



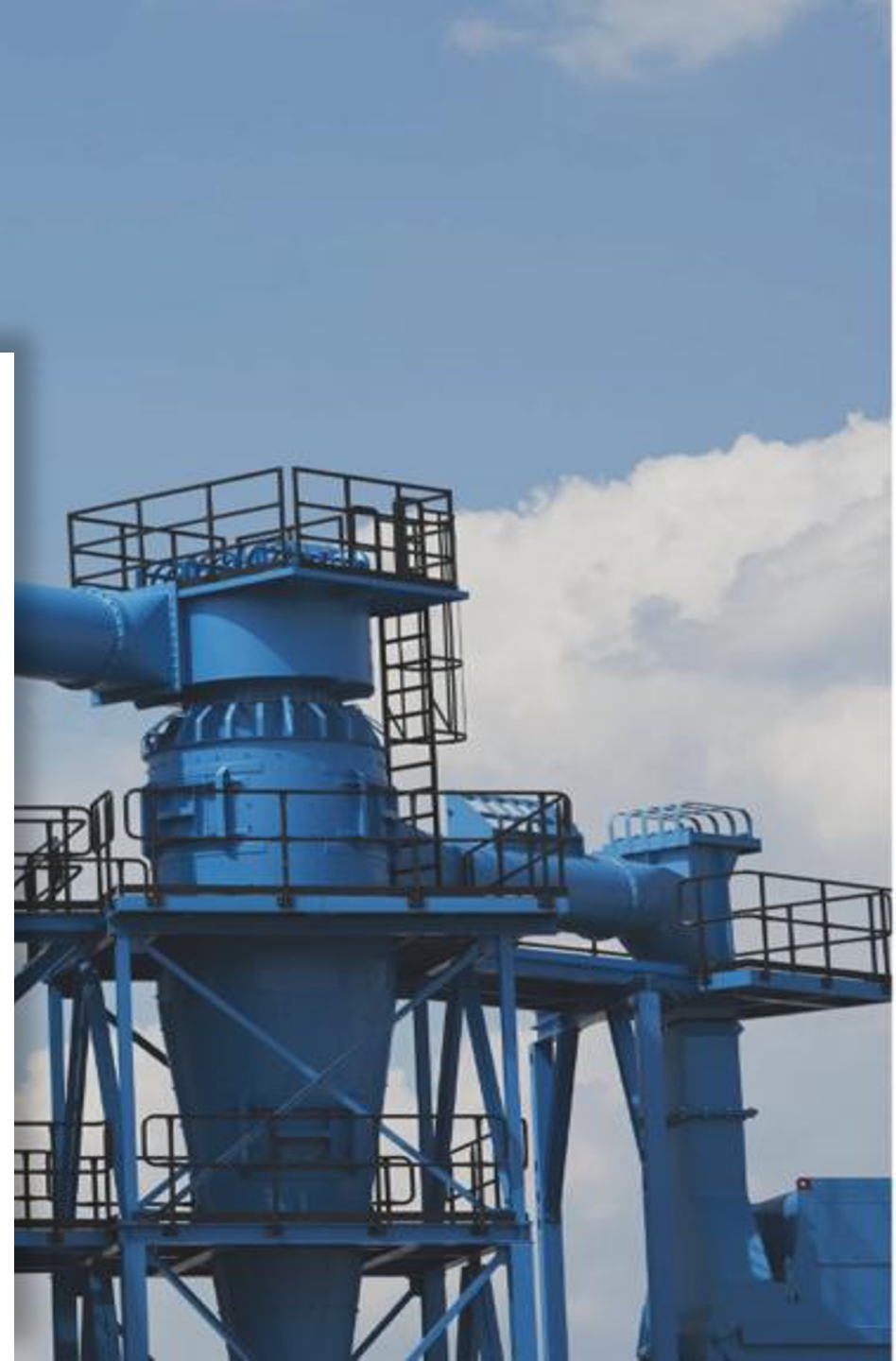
Circular
Economy
Hotspot

NRW 2022



NRW – Dutch cross-border opportunities

CHEMICAL RECYCLING



Freek van Eijk

CEO Holland Circular Hotspot

-- moderator --



PROGRAMME

13:00	Words of welcome
13:10	State of Development: Chemical Recycling (CR) in NRW and NL
13:30	Workshop 1: Challengers & Businesses Development Chemical Recycling
14:20	Coffee break
14:40	Workshop 2: Regulatory Development



PROGRAMME

- | | |
|--------------|---|
| 15:30 | Pitch corner by industry – focus on NRW/Germany |
| 16:05 | Coffee break |
| 16:15 | Pitch corner by industry – focus on The Netherlands |
| 16:50 | Final reflections |
| 17:05 | Walking dinner and drinks, including informal matchmaking |



Co-organized by



Ministerie van Infrastructuur
en Waterstaat



Generalkonsulat des
Königreichs der Niederlande
Düsseldorf

bottrop.

The State Government of
North Rhine-Westphalia



TNO innovation
for life



ZENIT



Peter Schuurmann

Consul General in Germany



Ministry of Foreign Affairs of the
Netherlands



Henning Wilts

Director - Division Circular Economy
Wuppertal Institute for Climate,
Environment, and Energy



NRW – Dutch cross border opportunities in Chemical Recycling
Side event Circular Hotspot Bottrop 2022


Chemical Recycling in the perspective of Northrhine-Westphalia

Dr. Henning Wilts

Framework conditions in NRW

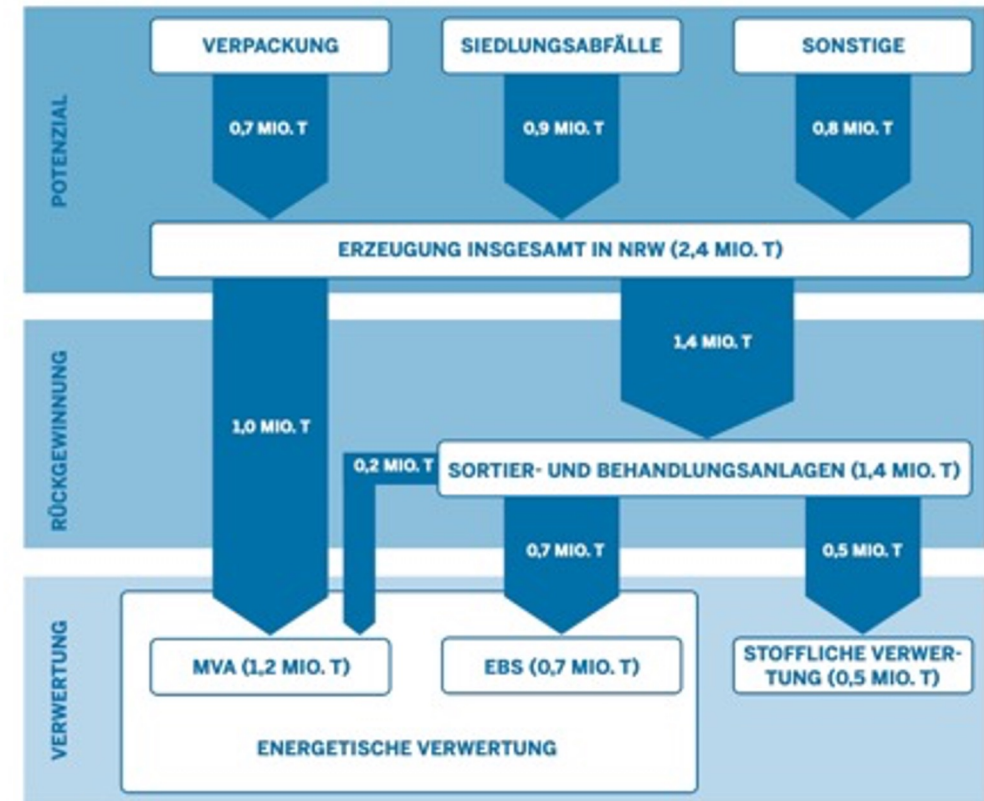
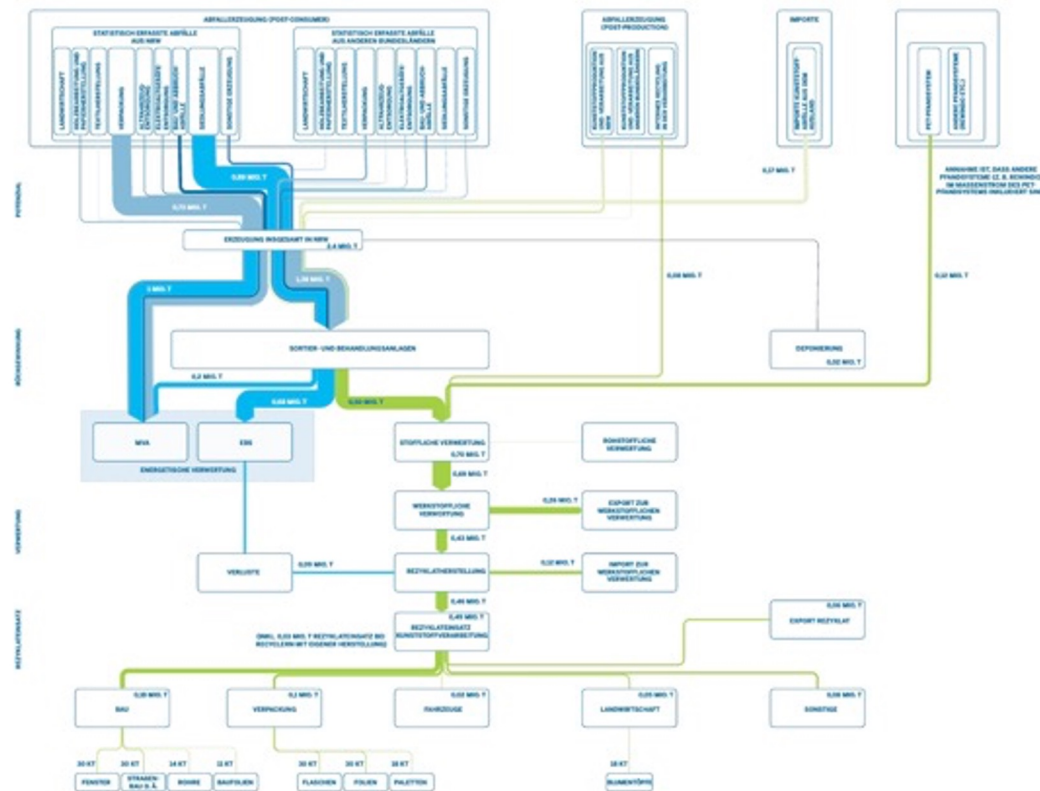
Potential benefits as well as limitations of chemical recycling intensively discussed

- Impulses from the policy level, e.g. the German coalition treaty
- High interest from industry, driven by climate ambitions as well as requirements to fulfil recycled content obligation
- Concerns by civil society stakeholders about potential environmental impacts

 **Debate evolved from “good or bad” to a much more differentiated view on the role of chemical recycling in the context of a circular economy**



Current system of plastic waste management in NRW is dominated by thermal recovery



In4Climate.NRW: Holistic Circular Economy approaches focussing on the role of the raw materials sector



**IN4
CLIMATE
.NRW**

Dieses Dokument wird von folgenden Unternehmen und Institutionen getragen:

 BASF We create chemistry	 Fraunhofer UMSICHT	 LANXESS	 RAIN RAIN CARBON INC.	 REMONDIS® IM AUFTRAG DER ZUKUNFT
 RHM Die Rohstoffhändler	 SCI4 CLIMATE .NRW		 S SOLVAY	

Eine Initiative der NRW-Landesregierung

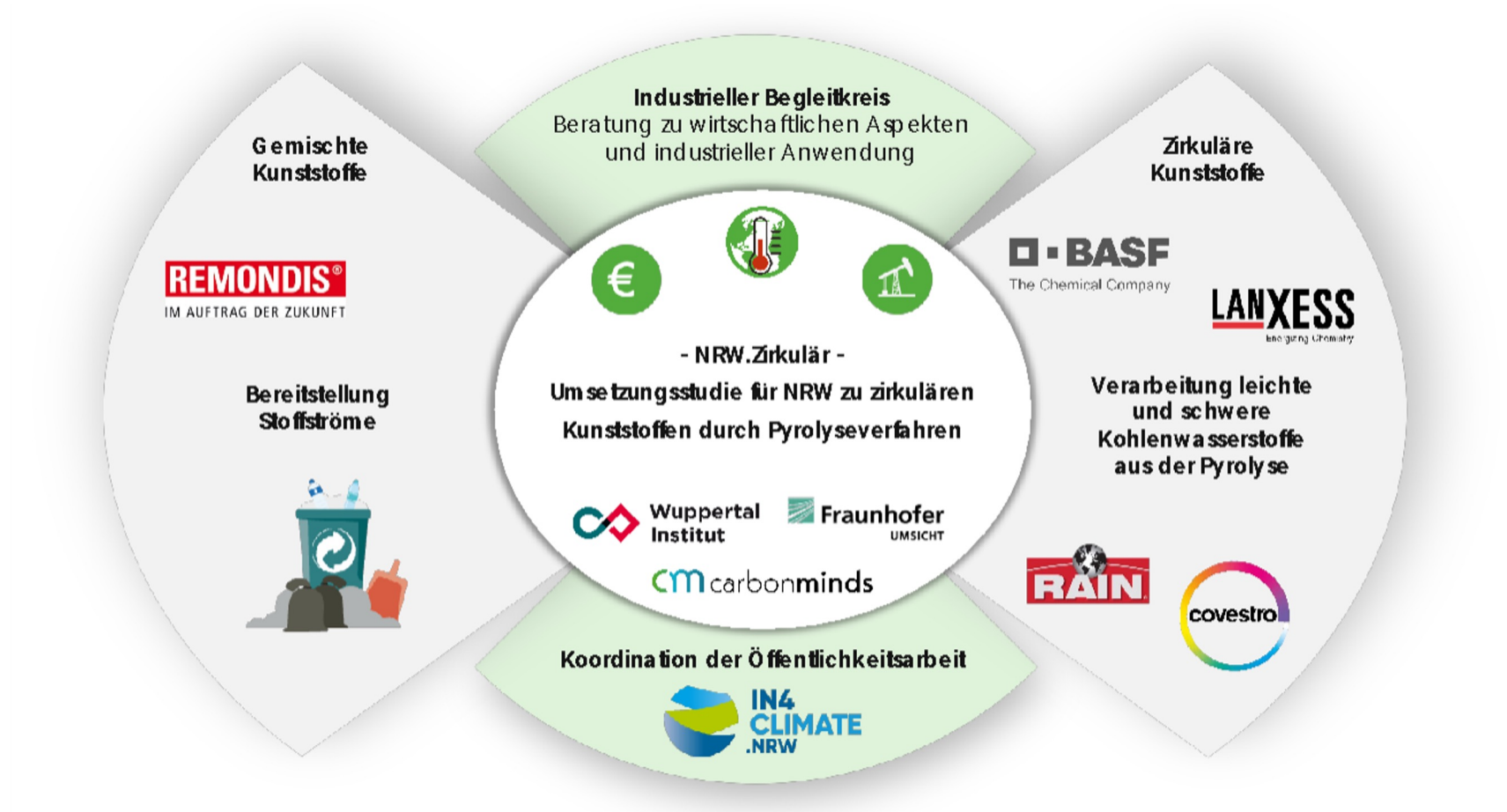
Ministerium für Wirtschaft, Innovation,
Digitalisierung und Energie
des Landes Nordrhein-Westfalen



Bildschirmfoto

Outlook

NRW Zirkulär aims to quantify environmental as well as economic impacts for a concrete pyrolysis process in NRW



Thank you very much
for your attention!



Dr. Henning Wilts
henning.wilts@wupperinst.org
0049 202 2492 290

Esther van den Beuken

Sr Consultant Circular Plastics

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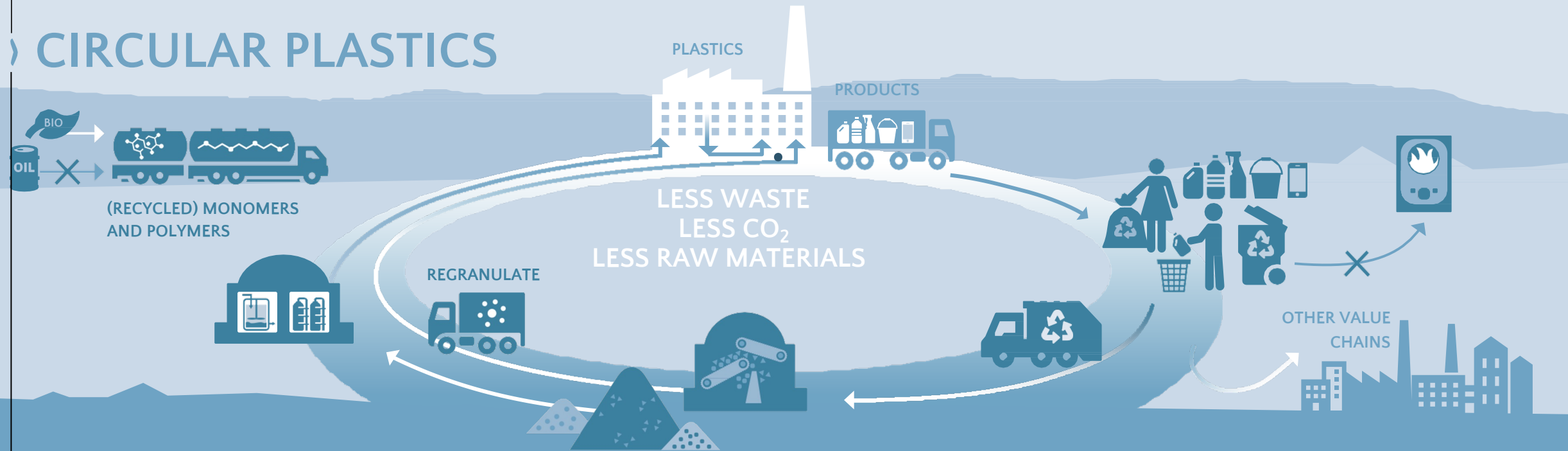
› OPPORTUNITIES FOR CHEMICAL RECYCLING IN THE NETHERLANDS

TNO innovation
for life



DR ESTHER VAN DEN BEUKEN, DR JAN HARM URBANUS, DR PIETER IMHOF

CIRCULAR PLASTICS



1
VALUE CHAIN DESIGN /
FUTURE SCENARIOS
AND LIFE CYCLE
ASSESSMENT



2
DESIGN
FOR
RECYCLING



3
SORTING AND
MECHANICAL
AND PHYSICAL
RECYCLING



4
CHEMICAL
RECYCLING



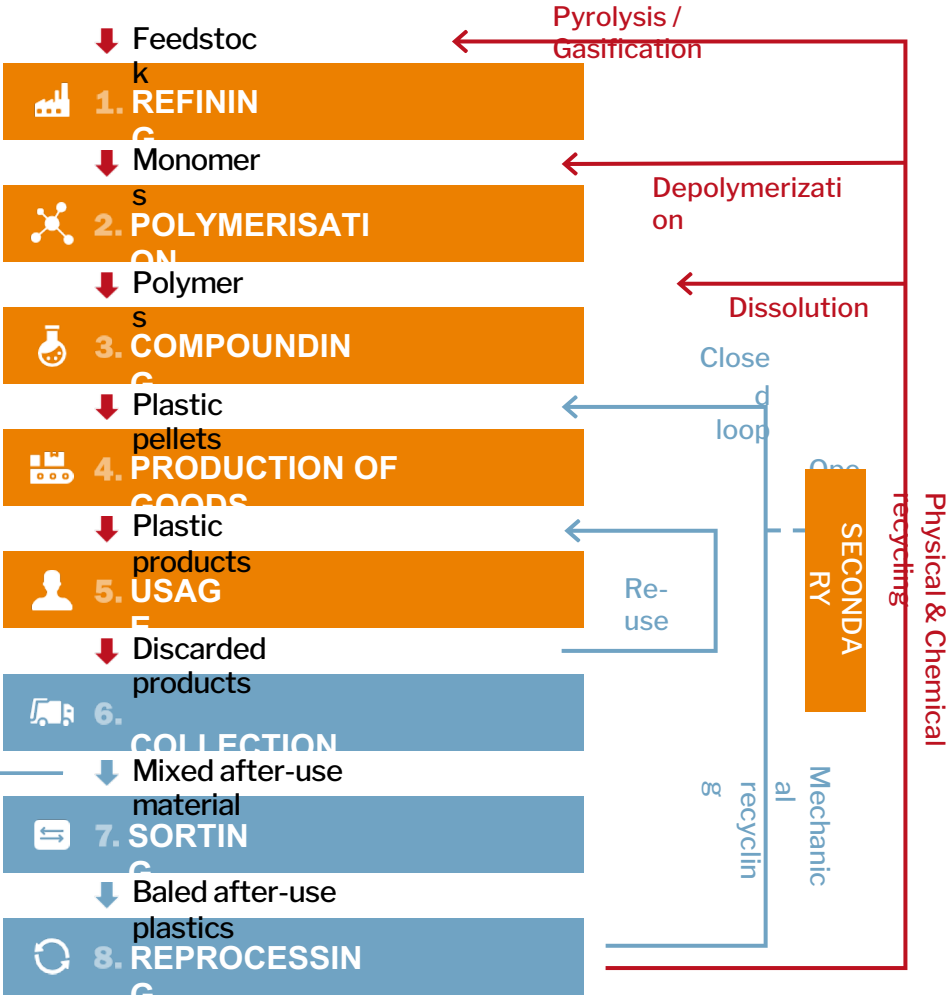
5
THERMO-
CHEMICAL
RECYCLING

CIRCULAR PLASTICS:

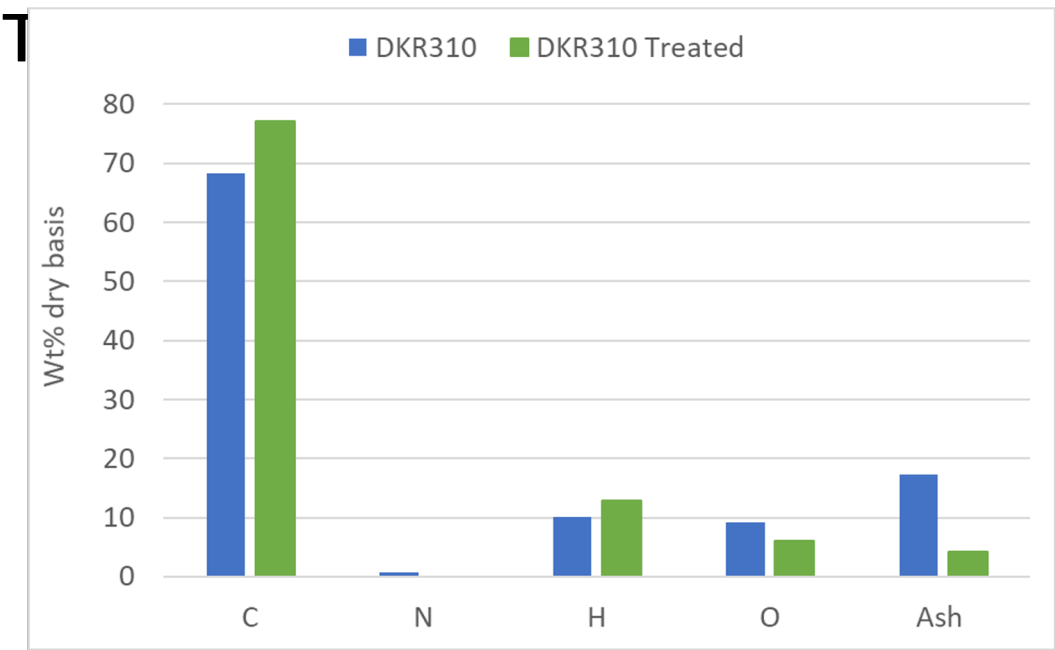
- REFUSE, REDUCE
- DESIGN FOR RECYCLING
 - › Improve lifetime
 - › Improve
 - › sortability
 - › Improve recyclability

MICR BOM PLC

ENERGY RECOVERY

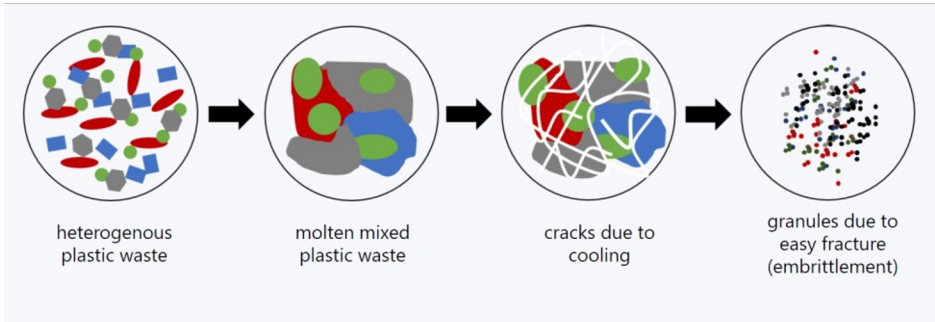


DECONTAMINATION TECHNOLOGY: UPWASH

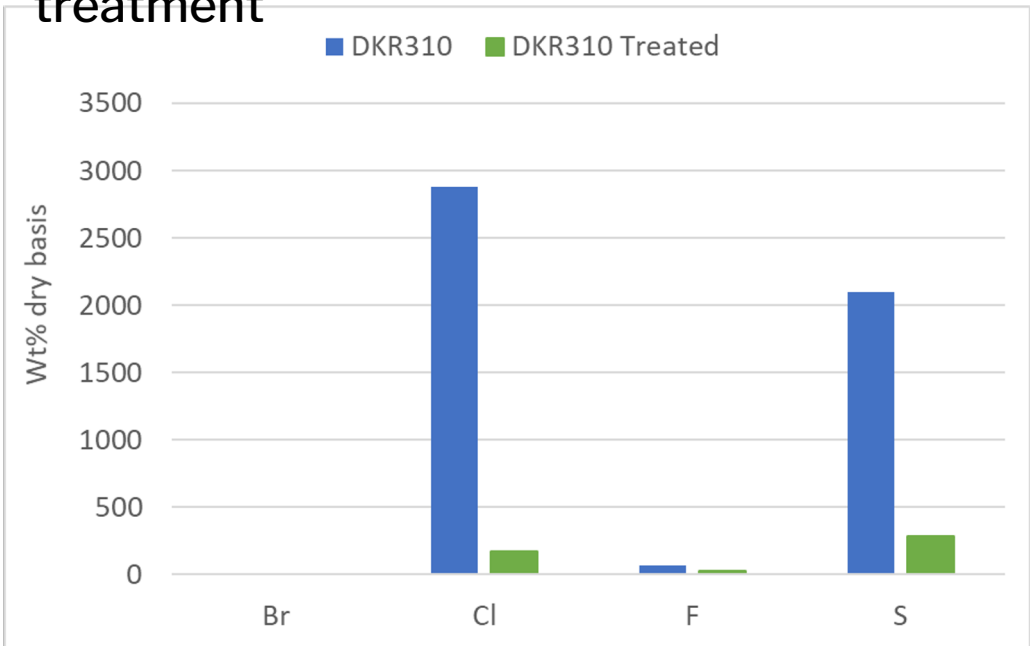


Strong reduction on ash composition upon treatment

Reduction of the organics fraction (O content)



Strong reduction of Cl and S upon treatment



STATE OF ART – SOLVENT-BASED RECYCLING/DISSOLUTION



- › Vinyloop (soft PVC). Solvay pilot plant (2002) in Italy for 10 kt/a closed in 2017



- › PolyStyreneLoop in Terneuzen (NL), 3 kt/a
- › Resolved Technologies (Netherlands): ABS, PVC

- › Polystyvert, Montreal (Canada)



Polystyreneloop demopilot



- › Obbotec (Plant One): planned to recycle a mix of waste plastics into near virgin PE & PP materials
- › CreaSolv pilot (Unilever) in Indonesia, 1 kt/a flexibles plastic to recover PE
- › PureCycle Technologies with P&G to purify PP, (2022) USA
- › APK Newcycling: multilayer packaging to produce LPDE/PA. 20 kt/a pilot plant Germany
- › Sulayr: PE lining from PET packaging, 22 kta. Spain

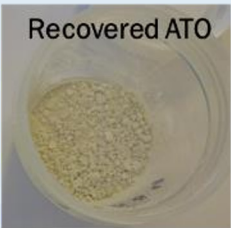
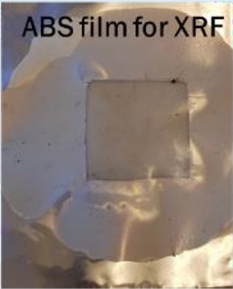
DISSOLUTION AT EXAMPLES

Purification of
polymers Multi-
layered materials



Product: PP
fraction

Recycling of polymer and removal of additives from multi-material
engineering
plastics



HIPS/AB
S

PC

P
C

STATE OF ART: CHEMICAL DEPOLYMERISATION

DEPOLYMERISATION:

Reverse polymerisation of polycondensation polymers with heat and catalysts, purification to recover pure monomers or oligomers in water, alcohol or amine solvents.

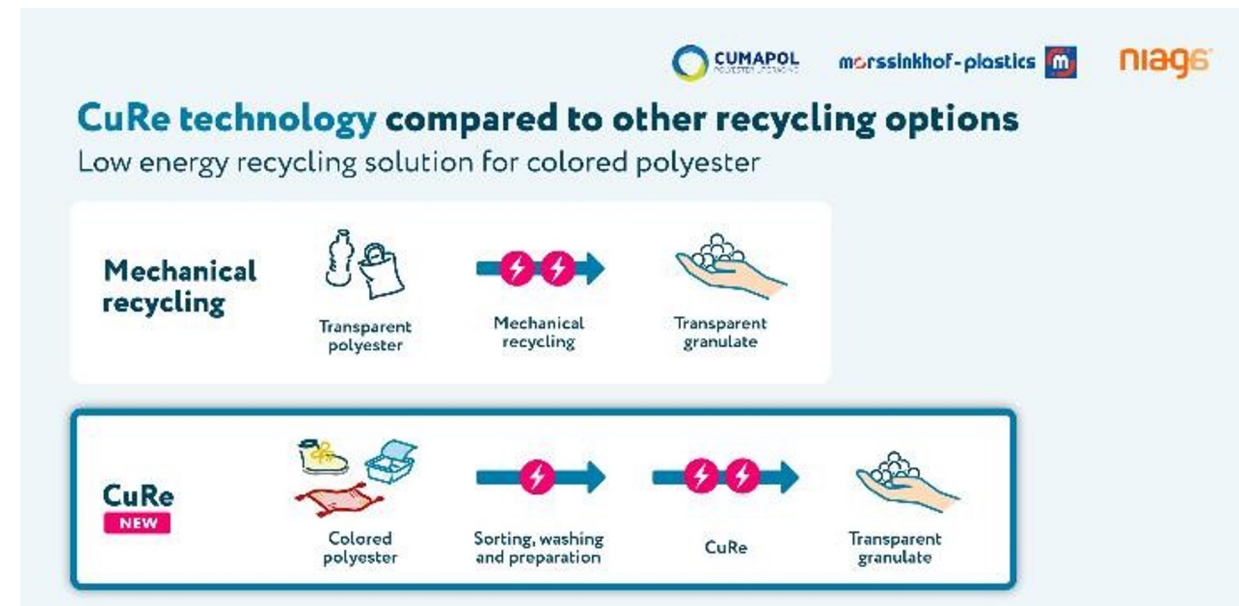
PET, PACKAGING, BOTTLES, TEXTILES

- › CURE (Netherlands), 25 kt/a in Emmen (NL) (to oligomers)
- › IONIQ (Coca Cola), 10 kt/a plant in Geleen (NL) (To monomers) Gr3n, microwave assisted process.
- › Switzerland pilot plant since 2014
- › Carbios (FR), biodegradation of PET
- › Loop industries, L'Oreal, Coca Cola, Danone, Nestlé. 21 kt/a plant with Indorama in 2020
- › Garbo/ChemPET 35 kt/a plant in Cerano (Italy)
- › PerPETual, 2 million plastic bottles

(India) DuPont-Teijin

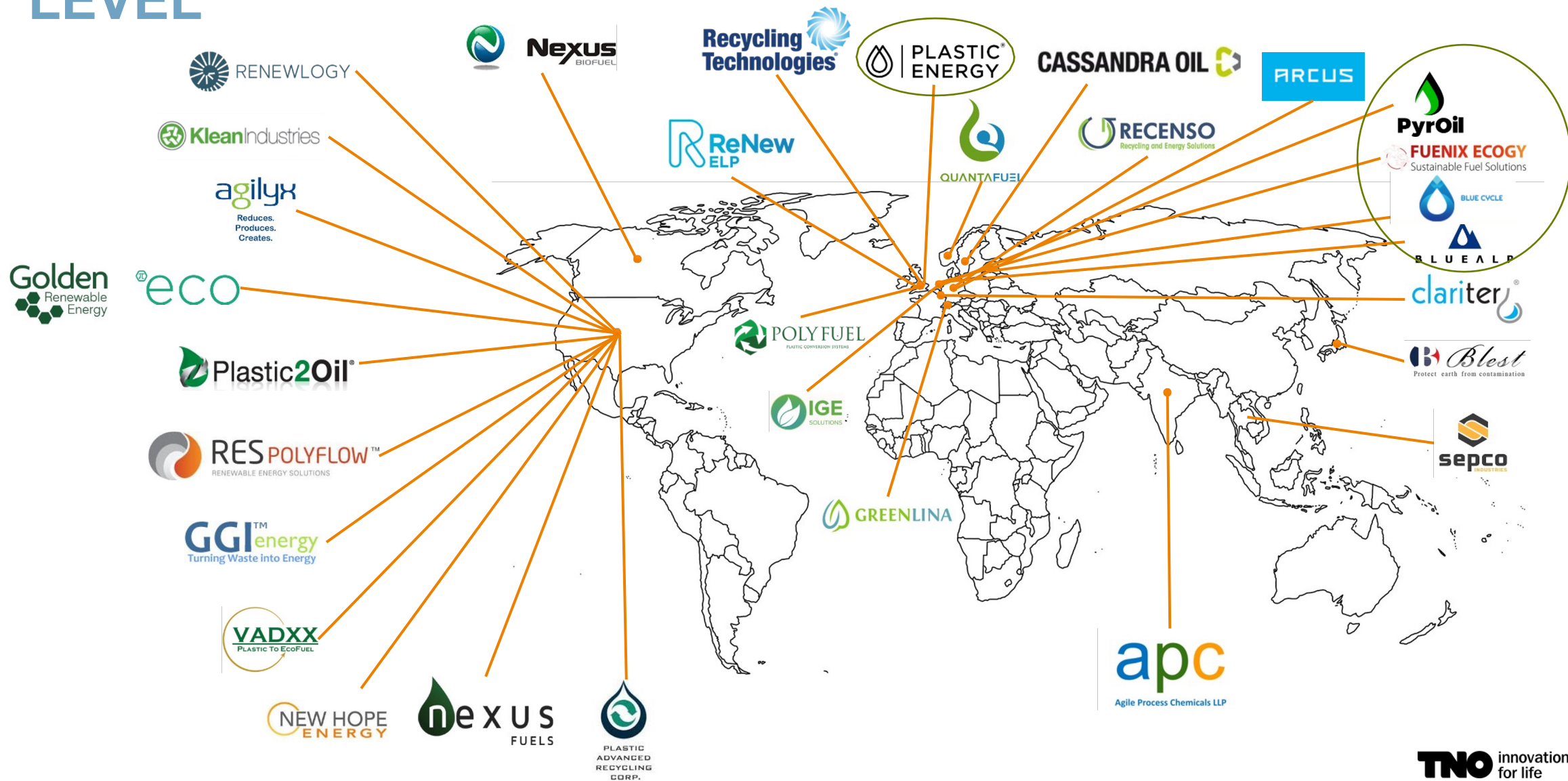
PA, POLYAMIDES, NYLON

- › Aquafil (Italy), used into new nylon yarn (fish nets, carpets)



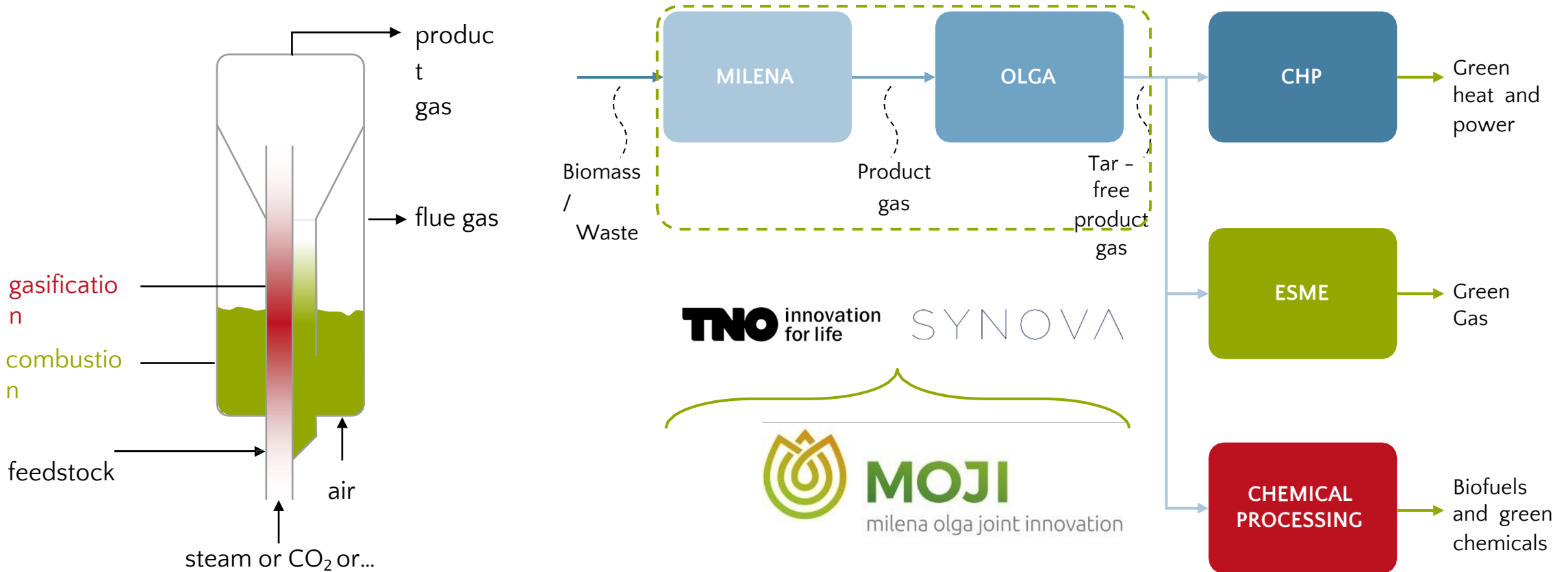
Source: Cumapol website

PYROLYSIS INITIATIVES ON INDUSTRIAL LEVEL



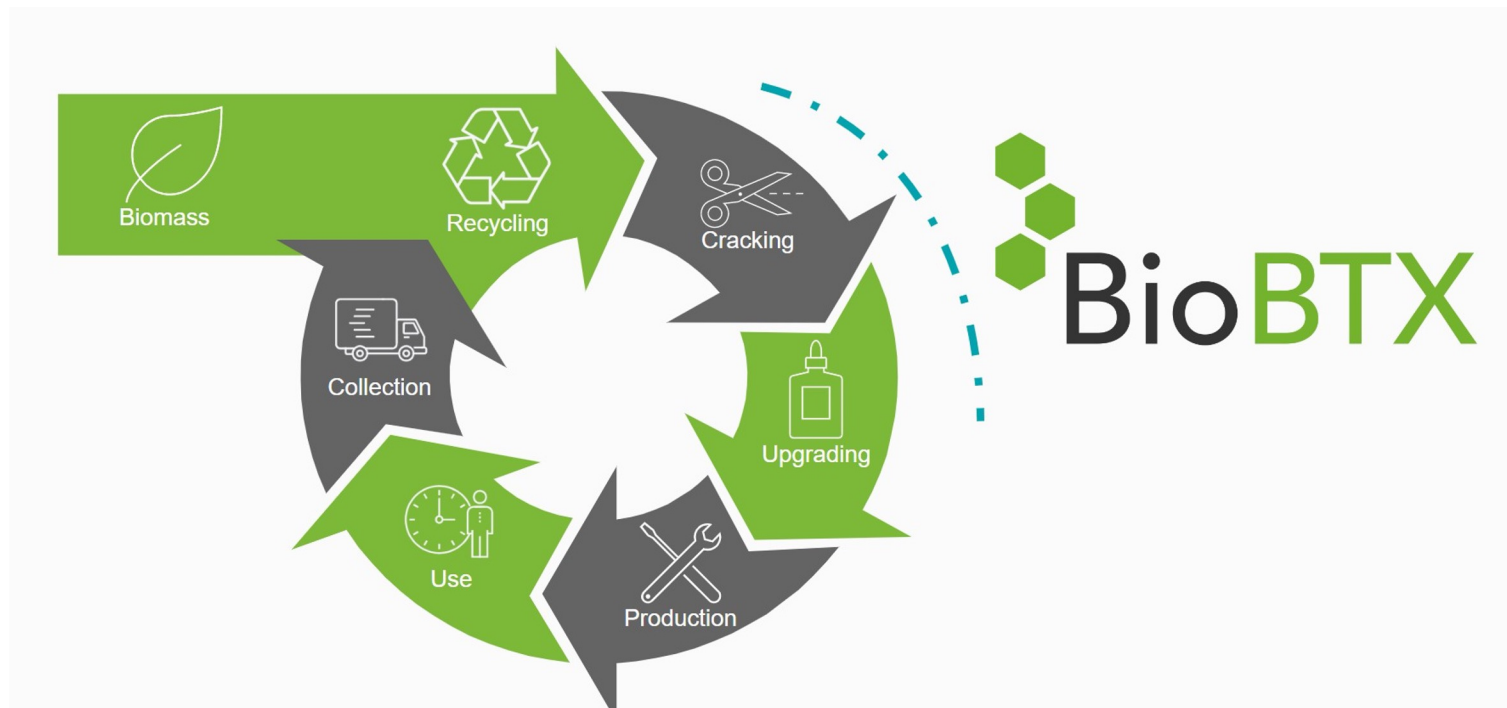
HIGH TEMPERATURE PYROLYSIS

A COMBINATION OF PYROLYSIS AND CRACKING IN 1 OPERATION



HIGH TEMPERATURE PYROLYSIS

A COMBINATION OF PYROLYSIS AND CRACKING IN 1
OPERATION



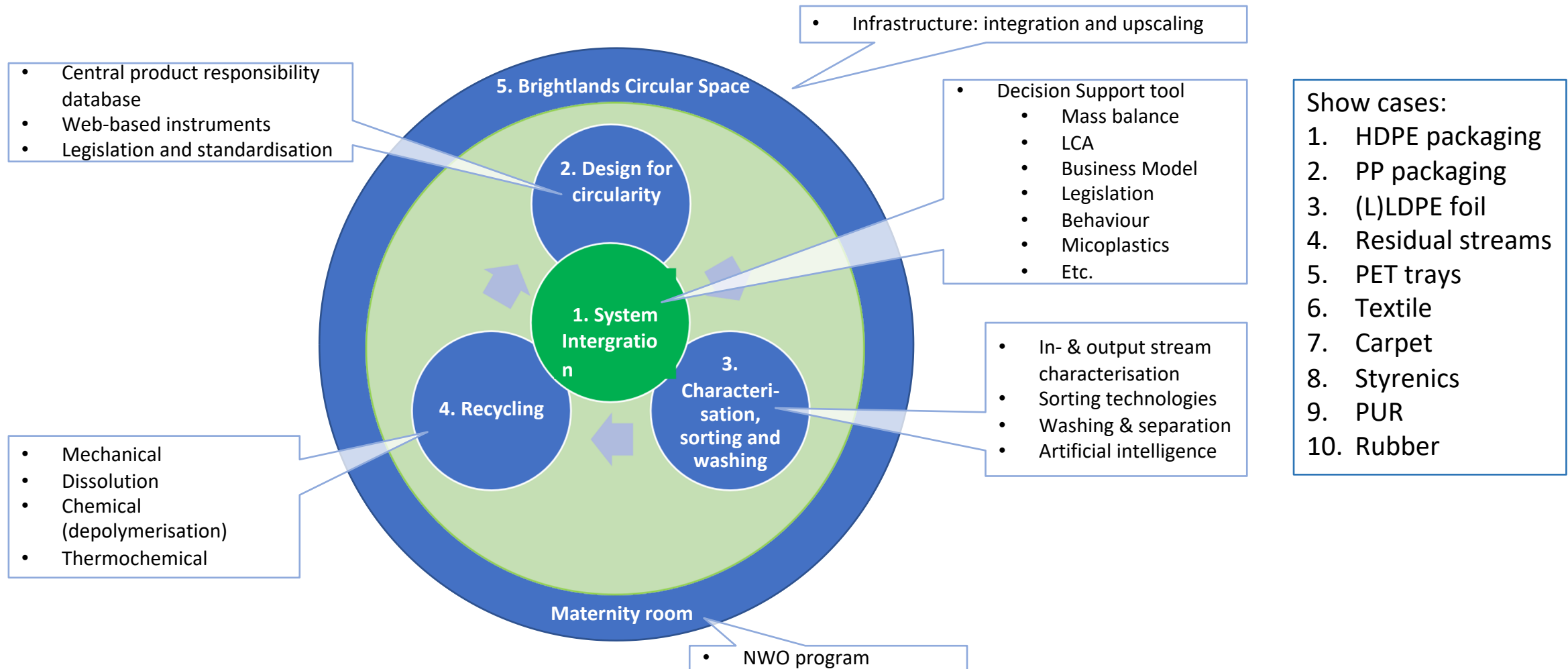
Source: BioBTX
website

Gasification locations in the Netherlands



220 MILLION EURO FOR CIRCULAR PLASTICS IN

Co-funded by industry with more than 50%



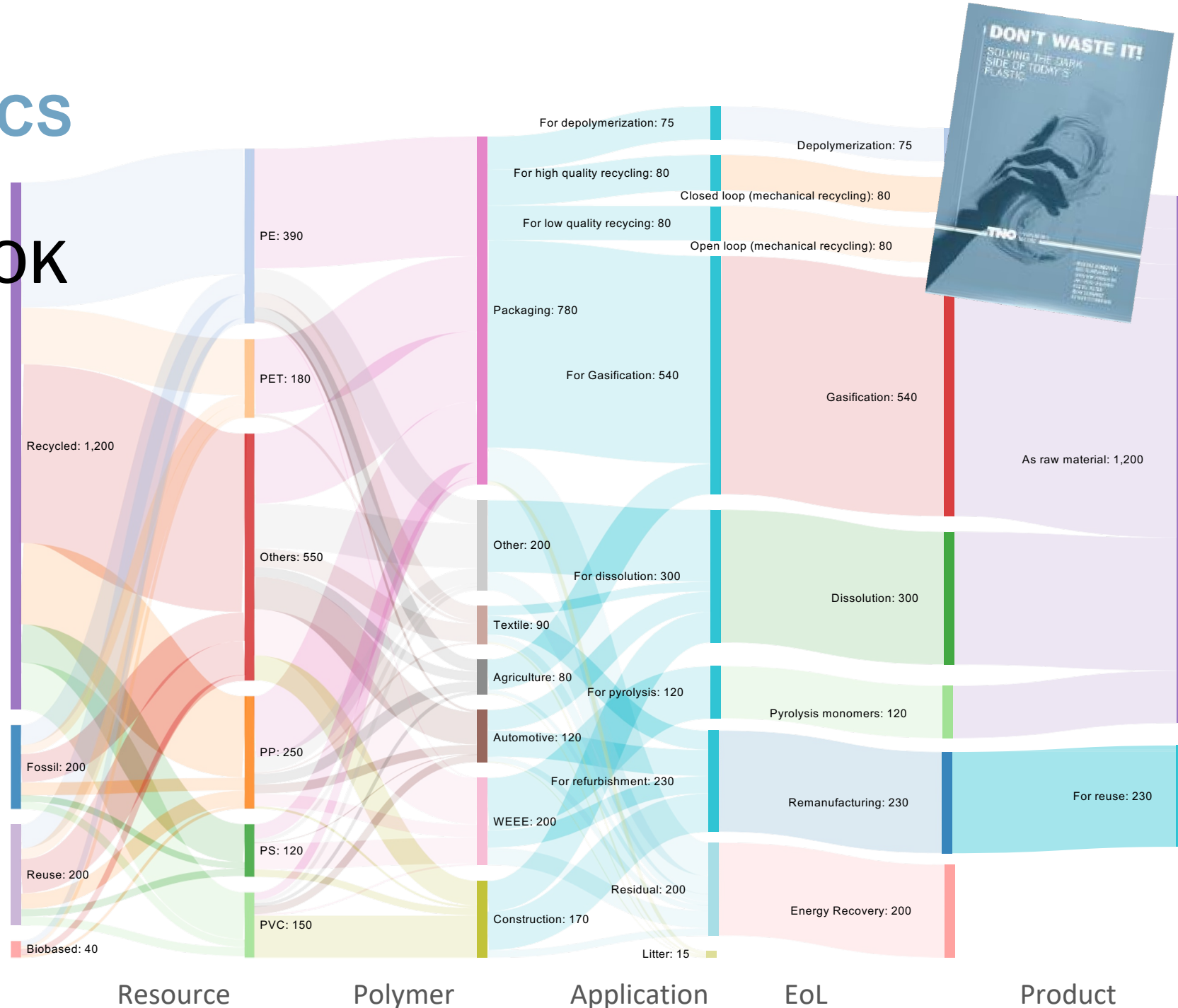
CIRCULAR PLASTICS

2050

HOW MIGHT IT LOOK LIKE?

Recycling routes selected based upon (relative) costs

- Waste flows, polymer composition
- Material and energy prices
- Different types of recycling technology, products, capex, opex
- Efficiency
- CO2 emissions



THANK YOU FOR YOUR
TIME
MORE
INFORMATION



<https://www.tno.nl/plastics>

CONTACT:



esther.vandenbeuken@tno.nl



jan_harm.urbanus@tno.nl



Pieter.imhof@tno.nl

TNO innovation
for life

Workshop 1: Challengers & Businesses Development Chemical Recycling

Moderators



Joop Groen

Circular Biobased Delta



Willem Sederel

Circular Biobased Delta



Iris Rieth

IN4climate.NRW



Saulo Freitas

Prosperkolleg



Challenge #1

Selecting the right chemical recycling feedstock without competing with mechanical recycling, in short, a specs vs feedstock availability.



Arjan Joossen

Business Opportunity Manager
Shell Chemicals Germany





Shell's commitment to chemical recycling

NRW-Dutch cross-border opportunities in
Chemical Recycling

A.J. Joossen
BOM Chemicals Rheinland

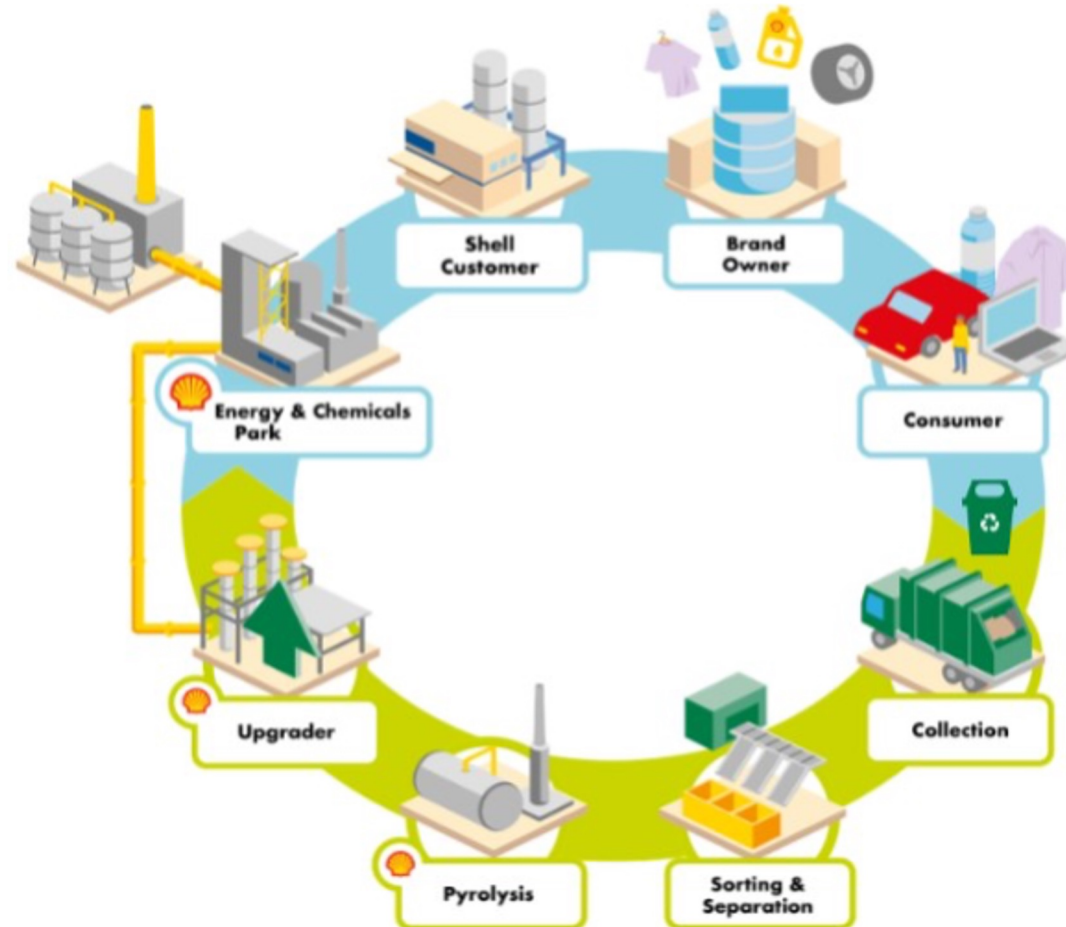


Plastic Circular Economy: 1M Tons of plastic waste recycled by 2025

By 2025, we aim to be using
**ONE MILLION
TONNES**

of plastic waste in our chemicals
plants each year. We are also
a founding member of the
Alliance to End Plastic Waste.

ALLIANCE
TO END
PLASTIC
WASTE



We are working to extend the use of plastics waste as a feedstock in Europe and Asia. Shell's strategic partnership with **BlueAlp Holding BV** will underpin the delivery of pyrolysis oil as feedstock, initially to Shell's Moerdijk and Rhineland crackers from 2023.



Shell Case: Recognising chemical recycling

Chemical recycling essential to increase recycling quota

- Only up to 50% of the (LWP) plastic waste can be recycled mechanically*
- Most of the remainder is incinerated (NL, DE, etc.) or landfilled (other countries)
- It is key the EU recognises chemical recycling as recycling, complementary to mechanical recycling
- Currently there is not driver for waste companies to supply plastic waste to chemical recycling

Challenge: How to enable chemical recycling and increase the recycling rates:

- What are the necessary actions to make the plastic waste feedstocks available for chemical recycling, instead of incineration?
- What legislation is needed or should be amended to enable chemical recycling at large scale?
- How do we drive a more positive public opinion of chemical recycling?


*Source: McKinsey plastic waste stream model



Challenge #2

INOVYN develops advanced recycling for raw materials containing 1 to 100% PVC waste.

Focus on obtaining the feedstocks, the transfer of the 3 advanced recycling technologies and the quality of the product flows.

Decorative curved lines in the bottom right corner, consisting of three overlapping arcs in light blue, light grey, and light orange.

Eric Romers

PVC Recycling R&D Manager

INOVYN



INOVYN's Circle Project Advanced Recycling of PVC

NRW-Dutch cross-border opportunities in Chemical Recycling
15th of September
Bottrop, Germany

Circle Project on advanced recycling of PVC

Inovyn's ambitions in Low Carbon Solutions

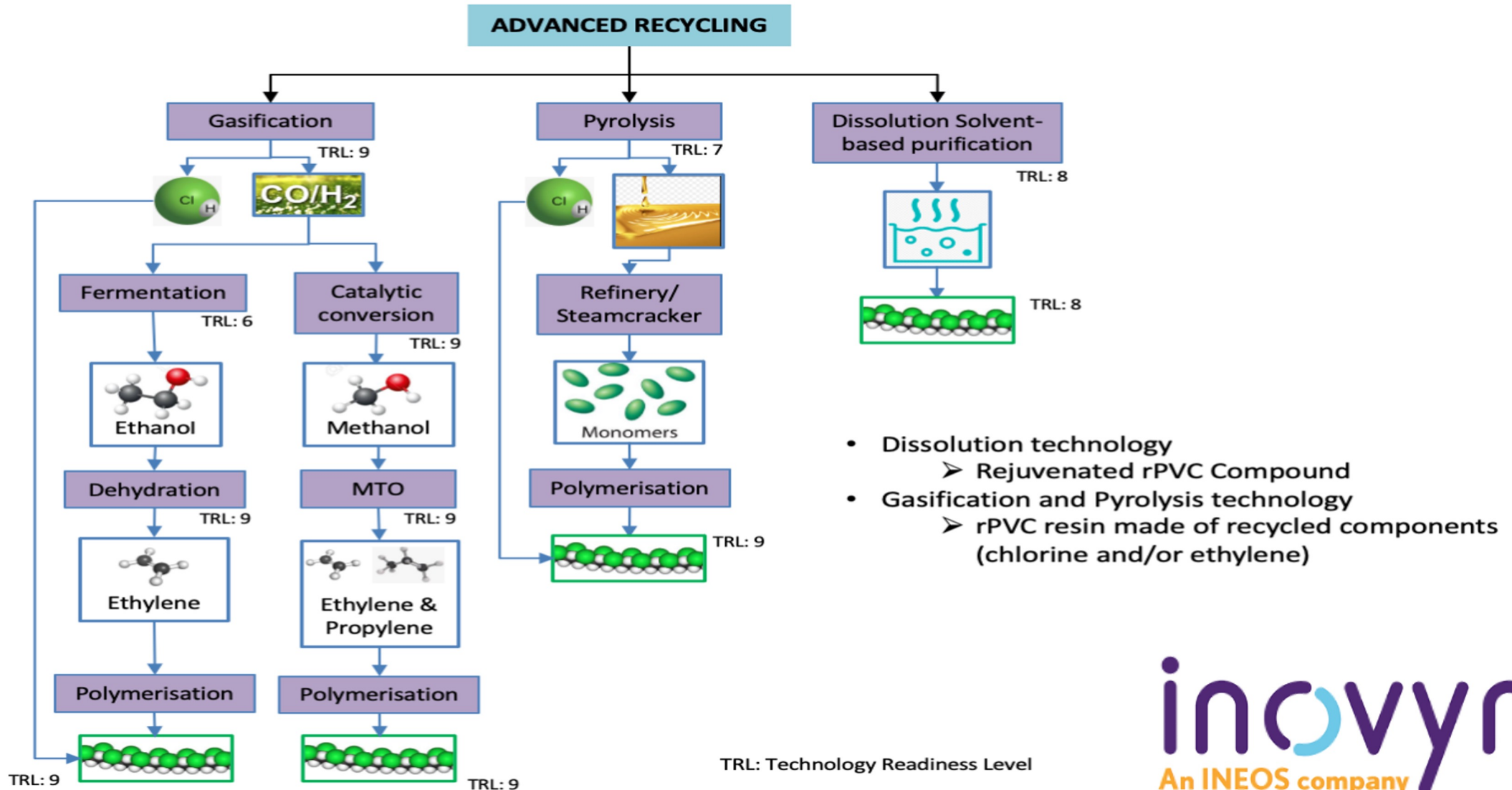
- Extend our knowledge of waste streams to identify and secure PVC waste feedstocks
- Further development of Inovyn's Vinyloop technology (Dissolution)
- Develop PVC gasification and pyrolysis technology to recover HCl and hydrocarbons
- Develop LCA and in particular the assessment of the carbon footprint of each technological solution

PVC Advanced Recycling Development Process steps

Technology

Product

Recycled polymer



Challenge #3

- 1. Missing data for pyrolysis of plastic waste*
- 2. Input specs as a limitation for business model*
- 3. German regulation as a hurdle*



Arne Köhne

Project Management, Remondis



Business Cases and Challenges



Do you identify yourself with the presented challenges?

Do you have further challenges regarding business cases in chemical recycling? (please describe)

Did you already tackle these challenges? How did you solve them?

Do you have ideas, how the challenges could be solved? (please describe)

Reinhold Rünker

Permanent Deputy

Department Economic Policy

-- moderator workshop 2 --

Ministry of Economic Affairs,
Industry, Climate Action and Energy
of the State of North Rhine-Westphalia



Michael Oberdörfer

Department Circular Economy

**Ministry for Environment,
Nature Conservation and Transport
of the Land North Rhine-Westphalia**





Regulatory framework of chemical recycling

NRW-Dutch cross-border opportunities in Chemical Recycling
15.09.2022 – Bottrop

Dr. Michael Oberdörfer, MUNV NRW



Main topics

- Recycling
- The German material recovery target
- Waste hierarchy
- End-of-waste status
- Ecodesign



Recycling

- Waste framework directive Art. 3 Nr. 17:
‘recycling’ means any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes. It includes the reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations;
- Chemical recycling is recycling
- Production of fuels: no recycling



The German material recovery target

- German packaging-waste act Art. 16 par. 2 (Recovery targets):
 - > 90 % recovery for plastic packaging
 - of which > 70 % material recovery (i.e.: 63 %)
 - “Material recovery” = “Mechanical recycling”
- Chemical recycling is not material recovery
- < 37 % of plastic packaging waste available for chemical recycling in Germany



Waste hierarchy

- Waste framework directive Art. 4 par. 2:
The waste hierarchy is not rigid!
Member States shall take measures to encourage the options that deliver the best overall environmental outcome. This may require specific waste streams departing from the hierarchy where this is justified by life-cycle thinking...
- Chemical recycling can substitute waste incineration when there is a proof of the ecological advantage



End-of-waste status (1)

Waste framework directive Art. 6 par. 1:

- a) the substance or object is to be used for specific purposes;
- b) a market or demand exists for such a substance or object;
- c) the substance or object fulfils the technical requirements for the specific purposes and meets the existing legislation and standards applicable to products; and
- d) the use of the substance or object will not lead to overall adverse environmental or human health impacts.



End-of-waste status (2)

Example:

pyrolysis oil substitutes naphta as input into steam cracker

- Hazardous properties are not decisive
- Similar composition of pyrolysis oil / naphta?
- Limit values for e.g. Chlorine, Dioxines?
(Quality assessment of input to pyrolysis plant!)
- Impact to output of steam cracker?
- REACH registration!



Ecodesign

- Both the Packaging and packaging waste directive (Annex II Essential requirements) and the German packaging waste act (§ 21 Ecological design of participation fees) foresee ecological requirements regarding a better recycling of packaging waste.
 - Producers already design packaging that fits best to the present recycling infrastructure.
 - My personal opinion:
The future of chemical recycling is mainly waste from long living, complex devices and possibly food packaging waste.



Thank you for your attention!



Contact:
michael.oberdoerfer@munv.nrw.de

Arnoud Passenier

Strategic International Advisor, NL Ministry
of Infrastructure and Water Management



Ministerie van Infrastructuur
en Waterstaat





Ministerie van Infrastructuur en Milieu



**NRW-Dutch Cross-
border opportunities in
Chemical Recycling**

Dutch perspective on Chemical Recycling of Plastics

Arnoud Passenier
Strategic advisor Circular
Economy

September 15th, 2022



Limits to mechanical recycling of plastics

- Degradation of mechanical properties/quality every cycle
- Separation of mixed and contaminated plastics economically -and sometimes technically- not feasible
- No food contact materials, except PET
- Additives recycled as well (also substances of concern), risk of accumulation





Opportunities with chemical recycling

- Output (polymers or building blocks) has virgin quality
 - Food contact packaging materials could be made from plastics waste
 - Hazardous substances can be phased out sooner
 - Contaminated and mixed plastics easier to recycle
- ❓ *Output chemical recycling to fuels = not recycling*





NL policy on chemical recycling

- Recycling \neq at the expense of 'higher' R- strategies (reduce & reuse)
- Ambitious recycling targets for 2030 can't be reached without CR
- Legal acknowledgement CR in National Waste Management Plan (LAP3)
- Hierarchy of technologies /sustainability:
 1. Mechanical Recycling
 2. Solvolysis/Depolymerisation
 3. Pyrolysis/Gasification
 4. Incineration
- Value chain collaboration (Plastics Pact)
- Subsidies/fiscal support CR (e.g. Circular Plastics NL programme €220 mln)
- Promotion recycled content in ESPR / PPWD
- Calculation rules input-output (mass-balance)
- Smooth cross-border transport (End-of-Waste)



DEMAND



WEDD
ARYAN



Scenarios for the longer term

1. Close collaboration between chemical and waste sector to align waste treatment processes (e.g. joint ventures)
1. Regulations to enforce the most sustainable plastic waste treatment?
3. Further innovation of sorting- and CR-technologies (prevent lock-in)



Ron Brinitzer

Managing Director, Kunststoffland NRW

--moderator industry pitch NRW --





Christian Haupts
Recenso / CARBOLIQ



Patrick Glöckner
Evonik Industries AG



Christian Haessler
Covestro Germany AG



Artur Völk
LANXESS Performance
Materials



Markus Helftewes
Duales System Deutschland

CARBOLIQ direct oiling technology

- a key to Circular Economy

Christian Haupts, Carboliq GmbH
Bottrop, 15.09.2022

The Carboliq logo is displayed diagonally within a white rectangular frame. The word 'carbol' is in a dark grey sans-serif font, while 'liq' is in a bold, orange-to-yellow gradient sans-serif font. A thick orange diagonal bar runs across the bottom right of the slide, partially obscuring the logo's frame. The background of the slide is a dark, industrial scene with yellow safety railings and complex machinery.

carbolliq

The Remscheid Engineering Team is committed to make circular technologies become real

over the last 18 years we have moved from mechanical to chemical recycling;

today we operate the only industrial size thermo-chemical conversion plant in

we turn
waste plastic
into oil



carboliq

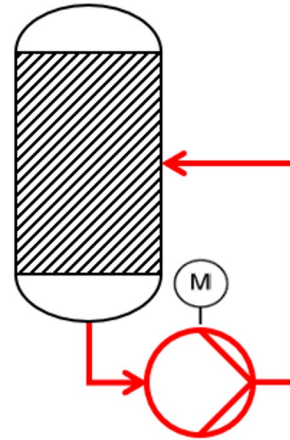
our one-stage conversion process is efficient and high on yield; the product replaces fossil oil in existing chemical processes

1.000 kg Mixed Plastic Waste (MPW)



Energy: 35 MJ/t MPW

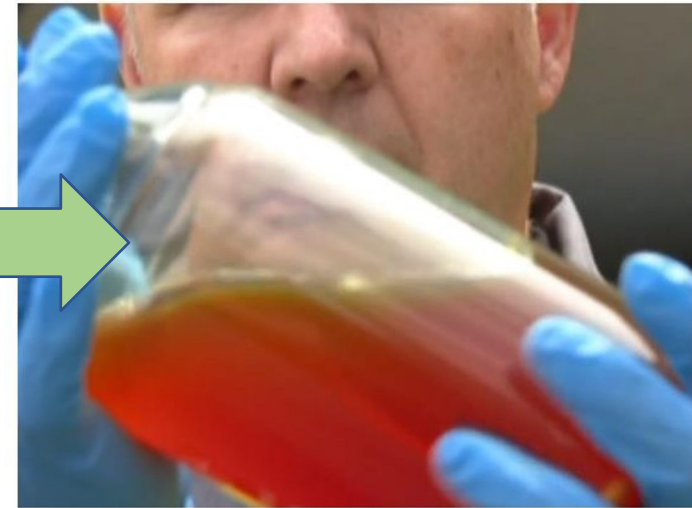
Conversion Rate (mass) =
75% $750/1.000$



Energy Consumption:
< 5 MJ/t MPW
(electrical energy only)

Energy Recovery Rate =
94% $(44 \cdot 75\%) / 35$

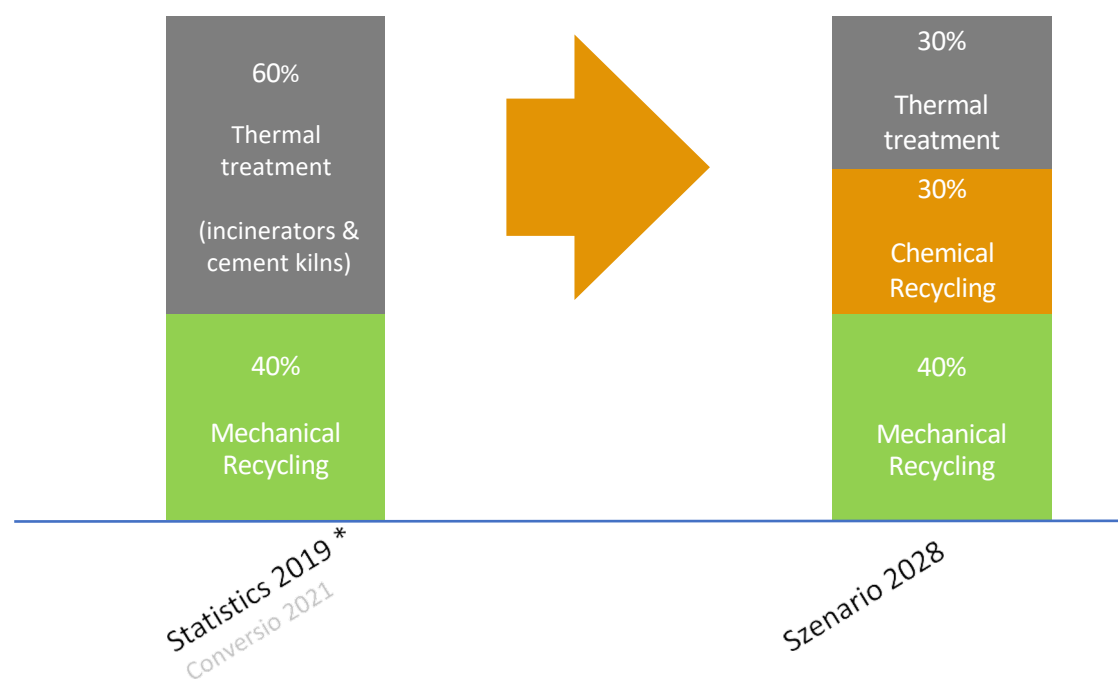
> 750 kg Circular Liquid Resource (CLR)



Energy: 44 MJ/t CLR

Process Efficiency Rate =
80% $(44 \cdot 75\% - 5) / 35$

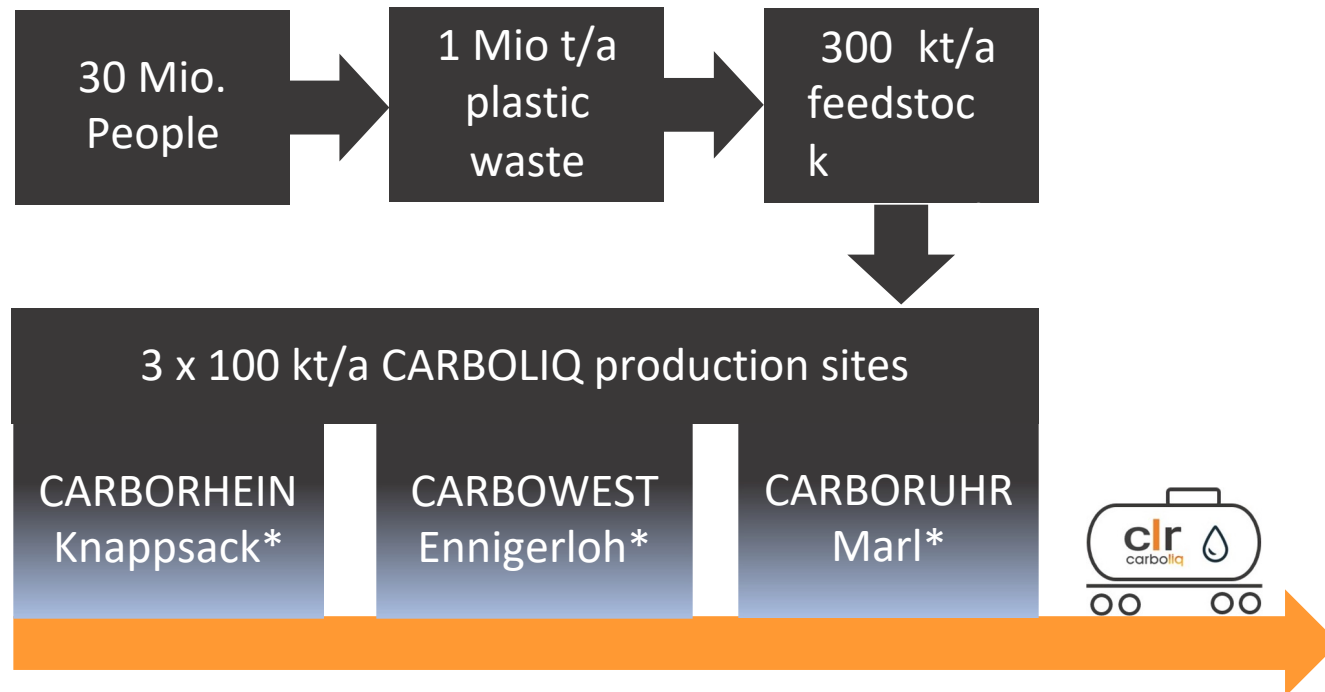
application of carboliqology is suitable for at least 30% of German plastic waste (6,3 Mio. t/a) that currently is burned



CO₂-emissions from thermal treatment will decrease by more than 4 Mio. t/a

the rate of plastic recycling will double !

let's make NRW the leader in circular plastics



- existing
 - R Remscheid – legal seat / headquarters
 - E Ennigerloh – pilot plant / test center
 - B Bochum – Ruhr University / research center
- industrial plant
 - C Chemieparks
 - K Zur Nachnutzung anstehende Kraftwerke

* sites not yet decided on yet; dependent on funding and feedstock arrangement

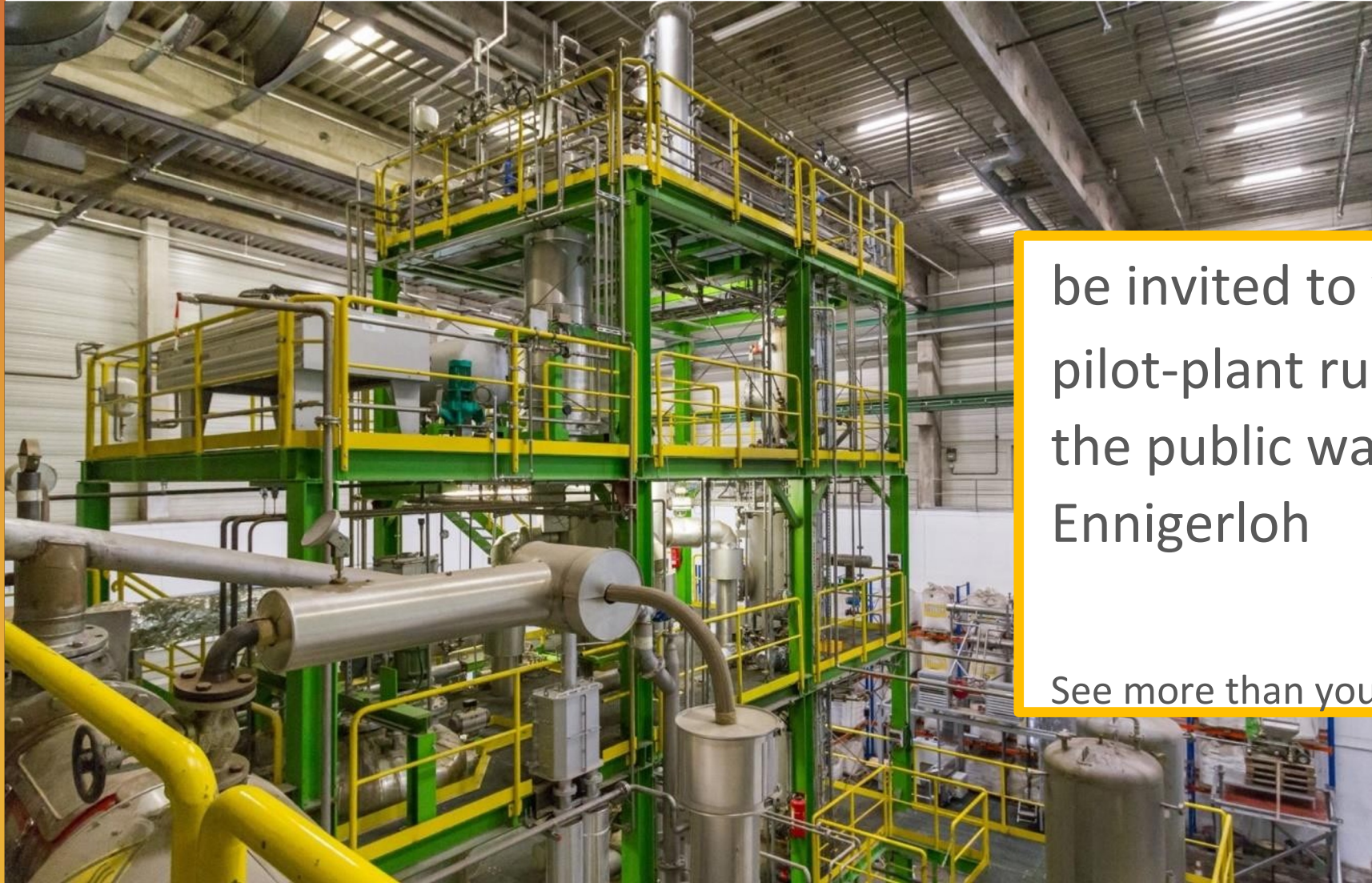
carboliq

*for to build industrial size
plants,*

carboliq *is looking for:*

sites	>10.000m ² ; suitable for waste handling and 24/7 operations; shut down power-plants or coal-pits preferred
feedstock	> 6.000 t/a of mixed plastic waste or RDF; contract for 5+ years
funds	> 10 Mio.€; ESG-funding; investment fully compliant with EU-taxonomy)
experience	from best agers that know how
hunger	from Youngsters that that know why

Thank You for Your attention



be invited to visit our
pilot-plant running 24/7 at
the public waste center in
Ennigerloh



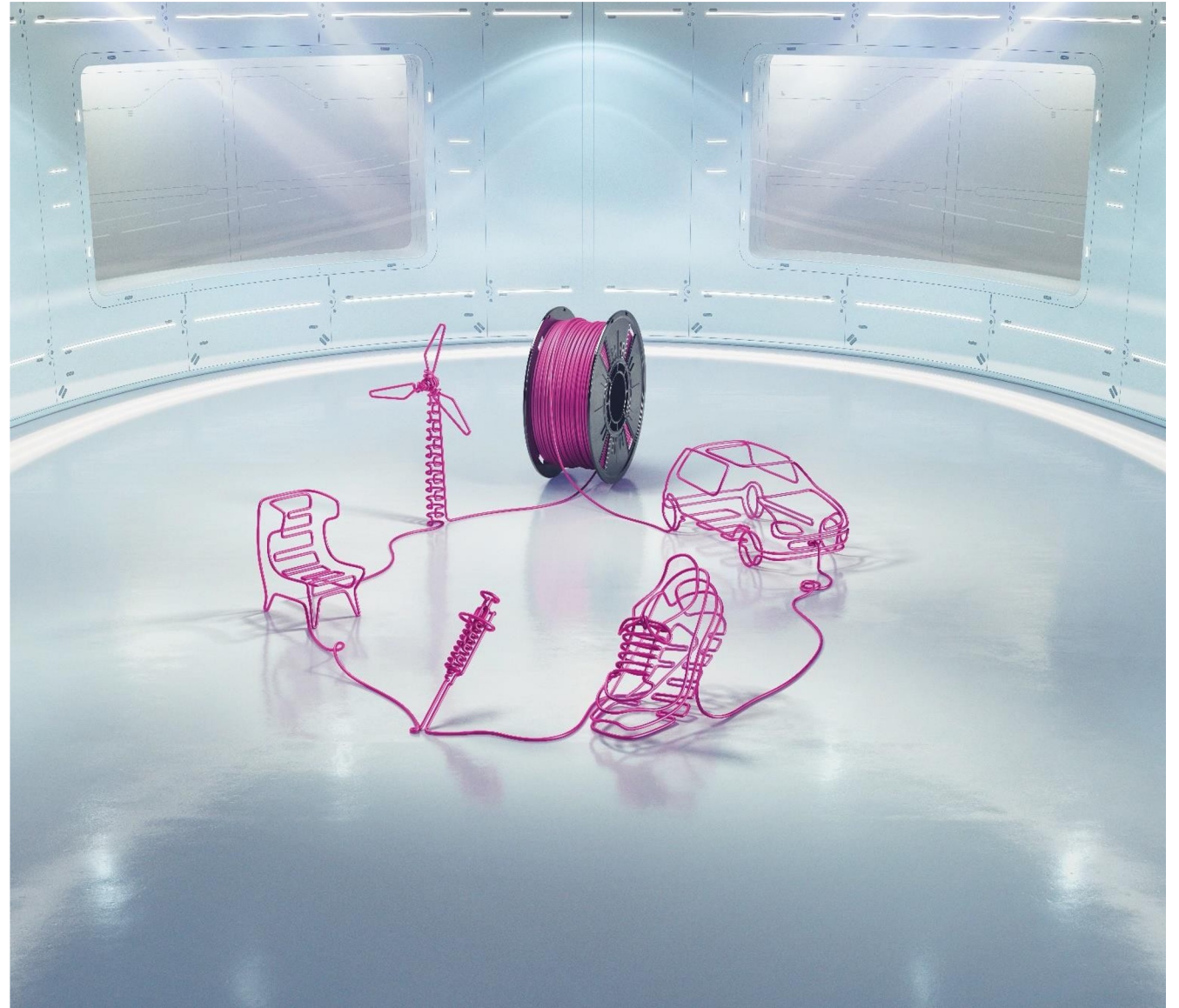
See more than you expect!

carboliq

SPECIALTIES TO ENABLE SUSTAINABLE PLASTIC APPLICATIONS

Patrick Gloeckner
Evonik Operations GmbH

NRW-Dutch Cross Border
Opportunities 2022, September 15th



Every circle needs a center: Evonik Circular Plastics Solutions

Enabling the transition
from linear to circular
plastic value chains
at competitive costs
and quality



**The Global
Circular
Plastics
Program**



**Innovation
Power**



**Cross-
industry
cooperation**



**Chemical
Recycling**



**Mechanical
Recycling**

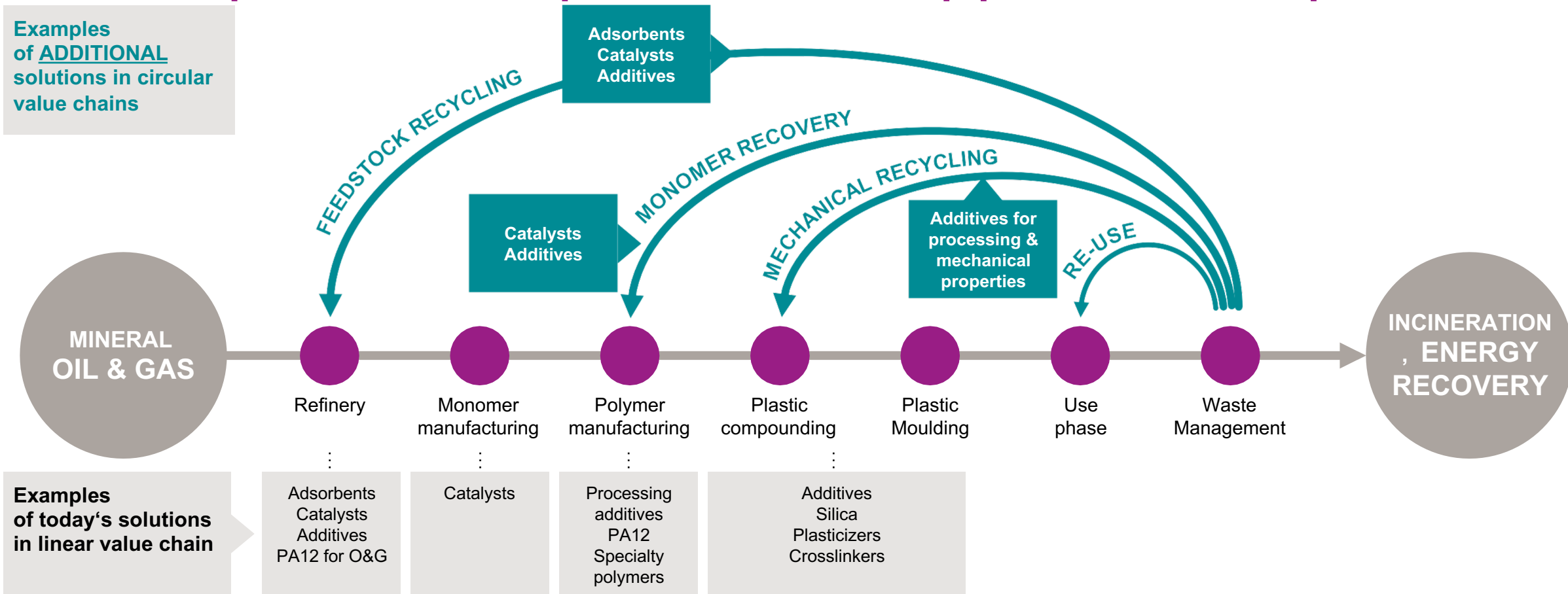


**Sustainable
Raw Material**



Evonik provides solutions along the entire Circular Plastics Value Chain.

With our Specialties we help our clients to keep plastic in the loop.





EVONIK

Leading Beyond Chemistry



We Will Be Fully Circular

Sustainability @ Covestro Covestro 2022

covestro.com



Forward-looking statements

This presentation may contain forward-looking statements based on current assumptions and forecasts made by Covestro AG.

Various known and unknown risks, uncertainties and other factors could lead to material differences between the actual future results, financial situation, development or performance of the company and the estimates given here. These factors include those discussed in Covestro's public reports which are available on the Covestro website at www.covestro.com.

Covestro assumes no liability whatsoever to update these forward-looking statements or to conform them to future events or developments.

Inventor and leader in high-tech material solutions

Covestro at a glance

WHAT WE DO

Covestro is among the world's largest polymer companies. Business activities are focused on the manufacture of high-tech polymer materials and the development of innovative solutions for products used in many areas of daily life.

The main segments served are the automotive, construction, wood processing and furniture, and electrical and electronics industries. Other sectors include sports and leisure, cosmetics and health.

Together with our partners and customers, we are taking big steps to tackle a fundamental challenge: Shifting towards a Circular Economy.

To achieve this bold goal, we are innovating efficient ways to close energy and material cycles. We are pushing boundaries in polymers.

WHAT WE STRIVE FOR

Purpose



To make the world a
will be brighter place

Vision



We

fully circular

Value



Curious,
courageous,
colorful

Goals



Financial 2022 and
non-financial 2025
goals

€15.9bn

Sales 2021

17,900

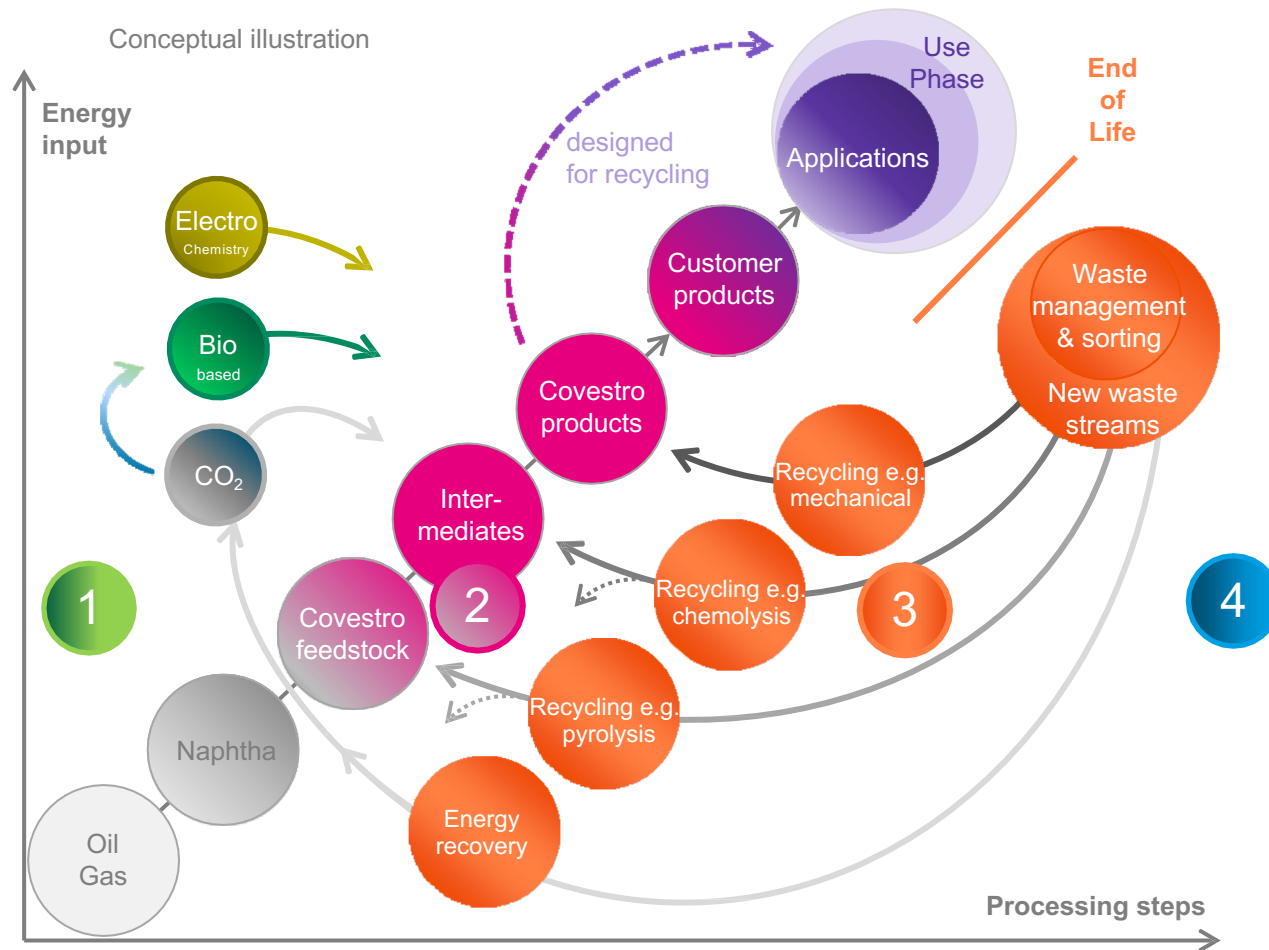
Employees (in FTE) 2021

#1

Global producer of PU
and its derivatives as
well as PC^(a)

Closing material and carbon loops

Circular and climate neutral economy



COVESTRO APPROACH TO CIRCULARITY

- 1 Renewable energy
- 2 Alternative raw materials
- 3 Innovative recycling for end-of-life solutions
- 4 Cross-industry collaborations



JOIN US

IN SHAPING

THE CIRCULAR ECONOMY!

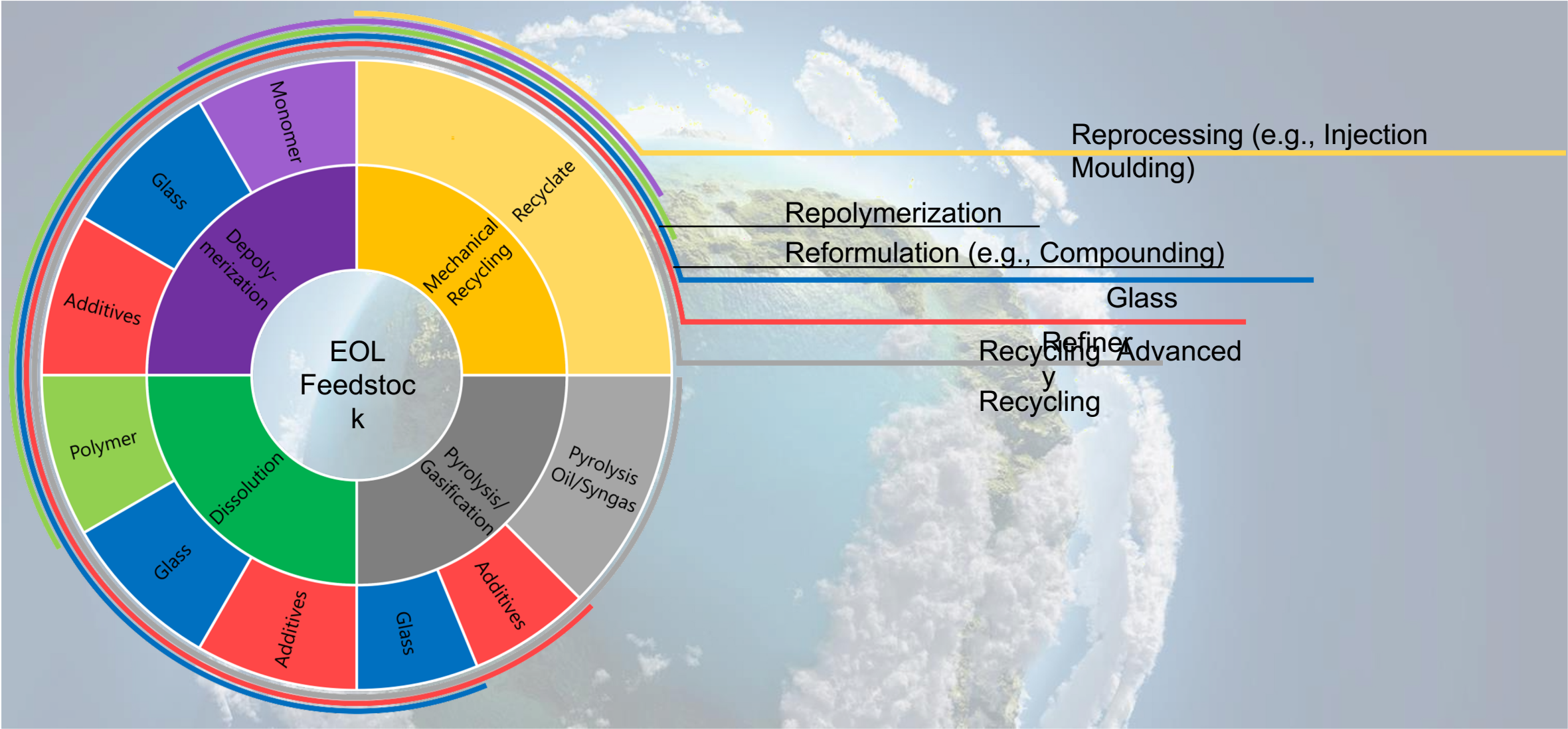
Chemical Recycling

NRW-Dutch Cross-border Opportunities & Matchmaking

LANXESS Performance Materials
GmbH Sustainability and Product
Management

August 2022

Chemical Recycling – Emerging Opportunities



Building up circular networks for chemical recycling

Recycling Process	Output	Applicable at	Related LANXESS Operations
Mechanical Recycling	Recyclate	Unfilled PA6, PA6.6, PC, ASA, PET, PBT	Compounding Network
Dissolution	Polymer	PA6, PA6.6, PC, ASA, PET, PBT	E-Glass
Depolymerization	Monomer	Caprolactam, BDO, PTA	
Pyrolysis/Gasification	Pyrolysis Oil, Syngas		PBT & PA6 Polymerization
			Glass Fiber Site





Dr.-Ing. Markus Helftewes

Since 2016 Managing Director of Duales System Deutschland GmbH and of the recycling plants (Systec Plastics Eisfeld and Hörstel GmbH)

2013 – 2016

Head of Business Development and Sustainability at DSD - Duales System Holding GmbH & Co. KG, Cologne

2009 – 2013

Team Leader in Central Technical Division at Veolia Umweltservice, Hamburg

2006 – 2009

Project Engineer at Sulo Umweltservice, Herford

Dr.-Ing., University of Rostock, Environmental and agricultural sciences

Dipl.-Ing. (FH), University of Applied Sciences of Münster, Civil engineering, water and waste management

- › **Wissenschaftspreis 2012**, Deutsche Gesellschaft für Abfallwirtschaft (DGAW)
- › **GES-Fellow 2010**, Institut für Weltwirtschaft Kiel (IfW)
- › **Förderpreis 2006**, Verein Deutscher Ingenieure (VDI)

Circular Resources and Der Grüne Punkt

A holistic solution for plastics recycling



Circular Resources Sàrl acquired Green Dot on August 11th, 2022 to create the first integrated solution of mechanical and chemical recycling on an industrial scale for plastic packaging.

Circular Resources



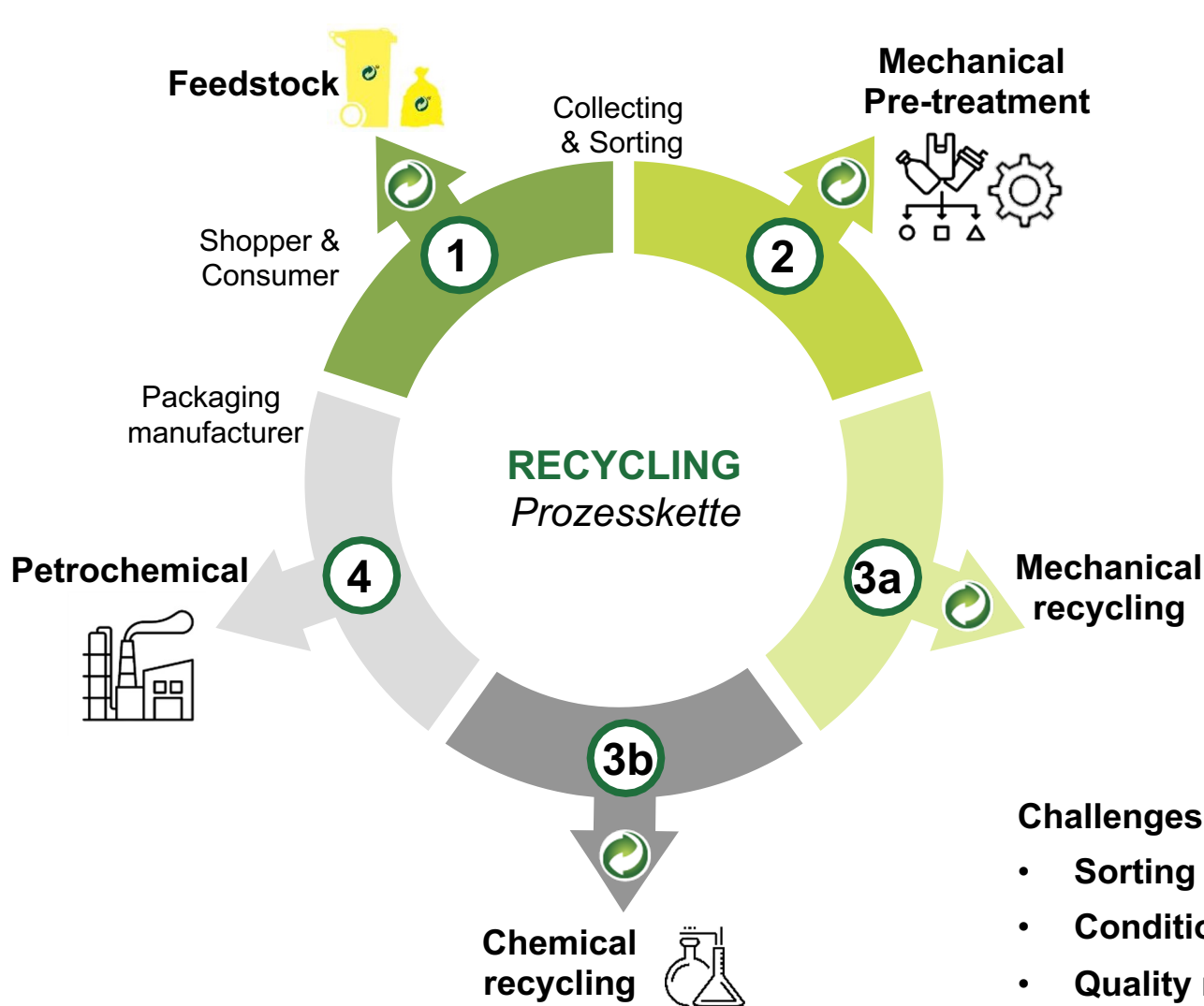
- Target group: globally recognized companies with a **growing need for recycled plastics** and a commitment to solving the plastic waste crisis
- Offer: **Recyclate solutions from a single source**

Der Grüne Punkt – Competence in packaging licensing and mechanical recycling



- Dual System in Germany (since 1991)
- One of eleven operationally active system operators
- **Systec Plastics plants** (in NRW and Thuringia)
- Approximately **50.000 tons of high-quality plastic recyclate annually**

Intelligent combination of mechanical and chemical recycling



- 1** Packaging waste from the yellow bag, + other waste from household collection
- 2** Pre-sorting, cleaning according to specification
 - **Challenge: Impurities, conversion rate**
- 3a** Extrusion → plastic granules
 - **Challenge: Optimization of color and odor**
- 3b** "Pyrolysis", breaking up of polymer molecules, liquefaction to pyrolysis oil
- 4** "Steamcracker" - recirculation & conversion to plastics for the **packaging industry**, etc.
 - **Challenge: Input quality requirements**

Challenges and starting points of possible partnerships

- **Sorting technology**
- **Conditioning technology**
- **Quality monitoring**

Pitch by industry - NL

Moderators



Willem Sederel
Chair



Joop Groen
Executive Board Member





Jörg Krüger
Synova



Danny Vancoppenolle
Bureau Veritas Group



Christophe Cappuyns
Alfa Laval



Marc Lankveld
Green Chemistry Campus



Yanto Schraa
360KAS

SYNOVA

CIRCULARITY 2.0



09.09.2022



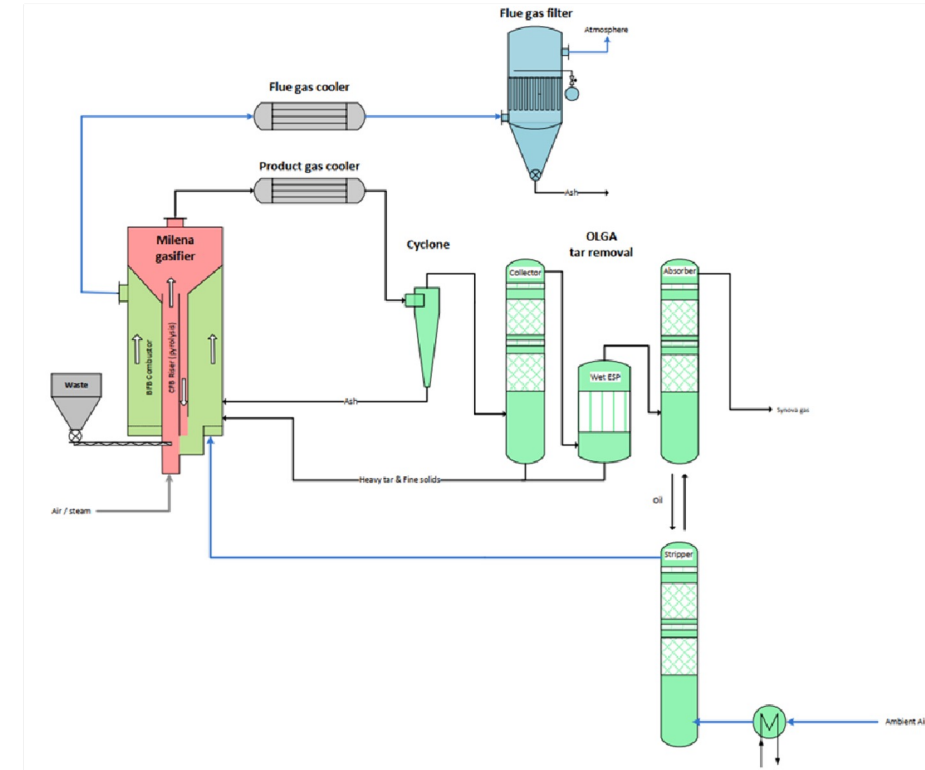
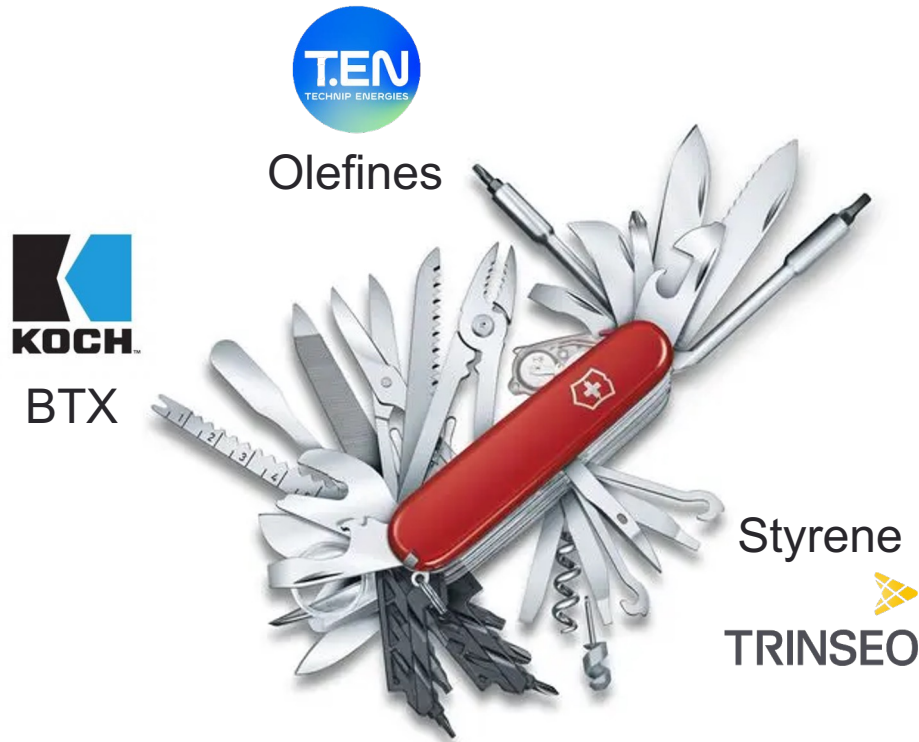
Synova's Belief and Mission

In order to rapidly mitigate climate change and achieve the global ambition for greenhouse gas emission reductions, the inflow of further fossil carbon from the ground into our system must be reduced as quickly as possible and by high volumes.

Make fossil carbon extraction obsolete!

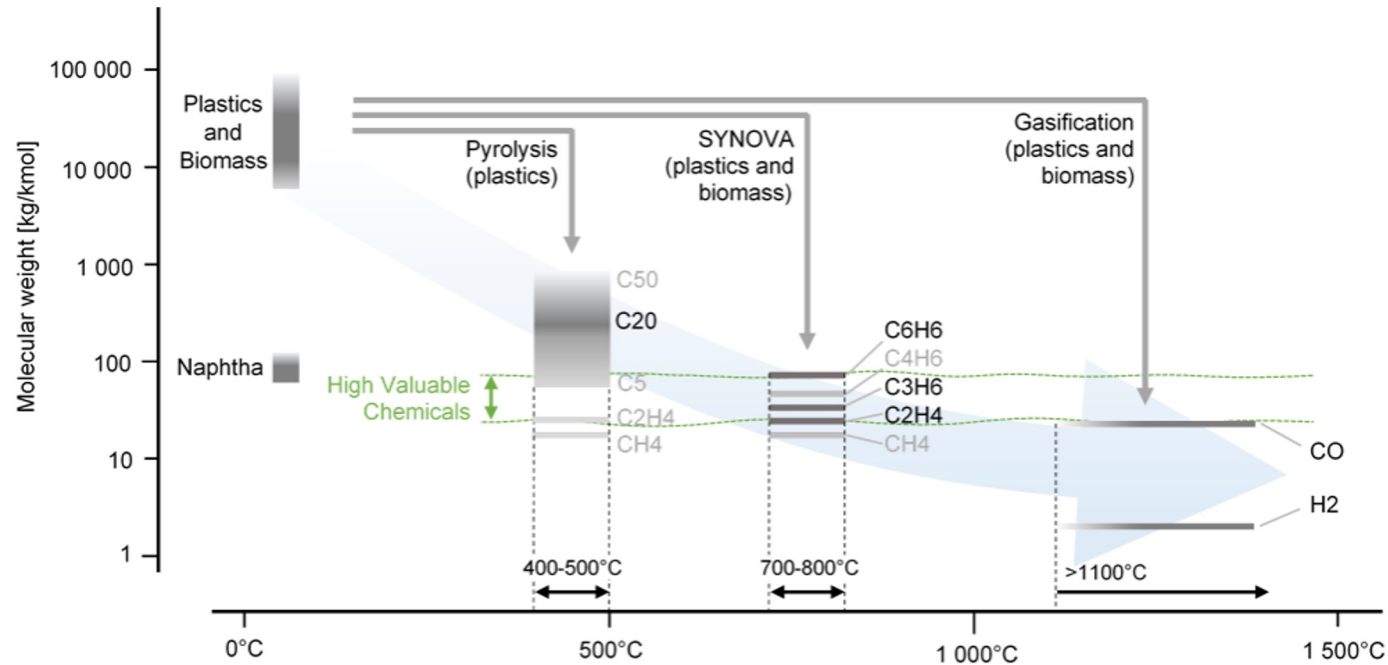
We have solutions,
developed together with strong partners that share our belief in the commercial and sustainability advantages of our technology

Synova's cracking/de-polymerization technology changes your view on chemical recycling



- Numerous technology reviews from partners, clients, and independents have confirmed
 1. The readiness to demonstrate the technology at industrial scale, and
 2. Its intrinsic commercial and sustainability advantages compared to its competitors

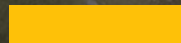
We have the most direct route to high-value chemicals. The most economical, and the most sustainable



- Our approach is a new benchmark in recycling and paves the way for true, carbon neutral circularity!
- The time is now to switch and move towards genuine circularity. Those bold enough to pursue better will claim huge rewards from being the leaders. Time to get on board and co-create a better future.



SYNOVA



Closing the gap in circularity



BUREAU
VERITAS

CHEMICAL RECYCLING

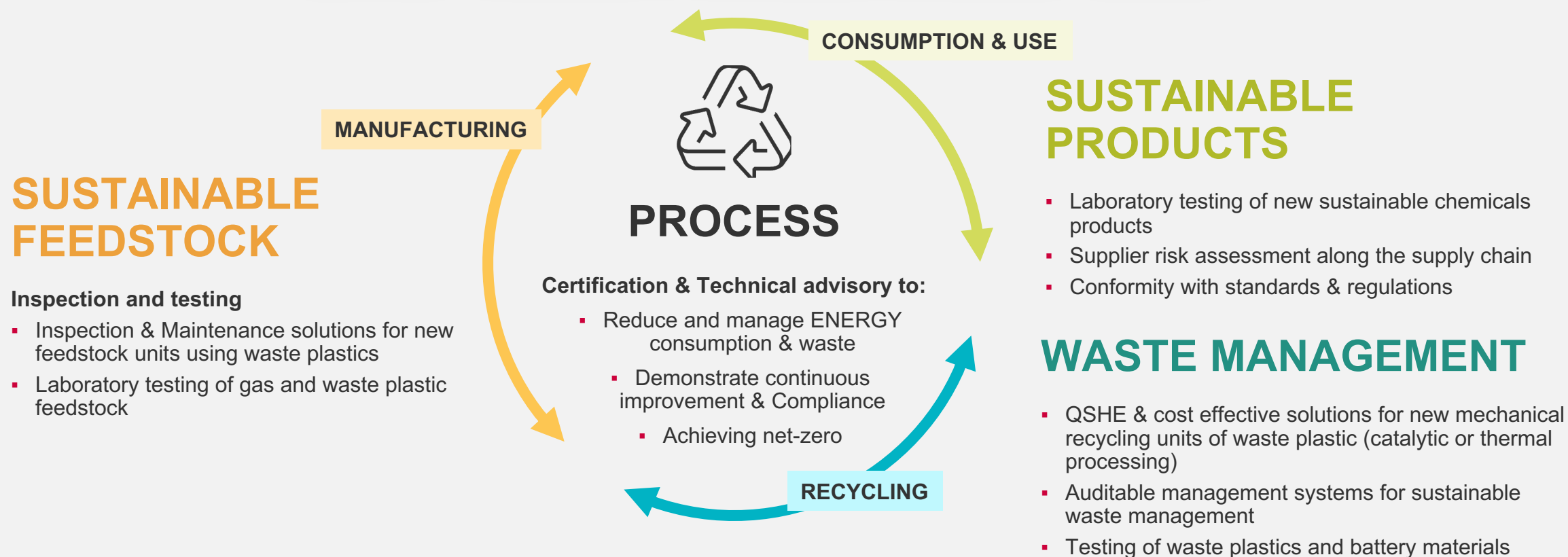
SHAPING A WORLD OF TRUST

A GLOBAL LEADER IN TESTING, INSPECTION & CERTIFICATION SERVICES

SEPTEMBER 2022

SUSTAINABILITY

MOVING TOWARDS A CIRCULAR ECONOMY MODEL

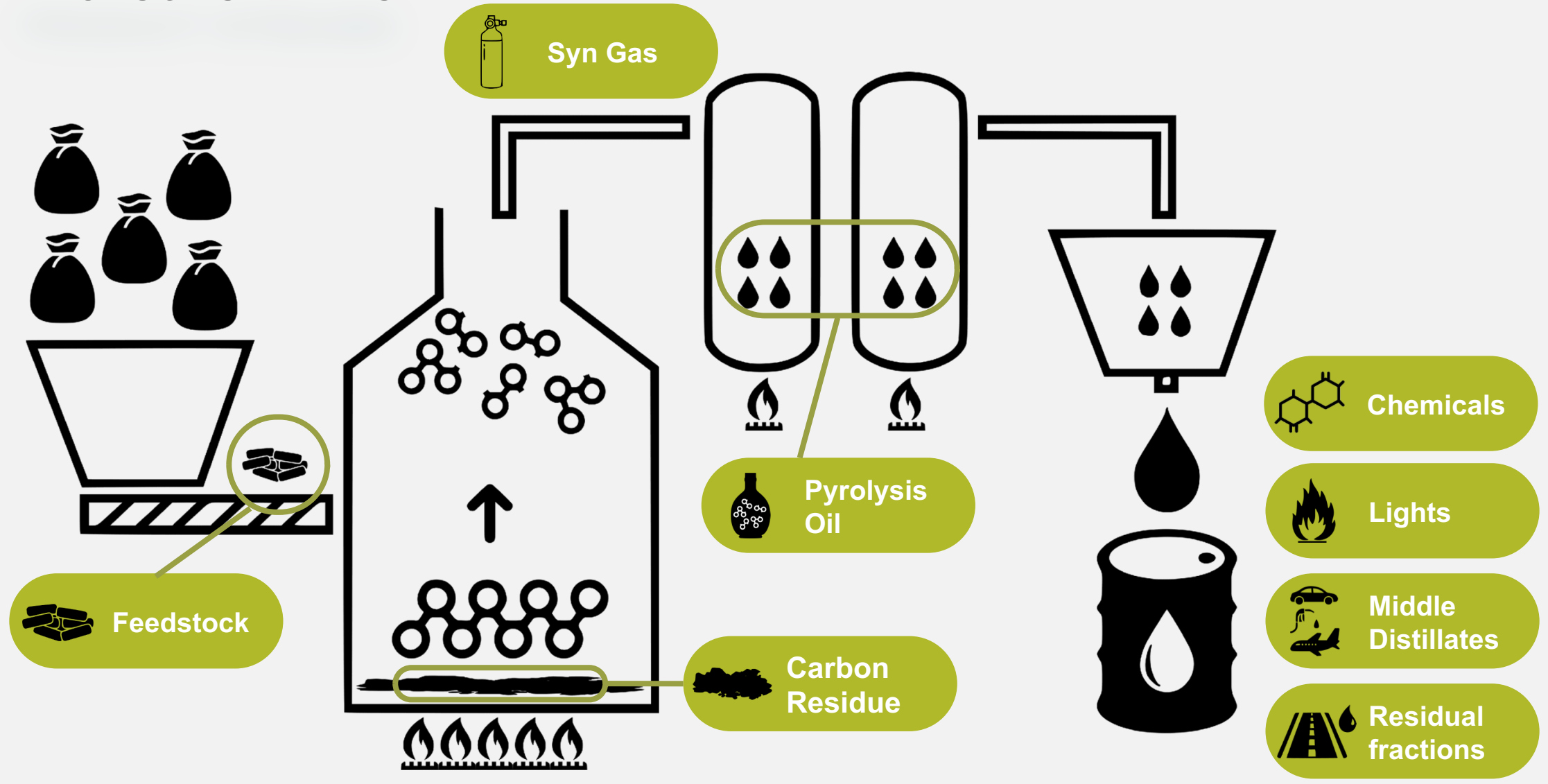


SUSTAINABILITY REPORTING

Report verification services to support chemicals companies in transparent reporting
e.g. to GRI standard

PLASTIC RECYCLING

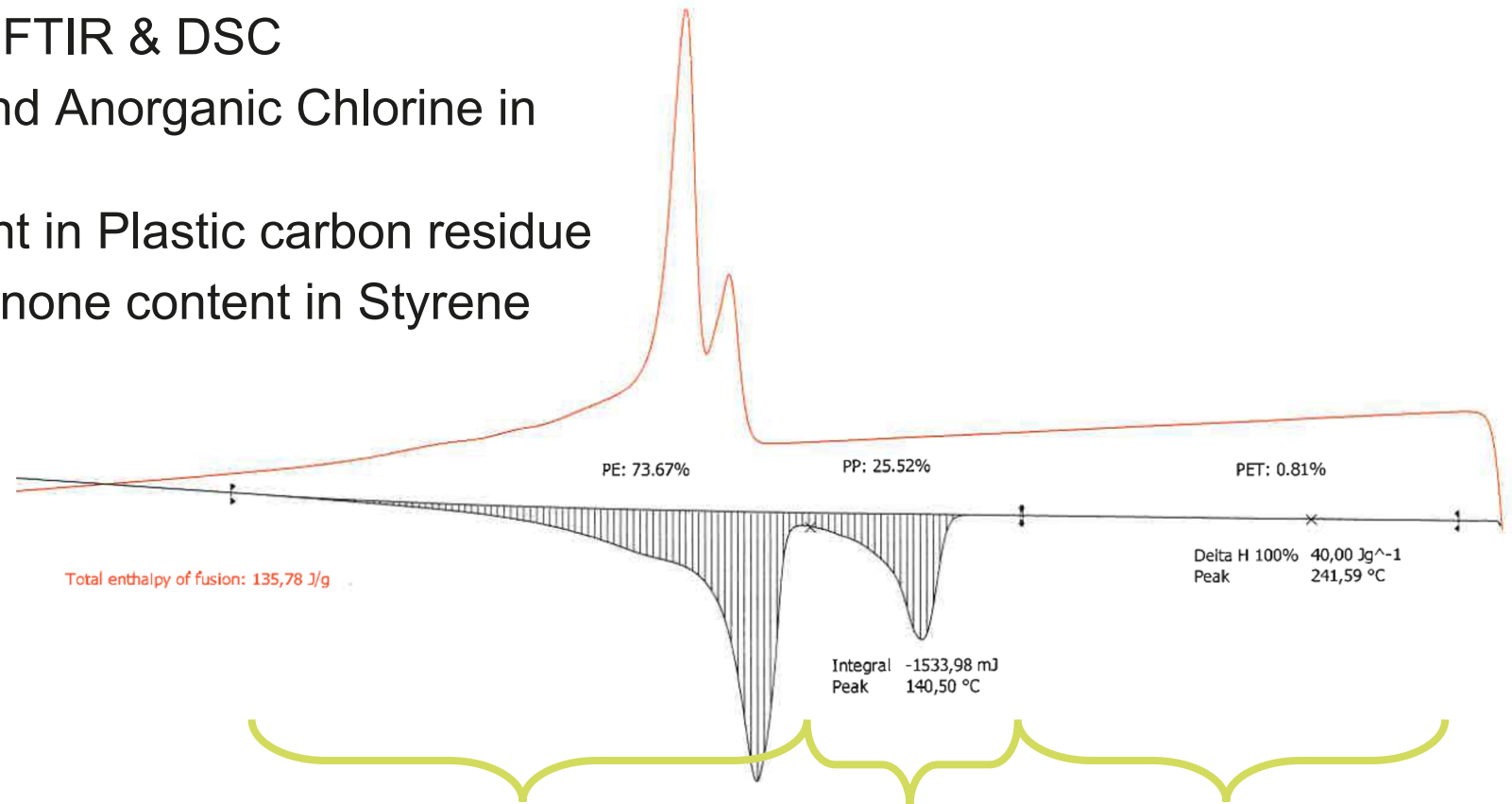
PRODUCT STREAMS



R&D FOR WASTE PLASTIC TO CHEMICALS RECYCLING

In cooperation with our industry partner, we created in-house methods for:

- Polymer identification by FTIR & DSC
- Differentiating Organic and Anorganic Chlorine in plastic waste
- Determining metal content in Plastic carbon residue
- Phenol and 1.4 benzoquinone content in Styrene

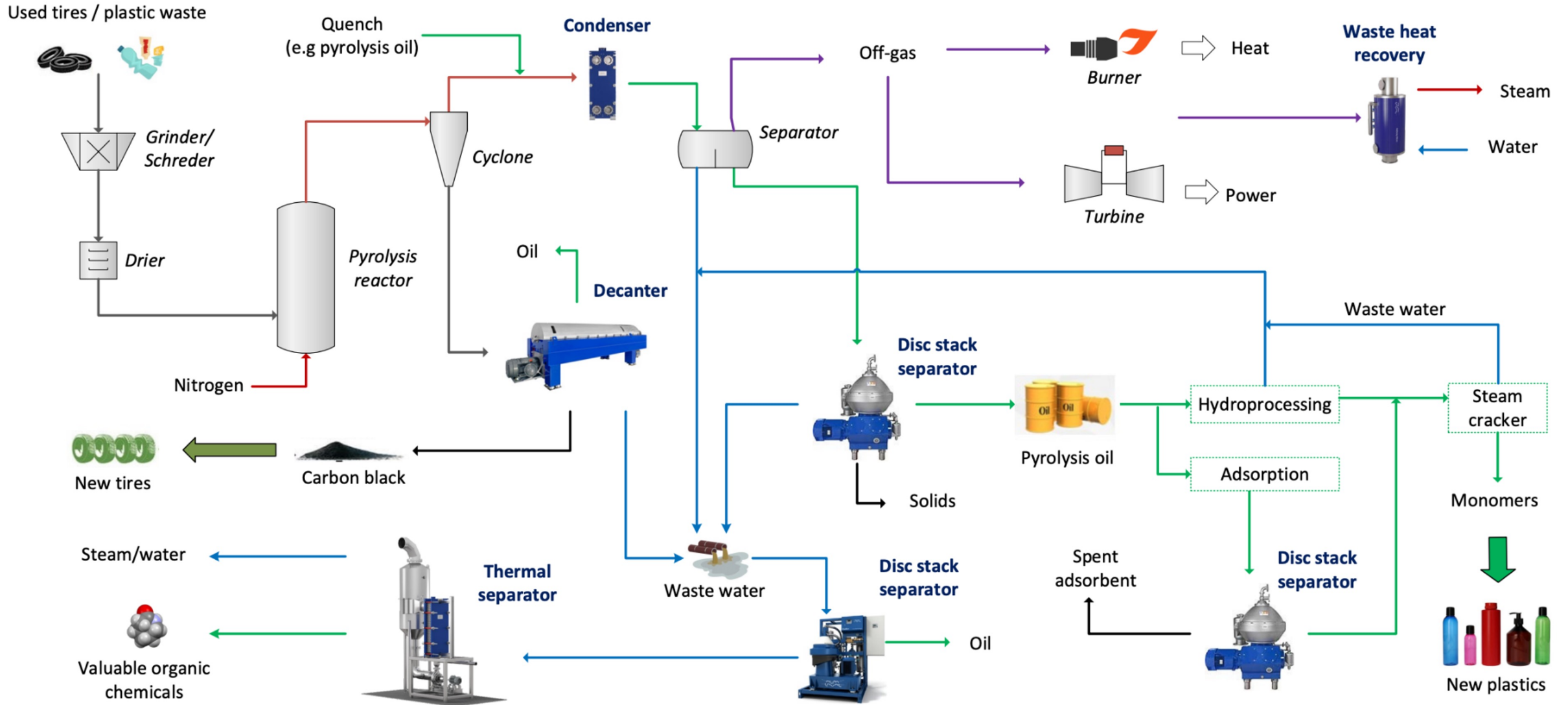




BUREAU
VERITAS

Shaping a World of Trust

Alfa Laval technology in pyrolysis application



Contact



Scan to add us on LinkedIn. Or see you at the reception.



Christophe Cappuyns

Application Engineer Business Development at
Alfa Laval

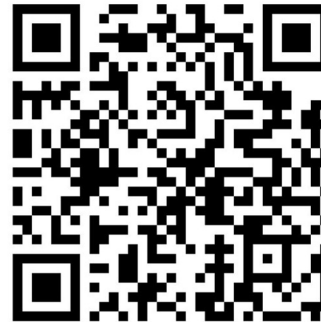


Contact for Belgium and
Netherlands market



Annalena Siebert

Energy Separation | Inside Sales
& Business Development | Alfa ...



Contact for German market



Tilo von Stephani

Das Leben ist die Schule
unseres Daseins.



Contact for German market

GREEN CHEMISTRY CAMPUS

TECHNOLOGY ACCELERATOR FOR SCALING UP
BIOBASED & CIRCULAR INNOVATIONS

UNIQUE LOCATION TO SCALE-UP GREEN & CIRCULAR CHEMISTRY

LOCATION : SABIC SITE, BERGEN OP ZOOM , NL

- Upscaling Green Chemistry Technology (TRL 4-8)
- BRZO-5 classification (NL)
 - Fully equipped: electricity, water/gas supply, waste (water) handling treatment, safe working environment
- Demo hall: 300 m²
- Demo plots: 12.000 m²
- Optional Demo plots: 10.000 m²
- Access via SABIC to pipelines for Hydrogen (H₂), carbon monoxide (CO) en nitrogen (N)
- Potential for further growth at the SABIC site with potential value chain synergies
- Subsidy Schemes (e.g. Just Transition Fund, JTF)



Refinery & Petrochemical



LNG Supply Chain

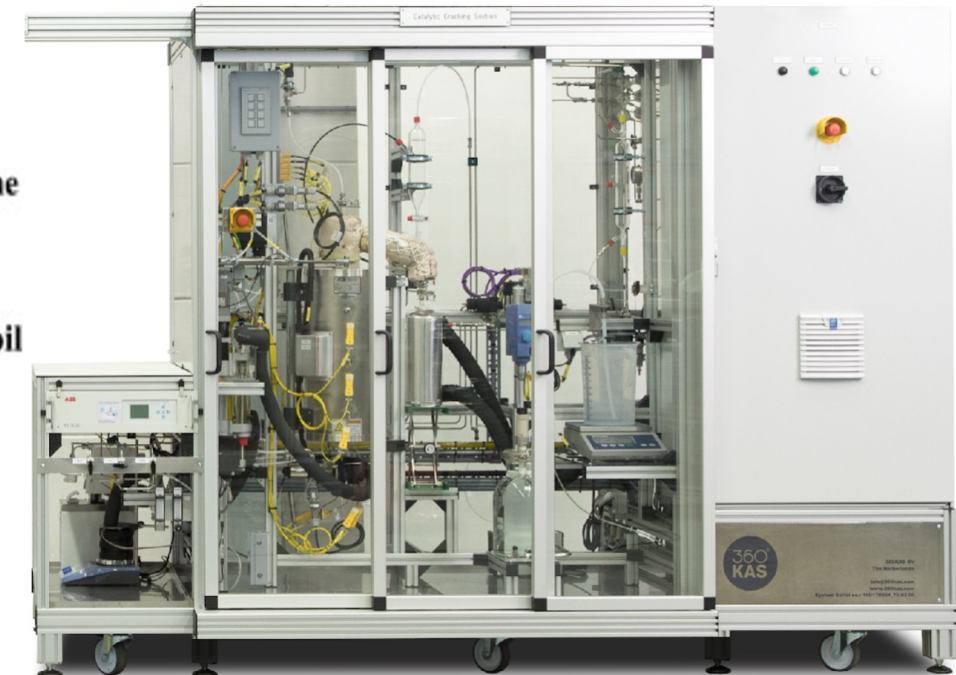
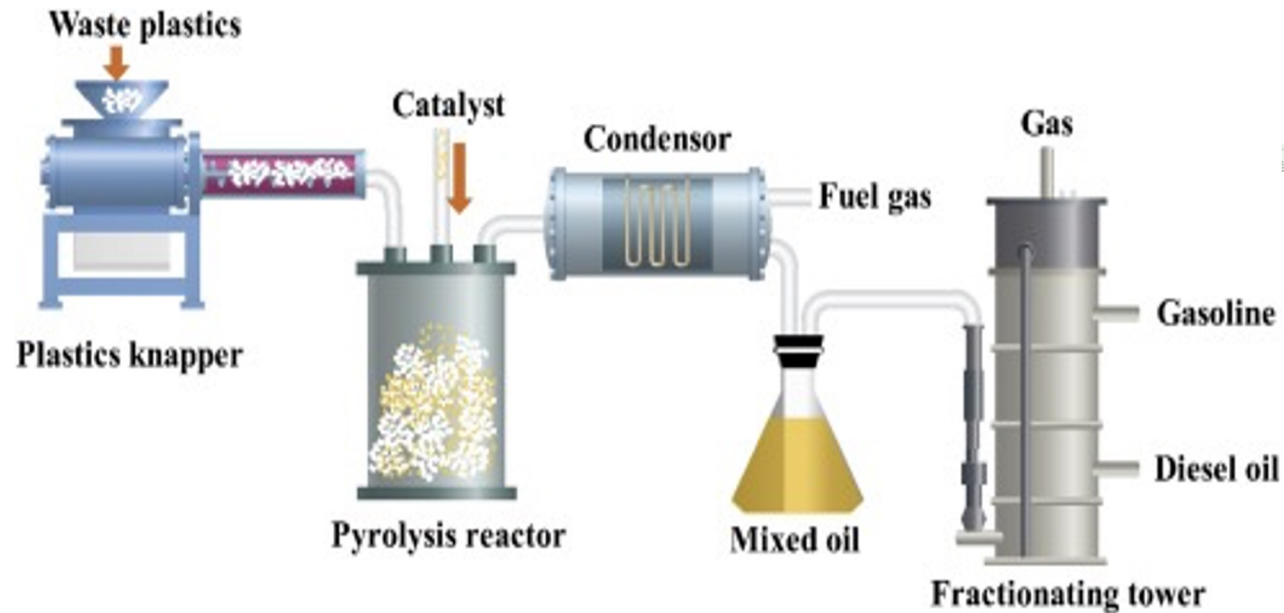


Power & H2



Our renewable & sustainable responsibility

Blending Bio Fuels with VGO.... It starts at lab scale



360KAS
Labscale Multi Feed reactor

To consider for continuous improvement

Blending Bio Fuels with VGO (Co-refining).... It all starts at lab scale

- *Determine the renewable content of final fuels after co-processing biogenic feedstocks in the fluid catalytic cracker (FCC) of a commercial oil refinery*
- *Behaviour of FCC catalysts on blended feed*
- *Influence of Purifying Bio fuels?*
- *Which bio mass can be used?*



Michael Oderdörfer
NRW Ministry of Environment



Reinhold Rünker
NRW Ministry of Economic Affairs




Arnoud Passenier
NL Ministry of Infrastructure &
Water management



Ron Brinitzer
Kunststoffenland



Willem Sederel
Circular Biobased Delta



*"If you want to go fast,
go alone.
If you want to go far
go together."*

Co-organized by



Ministerie van Infrastructuur
en Waterstaat



Generalkonsulat des
Königreichs der Niederlande
Düsseldorf

bottrop.

The State Government of
North Rhine-Westphalia



TNO innovation
for life



ZENIT





**Thank you for
your attention**



15 September, 2022