LIFE18/CCM/ES001094 CO_2IntBio PROJECT

CO_2 EMISSIONS REDUCTION BY INDUSTRIAL INTEGRATION AND THE VALUE CHAINS CREATION

CO_2Int Bio

Life

CARBUROS METALICOS
Grupo Air Products

enso
OPERATIONS AND MAINTENANCE

Bioeléctrica de Garray S.L.U.

Patrimonio Natural de Castilla y León

Junta de Castilla y León

With the contribution of the LIFE programme of the European Union

BASELINE DATA

LIFE CO2IntBio PROJECT

Starting date: 17/06/2019
Completion date: 16/06/2023
Duration (months): 48 months
Total estimated budget: €8,945,200
EU Contribution: €1,923,900
About the project: lifeco2intbio.eu

web

video

PARTNERS

Coordinator:

Fundación Patrimonio Natural de Castilla y León (FPNCyL)
patrimonionatural@patrimonionatural.org

Partners:

Sociedad Española de Carburos Metálicos, S.A.
info@carburos.com

Bioeléctrica de Garray, S.L.U.
info@enso.energy

ENSO Operations and Maintenance S.L.
info@enso.energy

CONTACT DETAILS

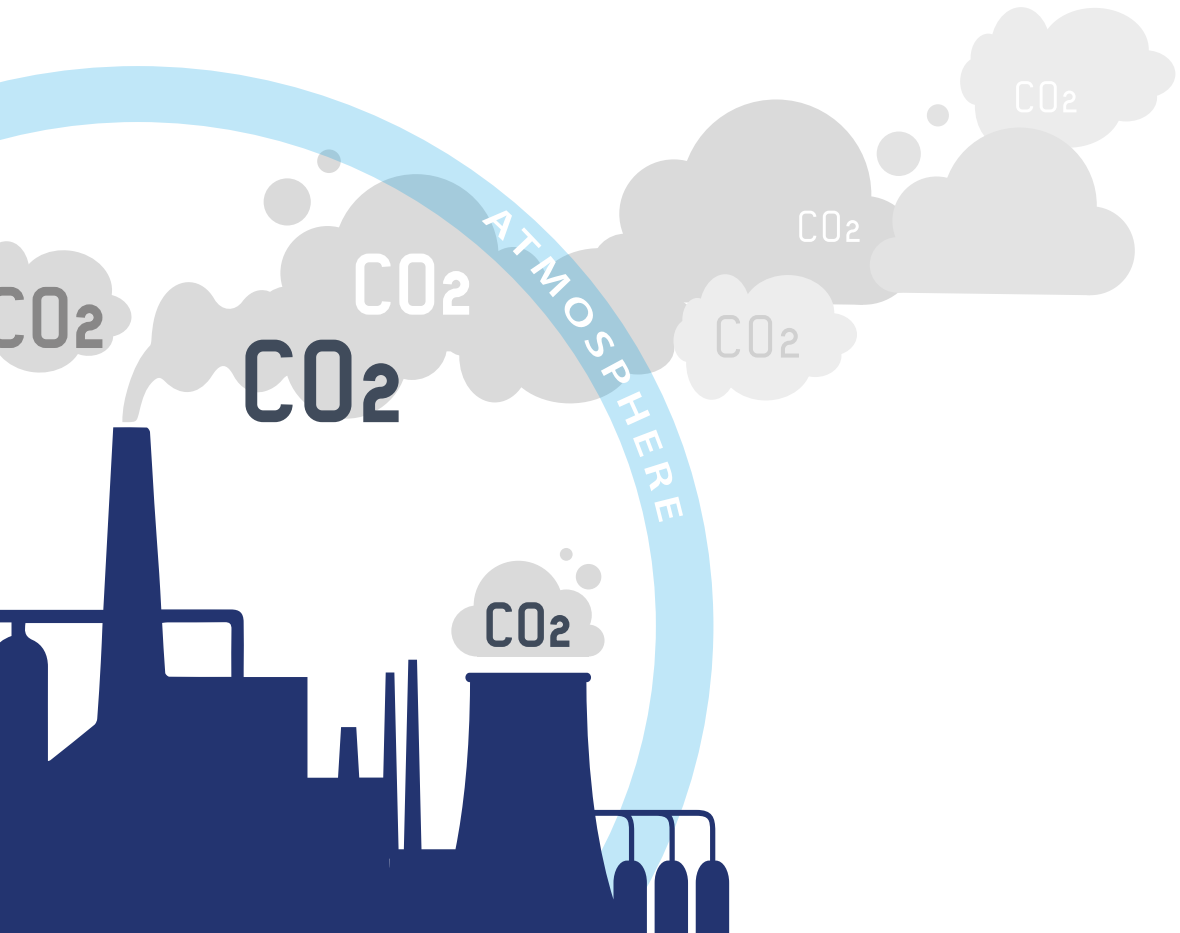
E-mail: lifeCO_2intbio@lifeCO_2intbio.eu
Telephone: +34 983345850 (FPNCyL)

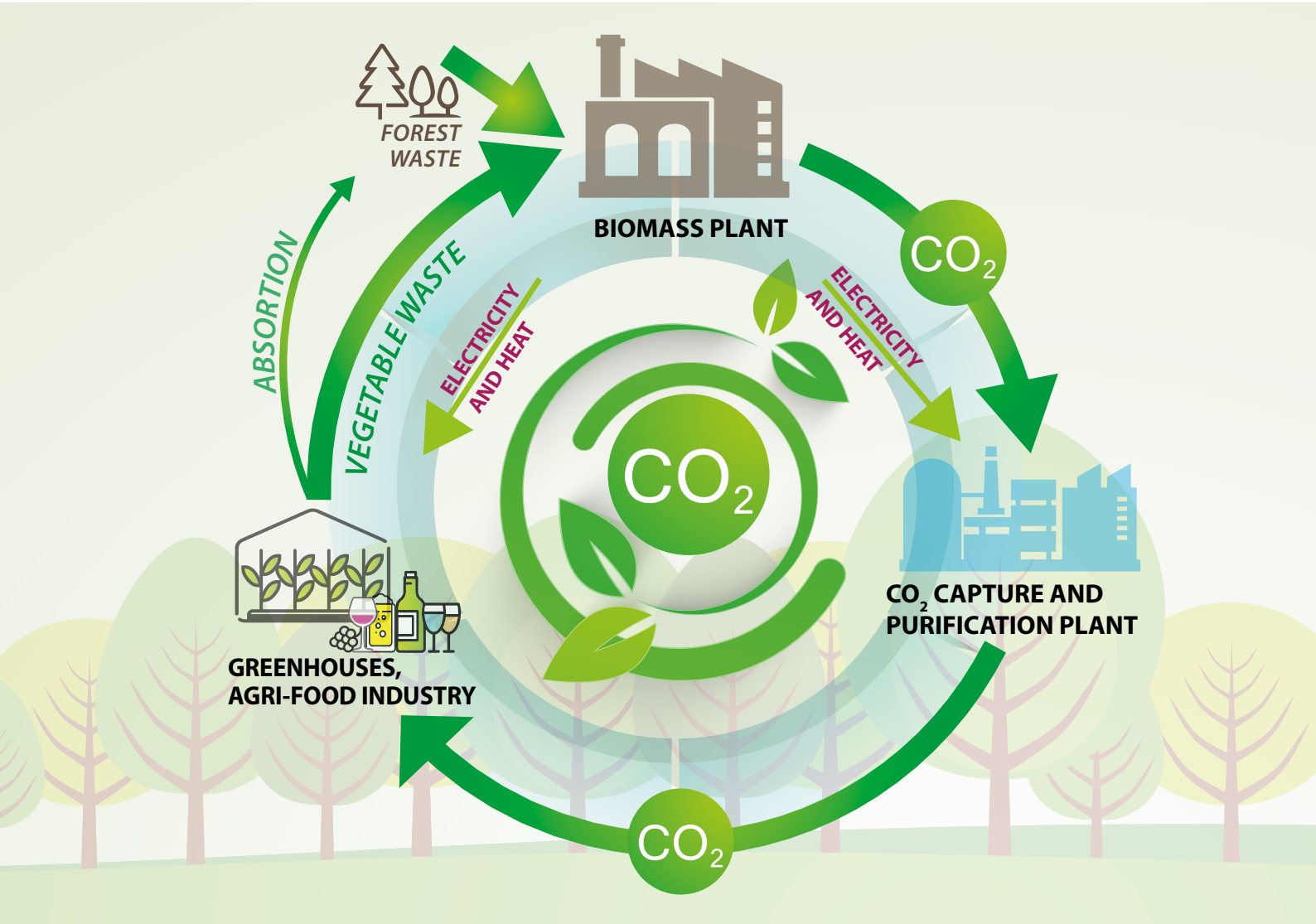
IDENTIFIED ENVIRONMENTAL **PROBLEM**

In addition to European policy efforts for the reduction of greenhouse gas emissions in the industrial sector and the use of the best available techniques, to reach the European Union's ambitious climate objectives it is necessary to use innovative approaches aimed at achieving more resource- and energy-efficient production processes.

LIFE CO_2IntBio is part of the European Union's LIFE Programme as a pilot project for reducing CO_2 emissions using carbon capture and utilization (CCU) technologies and renewable energy, through an innovative industrial integration approach.

CO_2 emissions from the combustion gases released by a biomass-based power plant are captured, purified and processed to obtain a new, added-value product: *green* CO_2, a type of CO_2 from 100% renewable high-quality biomass combustion for use in other industrial sectors.




FOREST
WASTE
BIOMASS PLANT
CO_2
ABSORTION
VEGETABLE WASTE
ELECTRICITY
AND HEAT
ELECTRICITY
AND HEAT
CO_2
CO_2 CAPTURE AND
PURIFICATION PLANT
GREENHOUSES,
AGRI-FOOD INDUSTRY
CO_2

PROJECT OBJECTIVES

The main purpose of the project is to contribute to CO_2 emission mitigation in energy-intensive industrial sectors through the implementation of new methods and technologies based on industrial integration and the creation of new value chains related to CO_2.

Besides, the project has the following specific goals:

1. To prove the benefits, effectivity and CO_2 reduction achieved using an innovative and integrated business approach, developed to reduce CO_2 emissions in various sectors, and aimed at mitigating climate change.

2. To create a value chain and a new product (*green* CO_2, from 100% renewable biomass combustion).

3. To increase energy efficiency in industrial processes, as well as the use of renewable energies, and to contribute to the attainment of sustainable development goals, according to the European Union's action plans and policies.

4. To prove the economic and technical feasibility of the capture and purification of CO_2 arising from combustion gases released by biomass plants.

5. To develop a circular economy by transforming a residue (biomass combustion gases) into new resources.

LIFE CO_2IntBio PROJECT ACTIONS

1. BUILDING OF A PLANT FOR THE CAPTURE AND PURIFICATION OF CO_2 FROM THE EMISSIONS OF A FOREST BIOMASS POWER PLANT.

The plant built as part of the LIFE CO_2IntBio project is a pilot plant for capturing and purifying CO_2 from biomass combustion gases. Although the technology already existed and was used in other plants that use industrial gas flows, it had to be adapted to process the emissions from the biomass energy generation plant because of their low CO_2 concentration and special impurity and particle characteristics. This adaptation is the pilot project's main demonstrative purpose.

The first step in the process is to channel the gases generated by the biomass power plant. The CO_2 from these emissions is captured through an amine-based chemical absorption process and purified to remove contaminants.

The CO_2 obtained can be available in gas or liquid form. Liquid CO_2 is stored in tanks where it will be analysed to ensure compliance with the specifications required for use in the different target markets, the food market among them.

2. ADAPTATION OF THE FOREST BIOMASS ENERGY PRODUCTION PLANT FOR THE CAPTURING OF COMBUSTION GASES AIMED AT CO_2 RECOVERY.

The implementation of a new CO_2 capture and purification plant in the Garray Bioelectric facilities has required an adaption of the existing infrastructures to meet the demands of the new plant.

The gas, heat, and electric energy supply from the biomass plant to the CO_2 plant involved improving and upgrading the already existing equipment, whose original dimensions were not intended for that purpose.

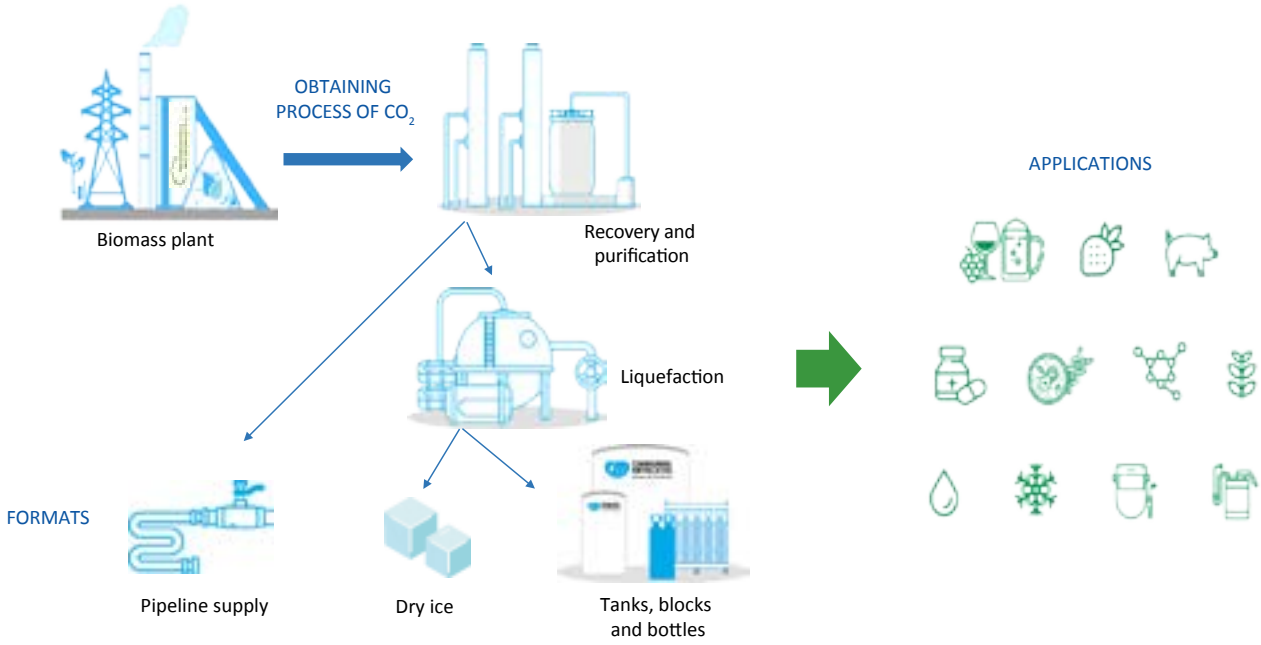
The main actions to be undertaken were defined following a detailed technical analysis of the project's requirements. In December 2020, after obtaining all the necessary permits, the implementation of the envisaged adaptations began.

3. CREATION OF VALUE CHAINS FROM CO_2 ARISING FROM BIOMASS COMBUSTION, TRANSFORMING IT INTO A MARKETABLE PRODUCT.

CO_2 as a commercial product has numerous applications and is widely used across different activity sectors, among them:

- Food and drink industry: carbonation, cooling, or packaging, to name a few.
- Greenhouses: enrichment of the atmosphere with CO_2 to optimize crop growth and productivity.
- Water treatment: pH neutralization, water remineralization and carbonation.
- Refrigeration: as an alternative to fluorinated gases.
- Industrial sector: welding and cutting, polyurethane and foamed plastic manufacturing, or dry ice blasting, among others.
- Pharmaceutical and healthcare sector: transport of refrigerated medicines and specimens, cell culture growing.

The LIFE CO_2IntBio project obtains CO_2 from the capture and purification of the combustion gases from a biomass energy generating plant, creating new value chains for the captured CO_2 thanks to its characteristics:



- Renewable origin (biomass combustion).
- It is regarded as neutral in emissions.
- The sophisticated processing and analysis of the product make it suitable for use in the agri-food sector.
- Supplier proximity reduces road transport emissions.
- It has an Environmental Product Declaration.

4. CREATION OF AN ECO-LABEL FOR THE NEW *GREEN* CO_2 PRODUCT BASED ON THE LIFE CYCLE ASSESSMENT AND THE ENVIRONMENTAL PRODUCT DECLARATION (EPD).

The special characteristic of the new product obtained is its 100% renewable origin since it comes from capturing biomass combustion gases and uses renewable energy in the CO_2 capture, purification, and treatment processes.

To highlight the added value of the product that is provided by its renewable origin, a **type III ecolabel** has been developed, an Environmental Product Declaration that describes the environmental impact of the production of CO_2 by means of this industrial integration model.

The environmental impact has been assessed using the Life Cycle Assessment methodology together with certain Product Category Rules for chemical products and has been accredited by a verifying authority.

PROJECT RESULTS

1. USE OF THE CO_2 CAPTURED IN BIOMASS PLANTS AS RAW MATERIAL, AFTER ITS PURIFICATION.

CO_2 is used in numerous industrial processes and it is consumed in many products on a daily basis. Besides, research into new sustainable uses of the gas is being carried out since it offers a more environmentally friendly alternative than other currently used products.

The LIFE CO_2IntBio project's *green* CO_2 has obtained the FSSC 22000 Food Safety certification, which guarantees the **highest quality** for the product to be used in the food sector, among others.

Further information: Use of the CO_2 captured | Life CO_2 IntBio

2. DEVELOPMENT OF A NEW PRODUCT: GREEN CO_2 FROM THE COMBUSTION OF 100% RENEWABLE BIOMASS.

The *green* CO_2 produced as part of the LIFE CO_2IntBio project comes from the combustion gases of a biomass energy generation plant. The sustainable management of biomass used as fuel is certified under the SURE voluntary scheme, in compliance with the European Union's REDII Directive.

Besides, the energy used to produce ***green*** CO_2 comes from the same biomass plant, which guarantees its **100% renewable origin.**

Further information: Development of a new product: Green CO_2 | Life CO_2 IntBio

3. DEVELOPMENT OF AN INDUSTRIAL SYMBIOSIS MODEL AMONG BUSINESSES FROM DIFFERENT SECTORS.

The LIFE CO_2IntBio project has proved the feasibility of an industrial symbiosis model between the biomass electricity and heat power plant and the CO_2 capture and purification plant, creating synergies that make both **industrial processes more efficient and sustainable:**

- Use of waste gases from biomass combustion as raw material that returns to the production flow (33,000 CO_2 tonnes/year are recycled, with a potential to recover up to 55,000 t/year).

- Direct electric and heat supply from the biomass plant to the CO_2 capture plant to produce *green* CO_2 (with an estimated use of renewable electric energy of 7,475 MWh/year and of heat energy of 45.350 MWh/year).

- Operational support for the integration of both production processes.

Further information: Development of an industrial symbiosis model among businesses from different sectors | Life CO_2 IntBio WWW

4. CO_2 FROM BIOMASS COMBUSTION LIFE CYCLE ASSESSMENT

The Life Cycle Assessment (LCA) is a methodology for objectively assessing the environmental impact of a product or service during the life stages of its existence.

The CO_2 production LCA has been approached in three different scenarios:

1. CO_2 synthesis from natural gas.
2. CO_2 synthesis from industrial gas use.
3. *Green* CO_2 synthesis (LIFE CO_2IntBio Project)

The comparative analysis of the three scenarios leads to the conclusion that **producing *green* CO_2 saves the emission of 420 kg of CO_2 equivalent** per tonne of CO_2 produced[1].

Further information: CO_2 from biomass combustion Life Cycle Assesment | Life CO_2 IntBio WWW

5. DEVELOPMENT OF AN ECO-LABEL FOR THE CARBON NEUTRAL CO_2: ENVIRONMENTAL PRODUCT DECLARATION (EPD).

The project has undertaken the development of the first **ecological type III label**, Environmental Product Declaration (EPD), for a product derived from CO_2 capturing. This EPD is based on the Life Cycle Assessment (LCA) methodology and provides knowledge of the environmental impact of *green* CO_2 production, also allowing its comparison with similar products that comply with the same Product

1. With regard to the habitual production by natural gas combustion.

Category Rules (specific LCA criteria per product type).
Further information: Development of an eco-label for the Green CO_2 | Life CO_2 IntBio

6. REPLICABILITY PLAN AND DEVELOPMENT OF INDUSTRIAL SYMBIOSIS MODELS FOR CO_2 RECOVERY AND REUSE.

The replicability and transferability of the project's results at the national level have been analysed considering the following:

- Location of CO_2 emission sources, volume and flow of CO_2 emitted, and origin of the emissions.

- Location of potential CO_2 consumers.

Three specific replicability conferences aimed at key sectors have been carried out with the participation of 50 people.
Further information: Replicability Plan | Life CO_2 IntBio

7. STUDY OF THE SOCIOECONOMIC IMPACT OF THE LIFE CO_2 IntBio PROJECT

The study of the socioeconomic impact drawn up leads to the following conclusions:

- The (direct and indirect) economic impact during the project's lifecycle is estimated at €37,893,259.65[2].

- With a stable production of 33,000 CO_2 tonnes/ year, the project could have an impact of up to €31,852,548.33/ year.

- With a stable production of 55,000 CO_2 tonnes/ year, the project could have an impact of up to €50,611,264.34/ year.

Further information: Study of the socioeconomic impact of the LIFE CO_2IntBio project | Life CO_2 IntBio

2. Including impact of plant´s first year of operation + impact of biomass plant adaptation + impact of CO_2 plant building

DISSEMINATION

Since the beginning of the project, several communication and dissemination activities have been carried out with the following objectives:

- Raise awareness about CO_2 and why it is necessary.
- Increase knowledge and awareness about climate change and mitigation measures.
- Disseminate the project among the general public, highlighting the carbon capture and utilization (CCU) concept, and promoting the creation of sustainable sources.
- Networking: to favour synergies and collaborations drawing from the project experience.

These are the **main activities** carried out so far:

- Dissemination through the website and social media (#lifeCO_2IntBio):
- Development of information material:
  - › Roll-up. Noticeboards and photocall.
  - › Information catalogue and infographics on CO_2 production and application.
  - › Project information leaflet.
  - › Creation of a 3D printed plant mock-up using biodegradable materials to explain how the gas travels and the purification process.

- Thematic infographics and micro-videos

  - Climate change mitigation (Infographics access. Micro-video access).
  - Commercial uses of CO_2 (Infographics access. Micro-video access).
  - Eco-labelling for CO_2-derived products. Environmental Product Declaration (Infographics access. Micro-video access).
  - Circular economy (Infographics access. Micro-video access).
  - Expected results (Infographics access. Micro-video access).

video

- Project video.
- Participation in specialized events (congresses, conferences, etc.).
- Participation in environment and climate change, energy and biomass, and chemistry specialized forums:

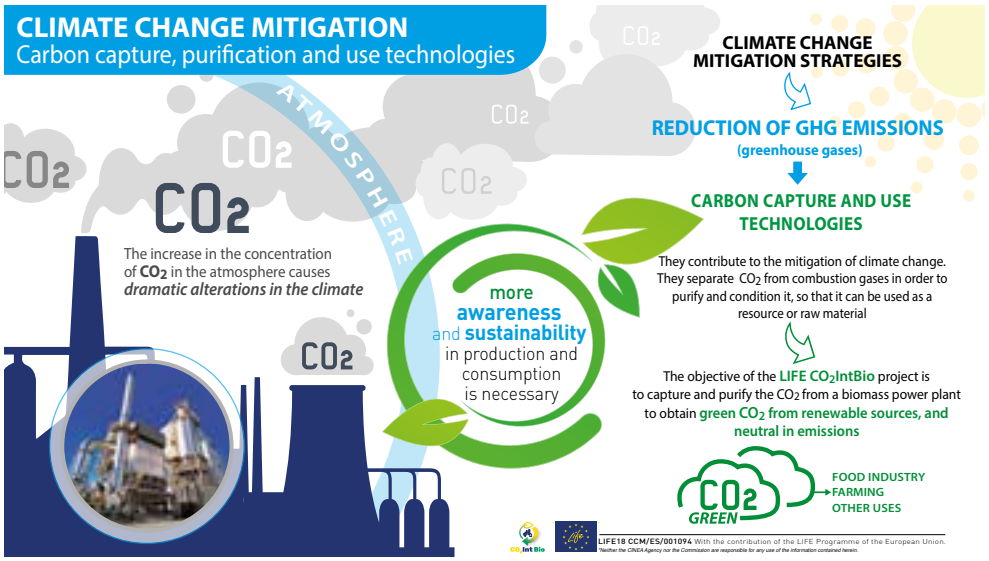
  - **CONAMA 2020,** held in June 2021. During the National Environment Congress, the project had its own stand and was presented in a technical session on Industrial Symbiosis.
  - Nacional Congress of Circular Economy and Environmental Communication, **ECCA**, in 2021.
  - **Expobiomasa** in 2019, presenting the project in a specific talk on "Communication and Circular Economy Using Bioenergy", as well as in other energy sector fairs, such as **Powergen** (Paris, 2019), or **Genera 2020** (Madrid, 2020).
  - The project was also presented at the 2021 **Expoquimia** edition and has played a prominent role in **Expoquimia 2023** with the speech on CO_2 capture, purification, and reuse in a biomass plant, during Smart Chemistry Smart Future.

- Press releases and publications in specialized media.
- Activities with students.
- Networking and replicability activities.

  › Networking activities: contact with projects related to Carbon Capture and Utilization (CCU) and Circular Economy. Organization, within the framework of CONAMA 2020, of a technical talk, "Transformation of CO_2 into raw material: new climate change mitigation strategies", aimed at political authorities in the area of climate change. Participation in the European Week of Regions and Cities 2021 in the "Our Forests, our Future", seminar. In both cases, showing the role of CCU technologies in environmental change mitigation policies.

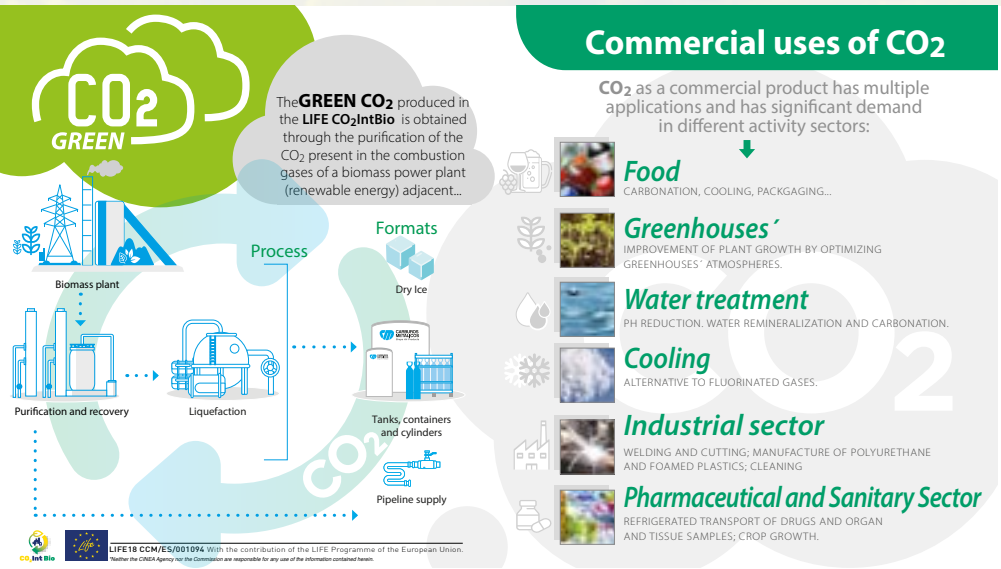
  › Replicability conferences as part of the project's replicability activities, conducted as technical events aimed at specific sectors:

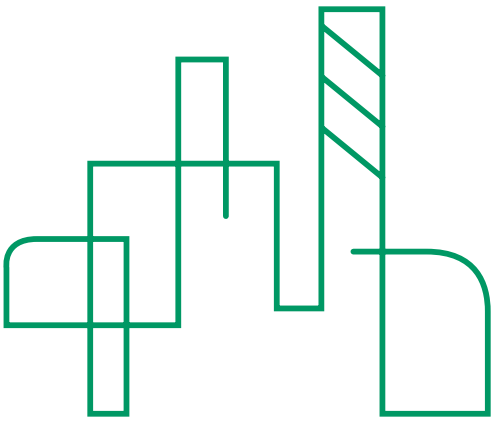
  - Online talk aimed at the public administration.
  - Onsite talk and tour aimed at the biomass and energy sector.
  - Onsite talk and tour aimed at CO_2 consumers / clients.



- Awards and distinctions:

  › The acknowledgements received by the end of the project are as follows:
  › CEX Excellence Award 2019: Best Practices in Circular Economy.
  › 4S Metal Carbides Awards.
  › Castile and León / El Mundo innovators awards.
  › Special mention at the I Environmental Sustainability Awards of Castile and León.





CO2Int Bio

RECUPERACIÓN DE CO_2 PARA SU INTEGRACIÓN EN CADENAS DE VALOR

Life

CARBUROS METÁLICOS
Grupo Air Products

Junta de Castilla y León

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