Avoiding Greenhouse Gas Emissions

The Essential Role of Chemicals

Renewable Polyethylene based on HVO (Hydrotreated Vegetable Oil) diesel

A SABIC case study

A Life Cycle Assessment study evaluated GHG emissions linked to polyethylene produced via two renewable routes: 1. Waste animal fats based renewable diesel and 2. Palm oil fatty acids based renewable diesel. These are compared with fossil naphtha route to produce polyethylene. Results indicate that the animal fats based route leads to a significantly lower carbon footprint than the fossil route. For the palm oil route, complete capture of methane emissions during palm oil processing is critical to ensure lower carbon footprint. Likewise, palm oil plantation must not have been associated with recent land transformation (forests to plantation) for it to have lower GHG emissions than the fossil route.

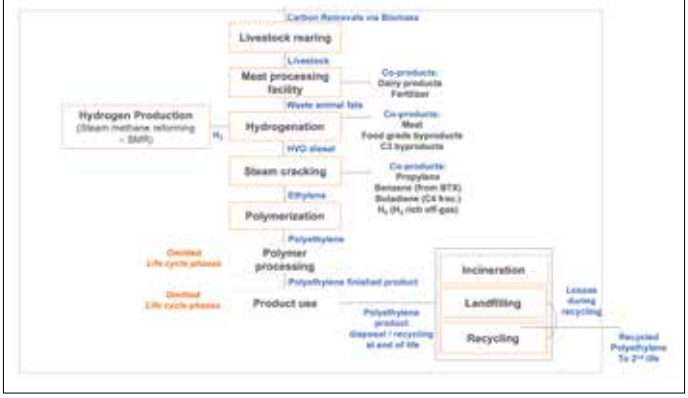
In the quest towards GHG mitigation, recent advancements in climate science warn of a dire need for drastic acceleration of efforts and significantly steeper reduction in global GHG (Green House Gas) emissions. SABIC has developed a renewable polyethylene product that is produced based on renewable feedstock for ethylene production via steam cracking prior to subsequent polymerization of the produced ethylene to polyethylene. Renewable feedstock for the cracker is Hydrogenated Vegetable Oil (HVO) diesel, which is produced from hydrogenation of waste animal fats. This feedstock does not interfere with food chains. On the other hand, it offsets requirement for fossil naphtha feedstock for the cracker on a proportional scale.

The study shows that polyethylene based on waste animal fats can lead to substantial avoided emissions. In parallel, the study shows that the palm oil based route may have avoided emissions potential but only if 00% or near 100% of the methane is captured.

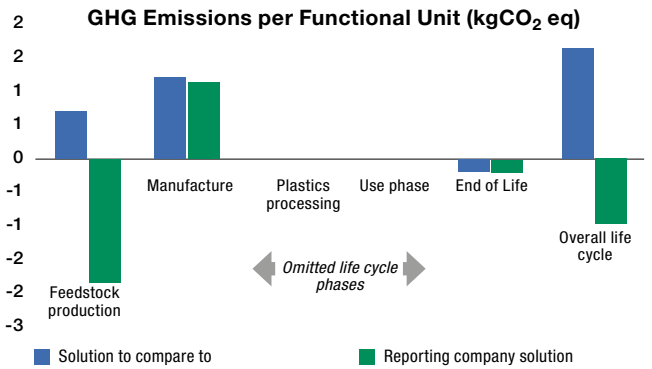
The significance of contribution of the chemical product (polyethylene in this case) to avoided emissions along the value chains is assessed to be “extensive” according to ICCA’s guidance criteria. Use of renewable feedstocks towards production of polymers that are recyclable at end-of-life is a good example of circular economy concept and it can provide important advantages in terms of GHG mitigation.

Full study available at: www.icca-chem.org/energy-climate

Product life cycle schematic of Polyethylene from waste animal fats



Avoided Greenhouse Gas Emissions over the lifecycle of renewable polyethylene based on waste animal fats versus conventional fossil naptha route



The avoided CO_2e emissions per functional unit			
Emissions per life cycle phase (kg CO_2 eq.)	**Reporting company’s solution (renewable polyethylene)**	**Solution to compare to (fossil polyethylene)**	**Avoided Emissions kg CO_2 eq./functional unit**
Feedstock production	-1.88	0.68	2.56
Manufacture	1.13	1.18	0.05
Plastics processing	0	0	0
Use phase	0	0	0
End of Life	-0.24	-0.24	0
Overall life cycle	**-0.99**	**1.62**	2.61

This case study illustrates how the reduction of greenhouse gas (GHG) emissions can be enabled by chemical products, as part of a series of case studies brought to you by ICCA. Chemical industry members offered Life Cycle Assessment [LCA] case studies for the purpose of showing illustrative examples on how to calculate avoided greenhouse gas emissions. The avoided emission calculations were based on the guidelines developed by ICCA and WBSCD (World Business Council for Sustainable Development) - Chemical Sector, with the support of Arthur D. Little and Ecofys. Other life cycle environmental impacts such as water and land use change were outside the scope and usually not considered.