

# CO<sub>2</sub> - Reduction Potential of the Supply Chain

Hege Botnen, HVL.

Jennifer Paola Oyaga Padilla, HVL.

Ruben Lindseth, HVL.

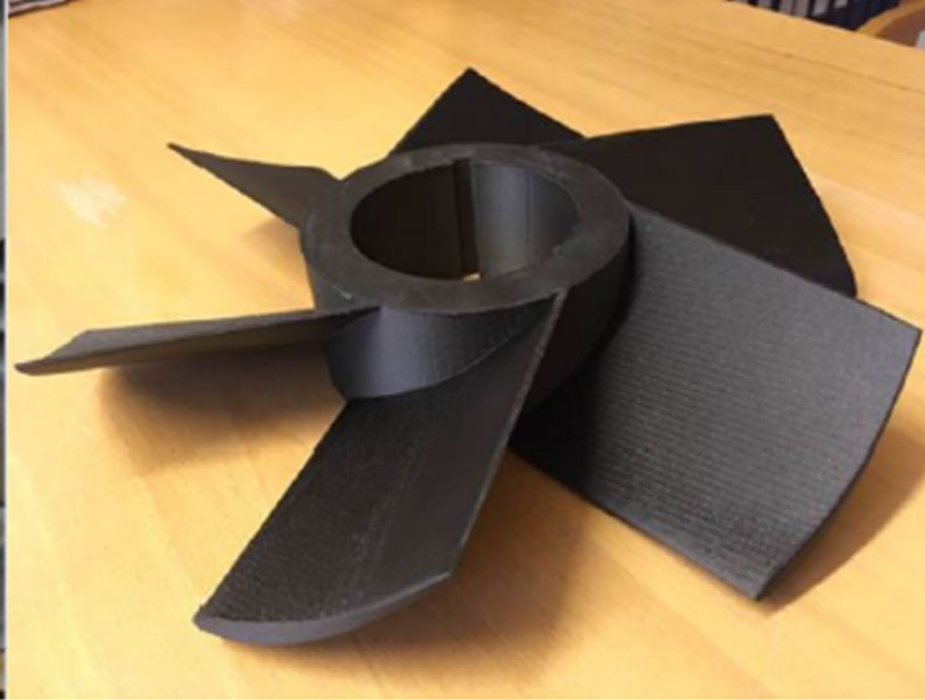
Richard J Grant, HVL.

Brede Lærum, Equinor.

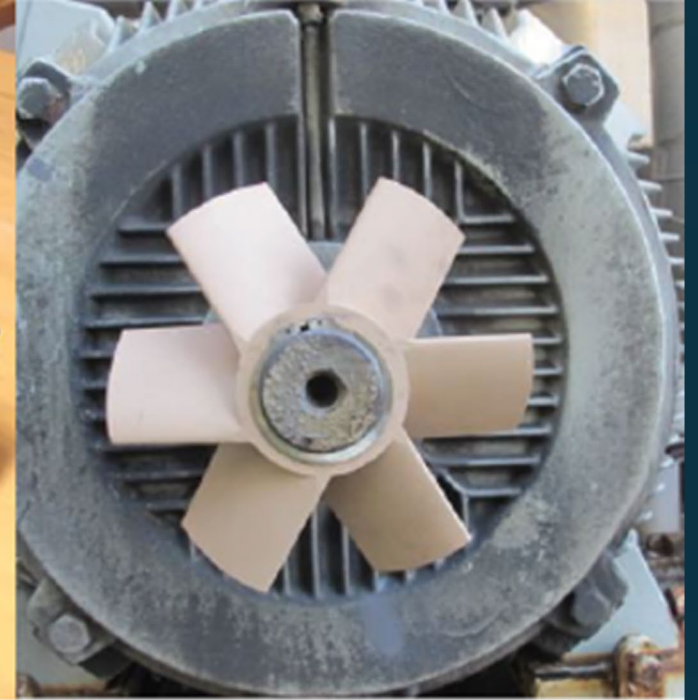
Energy Technology / Subsea Engineering  
Department of Mechanical and Marine Engineering



Original fan, Tjeldbergodden



Printed fan before coating



Printed fan on site

# Case study

- A broken and obsolete cooling fan on an electric motor at Equinor Tjeldbergodden
- Supplier suggested to buy a new motor
- A new fan was «printed» using AM

# Life Cycle Assessment

# Definitions

- **Life Cycle Assessment (LCA):** A management tool to examine the environmental impact of a product throughout its entire lifespan, from extraction of raw material to end of life
- **Global Warming Potential (GWP):** Unit where greenhouse gases are expressed as CO<sub>2</sub> equivalents over 100 years
- **Cradle-to-grave:** All activities from virgin raw material extraction to waste disposal at end-of-life
- **Cradle-to-cradle:** Raw material is recycled at the end-of-life and is looped back into the early stage of a products Life Cycle



# Product scope



image similar

SIMOTICS XP Motor type: 1CV2315B Low-voltage motor, IEC Squirrel-cage rotor, self-ventilated, IP55 Temperature class 155(F) according to 130(B) cast iron frame Basic line High Efficiency IE2 4-pole \* Size 315L, \* 200 kW (50 Hz) 230 kW (60 Hz) EX EC IIC T3 GC Version for Zone 2 according to IEC/EN 60 079-7

## Notes

Product Configuration is incomplete. Please check the configuration.

List Price

Show prices

Customer Price

Show prices

Service & Support (Manuals, Certificates, FAQs...)

Download

## Production

## AM

## CM

Raw material

Tveit propitary onyx

Aluminium

Technology

Fused Deposition Modelling (FDM)

-

Weight

267 g (after FDM)

916 g (originally)

Waste

Support parts

-

Transportation

regular shipment from supplier to usage

-

Electricity consumption

-

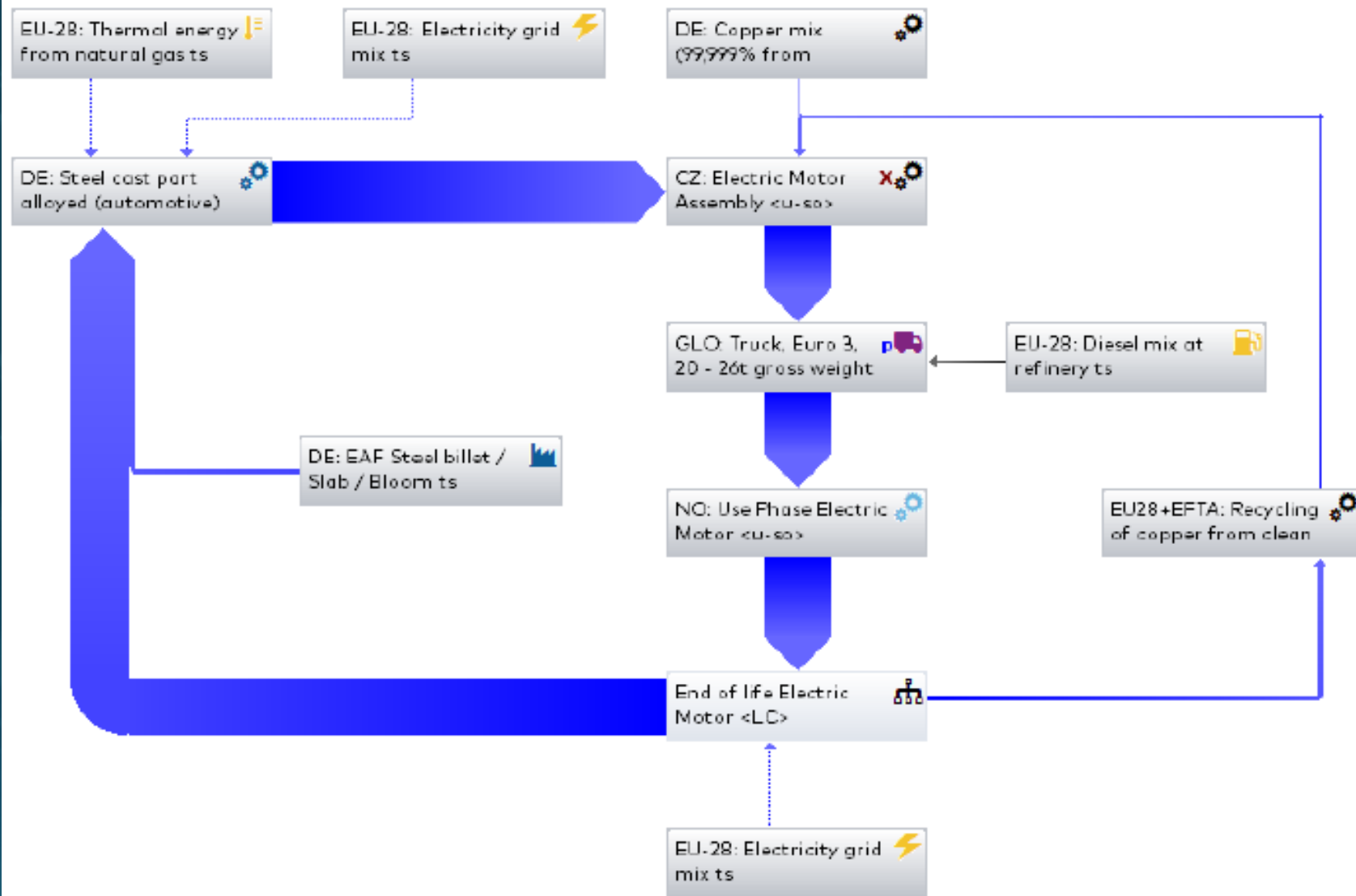
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# New Electric Motor

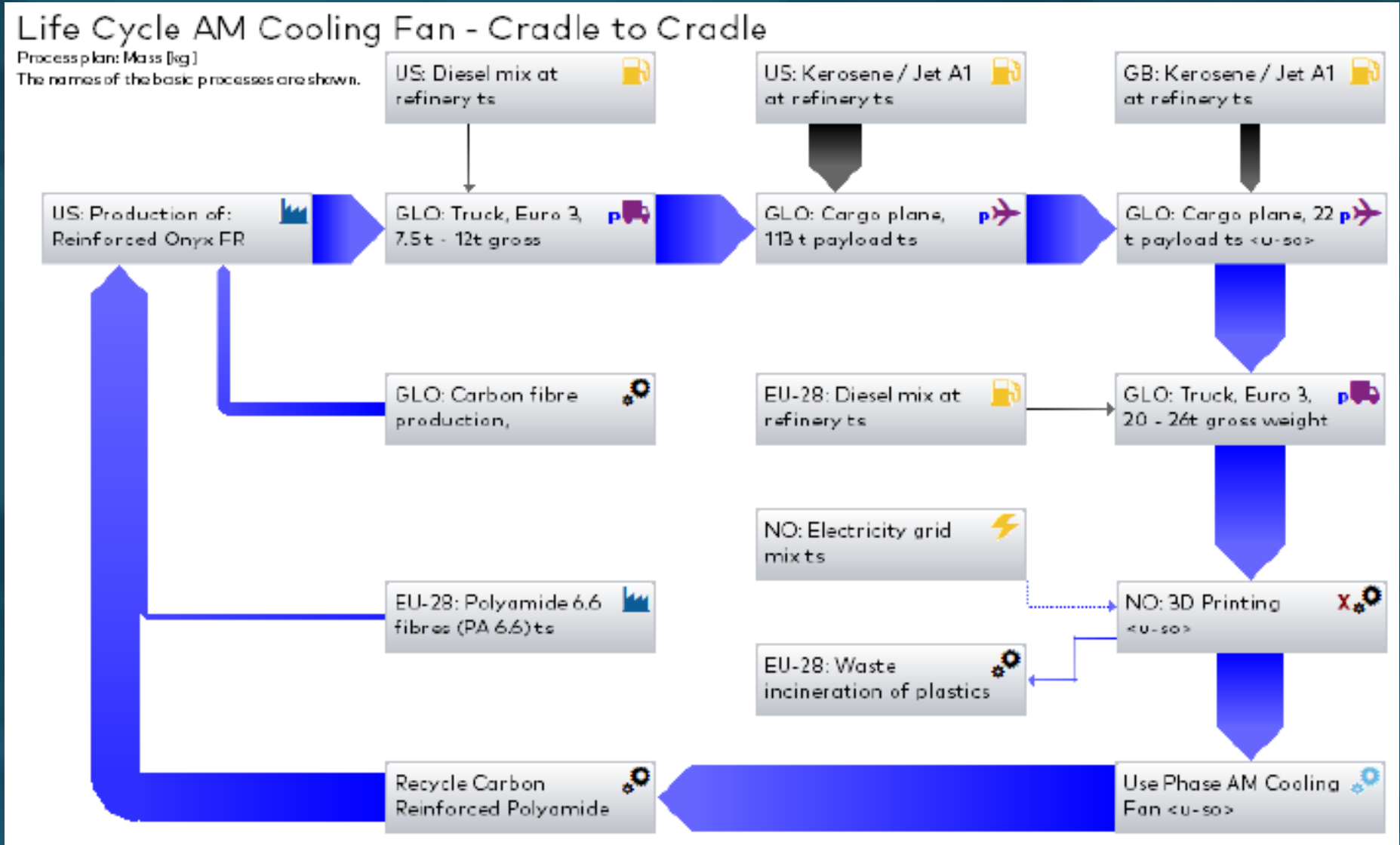
## Life Cycle New Electric Motor - Cradle to Cradle

Process plant: Mass [kg]

The names of the basic processes are shown.



# AM Cooling Fan

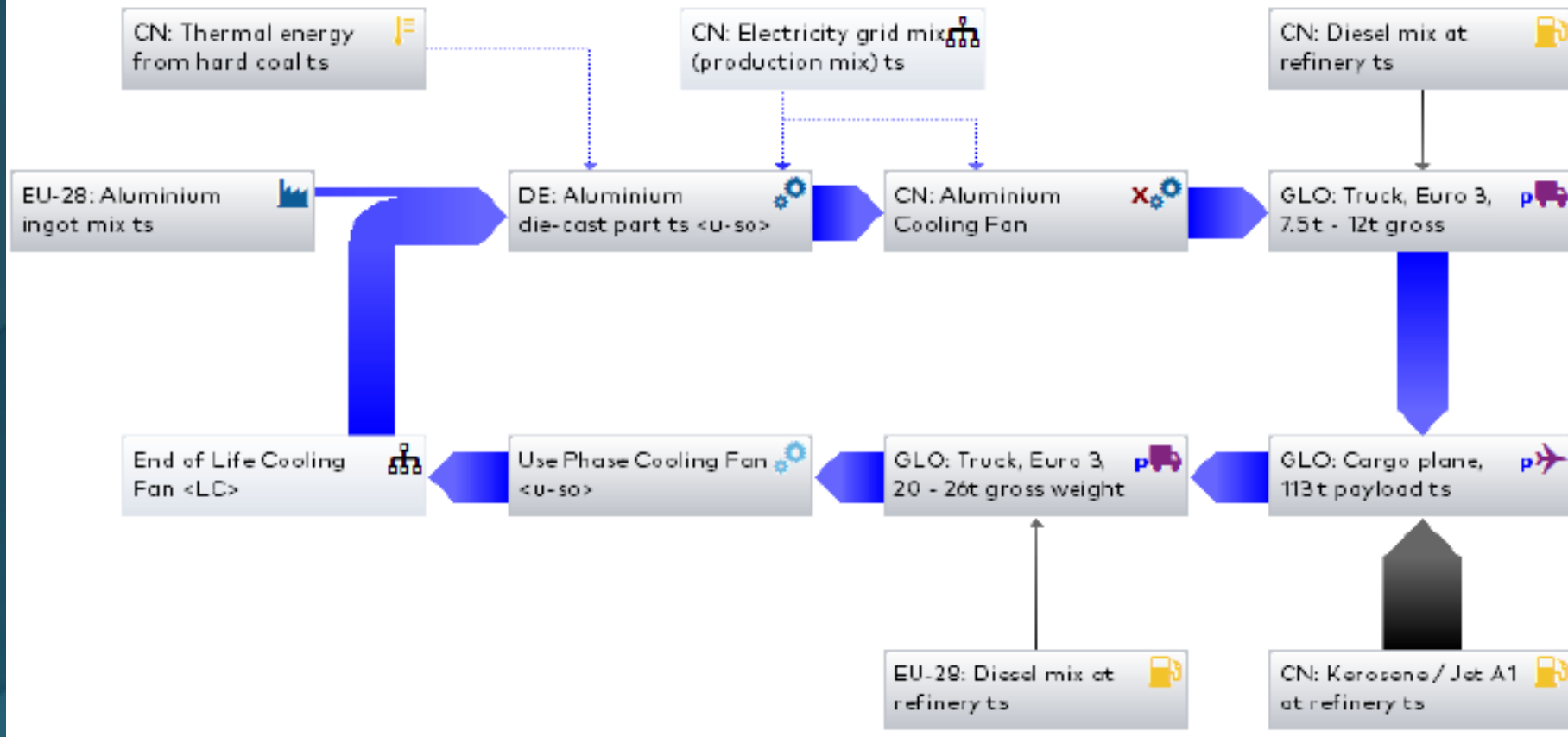


# CM Aluminium Cooling Fan

## Life Cycle CM Aluminium Cooling Fan - Cradle to Cradle

Process plan: Mass [kg]

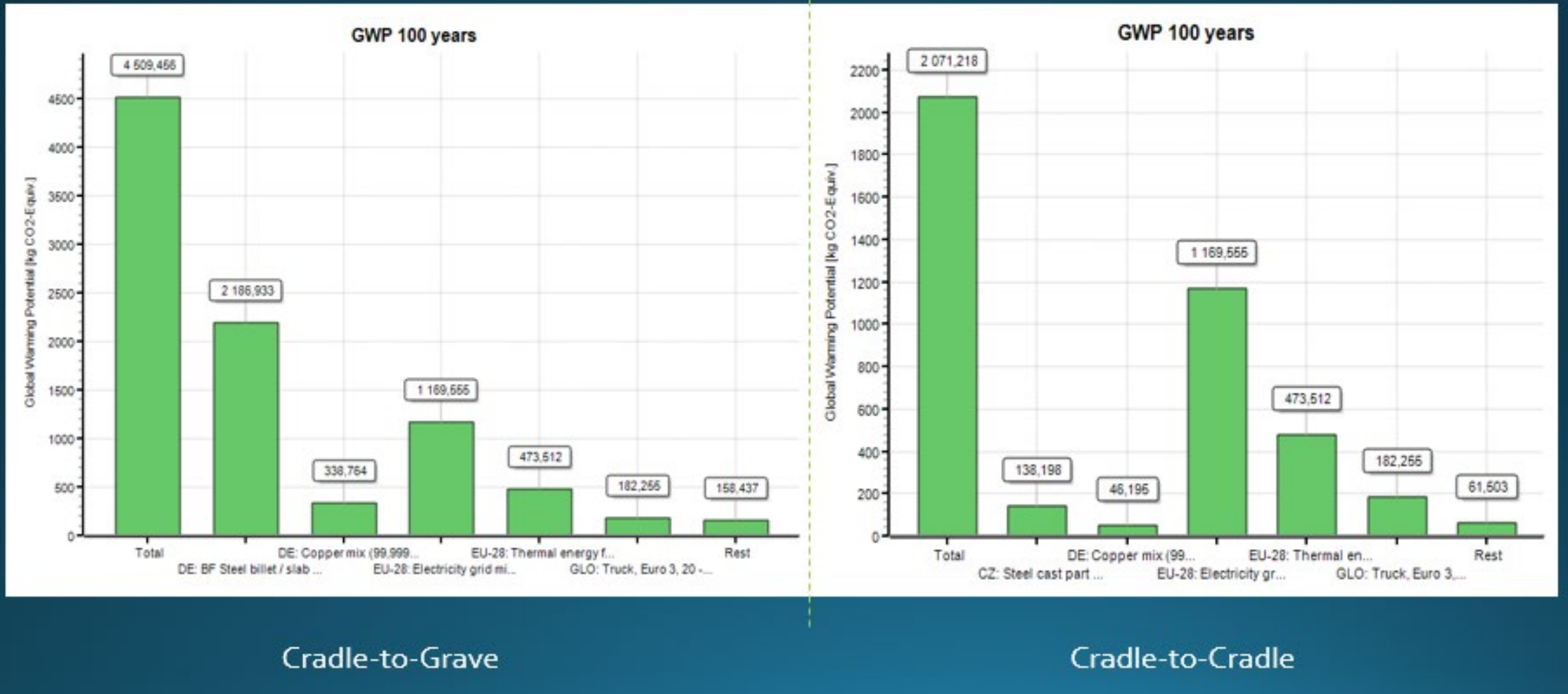
The names of the basic processes are shown.





# Results and identification of hotspots

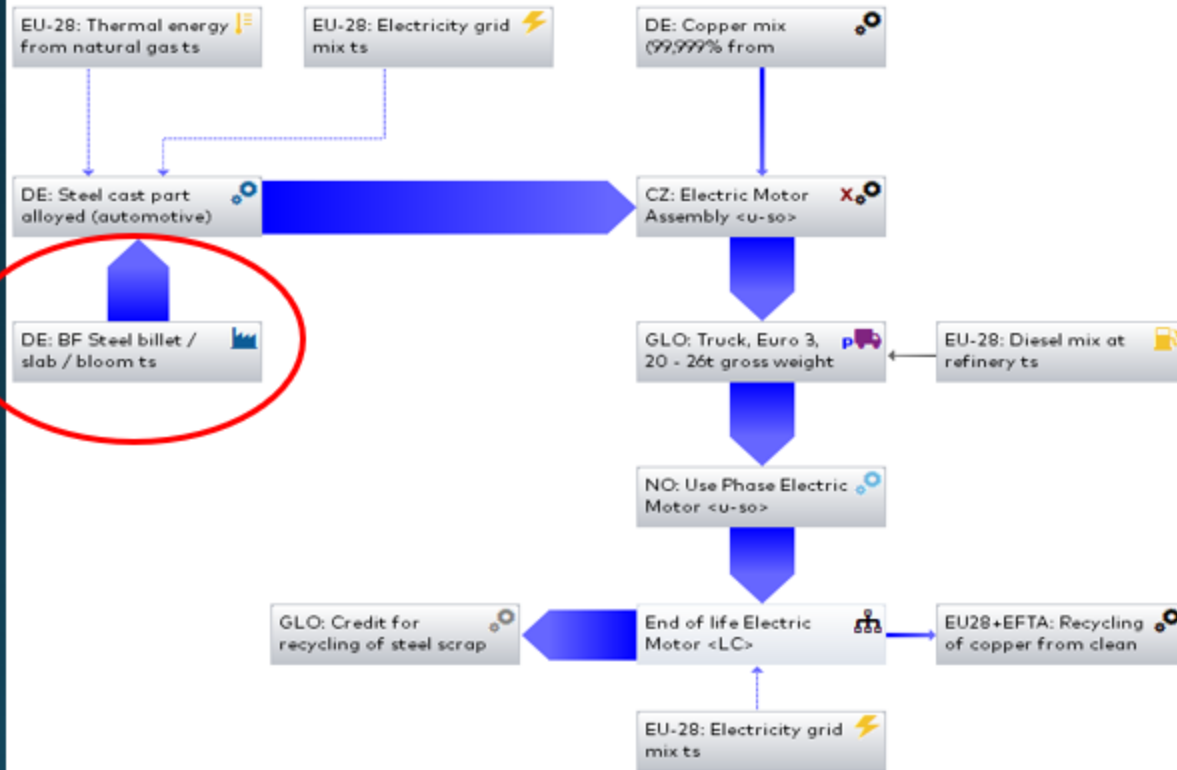
# Electric Motor



# Hotspot-Electric Motor

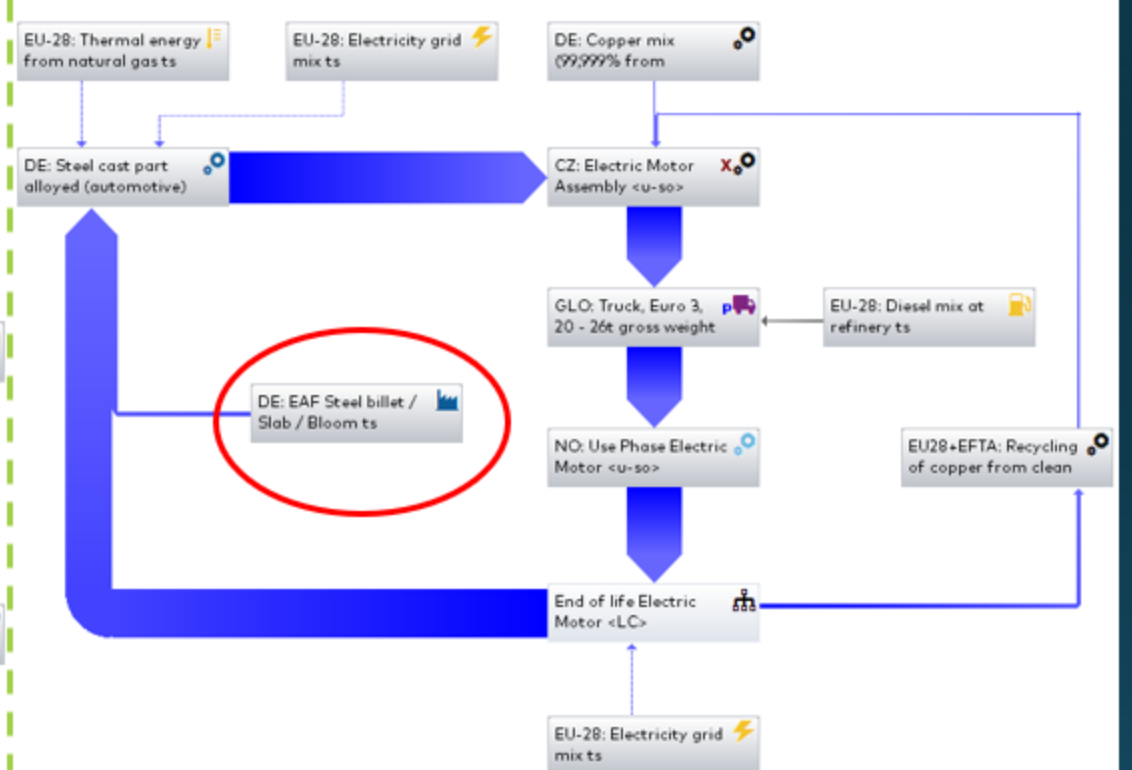
## Life Cycle New Electric Motor - Cradle to Grave

Process plan: Mass (kg)  
The names of the basic processes are shown.

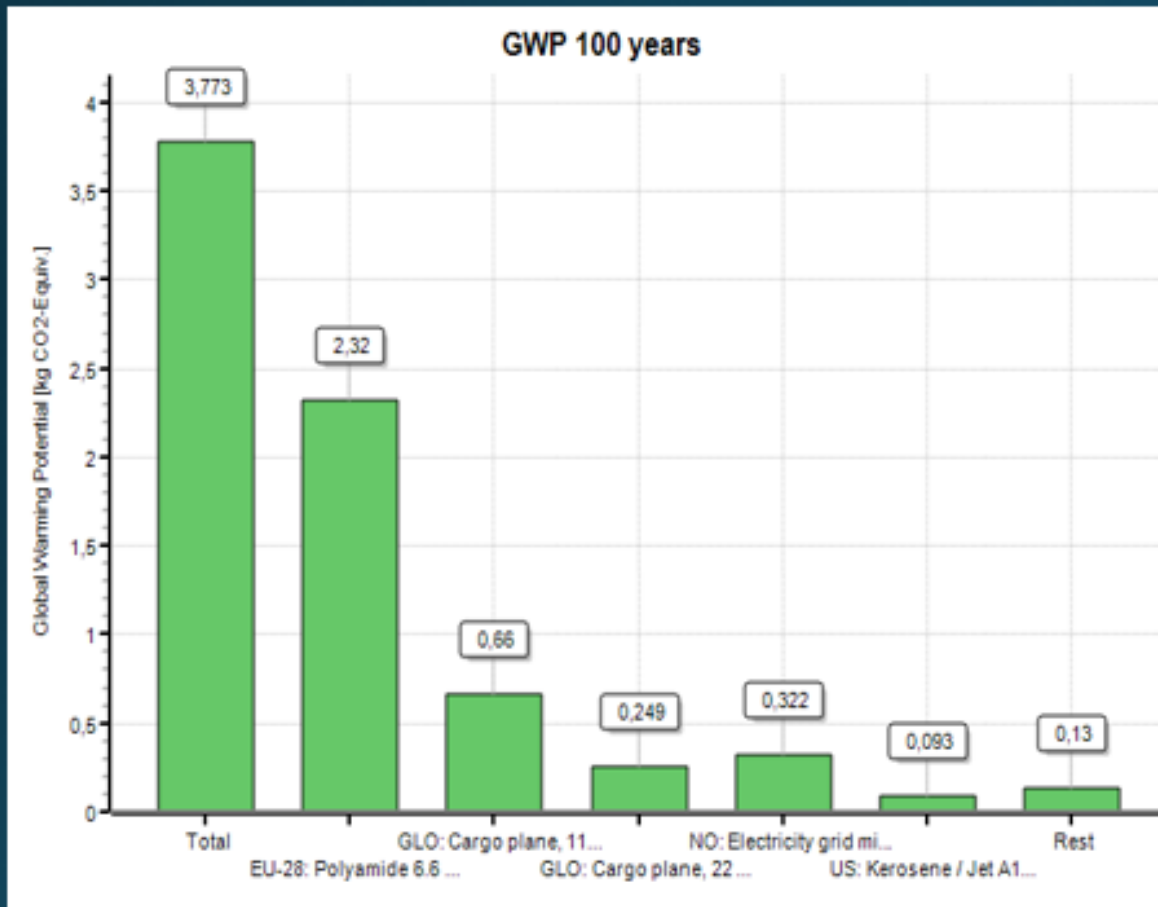


## Life Cycle New Electric Motor - Cradle to Cradle

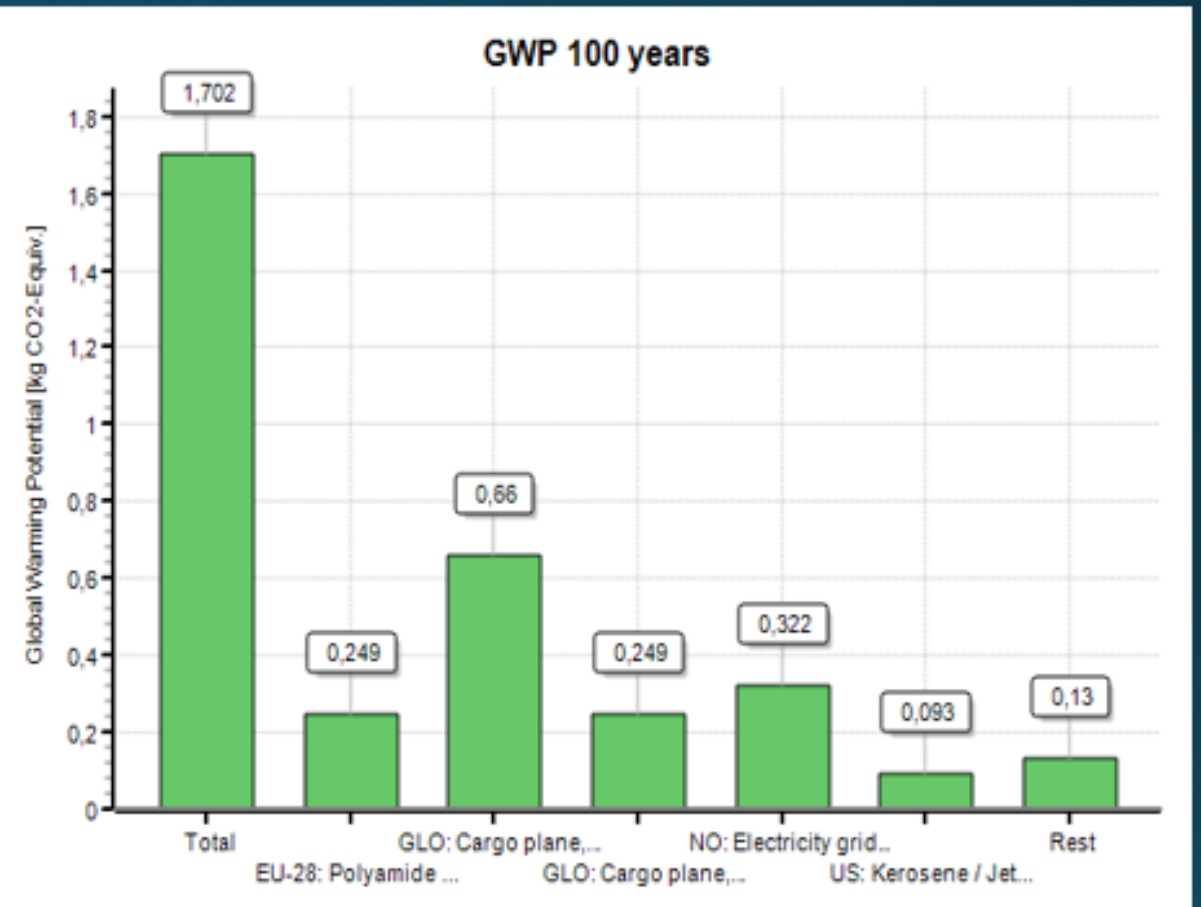
Process plan: Mass (kg)  
The names of the basic processes are shown.



# AM Cooling Fan



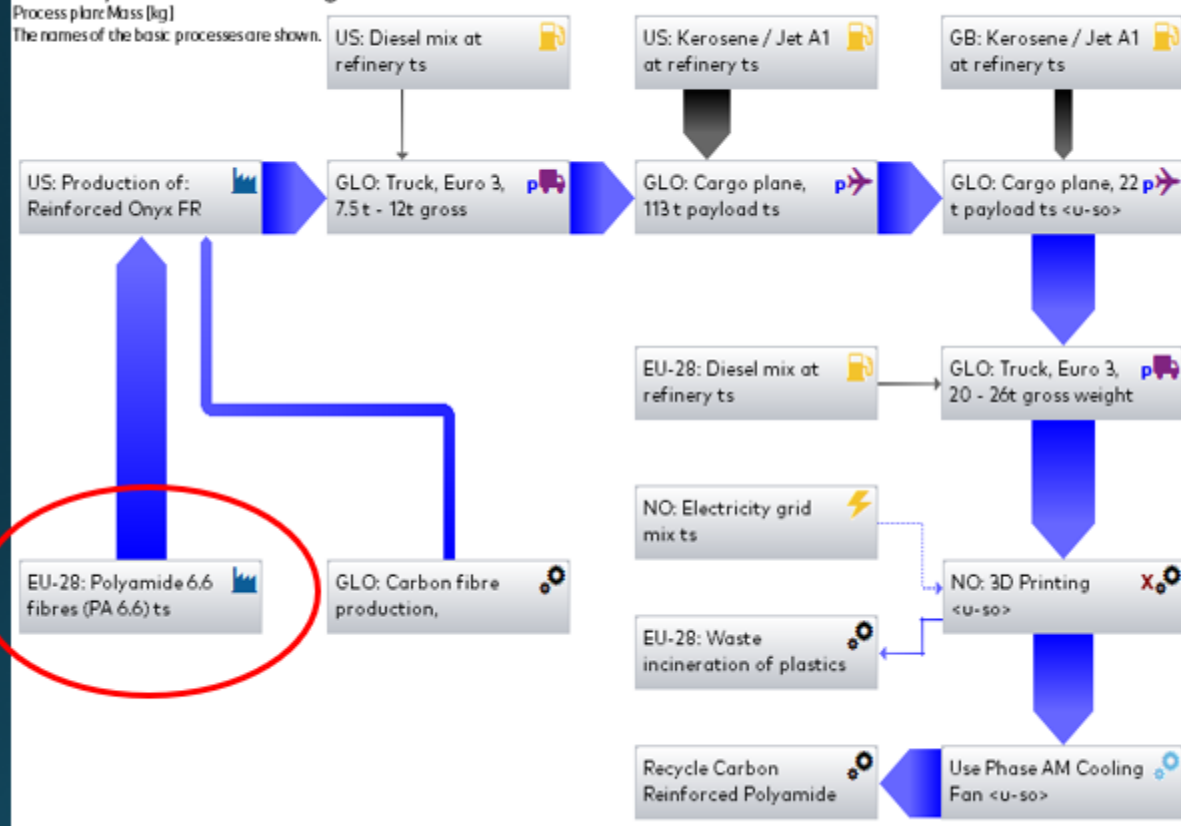
Cradle-to-Grave



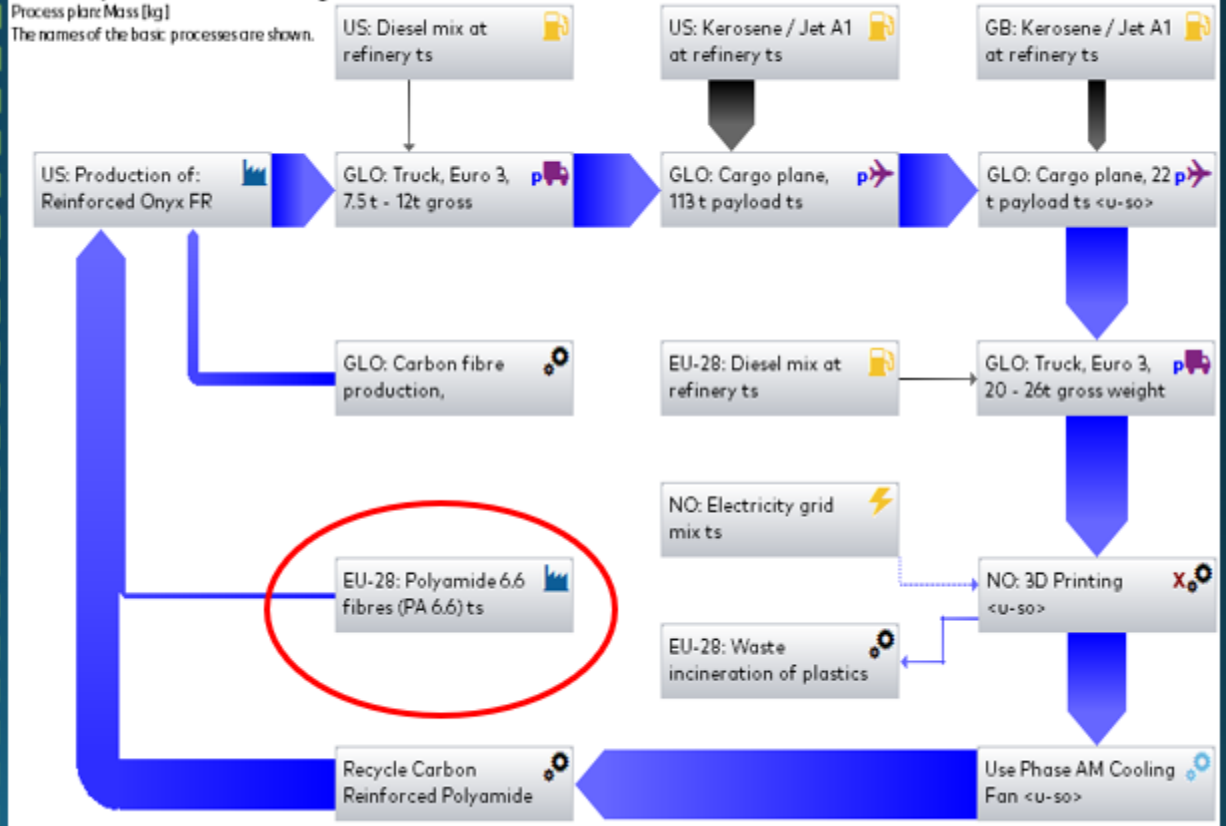
Cradle-to-Cradle

# Hotspot-AM Cooling Fan

## Life Cycle AM Cooling Fan - Cradle to Grave

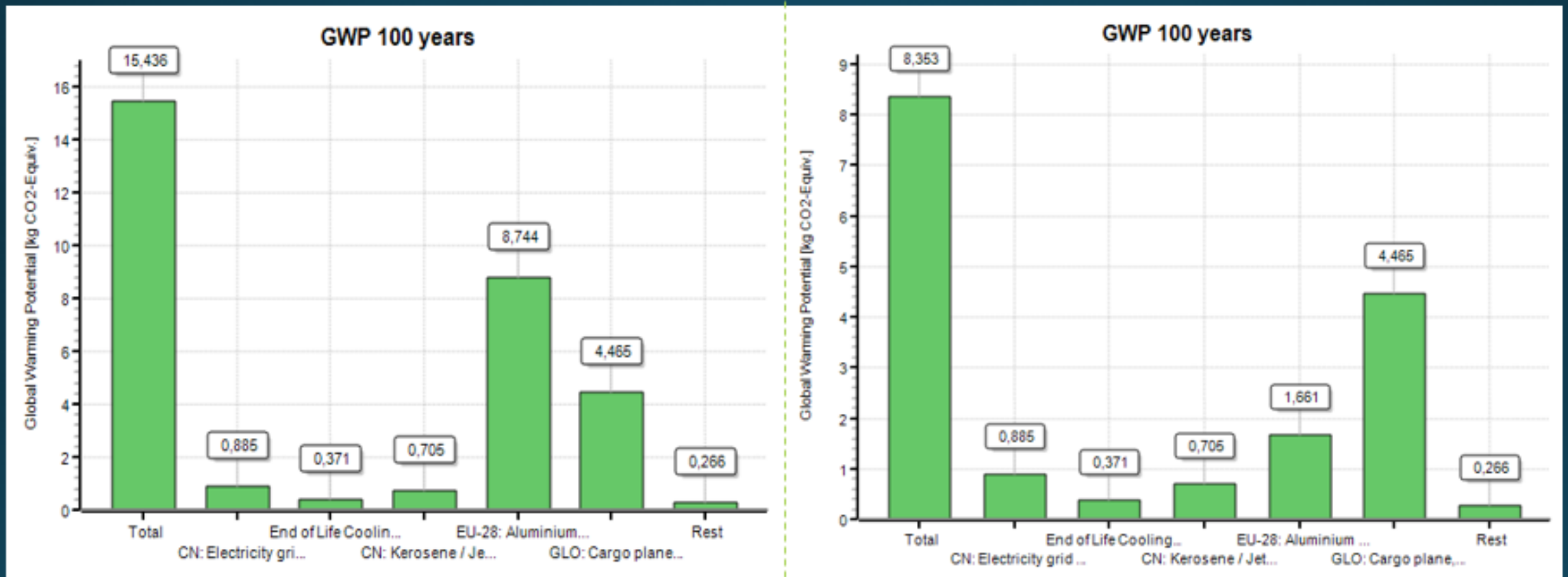


## Life Cycle AM Cooling Fan - Cradle to Cradle





# CM Cooling Fan



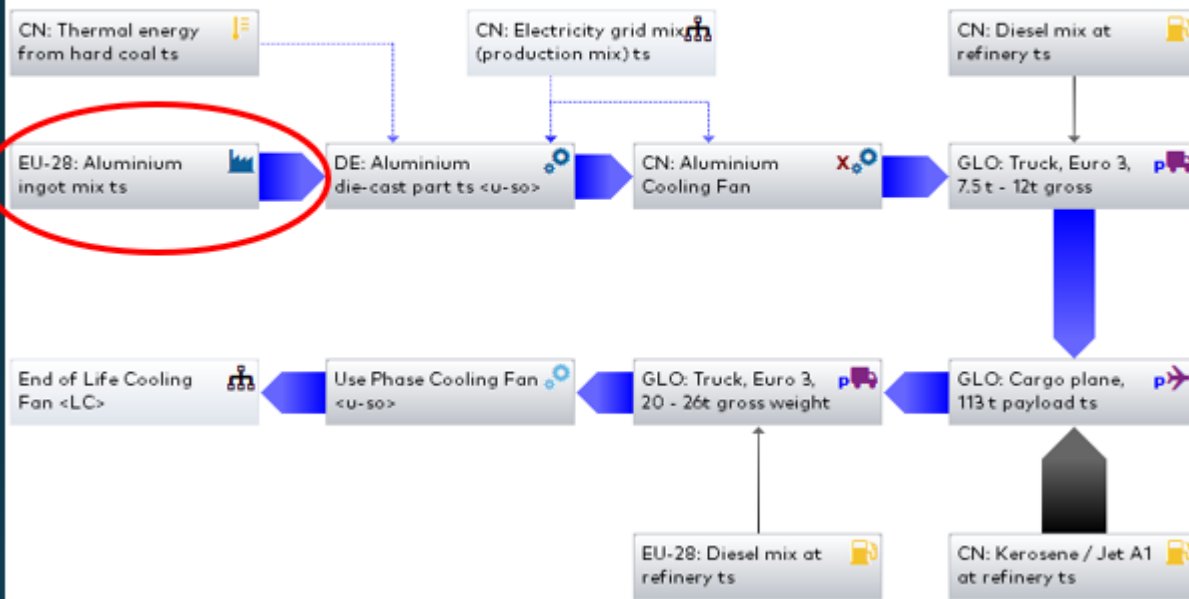
Cradle-to-Grave

Cradle-to-Cradle

# Hotspot CM Cooling Fan

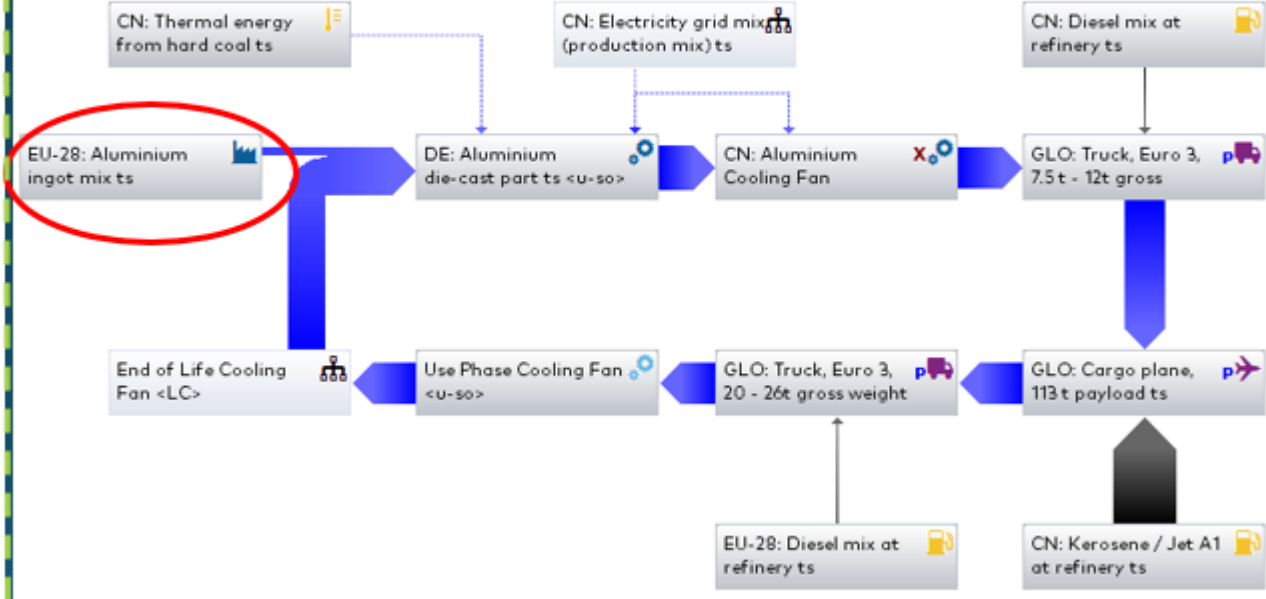
## Life Cycle CM Aluminium Cooling Fan - Cradle to Grave

Process plan: Mass [kg]  
The names of the basic processes are shown.

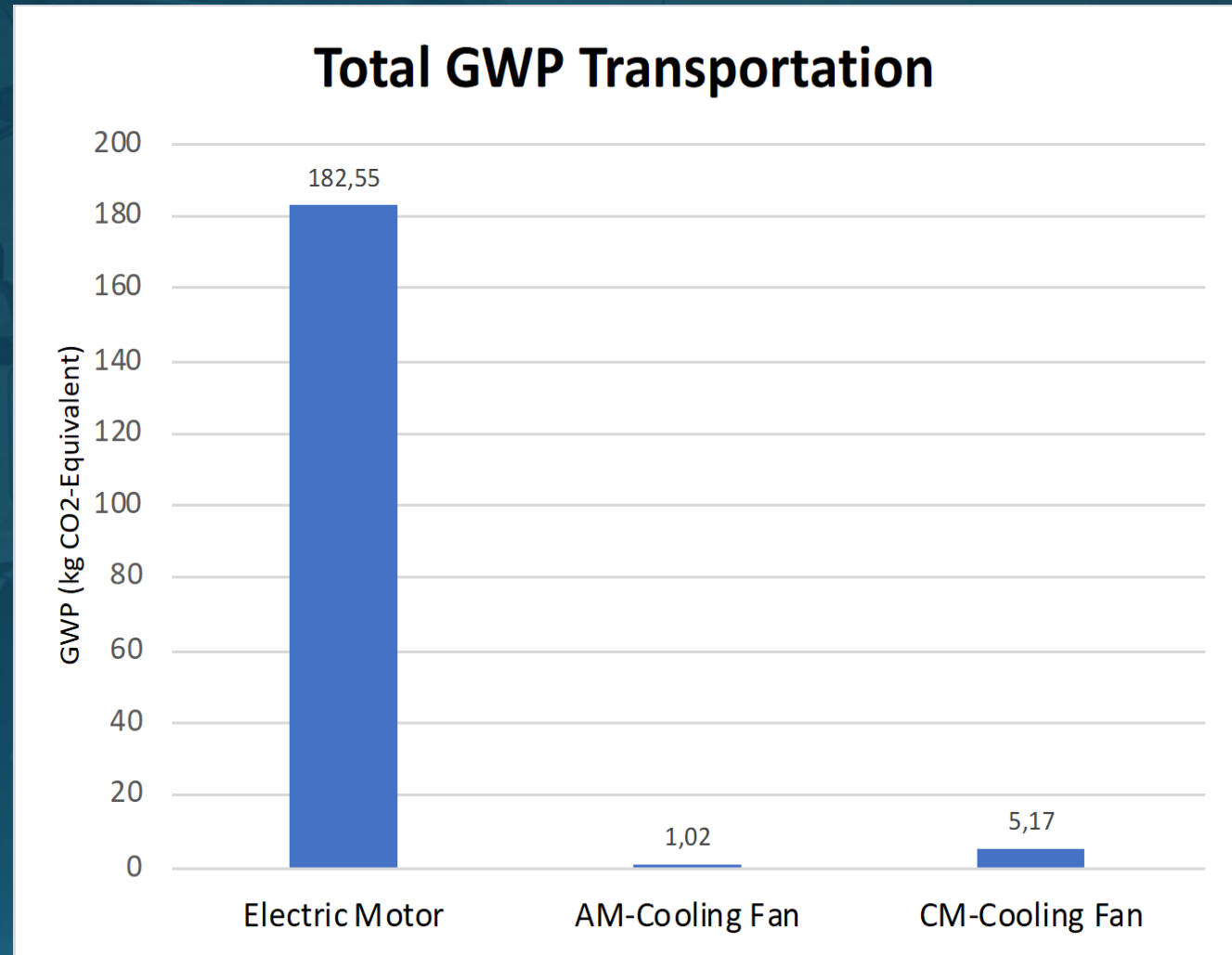


## Life Cycle CM Aluminium Cooling Fan - Cradle to Cradle

Process plan: Mass [kg]  
The names of the basic processes are shown.



# GWP due to transportation



# Discussion

## Transportation

- AM fan is about 1/5th of CM
- AM has fewer transportation “steps”
- AM has lower weight
  
- Volume not considered

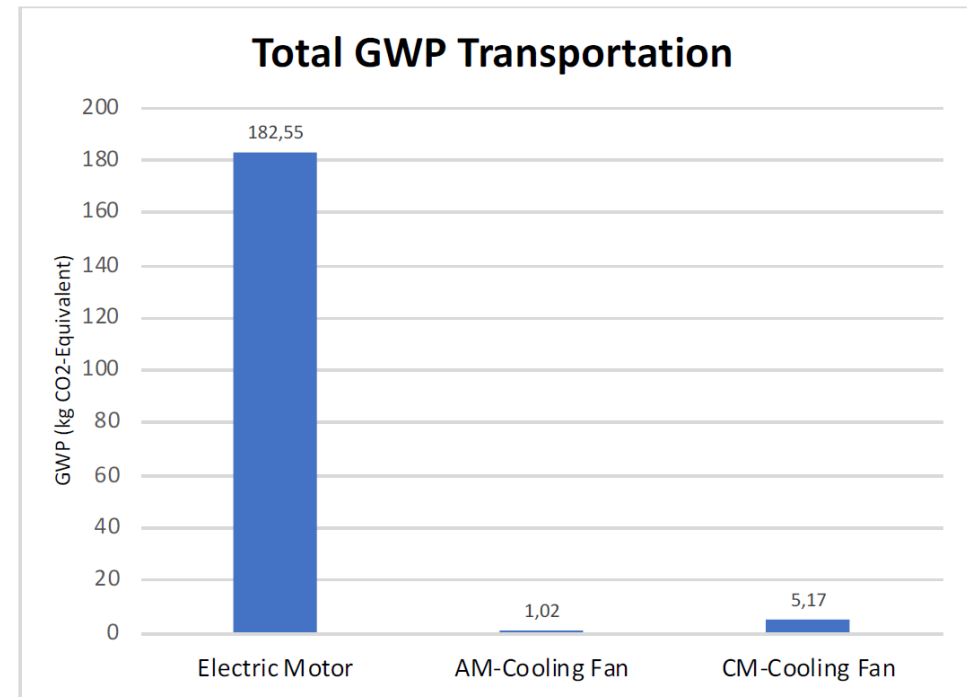


Figure 45: Total GWP Impact due to transportation

	Cradle to grave	Cradle to cradle	GWP from transportation
Electro motor	4509,456	2071,218	182,55
AM cooling fan	3,773	1,702	1,02
CM cooling fan	15,436	8,353	5,17

Unit [kg/CO2e]

# Discussion

- Recycling
- AM significant in favour
- 54.9% reduction
- Aluminium vs nylon
- AM = Pure materials

	Cradle to grave	Cradle to cradle	GWP reduction circular approach
<i>Electric motor</i>	4500,456	2071,218	54,1 %
AM cooling fan	3,773	1,702	54,9 %
CM cooling fan	15,436	8,353	45,9 %
GWP reduction AM vs. CM	75,6 %	79,6 %	

Unit GWP 100 [kg CO<sub>2</sub>e]

Table 2: The potential reduction of GWP



# Conclusion

The carbon footprint of an electric motor, a conventionally- and an additive manufactured cooling fan has been evaluated in regard to the GWP over 100 years. Results are in significant favour to the AM nylon fan, both compared to the CM aluminium fan and compared to the replacement of the electric motor. Recycling of raw material reduces the GWP from 45% to 54% in the three respective scenarios.

	Cradle to grave	Cradle to cradle	GWP reduction circular approach
Electro motor	4509,456	2071,218	54,07 %
AM cooling fan	3,773	1,702	54,89 %
CM cooling fan	15,436	8,353	45,89 %
GWP reduction AM vs CM	75,56 %	79,62 %	
GWP reduction AM vs new motor	99,92 %	99,92 %	



# Thank you for your attention

## Contact information:

Hege Botnen – [hegebot@gmail.com](mailto:hegebot@gmail.com)

Ruben Lindseth – [rubenruuben@gmail.com](mailto:rubenruuben@gmail.com)