

Abfälle als Rohstoffquelle erschließen – die iCycle®-Technologie zur Gewinnung von Metallen, Monomeren und Aromaten

»Chemisches Recycling – Aktuelle Entwicklungen, Optionen und Perspektiven«
Freiberg, 06. Juni 2019

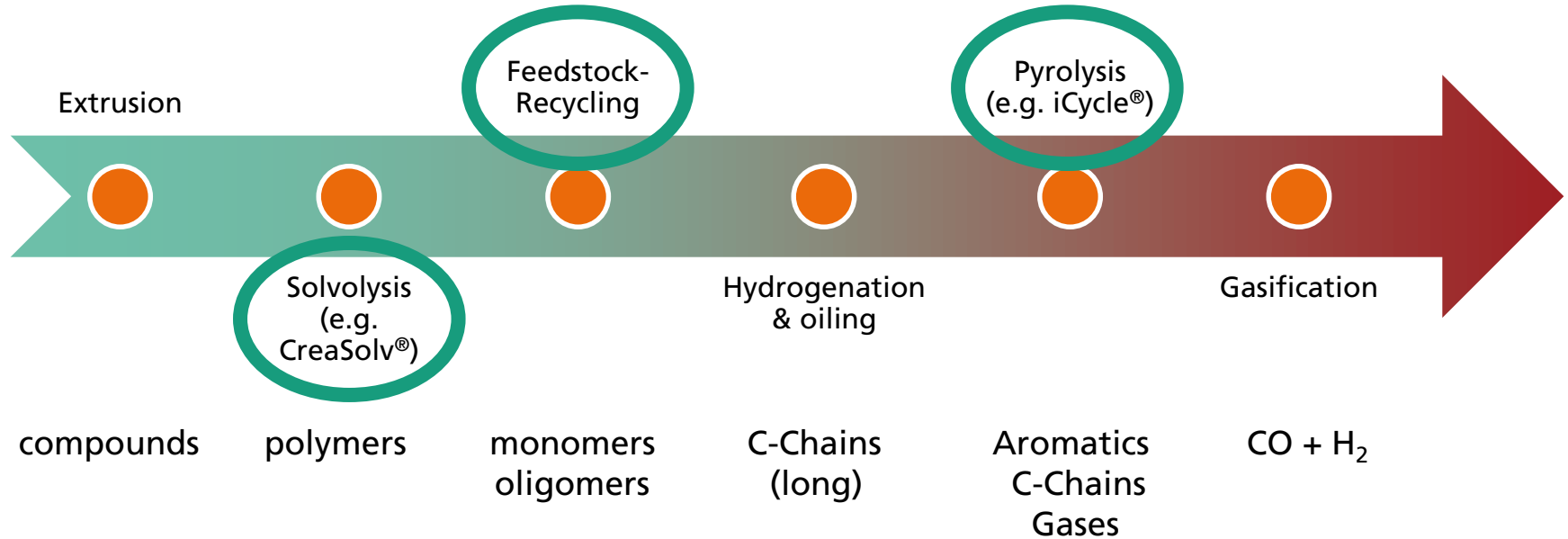


Dr. Peter Hense (Ph.D.)

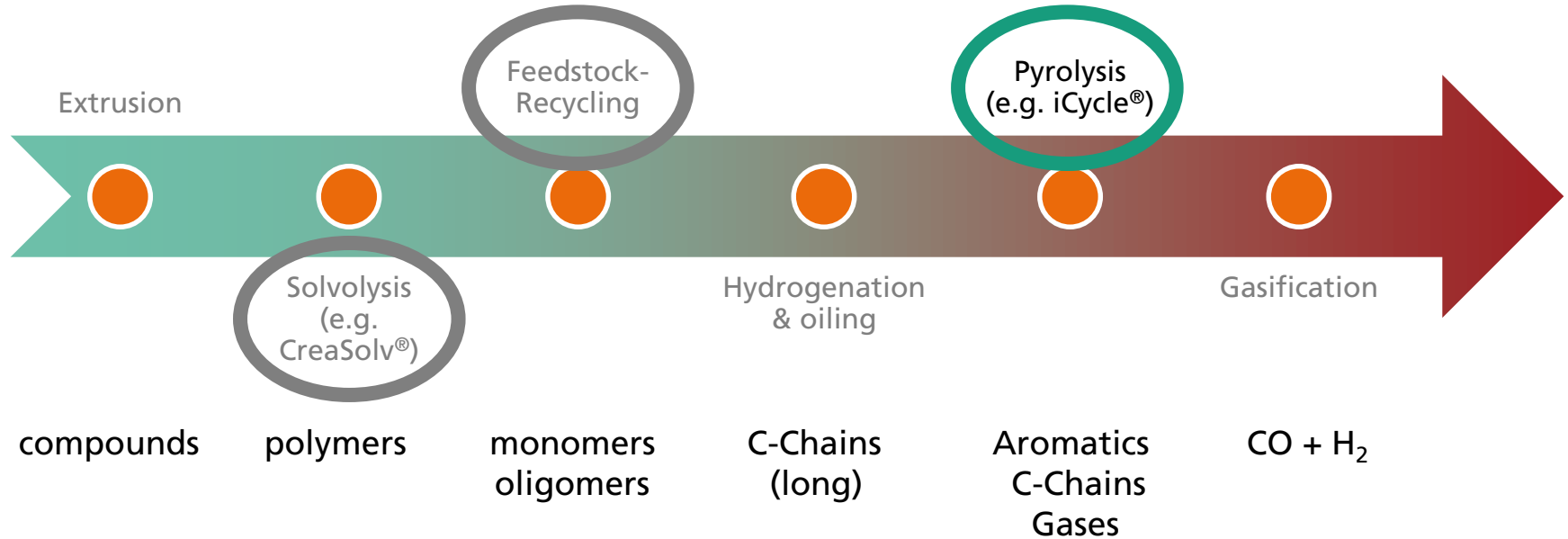
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Abfälle als Rohstoffquelle erschließen – die iCycle®-Technologie zur Gewinnung von Metallen, Monomeren und Aromaten



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Recycling of composite materials

Platform technology: iCycle®



waste plastics



E-Scrap



ASR



dust



CFRP / GFRP



Marine Litter



metal recycling /
fiber utilization

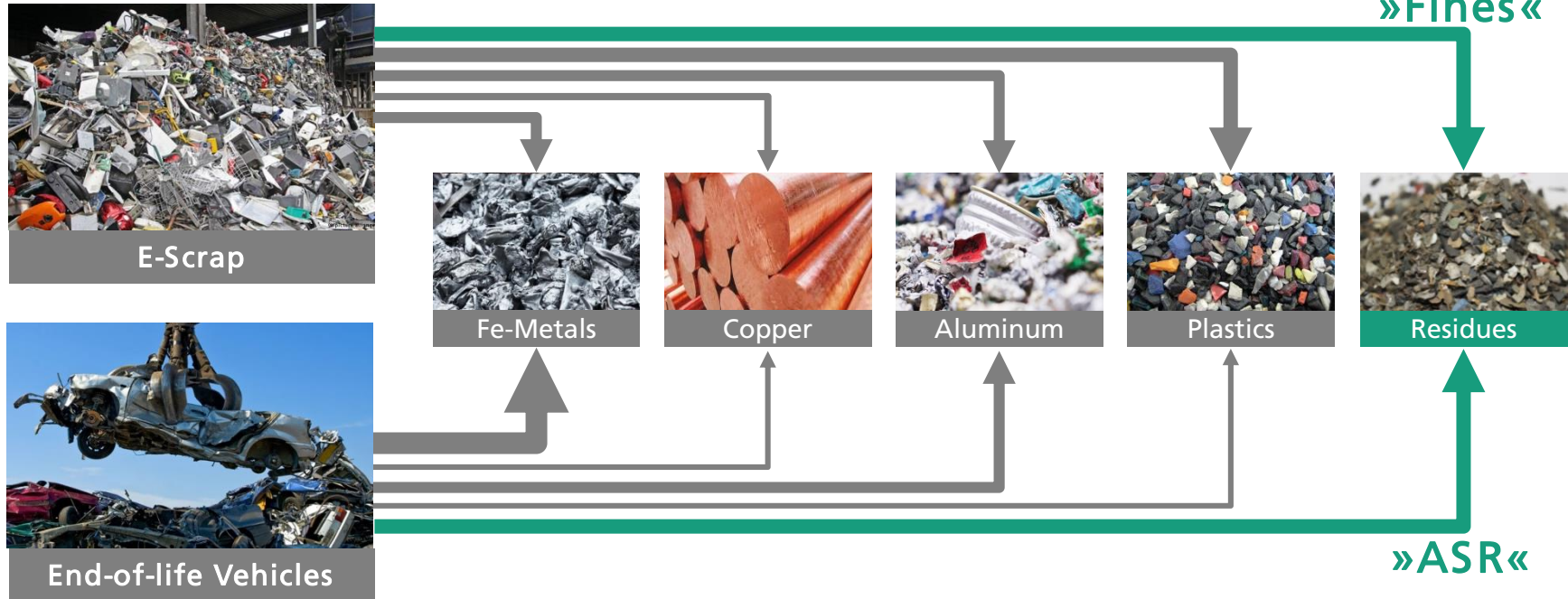


energetic utilization /
chemical recycling

*E-Scrap includes shredder residues from mechanical treatment on European standard,
ASR: Automotive Shredder Residues, CFRP / GFRP: Carbon / Glass Fiber Reinforced Plastics*

The iCycle[®] process

Application scenario for residues from mechanical treatment



Shredder Residues from E-Scrap

Enabling Metal Recycling using the iCycle® process



Shredder Residues
from E-Scrap



iCycle® Process



Integrated Copper
Smelters

- Accumulation of metals in a solid product
- Decomposition of plastics (low energy input)
- Safe handling of halogens
- Profitable and innovative solution

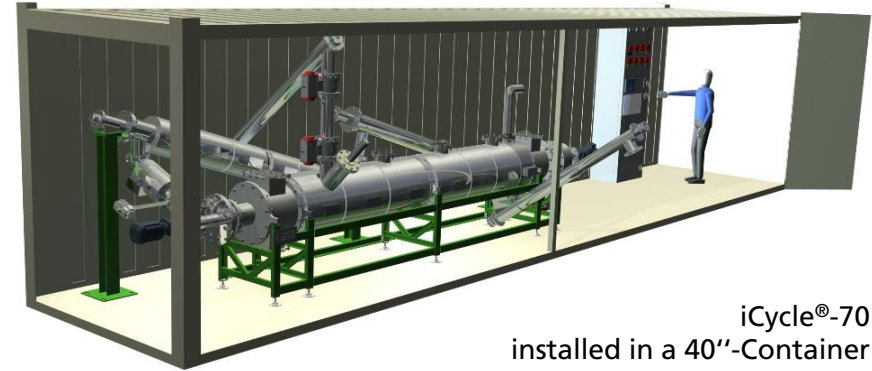
The iCycle® process for E-Scrap

Key facts



iCycle®: Key facts

- Thermo-chemical process (pyrolysis) for extraction of metals from plastics
- Main Product: Metal concentrate
- By-Products: Oil and gas for energetic utilization or feedstock recycling
- Highly profitable based on sale of metals



iCycle®-70
installed in a 40'-Container

Fields of application regarding E-Scrap

- *Formal, high-tech E-Scrap treatment (Europe):* Residual fractions from mechanical treatment
- *Informal, low-tech E-Scrap handling (Africa, Asia):* E-Scrap after small mechanical disintegration
- *Recovery of high-tech metals:* e.g. Recovery of Ta from PCB, In from LCD

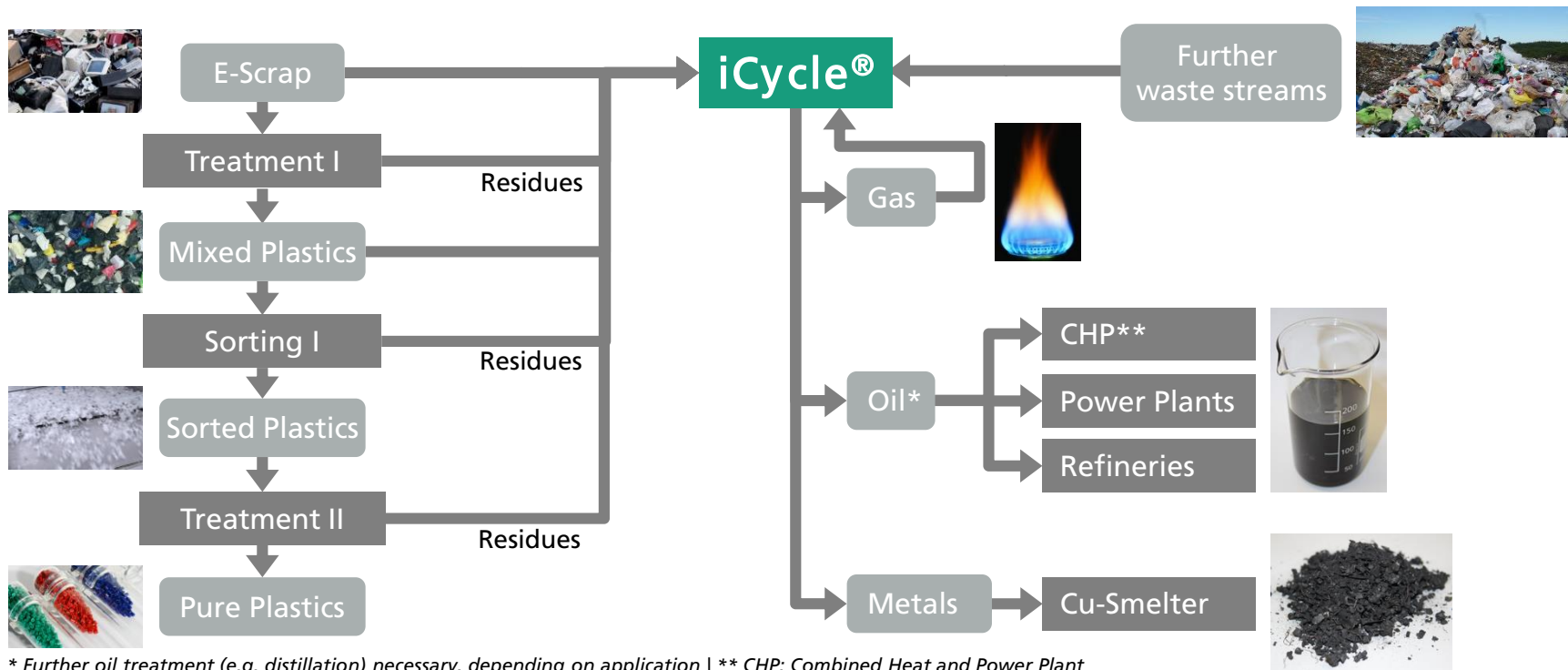
The iCycle[®] process for E-Scrap

Pilot plant (70 kg/h, continuous)



iCycle® Technology

Application scenarios along the treatment chain for plastics from E-Scrap



* Further oil treatment (e.g. distillation) necessary, depending on application | ** CHP: Combined Heat and Power Plant

Comparison to existing pyrolysis technologies

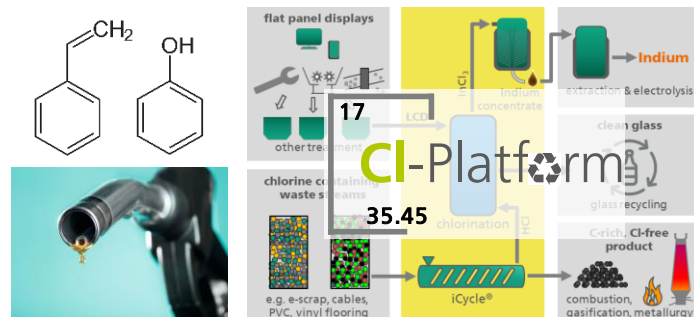
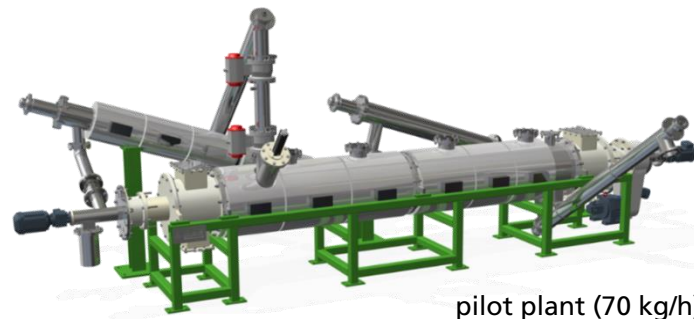
Advantages of iCycle®

Focus and technical area of iCycle®

- Wide range of feedstock with focus on metal recovery and formation of high-quality fuels
- Auger reactor for defined reaction times and prevention of fouling inside the reactor
- No limitations to halogen contents (Br, Cl)
- Products free of dioxins and furans
- Flexible scalability for a decentralized treatment

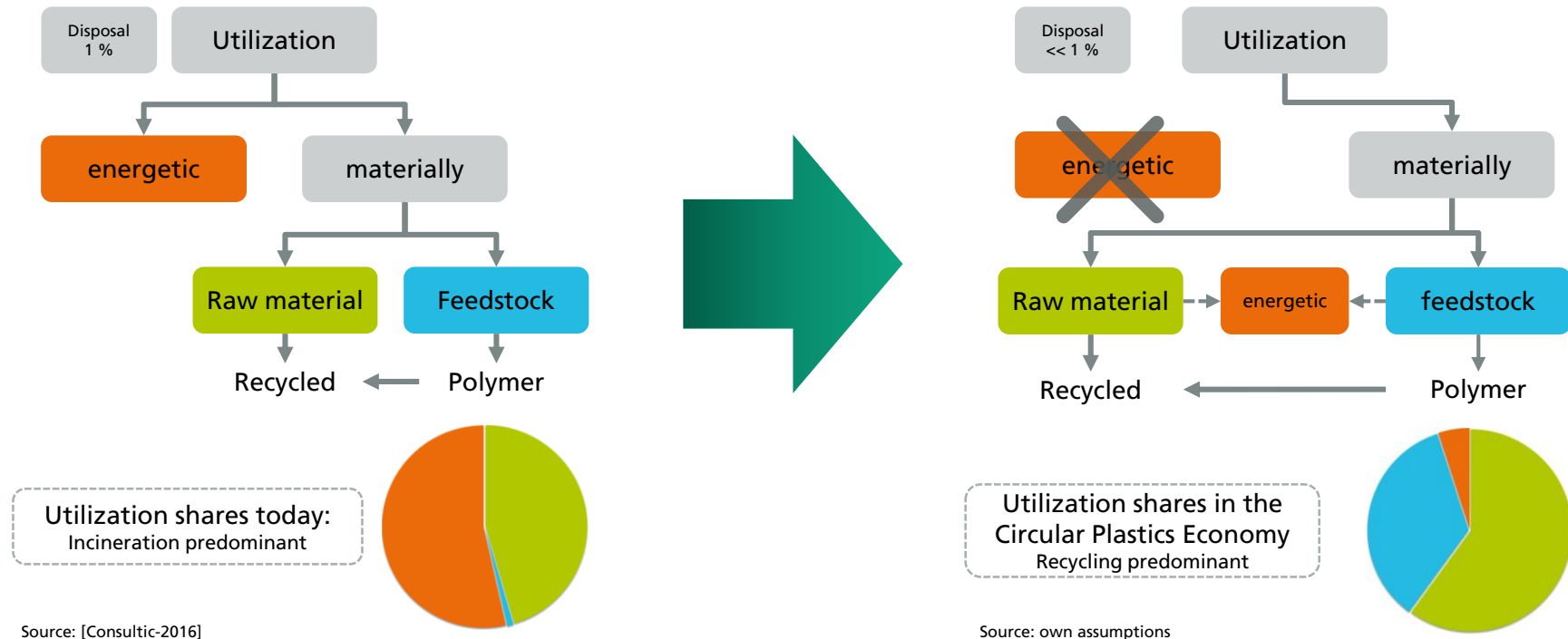
Add-ons to iCycle®

- Chlorination module for recovery of high-tech metals (e.g. In) using halogen containing waste (*Cl-Platform*)
- *CreaSolv*® process for high-quality recovery of plastics
- Recovery of aromatic compounds (e.g. phenols, styrene, BTEX)
- Molten polyolefin reactor for production of high-quality fuels

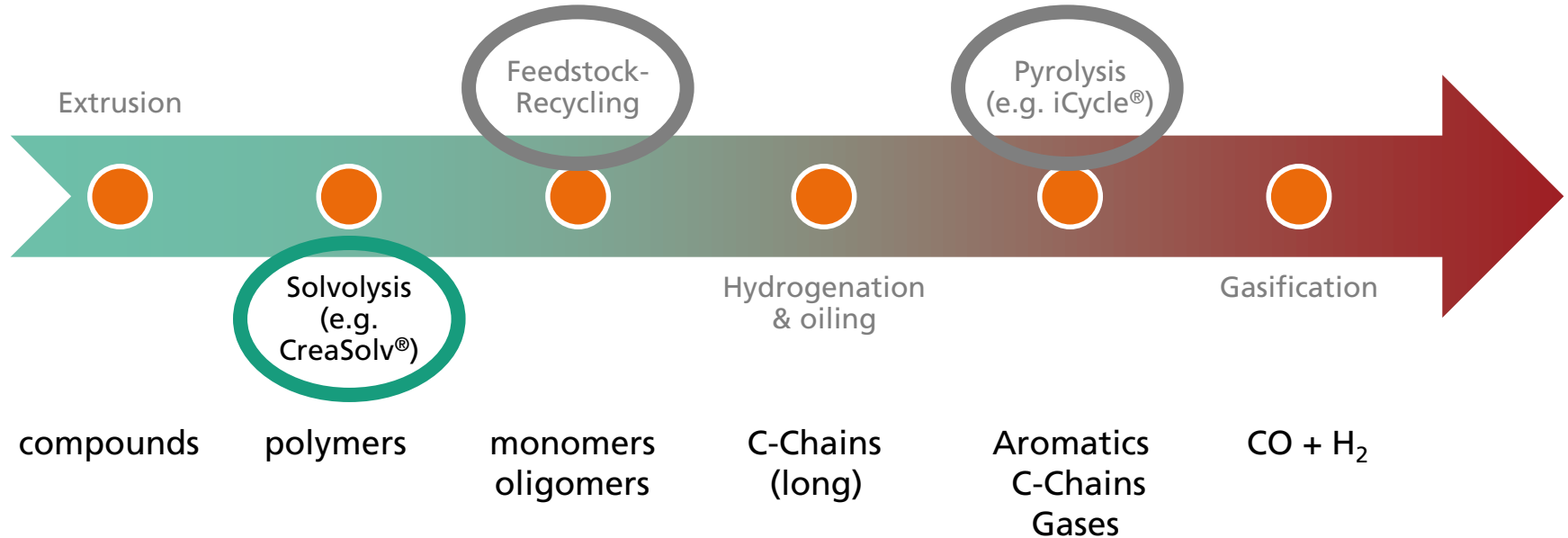


Feedstock recycling of polymers

Our vision



Abfälle als Rohstoffquelle erschließen – die iCycle®-Technologie zur Gewinnung von Metallen, Monomeren und Aromaten



iCycle® & CreaSolv® – Recycling of Plastics-Metal-Composites

Combination of market-ready technologies



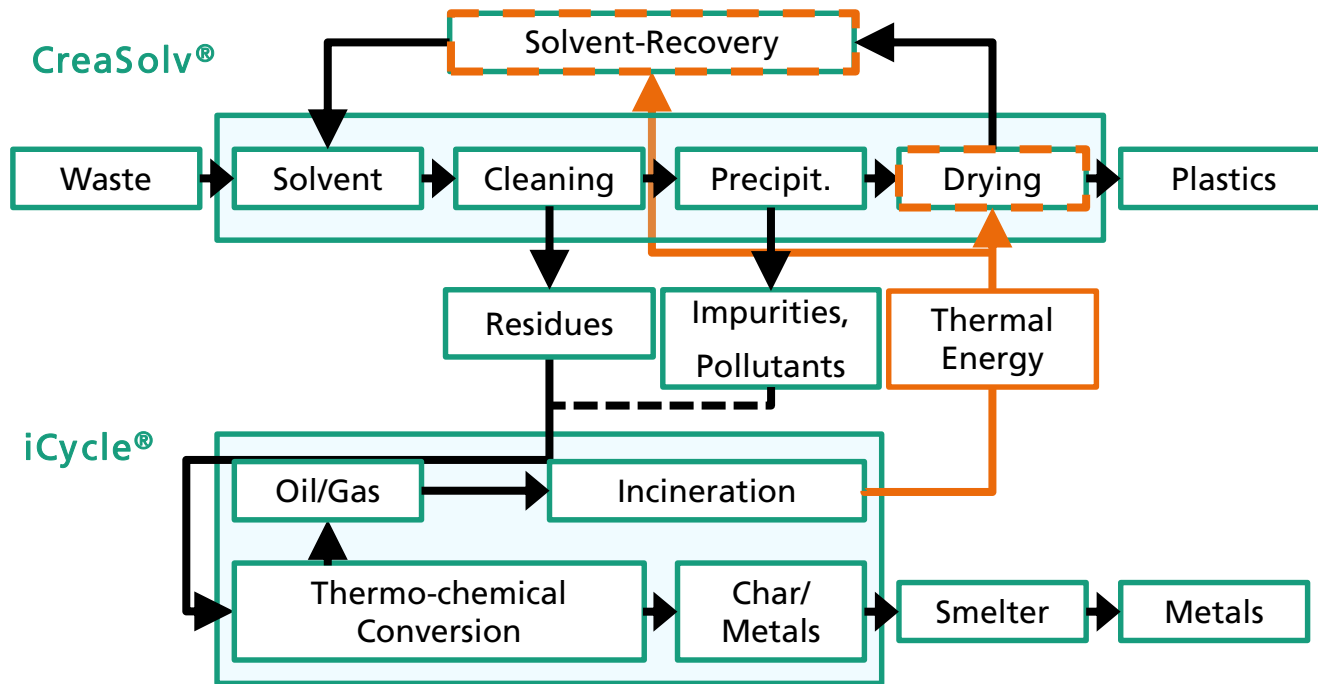
Packaging Plastics



WEEE

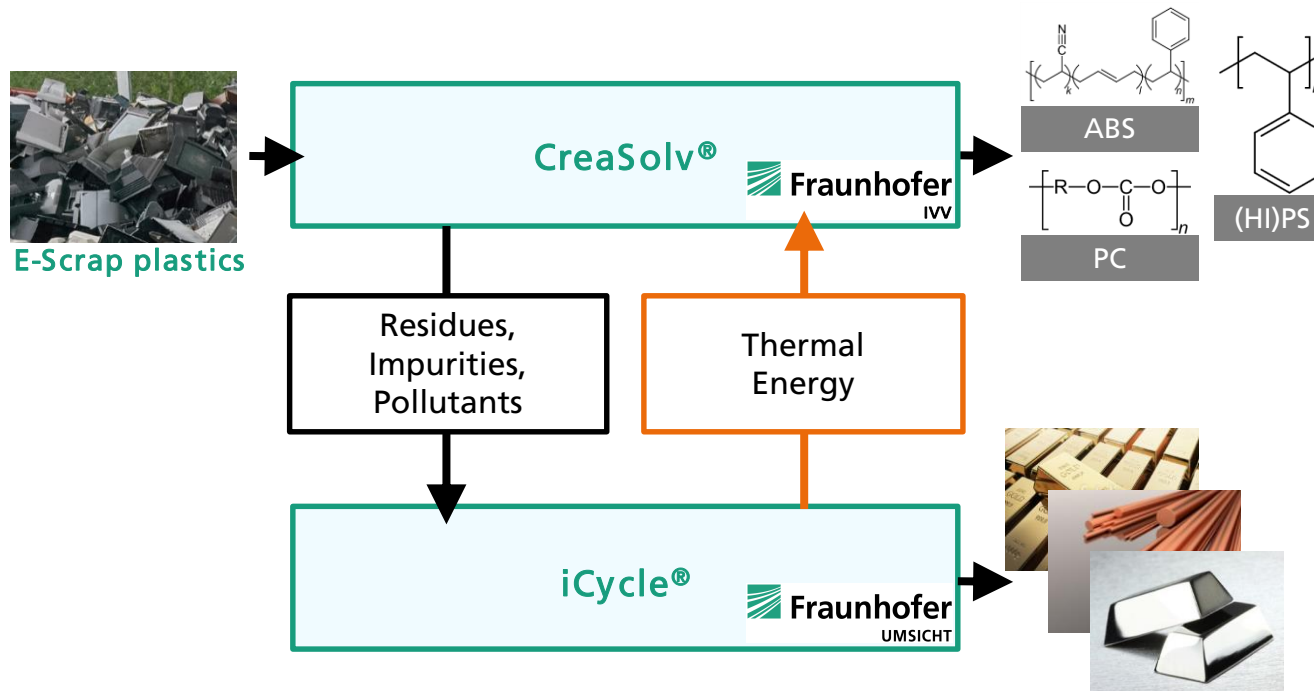


Automotive
Shredder Residues



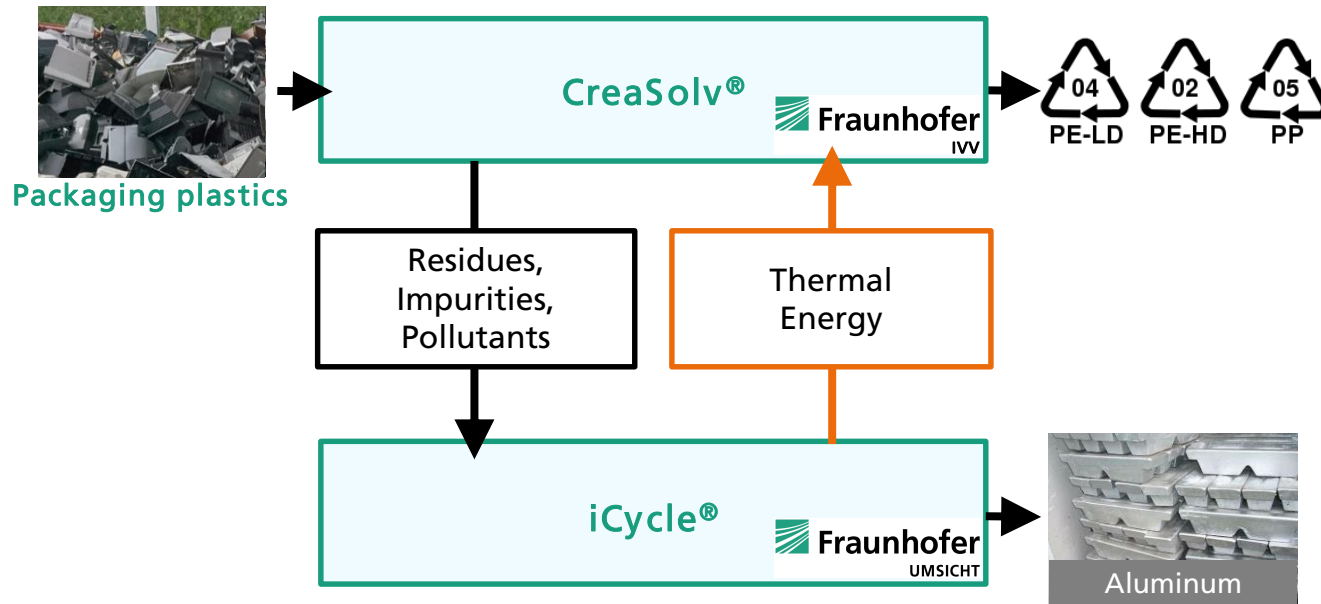
iCycle® & CreaSolv® – Recycling of Plastics-Metal-Composites

Combination of market-ready technologies



iCycle® & CreaSolv® – Recycling of Plastics-Metal-Composites

Combination of market-ready technologies



iCycle® & CreaSolv® – Recycling of Plastics-Metal-Composites

Combination of market-ready technologies



WEEE plastics: PS / ABS

CreaSolv®



PS / ABS on virgin quality level

Residue
(Sb, Ti)

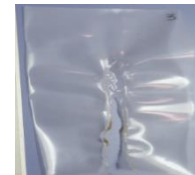
60 % Sb_2O_3

iCycle®



Flame retardant impact

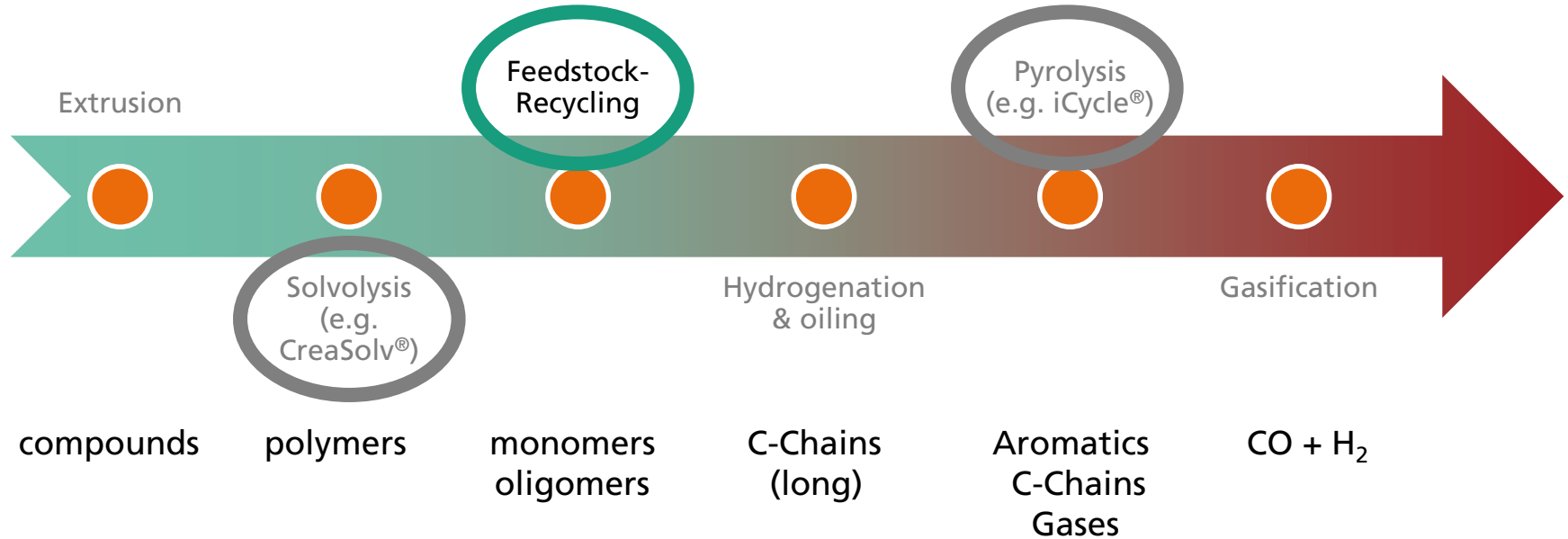
Virgin
Material



CreaSolv®
+ iCycle®

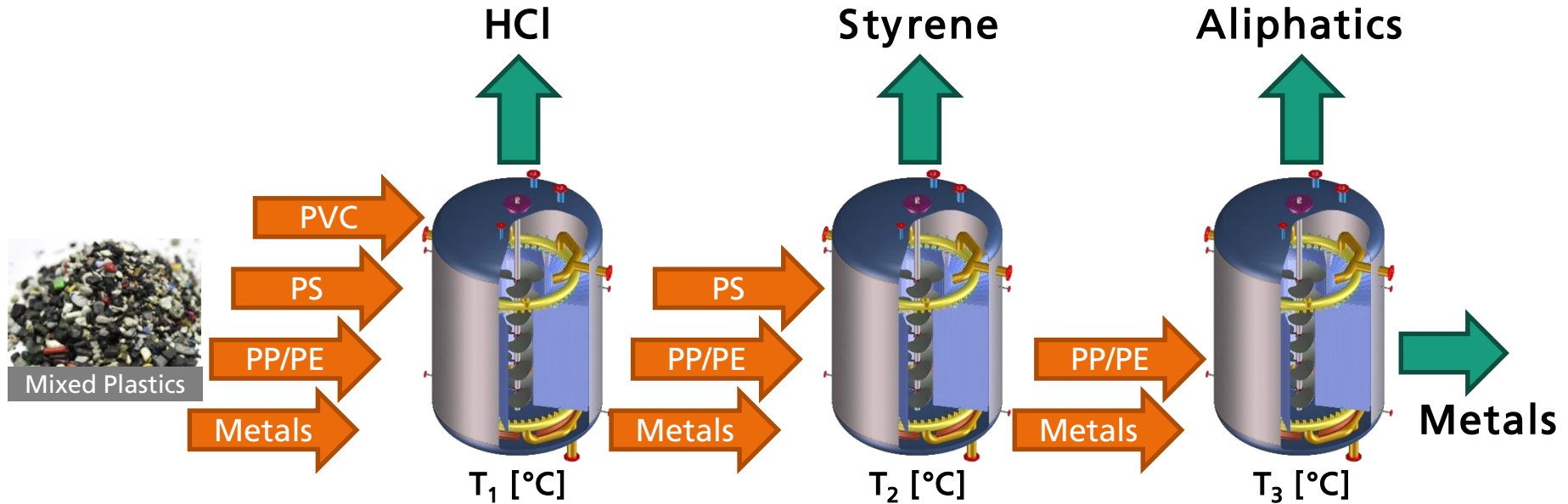


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Feedstock recycling of polymers

Fraunhofer UMSICHT developments

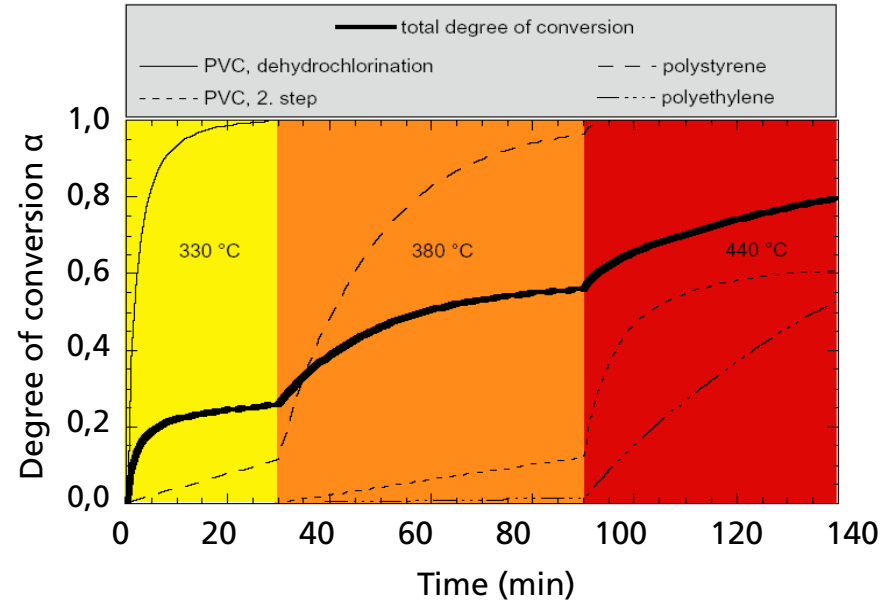


Feedstock recycling of polymers

Fraunhofer UMSICHT developments

Selective monomer recovery from complex waste plastic mixtures through stepwise degradation

- Target feedstock:
 - Waste plastic mixtures, which cannot be separated (easily)
- Selective recovery of monomers / HCl from mixtures of PVC, PA 6, PS and PE already shown
- Additionally, recovery of plastics and energy feasible (depending on feedstock)

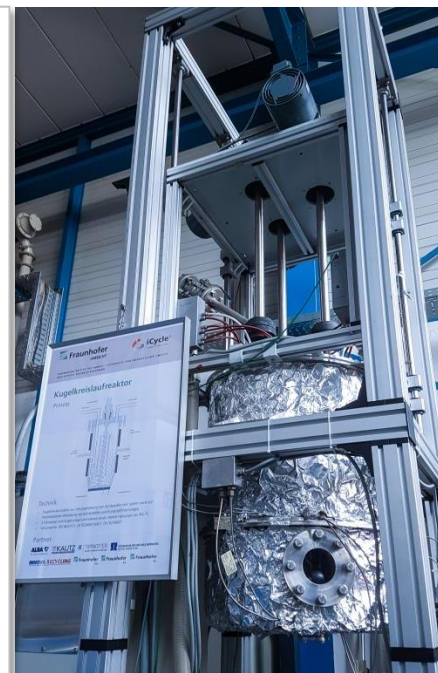
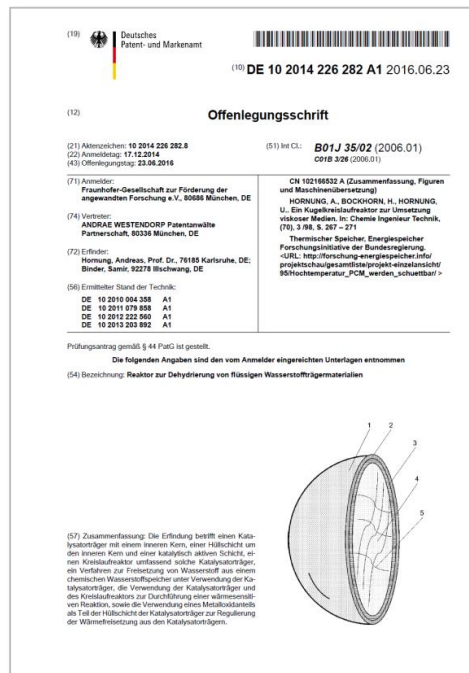


Feedstock recycling of polymers

Fraunhofer UMSICHT developments

Selective monomer recovery from complex waste plastic mixtures through stepwise degradation

- Important: reaction control and reactor design
- Fraunhofer UMSICHT designed and developed a special reactor (cycled-spheres reactor) and phase change materials
- Both enable a selective initiation of c-c bond cracking in melting reactions





Fraunhofer

UMSICHT



iCycle®

intelligent composite recycling

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