

A Big Data Analysis for Waste Plastic Recycling/Upcycling Technology: an Overview of Technology Transformation in the Past Decades

Research & Innovation Center



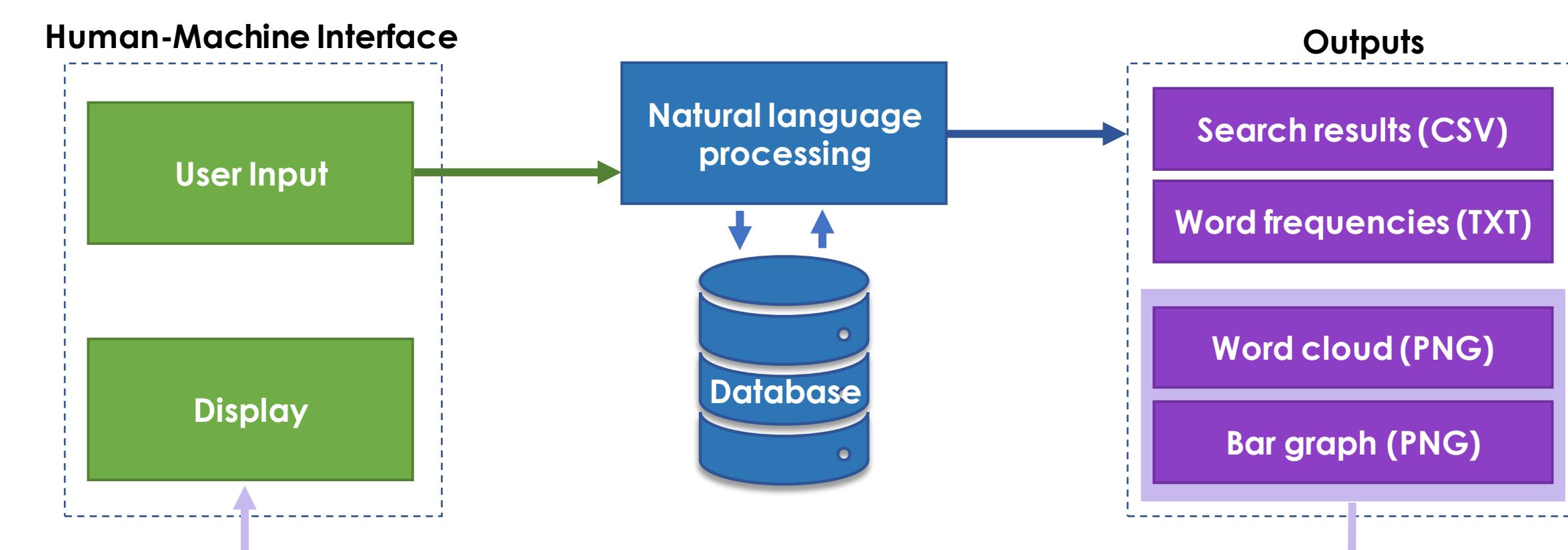
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Introduction

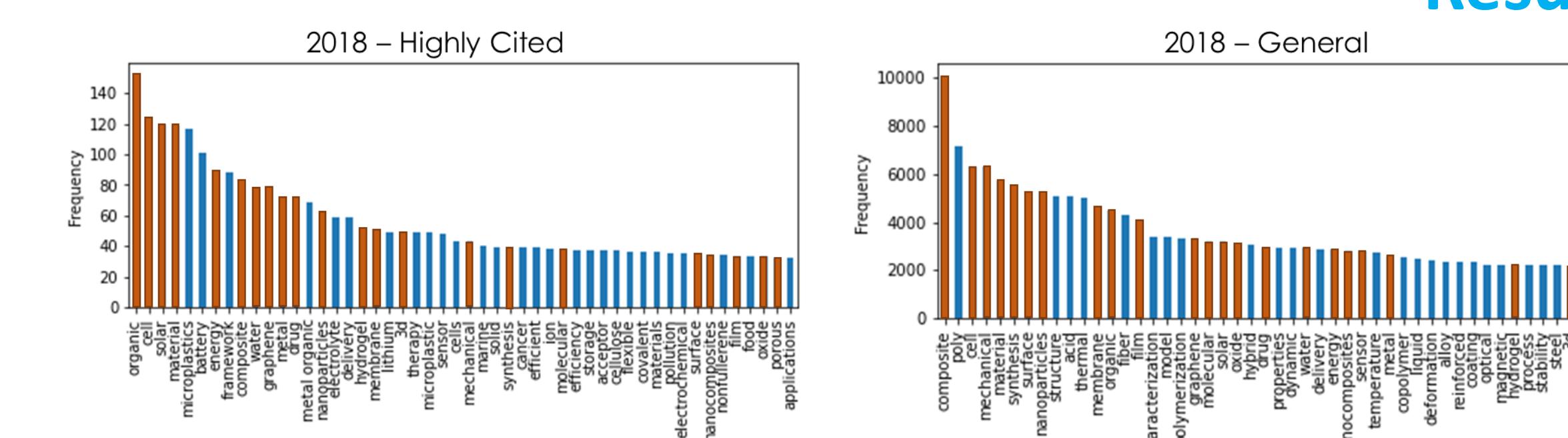
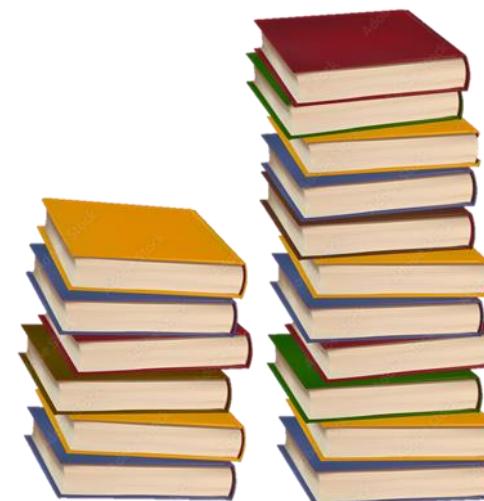
By using intelligent analytic techniques such as text analytics, machine learning, predictive analytics, data mining and so on, big data analysis provides a fast and effective pathway to evaluate massive amount of data sets from different sources. This analysis helps to uncover hidden patterns, correlations and other insights, and it guides future studies in different fields. Waste plastic recycling/upcycling technologies have been developed for many decades. There is a tremendous number of technical papers/reports/patents in this field. However, there is still no effective way to anticipate and predict the technology for the future.

In this study, we attempt to offer a "big-data" tool that explores emerging trends in waste plastic recycling/upcycling technologies and provides useful insight for future study. Approximately 10,000 papers related to waste plastic recycling/upcycling technologies in the past 60 years were analyzed using a python-coded program with natural language process tools. The most frequently used technical terms in title, abstract and main manuscript will be listed via a complete text statistics analysis. Careful mining of these data can reveal many useful indicators of waste plastic recycling/upcycling technologies, which can help in understanding their growth. This study provides a great opportunity for researchers to utilize this data for developing useful knowledge and insights.

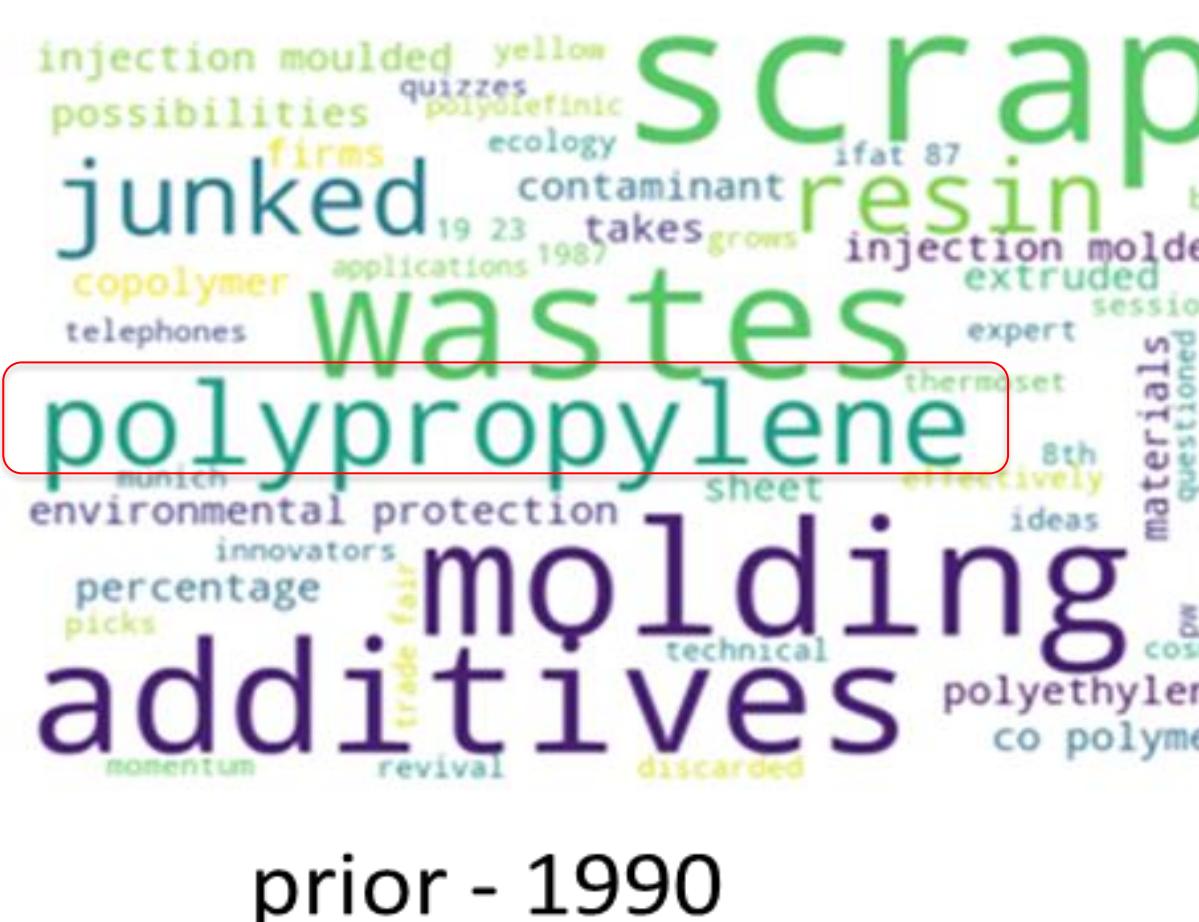


Methodology

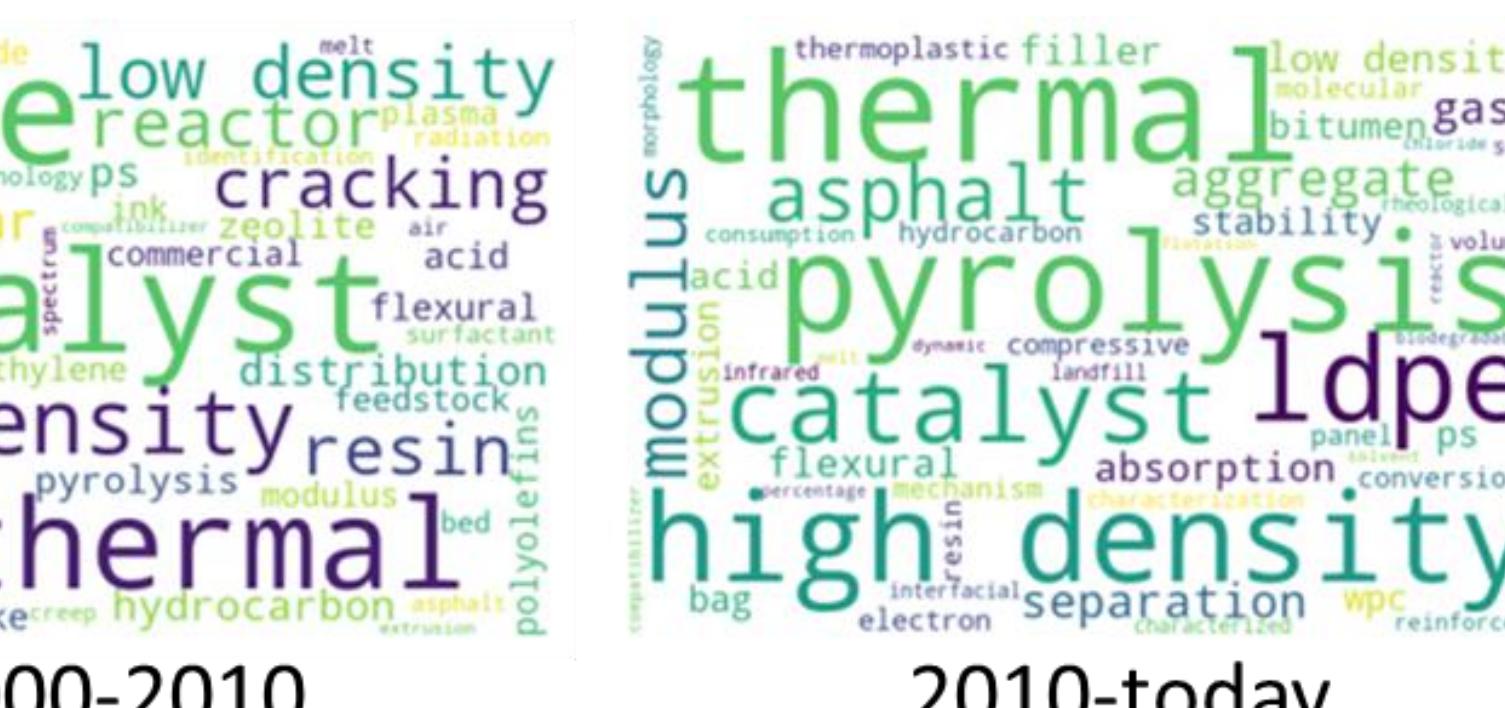
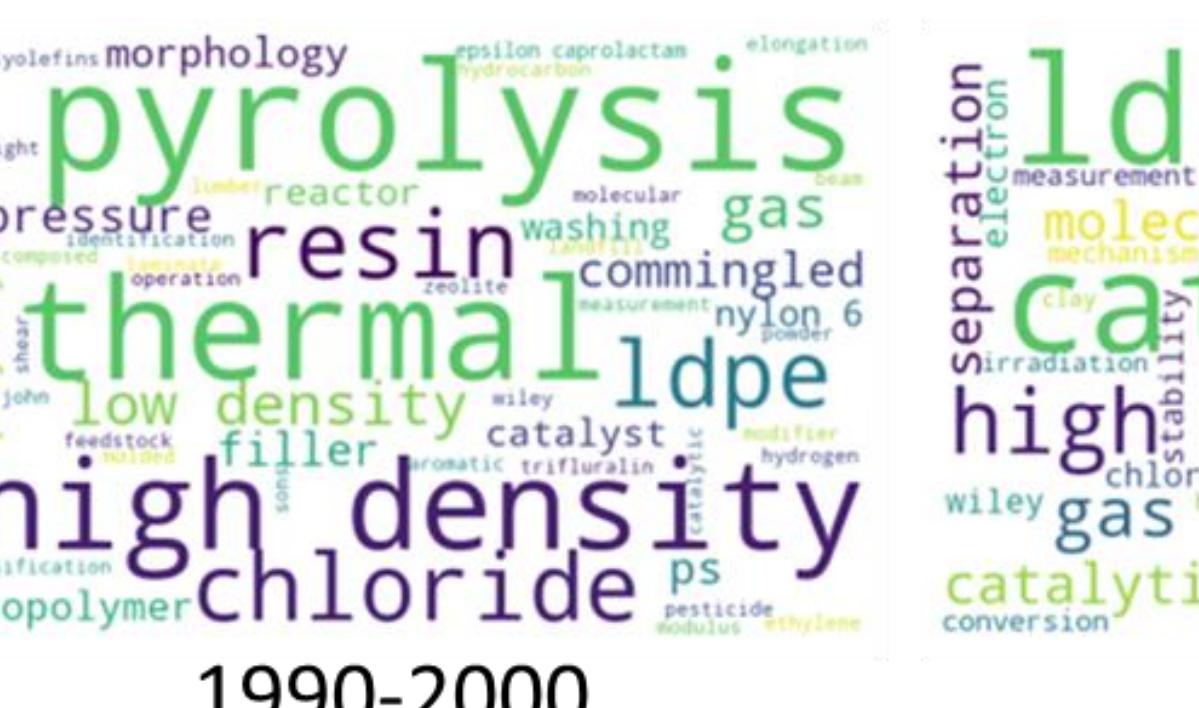
- Over 800,000 papers for a "general" database based on "plastic" or "polymer" search from Web of Science
- Compiled around 9,000 "highly cited" Web of Science articles from 2012-2022 for second database to compare representativeness with general papers



50% of the most frequent fifty technical terms found in the highly cited database appeared in the general database of the same year



1990 - 2000
2000 - 2010
Plastic Upcycling Over Time

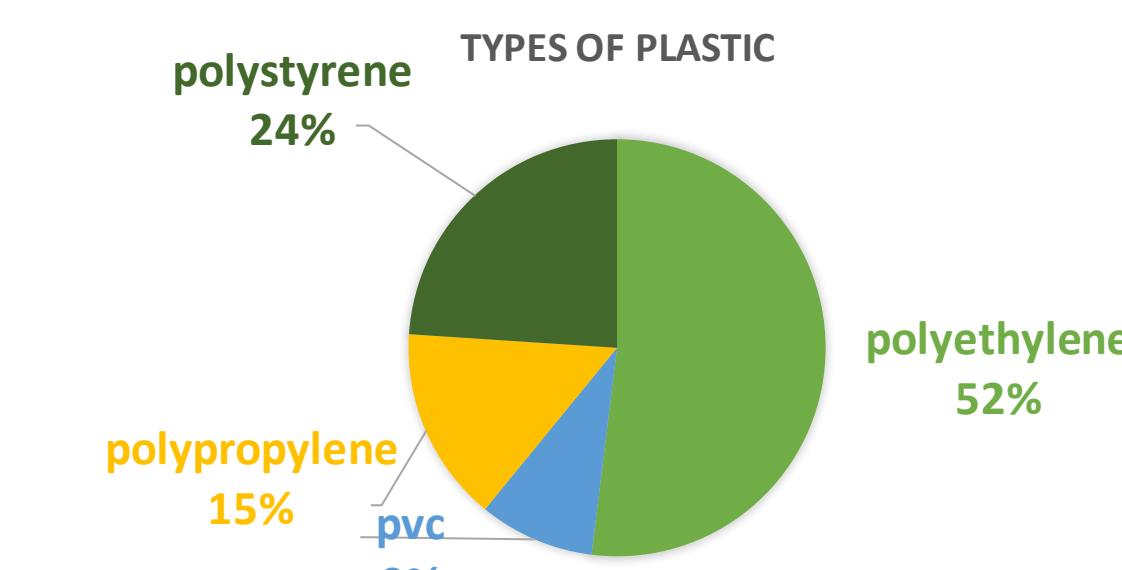


Thermal treatments (pyrolysis and gasification) and catalyst with polyethylene have gained lots of attentions since 1990

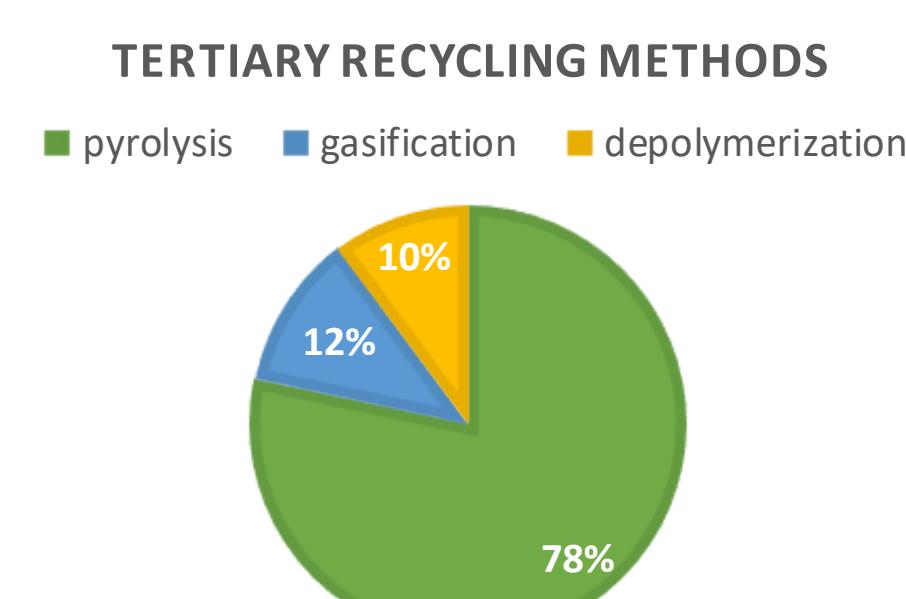
Acknowledgement & Disclaimer

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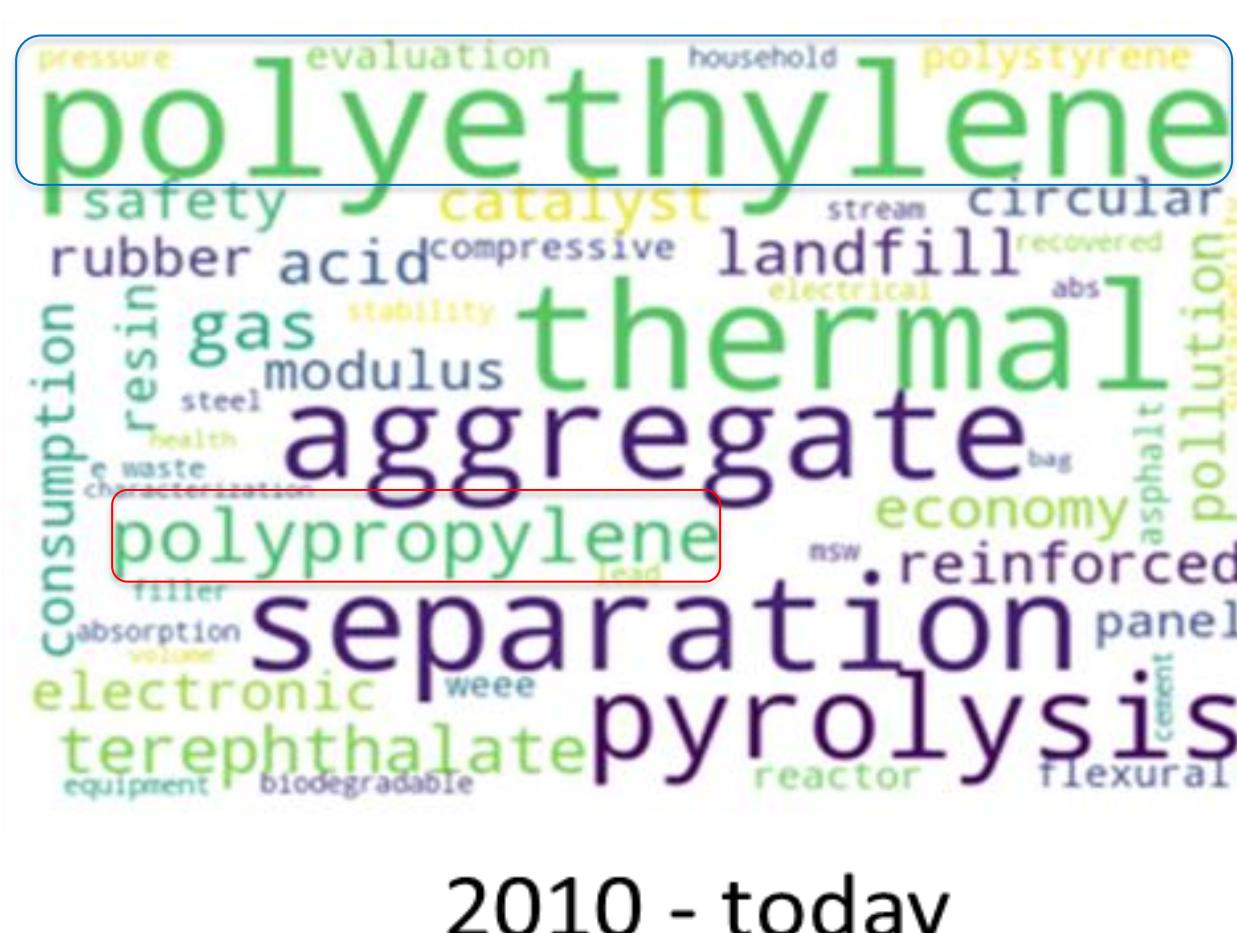
Results and Discussions



Types of plastic represented in highly cited papers from 2012-2022



Some tertiary recycling methods represented against one another in highly cited papers from 2012-2022



2010 - today

Summary

- Big-data analysis with Human-machine interface (HMI) tools can illustrate past and emerging trends in research.
- Within plastic upcycling, following emerging trends allow us to see the evolution of research:
 - In past decades, polyethylene being the most common and then polypropylene with very little being done about polystyrene and PVC
 - Attentions on thermal treatments (pyrolysis and gasification) with polyethylene began in the 1990s and catalyst ramped up in the 2000s.

Future Plan

- Incorporating machine learning (ML) with the existing big data tools can allow computers to learn and infer future trends without as much user input.