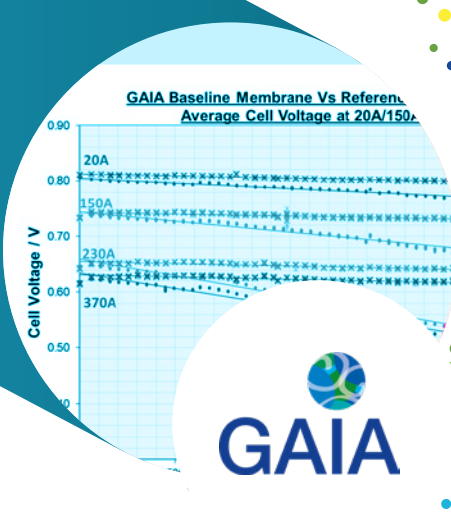
# GAIA

## NEXT GENERATION AUTOMOTIVE MEMBRANE ELECTRODE ASSEMBLIES

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|---|---|
| **Project ID:** | **826097** |
| **PRD 2023:** | **Panel 3 – H2 end uses – transport** |
| **Call topic:** | **FCH-01-5-2018: Next generation automotive MEA development** |
| **Project total costs:** | **EUR 5 065 614.39** |
| **Clean $H_2$ JU max. contribution:** | **EUR 4 493 025.00** |
| **Project period:** | **1.1.2019–30.6.2022** |
| **Coordinator:** | **Centre national de la recherche scientifique, France** |
| **Beneficiaries:** | 3M Deutschland GmbH, Bayerische Motoren Werke AG, Dyneon GmbH, Elmarco SRO, Freudenberg Performance Materials SE & Co. KG, Johnson Matthey Hydrogen Technologies Limited, Johnson Matthey plc, Pretexo, Technische Universität München, Technische Universität Berlin, Université de Montpellier, Zentrum für Sonnenenergie- und Wasserstoff-Forschung Baden-Württemberg |

**https://www.gaia-fuelcell.eu/**

### PROJECT AND OBJECTIVES

GAIA aims to develop high-performance automotive membrane electrode assemblies (MEAs) capable of achieving a 6 000-hour lifetime. By month 42, GAIA had developed new carbon support, catalyst, ionomer, membrane, reinforcement, gas diffusion and microporous layer components that were incorporated in MEAs and tested using optimised automotive drive cycle protocols in full automotive-sized 4-cell stacks and 10-cell short stacks. This testing demonstrated that the GAIA MEAs achieved a world-leading power density of 1.8 W/cm$^2$ at 0.6 V. By reaching this high power density without increasing platinum loading, the Pt-specific power density was reduced from 0.45 g Pt/kW to 0.25 g Pt/kW. Taking catalyst and ionomer recycling into consideration, the cost per kW of the final GAIA MEA approaches the €6/kW target of the 2019 Fuel Cells and Hydrogen 2 Joint Undertaking annual work plan. Furthermore, the voltage loss rate of a short stack with the GAIA MEAs was within the target range over the first 600 hours of operation of an automotive drive cycle, including at 105 °C, to achieve a predicted 6 000 hours of operation.

### NON-QUANTITATIVE OBJECTIVES

- The project aimed to perform outreach through two videos. The first was on catalyst preparation and characterisation by rotating disc electrode and catalyst integration into MEAs and testing/diagnostics. It was prepared by Technische Universität Berlin and Technische Universität München. The second was on electrospun nanofibre reinforcement development and fabrication of reinforced membranes at scale. It was prepared by Centre national de la recherche scientifique, Elmarco, Dyneon and Johnson Matthey plc.
- The project aimed to disseminate the results through articles in international journals; eight articles have been published to date, and others will follow.
- It also aimed to communicate results through the publication of newsletters on its website; three newsletters are available for download.

### PROGRESS AND MAIN ACHIEVEMENTS

- GAIA developed MEAs that provide 1.8 W/cm$^2$ at 0.6 V, corresponding to a Pt-specific power density of 0.25 g Pt/kW.
- The GAIA MEA cost approaches the €6/kW target, based on the assumptions of a high-volume production of 1 million m$^2$ MEA per year and the potential for platinum group metal and ionomer recycling.
- The stack voltage decay rate with GAIA MEAs was within the target range over the first 600 hours of automotive drive cycle testing, including at 105 °C, which represents a step change for the industry, especially for incursions at higher temperatures.

### FUTURE STEPS AND PLANS

GAIA ended on 30 June 2022. However, the advances in materials, components and MEAs are being transferred to the heavy-duty transport projects IMMORTAL and HIGHLANDER.

### QUANTITATIVE TARGETS AND STATUS

| Target source | Parameter | Unit | Target | Achieved to date by the project | Target achieved? |
|---|---|---|---|---|---|
| AWP 2019 | Power density at 0.6 V | W/cm$^2$ | 1.8 | 1.8 | ✓ |
| | Stack durability (voltage decay rate) | % | < 10 after 6 000 hours of operation, as extrapolated from 1 000 hours of actual testing | Voltage decay rate within target to achieve a predicted 6 000 hours of operation over the first 600 hours of automotive drive cycle | ⚙ |
| | MEA cost | €/kW | 6 | 9 | ✓ |




Clean Hydrogen Partnership
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