LINZ INSTITUTE
OF TECHNOLOGY

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JKU
LINZ INSTITUTE
OF TECHNOLOGY

circPLAST-mr –

Das österreichische Leitprojekt zum mechanischen Recycling

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Thanks to: Nikolai KUHN (MUL, WP2); Mauricio PANE (AEE INTEC, WP3); Moritz MAGER, Sandra CZAKER, Alexander FELGEL-FARNHOLZ (JKU, WP4); Tamara CWIORO (TCKT, WP5); Lukas ZEILERBAUER (Energieinstitut, WP7)

Separately collected waste

Specific products out of waste – is it possible?

Polypropylene cup
(injection molded product)

Polypropylene cup
(thermoformed product)

Product example – Polypropylene (PP) cup
Specifications of the cup and the material

- **Optics**
  - Color
  - Printability
- **Good mechanical properties**
  → Outstanding top load performance for transport
  - High Stiffness

  → Low costs for transport and storage
  - Low weight
- **High toughness**
  - Good impact strength
- **Good processibility**

Property profile of PP for injection molded cup:

MFR ↑
Tensile modulus & yield stress ↑
Strain at break ~
Charpy NIS ~

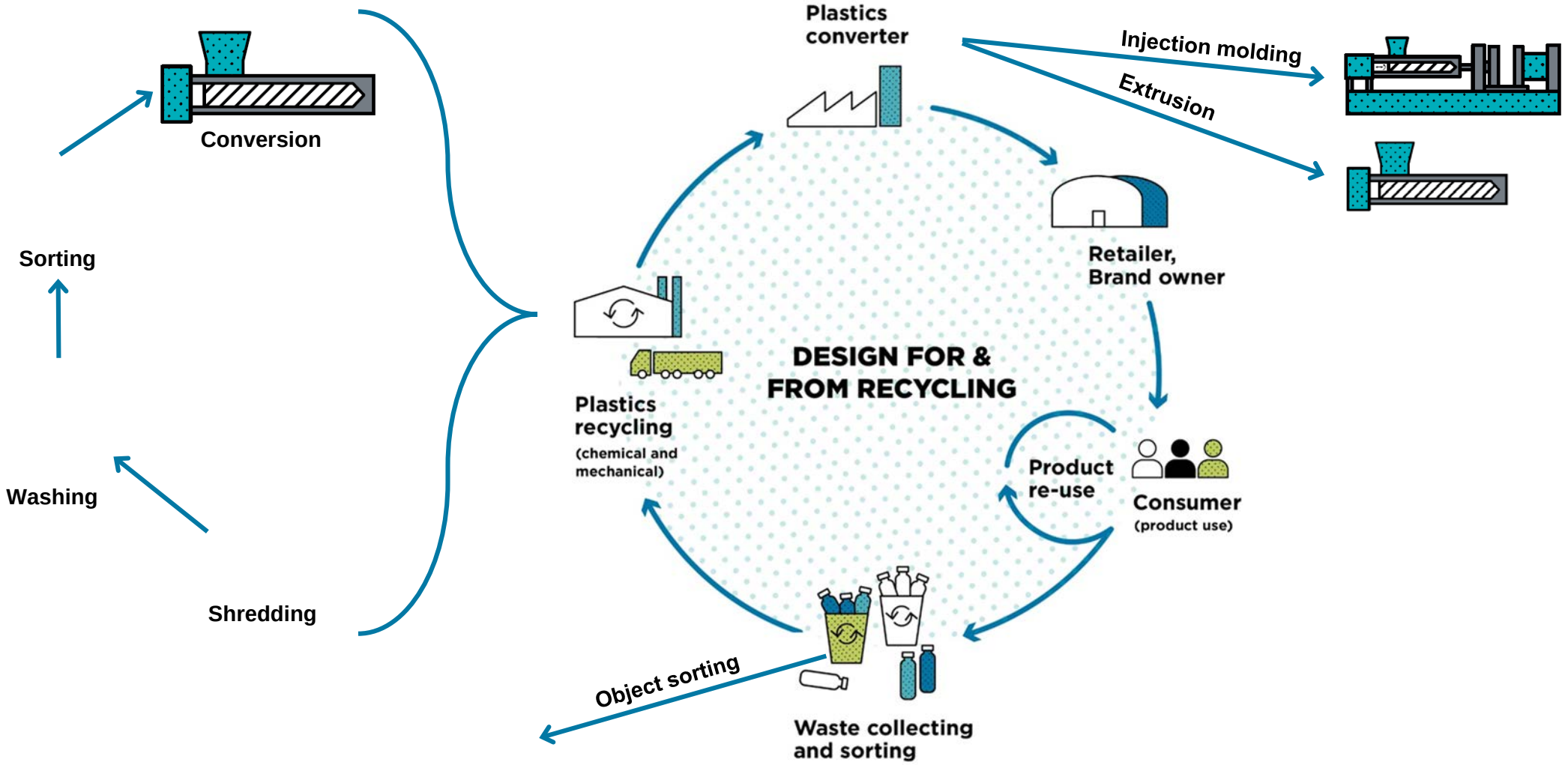
Polypropylene cup
(injection molded product)

Property profile of PP for thermoformed cup:

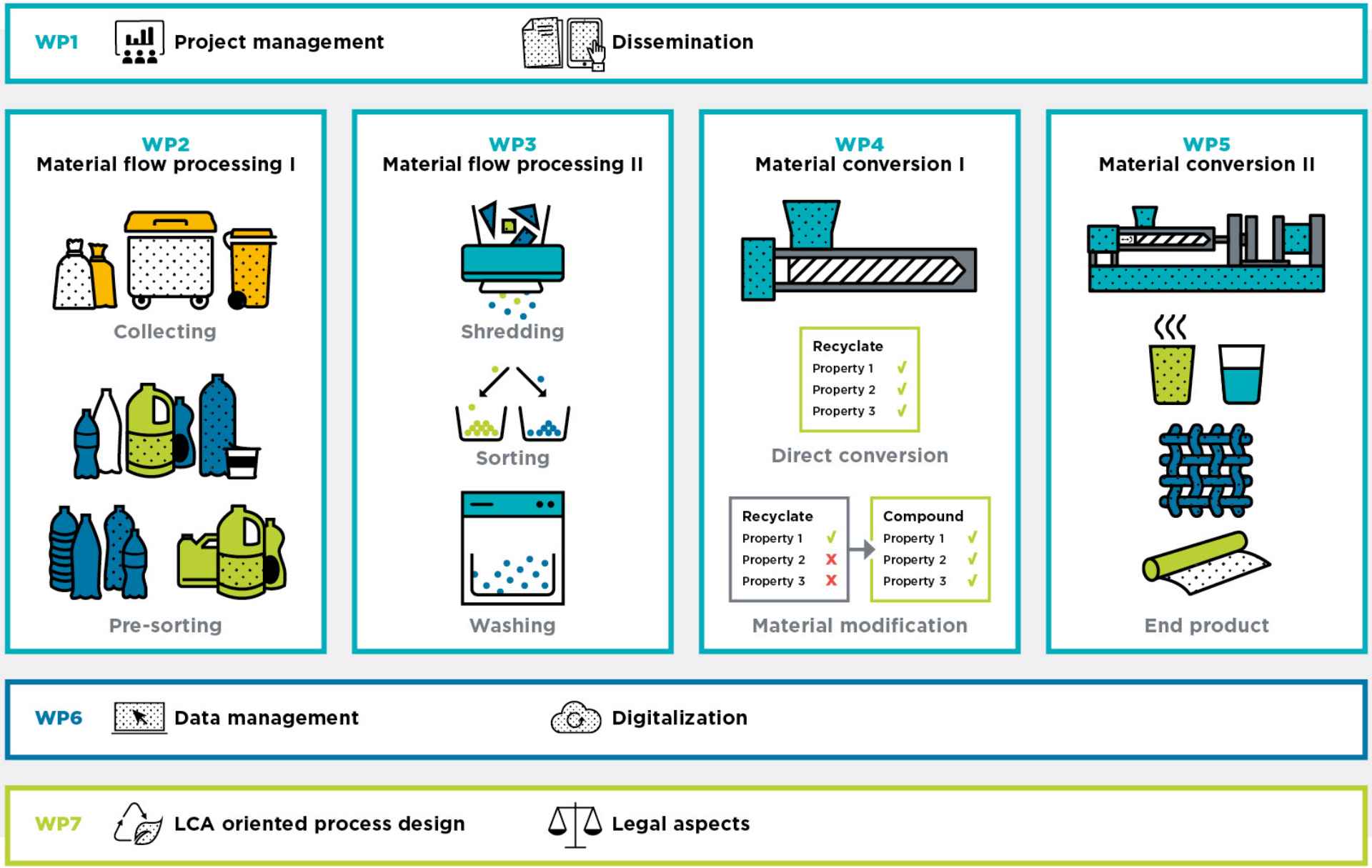
MFR ↓
Tensile modulus & yield stress ↑
Strain at break ~
Charpy NIS ~

Polypropylene cup
(thermoformed product)

Mechanical recycling of plastics



circPLAST-mr – Overview



circPLAST-mr – Project partners

11 Scientific partners:

- Johannes Kepler University (JKU) Linz:
  - Institute of Polymeric Materials and Testing (**JKU-IPMT**)
  - LIT Factory (**LIT Factory**)
  - Institute for Chemical Technology of Organic Materials (**JKU-CTO**)
  - Institute for Environmental Law(**JKU-IUR**)
- AEE INTEC (**AEE INTEC**)
- Competence Center CHASE GmbH (**CHASE**)
- Energy Institute at JKU Linz (**EI-JKU**)
- JOANNEUM RESEARCH Forschungsgesellschaft mbH (**JR-DIGITAL**)
- Montanuniversitaet Leoben:
  - Chair of Waste Processing Technology and Waste Management (**AVAW**)
- Software Competence Center Hagenberg GmbH (**SCCH**)
- Transfercenter für Kunststofftechnik GmbH (**TCKT**)

14 Company partners:

- ALPLA Werke Alwin Lehner GmbH & Co KG (**ALPLA**)
- Altstoff Recycling Austria AG (**ARA**)
- APC Advanced Polymer Compounds (**APC**)
- Borealis Polyolefine GmbH (**Borealis**)
- Business Upper Austria – OÖ Wirtschaftsagentur GmbH (**BIZ-UP**)
- ENGEL Austria GmbH (**ENGEL**)
- EREMA Engineering Recycling Maschinen u. Anlagen GmbH (**EREMA**)
- GAW technologies GmbH (**GAW**)
- Greiner Packaging International GmbH (**GPI**)
- Lindner Recyclingtech GmbH (**Lindner**)
- O.Ö. Landes-Abfallverwertungsunternehmen GmbH (**LAVU**)
- OSMO Membrane Systems GmbH (**OSMO**)
- Saubermacher Dienstleistungs AG (**SDAG**)
- Starlinger & Co. Gesellschaft m.b. H. – viscotec (**viscotec**)

circPLAST-mr – Overall objectives

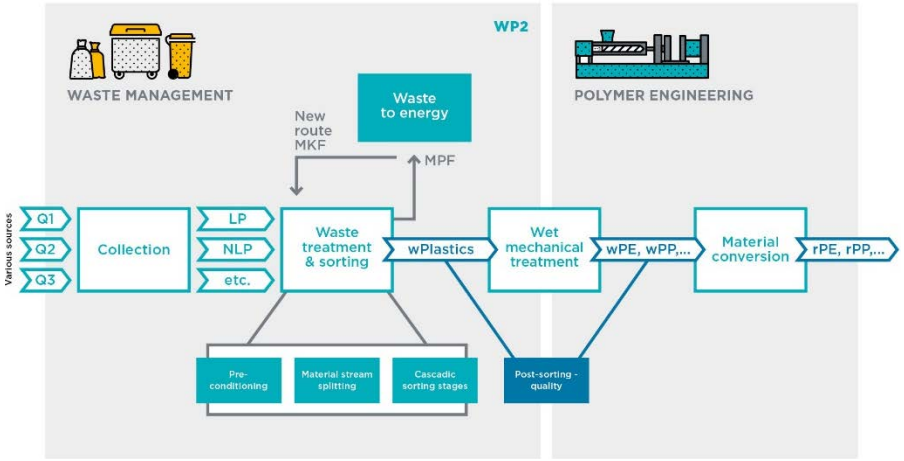
(1) **Detection and exploration of further, so far unused potentials** for the mechanical recycling of plastics,

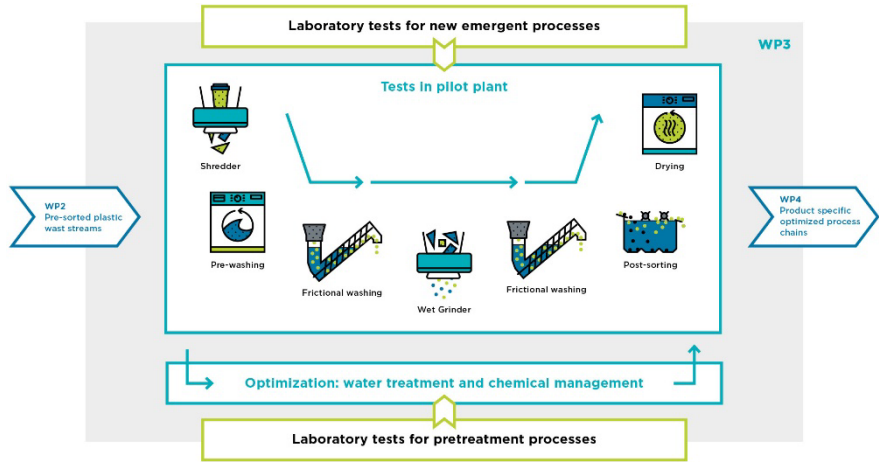
(2) **Definition, implementation and testing of central process steps** on a laboratory/pilot scale,

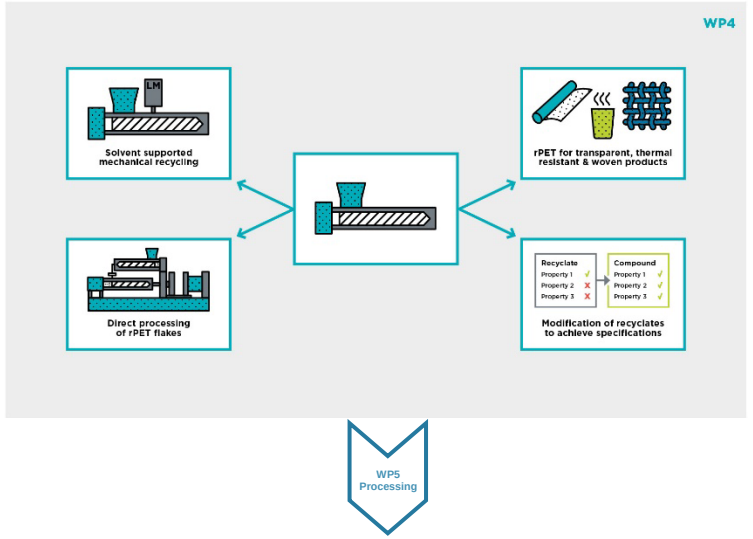
(3) **Demonstrate eco-efficient "marketability" of increased recycled plastic volumes** through product examples with improved quality and performance characteristics, and

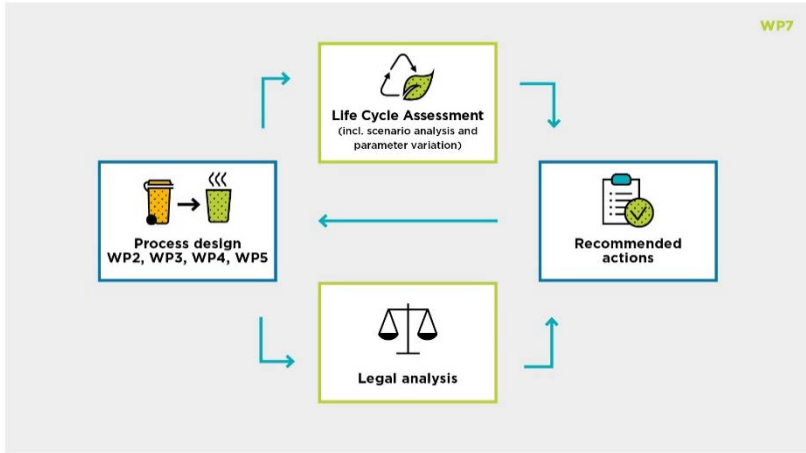
(4) **Demonstrate scalability** of the lab/pilot processes to production scale (case studies).

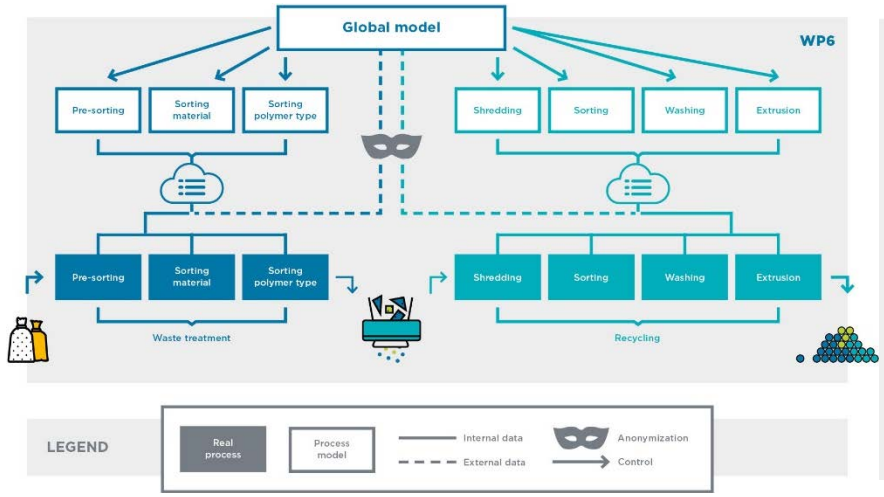
circPLAST-mr – Work packages

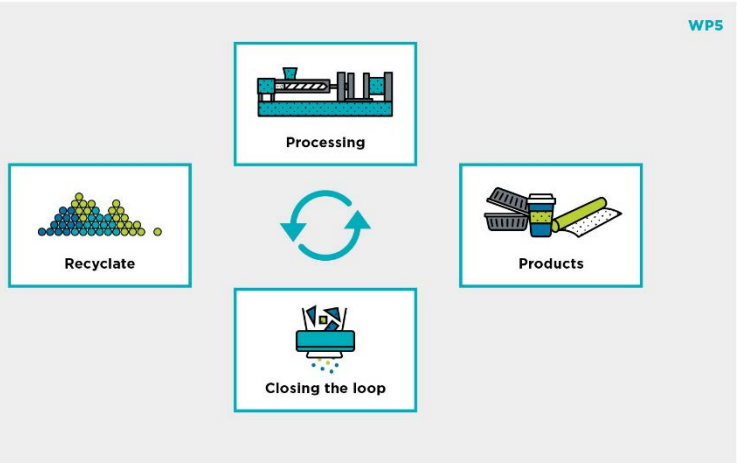




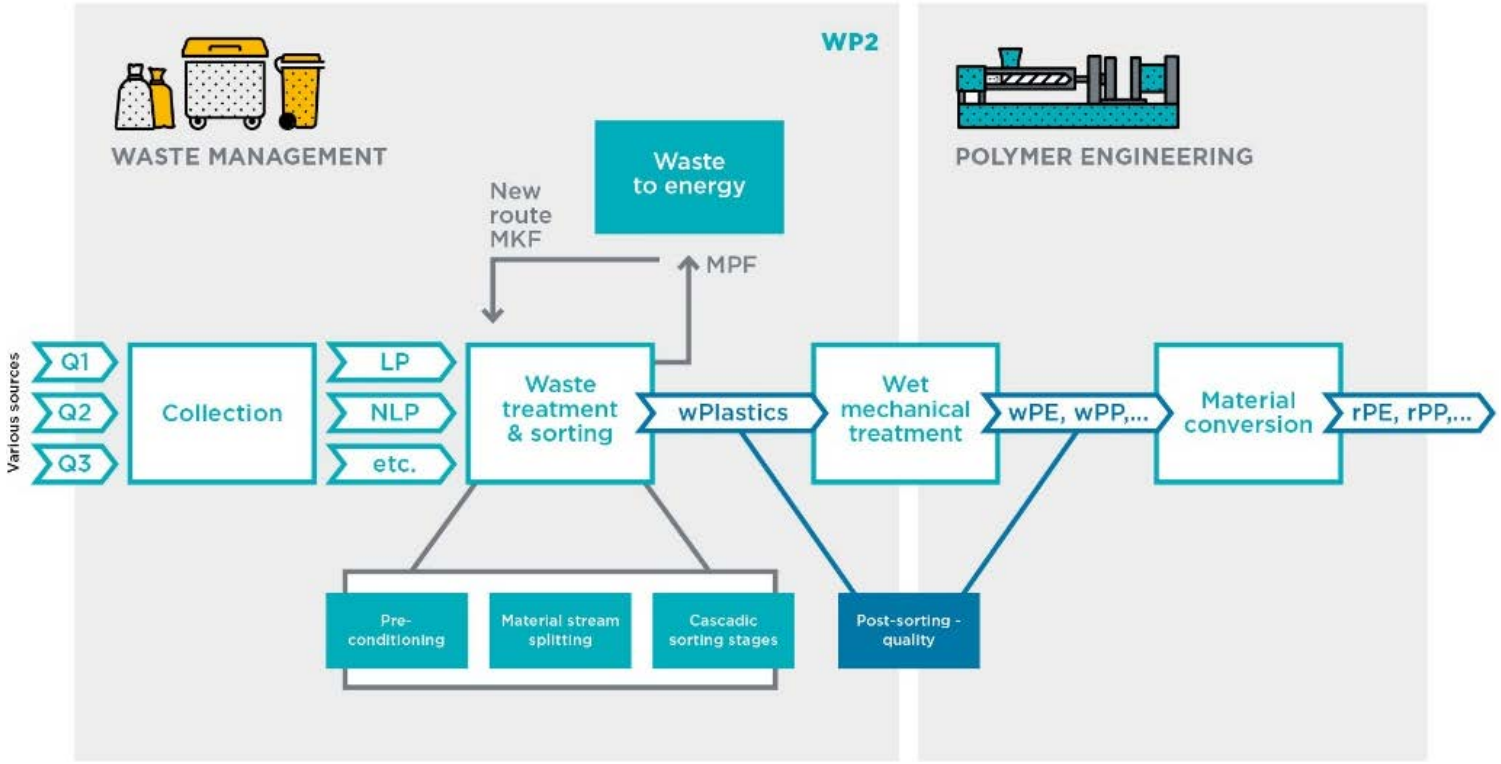








circPLAST-mr – Work packages



Donnerstag, 14.11.2024

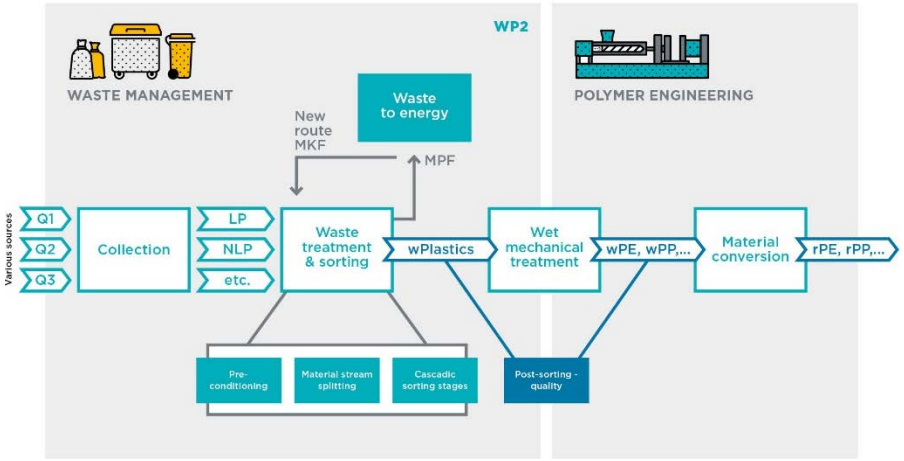
Leitprojekt circPLAST-mr (22)

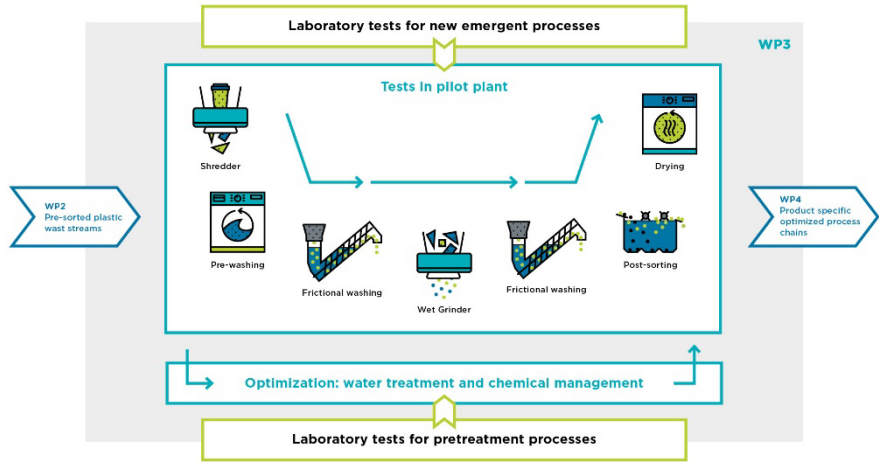
HS **Kupelwieser** (1.OG)

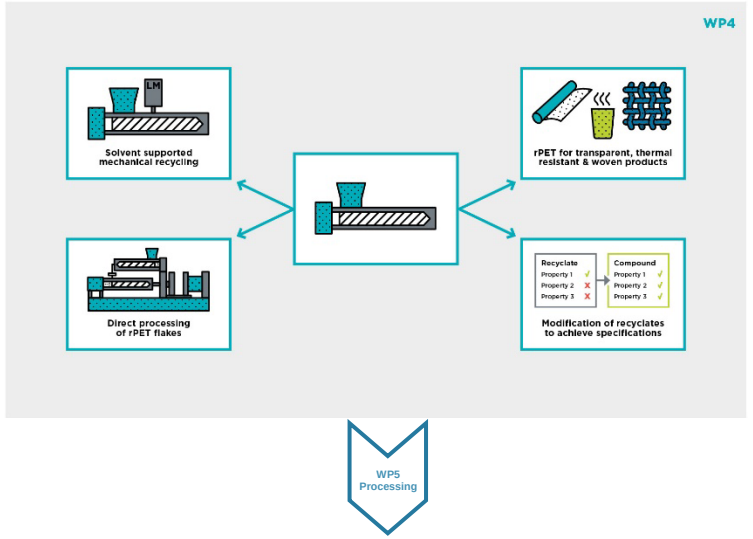
Chairperson: Roland Pomberger, Montanuniversität Leoben, Österreich

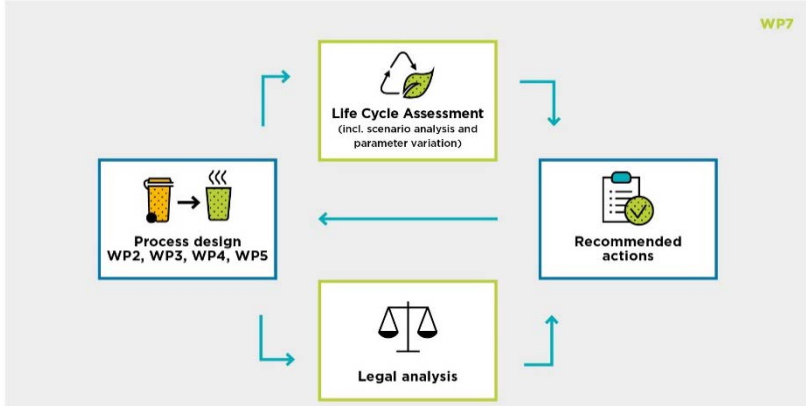
12.20	Berücksichtigung von Eigenschaftsprofilen bei der Aufbereitung von Leichtverpackungen aus Polypropylen Nikolai Kuhn, Montanuniversität Leoben, Österreich

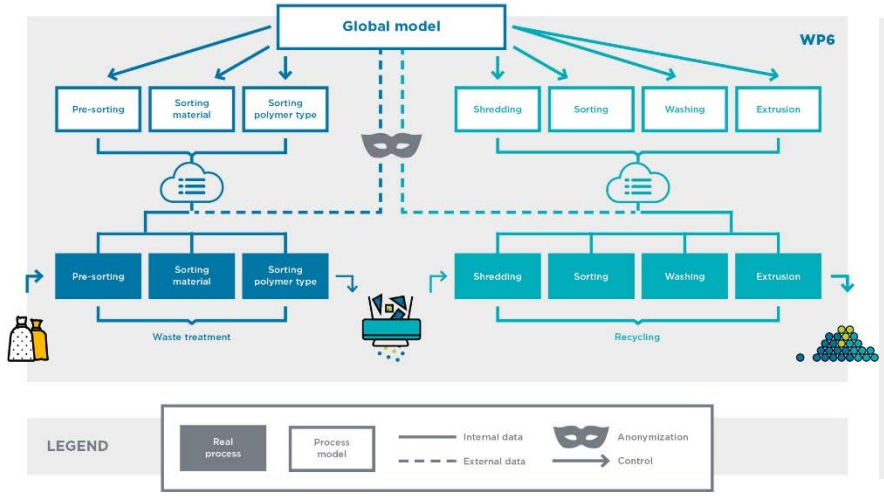
circPLAST-mr – Work packages

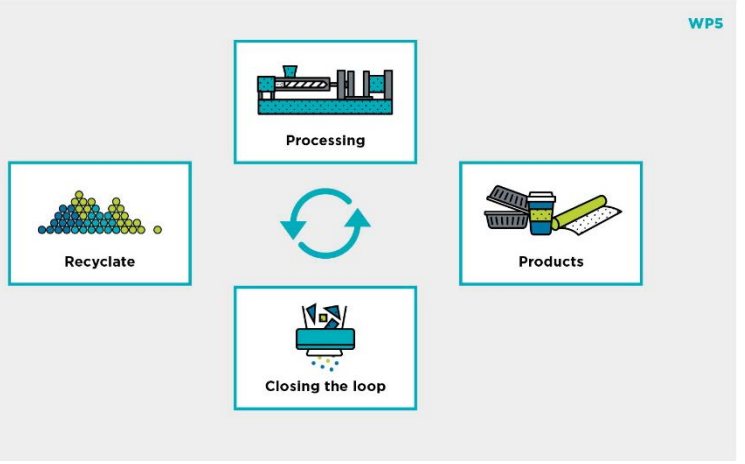




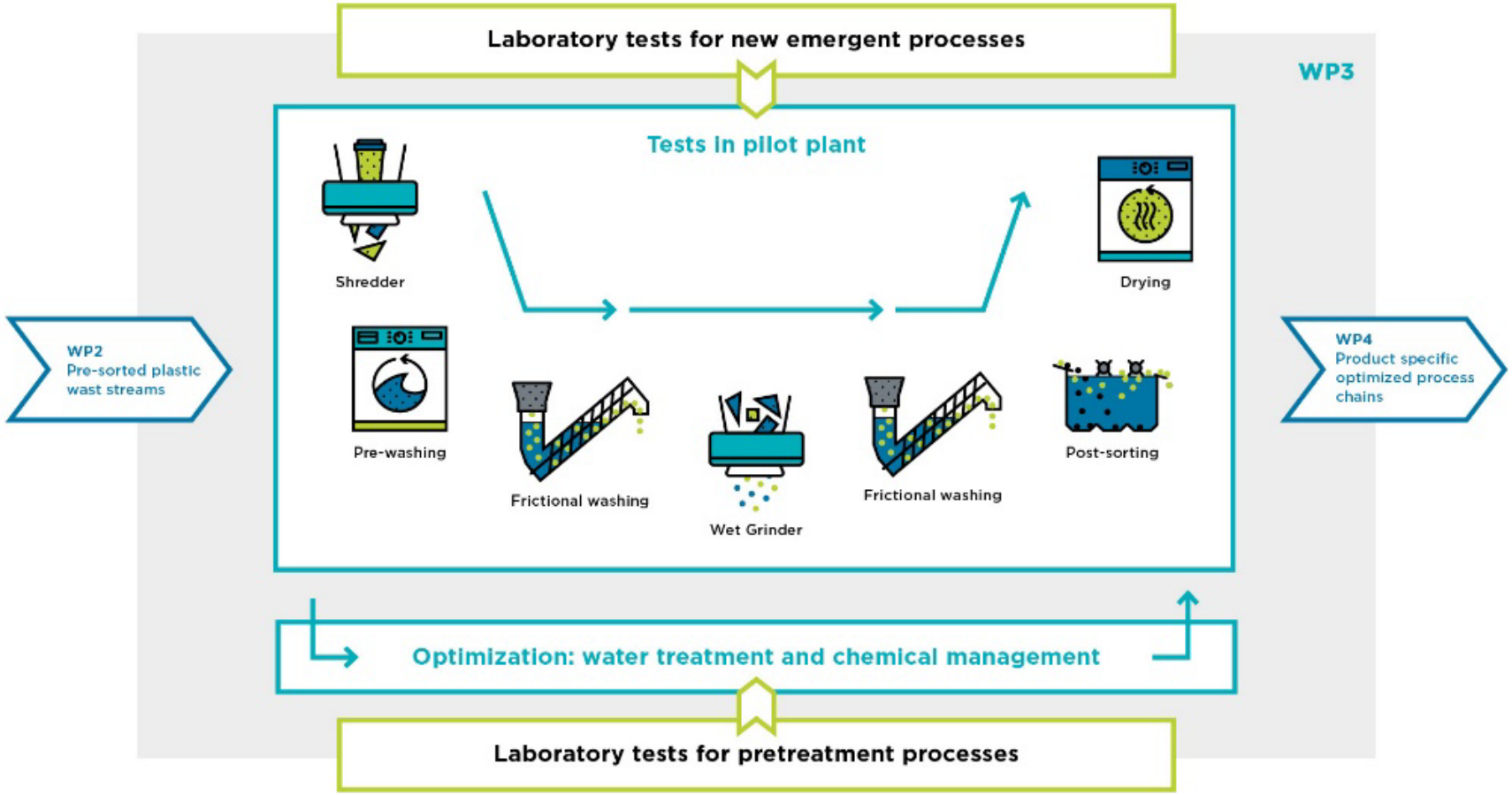








circPLAST-mr – Work packages



Freitag, 15.11.2024

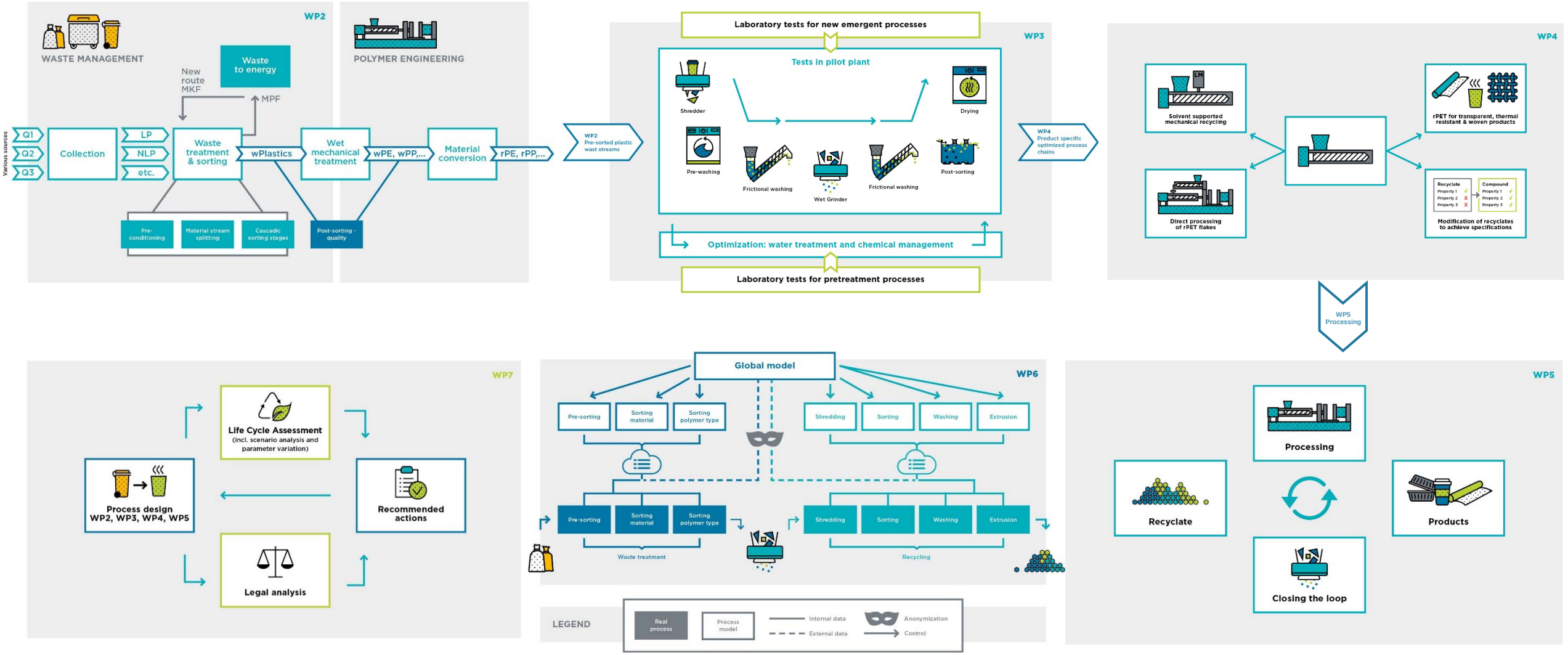
Kunststoffrecycling (40)

HS **Raiffeisen** (1.OG)

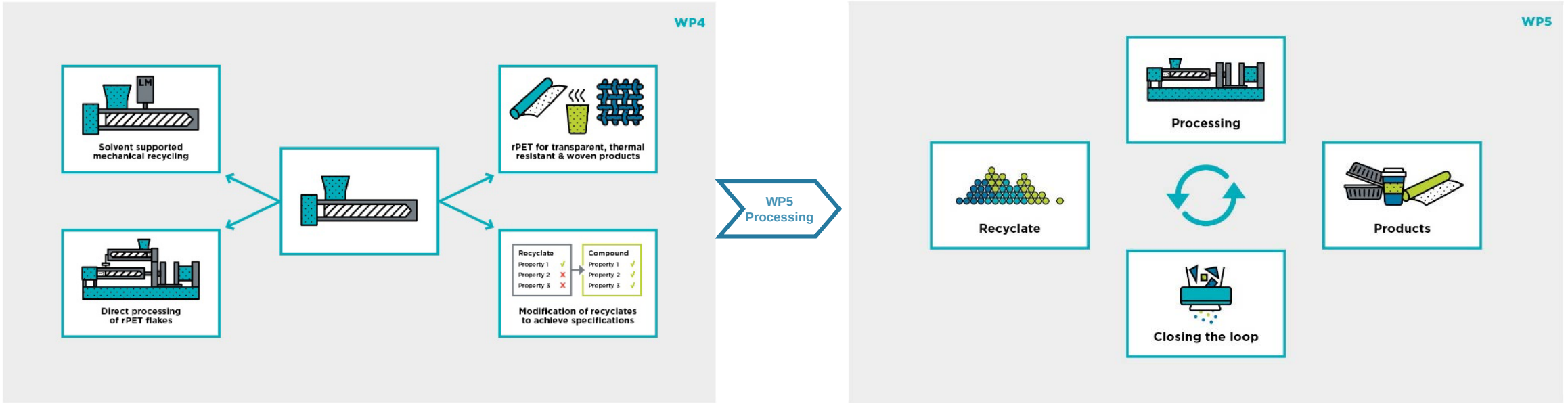
Chairperson: Thomas Lucyshyn, Montanuniversität Leoben, Österreich

09.00 Optimierungsparameter bei der Nassaufbereitung von Kunststoff-Flakes im mechanischen Kunststoffrecycling
Bettina Muster-Slawitsch, AEE – Institut für Nachhaltige Technologien, Österreich

circPLAST-mr – Work packages



circPLAST-mr – Work packages



Freitag, 15.11.2024

Kunststoffrecycling (40)

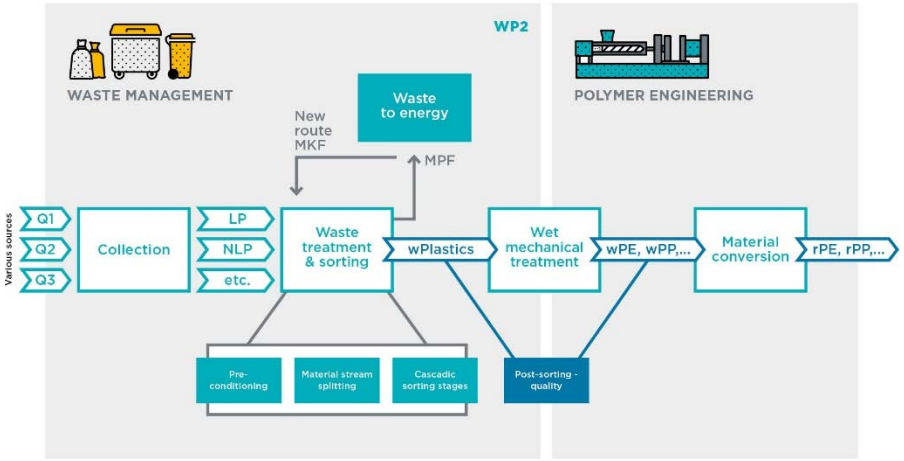
HS **Raiffeisen** (1.OG)

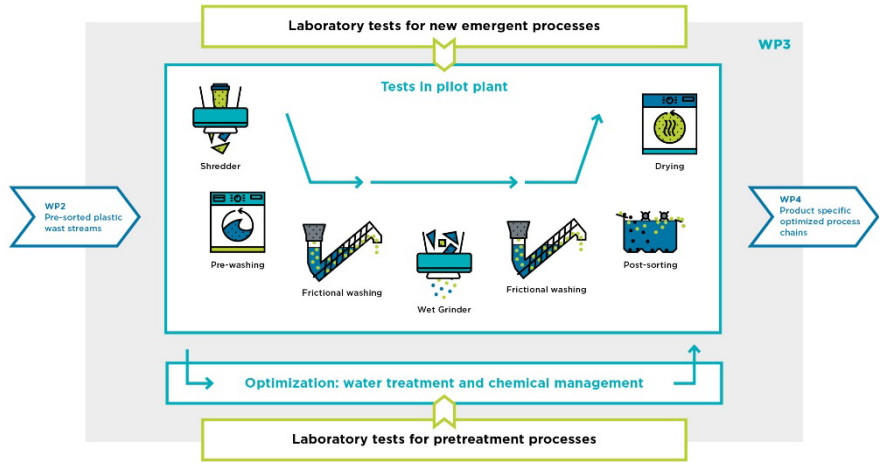
Chairperson: Thomas Lucyshyn, Montanuniversität Leoben, Österreich

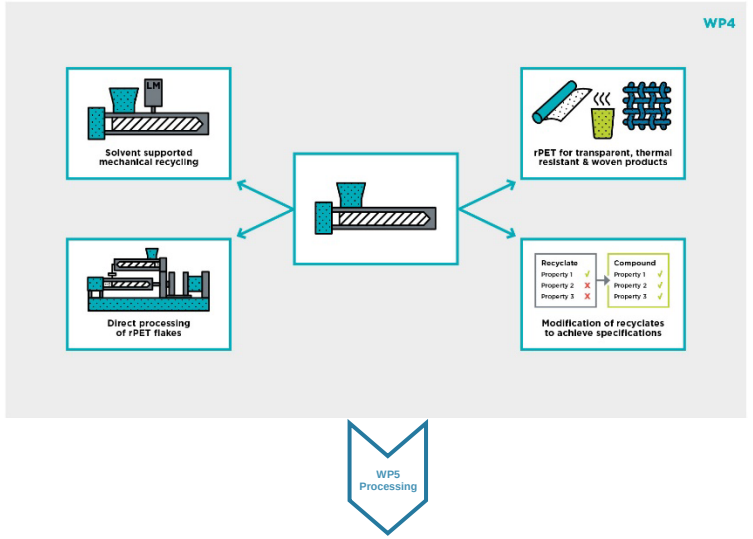
10.00 Open- und closed-loop Strategien für das mechanische Recycling der österreichischen PET-Restfraktion

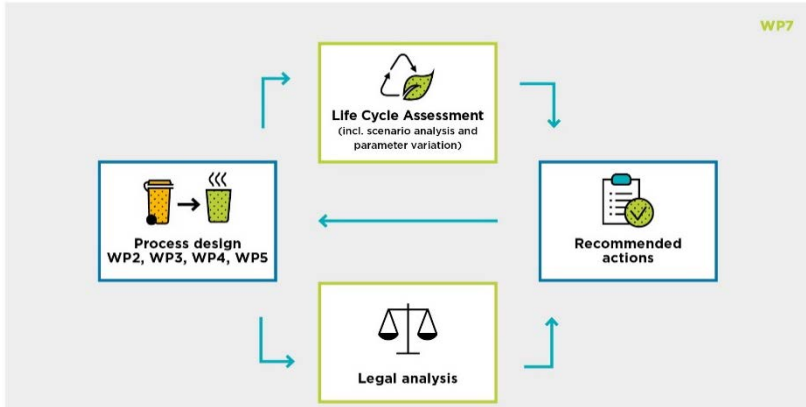
Moritz Mager, Johannes Kepler Universität Linz, Österreich

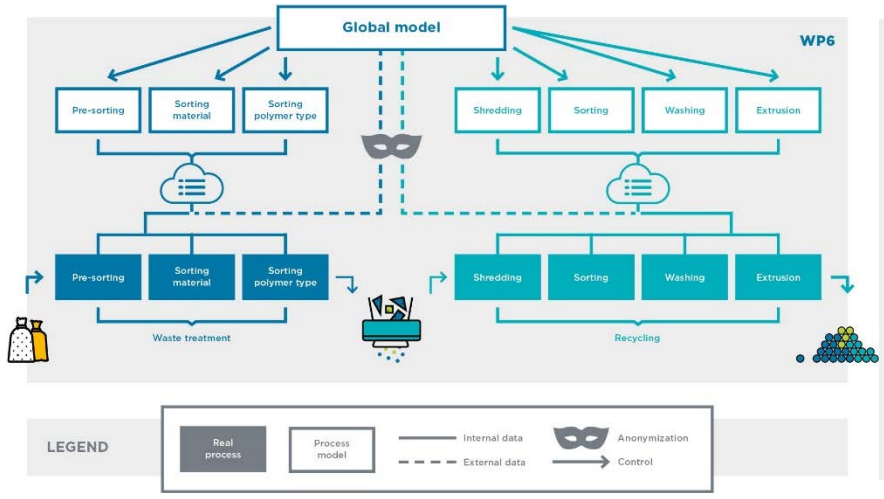
circPLAST-mr – Work packages

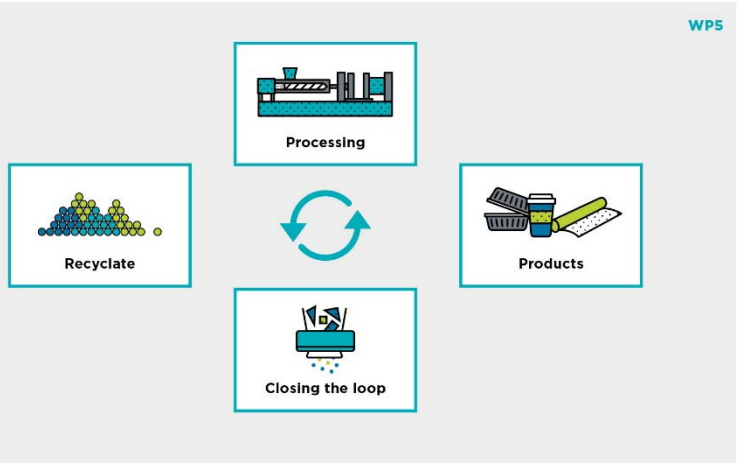




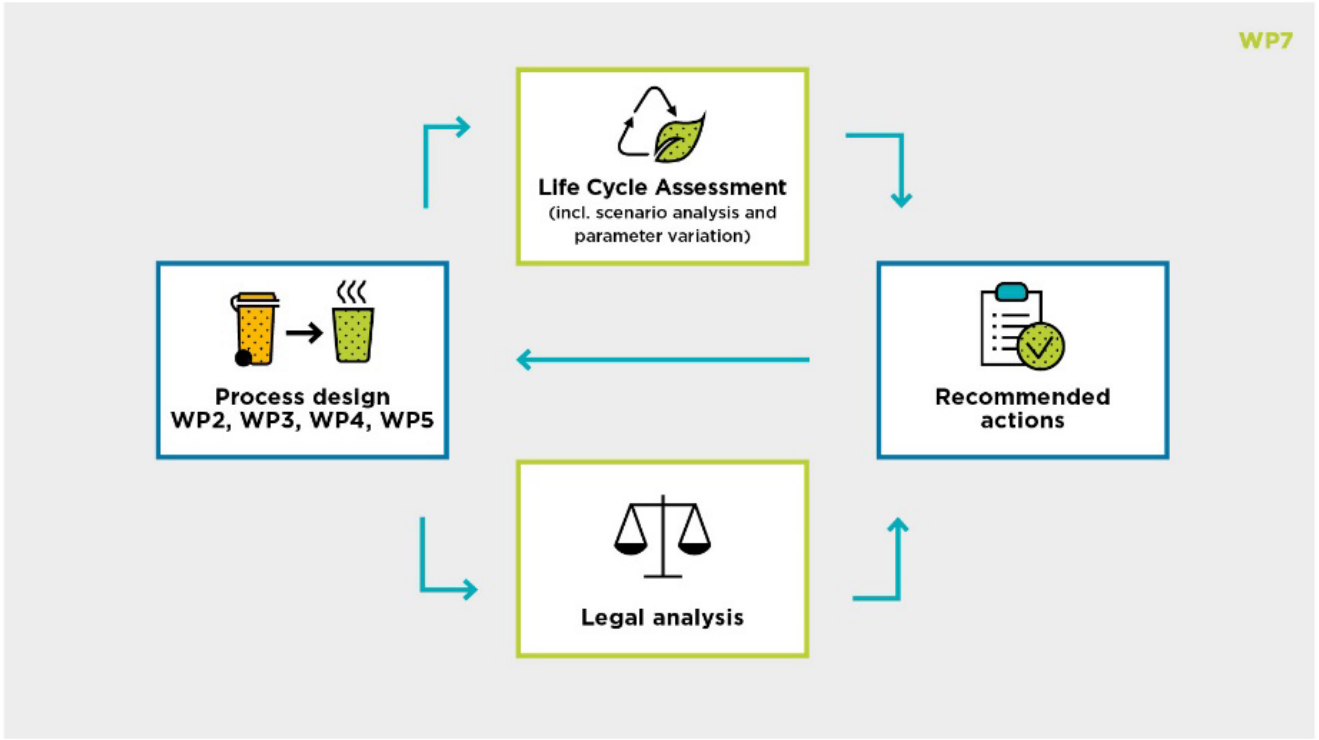








circPLAST-mr – Work packages



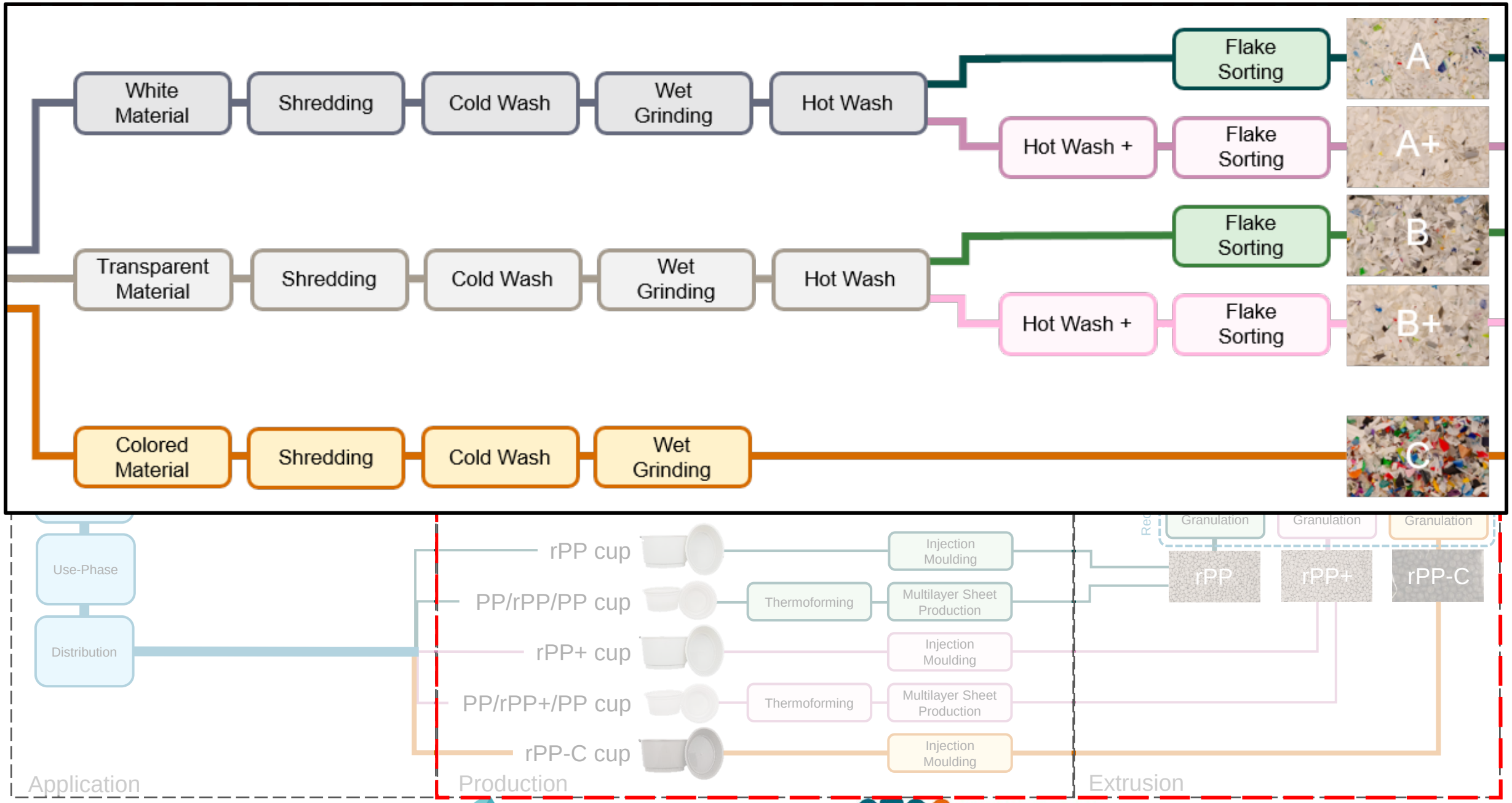
Donnerstag, 14.11.2024

Leitprojekt circPLAST-mr (22)

HS **Kupelwieser** (1.OG)

Chairperson: Roland Pomberger, Montanuniversität Leoben, Österreich

12.40	circPLAST-mr - LCA-orientierte Prozess-optimierung im Bereich mechanisches Recycling von Kunststoffen Lukas Zeilerbauer, Johannes Kepler Universität Linz, Österreich


White Material
Shredding
Cold Wash
Wet Grinding
Hot Wash
Flake Sorting
A
Hot Wash +
Flake Sorting
A+
Transparent Material
Shredding
Cold Wash
Wet Grinding
Hot Wash
Flake Sorting
B
Hot Wash +
Flake Sorting
B+
Colored Material
Shredding
Cold Wash
Wet Grinding
C
Use-Phase
Distribution
rPP cup
PP/rPP/PP cup
rPP+ cup
PP/rPP+/PP cup
rPP-C cup
Thermoforming
Thermoforming
Injection Moulding
Multilayer Sheet Production
Injection Moulding
Multilayer Sheet Production
Injection Moulding
Granulation
Granulation
Granulation
rPP
rPP+
rPP-C
Application
Production
Extrusion

From waste to PP cup

Pre-treated Flakes

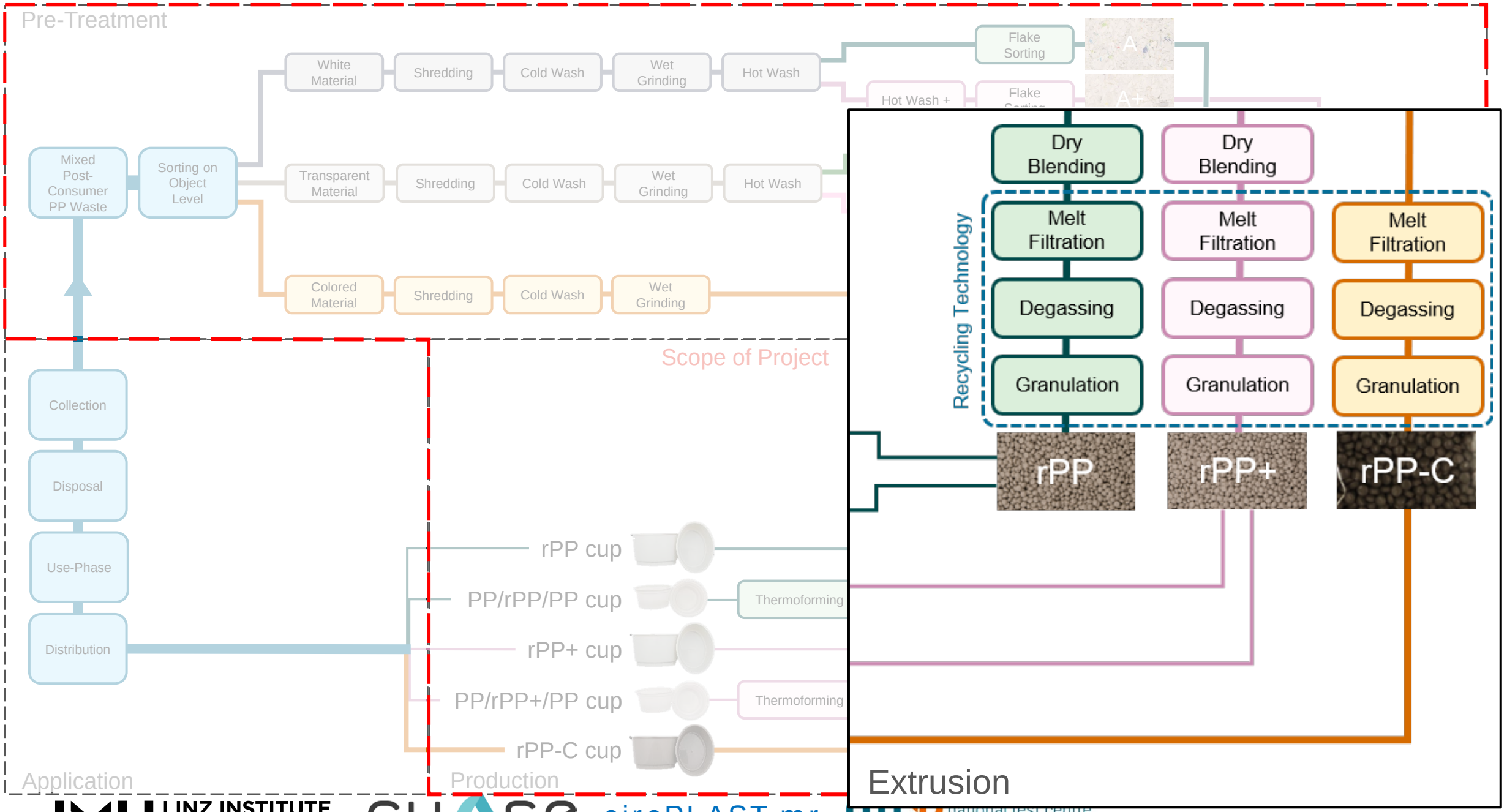
A
(flakes, white, hot wash)

B
(flakes, transparent, hot wash)

C
(flakes, colored, cold wash)

A+
(flakes, white, hot wash +)

B+
(flakes, transparent, hot wash +)


Pre-Treatment
Mixed Post-Consumer PP Waste
Sorting on Object Level
White Material
Shredding
Cold Wash
Wet Grinding
Hot Wash
Flake Sorting
A
Hot Wash +
Flake Sorting
A+
Transparent Material
Shredding
Cold Wash
Wet Grinding
Hot Wash
Colored Material
Shredding
Cold Wash
Wet Grinding
Scope of Project
Collection
Disposal
Use-Phase
Distribution
rPP cup
PP/rPP/PP cup
Thermoforming
rPP+ cup
PP/rPP+/PP cup
Thermoforming
rPP-C cup
Application
Production
Recycling Technology
Dry Blending
Dry Blending
Melt Filtration
Melt Filtration
Melt Filtration
Degassing
Degassing
Degassing
Granulation
Granulation
Granulation
rPP
rPP+
rPP-C
Extrusion

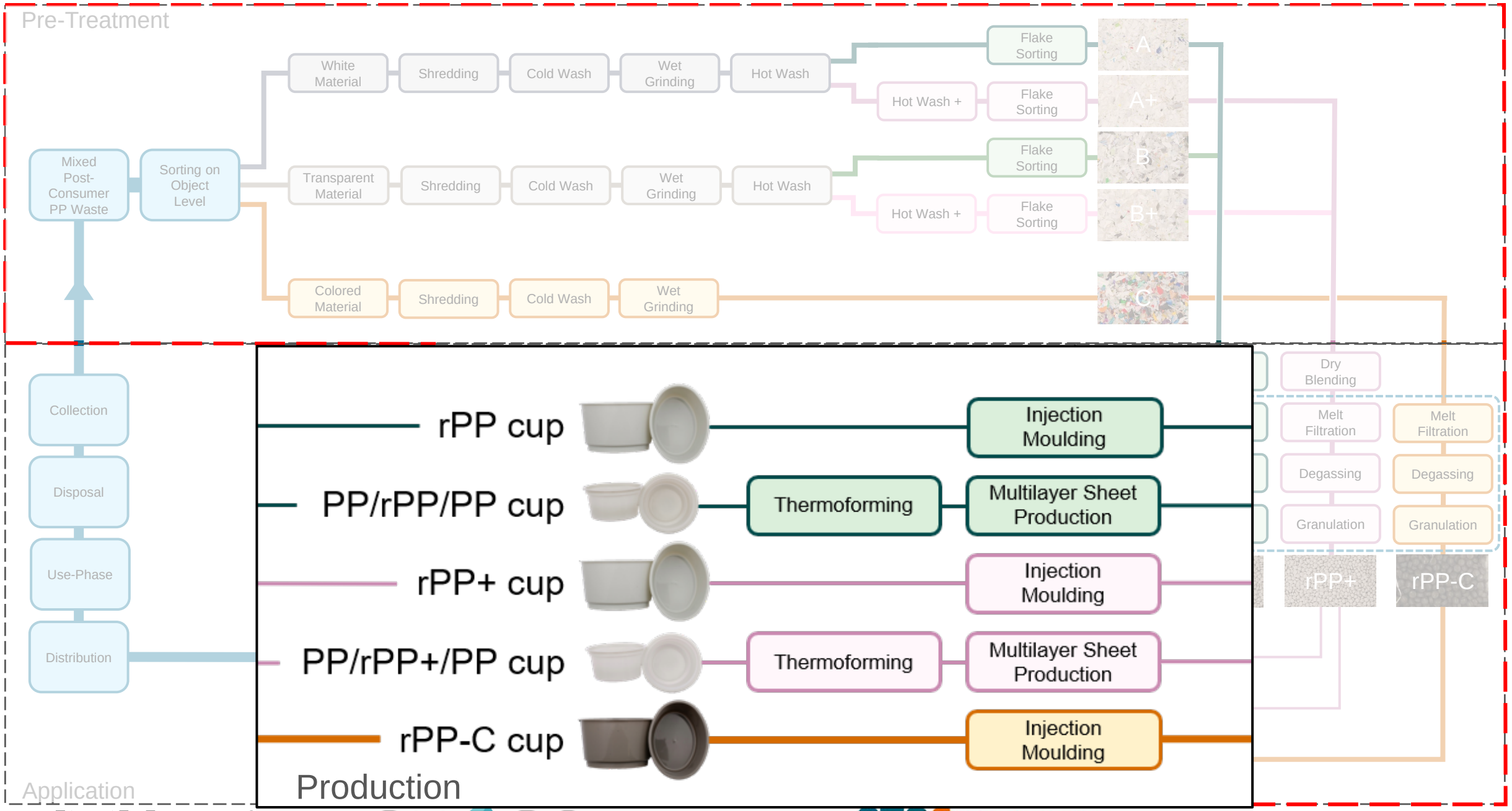
From waste to PP cup

Granulates

rPP
(granules, blend of A & B)

rPP+
(granules, blend of A+ & B+)

rPP-C
(granules of C)


Pre-Treatment
Mixed Post-Consumer PP Waste
Sorting on Object Level
White Material
Shredding
Cold Wash
Wet Grinding
Hot Wash
Flake Sorting
A
Hot Wash +
Flake Sorting
A+
Transparent Material
Shredding
Cold Wash
Wet Grinding
Hot Wash
Flake Sorting
B
Hot Wash +
Flake Sorting
B+
Colored Material
Shredding
Cold Wash
Wet Grinding
C
Collection
Disposal
Use-Phase
Distribution
rPP cup
PP/rPP/PP cup
rPP+ cup
PP/rPP+/PP cup
rPP-C cup
Thermoforming
Thermoforming
Injection Moulding
Multilayer Sheet Production
Injection Moulding
Multilayer Sheet Production
Injection Moulding
Dry Blending
Melt Filtration
Melt Filtration
Degassing
Degassing
Granulation
Granulation
rPP+
rPP-C
Production
Application

From waste to PP cup

Products

rPP cup
(injection molded product)

rPP+ cup
(injection molded product)

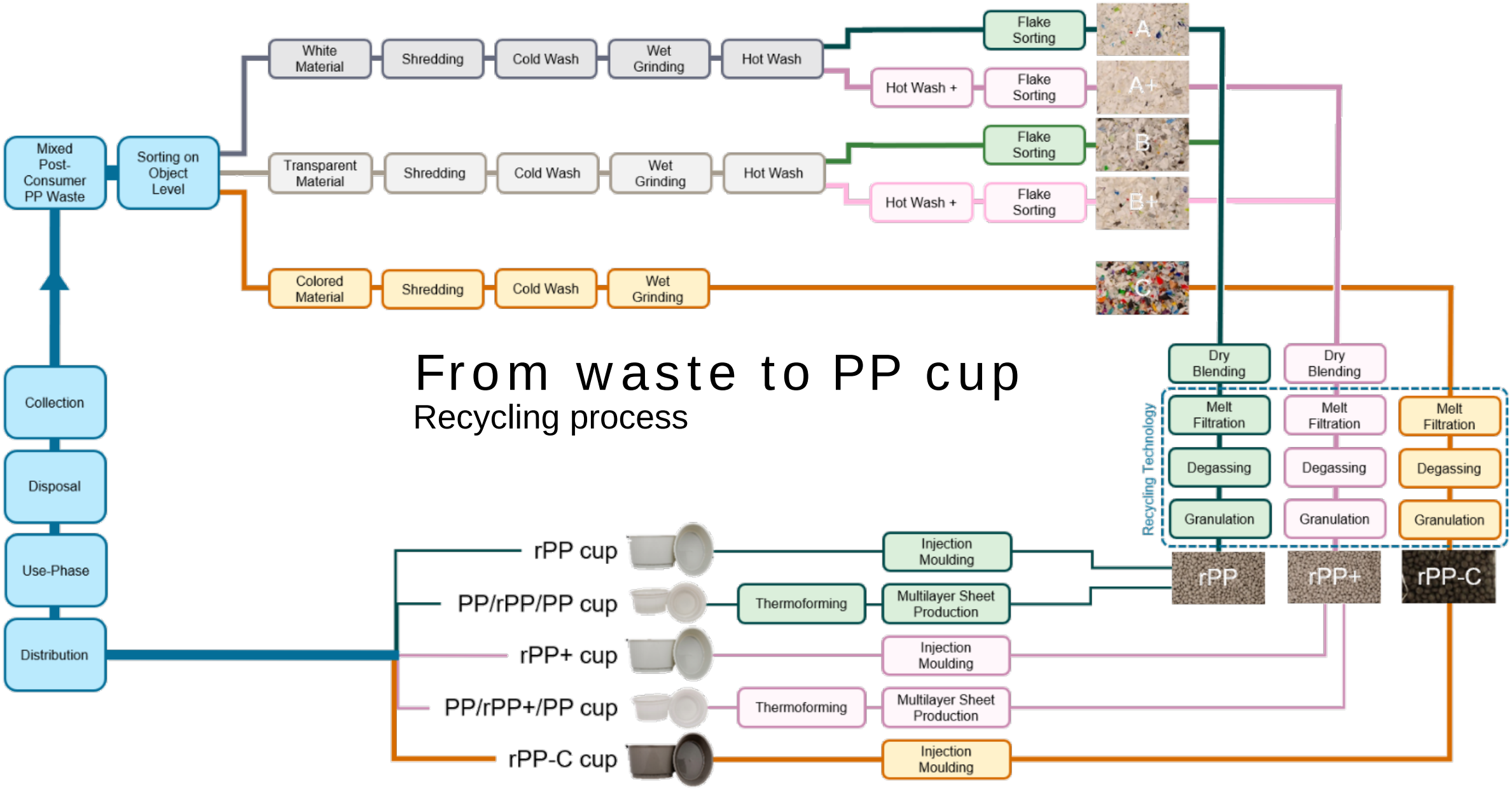
rPP-C cup
(injection molded product)

PP/rPP/PP cup
(thermoformed multilayer product)

PP/rPP+/PP cup
(thermoformed multilayer product)

From waste to PP cup

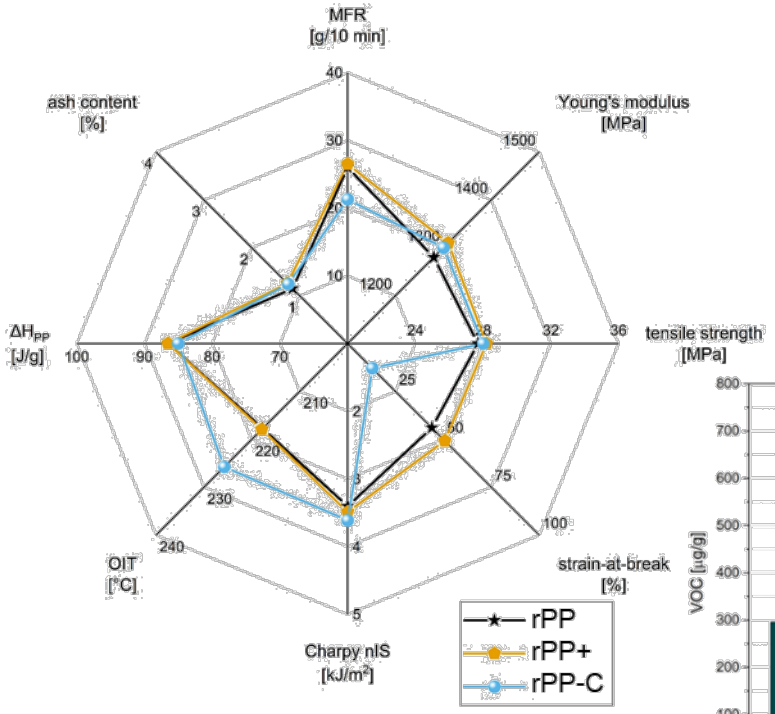
Recycling process

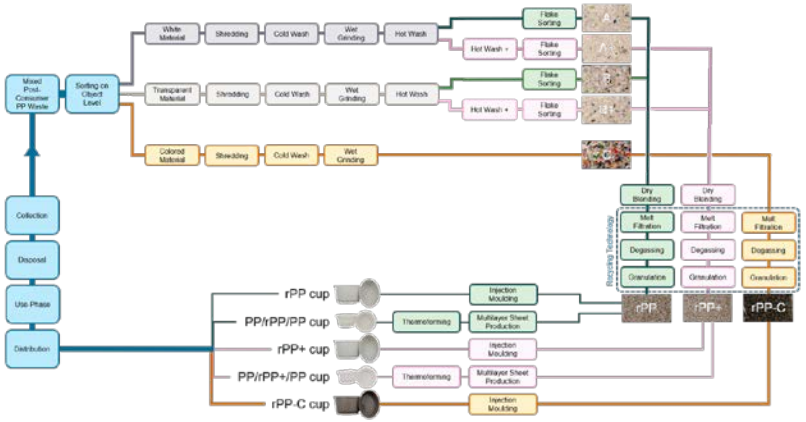


From waste to PP cup

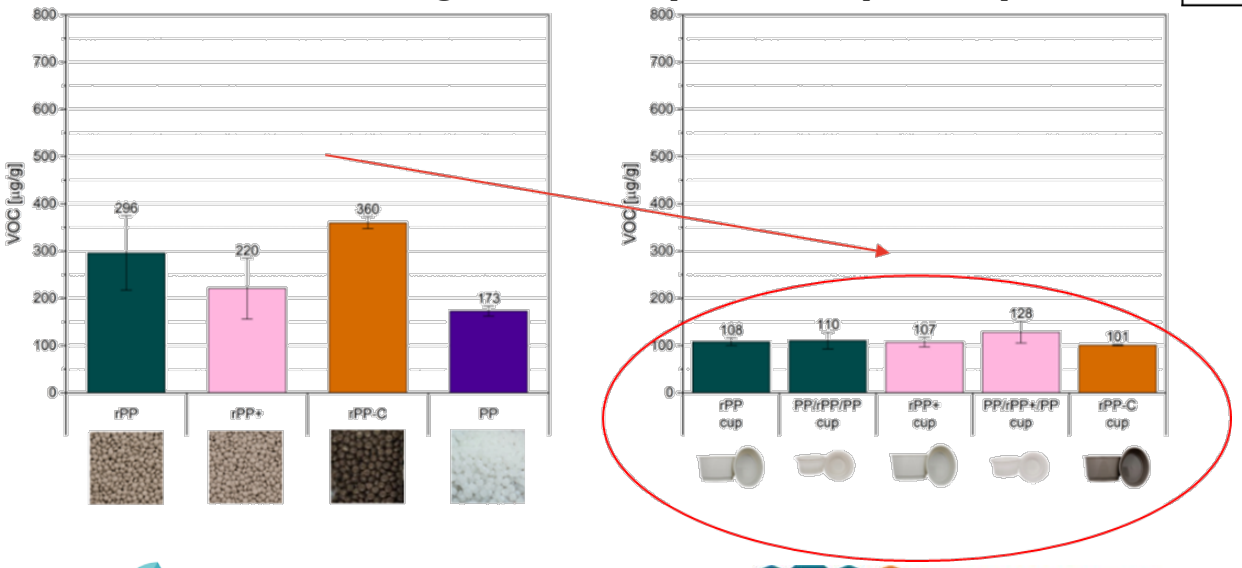
Material properties

Recyclate properties

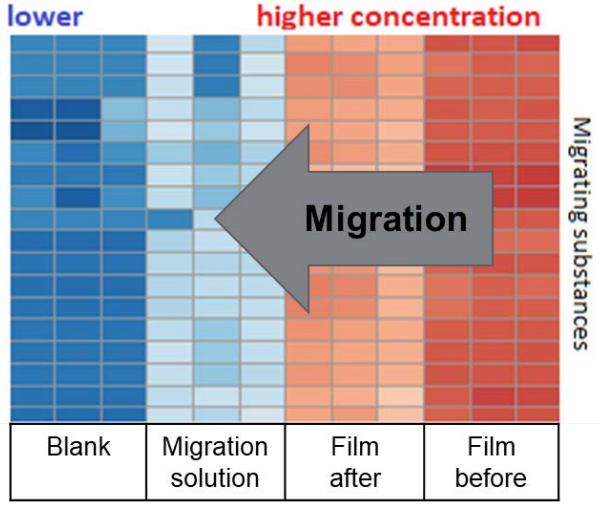




Volatile organic compounds (VOCs)



Migration results



JKU LINZ INSTITUTE OF TECHNOLOGY CHASE circPLAST-mr NTCP national test centre circular plastics

Source: Mager et al. (2024), in preparation; Czaker et al. (2024), in preparation; Felgel-Farnholz et al. (2024), in preparation

Re-Thinking Plastic!

Three new designed study programs at the Johannes Kepler University Linz.

JKU LINZ INSTITUTE OF TECHNOLOGY

https://www.jku.at/en/re-thinking-plastic/