



**LE**  
**BOOK**  
**Innovations**

# INTRODUCTION

To address the technological and societal challenges of each era, engineering has always relied on its ability to innovate, particularly in the design, study, or construction of structures, equipment, or products.

Regardless of the field where SEGULA Technologies operates - Automotive, Aeronautics, Energy, Naval, Rail, or Oil and Gas - our group's DNA is to find solutions to bring these projects to life and support their implementation as competitively as possible. Therefore, we naturally place innovation at the core of our development strategy and growth dynamics.

In highly competitive markets, our clients must innovate rapidly. To assist them, we are constantly a source of permanent proposals for innovative solutions, relying on:

**The efficiency of our organization:** our Research and Innovation (R&I) is located at the heart of our agencies, close to clients and operational teams, and is essential for understanding our clients' needs. This proximity also allows collaboration with SMEs, start-ups, laboratories, and competitiveness clusters, promoting cross-fertilization and creativity.

**The talent of our engineers and the passion that drives them:** our R&I teams develop more than 200 projects each year. These projects bring together skills to address major challenges in designing new products and systems, new services, or new methods.

**Open innovation:** significant partnerships and collaborative projects are established with renowned clients and partners, allowing us to innovate rapidly by capitalizing on new synergies.

Our engineers contribute to shaping the world of tomorrow in 3 main areas :



## Smart Industry

Industry 4.0

Connected and  
autonomous mobility



## Green Industry

Weight reduction /  
Materials recycling

Sustainable mobility  
and logistic

Water management /  
Clean water

Reduction of energy  
consumption

Energy storage



## Industry for Life

Bio printing

New materials

## Maturity Level of Innovations

Research

Testing

Roll Out

The objective of our book on innovations is to present in a simple manner some of the innovations that are currently developed by our teams.

# SEGULA'S ACTIVITIES

## GLOBAL ENGINEERING GROUP

SERVING THE COMPETITIVENESS OF ALL MAJOR INDUSTRIAL SECTORS



Automotive



Aerospace



Energy



Rail



Naval



Life Sciences



**13 000 +**  
Employees



**30 +**  
Countries



**140 +**  
Locations



**300 +**  
Customers



**200 +**  
R&I projects every year

## OUR VALUES

Responsiveness

Proximity

Ambition

Innovation

# SUMMARY



## Green Industry

6

Weight reduction  
Energy storage  
Sustainable mobility & logistics  
Water management / Clean water  
Reduction of energy consumption  
Material recycling



## Smart Industry

22

Industry 4.0  
Connected and autonomous mobility



## Industry for Life

30

Bio-printing



# GREEN INDUSTRY



**Anne-Christine Lombardi**, *Head of Open Collaboration Projects*

“Environmental problems pose a growing threat to our planet and the life on it. Collective action, focused on sustainability and environmental preservation, is essential to mitigate these threats and promote a more planet-friendly future.”

We are working with our customers and partners to find viable solutions, to address this critical issue, to help find solutions that work towards a greener future.”



## Weight reduction

- 8** TOLDO  
Increased resistance of composite structures
- 9** COMPOSITE CAB  
Truck cabin mass reduction solution



## Energy storage

- 10** CUVE  
Increased resistance of composite structures
- 11** REMORA  
Truck cabin mass reduction solution



## Sustainable mobility & logistics

- 12** MULTI-STACK FUEL CELL  
Fuel cell increased sizing and performance
- 13** ZERO  
Green liquid hydrogen-powered aviation
- 14** H2 BIMODO  
Fuel cell increased sizing and performance
- 15** GREEN DELIRIVER  
Green river-based urban logistics solution



## Water management / clean water

- 16** BIOFILTRATION  
Biological filtration system for industrial effluents
- 17** ATARA  
Water resources management tool



## Reduction of energy consumption

- 18** STABILOAD  
On-board load and stability AI model
- 19** BIOPTTE  
Energetic uses of biomass processing
- 20** INNOVATIVE THERMAL MANAGEMENT  
Complete thermal management tool



## Material recycling

- 21** CIMENT I3D  
3D-Printed concrete using industrial waste

## TOLDO

# INCREASED RESISTANCE OF COMPOSITE STRUCTURES

As impacts can compromise composite structures' integrity, TOLDO project **strengthens like-carbon structures** in the event of a collision.

Following the project validation, a technological solution has been developed to **enhance impact resistance** of composite structures even in a very hard ecosystem.

TOLDO advanced composite structure is a cross-sectorial solution that can **bolster durability** of automotive vehicles and aerospace systems.



PARTNERS  
ISAE, ICA, Airbus, CNRS,  
ArianeGroup



MATURITY  
TESTING  
TRL : 7



COMPETENCIES  
Aeronautics, Laminates,  
Numerical modelling





## COMPOSITE CAB



# TRUCK CABIN MASS REDUCTION USING NEW MATERIAL

COMPOSITE CAB is a **lightweight truck cabin** designed to minimize fuel consumption while retaining an optimal load capacity.

The use of composite materials in the cabin **reduces its weight (30% lighter cabin)**. This cabin also offers various internal features to enhance passenger comfort, including a sleeper configuration.

Our **patented sleeper concept** is currently used by Renault Trucks, but can also be proposed for application in other cross-sectoral domains.



PARTNERS  
Solvay, PO, Altair,  
Mecaplast, Saertex,  
Addiplast, Insa, Isat



PLANNING  
PoC in 2016  
Now Industrial part



MATURITY  
ROLLOUT  
TRL : 9

## CUVE

# PREDICTION OF TANK EXPOSURE TO EXTERNAL FORCES

CUVE is a **predictive tool** designed to assess risk of damage to tanks due to liquid sloshing and optimize their structure accordingly to enhance their safety.

- This tool considers various scenarios, including fluid-liquid interaction and liquid overflow, to **prevent potential accidents** that could compromise the integrity of the tank.
- By **optimizing the tank conception**, this solution not only **reduces the risk of harming people** and goods but also allows **better cost control** by extending the tank's durability.



**PARTNERS**  
LUSAC (University  
of Caen Normandy),  
LRAHE  
(University of Bejaïa,  
Algeria)



**PLANNING**  
Seismic loads: 2023,  
Sloshing reduction  
solution: 2024,  
Tank design  
optimisation: 2025



**MATURITY**  
ROLL OUT  
TRL : 8



**COMPETENCIES**  
Fluid-Structure  
Interaction, Sloshing



# REMORA



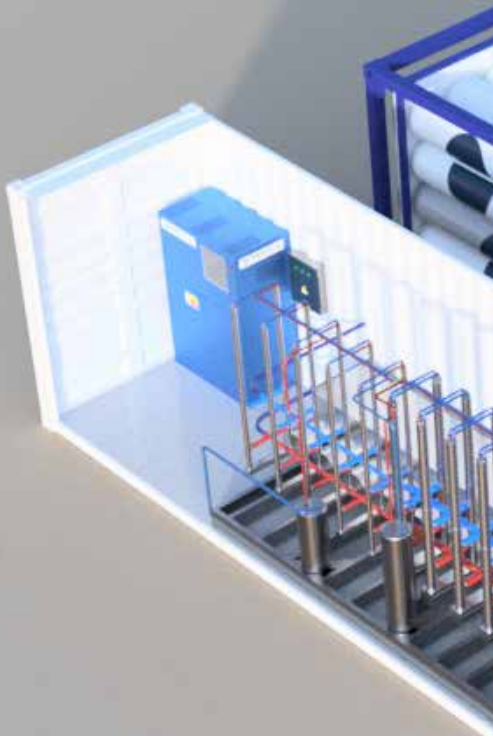
## EFFECTIVE AND DURABLE ENERGY STORAGE SOLUTION

REMORA addresses the **storage** issue of electrical energy, especially from renewable sources.

Our **patented** solution offers a **compressed air system** that enables more durable and very effective energy storage (up to 70% yield) compared to other storage solutions.

The first demonstrator designed to harness solar energy is expected for beginning of 2024.

REMORA offers a **flexible, high-yield, durable** storage solution tailored to meet renewable energy needs, for mid and long-term daily storage (>10-hour), also using recycling materials.



**PARTNERS**  
IMTA, CETIM, Nantes  
Université, ADEME,  
CORIA, LEMNA, LTEN,  
IREENA



**PLANNING**  
Prototype: 2019,  
Demonstrator: 2023,  
200 Kw container pilot:  
2025



**MATURITY TESTING**  
TRL : 5



**COMPETENCIES**  
Energy efficiency,  
Multi-physics  
simulation, Experimental  
development



## MULTI-STACK FUEL CELL

# FUEL CELL INCREASED SIZING AND PERFORMANCE

The project introduces an innovative fuel-cell system architecture that provides **enhanced autonomy** and **reduced recharging time**.

This program will allow us to develop tools to facilitate the sizing of optimized fuel cell systems integrated into a powertrain of any type of vehicle and adapted to their use cases.

As a result, this multi stack fuel cell solution **drives down the vehicle's maintenance costs** by extending of its internal components' **lifespan**.

As part of the project, a **test bench** is developed to validate small-scale fuel cell systems and also validate technical solutions for light mobility applications.



**PARTNERS**  
LUSAC (University of Caen Normandy), LRAHE  
(University of Bejaia, Algeria)



**PLANNING**  
Seismic loads: 2023,  
Sloshing reduction solution: 2024,  
Tank design optimisation: 2025



**MATURITY**  
**ROLL OUT**  
TRL : 8



**COMPETENCIES**  
Fluid-Structure  
Interaction, Sloshing



**ZERO**

## GREEN LIQUID HYDROGEN-POWERED AVIATION

ZERO's project ambition is to bring to market the **world's first hydrogen-powered commercial aircraft** by 2035.

ZERO explores a variety of configurations and technologies options for liquid hydrogen (LH2) storage, distribution and integration in the aviation sector. The project includes mockup **1:1 scale tests** to validate hydrogen combustion in real conditions.

By overcoming operational hurdles and safety implications, ZERO paves the way to **reduce aviation's carbon footprint** with up to 900,000 tons of CO2 avoided every year by 2050.



PARTNERS  
AIRBUS, Ingeteam, Applus,  
CESA, CITD



PLANNING  
2024



MATURITY  
TESTING  
TRL : 6



COMPETENCIES  
CFD



## H2 BIMODO

# THE WORLD'S FIRST LIQUID HYDROGEN TRAIN

H2 BIMODO promotes use of new traction technologies for the railway lines in order to make Europe climate neutral by 2050.

H2 BIMODO project transforms an **electric railcar into a new bimodal traction** system by combining **liquid green hydrogen** and batteries.

The project offers a **100% sustainable and disruptive solution**, making it possible to reach two European goals: decarbonation and revitalization of capillary lines.



**PARTNERS**  
RENFE (operator), Enagás,  
H2Vector, TACTICA TIC



**PLANNING**  
Operational in 2025



**MATURITY**  
**TESTING**  
TRL: 7



**COMPETENCIES**  
Liquid Hydrogen (LH2)



## GREEN DELIRIVER

# GREEN RIVER-BASED URBAN LOGISTICS SOLUTION

GREEN DELIRIVER is a boat designed to facilitate **clean logistics** from outer cities to urban areas, reducing road traffic CO2 emissions.

Hybrid electric/biogas (Compressed Natural Gas, CNG) propulsion allows for very low polluting emissions.

Notably, GREEN DELIVER has been selected to participate in the **opening ceremony of the 2024 Olympic Games** on the Seine River.



### PARTNERS

GRDF, COALIS, NGV Powertrain, CCI78, SYCTOM, HAROPA, SIGEIF (syndicate), VNF, GPS&O, Total Energies



### PLANNING

Demonstrator: 2024



### MATURITY

TESTING  
TRL: 7



### COMPETENCIES

Compressed Natural Gas (CNG), Hybrid propulsion

## BIOFILTRATION

# BIOLOGICAL FILTRATION SYSTEM FOR INDUSTRIAL EFFLUENTS

BIOFILTRATION offers an **alternative biological filtration** method for more efficient purification of effluents.

This method utilizes the natural capacity of some **microorganisms** and their **resistance to high temperatures**, pressures, radioactivity and hazardous environments.

BIOFILTRATION is an **eco-friendly solution** that helps industries grow more environmentally compliant with **cleaner effluents** at a lesser cost.



**PARTNERS**  
MAP laboratory M2E  
team (INSA LYON)



**PLANNING**  
Started in 2019  
PoC in 2019



**MATURITY**  
**TESTING**  
TRL: 2-3



**COMPETENCIES**  
Waste recovery,  
Depollution,  
Biotechnologies







## ATARA

# WATER RESOURCES MANAGEMENT TOOL

The Assistance Tool for Water Resources Management (ATARA) is a set of **multifaceted modelling tools** that simulate and enhance water management, storage and related services.

ATARA uses field monitoring methods, including satellites and in-situ monitoring units. Once collected, the data is analyzed and leveraged through 1D, 2D, or 3D modelling, which assists in the creation of **forecast scenarios**.

ATARA supports hydroelectric energy producers and other stakeholders in **improving water access and usage** in a context of scarcity that directly impacts the quality and quantity of water resources.



**PARTNERS**  
Lacs Sentinelles, EDF,  
Polytechnic University  
of Catalonia, University  
of Córdoba, French  
Biodiversity Agency  
(OFB)



**PLANNING**  
Started in 2016



**MATURITY**  
ROLL OUT  
TRL: 9



**COMPETENCIES**  
Simulation,  
Limnology,  
Water quality

## STABILOAD

# ON-BOARD LOAD AND STABILITY AI MODEL

Our Loading calculator provides more efficient management of the **freight mass distribution** on board to comply with stability criteria and **distribution of stresses on the structure**.

STABILOAD is **customizable and connected** on-board, it can **simulate** unusual and **specific configuration** to make a quick and safe loading of the boat.

It has a **Safe Return To Port module** which simulates flooding due to damage, calculating liquid hulls and the resistance of the structure connected to the ship's sensors increasing safety.

Utilizing advanced algorithms, this tool can achieve **up to a 5% reduction in energy consumption** during shipment, adjusting the boat's trim.



PARTNERS  
STX France, Brittany  
Ferries, EU H2020



MATURITY  
ROLL OUT  
TRL: 9



COMPETENCIES  
Naval architecture,  
Stability,  
Algorithmic



## BIOPTe

# ENERGETIC USES OF BIOMASS PROCESSING

Harnessing new energy sources like biomass, is a growing priority. Yet, its conversion into usable energy requires specific processing steps.

The BiOpTE tool **identifies the most efficient processing methods for transforming specific biomasses** into actionable energy sources such as roasting, pyrolysis, or gasification.

BiOpTE helps reduce industrial gas emissions (GHGs) and offers access to more sustainable energy sources, such as dihydrogen (H<sub>2</sub>).



PARTNERS  
LATEP (UPPA)



MATURITY  
RESEARCH  
TRL: 6



COMPETENCIES  
Energy,  
Industrial processing,  
Algorithmic



## INNOVATIVE THERMAL MANAGEMENT

# COMPLETE THERMAL MANAGEMENT TOOL

Innovative Thermal Management develops a complete tool to **simulate and optimize the thermal management** of all types of vehicles and architectures.

By taking into consideration the vehicle architecture, the materials used, the climatic conditions and the phases of use, SEGULA has developed a comprehensive tool that makes it possible to perfect the thermal management of vehicles without any architectural limitations. All this while ensuring the best possible passenger **thermal comfort**.

This **adaptable and predictive tool** allows to increase autonomy, to **reduce energy consumption**, and increase thermal comfort.



PARTNERS  
St Jean Industries,  
CETHIL (INSA LYON)



MATURITY  
ROLL OUT  
TRL: 9



COMPETENCIES  
Thermodynamic





## CIMENT I3D



# 3D-PRINTED CONCRETE USING INDUSTRIAL WASTE

CIMENT I3D focuses on designing tools and techniques for **producing concrete from waste materials** while maintaining the same final properties as cement.

Ongoing studies aim to master the processing phase and prevent reactions that could alter the composition of the waste-based concrete.

This **eco-friendly** solution helps diminish energy consumption in the construction industry but can also provide **significant cost reduction** from unused and accessible industrial waste.



**PARTNERS**  
SUEZ Recycling and valorization, IMT Mines Ales



**PLANNING**  
Started in 2020



**MATURITY TESTING**  
TRL: 5



**COMPETENCIES**  
Additive manufacturing, Innovative processes, Materials chemistry



# SMART INDUSTRY



**Soeren Muller**  
*Head of Software and  
Digitalization, Segula  
Germany*

“In order to make your operations safer, more convenient, more efficient and productive, system automation (or autonomous system) have become a requirement.

These systems are found in robotics, security, predictive maintenance, autonomous vehicles, energy management... SEGULA contributes to smart industries' progress and adoption, particularly in the fields of artificial intelligence, robotics and sensors.”



## Industry 4.0

- 24** ANAXAGORE  
Design & development process 4.0
- 25** SMARI  
Plant digitalization and object recognition
- 26** TOPONE  
Safe autonomous underground gallery inspections



## Connected and autonomous mobility

- 28** PREMCO  
On-board load and stability AI model
- 29** DESIS  
Contactless and remote vital signs detection

## ANAXAGORE

# DESIGN & DEVELOPMENT PROCESS 4.0

Industry 4.0 demands that industrial system design and **development processes** become more flexible, adaptable, and resource-efficient to respond quickly to the market in a personalized and cost-effective manner.

ANAXAGORE is a software that offers a standardized framework and tools to streamline the development of these systems. It integrates digital technologies into various design operations to **automatically generate executable codes** and deliverables.

This solution increases the **productivity of industrial designers & developers** and enhances the flexibility and reliability of design and development processes by shortening design times and efforts.



**PARTNERS**  
LabSTICC, IRISA  
LIAS, CRISTAL



**PLANNING**  
2024: Demonstrator



**MATURITY  
TESTING**  
TRL: 6



**COMPETENCIES**  
Thermodynamic







**SMARI**

## PLANT DIGITIZATION AND OBJECT RECOGNITION

Industrial plants need to evolve towards Industry 4.0, using reliable and up-to-date plans.

SMARI provides **AI tools to speed up 3D-modelling of complex industrial installations**, from on-site acquisition to CAD modelling, in a semi-autonomous manner, using a 3D-scan and object recognition model.

This project enables **time reduction** to redesign plans of existing installations, **minimization of risks** linked to human intervention for maintenance on installations and offer **high fidelity data** which can be used to construct digital twins.



**PARTNERS**  
Lab STICC



**PLANNING**  
Prototype in 2024  
User test in 2025



**MATURITY RESEARCH**  
TRL: 4/5



**COMPETENCIES**  
3D Scan, AI,  
Object Recognition

## TOPONE

# SAFE UNDERGROUND GALLERY INSPECTIONS

TOPONE is a prototype **drone** that can **autonomously inspect** any underground power line.

TOPONE solution combines **thermographic camera** to detect hot spots on the damaged cables, and an RGB camera that checks for breaks or cracks. Information on the environmental conditions (O<sub>2</sub> and harmful gas concentration, temperature) are also collected via on-board sensors.

TOPONE solution allows for **avoiding** -sometimes deadly- **accidents** of inspection missions and securing eventual technical intervention.



PARTNERS  
CATEC



PLANNING  
Prototype in 2024



MATURITY  
TESTING  
TRL: 5



COMPETENCIES  
Data processing





## PREMCO

# PREDICTING DANGEROUS MOVEMENT FOR TRAINS

PREMCO provides a **monitoring system** designed to **anticipate hazardous situations**, particularly when objects or humans approach the train.

This system utilizes image processing and AI, that **can accurately predict the trajectory of objects in motion**.

The solution not only **diminishes the cost** associated with **equipment downtime** periods but also ensures **better traffic management** by avoiding day-to-day incidents.



PARTNERS  
IRSEEM



PLANNING  
2022-2026: Prototyping  
2026-2027: Rolling Out



MATURITY  
TESTING  
TRL: 5



COMPETENCIES  
Modeling, Robotics, AI





## DESI

# CONTACTLESS AND REMOTE VITAL SIGNS DETECTION

DESI **collects vital data signs** to detect any problematic health conditions that could affect train conductors and their passengers.

By analyzing parameters such as heart rate DESI plays a crucial role in ensuring the safety of train conductors and customers on board.

This **cost-effective solution** helps railway companies avoid tragic accidents and potential lawsuits which can tarnish the company's reputation.

The project can also be used for **other usages**, such as : remote medical surveillance, or monitoring of incidents for other drivers (truck drivers, airplane pilots).



PARTNERS  
IFSTTAR/IEMN



PLANNING  
2022-2025: Prototype  
2025-2026: Roll Out



MATURITY  
TESTING  
TRL: 4



COMPETENCIES  
Modeling, Electronic,  
Signal processing



# INDUSTRY FOR LIFE



**Damien Convert**, *Chief Commercial Officer*

“Progress in life science is important and necessary, as it helps improve human health (e.g. population aging), with new and safer technology. It can also solve the issue of human organs and cells’ donations scarcity and in saving natural resources also preserve biodiversity, and avoid harming the environment.

Our collaborations with renowned laboratories allow us to have life sciences and new technologies meet, for promising projects for the future”



## Bio-printing

**32**

NEW ART

3D-Printed polymer for artery substitution

**33**

BIOPREENT

3D-Printed vegetal cells bio-ink

## NEW ART

PATENT 

# 3D-PRINTED POLYMER FOR ARTERY SUBSTITUTION

The growing demand for arteries prosthesis, coupled with the limited availability of donor organs, requires the exploration of alternative materials.

NEW ART introduces a **method for crafting customized biomaterials** (arteries substitutes) through additive manufacturing with no risk of patient rejection.

This artery prosthesis solution enables more **vital organ availability** and faster delivery for hospitals that usually wait long times for an available donor.



PARTNERS  
3d FAB Platform,  
Lyon 1 University



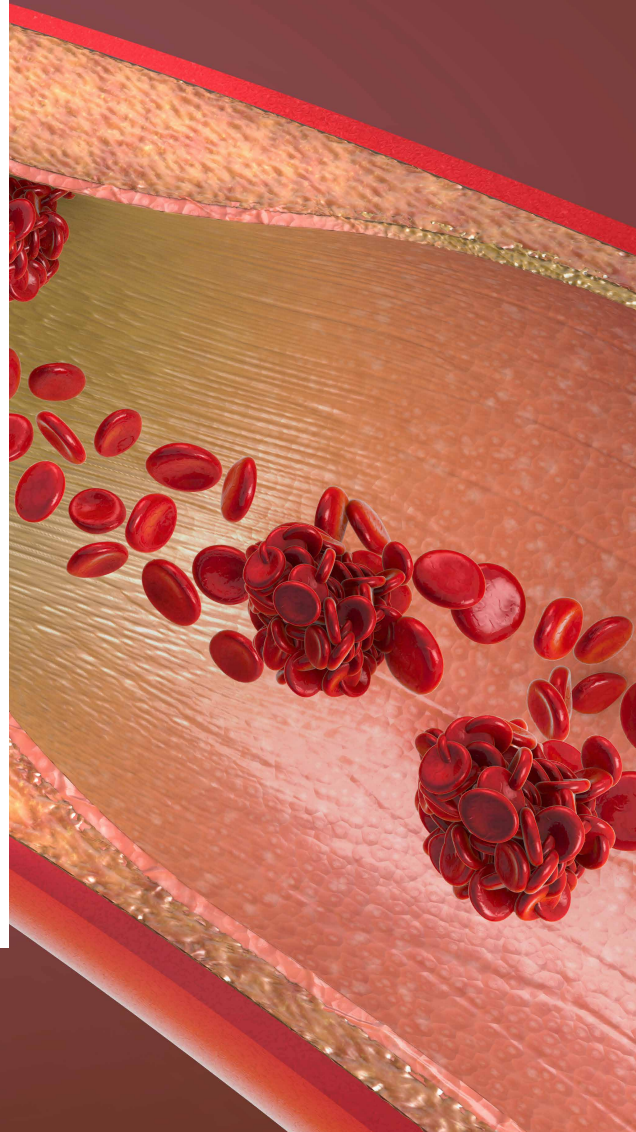
PLANNING  
Started in 2018



MATURITY  
TESTING  
TRL: 4/6



COMPETENCIES  
Polymer additive  
manufacturing, Controlled  
polymer degradation, Cell  
regeneration







## BIOPREENT

# 3D-PRINTED VEGETAL CELLS BIO-INK

As 3D printed vegetals hold significant promise for creating sustainable structures, BIOPREENT develops a **bio-ink based** on vegetal cells serving as a primary material for designing 3D printed structures like wood.

The technology lies in the utilization of **biosourced hydrogel**, a material also used in the production of bio-medical tissue.

This approach enables the fabrication of structures with low carbon cost. If successful, this solution could enable **significant cost savings**, notably in the construction industry.



**PARTNERS**  
3d FAB Platform,  
Lyon 1 University



**PLANNING**  
Started in 2020



**MATURITY**  
**TESTING**  
TRL: 5



**COMPETENCIES**  
Additive Manufacturing,  
Plant Biochemistry

# THEMATIC SUMMARY PER INDUSTRY



## AUTOMOTIVE

- 9** TOLDO  
INCREASED RESISTANCE OF COMPOSITE STRUCTURES
- 13** MULTI-STACK FUEL-CELL  
FUEL CELL INCREASED SIZING AND PERFORMANCE
- 21** INNOVATIVE THERMAL MANAGEMENT  
COMPLETE THERMAL MANAGEMENT TOOL
- 25** ANAXAGORE  
DESIGN & DEVELOPMENT PROCESS 4.0



## RAIL

- 15** H2 BIMODO  
THE WORLD'S FIRST LIQUID HYDROGEN TRAIN
- 25** ANAXAGORE  
DESIGN & DEVELOPMENT PROCESS 4.0
- 28** PREMCO  
HAZARD ANTICIPATION SOLUTION FOR TRAINS
- 29** DESIS  
VITAL SIGN REMOTE DETECTION SOLUTION



## BUS & TRUCKS

- 9** TOLDO  
INCREASED RESISTANCE OF COMPOSITE STRUCTURES
- 10** COMPOSITE CAB  
TRUCK CABIN MASS REDUCTION SOLUTION
- 13** MULTI-STACK FUEL CELL  
FUEL CELL INCREASED SIZING AND PERFORMANCE
- 29** DESIS  
VITAL SIGN REMOTE DETECTION SOLUTION



## AEROSPACE

- 9** TOLDO  
INCREASED RESISTANCE OF COMPOSITE STRUCTURES
- 14** ZERO  
GREEN LIQUID HYDROGEN-POWERED AVIATION
- 25** ANAXAGORE  
DESIGN & DEVELOPMENT PROCESS 4.0
- 29** DESIS  
VITAL SIGN REMOTE DETECTION SOLUTION



## CONSTRUCTION

**22** CIMENT I3D  
3D-PRINTED CONCRETE USING INDUSTRIAL WASTE

**26** SMARI  
PLANT DIGITIZATION AND OBJECT RECOGNITION

**27** TOPONE  
SAFE UNDERGROUND GALLERY INSPECTIONS



## NAVAL

**12** REMORA  
DURABLE ENERGY STORAGE SOLUTION

**16** GREENDELIRIVER  
SUSTAINABLE LOGISTICS SOLUTION

**19** STABLOAD  
FREIGHT MANAGEMENT SOLUTION



## LIFE SCIENCE

**32** NEW ART  
3D PRINTED BIOMEDICAL SOLUTION

**33** BIOPREENT  
3D PRINTED VEGETAL CELLS



## ENERGIES & UTILITIES

**6** CUVE  
PREDICTION OF TANK EXPOSURE TO EXTERNAL FORCES

**12** REMORA  
EFFECTIVE AND DURABLE ENERGY STORAGE SOLUTION

**17** BIOFILTRATION  
BIOLOGICAL FILTRATION SYSTEM FOR INDUSTRIAL EFFLUENTS

**18** ATARA  
WATER RESOURCES MANAGEMENT TOOL

**20** BIOPTÉ  
ENERGETIC USES OF BIOMASS PROCESSING

**25** ANAXAGORE  
DESIGN & DEVELOPMENT PROCESS 4.0

**26** SMARI  
PLANT DIGITIZATION AND OBJECT RECOGNITION

**27** TOPONE  
SAFE UNDERGROUND GALLERY INSPECTIONS



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