

Inventions & Innovators spearheading Sustainable Plastics

A view across the enabling technologies of Bio-degradable polymers, Bio-based polymers, & Sustainable Adhesives.

An estimated 80% of the 8.3 Bn tonnes of plastics produced globally since the 1950s has ended up in landfills or escaped into the environment. This comes at the detriment of the global ecosystem which is bearing the long-term consequences of the non-biodegradable nature of most plastics. Since 2015, the UN is looking to directly tackle the issue by setting out Sustainable Development Goals (SDGs) to promote responsible consumption and production patterns, as well as improve living conditions on land and below water. Our ambition is to provide an objective perspective of the global leaders and innovators contributing to accomplishing the SDGs, through the utilisation of published patent data.

In this update on innovation being made in critical technologies spearheading sustainable plastics, we provide our view of the leading innovators to watch based on recent published inventions and overall weightings to enabling technologies. The tech areas covered include Bio-degradable polymers, Bio-based polymers, & Sustainable Adhesives.



The World's Leading Sustainable Plastic Innovators To Watch

Cipher view of the world's leading innovators to watch based on recent publications and overall weighting of inventions to enabling sustainable plastic technologies: Bio-degradable polymers, Bio-based polymers, & Sustainable Adhesives

Cipher Sustainability Insight

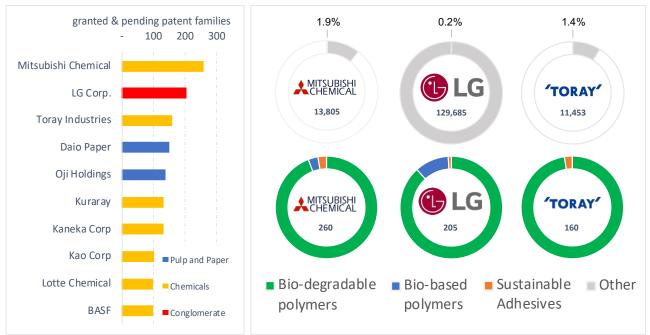
At Cipher, we support many of the world's largest organisations in scoring and benchmarking on sustainability innovation specific to the energy transition, climate change, the circular economy, clean water, health & wellbeing and more. For information on how you can access critical insight on sustainable innovation specific to your business and industry, please get in touch.

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Top invention owners worldwide in alternative sustainable plastic technologies include several Japanese Chemical and Pulp & Paper giants. Bio-degradable polymers represents the overwhelming majority tech area.

Sustainable plastic tech accounts for only a small portion of the published inventions owned by the top three invention owners Mitsubishi Chemicals, LG and Toray.



Top Invention Owners: Sustainable Plastic Technologies

Patent families classified according to technologies using Cipher's internal sustainability classifiers Global excluding China only patent families

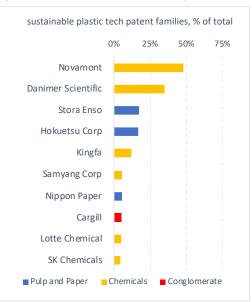
The extended list of 50 top owners is included on page 4.

Sustainable Plastic Tech Weighting: patent families owned as a percent of the total for each top owner

Sustainable plastic technologies represent a minor fraction of the top owners published inventions. For each of the top 10 owners, these technologies constitute less than 5% of their total portfolios. To see which companies place a strategic importance towards sustainable plastic innovation, we rank the top 50 owners by percent exposure.

The leaders in this regard are Bioplastic-oriented companies -Novamont and Danimer Scientific and Finnish Bioeconomy leader Stora Enso. Sustainability is at the forefront of each company's strategy, with the overall aim of reducing pollution from traditional plastics. 48% of Novamont's 112 active patent families are dedicated to sustainable plastic alternatives, followed by Danimer at 35% and Stora Enso at 17%. Interestingly, Danimer's acquisition of Novoner in 2021 increased their Bio-based polymer tech area by ten-fold.

Similarly, the top 10 largely features Chemical and Pulp & Paper companies specifically, with the exception of Cargill a US-based Conglomerate.





The leading sustainable plastic weighted innovators based on recent patenting activity by scale and overall exposure; Bio-degradable polymers the dominant technology enabler

These are the companies that we view as leaders to watch in sustainable plastic innovation. The full list is generated by screening those organisations with the most inventions published across the enabling technologies from start of 2021 to date and where recent innovation is relatively more weighted to those technologies over others.



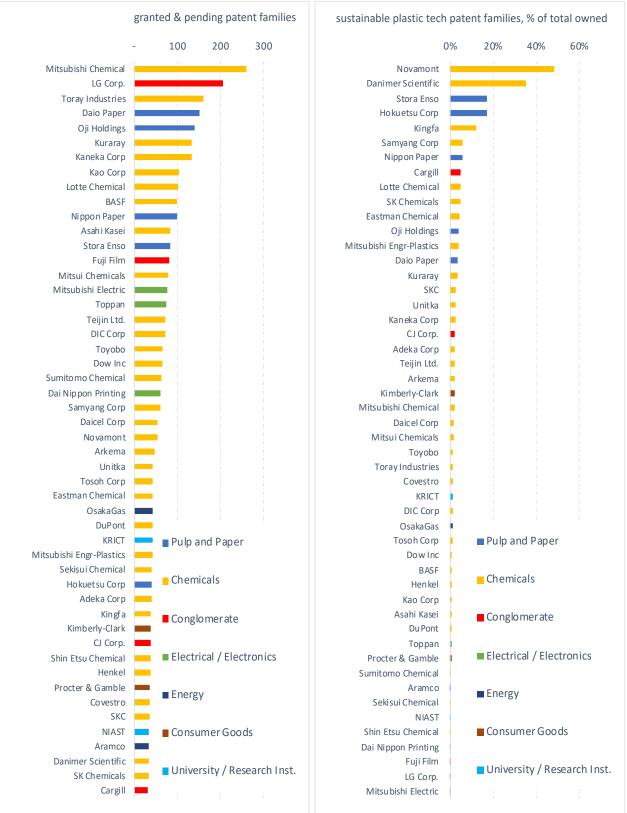
The World's Leading Sustainable Plastic Weighted Innovators To Watch *Technology breakdown of published inventions 2021 – 2022 (Nov)*

Cipher view of the world's leading innovators to watch based on recent publications and overall weighting of inventions to enabling sustainable plastic technologies: Bio-degradable polymers, Bio-based polymers, & Sustainable Adhesives. The extended list of 50 top innovators and their sustainable plastic tech weighting is included on page 5.



Top Invention Owners: Sustainable Plastic Tech *patent families owned*

Top Invention Owners, Sustainable Plastic Tech Weighting: % of patent families published to date relating to Sustainable Plastic, by organisation





Top Innovators Sustainable Plastic Tech

to Sustainable Plastic 2021-2022 (Nov), by

organisation

Weighting: % of patent families published relating

Top Innovators: Sustainable Plastic Tech patent families published 2021 – 2022 (Nov)

patent families published 2021 - 2022 (Nov) sustainable plastic tech patent families, % of total 20 40 60 0% 50% 100% LG Corp. GAIA BioMaterials Mitsubishi Chemical Rosiro Group Oji Holdings Nanjing Wurui Kaneka Corp Danimer Scientific Stora Enso Novamont Kuraray Stora Enso Nippon Paper Tomas Bata Univ. Mitsubishi Electric UPWr **DIC Corp** Celanese Samyang Corp Samyang Corp Toppan Politechnika Lodzka Toray Industries Nippon Paper SKC Kurarav Asahi Kasei Sumitomo Seika Chemicals Daio Paper Oji Holdings Fuji Film Lotte Chemical Lotte Chemical SKC KRICT Kaneka Corp Daicel Corp Eastman Chemical Danimer Scientific Adeka Corp Denka Mitsubishi Chemical CJ Corp. CJ Corp. Sumitomo Chemical Daio Paper Teijin Ltd. DIC Corp Dai Nippon Printing Daicel Corp Procter & Gamble Teijin Ltd. Tosoh Corp UBE Corp Celanese Nestle Hanwha Group KRICT Politechnika Lodzka Mitsubishi Gas Chemical Tomas Bata Univ. Tosoh Corp Sekisu i Chemical Den ka Mitsubishi Gas Chemical Procter & Gamble Novamont Toyobo Adeka Corp Pulp and Paper Pulp and Paper Asahi Kasei Nestle ITRI UP Wr Chemicals Toppan Chemicals GAIA Bio Materials **Toray Industries** Rosiro Group Mitsu i Chemicals Mitsui Chemicals Conglomerate Conglomerate Han wha Group BASF Sekisui Chemical Toyobo Electrical / Electronics Sumitomo Chemical Electrical / Electronics Aramco BASF Hokuetsu Corp 3M ITRI Energy Energy Aramco Sumitomo Seika Chemicals Dai Nippon Printing Nanjing Wurui Consumer Goods Mitsubishi Electric Consumer Goods Eastman Chemical LG Corp. 3M Fuji Film University / Research Inst. University / Research Inst. UBE Corp Hokuetsu Corp