5º Congresso Brasileiro do PLÁSTICO™

Realização:

Instituto SustenPlást

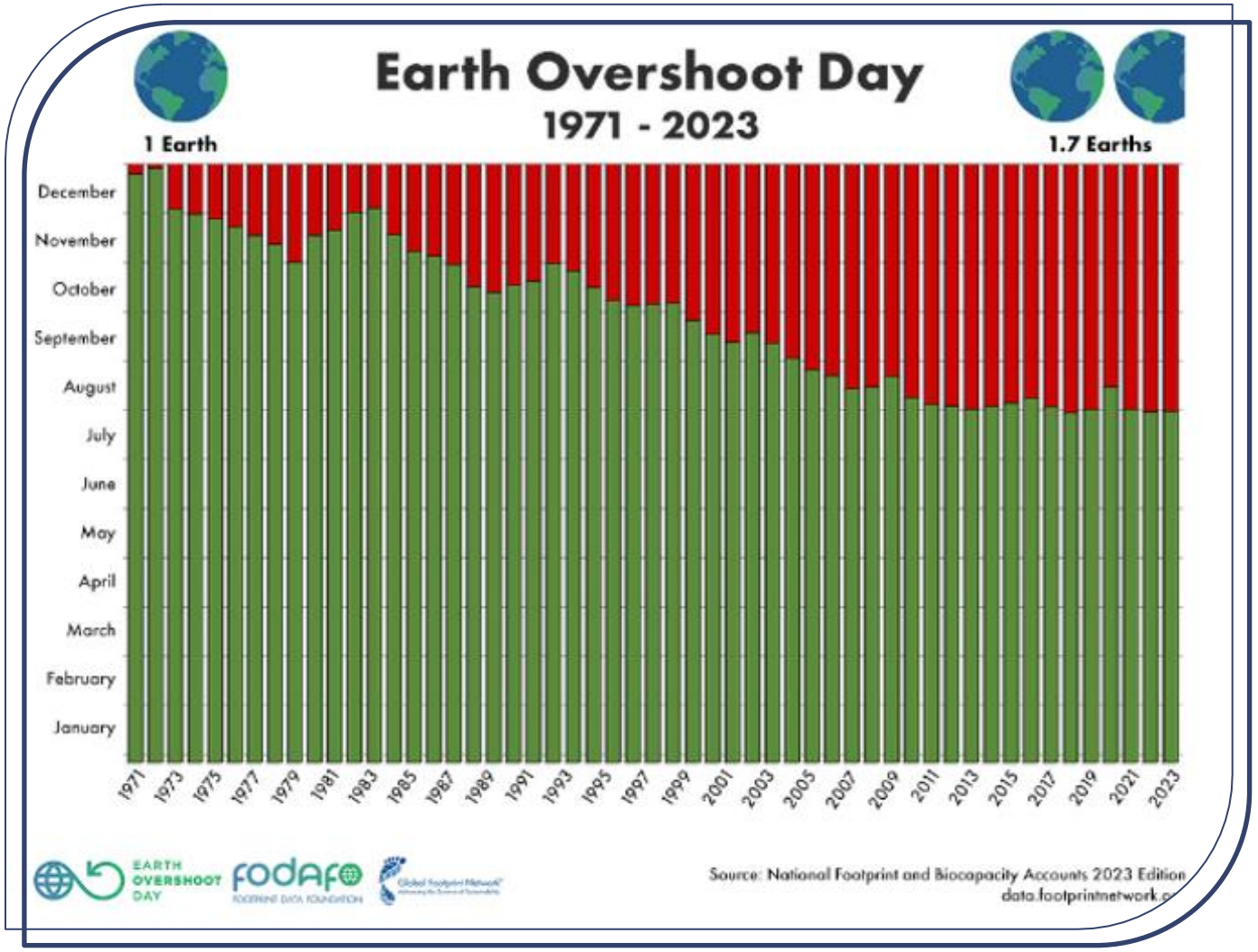
Chemical Recycling and Alternative Feedstock to

Leverage Circular Economy

FABIANA QUIROGA

SCENARIO

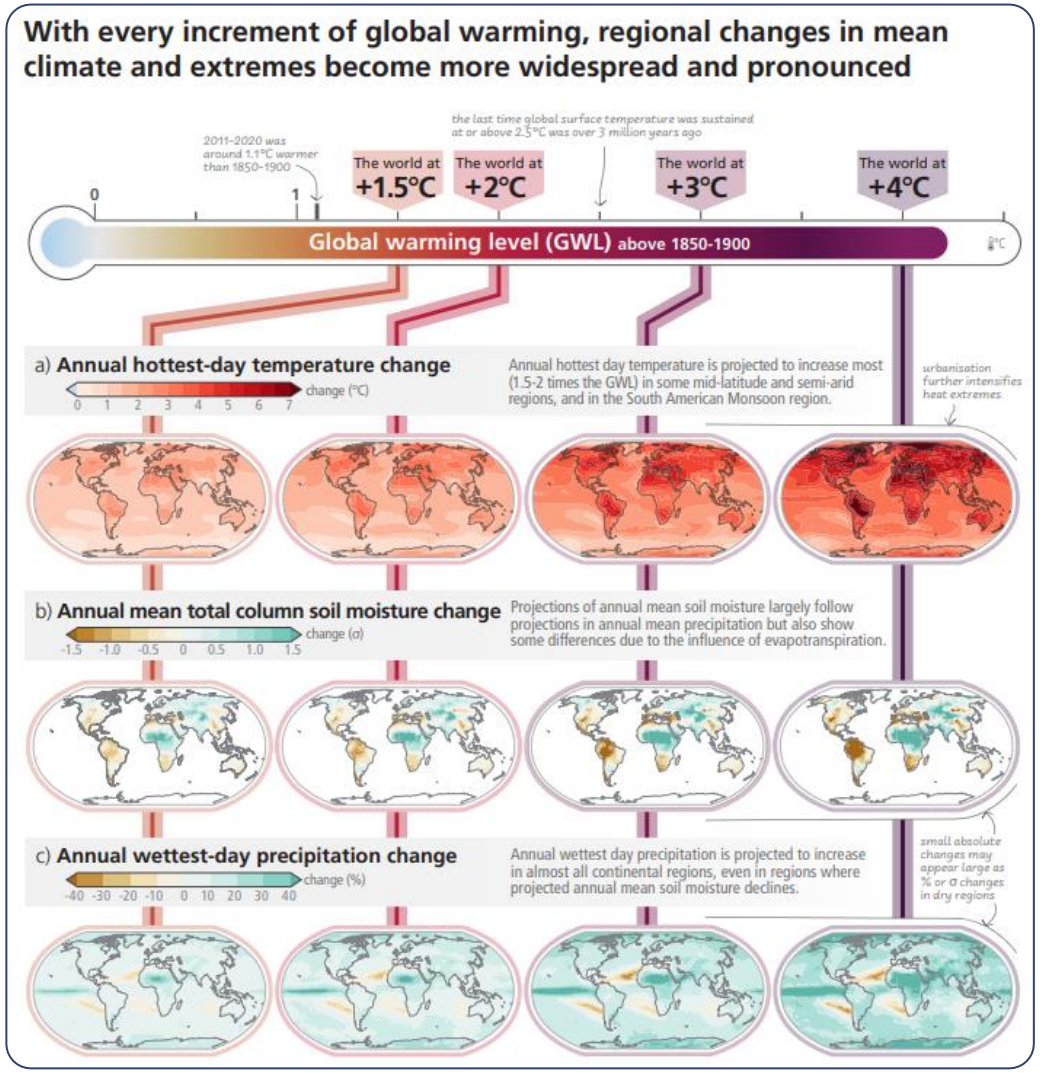
AUGUST 02, 2023 WAS THE DAY OF THE OVERLOAD OF THE EARTH, HIGHLIGHTING THE SCARCITY OF RESOURCES

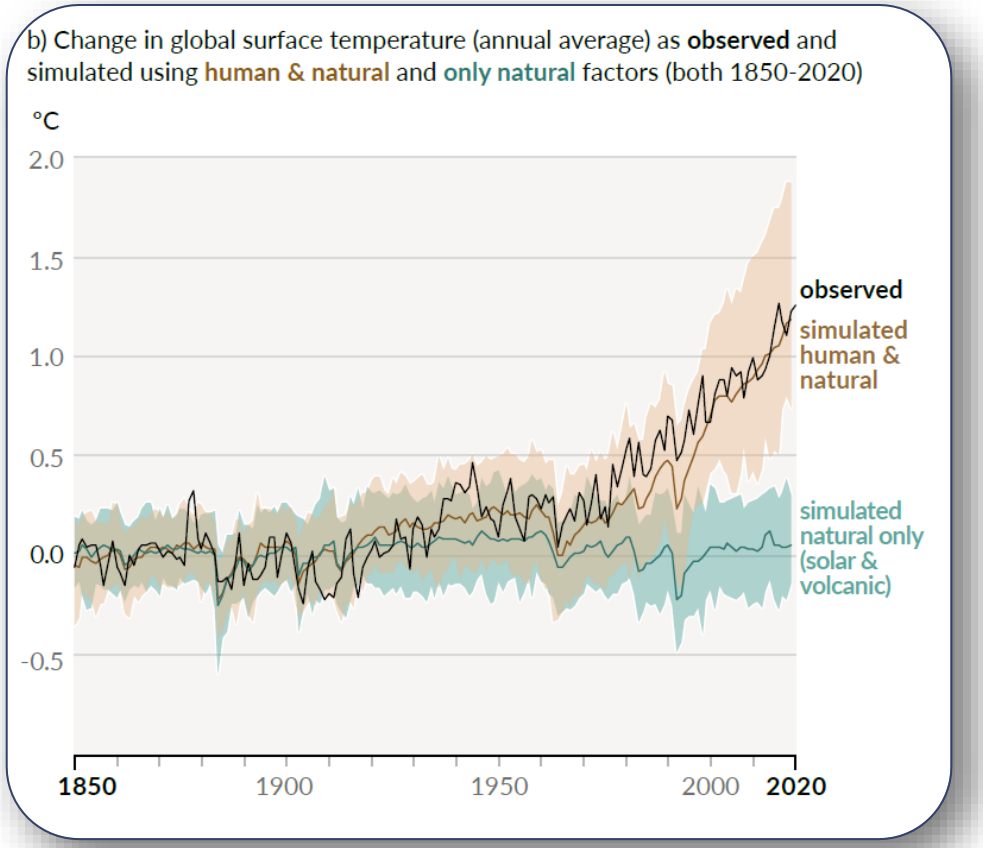


Humanity's demands for natural resources outstrip the Earth's ability to produce or renew resources in 365 days.

CLIMATE CHANGE IS HAPPENING

AND FORECASTS SHOW THAT BRAZIL CAN ALSO BE GREATLY IMPACTED

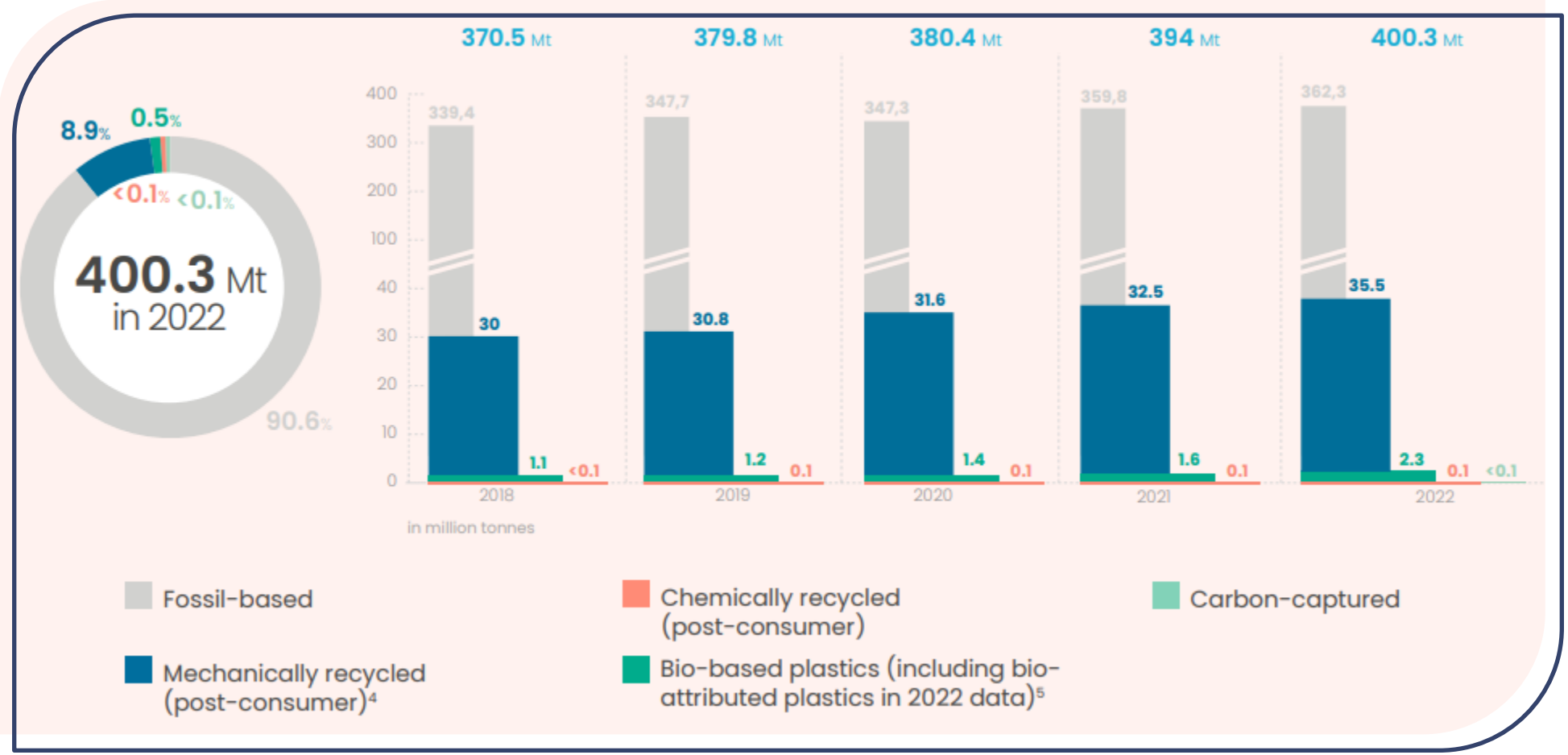




Source: IPCC (2021), Climate Change 2021, The Physical Science Basis

WORLDWIDE PLASTIC PRODUCTION

LESS THAN 9% COMES FROM MECHANICAL RECYCLING



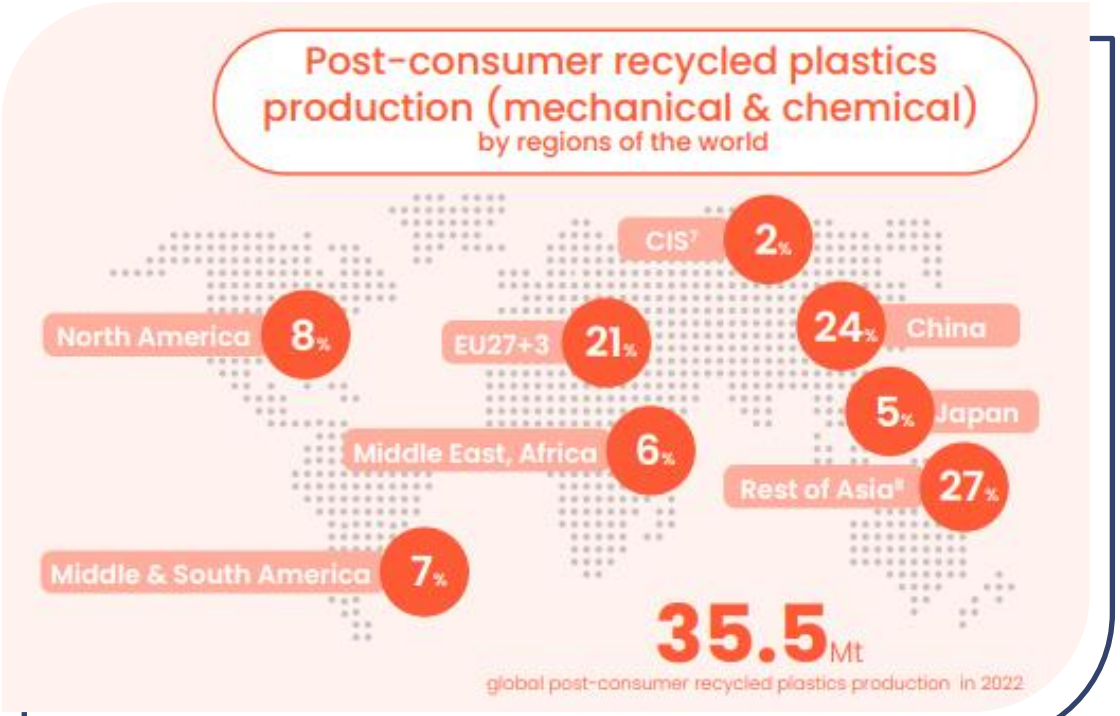
FONTE: PLASTICS – THE FAST FACTS – 2023 EDITION. ELABORAÇÃO: PLASTICS EUROPE.

WORLDWIDE PLASTIC PRODUCTION

HIGHER VOLUMES IN ASIA

BY REGION- 2022

POST CONSUMER (MECHANICAL AND CHEMICAL)



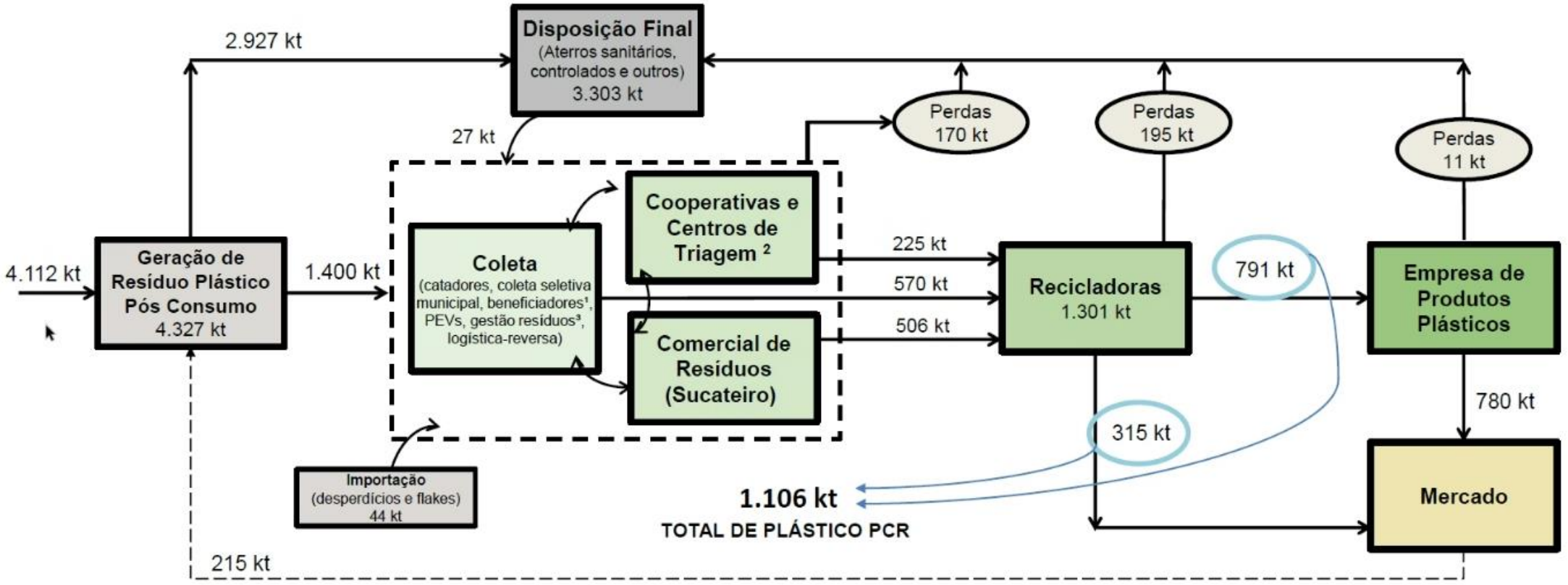
POST-CONSUMER PLASTIC RECYCLING INDEX

THE AVERAGE RATES OF POST-CONSUMER PLASTIC WASTE IN THE EUROPEAN UNION REACHED 35% IN 2020

COLLECTION AND DISPOSAL SYSTEMS ARE COMPLEX

LESS THAN 30% OF THE VOLUME COLLECTED IS DESTINED FOR RECYCLING IN BRAZIL

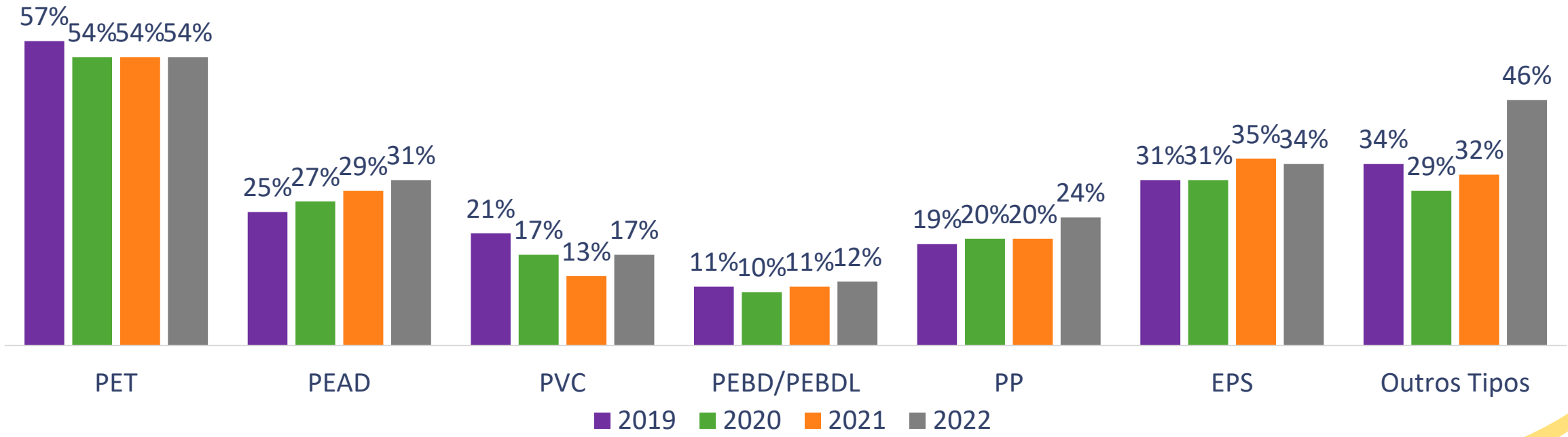
FLOWCHART: POST-CONSUMER PLASTIC RECYCLING CHAIN IN BRAZIL IN 2022



POST-CONSUMER PLASTIC RECYCLING INDEX

2019	2020	2021	2022
VOLUME OF WASTE CONSUMED IN RECYCLING			
1.325 K tons	1.402 K tons	1.587 K tons	1.722 K tons

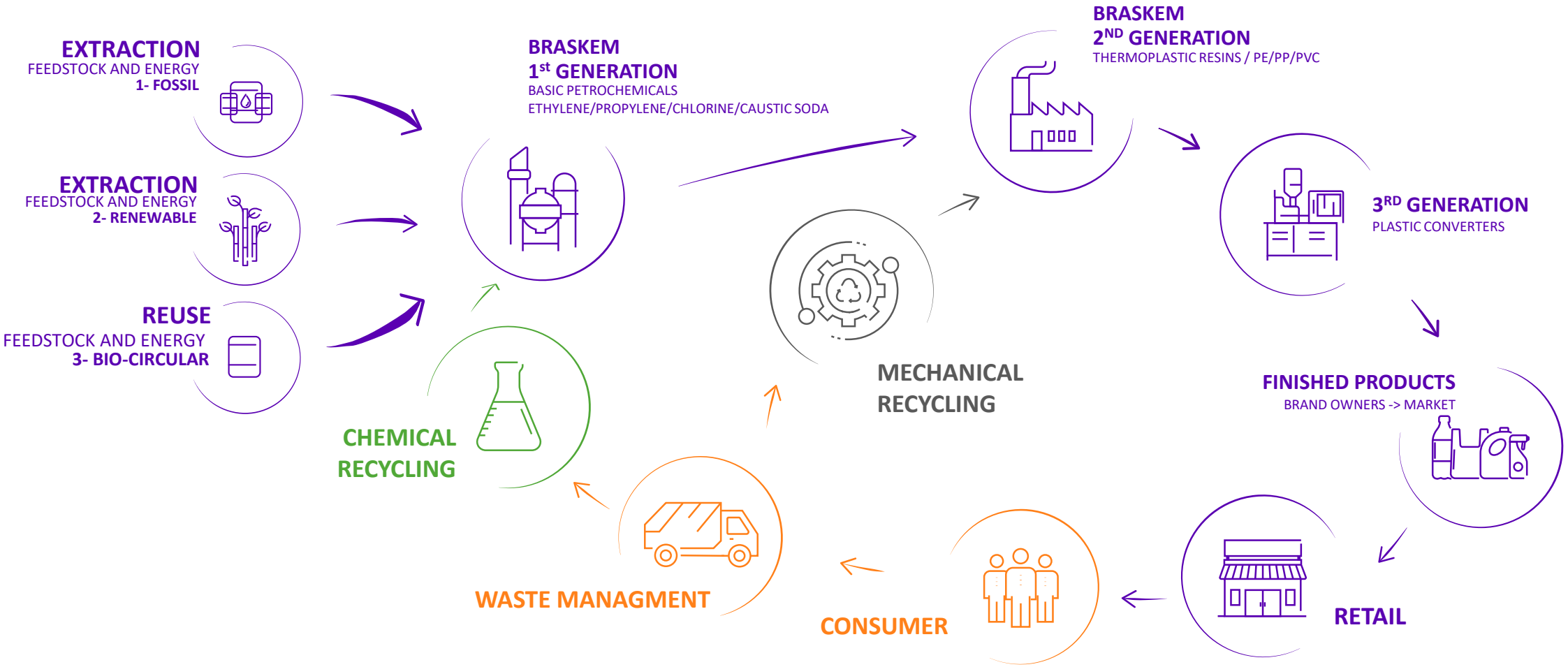
BY TYPE OF PLASTIC MATERIAL



Fonte: Maxiquim – 2019 a 2022

BRASKEM AND THE CIRCULAR ECONOMY

WORKING TOGETHER WITH ALL PLAYERS IN THE PLASTIC CHAIN



WENEW CIRCULAR ECONOMY ECOSYSTEM

BRASKEM HAS FOUR FRONTS OF ACTION

CIRCULAR PRODUCTS
Resins and chemicals with recycled content

TECHNOLOGY
Innovative technologies capable of boosting the circular economy

EDUCATION
Environmental education and consumer engagement initiatives

DESIGN CIRCULAR
Rethinking products and packaging design is essential for the circular economy

A Wenew brand embraces products, initiatives, partnerships and projects developed by Braskem to foster the journey through the Circular Economy. The new ecosystem has a major impact on Braskem's goal of reducing plastic waste.

SUSTAINABLE PORTFOLIO

BRASKEM HAS DIVERSIFIED ITS RESIN AND CHEMICAL SOLUTIONS

BIO-BASED RAW MATERIAL

PE, EVA, Ethene and Wax

Can come into **contact with food**

Measurable biobased content

Captures CO2 from the environment

BIO-CIRCULAR AND BIO-ATTRIBUTED BASE RAW MATERIAL

PP & Chemicals

Can come into **contact with food**

Certified ISCC bio-based mass balance

Promotes the transition towards a circular economy

Reduced carbon footprint

PROMOTING THE TRANSITION TO A CIRCULAR ECONOMY

MECHANICAL RECYCLING RESINS

OR, PP, PVC and EVA

Made from post-consumer recycled plastic

LOW CARBON SOLUTIONS MECHANICAL RECYCLING

PE

Cannot come into contact with food

Measurable **bio-based content**

Low-carbon solutions

CIRCULAR-BASED RAW MATERIAL – CHEMICAL RECYCLING

PE, PP, EVA & Chemicals

Can come into **contact with food**

Recycled ISCC Mass Balance Certificate

CIRCULAR SOLUTIONS IN CHEMICALS

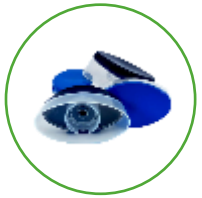
Solvents and Circular Caustic

Transformation of industrial waste into new products

DIVERSITY ON CIRCULAR SOLUTIONS

BRASKEM CURRENTLY HAVE MORE THAN 50 PRODUCTS IN PORFOLIO

PP



CAPS & CLOSURES

HOME APPLIANCES

FURNITURE

PE

FLEXIBLE

FILMS SHRINK

HYGENE PACKAGING

BAGS & TRASH BAGS

RIGID

PACKAGING

MOTOR OIL PACKAGING

PIPES

EVA

SOLES

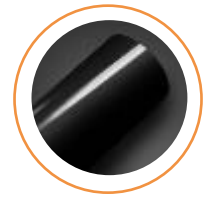
INSOLES

MATS

SPORTING GOODS

PVC

FLEXIBLE



LAMINATED

RIGID

VINYL PROFILES

VINYL FLOOR

CHEMICALS

SOLVENTS

HEXANE

STICKERS

DILUENTS

SENSITIS (ISOPARAFIN)

PAINTS

DILUENTS

OLIGOMERS

HOME CARE

DILUENTS

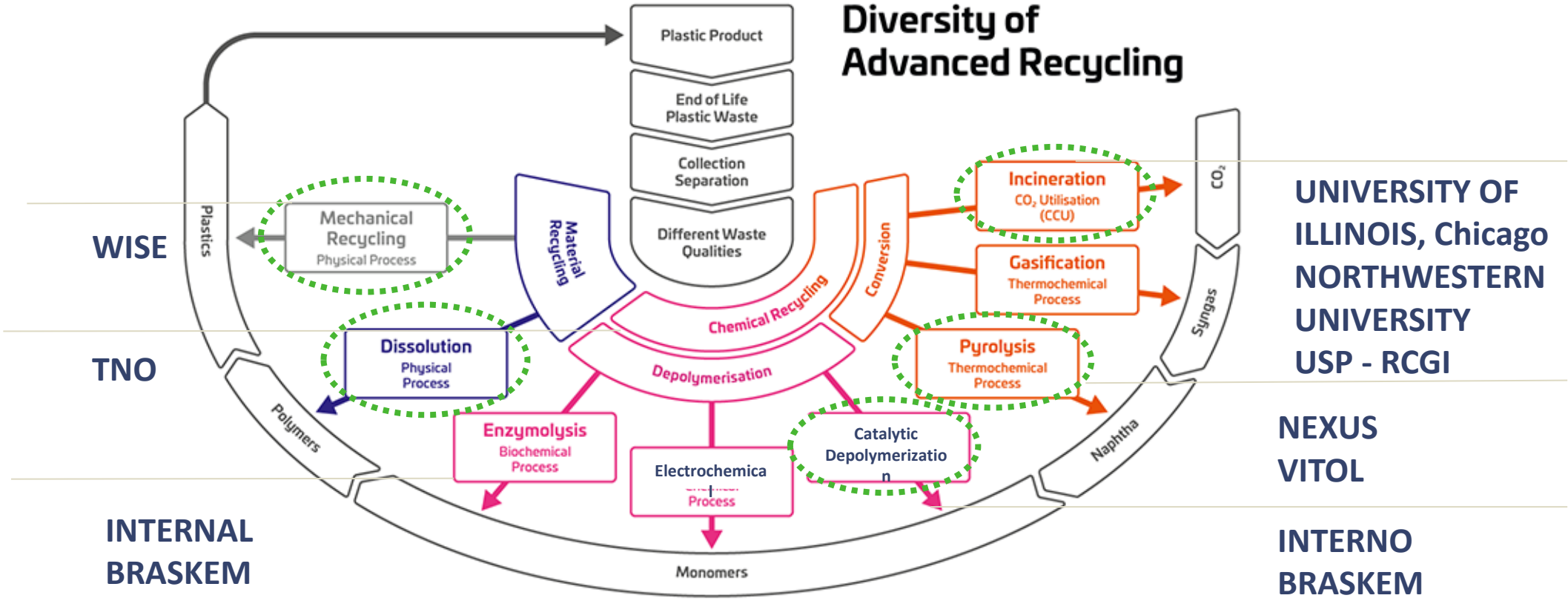
CIRCULAR CAUSTIC

CELULOSE PAPER PACKAGING

SOAPWORTS

DIVERSIFICATION OF RECYCLING TECHNOLOGIES

BRASKEM ACTING ON SEVERAL FRONTS



FONTE: Renewable Carbon -

MASS BALANCE PROCESS APPROACH

USED FOR BIO AND CIRCULAR FEEDSTOCK TO TRACE MATERIAL FLOW THROUGH THE VALUE CHAIN

BIO

Derived from **1st biomass/virgin feedstock**

- **Physical Segregation** → **BIO-BASED** → I'm green BIO-BASED
- **Mass Balance** → **BIO-ATTRIBUTED**

CIRCULAR

Derived from **mechanical/chemical** process of **recycled fossil material**

- **Controlled Blend** → **MECHANICAL RECYCLING** → WENEW
- **Mass Balance** → **CHEMICAL RECYCLING** → WENEW

BIO-CIRCULAR

Residues from **biological source** *(ex.: UCO)*

- **Mass Balance** → **ALTERNATIVE SUSTAINABLE PRODUCT**

ISCC PRINCIPLES

1. Protecting biodiversity in carbon-rich areas

2. Agricultural's good practices

3. Working safe conditions

4. Compliance with human, labor and fiduciary rights

5. Compliance with International laws and treaties

6. Good management practices and continuous improvement

MASS BALANCE

ISCC EU

Applicable for sustainable fuels used in the European Union

Recognized by the European Union Commission

Accepts other certification schemes recognized by the European Commission

ISCC PLUS

Voluntary application for non-regulated markets

Valid for renewable, circular and Bio-based products, food, feed and biofuels outside the EU

Accepts ISCC certification only

ISCC CORSIA

Applicable for sustainable aviation fuels under ICAO – International Civil Aviation Organization

ISCC CERTIFICATION

PROVIDES TRACEABILITY ALONG THE SUPPLY CHAIN AND VERIFIES IF COMPANIES ATTEND TO MASS BALANCE CERTIFICATION, AND ALLOWS BENEFIT TO THEM

ISCC PLUS is a **standard well-recognized** by all stakeholders for **recycled and bio-based materials**. For companies using the **mass balance approach**, ISCC PLUS certification verifies that the mass balance accounting follows **predefined and transparent rules**

- **Reduce** consumption of **fossil feedstock**
- Mass balance approach allows gradual transition towards **sustainability**
- **Drop in**: identical to conventional product
- Variety of **applications** (automotive, packaging, durable goods)
- 100% **recyclable**
- More than **280 companies** are member

NEXUS AND SHELL PARTNERSHIPS

AS A SOURCE OF PYROLYSIS OIL AND PROCESSING IN THE REFINERY

WPU, VITOL AND SHELL PARTNERSHIPS

AS A SOURCE OF PYROLYSIS OIL AND PROCESSING IN THE REFINERY

Plastic Waste

Waste Plastic to Feedstock Convertor

Pyrolysis Oil

Upgrade e Cracking

Transformation into new Circular products

New Products/Packaging

PARTNERSHIPS

AS A SOURCE OF CIRCULAR NAPHTHA AND BIONAPHTHA

Plastic Waste

Plastic, Oil, and Vegetable Waste Converters into Feedstock

Circular Naphtha and Bionaphtha

Import

Transformation into new Circular products

New Products/Packaging

PARTNERSHIPS FOR CIRCULAR ECONOMY EXPANSION

In 2023, Braskem and Vitol, a multinational energy and commodities company, signed an agreement to supply a circular raw material derived from plastic waste. Vitol will supply the pyrolysis oil, produced from the chemical recycling process, to Braskem.

In 2023, Braskem completed the acquisition of the equity interest of Wise Plásticos, a Brazilian company that is active in the recycling of olefins for consumer goods companies. Braskem currently has a 61.1% equity interest in the capital stock of Wise.

In this partnership, Braskem will produce certified circular polypropylene (PP) from the commercial-scale chemical recycling technology of Nexus Circular, a company that converts post-consumer plastic materials into circular raw materials used in the production of new plastics.

In partnership with Alcamare, the largest recycler in the region, Braskem Idesa is looking to increase the recycling of PE and PP. Products with recycled plastic are already being marketed and the companies continue to work together to offer recycled products with food-grade, that is, PCR for food contact.

In 2024, Braskem and Shell Chemicals entered a partnership to introduce bio-assigned and bio-circular certified propylene and polypropylene into the North American market. The agreement allows for more sustainable options for growing consumer demand in the packaging, film, automobile, and consumer goods markets.

BRASKEM ACTS IN FOUR DIFFERENT WAYS

TO ADDRESS THE MOST COMPLEX PLASTIC WASTE THOUGHT CHEMICAL RECYCLING

OPEN INNOVATION

Consortium with other companies to develop new and innovative technologies.

Institute for Sustainable Process Technology

- Development of technology for separation and chemical recycling of mixed plastic waste that will be sent for pyrolysis.
- Recovery of plastics that will become raw materials for the production of resins.
- Investiment: **€ 2 millions**

DEVELOPMENT WITH UNIVERSITIES

Mapping of opportunities that involves evaluating partners and technologies, as well as developing proprietary technologies, to leverage chemical recycling globally.

SENAI

- Catalysts to improve the quality of products generated in the plastic chemical recycling process.
- Investiment: **R$ 2,7 millions**

OFFTAKE CONTRACTS AND PARTNERSHIPS

Constant search to access circular raw materials from other companies, which have already decided to invest in their own production capabilities to enable the implementation of chemical recycling.

nexus CIRCULAR

Vitol

Shell

PROPRIETARY TECHNOLOGY DEVELOPMENT

Investment in the development of proprietary technologies through the *know-how* of Braskem and other institutions.

WASTE
CO2

CHEMICAL RECYCLING

INTERNAL DEVELOPMENT OF NEW TECHNOLOGY

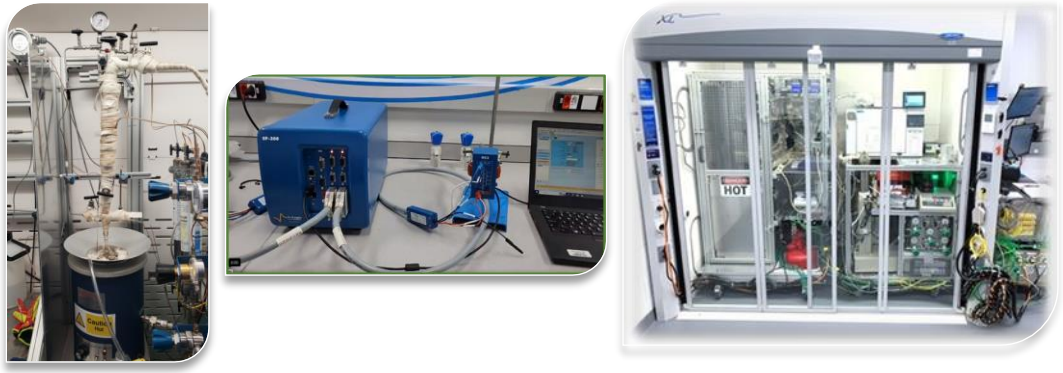
Braskem developing alternative technologies such as **catalytic depolymerization** for high circularity and low carbon footprint

OBJECTIVES

- **Plastics directly to chemicals** with proprietary process, with the catalyst acting as a molecular scissors.
- **Lower carbon footprint.**
- **Better** incomes and energy consumption.
- Ability to process **different feedstock.**
- **Robust for contaminants** such as PVC or PET.

BLUE SKY PROGRAM

- **Explore alternative technologies,** seeking better options and partners.
- **Electrochemistry, Plasma, Microwave, Enzymes.**

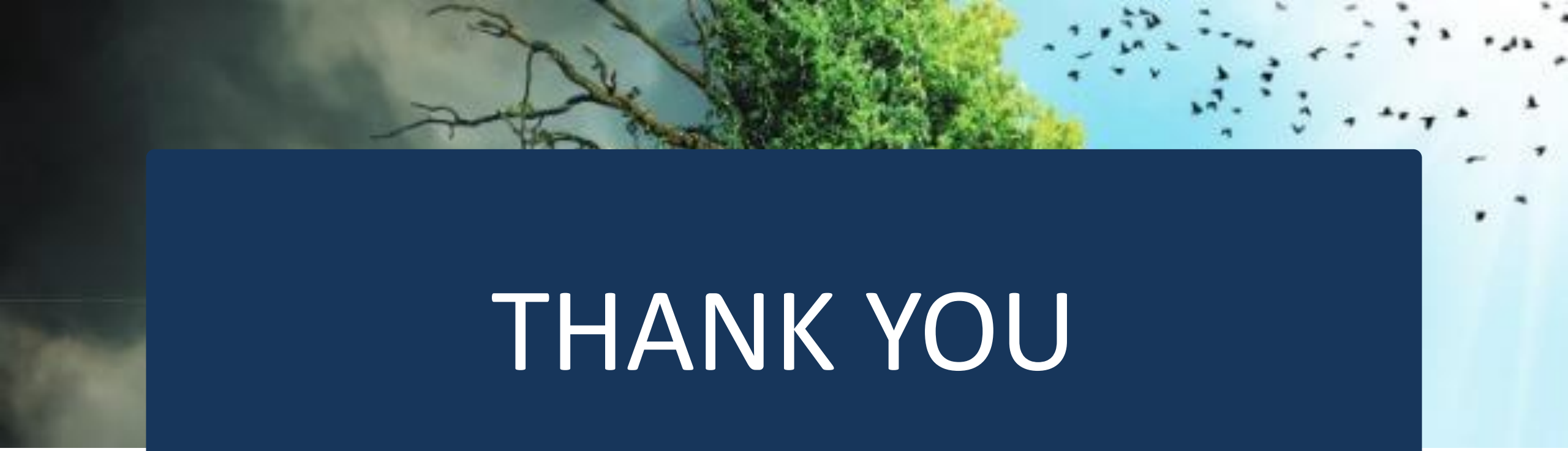


ANVISA

CHEMICAL RECYCLING FOR FOOD CONTACT

On February 29, 2024, a Q&A document was published that clarifies the use of **chemical recycling by pyrolysis can be used for the production of polymers intended for food contact** applications without any additional approval to the agency.

Another validation of the technology, breaking previous regulatory barriers and insecurities.



THANK YOU

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Realização Instituto SustenPlást