

27th Workshop on the Developments in the Italian PhD Research on Food Science Technology and Biotechnology

From Research to Business

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- Professore Emerito - Scuola Politecnica dell'Università di Napoli "Federico II"
- Consigliere per le politiche della ricerca presso il Ministero dell'Università e della Ricerca
- Presidente di Materias



UNIVERSITÀ DEGLI STUDI
DI NAPOLI FEDERICO II

MATERIAS[®]
ideas come to life for a sustainable world



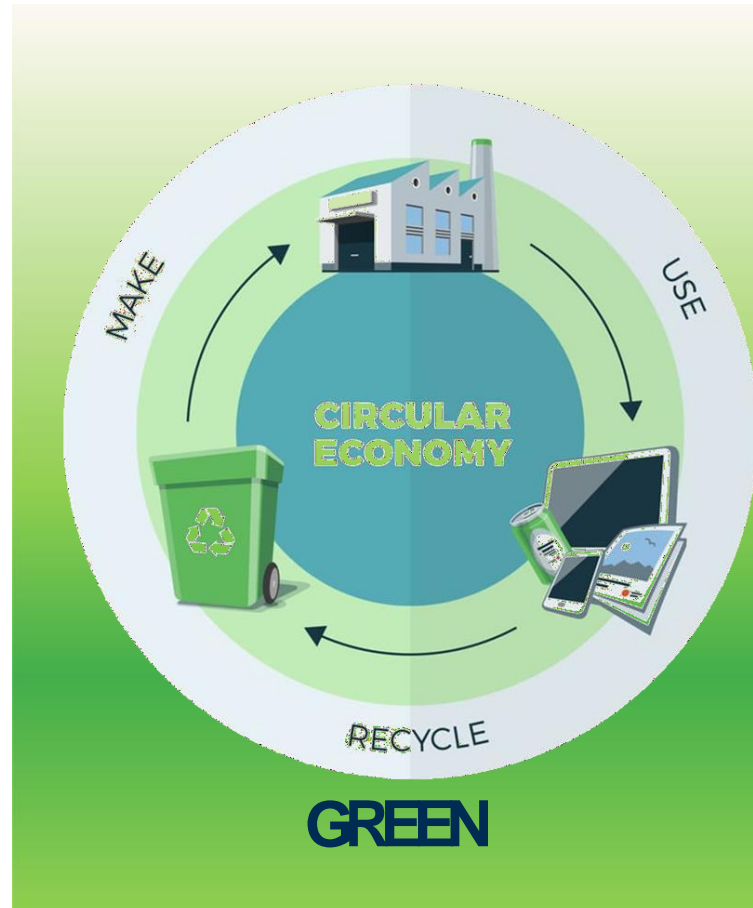
*Ministero dell'Università
e della Ricerca*

PORTICI (NA) - September 13th-15th, 2023

Dipartimento di Agraria, Università degli Studi di Napoli - Federico II

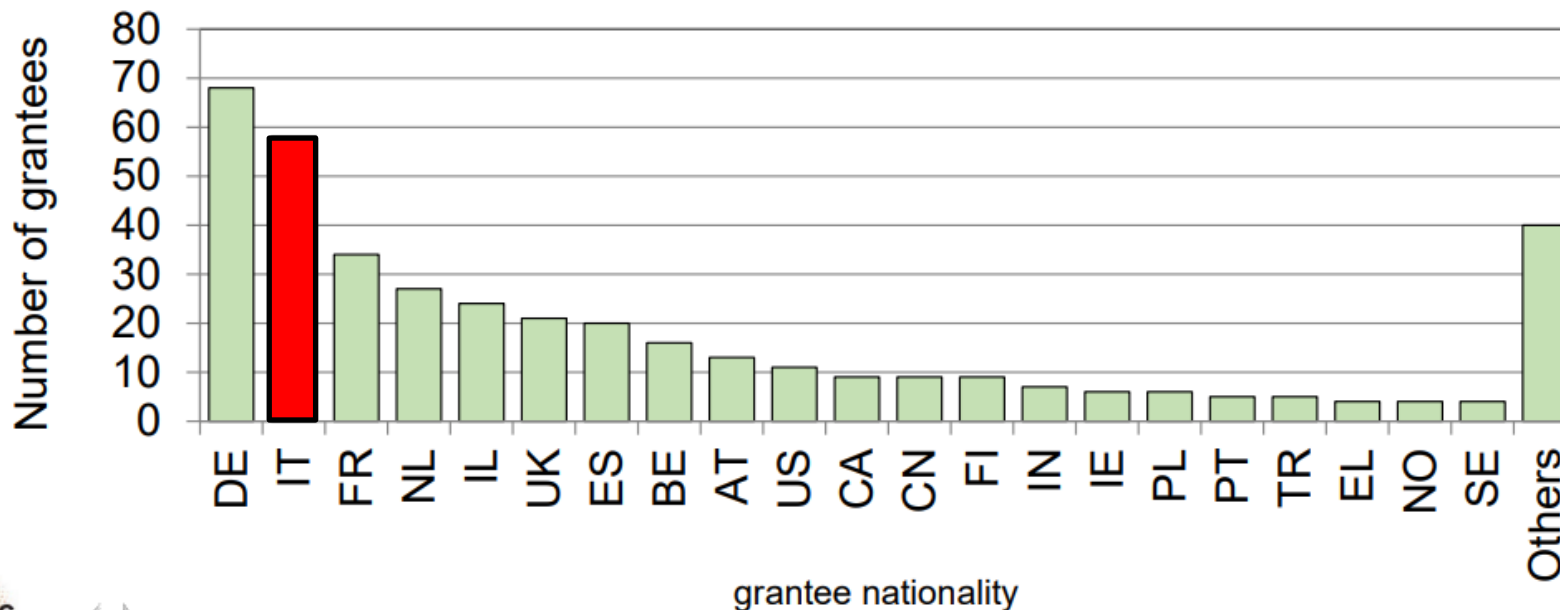
LE GRANDI TRANSIZIONI

La **trasformazione digitale** sta modificando tutti i settori creando nuove opportunità per le imprese, promuovendo una società aperta e democratica e un'economia vivace e sostenibile. Questa economia dovrà **combattere i cambiamenti climatici realizzando una transizione verde**. Gli investimenti in tecnologie avanzate, ricerca e innovazione promuovono sempre più i beni immateriali operando una **transizione dall'economia reale all'economia della conoscenza**.



ERC - STARTING GRANTS 2023

44 nationalities

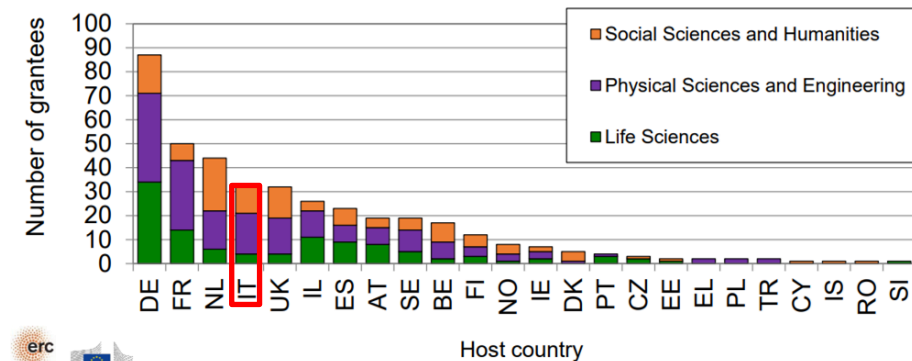


The European Research Council (ERC) has announced the awarding of its Starting Grants 2023 aimed to support young researchers (< 7 years of experience) in the early stage of their scientific career



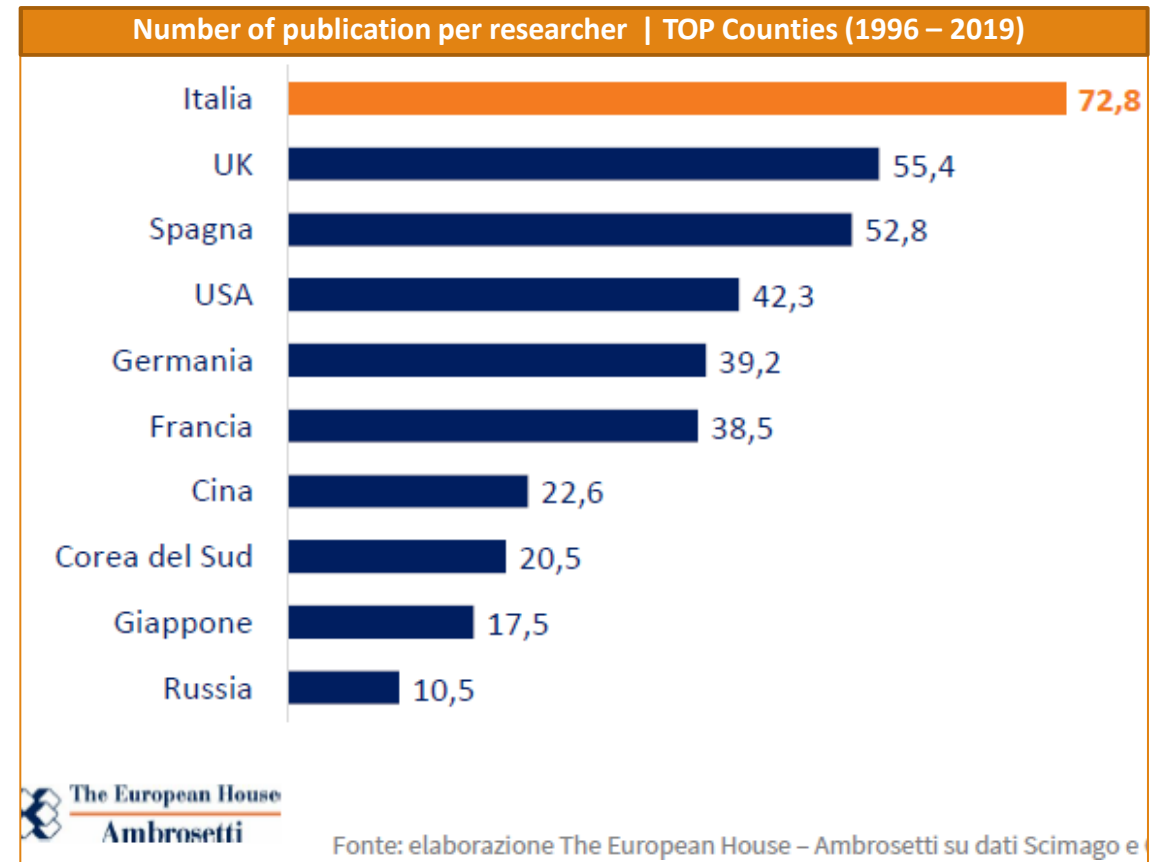
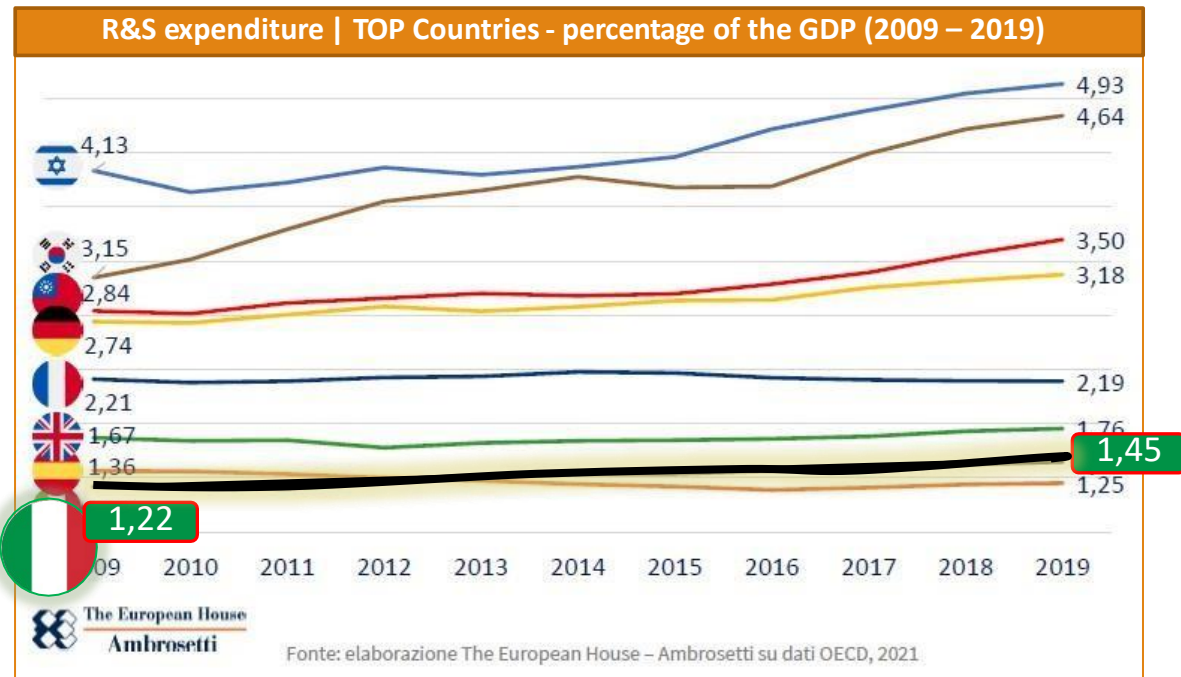
The statistics of the competition show that **Italian researchers** are the second most awarded in Europe with **57 projects**, but only 32 project will be carried out at Italian universities and research centres.

24 countries



PRODUZIONE SCIENTIFICA ITALIANA

Il livello di Innovazione e Competitività della produzione scientifica italiana è ai primi posti delle classifiche mondiali, qualunque siano gli indicatori che analizziamo (citazioni, impact factor, numero di articoli...) soprattutto se rapportato agli investimenti in ricerca.



EUROPEAN INNOVATION SCOREBOARD 2021

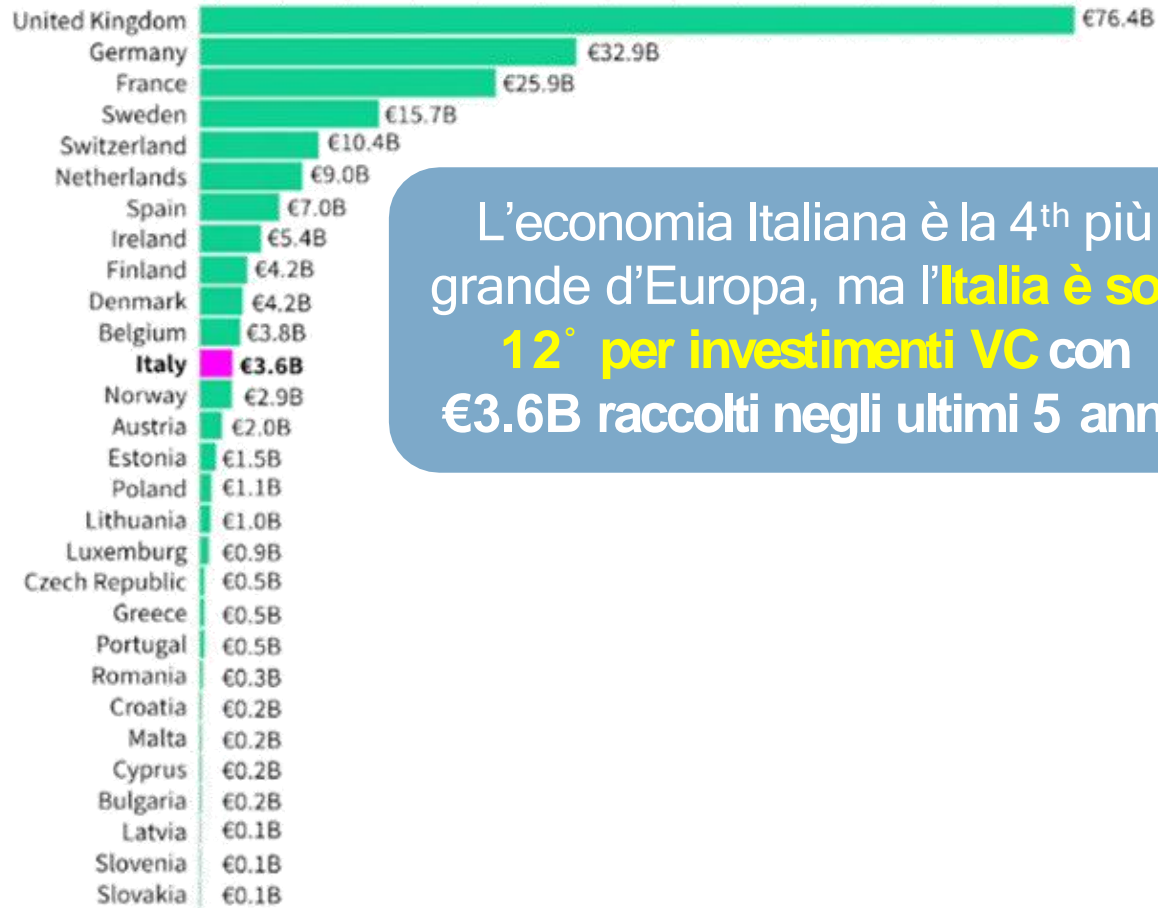
Per misurare quanto e in che modo ciascun Paese contribuisce allo sviluppo economico e sostenibile, l'UE ha lanciato l'annuale **European Innovation Scoreboard (EIS)**, che fornisce una valutazione comparativa della performance di innovazione degli Stati membri dell'UE.



La performance di Cipro, Repubblica Ceca, Grecia, **Italia**, Lituania, Malta, Portogallo, Slovenia e Spagna è inferiore alla media dell'UE. **Questi paesi sono innovatori moderati.**

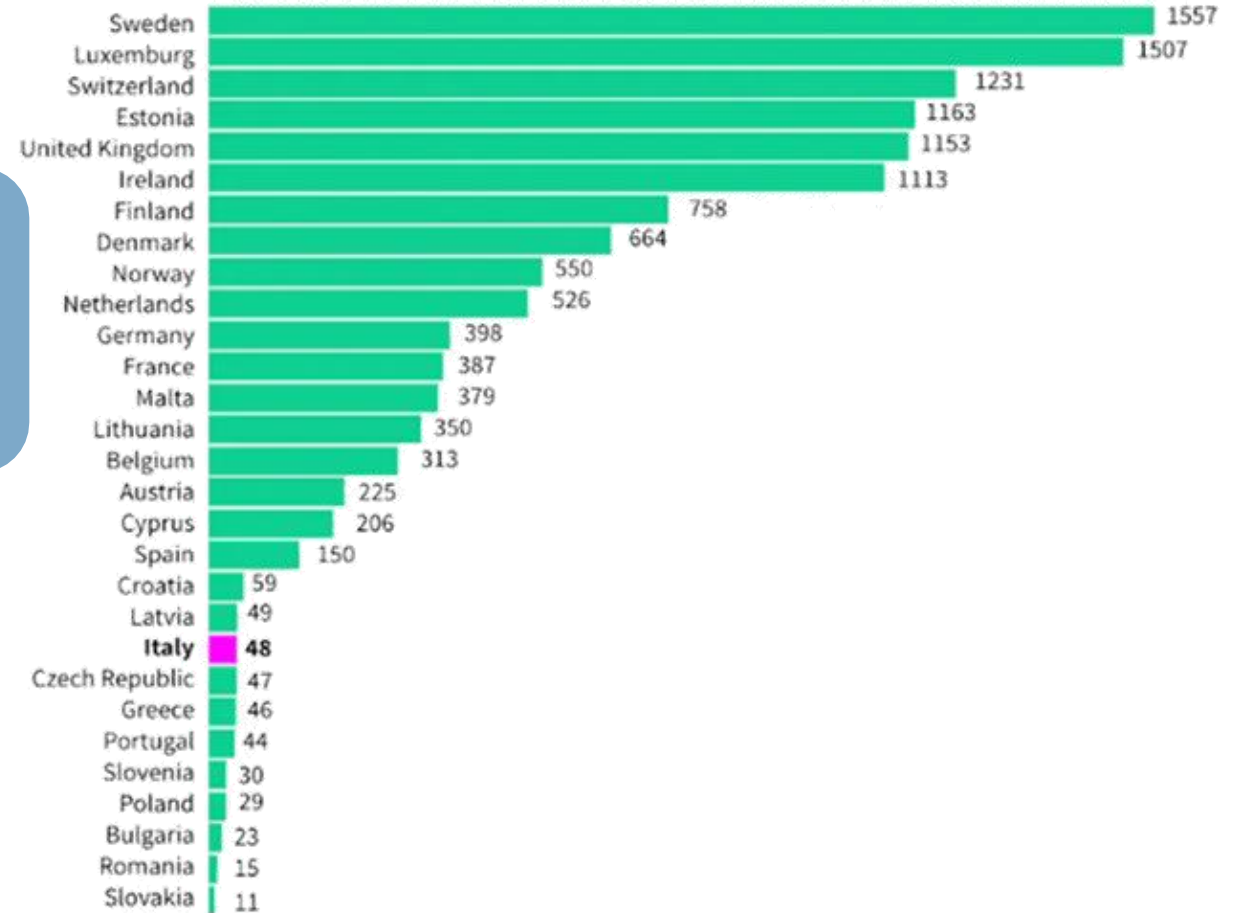
INVESTIMENTI DI VENTURE CAPITALS

VC funding by country (2016 - 2021)



L'economia Italiana è la 4th più grande d'Europa, ma l'Italia è solo **12° per investimenti VC** con **€3.6B** raccolti negli ultimi 5 anni.

VC funding per capita by country (€M, M inhabitants)



Source: Where is Italy at for startups and investment? - [Where is Italy at for startups and investment? | Dealroom.co](https://dealroom.co)

HORIZON EUROPE

Horizon Europe (2021-2027) - budget di circa € 100 miliardi.



La missione dell'ERC è supportare la ricerca di alta qualità Europea con dei finanziamenti competitivi, sostenendo la ricerca di frontiera in tutti i campi, sulla base dell'eccellenza scientifica.



L'EIC mira a identificare e supportare tecnologie innovative e innovazioni rivoluzionarie per creare nuovi mercati e opportunità di crescita a livello internazionale.

ERC → Fondo Italiano per la Scienza



Il Fondo Italiano per la Scienza (FIS): l'allocazione delle risorse avverrà attraverso procedure concorsuali ispirate ai parametri dell'ERC, con particolare riferimento a: Starting Grant e Advanced Grant.

Budget: € 50 MN per il 2021 e € 150 MN/anno a partire dal 2022.

Fondo Italiano per le Scienze Applicate



Il FISA sostiene progetti presentati da singoli ricercatori (Principal investigator), appartenenti al settore pubblico o privato della ricerca nazionale, in qualsiasi campo della scienza e che mostrino spiccate caratteristiche di originalità e innovatività e siano in grado di favorire ricadute socio-economiche e industriali.

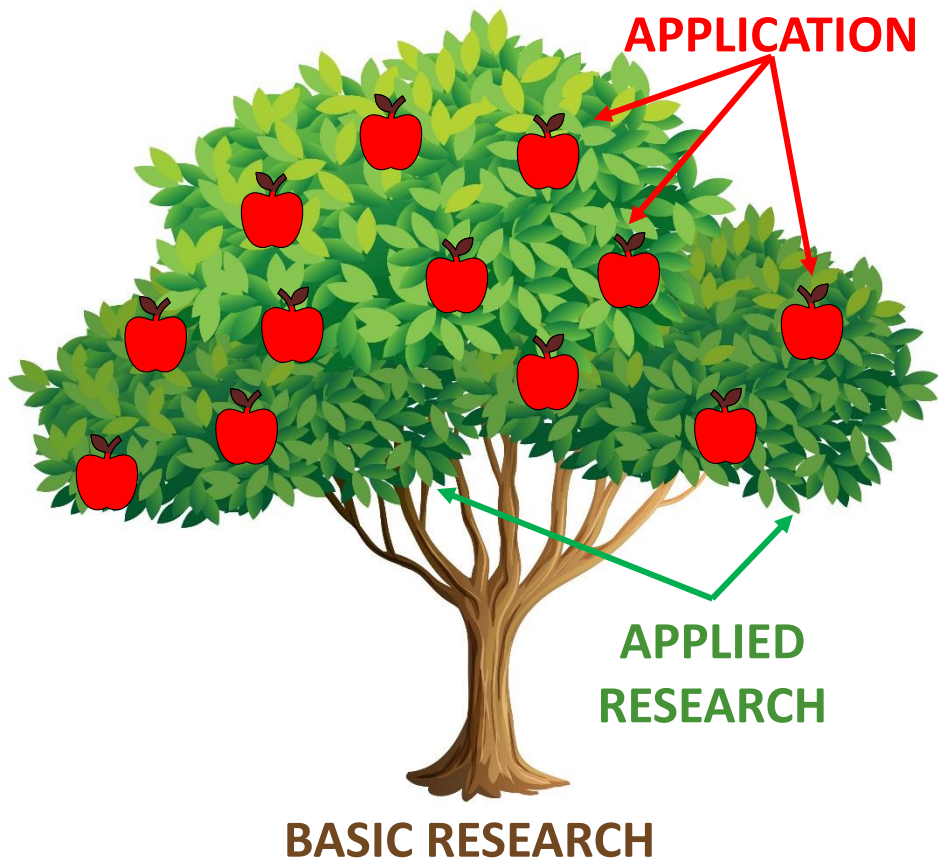
Budget: € 50 MN per il 2022, fino a € 250 MN nel 2025

EIC → MISSIONE4 C2 FROM RESEARCH TO BUSINESS



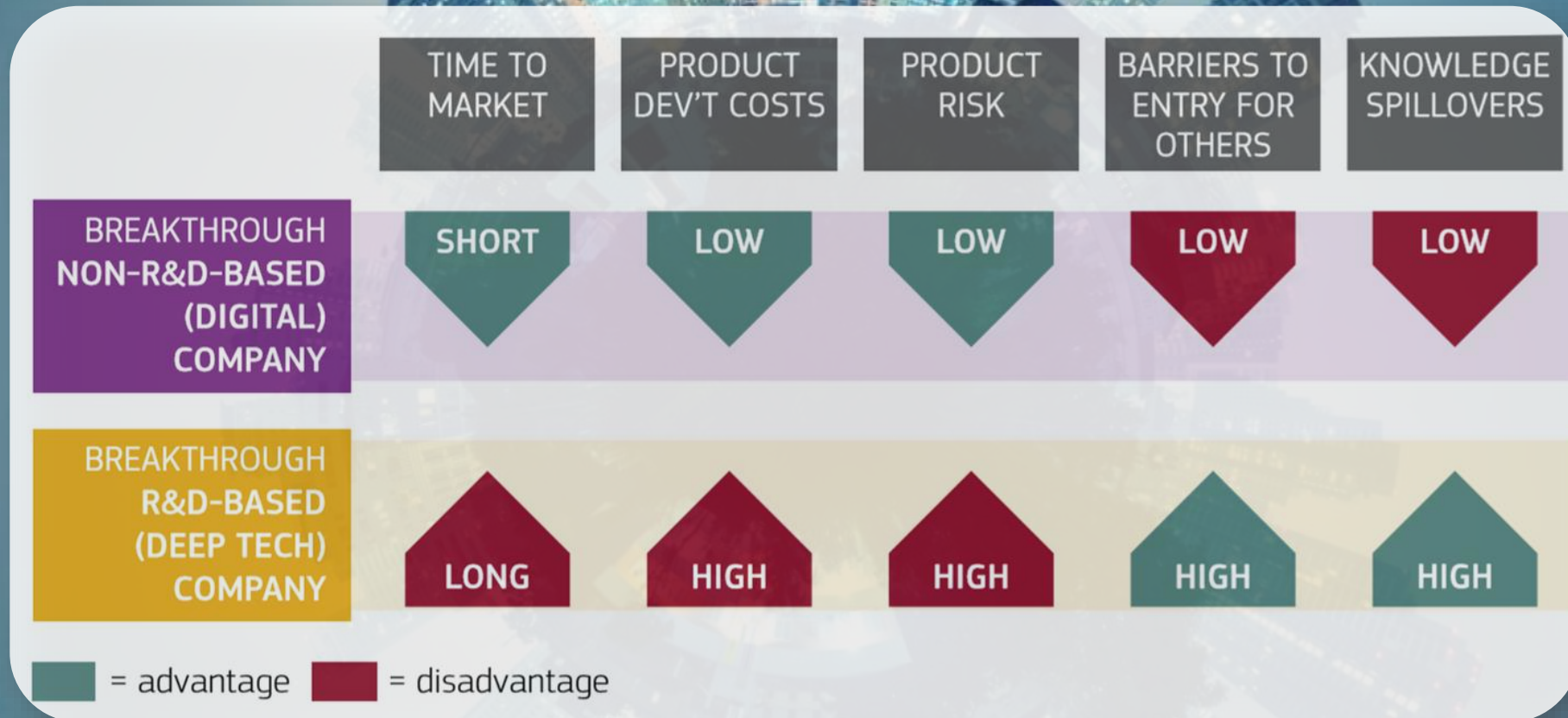
La componente 2 mira a sostenere gli investimenti in R&I, a promuovere l'innovazione e la diffusione delle tecnologie, a rafforzare le competenze e la transizione verso un'economia basata sulla conoscenza. Le tre linee di intervento coprono l'intera filiera dell'innovazione, dalla ricerca di base al trasferimento tecnologico.

FROM RESEARCH TO BUSINESS

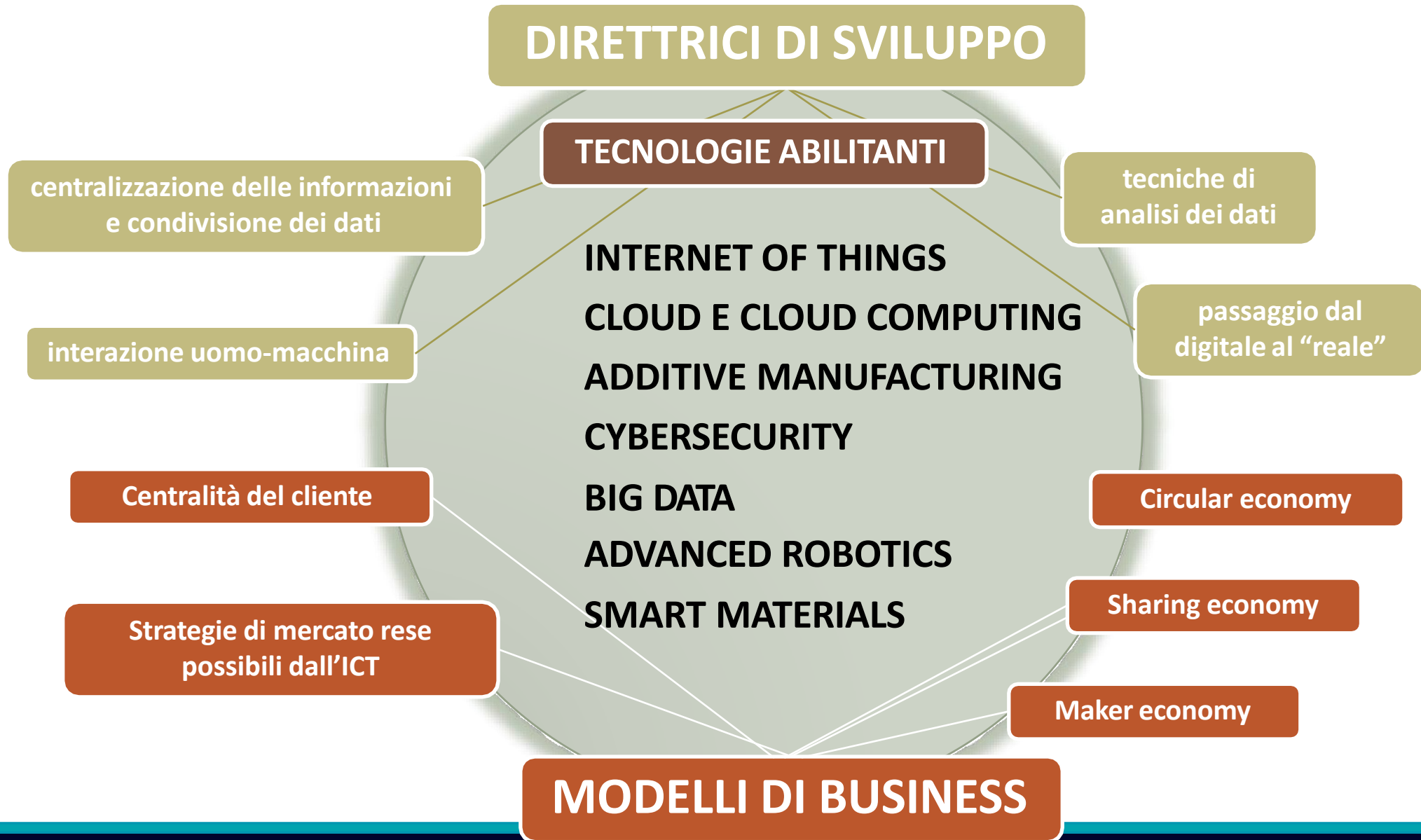


La componente mira a sostenere gli investimenti in R&S, a promuovere l'innovazione e la diffusione delle tecnologie, a rafforzare le competenze, favorendo la transizione verso una economia basata sulla conoscenza. Le tre linee d'intervento previste coprono l'intera filiera del processo di ricerca e innovazione, dalla ricerca di base al trasferimento tecnologico, con misure che si differenziano sia per il grado di eterogeneità dei network tra Università, centri/enti di ricerca e imprese sia per il grado di maturità tecnologica o TRL (Technology Readiness Level). Per tutte le misure sono previste procedure di selezione su base competitiva.

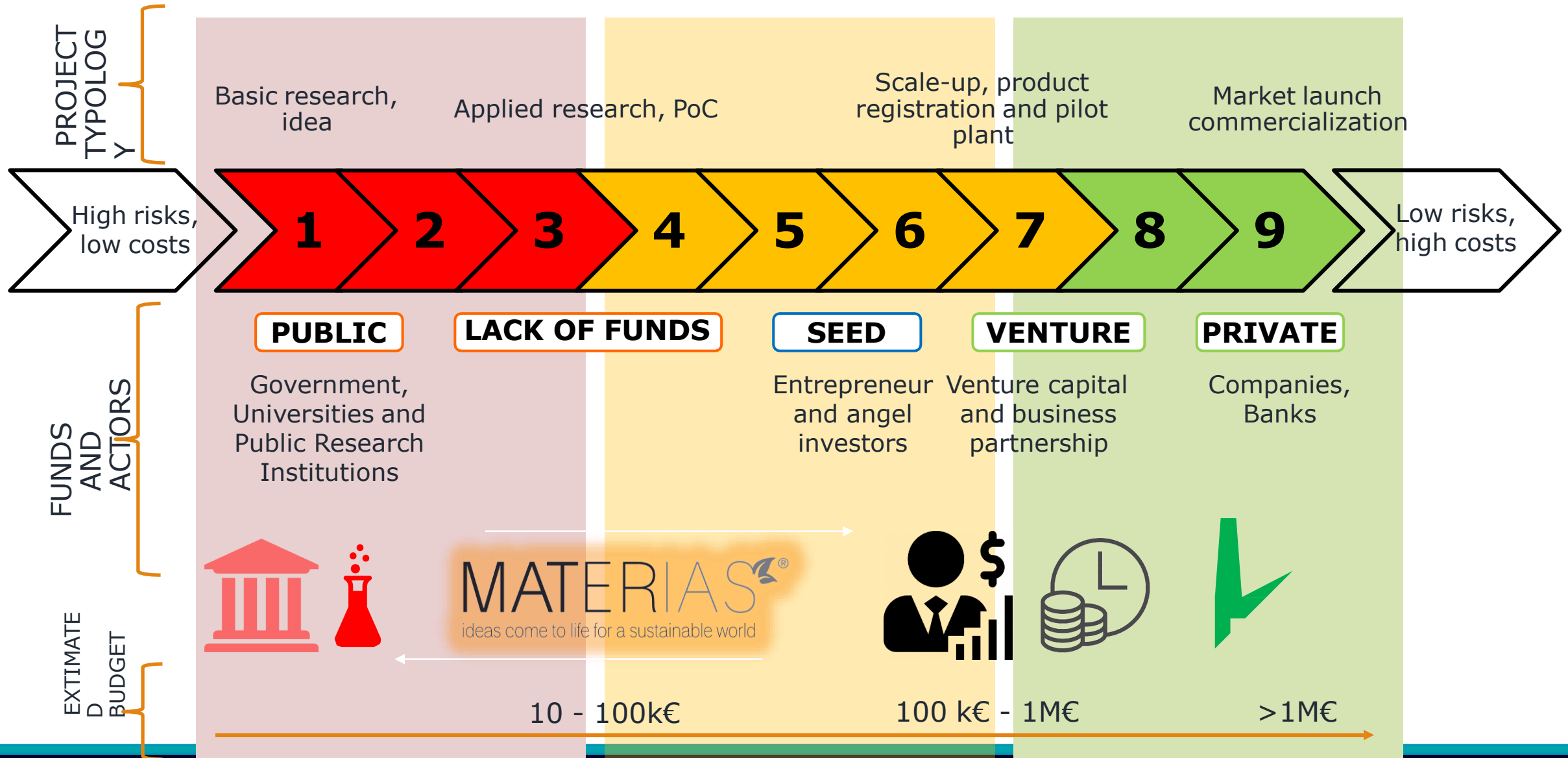
Breakthrough innovations in Digital and 'Deep Tech' (R&D based)



Source: Europe is back: Accelerating breakthrough innovation, European Commission, Directorate-General for Research and Innovation (2017).

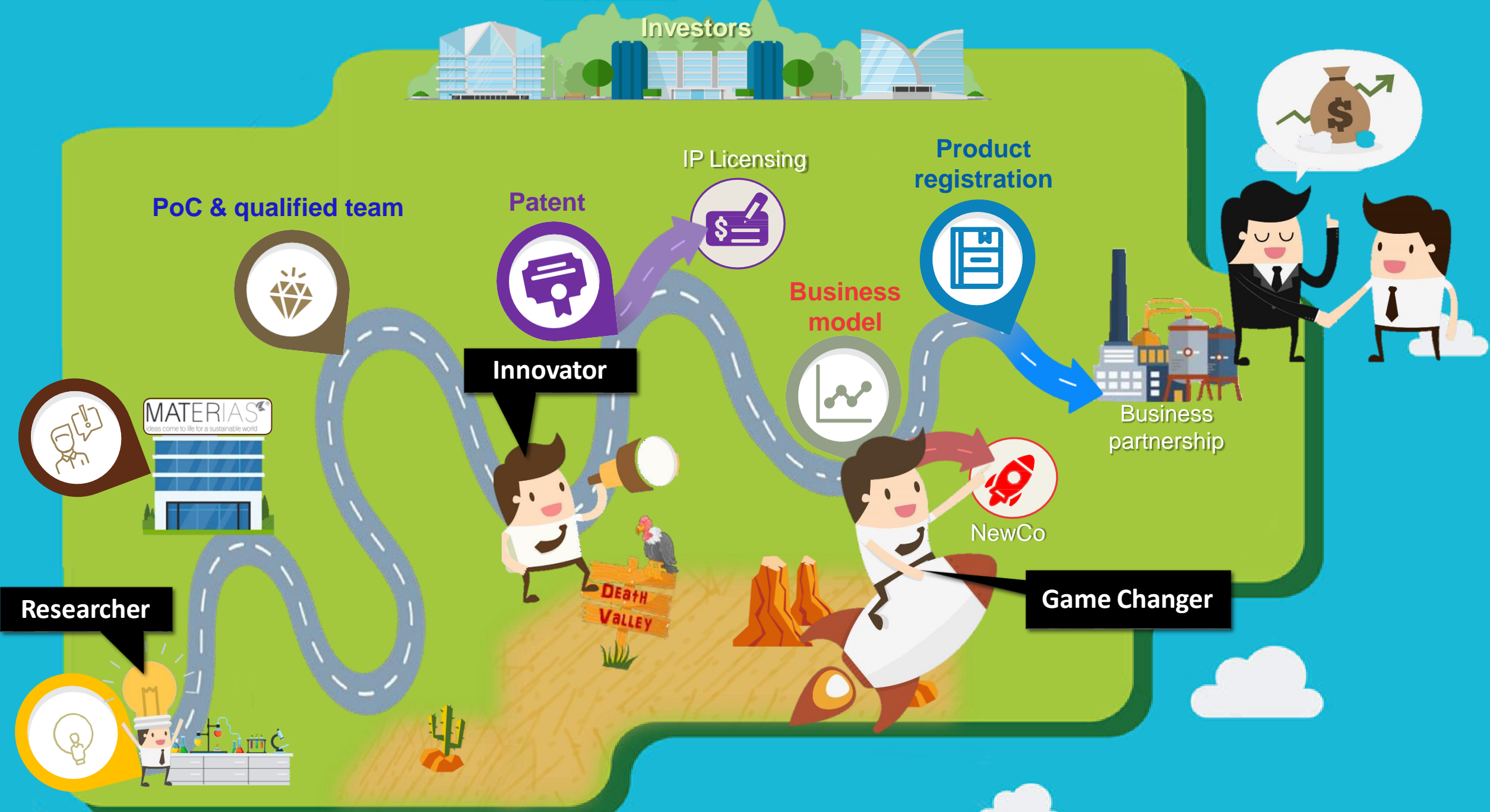


LIVELLO DI MATURITÀ DELLE TECNOLOGIE (TRL)



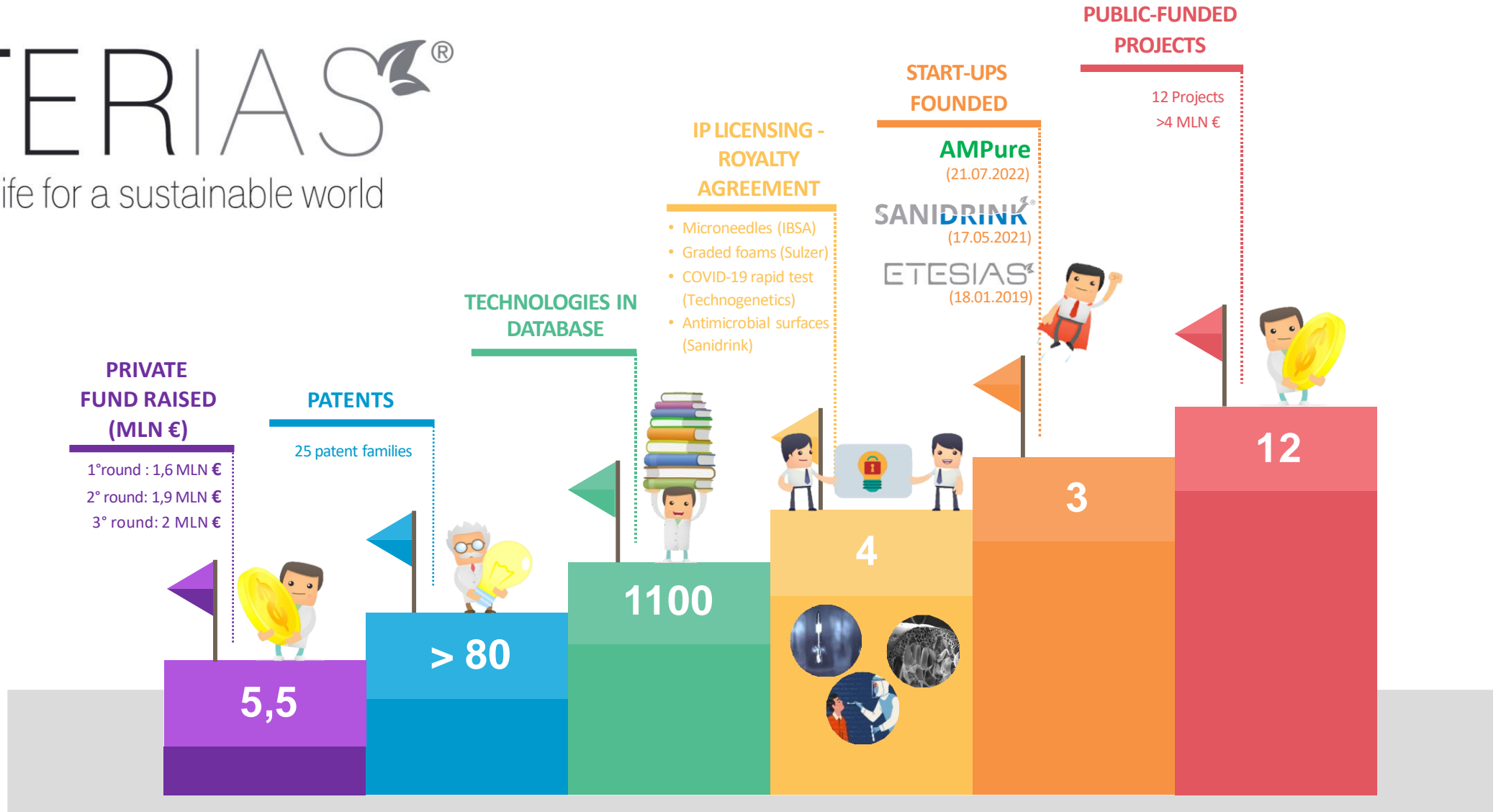
Good ideas can lead to...





MATERIAS[®]

ideas come to life for a sustainable world



INNOVATION ECOSYSTEM 2022




ENEA
Agenzia nazionale per le nuove tecnologie,
l'energia e lo sviluppo economico sostenibile



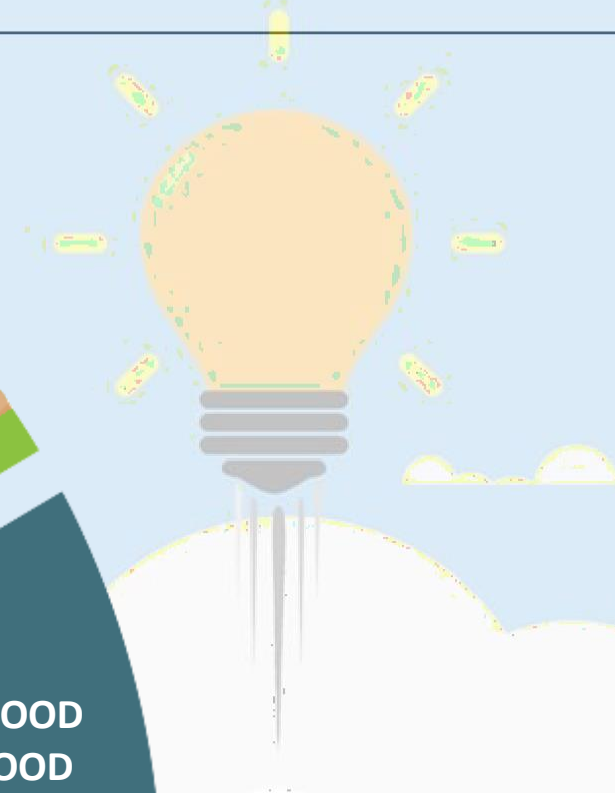
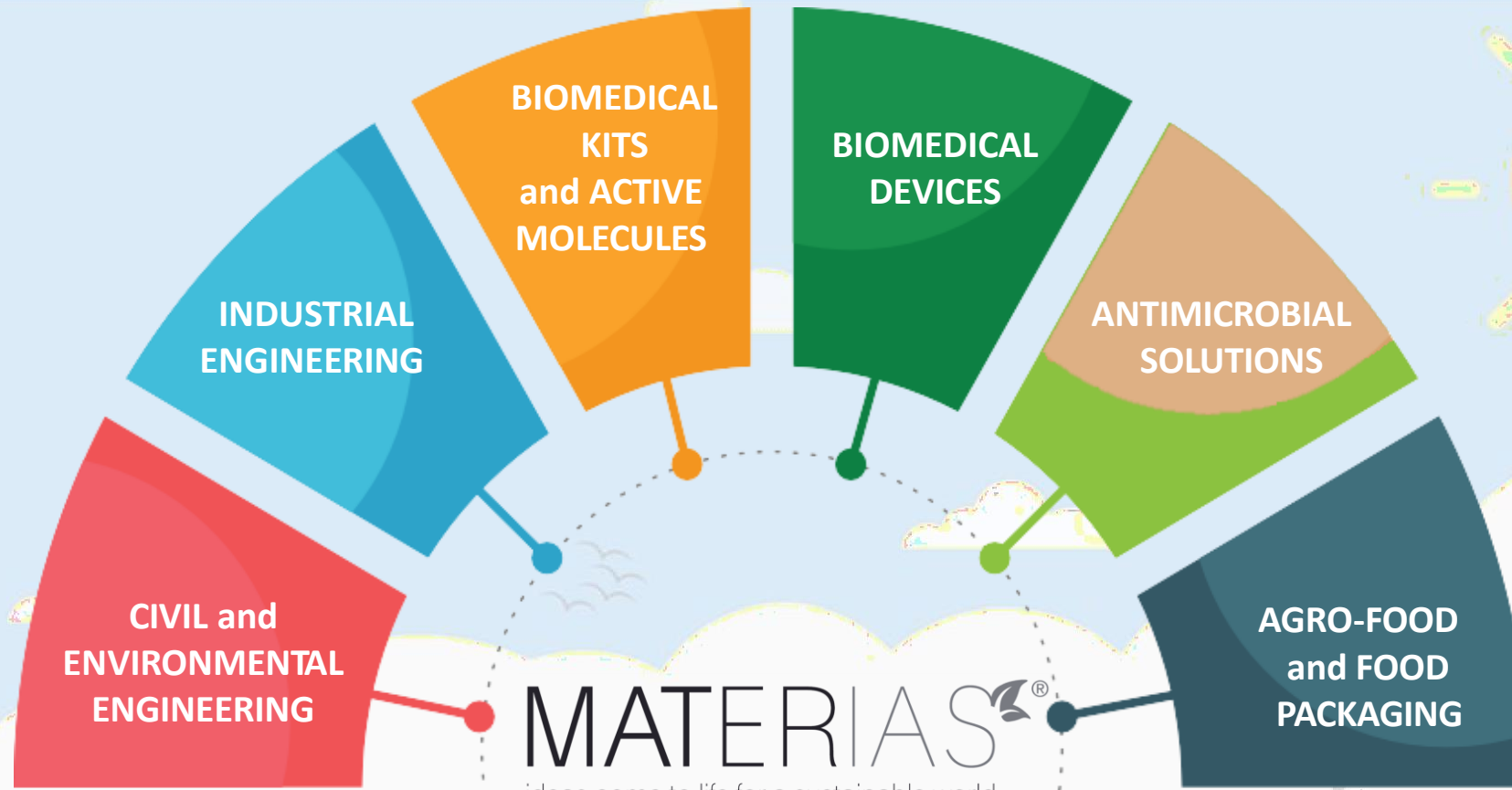
Consiglio Nazionale
delle Ricerche
Through research
departments



Istituto Zooprofilattico
Sperimentale
del Mezzogiorno

Agreements with Universities,
Research Institutions and
Organizations that operates in
Materials Science and Engineering

APPLICATION FIELDS



PER(FOAM)ANCE

PEPTIDES

MICRONEEDLE

ACTIVE TEXTILES

WOUND HEALING

OTHER PROJECTS

- Batch foaming
- Foam injection moulding
- Extrusion foaming
- Bakery products without yeast

- Antimicrobial peptides (AMPs)
- Biostimulant peptides for agriculture

- CO.RE.: Controlled release of active molecules
- HONOR: Microneedle by optical fibers
- VITILIGO patch

- s-PS active textiles for absorption/filtration
- s-PS active textiles for active molecules release

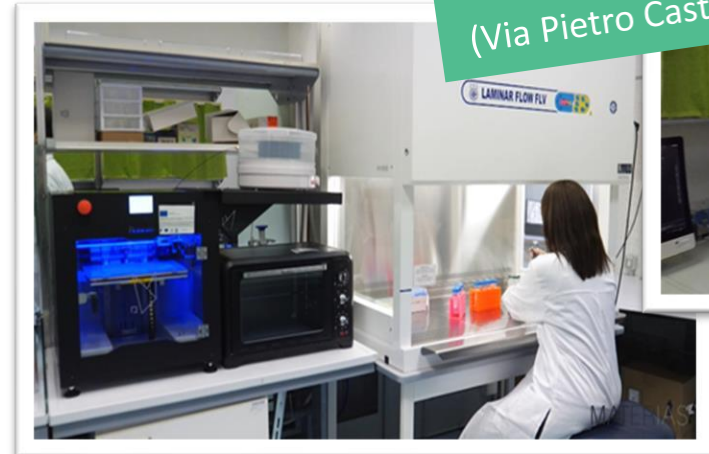
- Self-gelling powder for wound healing

- Use of Deiodinase-2 (D2) inhibitors in cachexia
- HyRES
- Biofertilizers production from cyanobacteria
- PPO films
- Oled Wind
- TiO₂ SENS





Microneedles & Peptides Laboratories
(Via Pietro Castellino – Naples)

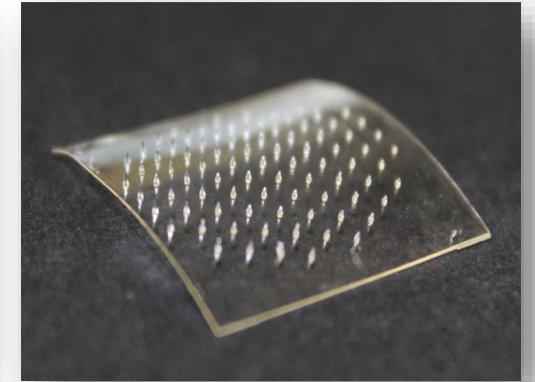


Materias FoamLab
(Piazzale Vincenzo Tecchio, 80 - Naples)



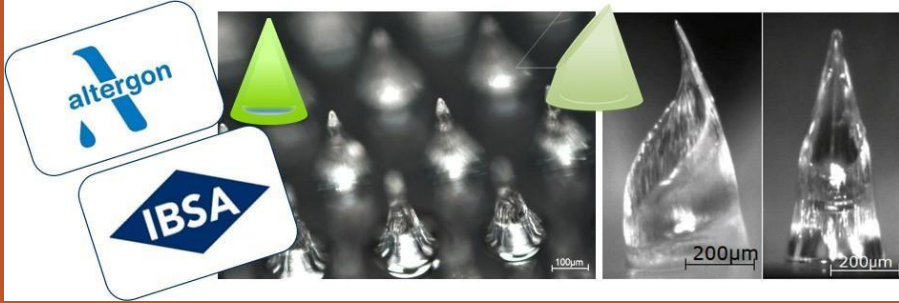
SOME INNOVATION PROJECTS





Medical Device

- Patches of microneedles (hollow or solid) able to release active biomolecules under the skin.
- The technology that uses photolithography was developed and patented in 2018. The IP was transferred to a Swiss leading pharmaceutical company (IBSA). Materias is supporting the technological transfer.
- This company has developed a small-scale plant in 2019 and conducted a feasibility study for the construction of a pilot plant (2021).
- In 2022 IBSA/Altergon has started the procedure for registering the medical device.



The patented technology allows to realize, through a simple single-step process, biocompatible polymeric solid or hollow microneedles for the transdermal administration of active molecules and/or for the sampling of biological fluids.

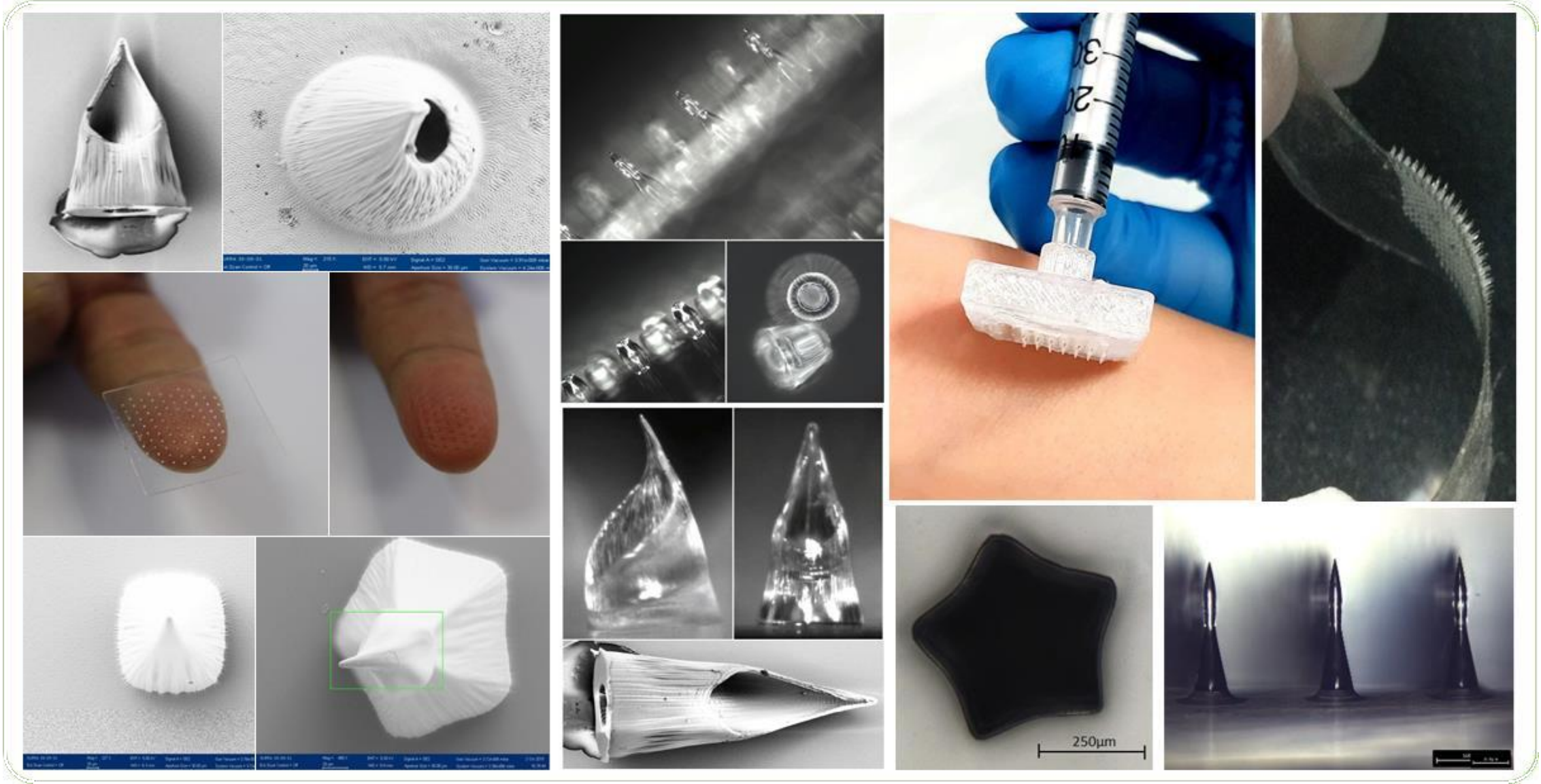
The microneedles are mechanically strong to penetrate skin, increasing the permeability of encapsulated drug through skin.

The drug diffuses from the drug reservoir (membrane backplate) via the microneedles into the skin.

THE PLATFORM

- **Solid microneedle** are used as a pretreatment, after which drug can diffuse through residual holes in skin from a topical formulation (solid MN)
- After insertion of **drug-coated microneedles** into the skin, the drug coating dissolves off the microneedles in the aqueous environment of the skin (coated MN)
- **Drug-loaded microneedles** are made of **water-soluble or biodegradable materials** encapsulating drug that is released in the skin upon microneedle dissolution (dissolving MN)
- **Hollow microneedles** are used to inject liquid formulations into the skin (hollow MN)

MICRONEEDLES CONTROLLED RELEASE PLATFORM



SANIDRINK – ANTIMICROBIAL SURFACES



SANIDRINK®

An innovative and sustainable solution for food and biomedical safety

Antimicrobial products

- Materias has developed and patented a peptide-based technology for the functionalisation of surfaces with the aim of making them antimicrobial
- The technology was transferred to an innovative start-up, Sanidrink, founded in 2021, that works to optimize the functionalization process, validate foodtech and biomedical products.
- In 2022 Ferrarelle Group S.p.A. acquired 30% of the share capital of Sanidrink. With the support of Ferrarelle, Sanidrink is building a pilot plant and developing new products



Intellectual property of SANIDRINK

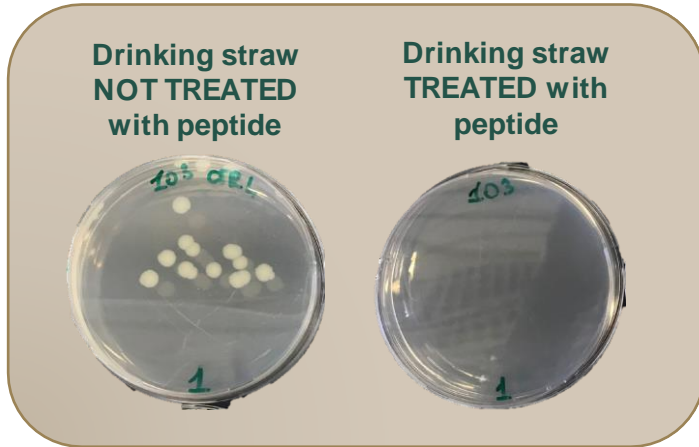
• WO2021191851A1 and WO2021191852A1
National phases (EU, Canada, USA, China, India, Israel)



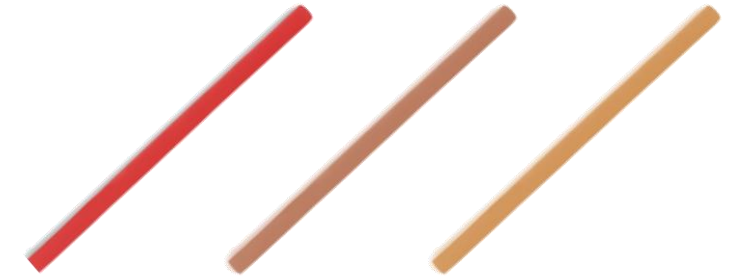
Private and confidential

SOME RESULTS...

E. Coli - 10^3 CFU/ml



E. Coli - 10^4 CFU/ml



- ✓ **Silicone drinking straws** were functionalised with peptides.
- ✓ Results obtained after **24 hours** of incubation.
- ✓ The same results were obtained by **reusing the same drinking straw (washed)**
- ✓ **high antimicrobial activity** maintained also after two washing cycles (ISO 22196:2011)

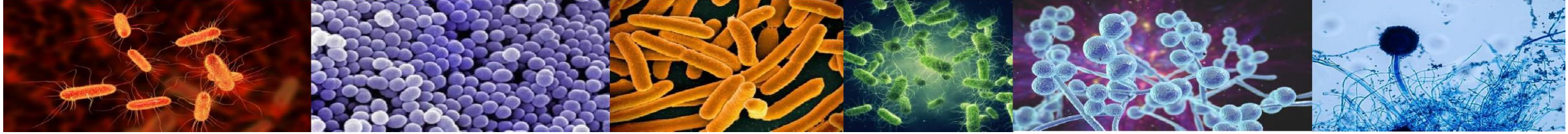
E. Coli - 10^5 CFU/ml



E. Coli - 10^6 CFU/ml



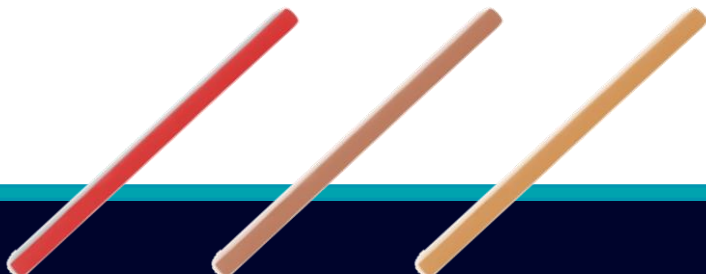
ANTIMICROBIAL ACTIVITY – ISO 22196:2011



STRAIN	Inoculum Concentration (CFU/mL)	Log Reduction (R)	Microbial Reduction (%)
Escherichia coli	9,0*10 ⁵	4,31	>99,99
Staphylococcus aureus	8,2*10 ⁵	4,27	>99,99
Listeria monocytogenes	4,4*10 ⁵	3,74	>99,98
Salmonella serovar Typhimurium	3,9*10 ⁵	3,67	>99,98

STRAIN	Log Reduction (R)	Microbial Reduction (%)	Valid test
Escherichia coli (after 24h of washing)	3,61	>99,99	yes
Staphylococcus aureus (after 48h of washing)	3,25	>99,99	yes

After washing samples for 24h and 48h with distilled water to simulate the use of reusable bottles





AMPure[®]

Dermocosmetic products

- Materias has developed and patented peptides with antimicrobial properties
- A dermocosmetic product based on peptides and hyaluronic acid has been developed, in collaboration with company C4T, for the treatment of acne
- In 2022, the innovative start-up, AMPURE, was established. AMPURE is working on optimizing the formulation and registering the dermocosmetic product



Inspired by nature

Hyaluronic acid

already naturally occurring in the body

attracts and holds on to moisture in skin cells

allows skin to feel more hydrated and plump

reduces blemishes, inflammation and prevents scar formation

Antimicrobial peptides



present in natural innate immune system of the skin

have broad spectrum of action against Gram+/- bacteria

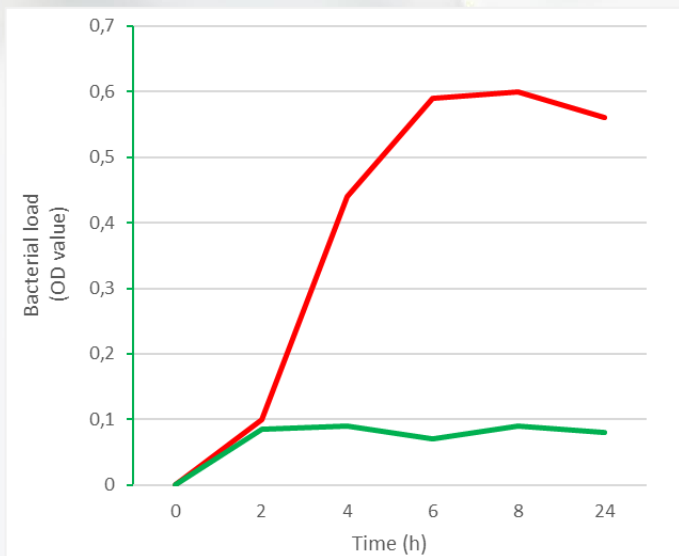
avoid skin irritation and photosensitivity

purify the skin and control bacteria proliferation

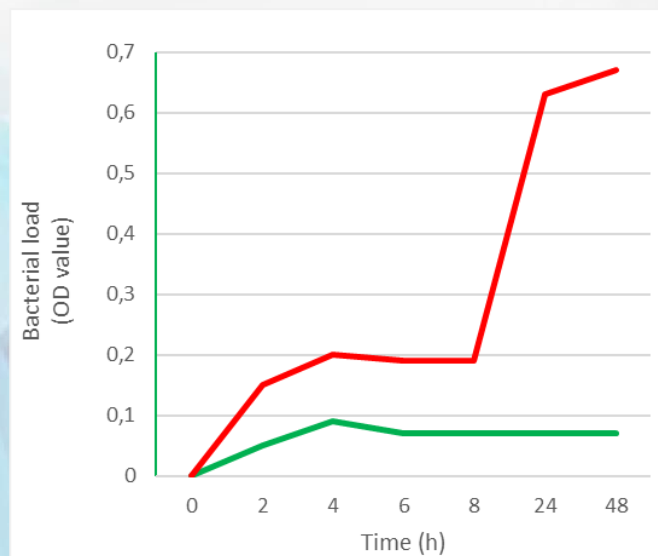
Results

Verified antimicrobial and antibiofilm efficacy in certified laboratories on bacterial strains involved in acne

Antimicrobial activity on *S. epidermidis*



Antimicrobial activity on *C. acnes*



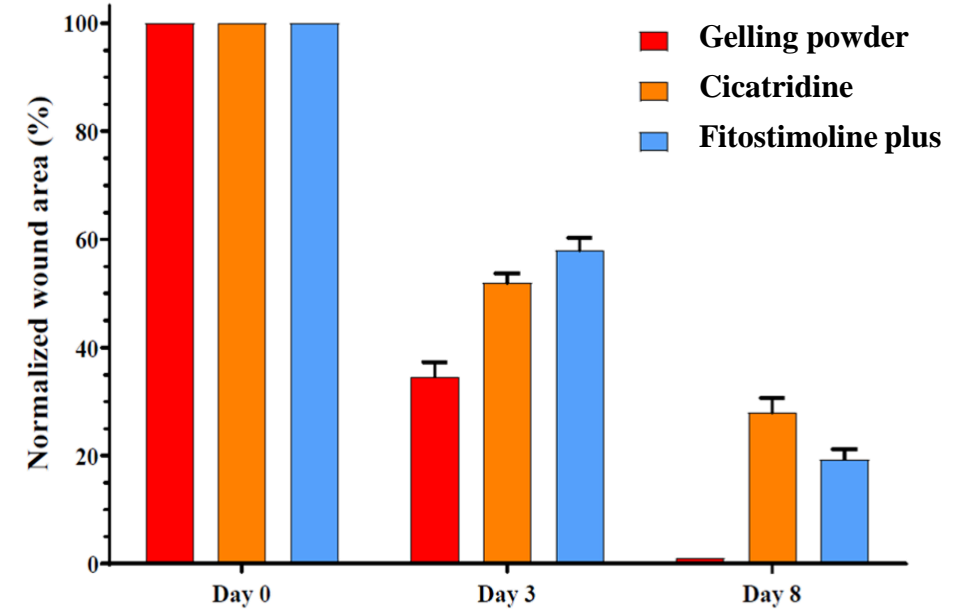
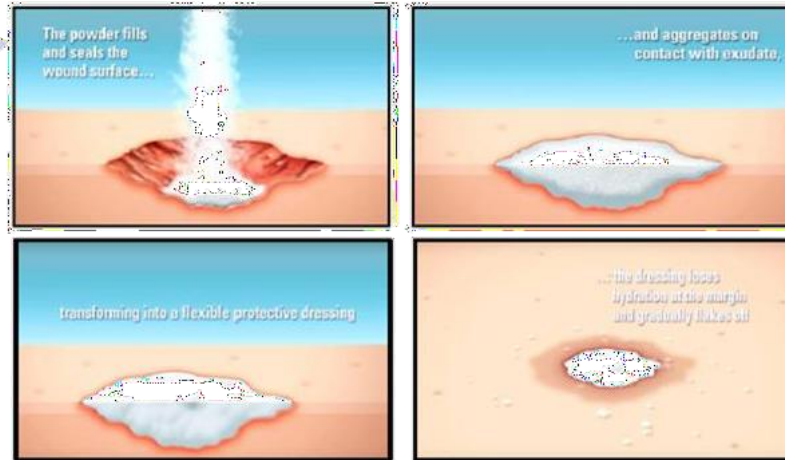
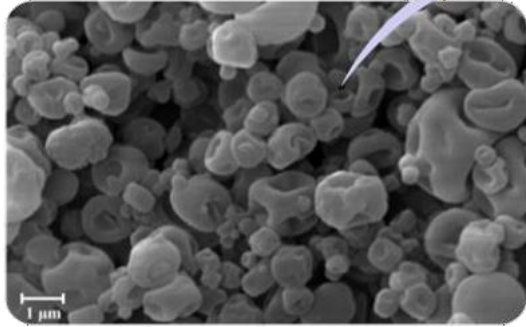
Antimicrobial activity on *P. aeruginosa*
(BS EN 1276:2019 "chemical disinfectants and antiseptics")

Test suspension	Antimicrobial peptide [50uM]	Antimicrobial peptide [25uM]	Antimicrobial peptide [10uM]
10 ⁻⁶ : 251 - 251 10 ⁻⁷ : 38 - 24 N: 2,56 - 10 ⁸ N ₀ : 2,56 - 10 ⁷ Log N ₀ : 7,41	10 ⁰ : 3 - 1 N _a < 1,40 x 10 ² Log N _a < 2,15 Log R > 5,26	10 ⁰ : 3 - 1 N _a < 1,50 x 10 ² Log N _a < 2,18 Log R > 5,23	10 ⁰ : 3 - 1 N _a < 1,40 x 10 ² Log N _a < 2,15 Log R > 5,26
	Active	Active	Active

N: number of CFU/ml in the test suspension
N₀: number of CFU/ml in the test mixture (beginning of the contact time)
N_a: number of CFU/ml in the test mixture (end of the contact time)
R: reduction in viability (log R = log N₀ - log N_a)

Active if log R ≥ 5

WOUND MANAGEMENT



Medical Device

- Materias has developed and patented an innovative blend of biodegradable polymers able of gelling in contact with wound exudate, protecting it from infections and accelerating the healing process. It can carry and delivery active molecules.
- The scale-up of the production process was finalized in 2020 and Materias is studying the realization of devices capable of dispensing the powder in spray mode
- In 2022, in vivo tests allowed to verify the efficacy of powder
- Materias has started the procedure for registering the medical device (powder without active ingredients)

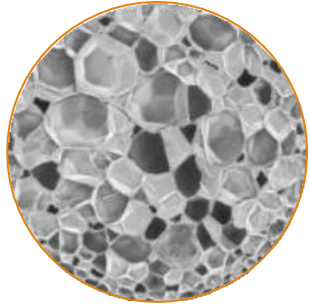
INTELLECTUAL PROPERTY

IT102017000127474A1;
WO2019092608A1, National phases
(EU, Canada, China, Russia, USA,)



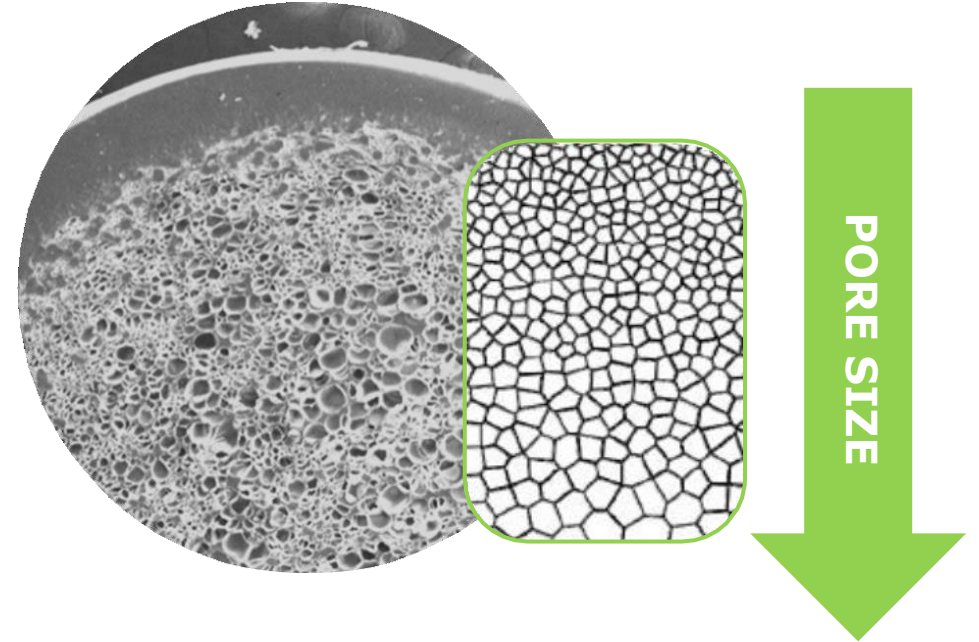
GRANTED

PENDING



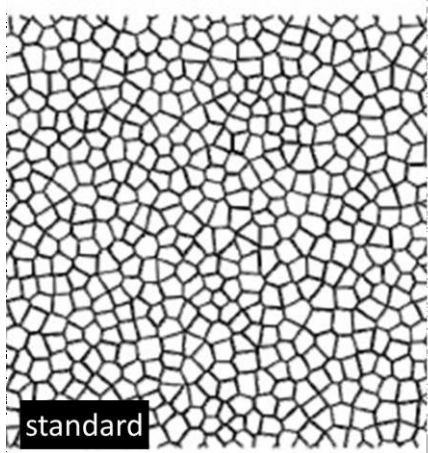
NEW GRADED FOAM MATERIALS

- Materias has patented a new process for the production of porosity gradient foam systems. The process allows the density gradient to be designed ex ante and the characteristics of the final product to be defined directly during the design phase. High performance can be achieved in terms of impact absorption, noise and end-of-life recycling
- Numerous projects are underway involving collaborations with multinational companies

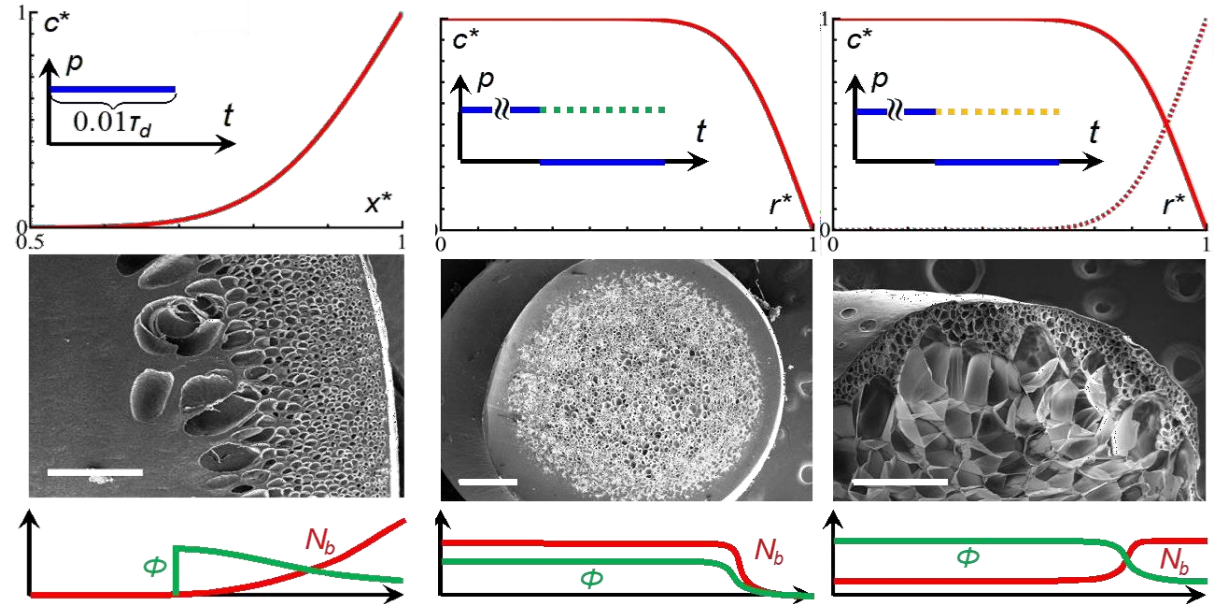


- Metodo per la realizzazione di materiali polimerici espansi stratificati (IT 102018000004727, PCT/IB2019/050068 - National phase: EU, Canada, China, Japan, U.S.A., Vietnam)
- Perline espanse con gradienti di morfologia e/o densità, e schiume sinterizzate da esse ottenute (IT102019000012666, PCT/IB2020/056883, National Phase: EU, USA, Canada, China)
- Procedimento per realizzare prodotti in materiale polimerico espanso multi-gradiente (IT 102019000019310, PCT/IB2020/059090, National Phase in progress: EU, USA, Canada, China, Japan, India)
- Procedimento per la realizzazione di materiali polimerici espansi (IT102022000003512)

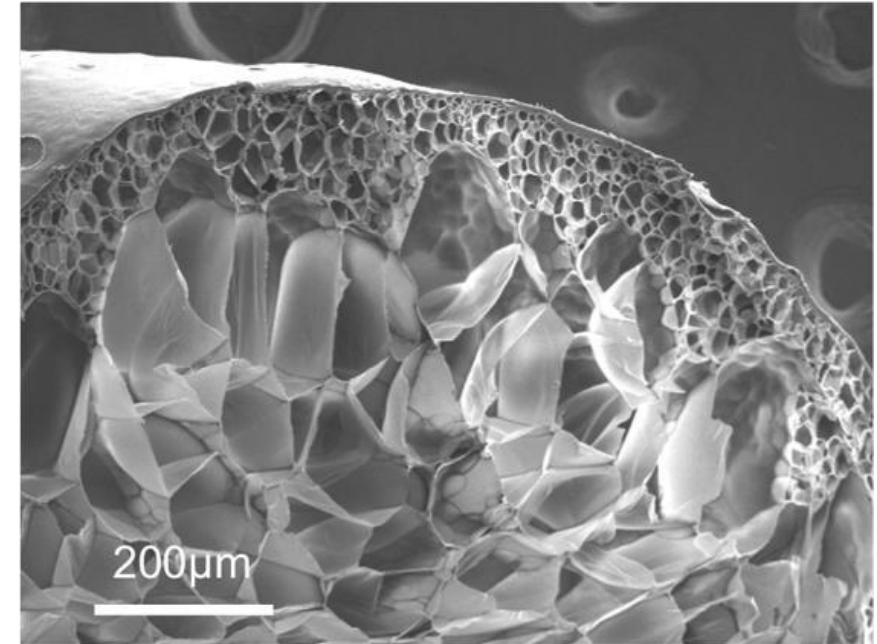
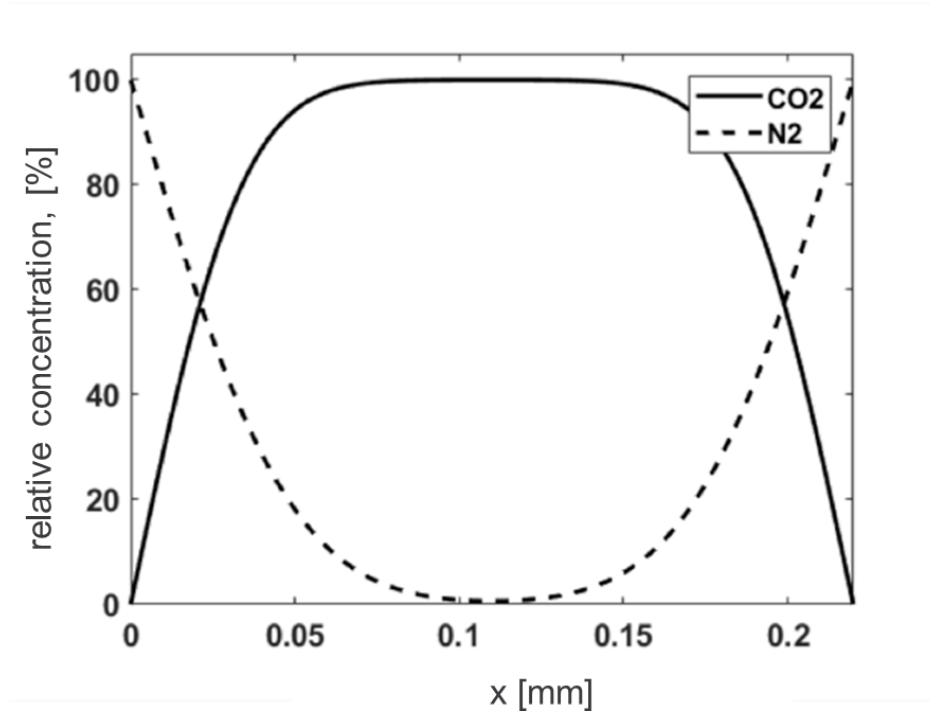
GRADED STRUCTURE – ADVANCED FOAMS



The Patented process generate layered and graded polymeric foams by using the simple gas foaming technology, with the sole introduction of time-varying boundary conditions of the gas sorption stage.



Examples of possible graded foamed structures: red curves representing the blowing agent concentration in *one-half* of the polymeric samples attained at the end of the sorption stage conducted with the pressure history depicted in the inset (blue curve).



In this example, **two different blowing agents** (carbon dioxide and nitrogen) were used during the sorption phase of the graded foaming process.

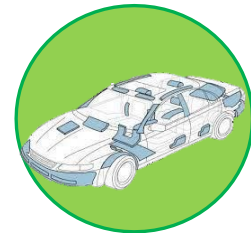
The core of the sample was saturated with carbon dioxide, while the periphery with nitrogen. This process allowed obtaining a **bimodal foamed structure** composed of a low density and large bubbles in the core and a high density and small bubbles in the periphery.



graded structures for impact protection sportswear



sintered graded beads for shoe mid-sole



graded systems for automotive components



graded technopolymers for aeronautic components

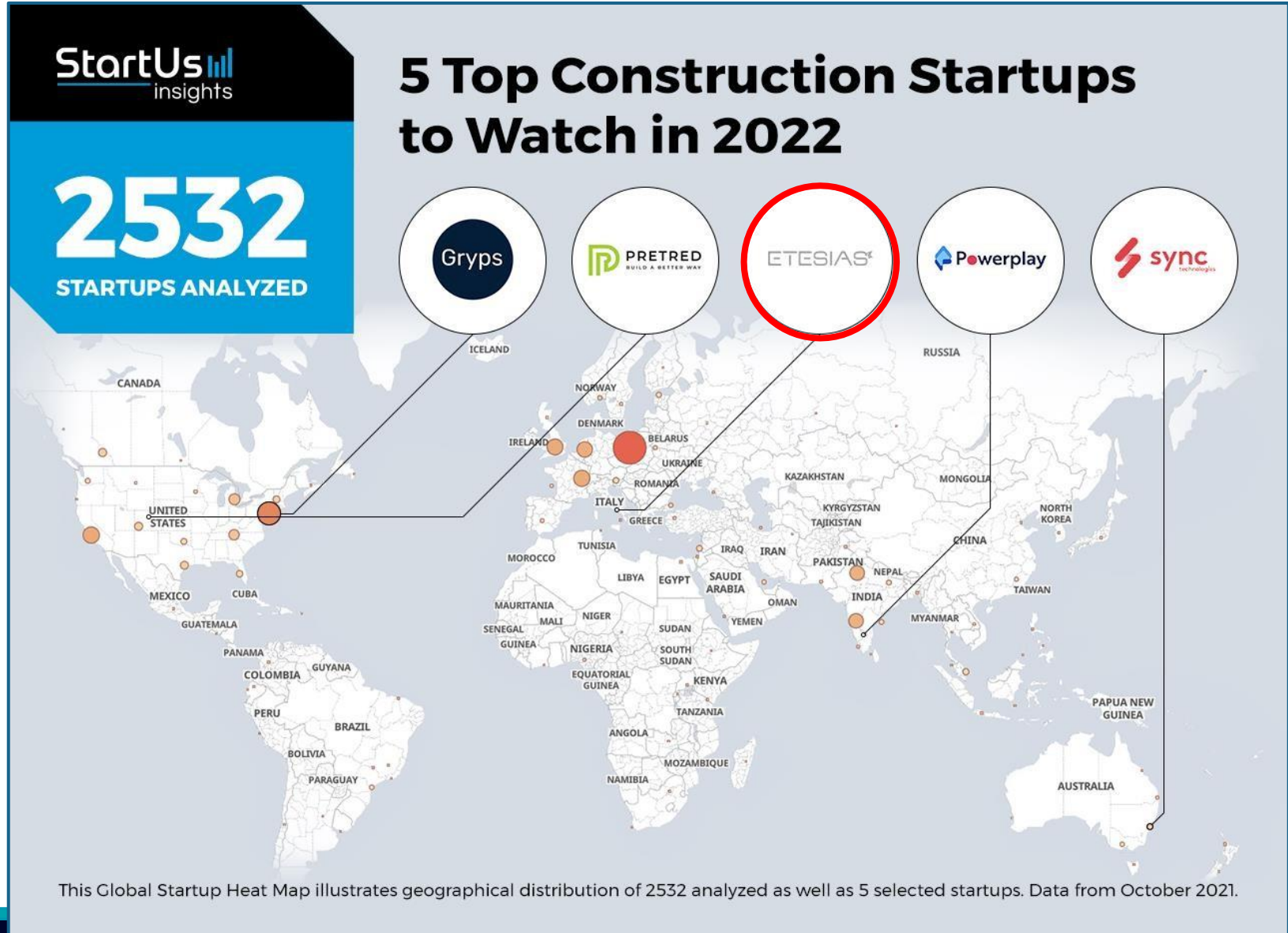
A novel approach to the fabrication of reinforced concrete (RC) beams based on 3D printing technology of concrete has been developed.

The approach is based on the partition of a RC beam into concrete segments to be printed separately and then assembled into a unique monolithic element along with the steel rebar reinforcement system.

This technology is expected to save up to the 50% of concrete and to facilitate the production of curved elements with variable cross-section. Additive manufacturing allows the beam to be partially hollow, in order to save materials, provide functional uses and reduce the final weight, while still guaranteeing adequate mechanical properties.

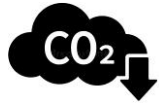


Startus-insights has developed a Global Startup Heat Map that highlights the 5 construction startups that should be watched in 2022 between the 2.527 startups & scaleups analyzed. The report highlights the 5 construction startups starting from scouting of authors, taking into account factors such as location, founding year, the relevance of technology, and funding, among others.



THE SOLUTION

ETESIAS[®]



- Over 50% CO2 reduction



- Possibility of creating non-linear and complex shapes



- Reduction in the use of concrete, with a 50% reduction in weight



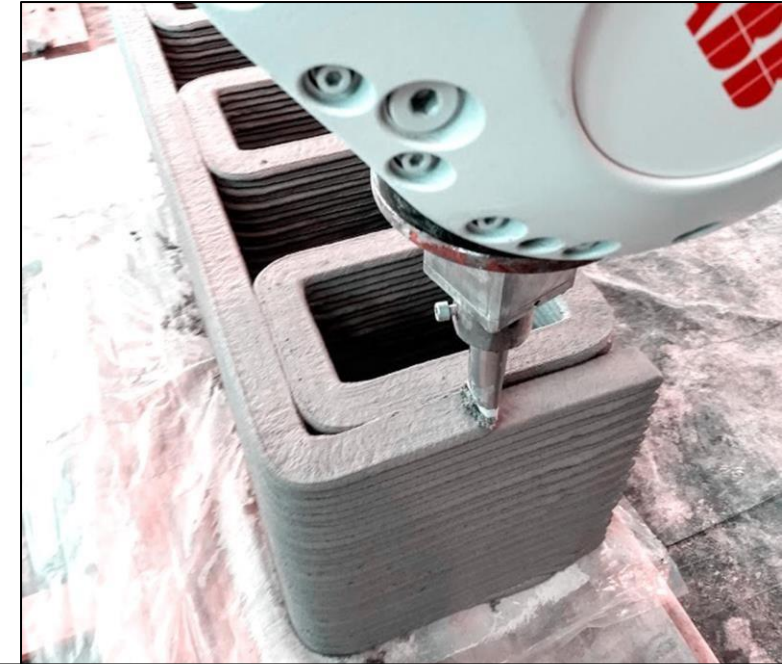
- Reduction of production times



- Efficiency in security management



- Implementation of digitization of the entire construction process



ETESIAS[®]



Leonardo da Vinci

CNR (Rome), Sala Marconi – A. Achilli 1936-1937

THANK YOU

La Luce della Scienza cerco...e
'l beneficio
(Leonardo da Vinci, 1452 – 1519)

*I'm looking for the Light of
Science...and its benefit*