



EURECA-PRO

The European University Alliance on Responsible Consumption and Production

Participants:	Montanuniversität Leoben, Technical University Freiberg, University of Petrosani, University of León, Technical University of Crete, Silesian University of Technology, Mittweida University of Applied Sciences
WP 3:	Research, Montanuniversität Leoben
	Report on the MSCA European Green Deal Cluster Event held on 06th and 07th July 2021, organised by EC and REA
Author:	Volkmar Kircher
Type:	E-Book
Submission:	22.07.2021

Grant Agreement No.: 101004049
Project duration: 1.11.2020 – 31.10.2023

Co-funded by the
Erasmus+ Programme
of the European Union



Report on the MSCA European Green Deal Cluster Event

On 6th and 7th July 2021, the European Commission and the European Research Executive Agency (REA) organised an online “European Green Deal Cluster Event”. The event brought together excellent projects and researchers funded under the Marie Skłodowska-Curie Actions (MSCA), as well as other research and innovation initiatives under the remit of the European Commission’s Directorate-General for Education, Culture, Youth and Sport. These include the European Institute of Innovation and Technology (EIT), European University Alliances, Erasmus+ and Creative Europe projects. More than 600 participants registered for the event and had the opportunity to listen to leading researchers representing MSCA projects in the following Thematic Panels [1]:

- Biodiversity
- Sustainable agriculture & soil health
- Clean energy
- Eliminating pollution
- Climate action
- Green transport

The speakers provided previously recorded videos from their research, that were shown during the Thematic Panels followed by a Question and Answer session and a Panel Discussion. A total of 60 projects were shown in two consecutive days and 6 Thematic Panels with 5 presentations each.

The **Opening Session on Tuesday 06.07.2021** was chaired by Klaus Haupt, Head of Unit MSCA Doctoral Networks, European Research Executive Agency. After the welcome messages, there was an introduction to the European Green Deal, Green Deal research in the Marie Skłodowska-Curie Actions and a plenary speech of Alexandra DUBINI, MSCA Fellow and Board Member of the Marie Curie Alumni Association (MCAA), about Scientific leadership towards a sustainable future.

¹ MSCA European Green Deal Cluster Event, European Commission and the European Research Executive Agency (REA), viewed 22 July 2021, <<https://www.msca-greendeal.eu/en/page/information/>>

A **Virtual Exhibition** showcased a great variety of 26 additional R&I projects funded by the MSCA, the EIT, Erasmus+ and Creative Europe. A small newly planted forest in Spain with different tree species was dedicated to the winner. The winner of the Virtual Exhibition was María del Prado Garcia-Aparicio from University of Alcalá with a presentation about „Biotechnology approaches for food waste valorisation”[1, 2].

The project primarily focuses on the biorefinery assessment of selected plant-based food byproducts in terms of chemical composition, bioactive profile, antioxidant capacity, and enzyme accessibility of the carbohydrate fraction after different drying treatments [2].

The Green Deal cluster event is part of the EU’s feedback-to-policy activities and convenes EU policymakers, researchers and experts to explore how R&I can help achieve the goals of the [European Green Deal](#) [1]. Discussed topics were the key areas that EU actions should focus on investing for achieving the set targets, like to reduce greenhouse gas emissions by at least 55% by 2030, to be climate-neutral in 2050 and to engage citizens and all parts of society in climate action. The Thematic Panel discussions covered all above-mentioned R&I areas from biodiversity to green transport. It was further discussed which measures should the EU take to support researchers working on key policy areas, such as climate action. There was a consensus among researchers that the European Commission should tackle precarious work in higher education through increased funding, longer funding periods and longer or permanent employment contracts. The continuation of the vision of European Universities was addressed as well as the support for climate change active NGOs and associations.

The event was recorded and the videos inclusive Panel discussions can be viewed on the MSCA European Green Deal Cluster Event website (viewed 22 July 2021):

<https://www.msca-greendeal.eu/en/page/watch-again/>

² María DEL PRADO GARCIA-APARICIO (Universidad de Alcalá), Biotechnology approaches for food waste valorisation (GOT ENERGY) – MSCA COFUND (2016) project ID 754382, presentation at the MSCA European Green Deal Cluster Event, 06-07.07.2021, p.12

EURECA-PRO video presentation

EURECA-PRO was represented at MSCA European Green Deal Cluster Event by Dipl.-Ing. Dr.mont. Volkmar KIRCHER (Montanuniversität Leoben). He was a speaker for the Climate action Panels (part 4B) on 07.07.2021 10.15 – 11.15 AM (CEST/Brussels time). The video presentation entitled “European University on Responsible Consumption and Production - Carbon Storage and Air Pollution” focused on the research of EURECA-PRO in general and on three selected projects in the areas of Carbon Storage and Air Pollution. The presentation can be found in ANNEX 1, the presentation and speaker announcement in ANNEX 2 and 3 respectively.

The research of EURECA-PRO covers Circular Production Industry from Exploration of primary resources via Processing of mined raw materials, Smart Production, Industrial Environment Engineering & Protection to Recycling of valuable materials. Responsible Production is linked to Consumption and therefore EURECA-PRO considers both, responsible Industrial Consumption & End/Private Consumption.

The first project shown in the video is entitled “Petrophysical characterization of the Dolomitic Member of the Boñar Formation (Upper Cretaceous; Duero Basin, Spain) as a potential CO₂ reservoir”. The project was carried out by Gómez-Fernández et al. [3] from the University of León. The outcome of the project is that the porosity of the Dolomitic Member is within the acceptable range for CO₂ sequestration but the permeability is far too low. This result minimises the chance that the dolomite member, and probably the entire Boñar formation, will become a suitable CO₂ reservoir. The presentation showed that petrophysical characterisation is crucial for the identification of potential CO₂ reservoirs and the subsequent reduction of CO₂ emissions to the atmosphere. The abstract of the project is attached in ANNEX 4.

³ F. Gómez-Fernández^{1,3}, P. Caldevilla^{1,3}, A. Suárez-González^{1,2}, T. Kovács², A. Herrero-Hernández³

1 Escuela Superior y Técnica de Ingenieros de Minas, Universidad de León, Campus de Vegazana, s/n, 24071

2 Fundación Ciudad de la Energía, II Avenida de Compostilla, 2, 24400 Ponferrada (León)

3 Grupo de Investigación Ingeniería Geológica y de Materiales, E.S.T.I. de Minas, Universidad de León, Campus de Vegazana, s/n, 24071

The second project “Bio-HTL - Hydrothermal Co-liquefaction of microalgae and biogenic residues” [4] was conducted by the Montanuniversität Leoben and deals with Carbon (CO₂) Capture & Use by means of Industrial Algae Production in Photobioreactors (PBR).

PBRs use CO₂, light and water to produce biomass. Targets for industrial PBRs are low area demand, optimization of the light management & CO₂-supply and efficient downstream processing. The project resulted in a PBR concept that provides microalgae biomass, produced at energy-intensive industrial sites (e.g. power plants, cement works, iron and steel works or brick manufacturers), by using flue gas CO₂ and wastewater sources available on site. In the project the microalgal biomass was used for the conversion of biomass into a drop-in feedstock for crude oil processing (biofuel) but it can be also used for the green production of synthesis gas and hydrogen, food, beverages, cosmetics and pharma purposes.

The results of the third project, from the Silesian University of Technology, demonstrate the necessity of outdoor and indoor air quality analysis in the vicinity of industrial areas. The target was a better understanding of the influence of indoor air quality (IAQ) on the health of children attending nursery schools in Upper Silesia (industrial area in Poland). The air was analysed regarding concentration levels of chemical and biological pollutants. Sources influencing the relationship between outdoor and indoor air (4 nursery schools) have been identified. Particulate matter (PM) describes the size of solid particles and liquid droplets in the air. PM₁ represents a particle size < 1µm and among determined concentrations of trace elements (Cd, Cr, Mn, Ni, Pb, Sb and Se) in PM₁ collected in indoor air (in preschools), and in the outdoor air (in the surroundings of power plants and coking plants), the highest concentrations were evidenced for Cr, Cd, Mn and Ni [5].

The results clearly indicate a problem of high PM_{2.5} metal concentrations inside the classrooms, exceeding the WHO short-term guidance values and high levels of CO₂ confirmed low indoor air quality inside the classrooms.

⁴ Bio-HTL, Montanuniversität Leoben, Chair of Process Technology and Environmental Protection, viewed 22 July 2021, <<https://www.vtiu-unileoben.at/en/research/renewable-materials-processing/projects#biohtl>>

⁵ A. Mainka and E. Zajusz-Zubek, PM₁ in Ambient and Indoor Air—Urban and Rural Areas in the Upper Silesian Region, Poland. Atmosphere 2019, 10, 662; doi:10.3390/atmos10110662

Air quality analysis is essential to enforce an effective improvement of indoor air quality (IAQ) in nursery schools, schools, work spaces or similar. These results are important for raising awareness in governments, institutions and companies.

At the end of the presentation, a page of other selected EURECA-PRO consortium research related to air pollution and carbon storage/recycling was shown to demonstrate the breadth of our research agenda in these areas.

On **Wednesday 07.07.2021** a **Plenary Session** took place after the Thematic Panels, chaired by Begoña Arano, Head of Department, European Research Executive Agency (REA).

The programme started with the presentation “The MSCA and the Green Deal: trends, themes and challenges” followed by a Round table: What’s next for climate research and education? and an introduction in “EU funding opportunities for Green Deal R&I”. In the end ARANO announced the Virtual Exhibition winner and made closing remarks.

ANNEX 1

Presentation “European University on Responsible Consumption and Production - Carbon Storage and Air Pollution”



Co-funded by the
Erasmus+ Programme
of the European Union



European University on Responsible Consumption and Production

Carbon Storage and Air Pollution

Volkmar Kircher

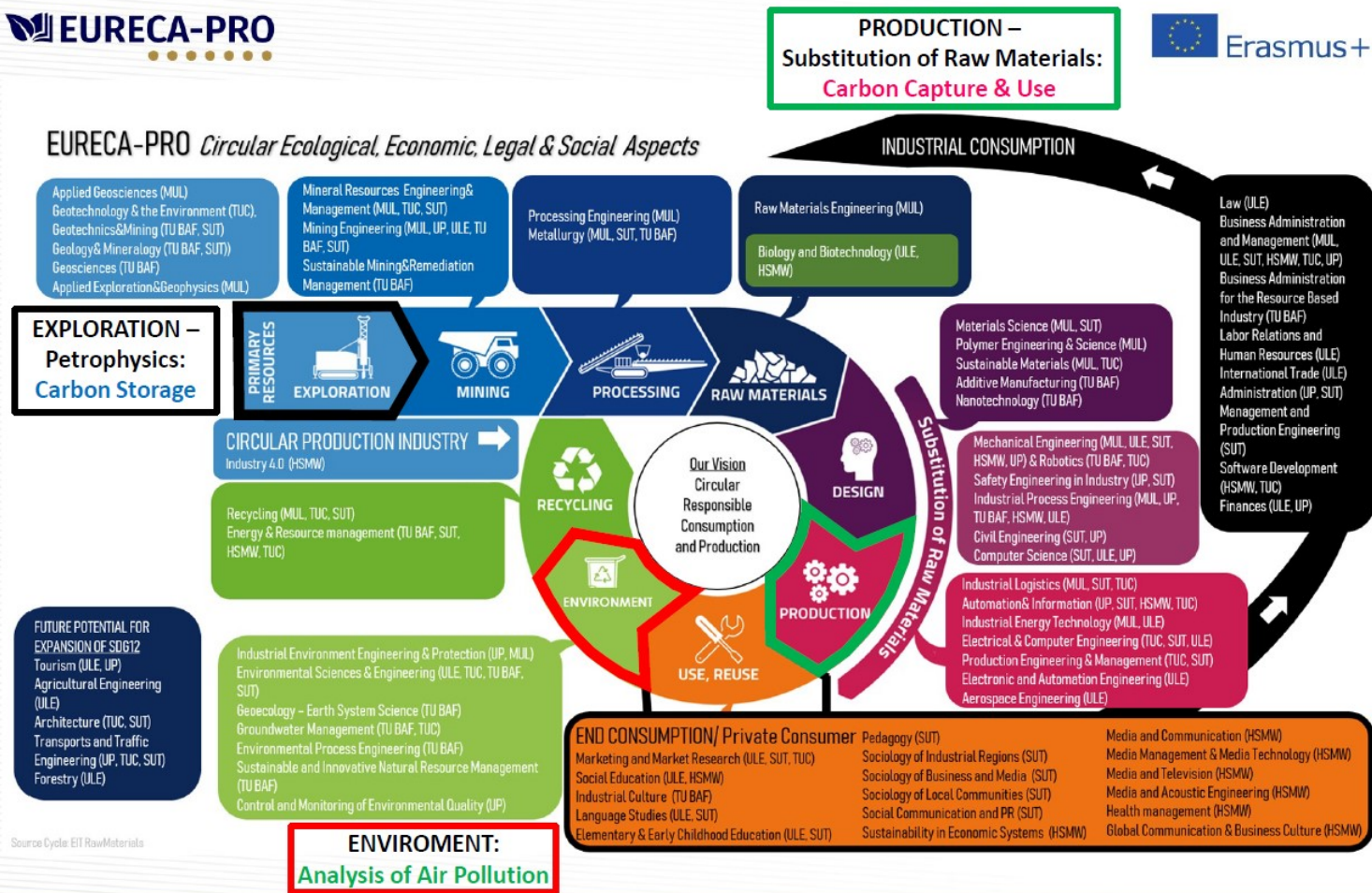
European Green Deal online cluster event



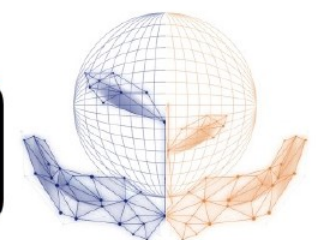
#EurecaPro
www.eurecapro.eu



EURECA-PRO *Circular Ecological, Economic, Legal & Social Aspects*



- Universidad de León
- HOCHSCHULE MITTWEIDA
- Technical University of Crete
- Silesian University of Technology
- MONTAN UNIVERSITÄT LEOBEN
- TU BERGAKADEMIE FREIBERG
- UNIVERSITATEA PETROSANI



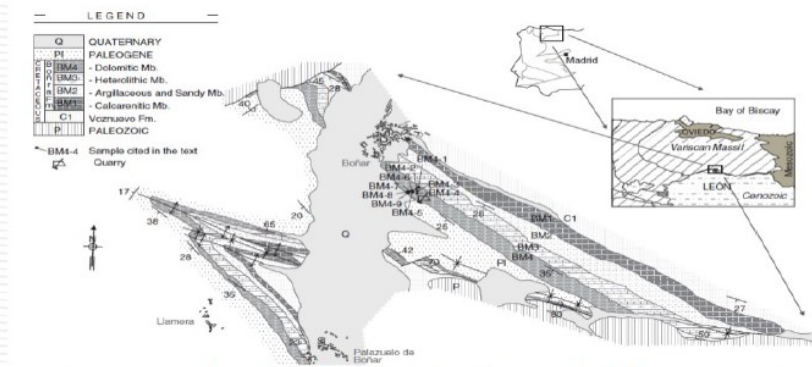


Carbon Storage

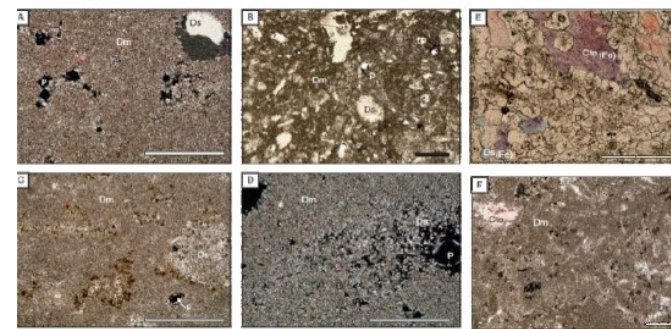


Target Petrophysical characterisation of the Dolomitic Member of the **Boñar Formation** (Upper Cretaceous; Duero Basin, Spain) as a **potential CO₂ reservoir**

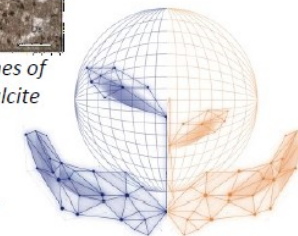
- The main objective of this study was to evaluate the potential as a geological reservoir for CO₂ sequestration by means of porosimetry, permeability and microscopy.



Location and stratigraphy of the area of study



MOP images showing representative microtextures of dolostones of BM 4, composed of dolomicrite (Dm), dolosparite (Ds), Cte=calcite
Scale bar = 500 µm.



Project 1: Petrophysical characterization of the Dolomitic Member of the Boñar Formation (Upper Cretaceous; Duero Basin, Spain) as a potential CO₂ reservoir



Target Petrophysical characterisation of the Dolomitic Member of the **Boñar Formation** (Upper Cretaceous; Duero Basin, Spain) as a **potential CO₂ reservoir**

- The main objective of this study was to evaluate the potential as a geological reservoir for CO₂ sequestration by means of porosimetry, permeability and microscopy.

Outcome

- Porosity of the Dolomitic Member is within the acceptable range for CO₂ sequestration
- Permeability is far too low
- The result minimises the chance that the dolomite member, and probably the entire Boñar formation, will become a suitable CO₂ reservoir.

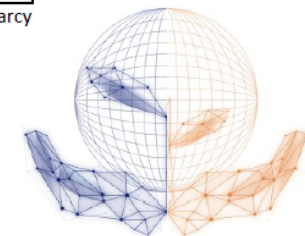
Table 1.—Results of petrophysical characterization.

Sample	Density		Porosity		Permeability	
	g/cm ³	St. dev.	%	St. dev.	mD	St. dev.
BM4-1 (beige)	2.85	0.0008	20.62	0.41	0.52	0.0088
BM4-2 (beige)	2.83	0.0009	18.10	0.17	0.10	0.0072
BM4-3 (beige)	2.84	0.0070	17.87	0.44	0.17	0.0027
BM4-4 (grey)	2.80	0.0114	13.53	1.06	0.01	0.0027
BM4-5 (beige)	2.81	0.0072	10.38	2.38	0.13	0.1847

mD ... milliDarcy

- Petrophysical characterisation is crucial for identifying potential CO₂ reservoirs and subsequently reducing CO₂ emissions to the atmosphere.

Project 1: Petrophysical characterization of the Dolomitic Member of the Boñar Formation (Upper Cretaceous; Duero Basin, Spain) as a potential CO₂ reservoir



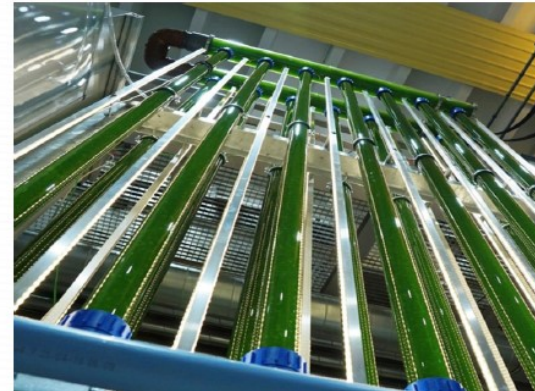


Carbon Capture & Use



Target Industrial Algae Production in Photobioreactors (PBR)

- Optimization of light management & CO₂-supply
- Development of industrial usable PBR with low area demand
- Optimized and efficient downstream processing



PBR artificially illuminated with a volume of 135 l, 3.5 m high, equipped with an airlift system for culture mixing



Project 2: Bio-HTL - Hydrothermal Co-liquefaction of microalgae and biogenic residues



Carbon Capture & Use



Target Industrial Algae Production in Photobioreactors (PBR)

- Optimization of light management & CO₂-supply
- Development of industrial usable PBR with low area demand
- Optimized and efficient downstream processing

- Outcome**
- PBR concept provides microalgae biomass produced at energy-intensive industrial sites (e.g. power plants, cement works, iron and steel works or brick manufacturers)
 - PBR use flue gas CO₂ and wastewater sources available on site and reduce costs

- Use**
- Conversion of microalgal biomass into a drop-in feedstock for crude oil processing (biofuel)
 - Green production of synthesis gas + hydrogen
 - Food, Beverages, Cosmetics, Pharma etc.



PBR artificially illuminated with a volume of 135 l, 3.5 m high, equipped with an airlift system for culture mixing

➤ The system is currently implemented on a large scale by an industrial partner

Project 2: Bio-HTL - Hydrothermal Co-liquefaction of microalgae and biogenic residues



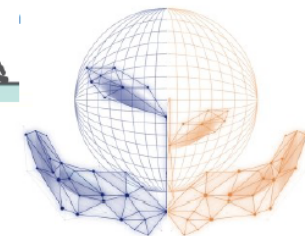
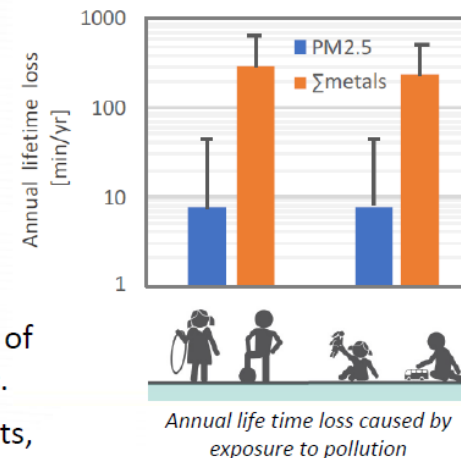


Target Better understanding the **influence of indoor air quality (IAQ) on the health of children** attending nursery schools in Upper Silesia (industrial area in Poland).

- Analysis of the air regarding concentration levels of chemical and biological pollutants
- Sources influencing the *relationship between outdoor and indoor air* (4 nursery schools)

Outcome The results clearly indicate a problem of high PM2.5 metal concentrations inside the classrooms!

- PM2.5 metal values are exceeding the WHO short-term guidance values
 - High levels of CO₂ confirmed low indoor air quality inside the classrooms
- Air quality analysis is essential to enforce an effective improvement of indoor air quality (IAQ) in nursery schools, schools, work spaces, etc.
- These results are important for raising awareness in governments, institutions and companies





Selected research related to air pollution and carbon storage/recycling



- **Atmospheric Environment:** Aerosol-precipitation interaction, bioaerosols, emissions from coal combustion, aerosol radiative forcing, links between bioaerosols, allergenic proteins, precipitation, atmospheric pollutants (especially black carbon) for respiratory allergies prevention
- Biogeochemistry of material cycles in atmosphere (chemistry of fog, aerosols), hydrosphere and pedosphere
- Geochemical and environmental analytics, toxicology
- Isotope investigations and geochronology
- Soil and ecosystem respiration studies
- **Climate Change** in different regions
- Innovative technologies for climate change mitigation by Mediterranean agricultural sector, LIFE17 CCM/GR/000087 (ClimaMed)
- The role of acid gas (H_2S and CO_2) in the formation of deep hydrogeochemical systems
- Evaluation of CO_2 storage capacity of lithofacies, based on porosimetry, permeability, microscopy, high pressure CO_2 injection tests, image analysis and numerical modelling
- Monitoring and forecasting **CO_2 sequestration in poplar plantations** using 3D laser data (Poplar4D)
- System for monitoring and analysis of agricultural crops in isolated areas using drones
- Use of graphene to protect heritage
- Closing the carbon cycle through sector coupling i.e. integration of energy, chemical, waste management and recycling
- Carbon performance and financial performance of firms: Sustainability as first aim
- Research Infrastructure for the Valorization of Wastes and Sustainable Management of Resources (INVALOR)
- Value chains for disruptive **transformation of urban biowaste into biobased products** in the city context (WaysTUP!)
- Zero waste concepts, e.g. metallurgy through new recycling processes of residual materials (dusts, slags, sludges), so that these no longer have to be landfilled but recycled or residual metals recovered (2sDR project)
- **Methane pyrolysis** to produce hydrogen (also anchored in strategies at the European level)
- **Sustainable transport** - rolling out cleaner, cheaper and healthier forms of private and public transport





Acknowledgements

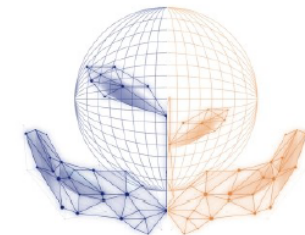
Participation in the Green Cluster Event is possible thanks to *ERASMUS+* funding.

Multiple projects have received funding from the European Union’s *Horizon 2020* research and innovation programme.

Project 1: This work was carried out at the Technology Development Centre for CO₂ Capture, owned by Fundación Ciudad de la Energía (Spanish Ministry of Industry, Energy and Tourism).

Project 2: Project financed by *FFG’s BRIDGE Programme* (26th call)

Project 3: Project financed from the *Norway Grants* under the Polish - Norwegian Research Cooperation programme implemented by the National Centre for Research and Development.



ANNEX 1

Presentation “European University on Responsible Consumption and Production - Carbon Storage and Air Pollution”



The slide features a central logo for EURECA-PRO, which consists of a network of gold nodes above a stylized blue leaf and book icon. Below this, the text "EURECA-PRO" is written in bold blue letters, followed by "European University on Responsible Consumption and Production" in gold. In the top right corner, the website "www.eurecapro.eu" is listed, along with the text "Co-funded by the Erasmus+ Programme of the European Union" and the European Union flag. The bottom of the slide displays a row of partner logos: Universidad de León, MONTAN UNIVERSITÄT LEDBEN, HOCHSCHULE MITTWEIDA University of Applied Sciences, Technical University of Crete, TU BERGAKADEMIE FREIBERG, Silesian University of Technology, and UNIVERSITATEA DIN PETROȘANI. A dark blue vertical sidebar on the right contains the hashtag "#EurecaPro" and the page number "8 | 8".

www.eurecapro.eu

Co-funded by the Erasmus+ Programme of the European Union

EURECA-PRO

European University on Responsible Consumption and Production

universidad de león

MONTAN UNIVERSITÄT LEDBEN

HOCHSCHULE MITTWEIDA University of Applied Sciences

Technical University of Crete

TU BERGAKADEMIE FREIBERG

Silesian University of Technology

UNIVERSITATEA DIN PETROȘANI

#EurecaPro

8 | 8

ANNEX 2

EURECA-PRO presentation announcement in the programme on the website of the event: <https://www.msca-greenddeal.eu/en/me/programme/> (22.07.2021)

Wednesday 7th July 2021

Parallel Thematic Panel (4B): Climate action

10:15 AM

11:15 AM

(Europe/Vienne)

Parallel Thematic Panel (4B)

Climate action

Chair: Fredrik OLSSON HECTOR, Head of Unit MSCA and citizens, COFUND, Global Postdoctoral Fellowships, European Research Executive Agency

Moderator: Katarzyna BALUCKA-DEBSKA, Policy Officer, DG CLIMA

- **Corrado ALTOMARE** (Universitat Politècnica de Catalunya – BarcelonaTech) - *Amending the design criteria of urban defences in low elevation coastal zones through Composite-modelling of WAVE overtopping under climate change scenarios (DURCWAVE)* - MSCA Individual Fellowship (2019) project ID: [792370](#)
- **Susanna STRADA** (The Abdus Salam International Centre for Theoretical Physics) - *Unravelling the role of water stress in Mediterranean isoprene emissions to better project future regional climate-air quality interactions (IDIOM2)* - MSCA Individual Fellowship (2018) project ID: [791413](#)
- **Louis-Alexandre COUSTON** (University of Lyon) - *Modelling ice-shelf melting and ice-ocean processes via the phase-field method and direct numerical simulation (MIMOP)* - MSCA Individual Fellowship (2018) project ID: [793450](#)
- **Tabish NOORI** (University of Alcalá) - *Microbial osmotic desalination with energy and nutrient recovery (MODERN - GOT ENERGY)* - MSCA COFUND (2017) project ID: [754382](#)
- **Volkmar KIRCHER** (Montanuniversität Leoben) - *The European University on Responsible Consumption and Production (EURECA-PRO)* - Erasmus+ European University Alliance - <https://www.eurecapro.eu/>

Questions & Answers

11:15-11:30

Coffee Break

ANNEX 3

Speaker announcement

On the website of the European Green Deal Cluster Event:

<https://www.msca-greendeal.eu/en/page/5-climate-action/> (22. 07.2021)



Dipl.-Ing. Dr. mont. Volkmar KIRCHER

Lead Coordinator, EURECA-PRO Research Agenda

He studied Building Materials and Ceramics at the Montanuniversität Leoben (MUL) and became university assistant at the Chair of Ceramics there. In 2017, he completed his doctorate and was engaged in research activities, scientific publishing, teaching and project management. Since March 2021 he is working for EURECA-PRO at MUL as LEAD Coordinator for the EURECA-PRO RESEARCH Agenda.

Speaker announcement on the EURECA-PRO website:

<https://www.eurecapro.eu/msca-european-green-deal-cluster-event-6-7-july/> (22.07.2021)



On 6 and 7 July 2021, the European Commission and the European Research Executive Agency (REA) are organising a "European Green Deal Cluster Event".

The event will bring together excellent projects and researchers funded under the Marie Skłodowska-Curie Actions (MSCA), as well as other research and innovation initiatives under the remit of the European Commission's Directorate-General for Education, Culture, Youth and Sport. These include the European Institute of Innovation and Technology (EIT), European University Alliances, Erasmus+ and Creative Europe projects.

The participants to the event will have the opportunity to listen to leading researchers representing MSCA projects in the following areas:

- Biodiversity
- Sustainable agriculture & soil health
- Clean energy
- Eliminating pollution
- Climate action
- Green transport

A Virtual Exhibition will showcase a great variety of additional R&I projects funded by the MSCA, the EIT, Erasmus+ and Creative Europe.



Dipl.-Ing. Dr. mont. Volkmar KIRCHER

EURECA-PRO is represented at MSCA European Green Deal Cluster Event by Dipl.-Ing. Dr. mont. Volkmar KIRCHER (Montanuniversität Leoben). He will be a speaker for the Climate action Panels (part 4B) on 07.07.2021 10.15 – 11.15 AM (CEST/Brussels time).

Three projects supporting the European Green Deal goal "to become climate-neutral by 2050" will be presented at the Green Deal Cluster event, Climate action area.

The first project about Carbon Storage shows that *Petrophysical Characterisation* is crucial for identifying potential CO₂ Reservoirs and subsequently reducing CO₂ emissions to the atmosphere (ESP). Project 2 deals with *Carbon (CO₂) Capture & Use* by means of *Industrial Algae Production in Photobioreactors* (AUT) and the project 3 demonstrates the necessity of *Outdoor and Indoor Air quality analysis* in the vicinity of industrial areas (POL).

The research on EURECA-PRO covers Circular Production Industry from *Exploration* of primary resources via *Processing* of mined raw materials, *Smart Production*, *Industrial Environment Engineering & Protection* to *Recycling* of valuable materials. Responsible Production is linked to Consumption and therefore EURECA-PRO considers both, responsible *Industrial Consumption & End/Private Consumption*.

ANNEX 4

Abstract Gómez-Fernández et al.

Petrophysical characterisation of the Dolomitic Member of the Boñar Formation (Upper Cretaceous; Duero Basin, Spain) as a potential CO₂ reservoir

A set of density, porosity and permeability tests have been carried out from samples of dolomites collected on the surface in the vicinity of the town of Boñar (León). The quantification and interpretation of these petrophysical properties shows that the porosity of the rocks of the Dolomitic Member is adequate for the objective sought, although their permeability values are quite low, which reduces the possibilities of this member and most probably of all the formation of becoming a reservoir of CO₂.

The Boñar Formation (Upper Cretaceous) is a carbonatic succession that outcrops to the North of the Duero Basin (Spain). According to previous data, the Dolomitic Member of this formation is the one that shows the most favorable petrographic characteristics for geological CO₂ storage.

The main objective of this work is the contribution of elements of judgment that support, clarify and specify –at a preliminary study level– the potentiality of the Dolomitic Member of the Boñar Formation as a storage rock.

The petrophysical homogeneity of the Dolomitic Member was confirmed: density, porosity and permeability values are quite similar in each plug. There are, however, slight variations in the petrophysical properties due to petrographical differences between the beige dolomicrites (BM4-1 to BM4-3), the grey dolomicrite (BM4-4) and the dolosparite (BM4-5).

Samples BM4-1 to BM4-3 show similar density values, which is in accordance with their similar petrography. Density values of the other two samples (BM4-4 and BM4-5) are lower, however. The higher concentration of calcite in BM4-5 may account for the lower density of this sample. In case of the BM4-4 sample, the lower density may be due to some variation in the mineralogy – also responsible for the different colour. This hypothesis, however, must be confirmed by further research.

We can observe a similar tendency in porosity as in the density values. In this case, the lowest porosity belongs to the BM4-5 sample. This can be explained by the textural difference (i.e. dolosparite vs. dolomicrite), also confirmed by the microscopic observation. On the other hand, the grey variety of dolomicrite (BM4-4) shows lower porosity than the beige, as described by previous studies (Gómez- Fernández et al., 2003).

The comparison of the permeability values of each sample is not practical given that all of them fall in the poor permeability class ($k < 1$ mD), according to Tiab & Donaldson (2015). The high standard deviation values further complicate the interpretation.

ANNEX 4

Abstract Gómez-Fernández et al.

The highest permeability value was obtained for the BM4-1 sample, which also shows the highest porosity among the samples. For the other samples, however, no correlation between the porosity and permeability values can be established.

The dominantly carbonate Upper Cretaceous succession of the Duero basin has been considered as a suitable CO₂ reservoir, on a regional scale (Zapatero Rodríguez et al., 2009; Hurtado Bezos, 2010).

This study assesses the outcropping rocks of the Dolomitic member of the Boñar formation (North Duero basin), which, in theory, is the most suitable level of the mentioned formation for CO₂ storage (Gómez-Fernández et al., 2003). However, according to the analysis and interpretation of the petrophysical properties obtained in this study, permeability of this member is far too low for CO₂ geological storage, although the porosity values are sufficient.

In all, results obtained are considered representative enough to conclude that the Dolomitic Member, and probably the whole Boñar Formation, are not appropriate CO₂ reservoirs. However, a local study of outcrop rocks should be considered as a preliminary approach; hence, further studies based on bore-hole samples are suggested to definitely confirm this main conclusion.

References

Gómez-Fernández, F.; Bahamonde Rionda, J.R. & Méndez Cecilia, A. (2003). La Formación Boñar (Cretácico Superior, Norte de León): estratigrafía, geoquímica y potencial productor de roca ornamental. *Revista de la Sociedad Geológica de España*, 16: 61–71.

Hurtado Bezos, A. (2010). Metodología para la estimación regional de la capacidad de almacenamiento de CO₂ en formaciones permeables profundas y sus incertidumbres. Tesis doctoral, Universidad de León, 404 pp.

Suárez-González, A., Kovács, T., Herrero-Hernández, A., & Gómez-Fernández, F. (2016). Petrophysical characterization of the Dolomitic Member of the Boñar Formation (Upper Cretaceous; Duero Basin, Spain) as a potential CO₂ reservoir. *Estudios Geológicos*, 72(1), e048. <https://doi.org/10.3989/egeol.42191.384>

Zapatero Rodríguez; M.Á.; Suárez Díaz, I.; Arenillas González, A.; Suárez Díaz, I.; Catalina Nita, R. & Martínez Orío, R. (2009). Proyecto Geocapacity: Estimación de la capacidad europea para el almacenamiento de CO₂. Caso español. Madrid: IGME, 157 pp.