

Market development, trends and prospects

Opportunities for market entries

Michael Carus, GF nova-Institut



nova-Institut GmbH – SME

private and independent research institute
interdisciplinary, international team

renewable carbon strategies

- nova-Institute is a private and independent research institute, founded in 1994
- Research and consultancy with a focus on the transition of the chemical and material industry to renewable carbon
- Future challenges, environmental benefits and successful strategies to substitute fossil carbon with biomass, direct CO₂ utilisation and recycling
- Unique understanding to support the transition of your business into a climate neutral future.
- Our subjects: feedstock, technologies and markets, economy and policy, sustainability, communication and strategy development
- nova-Institute has 35 employees and an annual turnover of more than 3 million €.




Selected Customers from all Industrial Sectors



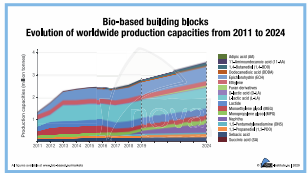
Selected Customers from Chemical Industry



UPDATE
MAY 2020




Commercialisation updates on bio-based building blocks



Bio-based building blocks
Evolution of worldwide production capacities from 2011 to 2024

Author:
Doris de Guzman, Tecnon OdeChem, United Kingdom
Updated Executive Summary and Market Review May 2020 – Originally published February 2020
This and other reports on the bio- and CO₂-based economy are available at www.bio-based.eu/reports

NEW




Levulinic acid – A versatile platform chemical for a variety of market applications

Global market dynamics, demand/supply, trends and market potential

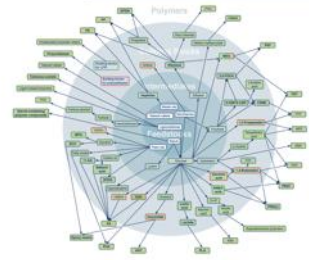


Authors: Achim Raschka, Pia Secorossi, Raj Chintapalli, Angel Puente and Michael Carus, nova-institut GmbH, Germany
October 2019
This and other reports on the bio-based economy are available at www.bio-based.eu/reports

DATA FOR
2019



Bio-based Building Blocks and Polymers – Global Capacities, Production and Trends 2019–2024



Authors:
Pia Secorossi, Raj Chintapalli, Michael Carus, Wolfgang Baltes, Doris de Guzman, Harald Kieß, Achim Raschka, Jan Ravenstijn
January 2020
This and other reports on the bio- and CO₂-based economy are available at www.bio-based.eu/reports

UPDATE
2019




Succinic acid – From a promising building block to a slow seller

What will a realistic future market look like?


Pharmaceutical/Cosmetic <ul style="list-style-type: none"> Active ingredients for various drugs Active Carboxylic acid in anti-inflammation Efficient solvents Intermediate for perfumes Pharmaceutical production (antibiotics, antipsychotic, antidepressants, antiepileptic, anticonvulsants, antitumor, antibiotics) Flavourings for cosmetics Monomers for polymers Used for the preparation of vitamins 	Industrial <ul style="list-style-type: none"> Di-ols Engineering plastics and other engineering plastics Intermediate for polyurethanes Plasticizer for polyurethanes, polyurethane Plastics Substrates, solvents Surface coatings Group electrocatalytic, heterogeneous catalysis
Feed <ul style="list-style-type: none"> Broiler feed supplement Flavour enhancer Flavouring agent and stabilising emulsifier in broiler feed Microencapsulation of flavouring oils Preventative treatment, drug feed Protein supplement and 17% protein concentrate for swine Preventative treatment of 17% protein concentrate for swine Used for the preparation of vitamins 	Succinic Acid <ul style="list-style-type: none"> Building blocks Chemical ester, polyurethane, polyurethane Chemical, fine specialty polymerisation, waste water, waste for water based paint, for microencapsulation, for leather Flavour, food, drug as well as other Flavouring agent and stabilising emulsifier in broiler feed Intermediate for polyurethanes, polyurethane Plasticizer for polyurethanes, polyurethane Used for the preparation of vitamins
Other <ul style="list-style-type: none"> Building blocks Chemical ester, polyurethane, polyurethane Chemical, fine specialty polymerisation, waste water, waste for water based paint, for microencapsulation, for leather Flavour, food, drug as well as other Flavouring agent and stabilising emulsifier in broiler feed Intermediate for polyurethanes, polyurethane Plasticizer for polyurethanes, polyurethane Used for the preparation of vitamins 	

Authors: Raj Chintapalli, Angel Puente, Pia Secorossi, Achim Raschka, Michael Carus, nova-institut GmbH, Germany
October 2019
This and other reports on the bio-based economy are available at www.bio-based.eu/reports

UPDATE
2019



Carbon dioxide (CO₂) as chemical feedstock for polymers – technologies, polymers, developers and producers




Authors: Achim Raschka, Pia Secorossi, Jan Ravenstijn and Michael Carus, nova-institut GmbH, Germany
February 2019
This and other reports on the bio-based economy are available at www.bio-based.eu/reports



Standards and labels for bio-based products




Authors: Lara Dammer, Michael Carus and Dr. Astrid Partanen
nova-institut GmbH, Germany
May 2017
This and other reports on the bio-based economy are available at www.bio-based.eu/reports




Bio-based polymers, a revolutionary change

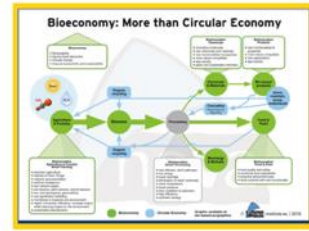
Comprehensive trend report on PHA, PLA, PUR/TPU, PA and polymers based on FDCA and SA. Latest developments, producers, drivers and lessons learnt




Author: Jan Ravenstijn, Jan Ravenstijn Consulting, the Netherlands
March 2017
E-mail: L.ravenstijn@novainstitut.de
Mobile: +31 6 2247 8593
This and other reports on the bio-based economy are available at www.bio-based.eu/reports



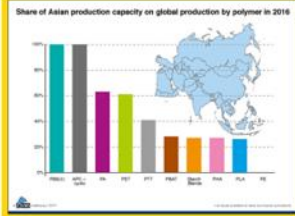
Policies impacting bio-based plastics market development and plastic bags legislation in Europe



Authors: Dirk Caratz, Clever Consult, Belgium
Jan Philipp, OECD, France
Dr. Harald Kieß, novonova-Innovation Consulting, Germany
Lara Dammer & Michael Carus, nova-institut, Germany
March 2017
This and other reports on the bio-based economy are available at www.bio-based.eu/reports



Asian markets for bio-based chemical building blocks and polymers



Author: Wolfgang Baltes, Wobart Expedition Consulting, Thailand
This and other reports on the bio-based economy are available at www.bio-based.eu/reports




Market study on the consumption of biodegradable and compostable plastic products in Europe 2015 and 2020

A comprehensive market research report including consumption figures by polymer and application types as well as by geography, plus analyses of key players, relevant policies and legislation and a special feature on biodegradation and composting standards and labels



Bestsellers:
Disposable tableware, Biowaste bags, Carrier bags, Rigid packaging, Flexible packaging

Authors: Harald Kieß, novonova-Innovation Consulting, Germany
Lara Dammer, Munich, Germany
April 2016
This and other reports on the bio-based economy are available at www.bio-based.eu/reports

The most important service of nova-Institute:

Bio-based News – Daily news on Bio-based and CO₂-based Economy worldwide

- 170,000 readers monthly
- > 25,000 reports
- > 11,600 companies
- > 3,000 Twitter followers: @Biobased_News

www.bio-based.eu/news



Bio-based News | BIO-BASED ECONOMY
BIO-BASED CHEMICALS AND MATERIALS
INDUSTRIAL BIOTECHNOLOGY
CARBON CAPTURE AND UTILIZATION

www.bio-based.eu/news

Bioeconomy **Bio-based News** **Industrial Biotechnology** **Innovation** **Bio-based**

environment granulates plant oils
Bioplastics
Sustainability markets building blocks
biomass
Research
CO₂
Algae
Biocomposites
wood-plastic composites
3D printing
acrylic acid
natural fibre
biorefinery
natural
power-to-liquid
PHA
PEF
CCU
PMMA
hemp
PBT
PBAT
solvents
lignocellulose
succinic acid
ethylene
superabsorbent polymers
packaging
sugar beets
solvents
tomato
natural
PBAT

Stay Up-to-Date with Daily News from the Bio- and CO₂-based Economy

 nova-Institut GmbH
Chemiepark Knapsack
Industriestrasse 300
50354 Hürth, Germany

 www.bio-based.eu



IBIB – International Directory for Bio-based Businesses

[iBIB Online database](#)
[Book now for free](#)
[More info](#)
[History](#)
[Imprint](#)

Index Search [Reset Selection](#) [Get Search URL](#)

Institution

- Associations and agencies
- Engineering
- R&D, certifiers and consultants
- Suppliers

Fields of activities

- Bio-based additives
- Bio-based building blocks
- Bio-based elastomers / Natural rubber
- Bio-based plastics
- Biomass supply
- Certification
- CO₂-based chemicals and materials
- Enzymes
- Lubricants
- Natural Fibre Composites (NFC)
- Oleochemistry
- Surfactants
- Wood-Plastics Composites (WPC) and other cellulose-reinforced plastics
- Other

Application area

- Agriculture and horticulture
- Automotive
- Building and construction

Bio-based additives


















- Adhesive agents / Glues
- Anti yellowing
- Binders / Emulsifiers
- Chain extenders
- Coatings / Lacquers / Finish
- Colours / Pigments
- Denesting aids
- Flame retardants
- Impact modifiers
- Plasticizers
- Processing aids
- Protection against biological infestation
- Stabilizers
- Other

Special properties

- Antistatic
- Biodegradable in freshwater environment
- Biodegradable in marine environment
- Biodegradable in soil
- Breathability
- Flame retardant
- Food safe
- Home compostable
- Industrial compostable

Suppliers, Engineering, Associations and Agencies, R&D, Certifiers and Consultants of the iBIB

113 company profiles found

 3R-BIOPHOSPHATE LTD.	 ACIB GMBH	 ADDIPLAST	 ADVANCE NONWOVEN A/S	 ADVANCED BIOCHEMICAL	
 AGRODOME	 AGROTECH	 AIMPLAS	 ALBRECHT DINKELAKER	 ASSOBIOTEC	
 BEG GROUP LLC	 BELGIAN BIOPACKAGING	 BEOLOGIC NV	 BIO	 BIO BASE EUROPE PILOT PLANT	 BIO-BASED WORLD NEWS



- Up to 50,000 downloads of company profiles per year
- 114 companies in the database

European Bioeconomy in Figures 2008–2017

Authors

Olaf Porc, Nicolas Hark, Michael Carus, Lara Dammer (nova-Institut),
Dr. Dirk Carrez (BIC)

Commissioned by



Forestry House, Rue du Luxembourg 66, B-1000 Brussels, Belgium
info@biconsortium.eu, www.biconsortium.eu

September 2020

nova-Institute for Ecology and Innovation

Chemiepark Knapsack
Industriestraße 300
50354 Hürth
Germany

Tel. +49-2233-48-14 40
Fax +49-2233-48 14 50
Email: contact@nova-institut.de
Internet: www.nova-institute.eu

Will published in
September 2020
Free download:
www.bio-based.eu

Stay informed:
www.bio-based.eu/email/

Bioeconomy overall € 2.4 trillion

Agriculture and forestry
€ 0.46 trillion

Bio-based industries
€ 0.75 trillion



Chemicals and
plastic materials
€ 0.06 trillion

Food and feed
€ 1.2 trillion

Bioeconomy overall 18.5 million

Agriculture and forestry
10.1 million

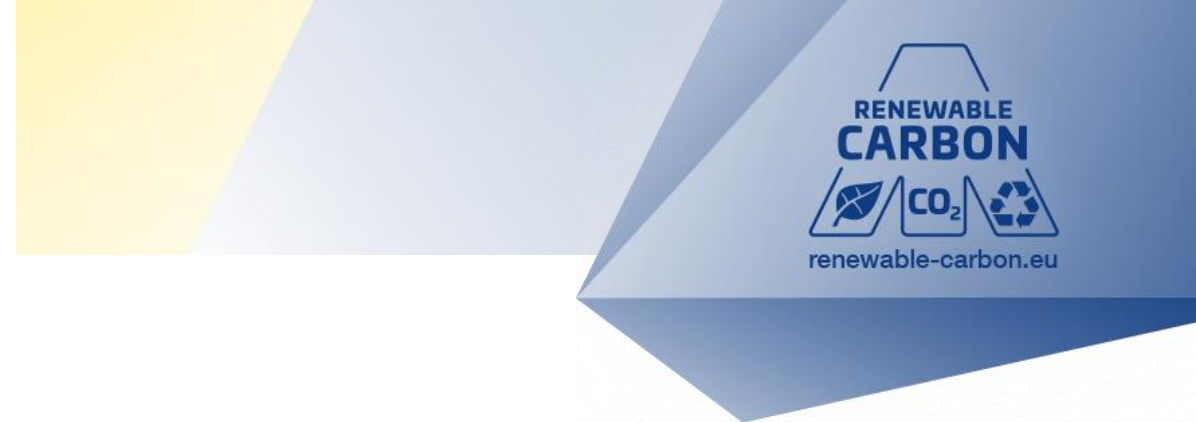
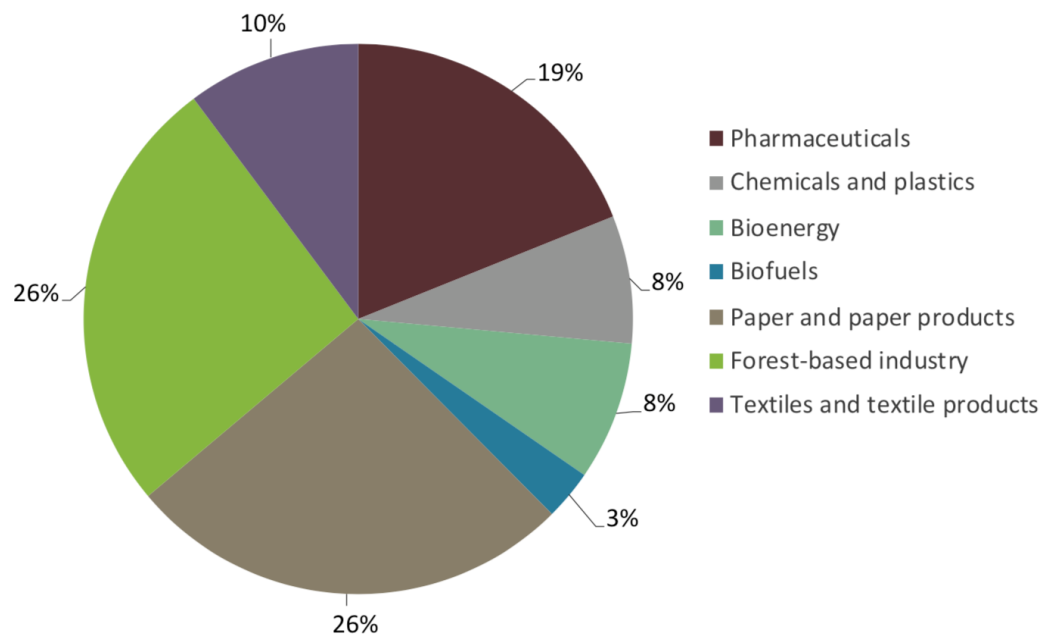
Bio-based industries
3.6 million



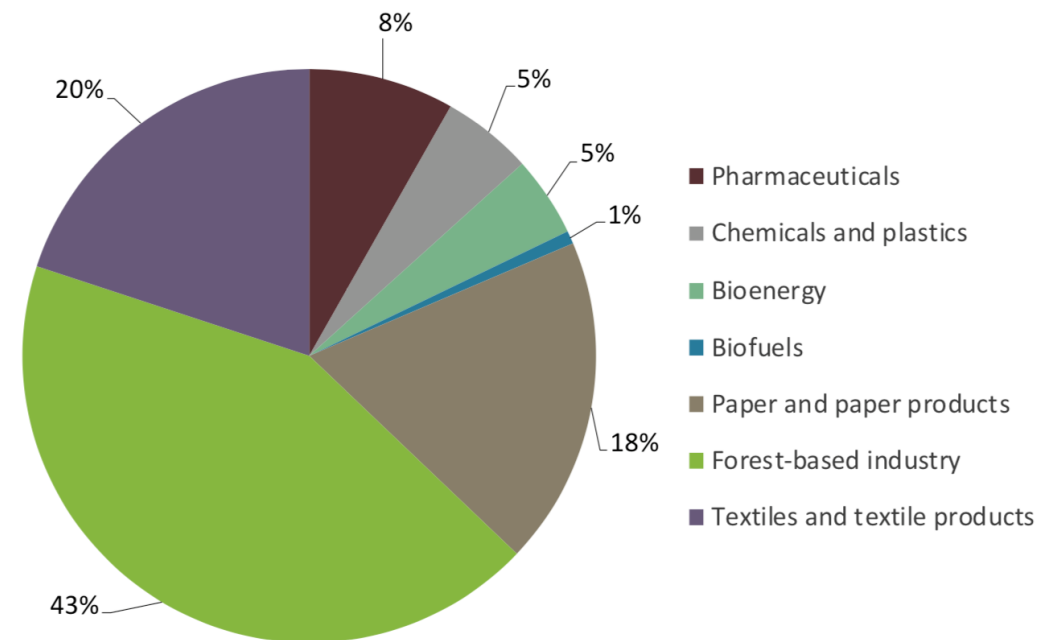
Chemicals and
plastic materials
0.18 million

Food and feed
4.8 million

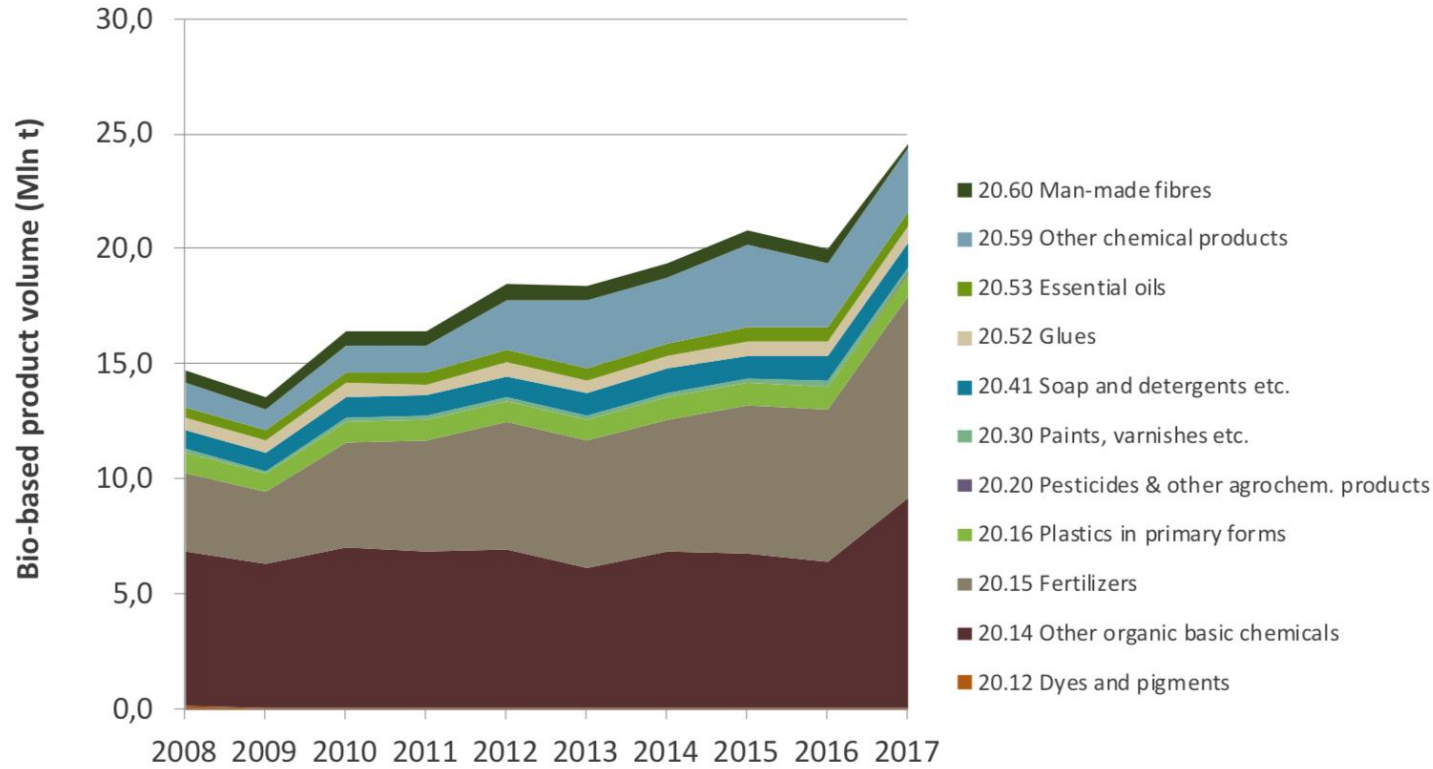
Turnover in the bio-based economy in the EU-28, 2017, total: 750 billion Euro*



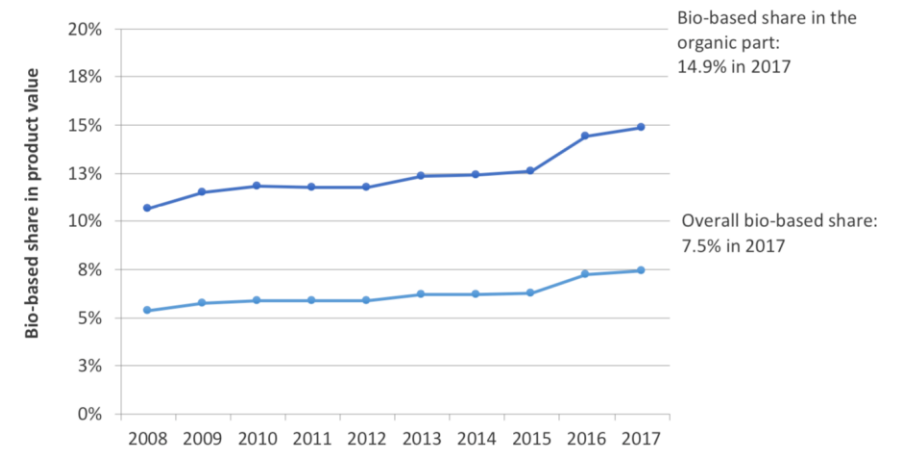
Employment in the bio-based economy in the EU-28, 2017, total: 3.6 million*



Contribution of NACE classes to the total product volume of bio-based chemicals in mln t, EU-28, 2008–2017



Bio-based shares in the product value of chemicals and chemical products (NACE division 20)*, EU-28, 2008–2017



First survey on the existing of renewable carbon in the chemical industry and sent a questionnaire to the 50 largest chemical companies producing in Europe. About 20% of the companies returned the completed questionnaire. **“What is the share of the different carbon sources in the total carbon use in your European production?”**

The results of the survey clustered chemical companies by their branch and share of renewable carbon into the following four groups:

- **Traditional petrochemical companies show renewable carbon shares of 1-5%**
- **Several wood-based chemical companies show renewable shares of 80-90%**
- **In between is a group of mainly chemical companies with a traditional focus on plant oils and animal fats showing 40-50% renewable carbon shares**
- **Notably, a small number of petrochemical companies, which had renewable carbon shares of <1% in the past, already developed to shares around 20%**

Currently, the largest share of renewable carbon is provided via **biomass** from agriculture and forestry, but **recycling** shares are increasing and the **utilisation of CO₂** begins in a serious way. Most of the chemical companies have already or are currently developing concepts and strategies to increase the share of renewable carbon.

nova-Institute and COWI estimate that the **current average renewable carbon share in the European chemical and plastic industry lies between 20 and 25% – 15% from biomass and 5-10% from recycling.**

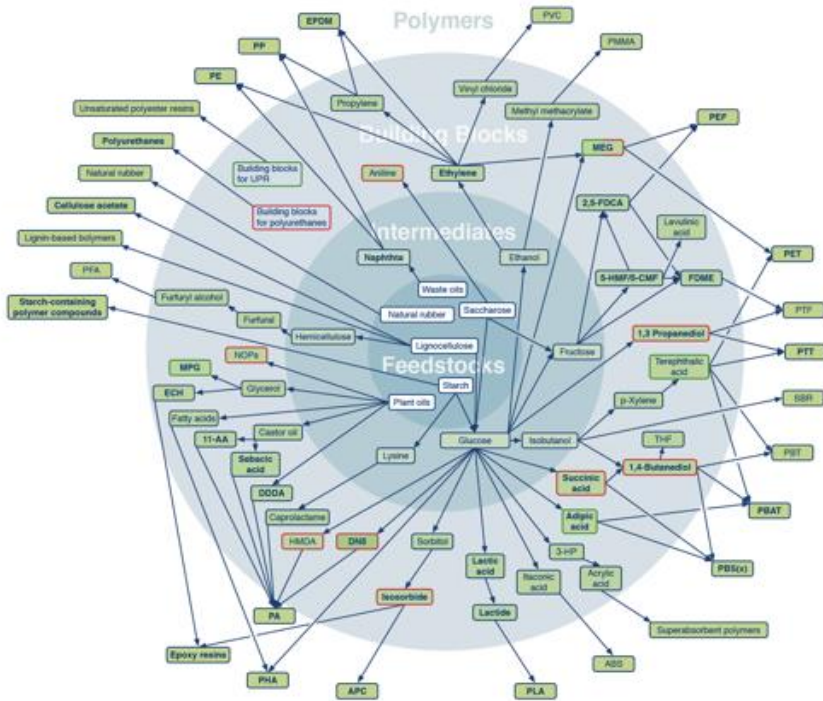
High growth areas

- ◆ Fine Chemicals CAGR >5%:
Body care, detergents, cosmetics,
pharma
- ◆ Cellulose Fibres: CAGR 5-10%
- ◆ Bio-based Naphtha, high demand

Average growth

- ◆ Bio-based polymers CAGR 3-4%
(such as fossil-based)
- ◆ No political support (except R&D),
but barriers (SUPD)

Bio-based Building Blocks and Polymers – Global Capacities, Production and Trends 2019–2024



Authors:
 Pia Skoczinski, Raj Chinthapalli, Michael Carus, Wolfgang Baltus,
 Doris de Guzman, Harald Käb, Achim Raschka, Jan Ravenstijn

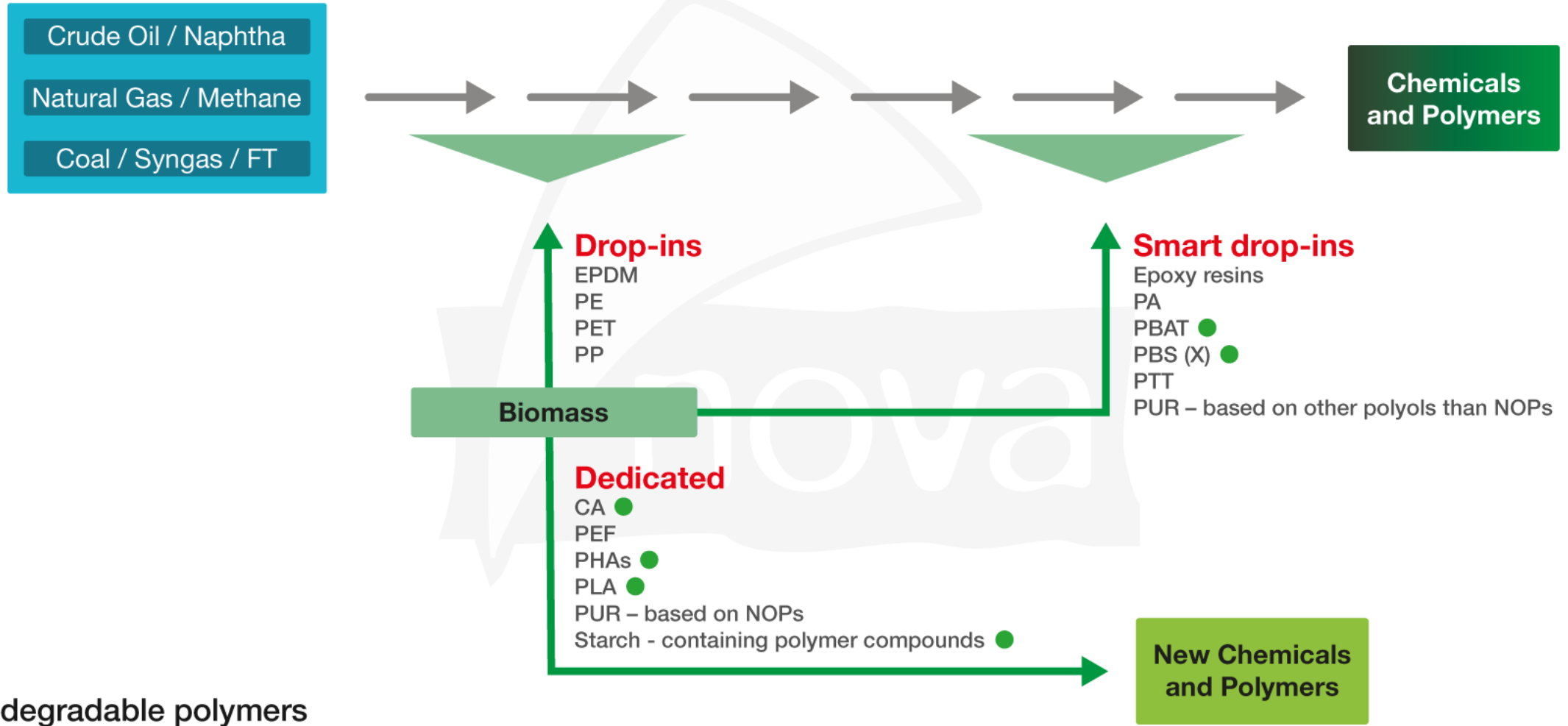
January 2020

This and other reports on the bio- and CO₂- based economy are available at www.bio-based.eu/reports



- Published in January
- Data for 2019
- 379 pages
- 18 bio-based building blocks and 17 polymers
- 170 company profiles
- 3,000 € – www.bio-based.eu/reports

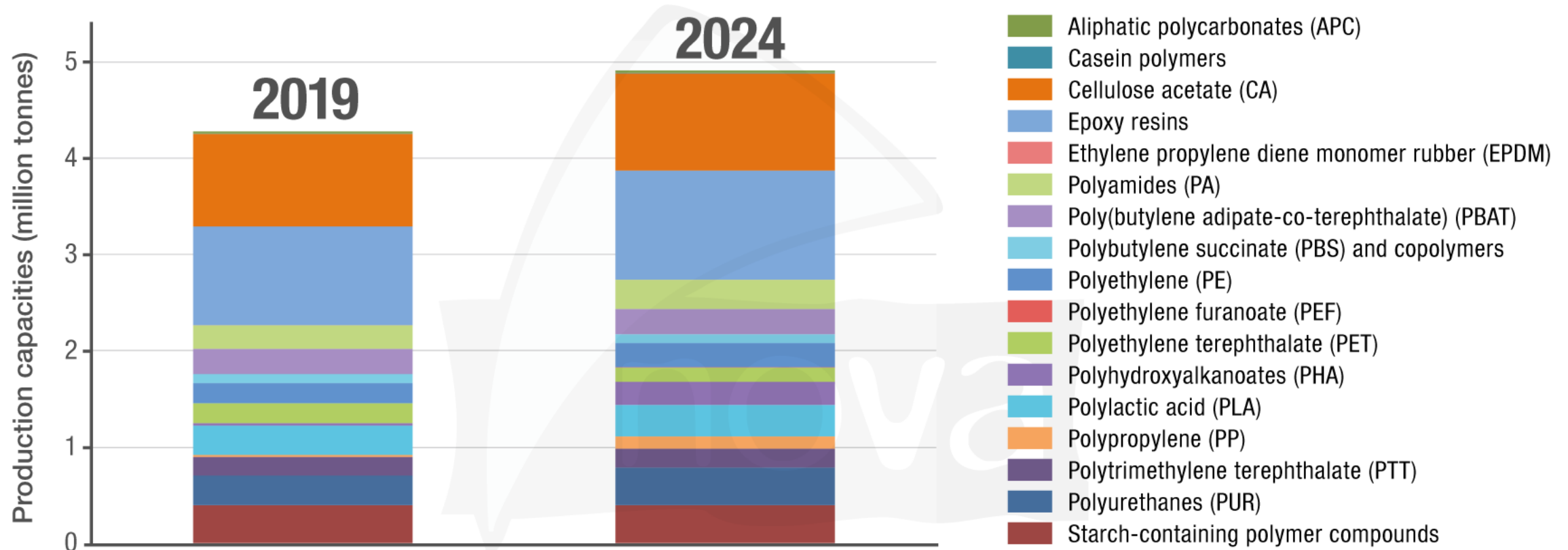
Schematic differentiation of pathways of drop-in, smart drop-in and dedicated bio-based chemicals and polymers



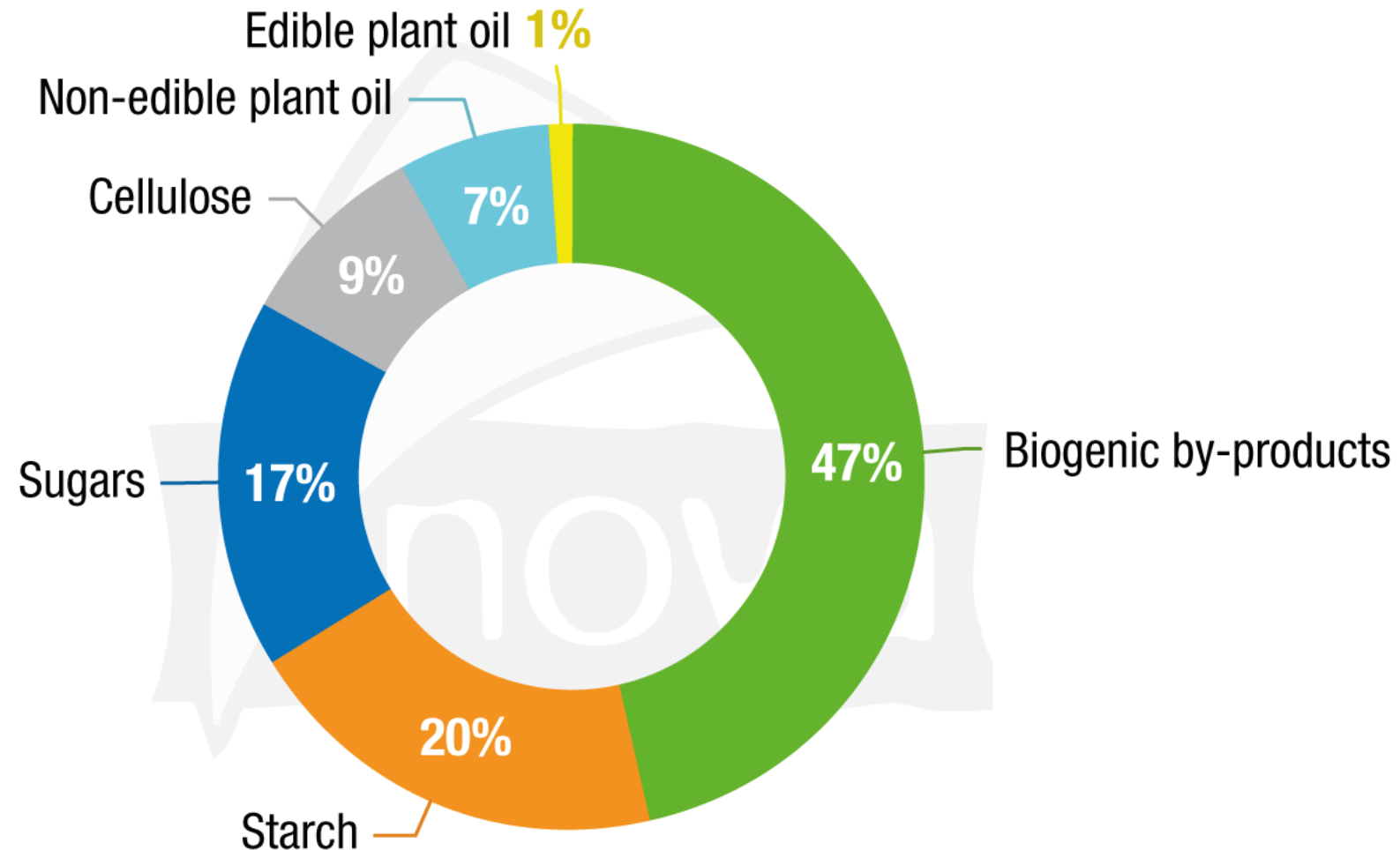
Turbulent times for bio-based polymers in 2019:

- **PLA** sold out despite expansion, as did **PHA**.
- **Bio-based PP** available for the first time, increased production of **PBAT, PBS, bio-based PE, starch-containing polymer compounds and epoxy resins**.
- Lower production is seen particularly in **bio-based PET**.
- Lack of support from policy makers, who are taking bio-based and biodegradable plastics into collective punishment with fossil plastics in the Plastic Policy.
- In 2019, the total production volume of **bio-based polymers was 3.8 million tonnes, which is 1% of the production volume of fossil-based polymers and about 3% more than in 2018** – this CAGR is expected to continue until 2024.
- The major biomass feedstock used for bio-based polymer production are **biogenic by-products (47%)**, especially the by-product **glycerol** from the biodiesel production, used for epoxy resin production.

Bio-based polymers production capacities in 2019 and 2024

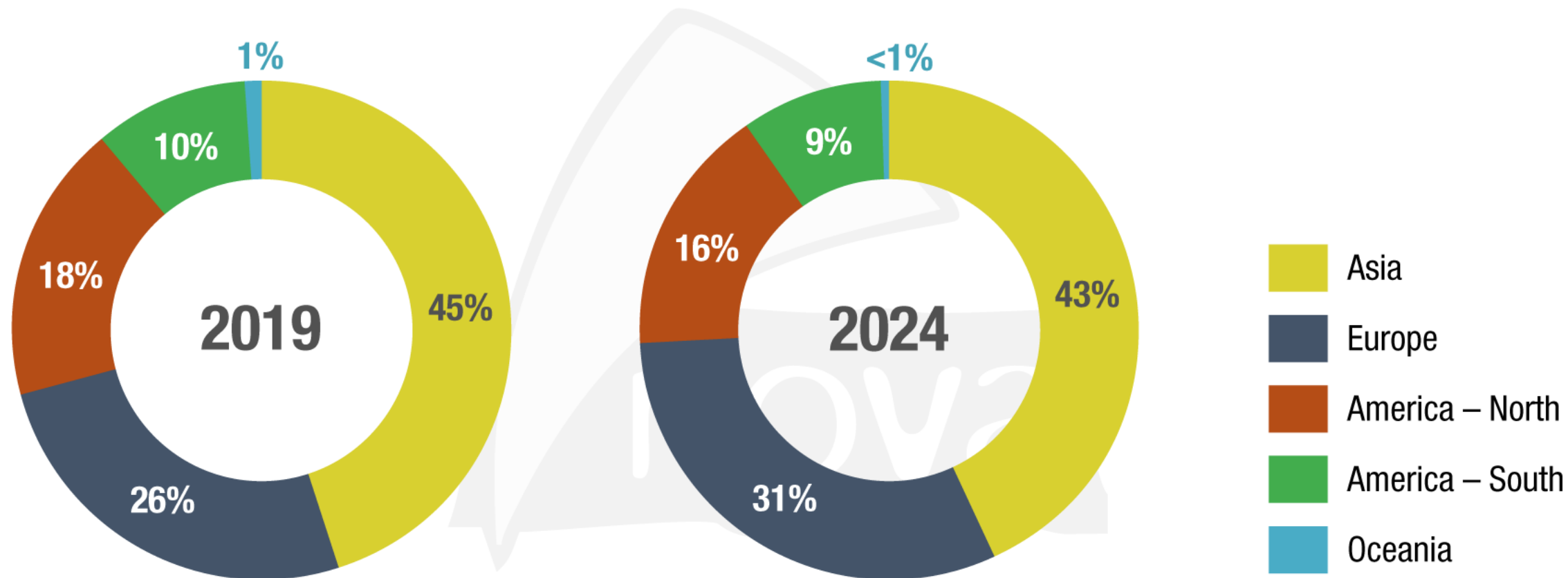


5.0 Mt Biomass Feedstock for 3.6* Mt Bio-based Polymers (with a 43% bio-based share) in 2019 – worldwide



Global production capacities of bio-based polymers by region in 2019 and 2024

(excluding cellulose acetate, epoxy resins and polyurethanes)



Bio-naphtha for PE and PP – bio-based or biomass balance approach, according to customers request

In 2019, **Neste, UPM and Eni** produced a total volume of **bio-naphtha** for use as chemical feedstock in Europe of **between 100 and 150 ktpa**, which means a share of about 0.3% of the total consumption of naphtha in Europe (43 mtpa). **Diamond Green Diesel** is the largest HVO processor in the USA

Different value chains as an example:

- **Neste** bio-naphtha based on used cooking oil and animal fat (Singapore)
 - Neste's** bio-based naphtha supply to **LyondellBasell** for bio-based PE and PP (Wesseling close Cologne, Germany), customers: **IKEA** ...
 - Neste's** bio-based propane supply to **Borealis** for bio-based PP (Kallo and Beringen, Belgium; biomass balance approach (first) and later bio-based), customers: **Henkel** (for packaging) ...
- **UPM BioVerno**: bio-naphtha based on tall oil (wood pulp by-product) (Lappeenranta, Finland)
 - UPM's** bio-based naphtha supply to **Dow** for bio-PE, bio-based and biomass balance approach (Terneuzen, the Netherlands), customers: **Elopak** (packaging) ...
 - UPM's** bio-based naphtha supply to **INEOS** for bio-PVC based on biomass balance approach (Cologne, Germany)
 - UPM's** bio-based naphtha supply to **SABIC** for ethylene (TRUCIRCLE™) -> **DSM Dyneema®** high performance fibres (biomass balance approach) (SABIC and DSM production in the Netherlands)
 - UPM's** bio-based naphtha supply to iQ Natural vinyl flooring (SE) ("Biovyn™")
- **SABIC** bio-ethylene for **Vynova** for bio-PVC (Beek (The Netherlands) and Mazingarbe (France)), and for **DSM Dyneema's** high-performance fibres (both based on mass balance approach)

Renewable Carbon is the Key



RENEWABLE CARBON





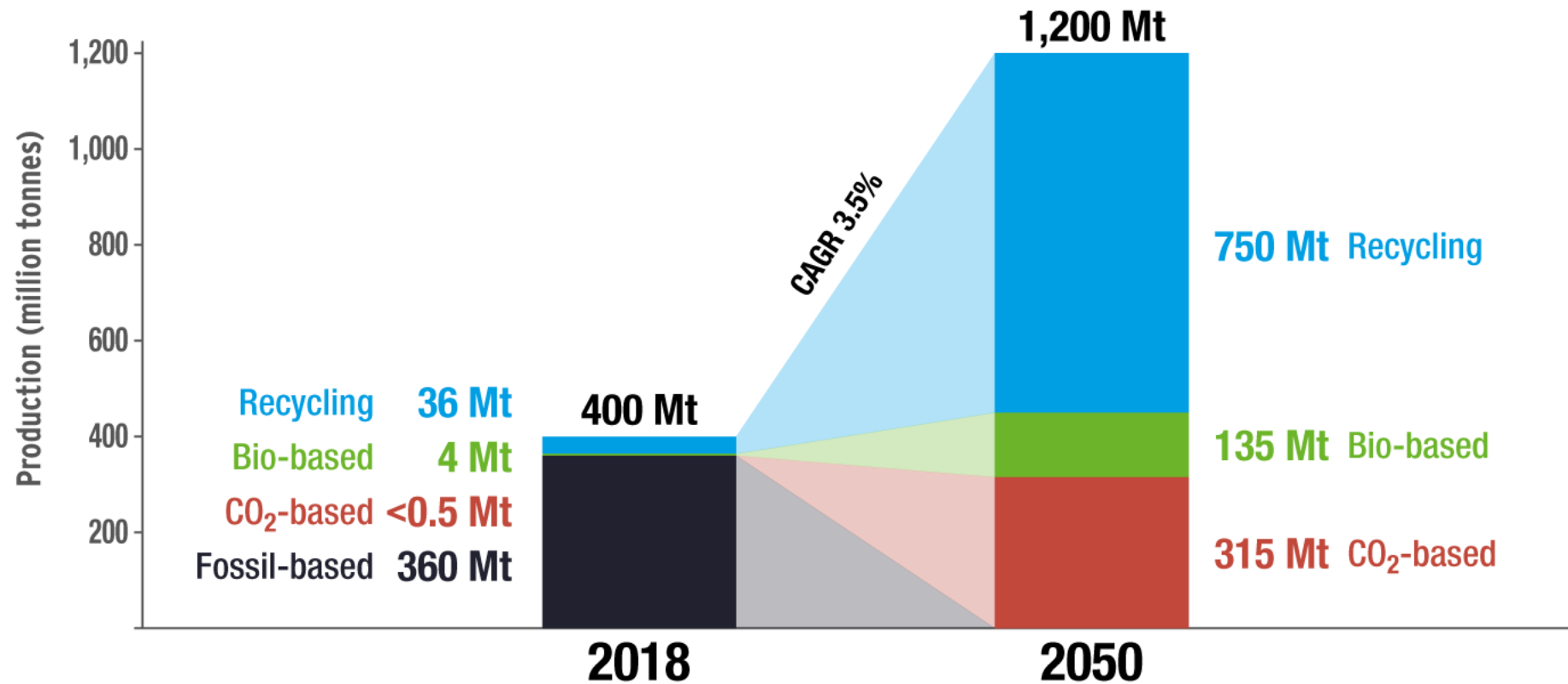
RENEWABLE CARBON

entails all carbon sources that avoid or substitute the use of any additional fossil carbon from the geosphere. Renewable carbon can come from the atmosphere, biosphere or technosphere – but not from the geosphere. Renewable carbon circulates between biosphere, atmosphere or technosphere, creating a **carbon circular economy**.

Fossil carbon shall be completely substituted by renewable carbon, which is carbon from alternative sources: biomass, CO₂ and recycling. This is the only way for chemicals and plastics to become sustainable, climate-friendly and part of the circular economy – part of the future!

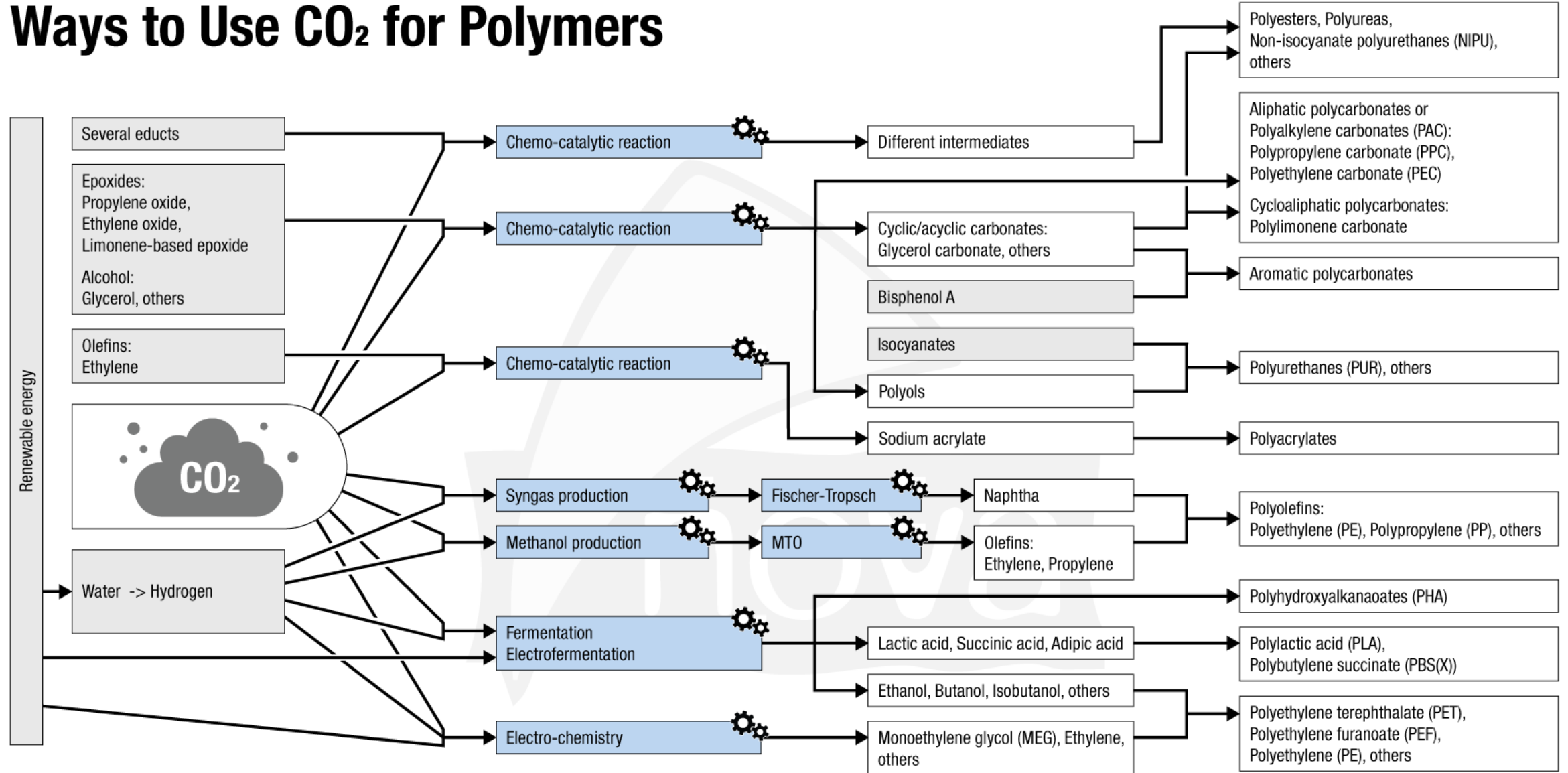
#renewablecarbon

World Plastic Production and Carbon Feedstock in 2018 and Scenario for 2050 (in Million Tonnes)



The virgin plastic production of 364 Million t in 2018 will increase to 450 Million t in 2050, completely based on renewable carbon. The total demand for plastics of 1,200 Million t in 2050 will be mainly covered by recycling.

Ways to Use CO₂ for Polymers





THE RENEWABLE CARBON INITIATIVE

lead by nova-Institute is launched in September 2020.

The aim of the initiative is to support and speed up the transition from fossil carbon to renewable carbon for all organic chemicals and materials.

The Renewable Carbon Initiative addresses the core problem of climate change, which is extracting and using additional fossil carbon from the ground that will eventually end up in the atmosphere. Companies are encouraged to focus on phasing out fossil resources and to use renewable carbon instead.

The initiative wants to drive this message, initiating further actions by bringing stakeholders together, providing information and shaping policy to strive for a climate-neutral circular economy.



BOARD MEMBERS OF THE INITIATIVE

Beiersdorf

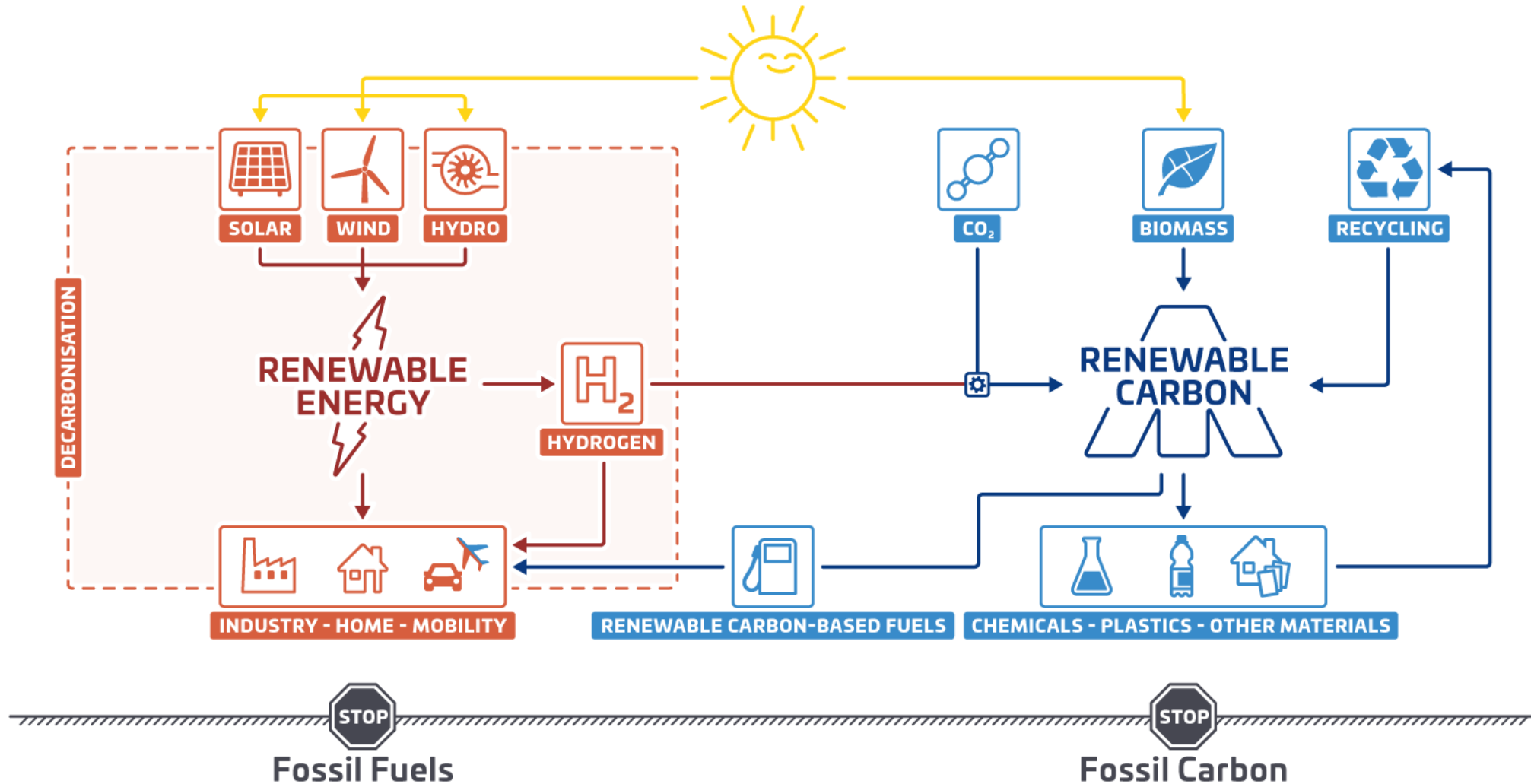


NESTE



More than 100 personal supporters from the industrial and research sectors back the initiative! Please join the initiative as member, partner or personal supporter.

Renewable Energy and Renewable Carbon for a Sustainable Future



Save the Date!

nova Session
“EU Circular Economy and Plastic Policy”

13 October 2020, online



2nd
International Conference on
CELLULOSE FIBRES
2–3 February 2021, Cologne (Germany)

9th Conference on



CO₂

Carbon Dioxide
as Feedstock for
Fuels, Chemistry
and Polymers

23–24 March 2021, Maternushaus, Cologne (Germany)

1st Renewable Materials Conference

18–20 May 2021



Contact: Mr. Dominik Vogt, +49 (0) 2233 48 14 49, Dominik.vogt@nova-institut.de

All conferences at www.bio-based.eu

Thank you for your attention!

CEO



Sustainability
Dipl.-Phys. Michael Carus
+49 (0) 2233 48 14-40
michael.carus@nova-institut.de

Bio-based economy
Markets & marketing
Sustainability & policy

