



We create chemistry

Circular Economy: Decoupling growth from resource consumption

January 2020





Our purpose:

We create
chemistry for a
sustainable future

Sustainability



What we want to achieve

- We want to be a thought and action leader in the area of sustainability.
- We want to increase the role of sustainability in our business decisions.
- We want to show how we add value to society along the value chain.

Key measures

- Decouple our CO₂ emissions from organic growth through a Carbon Management program.
- Invest in cutting-edge technologies to speed up the transition to a **circular economy**, such as our ChemCycling project.
- Further increase our sales from Accelerator products, which make a substantial sustainability contribution in the value chain.

Circular Economy transforms value chains ...

Public awareness strongly increasing



How can we contribute?

Legislation becoming more concrete



What does it mean for technology and business?

OEMs are setting their own targets



How to reach recycled plastics in all cars?

Recycled replaces virgin materials



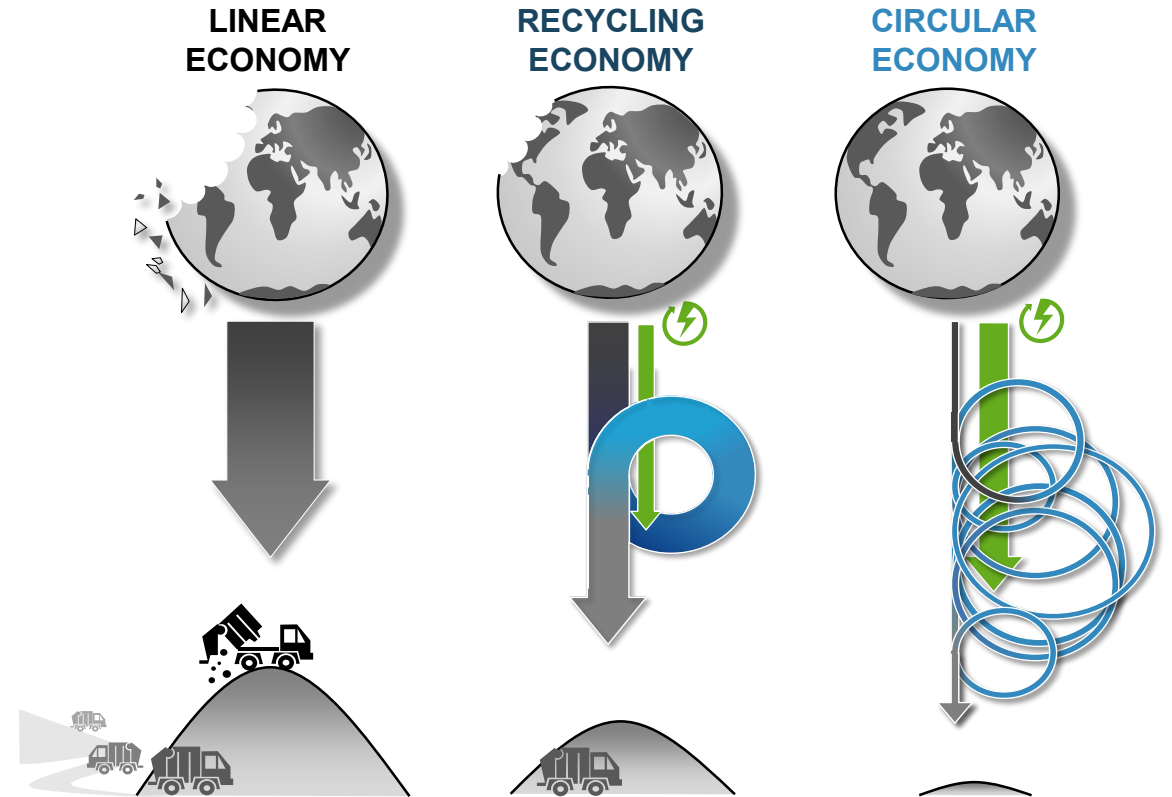
How is the value chain changing?

... and is fueled by more stringent regulatory changes

Circular Economy means

Decoupling growth from resource consumption

- Keep **resources in use** for as long as possible
- **Minimize** residual **waste**
- **Recover and regenerate** products and materials



To decouple growth from resource consumption, we need more “close the loops” solutions

External factors driving the shift towards circularity



Technology shifts

e.g. precision farming, electric vehicles



Consumption changes

e.g. sharing of cars, household goods



New regulations

e.g. EU Circular Economy package, building insulation standards

Our contribution



KEEP IT SMART

Increase efficiency of processes, enhance effectiveness of products and solutions

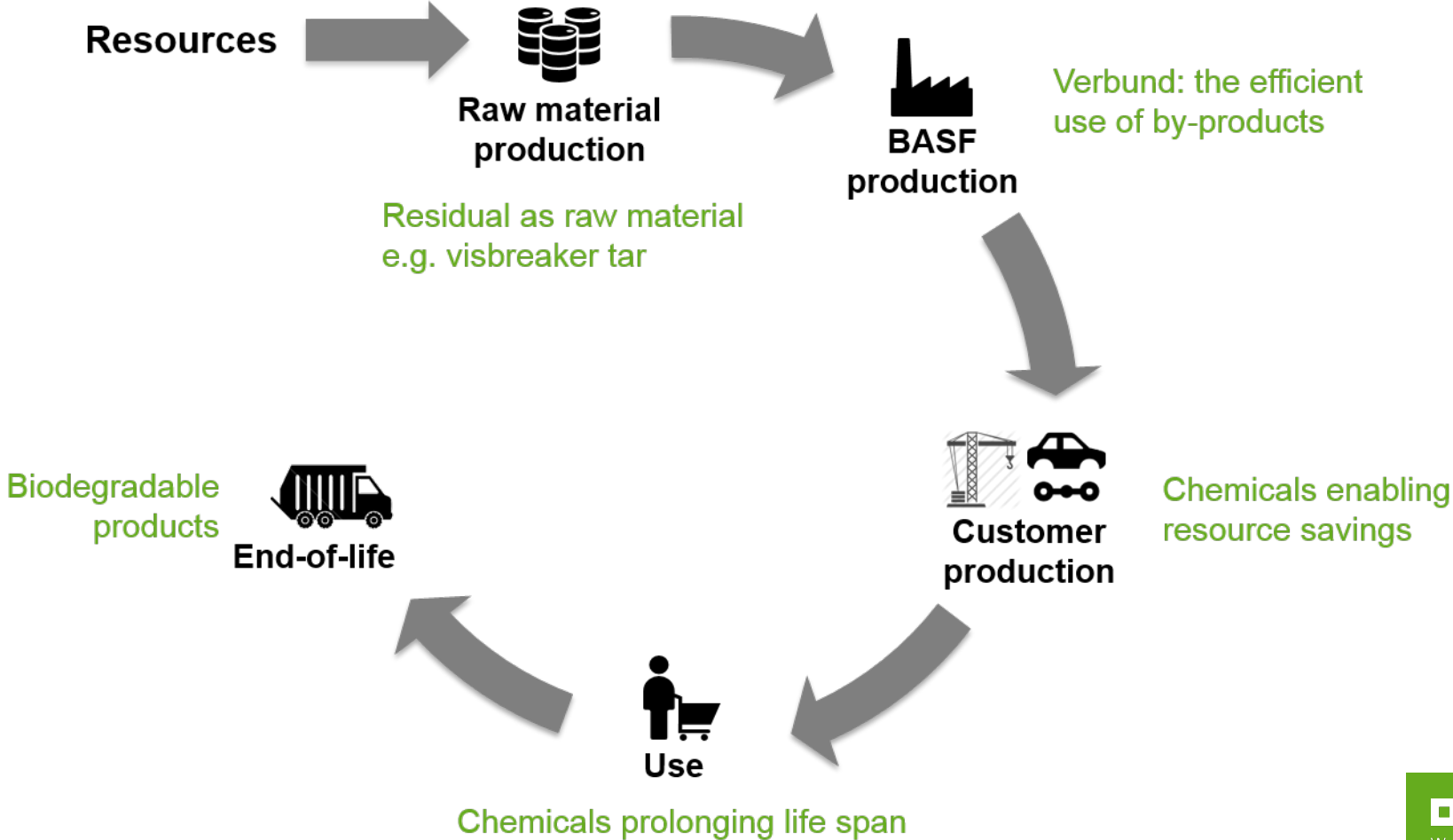


CLOSE THE LOOP

Turn waste into resources, use natural loops

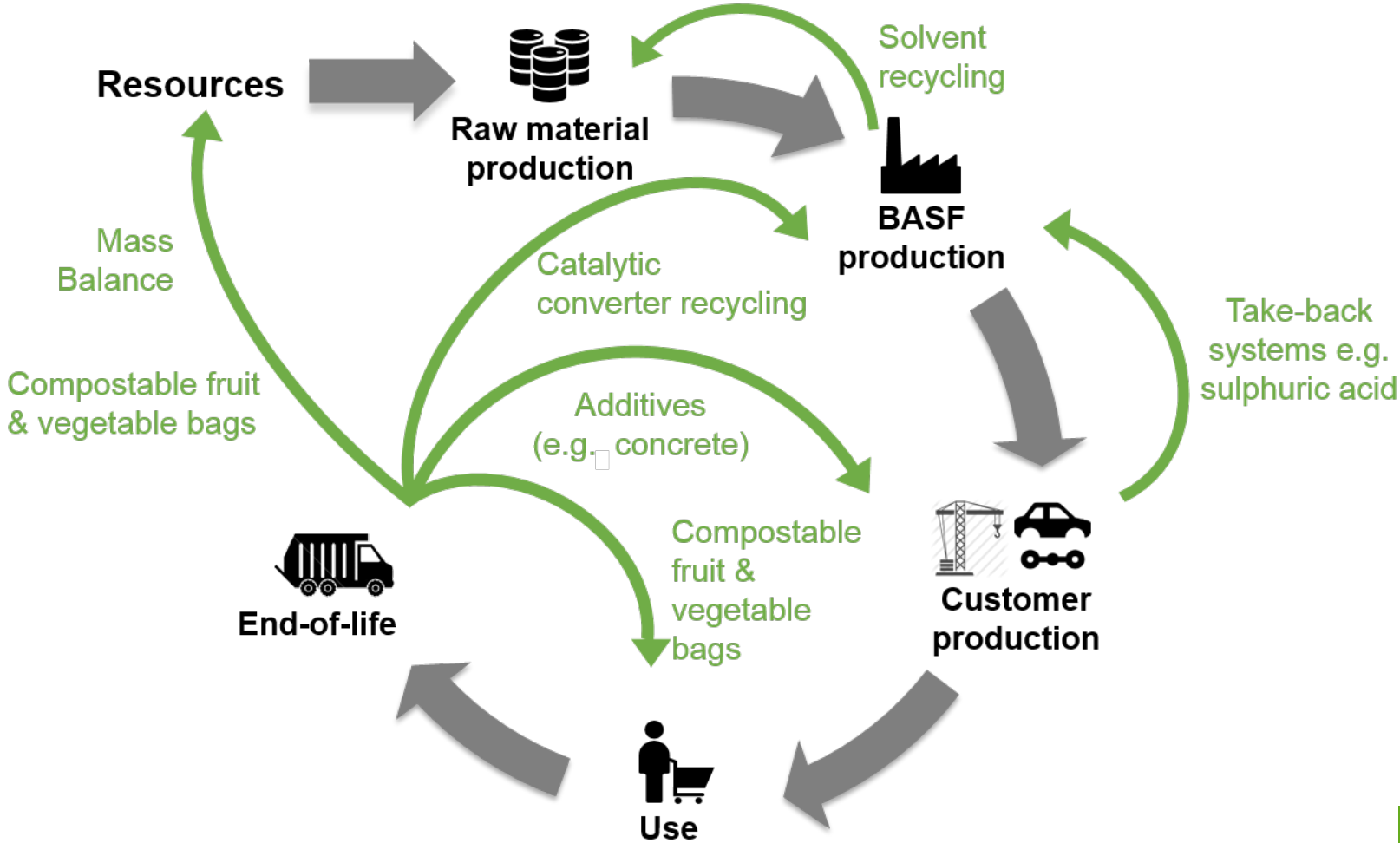
Keep it smart

Increase efficiency of processes and enhance effectiveness of products and solutions

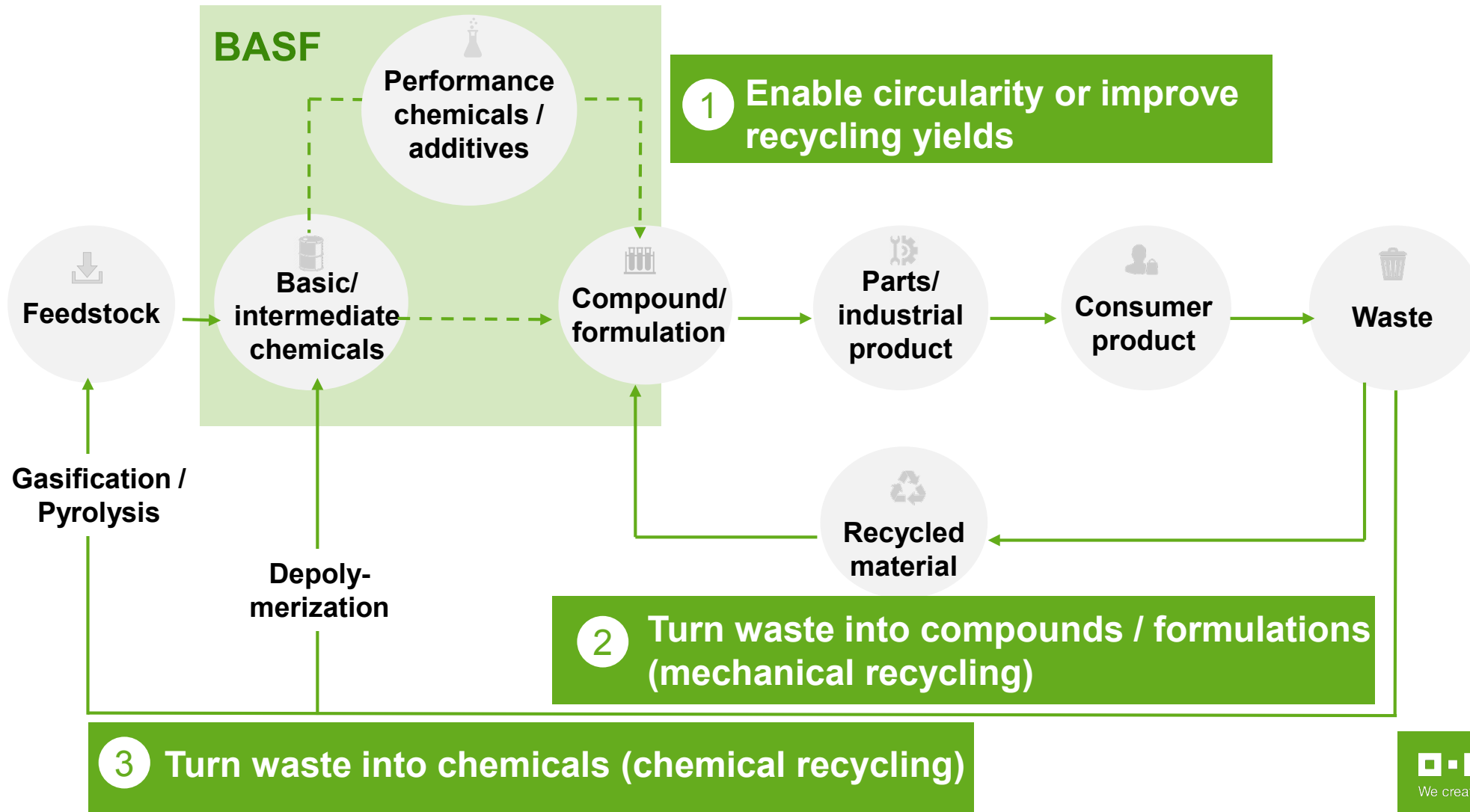


Close the loops

Turn waste into resources, use natural loops



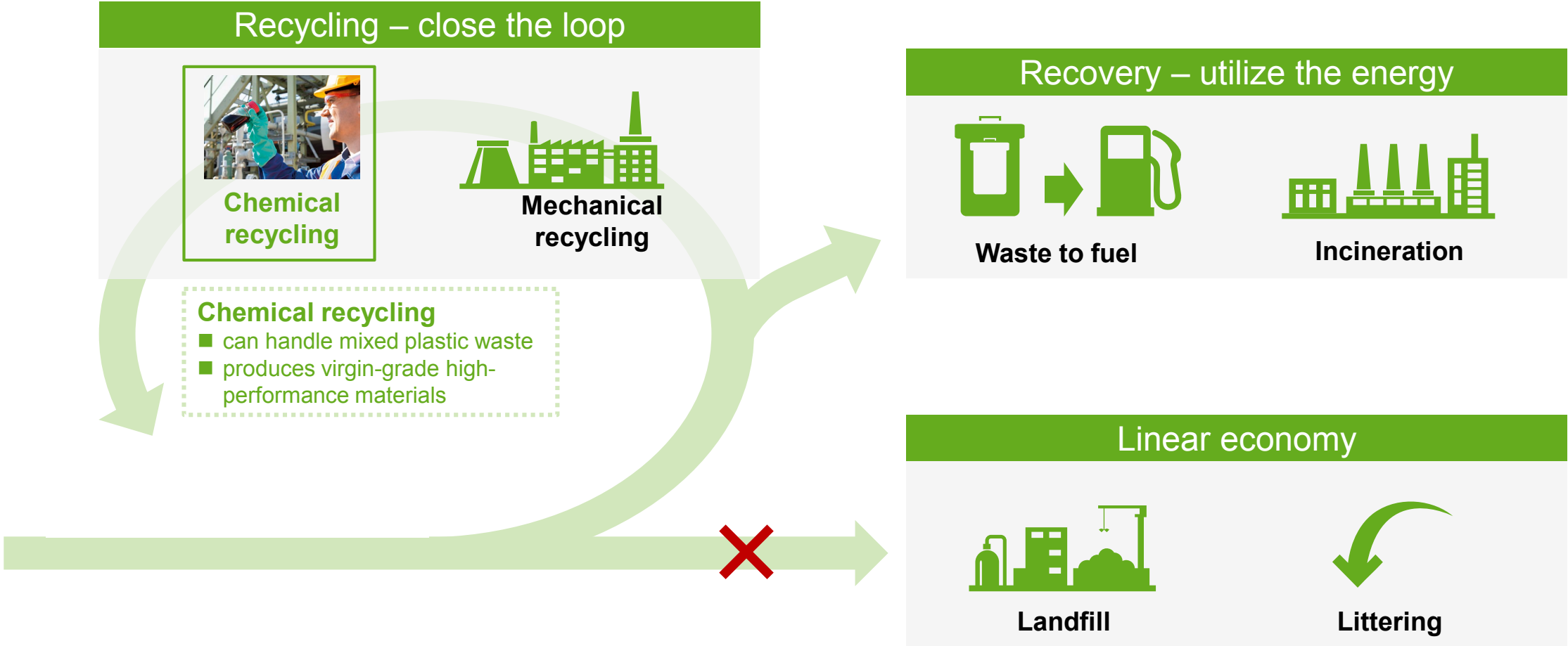
We have identified three main opportunity fields for CE



**A chemical recycling
approach:
ChemCycling™**

Chemical Recycling

A missing link to close the loop



BASF's ChemCycling™ project

Breaking new ground in plastics waste recycling



Benefits of the ChemCycling™ project

Contributing to a circular economy and saving resources and emissions

- **Plastic waste** for which no high-value recycling processes are established yet **is turned into virgin-grade high performance materials**
- Using recycling feedstock from plastic waste in chemical production helps to **save fossil resources**
- **CO₂ emissions are saved** against conventional plastic production and incineration of plastic waste



Our customers can achieve their recycling targets by using Cycled™ materials – materials based on chemically recycled plastic waste



With ChemCycling™ more plastic waste will be recycled

- We contribute to the recycling of **plastic waste for which no high value recycling processes are established** yet.
- ChemCycling™ is not a competition but a **complementation to mechanical recycling**.
- Examples of waste plastics which are difficult to recycle mechanically or which are incinerated include:
 - ▶ Plastics with adhering food residues
 - ▶ Multi-layer food packaging
 - ▶ Scrap tyres and composite plastics used in the automotive and construction industries



Post-consumer waste



Scrap tyres

With ChemCycling™ we increase recycled content in efficient materials for demanding applications

- Products based on chemically recycled plastic waste do achieve the **same level of quality and purity as virgin plastics**, because the polymer chains of the plastics are chemically broken down into chemical feedstock.
- This makes it possible to **manufacture products with recycled content that have to meet high quality and hygiene standards**, for example food packaging.



ChemCycling™ therefore offers **opportunities for innovative business models for customers**, who place great value on products and packaging made from recycled materials but who cannot or do not want to compromise on quality.



Allocation of recycled feedstock with the mass balance approach

How it works

Feedstock

Fossil



Recycled

Use of recycled feedstock in very first steps of chemical production (e.g., steam cracker)

BASF Production Verbund



Utilization of existing Production Verbund for all production steps

Products

Conventional product



Mass balance product

Allocation of recycled feedstock to selected products

Status of BASF's ChemCycling™ project

(January 2020)

● Project start

Network and partnerships along the value chain developed

2018

●
First batches of pyrolysis oil fed into the Verbund

●
First certified ChemCycling™ product prototypes realized with customers

●
Certification system for recycled products developed together with ecocycle

2019

●
Presentation of customer prototypes at K press conference and K fair

●
Investment into Quantafuel to jointly drive chemical recycling of mixed plastic waste

2020

●
First commercial applications of high-performance plastics from recycled feedstock in demanding applications

The Biomass Balance approach

The Biomass Balance Approach: Replacing fossil resources in the current Production Verbund

Feedstock

Fossil



Renewable

Use of renewable feedstock in very first steps of chemical production (e.g., steam cracker)

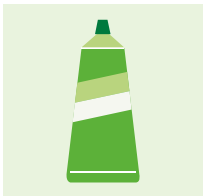
BASF Production Verbund



Utilization of existing Production Verbund for all production steps

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Conventional product

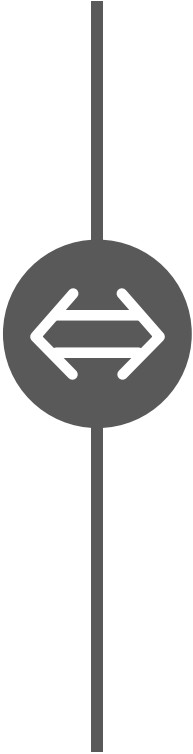
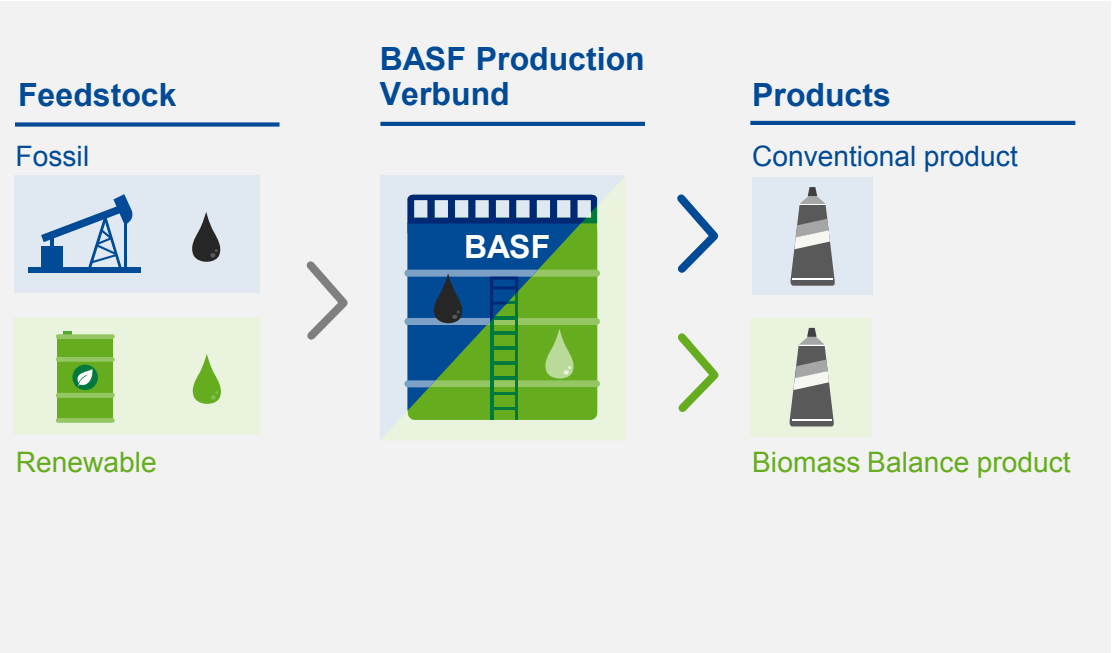


Biomass Balance product

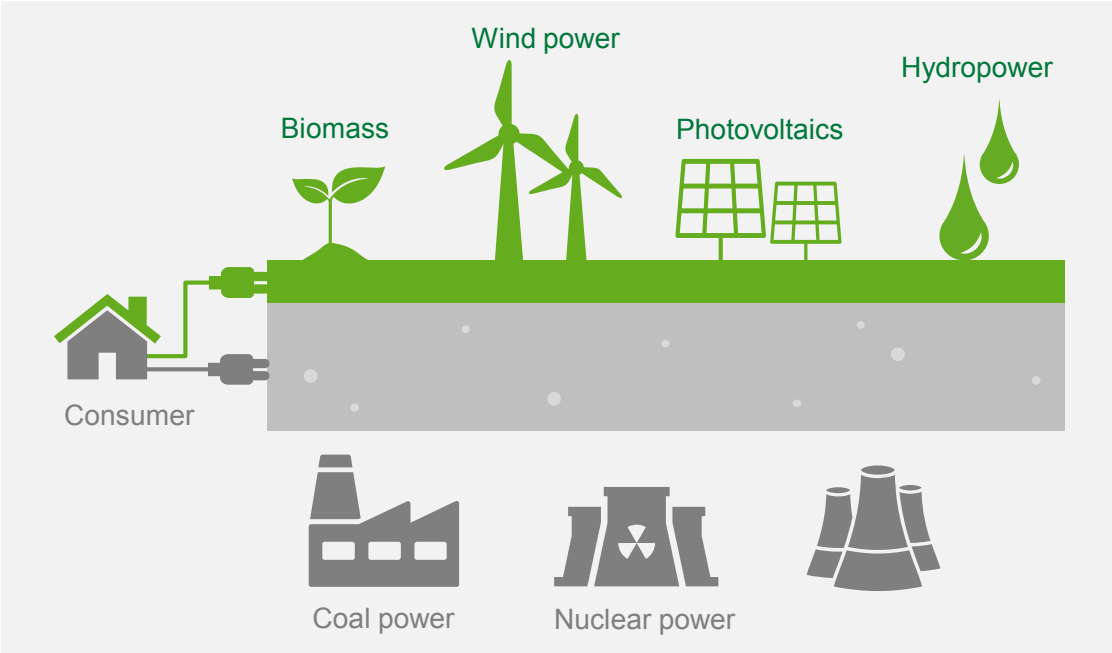
Allocation of renewable feedstock to selected products

Biomass Balance Approach can be compared to green electricity

Biomass Balance Approach



Green electricity



Renewable raw materials need to be sourced sustainably

Use certified renewable raw materials

- Waste/residues are preferred renewable raw materials
- Independent sustainability certification from recognized schemes, e.g., REDcert-EU and ISCC-EU

Apply standardized sustainability criteria

- Minimum sustainability criteria as in EU RED*
- Greenhouse gas emissions savings
- Responsible biomass production
- Protection of areas with high biodiversity and large carbon stocks



Industries already benefit from our Biomass Balance products



HySorb® Biomass Balanced – Sustainable superabsorber for baby diapers



R-M® automotive refinish products



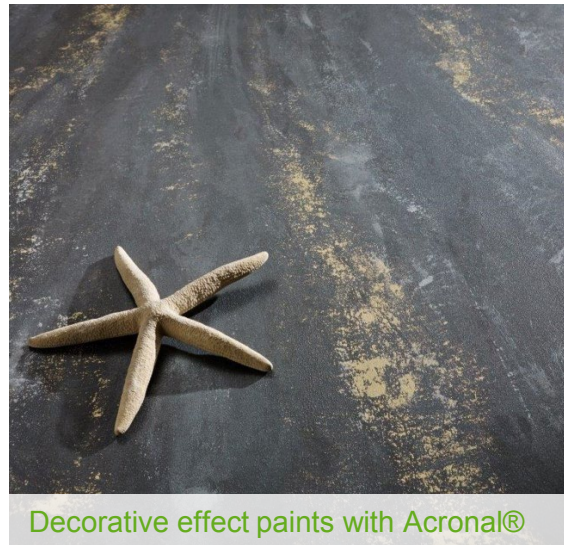
EU-REDcert-Methanol



Glasurit® automotive refinish products

- Saves fossil resources
- Recyclable/ Reusable
- No compromise on performance
- Identical product derived from biomass
- Reduces greenhouse gas emissions (CO₂)
- Independently certified by TÜV SÜD

Ultramid® polyamide for textile application



Decorative effect paints with Acronal®



Flexible films for new packaging made of Ultramid®



Acronal® binders for interior paints



Styropor packaging solution

Circular Economy Solution Examples

Accelerator HySorb® Biomass Balanced

Process information

Application: Superabsorbent polymers for disposable diapers, feminine hygiene and incontinence products

Customer Industry: Hygiene Industry

Market: Global

Sustainability performance

- BASF's biomass balance approach drives the replacement of fossil with renewable resources in the value chain of this or other BASF products.
- Renewable feedstock with sustainability certificate is used at the beginning of the production chain and then allocated to this biomass balanced product*, based on third-party standard by REDcert².
- LCA results (3rd party reviewed BASF assessment): saves fossil resources and reduces carbon footprint compared to non biomass balanced HySorb®.
- High performance superabsorbent: drop-in solution.

→ High performance superabsorbent driving the use of biomass



Baby Care



Adult Inco



Feminine Care

Differentiation potential

- Renewable feedstock
- Climate change
- Additional resource efficiency through preferred use of waste vegetable oil & fat, organic waste biogas
- Added value proposition, for consideration by customers in developing their claims

Accelerator Cetiol® Ultimate

Process information

Application: Ultra-fast spreading emollient for face, body, sun care and color cosmetics

Customer Industry: Personal care

Market: Global

Sustainability performance

- 100 percent renewable-based and volatile emollient
- Replacement of volatile silicones possible
- Easier to use than volatile hydrocarbons
- Readily biodegradable
- Gives more flexibility in the development of natural cosmetic concepts for improved skin feel

→ Regarded as break through innovation and was awarded with market prizes



Differentiation potential

Customer:

- Plant based chemistry for possible cyclomethicone substitution
- New formulation textures and claims possible

Consumer:

- New natural cosmetic concepts

Accelerator ecovio[®] M2351 (mulch film)

Process information

Application: Mulch film

Customer Industry: Agriculture

Market: Global



Sustainability performance

- Biodegradability in soil leaving no residues in the field after ~2 years, unlike traditional polyethylene films
- Resource efficiency and water savings over time (higher yields by avoiding the white pollution of PE residues)
- Avoiding emissions of toxic substances from open burning of PE mulch film
- Waste reduction, avoiding soil displacement by PE residues

Differentiation potential

- Cost Savings Downstream
- Pollution (air, soil)
- Resource Efficiency
- Climate Change & Energy
- Biodiversity

→ Over time, ecovio[®] biodegradable mulch film helps to avoid adverse consequences of the white pollution in agriculture such as crop yield decrease and water savings

Accelerator Glasurit® 151-170E

Process information

Application: Rapidly drying primer filler, ideally suited for minor and moderate repair jobs

Customer Industry: Automotive refinish coatings

Market: EMEA

Sustainability performance

- Repairs of minor to moderate damages to car parts are now among body shops' most common repair jobs. They have to work profitably in this segment.
- UV-A technology ensures quicker drying than any other heat source, commonly used in body shops. It therefore enables them to save energy costs and drying time.
- Saves further process times because it eliminates the cooling phase.
- UV-A radiation is the least harmful part of ultraviolet light. This makes the technology safe and easy to use.
- Biomass balanced product: 100 percent of fossil resources are mathematically replaced by renewable resources, the method is certified by REDcert².

→ Boost efficiency at the speed of light



Differentiation potential

Customer:

- Cost savings downstream
- Resource efficiency
- Climate change and energy

Accelerator Cavipor® FTX 1

Process information

Application: Thermal insulation

Customer Industry: Construction

Market: Europe

Sustainability performance

- Ecological – natural and upcycled raw material
- CO₂ – efficient – low energy consuming production
- Non combustible – mineral based
- Non hazardous – foamed with water and air
- Recyclable – re-use of old material

→ Reliable insulation




Cavipor®

Differentiation potential

- Homogeneous insulation
- Transport and store 1/10 of foam volume
- Safe, fast and clean application
- Breathable
- Easily disposable



We create chemistry