middle East, OECD-Europe instead of Russia) |
| **Further technological correlation** | Data from enterprises, processes and materials under study | Data from processes and materials under study (i.e. identical technology) but from different enterprises | Data from processes and materials under study but from different technology | Data on related processes or materials | Data on related processes on laboratory scale *or* from different technology |

## U.S Life Cycle Inventory Database

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

# Fiber Reinforced Composite Materials

# FIBER REINFORCED COMPOSITE MATERIALS



# UNSATURATED POLYESTER RESIN INPUT PROCESS DATA SET

| Source UP unspecified | EI | USLCI | SP | Eu Cia |
|---|---|---|---|---|
| **Input from Technosphere: Materials Resources** | | | | |
| Acetic anhydride | ■ | | | |
| Adipic acid | ■ | | | |
| Butadiene | | | | ■ |
| ethylene glycol | ■ | ■ | | ■ |
| ethylene at plant | | ■ | | |
| Maleic anhydride | | ■ | ■ | ■ |
| Neo pentyl glycol | | ■ | | |
| Phthalic anhydride | ■ | ■ | ■ | ■ |
| Polyethylene terephthalate | | ■ | | |
| Purified terephthalic acid | | ■ | | ■ |
| Propylene glycol, liquid | ■ | ■ | ■ | ■ |
| Terephthalic acid | | ■ | | |
| Di ethylene glycol | | | | ■ |
| Ethylene | | ■ | | |
| Tetrabromophthalic acid | | ■ | | |
| Styrene | | ■ | ■ | ■ |
| Catalyst | | | ■ | |
| Nitrogen | | | ■ | ■ |
| chemical factory, organics | ■ | | | ■ |

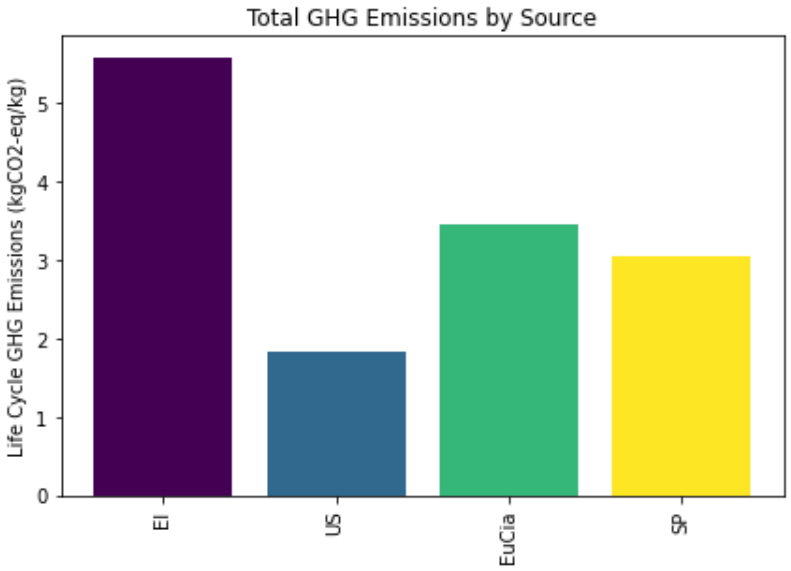
| Input from environment | | | | |
|---|---|---|---|---|
| Water for cooling | ■ | | | |
| Water | ■ | ■ | | |
| **Input from Technosphere: Energy** | | | | |
| electricity, medium voltage | ■ | ■ | ■ | ■ |
| heat natural gas | ■ | ■ | ■ | ■ |
| Heat Fuel | ■ | | | |
| Heat Diesel | | ■ | | |
| Steam | | | | ■ |
| **Input from technosphere: Transport** | | | | |
| Transport combined | | ■ | | ■ |
| Transport , Train, Diesel Powered | | ■ | | |

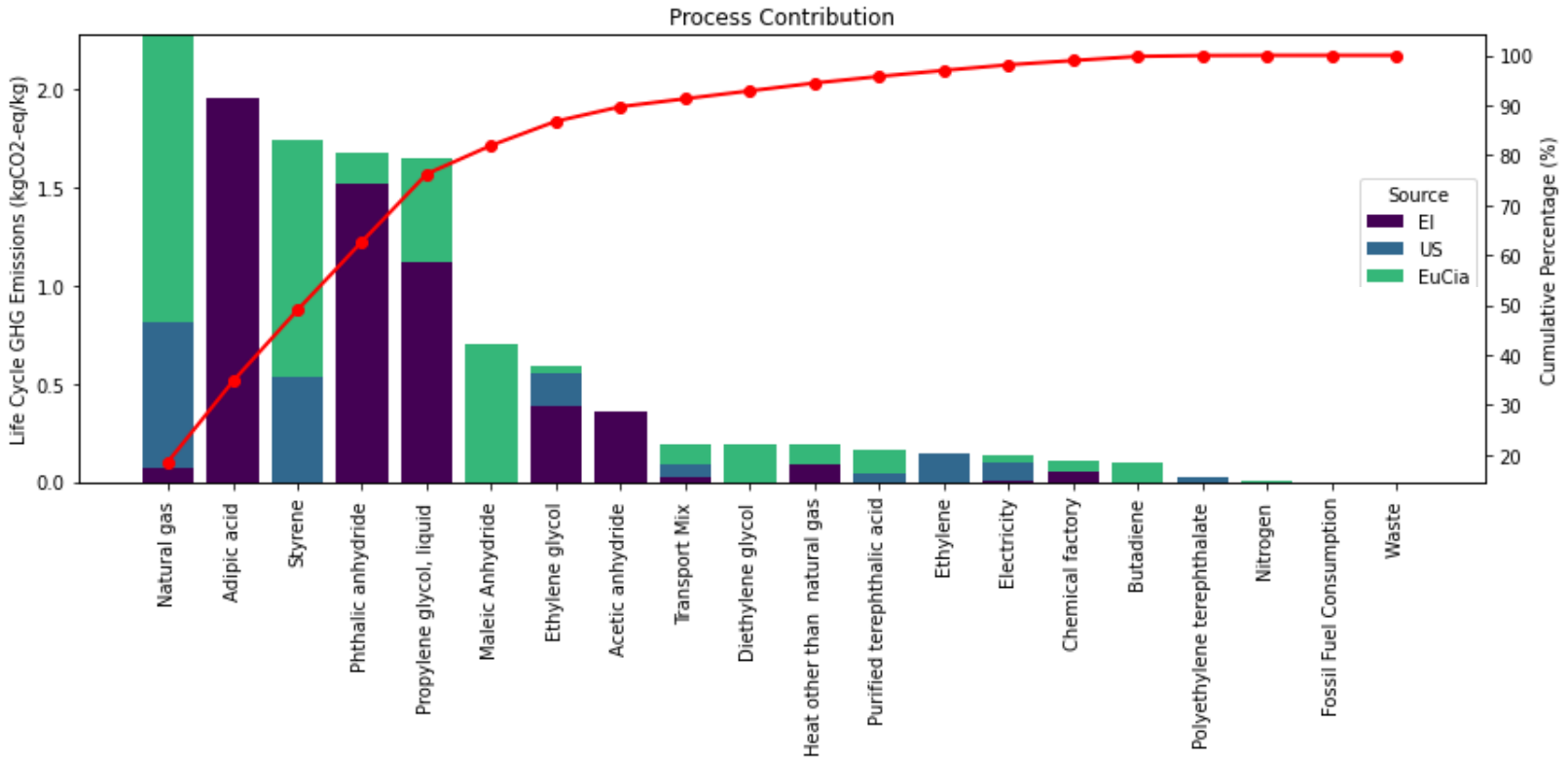
# UNSATURATED POLYESTER RESIN OUTPUT PROCESS DATA SET

| **Output** | | | | |
|---|---|---|---|---|
| **Source UP unspecified** | **EI** | **US** | **SP** | **Eu Cia** |
| 1-Butanol | | | | |
| Carbon dioxide, fossil | | | | |
| Carbon monoxide | | | | |
| Dicyclopentadiene | | | | |
| Ethylene glycol | | | | |
| Heat, waste | | | | |
| Hydrocarbons, unspecified | | | | |
| Maleic anhydride | | | | |
| Methane | | | | |
| Methyl methacrylate | | | | |
| Nitrogen oxides | | | | |
| Hydrocarbons, unspecified | | | | |
| Particulates, > 2.5 um, and < 10um | | | | |
| Particulates, < 2.5 um | | | | |
| Particulates, unspecified | | | | |
| O-phthalic acid | | | | |
| Styrene | | | | |
| Sulfur oxides | | | | |
| Toluene, vinyl | | | | |
| NMVOC, non-methane volatile organic compounds | | | | |
| Xylene | | | | |
| Emissions to water | | | | |

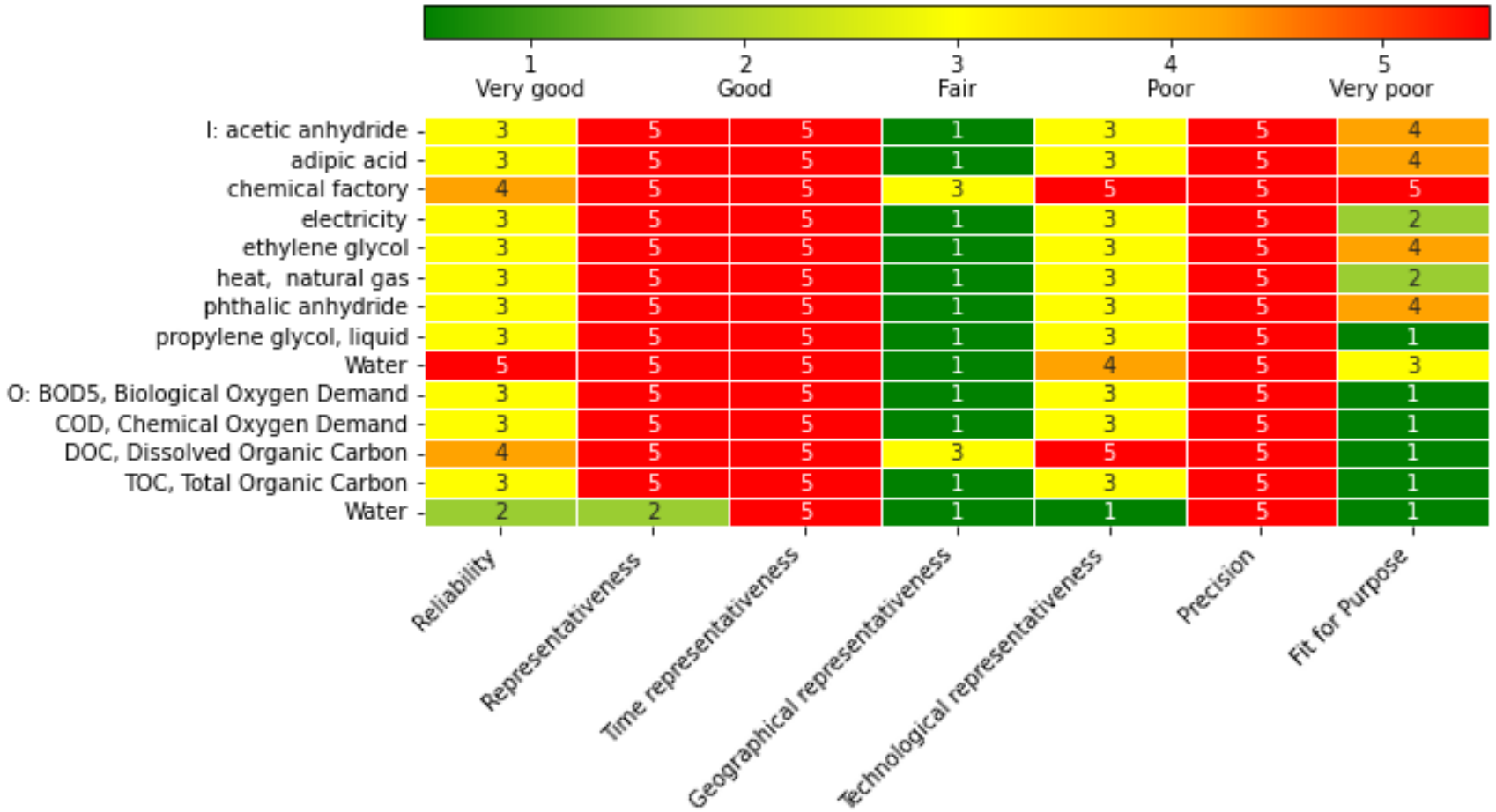
| | | | | |
|---|---|---|---|---|
| Aluminium | | | | |
| BOD5 (Biological Oxygen Demand) | | | | |
| Cadmium | | | | |
| Chromium | | | | |
| COD (Chemical Oxygen Demand) | | | | |
| Cyanide | | | | |
| Suspended solids, unspecified | | | | |
| Lead | | | | |
| Nickel | | | | |
| Oils, unspecified | | | | |
| Suspended solids, unspecified | | | | |
| DOC, Dissolved Organic Carbon | | | | |
| TOC, Total Organic Carbon | | | | |
| Water, RER | | | | |
| Zinc | | | | |
| Unsaturated Polyester resin scrap | | | | |
| **Outputs to technosphere: Waste** | | | | |
| Disposal solid waste to municipal incineration | | | | |
| Disposal solid waste to waste energy | | | | |
| Disposal solid waste to sanitary landfill | | | | |
| Hazardous waste incineration | | | | |
| Wastewater | | | | |

# LIFE CYCLE GHG EMISSIONS: CONTRIBUTION ANALYSIS



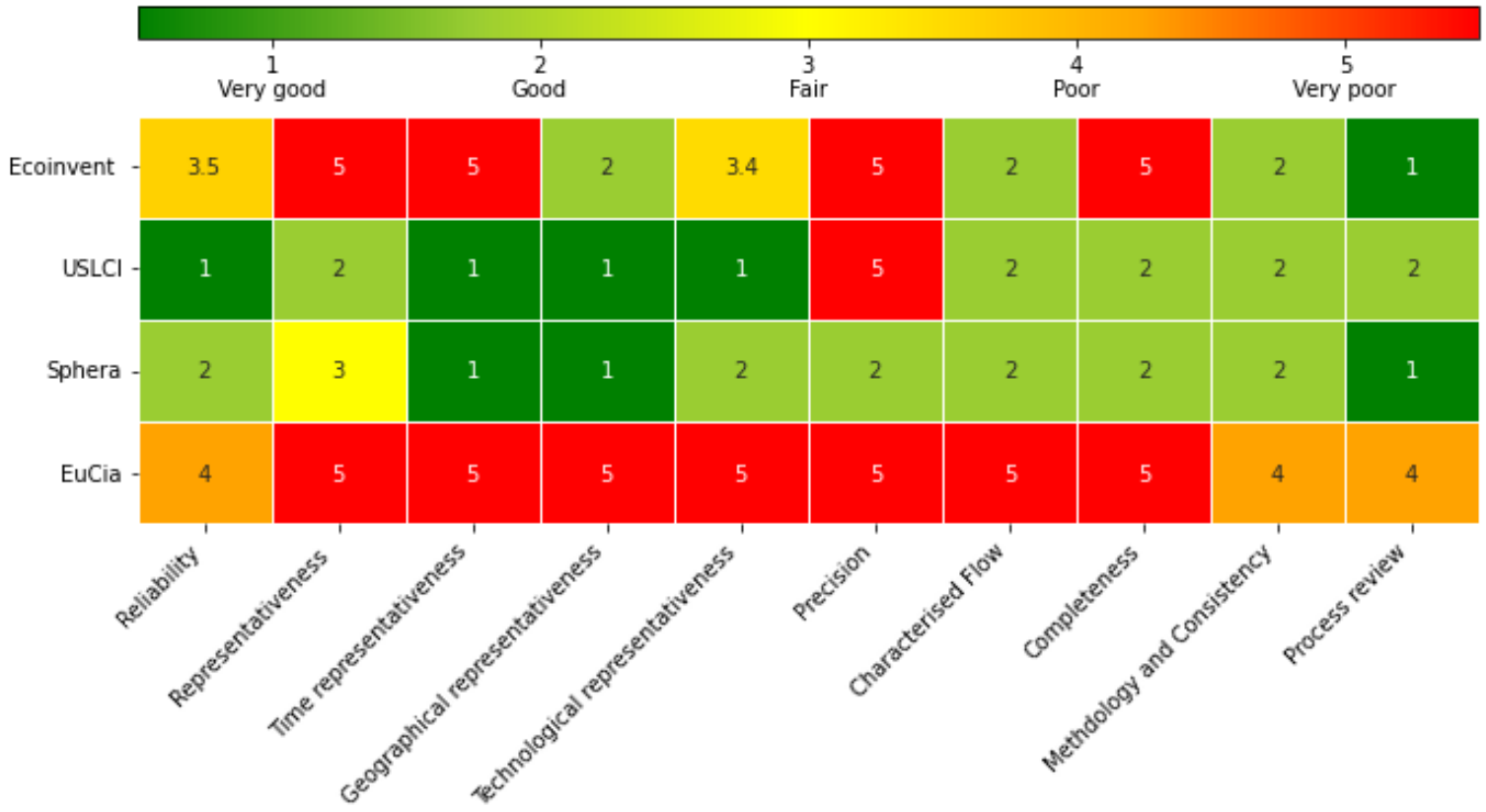



# DATA QUALITY ASSESSMENT @ FLOW LEVEL: UNSATURATED POLYESTER RESIN




- Ecoinvent
- Polyester resin production, unsaturated – RER (Europe)
- Period : 1995-01-01 to 2021-12-31

# DATA QUALITY ASSESSMENT @ PROCESS LEVEL: UNSATURATED POLYESTER RESIN




| Source | Location | Period |
|---|---|---|
| Ecoinvent | RER | 1995 - 2021 |
| USLCI | US | 2010 - 2011 |
| Sphera | DE | 2019 - 2022 |
| EuCia | RER | 2015 - 2022 |

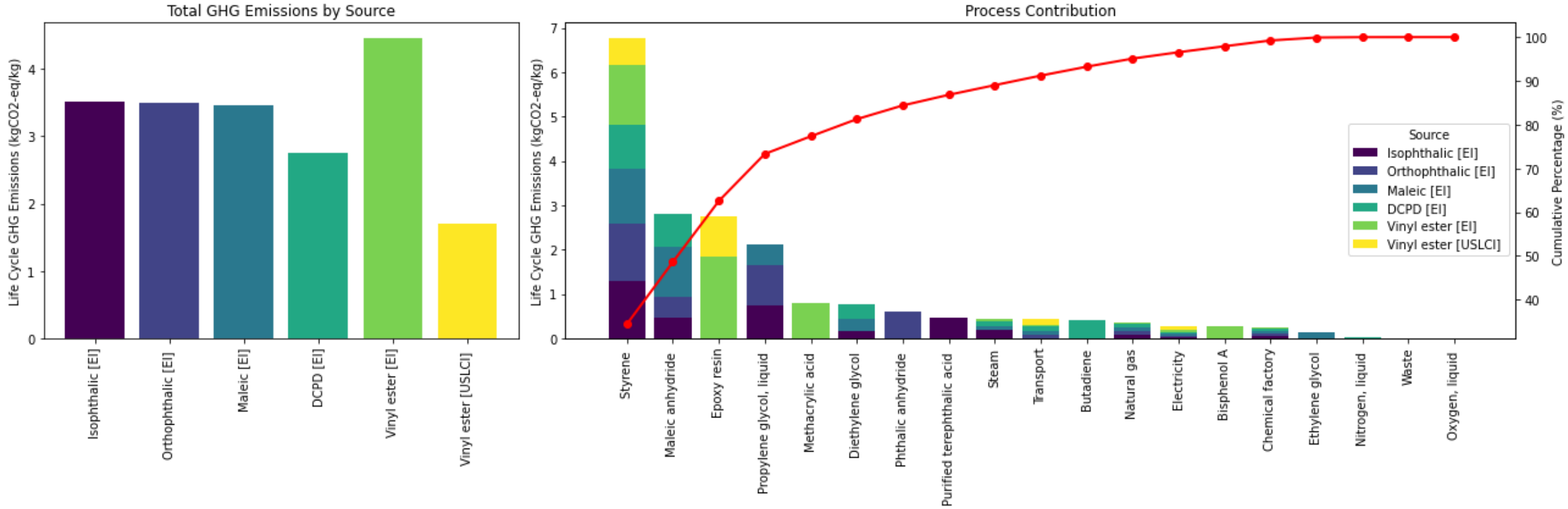
# UNSATURATED POLYESTER RESINS INPUT PROCESS DATA SET

| Source | ISO | Ortho | DCPD | Vinyl | Vinyl US |
|---|---|---|---|---|---|
| **Input from technosphere: Materials Resources** | | | | | |
| Bisphenol A, powder | | | | | |
| Acrylic acid | | | | | |
| Epoxy | | | | | |
| Diethylene glycol | | | | | |
| Maleic anhydride | | | | | |
| Methacrylic acid | | | | | |
| Butadiene | | | | | |
| Propylene glycol | | | | | |
| Purified terephthalic acid | | | | | |
| Styrene | | | | | |
| Oxygen, liquid | | | | | |
| Nitrogen, liquid | | | | | |
| Chemical factory | | | | | |
| Phthalic anhydride | | | | | |
| Silica Sand | | | | | |
| Electricity, low voltage | | | | | |
| Electricity, renewable energy | | | | | |
| Heat | | | | | |
| Steam, in chemical industry | | | | | |
| Input from technosphere: Transport | | | | | |
| Transport combined truck | | | | | |
| Transport , Train, Diesel Powered | | | | | |
| Transport ocean freighter | | | | | |
| **Input from environment** | | | | | |
| Water | | | | | |

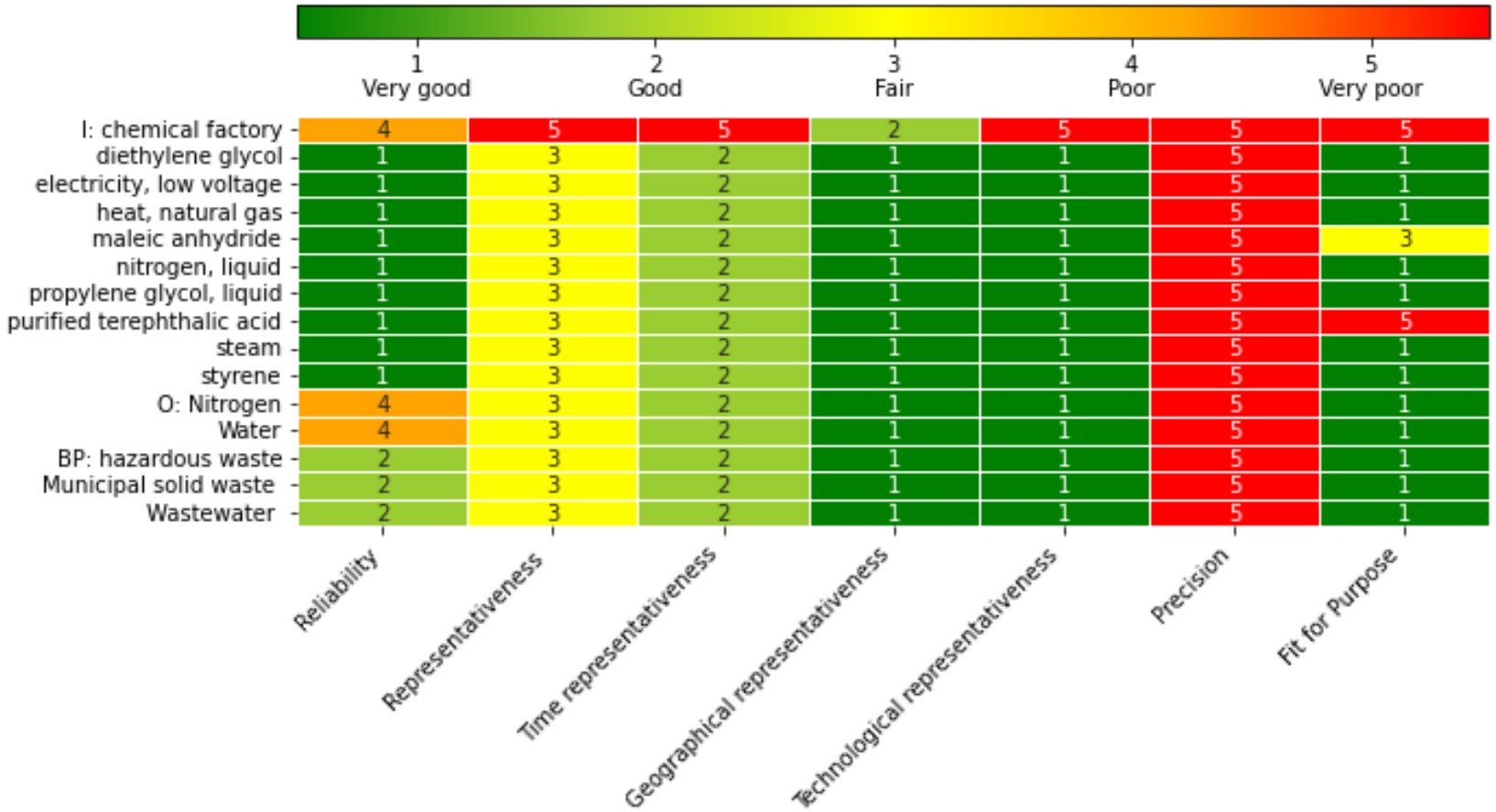
# UNSATURATED POLYESTER RESINS OUTPUT PROCESS DATA SET

| Source | ISO | Ortho | DCPD | Vinyl | Vinyl US |
|---|---|---|---|---|---|
| Nitrogen, atmospheric | | | | | |
| NMVOC, non-methane volatile organic compounds | | | | | |
| Methyl methacrylate | | | | | |
| Particulate matter | | | | | |
| Emissions to water | | | | | |
| Water/m3 | | | | | |
| Hazardous waste, for incineration | | | | | |
| Municipal solid waste | | | | | |
| Wastewater | | | | | |
| Municipal solid waste to landfill | | | | | |
| Solid waste to incineration with energy recovery | | | | | |
| Solid waste to incineration without energy recovery | | | | | |
| Recycling Solid waste | | | | | |

# LIFE CYCLE GHG EMISSIONS: UNSATURATED POLYESTER RESINS

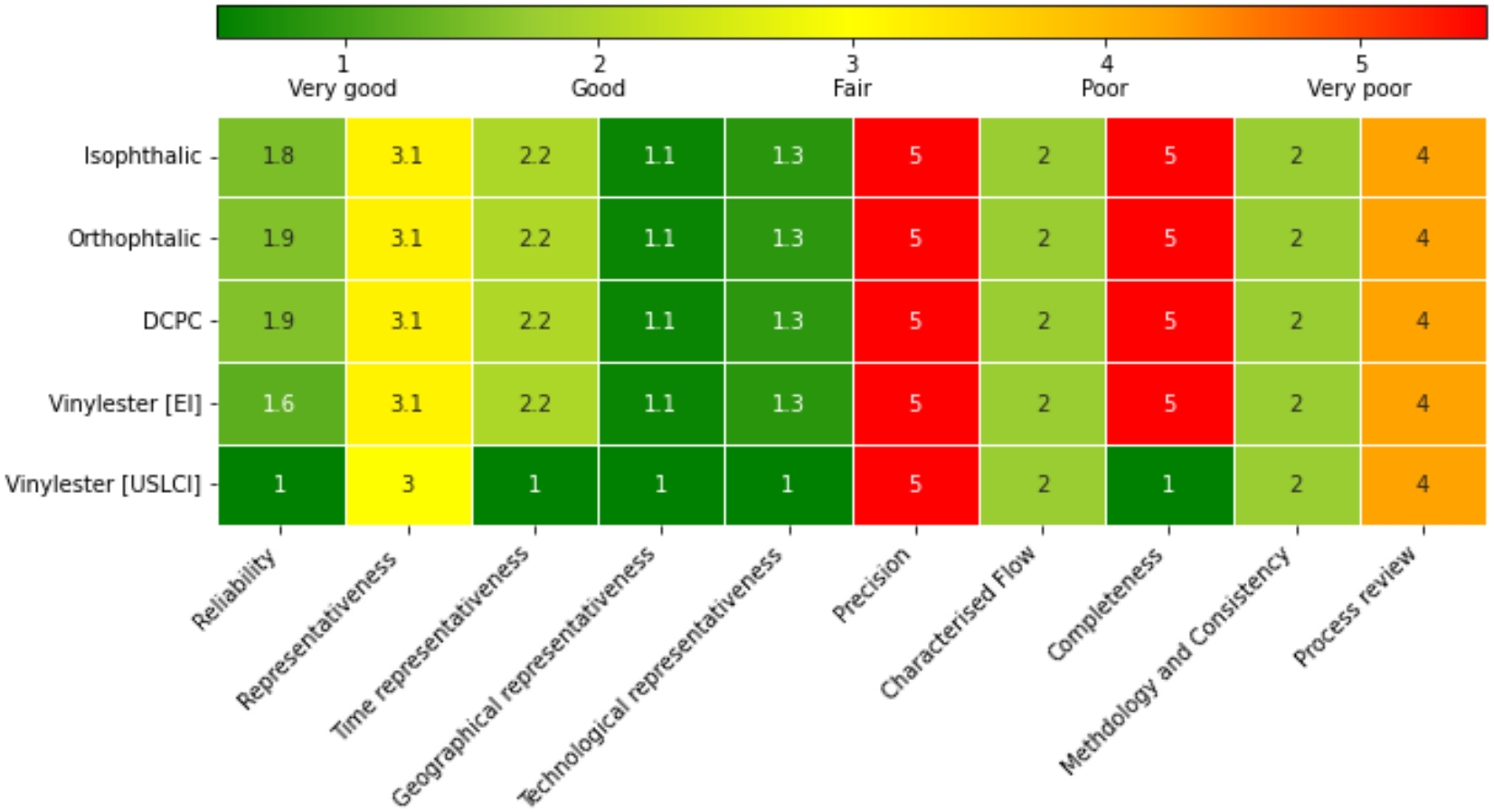


# DATA QUALITY ASSESSMENT @ FLOW LEVEL: ISOPHTHALIC UNSATURATED POLYESTER RESIN




- Ecoinvent/EuCia
- isophthalic acid based unsaturated polyester resin production – RER
- Period : 2013 to 2022

# DATA QUALITY ASSESSMENT @ PROCESS LEVEL: UNSATURATED POLYESTER RESINS




| Source | Location | Period |
|---|---|---|
| Ecoinvent | RER | 2013 - 2022 |
| USLCI | US | 2021 - 2022 |

# EPOXY INPUT PROCESS DATA SET

| Source Epoxy | EI | PE | US | Sphera |
|---|---|---|---|---|
| Bisphenol A, powder | ■ | ■ | | ■ |
| Epichlorohydrin | ■ | ■ | | ■ |
| Nitrogen | | | | ■ |
| Sodium hydroxide, without water | ■ | ■ | | ■ |
| Isopropanol | | | | ■ |
| Hydraulic Acid | | | | ■ |
| Catalyst | | | ■ | ■ |
| Styrene | | | | ■ |
| Oxygen, liquid | | | | ■ |
| Nitrogen, liquid | ■ | | | ■ |
| Chemical factory | ■ | | | ■ |
| Crude oil | | ■ | ■ | |
| Electricity, low voltage | ■ | ■ | ■ | ■ |
| Heat | ■ | ■ | ■ | ■ |
| Steam, in chemical industry | ■ | ■ | | ■ |
| Electricity Mix | | ■ | | ■ |
| Water, cooling, unspecified natural origin | ■ | | | |
| Water, river | ■ | | | |
| Water, well, in ground | ■ | | | |
| Deonised Water | | ■ | | ■ |

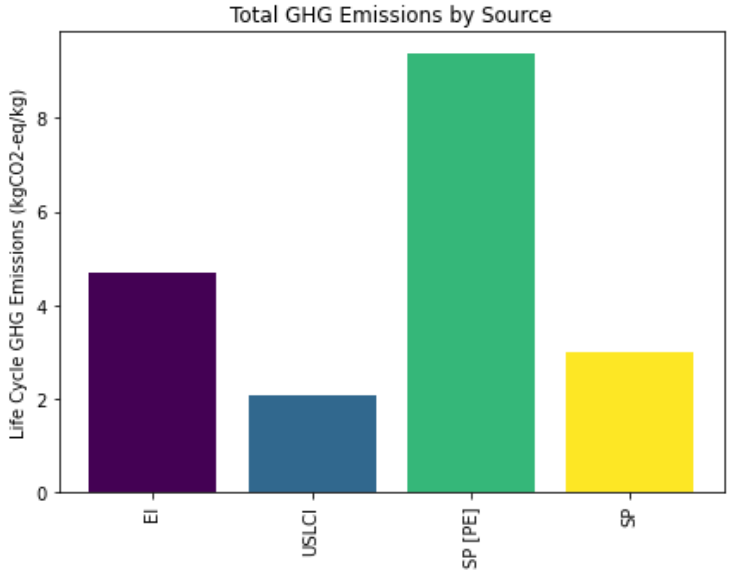
| | | | | |
|---|---|---|---|---|
| Deionised water | | | ■ | |
| Quartz sand | | | ■ | |
| Packaging | | ■ | | |
| Electricity, medium voltage | ■ | ■ | ■ | ■ |
| Heat, district or industrial, natural gas | ■ | ■ | ■ | ■ |
| Propane | | ■ | | |
| Light fuel oil | | ■ | | |
| Heavy fuel oil | | ■ | | |
| Oxygen | | ■ | | |
| **Input from Technosphere: Transport** | | | | |
| Transport | | ■ | | ■ |
| River transport | | ■ | | ■ |
| Rail transport | | ■ | | ■ |
| Road transport | | ■ | | ■ |

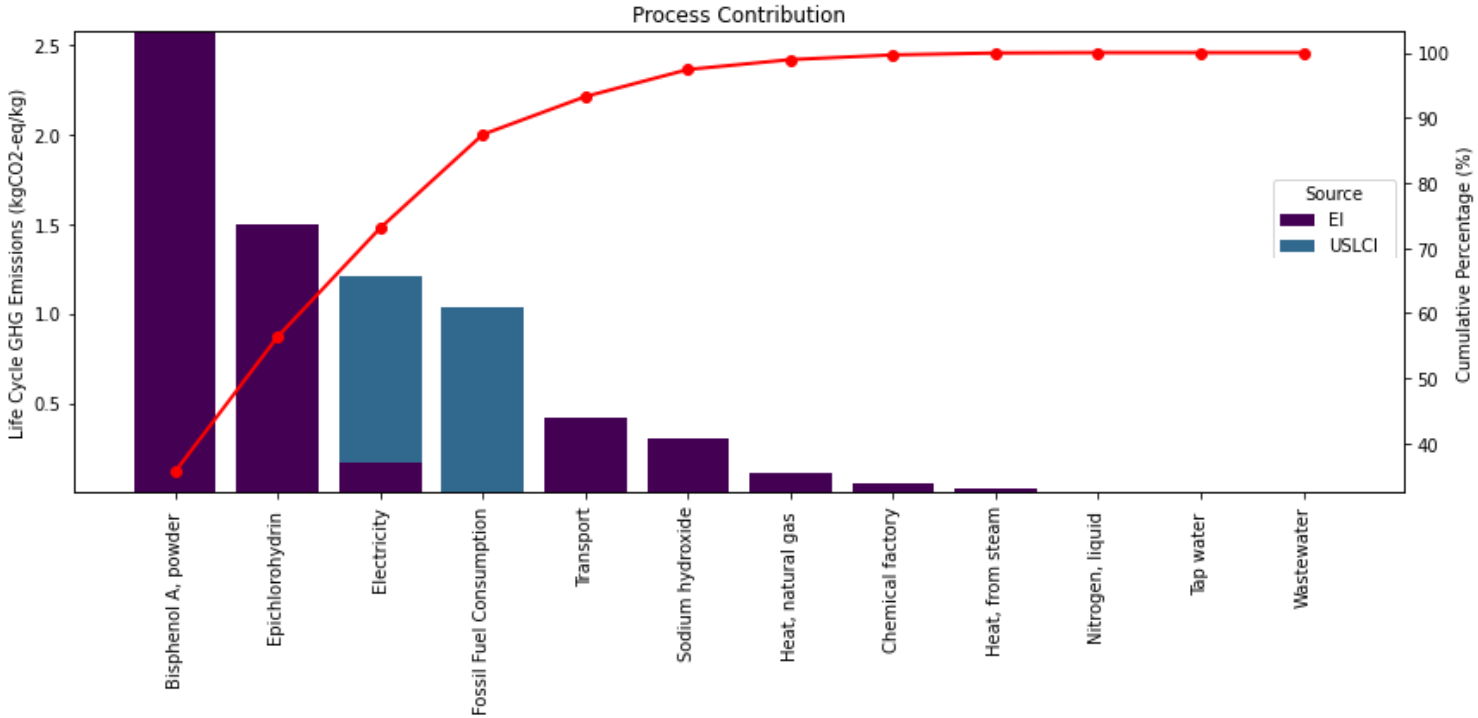
# EPOXY OUTPUT PROCESS DATA SET

| **Output: Emission to Air** | | | | |
|---|---|---|---|---|
| Antimony | | | | |
| Arsenic | | | | |
| Cadmium | | | | |
| Carbon dioxide, fossil | | | | |
| Hydrogen chloride | | | | |
| Hydrogen fluoride | | | | |
| Nitrogen oxides | | | | |
| NMVOC, non-methane volatile organic compounds | | | | |
| Particulates, < 2.5 um | | | | |
| Particulates, > 10 um | | | | |
| Particulates, > 2.5 um, and < 10um | | | | |
| Sulfur dioxide | | | | |
| **Emissions to Water** | | | | |
| Water/m3 | | | | |
| Water, RER | | | | |

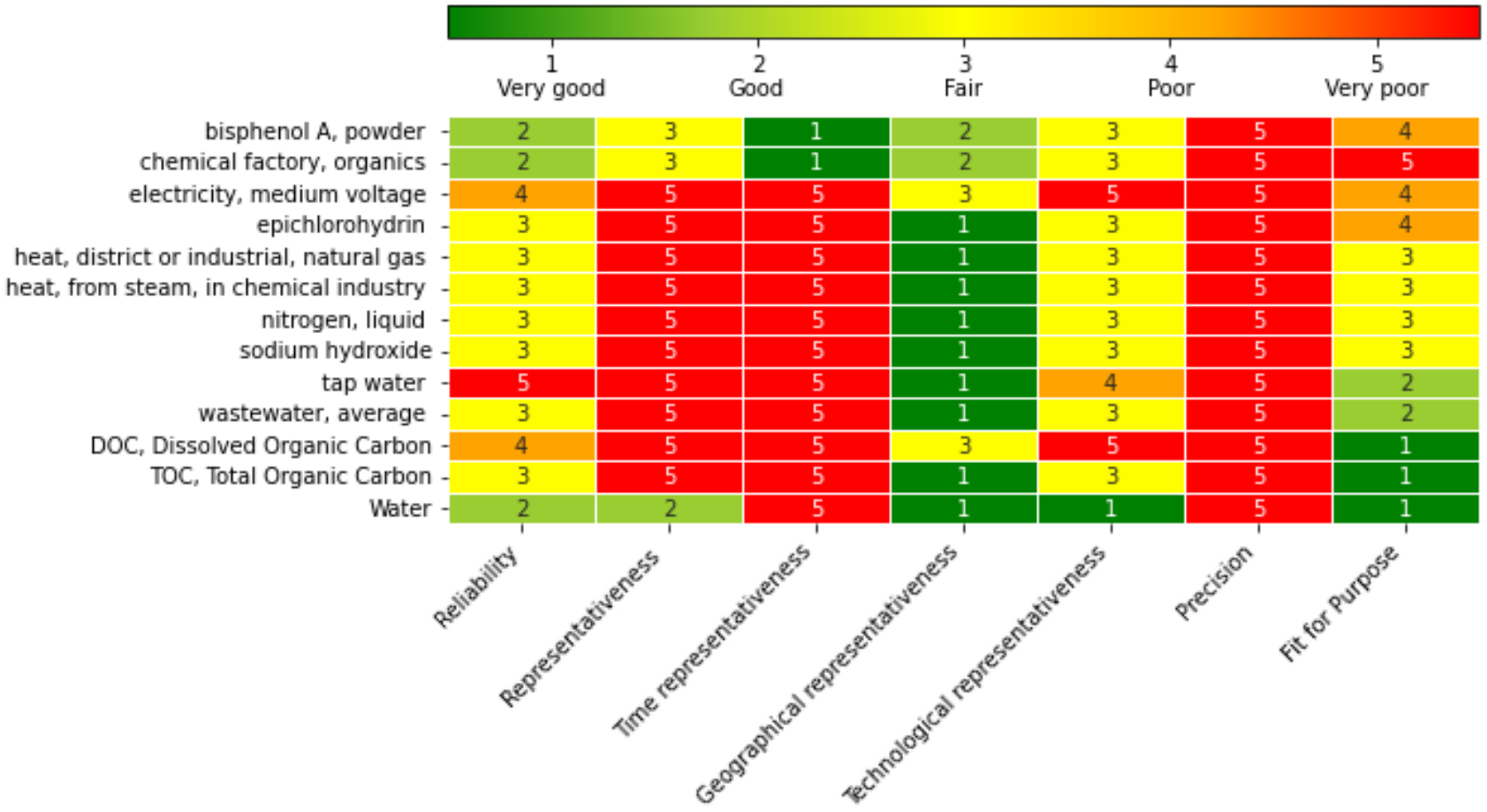
| **Waste** | | | | |
|---|---|---|---|---|
| Waste mineral oil | | | | |
| Waste mineral wool, for final disposal | | | | |
| Waste mineral wool, for final disposal | | | | |
| Waste paint | | | | |
| Wastewater from glass production | | | | |

# LIFE CYCLE GHG EMISSIONS: EPOXY RESIN



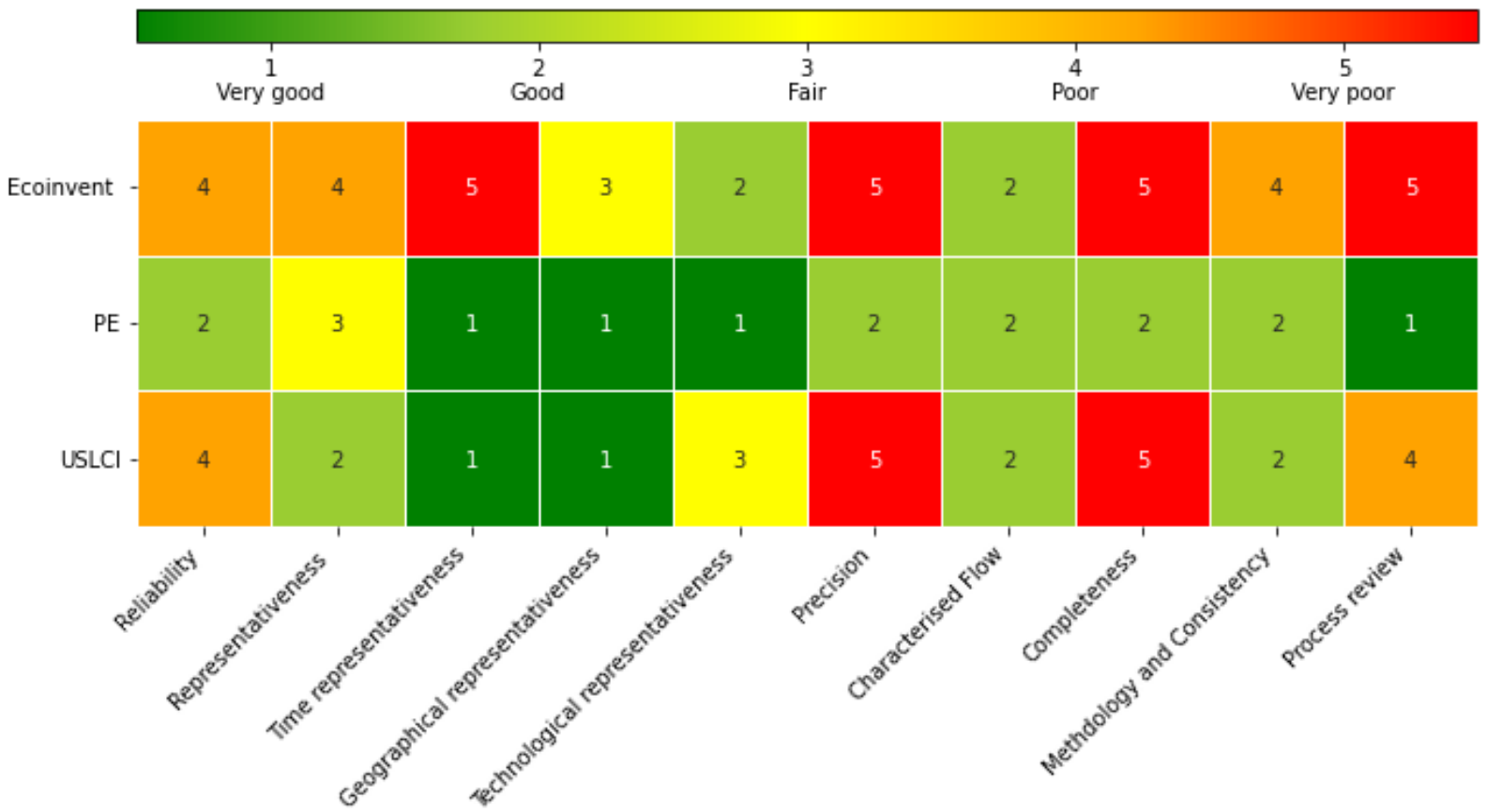



# DATA QUALITY ASSESSMENT @ FLOW LEVEL: EPOXY RESIN




- Ecoinvent
- Epoxy resin production, liquid - RER
- Period : 2015 to 2021

# DATA QUALITY ASSESSMENT @ PROCESS LEVEL: EPOXY RESIN




| Source | Location | Period |
|---|---|---|
| Ecoinvent | RER | 2015 - 2022 |
| USLCI | US | 2019 |
| PE | RER | 2005 |

# CARBON FIBRE INPUT PROCESS DATA SET

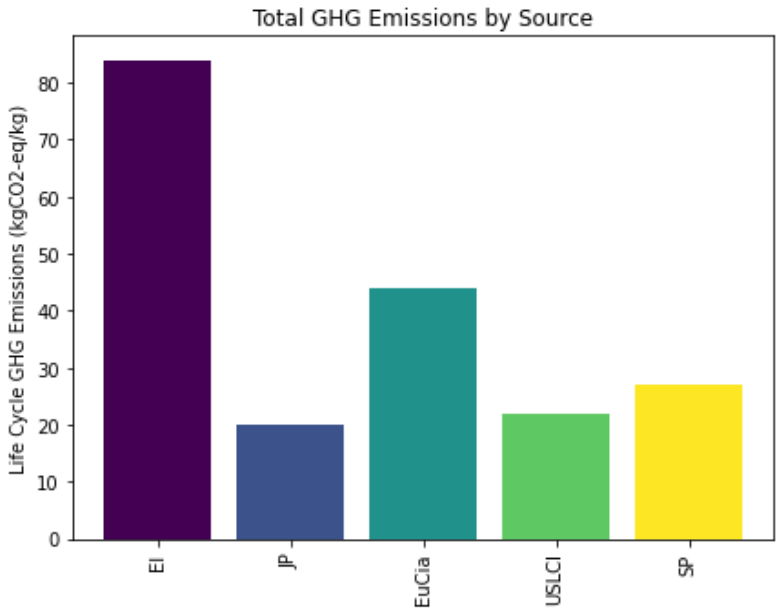
| **Source** | SP | EI | EuCia | US | JP |
|---|---|---|---|---|---|
| **Inputs from technosphere** | | | | | |
| Polyacrylonitrile fibres | ■ | | ■ | ■ | |
| Acrylonitrile butadiene styrene copolymer | | ■ | | | |
| Acrylonitrile | | | | | ■ |
| Comonomer | | | | | ■ |
| Polymerization catalyst | | | | | ■ |
| Solvent | | | | | ■ |
| PAN fiber oil | | | | | ■ |
| Chemical organic | ■ | | | | |
| Injection moulding | ■ | | | | |
| Carbon fiber sizing agent | | | | | ■ |
| Electrolyte (sulfuric acid) | | | | | ■ |
| Outer packaging material | | | | | ■ |
| Epoxy resin | ■ | | | ■ | |
| Hexamethylene diamine (HMDA) from acrylonitrile via adiponitrile | | | | ■ | |
| Potassium permanganate | | | ■ | | |
| ammonium bicarbonite | | | ■ | | |
| Sulfuric Acid | | | ■ | | |
| Polydimethylsiloxane | | | ■ | | |
| Nitrogen (gaseous) | ■ | | | | ■ |
| Ammonia Hydrogen carbonate | ■ | | | | |

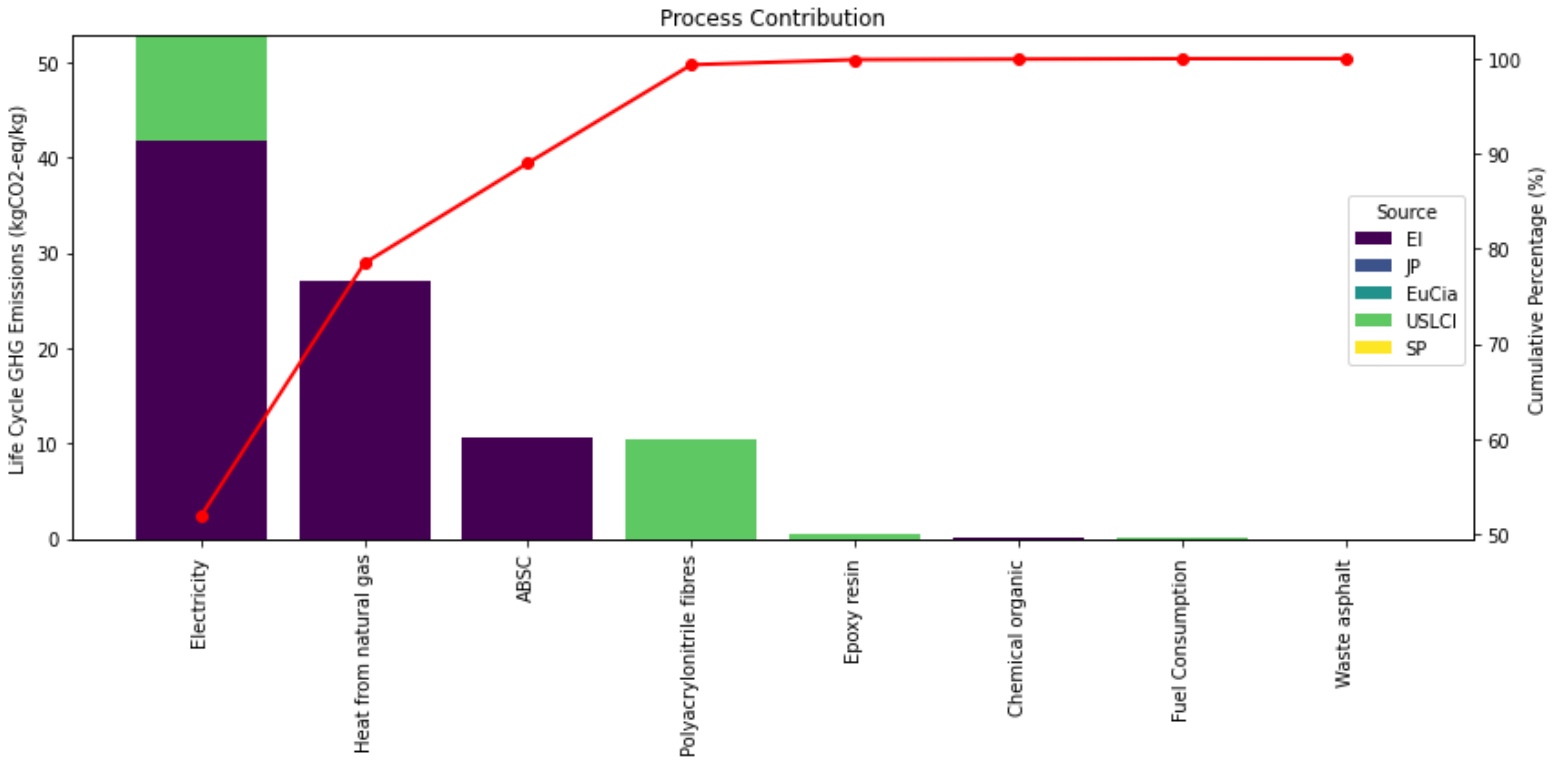
| **Energy/heat** | | | | | |
|---|---|---|---|---|---|
| Electricity | ■ | ■ | ■ | ■ | ■ |
| Heat from natural gas | | ■ | ■ | ■ | |
| Carbonization HT primary gas | | | ■ | | |
| Carbonization HT primary electricity | | | ■ | | |
| Carbonization LT primary gas | | | ■ | | |
| Carbonization LT primary electricity | | | ■ | | |
| Washing primary electricity use | | | ■ | | |
| Washing primary gas | | | ■ | | |
| Drying-I primary electricity use | | | ■ | | |
| Drying-I primary gas use | | | ■ | | |
| Avivage primary electricty | | | ■ | | |
| Avivage primary gas use | | | ■ | | |
| Drying-II primary electricity | | | ■ | | |
| Drying-II primary gas use | | | ■ | | |
| Spooling primary electricity | | | ■ | | |
| Spooling primary gas | | | ■ | | |
| Steam Consumption | | | | | ■ |
| Fuel Consumption | | | | ■ | ■ |

# CARBON FIBRE OUTPUT PROCESS DATA SET

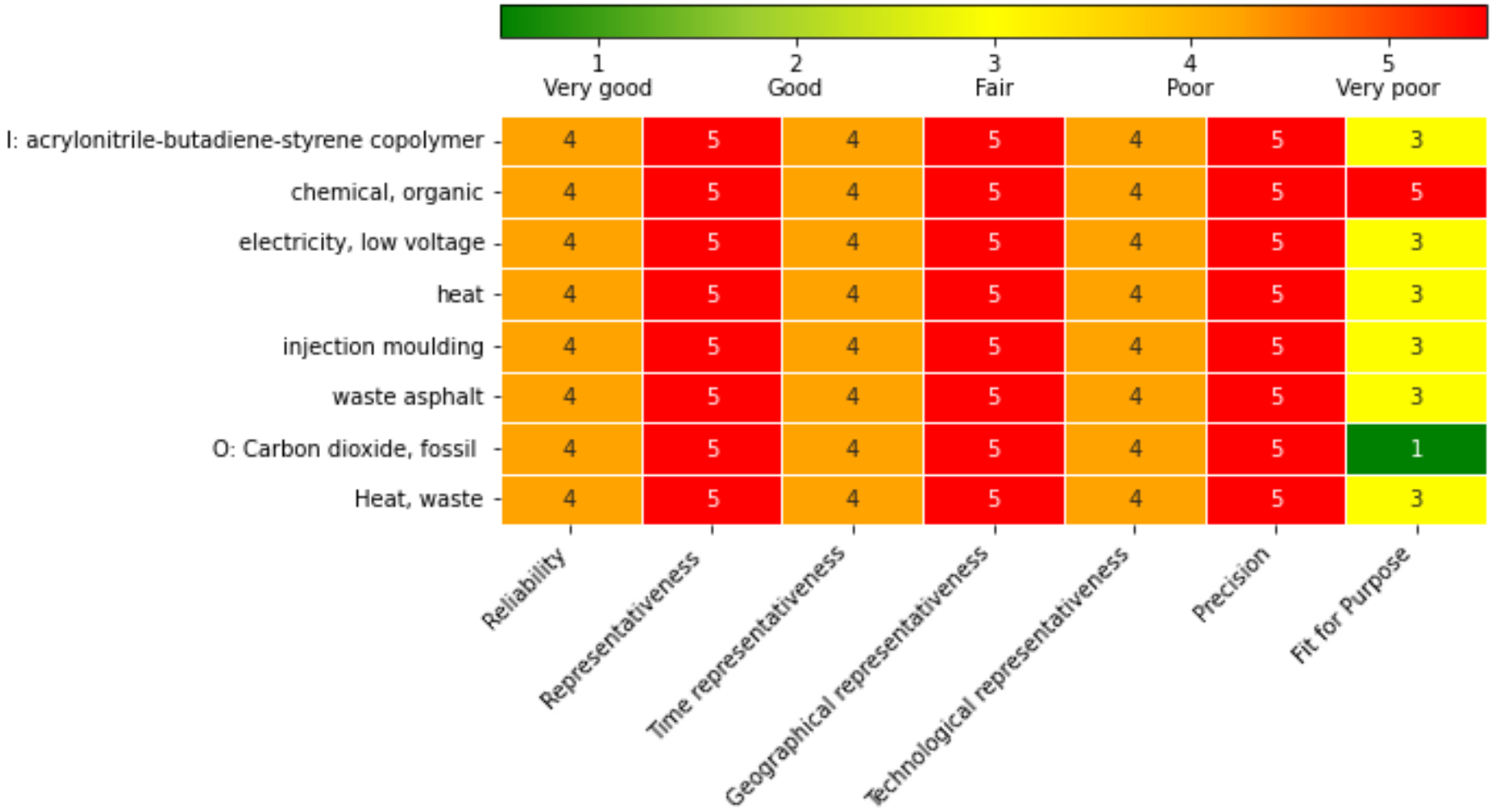
| **Source** | SP | EI | EuCia | US | JP |
|---|---|---|---|---|---|
| Carbon dioxide, fossil | | | | | |
| Heat, Waste | | | | | |
| Nitrogen oxide (NOx) | | | | | |
| **Emissions to water** | | | | | |
| Water | | | | | |
| **Waste** | | | | | |
| Waste asphalt | | | | | |
| Solid waste | | | | | |
| Exhaust gas treatment | | | | | |
| Elektrolysis | | | | | |
| **Transport** | | | | | |
| Transport Mix | | | | | |

# LIFE CYCLE GHG EMISSIONS: CARBON FIBRE



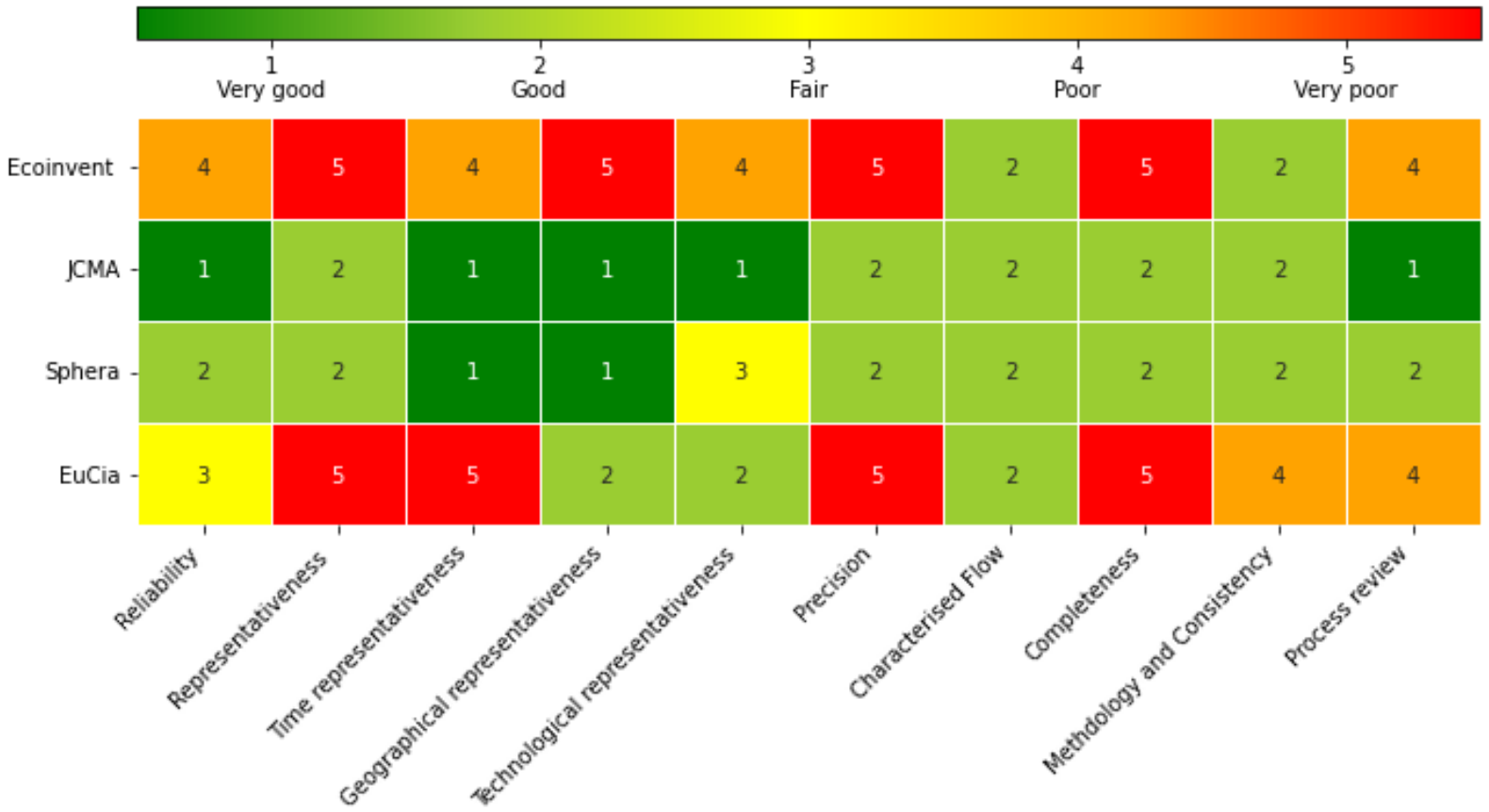



# DATA QUALITY ASSESSMENT @ FLOW LEVEL: CARBON FIBRE




- Ecoinvent
- Carbon fibre reinforced plastic, injection moulded – GLO
- Period : 2016 to 2021

# DATA QUALITY ASSESSMENT @ PROCESS LEVEL: CARBON FIBRE




| Source | Location | Period |
|---|---|---|
| Ecoinvent | RER | 1995 - 2021 |
| JCMA | JP | 2010 - 2011 |
| Sphera | DE | 2019 - 2022 |
| EuCia | RER | 2015 - 2022 |

# GLASS REINFORCED PLASTIC (GRP) INPUT PROCESS DATA SET

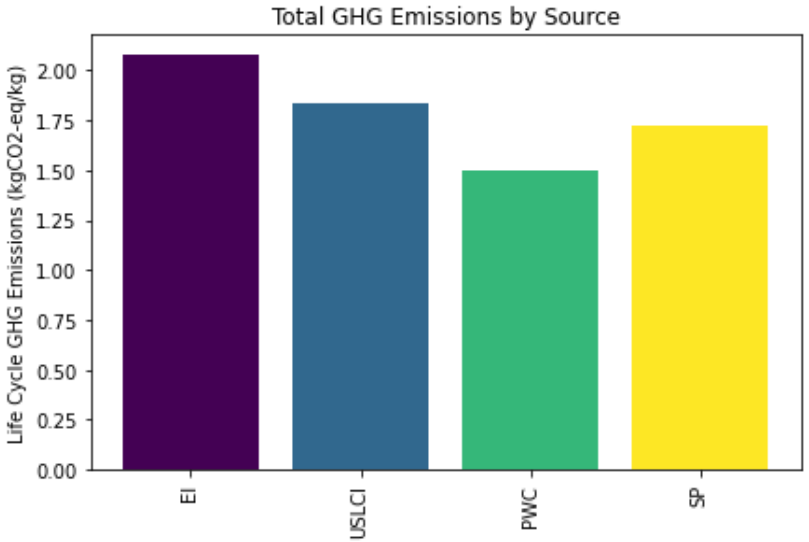
| Source | EI | PwC | SP | US |
|---|---|---|---|---|
| **Input from Technosphere: Materials Resources** | | | | |
| Aluminium oxide, non-metallurgical | ■ | | | |
| Boric acid, anhydrous, powder | ■ | | | ■ |
| Boric oxide | | | | |
| Borax anhydrous | | | | ■ |
| Burnt dolomite | | ■ | | |
| Chemical, organic | ■ | | | |
| Calcium borat | | | | ■ |
| Colemanite | | ■ | ■ | |
| Ethylene glycol | | | | ■ |
| Epoxy resin | | | | ■ |
| Feldspar | | ■ | | |
| Kaolin | | ■ | | |
| Clay | ■ | | ■ | ■ |
| Dolomite | | | ■ | |
| Gypsum | | ■ | | |
| Polyvinyl acetate | | | ■ | |
| Flat glass factory | ■ | | | |
| Filmformer | | ■ | | |
| Fluorspar, 97% purity | ■ | ■ | ■ | |
| Phenolic resin | | | ■ | |
| Lime | ■ | ■ | | |
| Quicklime | | ■ | | ■ |
| Limestone | | ■ | ■ | ■ |
| Magnesium oxide | | ■ | | |
| Hydrated Lime | | ■ | | |
| PH-modifier | | ■ | | |
| Lubricating oil | ■ | ■ | ■ | |
| Phthalic anhydride | ■ | | | |
| Silica Sand | | | | |
| Electricity, low voltage | ■ | ■ | ■ | ■ | ■ |
| Electricity, renewable energy | | | | | ■ |
| Heat | ■ | ■ | ■ | ■ | ■ |
| Steam, in chemical industry | ■ | ■ | ■ | ■ | |
| **Input from technosphere: Transport** | | | | | |
| Transport combined truck | | ■ | | | ■ |
| Transport , Train, Diesel Powered | | | | | ■ |
| Transport ocean freighter | | | | | ■ |
| **Input from environment** | | | | | |
| Water | | | | | ■ |

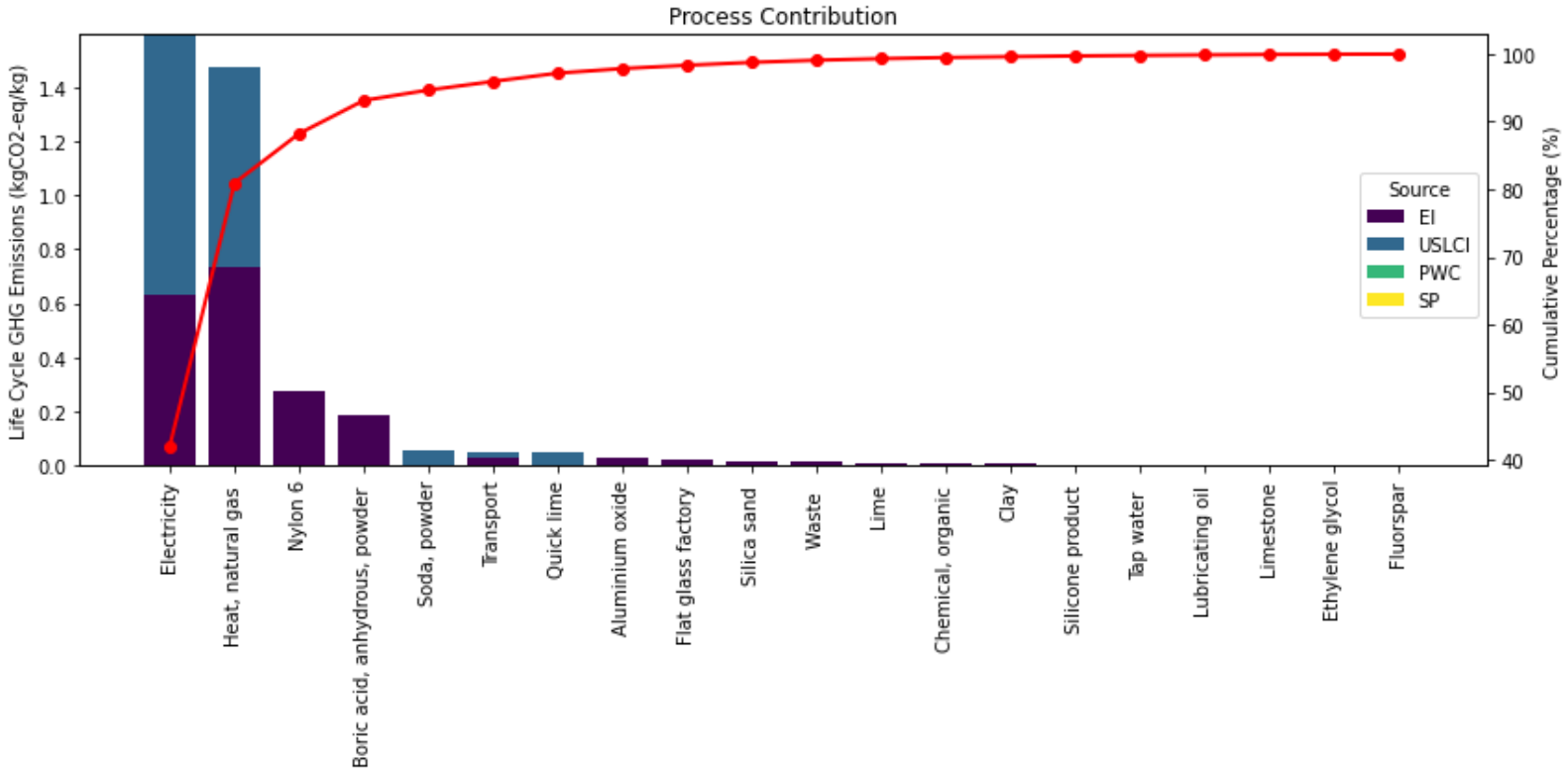
# GLASS REINFORCED PLASTIC (GRP) OUTPUT PROCESS DATA SET

| Source | EI | PwC | SP | US |
|---|---|---|---|---|
| **Output: Emission to Air** | | | | |
| Antimony | ■ | | | |
| Arsenic | ■ | | | |
| Cadmium | ■ | | | |
| Carbon dioxide, fossil | ■ | | | |
| Hydrogen chloride | ■ | | | |
| Hydrofluoric acid | | | | ■ |
| Hydrogen fluoride | ■ | | | |
| Nitrogen oxides | ■ | | | ■ |
| NMVOC, non-methane volatile organic compounds | ■ | | | |
| Volatile organic compounds | | | | ■ |
| Methanol | | | | ■ |
| Particulates, < 2.5 um | ■ | | | ■ |
| Particulates, > 10 um | ■ | | | ■ |
| Particulates, > 2.5 um, and < 10um | ■ | | | ■ |
| Sulfur dioxide | ■ | | | ■ |
| Xylene | | | | ■ |
| Styrene | | | | ■ |

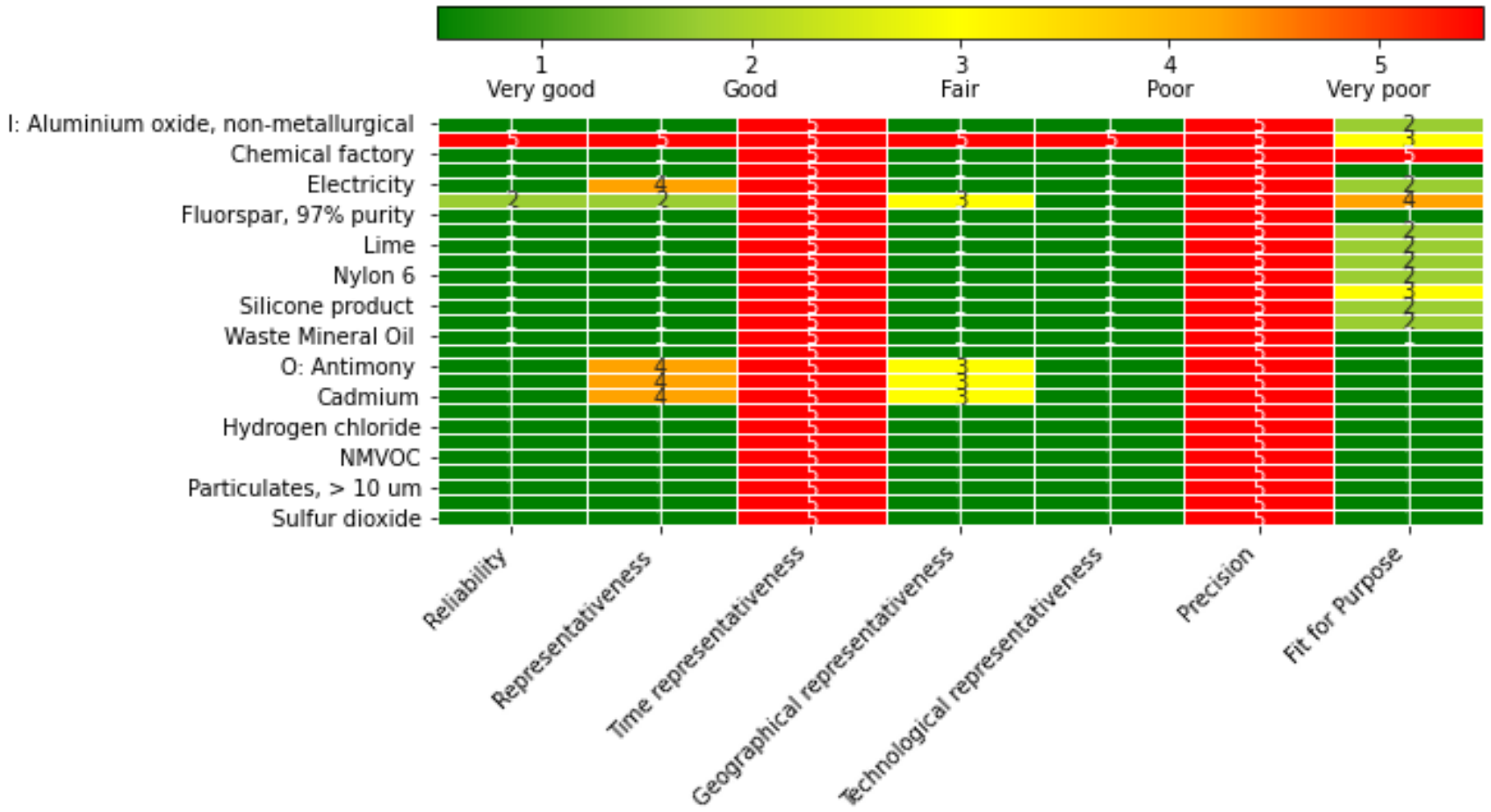
| Emissions to Water | | | | |
|---|---|---|---|---|
| Water/m3 | ■ | | | |
| Water, RER | ■ | | ■ | |
| **Waste** | | | | |
| Waste mineral oil | ■ | ■ | | |
| Waste mineral wool, for final disposal | ■ | ■ | ■ | ■ |
| Waste paint | ■ | | | |
| Wastewater from glass production | ■ | | | |

# LIFE CYCLE GHG EMISSIONS: GLASS REINFORCED PLASTIC (GRP)



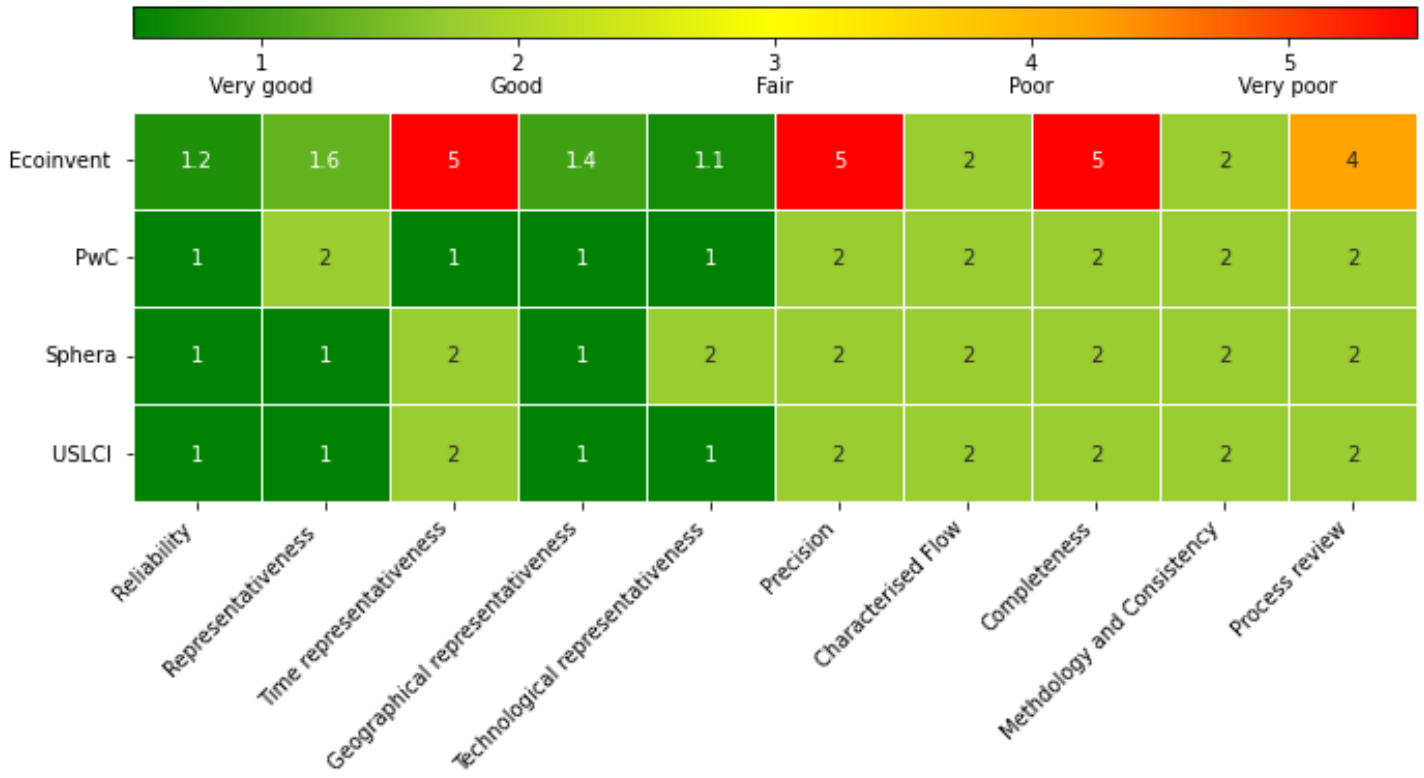



# DATA QUALITY ASSESSMENT @ FLOW LEVEL: GLASS FIBRE




- Ecoinvent
- Glass fibre production RER
- Period : 2000 to 2021

# DATA QUALITY ASSESSMENT @ PROCESS LEVEL: GLASS FIBRE



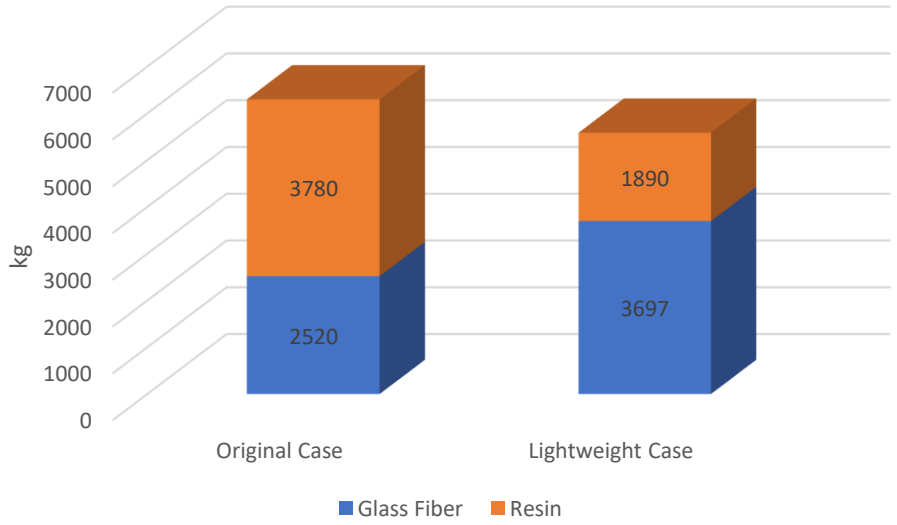

| Source | location | Period |
|---|---|---|
| Ecoinvent | RER | 2000 - 2021 |
| PwC | RER | 2022 - 2023 |
| Sphera | DE | 2019 - 2022 |
| USLCI | US | 2010 - 2011 |

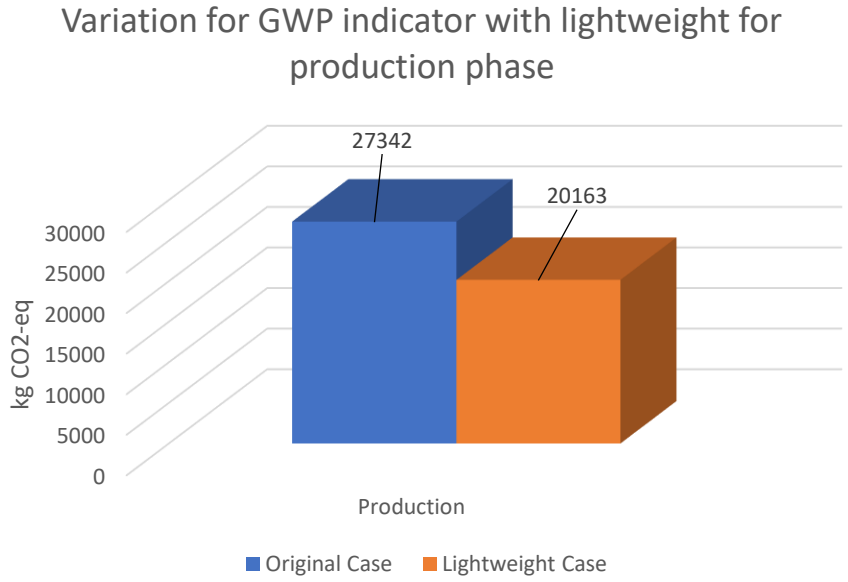
# ILLUSTRATIVE CASE STUDY

한국정밀공학회지 제 36 권 제 9 호 pp. 875-881 September 2019 / 875
J. Korean Soc. Precis. Eng., Vol. 36, No. 9, pp. 875-881 https://doi.org/10.7736/KSPE.2019.36.9.875
ISSN 1225-9071 (Print) / 2287-8769 (Online)

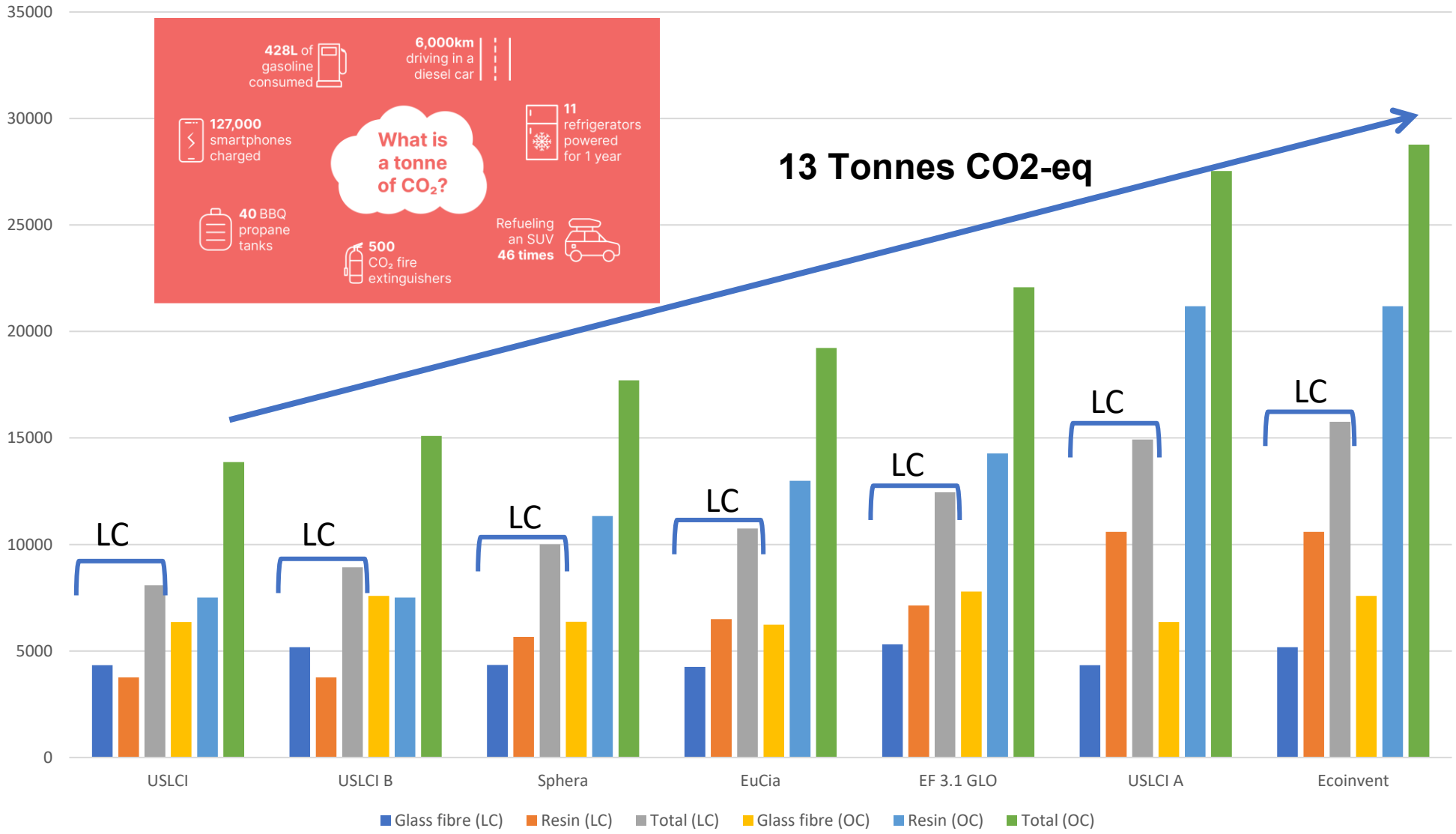
**Environmental Impact Evaluation on Lightweight Structure Design of a Composite Ship by LCA (Life Cycle Assessment)**

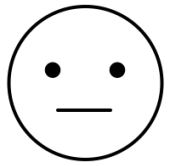
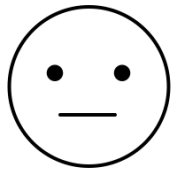
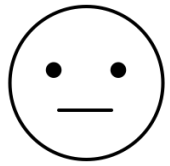
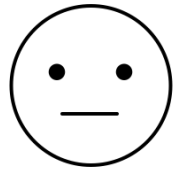
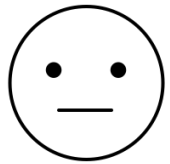
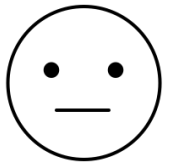
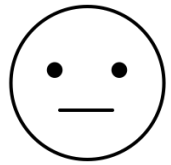
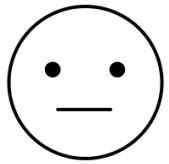
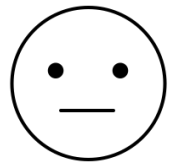
(Daekyun Oh *et al*, 2019)



# ILLUSTRATIVE CASE STUDY



| | UP resin unspecified | Ortho/ISO/DCPD/ Vinyl ester | Epoxy resin | Glass fiber | Carbon fiber |
|---|---|---|---|---|---|
| ecoinvent |  |  |  |  |  |
| FEDERAL LCA COMMONS |  | |  |  |  |
| sphera® |  | |  |  |  |
| EuCIA The European Voice of Composites |  |  |  |  |  |
| The Japan Carbon Fiber Manufacturers Association | | | | |  |

## RECOMMENDATIONS

**For LCA Practitioner:**

**S**elect proxy data and data sources carefully

**C**ompare Data from different sources especially for high contributing process elements

**A**ssess the data quality and uncertainty

**C**ommunicate the data quality and availability issues

**I**nterpret the influence of data quality and data gaps on the LCA results

## RECOMMENDATIONS

**For Databases, Sector Platforms, Composite Industry:**

**Guidelines:** Create industry-specific LCI data collection and analysis guidelines

**Harmonisation:** Standardise data quality assessment methods across the sector.

**Criteria:** Define acceptable data quality levels for composites LCI datasets.

**Communication:** Ensure transparency about data quality and availability.

**Centralisation:** Establish a central LCI database for composites.

**Automation:** Introduce an automated system for visualising data quality in relation to process contributions.

**Focus Areas:** Focus on data completeness, precision, and thorough process review.

# MATERIALS SAFETY DATA SHEET (MSDS)

# LIFE CYCLE INVENTORY DATA SHEET (LCIDS)