November 14th, 2023
Brussels, Belgium

Funded by the European Union

PUBLIC PERCEPTION AND BUSINESS MODELS JOINT EVENT

Organised by the Carbon Capture, Utilisation and Storage (CCUS) & Alternative Fuels Horizon 2020/ Horizon Europe CLUSTER projects

Supported by CINEA - European Climate, Infrastructure and Environment Executive Agency

Joint event for CCUS & Alternative fuels CINEA cluster projects organised by:
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VIVALDI - InnoVative bIo-based chains for CO_2 VALorisation as aDded-value organIc acids

Project Start/End: Jun 2021 – May 2025
Total Budget: €6,969,835
Consortium: 16 partners in 9 countries

Case study

Dr. Jorge Senán-Salinas
Dr. Elvira Serra

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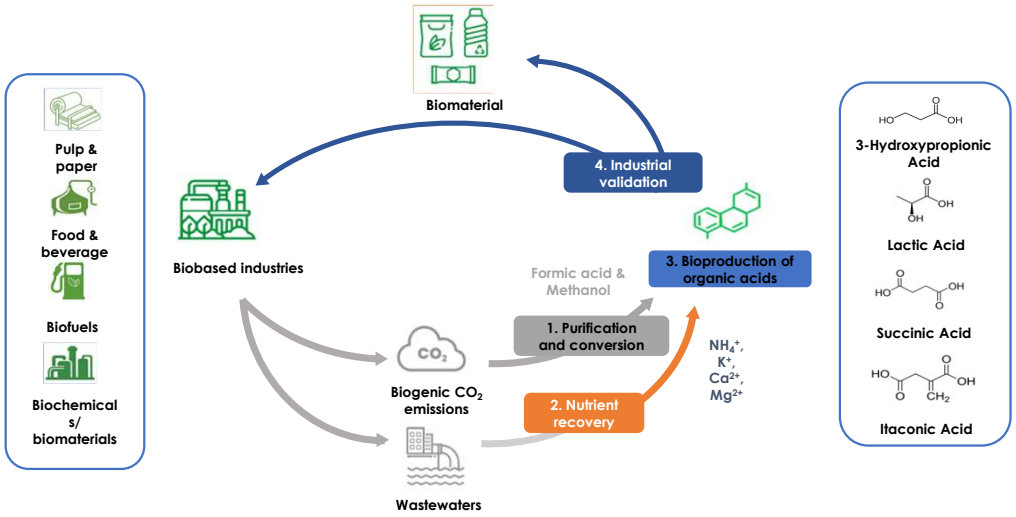
The VIVALDI project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 101000441

Baseline



- CO_2 emissions should **not only be reduced or mitigated** but should be **adopted as a novel feedstock** for an alternative production of biobased chemicals
- **VIVALDI integration within the BIs**
  - BIs adapting **some of the VIVALDI solutions**
  - Bis adapting **the whole VIVALDI concept**
- **BIs move from:**
  - A **linear structure**
    - Fossil-based reagents transformed into products
    - Wastewater to be treated
    - CO_2 emitted to the atmosphere
  - To a **circular concept** where **CO_2 and wastewater** are transformed into **novel sustainable compounds** to be **reused in the plant flowchart** or to be **sold externally**

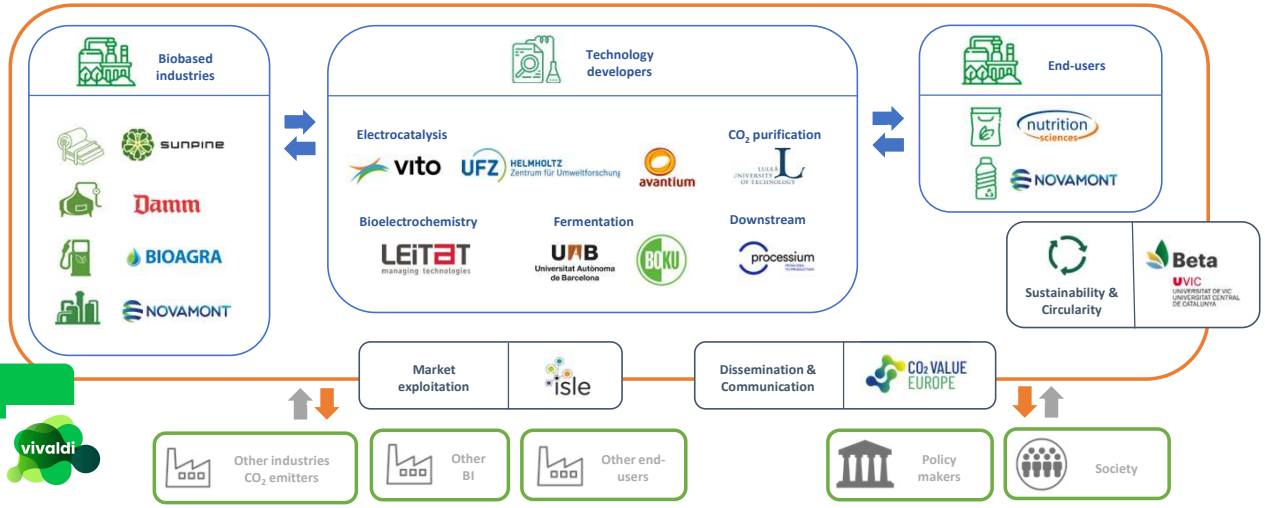
NEW BUSINESS MODELS

TWO PATH - compatible Business models (BM)

1st BM – BIs producing **CO_2. based chemicals to use internally**

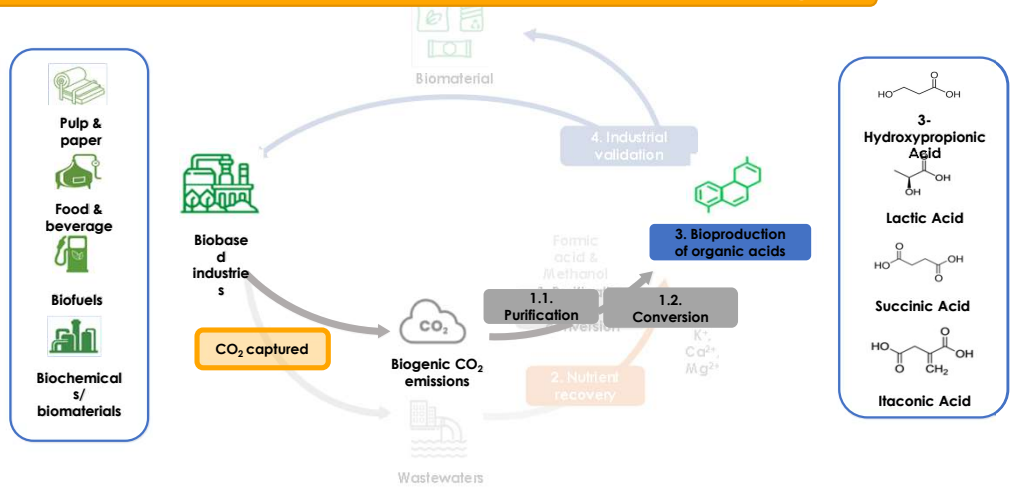
2nd BM – BIs diversify their economic base and **become sellers** to external industries of VIVALDI products as alternative bio-based compounds to current fossil-based chemicals – focus on **external end-users of the targeted biobased products**

Whole value chain

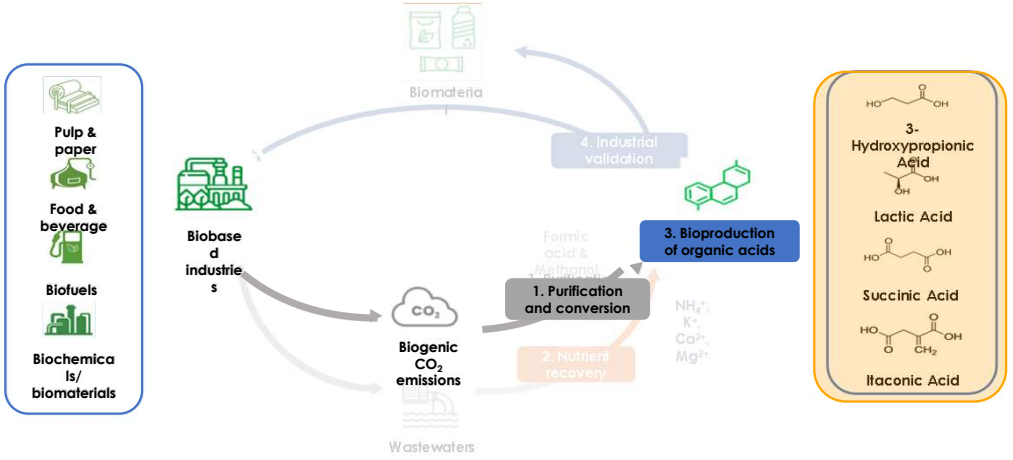


Methodology

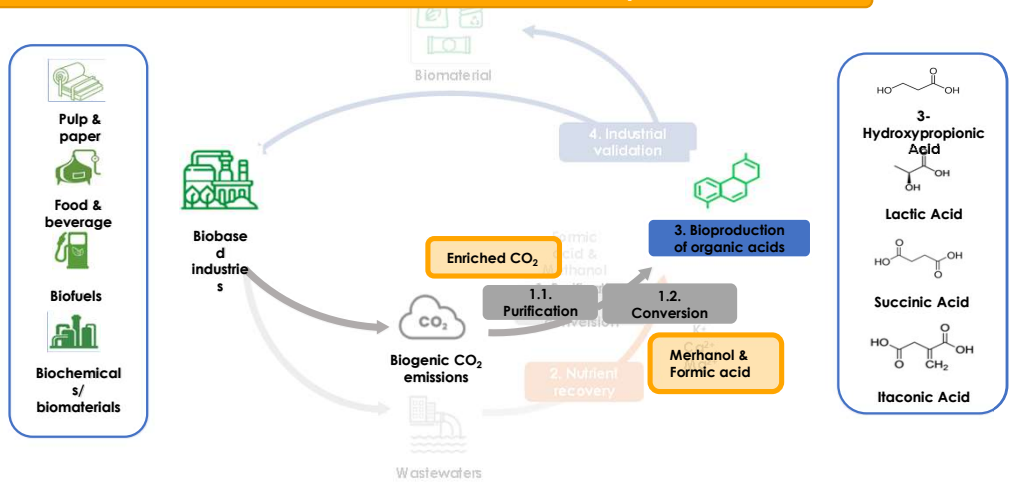
BM & TEA scenario- focused on **implementation as CCU technology**



BM & TEA scenario - focused on **biobased organic acids production**



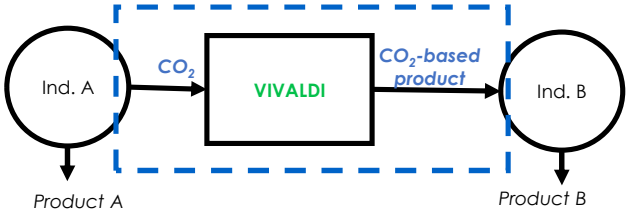
BM & TEA scenario- focused on **intermediate products**



Prospective TEA

- **Business model orientation** of early stages CCU technologies (Low TRL: 3-5)
- **Stoichiometric relation between the captured CO_2 and the CO_2-based product**
- **Carbon Removal Credits Mechanism (CRCM) as** an additional income.
- **Assuming the average prices of the ETS** for carbon emission permit in 2022: € 83 · MT^{-1}
- **Assuming long term residence time in the economy.**

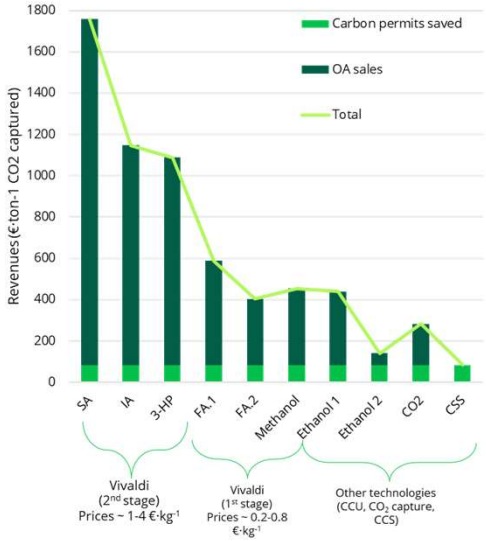
$$1\ mol\ C_{CO_2} = 1\ mol\ C_{CO_2-based\ product}$$



Results

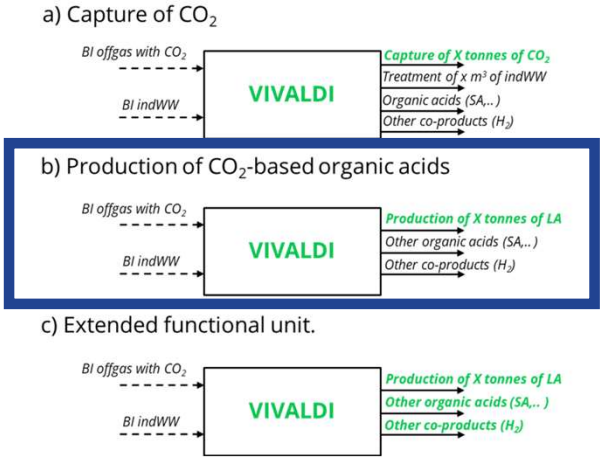
Potential revenues of VIVALDI

- **Selling Organic Acids is the main driver of the activity.**
- Biogenic CO_2 streams from studied BBIs have **high purity** (>98%).
- Market prices of **liquid-CO_2 up to € 355 TM^{-1} in 2022.** Then, production of the OAs should be the FU.



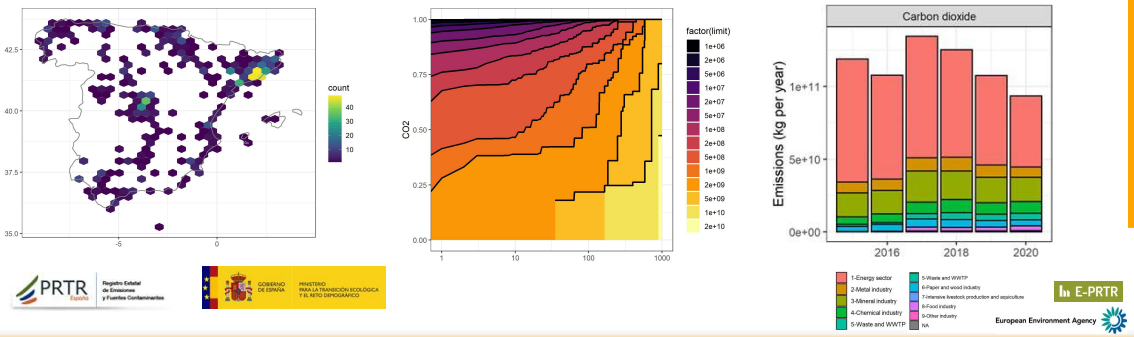
Influences in the Life Cycle Assessment (LCA)

- **The Functional Unit (FU)** aims to represent the quantified performance of a product system for use as a reference unit.



Industrial symbiosis

- First test within Spain to test the **methodology for clustering feedstock sources** of CO_2 and N.
- The method allows **the identification of locations, reverse logistics and plant sizes**



Drivers and barriers

Drivers

Implementation as CCU technology

- Road to Net-Zero
- Key Marketable Products:
- Integrated Biorefinery
- Retrofitting - CO_2-based value chains in other sectors
- Renewable Energy use
- CCS does incur high CAPEX and OPEX costs capture than CCU

Barriers

- Technological Maturity - Some CCU technologies commercially available others are still in development
- Cost of CCU technology depends on type of industry and point resources
- CCU seen as complementary to CCS. .
- CCU applications are technically feasible but industrial implementation at scale is costly.
- Market Acceptance - Convenience of business-as-usual

Implementation as biobased organic acids productions

Drivers

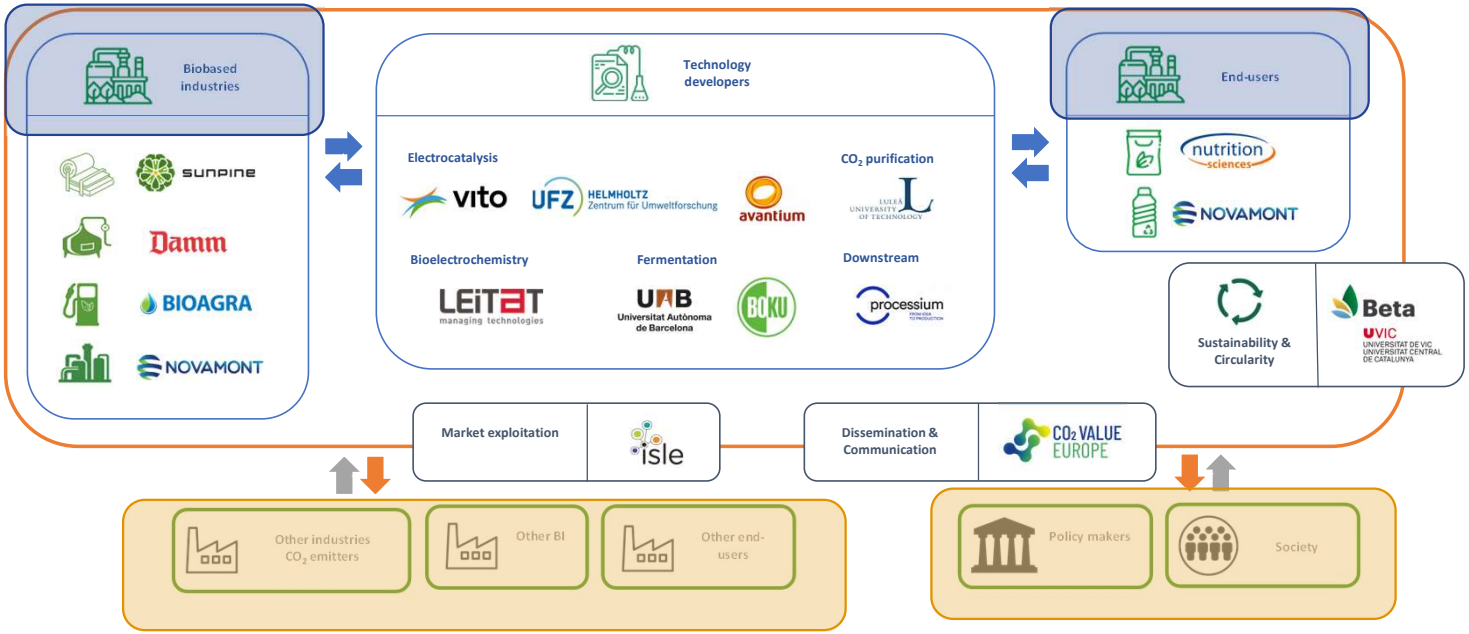
- Reduced dependency on fossil-based feedstocks
- Vertical integration:
- Untapped opportunities - Organic acids as a chemical building blocks.
- Industrial Symbiosis
- Developing country context:
- Hybrid Chemical and Biological Approach

Barriers

- Market acceptance - new approach, organic acid production may face market acceptance challenges
- Cutting-edge technology - the VIVALDI may face challenges of optimization, scalability, and commercial viability.
- Product Separation and Purification- Organic acids need to be separated and purified to obtain high-purity final products.
- Process Efficiency
- Economic viability

Stakeholder impact

- The **main actors of the VIVALDI value chain** are directly involved in the project as partners. That provides **first-hand market intelligence** supporting the design of the business models and strategies.
- **The VIVALDI project is actively engaging** with policy makers, end-users and investors through **tailored made activities focused on knowledge transfer** but also **on co-design and co-creation of the business models through market focus workshops**.



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