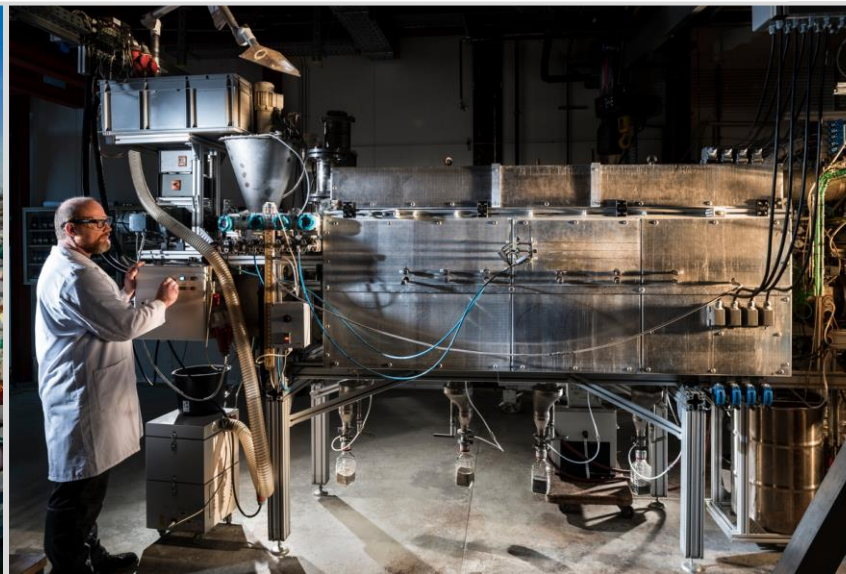


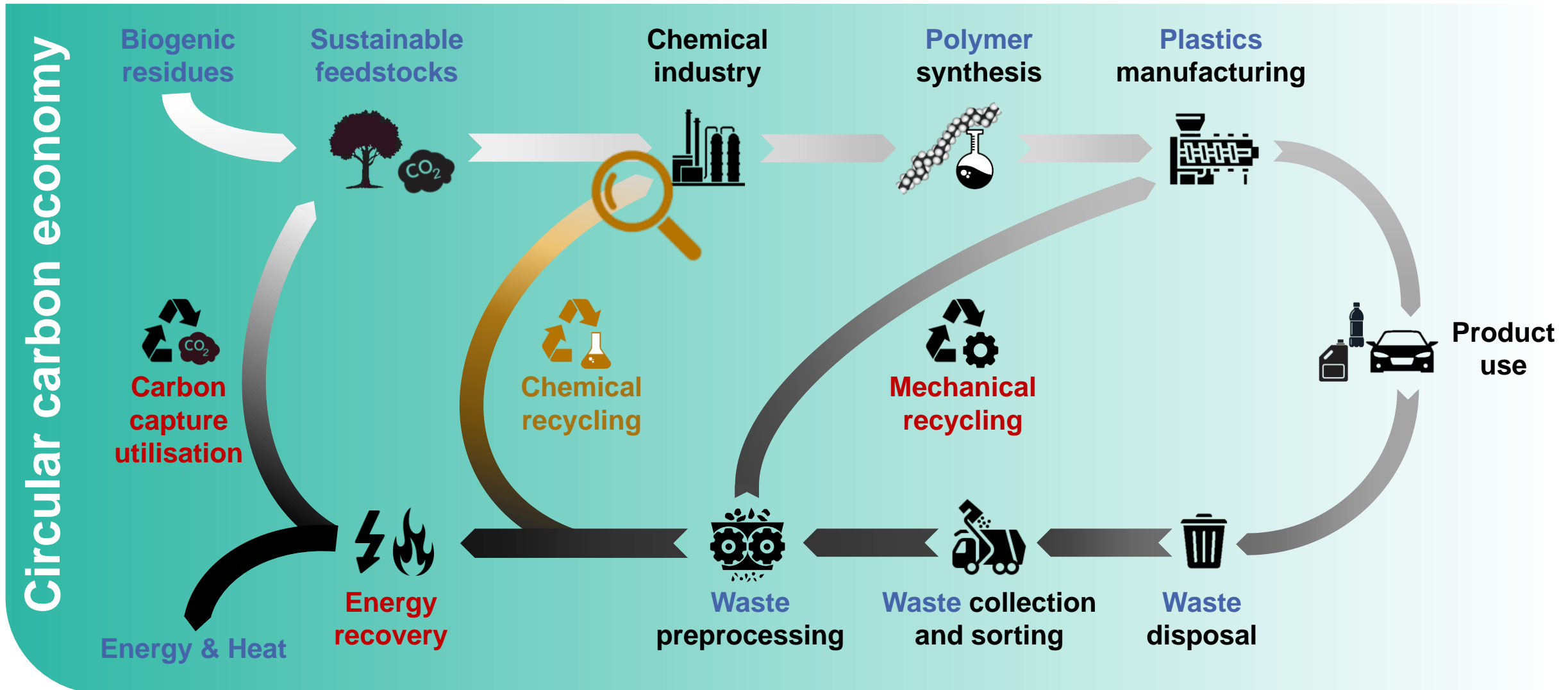
Advanced analytical methods for characterization of condensable pyrolysis products from plastic waste

KNT-Symposium 'Chemical Engineering for a Sustainable World'

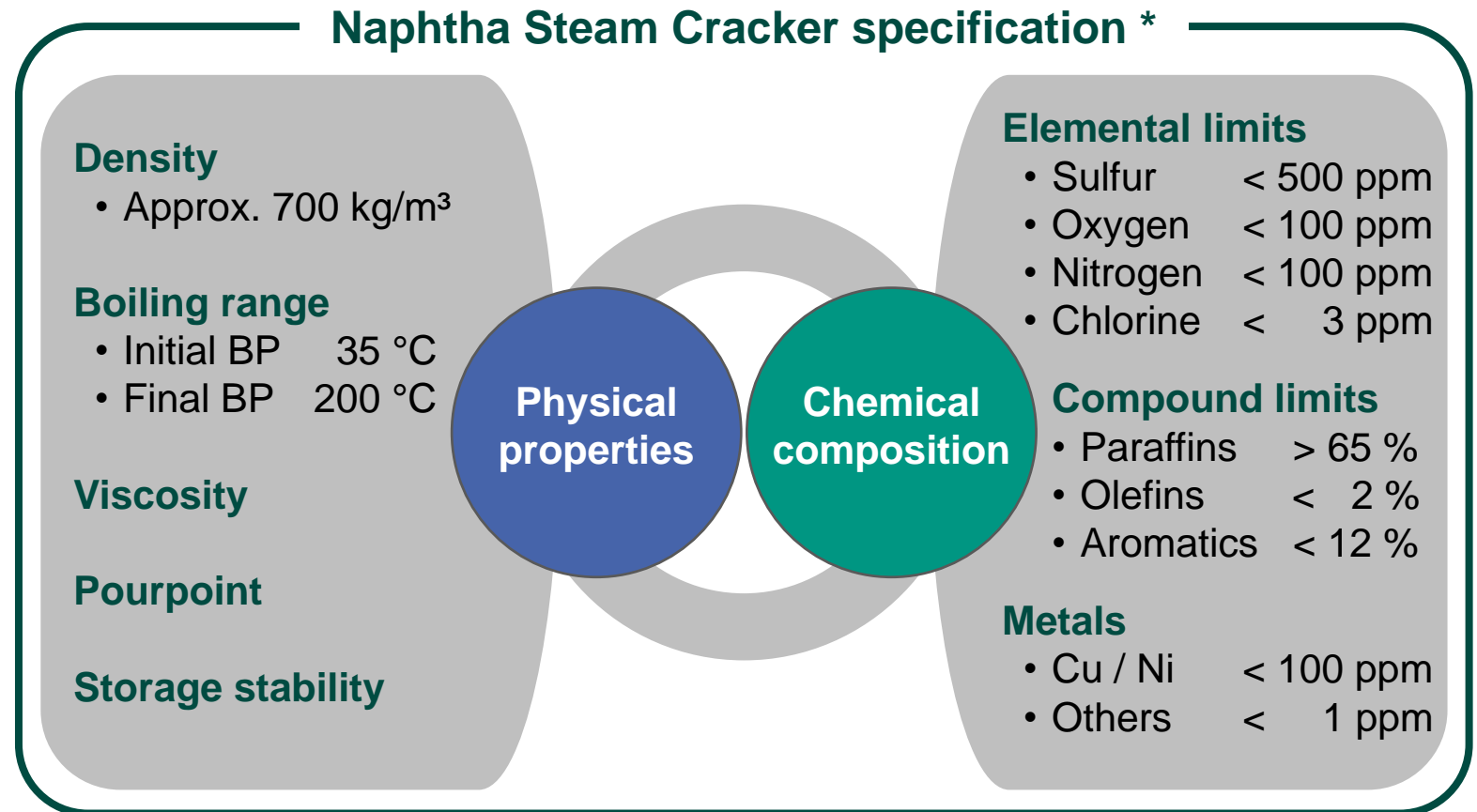
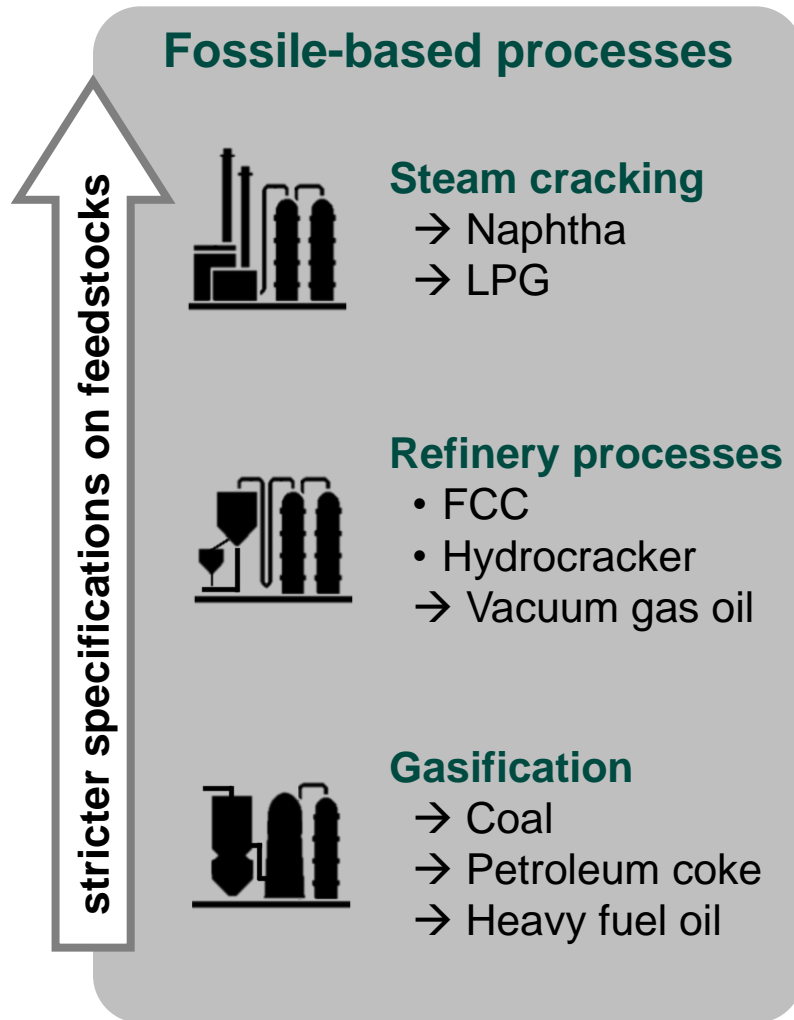
N. Netsch, T. Schmedding, A. Pöplow, M. Zeller, B. Bergfeldt, G. Straczewski, S. Tavakkol, D. Stapf



Future perspectives for plastic lifecycle

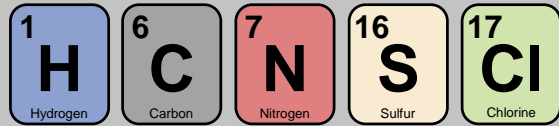


Pyrolysis integration into chemical industry



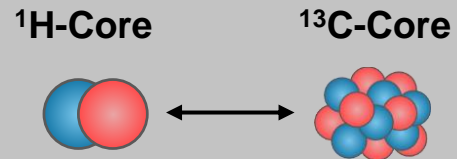
* Kusenberg et al. 2022. *Waste Management*

Holistic pyrolysis condensate characterization requires combination of multiple analytical techniques



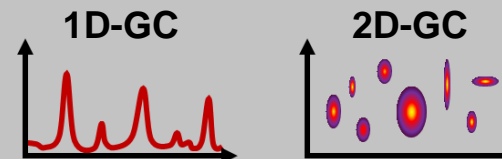
Elemental analysis

→ Integral quantification of heteroatoms



Low-field NMR

→ Quantification of paraffinic, olefinic and aromatic product distribution



Gas chromatography

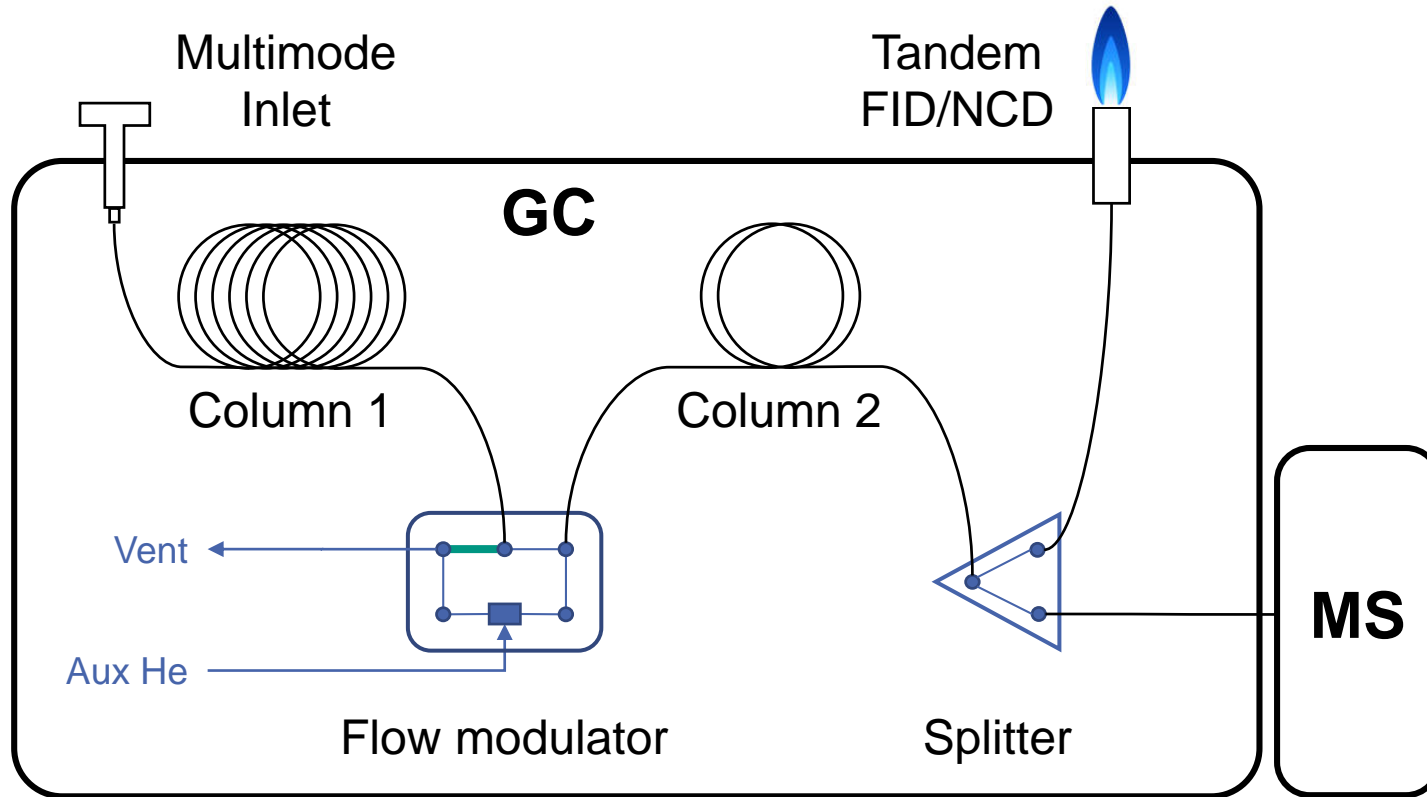
→ Identification and quantification of main compounds and molecule classes



Supporting analysis

→ Water content
→ Density
→ Boiling curve
→ Calorimetry

2D-GC – Fundamentals

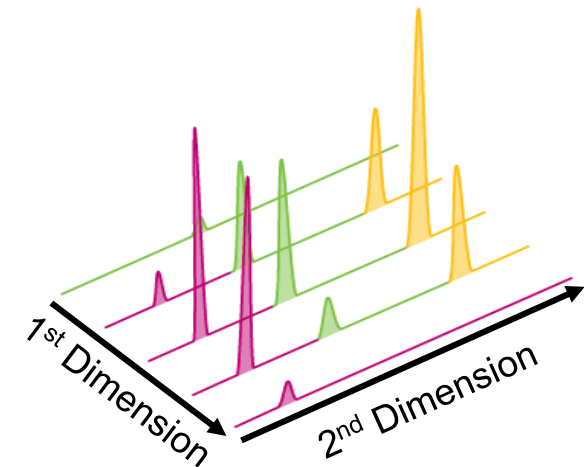


- Column 1: Agilent DB-5MS
- Column 2: Trajan BPX50
- FID: Flame ionisation detector
- NCD: Nitrogen chemiluminescence detector
- MS: Mass spectrometry

Chromatogramm after column 1



Processed 2D chromatogramm



Adapted from Agilent (2021)

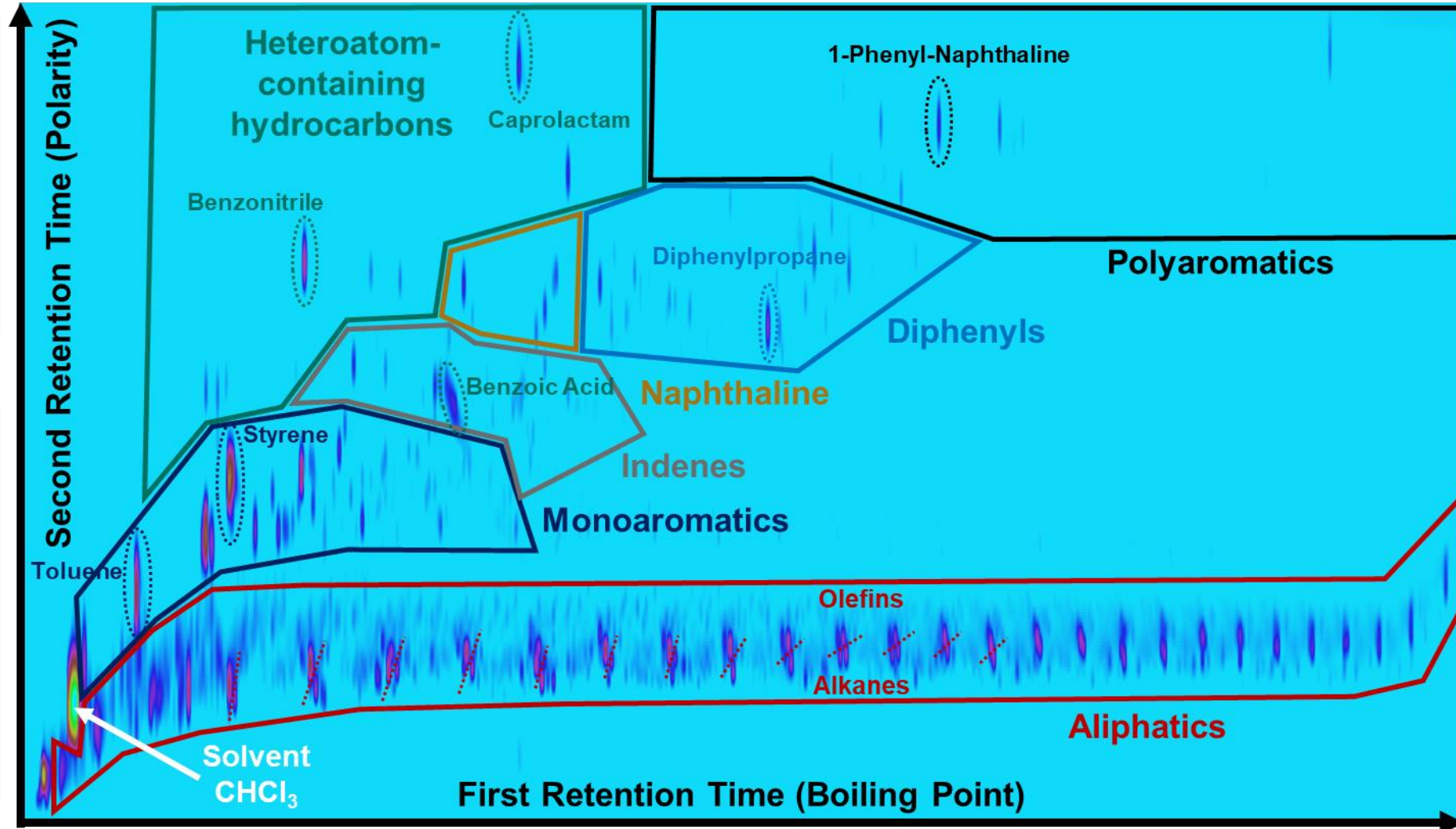
Pyrolysis oil example: Mixed thermoplastic reference

Feedstock composition

Low-density PE	50 m.%
PP	15 m.%
PS	10 m.%
PET	10 m.%
ABS	5 m.%
PA6	5 m.%
PVC	5 m.%

Elemental analysis

in m.%	Feed	Oil
Ash	0.5	-
Moisture	0.1	-
C	80.6	87.5
H	11.6	11.4
N	0.9	0.6
S	0.0	0.0
Cl	2.4	0.3
O	3.9	0.2



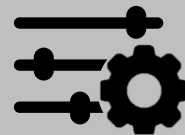
Conclusion & Outlook



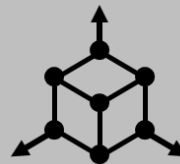
Analytical procedure allows evaluation of pyrolysis oil specification compliance



Screening of suitable waste fractions



Process parameter optimization



Reactor development and scale up

Fundamental research on waste plastic pyrolysis