

FreeMe

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**TOXIC FREE
METALLIZATION
PROCESS
FOR PLASTIC
SURFACES**

4TH ISSUE

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AN OVERVIEW OF FREEME PROJECT

SUMMARY

Plating on Plastics (PoP) is widely used in several manufacturing sectors including automotive, home appliances and aerospace to protect plastic items, parts, or components from wear, corrosion, impact, electromagnetic radiation etc., while also providing a shiny, aesthetically attractive exterior. However, the current PoP process encounters significant challenges related to environmental hazards and occupational safety risks. The FreeMe project, funded by the European Union (Grant Agreement ID: 101058699), is revolutionizing PoP by incorporating Safe and Sustainable by Design (SSbD) methods and protocols to eliminate toxic or expensive materials from the PoP process, like hexavalent chromium (Cr^{6+}) compounds and palladium (Pd). FreeMe is addressing these challenges by implementing innovative surface metallisation technologies that involve less hazardous etching systems or spraying of bio-based epoxy resins (instead of Cr^{6+}) and use nickel (Ni) instead of Pd as activation sites.

OBJECTIVES



Implement an SSbD strategy during the development of the two new FreeMe technologies for PoP that will cover the whole lifecycle.



Technology-1: Pre-treatment of plastic surfaces with Piranha instead of Cr^{6+} -containing solutions and with nickel salts instead of Pd.



Technology-2: Replace etching & activation of plastic surface pre-treatment stages with a spraying technology using sprayable and UV-curable composite biobased resins.



Develop in-silico techniques (simulation and modelling) facilitating the development, synthesis, and application of the sprayable composite resins, as well as the optimisation of plastic surface etching using multi-scale models, ranging from atomic to mesoscopic scales.



Develop fast and accurate inspection methods based on spectroscopic imaging ellipsometry and optical coherence tomography for micro-scale monitoring (up to $3\mu\text{m}$) and quality control of the process.



Demonstrate the FreeMe technologies in automotive, aerospace and home appliances demonstrators by applying and validating SSbD metallic coatings on plastic components.



Assess the recyclability of coated polymers based on the current state-of-the-art technologies for recycling.



Develop a data-driven Decision Support Tool combining data from SSbD assessment, in-silico approaches, experimental/manufacturing results, LCA/LCC assessment and specification/requirement of test cases, to support industrial end users on the selection, development and application of the most suitable PoP technology.

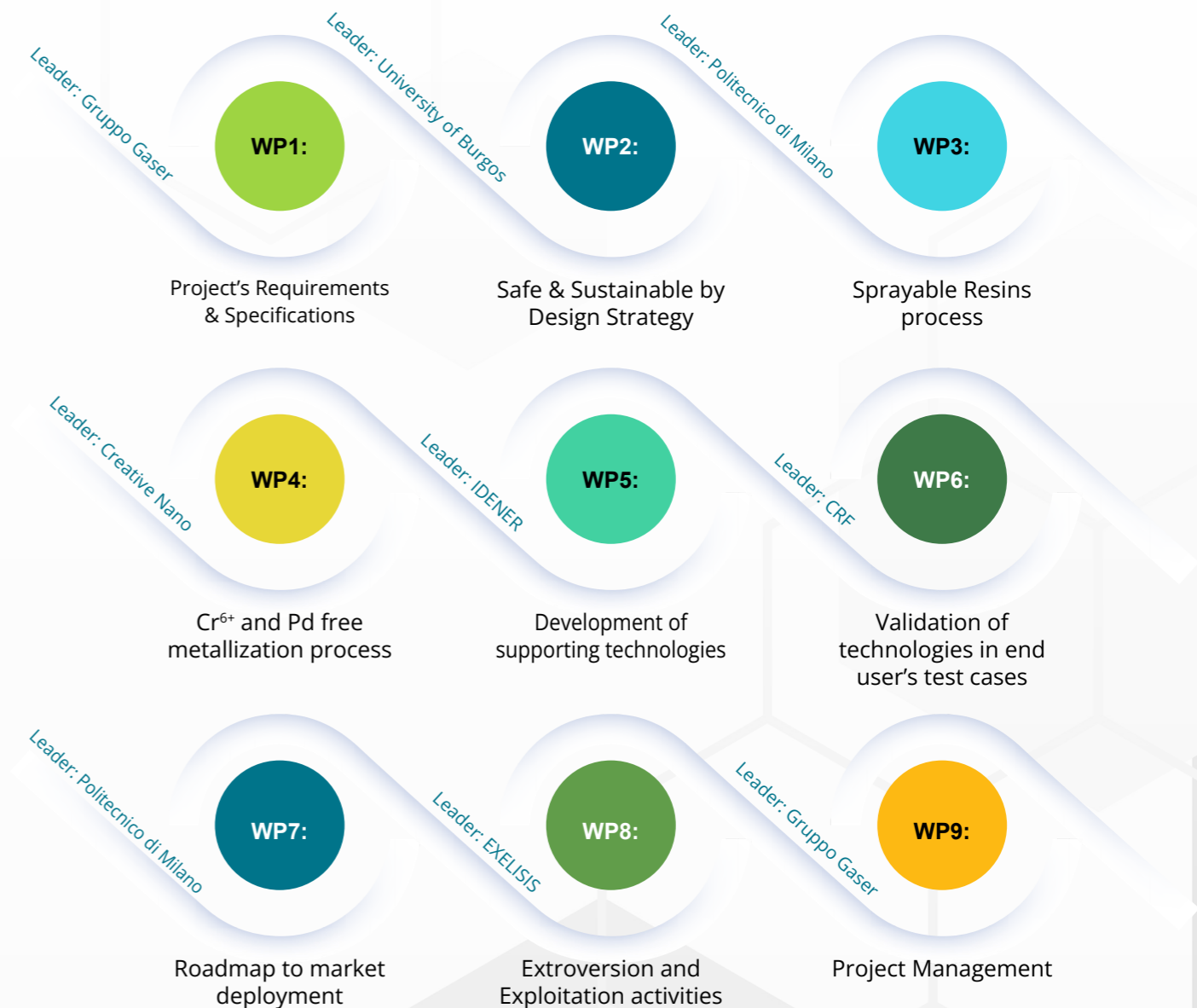


Facilitate the acceptance of the new technologies by the market, defining the standardisation landscape and contributing to future standards development.



Prepare business plans and define exploitation routes for the project partners and enhance the impact of results by undertaking targeted dissemination and exploitation activities, including training courses for the PoP industry.

FreeMe Work Packages:



SSbD approaches

for metallisation of polymeric surfaces

Supporting technologies

Sprayable Composites resins process

Cr^{6+} & Pd free metallisation processes

In silico modeling

In line optical inspection system

INTERVIEW

GRUPPO GASER



GRAZIELLA GALATI

Please introduce yourself and describe your entity's role in the FreeMe project. Also, please introduce your team.

My name is Graziella Galati and I am Innovation Manager at Gruppo Gaser. For several years, I have been working on innovation within the Group, coordinating product and process innovation projects, digitalisation initiatives, and the development of the Innovation Management System. I act as a key interface between the Company Management – with whom I define and regularly update the innovation strategy – and the technical functions, translating strategic guidelines into concrete objectives and projects.

Gruppo Gaser is an Italian leader in metal surface treatments and coatings, with over 70 years of experience and a strong commitment to innovation. The



MIRCO VALSECCHI

Group offers one of the most comprehensive portfolios of processes in the sector, including electroplating treatments, heat treatments, functional polymer coatings, and thermal spraying technologies, all supported by advanced research and development activities.

In the FreeMe project, I served as consortium coordinator, with primary responsibility for the administrative and financial coordination of the project and for the relationship with the European Commission, working in close collaboration with the technical coordinator. Throughout the four years of the project, I oversaw its overall progress, ensuring compliance with rules, timelines, and contractual commitments, while facilitating dialogue and alignment among partners with different roles and expertise. A key aspect of my contribution was ensuring

coherence between the project's scientific objectives and its industrial and application-oriented requirements.

As an industrial partner, Gaser contributed to the project by providing its expertise in electroplating processes, with a particular focus on plastic electroplating, and by playing a key role in the demonstrative activities. These activities were essential to test the effectiveness, sustainability, and performance of the technologies developed within the project before their final validation by the end users.

The Gaser team involved in the project mainly consisted of myself and Mirco

Valsecchi, R&D Manager at Gruppo Gaser. Mirco was directly responsible for the demonstrative and experimental activities, making a decisive contribution to the technical validation of the developed solutions and acting as a key technical reference within the consortium.

As the coordinator of the FreeMe project, how would you describe the overall journey of the consortium over the past four years?

FreeMe was a complex and highly ambitious project and, for me, one of my first experiences as a coordinator in a European context of this level. From the very



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beginning, it was clear that achieving the project objectives required a highly multidisciplinary consortium, composed of industrial and scientific partners with very different yet complementary expertise.

One of the most significant aspects of the FreeMe journey was the strong sense of shared responsibility within the consortium. From the early stages, all partners demonstrated a clear awareness of their role and a strong commitment to achieving the common project objectives. The level of professionalism and maturity within the consortium was consistently high and further strengthened over the four years of the project.



Collaboration was a constant throughout the entire project, characterised by open and constructive dialogue and by each partner's willingness to share their expertise. This cooperative spirit became particularly evident during moments of criticality, which inevitably arise in projects of this complexity. In such situations, the consortium always demonstrated strong cohesion and the ability to work together to identify solutions, while maintaining a clear focus on project results.

FreeMe was also an important journey of human enrichment, in addition to professional growth. The active participation in consortium meetings helped to build a climate of trust and collaboration, turning these meetings not only into moments for technical review, but also into opportunities for informal exchange and personal connection, giving a human face to the people behind the project. This was particularly evident during the final project event, the Coatings 2026 conference held in Athens last April, where I had the pleasure of meeting several consortium partners again and personally experienced the positive, friendly atmosphere and mutual respect that had developed over time.



Overall, I consider my experience within the FreeMe project to have been extremely positive and highly enriching, both from a personal perspective and in terms of competence development, as well as an opportunity to build strong lasting relationships within the consortium.

What were some of the main challenges faced during the coordination and implementation of the project?

Coordinating and implementing a project such as FreeMe involved several challenges, mainly related to the intrinsic complexity and ambition of the project itself. One of the first challenges was the need to effectively coordinate a large and highly multidisciplinary consortium, composed of partners with different backgrounds, roles, expectations and working cultures. Aligning scientific,

technical and industrial perspectives, while ensuring a shared understanding of objectives, priorities and timelines, required continuous dialogue and a strong commitment from all partners.

From a coordination perspective, a key challenge was ensuring the smooth and timely implementation of the project from an administrative and financial point of view, in full compliance with the rules and requirements of the European Commission. Managing reporting activities, financial monitoring and contractual obligations over a four-year project duration required constant attention, flexibility and close interaction with all partners, especially in a context where technical developments can evolve over time.

Another important challenge was managing the natural evolution of the

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project, particularly when addressing technical or organisational criticalities that emerged during the implementation phase. In such cases, it was essential to maintain a balance between respecting the original project framework and allowing the necessary adaptability to respond to unforeseen issues, without losing sight of the overall project objectives.

Finally, external factors and the broader context in which the project was implemented also required the consortium to be resilient and responsive. The ability of the partners to communicate openly, collaborate effectively and jointly find solutions played a crucial role in overcoming these challenges. Looking back, the way the consortium addressed and managed these difficulties represents one of the most valuable outcomes of the

FreeMe project, both in terms of results achieved and in terms of strengthened collaboration and mutual trust.

Collaboration played a major role throughout FreeMe. How important was the multidisciplinary nature of the consortium in achieving the project objectives?

The multidisciplinary nature of the FreeMe consortium was a fundamental element in achieving the project objectives and represented one of its key strengths. The challenges addressed by FreeMe, both from a technological and sustainability perspective, required diverse and complementary expertise that no single partner could have provided on its own.



Collaboration between academic partners, research organisations, industrial companies and end users enabled the integration of advanced scientific knowledge with a concrete, application-oriented perspective. This continuous dialogue between research and industry was essential to develop solutions that were not only technologically sound, but also realistic, scalable and aligned with industrial needs.

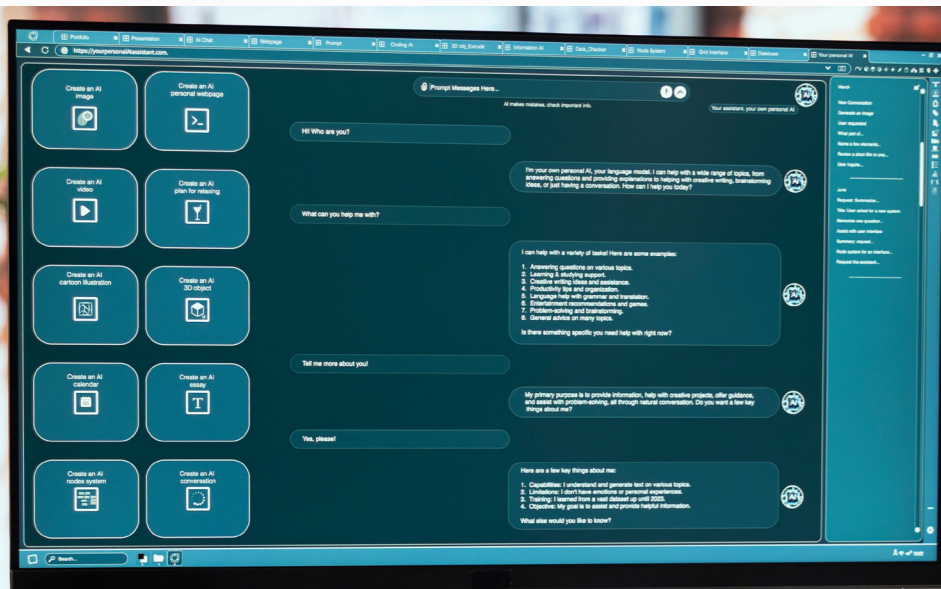
The multidisciplinary composition of the consortium also fostered constructive dialogue and a shared approach to addressing the critical issues that emerged during the project. Over time, this collaboration evolved into a common way of working, based on trust, openness and mutual respect.

Ultimately, the success of FreeMe is closely linked to its collaborative and multidisciplinary approach, which enabled the consortium to achieve

meaningful results and to lay solid foundations for future collaborations beyond the duration of the project.

The project placed significant emphasis on Safe-and-Sustainable-by-Design approaches. How do you see SSbD influencing future industrial processes and innovation?

Safe-and-Sustainable-by-Design (SSbD) is an approach that allows safety and sustainability aspects to be systematically integrated already at the design stage of products and processes, considering their entire life cycle. In the FreeMe project, which was conceived with the aim of developing a safer and more sustainable Plating on Plastic process compared to traditional solutions, the application of the SSbD approach represented a fundamental and fully coherent step toward achieving the project's intrinsic safety and sustainability objectives.



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I consider SSbD to be a strategic methodology that, if widely adopted, could make a concrete contribution to achieving the EU's objectives in the fields of safety and sustainability. Today, these topics are increasingly central for all actors involved, from research to industry, and require a systemic change in mindset. However, for this change to be truly effective, concrete tools and approaches are needed to support decision-making already at the early design stages.

From an industrial perspective, particularly that of an SME, company projects already include considerations related to improving process sustainability and ensuring safer working environments. However, these assessments are often not sufficiently structured, due to the lack of consolidated methodologies, dedicated internal competences, or the economic sustainability of systematical-

ly relying on external consultants. While these efforts represent a first step in the right direction, there is still significant room for improvement.

In this context, SSbD can represent a highly valuable approach, provided that it is made accessible and applicable within real industrial settings, especially for SMEs. As also emerged during the SSbD workshop organised as part of FreeMe's final event – the Coatings 2026 conference – where Gaser was invited to contribute by presenting the industrial point of view, the application of SSbD is currently complex. It requires the availability of extensive process data, specific expertise and the ability to address the significant challenges associated with scaling up from laboratory to industrial environments.

Despite these challenges, I strongly believe that SSbD is an approach worth

investing in. If properly adapted and supported, it could become a reference methodology to guide industrial innovation in a safer and more sustainable way, while also representing a concrete opportunity and a competitive advantage for the European industrial ecosystem.

Finally, what message would you like to share with the FreeMe consortium and the project's wider community as the project reaches its conclusion?

The message I would like to share, first and foremost, is a sincere thank you to the entire FreeMe consortium and to the wider community that has supported the project over these four years. For me, FreeMe was much more than a European project: it was a journey of great enrichment, both professional and personal, which allowed me to grow, learn

and engage with people of outstanding human and professional calibre.

Coordinating such a competent, collaborative and motivated consortium was a truly valuable opportunity. The atmosphere of trust, open dialogue and willingness to engage demonstrated how essential teamwork is to successfully address complex challenges such as those faced in FreeMe.

I sincerely hope that the results, knowledge and relationships built throughout this journey will not come to an end with the formal conclusion of the project but will instead represent a solid foundation for future collaborations and further developments. FreeMe has left an important legacy, made not only of technical and scientific results, but also of relationships, mutual trust and a shared vision on how to drive innovation in a safer and more sustainable way.



EVENTS

FREEME'S FINAL EVENT

COATINGS 2026 CONFERENCE



Figure 1. Coatings 2026 Conference

The final event of the FreeMe project (Coatings 2026 conference) took place in M47 (April 2026), co-organised by FreeMe DC manager EXELISIS and MDPI. The conference was held between 20 - 22 April 2026 in Athens, Greece with the participation of more than 150 attendees from all over the world from academia, industry, and the research and innovation ecosystem. NICKEFFECT, one of FreeMe's sister projects, also contributed as a sponsor of the event.

Throughout the conference, FreeMe maintained a strong scientific and networking presence through oral presentations, poster contributions, technical discussions, and stakeholder interactions. The event provided an important platform for bringing together project partners, researchers, industrial stakeholders, and representatives from the wider coatings and surface engineering community, fostering collaboration and

knowledge exchange in an international environment.

FreeMe partners actively contributed to dedicated sessions focused on "Phasing out substances of concern from the surface finishing industry" and "AI tools and simulations". The first session was chaired by Prof. Dr. Eugenia Valsami-Jones and included presentations by Michalis Kartsinis (CNano) titled "Cr(VI) and Pd-Free Metallization of Plastics" and Prof. Dr. Luca Magagnin (POLIMI), FreeMe's Technical Manager, titled

"Self-Activating Sprayable Resins for Sustainable Plating on Plastics", focusing on sustainable metallisation technologies and the replacement of hazardous substances in plating-on-plastics processes. In parallel, the sessions on "AI tools and simulations (Part 1 & 2)", chaired by Prof. Dr. Andreas G. Boudouvis, featured presentations by Kostas Pyrgakis titled "POPEYE - Plating On Plastics Equation-based sYstems Engineering: Unit operations and properties prediction models for emerging plating on plastics technologies" and Francisco Daniel García Romero (IDENER) titled "A Multi-scale Modelling Framework for Adhesion, Etching and Ni Deposition in Cr(VI)-Free Metallization of Polymers", highlighting FreeMe's activities in modelling, simulations, and decision-support tools for sustainable PoP technologies.



Figure 2. Presentations of FreeMe's partners during the Final Event - Coatings 2026 conference

In parallel with the oral presentations, the conference also featured a poster session showcasing more than 50 scientific posters from researchers, EU-funded projects, and industrial participants. The poster session provided an additional platform for networking, technical discussions, and dissemination of innovative research related to coatings, surface engineering, modelling, and SSbD approaches. FreeMe technologies and project activities were also showcased during the session by FreeMe part-

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ners CNano and AUTH, further strengthening the project's visibility and interaction with conference participants.



Figure 3. Conference Room



Figure 4. Poster session during Coatings 2026 conference

A particularly important recognition for the project was the best poster award received by Michalis Kartsinis (CNano) for the poster titled "Enzyme-assisted pretreatment of PA12 for sustainable plating on plastics: Replacement of Cr(VI) etching and Pd activation". This distinction highlighted the sci-



Figure 5. Best Poster Award

FREEME'S FINAL EVENT

entific quality, innovation potential, and industrial relevance of the work developed within the FreeMe project.



Figure 6. FreeMe's Dissemination Material

In addition to the scientific programme, the conference also included networking and social activities that further strengthened collaboration among participants and project partners. The conference gala dinner, organised at the Royal Olympic Hotel in the centre of Athens with views of the Acropolis and nearby historical landmarks, provided an informal environment for discussions, networking, and exchange of ideas between representatives from academia, industry, and EU-funded initiatives. These activities further reinforced the collaborative spirit and international networking opportunities promoted through the FreeMe project.

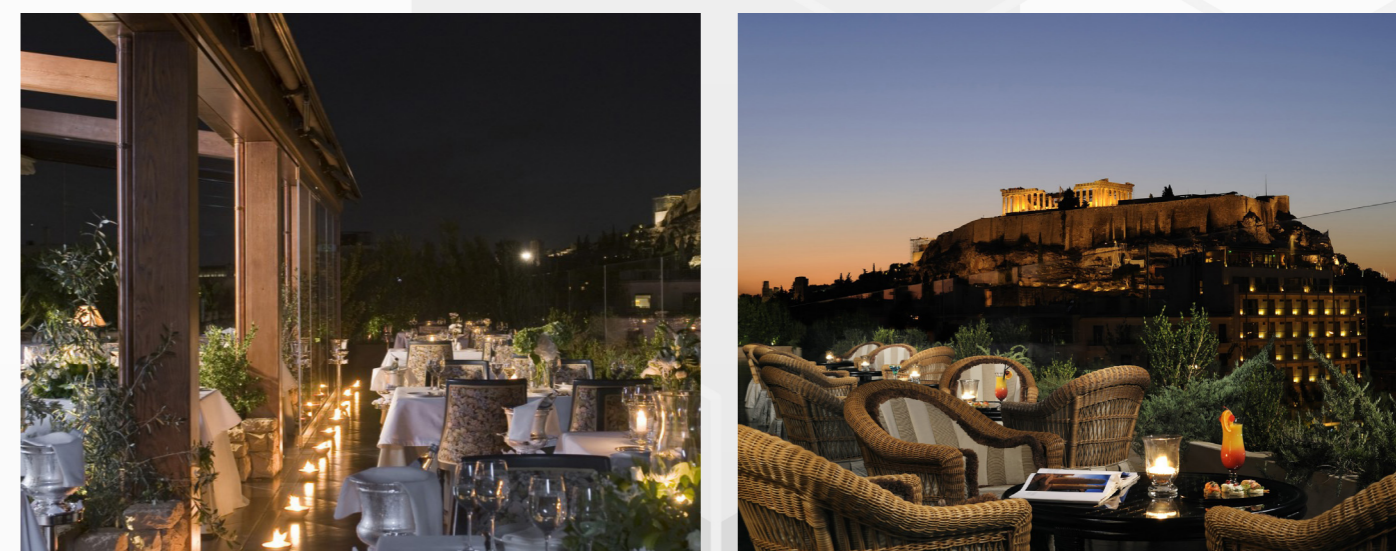


Figure 7. Conference gala dinner at Royal Olympic Hotel in Athens

EVENTS

6TH CONSORTIUM MEETING

The FreeMe consortium gathered in Seville on 12–13 February 2026 for the project's M45 consortium meeting, hosted by FreeMe's partner IDENER. The meeting brought together representatives from the consortium to review the latest technical developments, discuss progress across the different work packages, and coordinate the final activities of the project as FreeMe approaches its completion phase.



During the two-day meeting, partners presented updates on the project's key technologies and demonstrators, including developments related to Cr(VI)- and Pd-free metallisation processes, modelling and simulation activities, inspection systems, and Safe-and-Sustainable-by-Design (SSbD) approaches. Particular emphasis was placed on the final validation activities, exploitation planning, dissemination actions, and preparation of the project's final event and deliverables.

In addition to the technical discussions, the meeting provided an important opportunity for in-person collaboration and strategic alignment among the partners, reinforcing the strong cooperation established throughout the project and supporting the successful completion of FreeMe's final phase.



CONSORTIUM MEETINGS

7TH CONSORTIUM MEETING

The FreeMe consortium gathered between 21-22 May 2026 in Bergamo and Milan, Italy, for the project's final consortium meeting, bringing together all partners to review the latest technical developments, discuss final project activities and deliverables, and coordinate the closing steps towards the successful completion of the project.

The first day of the meeting was hosted

at the premises of Grupo Gaser in Bergamo, where partners exchanged updates across the different work packages and participated in technical discussions related to FreeMe's sustainable and toxic-free plating on plastics technologies. The agenda also included an internal workshop and a guided tour of Grupo Gaser's facilities, providing consortium members with valuable insight into the company's industrial processes, technological capabilities, and activities related to safe and sustainable by design coating technologies.

The second day continued at the premises of PoliMi in Milan, further strengthening collaboration and technical exchange among the consortium partners. During the meeting, partners presented updates regarding the project's final technical activities, modelling developments, dissemination actions, and exploitation planning.



In parallel, FreeMe also organised an exhibition booth showcasing the project's dissemination and communication materials, including the project's roll-ups, flyers, agendas, bags, pens, folders, cups, and other promotional items. The booth created an open interaction point where participants could learn more about the project, discuss FreeMe technologies and objectives, and engage directly with consortium representatives.



PROJECT PROGRESS

DELIVERABLES SUBMITTED

- D1.1 - Report on specifications – GASER – M24
- D2.1 - Recommendations for SSbD products and processes A – ICCRAM – M18
- D2.2 - Recommendations for SSbD products and processes A – ICCRAM – M36
- D3.1 - Intermediate report of progress of the activities of WP3 – PoliMi – M18
- D3.2 - Report including the resins' formulation and optimized methods for application on polymer surfaces – AUTH – M36
- D3.3 - Report on the optimized activation & metallization processes of sprayed resins – GASER – M36
- D4.1 - Intermediate report of progress of the activities of WP4 – Creative Nano – M18
- D4.4 - Report on toxic-free wet process for metallization of plastic surfaces – CNano – M36
- D5.1 - First report of progress of the activities of WP5 – IDENER – M18
- D5.1 - First report of progress of the activities of WP5 – IDENER – M18
- D5.2 - Second report of progress of the activities of WP5 – IDENER – M36
- D8.1 - First PEDRC – EXELISIS – M6
- D8.2 - Data Management Plan – PoliMi – M6
- D8.3 - Second PEDRC – EXELISIS – M18
- D8.4 - Third PEDRC – EXELISIS – M36

MILESTONES ACHIEVED

- MS4 - First successful UV-curing of bio-based composite resin in lab – PoliMi – M14
- MS5 - Utilization of spray apparatus for application of resin in substrates – PoliMi – M19
- MS12 - Open event for public engagement & Training workshop for industry – Gasser – M48



www.freeme-project.eu
info@www.freeme-project.eu

