

#### Plast – en trussel eller avgjørende for en bærekraftig fremtid?

Ronny Ervik Norner AS Norner - A global market leader of Industrial R&D services in Polymers





#### **New European Polymer Exploration Centre - 2022**

Full service-portfolio in the plastics value chain from polymer to processing and end use innovations



Almost 390 million tons of plastic were produced in 2021

More than 90% of plastic is NOT recycled (globally) Each year 9 million tons of plastic waste end up in the ocean

More than a third of all plastic is used for packaging Packaging waste accounts for half of the plastic waste

Mance Zuma messi

#### Plastics - an integrated part of modern society



## Plastics – enabling our sustainable future

- Plastics deliver numerous benefits to society
- The circular economy for plastics requires us to
  - eliminate problematic/unnecessary plastic
  - eliminate leakage from the plastic value chain
  - increase recycling (mechanical, chemical)
  - decouple feedstock from fossil sources



Everyday life



Medical devices



Packaging

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e-Mobility

Strong - Lightweight - Durable - Safe - Versatile



# Plastic is too valuable to waste...

24 Hour

1 Tablet

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Claritin 🐸







#### Without value – plastics are lost everywhere!



## Many types of plastics – but dominated by a few!



# What if we replace plastics packaging with available alternatives?

![](_page_9_Figure_1.jpeg)

![](_page_9_Picture_2.jpeg)

### Food production: 1/3 of total GHG gas emissions

![](_page_10_Figure_1.jpeg)

## LCA's are required to make sound decisions!

![](_page_11_Figure_1.jpeg)

## To consume less – the biggest sustainability challenge?

Million tonnes

![](_page_12_Figure_2.jpeg)

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#### Without sustainable use – the use will be restricted!

GLOBAL Basel convention Single use plastic bans Extended Producer Responsibility

#### UNITED STATES

#### o Save Our Seas Act (2020)

- RECYCLE Act
- RECOVER Act
- o ZERO WASTE Act
- o The Plastic Waste Reduction and Recycling Act
- o Break Free From Plastic Pollution Act

#### EUROPE

- o Packaging and Packaging Waste Directive
- Circular Economy Package
- o Single Use Plastics Directive
- o EU Plastics waste charge
- o Country specific plastic packaging taxes

#### **ASIA PACIFIC**

- o National Sword / Plastic waste import ban (China)
- Waste export ban and Recycling Modernisation Fund (Australia)
- o Deposit return schemes

![](_page_13_Picture_18.jpeg)

# EU defines sustainable plastic manufacturing

Manufacture of plastics in primary form shall comply with at least one of the following three criteria:

- 1. Manufactured by mechanical recycling
- 2. Manufactured by chemical recycling\*
- 3. Wholly or partially derived from renewable feedstock \*

\*The <u>carbon footprint shall be lower</u> than the carbon footprint of the plastics in primary form manufactured with fossil fuel feedstock

![](_page_14_Figure_6.jpeg)

Environmental objectives:

- 1. Climate change mitigation
- 2. Climate change adaptation
- 3. Sustainable use and protection of water and marine resources
- 4. Transition to a circular economy
- 5. Pollution prevention and control
- 6. Protection and restoration of biodiversity and ecosystems

![](_page_14_Picture_14.jpeg)

# The challenge – the industry needs "virgin" recyclates

![](_page_15_Figure_1.jpeg)

![](_page_15_Figure_2.jpeg)

• Un-used capacity due to poor quality of output

![](_page_15_Figure_5.jpeg)

• Europe needs better recycling technologies to reach 10 MT within 2025

![](_page_15_Picture_7.jpeg)

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#### The recycled material 5 challenges

#### Mechanical properties

![](_page_16_Picture_2.jpeg)

Gels & impurities

![](_page_16_Picture_4.jpeg)

Processing

![](_page_16_Picture_6.jpeg)

Colour

![](_page_16_Picture_8.jpeg)

Odour & migration

![](_page_16_Picture_10.jpeg)

![](_page_16_Picture_11.jpeg)

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# We need to transform the way plastic products are designed, produced, used and recycled + <u>document</u>!

Europe 2019:

- 29.1 million tonnes collected
- 4 million tonnes used
- Mechanical recycling is not fulfilling the requirements needed to enable targeted use

![](_page_17_Figure_5.jpeg)

![](_page_17_Figure_6.jpeg)

Digital transformation will change how we inform about, design, track, trace, sort and recycle plastic packaging

Multi Frui Yogurt

![](_page_18_Figure_1.jpeg)

# Recyclers need to operate as resin suppliers – with quality and application mindset

![](_page_19_Figure_1.jpeg)

![](_page_19_Picture_2.jpeg)

#### High quality mechanical recycling via value chain integration

![](_page_20_Figure_1.jpeg)

![](_page_20_Picture_2.jpeg)

#### Mechanical recycling can only go so far...

![](_page_21_Figure_1.jpeg)

## We need a multifaceted approach

#### The circular economy: Reduce – reuse – recycle

![](_page_22_Figure_2.jpeg)

- Mechanical recycling: Less energy consuming (keep polymer structure), but limited cleaning effect
- Monomer Recycling: Break polymer bonds; purify monomers
- Pyrolysis (chemical recycling): High energy demand reduction to basic feedstock – highest cleaning effect

![](_page_22_Picture_6.jpeg)

## The race in technology development is on..

Polymer to Polymer Recycling Polymer (pure stream) Polymer Polymer Polymer

a) Mechanical Recycling

Recyclate quality directly dependent on purity and specification (e.g. M) of input

Low energy need, can be powered by renewable electricity

No / very limited capability of removing contaminants

b) Solvent-based Recycling Polymer to Polymer

![](_page_23_Picture_6.jpeg)

Recyclate quality dependent on purity and specification of input

Medium energy need, can be powered by renewable electricity

Contaminants / other polymers can be removed if different solubility

#### c) Depolymerisation Polymer to Monomer

# Pure polymer by type, , varying M

Can recycle chemically identical polymers of different quality / M

Medium energy need, process heat by renewable electricity or with CCS/CCU

Removal of contaminants possible, achieves virgin quality

#### d) Thermochemical Processes (Mixed) Plastics to Feedstock

![](_page_23_Picture_16.jpeg)

Can recycle (a range of) mixed plastics waste of different quality and  $M_{\rm w}$ 

Relatively high energy need, process emissions likely need CCS/CCU

Removal of contaminants possible, achieves virgin quality

#### Winning criteria: Profitable, scalable, low eco-footprint, high quality products!

![](_page_23_Picture_21.jpeg)

# CHANGE OR BE CHANGED!

![](_page_24_Picture_1.jpeg)

![](_page_24_Picture_2.jpeg)

![](_page_25_Picture_0.jpeg)

# Thank you!

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