Third Party and Critically Reviewed plantMPG™ Life Cycle Assessment (LCA)

Compliant with the guidelines of ISO 14040/14044

Avantium Renewable Chemistries

October 2022

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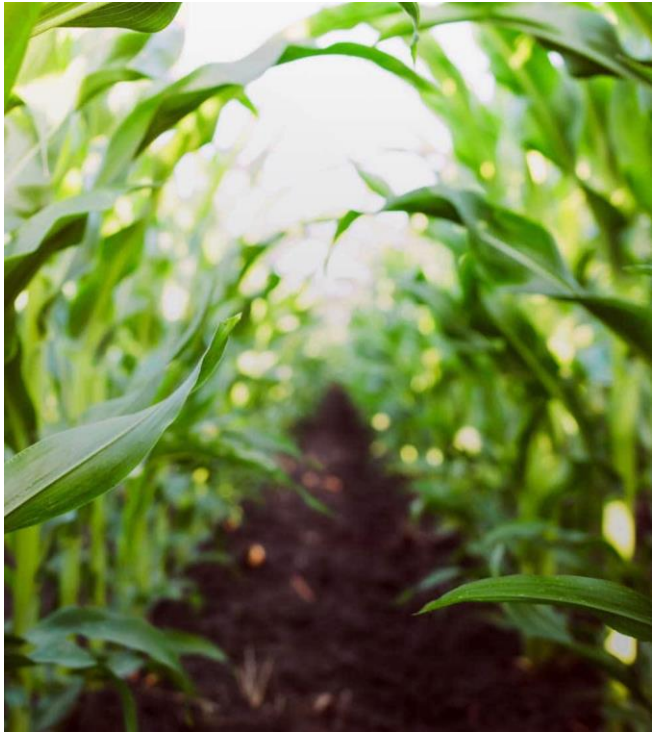


Executive Summary of Ray plantMPG™ Life Cycle Assessment

Avantium N.V, a leading technology company in renewable chemistry, recently conducted a third party and critically reviewed Life Cycle Assessment (LCA) study on the environmental impacts of its plantMPG™ (mono-propylene glycol) from its Ray Technology™

The Life Cycle Assessment (LCA) is based on the following key assumptions and considerations:

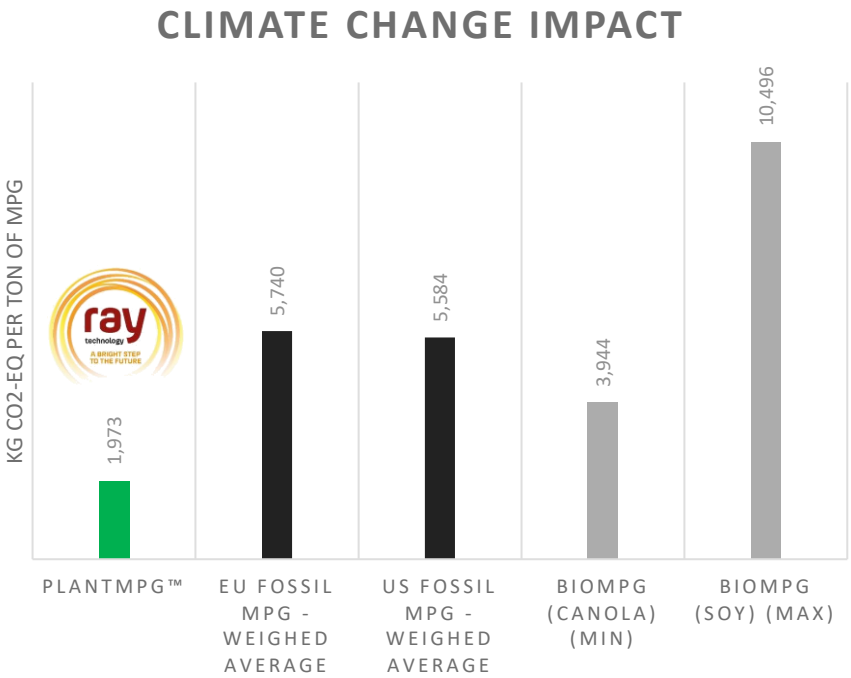
- Cradle-to-grave LCA with a regional and end-of-life focus on Europe and wastewater treatment, respectively.
- Use of Cosun Beet Company beet sugar, green electricity, natural gas-based steam and green hydrogen.
- European and US fossil and renewable incumbent technology scenarios are used for benchmarking.

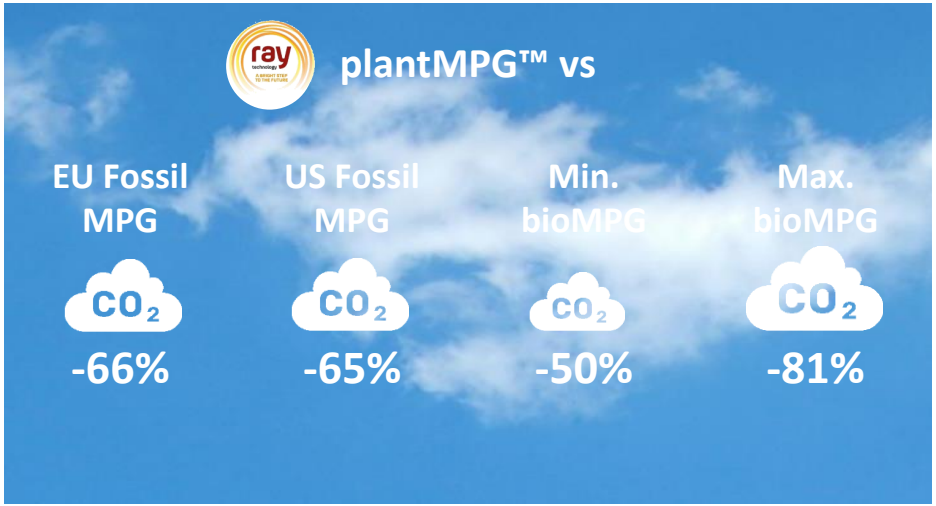
The LCA shows a greenhouse gas (GHG) emission reduction of up to 81% over the life cycle when Avantium's plantMPG™ is compared with its fossil-and biobased incumbents

- Climate change impact of Ray plantMPG™ is lowered with 50-81%[2] compared to fossil- and biobased MPG.
- Next to being best-in-class in climate change impact, Ray plantMPG™ outperforms all incumbent technologies in the water use (13-99% lower) and non-renewable primary energy demand (41-82% lower) impact category.
- The agricultural dependency of biobased technologies like Ray Technology™ drives the Marine and Terrestrial Eutrophication, Acidification and Land Use impact. Nevertheless, Ray plantMPG™ is either performing in a similar order of magnitude compared to the fossil incumbents and/or outperforming the biobased MPG incumbents across these respective impact categories.

[1] A representative end-of-life for MPG used in home care and aircraft deicing applications
[2] Range depending on incumbent biobased glycerine source, fossil propylene source and the respective propylene oxide route

Climate change impact of Ray plantMPG™ is lowered with 50-81% compared to fossil- and biobased alternatives

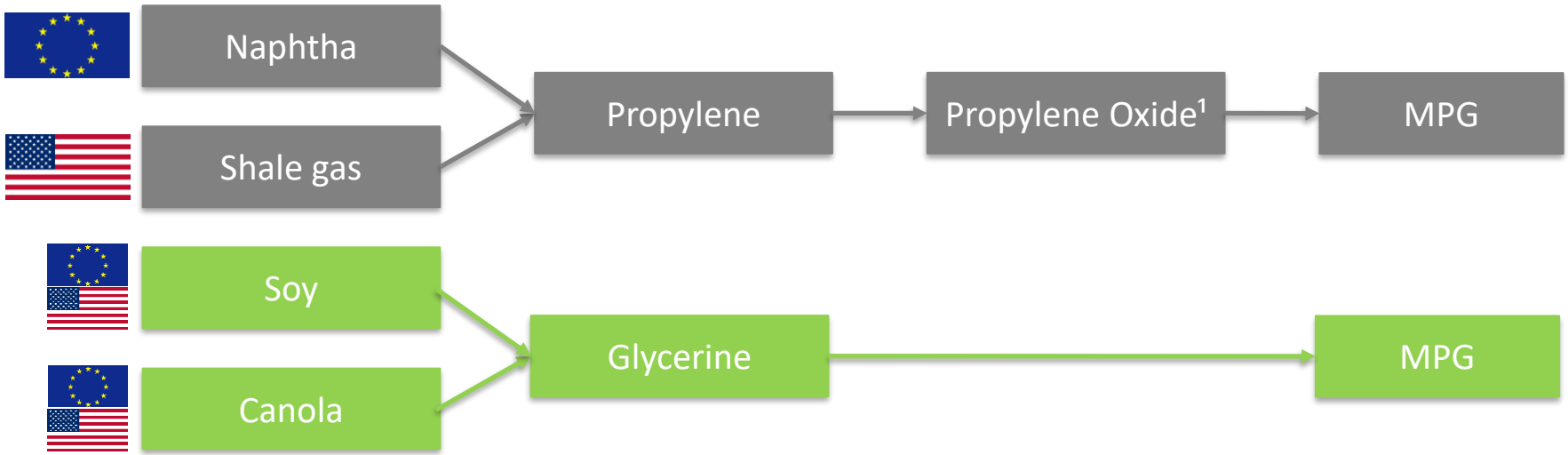




Source: Final outcomes of environmental cradle-to-grave life cycle analysis, performed with Sphera and subjected to independent panel review. Economic Allocation Is applied across all technologies. Wastewater treatment as End of Life), plantMPG™ based on Dutch beet sugar and green H_2. The regional fossil MPG weighed averages are determined based on regional deployment share of respective MPG production routes.

Introduction

A set of relevant incumbent technologies has been selected for the comparative assessment



[1]Propylene oxide (PO) is produced from propylene via four main processes: PO/Tertiary Butyl Alcohol (TBA) process, PO/Styrene Monomer (SM) Process and the Chlorohydrin Processes (using $Ca(OH)_2$ and NaOH, respectively). The respective relevance of these PO processes differs between Europe and US. Weighed averages have been determined based on the regional deployment share.

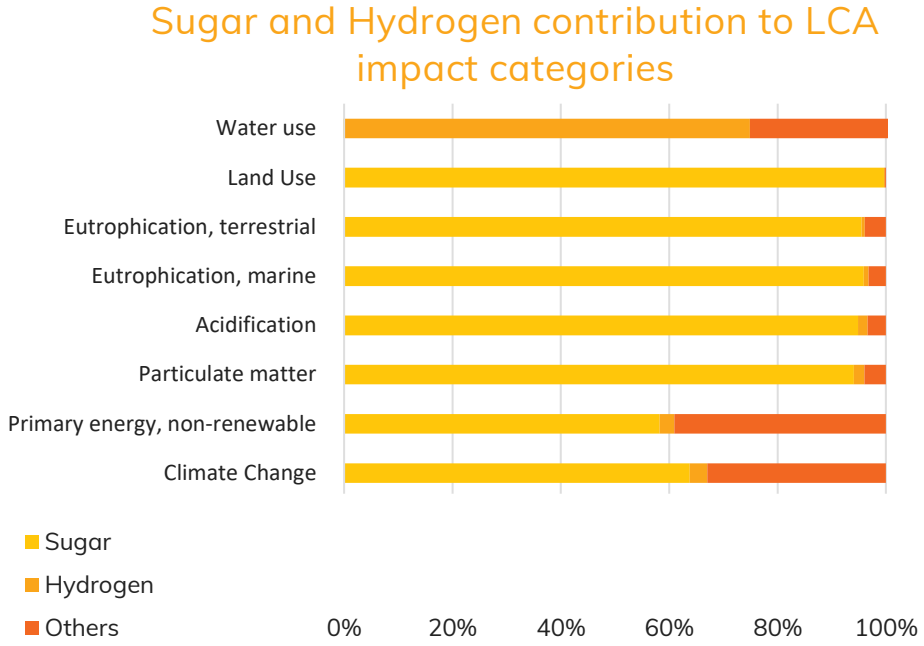
A broad range of environmental impact categories have been assessed

Impact Category	Unit of Measurement
Climate Change	kg CO_2-eq
Water Scarcity	m^3
Eutrophication	
Terrestrial	Mole of N-eq
Marine	Kg of N-eq
Land Use	Pt
Acidification	Mole of H-eq
Primary Energy Demand	
Non-Renewable	MJ
Particulate Matter	Disease incidences

All figures are expressed on a "per ton MPG" basis

The carbohydrate feedstock is the most significant contributor to most of the LCA impact categories

As sugar is the most important feedstock in the Ray Technology™ it logically is the most significant contributor to the majority of the LCA impact categories



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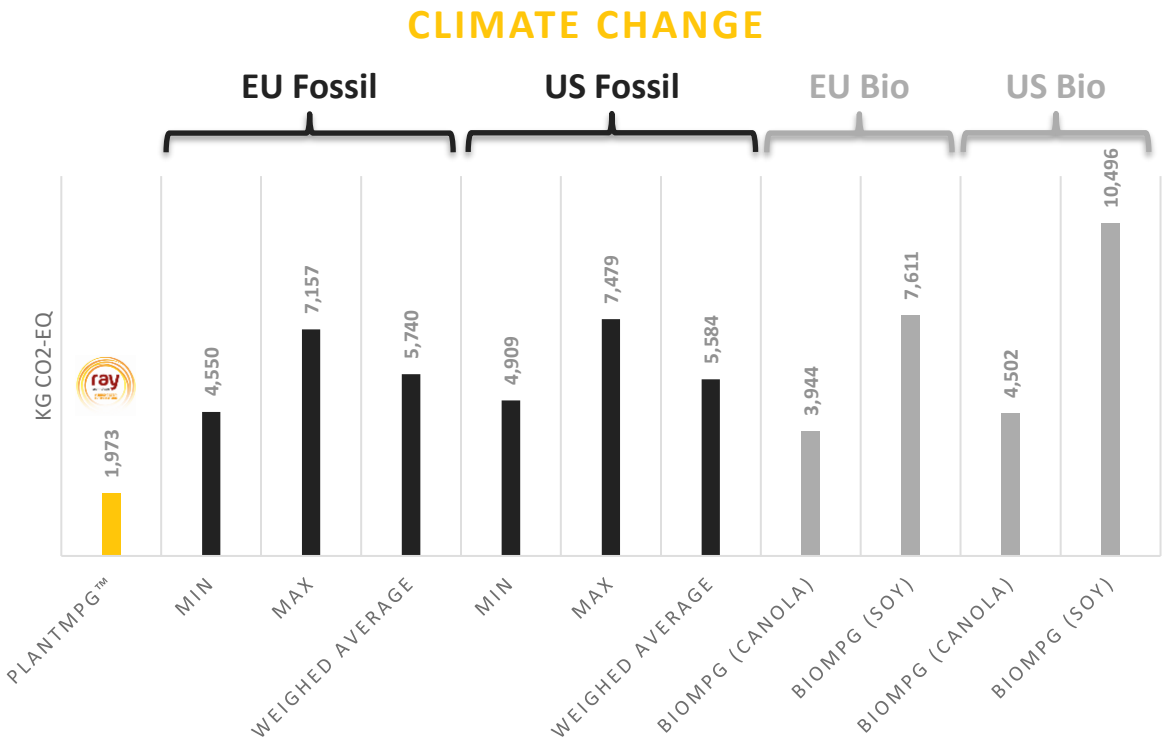
Climate Change Impact

Ray plantMPG™ is best-in-class on the Climate Change Impact Category, driving up to 81% reduction potential

- Ray Technology™ outperforms all incumbent technologies
- The climate change reduction for Ray Technology is largely driven by the feedstock contribution and biogenic nature.
- The climate change reduction potential of plantMPG™ ranges from 50-81%



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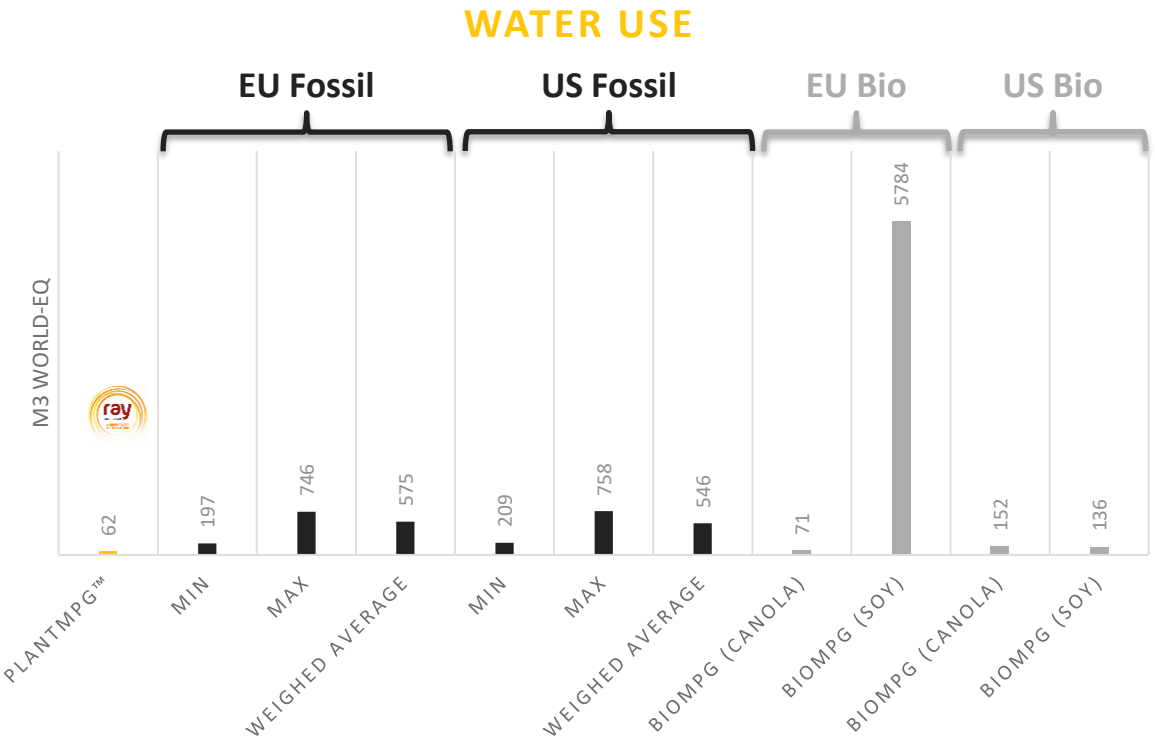
Other Environmental Impact Categories

Water Scarcity

- Ray Technology™ outperforms all incumbent technologies
- This is driven by the limited relevance of water scarcity in North-Western Europe, the inherent limited net use of water in Ray Technology™ and the advantaged water footprint of Cosun Beet Company beet sugar (compared to soy and canola agriculture)



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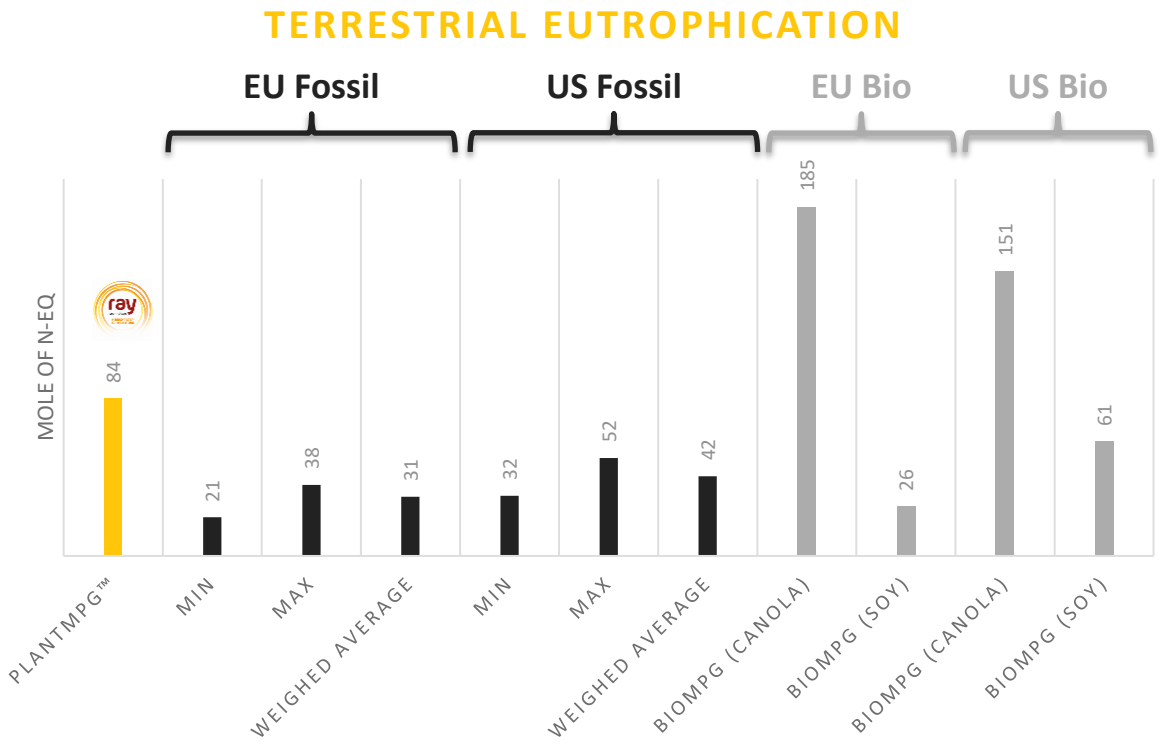
Eutrophication - Terrestrial

- Technologies, relying on biomass feedstock, typically result in more terrestrial eutrophication compared to fossil technology due to the dependence on and impact of agriculture
- Nevertheless, Ray Technology performs within a similar order of magnitude compared to its incumbents



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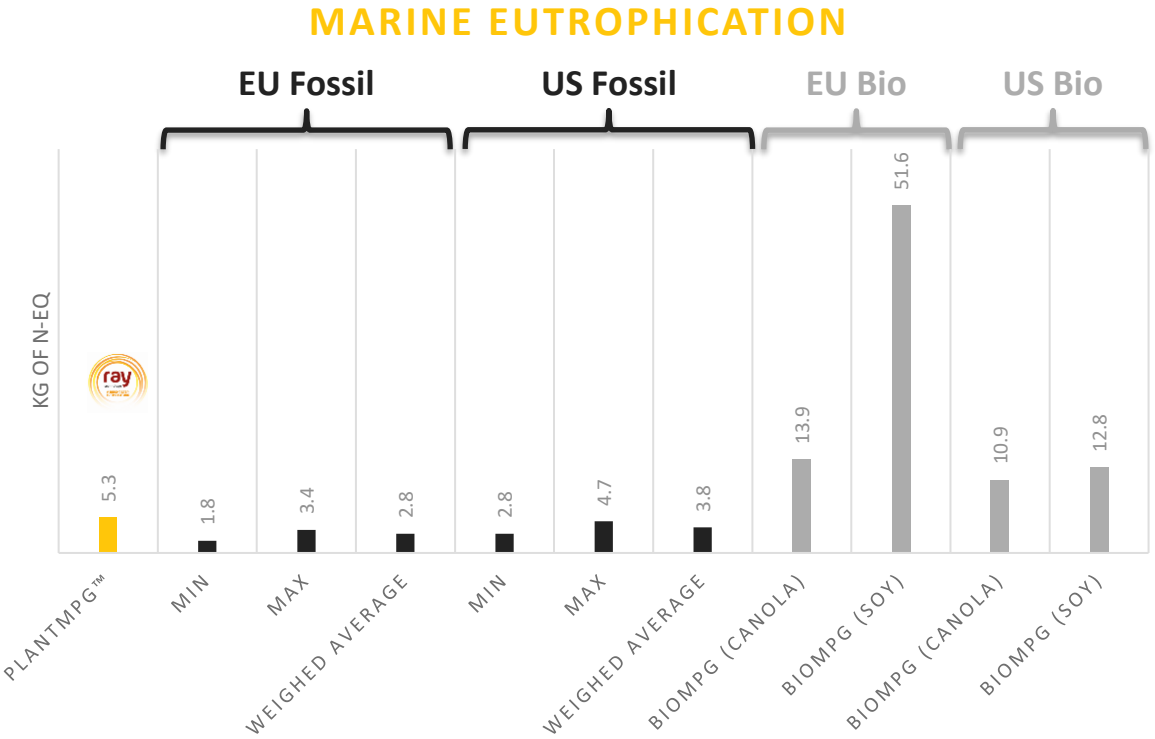
Eutrophication - Marine

- Technologies, relying on biomass feedstock, typically result in more marine eutrophication compared to fossil technology due to the dependence on and impact of agriculture
- Nevertheless, Ray Technology performs within a similar order of magnitude compared to its incumbents



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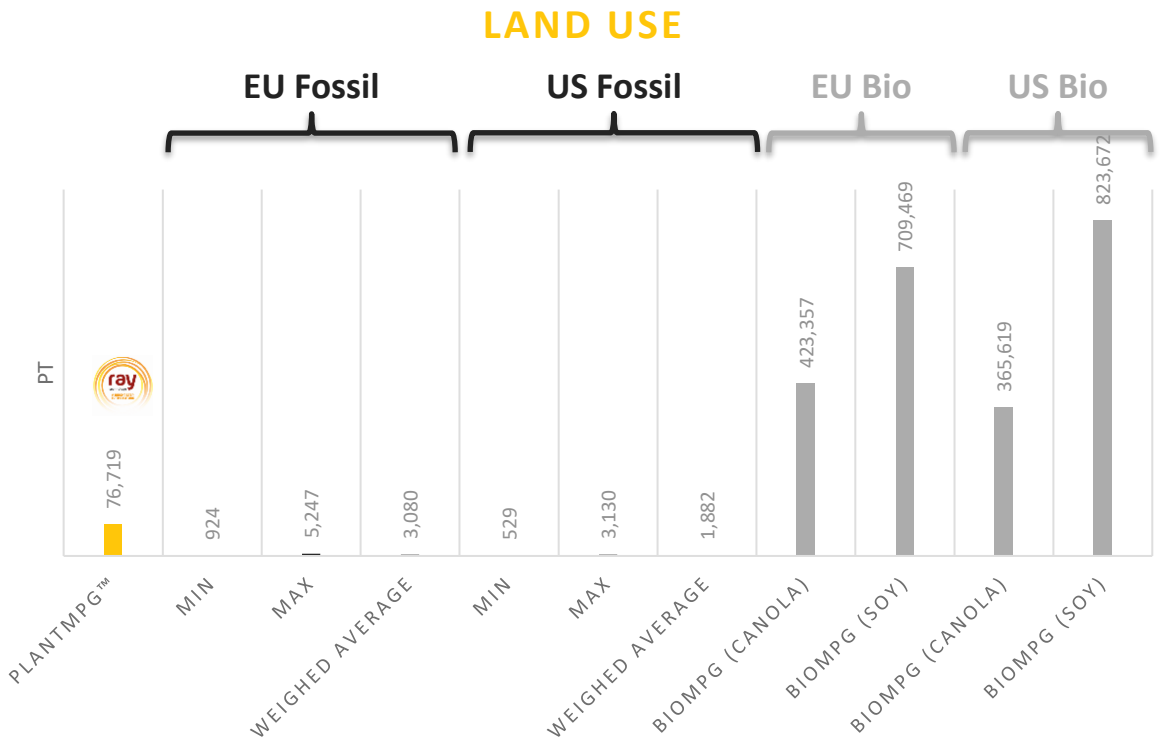
Land Use

- Technologies, relying on biomass feedstock and agriculture, typically result in more land use compared to fossil technologies
- Nevertheless, Ray plantMPG™ is more advantaged than the biobased MPG incumbents



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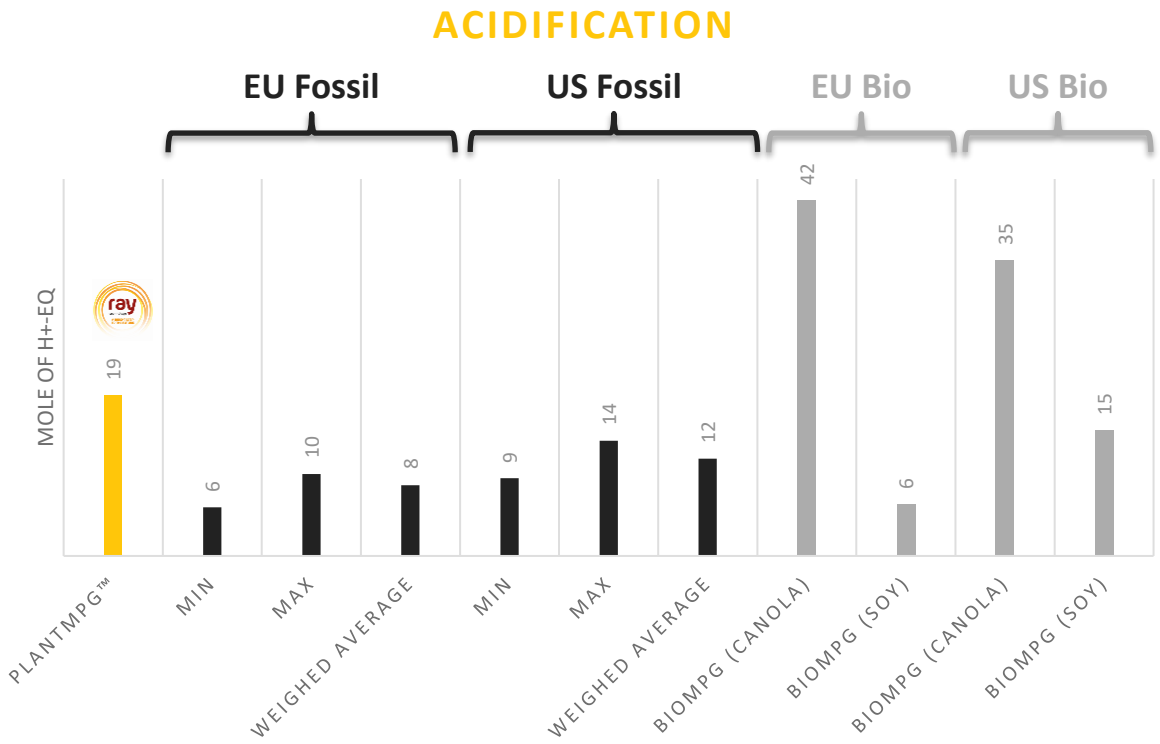
Acidification

- Technologies, relying on biomass feedstock and agriculture, typically result in more acidification compared to fossil technologies
- Nevertheless, Ray Technology performs within a similar order of magnitude compared to its incumbents



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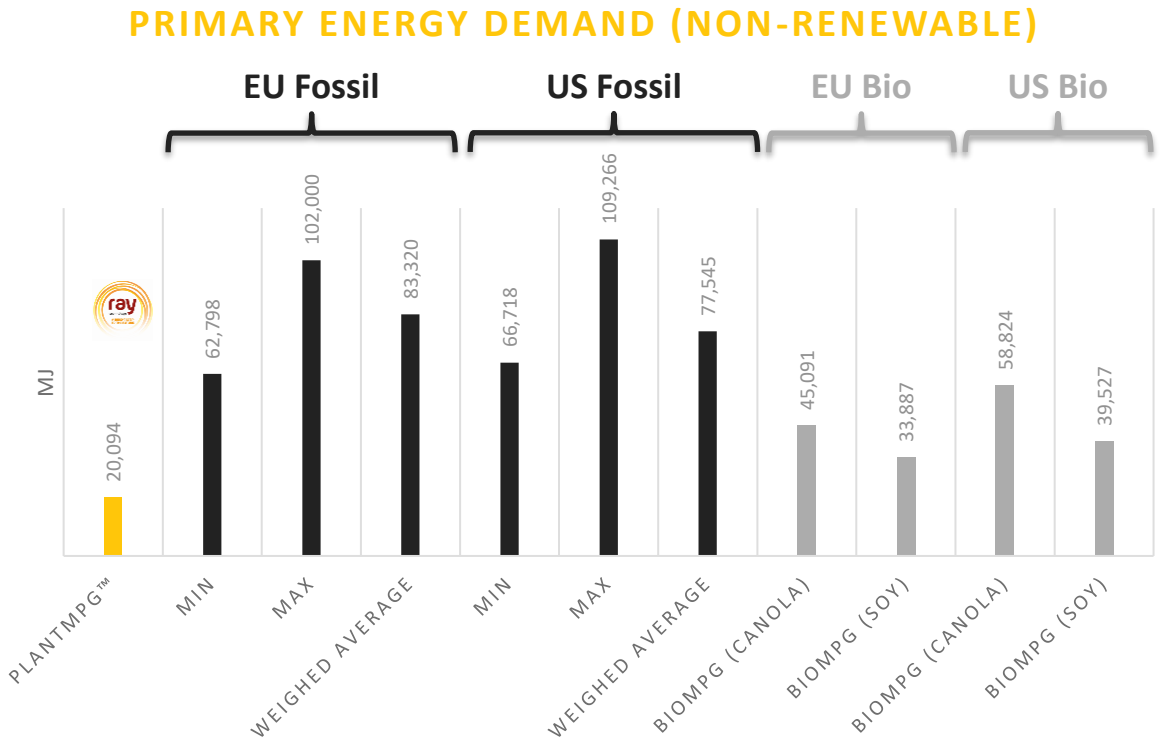
Primary Energy Demand, Non-Renewable

- Ray plantMPG™ outperforms all incumbent technologies on the Non-Renewable Primary Energy Demand Impact Category



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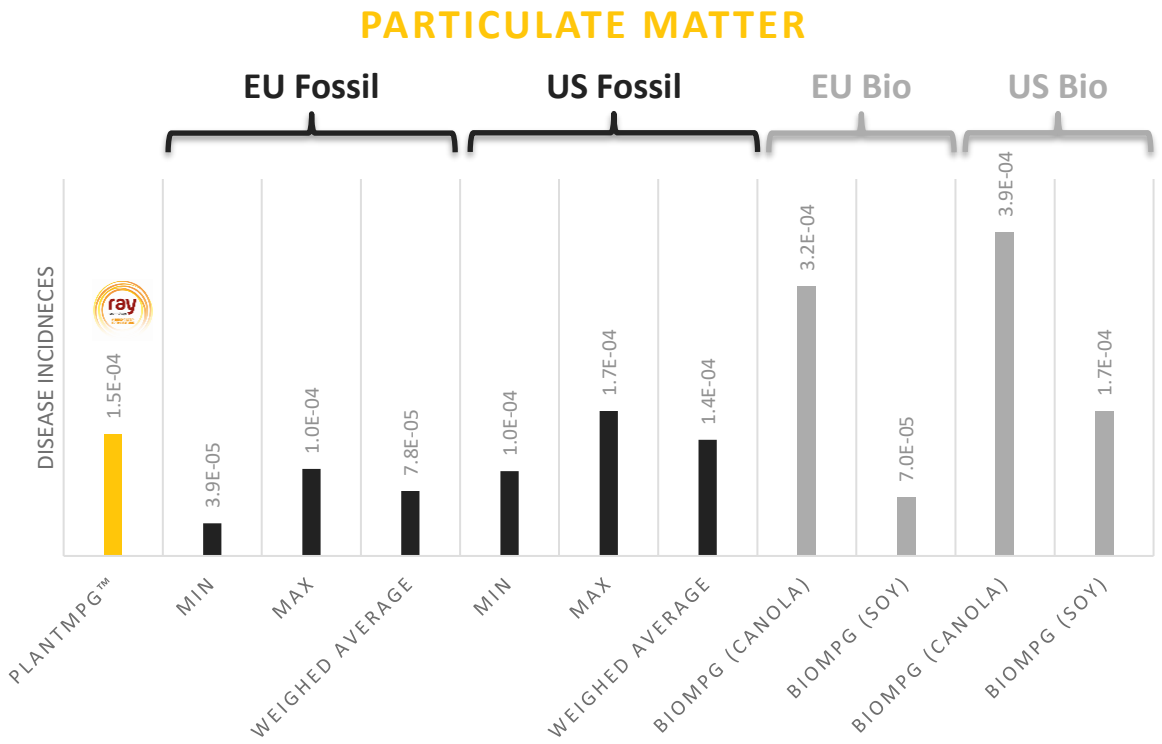
Particulate Matter

- Ray plantMPG™ performs within a similar order of magnitude compared to its incumbents



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Acknowledgement

The following projects have supported the establishment of the plantMPG™ LCA:

BBI JU

Horizon 2020
European Union Funding
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IMPRESS

Bio·based Industries
Consortium

VEHICLE

SNN
SAMENWERKINGSVERBAND
NOORD-NEDERLAND
• Stimuleert • Faciliteert • Verbindt

Europese Unie
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