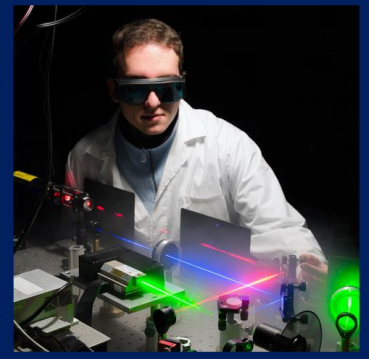
Consiglio Nazionale delle Ricerche



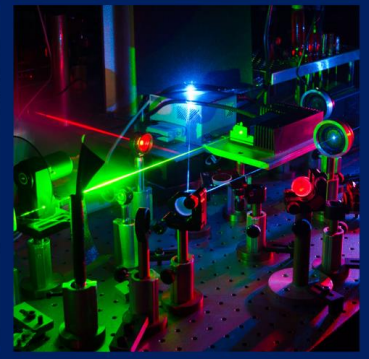









MARIA CHIARA CARROZZA, PRESIDENTE CNR

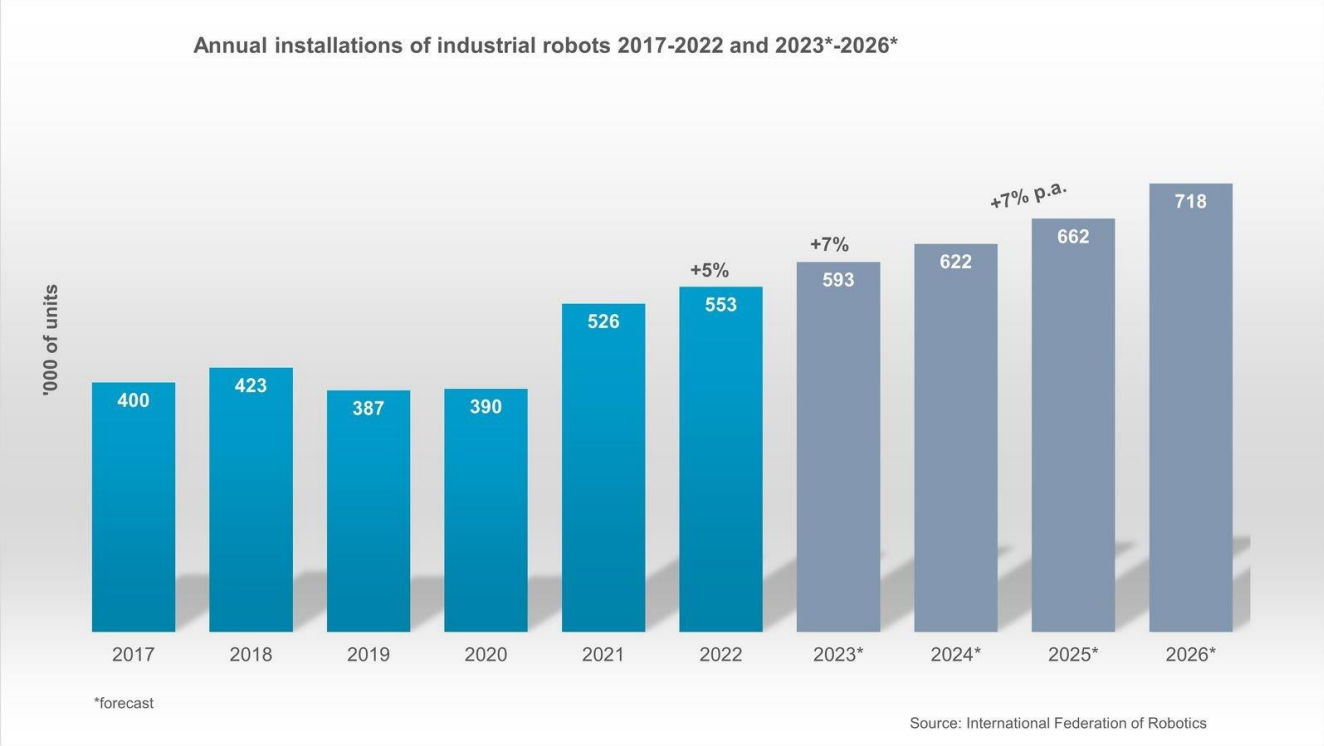
RICERCA E INNOVAZIONE: QUALI PROSPETTIVE PER L'ITALIA?

27 novembre 2023, Università degli studi di Udine

Consiglio Nazionale delle Ricerche

ECO-ROBOTICA

World Robotics 2023 Report



The new World Robotics report recorded 553,052 industrial robot installations in factories around the world – **a growth rate of 5% in 2022**, year-on-year.

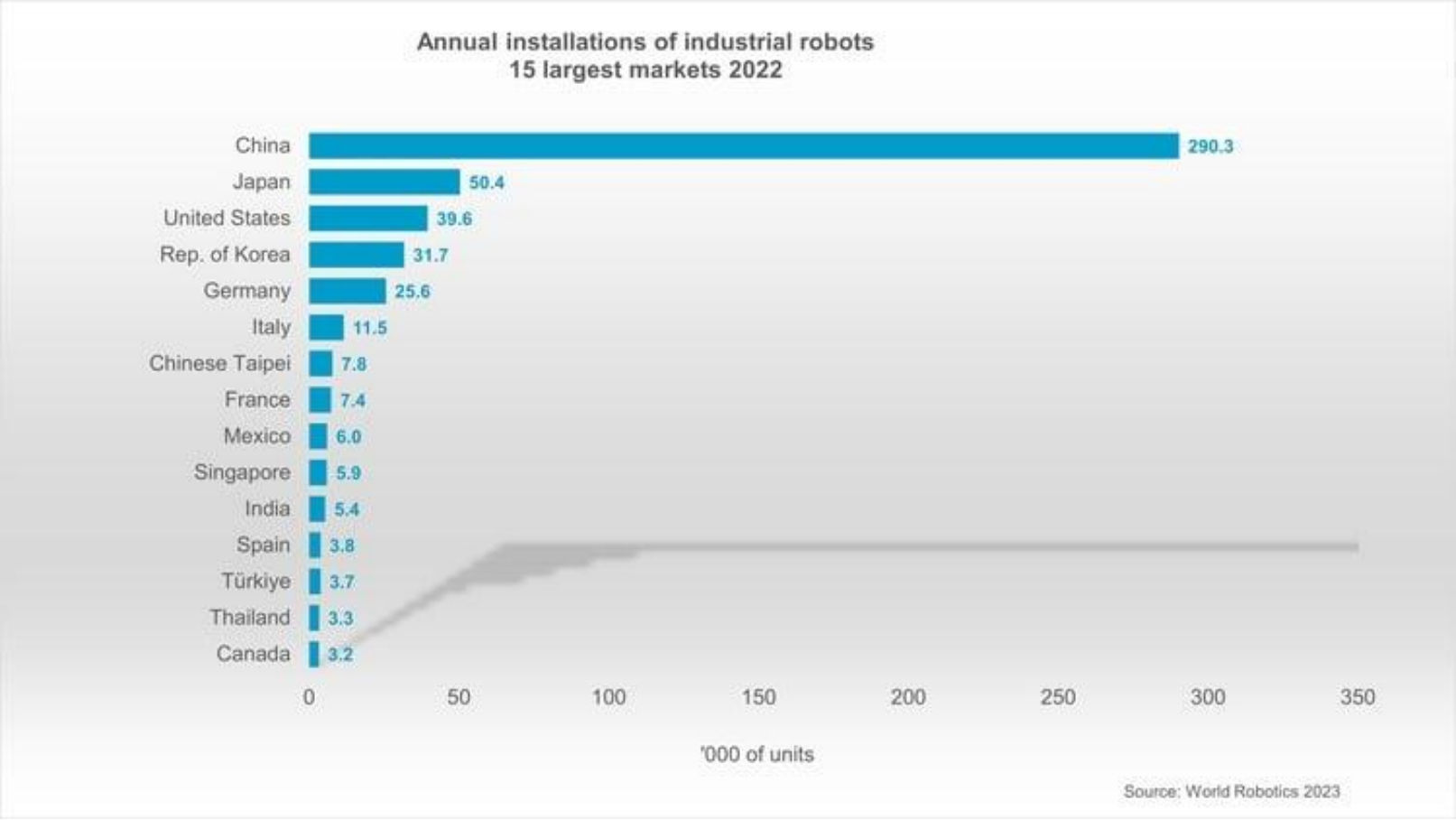
By region, **73%** of all newly deployed robots were installed in **Asia**, **15%** in **Europe** and **10%** in the **Americas**.

Outlook 2023 – 2026

- The ongoing year 2023 is characterized by a slowdown of global economic growth. Robot installations in 2023 are not expected to follow this pattern. Robot demand is still at a higher level than it was before COVID-19.
- **Global robot installations** are expected to **grow by 7%** to more than 590,000 units in 2023.
- The global economic slowdown is expected to manifest in robot installations in 2024 but growth rates are expected to accelerate slightly in 2025 and more strongly in 2026.

Consiglio Nazionale delle Ricerche

World Robotics 2023 Report



The **European Union** remains the world´s **second largest market** (70,781 units; +5%) in 2022.

Germany is one of the top five adopters worldwide with a market share of 36% within the EU.

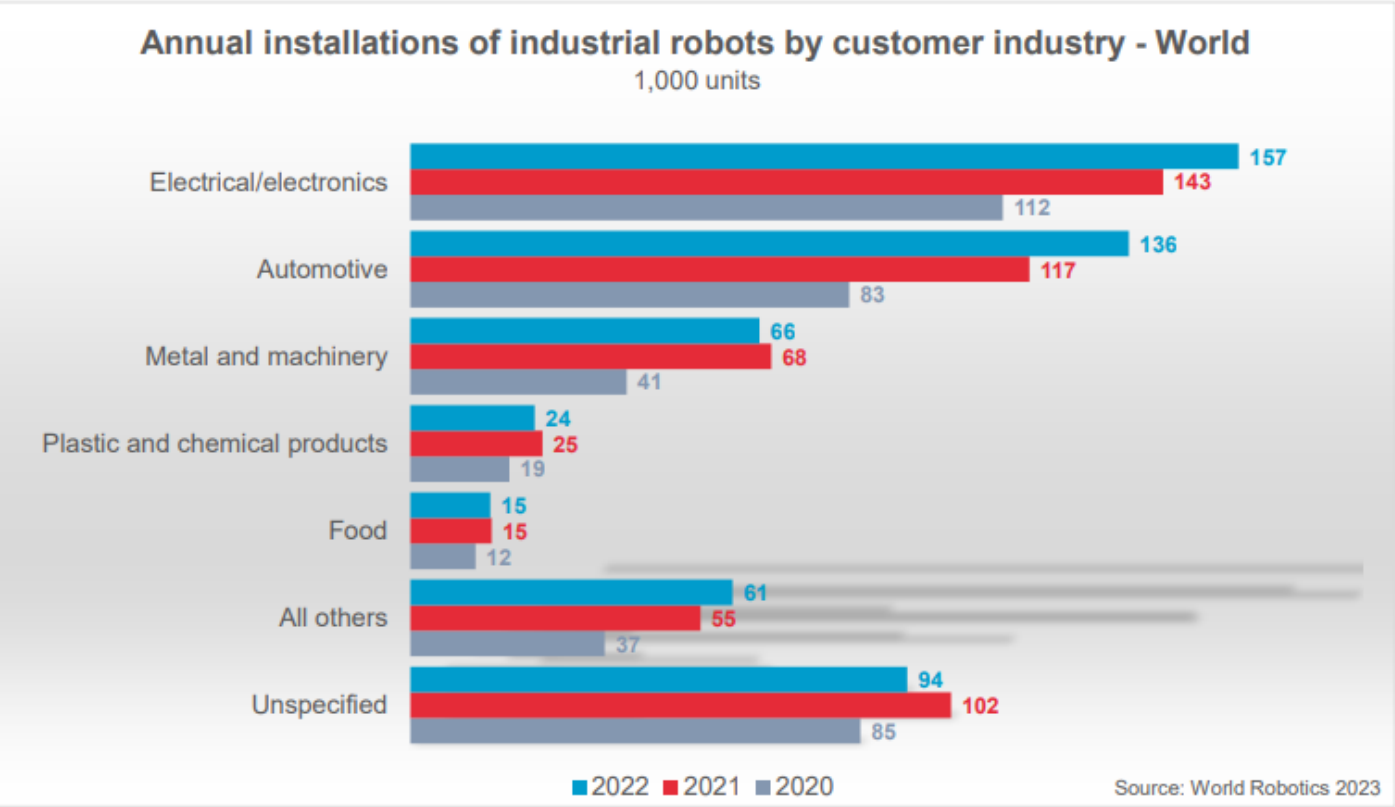
Italy follows with a market share of 16% within the EU - installations grew by 8% to 11,475 units.

The third largest EU market, **France**, recorded a regional market share of 10% and gained 13%, installing 7,380 units in 2022.

The five major markets for industrial robots are **China**, **Japan**, **the United States**, **the Republic of Korea**, and **Germany**. These countries accounted for **79% of global robot installations** (437,599 units)

Consiglio Nazionale delle Ricerche

World Robotics 2023 Report



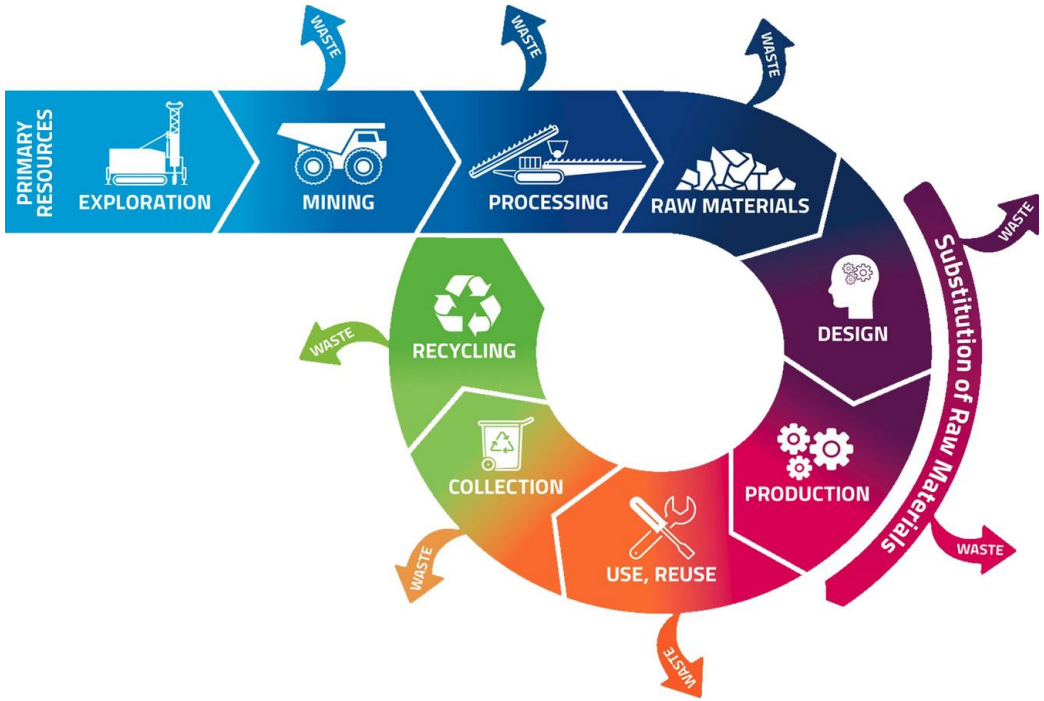
- The **electronics industry** was the largest customer of robots, a position it gained in 2020 and has maintained since, claiming 28% (+1 pp) of all robots newly installed in 2022.
- The **automotive industry** followed suit with 25% of installations (+3 pp), growing in both the car manufacturer and the parts supplier segment.
- The **metal and machinery industry** retained its third place (12%; -1 pp), followed by the **plastic and chemical products** industry (4%) and the **food and beverage industry** (3%).

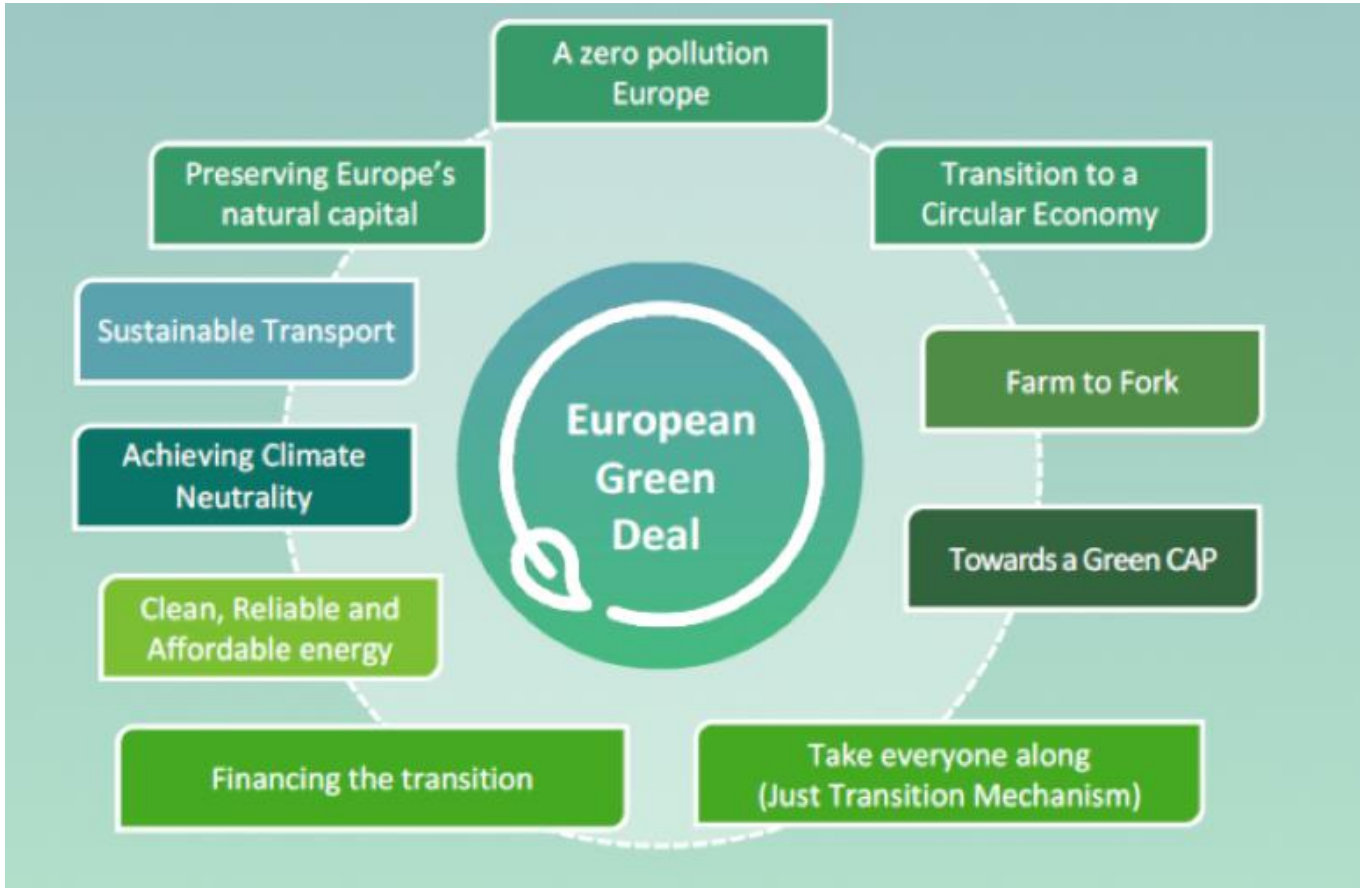
Consiglio Nazionale delle Ricerche

THE EUROPEAN GREEN DEAL

Il cambiamento climatico e il degrado ambientale sono una minaccia esistenziale per l'Europa e il mondo. Per superare queste sfide, il Green Deal europeo trasformerà l'UE in un'economia moderna, efficiente sotto il profilo delle risorse e competitiva, garantendo:

- ❑ 'zero netto' emissioni di gas serra entro il 2050
- ❑ crescita economica dissociata dall'uso delle risorse
- ❑ nessuna persona e nessun luogo lasciato indietro





IL CAPITALE NATURALE NELL'ANTROPOCENE

RESEARCH

EXTINCTION

Avoiding ocean mass extinction from climate warming

Justin L. Penn[1,2]* and Curtis Deutsch[1,2]*

Global warming threatens marine biota with losses of unknown severity. Here, we quantify global and local extinction risks in the ocean across a range of climate futures on the basis of the ecophysiological limits of diverse animal species and calibration against the fossil record. With accelerating greenhouse gas emissions, species losses from warming and oxygen depletion alone become comparable to current direct human impacts within a century and culminate in a mass extinction rivaling those in Earth's past. Polar species are at highest risk of extinction, but local biological richness declines more in the tropics. Reversing greenhouse gas emissions trends would diminish extinction risks by more than 70%, preserving marine biodiversity accumulated over the past ~50 million years of evolutionary history.

Human activities are altering the global climate, physically transforming habitats, and overexploiting ecosystems of land and sea (*1*, *2*). As a result, rates of species extinction have risen above

luating the severity and drivers of a "sixth mass extinction" (*3*, *18*).

Here, we project global and local extinction risks for marine animals (as a percentage of species lost) on the basis of habitat loss from

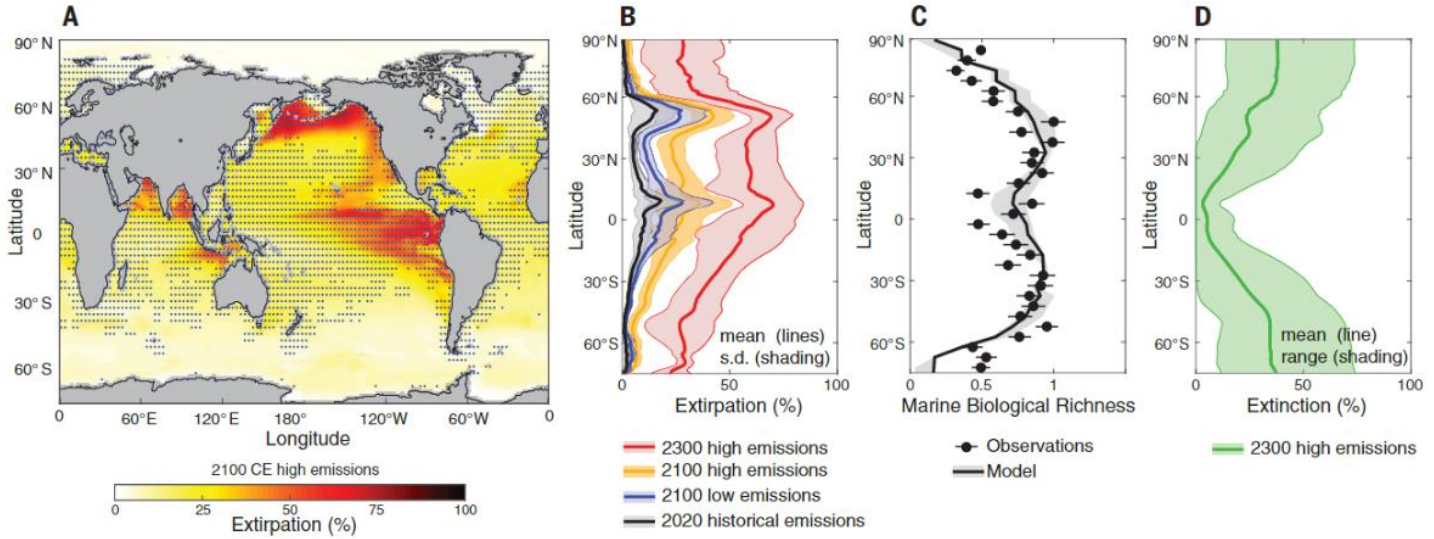


Fig. 2. Spatial variation in species losses and marine biological richness. (**A**) By 2100, regions of strong extirpations overlap past productive fisheries (blue points), where catch rates exceed the global median from 1950 to 2014 (*36*). (**B** to **D**) Patterns of extirpation risk (B), marine biological richness (C), and global extinction risk [(D); averaged across colonization scenarios] are shown versus latitude. Observed biological richness (number of species) estimated using rarefaction (*31*) is reproduced by the trait-based habitat model applied to climatological distributions of temperature and O_2 (*37*, *38*) across a range of maximum summation depths [(C) line is 500 m; shading is 0 and 5000 m; (*19*)]. Richness is normalized to the maximum observation. Extirpation and global extinction risks are averaged from 0 to 500 m, across Earth system models, and across longitude in (B) and (D).

Le attività umane stanno alterando il clima globale, trasformando fisicamente gli habitat e sfruttando eccessivamente gli ecosistemi terrestri e marini. Di conseguenza, i tassi di estinzione delle specie sono aumentati

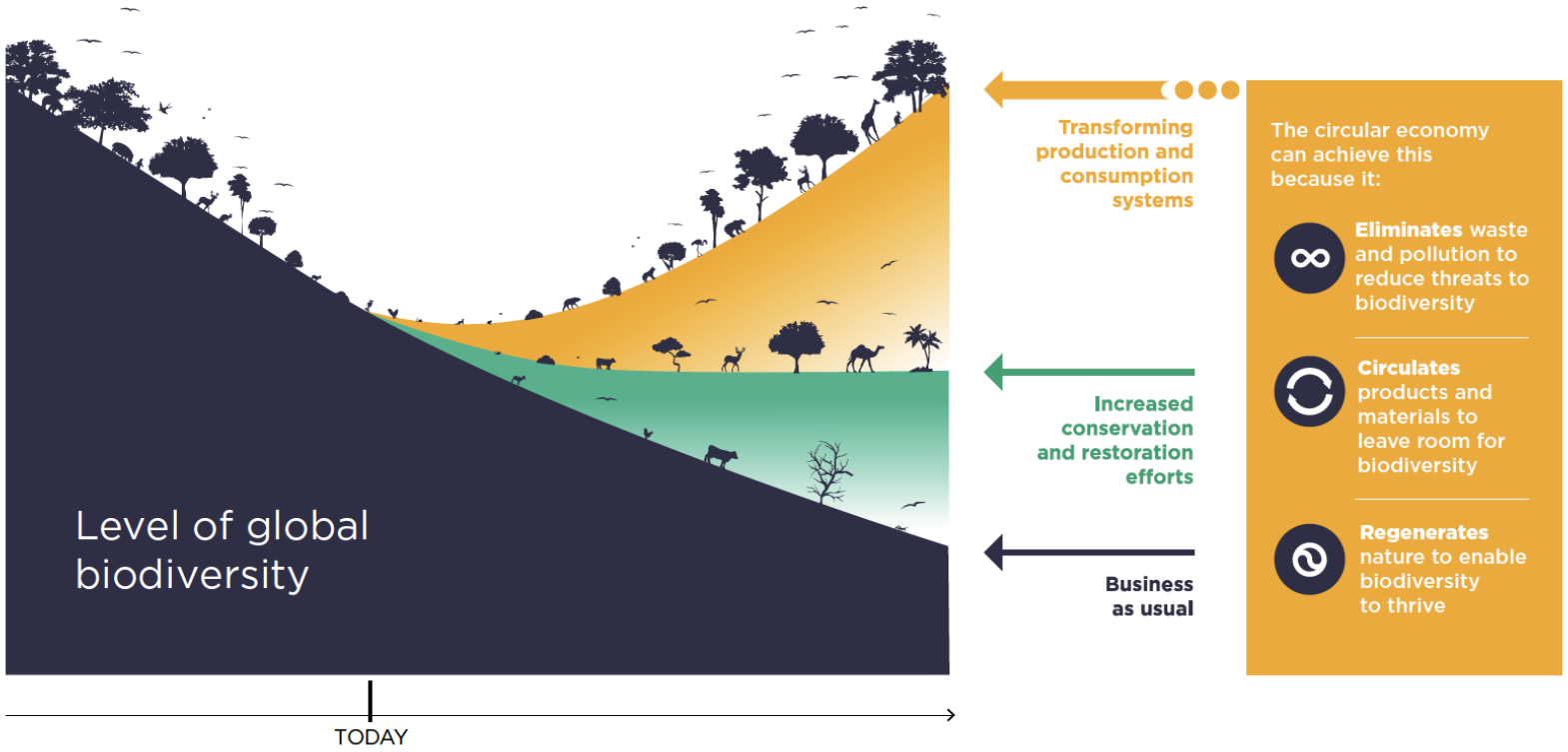
Le estinzioni documentate sono in gran parte limitate alla terraferma, dove gli impatti umani industriali sono iniziati prima e rimangono più pervasivi nonostante la rapida crescita della pesca commerciale, dell'inquinamento marino e dei trasporti

PROTEGGERE LA NATURA, OLTRE L'ETICA

«La perdita di biodiversità è ampiamente riconosciuta come un rischio sistemico che minaccia non solo la nostra prosperità, ma anche il nostro stesso futuro come specie. Per fermare e invertire questa perdita, è urgentemente necessario un cambiamento trasformativo della sua principale causa sottostante - la nostra economia estrattiva, dispendiosa e inquinante».

Ellen MacArthur Foundation – The Nature Imperative

FIGURE 1 **THE CIRCULAR ECONOMY PLAYS A CRUCIAL ROLE IN BENDING THE CURVE ON BIODIVERSITY LOSS** [1]



FATTORI DIRETTI DELLA PERDITA DI BIODIVERSITÀ

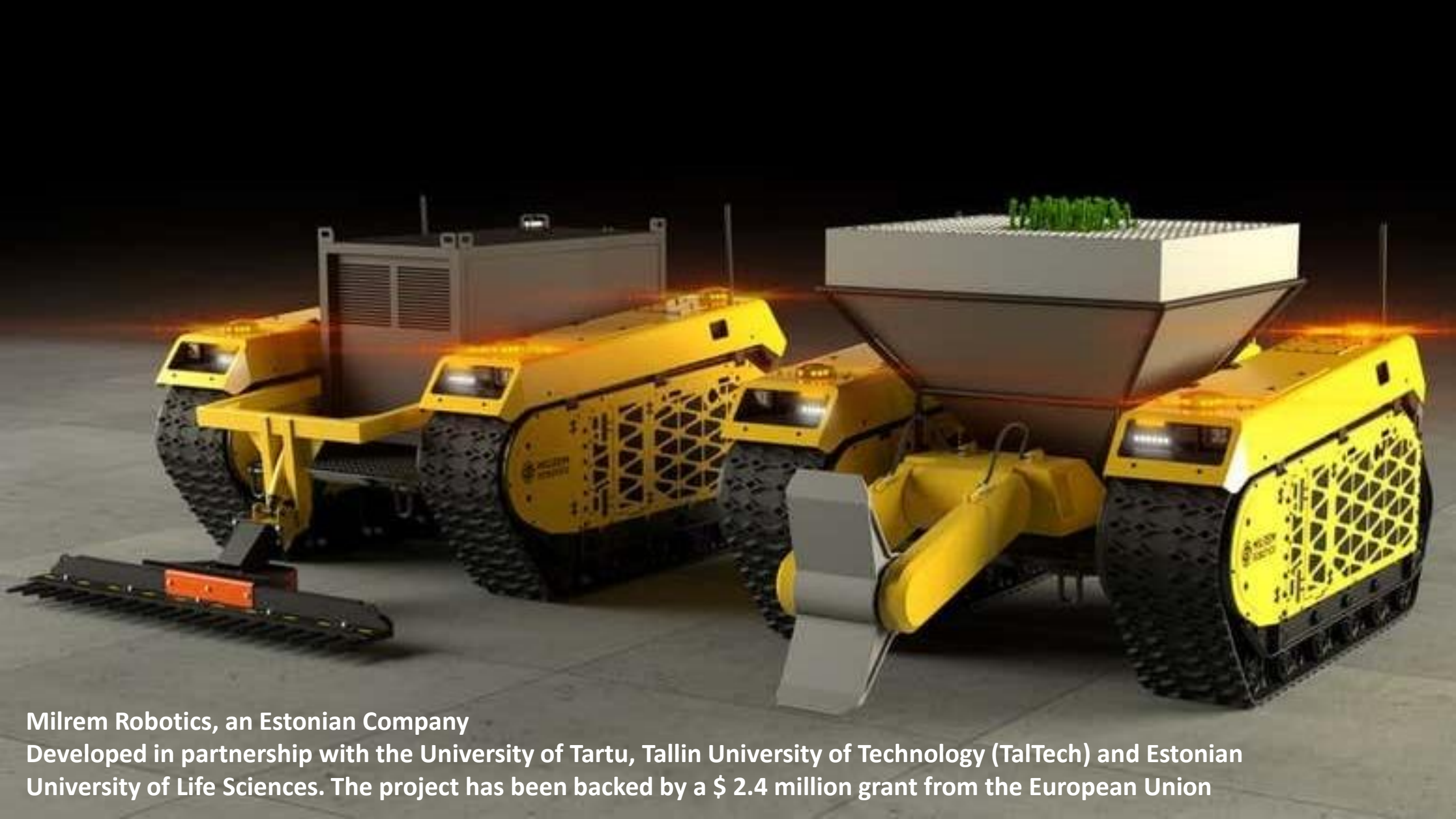
- ❑ USO DEL MARE E DELLA TERRA
- ❑ SFRUTTAMENTO ECCESSIVO
- ❑ CAMBIAMENTI CLIMATICI
- ❑ INQUINAMENTO DA SPECIE ALIENE

ROBOTICS & REFORESTATION

ABB’s cobot YuMi

The pilot project, established by ABB Robotics and the non-profit organization Junglekeepers, uses a solar-powered YuMi robot to accelerate the seed planting process. Designed to work alongside humans, the collaborative robot (cobot) features a robotic arm with two “hands” that shift soil and handle seeds.

Consiglio Nazionale delle Ricerche



Milrem Robotics, an Estonian Company
Developed in partnership with the University of Tartu, Tallin University of Technology (TalTech) and Estonian University of Life Sciences. The project has been backed by a $ 2.4 million grant from the European Union

ROBOTICS & BIODIVERSITY

PlantScreen™ Robotic XYZ System

CNR IRET
Istituto di Ricerca sugli Ecosistemi Terrestri

NBFC

Consiglio Nazionale delle Ricerche

ECO-ROBOTICS @CNR

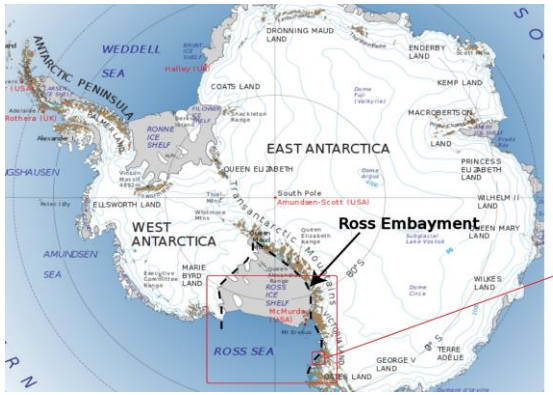
1923 CNR 2023

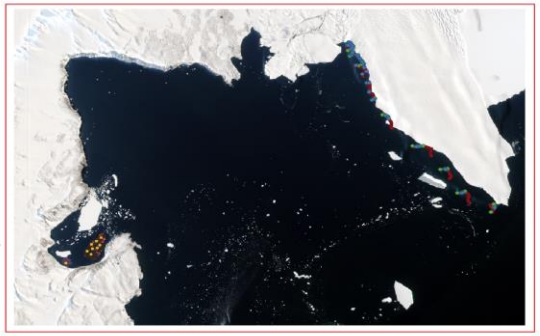
RESTORE – PNRA PROJECT

Robotic-based invESTigation and mOnitoring Ross sEa

Scopo del progetto: sviluppare una **tecnologia robotica portatile** per eseguire **analisi multi-parametriche** e **mappatura 3D dell'ecosistema marino** con particolare attenzione al **Mare di Ross** situato in Antartide tra la Terra della Regina Vittoria e la Terra di Marie Byrd.

Per fare questo è stata sviluppata una **nuova versione del robot PROTEUS**, veicolo marino polimorfo in grado di eseguire analisi in diverse configurazioni. Inoltre, è stata acquisita e integrata una serie di sensori e campionatori in grado di raccogliere, in modo integrato, dati geomorfologici, chimici, fisici e biologici del Mare di Ross .





Novembre 2022-Febbraio 2023

Nell'ambito del progetto RESTORE finanziato dal Piano Nazionale di Ricerche in Antartide differenti campionamenti sono stati effettuati grazie a PROTEUS durante la XXXVIII Spedizione Italiana in Antartide

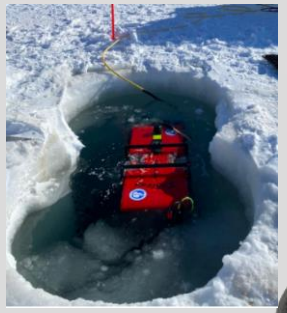
CNR ISMAR ISTITUTO DI SCIENZE MARINE

Università Ca'Foscari Venezia

PROTEUS - Portable RObot TEchnology for Underwater Surveys

PROTEUS-ROV
Remotely Operated Vehicle

3D MAPPING
Ice water bottom

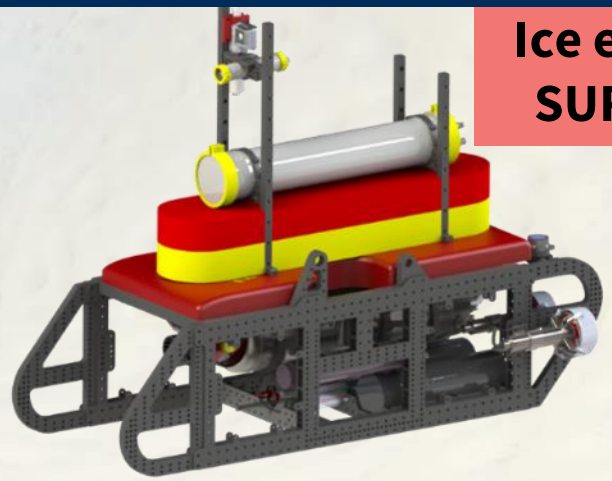


PROTEUS-AUV
Autonomous Underwater Vehicle

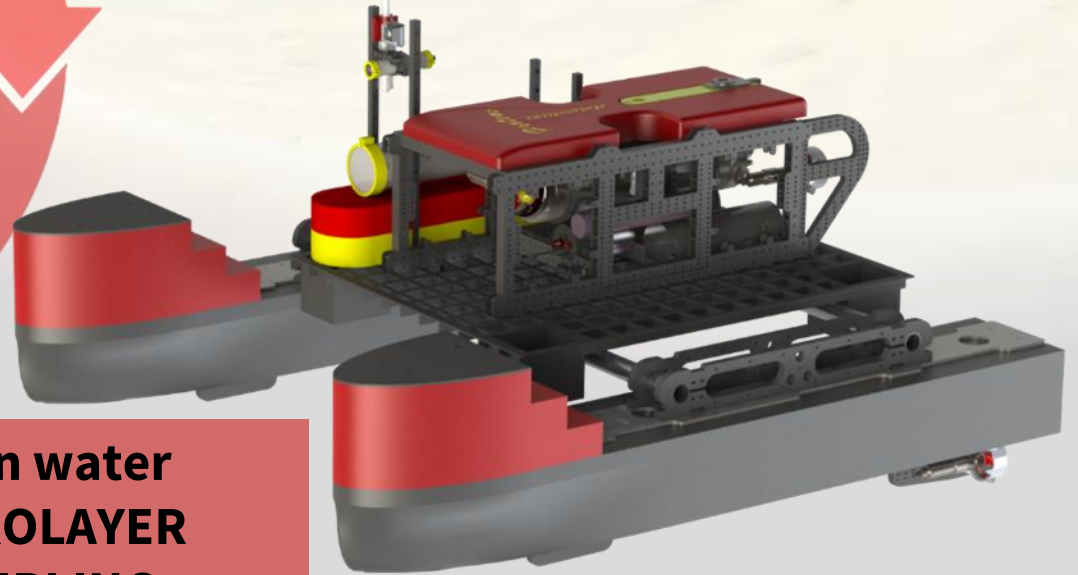
PROTEUS

Open water
MICROLAYER
SAMPLING

Ice edge open water
SURVEY & SAMPLE



PROTEUS-USSV
Unmanned Semi-Submersible Vehicle



PROTEUS-USV
Unmanned Surface Vehicle

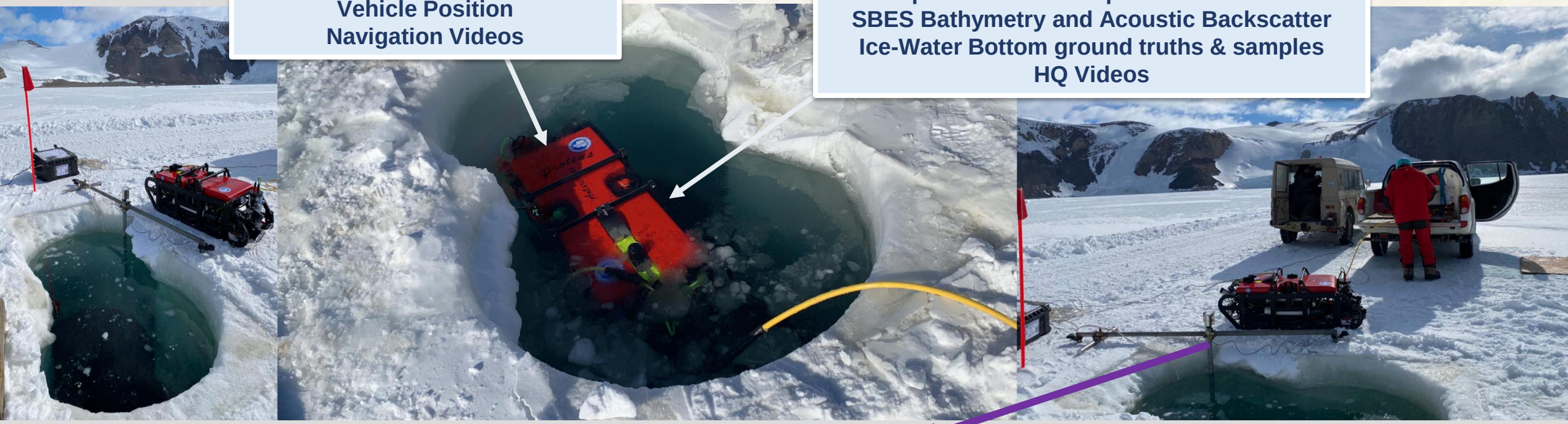
“Surgical Precision” data collection in 3D MAPPING

Robotics Data:

Robot Telemetry
Vehicle Navigation Sensors
(DVL, AHRS, FOG, USBL)
Vehicle Position
Navigation Videos

Oceanographic Data:

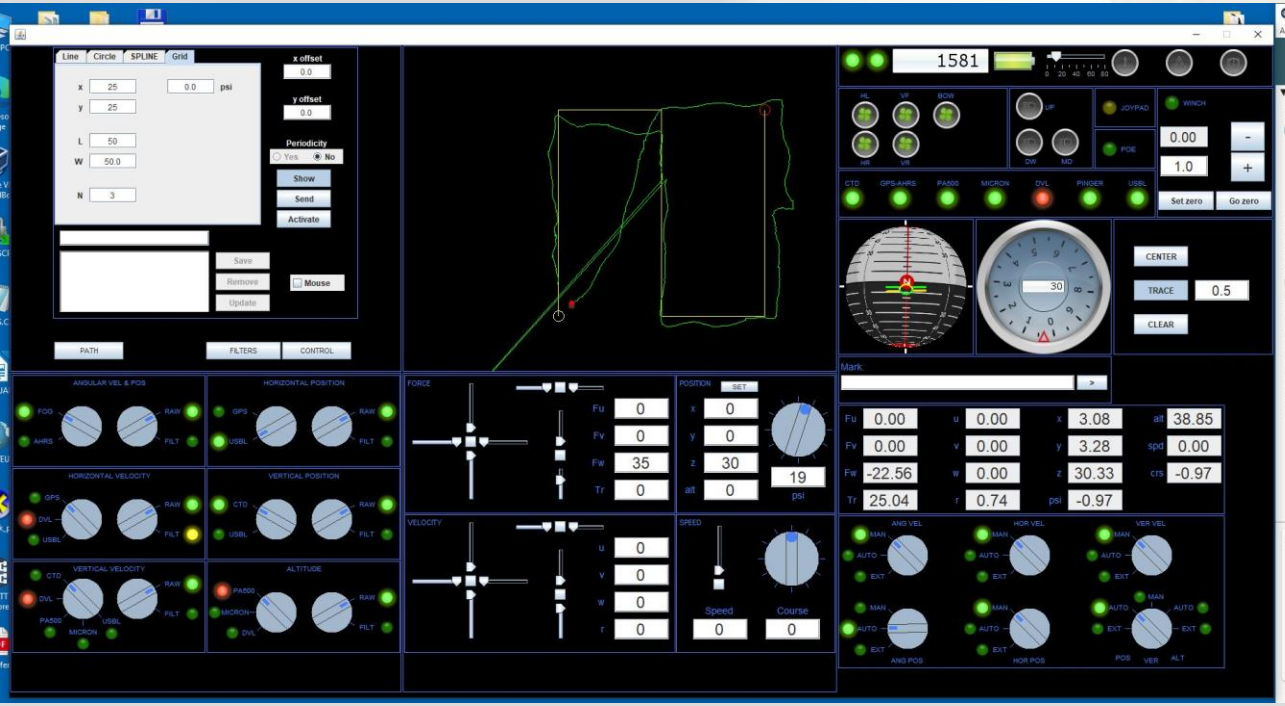
Depth, Temperature, Conductivity
Sound Velocity, Salinity, Oxygen, pH, Redox, eh
Chlorophyll
Nephelometer and Optical Backscatter
SBES Bathymetry and Acoustic Backscatter
Ice-Water Bottom ground truths & samples
HQ Videos

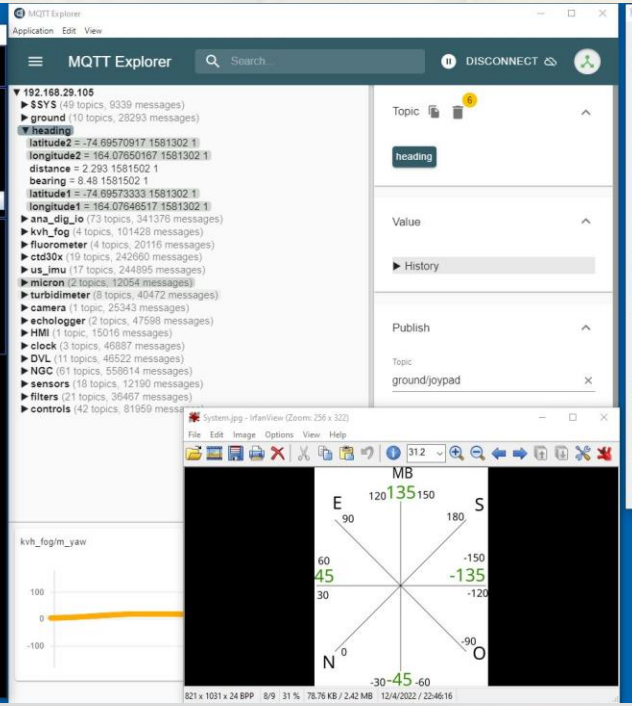


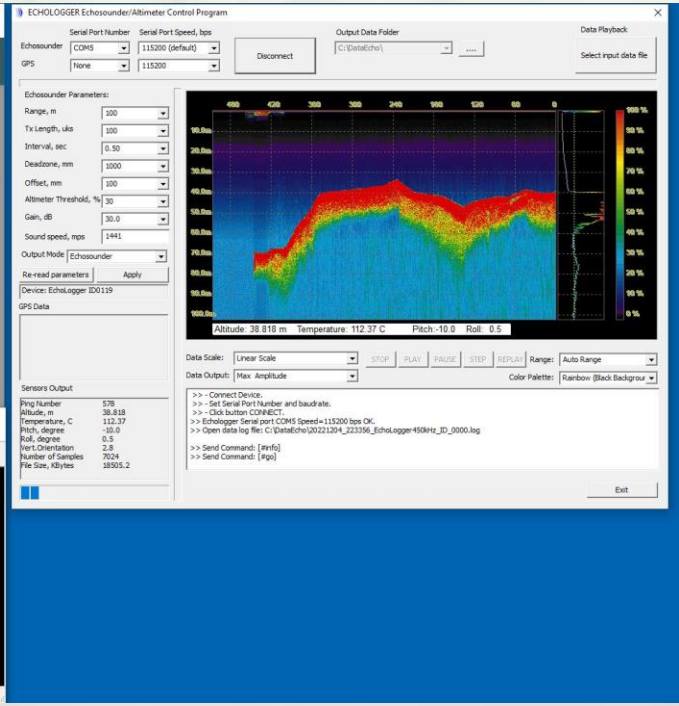
Geo-referenced (through USBL and GPS)

Time-referenced (through Vehicle-Sensors and Cameras Synchronisation)

Real-time Data Control







Consiglio Nazionale delle Ricerche

Ecorobotica marina

Advances technological platforms for sea monitoring and forecasting

Ecorobotica terrestre

Advanced technologies and robotic solutions for precision agriculture and land management

Foto Faimali - CNR

La Terra è un bel posto, e vale la pena lottare per lei

Ernest Hemingway

Artificial Intelligence & Robotics @CNR

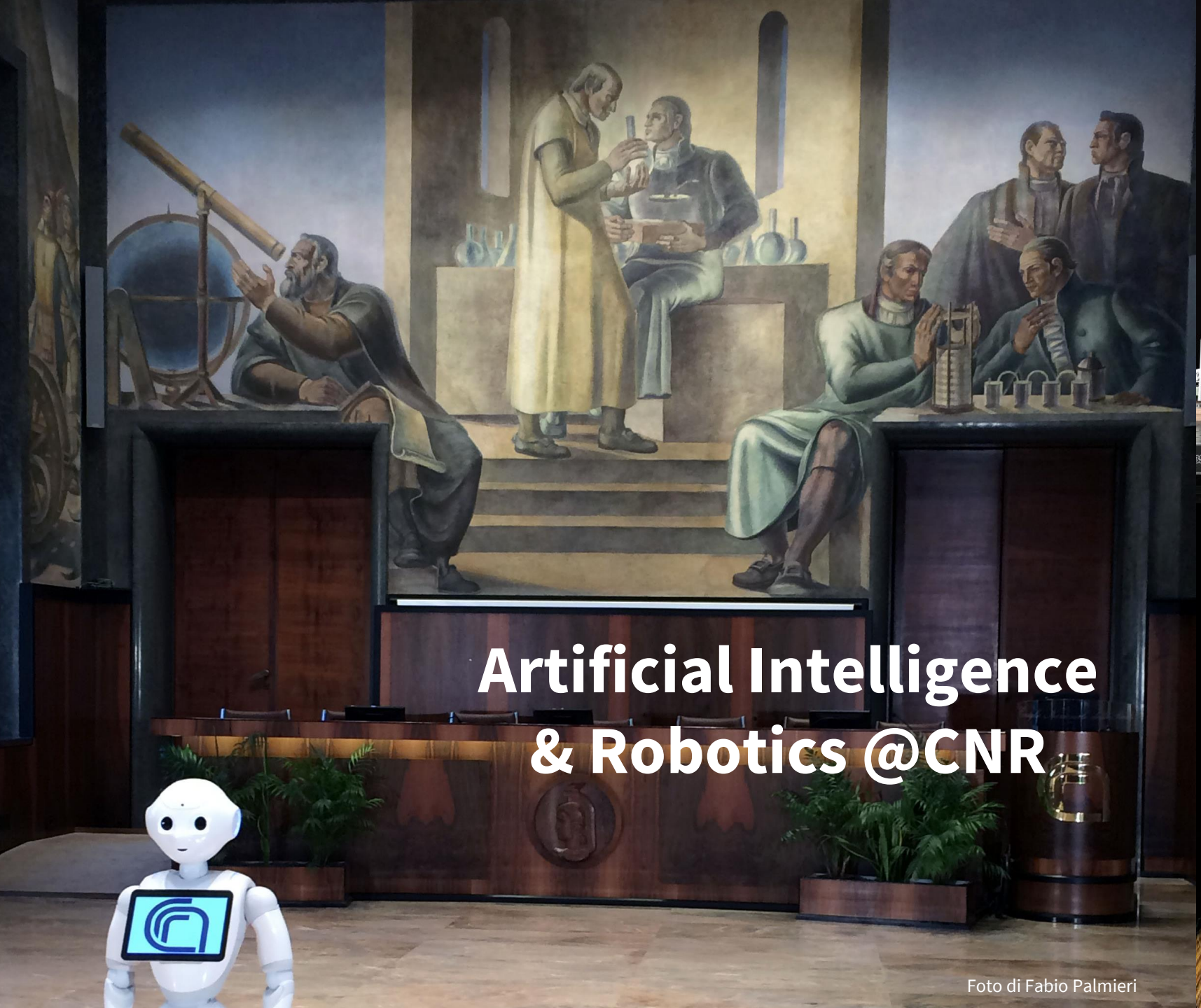


Foto di Fabio Palmieri

Foto di Agnese Augello

Foto di Agnese Augello

Fit4MedRob
Fit for Medical Robotics

44 months to revolutionize rehab and assistive models

FIT4MEDROB
Fit for Medical Robotics

Ministero dell'Università e della Ricerca

Italiadomani
PIANO NAZIONALE DI RIPRESA E RESILIENZA

PNC
Piano nazionale per gli investimenti complementari al PNRR
Ministero dell'Università e della Ricerca

Consiglio Nazionale delle Ricerche

Fit4MedRob

THE CONSORTIUM

25 partners: 13 public and 12 private

Research partners

Consiglio Nazionale delle Ricerche
Scuola Superiore Sant'Anna
Università degli studi di Pavia
Università degli studi di Napoli
Università degli studi di Firenze
Università degli studi di Genova
Università degli studi di Modena e Reggio Emilia
Università di Pisa
Università degli studi di Siena
Università Campus Bio-Medico di Roma
Istituto Italiano di Tecnologia

Clinical partners

IRCCS -Istituto Giannina Gaslini
IRCCS Ospedale Policlinico San Martino
IRCCS - Associazione La Nostra Famiglia Istituto Scientifico E. Medea
Istituti Clinici Scientifici Maugeri
Fondazione Don Carlo Gnocchi
IRCCS Fondazione Mondino
IRCCS Fondazione Stella Maris
C.O.T. Cure Ortopediche Traumatologiche S.P.A.
Fondazione Policlinico Universitario Campus Bio-Medico
Congregazione Suore Infermiere dell'Addolorata
INAIL Centro Protesi Vigorso di Budrio

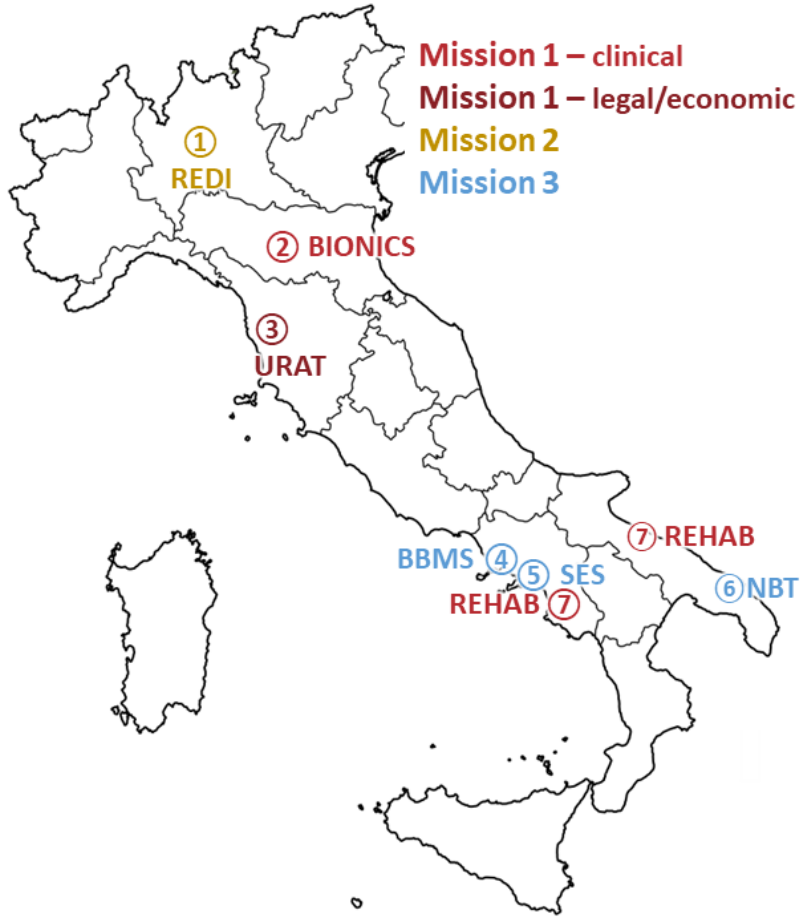
Industrial partners

Eustema S.p.A.
Item Oxygen SRL
Tecnobody s.r.l.

Consiglio Nazionale delle Ricerche

CENTERS OF EXCELLENCE (CoE)

7 permanent **Centers of Excellence (CoE)** designed to build the future of **robotic rehabilitation**, generating a net of research sites scattered throughout Italy as incubators of both visionary new ideas and young scientists in the various sectors of **biorobotics**.



- **REDI** REhabilitation devices and Digital Instruments – Lecco Pavia
- **BIONICS** – Budrio INAIL
- **URAT** Uptake of Robotics and Allied Technologies – Pisa SSSA
- BBMS Biorobotic and Bionic Materials and Systems – Naples II
- SES Sustainable Energy Sources – Naples CNR
- NBT – Lecce CNR
- REHAB – Bari ICSM, Salerno FDG

Fit4MedRob

SOCIETAL, SCIENTIFIC, TECHNOLOGICAL AND CLINICAL GOALS

to cover technological, economical, legal and policy gaps

O1
- **Identifying** the **needs** of the patients

O2
- **Tailoring** the most advanced and **ready-to-use robots**

O3
- **Clinically assessing robots** to provide conclusive clinical evidence of their efficacy

O4
- **Performing** a detailed cost-benefits analysis of such clinical assessments to assess their **sustainability**.

O5
- **Optimizing** the clinical protocols

O6
- **Developing** with **policy** makers the inclusion of sustainable robots and treatments in the national healthcare system.

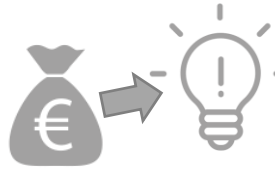
O7
- **Preparing** for the **next generation** of **healthcare** and **personal care robotics**

Consiglio Nazionale delle Ricerche

Fit4MedRob

Mission 1
Clinical Translation & Innovation

Mission 3
Next Generation Components



Cascade call Program
Technical, clinical, social domains

Educational & Cultural Program
Master's Diplomas, PhD, seasonal schools

7 Centers of Excellence
Technical, clinical, social domains

Mission 2
Biorobotic Platforms & Allied Digital Technologies

A1-2 - Needs and trials

A3-4 - HTA and LEPA

A5 - Healthcare robots

A6 - Personal care robots

A7 - Digital infrastructure, environments, and services

A8-9 - Robot bodyware, intelligence, human-machine interfaces and interaction

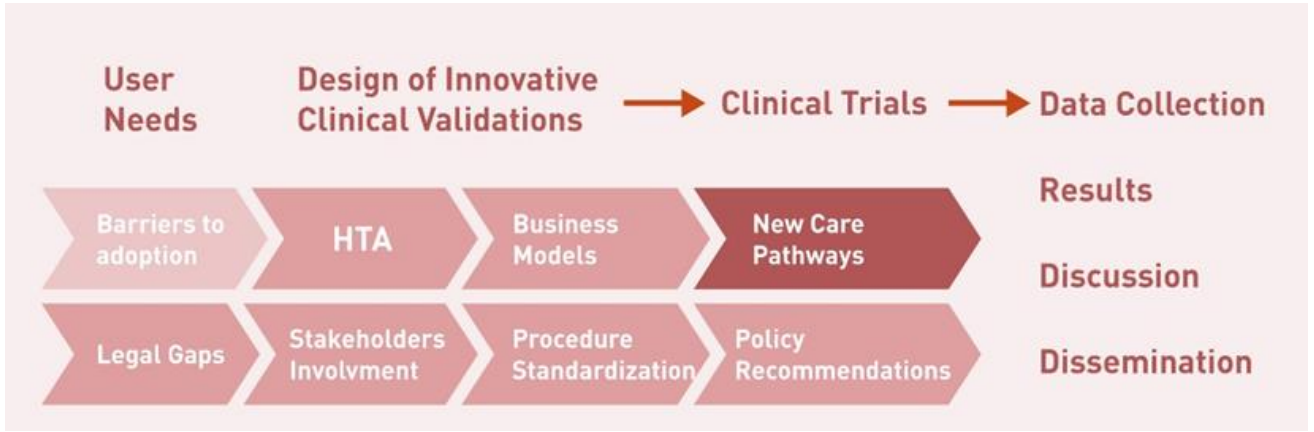
A10 - Biohybrid interfaces and biomaterials

Consiglio Nazionale delle Ricerche

Fit4MedRob

MISSION 1 - Clinical Translation & Innovation

Aims to run extensive, multicentric, clinical trials using healthcare or personal care robots



A1. Needs of target individuals
A2. Clinical validation of robotic rehabilitation and treatment
A3. Sustainability ad HTA
A4. Policy and regulatory acceleration

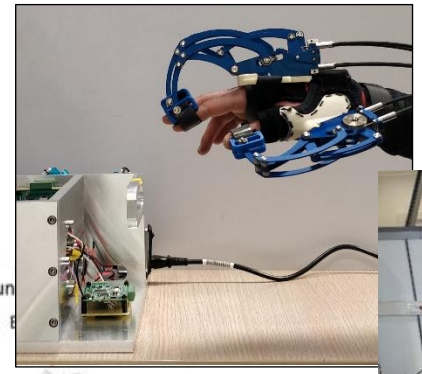
Consiglio Nazionale delle Ricerche

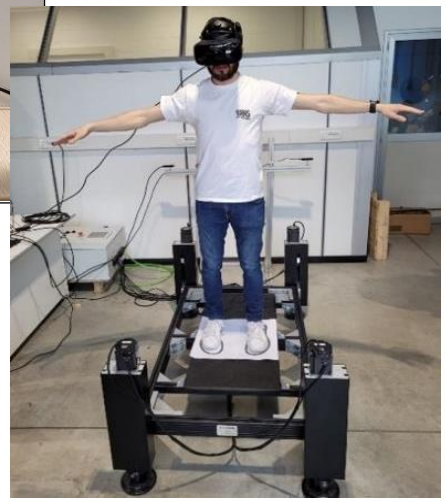
Fit4MedRob

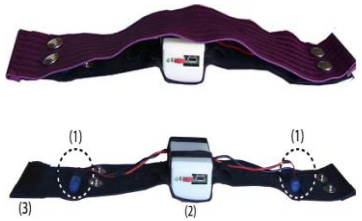
MISSION 2 - Biorobotic Platforms & Allied Digital Technologies

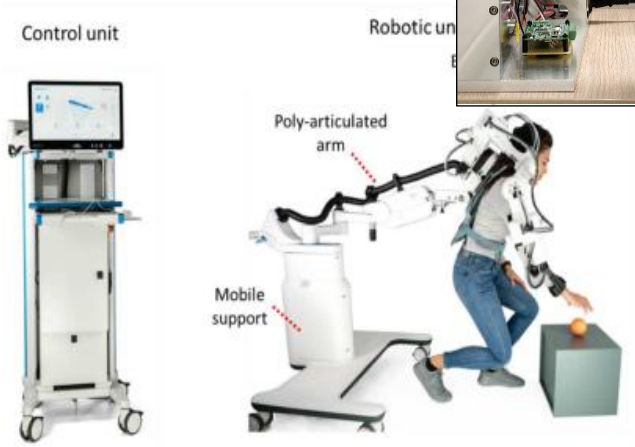
Aims to provide validated healthcare and personal care robots already available to the Consortium, and specifically adapted to the unmet needs of the target groups, to run the clinical trials.

Mission 2
Biorobotic Platforms & Allied Digital Technologies









A5. Healthcare robots

A6. Personal care robots

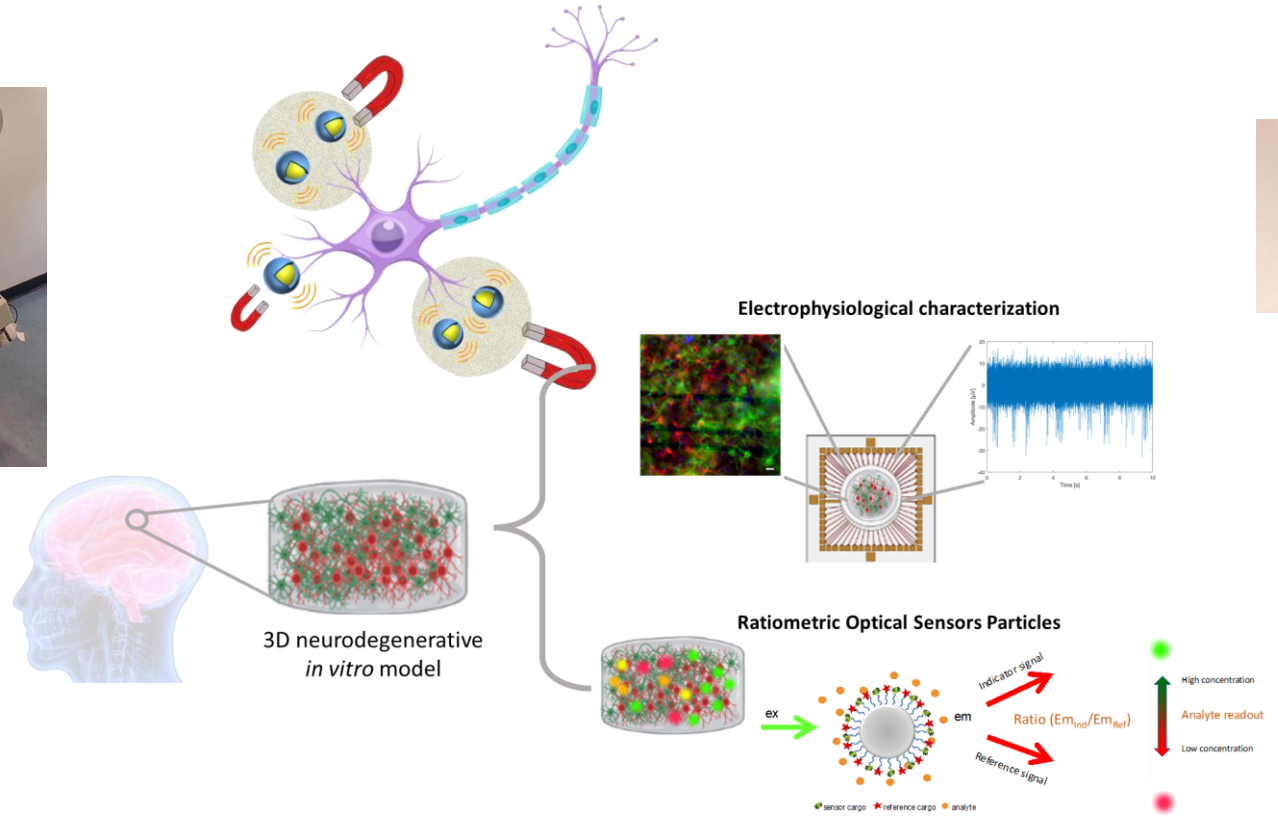
A7. Digital infrastructure, environment, and services

Consiglio Nazionale delle Ricerche

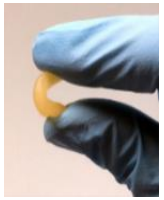
Fit4MedRob

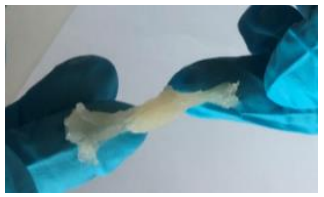
MISSION 3 - Next Generation Components

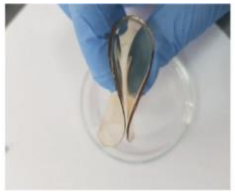
Aims to support **basic studies** pertaining to physical and computational aspects of robot bodies, robot intelligence, and interfaces with human tissues and organs.



Mission 3
Next
Generation
Components







A8. Robot bodyware

A9. Robot intelligence, human machine interfaces and interaction

A10. Biohybrid interfaces and biomaterials

Consiglio Nazionale delle Ricerche

Consiglio Nazionale delle Ricerche

AI @CNR

1923 CNR 2023

Finanziato dall'Unione europea
NextGenerationEU

Ministero dell'Università e della Ricerca

Italiadomani
PIANO NAZIONALE DI RIPRESA E RESILIENZA

Future Artificial Intelligence Research

FAIR

Partenariato Esteso su Intelligenza Artificiale

Future Artificial Intelligence Research

FAIR: Future AI Research

- *Consiglio Nazionale delle Ricerche* (CNR) has been the coordinator of the Enlarged Partnership proposal on «*Future AI Research*» (FAIR) for the Thematic area #1.
- FAIR partnership was **funded by NRRP with 114.5 Meuro**, with at least 40% of the budget reserved to southern regions;
- FAIR activities started on January 1st 2023;
- FAIR activities are coordinated by the **Future AI Research Foundation**

FAIR Foundation

- FAIR is a **public/private** foundation aimed to:
  - Implement, coordinate and manage the *Future Artificial Intelligence Research* partnership;
  - Promote the creation of a National ecosystem on Artificial Intelligence involving researchers, citizens and companies.

Consiglio Nazionale delle Ricerche

FAIR Scientific Partners

12 PUBLIC INSTITUTIONS CONTROLLED BY MUR

Other 6 PUBLIC/PRIVATE INSTITUTIONS

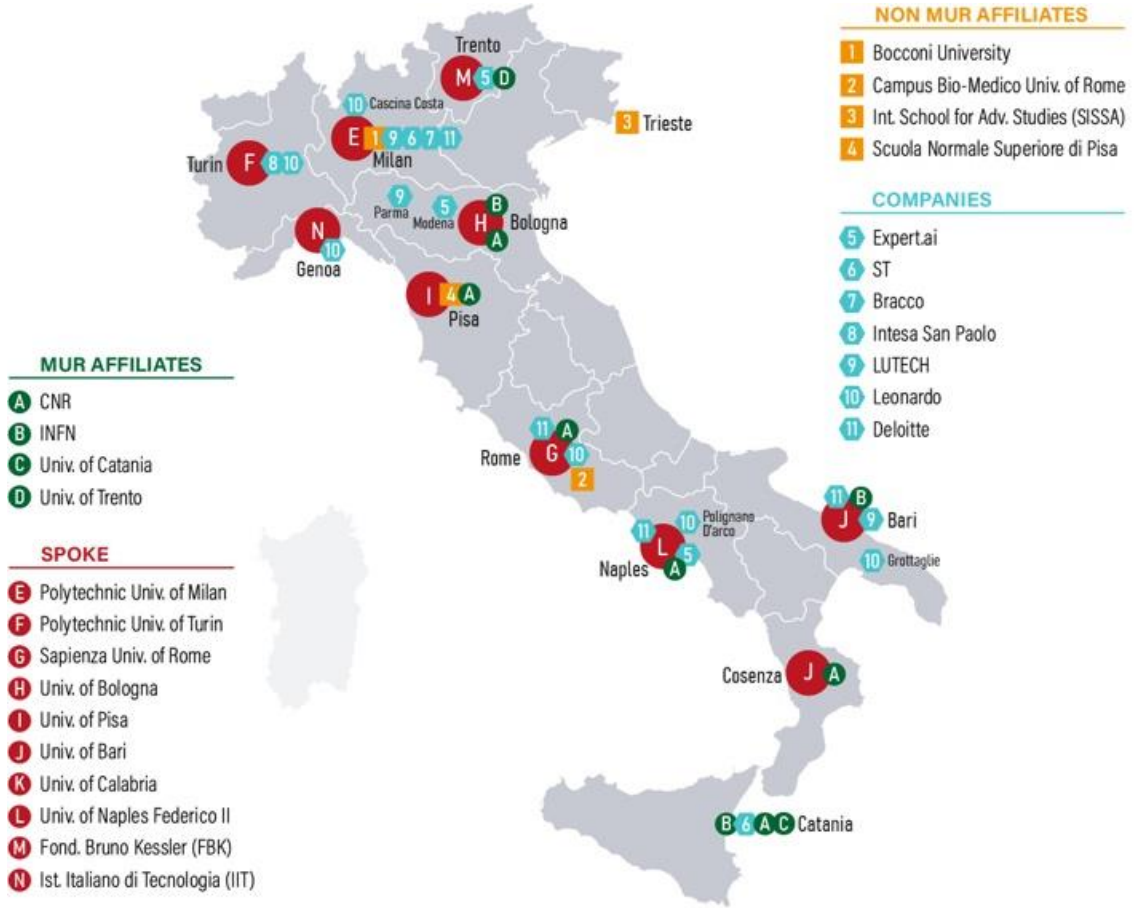
7 COMPANIES

Consiglio Nazionale delle Ricerche

FAIR Scientific Partners

Some statistics

- A critical mass of 350 researchers
  - 3619 PM - at least 3 PM/year per researcher
  - 24.45% female - target to achieve: 40%
  - 42.30% southern researchers
  - 11.38% early stage researchers



Consiglio Nazionale delle Ricerche

FAIR Hub & Spoke Organization

SPOKE 1 - **HUMAN-CENTERED AI**: interacting and collaborating with humans

SPOKE 2 - **INTEGRATIVE AI**: integrating AI methods, technologies and disciplines

SPOKE 3 - **RESILIENT AI**: operating in challenging, noisy, uncertain real-world settings

SPOKE 4 **- ADAPTIVE AI**: perceiving, learning and acting within dynamically evolving contexts

SPOKE 5 - **HIGH-QUALITY AI**: meeting high-quality standards for high-risk, safety critical applications

SPOKE 6 - **SYMBIOTIC AI**: promoting effective human-machine interactions and collaborations

SPOKE 7 - **EDGE/EXASCALE AI**: operating on the edge and on the cloud;

SPOKE 8 - **PERVASIVE AI**: operating ubiquitously in different social settings;

SPOKE 9 - **GREEN-AWARE AI**: considering the environment dimension by design

SPOKE 10 - **SUSTAINABLE AND BIO-COGNITIVE AI**: mimicking the biological systems at multiple scales

Consiglio Nazionale delle Ricerche

AI Foundational Aspects

FAIR's goal is to build AI systems capable that are:

- **interacting and collaborating with humans;**
- perceiving and acting within **evolving contexts;**
- being aware of their own limitations and **able to adapt to new situations;**
- interact appropriately in **complex social settings;**
- being aware of their **perimeters of security and trust;**
- being attentive to the **environmental and social impact** that their implementation and execution may entail.

To achieve this goal, FAIR adopts a **multidisciplinary research approach** aimed at rethinking the AI foundations, involving, in addition to STEM researchers, lawyers, philosophers, social scientists, neuroscientists, psychologists, etc.

From Research to Innovation: the FAIR Ecosystem

FAIR Ecosystem: we are working to promote the creation of an Italian AI ecosystem involving, in addition to the public and private partners that are already members of FAIR, other research institutions, citizens and companies:

We have already received many expressions of interest of public and private entities to collaborate with FAIR:

PA entities:

- Tuscany Region government and its economic programming agency IRPET;
- Innovapuglia S.p.A ;
- The National Cybersecurity Agency (ACN);
- Istituto Superiore di Sanità;
- The ICCD institute of the Italian Ministry of Culture;
- CONSOB;
- SOGEI;
- ....

Private entities: More than 100 companies, and 20+ startups and spin-offs;

FAIR Ecosystem: Cascade Calls

1. Cascade calls for Basic Research Activities
Totale costo **18.000.000 €**
Totale agevolazione **18.000.000 €**
- **Beneficiari: Università e Organismi di Ricerca**
- **Tempistica : Ottobre-Novembre 2023**

2. Cascade calls for PMI
Totale costo **17.000.000 €**
Totale agevolazione **11.900.000 €**
- **Beneficiari: PMI**
- **Tempistica: Marzo-Giugno 2024**

2.1 Cascade calls for Use cases
Costo 4.000.0000 €
Agevolazione 2.800.000 €

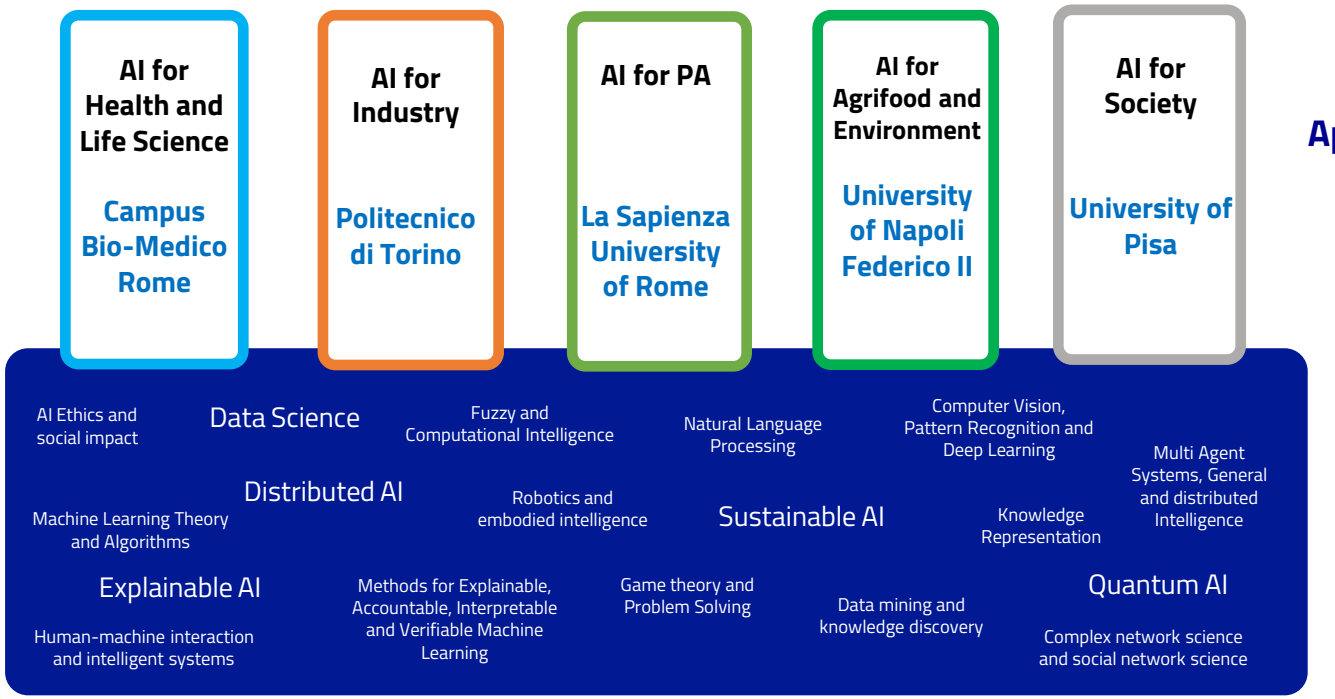
2.2 Cascade calls for Technology Validation and Testing
Costo 9.000.0000 €
Agevolazione 6.300.000 €

2.3 Hosting Grant
Costo 4.000.0000 €
Agevolazione 2.800.000 €

Create AI Talents: the National AI PhD Program

The National PhD Program on AI (https://www.phd-ai.it/) has been established in 2021 under the coordination of CNR and University of Pisa. It is a "federation" of 5 PhD programs:

- Each program is characterized by an application area;
- The training on AI foundational aspects is shared among the 5 programs.



Artificial Intelligence core research activities (not exhaustive list)

Consiglio Nazionale delle Ricerche

FAIR PROJECT: Actual Recruitment

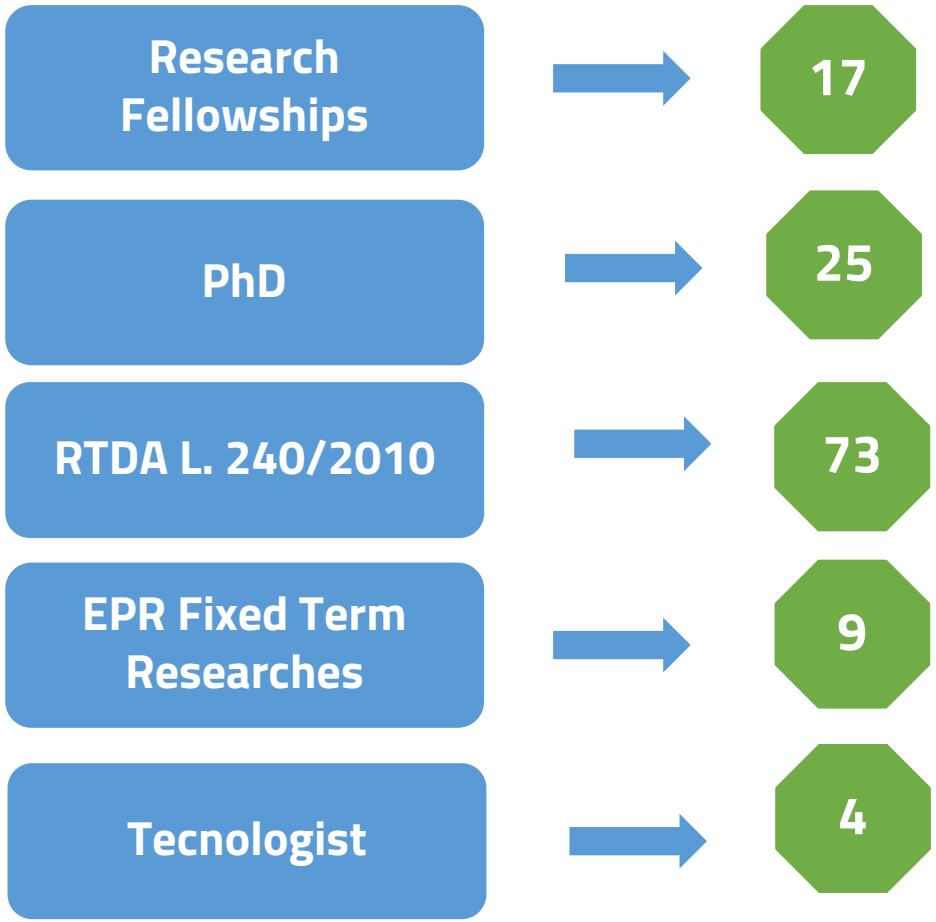


Foto Grasso - CNR

La scienza contempla il mondo per cambiarlo, rendendolo sostenibile

Maria Chiara Carrozza

Consiglio Nazionale delle Ricerche

GRAZIE

1923 CNR 2023