

METAL MORPHOSIS

Optimization of joining processes for new automotive metal-composite hybrid parts

Final Seminar

Life-Cycle Assessment of the MetalMorphosis approach

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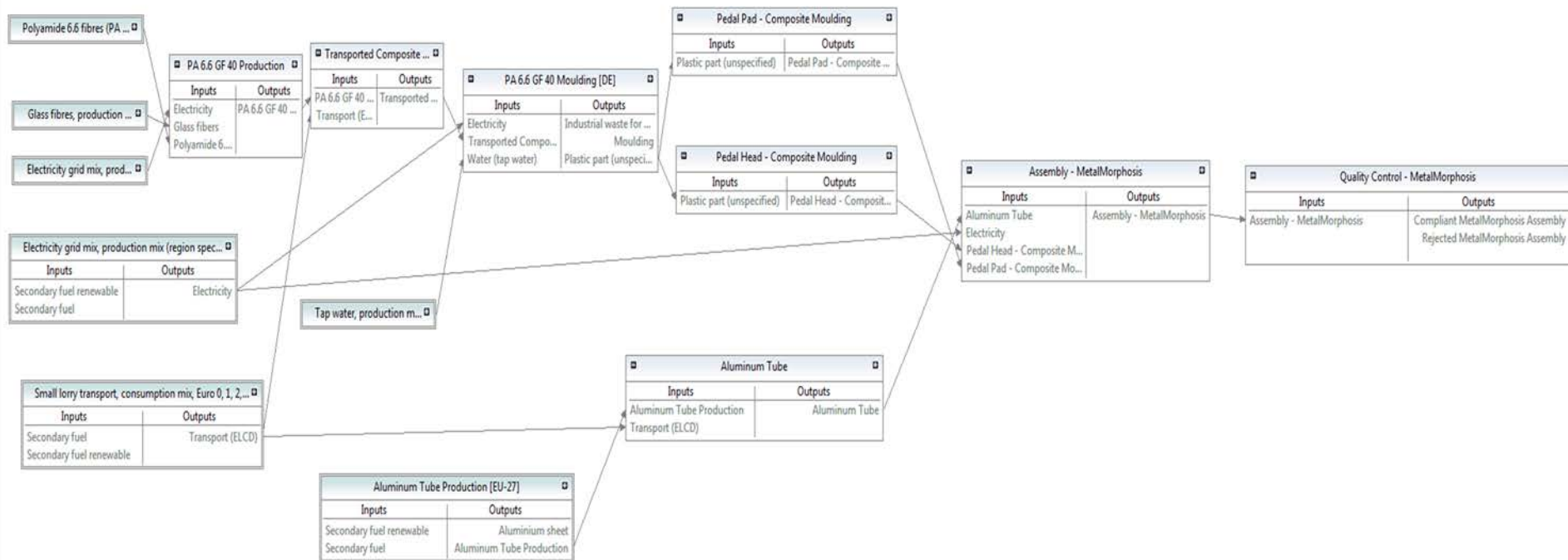
Life-Cycle Assessment

- The first step is the Life Cycle Inventory: an objective, data-based process for quantifying energy and raw materials requirements, emissions and other environmental releases generated.
- Then the environmental impacts of the proposed joining processes are analyzed through a Life-Cycle Impact Analysis.
- LCA needs specific software tools and proper databases for background information.
- The chosen software was OpenLCA; GaBi professional database was selected for the background information of the LCI.

Life Cycle Inventory

openLCA example model:

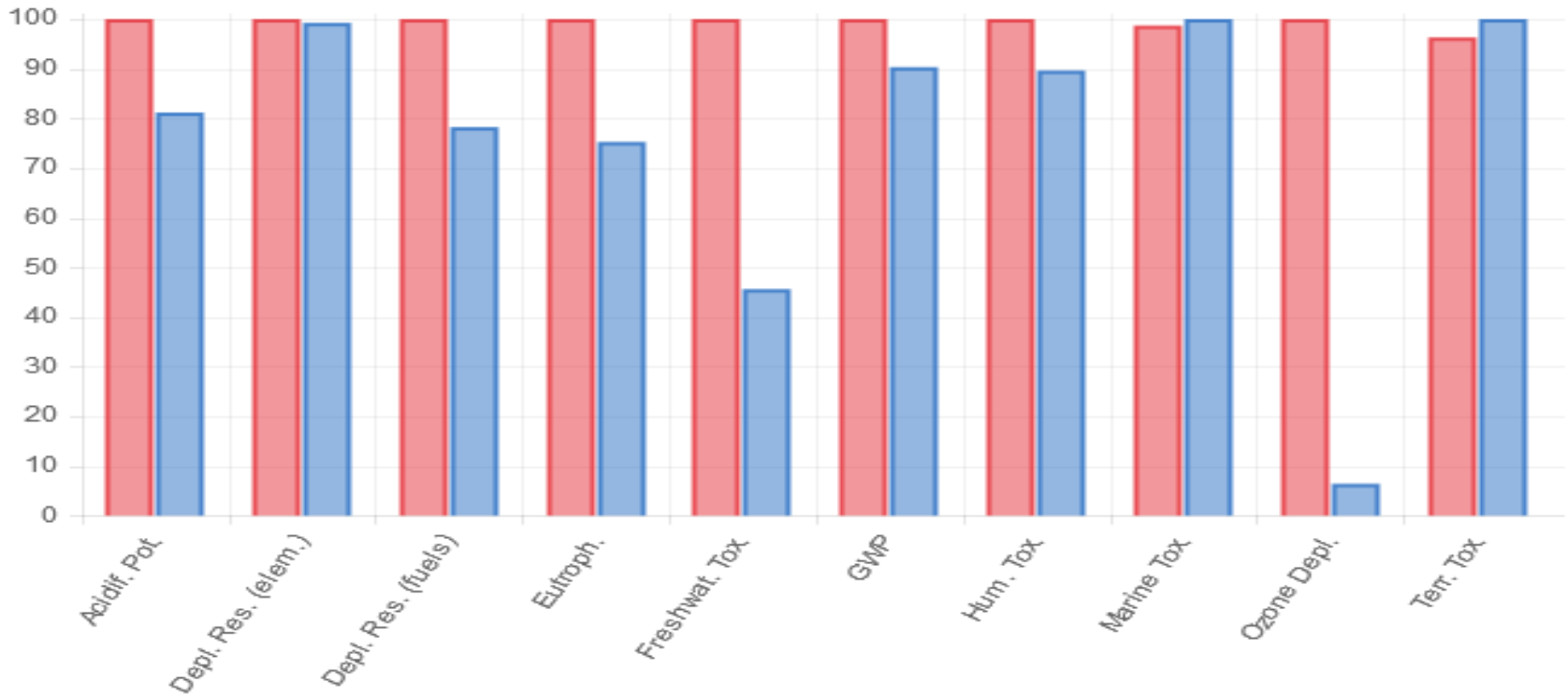
Brake Pedal - MetalMorphosis manufacturing method – Production & QC



Life Cycle Impact Assessment

- Stam has chosen to follow the CML method, i.e. the methodology of the Center for Environmental Studies (CML) of Leiden University.
- It is based on the calculation of the following impact indexes:
 - Acidification potential - [kg SO₂-eq]
 - Climate change – Global Warming Potential - [kg CO₂-eq]
 - Depletion of abiotic resources - elements, ultimate reserves - [kg antimony eq]
 - Depletion of abiotic resources - fossil fuels - [MJ]
 - Eutrophication - [kg PO₄-eq]
 - Freshwater aquatic ecotoxicity - [kg 1,4-dichlorobenzene eq]
 - Human toxicity - [kg 1,4-dichlorobenzene eq]
 - Marine aquatic ecotoxicity - [kg 1,4-dichlorobenzene eq]
 - Ozone layer depletion - [kg CFC-11 eq]
 - Terrestrial ecotoxicity - [kg 1,4-dichlorobenzene eq]

Shock Absorber: Manufacturing & QC

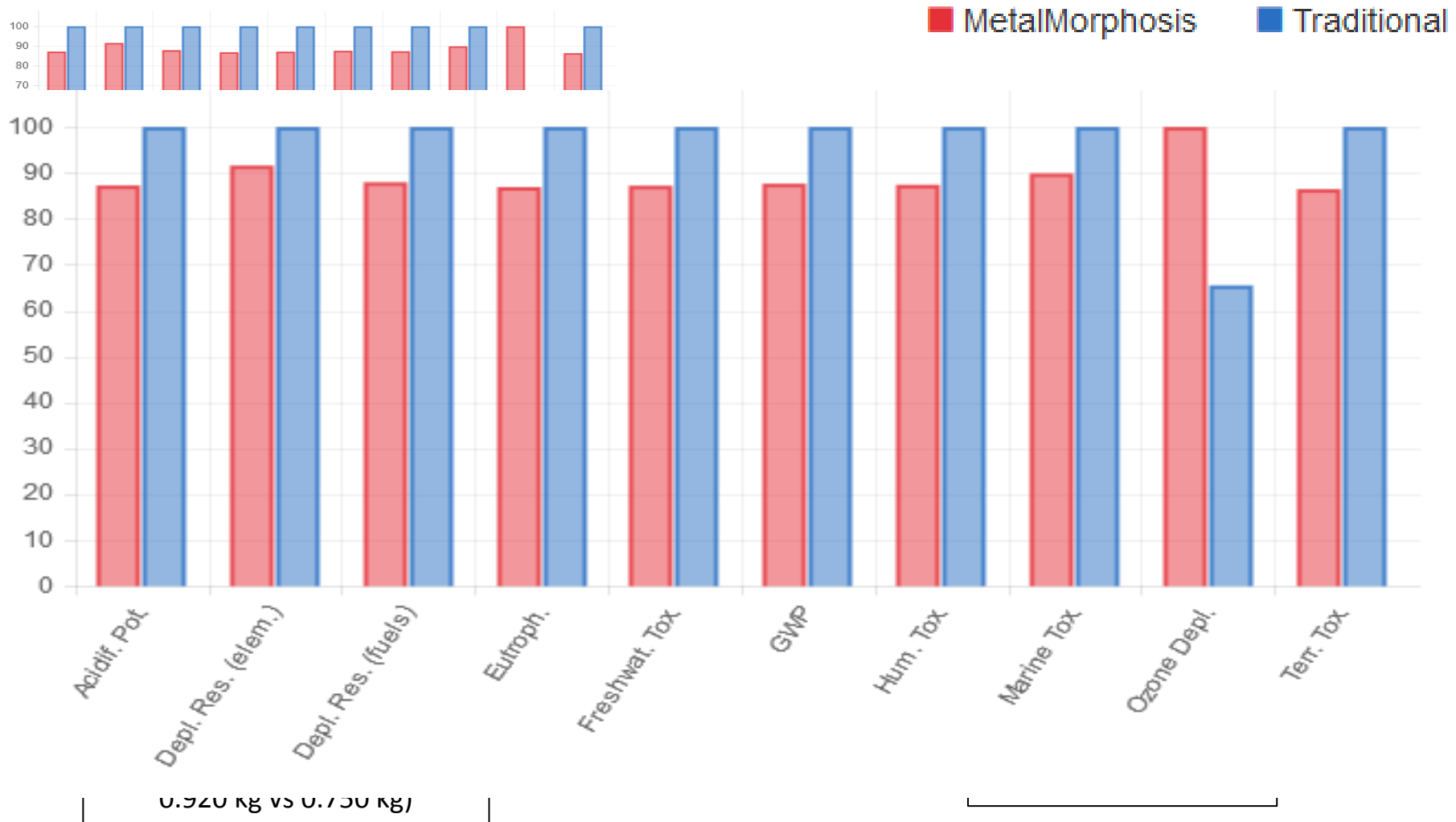


Steel tube production

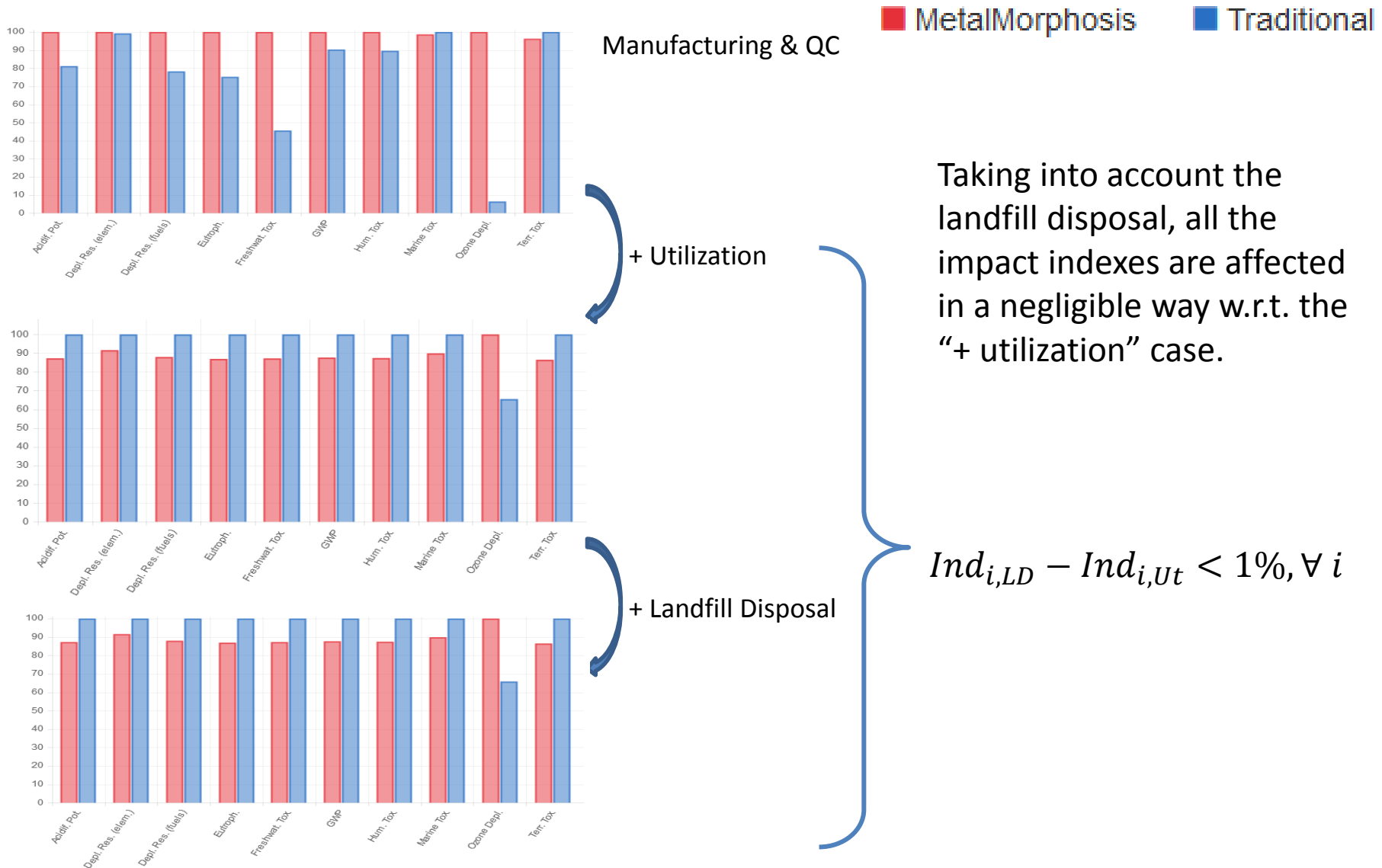
Polyamide production

Energy consumption for composite production

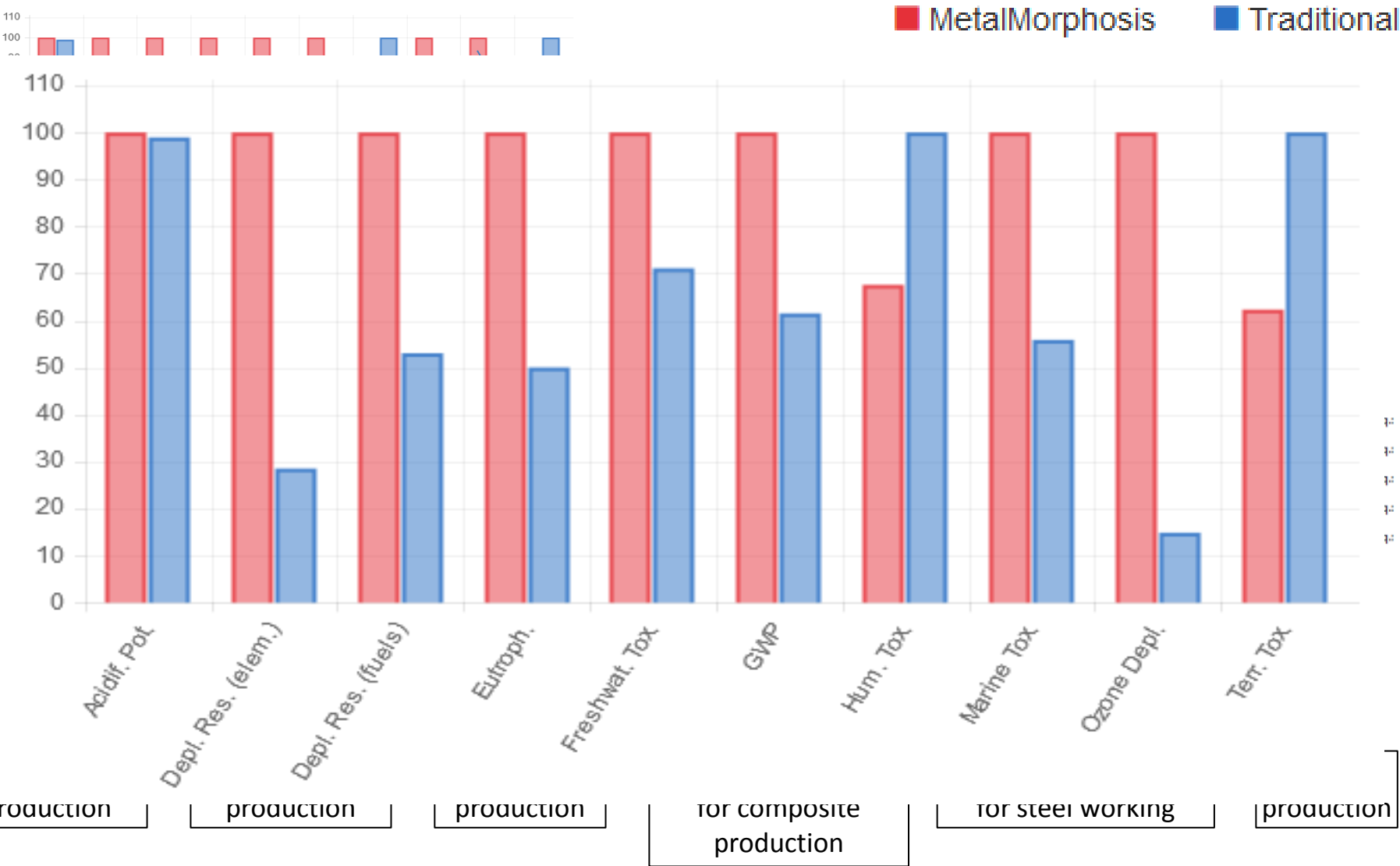
Shock Absorber: + Utilization



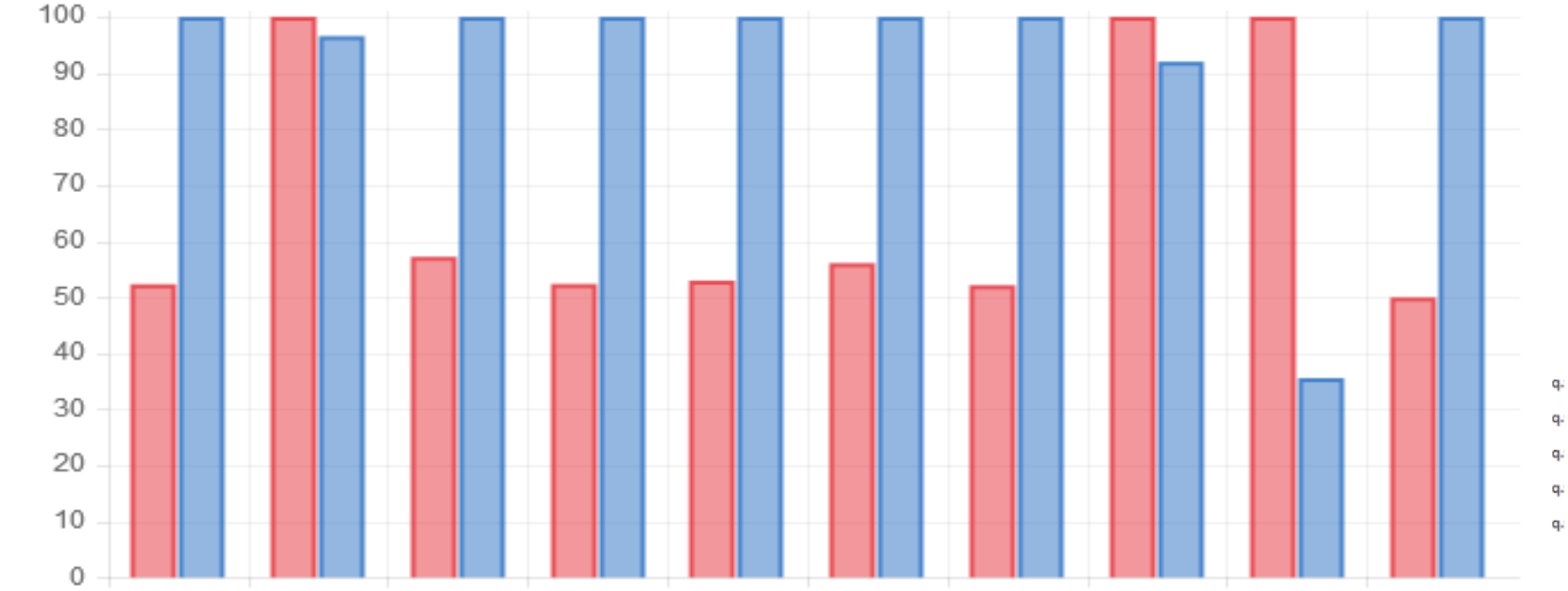
Shock Absorber: + Landfill Disposal



Brake Pedal: Manufacturing & QC



Brake Pedal: + Utilization



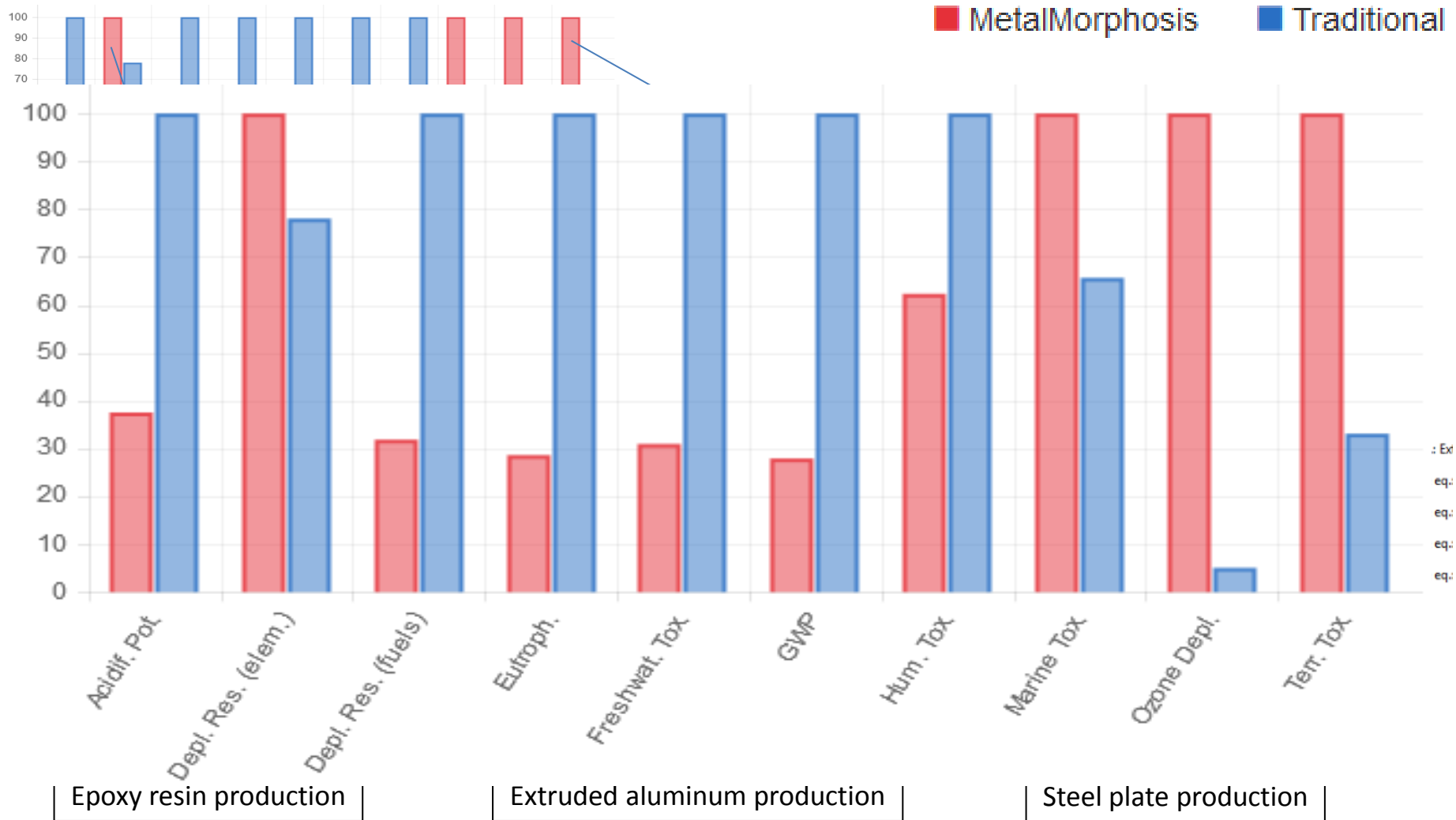
0.916 kg Vs 0.455 kg

production

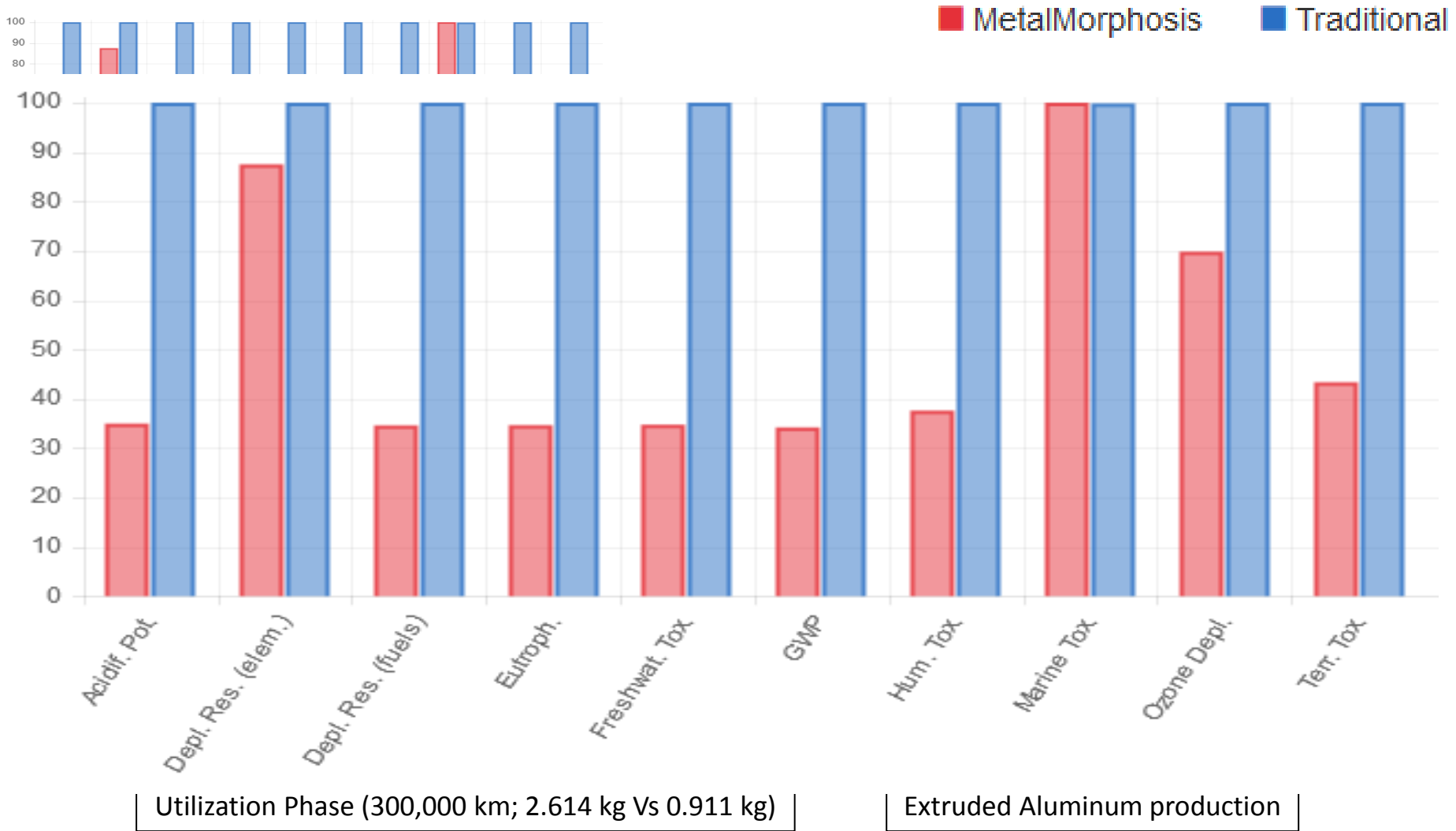
composite production

production

Car Bumper: Manufacturing & QC



Car Bumper: + Utilization



Conclusions

- The MetalMorphosis method generally reduces environmental impacts during the products utilization
- The components where the highest weight save is reached show the greatest advantages of the MetalMorphosis
- The most impacting processes are: composite materials production, steel working, raw aluminum production
- Possible corrective actions to further improve the MetalMorphosis approach w.r.t. state-of-art manufacturing:
 - Investigating less impacting PA 6.6, glass fibers and epoxy resin production methods, mainly concerning Ozone layer depletion
 - Replacing aluminum with less impacting metals concerning Ozone layer depletion and Marine Ecotoxicity

Thanks for your attention!