



TECHNOLOGICAL INNOVATIONS FROM PLASTIC OMNIUM

Working to make mobility cleaner, safer and unique



Portfolio of technologies from Plastic Omnium

Plastic Omnium leverages its technological expertise to offer solutions combining frugality, comfort, intelligence and safety. For mobility that is sustainable and continues to inspire.



Energy transition will not happen with any one powertrain, it will require a combination of solutions.

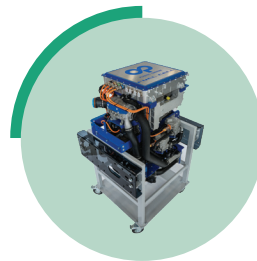


The aim Decarbonized mobility



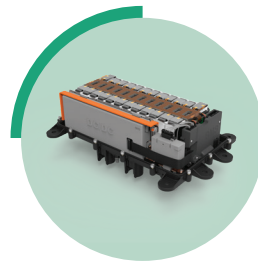
175-liter hydrogen tank

P.04/05



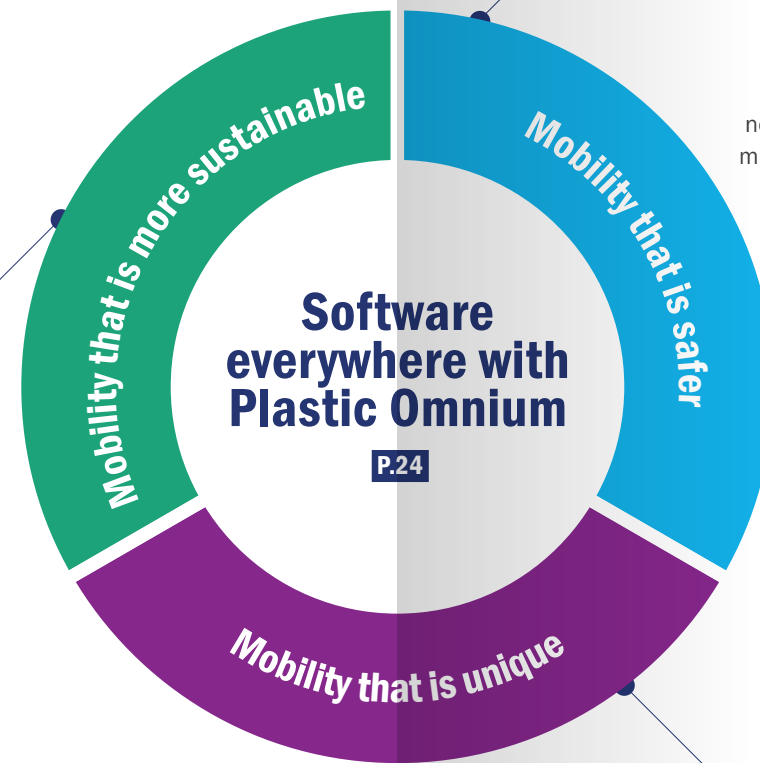
150 kW fuel cell system

P.06/07



48 V battery

P.08/09



Vehicle body panels are no longer just a commodity, they are packed with technology and incorporate complex functions such as innovative lighting solutions and a range of ever more advanced sensors.



The aim More safety



See better, drive better: new high-resolution microLED projection module

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With Sonatus, Plastic Omnium controls message displays in vehicle tail lights

P.12



High definition, ultra-high luminosity display at the rear of vehicles

P.13



Face recognition to unlock the vehicle

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Convenience, comfort, looks: mobility is evolving to reflect changing consumer tastes.



The aim More pleasure



Smart Tailgate: the new generation of smart tailgates

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SmartFACE 2023: the new generation of front bumpers

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Dynamic interior dashboard projection

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Comfort LID: a highly compact module for quick and easy vehicle charging

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175-liter hydrogen tank



The 175-liter hydrogen tank is a high-pressure vessel for storing hydrogen (type 4, 700 bar, made from an inner plastic liner covered with carbon fiber) for use on medium and heavyweight vehicles: commercial vehicles, small and mid-size trucks, etc. In the US market, this type of tank is perfect for use in pickups.



+ To find out more

High-pressure hydrogen tanks are designed to store the energy that vehicles use to move. Hydrogen is stored in a tank then transferred to the fuel cell where it is converted into electricity where it is combined with oxygen present in the air. Every 175-liter tank holds around 7 kg of hydrogen. Pickups are usually fitted with 3 tanks, a total of just over 20 kg of hydrogen that delivers a range of close to 500 kilometers.

Hydrogen tanks for all forms of mobility: cars, buses, trains and trucks

Tank sizes adapted to suit each class of vehicle:

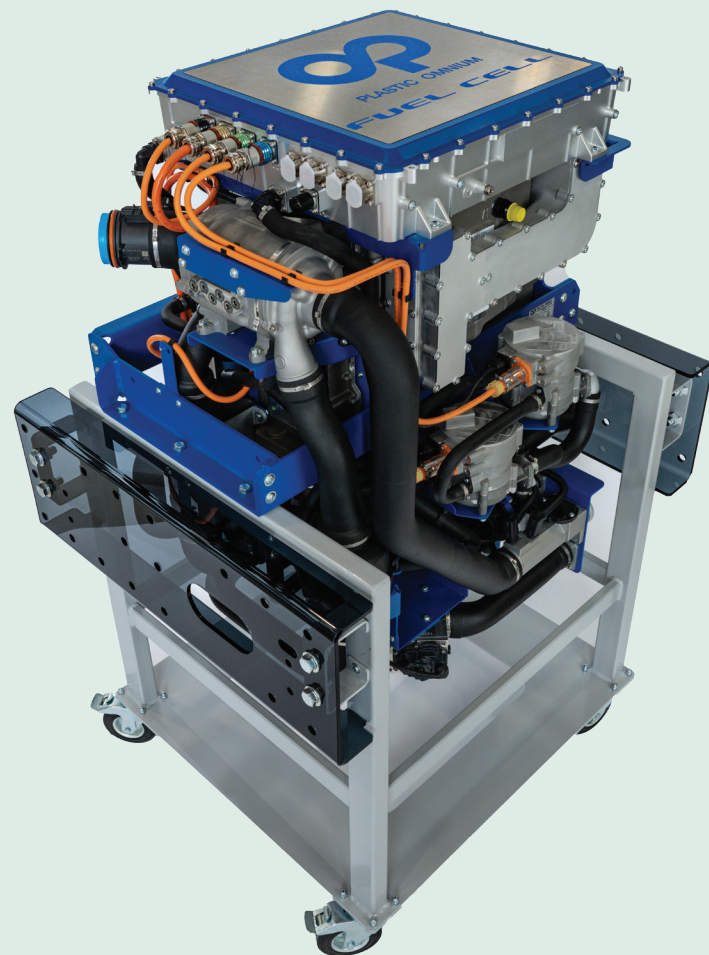
- Trucks and buses: 5 to 7 tanks per vehicle, holding 50 to 70 kg of hydrogen in 237-liter tanks. And 80 to 110 kg in 400-liter tanks.
- Light commercial vehicles: different sizes depending on the vehicle, usually 3 tanks holding between 6 and 20 kg of hydrogen.
- Private cars: shapes to suit the vehicle, holding 4 to 6 kg of hydrogen.

Plastic Omnium's commercial successes in hydrogen tanks

- **2 Chinese automakers (September 2023) PO-Rein joint venture**
High-pressure hydrogen storage systems.
- **Major US automaker (August 2023)**
Annual production of 100,000 high-pressure storage systems for trucks and commercial vehicles.
- **Stellantis (September 2022)**
Design and production of 700-bar high-pressure hydrogen storage systems to be fitted to commercial vehicles.
- **HYVIA (September 2022) – Plug Power and Renault joint venture**
Design and production of 700-bar hydrogen storage systems to be fitted to commercial vehicles.
- **Safra (September 2022)**
350-bar high-pressure type VI hydrogen storage systems for buses.
- **Ford Truck (September 2022)**
700-bar high-pressure hydrogen tanks for demonstrator trucks.
- **Hyliko (May 2022)**
350-bar high-pressure storage systems for a fleet of 45 trucks.
- **Alstom (September 2021)**
350-bar hydrogen storage systems to be fitted to regional trains in Italy and France.
- **Hyundai (September 2021)**
Contract for the supply of 700-bar high-pressure hydrogen tanks.

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150 kW fuel cell system



The 150 kW FCM (Fuel Cell Module), a next-generation fuel cell, is a heavy mobility solution (for trucks 16 tonnes and over) that acts like an on-board vehicle power plant, instantly generating electricity from hydrogen and oxygen present in the air and powering the electric motor.

To find out more

As its name suggests, the FCM 150 fuel cell system comprises a fuel cell and a system that supplies it with hydrogen and makes sure it operates correctly.

- **The fuel cell** acts as the vehicle's power plant, producing electricity that powers the electric motor. It uses an electro-chemical process to combine hydrogen with oxygen in the air to produce electricity. The only emissions are water and heat.

- **The system surrounding the fuel cell** incorporates over 160 components that have to provide vital additional functions, such as thermal control, electronic management, air supply (compressed air and humidity), hydrogen supply and conversion of the voltage between fuel cell and battery.

What now?

Plastic Omnium is already developing the next generation of fuel cell systems offering a power output of 300 kW for the heaviest trucks (over 40 tonnes). The aim: 2027.

The FCM 150 kW powers heavy trucks 16 tonnes and over

The 150-kW fuel cell meets the needs of heavy trucks in Class 8 and above (over 16 tonnes). For the smallest trucks in this class, 16 tonnes, only a single 150-kW fuel cell is needed. Above 16 tonnes, the idea is to use modularity to deliver 300 kW or 450 kW by interconnecting 2 or 3 systems in increase the power output.

For these types of long-distance heavy trucks, all-battery solutions are unsuitable because of the time needed for charging, the space required and the vehicle's load-carrying capacity (batteries take up space and are very heavy!), as well as the potential impact on power grid infrastructure (large amounts of power needed to limit charging times).

Mobility conditions for hydrogen vehicles closely resemble those of internal combustion vehicles, offering several advantages: high energy density (able to load a large amount of energy and to travel long distances) and it only takes a few minutes to refuel a vehicle.



The FCM 150 showcases Plastic Omnium's expertise in ultra-compact manufacturing: 160 components are packed into the limited space around the fuel cell, with optimized design, integration, durability and reliability. It offers an outstanding power-to-weight ratio of 0.5 kW per kilo and a 60% conversion efficiency rate.

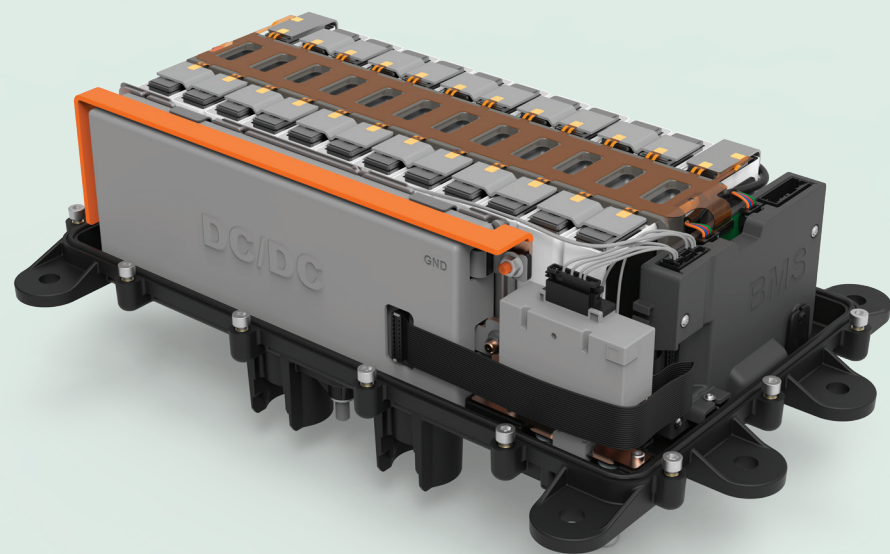


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48 V battery

Plastic Omnium's 48 V battery is a battery for mild hybrid vehicles, whether they are private cars, commercial vehicles, buses or trucks. This is a power battery that works with the internal combustion engine: electrical energy is used to assist the internal combustion engine, particularly when accelerating.



+ To find out more

In addition to providing a boost during acceleration, the battery also handles a range of on-board electrical functions, such as stop-start and preheating for the catalytic converters. There is no need for drivers to remember they are driving a hybrid vehicle; the battery charges itself, primarily during deceleration and braking. The ultimate aim? To optimize vehicle fuel consumption and deliver savings in CO₂ emissions of up to 15%.

In 2022, Plastic Omnium set up a new division called e-Power to develop solutions for battery systems and power electronics for hybrid and all-electric vehicles. With e-Power technologies now part of its portfolio, Plastic Omnium is developing energy storage solutions for all types of powertrain: petrol, diesel, hybrid, rechargeable hybrid, all-electric, hydrogen, etc.

Plastic Omnium's commercial successes in batteries

- **Major automaker (2023)**
48 V batteries for hybrid vehicles. These batteries, which are designed to meet Euro 7 regulations and improve the fuel consumption of vehicles, use NMC lithium-ion technology.
- **Hyvia (2023)**
High-voltage batteries for fuel cell commercial vehicles powered by hydrogen.
- **Siemens (2021)**
High-voltage batteries (750 V - LTO lithium) for hybrid and electric trains in Germany, Denmark and Austria.
- **Stadler (2020)**
High-voltage batteries (BEMU - battery electric multiple unit) (750 V - LTO lithium) for hybrid trains destined for the European market.
- **Hess (2021)**
High-voltage batteries (LTO lithium) for trolley buses operating in the cities of Nantes and Geneva.
- **Vanhool (2020)**
24 kWh high-voltage batteries (LTO lithium) for 12-meter fuel cell hydrogen buses and trolley buses.
- **Alstom (2022)**
Order for energy batteries (750 V - NMC lithium) to electrify trains that are replacing diesel locomotives.
- **Allison (2021)**
High-voltage batteries (650 V - LTO lithium) for hybrid coach powertrains in the USA.



With its new e-Power business, Plastic Omnium is diversifying its product line-up as well as the markets it serves. A longstanding specialist in the car industry, products from Plastic Omnium are now found in trains, buses and trucks as well as off-highway industrial vehicles such as forklifts, self-guided vehicles and mining trucks.



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See better, drive better: new high-resolution microLED projection module



Plastic Omnium's new high-resolution microLED projection module offers a multitude of functions that improve safety and driver comfort. The module uses 25,000 pixels on a single chip, as well as an optical projection system with three lenses incorporated into a single module.

+ To find out more

MicroLED technology offers numerous benefits. It provides drivers with maximum visibility while at the same time avoiding causing irritation to anybody else who happens to be near the vehicle. The module can, for example, offers pinpoint lighting control to prevent the main beam dazzling a pedestrian's face but light up the rest of their body so they remain visible. It can also automatically adjust headlight height and alert drivers to small objects or items that suddenly appear on the highway by lighting them up or triggering a warning light.



MicroLED module for projecting information

Far more than just a front lighting module, it can also project a wide range of digital symbols in reaction to multiple different scenarios. MicroLED can be used to project information relevant to the safety of drivers or pedestrians onto the road surface in front of the vehicle. For instance, it can project a vehicle's predicted trajectory to inform other people nearby, or as a warning to inform the driver.

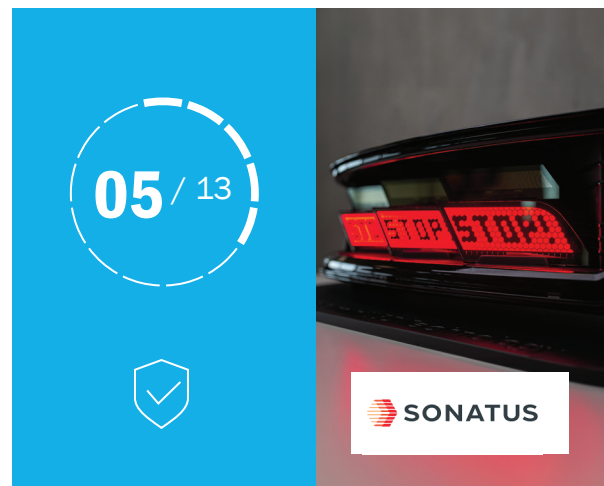
In addition to the safety aspects, this module also offers convenient new services for an improved driver experience: for example, projecting a welcome light on the ground as the driver approaches the vehicle, even if it is not running.



The technology used in Plastic Omnium's new high-resolution microLED projection module is the core technology behind its advanced lighting functions and on-road symbol projectors.



Plastic Omnium seals key partnerships to develop the mobility technologies of tomorrow



Working with Sonatus, Plastic Omnium can control messages displayed on vehicle tail lights

Plastic Omnium and Sonatus join forces to bring smart technologies to vehicle tail lights. Sensors fitted at the front of the vehicle identify its environment. The challenge lies in analyzing this data to deduce the appropriate message to display in the tail lights. The aim? Better road safety for every user.

The next stage

In addition to this first solution, the two partners are determined to take the concept to the next stage by offering over-the-air functions that automatically update throughout vehicle lifetime, similar to how iPhones behave. They are also looking into solutions for vehicle ECUs to monitor each other — they already communicate with each other — so they can detect any faults that might occur and give a warning if they do.

Plastic Omnium and Sonatus work together on the software-enhanced vehicle of the future. They started with a simple idea: identify problems in front of the vehicle and send out a message to inform others nearby.

To find out more
Sonatus, a major actor in the software-defined vehicle ecosystem, is responsible for monitoring and collecting data from various on-board sensors,

using the information to interpret situations that can happen while driving and then sending the data to a software platform. Plastic Omnium's task is to retrieve the data from Sonatus, define the appropriate message, then display it on

mini-LED screens embedded in the vehicles' tail lights. Several possible scenarios have been identified:
 ■ the vehicle encounters pedestrians crossing the road, so the display shows an animation of a pedestrian;

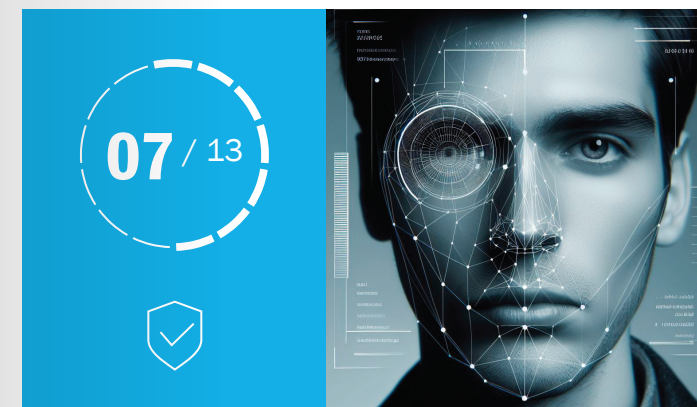
- the vehicle encounters roadworks, so the display shows an animation of roadworks;
- the vehicle encounters a traffic jam, so the display shows the appropriate animation.



An ultra-bright HD display on the rear of vehicles, to improve safety

EyeLights technology delivers 10 times more luminosity than current solutions, enabling optimum legibility in outdoor conditions. Integrating this technology into a tailgate is child's play for Plastic Omnium, the world's no. 1 manufacturer of plastic exterior body parts. The Group has been mastering the integration of elements in bumpers and tailgates for some ten years.

Plastic Omnium has teamed up with start-up EyeLights to offer a unique technology: a high-brightness, high-definition display integrated into the rear of vehicles (in the tailgate). The aim? Communicate with the outside environment over long distances (30 meters), whatever the weather conditions...even in the hot summer sun! Whether it's during a sudden slowdown or to signal an object on the road, the technology developed with EyeLights, combined with Plastic Omnium's expertise, will enhance the safety of all road users.



Face recognition to unlock the vehicle

Modeling the user's face significantly reduces the number of frauds. For example, showing a photo of the driver is not enough to unlock the vehicle. The vehicle will only unlock in the presence of the driver's real face.

Plastic Omnium is working with Paravision on face recognition technologies for vehicles. Paravision's face recognition products produce mathematical models of the face. No photos are stored or analyzed, only a mathematical representation of the face (distance between the eyes, etc.). This considerably boosts the system's accuracy and reliability. For its part, Plastic Omnium adds functionalities to bodywork panels by incorporating the sensors into the front and rear doors of a vehicle.

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Smart Tailgate: the new generation of smart tailgates



Smart Tailgate from Plastic Omnium is a smart plastic tailgate that offers disruptive functions: it incorporates vehicle lighting, design statements and a screen for communicating with the vehicle's environment. What makes it unique? It is offered to our automaker customers as a single integrated unit, rather than as a range of different modules that are added to the tailgate. The aim? Cars with greater connectivity that are safer and smarter.



To find out more

In 2019, the teams at Plastic Omnium set themselves a challenge: to design a specific tailgate architecture offering automaker customers a one-piece body panel with incorporated lighting, a screen and design motifs. The aim? To strengthen Plastic Omnium's product line-up by offering tailgates with higher added value, smart, lightweight, distinctive and adaptable to manufacturers' requirements, making them a truly differentiating component for their brand.

The plastic tailgate offers design freedom and adapts to align with brand identity: this new generation of tailgate makes it possible to imagine a multitude of styles and design motifs.



With its Smart Tailgate, Plastic Omnium brings plastic body panels to life. This is unquestionably a leading edge solution, pointing the way to future external systems and showcasing the possibilities offered by advanced external design and fully integrated bodywork.



Harmoniously integrated lighting

Plastic Omnium's Smart Tailgate incorporates lighting that can extend across the entire width of the part, without any visible separation between the tailgate lighting area and the bumper. The light spreads in an unbroken line across the entire width of vehicle's rear. This is what we call transparent integration.

Integrated design motifs

Since 2020, Plastic Omnium has offered several different design motifs in response to demand from its customers:

- laser etching removes small areas of paint from the tailgate to reveal two distinct surfaces,
- Plastic Omnium uses screen printing to offer a broad palette of colors: a thermo-formed film lines the contours of the mold to give the part color and allow light to pass through.

Integrated screen for communicating with the nearby environment. New for 2023

With a screen integrated into the center of the tailgate, Plastic Omnium makes it possible for the vehicle to communicate easily and clearly with drivers behind. The aim? To display messages and symbols for the benefit of other drivers and pedestrians to improve everybody's safety and comfort. Thanks to this screen, Plastic Omnium can offer welcome lighting animations, personalized lighting signatures and the ability to display warning safety messages.

Plastic Omnium's prototype has been subjected to functional testing according to automakers' specifications: this technology is now ready for market, with potential at-scale applications arriving from 2025.

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SmartFACE 2023: the new generation of front bumpers

SmartFACE 2023 bumpers incorporate all lighting functions and drive-assistance sensors in the same part in a way that is completely unbroken, meaning there is zero disruption to lighting.



+ To find out more

SmartFACE 2023 is a response to new electric vehicle architectures. They no longer have front-end grilles to supply the engine with cooling air, meaning a new area is available at the front of vehicles where disruptive new solutions can be integrated, such as bumpers with reinterpreted volumes and finishes that incorporate lighting signatures, sensors and even design motifs.

Plastic Omnium adds decorative motifs to bumpers

2023 saw teams from Plastic Omnium continue their drive for innovation, adding decorative elements to SmartFACE 2023 bumpers. They explored three technologies:

- laser etching to remove precise amounts of paint in certain areas to reveal two different surfaces;
- micro-perforation: light passes through tiny holes
- concealing lighting units beneath the paint

An infinite number of permutations will be available to designers from brands that use Plastic Omnium's surface treatment technologies.

Easier to repair

Plastic Omnium has designed its SmartFACE 2023 so that specific modules can be repaired without having to replace the entire unit. This makes it easier to reuse components, and the ability to swap them out was designed into the module from the outset.

Plastic Omnium illuminates logos

In the past, vehicle logos were produced in 3D with a chrome effect. With Plastic Omnium, logos are illuminated and, better still, are now also compatible with integrated radar as they are transparent to electromagnetic waves.

Commercial successes

By the end of 2024, SmartFACE 2023 from Plastic Omnium will be fitted to an electric vehicle and will be on the road.

“Plastic Omnium offers complete mastery of lighting signatures that run without interrupting the light across the full width of the part, without dark areas of several millimeters between each lighting module.”

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Explore the designs of tomorrow



Plastic Omnium explores different combinations of shapes, materials and textures that can be integrated into body panels, from the most conventional to the most disruptive.

+ To find out more

Arranged into three key trends, Plastic Omnium is also exhibiting eight different visions of tomorrow's body panels. The aim is clear: to offer the freedom to customize vehicles, following a set of specifications, while also limiting the environmental impact. All green: where sustainability, style and performance meet.

- Plastic Omnium incorporates several sources of recycled plastic, such as shredded bumpers, flakes made from food packaging or plastic bottle stoppers. It even uses recycled particles in its paints!
- À la carte: no matter what the automaker's designers demand, Plastic Omnium can respond with unlimited customization options.
- All-in-one: bodywork can look great while also incorporating functions such as radar and lighting. This means that style is never compromised.

Close-up on sustainability

Plastic Omnium uses recycled materials in its body panels and takes this process to new aesthetic heights by incorporating recycled or bio-sourced materials such as grape seeds and oyster shells. The aim? To diversify the range of looks and finishes without compromising the performance, quality and visual appeal of its body panels. Plastic Omnium has solved all technical issues and is skilled in the use of recycled materials while also meeting the very highest performance standards.

Commercial successes

Laser, pad printing, hot marking: Plastic Omnium already offers automakers bodywork parts featuring original finishes to its automaker customers. Plastic Omnium also offers trompe l'œil 3D effects for lower body panels.



Plastic Omnium's core business involves translating automakers' design ideas into a bodywork part that respects the extremely strict specifications demanded by regulatory requirements.



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Dynamic dashboard projections



Plastic Omnium has developed the dynamic dashboard projection system, an innovative system comprising of a projection module fitted behind the central screen of the passenger compartment that creates dynamic light projections on the surface of the dashboard.

“
When it is switched off, the dashboard surface is very modern and neutral. When the projections are activated, the dashboard springs to life.”



+ To find out more

Plastic Omnium's dynamic projection system lights up the entire dashboard with colors and motifs chosen by the driver. Already featured in the new electric Mini Cooper, this creates an immersive driving experience that combines lighting with animations and projections.

More specifically, the module is made up of several micro lens arrays (MLA), each incorporating their own motifs. The light beam

itself is projected using RGB (red-green-blue) LEDs. These three colors can be combined to create all other colors. The beam is sent to the micro lenses, around 200,000 in all, which then project the chosen motifs onto the dashboard. This is the first time that several micro lens arrays with RGB LEDs have been used in an automotive lighting system, further proof of Plastic Omnium's mastery of innovative technologies applied to automotive lighting and infotainment.

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Comfort LID: a compact, easy-to-use charge module for automakers

Designed for high-end vehicles, Comfort LID from Plastic Omnium is a smart module that combines several functions in a highly compact package. Its compact design helps reduce vehicle bulk: the module is no larger than a tennis ball!



Innovations from the teams at Plastic Omnium

Even with today's much improved technology, the average time it takes to charge an electric vehicle is still far longer than it takes to refuel an internal-combustion vehicle. It can take several hours before the batteries are fully charged. The charging flap generally stays open all this time, which can lead to being damaged. The teams at Plastic Omnium have looked at this problem and came up with solutions for protecting the charging flap, which slides into the bodywork with the socket extending outwards. This prevents dirt, snow, rain or anything else from the outside getting in!

+ To find out more

Comfort LID is fully protected while the vehicle is charging: the flap opens automatically and disappears into vehicle and a mechanism moves the socket to the outside at the same time. This leaves no small spaces for dirt to find its way in.

Comfort LID also incorporates lighting, making the socket visible so it is easier to plug in when it is dark. The user can also monitor the charging status.

“ Comfort LID does not just provide a fast way to charge a vehicle, it is also designed to make users' lives easier: the flap opens automatically, the socket is illuminated to make it easier to use at night, and special lighting is also used to indicate the charge level.

Software everywhere with Plastic Omnium



In January 2023, Plastic Omnium set up OP'nSoft, an in-house organization exclusively dedicated to software development. The aim? To create in-house all of the software that is integrated into Plastic Omnium's technologies. One year later, January 2024, and OP'nSoft is 100% operational with 150 developers based at 12 sites in 9 countries at work on 100 projects of strategic importance to Plastic Omnium. A key milestone has been reached: today, all embedded software in products from Plastic Omnium has been developed by OP'nSoft

To find out more

OP'nSoft works across Plastic Omnium's entire product portfolio to develop software used primarily in hydrogen storage and conversion, vehicle electrification, driver assistance tools such as radar and cameras, lighting solutions as well as services for OEMs and end users.

OP'nSoft is advancing toward achieving A-SPICE Level 2 certification and gaining all the cybersecurity and operational safety expertise required to meet the latest OEM regulations that come into force in 2024.



OP'nSoft celebrates its first birthday. In just 12 months, this new unit focused exclusively on software development has already racked up 200,000 hours of development work. The goal for 2024: 400,000 hours!



Plastic Omnium continues to innovate as it embraces AI

Working closely with Cap Gemini, Plastic Omnium uses generative AI for its day-to-day activities. Specifically, its teams rely on generative AI to process documents received from customers (RFQ) or in-house teams. The AI reads the complete document (sometimes several hundred pages), analyzes it and transcribes the information in a format that corresponds to the A-SPICE working method. This means that very large quantities of data are processed automatically, with key elements highlighted in a common format and language. The aim? To save time and ensure perfect alignment between in-house developments and customer requirements.

Digital clones and predictive maintenance

Software is integral to fuel cells, ensuring they run smoothly. The number one role is strictly functional: pressure, temperature, air and hydrogen flows all have to be regulated to ensure fuel cells operate correctly.

Once this happens, the next task is to make sure the fuel cell works efficiently. To do this, software is used to keep the fuel cell in optimum usable condition, particularly in terms of operating temperature. This optimizes yield and performance, which in turn ultimately extends its service life.

To make sure that these conditions remain optimal, the software monitors the fuel cell continuously in real time, like a doctor caring for a patient. When combined with connectivity and data transfer to the cloud, it is possible to create a digital clone and simulate fuel cell use over time to predict how it will age. This is what is known as predictive maintenance: creating a digital model of fuel cell use to simulate 20 or 30 years' service life in only a few months. Put another way, the fuel cell is pushed to its limits to see how it reacts. The aim? To optimize its cost and lifespan.



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