ADDRESSING CHALLENGES AND UNLOCKING CARBON CAPTURE & UTILIZATION

Circular Carbon Advancement through Policy Reform

Free Webinar | **Febraury 20, 10AM - 12PM**

CO2SMOS
Solutions for a circular biobased industry

vivaldi

CATCO2NVERS

The projects has received funding from the European Union's Horizon 2020 research and innovation programme, under grant agreement No 101000441, 101000580 and 10100079

WELCOME & INTRODUCTION

Workshop organisers: 3 Horizon 2020 projects

The CO2SMOS project develops solutions to transform the carbon emissions generated from bioprocesses into different sustainable bioproducts: durable polymers, renewable biochemicals, and biodegradable materials. With these compounds, it is possible to produce greener end-products such as packaging, coatings and textiles.

The CATCO2NVERS project aims to reduce greenhouse gas emissions from the biobased industry by developing five innovative and integrated technologies based on three catalytic processes. The goal is to transform waste-CO_2 from two biobased industries into five added-value chemicals with application in the chemical, cosmetics, and plastic industries.

Focusing on four key bio-industry sectors (Pulp & Paper, Food & Drinks, Bioethanol and Biochemicals), the VIVALDI project transforms real off-gases into 4 organic acids. These high-value chemicals can re-enter the plants' production process to enhance their sustainability, or open new business opportunities as building blocks for novel biomaterials.

Organisation team | CO_2 Value Europe

CO_2 Value Europe is an international and non-profit association representing the **Carbon Capture and Utilisation** (CCU) community in Europe. The association brings together over 90 pioneer members covering the entire value chain, and develops a vast network of many more organisations and individuals who share the belief that CCU technologies are necessary to help the EU reach climate targets, especially for hard-to-abate sectors.

CO_2 Value Europe is proudly leading the **policy** and the **communication & dissemination** work in the **CO2SMOS and VIVALDI projects**.

Anastasios Perimenis
Secretary General

Tudy Bernier
Policy Director

Lara Tottolo
Communications & Events Manager

Organisation team | alchemia-nova

alchemia nova
circular by nature

Research & Market high-impact nature-based solutions (NBS) and **circular economy** (CE) services in pursuit of our Mission: *"to create a world where all resources are truly valued and preserved, contributing to circularity and regeneration."*

Over 20 years of experience in EU and National level research & development projects in the field of **sustainability** & **nature-based technologies**, with resulting expertise in bioengineering, resource capture wastewater treatment & biogenic substitutes for fossil-based products.

Francesco Menconi
Managing Director

Iris De Cesare
Project Manager

Robert Slade
Project Development

CO2SMOS
Solutions for a circular biobased industry

vivaldi

CATCO2NVERS

Challenges addressed

1	Harnessing the benefits of alternative carbon feedstock such as captured biogenic carbon for the production of plastics and chemicals by creating binding targets for non-fossil carbon content and contributing to recycling obligations.
2	Streamlining the regulatory approval requirements for bioconversion processes in the valorisation of captured biogenic carbon through reducing the administrative red tape (registration costs, approval times, third-party involvement, etc.), and the harmonisation of national regulations.
3	Securing a significant market share for captured biogenic carbon chemicals and products by establishing effective market pull mechanism, whilst evaluating the complexity of standardisation and labelling of final CCU products and ensuring that product properties respect the downstream regulations.

Agenda

Topic	Time	Speaker
Welcome & introduction	10 am	Moderator (Francesco Menconi, ALCN)
Introduction of the CO2SMOS project	10.10 am	Nicolás Martín Sánchez , CO2SMOS project coordinator
CO2SMOS perspective on Challenge 1	10.15 am	Gert-Jan Gruter, Avantium
Introduction of the CATCO2NVERS project	10.25 am	Oscar Ramírez, CATCO2NVERS project coordinator
CATCO2NVERS perspective on challenge 2	10.30 am	Didem Bilir, Evyap
Introduction of the VIVALDI project	10.40 am	Albert Guisasola, VIVALDI project coordinator
VIVALDI perspective on challenge 3	10.45 am	Elvira Serra, Isle Utilities
Transition pathway of the chemical industry in Europe	10.55 am	Algreit Dume, European Commission
Open discussion and Q&A	11.10 am	All speakers Moderator: Tudy Bernier, CVE
Conclusions and key learnings	11.50 am	Anastasios Perimenis, CVE

CO2SMOS PROJECT AND CHALLENGE 1

Nicolás Martín

CO2SMOS project coordinator

Scientific Researcher at CARTIF

Gert-Jan Gruter

CTO at Avantium

PUBLIC

Solutions for a circular biobased industry

CO2SMOS-CATCO2NVERS-VIVALDI Policy Workshop

CO2SMOS PROJECT

Biogenic CO_2 emissions in innovative chemicals for biobased industries

- Nicolás Martín Sánchez [CARTIF Technology Centre]
- *nicmar@cartif.es*

The CO2SMOS project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000790

CO2SMOS concept

CHALLENGE: Europe generates a significant amount of **CO_2** from different **green sources** (e.g. biogas, bioethanol and other fermentation processes). It is estimated than more 506.7 Mt/year biogenic CO_2 are currently produced.

SOLUTION: CO2SMOS works on the development of a **set of novel and cost-competitive CO_2 conversion technologies** to transform the biogenic **CO_2 emissions of biobased industries** into a set a of **high added-value chemicals** with direct use **as intermediates for bio-based products**.

GOAL: enhancing the **circularity of biobased industries** and favour their long-term sustainability.

- Developing **breakthrough technologies** for the conversion of CO_2 into high added-value chemicals
- Designing an integrated process with **zero or negative greenhouse gas emissions**
- Creating **new business models** and value chains in the CO_2 utilization sector

CO2SMOS technologies and products

Primary conversion of CO_2 into two platform bulk chemicals

- Syngas
- Bio-acetate

Secondary conversion of CO2 and intermediates into 7 added-value chemicals

- mcl-PHA and PHB
- 2,3-butanediol (2,3-BDO)
- long chain dicarboxylic acids (LcDCAs)
- hydroxycarboxylic acids (HCAs)
- cyclic carbonates
- BTEX

Final formulation of bio-products

Polymers (Plastics)

CO2SMOS technologies and products

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Final formulation of bio-products

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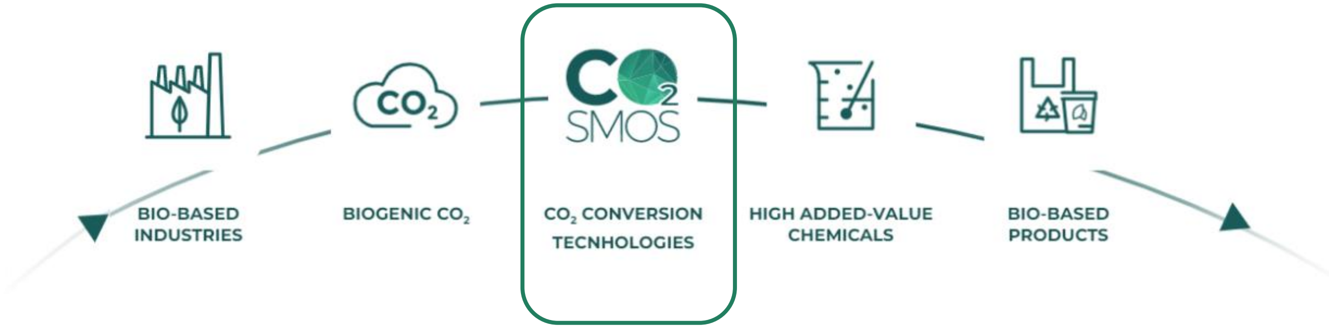

CO_2 conversion technological toolbox:

- Multi-stage **gas-liquid fermentation** cascade process
- **Catalysis, biocatalysis** and **Co-electrocatalysis** technologies

Supported by renewable sources such as green H2 and biomass

CO2SMOS technologies and products

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Final formulation of bio-products

Polymers (Plastics)

TRL 3 → TRL 5

- TRL 3: Optimisation of technologies at lab scale
- TRL 5: Process upscaling and pilot plant validation

CO_2 conversion technological toolbox:

- Multi-stage **gas-liquid fermentation** cascade process
- **Catalysis, biocatalysis** and **Co-electrocatalysis** technologies

Supported by renewable sources such as green H2 and biomass

https://co2smos.eu/

CO2SMOS consortium

TECHNOLOGY DEVELOPERS

UNIVERSITY OF AMSTERDAM
CSIC Consejo Superior de Investigaciones Científicas
FUNDITEC
SINTEF
emi twente
CENTRO TECNOLÓGICO CARTIF

INTERDISCIPLINARY RESEARCH INSTITUTIONS

CERTH CENTRE FOR RESEARCH & TECHNOLOGY HELLAS
RWTH AACHEN UNIVERSITY

SERVICE PROVIDERS

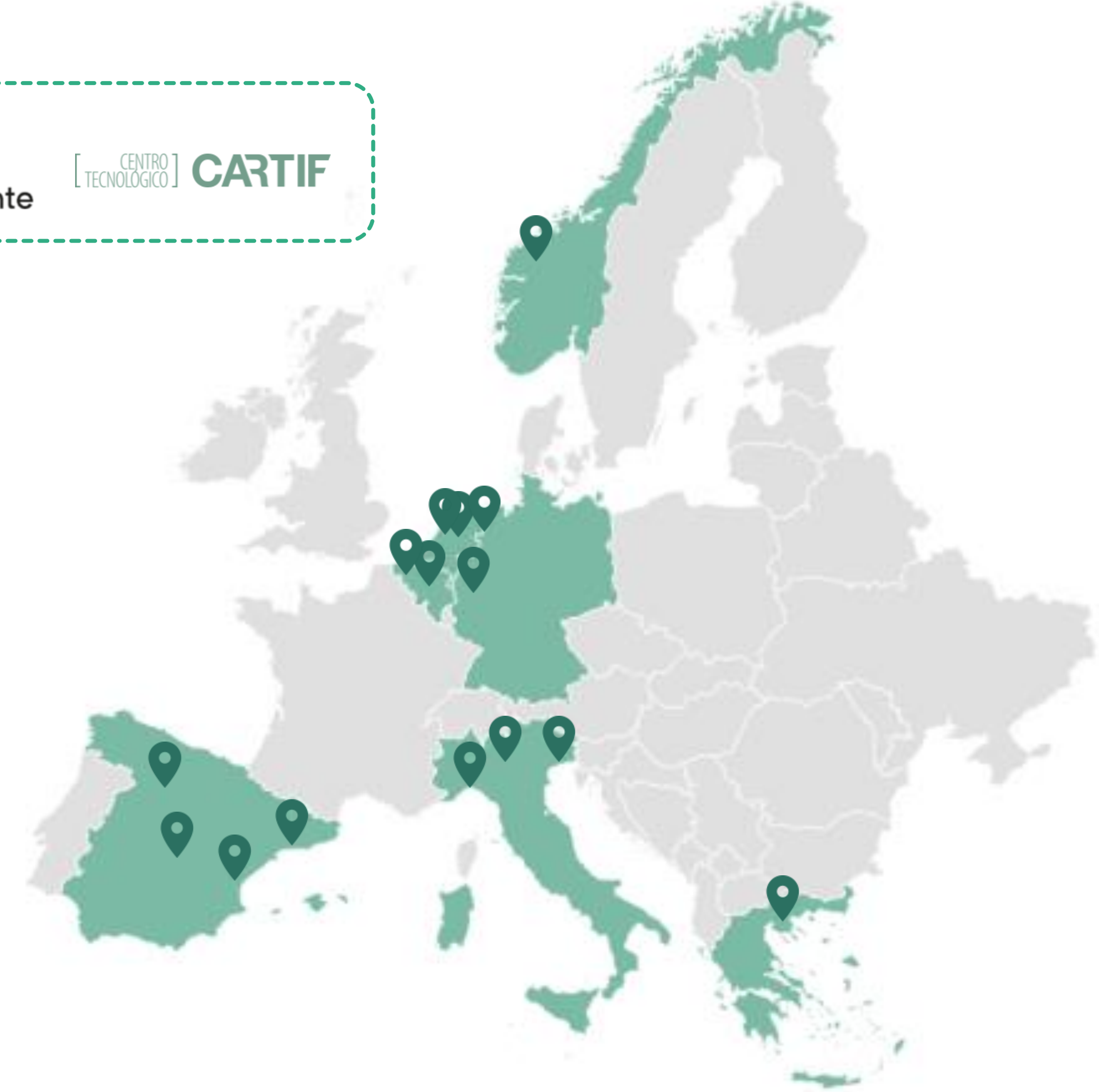
HERA
RINA
Bio Base Europe Pilot Plant

KNOWLEDGE HUBS

CO2 VALUE EUROPE

INDUSTRIAL END-USERS

NOVAMONT
NADIR Plasma & Polymers
avantium



CO2SMOS
Solutions for a circular biobased industry

Thank you!

- Nicolás Martín Sánchez [CARTIF Technology Centre]
- *nicmar@cartif.es*

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Addressing Challenges and Unlocking CCU:
Circular Carbon Advancement through Policy Reform

High potential polyesters from CO_2

g.j.m.gruter@uva.nl

20 February 2024

Gert-Jan Gruter

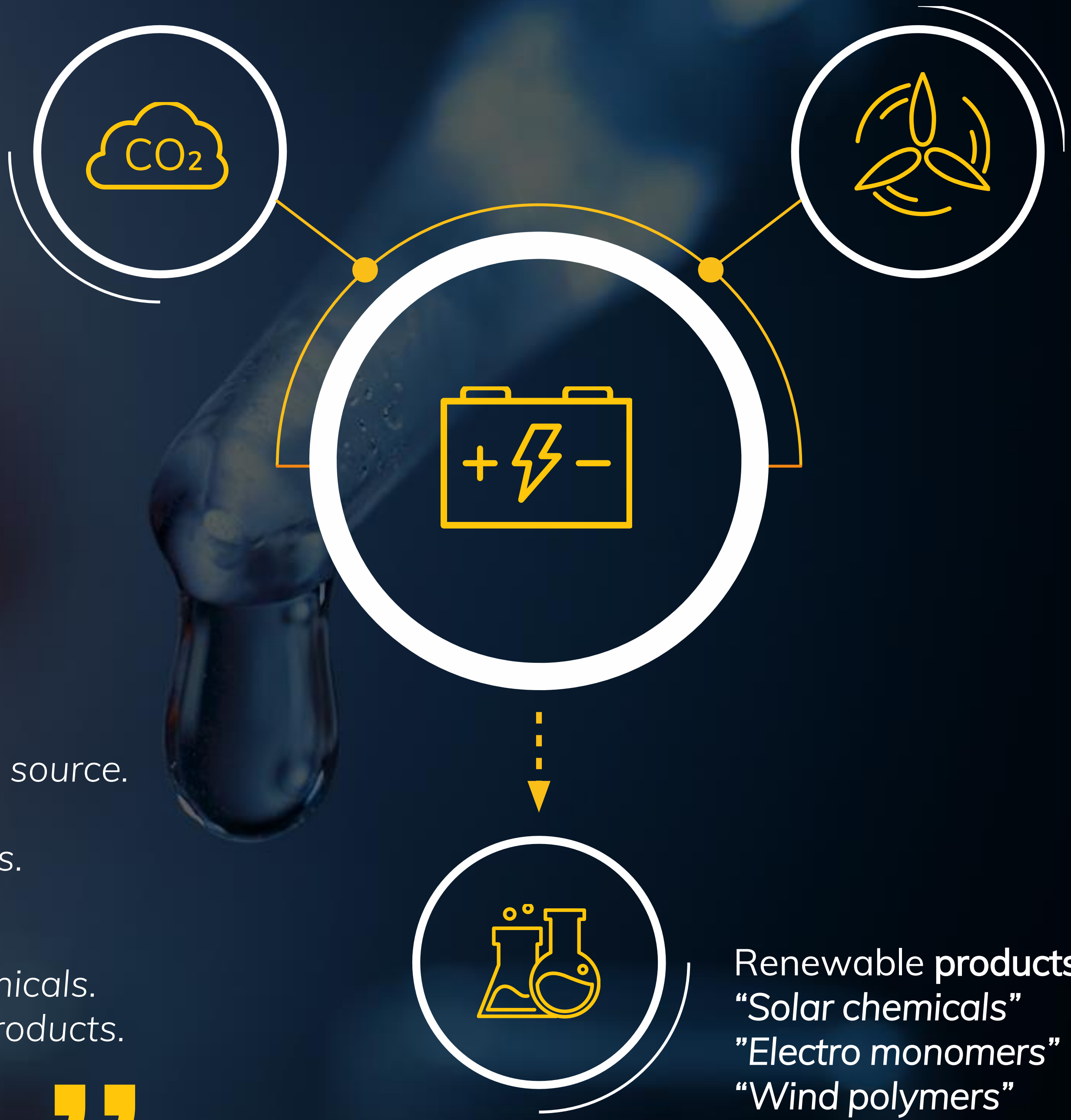
avantium

Universiteit van Amsterdam

Funded by
the European Union


avantium

Volta is a Disruptive Clean Technology



“

We use electricity as a renewable energy source.
We use electrons as a reagent.
This makes it the cleanest of technologies.

We use CO_2 as a feedstock.
We turn waste carbon into valuable chemicals.
This opens the way to carbon negative products.

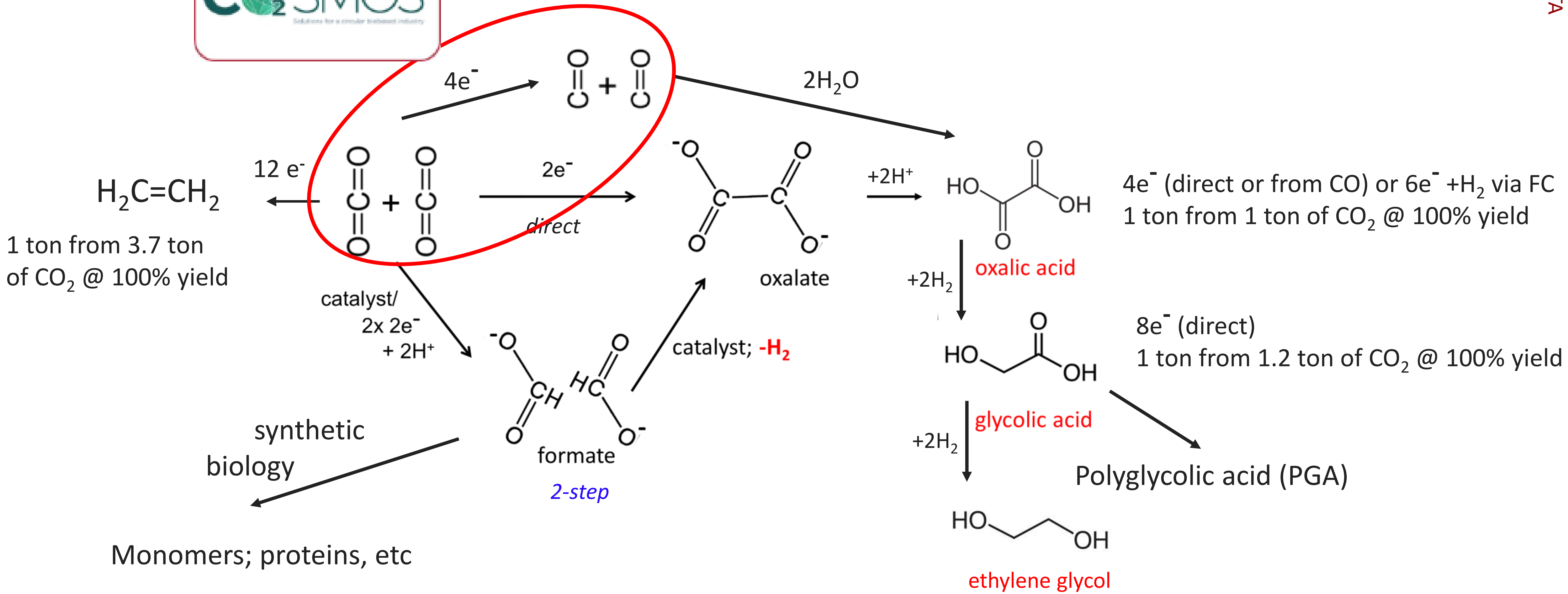
”

Renewable **products:**
“Solar chemicals”
”Electro monomers”
“Wind polymers”

Benefits of ambient temp. electrocatalytic CO_2 Reduction

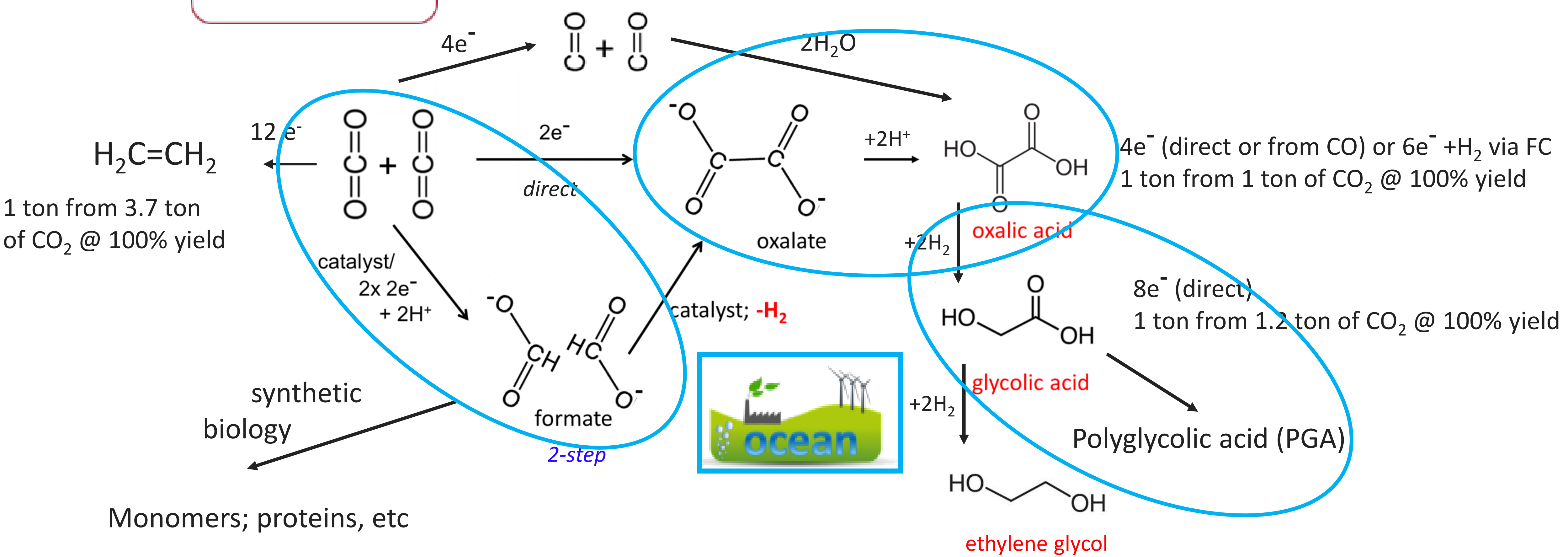
Defined	• CO_2 is well defined vs biomass feed stock
Agnostic	• Multiple sources are possible- Biogenic and DAC are preferred for the long term
Competitive	• No competition with food/land use/deforestation; no GMO
Clean	• Electrons as a reagent; very high selectivity
Flexible	• Technology allows “peak-shaving”
Valuable	• One of the few technologies to turn CO_2 into valuable products with the potential to enable carbon negative materials
De-risked	• Scaling out electrochemical cell stacks dramatically reduces the risk of scale-up
Potential	• Ability to address large markets (proteins, ethanol, chemicals, polymers and fuels)

Which monomers from CO_2 will be winning ?



Avantium | VOLTA

Which monomers from CO_2 will be winning ?



PLGA 5/95

CO_2 based

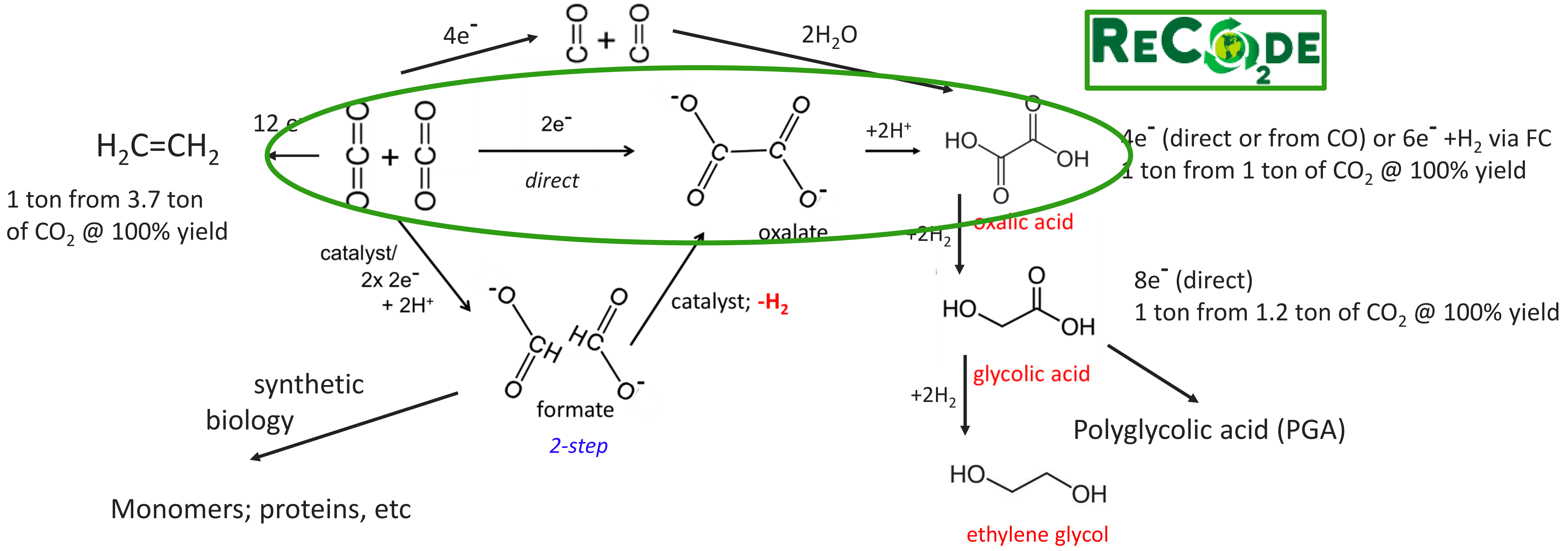
Closed loop recyclable

Very good gas barrier (OP = 50x better than PET

Home compostable

Marine degradable
(non-enzymatic hydrolysis)

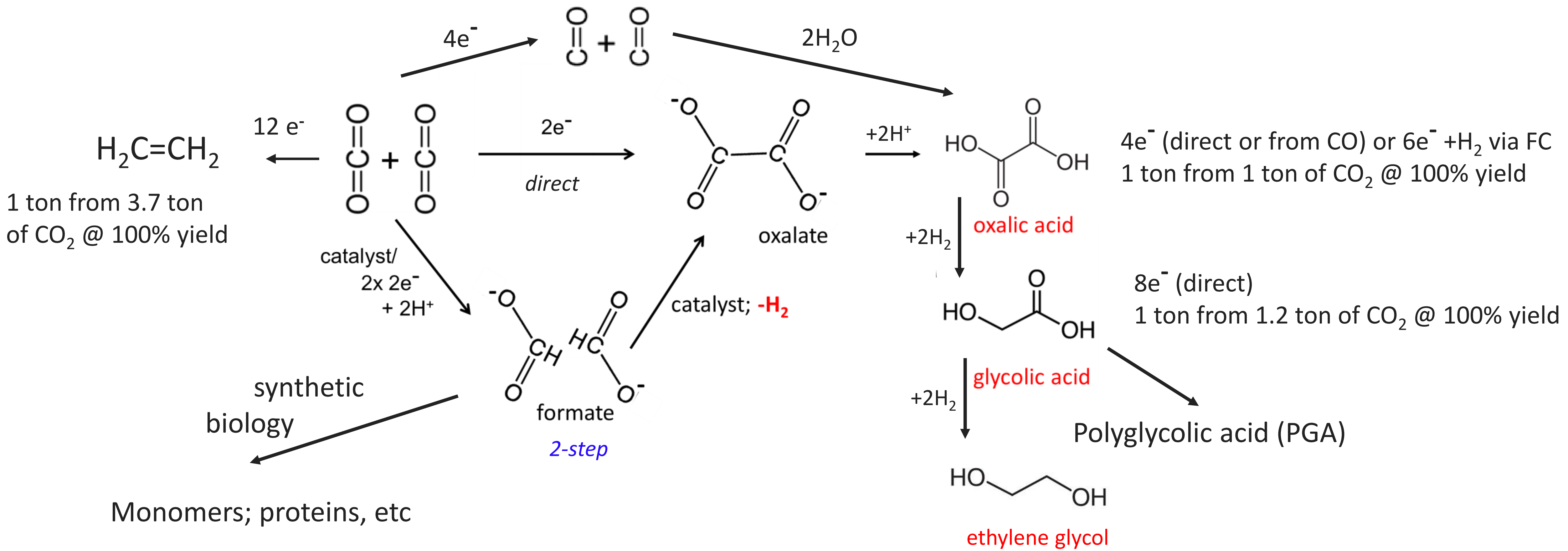
Which monomers from CO_2 will be winning ?



Avantium | VOLTA

Which monomers from CO_2 will be winning ? Oxalic acid as platform !

- ✓ CO_2 to oxalic acid [HOOC-COOH]: **4 MWh/ ton oxalic acid.** (**€180**/ton; electricity @ €0.05/kWh & 3V)
- ✓ CO_2 to glycolic acid (w. green H_2): [HOOC-CH_2OH]: **9.5 MWh/ ton glycolic acid** (**€470/ton**; electricity @ €0.05/kWh & 3V)
- ✓ CO_2 to ethylene [C_2H_4]: **38 MWh/ ton ethylene.** (**€1720/ton**; electricity @ €0.05/kWh & 3V)
  (producing 1 ton of H_2 requires ~80MWh)

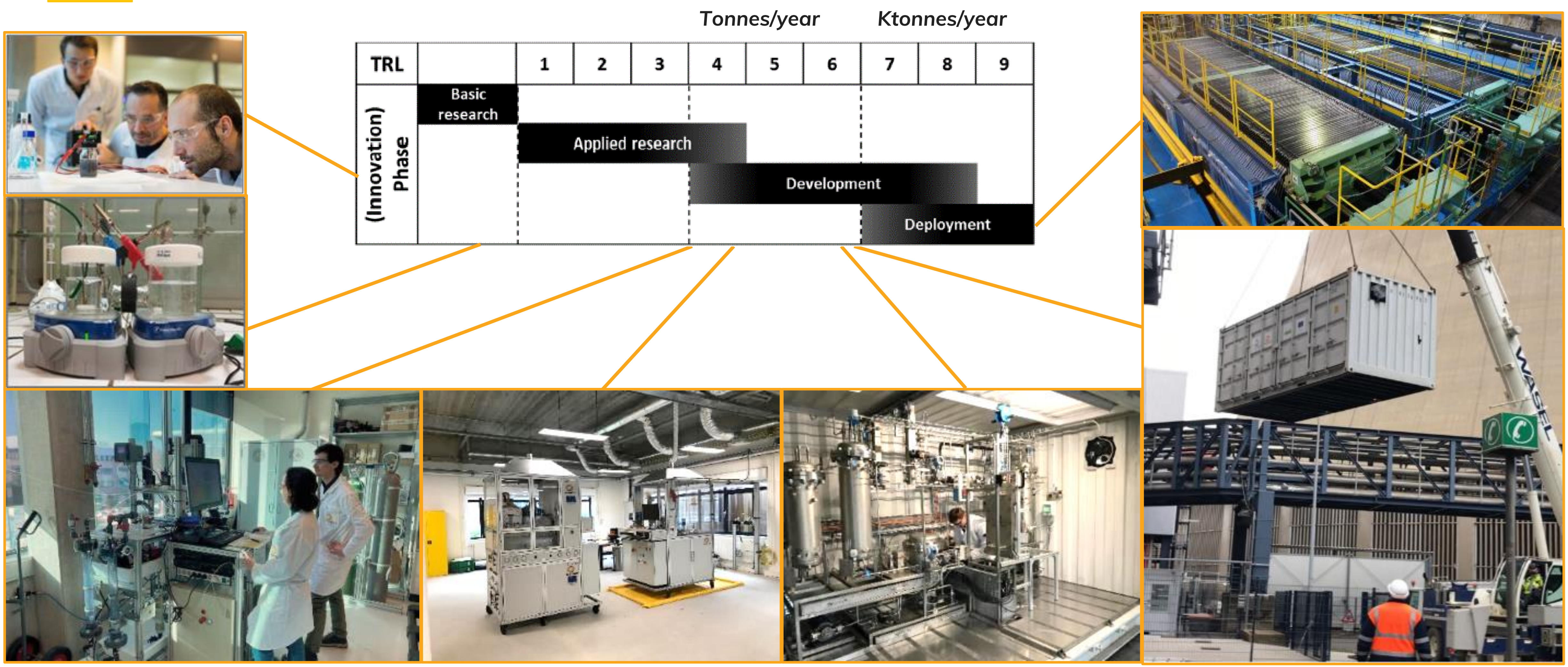


Value proposition:

cost competitive oxalic acid as platform (bio OA @ €1300/t)

plastics as largest volume outlet

Volta Technology - Scaling



~8 Tonnes/year


avantiu
HYSYTE
C-420
LSH-407
E-227

Demonstration at TRL5/6

RWE Power

ocean

TITAN

ReCO2DE

CO_2 → Formate

Oxalic acid → Glyoxylic acid

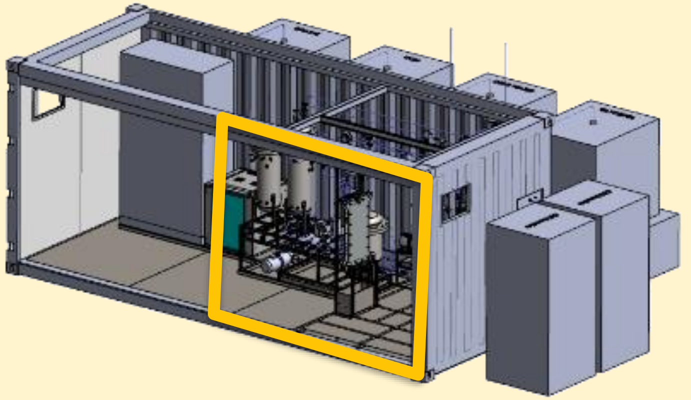
- 20 ft containers
- 0.25 – 0.5 kg/h
- Cell size 0.2 m^2

Ocean testing campaign 2022:

>1000 hours of operation at TRL6 (current >3500 h)

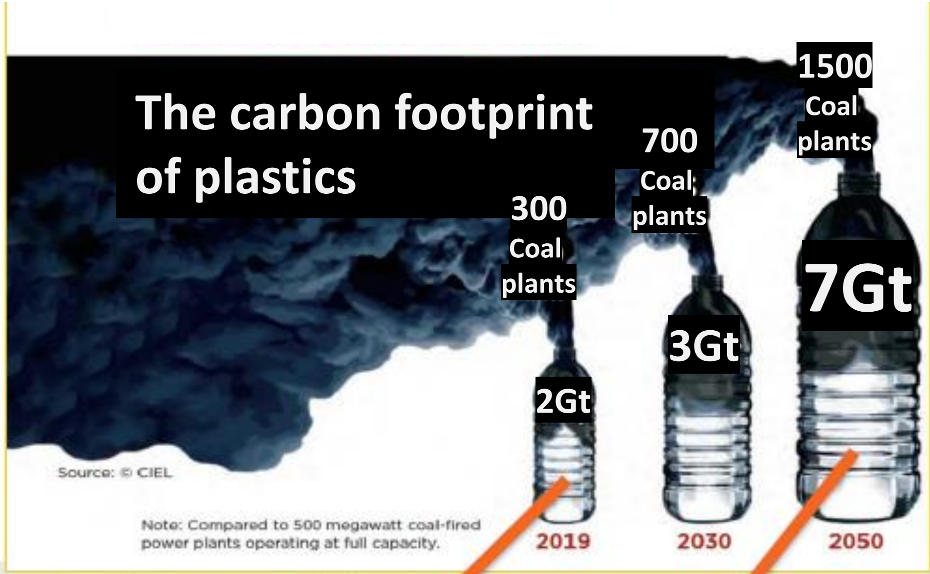
First of a kind 1m high GDE electrochemical cell

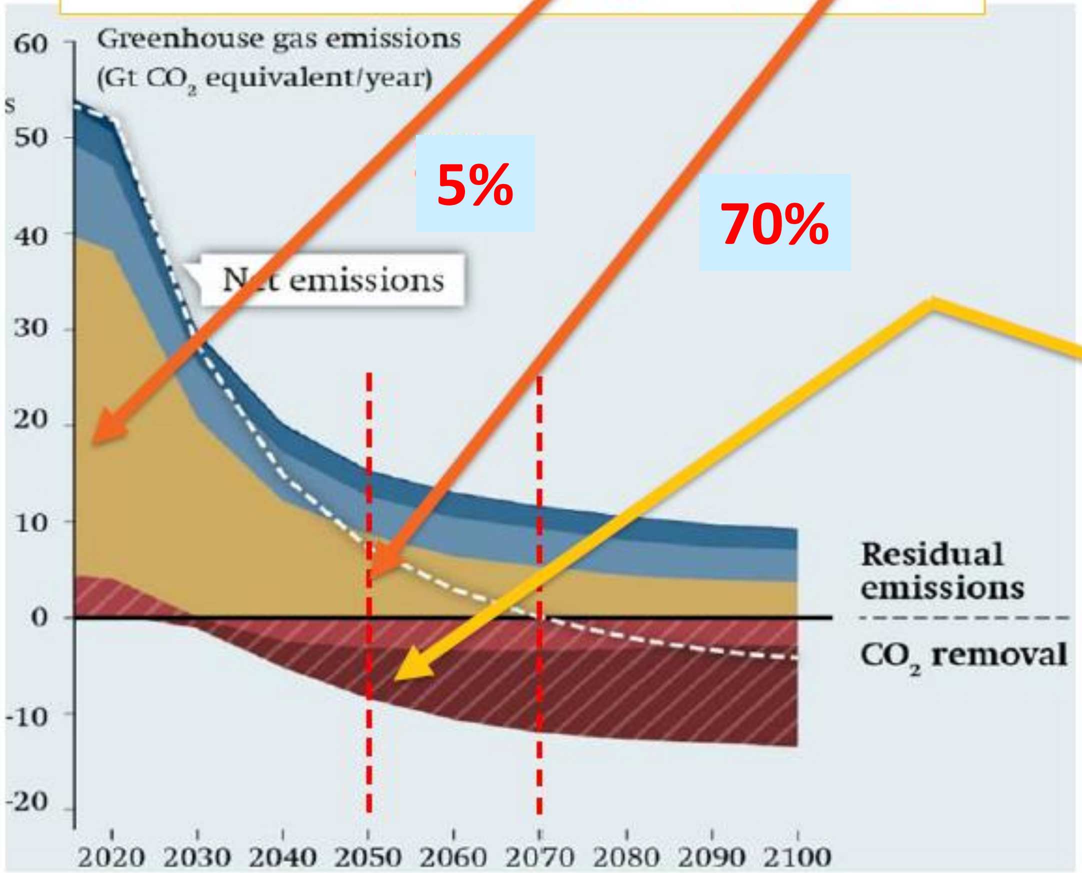
0.25-0.5 kg/h CO_2 converted

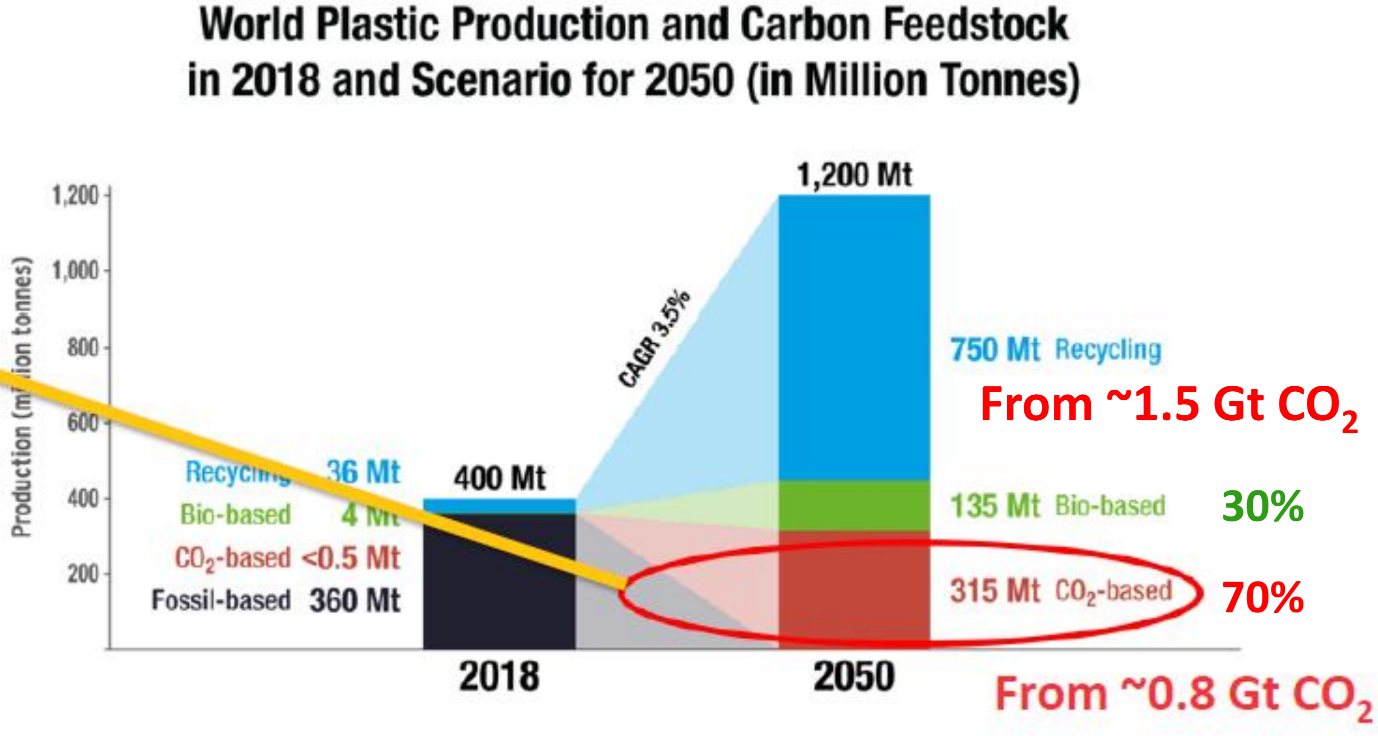


UNIVERSITEIT VAN AMSTERDAM avantium

The plastic materials transition







Avantium | CorpTech

nova Institute for Ecology and Innovation

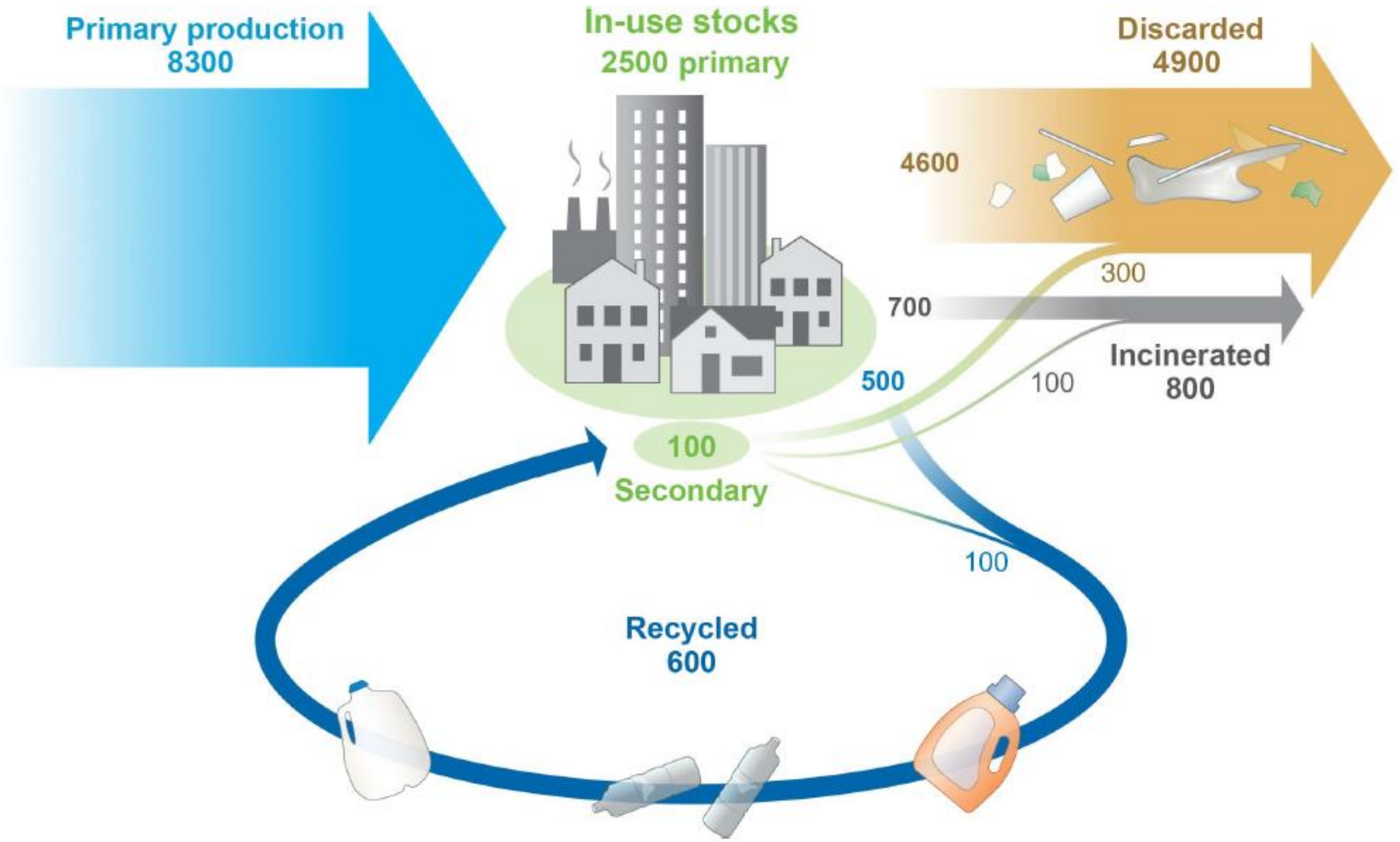
SCIENCE ADVANCES | RESEARCH ARTICLE

PLASTICS

Geyer, Jambeck, Law *Sci. Adv.* 2017;**3**:e1700782 19 July 2017

Production, use, and fate of all plastics ever made

Roland Geyer,[1]* Jenna R. Jambeck,[2] Kara Lavender Law[3]



Global production, use, and fate of polymer resins, synthetic fibers, and additives (1950 to 2015; in million metric tons).
"in-use stocks" of 2.5 Gt is 7x annual Plastic production in 2017.

Energy & Environmental Science

ROYAL SOCIETY OF CHEMISTRY

PERSPECTIVE

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Check for updates

When are negative emissions negative emissions?†

Samantha Eleanor Tanzer * and Andrea Ramírez

Cite this: *Energy Environ. Sci.*, 2019, 12, 1210

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The most consistent usage feature was that 70% (199) of papers state that purpose of negative emissions is to reduce global warming or, more specifically, to reduce atmospheric concentrations of greenhouse gases. Therefore, logically, the quantity of greenhouse gas in the atmosphere must be lower after NET use than before it. This requires not only that greenhouse gases are removed from and stored outside the atmosphere, but also ensuring that any greenhouse gases emissions that result from this process are not greater than the amount of greenhouse gases removed. Of the papers reviewed, only

Avoided emissions refer to the potential of adding a smaller, but still positive, amount of greenhouse gas to the atmosphere.

house gases in the cradle-to-grave system. Based on the most common defining elements seen in explicit and implicit usage of the term "negative emissions", and keeping in mind the goal of negative emissions—reducing atmospheric level of greenhouse gases—four key criteria can be considered "minimum qualifications" for determining whether a technology results in negative emissions:

1. Physical greenhouse gases are removed from the atmosphere.
2. The removed gases are stored out of the atmosphere in a manner intended to be permanent. do not agree with permanent
3. Upstream and downstream greenhouse gas emissions associated with the removal and storage process, such as biomass origin, energy use, gas fate, and co-product fate, are comprehensively estimated and included in the emission balance.
4. The total quantity of atmospheric greenhouse gases removed and permanently stored is greater than the total quantity of greenhouse gases emitted to the atmosphere.

Challenges

1. Harnessing the benefits of alternative carbon feedstock such as captured biogenic carbon for the production of plastics and chemicals by creating binding targets for non-fossil carbon content **and contributing to recycling obligations**.

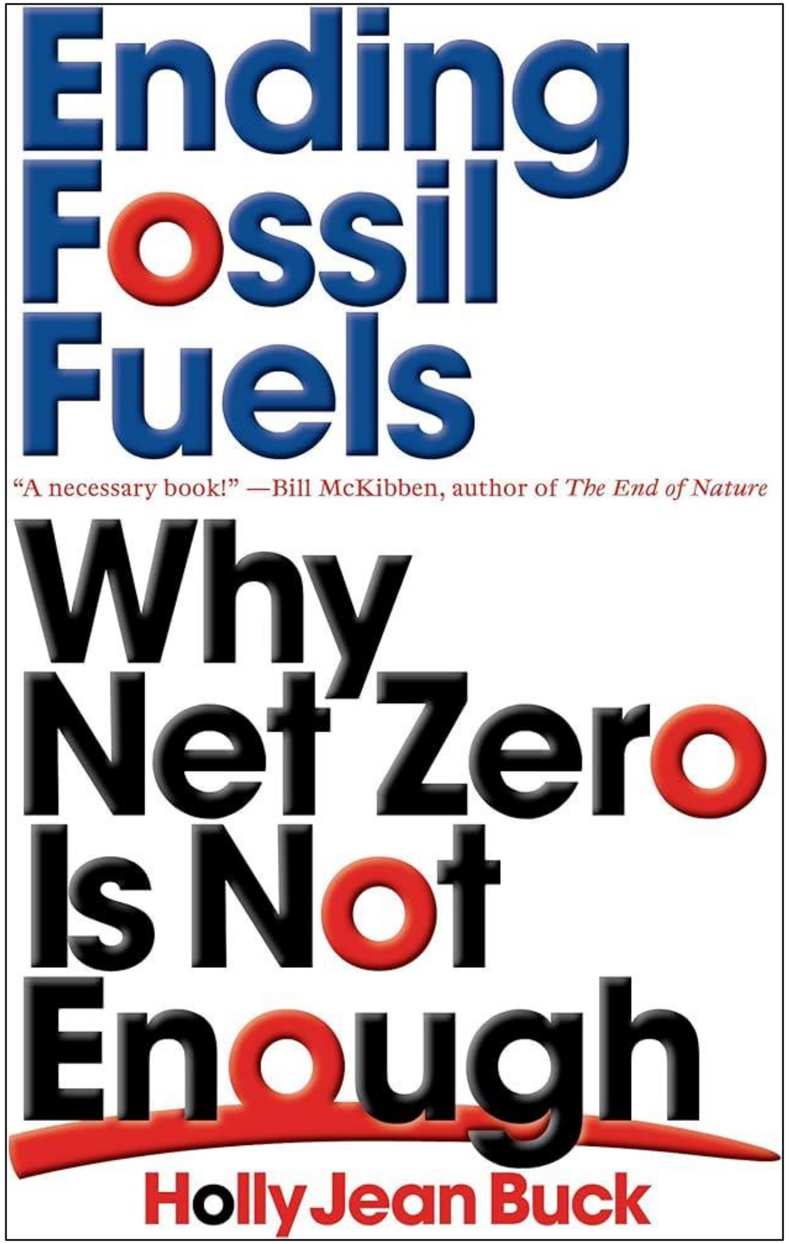
→ use CCS **ONLY** for compensation non avoidable emissions. Industry abuses CCS as cost for continuing fossil production.

2. Streamlining the regulatory approval requirements for bioconversion processes in the valorisation of captured biogenic carbon through reducing the administrative red tape (registration costs, approval times, third-party involvement, etc.), and the harmonisation of national regulations.

3. Securing a significant market share for captured biogenic carbon chemicals and products by establishing effective market pull mechanism, whilst evaluating the barriers of introducing final CCU products.

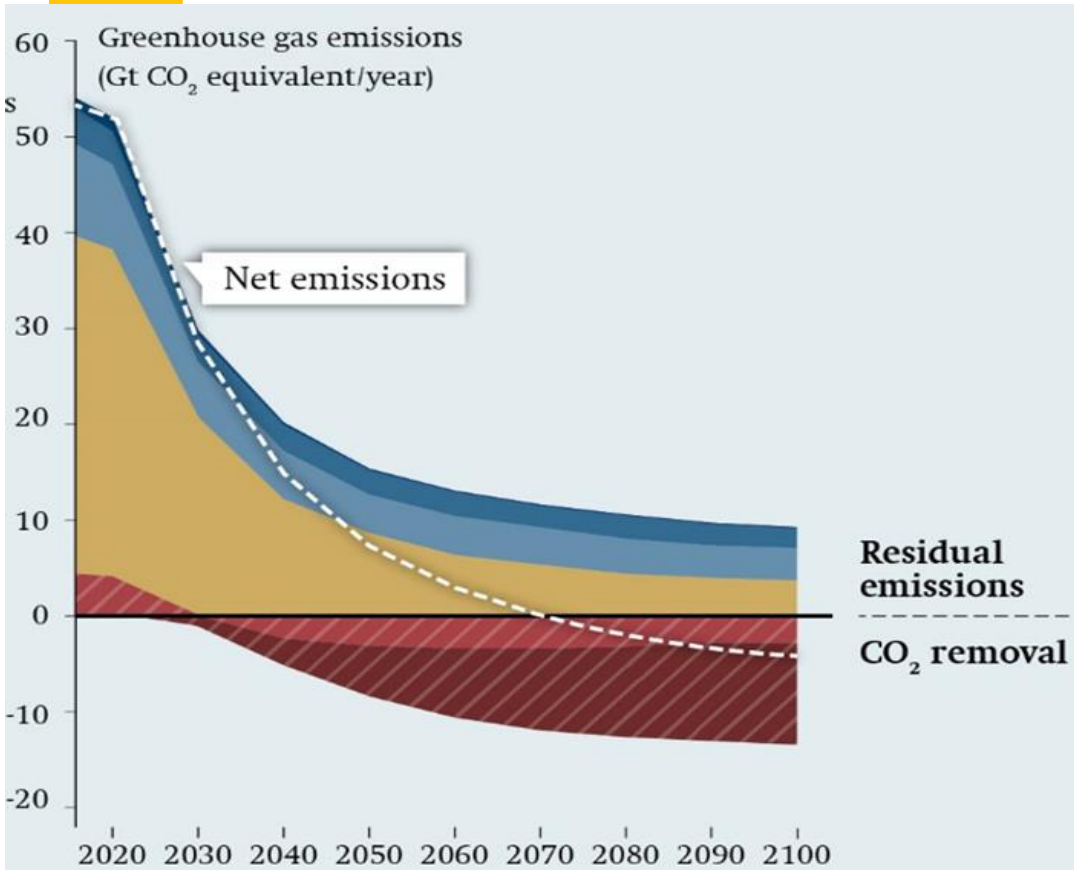
→ Avoid competition for CO_2 feedstock with CCS as “must have” for industry to compensate and “buy-off” fossil emissions. High C tax will lead to higher prices for captured CO_2.

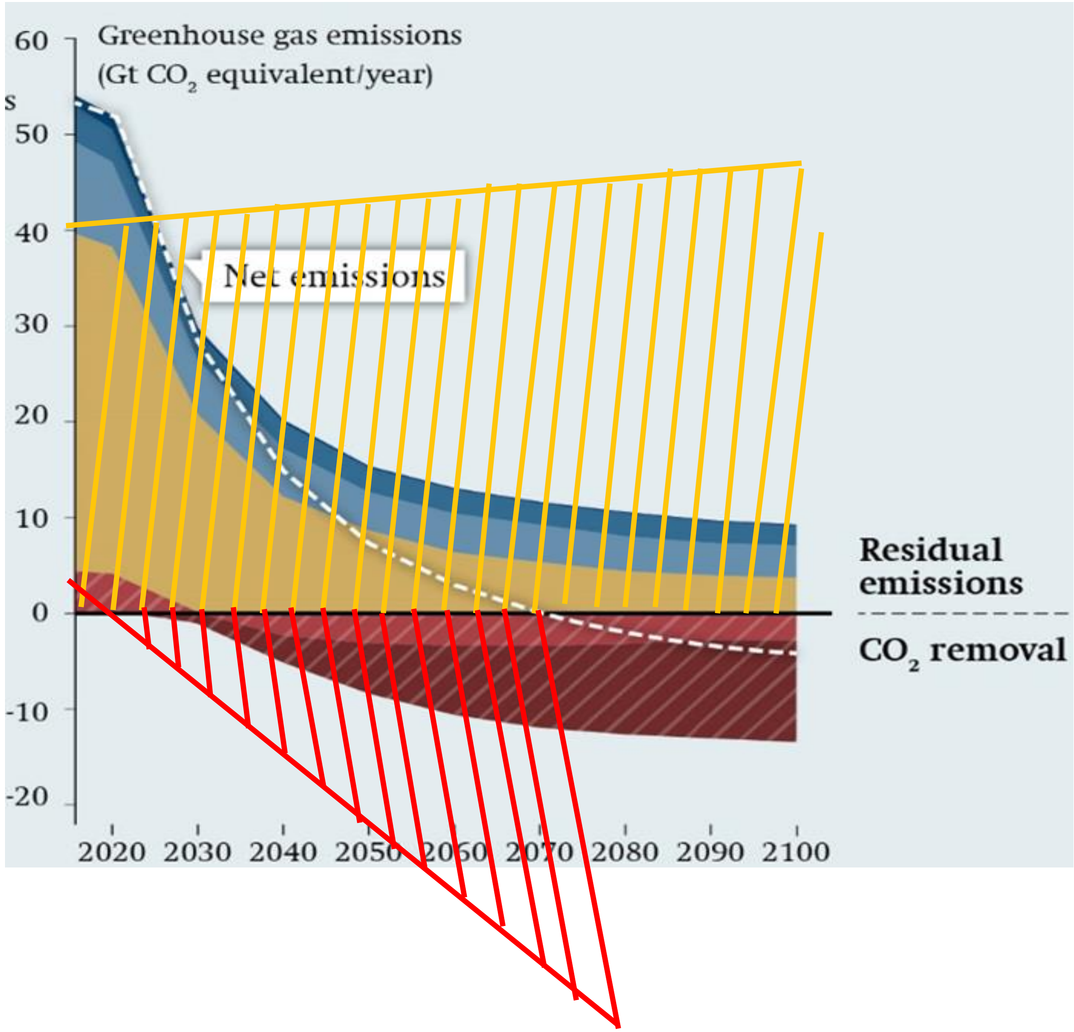
→ **Avoid** statements about negative emissions only resulting from permanent storage. Next century we will be in growth mode !



Around the world, countries and companies are setting net-zero carbon emissions targets. Chemical companies will continue to produce billions of tons of atmospheric CO_2 while relying on a symbiotic industry to scrub the air clean and store the CO_2.
Focusing on emissions draws our attention away from the real problem: the point of production.

The chemical industry must come to an end but will not depart willingly; governments must intervene.


Greenhouse gas emissions
(Gt CO2 equivalent/year)
Net emissions
Residual emissions
CO2 removal
60
50
40
30
20
10
0
-10
-20
2020 2030 2040 2050 2060 2070 2080 2090 2100


Greenhouse gas emissions
(Gt CO2 equivalent/year)
Net emissions
Residual emissions
CO2 removal

CATCO2NVERS PROJECT AND CHALLENGE 2

Oscar Ramírez

CATCO2NVERS project coordinator

Senior Project Manager at FUNDITEC

Didem Bilir

R&D Manager at EVYAP


CAT
NVERS
2

CATCO2NVERS

Creating added-value chemicals from bio-industrial CO_2 emissions using integrated catalytic technologies

H2020-LC-FNR13-2020
GA nº 101000580

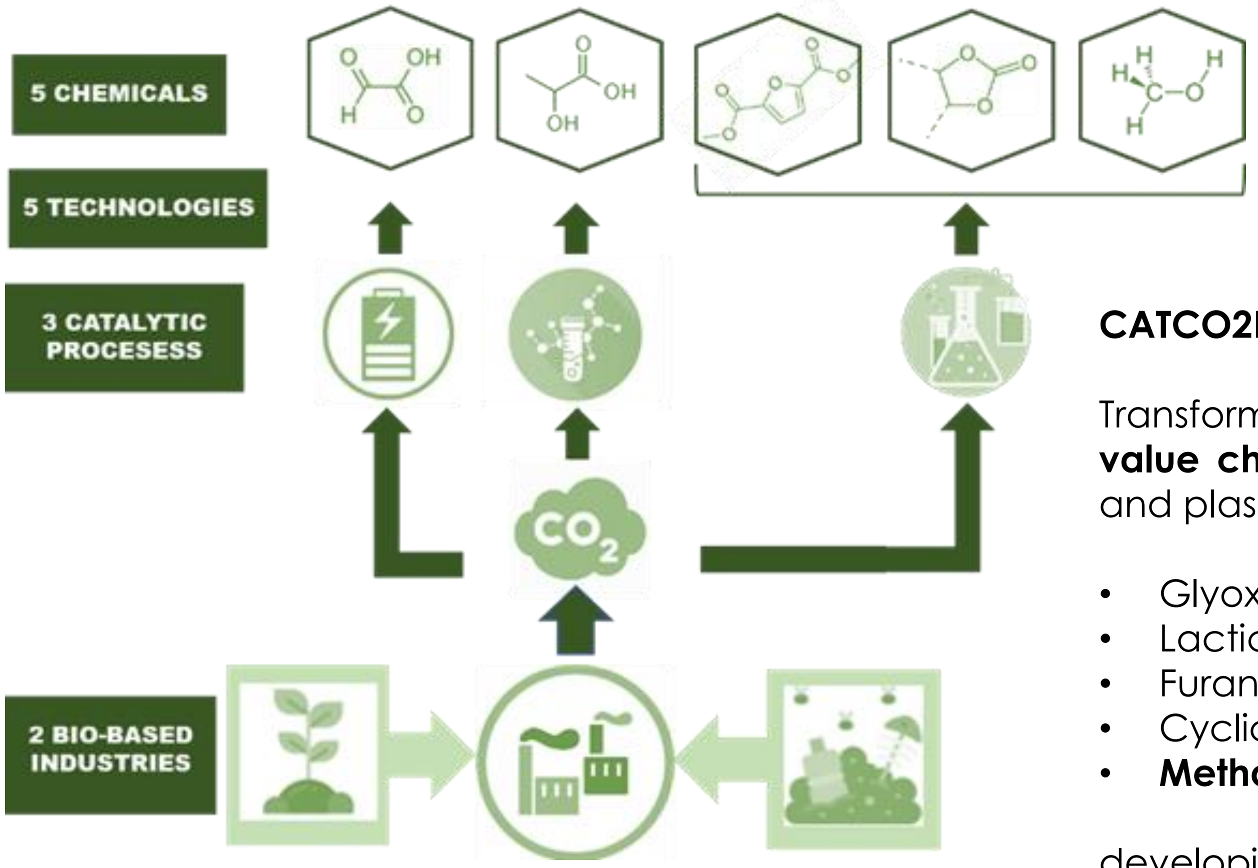
48 months
May 2021- April 2025

6,6M€

The key objective of **CATCO2NVERS** project is to simultaneously **reduce industrial CO_2 emissions** while **exploring innovative catalytic technologies for the valorisation of CO_2** into **added value bio-products**

This Project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement N. 101000580.

Concept



CATCO2NVERS will:

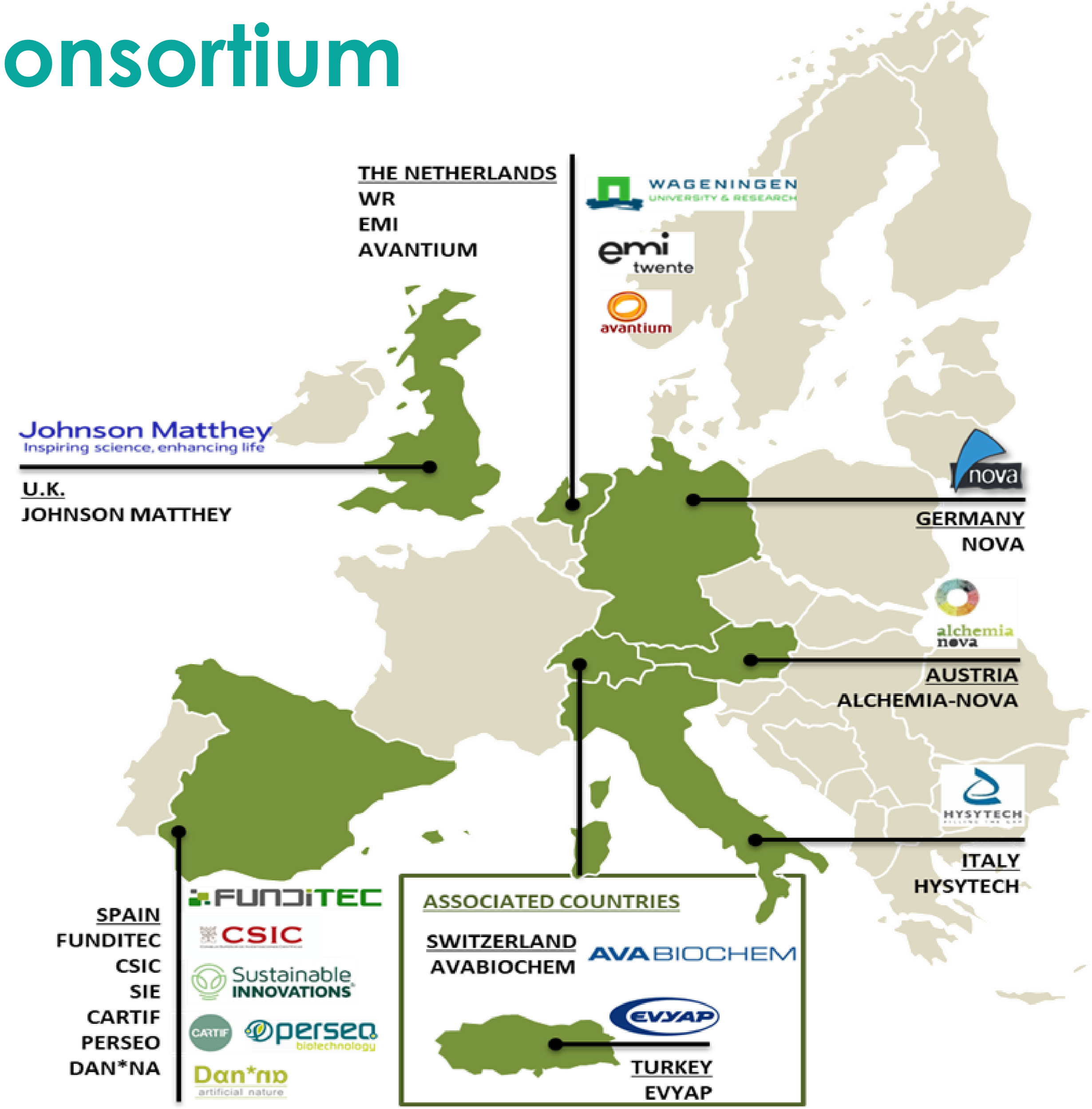
Transform waste-CO_2 from **2 bio-based industries** into **5 added-value chemicals,** with application in the chemical, cosmetics and plastic industry.

- Glyoxylic acid (**GA**),
- Lactic acid (**LA**),
- Furan dicarboxylic methyl ester (**FDME**),
- Cyclic carbonated fatty acid methyl esters (**CCFAMEs**)
- **Methanol**

developing **5 innovative and integrated technologies** based on **3 catalytic processes** (electrochemical, enzymatic and thermochemical).

This Project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement N. 101000580.

Consortium



8 EU countries

4 RTDs

1 UNI

8 SMEs

2 LE

15 participants

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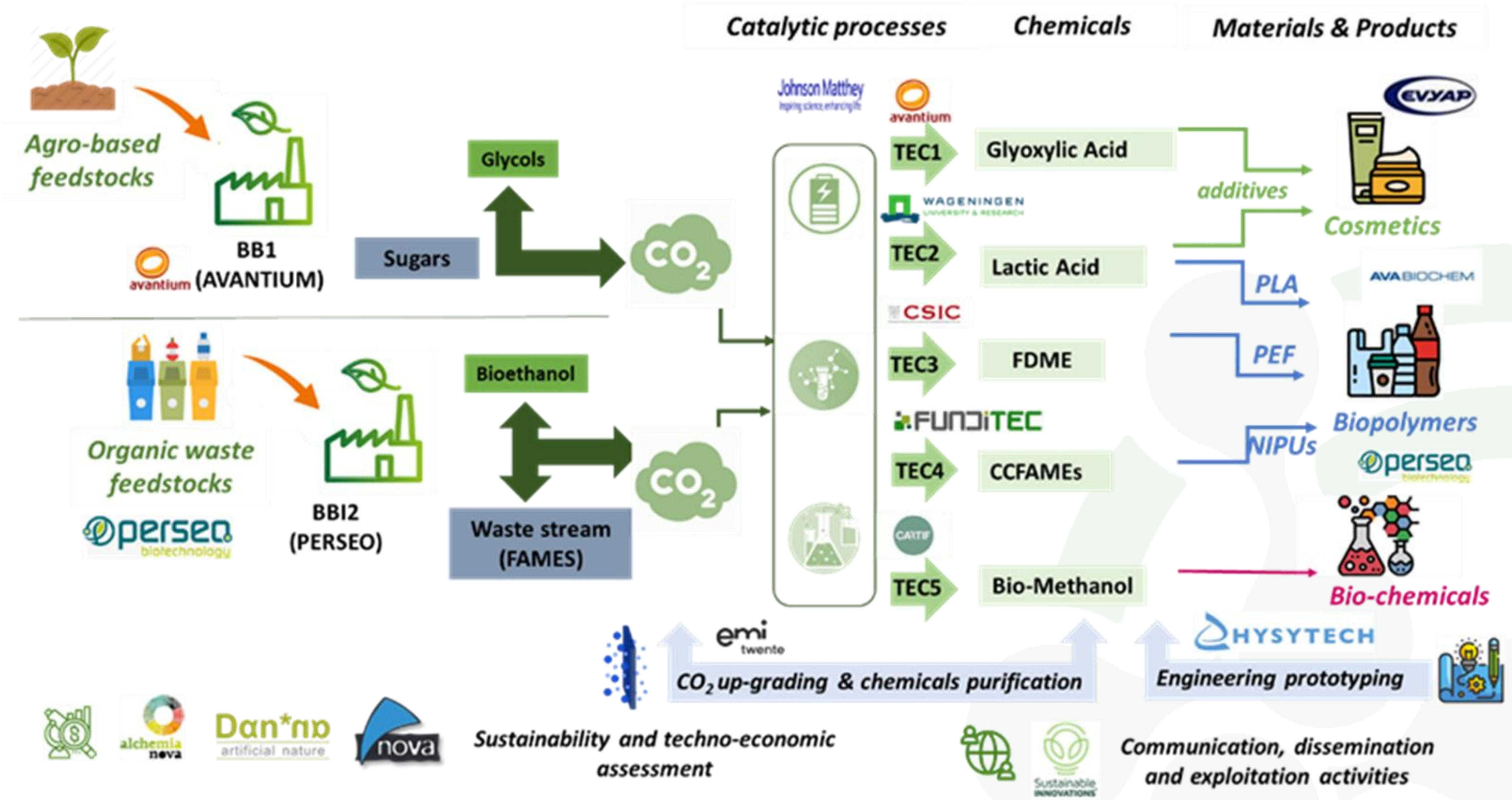
Roles & Approach



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Chemicals and Products

CO_2

GA

Glyoxylic acid

is an important C2 building block for many organic molecules of industrial importance, finds application in personal care as neutralizing agent, it is widely used in hair products (shampoos, conditioners, lotions, creams)

In **CATCO2NVERS**, GA will be **tested in cosmetics formulation** by industrial partner **EVYAP.**

LA

Lactic Acid

is often used in creams & lotions at a lower concentration for a gentler acid-based peel, is also an active ingredient used as disinfectant in hand sanitizers and disinfectant surface cleaners.

In **CATCO2NVERS**, LA will be **tested in cosmetics formulation** by industrial partner **EVYAP** and for the synthesis of **biopolymers (PLA)** by industrial partner **AVABIOCHEM.**

FDME

FDME plays a particularly important role as monomer for various organic high-performance polyesters. It can replace terephthalic acid in a wide range of applications and substitute FDCA in the synthesis of PEF.

In **CATCO2NVERS**, FDME will be **validated by** industrial partner **AVABIOCHEM** as monomer in the **synthesis of PEF.**

CCFAME

Cyclic carbonates like propylene and ethylene carbonate are used as components of electrolytes in lithium batteries, polar aprotic solvents, and industrial lubricants.

Special carbonates like **CCFAMEs are useful** in the synthesis of non-isocyanate polyurethanes (NIPUs).

In **CATCO2NVERS**, CCFAMEs will be validated by industrial partner **AVABIOCHEM in the synthesis of PURs.**

MeOH

Bio-MeOH is a versatile and useful chemical. Its use from biomass is more advantageous than fossil products because of its lower impact compared with the current obtaining methods and raw material availability; furthermore, the characteristics of this alcohol are identical to those of fossil fuel. In **CATCO2NVERS**, bio-MeOH will be **validated** by industrial partner **PERSEO.**

This Project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement N. 101000580.

M34

May 2021 → April 2025

CATO2NVERS

5 Catalytic Technologies

FUNDITEC
WAGENINGEN UR For quality of life
CARTIF
CSIC Consejo Superior de Investigaciones Científicas
UNIVERSITY OF TWENTE.
avantium
perseo biotechnology
HYSYTECH FILLING THE GAP
nova
Dan*na artificial nature
Sustainable INNOVATIONS®
alchemia nova
AVA BIOCHEM
EVYAP
JM Johnson Matthey Inspiring science, enhancing life

5 Chemicals

This Project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement N. 101000580.

Creating added-value chemicals from bio-industrial CO_2 emissions using integrated catalytic technologies

FUNDITEC

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Contact:

Oscar Ramírez Gutiérrez, Ph.D (Project coordinator): ohramirez@funditec.es
Dulce Muñoz, Ph.D (Technical Manager): dmunoz@funditec.es

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Thank you!

Dulce Muñoz Subtil, Ph.D
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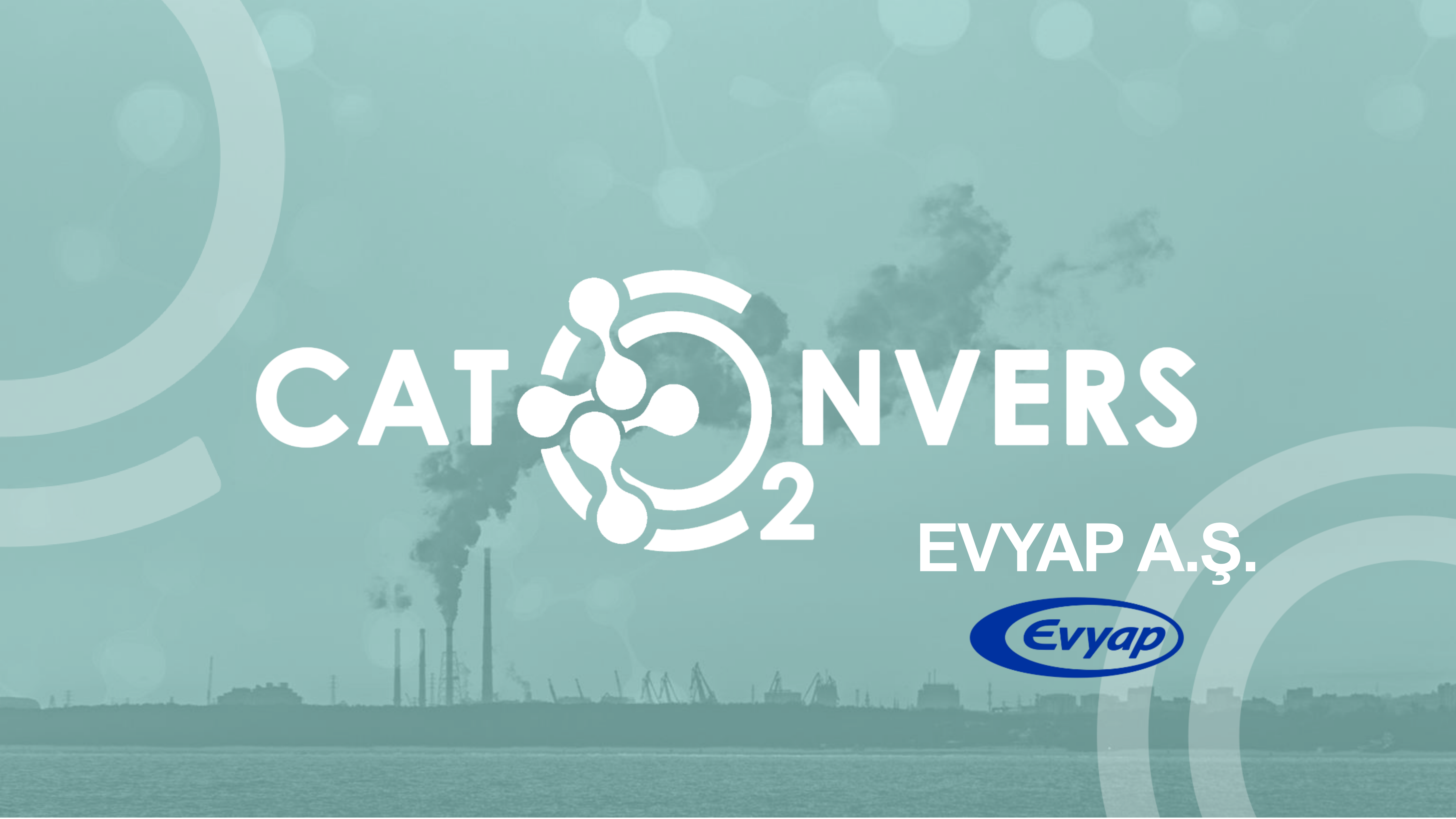
CATCO2NVERS
EVYAP A.Ş.
Evyap

Brief history of EVYAP

- *Founded in **1927**, by Mehmet Rıfat EVYAP.*
- ***Operates in 4 business** areas: FMCG, Oleochemicals, Port Management and Real Estate*
- *One of the biggest privately owned soap manufacturers of the world today.*
- *Number one exporter of soap and personal care products in Turkey.*
- *Manufactures in **3 different countries** worldwide through sophisticated systems aligned to European standards.*
- ***Exists in more than 100 countries**, with a wide range of products from soap to shower gel, shampoo, shaving products, skin-care creams, scented cosmetics, baby diapers, and toothpaste.*
- ***One of top 100** Turkish industrial firms.*
- *Engages in "contract manufacturing" for leading global firms as well, in addition to manufacturing for its own brands.*
- *Hosts Evyapport, Turkey's 4th biggest private port.*
- ***Employs about 3.000 people.***
- *Developer of well-known brands such as **Duru, Arko Men, Arko Nem, Evy Baby, Fax and Activex.***
- *R&D Center, **38 people***

%15 PhD
%55 Engineers
%25 Technicians
1/2 female

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Facilities

This Project has received funding from the Europ
Union's Horizon 2020 Research and Innovatio
Programme under Grant Agreement N. 101000

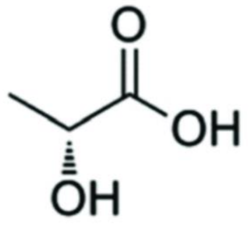
AGENDA:

- LACTIC ACID
- GLYOXYLIC ACID

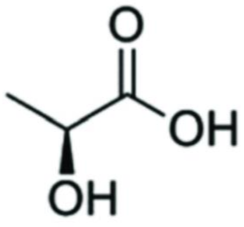
This Project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement N. 101000580.

LACTIC ACID

Regulated In Regulations:
1) EU Cosmetic Products Regulation (EC) No. 1223/2009
2) The Biocidal Products Regulation (BPR, Regulation (EU) 528/2012)



L-(+)-Lactic acid



D-(-)-Lactic acid

EC No.	201-196-2 (general 200-018-0)
CAS No.	79-33-4 (general 50-21-5)
E-No.	E 270
Characteristics	Colourless to yellowish, nearly odourless or with a characteristic odour, syrupy liquid with an acid taste, consisting of a mixture of lactic acid and lactic acid lactate. Relative density (20°C): 1.18 – 1.20 g/ml

Use of the Substance/Mixture : Food additive, Feed additive, Personal care, Cleaning agent, Biocidal product, Industrial use, Pharmaceutical raw material

This Project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement N. 101000580.

LACTIC ACID (CAS:50-21-5)

CAT O2 NVERS

European Commission

CosIng - Cosmetics Ingredients

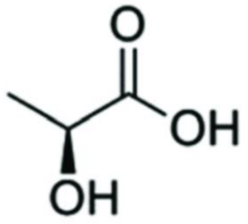
Home | Advanced Search | Reference data | User manual

Home > LACTIC ACID

Ingredient: LACTIC ACID

PDF

INCI Name	LACTIC ACID
Description	
CAS #	50-21-5
EC #	200-018-0
Identified INGREDIENTS or substances e.g.	
Cosmetics Regulation provisions	
Functions	• BUFFERING • HUMECTANT • SKIN CONDITIONING
SCCS opinions	• Position paper on the Safety of alpha-Hydroxy Acids • Updated position paper concerning consumer Safety of alpha-hydroxy acids



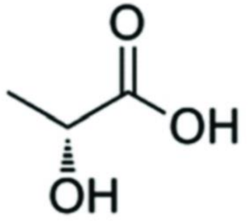
D-(-)-Lactic acid

https://ec.europa.eu/growth/tools-databases/cosing/details/34809

Programme under Grant Agreement N. 101000580

LACTIC ACID (CAS:79-33-4)

Synonyms : 2-Hydroxypropionic acid
Molecular Formula : $CH_3CH(OH)COOH$



L-(+)-Lactic acid

Assay	79.5 – 80.5 %
Stereochemical purity (L-isomer)	min. 97 %
Colour (fresh)	max. 200 apha
Identification	conforms
Sulphated ash	max. 0.1 %
Chloride	max. 10 mg/kg
Sulphate	max. 10 mg/kg
Cyanide	max. 5 mg/kg
Iron	max. 10 mg/kg
Arsenic	max. 1 mg/kg
Lead	max. 0.5 mg/kg
Mercury	max. 1 mg/kg
Heavy metals (as Pb)	max. 10 mg/kg
Calcium	max. 20 mg/kg

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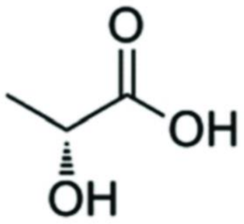
LACTIC ACID (CAS:79-33-4)

CAT2NVERS

ANNEX

Common Name	IUPAC NameIdentification Numbers	Minimum degree of purity of the active substance[a]	Date of approval	Expiry date of approval	Product type	Specific conditions
L(+) Lactic acid	IUPAC Name: (S)-2-Hydroxypropanoic acid EC No: 201-196-2 CAS No: 79-33-4	95,5 % w/w	1 July 2017	30 June 2027	1	The authorisations of biocidal products are subject to the following conditions: 1. The product assessment shall pay particular attention to the exposures, the risks and the efficacy linked to any use covered by an application for authorisation, but not addressed in the Union-level risk assessment of the active substance. 2. In view of the risks identified for the uses assessed, the product assessment shall pay particular attention to non-professional users.



L-(+)-Lactic acid

a The purity indicated in this column was the minimum degree of purity of the active substance evaluated in accordance with Article 89(1) of Regulation (EU) No 528/2012. The active substance in the product placed on the market can be of equal or different purity if it has been proven to be technically equivalent to the evaluated active substance.

(1) OJ L 167, 27.6.2012, p. 1.

(2) Directive 98/8/EC of the European Parliament and of the Council of 16 February 1998 concerning the placing of biocidal products on the market (OJ L 123, 24.4.1998, p. 1).

https://www.legislation.gov.uk/eur/2016/2291?view=plain

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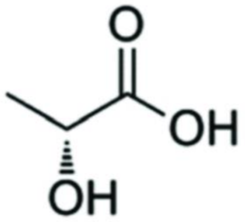
LACTIC ACID (CAS:79-33-4)



L-(+)-Lactic acid

- The CLP classification of L-Lactic acid (CAS Number 79-33-4) has changed. It has to be classified as a substance corrosive for the skin, based on a new recommendation from the European Chemicals Agency (ECHA).
- A new Annex VI of the CLP (Classification, Labelling and Packaging) Regulation (EC) 1272/2008 was published on August 11, 2020. This Annex includes L-Lactic acid with a classification containing new hazard phrases for product labels:

H314 '*Causes severe skin burns and eye damage*' and **EUH 071** '*corrosive to the respiratory tract*' (only valid in the EU) instead of the current **H315** '*Causes skin irritation*' and **H318** '*Causes serious eye damage*.'

- The hazard pictogram on the labels stays the same (Corrosive). Therefore, product handling should adhere to the local regulation for corrosive products.
- The industry was allowed a period of 18 months from publication of the new regulation to implement this change. This means the change went into effect by March 1, 2022.
- The new classification implies that lactic acid should also fall under the ADR regulation where applicable. Lactic acid was included in the generic UN number "***UN 3265 for class 8 - Corrosive liquid, acidic, organic, n.o.s***." This was implemented by March 1, 2022.
- Please note that this classification does not apply to lactic acid salts (lactates).
- The classification change applies to the chemical L-Lactic acid (CAS 79-33-4), i.e. is in principle independent from the physical form it is available.

This Project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement N. 101000580.

Activex – Antibacterial Liquid Hand Soap

Kills %99,9 of Bad Bacteria, Protect Good Bacteria*

*Tested under laboratory conditions *bad bacteria: S. aureus ATCC 6538, P. aeruginosa ATCC 15442, E. coli ATCC 10536, E. hirae ATCC 10541; **good bacteria: B. bifidum, L. fermentum, L. crispatus ve S. epidermidis.*

Use biocides safely. Rea.d the label before use. For detailed information please visit www.activex.com.tr

This Project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement N. 101000580.

Activex – Antibacterial Liquid Hand Soap

Type of Microorganism Tested Under Laboratory Conditions – Life Stage (*)

Type of Microorganism	Application Area and Form	Application Dose	Application Frequency
Staphylococcus aureus **ATCC 6538** ***Pseudomonas aeruginosa*** **ATCC 15442** ***Escherichia coli K12 NCTC*** **10538** ***Enterococcus hirae*** **ATCC 10541** ***Candida Albicans*** **ATCC 10231**	General public Rinse after applying hands and palms	Foam product (about 2 g) in the palm of your hand and rub it for 60 seconds, then rinse with water .	10 times a day

This Project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement N. 101000580.

L(+)-Lactic Acid

Formula: $C_3H_6O_3$
MW: 90,08 g/mol
80% w/w

Classification, Labeling and Packaging of Substances and Mixtures Open data in compliance with the regulation

It is classified as hazardous according to the criteria of Regulation (EC) No 1272/2008

Hazard Pictogram

Danger

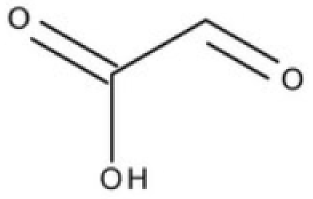
Precautionary Statements

l funding from the European
Research and Innovation
Agreement N. 101000580.

GLYOXYLIC ACID

Regulated In:

1. EU Cosmetic Products Regulation (EC) No. 1223/2009



Synonyms : Glyoxylic acid, Oxoacetic acid, 2-Oxoacetic acid, Formylformic acid
Molecular Formula : $C_2H_2O_3$
CAS No : 298-12-4
EINECS No : 206-058-5

Use of Substance : High purity cosmetic grade with only trace content of CMR impurity glyoxal and without formaldehyde. This allows formulators to use levels up to 25% in hair straightening cosmetics without exceeding the maximum permitted level of 100 ppm glyoxal establistged by EU & other cosmetic regulations.
also it is used in cosmetics made to brighten the skin, to fill wrinkles in the skin, prevent moisture loss of the skin and increase hyaluronic acid production.

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European Commission

CosIng - Cosmetics Ingredients

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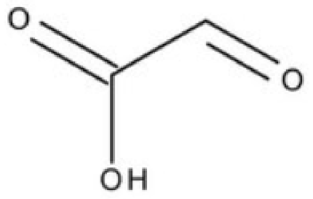
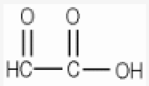
Home > GLYOXYLIC ACID



Ingredient: GLYOXYLIC ACID

PDF

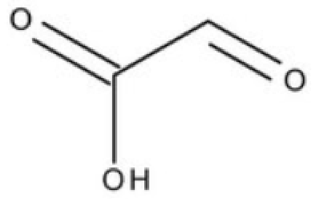
INCI Name	GLYOXYLIC ACID
Description	
CAS #	298-12-4
EC #	206-058-5
Identified INGREDIENTS or substances e.g.	
Cosmetics Regulation provisions	
Functions	• ANTISTATIC • BUFFERING • HAIR WAVING OR STRAIGHTENING
SCCS opinions	

https://ec.europa.eu/growth/tools-databases/cosing/details/34158

This Project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement N. 101000580.

GLYOXYLIC ACID

Product Name	Glyoxylic Acid Monohydrate	
Item	Qualified	High Quality Products
Glyoxylic Acid Monohydrate	≥98.00%	≥98.5%
Formic acid	≤0.50%	≤0.4
Oxalic acid	≤1.25%	≤0.9
Maleic acid	≤0.25%	≤0.2



Product Name		**Glyoxylic Acid 50%**	
Item	Qualified	First-grade Products	High Quality Products
Glyoxylic Acid	≥50.00%	≥50.00%	≥50.00%
Formic acid	≤0.30%	≤0.30%	≤0.20%
Oxalic acid	≤0.90%	≤0.50%	≤0.25%
Maleic acid	≤0.15%	≤0.15%	≤0.15%

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COSMETIC FORMULATIONS PRODUCT TESTS

Stability tests
4-6 months (at 5°C & 25°C & 40°C)
1 month @ 45°C & 2 weeks @ 50°C
Cycle Test (Freeze / Thaw)
Suntest with Atlas Suntest XLS +
24-48 hr @ 45°C; Irradiance control 300-800nm; Irradiance: 250 w/m2
Microbiological tests & Challenge tests
Dermatological test (Patch Test)
For sensitive products; sensitive skin tests and Hypoalergenic tests are needed.
Claim substantion tests (if any, according to claims)

Heavy metal limits for cosmetic product max (%) (Pb: 20 ppm As: 5 ppm Cd: 5 ppm Hg: 1 ppm Sb: 10 ppm)
For all cosmetic products Safety assessment should be reported by Safety Assessor.
Margin of Safety (MoS) should be higher than 100. This value changes according to target group (eg. For baby products 230) and should be calculated by Safety Assessor.

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SAFETY ASSESSMENT

If the ingredient is listed at the annexes, it is considered safe when the rules at the Reg. 1223/2009 are followed.

NOAEL (No-observed-adverse-effect level)
MoS (Margin of Safety) for target group is checked.

The skin surface area to body mass ratio in children is higher than in adults, then, the ratio between the SSA/BW ratios of children and adult changes from 0 to 10 years (Renwick, 1998)
•2,3 times higher in infants at birth than in adults.
•1,8 times higher at 6 months.
•1,6 times higher at 12 months.
•1,5 times higher at 5 years.

The calculation of the MoS for children and infants it would be adjusting the default assessment factor of 100 for adults by multiplying this factor by the difference in Skin Surface Area over Body Weight ratio (SSA/BW) between adults and children (SCCNFP/0557/02).

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REGULATIONS

1.EU Cosmetic Products Regulation (EC) No. 1223/2009

2.The Biocidal Products Regulation (BPR, Regulation (EU) 528/2012)

3. REACH; The Registration, Evaluation, Authorization, and Restriction of Chemicals Regulation (EC) No 1907/2006 (REACH)

4. CLP; REACH is connected to the Classification, Labelling and Packaging of Substances and Mixtures Regulation (EC) No 1272/2008 (CLP).

5. Scientific Committee on Consumer Safety (SCCS) Opinions
6. ECHA (European Chemicals Agency)

NATIONAL REGULATIONS

1. 11 Aralık 2013 tarihli, 28848 Sayılı, Maddelerin Ve Karışımların Sınıflandırılması, Etiketlenmesi Ve Ambalajlanması Hakkında Yönetmelik.
2. T.C. Çalışma ve Sosyal Güvenlik Bakanlığı, 12 Ağustos 2013 tarihli, 28733 sayılı, Kimyasal Maddelerle Çalışmalarda Sağlık ve Güvenlik Önlemleri Hakkında Yönetmelik.
3. T.C. Çalışma ve Sosyal Güvenlik Bakanlığı, 2 Temmuz 2013 tarihli, 28695 sayılı, Kişisel Koruyucu Donanımların İşyerlerinde Kullanılması Hakkında Yönetmelik.
4. T.C. Çalışma ve Sosyal Güvenlik Bakanlığı, 30 Haziran 2012 tarihli, 6331 sayılı, İş Sağlığı ve Güvenliği Kanunu.
5. T.C. Çevre ve Şehircilik Bakanlığı, 2 Nisan 2015 tarihli, 29314 sayılı, Atık Yönetimi Yönetmeliği.

This Project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement N. 101000580.

References:

1.https://webbook.nist.gov/cgi/cbook.cgi?ID=C50215&Mask=80

2.http://www.inchem.org/documents/icsc/icsc/eics0501.htm#:~:text=Flash%20point%3A%20110%C2%B0C%20c.c.&text=The%20substance%20can%20be%20absorbed,its%20aerosol%20and%20by%20ingestion.&text=The%20substance%20is%20corrosive%20to,the%20skin%20and%20respiratory%20tract

3.https://pubchem.ncbi.nlm.nih.gov/compound/Lactic-acid#section=Density

4.https://bmrb.io/metabolomics/mol_summary/show_data.php?id=bmse000208&whichTab=1

5. https://www3.epa.gov/pesticides/chem_search/reg_actions/registration/decision_PC-128929_1-Jun-09.pdf

6.https://echa.europa.eu/bg/registration-dossier/-/registered-dossier/14252/5

7. https://echa.europa.eu/bg/registration-dossier/-/registered-dossier/14252/6

8. https://echa.europa.eu/bg/registration-dossier/-/registered-dossier/14252/7

9. https://www.ncbi.nlm.nih.gov/books/NBK470202/

This Project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement N. 101000580.

Thank you for your attention...

This Project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement N. 101000580.

VIVALDI PROJECT AND CHALLENGE 3

Albert Guisasola

VIVALDI project coordinator

Full professor at UAB

Elvira Serra

Principal Consultant at Isle Utilities

VIVALDI project

Addressing Challenges and Unlocking Carbon Capture Utilization: Circular Carbon Advancement through Policy Reform

February 20th 2024

Albert Guisasola Canudas (PI)
GENOCOV (www.genocov.com)
Universitat Autònoma de Barcelona

The VIVALDI project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000441.

PUBLIC

Overview

Turns CO_2 emissions into sustainable bioproducts

Start date: 1.6.2021

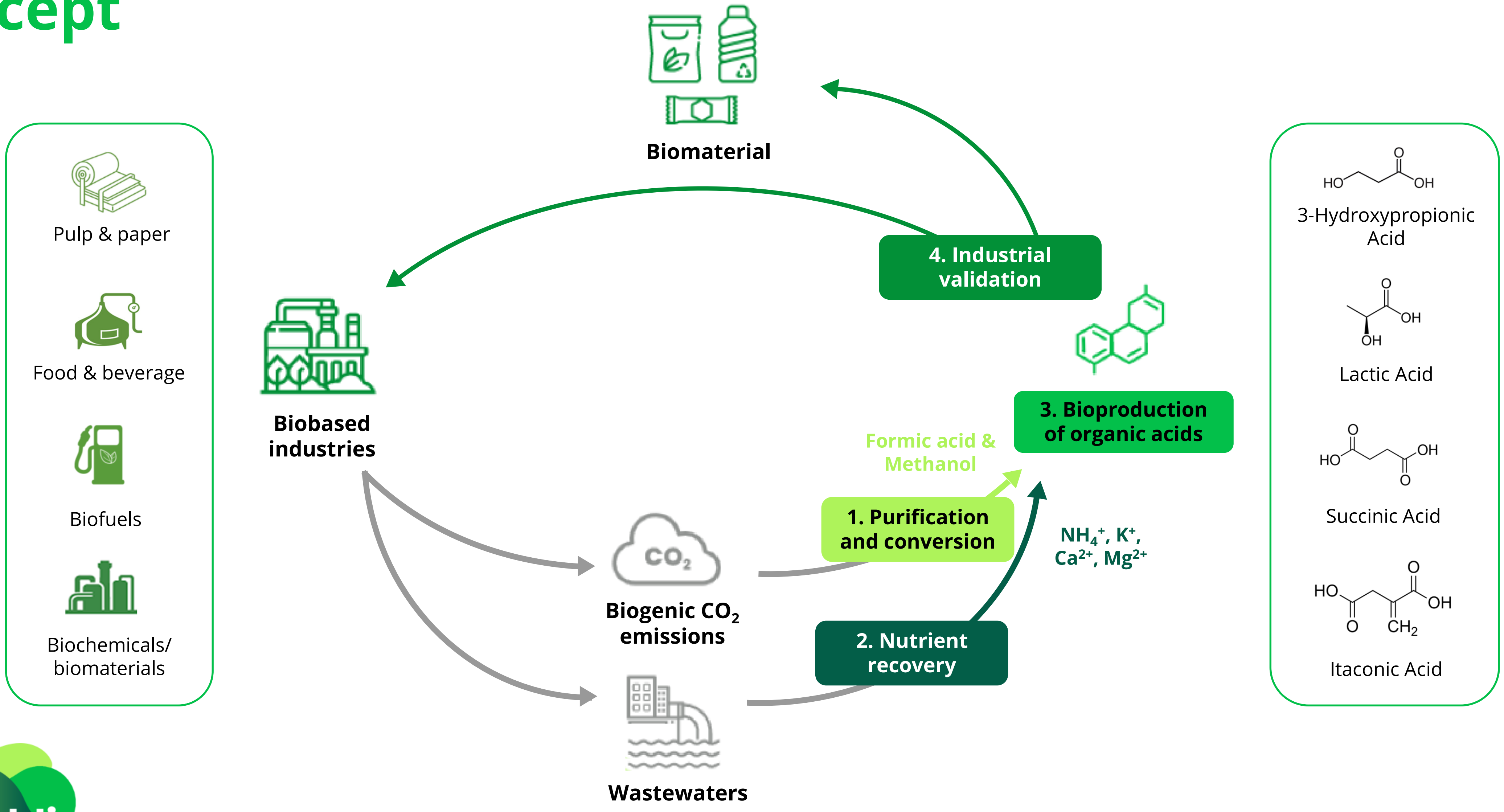
Funded under: H2020-EU 3.2.

Duration: 4 years

16 partners

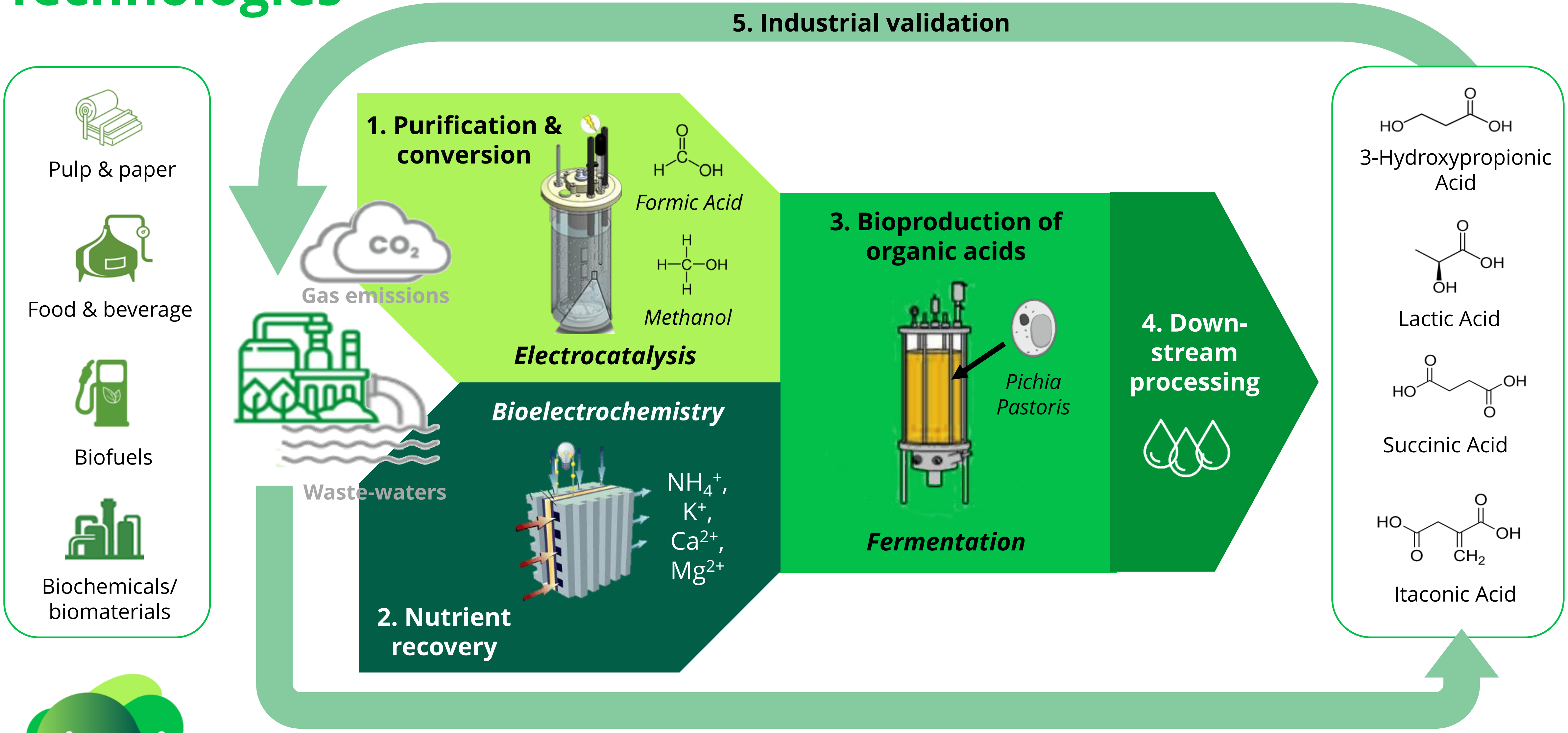
Budget: 7 M€

Concept



Pulp & paper
Food & beverage
Biofuels
Biochemicals/ biomaterials
Biomaterial
Biobased industries
4. Industrial validation
3. Bioproduction of organic acids
Formic acid & Methanol
1. Purification and conversion
NH_4^+, K^+, Ca^{2+}, Mg^{2+}
Biogenic CO_2 emissions
2. Nutrient recovery
Wastewaters
3-Hydroxypropionic Acid
Lactic Acid
Succinic Acid
Itaconic Acid

Technologies

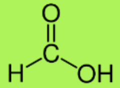


vivaldi
Turns CO₂ emissions into sustainable bioproducts

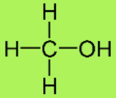
Electrocatalysis

1. **Purification & conversion**

Gas emissions



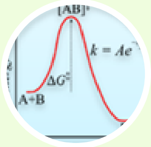
Formic Acid



Methanol

Electrocatalysis

Why electrocatalysis?



CO_2 transformation is limited by thermodynamic and kinetic inertness. To overcome the high energy barriers of CO_2 activation, catalysts are required.

It can be produced at biocompatible conditions (neutral pH, ambient temperature and pressure, physiologic salinity and under presence of components of microbial media).

Depending on the conditions and electrode materials, different products can be obtained. Understanding ECO_2R opens a plethora of novel possibilities of CO_2 valorisation as microbial feedstock.

ECO_2R provides a pathway for the utilization and (temporary) storage of electric energy. Electricity from photovoltaic cells, wind turbines, or off-peak grid power sources can be used to drive CO_2 reduction.

Why Formic Acid (FA) and Methanol (MeOH)?

i. CO_2 reduction to added-value chemicals (i.e. FA) leads to short-term economic feasibility to **a higher market price** and (MWh/tC) among similar **higher energy content** products.

ii. **Biomethanol** from wastes has a higher value (400–450 €/ton) than its cost of production 200 €/ton

iii. The **energetic efficiency** of converting FA/MeOH into biomass aerobically can reach 50%, while for other C1-feedstocks it lies in a range of 20–40%.

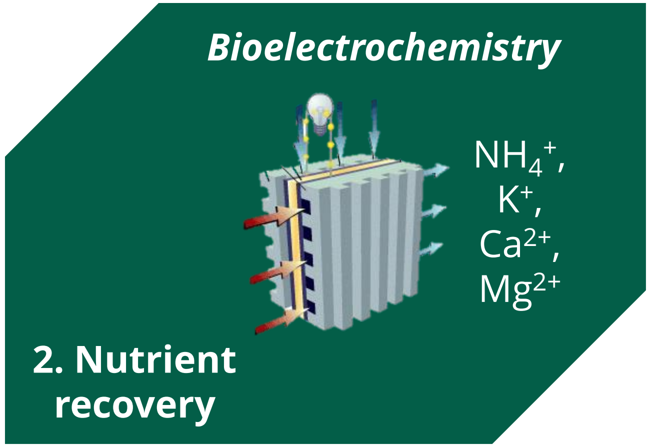
iv. Microbial utilisation of FA and MeOH as C-source needs a **minimal media and simple nitrogen sources**

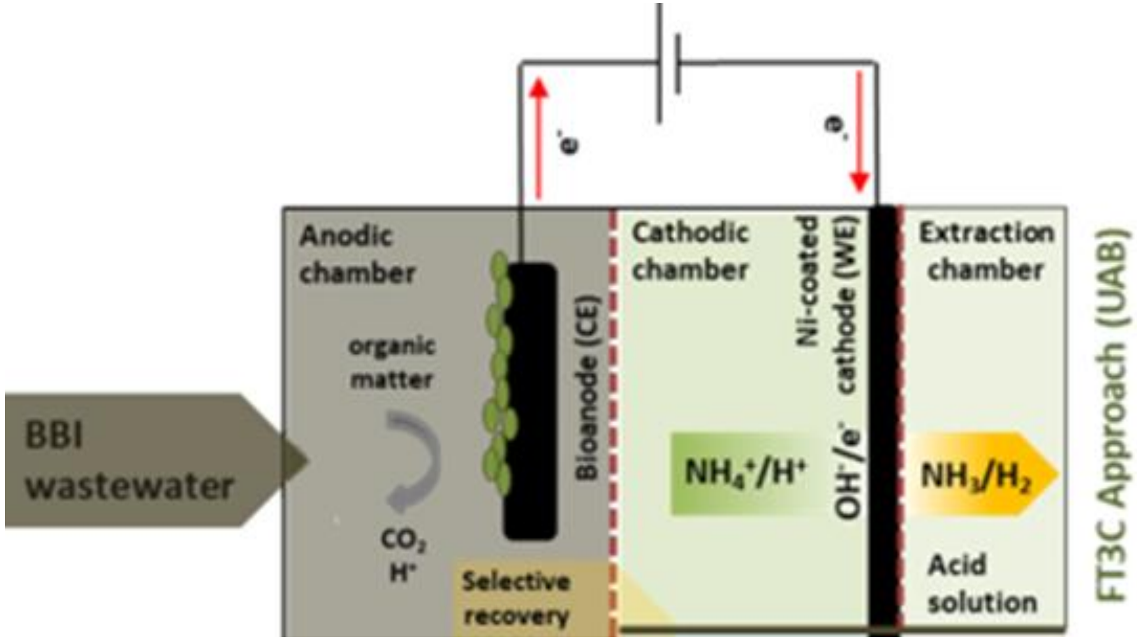
v. Cultivation of microorganisms on C1-gases (e.g. CH_4, CO, and H_2/CO_2) has several drawbacks: low water solubility, limited mass transfer (due to phase boundaries), issues with storage and transportation, low yield and low microbial productivity.

Bioelectrochemistry

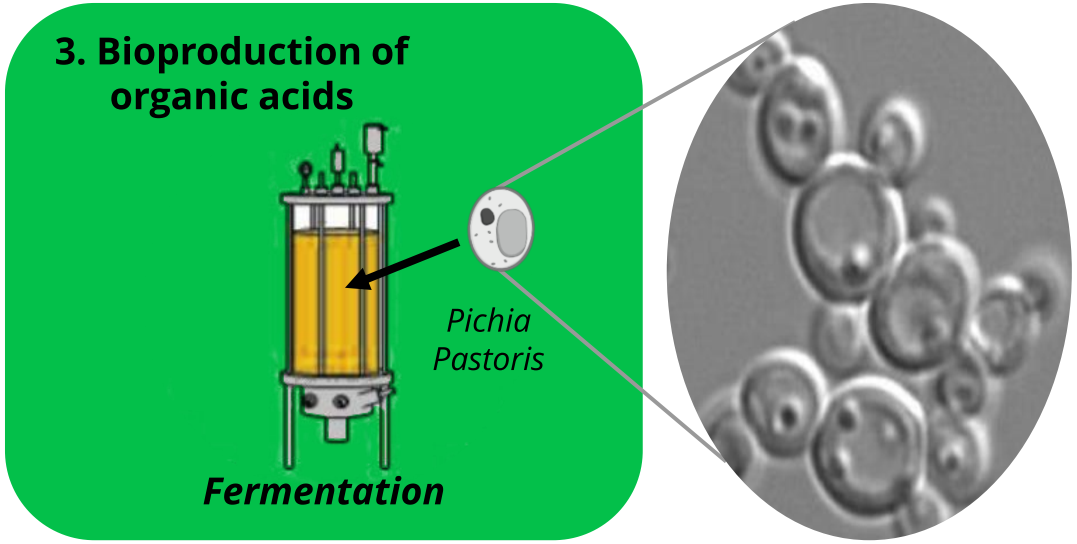
Bioelectrochemical Nutrient Recovery

Organic matter from the indWW (or externally amended) is oxidised at the anode side and electrons flow from the anode to the cathode since a potential is applied in the cell. The charge balance due to the electron transport is balanced by cation transport over the cation exchange membrane to maintain electroneutrality. Therefore, ammonium and other cations are concentrated in the cathode compartment.





Fermentation



Why *Pichia Pastoris*?

i. Grows at optimal conditions for recovery of free organic acids: low extracellular pH and high product concentration

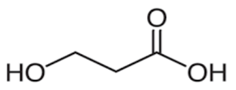
ii. Grows on MeOH and can use FA as auxiliary substrate

iii. Can grow and produce on simple mineralic media

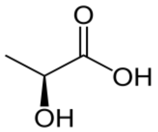
iv. Industrial scale fermentation is established

v. Genetics and metabolisms are well studied, a genome scale metabolic model and synthetic biology tools are established

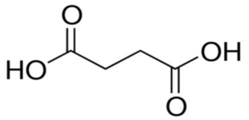
Target compounds



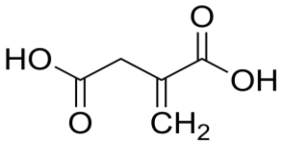
3-Hydroxypropionic Acid



Lactic Acid



Succinic Acid



Itaconic Acid

	3-hydroxypropionic acid (3-HP)	Lactic Acid (LA)	Itaconic Acid (IA)	Succinic Acid (SA)
Current synthesis	Microbial/enzymatic production under aerobic conditions with glycerol/glucose as substrate and coenzyme-B12/ NADPH as cofactors	Microbial fermentation from C5-C6 sugars or chemical hydrolysis of lactonitrile by strong acids produces a racemic mixture.	Microbial fermentation with sugar or starch as raw materials. A mixture of IA and derivatives is obtained by reacting succinic anhydride with formaldehyde	Chemical production from maleic acid hydrogenation. Fermentation of sugars by wild strains or genetically engineered well-known industrial microorganisms
Market	3-HPA market is still under development: 40 kt/yr in 2015	800-1200 (2016) kt/yr with expected growth of 1% per year	40 kt/yr (2015). Projection of 50-170-410 kt/ yr in 2025).	50 kt/yr (2014) Projection of 270 kt/yr (2025) at a CAGR 6.8%
€/kg	1.5-2	1.30-2.30	1.5-2	1.8-3
Significance	12 top building-block chemicals that can be produced from biomass[21]	Monomer of PLA (market size was US$1.2 billion in 2018 and a CAGR of 19.8%)	12 top building-block chemicals that can be produced from biomass[21]	Top 10 chemicals that could be produced from renewable resources[21]
	Platform chemical for acrylic acid methylene chloride and 1,3-propanediol	Precursor of propylene glycol, acrylic polymer	Replacement for acrylic acid, maleic anhydride. Precursor of methyl methacrylate. Monomer of polyitaconic acid	Replacement for adipic acid or maleic anhydride. Used in food, pharmaceutical, personal care and chemical sector

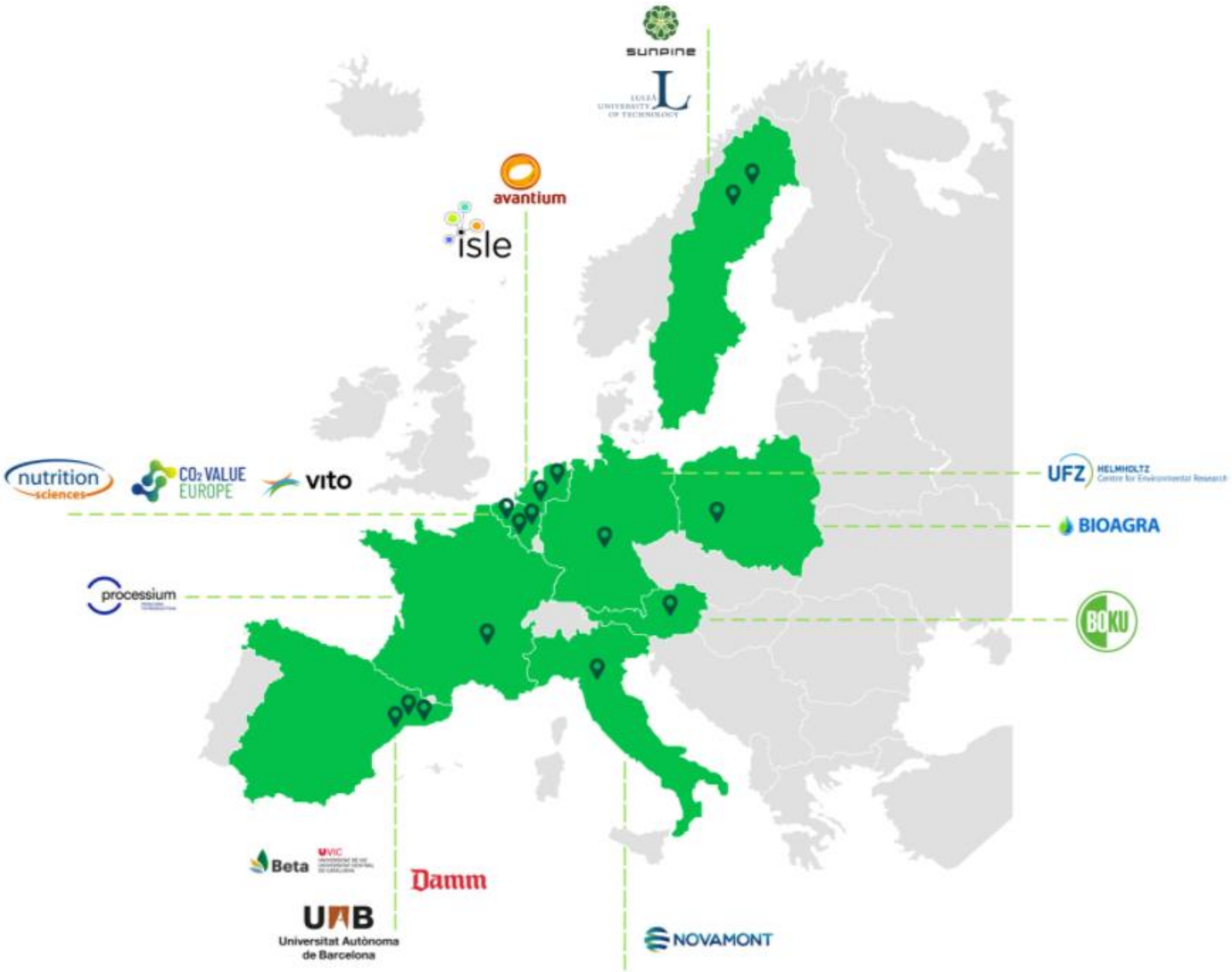
vivaldi

Turns CO_2 emissions into sustainable bioproducts

Project partners

The multidisciplinary and international consortium is formed by **16 partners**, including:

- biobased Industries
- technology developers
- end-user
- knowledge hubs



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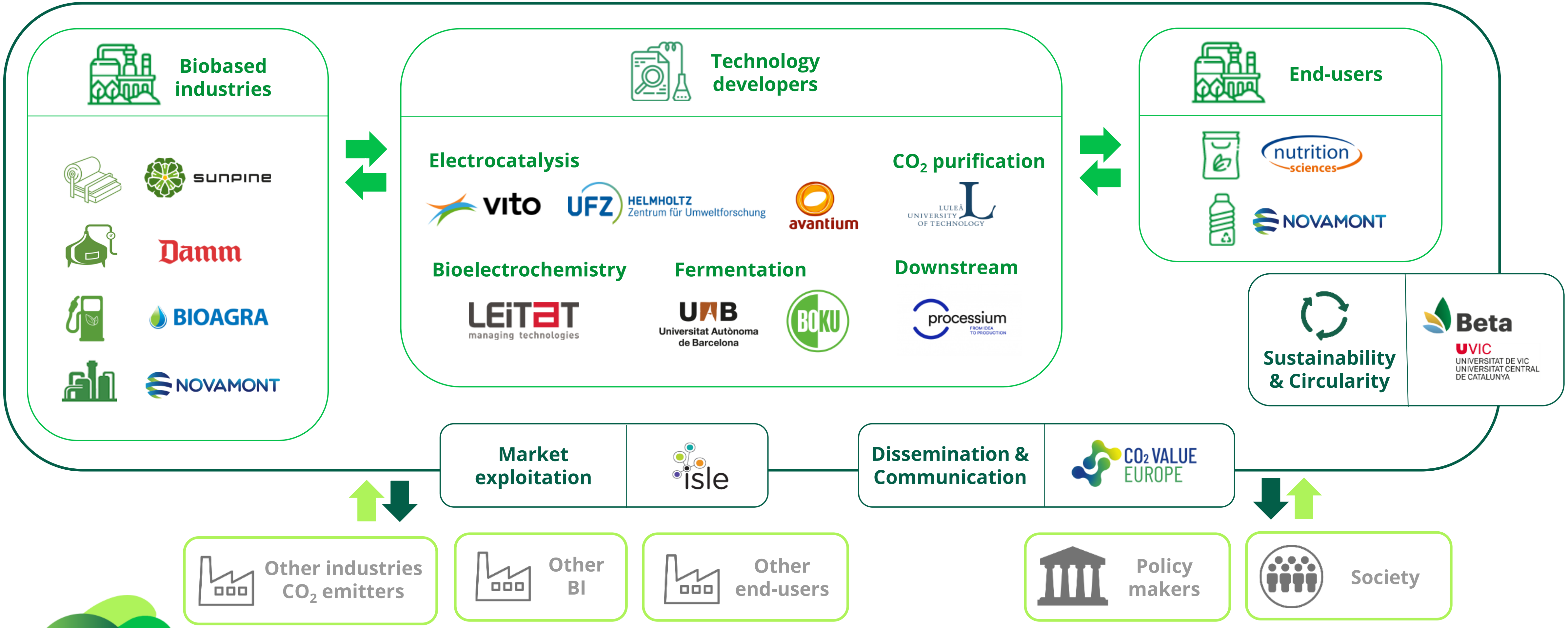
Turns CO_2 emissions into sustainable bioproducts

Methodology



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Vivaldi
Turns CO_2 emissions into sustainable bioproducts

Thank you!

Albert Guisasola
GENOCOV (www.genocov.com)
Universitat Autònoma de Barcelona

The VIVALDI project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101000441.

PUBLIC

Market opportunities and potential barriers for the market uptake of CO_2 – based products

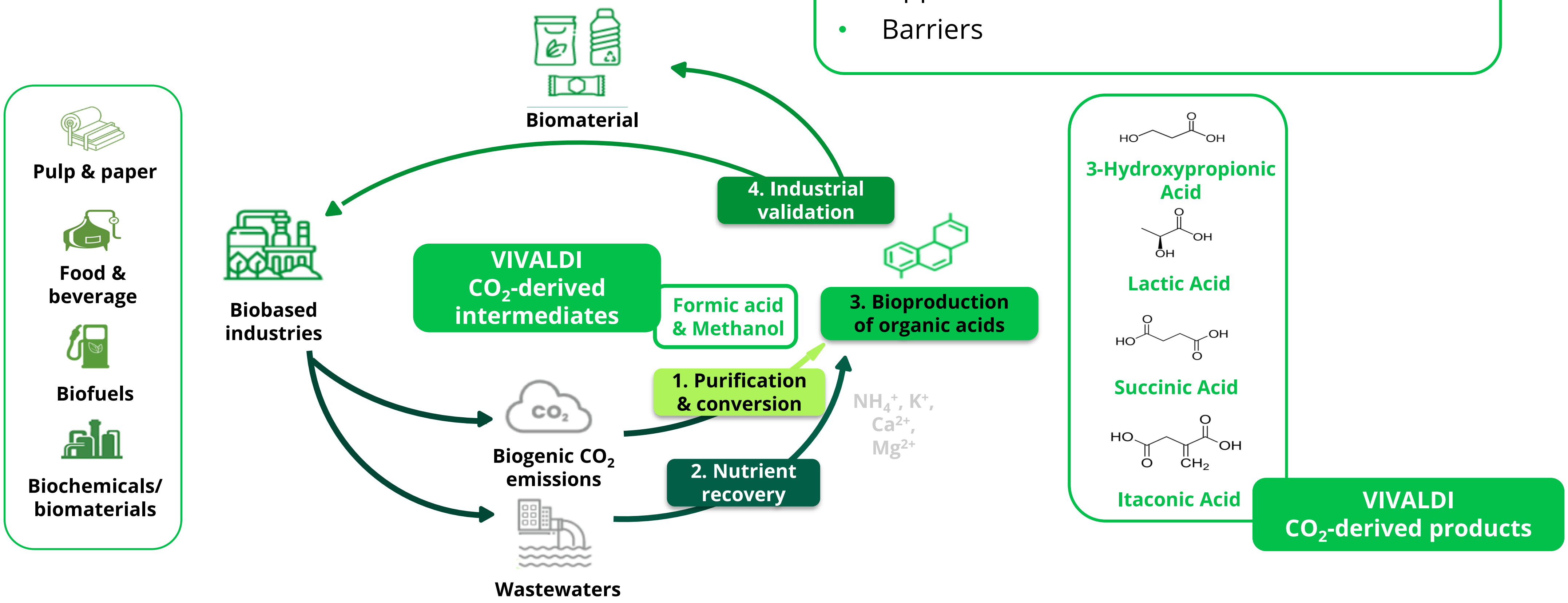
Elvira Serra, PhD

The VIVALDI project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101000441.

Market analysis approach

VIVALDI CO_2 - products & intermediates market

- Opportunities
- Barriers

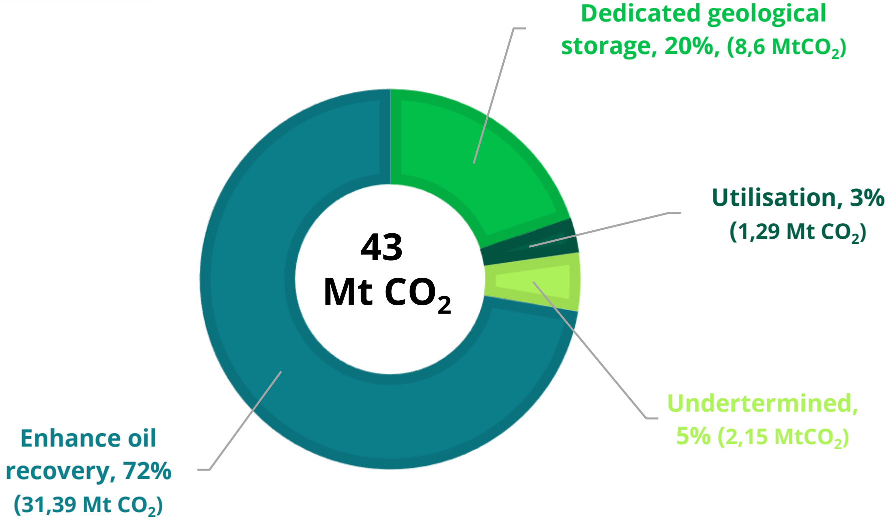


CCU market

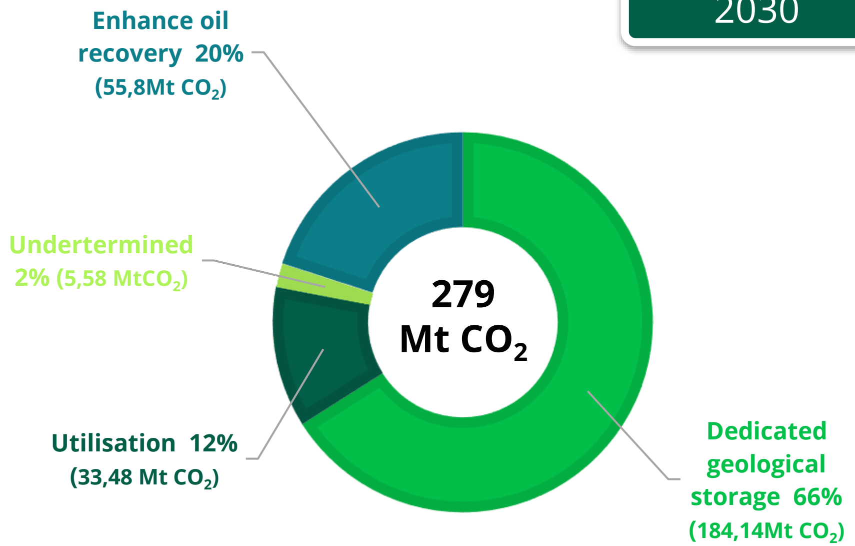
- Value creation from CO_2
- Market influences for CO_2- derived products

CCU market – Value creation from CO_2

2021



2030



Adapted from IEA's **roadmap Net Zero by 2050**

- **Capture capacity** expected to increase to **279 Mt CO_2** (0.6% of today's emissions)
- **12% of CO_2** expected to be **used in CCU processes (33.48 $MtCO_2$) – 96% increase** compared to 2021 **(1.29 Mt CO_2)**

CCU market – Value creation from CO_2

Carbon utilisation: market, process, and landscape overview

A booming market

By 2030, we will have...

220 Mt CO2 from DAC available to be used feedstock.

1 -7 Gt CO2 market for CO2-derived products and services.

The basics of chemistry

- CO2 molecules are relatively stable and therefore require high energy input to be transformed.
- The goal is to create products with long hydrocarbon chains; they store more energy and are easier to transport off-grid.

CO2 valorisation methods worth looking into:

Thermochemical conversion

- CO2 to natural gas
- CO2 to e-fuels
- CO2 to methanol
- CO2 to ethanol
- CO2 to synthesis gas
- CO2 to polymers
- CO2 to formic acid

Electrochemical conversion

- CO2 to carbon monoxide
- CO2 to formic acid
- CO2 to natural gas and methanol
- CO2 to ethylene and ethanol
- CO2 to carbon nanomaterials

Biological conversion

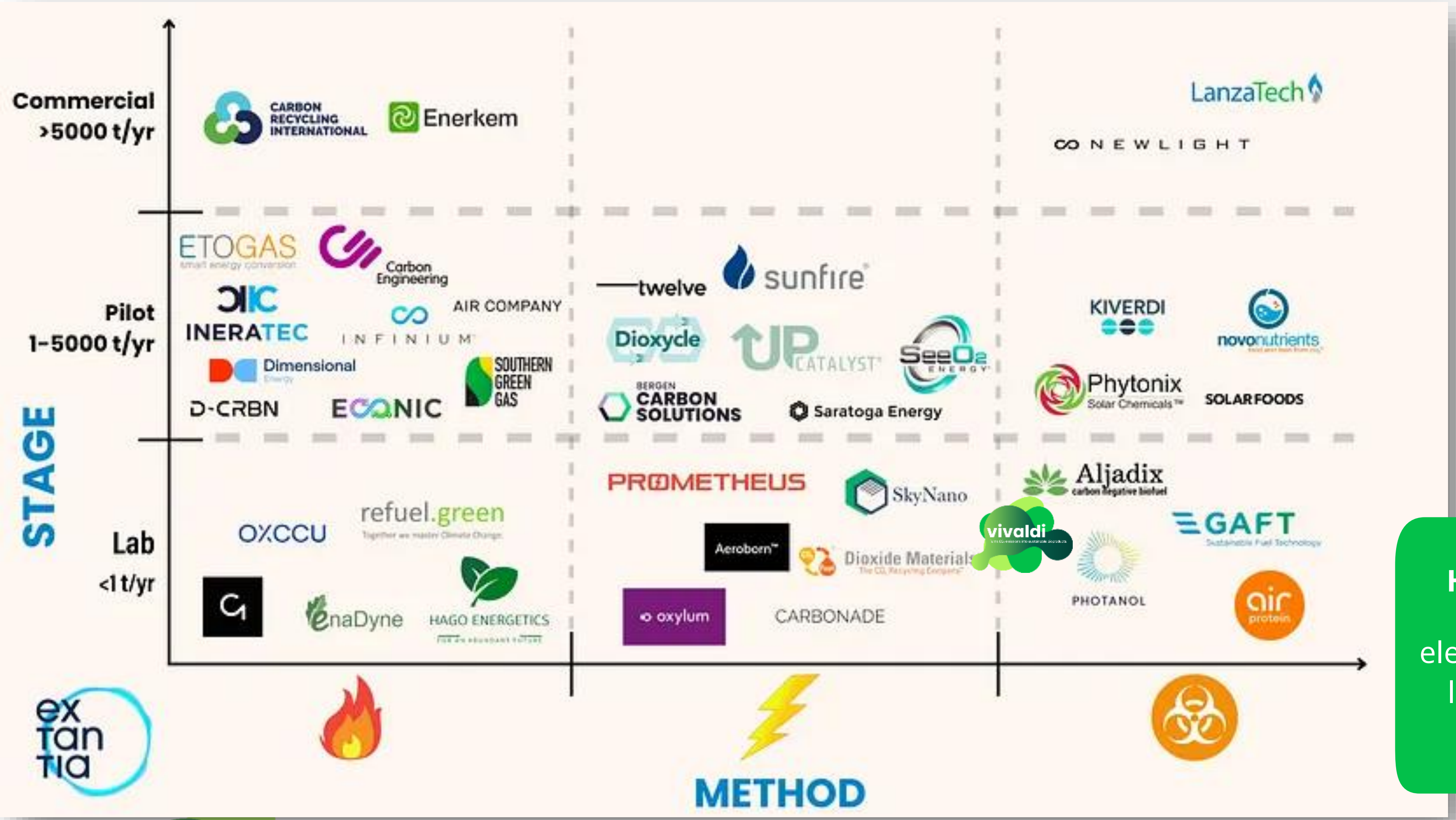
- CO2 to methane
- CO2 to e-fuels
- CO2 to fatty acids
- CO2 to amino acids and proteins

Source: IEA

extantia

Startups working on CO_2 valorisation (Extentia, 2022).

CCU market – Value creation from CO_2



Startups working on CO_2 valorisation (Extentia, 2022).

Thermochemical conversion for CO_2 valorisation – most companies have focused on them from lab scale to commercial solutions

Hybrid methods to produce organic acids— merging techniques like electrolysis, catalysis, and fermentation — like in the **VIVALDI project** are **at a pioneering stage**

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CCU market – Market influences for CO_2 – derived products

CO_2 source

- The **origin of the CO_2 feedstock and purity** has significant implications accounting for **up to 90% of expenses.**
- **Direct air capture (DAC)** is the priciest method
  - ✓ **Industrial CO_2 (Non-Biogenic):** \$10 to \$300 /CO_2 tonne.
  - ✓ **Biogenic CO_2:** \$10/CO_2 tonne due **to higher concentration and purity.**

Hydrogen

- For CO_2-based fuels and chemicals, **cheap renewable energy** is imperative.
- The most eco-friendly choice is **"green hydrogen"** using renewable energy and electrolysis (\$2.5-6/kg H_2).
- Hydrogen prices **differ across regions** due to the renewable energy prices **which makes scalability difficult.**

Scalability

- The widespread use of **hydrogen and CO_2** requires a large-scale transport infrastructure.
- **Clusters**, optimise efficiency, reduce costs, and foster cooperative industrial ecosystems.

CCU market – Market for CO_2 – derived products

DRIVERS

- **Hybrid chemical and biological approach:** High specificity and energetic efficiency under ambient conditions, making it attractive for a circular carbon economy.
- **Integrated Biorefinery:** **VIVALDI** can mitigate 200 Mt biogenic CO_2 in Europe (31% from pulp and paper facilities, 18% from waste-to-energy facilities) taking over BECCS or BioCCS.
- **Industrial symbiosis:** CO_2 hubs and decentralized WWTPs receiving wastewater with high N concentrations.

VIVALDI ADDITIONAL DRIVERS

✓ … CO_2, … al … GHG emissions.

✓ **Customisability for Industries:** CCU processes can be tailored to different industries and their specific CO_2 streams

CCU market – Market for CO_2 – derived products

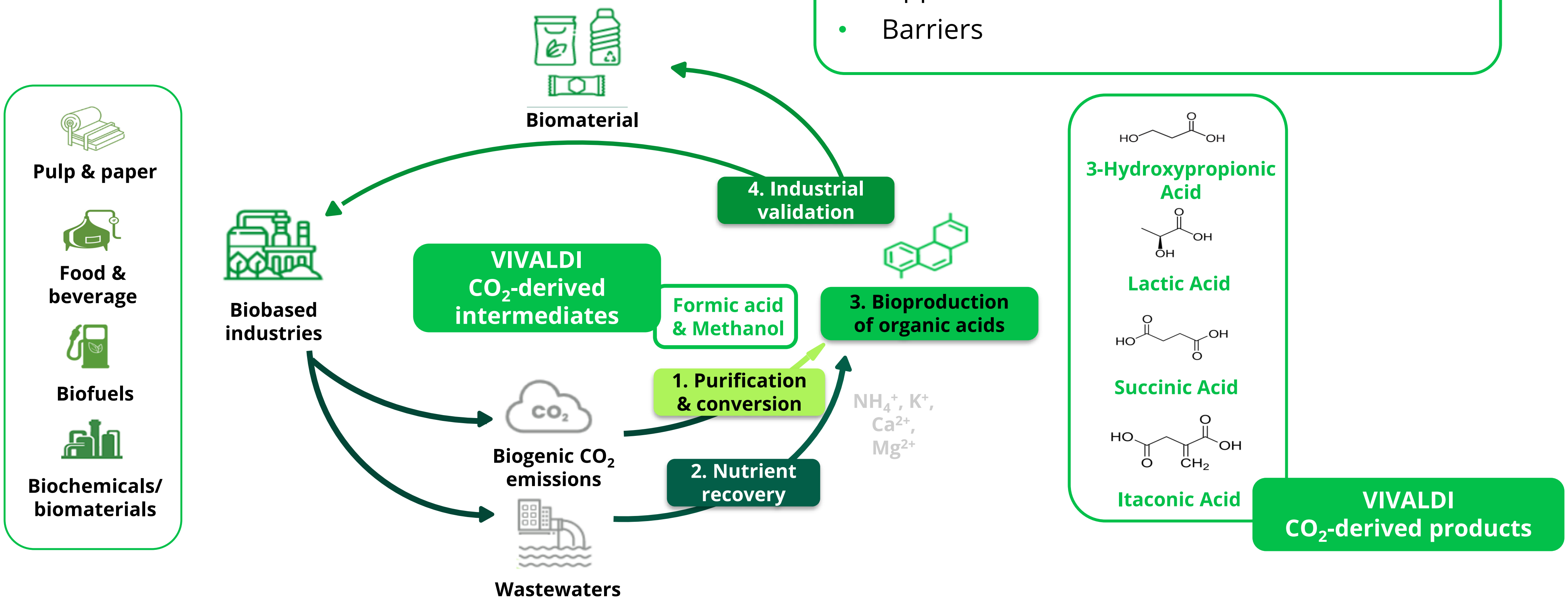
BARRIERS

- ✓ **Technological Maturity**: Some CCU technologies are commercially available (methanol, urea and CO_2 use in concrete) , others are still in development.
- ✓ **Renewable Energy:** Major source of energy in CCU scenario is H_2 produced through water electrolysis.
- ✓ **Point resources:** Cost of CCU technology depends on the type of industry and point resources ($20-175t CO_2 from ethanol, $ 20-70t CO_2 from pulp and paper mills).
- ✓ **Status quo:** CCU seen as complementary to CCS.
- ✓ **Emissions Concerns:** Concerns associated CO_2 emissions from production and consumption of the CCU products.
- ✓ **Conventional production paths:** CCU applications are technically feasible but industrial implementation at scale is costly.

Market analysis approach

VIVALDI CO_2 - products & intermediates market

- Opportunities
- Barriers



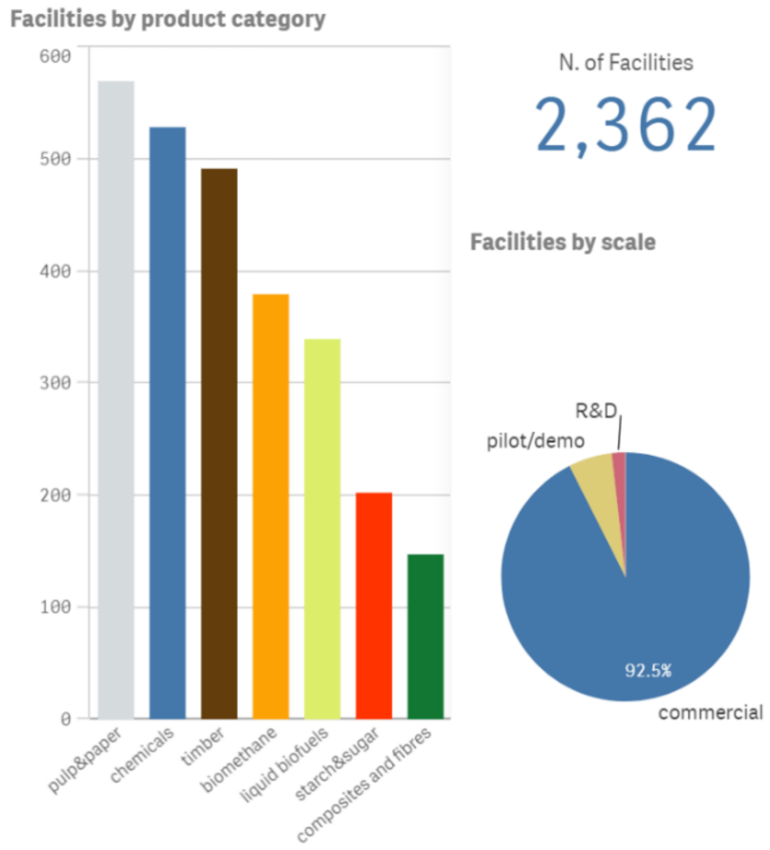
VIVALDI CO_2 –derived products and intermediates – Market

BIO-BASED CHEMICALS IN EUROPE

- **Consumption** with a 10% CAGR **is higher** than **production** (0.3% bio-based production share)
- **30%** of overall chemical production expected to be bio-based by 2030 - over **50% for high added-value chemicals and polymers.**
- **Bio-based platform chemical market** was expected to reach **$14.45 billion in 2023** and **grow 6.6% CAGR.**

VIVALDI CO_2 –derived products and intermediates – Market

BIO-BASED CHEMICALS IN EUROPE



- **Out of 2,362 biorefineries, only 240 plants** manufacture diverse product categories—a **need for integrated solutions to reach 2030 targets**.
- Currently, **265 bio-industries** utilizes waste; **77** of them engaged in chemical **production- trend which is favoring chemical production**

- **Regional feedstock variations and resource efficiency** shift toward utilizing waste **streams**— presents **a prime opportunity**
- **Organic acids as platform chemicals** has **multifaceted applications** and derivatives which **expands the market opportunity**

VIVALDI OPPORTUNITIES

VIVALDI CO_2 –derived intermediate and products market

DRIVERS

- ✓ **Reduced dependency on fossil-based feedstocks: :** Direct conversion of CO_2 to organic acids and futureproofing against paradigm change and price volatility.
- ✓ **First generation feedstock:** Concerns about resource availability and system boundary starting from the extraction of raw materials
- ✓ **Vertical integration:** CCU brings economic optimisation to supply chains-resource availability.
- ✓ **Untapped opportunities:** Increasing global market demand for organic acids as a chemical building block.
- ✓ **Biorefinery Approach:** Expected biogenic CO_2 capture capacity by 2050 330Mt CO_2/y in Europe with high purity
- ✓ **Industrial Symbiosis and Clusters :** Promotion of microeconomy of integrated CO_2 utilisation technologies and products.
- ✓ **Retrofitting:** CO_2-based value chains in other sectors with similar CO_2 emissions issues (cement, steel, urea).
- ✓ **Contribution to microeconomy:** Promotion of sustainable development and innovation with local economic and social benefits would create new business opportunities and markets.

VIVALDI CO_2 –derived intermediate and products market

BARRIERS

- **Market acceptance:** As a relatively new approach, organic acid production from CO_2 utilization may face market acceptance challenges.
- **Technological challenges:** As a cutting-edge technology, the production of organic acids in VIVALDI may face challenges of optimisation, scalability, and commercial viability.
- **Product Separation and Purification:** Organic acids need to be separated and purified from the fermentation broth to obtain high-purity final products.
- **Process Efficiency:** Achieving high yields and conversion efficiency of feedstocks to organic acids is crucial to be competitive.
- **Dependence on Renewable Energy Availability:** Operational efficiency tied to the availability of renewable sources.
- **Heterogenous Policies:** Geographic variation in policy and regulatory frameworks.
- **Resource and Energy Price Volatility:** Fluctuations in input costs could affect cost-effectiveness.
- **Intensifying Competition and Regulatory and Policy Shifts:** Need for continuous innovation and adaptation to market changes

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THANK YOU

Elvira Serra, PhD

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THE FUTURE OF THE CHEMICAL INDUSTRY IN EUROPE

Algreit Dume

Policy Officer at the European Commission's Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs (DG GROW).

Working in Unit F.2 – *Bioeconomy, chemicals, cosmetics* within the Directorate, he focuses on the Transition Pathway for the Chemical Industry in Europe.

Mr. Dume holds MSc in Economics and Business Administration and brings expertise in chemical policy and legislation as well as deeply-rooted experience from the private sector having worked with global companies and start-ups in the Energy, Financial and Pharmaceutical Industries.

The Transition Pathway for the Chemical Industry

Online workshop: "Addressing Challenges and Unlocking Carbon Capture Utilization: Circular Carbon Advancement through Policy Reform", 20th February 2024

European Commission

1. Background

The EU Chemical Industry

3rd Industry sector in terms of direct CO_2 emissions[4] , behind the cement and steel industries.

Global direct CO_2 emission from primary chemical production in 2020: 923MtCO_2

Europe is the **2nd largest chemical producer** in the world with €499 billions of sales in 2020[1]

4th largest manufacturing industry with
7% of EU manufacturing turnover
1.2 million direct highly skilled jobs[2]
3.6 million indirect jobs
19 million jobs across all value supply chains

The chemical industry is at the heart of many value chains: **56% of chemicals** are sold to other industries

European Commission

The changing landscape for the EU chemical industry (1)

Global market share
- Decreasing pattern (2030 forecast)

Energy prices
- Increasing, unstable

Geopolitics
- Russian war of aggression against Ukraine;
- China zero-Covid policy;

Technology
- *Alternative feedstock*
- *Digitalisation*

The changing landscape for the EU chemical industry (2)

Climate

Green Deal, European Climate Law, Landfill Directive, Packaging and Packaging Waste Directive, Waste Framework Directive, Sustainable Carbon Cycle, Sustainable Product Initiative, ETS

Energy

REPowerEU
Renewable Energy Directive
Industrial Emission Directive

Chemical Strategy for Sustainability

Restriction Roadmap
Safe and Sustainable by Design
Toxic-free environment

Resilience

Update of the Industrial Strategy
Due Diligence in the Supply Chain
Advanced Materials manifesto and the critical raw material strategy

Digitalization

Digitalisation of Chemical Production
Data sharing
Product Passport

2. The Transition Pathway for the Chemical Industry

European Commission

The Transition Pathway for the Chemical Industry

- Publication: 27 January 2023;
- It is an actionable plan co-developed by the European Commission with EU countries, industry, NGOs and other stakeholders
- Based on 8 building blocks developed by Industrial Forum

Sustainable competitiveness	Investment and funding	Research and Innovation	Regulation and Public Governance	Access to energy and feedstock	Infrastructure	Skills	Social dimension

- It identifies about 190 actions, grouped in 26 topics, needed for the twin transition and increased resilience of the EU Chemical Industry

Content: The R&I chapter (1/2)

Background

- Need to adopt new techniques and technological solutions developed and scaled up through a well supported R&I policy agenda
- The principles of co-creation, diffusion, updating, transformation and directionality should guide this agenda.
- There are different barriers – e.g. financial legislative, related to knowledge gaps – affecting this agenda. Specific actions are required to address these barriers at different stages of R&I.

Outcome

- Actions fostering a better conceptualisation of new techniques and technological solutions (e.g. sharing knowledge on the SSbD and digital maturity assessment frameworks; developing technology roadmaps)
- Measures to support the development of these techniques and technological solutions (e.g. public-private partnerships, financial and regulatory support).
- Actions for the deployment of new techniques and technological solutions (e.g. developing market pull measures; cooperation to address investment gaps).

Topic 8: Better conceptualisation of new techniques and technical solutions (TRL 1 to 5)		
Actions	**Actors**	**Timeframe**
8.1 Promote safety and sustainability-assessment approaches		
• Share expertise in the implementation of SSbD frameworks considering existing criteria initiatives	Industry and MS	M
• Innovate safety testing and chemical-risk assessment	Industry and EU/MS	S/M
8.2 Promote the use of Digital Maturity Assessment Frameworks		
• Share knowledge on and encourage the use of digital maturity assessment frameworks	Industry and EU/MS	S/M
8.3 Development of an industrial technology roadmap		
• Publish additional technology roadmaps on circular economy	Industry and EU/MS	S
• Consider developing national roadmaps for a low-carbon or circular chemical sector, where not existing	Industry and MS	S

Topic 10: Deployment of new techniques and technological solutions (TRL 8 to 9)		
Actions	**Actors**	**Timeframe**
10.1 Permitting and commercialisation		
• Active involvement of INCITE on emerging processes or techniques for decarbonisation, depollution and/or increasing circularity in the sector	Industry and EU/MS	S
• Assess the potential for – and design the scope of – cooperation among future potential users to address the investment gap so that innovative low-carbon technologies can timely be brought to the market	Industry and EU/MS	M
• Support the development, commercialisation, deployment and uptake (including through 'market pull' and pre-commercial procurement) of new techniques and technological solutions	EU/MS	M/L

Topic 9: Developing new techniques and technological solutions (TRL 6 to 7)		
Actions	**Actors**	**Timeframe**
9.1 Foster collaboration and partnerships		
• Increase cooperation between research institutions and universities and industry, fostering applied research and targeting key enabling technologies for industry	Industry	S
• Engage in public-private partnerships (e.g. Processes4Planet, Circular Bio-based Europe) to develop and demonstrate energy efficiency and climate neutral, circularity and zero pollution chemical industry processes *(link with topic 5.3.)*	Industry and EU/MS	M
• Develop Chemical Data Spaces with the support of the Data Spaces Support Centre to leverage the potential of data exchange for more transparency and manageability	Industry	S
9.2 Support for development		
• Appropriate financial and regulatory support between different levels of technology readiness, including by establishing a community of practice to facilitate the authorisation for first-of-a-kind installations for low-carbon industrial technologies[1]	EU/MS	S
• Co-implement the strategic research and innovation plan (SRIP) for safe and sustainable chemicals and materials to guide future R&I priorities	Industry and EU/MS	S

Content:

The R&I chapter (2/2)

3. Co-implementation

Co-implementation: key elements

Stakeholders participation

- **Collaboration** is needed to exchange information and set priorities on the actions to be taken for the twin transition.
- Meetings with stakeholders: **3 plenary meetings in 2023;** dedicated **task forces and bilateral meetings** and presentations at different events.

Call for Transition Initiatives

- **In July 23, the Commission launched an open call for transition initiatives** to support the co-implementation of the Transition Pathway.
- **Transition initiatives are concrete projects** (e.g. in CO_2 emissions reduction, green tech) linked to the objectives of the Pathway.

Task Forces

- **Three task force to support the co-implementation of high priority topics** of the Transition Pathway: circularity; analysis of energy and feedstock needs; development of indicators for the twin transition (this work is almost finalised).
- One of the task forces will start at the end of February to analyse possible **market pull measures** for the uptake of **bio, CO_2-based waste-based feedstocks.**

Guidance on Funding

- **The guidance aims to provide more clarity on what are the relevant calls and programs that can finance investments for the twin transition,** who can apply and by when.
- Expected publication by **the end of Feb.**

Annual Progress Report

- Objective is to assess **the state of play of the co-implementation process** and summarise the input collected from stakeholders.
- **Input collected will be considered** to inform the development of the **next COM's Working Programme.**
- To be discussed at the next co-implementation meeting on **18th March** with stakeholders.

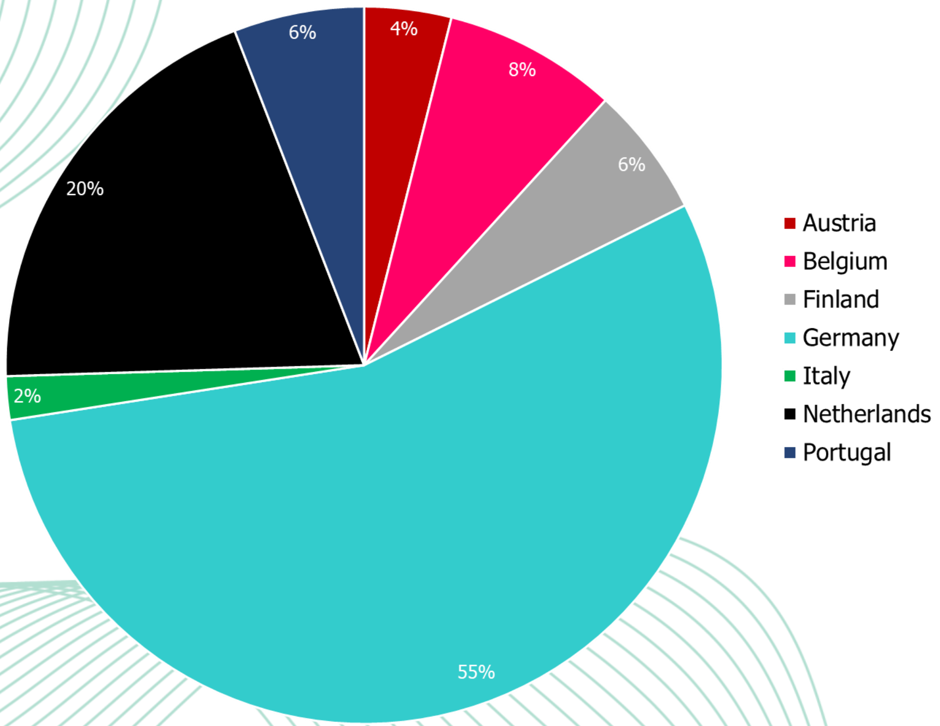
European Commission

Call for Transition Initiatives

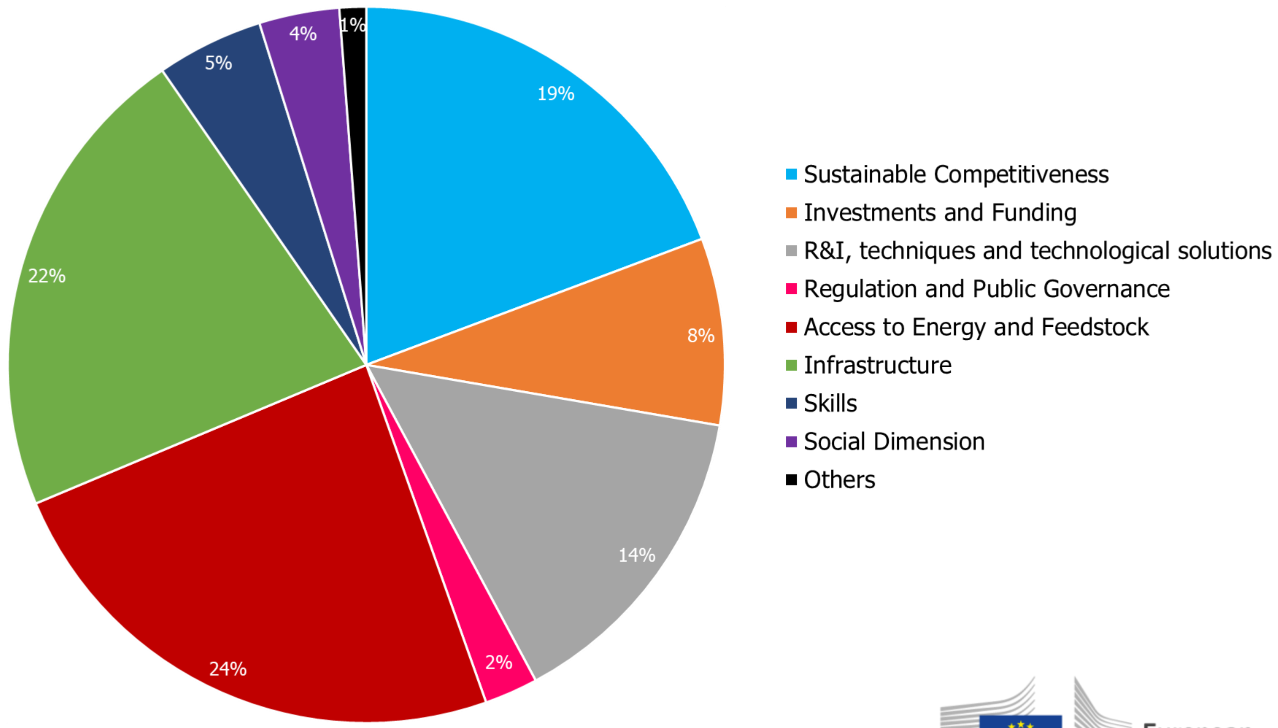
First batch of 83 initiatives published in December 2023

- Industry was the largest contributor, accounting for more than 90% of the initiatives. In particular, large companies and trade and business associations were particularly active in reporting their actions
- Around two thirds of the initiatives focus on alternative feedstocks, clean energy infrastructure, digitalisation and chemical substitution
- New initiatives to be published soon. In the meantime, we will continue to receive and review transition initiatives.

% of submissions (by country)



% of submissions (by building block)

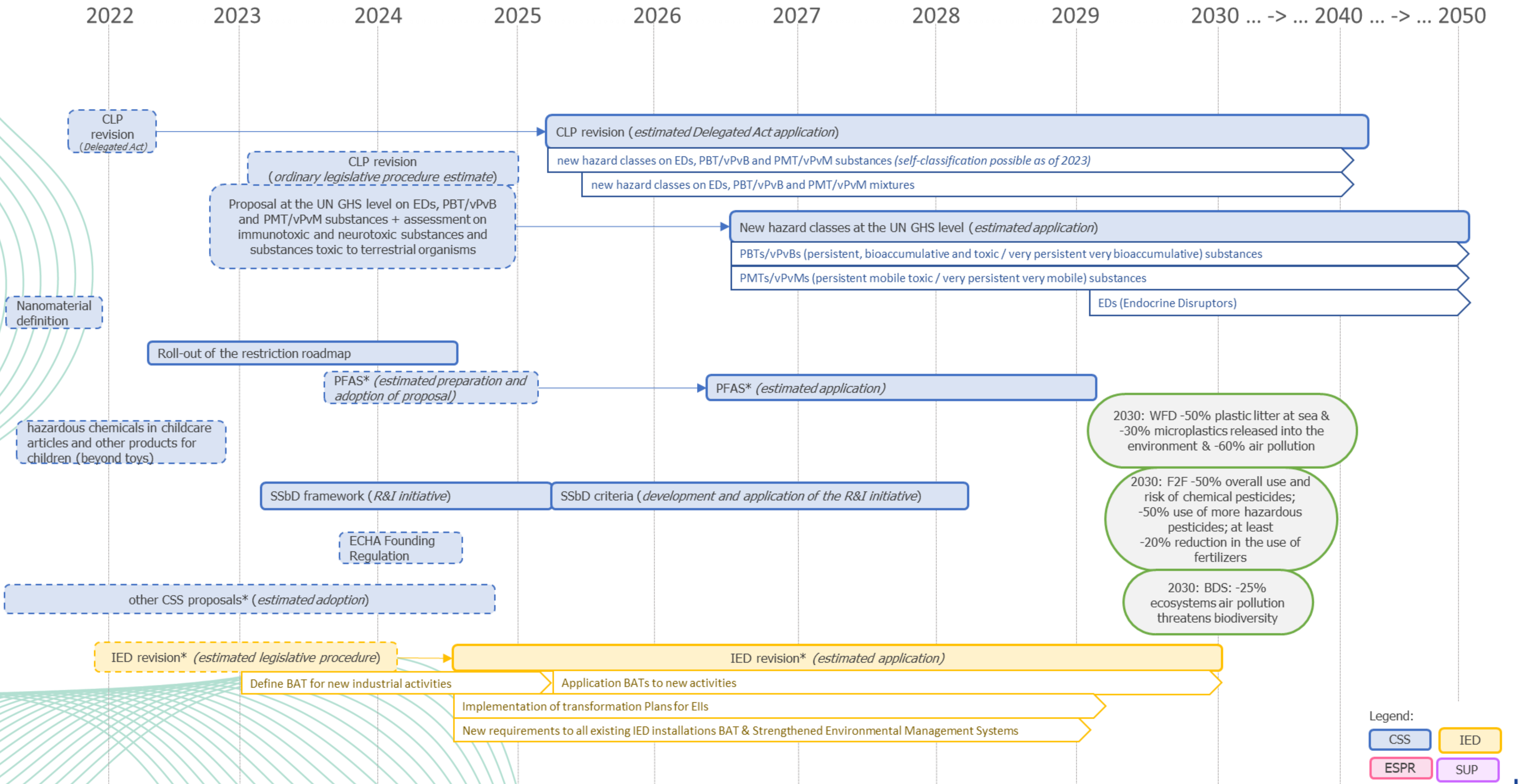


European Commission

EU Funding to support the co-implementation process

Budget	
€ 724 (billion)	Recovery and Resilience facility (RRF)
€ 348 (billion)	Regional Development and Cohesion Funds
€ 40 (billion)	The Innovation Fund
€ 19 (billion)	Just Transition Fund
€ 7.6 (billion)	The Digital Europe Programme
€ 87 (billion)	The Social Climate Fund
€ 95 (billion)	Horizon Europe
€ 4.2 (billion)	The Single Market Programme
€ 26 (billion)	Erasmus +
€ 26 (billion)	InvestEU
€ 5.4 (billion)	LIFE

Regulatory roadmap (1/2)

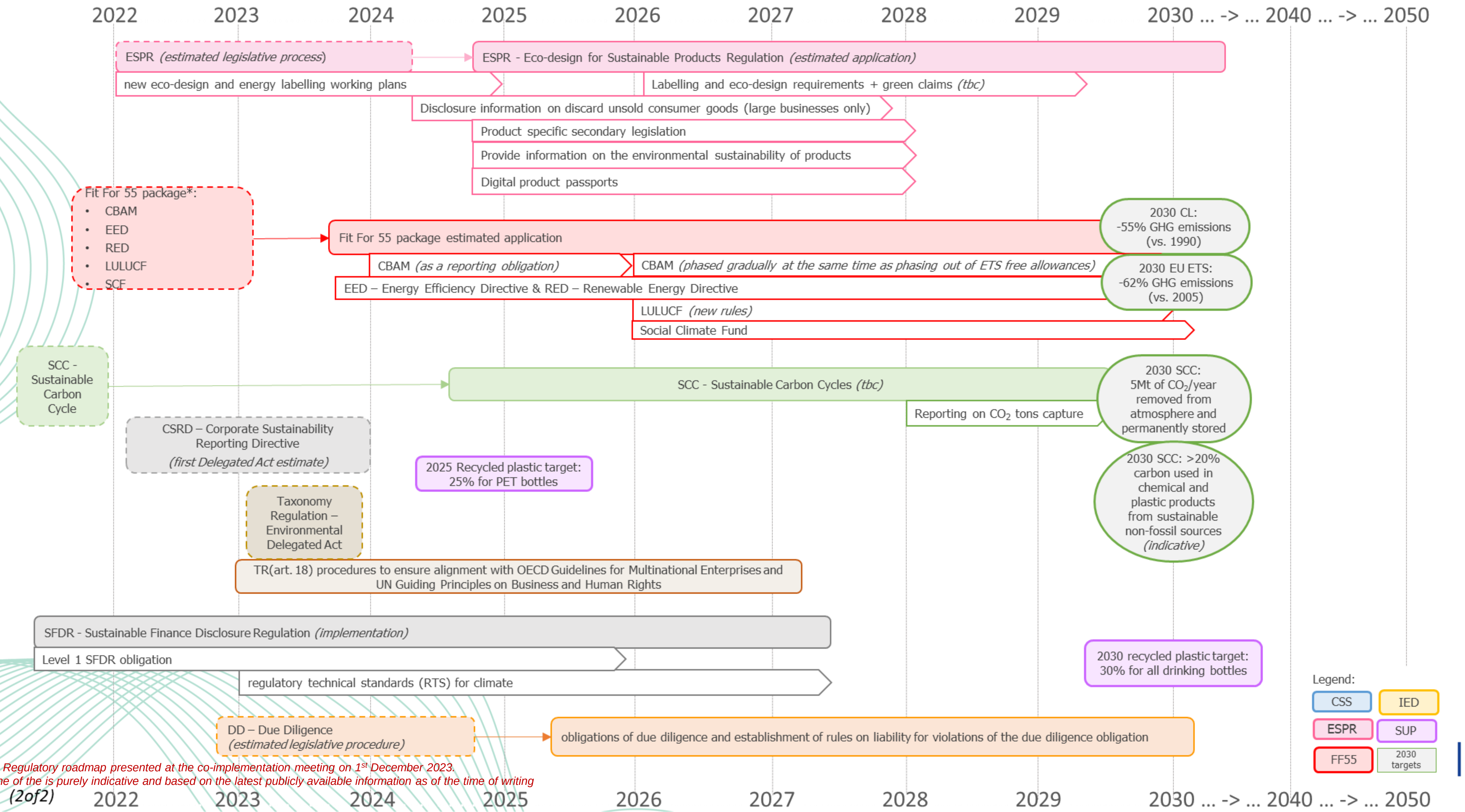


Notes

This is the Regulatory roadmap presented at the co-implementation meeting on 1st December 2023.
The timeline of the is purely indicative and based on the latest publicly available information as of the time of writing

(1of2)

Regulatory roadmap (2/2)



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(2of2)

Co-implementation: timeline

Key Milestones

- **Transition Pathway publication** (27th Jan)
- **Launch open call for transition initiatives** (12th Jul)
- **Stock tacking transition initiatives** (11th Oct)
- **Publication 1st batch of initiatives** (14th Dec 23)
- **Publication Guidance on Funding** (*by end Feb)
- **Presentation Annual Progress Report** (*4th plenary)

Q1 2023 | Q2 2023 | Q3 2023 | Q4 2023 | Q1 2024

Meetings

- **High Level Round Table on the Chemical Strategy for Sustainability** (1st Feb)
- **1st Plenary Meeting** (6th Mar)
- **1st Task Forces Meetings** (end Apr)
- **2nd Plenary Meeting** (22nd June)
- **2nd Task Forces Meetings** (end Sep)
- **3rd Task Forces Meetings** (Nov)
- **3rd Plenary Meeting** (1st December)
- **4th Task Forces Meetings** (Jan-Feb)
- **4th Plenary Meeting** (18th March)

Notes
**Expected timeline*

European Commission

Key Messages

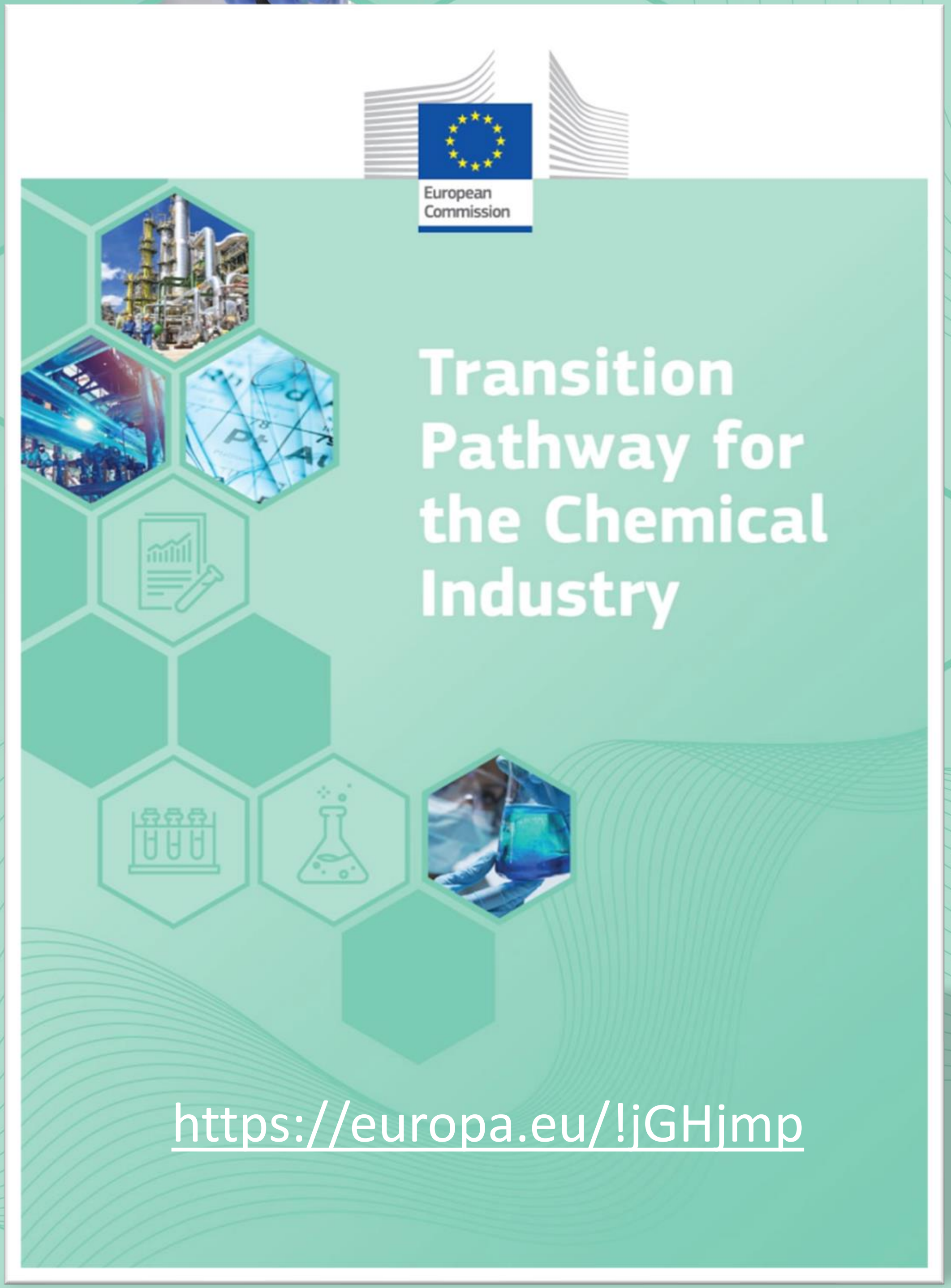
The Transition Pathway for the Chemical Industry solves the equation between **fostering competitiveness and strengthening sustainability**

The **active involvement** of businesses, organisations and MS is key to achieve the twin transition and increase resilience of the Chemical Industry.

Call for transition initiatives - Are you on the pathway towards the green and digital transition? Please tell us! Link on the European Commission Website

Thank you!

GROW-CHEMTP@ec.europa.eu



https://europa.eu/!jGHjmp

OPEN DISCUSSION AND Q&A

CONCLUSIONS AND KEY LERNINGS

THANK YOU

FOLLOW THE PROJECTS:

CO2SMOS — Solutions for a circular biobased industry

co2smos.eu

CATCO2NVERS

catco2nvers.eu

vivaldi — Turns CO2 emissions into sustainable bioproducts

Vivaldi-h2020.eu