

NEWSLETTER 03

JANUARY 2018

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The main outcomes and results of the second year of the project MEDEAS are briefly presented below.

DATA ANALYSIS

The Deliverable constitutes the basis for the development of the MEDEAS model, providing the necessary analyses to set-up scenarios and pathways.

It describes the sectors to be analysed for evaluating the energy demand for the future scenarios and pathways and future change in energy mixes. The sectors and focus areas are the (1) electricity sector, (2) transportation, (3) total primary energy extraction, (4) industry, residential and commercial energy requirements and (5) social welfare and environmental impacts indicators. The analysis focuses on MEDEAS model development by investigating three steps: (a) ways of model integration, (b) necessary analyses and (c) data availability.

The complete Deliverable can be found [here](#).

TRANSITION SCENARIOS 1

The Deliverable presents the time-series of data on transition scenarios and pathways.

It focuses on a description of IPCC's Shared Socioeconomic Pathways (SSP) data at the global, regional, and country level for MEDEAS scenarios/pathways analysis. It also outlines the final scenario for 2050, using GHG emissions regulations by the EC together with the different energy plans in EU for a transition to a low carbon energy system within a decarbonised economy.

The complete Deliverable can be found [here](#).

TRANSITION SCENARIOS 2

The Deliverable describes the Business as Usual (BAU) scenarios, which shows that keeping the current trend of the energy sector, based mainly on fossil fuels, will cause a rapid depletion of the energy resources and an irreversible growth of the planet average temperature.

To avoid this situation, all the changes to promote energy transition toward renewable energy and low carbon society must take into account the residual carbon budget. For this reason, two possible alternatives at the BAU scenarios were proposed: the Mid-Level Transition (MLT) scenarios and the Optimal Transition (OT) scenario. In particular, MLT scenarios concentrate the decarbonizing actions starting from a close future (2020 or 2030) and the result of the analysis shows that before we start, less effort is necessary to reach the goal. OT scenario describes the more efficient pathways to reach the goal, with the hypothesis that the mitigation measures should not decrease the present supply of energy per capita.

The complete Deliverable can be found [here](#).

TRANSITION PATHWAYS

The Deliverable explores the possible pathways toward a decarbonized society.

These pathways are described in terms of the main key variables that can drive the transition, both at global and European levels. It focuses on three main studies: (1) Narrative and semi-quantitative Socioeconomic scenarios at World and European levels for the rate of changes in BAU scenario, and in

other alternative scenarios, (2) Qualitative and quantitative analysis of OT scenario for EU and an example of country level (USA), keeping the ratio secondary energy/capita constant along the way up to 2050 and (3) Qualitative and quantitative estimation of the World total energy demand and the energy demand by sector, split also by energy sources, in MLT-2020 and MLT-2030. Each study evidences, the urgency to formulate and apply stringent climate policies throughout the world.

The complete Deliverable can be found [here](#).

ADAPTATIVE SCENARIOS

The Deliverable explores the variability of the scenarios and pathways proposed in the Transition Scenarios 1 Report using simple calculations and physical constraints.

This approach is undertaken by means of a gross and net energy accounting of each economic sector considered in the selected scenario. The required net energy amount to keep operating an economic

sector is also considered for this purpose. The energy and monetary fluxes between socio-economic sectors in each adaptive scenario are outlined. The report focuses on three studies: (1) Evaluation of net energy and exergy of each economic sector in the OT and MLT, which examines the possible rate of change in the mix of energy resources to 2050, taking into account the limits of carbon budgets, (2) Evaluation of monetary fluxes between sectors necessary to achieve the planned scenarios for OT and MLT, which derives the monetary fluxes by using input-output analysis, based on the World Input-Output Database structure. The constructed (monetary) input-output tables fulfill the aim of a low-carbon economy in 2050, in order to stay within the 2°C increase of temperature, (3) Variability of the proposed scenarios and pathways due to physical constraints, which takes into account also feedbacks between final energy availability and the economy, as well as the effects of climate change. These feedbacks cause dynamics in the model that are not usually described in the open-loop scenarios.

The complete Deliverable can be found [here](#).

FIRST MEDEAS BOARD OF STAKEHOLDERS MEETING

The 1st Board of Stakeholders meeting of the MEDEAS project “Presentation and Discussion of the MEDEAS Model: Structure, Features, Hypotheses” was held on December 12, 2017 in the form of a webinar.

The stakeholders that participated were a geographically dispersed group of 9 academics and policy makers proposed by project partners. The stakeholders were introduced to the MEDEAS World model structure, the main hypotheses and assumptions of the model, as well as possible policy targets and simulated scenarios and results of the model.

The main focus of the meeting was to conduct an exchange with stakeholders and receive their feedback, guidance and insight regarding the MEDEAS world model, in particular regarding the model's limitations and further development.

The meeting was a success, as participants expressed positive impressions and intense interest in the presentations and the model, its use, and the concepts behind its development. The next two Board of Stakeholders meetings are anticipated in 2018 and 2019.



THERMODYNAMIC APPROACH TO EVALUATE THE CRITICALITY OF RAW MATERIALS AND ITS APPLICATION THROUGH A MATERIAL FLOW ANALYSIS IN EUROPE

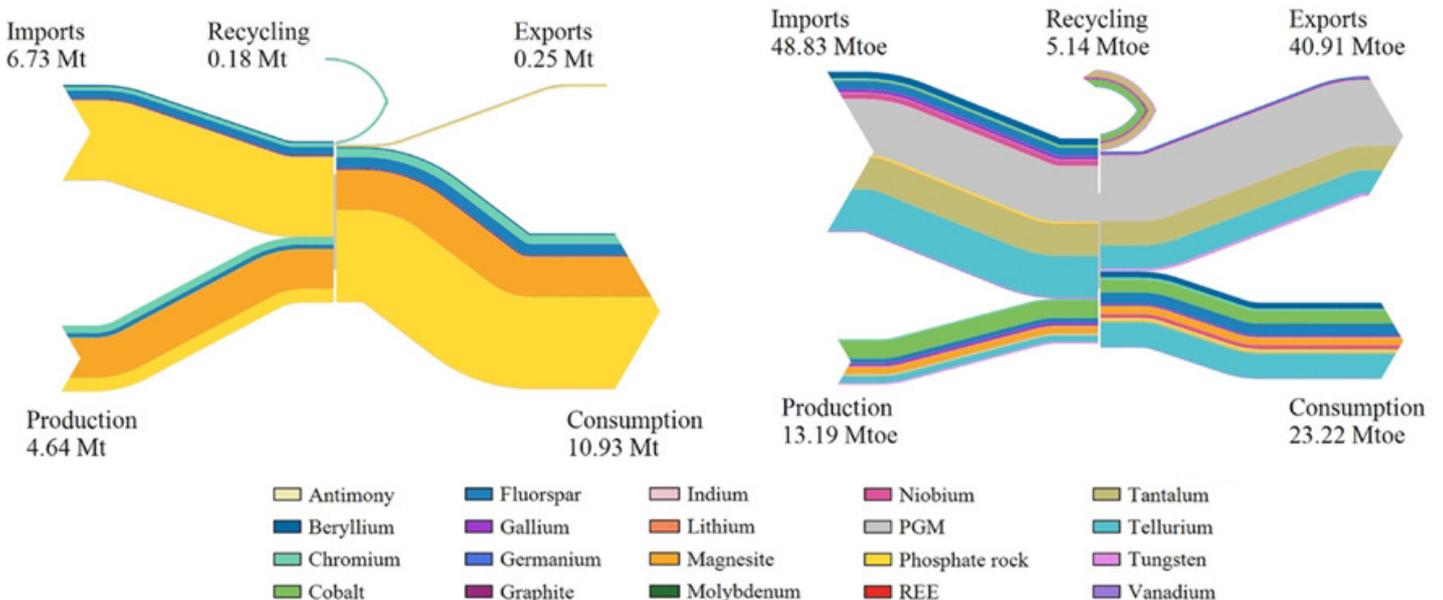
MEDEAS partners from CIRCE published a scientific article in the *Journal of Industrial Ecology*.

Critical raw materials are currently assessed by the European Commission based on their supply risks and economic importance to the region. Such an approach, however, neglects important aspects of the physical reality of minerals. In this paper, a new dimension in assessing the criticality of raw materials is proposed on the basis of thermodynamics. Accordingly, a given raw material will be thermodynamically rare if it is: (1) currently energy intensive to obtain and (2) scarce in nature.

Considering this new dimension, we found that at least Li, Ta, Te, V and Mo should be also added to the criticality list. With this new list and using Sankey diagrams, a material flow analysis was carried out for Europe (EU-28) for 2014, comparing the results

when using tonnage and thermodynamic rarity as units of measure. Through the latter, one can put emphasis on the quality and not only the quantity of minerals traded and domestically produced in the region, thereby providing a tool for improving resource management.

The complete article can be found [here](#).

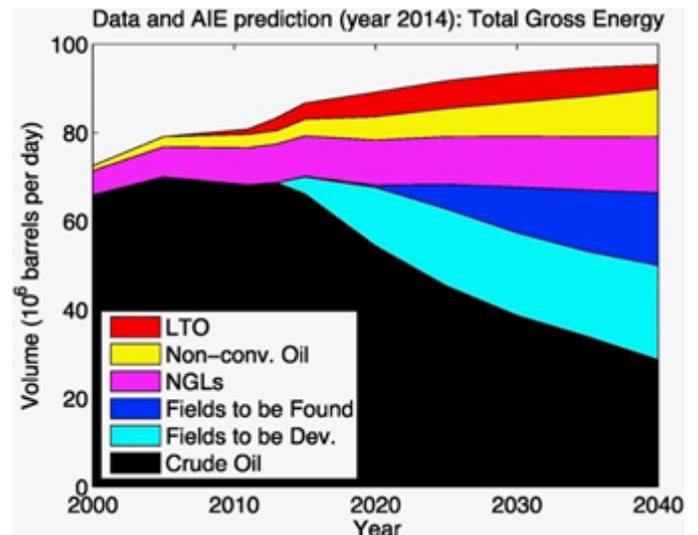


RENEWABLE TRANSITIONS AND THE NET ENERGY FROM OIL LIQUIDS: A SCENARIOS STUDY

MEDEAS partner team of [ICM-CSIC](#) published a scientific article in the *Renewable Energy Journal*.

We use the concept of Energy Return On Energy Invested (EROI) to calculate the amount of available net energy that may reasonably be expected from world oil liquids in upcoming decades (until 2040). Our results indicate a decline in available oil liquids net energy from 2015 to 2040. This net energy evaluation is used as a starting point for discussing the feasibility of a Renewable Transition (RT). To evaluate the maximum rate of Renewable Energy Sources (RES) development for the RT, we assume that by 2040, RES will achieve a power of 11 TW (10^{12} Watt). In this case, by 2040, between 10 and 20% of net energy from liquid hydrocarbons will be required. Taking into account the net energy decay of oil liquids, we calculate the minimum annual rate of RES deployment to compensate for it in different scenarios. Our study shows that if we aim at a 3% net energy increase per annum, an 8% annual rate of RES deployment is required; these rates of RES development are also compatible with the IEA forecast of 5% mean RES growth over the next 5 years. We have also commented on possible negative feedbacks from the RT where the possibility of an oversupply of host products that will eventually become unnecessary may lower RES prices and then discourage life recycling of those metals, a situation that has presently trapped emerging economies strongly dependent on commodities.

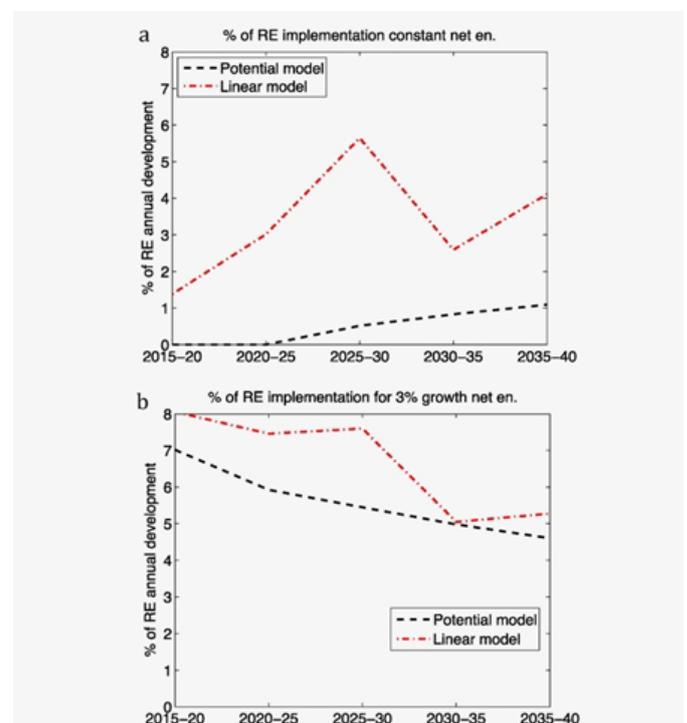
On the other hand, the environmental impact of extracting and processing huge quantities of raw materials, translates, in the best case, into an increase in GHG emissions that exceeds the benefits of the RT savings and, in the worse case, into an increase in highly poisonous heavy metals and radioactive elements. The figures presented in this project should be taken as optimistic/conservative estimates about the needs for a future RT; actually



required rates of deployment and energy needs may be significantly greater than those presented here if other factors are properly accounted for.

Our results point out the urgent necessity of a determined policy at different levels (regional, national and international) favouring RT implementation in coming decades.

The complete article can be found [here](#).



LESS THAN 2°C? AN ECONOMIC-ENVIRONMENTAL EVALUATION OF THE PARIS AGREEMENT

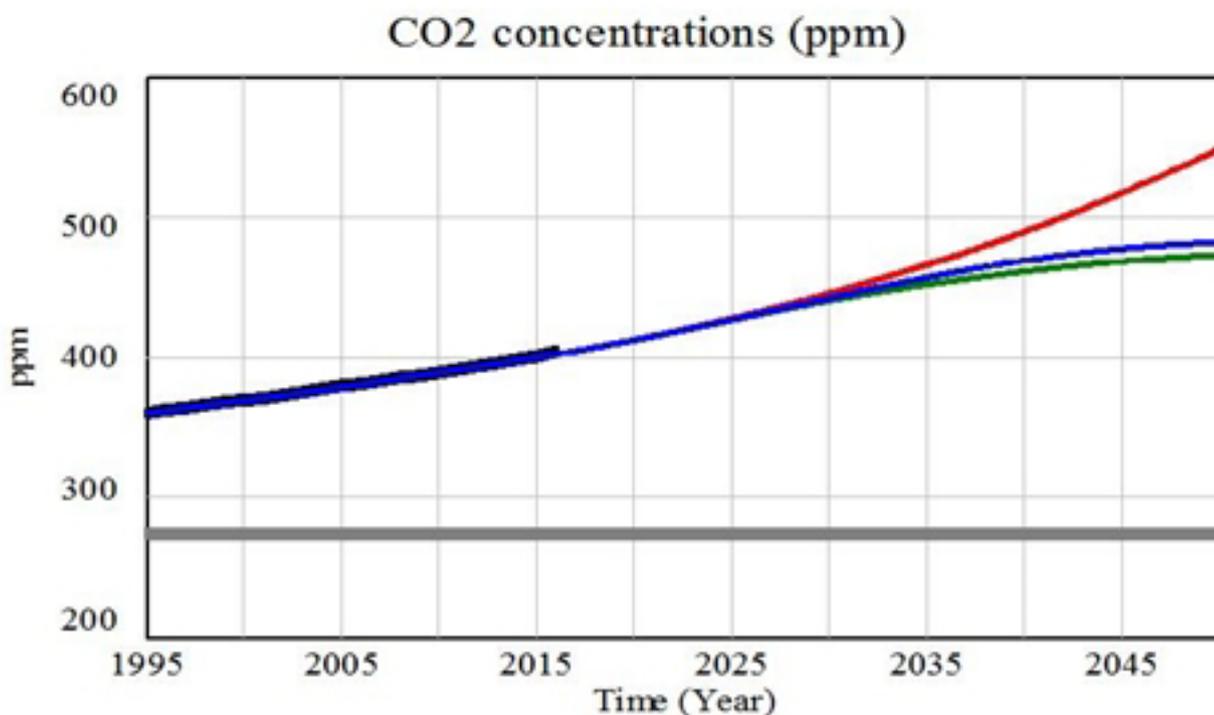
MEDEAS partners from the [University of Valladolid](#) published a scientific article in *Ecological Economics*.

The literature dedicated to the analysis of the different climate agreements has usually focused on the effectiveness of the aims for emissions in light of the advance in climate change. The article quantifies the variation in emissions that the Intended Nationally Determined Contributions (INDCs) will entail and their financial allocation and policies country-by-country and regionally.

The objective is to evaluate the feasibility of the Paris Agreement with regard to the INDCs and its economic and environmental constraints. The criteria by which the 161 INDCs are analysed are as follows: i) the socio-economic impact of the transition; ii) focus on energy management; iii) substitution of non-renewable sources; iv) the role of technology; v) the equality of the transition; vi) compliance with emission reductions. The results obtained show that the Paris Agreement relies

excessively on external financial support (41.4%). Moreover, its unilateralist approach and socio-economic and biophysical constraints could form an underlying cause for the 2 °C objective being rendered ineffective. Each country would emit an average of 37.8% more than in the years 2005–2015. When this is weighted, the resulting figure is a 19.3% increase, attributable mainly to increases from China and India. These figures would lead to temperature increases of up to 3°–4 °C.

The complete article can be found [here](#).



SUMMER ACADEMY IN FLORENCE



The [Summer Academy](#) of the Club of Rome was a high-level workshop that collected experts in sustainability worldwide to offer information and conduct discussions with a group of about 100 young activists from around the world.

It was held in Florence, Italy with the support of the University of Florence from September 8-13, 2017.

WORLD RESOURCES FORUM 2017

MEDEAS held an open workshop at the [WRF](#) to introduce the MEDEAS model and scenarios at world level, and discuss the preliminary results with participants in order to obtain their feedbacks.

The WRF 2017 was held in Geneva, Switzerland on October 24-25, 2017. It addressed the topic of "Accelerating the Resource Revolution", highlighting the importance of the Sustainable Development Goals and Paris Climate Agreement as calls for action. More than 450 participants from 50 countries shared four days of discussions, networking and side events.

The workshop consisted of 5 presentations relative to the various aspects of the MEDEAS project. The program included a round table on the following subjects:

One Academy session was organized by the MEDEAS team, with the participation of Jordi Sole (Institute of Marine Sciences), Davide Natalini (Anglia Ruskin University), Inigo Capellan Perez (University of Valladolid), and the members of the INSTM (National Interuniversity Consortium of Materials Science and Technology) team, Ugo Bardi, Sara Falsini, and Ilaria Perissi.

The presentation involved practical tests of the model and some 30-40 participants attended. The participants were asked to use the MEDEAS model to simulate a set of policies designed to carry the world system through the energy transition, while satisfying the requirement of the 2015 Paris treaty. This turned out to be a considerable, but not impossible, challenge. A comment published on the Cassandra's Legacy blog can be found [here](#).

- Openness, sharing, and reproducibility in energy models: the MEDEAS project
- Resource depletion: where do we stand almost 50 years after "The Limits to Growth?"
- Feedback between energy resources and the economy in the MEDEAS global model and key points for the energy transition towards a low carbon economy in the MEDEAS global model
- Applications of dynamic models to economic systems: Scenarios for the world's reduction of carbon emissions.



STAKEHOLDERS MEETING IN MADRID

A first meeting with stakeholders was held in Madrid on July 11, 2017. The meeting was organized by the GEEDS Research Group of the University of Valladolid. The stakeholders invited were 14 experts in economics, energy, and sustainability who belong to foundations, companies, labour unions, NGOs, and universities.

The main focus of the meeting was the MEDEAS global model and the initial results. The scope and capabilities of the model were demonstrated, as well as the limitations on interpreting the results. Among the issues discussed was the importance of taking prices into account, the role of the financial system in the economic module and the need for introducing management policies into the demand component of the model.

Stakeholders asked numerous concrete questions and made comments on the model. Among the

issues of greatest concern are the uncertainty on the social impact of the energy transition and its consequences. Likewise, they showed an interest in open use of the model to experiment with the simulation of alternatives and the capability to contribute in some cases to the communication and diffusion of results.



H2020 CONTRACTORS' WORKSHOP ON ENERGY SYSTEM MODELLING IN BRUSSELS

On November 28, 2017 the MEDEAS project participated in the H2020 Contractors' Workshop on Energy System Modelling, organised by the Innovation and Networks Executive Agency (INEA) in Brussels.

Four H2020 Energy projects devoted to energy systems modelling participated in the event with the aim of exchanging know-how and discussing potential synergies, overlaps, and overcoming barriers.

The four projects introduced the main outcomes and the future actions foreseen. MEDEAS introduced the project DataBase with the user friendly MEDEAS Database Management System and the MEDEAS World model. The Outreach and Dissemination main achievements reported included the scientific publications and conferences, outreach conferences and workshops, appearance in the mass media, and the project website.

In addition to presenting each project, the so-called LCE21 group agreed on a set of joint actions in the areas of: models & scenarios, methodology, data and dissemination, and outreach. Moreover, the four projects will jointly organize the 2018 Energy Modelling Platform for Europe (EMP-E) conference.

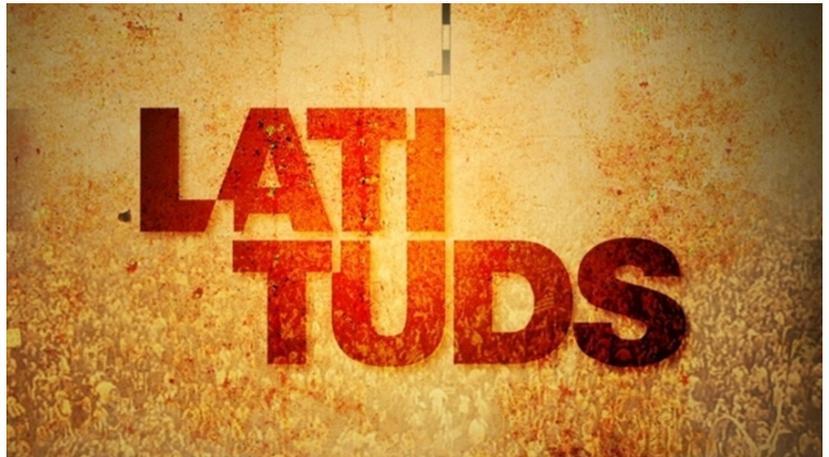


SPECIAL PROGRAM FOR MEDEAS ON TV SHOW “LATITUDS”

A special issue of the “Latituds” TV program devoted to MEDEAS, “Modelling the Energy Transition”, was broadcast on December 18, 2017.

The program was aired by Catalan TV3, Channel 33, and was based entirely around the MEDEAS project.

The program is available [online](#). The video is available [here](#).



OTHER EVENTS

Besides events at which the main outcomes of the MEDEAS project were presented, there were also several opportunities for individual partners to share their own research related to the project.



Christian Kimmich ([Masaryk University](#)) asked “Is there a growth paradox? Monetary and institutional perspectives on growth imperatives and stagnation” at the EAEPE Conference in Budapest, Hungary (October 19-21, 2017).



Iñigo Capellán-Pérez ([University of Valladolid](#)) presented the MEDEAS-World model and performed a simulation game during the IV Course of Ecological Economics in Bilbao, Spain (October 26, 2017). An updated version of the simulation game performed in the Club of Rome Summer Academy in Florence was organized, where participants had the opportunity to contrast their mental models with a formal model. Suggestions and ideas on improving both the model and the game were put forward, with the intent of incorporating them into future editions.



Aled Jones ([Anglia Ruskin University](#)) and Ugo Bardi ([INSTM](#)) participated in the Veolia Institute’s 10th International Conference, held in partnership with the Oxford Martin School, UK, on “Strategic Materials for a Low-Carbon Future: From Scarcity to Availability” (November 2-3, 2017). Professor Aled Jones discussed “Low carbon energy production: resource scarcities, surpluses, and uncertainties”. Professor Ugo Bardi presented the topic “The paradox of extraction and energy consumption in a low-carbon transition”.

UPCOMING EVENTS

SECOND GENERAL ASSEMBLY IN FLORENCE

The Second General Assembly of the MEDEAS project will be held in Florence on February 5-9, 2018.

It will be hosted by the Interuniversity Consortium on the Science and Technology of Materials (INSTM), which supports the partnership of the Florence group in MEDEAS. The agenda of the meeting is still being drawn up, but it will include extensive discussion, a review of the progress of the model and the status of the deliverables.



MISCELLANEOUS

POSTDOC POSITION

A postdoc position has been created in relation to the MEDEAS project

A postdoc position has been created in the field of Energy and Environmental Analysis in the Department of Physical and Technological Oceanography at the Institute of Marine Sciences (ICM-CSIC). More information about the job can be found [here](#).



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