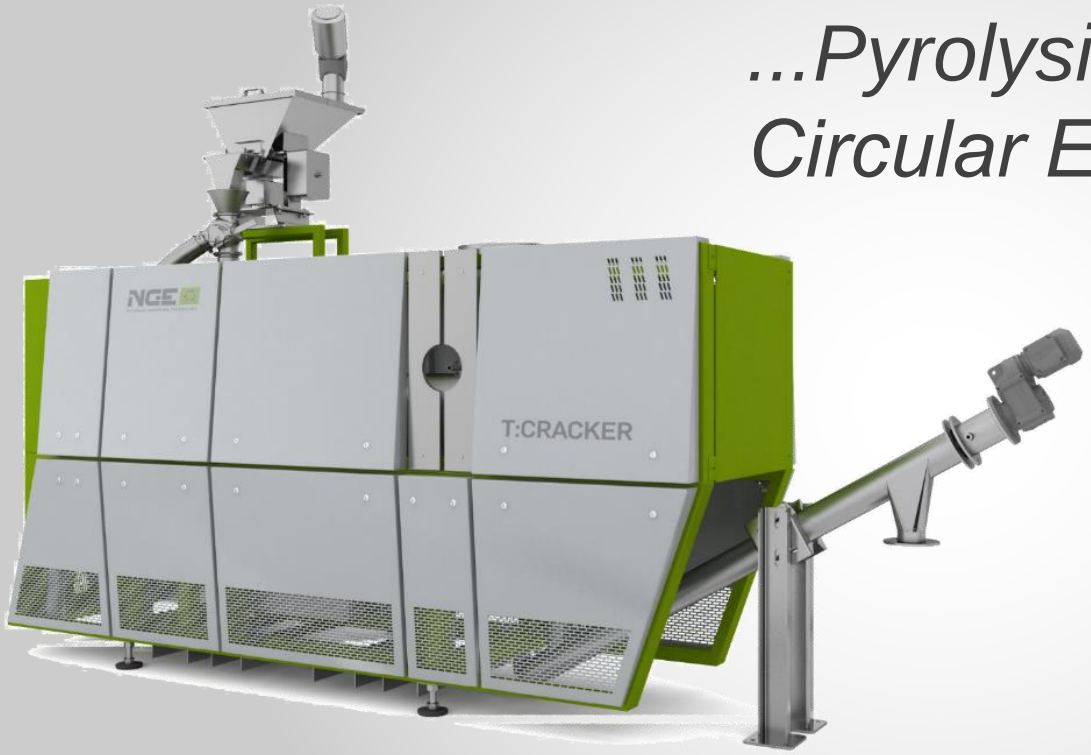
ÖGEW/DGMK
Herbsttagung 2019

NGE
MATERIAL MORPHING TECHNOLOGY

T:CRACKER®
One Solution - Many Opportunities



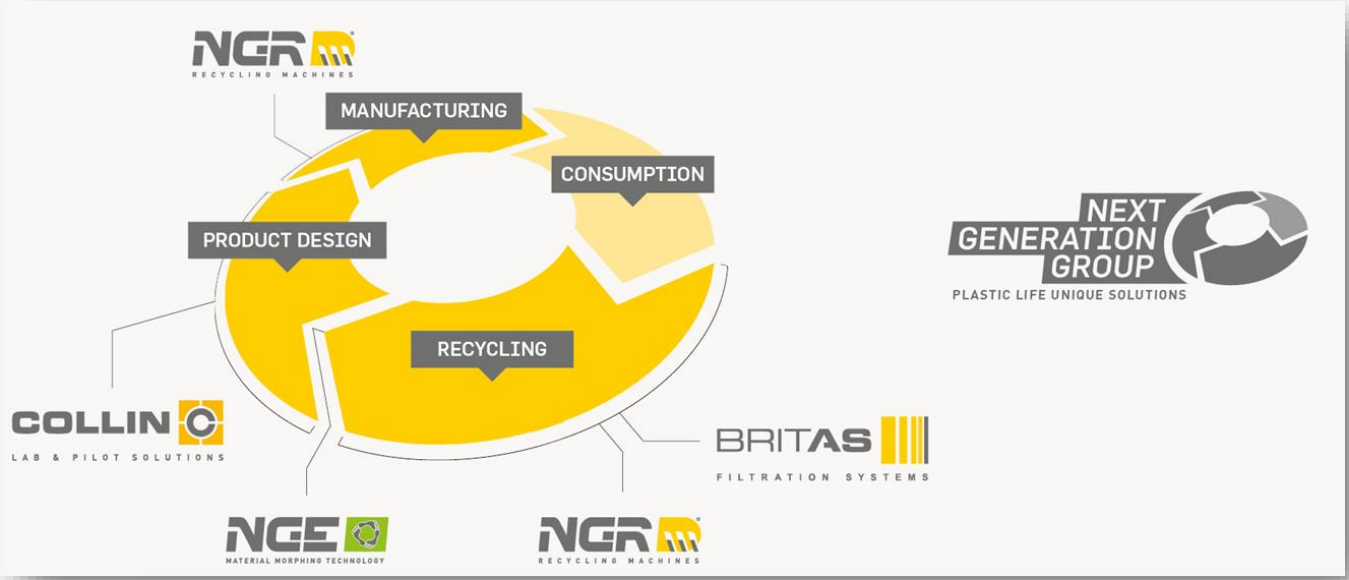
...Pyrolysis as part of modern Circular Economy…

...is Chemical Recycling of plastic waste an option or already a must?

Dr. Andreas Hackl
NGE GmbH

Next Generation Group Overview…

MATERIAL MORPHING TECHNOLOGY



Next Generation Recyclingmaschinen GmbH
HQ, Production & Customer Care Center Europe
4101 Feldkirchen, Austria

www.ngr.at

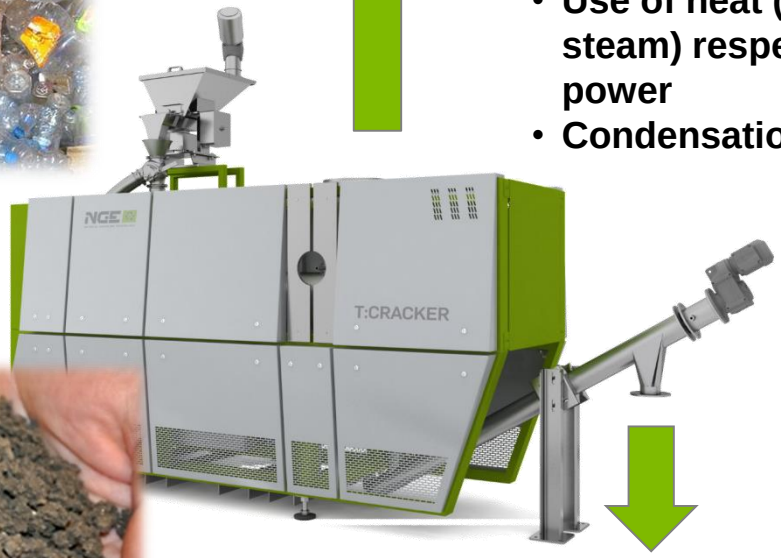
Number of Employees:
(NEXT GENERATION GROUP): 280
Annual Sales: 80 Mio €

Pyrolysis as thermal Recycling Process…

MATERIAL MORPHING TECHNOLOGY

Definition: Pyrolysis as thermo-chemical process (200-900°C) to treat mainly organic Substances under absence of oxygen.

Waste incineration as classical thermal treatment process can be supported by pyrolysis as complementary technology



Pyrolysis Gas

- **Average/high calorific gas**
- **Use of heat (e.g. process heat or steam) respectively to generate E-power**
- **Condensation → PyroOil**

Pyrolysis Coke

- **Significant mass- and volume reduction**
- **Good sortability (particle size, ferrous/non-ferrouse etc.) resp. further direct use**

A successful partnership…

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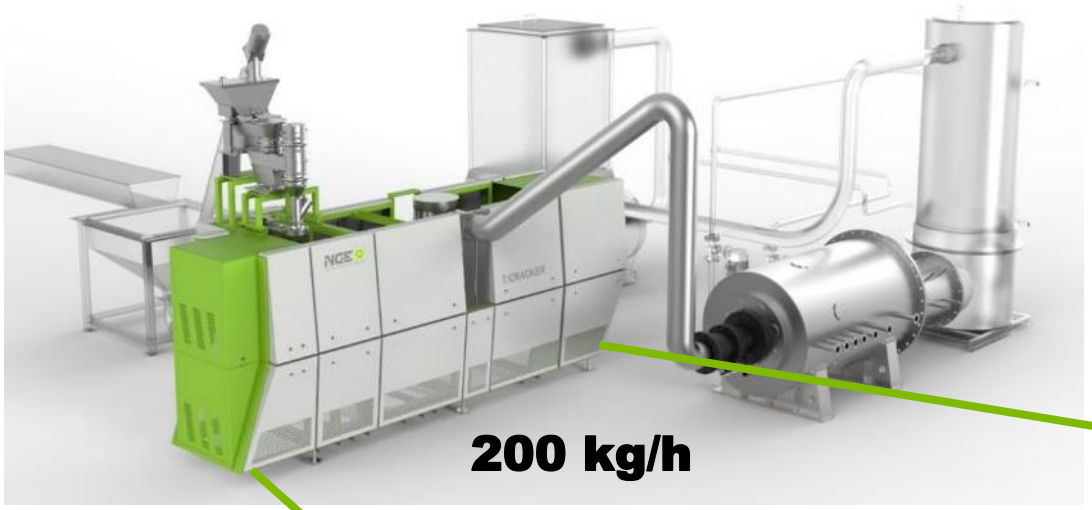
MATERIAL MORPHING TECHNOLOGY

JOHANNES KEPLER
UNIVERSITÄT LINZ | JKU

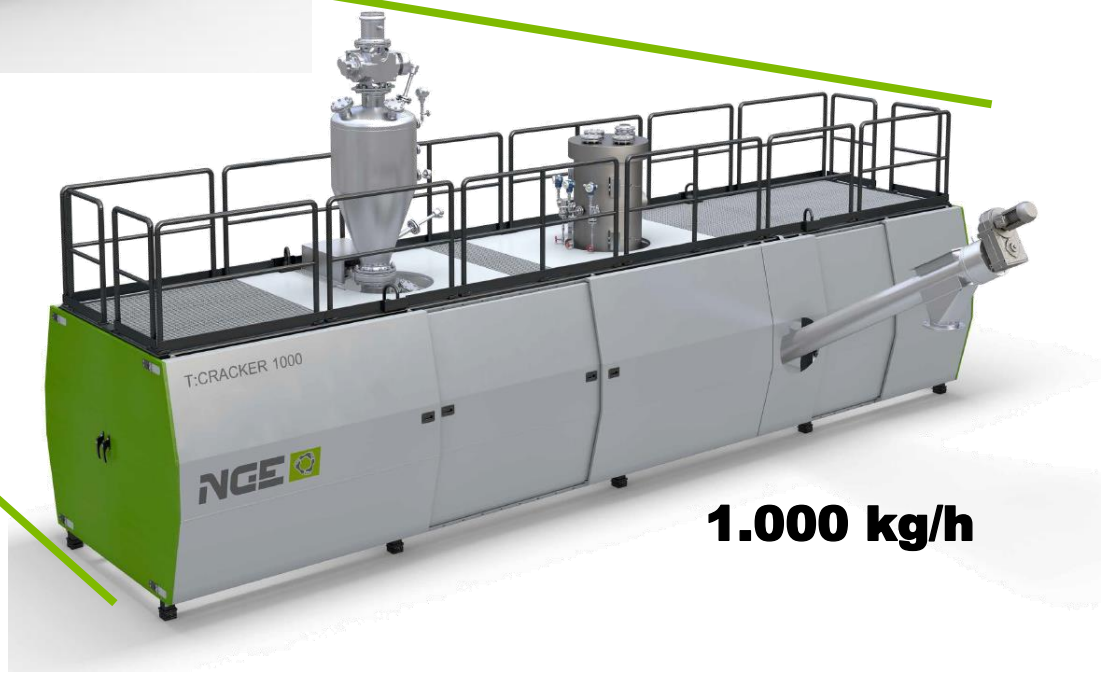
FFG
Austrian
Research Promotion Agency

T:CRACKER – Modular plant design…

MATERIAL MORPHING TECHNOLOGY



Modular concept for compact and flexible plant design …



….from 200 kg/h up to 1.000 kg/h via one T:CRACKER unit

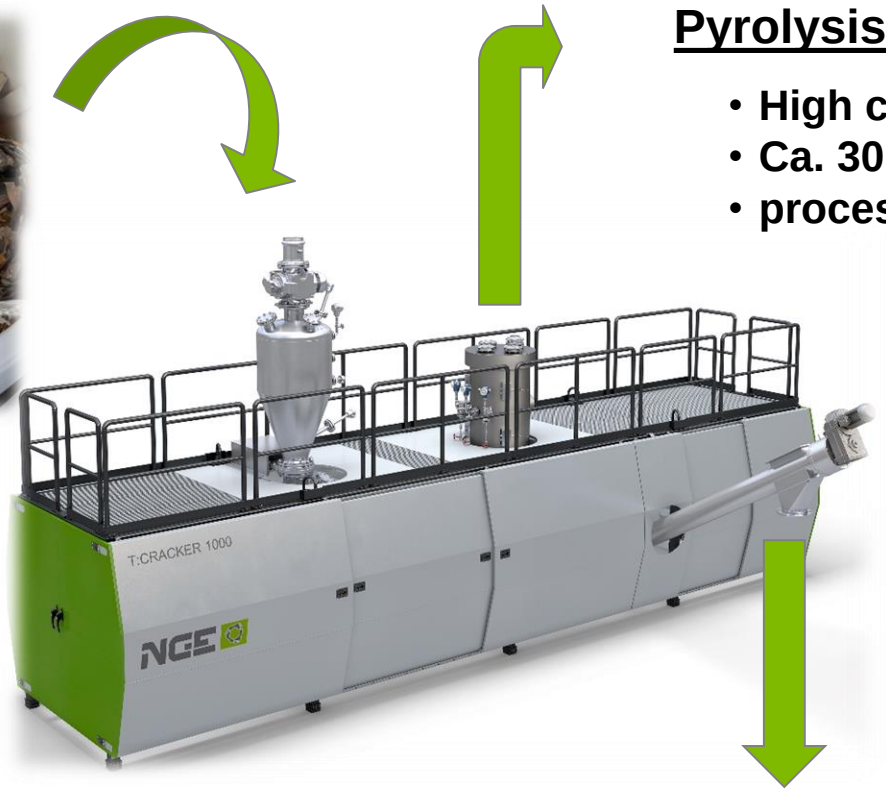
Industrial Pyrolysis Reactor
T:CRACKER 1000

MATERIAL MORPHING TECHNOLOGY

Plastic-2-Value

Alu Recycling from Laminates

MATERIAL MORPHING TECHNOLOGY



Pyrolysis Gas

- **High calorific Gas**
- **Ca. 30 MJ/kg**
- **process gas**

PyroCoke

- **Significant reduction in mass- und volume (80-90%)**
- **Good ability for separation (particle size, Metal/None-Metal etc.)**

Plastic-2-Value

Niche Application CFRP Recycling

MATERIAL MORPHING TECHNOLOGY

CFRP – from magic material to nightmare in disposal…Pyrolysis as Option!

PyroGas

- **High Quality Gas**

Recycled Carbon Fiber r-CF

Plastic-2-Value

Production Residues

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MATERIAL MORPHING TECHNOLOGY

Pyrolysis Gas

- High calorific Gas
- Ca. 30 MJ/kg
- Process Gas

r-Carbon Black

- C-content approx 95% !!
- Recycling of rCB
- value: 400-500 EUR/t

„Plastic Planet“ overview

How to achieve the recycling goals?

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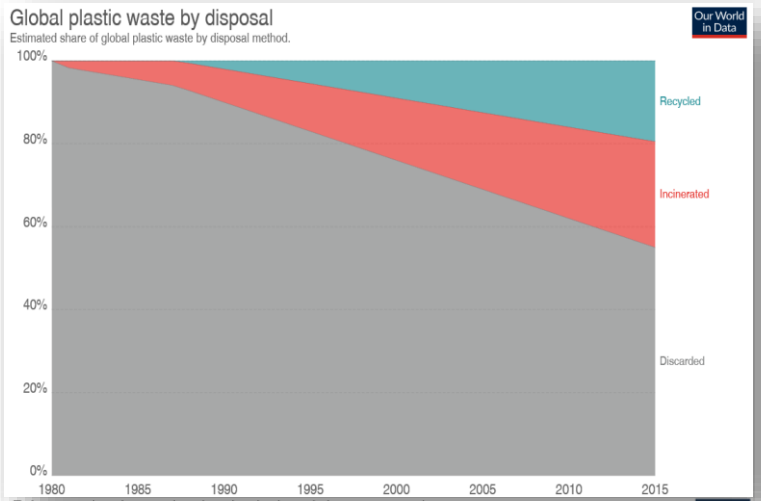
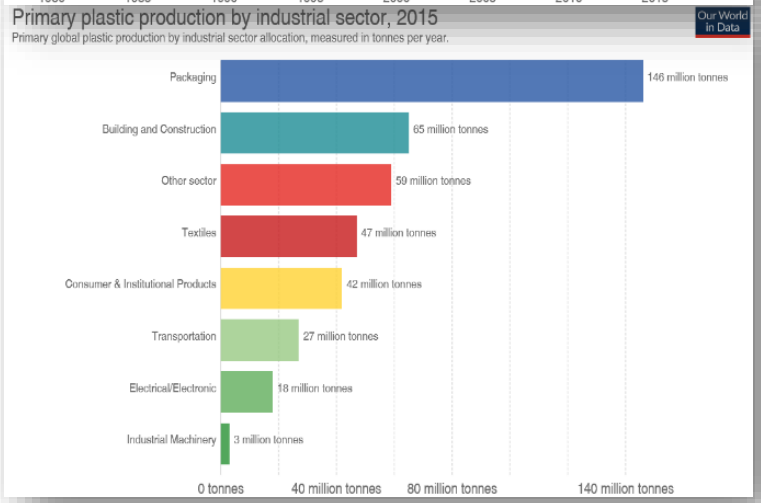
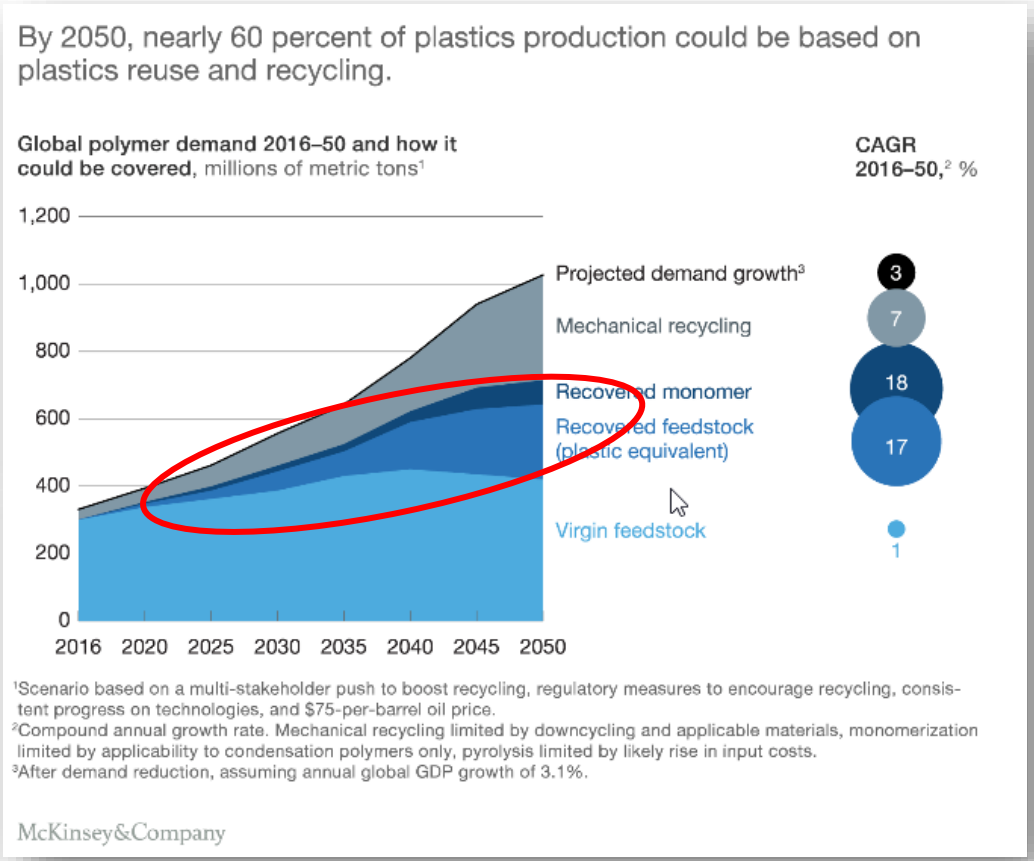
Annual production of plastic: 360 mio t (2018); till 2050 it will increase to >1,1 bn t





CHEMICAL RECYCLING AS MISSING LINK…?



https://www.mckinsey.com/industries/chemicals/our-insights/how-plastics-waste-recycling-could-transform-the-chemical-industry

Plastic-2-Value

Thermo/Chemical Recycling (T/CR)

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Available technologies:

- Plastic Energy (GB/ESP) – SABIC etc.
- ReOil (AT) - OMV
- Quantafuel (NOR) - BASF
- Plastic 2 Oil (USA)
- Neste (FIN) - REMONDIS

PLASTIC ENERGY

QUANTAFUEL

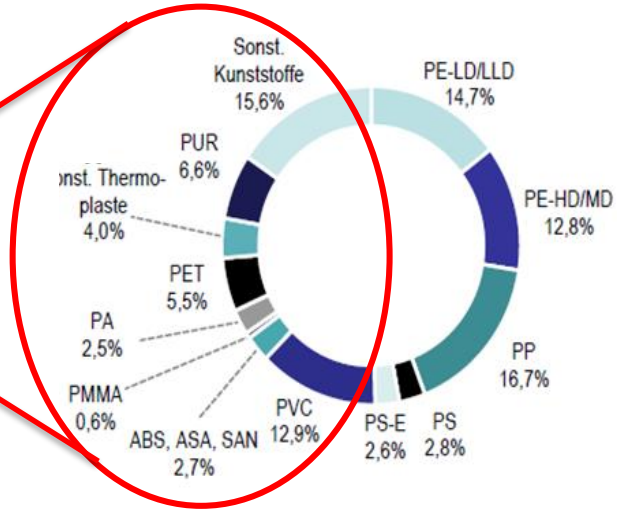
Plastic2Oil

Process:

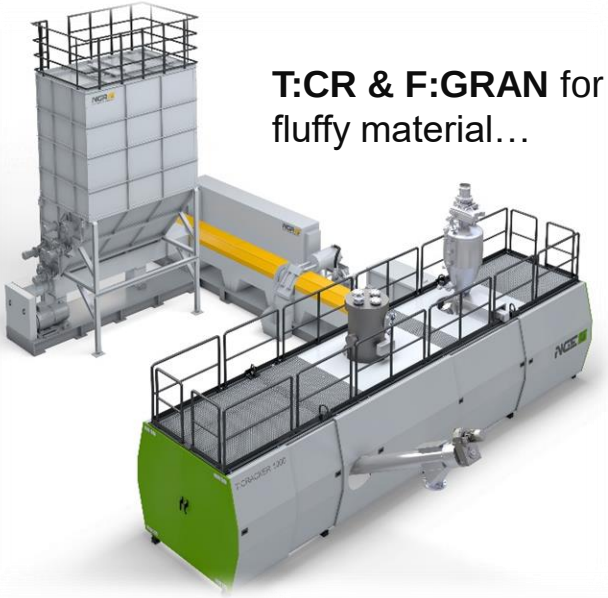
- **Anaerobic, thermal treatment** (=Pyrolysis) of solid input, melts or in combination with carrier liquids (high temperature solvents)
- After the cracking a **refining process** is needed to separate and **clean up the oil, gas and coke fraction**
- Input: **Polyolefins (PP, PE), PS**
- Unusable input : PET, PA, PVC, multilayers etc …

→ **What should be done with this fractions?**

→ **Why not via decentralized solutions?**

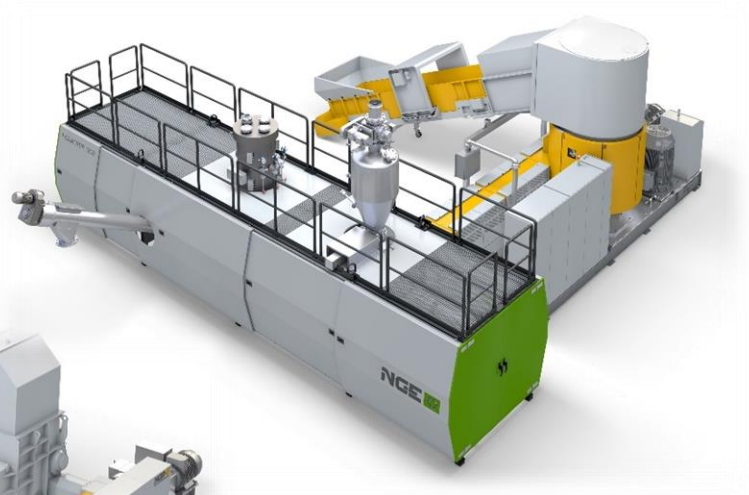


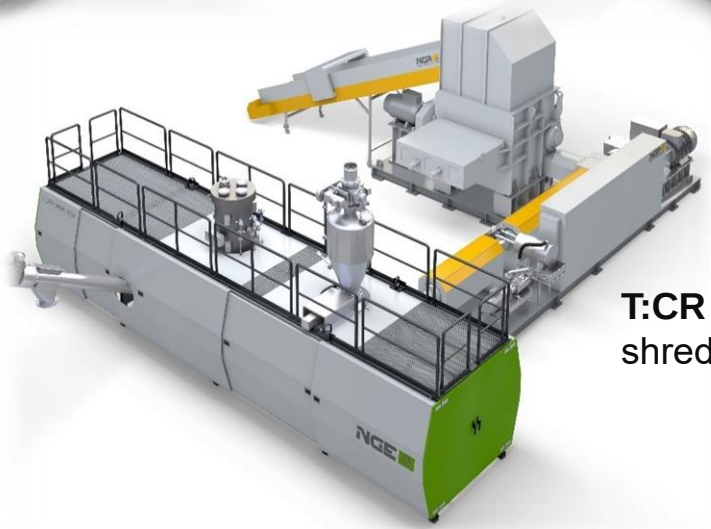
T/CR via decentralized plant setup…



T:CR & F:GRAN for handling of e.g. 2D and fluffy material…

T:CR & C:GRAN for handling of to be cutted and dried material…





T:CR & X:GRAN for handling of to be shredded material…

Thermo-chemical Plastic Conversion
Plastic-2-Gas → Plastic-2-?

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"We start where others having their limits…"

Pyrolysis Gas

- Condensation to PyroOil ?
- High Calorific Gas (ca. 30 MJ/kg)
- Heat utilization (e.g. process heat or steam) → E-production

PyroCoke

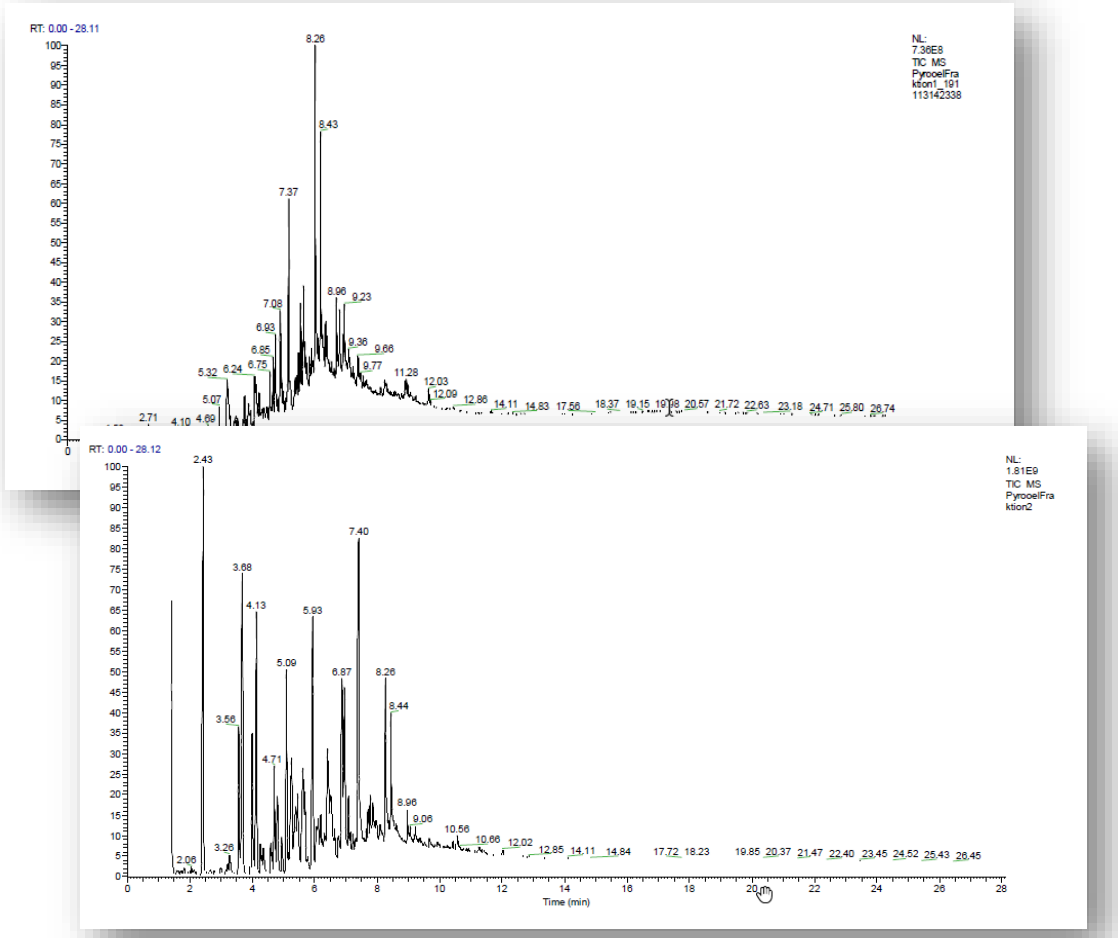
- Significant reduction in mass- und volume (80-90%)
- Good ability for separation (particle size, Metal/None-Metal etc.)

Plastic-2-Oil

NGE's 1st steps…

MATERIAL MORPHING TECHNOLOGY

PyroOil condensed into Diesel
from Al/PE laminates…



GC-MS Analytics of PyroOil:

- Significant amounts of Aromats (Xylene, Toluene, etc) Akylaromatics, Naphtalene (& Derivates) …

Plastic treatment
Post-Consumer material

MATERIAL MORPHING TECHNOLOGY

STATUS:

- amount of plastic will increase in general
- Complexity of used plastic(compounds) will increase; (e.g. multilayers etc.)
- → therefore plastic amount of not being recyclable will increase dramatically!
- Thermal treatment (=incineration) faces technical and capacity limits

OPTIONS & CHALLENGES:

- Thermo-chemical treatment becomes more and more attractive whereby the **utilization (thermal use or/and condensation)** of pyrolysis gas will be a core aspect to be considered in regards to the allocation and **prize level for inputs** as well for **outputs**!
- **Utilization of the coke** fraction in consideration of the input
- Management in regards of **quality** and **quantity** (composition, morphology, humidity etc.) and **logistics**!
- Permission coordination
- Building up of alliances between origin and end-user of material and energy
  - origins: plastic industry, collector and sorter, recycling companies…
  - Pot. End-user: energetically intensive industry with focus on gas…power plants, Metal, cement plants, paper mills, **Oil & Gas Companies**…

PLASTIC LIFECYCLE-COMPETENCE
NEXT GENERATION GROUP

BIG ENOUGH TO INNOVATE, SMALL ENOUGH TO COOPERATE!

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