

HORIZON  
2020

# Low temperature catalytic methane decomposition for COx-free hydrogen production

## Wyniki

Informacje na temat projektu

**112CO2**

Identyfikator umowy o grant: 952219

[Strona internetowa projektu](#)

**DOI**

[10.3030/952219](https://doi.org/10.3030/952219)

Projekt został zamknięty

**Data podpisania przez KE**

29 Czerwca 2020

**Data rozpoczęcia**

1 Września 2020

**Data zakończenia**

30 Listopada 2024

**Finansowanie w ramach**

EXCELLENT SCIENCE - Future and Emerging Technologies (FET)

**Koszt całkowity**

€ 3 585 178,75

**Wkład UE**

€ 3 585 178,75

**Koordynowany przez**

UNIVERSIDADE DO PORTO



Portugal

CORDIS oferuje możliwość skorzystania z odnośników do publicznie dostępnych publikacji i rezultatów projektów realizowanych w ramach programów ramowych HORYZONT.

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# Rezultaty

## Documents, reports (14)

### [3rd Scientific and technical dissemination summary report](#)

Several reports will be prepared to describe the scientific and technical dissemination activities carried out during the first year of the project (M12) and updated at M24, M36 and at the end of the project (M42).

### [Report on the optimised methane decomposition \(MD\) reactor](#)

Based on the best knowledge acquired in D4.1 and 4.2, the design of the MD reactor will be optimised and constructed to be loaded with the best MD catalyst and integrated with the best performing PCC system.

### [First social impact analysis](#)

This deliverable reports the results from life cycle and economical assessments (D6.2), providing relevant sustainability and economic characteristics into a general public acceptance survey conducted through inquiries to the field visitors. The 112CO2 consortium will evaluate the potential economic impact with the social acceptance to produce a comprehensive document summarizing the main conclusions and improve its effectiveness.

### [Technology exploitation roadmap](#)

This deliverable reports on the general Plan for the Exploitation and Dissemination of Results (PEDR), which will be coordinated by partner PW and supported from PV, as the main end user and potential exploiter of this technology, but all partners will also contribute. It should detail all exploitation activities, market analysis and potential exploitation scenarios to be undertaken during the implementation stage (M24) and at the end of the project (M42). This roadmap will foresee the potential commercial use of 112CO2 solution, and also future use of knowledge gained within the project (i.e. of research results that cannot be commercially exploited) and with third parties involved. The definition of exploitation paths to the industrial sector will be made in cooperation with “independent” experts/advisors, who will contribute by reviewing and validation the envisaged plans.

### [2nd Scientific and technical dissemination summary report](#)

Several reports will be prepared to describe the scientific and technical dissemination activities carried out during the first year of the project (M12) and updated at M24, M36 and at the end of the project (M42).

### [First interdisciplinary community and ecosystem report](#)

This deliverable reports on the establishment of strong know-how and skills that will place EU ahead of the development and industrial application of low temperature methane decomposition (within and beyond the 112CO<sub>2</sub> consortium). Two monetary prizes will be awarded to third parties that will compete for the integration of MD process in natural gas-running buses or with other technologies, such as SOFC and methanation (Sabatier reaction). To further stimulate the emergence of creating an eco-system around MD, three types of grants will be made available: i) financial support to NGOs for promoting policy debates; ii) financial support for receiving European science undergraduates and involving graduates from other fields (e.g. economics, humanities, press, marketing); and iii) grants for start-ups/end-users for helping in the scale-up of the technology developed within the project. It is envisaged the active contribution of all partners in the creation of a hydrogen society balancing aspects such as education, gender differences and long-term societal, ethical and legal implications related to methane decomposition.

#### [Technology exploitation roadmap - Final update](#)

This deliverable reports on the general Plan for the Exploitation and Dissemination of Results (PEDR), which will be coordinated by partner PW and supported from PV, as the main end user and potential exploiter of this technology, but all partners will also contribute. It should detail all exploitation activities, market analysis and potential exploitation scenarios to be undertaken during the implementation stage (M24) and at the end of the project (M42). This roadmap will foresee the potential commercial use of 112CO<sub>2</sub> solution, and also future use of knowledge gained within the project (i.e. of research results that cannot be commercially exploited) and with third parties involved. The definition of exploitation paths to the industrial sector will be made in cooperation with “independent” experts/advisors, who will contribute by reviewing and validation the envisaged plans.

#### [Report on the environmental and economical assessments of the best performing reactor configuration](#)

The environmental and economical assessments will be performed to benchmark the materials and technology proposed/developed in 112CO<sub>2</sub> against alternative technologies and to help future suppliers and customers making more and better-informed decisions. For the life cycle assessment (LCA), special attention shall be given to GHG emissions avoidance (including the energy penalty for CO<sub>2</sub> capture process), negative CO<sub>2</sub> emissions, and to the efficient use of resources over the 112CO<sub>2</sub> life cycle and reference technologies, as per the expected impact.

#### [Final Scientific and technical dissemination summary report](#)

Several reports will be prepared to describe the scientific and technical dissemination activities carried out during the first year of the project (M12) and

updated at M24, M36 and at the end of the project (M42).

[Report on catalyst performance in the optimal reactor prototype under conditions relevant for the technical deployment of methane decomposition, in conjunction with the H<sub>2</sub>-regeneration approach](#)

Based on the results described in D2.1, the best performing catalyst(s) will be initially loaded on the reactor prototype described in D4.1 and then on the optimal reactor (D4.3). Apart from describing the experimental results in the two reactors, post-mortem physicochemical analyses on the catalyst after a technically relevant operation time will be reported and correlated with the performance in terms of experimental catalytic activity, stability and regenerability. Moreover, there will be important interactions in terms of inputs and outputs with results reported on both D2.3 and D4.2.

[Final interdisciplinary community and ecosystem report](#)

This deliverable reports on the establishment of strong know-how and skills that will place EU ahead of the development and industrial application of low temperature methane decomposition (within and beyond the 112CO<sub>2</sub> consortium). Two monetary prizes will be awarded to third parties that will compete for the integration of MD process in natural gas-running buses or with other technologies, such as SOFC and methanation (Sabatier reaction). To further stimulate the emergence of creating an eco-system around MD, three types of grants will be made available: i) financial support to NGOs for promoting policy debates; ii) financial support for receiving European science undergraduates and involving graduates from other fields (e.g. economics, humanities, press, marketing); and iii) grants for start-ups/end-users for helping in the scale-up of the technology developed within the project. It is envisaged the active contribution of all partners in the creation of a hydrogen society balancing aspects such as education, gender differences and long-term societal, ethical and legal implications related to methane decomposition.

[Final social impact analysis](#)

This deliverable reports the results from life cycle and economical assessments (D6.2), providing relevant sustainability and economic characteristics into a general public acceptance survey conducted through inquiries to the field visitors. The 112CO<sub>2</sub> consortium will evaluate the potential economic impact with the social acceptance to produce a comprehensive document summarizing the main conclusions and improve its effectiveness.

[1st Scientific and technical dissemination summary report](#)

Several reports will be prepared to describe the scientific and technical dissemination activities carried out during the first year of the project (M12) and updated at M24, M36 and at the end of the project (M42).

[Report on the performance of the best proton conducting ceramics \(PCC\)](#)

Report on electrochemical results upon operation under several H<sub>2</sub>/CH<sub>4</sub> mixtures by means of electrochemical efficiencies, and chemical/mechanical stability. Additionally, the optimization envisaged to minimize coke deposition will also be properly reported to provide relevant inputs to integrate afterwards with the MD reactor.

## Demonstrators, pilots, prototypes (1)

[Report on the long-term performance of the prototype under real conditions !\[\]\(2e897e890e69d81eae4503a8342c36b0\_img.jpg\)](#)

The optimised reactor prototype developed in D5.1 will run for at least 3000 h under real environment. Long-term performance will be assessed, namely, methane conversion and hydrogen purification electrical efficiency over time.

## Websites, patent fillings, videos etc. (3)

[Conference/symposium/workshops Report - Final update !\[\]\(74d4806277d7e73349d8e8c0897931e9\_img.jpg\)](#)

112CO<sub>2</sub> consortium will organize two international workshops/fairs (one of them might be co-organised within an international conference) and a final conference/symposium on the topic of methane decomposition and cost-competitive hydrogen economy, inviting recognized speakers on the field. Project's results will be widely presented in order to make a final balance concerning this topic.

[Project website !\[\]\(830769b31eeeaca920791081939ff8ba\_img.jpg\)](#)

A website will be constructed to allow general public, and in particular industry and academia, to get familiarized with the topics studied within 112CO<sub>2</sub>. Relevant results and breakthroughs will be highlighted in the news of the website, as well as dissemination activities.

[Open days - Final update !\[\]\(8bba887393ca45b761e5cb49e755e762\_img.jpg\)](#)

112CO<sub>2</sub> consortium will promote four open days (occurring at the second and third years of the project) when labs will be opened to guided visits and tours for students and early-stage researchers for promoting critical scientific thinking across Europe. These four days will occur at partners EPFL, UPORTO, UPV-CSIC and DLR, being coordinated by each host, but counting with the presence of all the consortium partners for promoting dialog and technical discussions on site across different locations in Europe. These days will be scheduled together with consortium meetings conveniently located for this purpose.

## Peer reviewed articles (8)



[Development of Proton Conducting Ceramic Cells in Metal Supported Architecture](#)

**Autorzy:** Noriko Sata, Feng Han, Haoyu Zheng, Amir Masoud Dayaghi, Truls Norby, Marit Stange, Robert Semerad, Rémi Costa

**Opublikowane w:** ECS Transactions, Numer 103/1, 2021, Strona(/y) 1779-1789, ISSN 1938-5862

**Wydawca:** Electrochemical Society, Inc.

**DOI:** 10.1149/10301.1779ecst

[Low-temperature catalytic methane splitting: a new reactor design for long-term hydrogen production](#)

**Autorzy:** Vítor Pereira, Luís Alves, Paula Dias, Tiago Lagarteira, Adélio Mendes

**Opublikowane w:** Fuel, 2025, ISSN 0016-2361

**Wydawca:** Elsevier BV

**DOI:** 10.1016/j.fuel.2025.135316

[Green Utopia Now! A Transdisciplinary Symposium on How to Deal with the Climate Crisis: November 30, 2022, University of Ferrara, Italy](#)

**Autorzy:** Manuel Sousa Oliveira, Ilenia Vittoria Casmiri, Fabiola Onofrio, Tânia Cerqueira, Francisca Teixeira, Florian Wagner

**Opublikowane w:** Utopian Studies, Numer 34, 2023, Strona(/y) 368-377, ISSN 1045-991X

**Wydawca:** Pennsylvania State University Press

**DOI:** 10.5325/utopianstudies.34.2.0368

[Regeneration of methane splitting catalysts by interfacial hydrogenation](#)

**Autorzy:** Luís Alves, Vítor Pereira, Sofia Delgado, Niloufar Atashi, Paula Dias, Tiago Lagarteira, Gonzalo Prieto, Adélio Mendes

**Opublikowane w:** Chemical Engineering Journal, Numer 500, 2025, Strona(/y) 157046, ISSN 1385-8947

**Wydawca:** Elsevier BV

**DOI:** 10.1016/j.cej.2024.157046

[Catalytic methane decomposition to boost the energy transition: Scientific and technological advancements](#)

**Autorzy:** Luís Alves, Vítor Pereira, Tiago Lagarteira, Adélio Mendes

**Opublikowane w:** Renewable and Sustainable Energy Reviews, Numer 137, 2021, Strona(/y) 110465, ISSN 1364-0321

**Wydawca:** Elsevier BV

**DOI:** 10.1016/j.rser.2020.110465

[Effect of macro-structure of Ni-based catalysts on methane splitting systems](#)

**Autorzy:** Luís Alves, Vítor Pereira, Paula Dias, Tiago Lagarteira, Simone Meloni, Gonzalo Prieto, Adélio Mendes

**Opublikowane w:** Fuel, Numer 379, 2024, Strona(/y) 133115, ISSN 0016-2361

**Wydawca:** Elsevier BV

**DOI:** 10.1016/j.fuel.2024.133115

[High-performance hydrogen separation using cellulose-based carbon molecular sieve membranes](#)

**Autorzy:** Tiago Araújo, Gabriel Bernardo, Adélio Mendes

**Opublikowane w:** Journal of Membrane Science, Numer 693, 2023, Strona(/y) 122337, ISSN 0376-7388

**Wydawca:** Elsevier BV

**DOI:** 10.1016/j.memsci.2023.122337

[Stakeholders' perceptions of hydrogen and reflections on energy transition governance](#)

**Autorzy:** Cristina Parente, Francisca Teixeira, Jorge Cerdeira

**Opublikowane w:** Energy, Sustainability and Society, Numer 14, 2024, Strona(/y) 15, ISSN 2192-0567

**Wydawca:** Energy, Sustainability and Society

**DOI:** 10.1186/s13705-023-00429-w

## Conference proceedings (3)

[Conference on Artificial Photosynthesis and Green Catalysis](#)

**Autorzy:** Jing Gao, Lukas Pfeifer, Paula Dias, Adélio Mendes, Michael Graetzel

**Opublikowane w:** CHIMIA, Numer 77, 2023, Strona(/y) 881-882, ISSN 0009-4293

**Wydawca:** Schweizerische Chemische Gesellschaft

**DOI:** 10.2533/chimia.2023.881

[The role of Ni foil structure on catalytic methane decomposition - Poster](#)

**Autorzy:** Luís Alves, Vítor Pereira, Tiago Lagarteira, Paula Dias, Adélio Mendes, Gonzalo Prieto

**Opublikowane w:** Book of Abstracts: 22nd European Meeting on Environmental Chemistry, 2023, Strona(/y) 101, ISBN 978-961-297-035-2

**Wydawca:** University of Ljubljana Press

**DOI:** 10.13140/rg.2.2.20930.86729

[New reactor approach for low-temperature catalytic methane decomposition - Oral](#)

**Autorzy:** Vítor Pereira, Luís Alves, Paula Dias, Fernando Pereira, Tiago Lagarteira, Adélio Mendes

**Opublikowane w:** Book of Abstracts: 22nd European Meeting on Environmental

Chemistry, 2023, Strona(/y) 99, ISBN 978-961-297-035-2

**Wydawca:** University of Ljubljana Press

**DOI:** 10.55295/9789612970352

## Other (2)

[Does moving away from the climate disaster signal a departure from the hydrogen economy? !\[\]\(6605b201d6f14d9b3bcb8ab5f274d107\_img.jpg\)](#)

**Autorzy:** Adélio Mendes

**Opublikowane w:** Open Access Government, 2025

**Wydawca:** Open Access Government

**DOI:** 10.56367/oag-046-10099

112CO<sub>2</sub> Project - Emergency CO<sub>2</sub> Low Temperature Catalytic Methane Decomposition For CO<sub>x</sub> Free Hydrogen Production

**Autorzy:** Adélio Mendes, Paula Dias, Tiago Lagarteira

**Opublikowane w:** European Energy Innovation - Autumn 2021, 2021, Strona(/y) 36

**Wydawca:** Prologue Media Ltd

## Thesis and dissertations (5)

[Nanoscale effects on carbon filament growth during catalytic methane decomposition for high-purity hydrogen production !\[\]\(e3f255517d37bb309a3a931ec4849e6a\_img.jpg\)](#)

**Autorzy:** Adrià Palomares Ferrando

**Opublikowane w:** 2023

**Wydawca:** Universitat Politècnica de Valencia

**DOI:** 10.5281/zenodo.15200170

A study on heating requirements and economic analysis of the low-temperature methane decomposition for clean hydrogen production

**Autorzy:** Inês Moreira Marques

**Opublikowane w:** 2022

**Wydawca:** University of Porto

Development of engineered catalysts for the low-temperature methane decomposition

**Autorzy:** Ricardo Coelho

**Opublikowane w:** 2022

**Wydawca:** University of Porto

[Development of cyclic regeneration catalytic systems for low temperature methane decomposition !\[\]\(ade431365d5a245a24c736a8cc4219e3\_img.jpg\)](#)

**Autorzy:** Luís Daniel Martins Alves

**Opublikowane w:** 2024

**Wydawca:** Faculty of Engineering of University of Porto

**DOI:** 10.5281/zenodo.15191228

[Development of catalytic substrates for methane decomposition reactors](#) 

**Autorzy:** João Gabriel Gouvea Diaz

**Opublikowane w:** 2023

**Wydawca:** Faculty of Engineering of University of Porto

**DOI:** 10.5281/zenodo.15184204


## Non-peer reviewed articles (2)

112CO<sub>2</sub>: Low temperature catalytic methane decomposition for CO<sub>x</sub>-free hydrogen production

**Autorzy:** Paula Dias, Tiago Lagarteira, Gonzalo Prieto, Noriko Sara, Adélio Mendes

**Opublikowane w:** Open Access Governmental - January 2022, 2022, Strona(/y) 362-363, ISSN 2516-3817

**Wydawca:** Adjacent Digital Politics Ltd

[Understanding catalytic methane decomposition: a swift and cost-effective energy decarbonization pathway](#) 

**Autorzy:** Adélio Mendes

**Opublikowane w:** Open Access Governmental - April 2023, 2023, Strona(/y) 430-431, ISSN 2516-3817


**Wydawca:** Adjacent Digital Politics Ltd

**DOI:** 10.56367/oag-038-10098

## Pozostałe produkty badawcze

### Pozostałe produkty badawcze dostępne przez OpenAire (1)



[22nd European Meeting on Environmental Chemistry: Book of Abstracts - The Role of Ni Film Structure on Catalytic Methane Decomposition](#) 

**Autorzy:** Luis Alves

**Opublikowane w:** Zenodo

**Ostatnia aktualizacja:** 17 Kwietnia 2025

**Permalink:** <https://cordis.europa.eu/project/id/952219/results/pl>

European Union, 2025

