CHEMISTRY THAT MATTERS™

CIRCULAR ECONOMY AND COMMODITY PLASTICS: HOW TO FIND CONCEPTS FOR THE FUTURE

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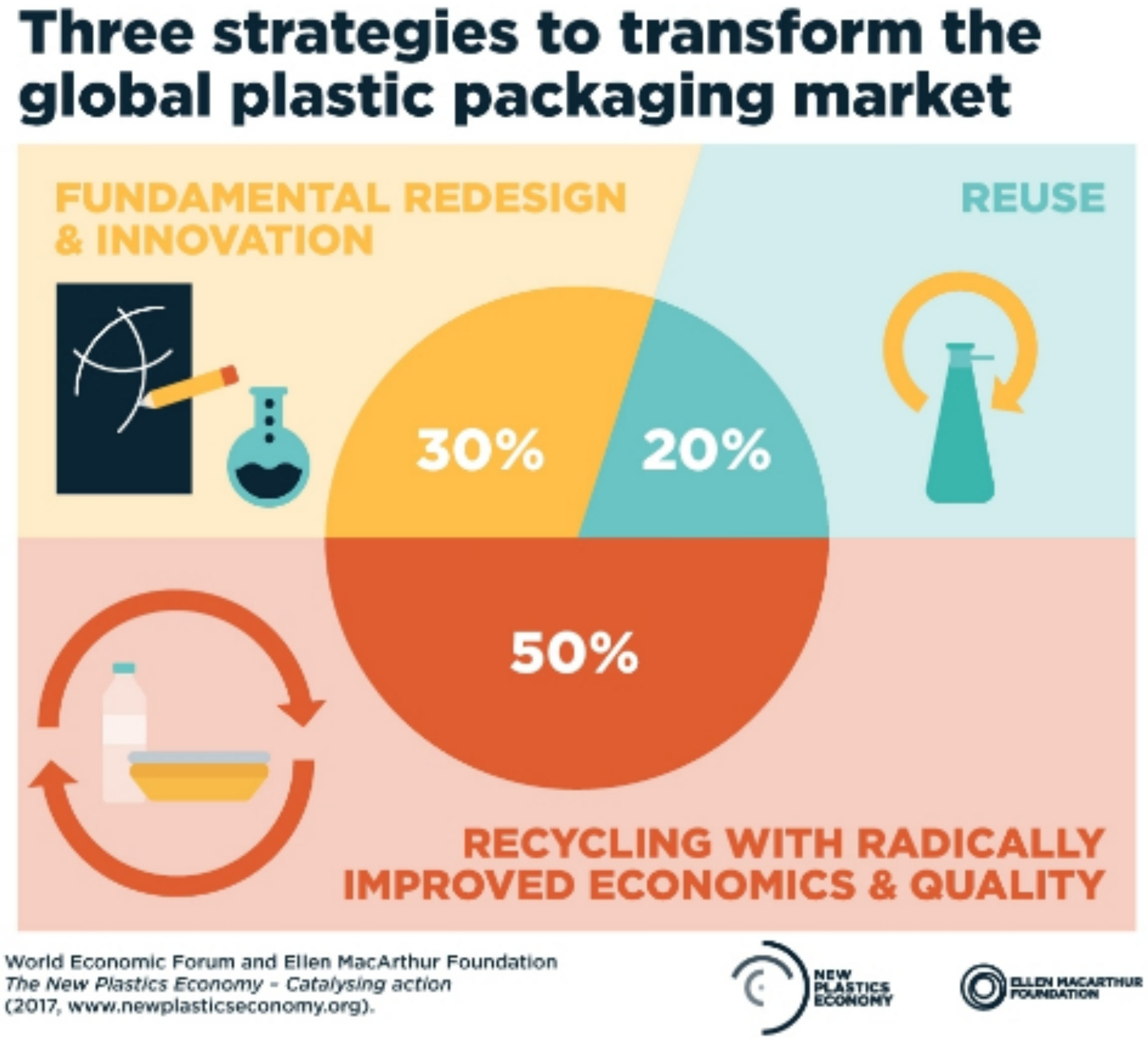
SABIC AT-A-GLANCE

1976	34,000	50	3rd	120th	4
Company established	Employees around the world	Countries of operations	Largest global chemical company*	Largest public company in the world*	Core businesses
86 US$ B**	4.9 US$ B**	39.9 US$ B**	≈ 150	11,534	64
Total assets	Net income	Annual revenue	New products each year	Global patent filings	World-class plants worldwide

*Forbes 2018 **Billion

THE CHALLENGE TO THE PLASTICS INDUSTRY

WEF AND EMF PUSH FOR A “NEW PLASTICS ECONOMY”



Fundamental redesign

- Small-format packaging
- Multi-material packaging
- Uncommon plastic packaging materials
- Highly nutrient-contaminated packaging

Have low probability of being recycled

Reuse

- Reusable packaging in the cleaning- and personal-care market (e.g. reusable dispensers)
- Reusable shopping bags, beverage bottles
- Packaging in the business-to-business market

Recycling

- Economically attractive recycling will add value to the materials

CIRCULAR ECONOMY AND VALUE CHAIN COOPERATION

NEW PARADIGM: CIRCULARITY

Value retention of materials
Resources and energy are invested to keep products in the cycle, monetary costs and energy consumption are secondary

Minimize waste generation
Materials should not leave the circle through disposal, incineration or energy recovery

Circularity is the solution for many economic and environmental issues

Picture taken from Teppfa magazine spring 2016 and from United Nations

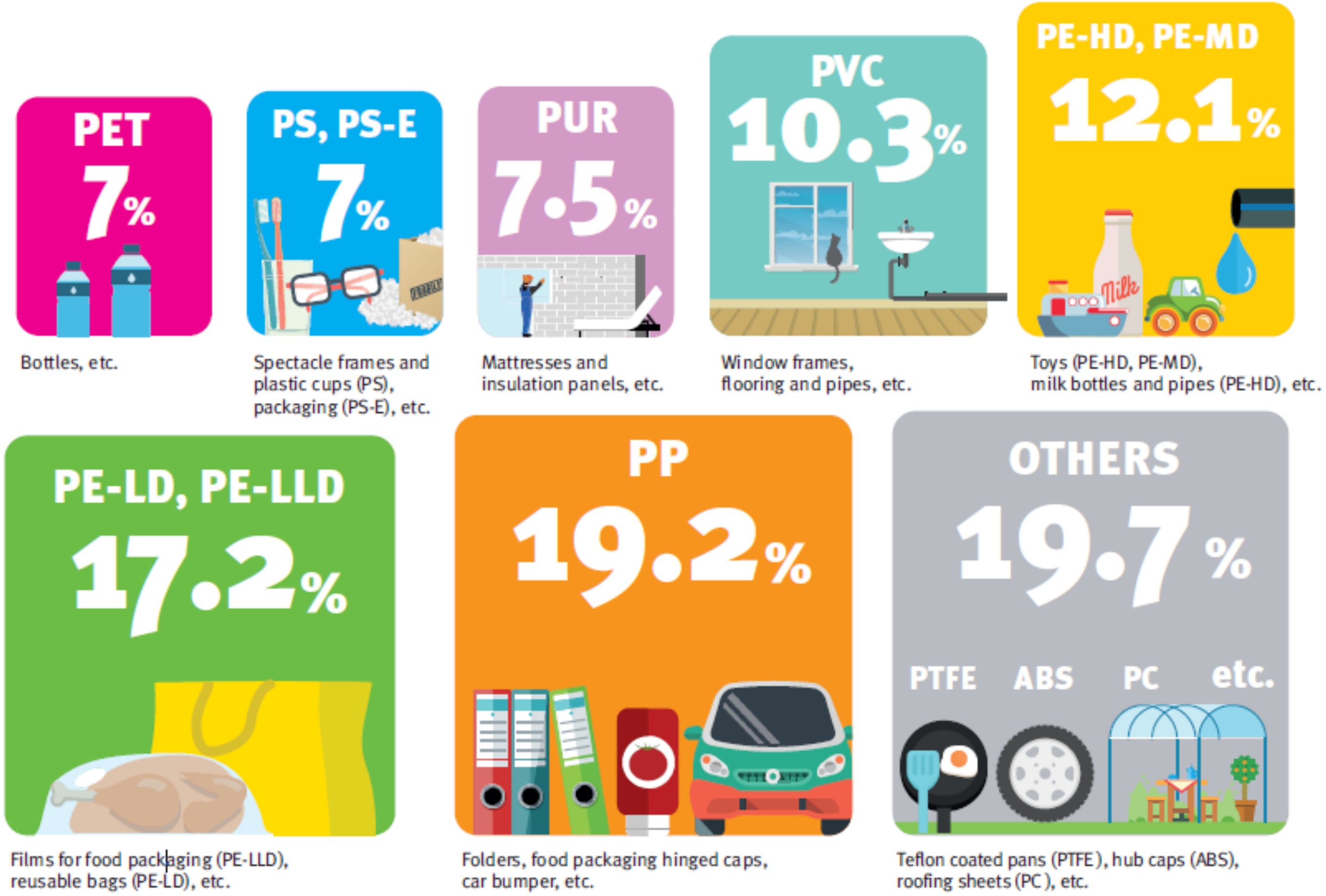
CIRCULAR ECONOMY THINKING

- Circularity as aspirational design criterion
- Focus on materials consumption and recycling
- At each value chain step circularity must be a key business model criterion, take the whole chain into account
- New concept so quantification of circularity needs further work

Raw mat	Design	Prod	Distr	Use	Collect	Recycle
• Biobased • Recoverable materials	• Design for recycling • Disassembly	• Renewable energy • Minimize materials use	• Local production • Supply chain design	• Durable products • Reparable products	• Component Separation • Collection infrastructure	• Reuse • Disassembly • Recycle

Collaboration along the value chain is essential

A VARIETY OF PLASTICS FOR DIFFERENT NEEDS



- Polyolefins accounts for almost 50% of total market with growing share
- Biodegradable and renewable plastics represent <1% of total market

Source: PlasticsEurope ; Plastics – The Facts 2015

THE FOOD WASTE PROBLEM (IN NUMBERS)

Scale

- ✓ Edible food wastage worldwide = **1.3 billion tonnes**
- ✓ Land use: ~ 30% of the world’s agricultural land (**1.4 billion hectares**)

Environment

- ✓ Food Waste is the **third biggest source of carbon emissions** after USA and China
- ✓ About **30 percent of the environmental footprint of an average European** are linked to the production and distribution of food and to nutrition

Economic impact

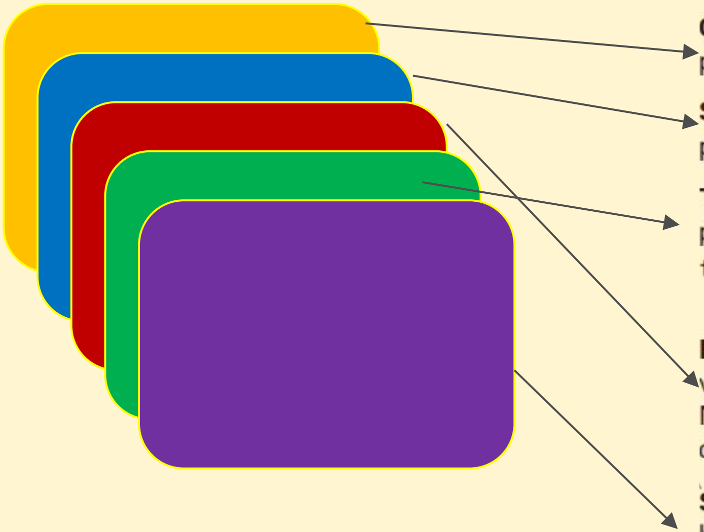
- ✓ On a global scale, the **cost** (based on 2009 producer prices) of food wastage is **750 billion USD**
- ✓ This is equivalent to the GDP of Switzerland

Source FAO Study 2013; Carbotech, European Food & Beverage Plastic Packaging 2016

PACKAGING IS HIGH TECH

Highly engineered

Each component of a flexible multilayered package imparts important functions to the overall architecture.



Coating: This optional thin film protects the printed material. It can be any of a number of specialty polymers.

Outer layer: This layer provides a printing surface and is usually polyethylene or polyethylene terephthalate (PET).

Structural layer: This layer gives the package its shape and prevents tearing and puncturing. Polyethylene is the workhorse. PET might be used for greater toughness.

Tie: A tie layer combines two chemically dissimilar polymers, such as nylon and polyethylene, that tend to separate. Functionalized polyolefins are common tie-layer resins.

Barrier: This layer primarily keeps oxygen from infiltrating the package. Ethylene-vinyl alcohol offers high performance and is considered the industry standard. Nylon and PET can be used when less oxygen blocking is needed. Aluminum, deposited on a polymer or used as foil, offers the highest level of performance.

Seal: The polymer in this layer usually has a low melting point so it can be heat-sealed. It also must not interact chemically with the food it contacts. Polyethylene is often used. Companies look to ethylene-vinyl acetate or ionomer when they need higher performance.

Note: The example is generic. Various products and environments require different arrangements of layers.

CREDIT: YANG H. KU/C&EN/SHUTTERSTOCK (ALL)




NEW PACKAGING CONCEPTS REQUIRED

Mono-material solutions

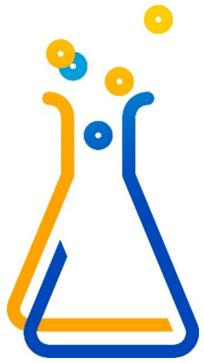
PE for flexible, PP for rigid, PET for bottles

Barrier coatings

Easy to remove, not humidity dependent, prolongs shelf life reliable

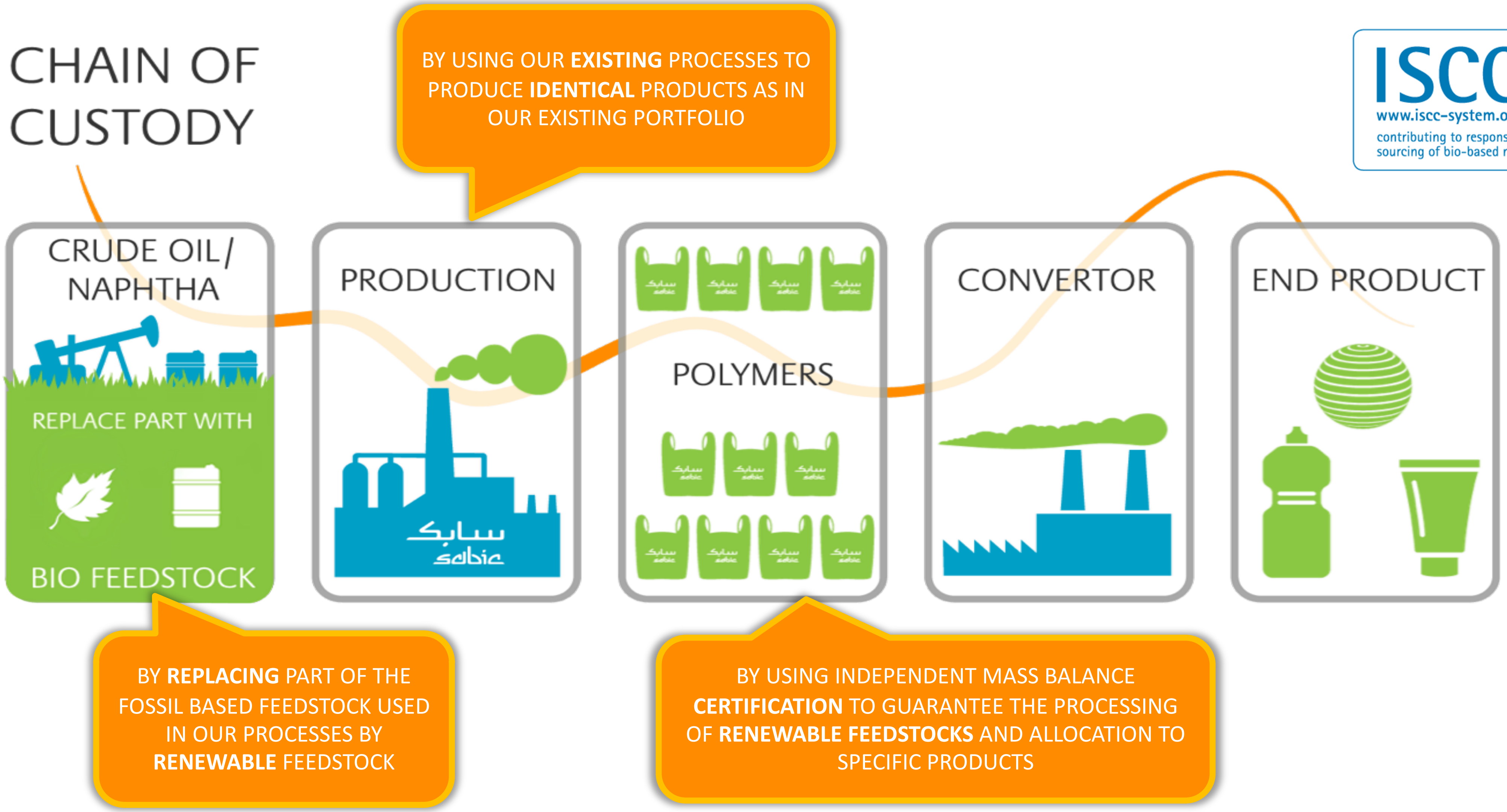
Lightweight packaging

Foaming, new strong materials



SABIC’S SOLUTIONS

CERTIFIED RENEWABLE PE AND PP MATERIALS



ISCC
www.iscc-system.org
contributing to responsible sourcing of bio-based materials

WHAT WILL SABIC DO?

mixed plastic waste back to chemicals and/or plastics.

SABIC is investing in a demonstration plant consisting out of infrastructure and equipment that upgrades pyrolysis oil*) to a suitable feedstock for our crackers. The project is being executed near one of our cracker facilities.

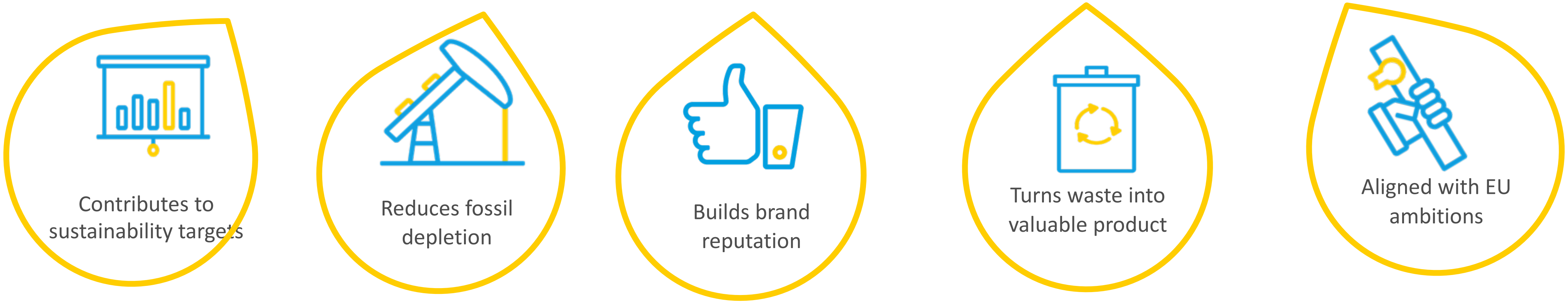
SABIC intends to build a facility with an annual capacity for handling pyrolysis oil between 10,000 and 20,000 tons and targets this demonstration plant to be operational within 3 years.

A new value chain will need to emerge for this Chemical Recycling of mixed plastic waste. SABIC is cooperating with different stakeholders to make this Circular Economy value chain profitable.

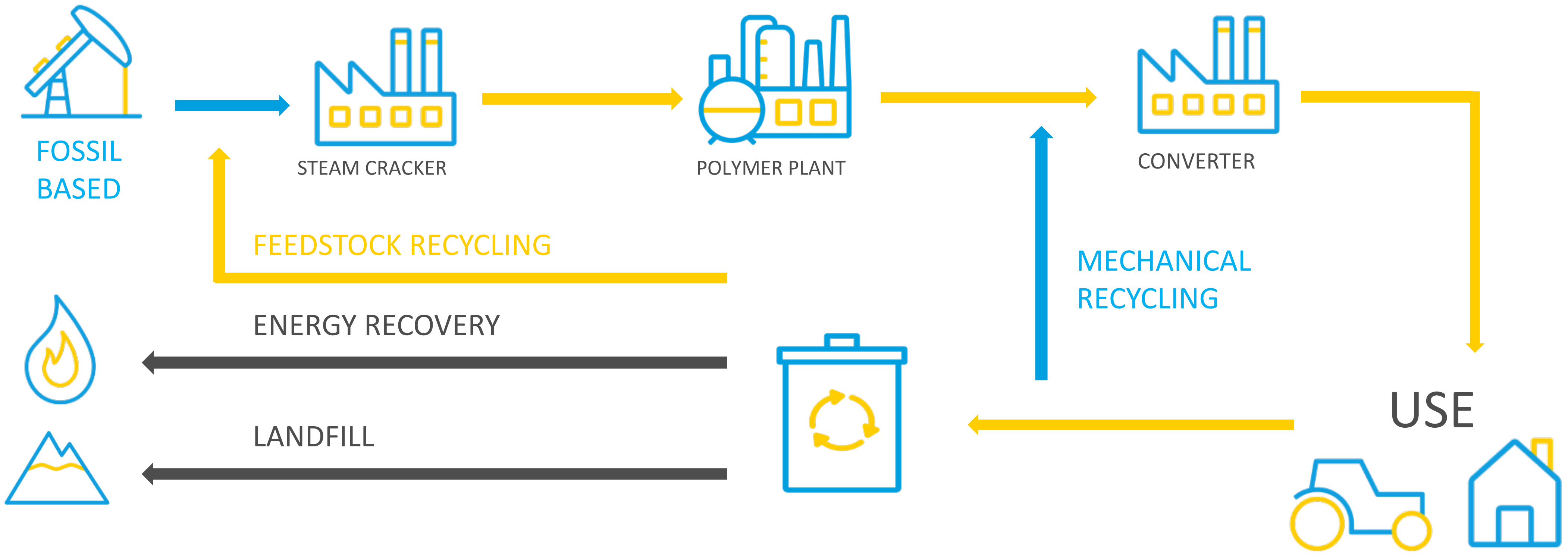
*) Pyrolysis oil derived from pyrolysis of mixed plastic waste.

THE BEAUTY OF FEEDSTOCK RECYCLING

SABIC IS COMMITTED TO SCALE UP HIGH-QUALITY RECYCLING PROCESSES FOR CHEMICAL RECYCLING OF MIXED PLASTIC WASTE TO THE ORIGINAL POLYMER.



PLASTIC WASTE TO FEEDSTOCK FOR PETROCHEMICALS



Feedstock recycling saves fossil resources, turns waste into a valuable product and is an opportunity to strengthen SABIC's sustainability position by establishing a circular economy.

CONCLUSIONS

AREAS FOR FEASIBLE CE PROJECTS

Electrification of chemical processes (transport and heating), integration with renewable energy sources

Scale up of biobased feedstock, recycled feedstock and new developments of the use of low grade biomass for the chemical industry

Waste sorting, cleaning, upgrading, mechanical and chemical recycling

Product identification, labelling, data management

CONCLUSIONS

Sustainability shifts it focus from efficiency to effectivity

Circular Economy strives to close cycles and to avoid pollution

The chemical industry in a circular economy will be radically different from our current industry model

A prerequisite for making the economy circular will be the emergence of successful new business models: the transition can only be driven by business

CONCLUSION

Closing the loop requires commitment of the complete value chain and cross-discipline academic collaboration


THANK YOU
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sabic