



Sistemi e Tecnologie Industriali Intelligenti
per il Manifatturiero Avanzato
Consiglio Nazionale delle Ricerche

Robotics towards EVs battery pack disassembly: *technologies, requests, standards and safety requirements*

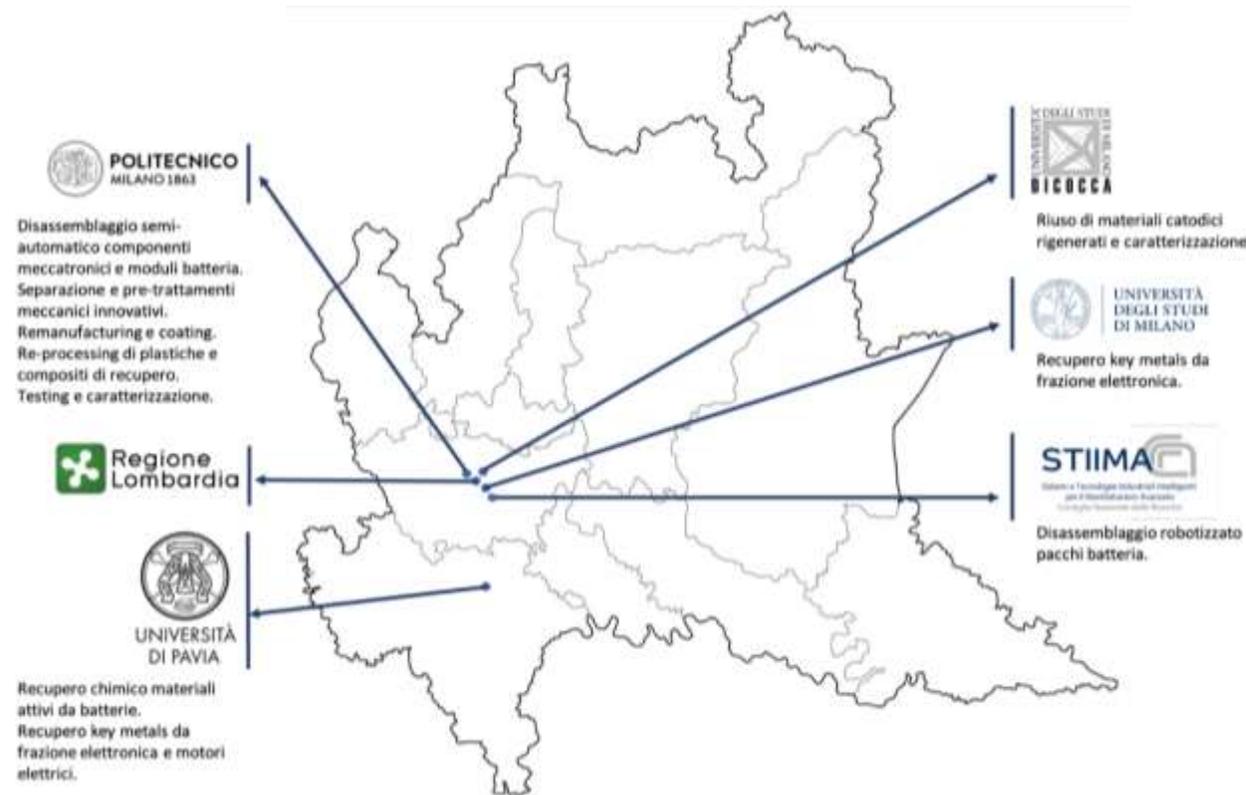
Enrico Villagrossi, Researcher





CNR-STIIMA is involved in the Hub for the Circular Economy and Manufacturing (EcoCirc) activities, funded by Regione Lombardia.

From 2021 CNR and Regione Lombardia are creating a technical demonstration that will be the backbone of the next Hub.



- Total budget of EcoCIRC: **10.056.415euro**
- Investment by Regione Lombardia: **5.000.000euro**
- CNR-STIIMA budget: **993.083euro** (of which **490.000euro** funded by RL)

Workpackage	2021 (Giugno-Dicembre)		2022 (Gennaio-Dicembre)				2023 (Gennaio-Dicembre)				2024 (Gennaio-Maggio)
	M1-M4	M5-M7	M8-M10	M11-M13	M14-M16	M17-M19	M20-M22	M23-M25	M26-M28	M29-M31	M32-M36
WP1: Progettazione e realizzazione dell'infrastruttura di ricerca.											
WP2: Remanufacturing.											
WP3: Riciclo e separazione per il riuso.											
WP4: Processi di produzione circolari.											
WP5: Piattaforme e strumenti digitali.											
WP6: Modelli di business innovativi.											
WP7: Dimostrazione e valutazione impatti											
WP8: Dissemination, training e trasferimento.											
WP9: Project Management											

Duration: **36 months**

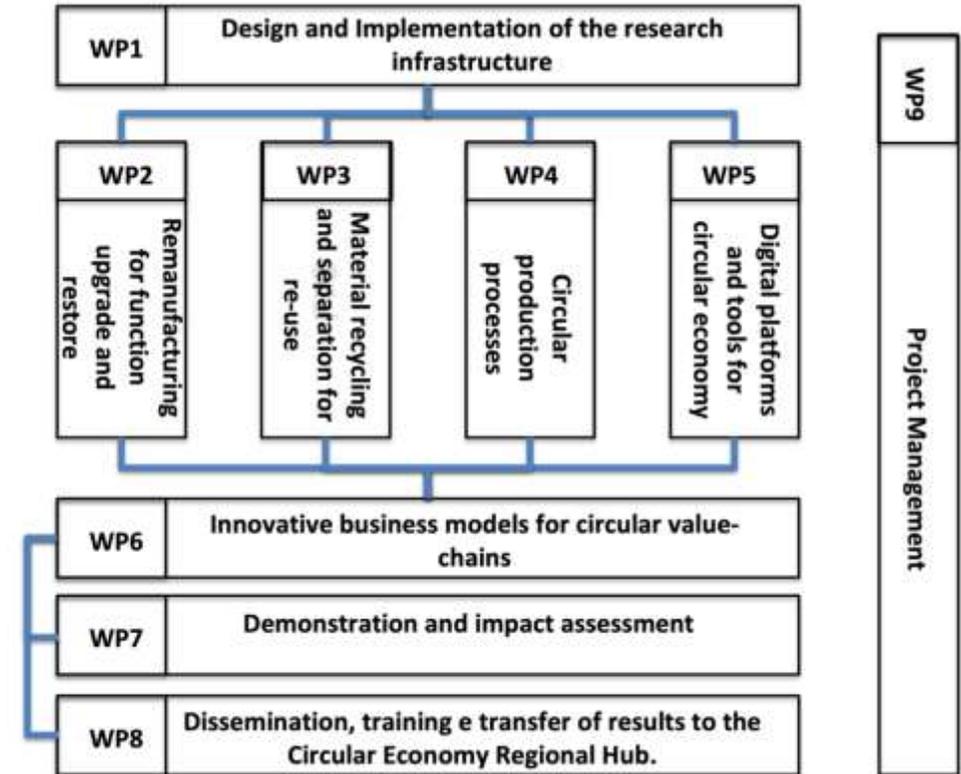
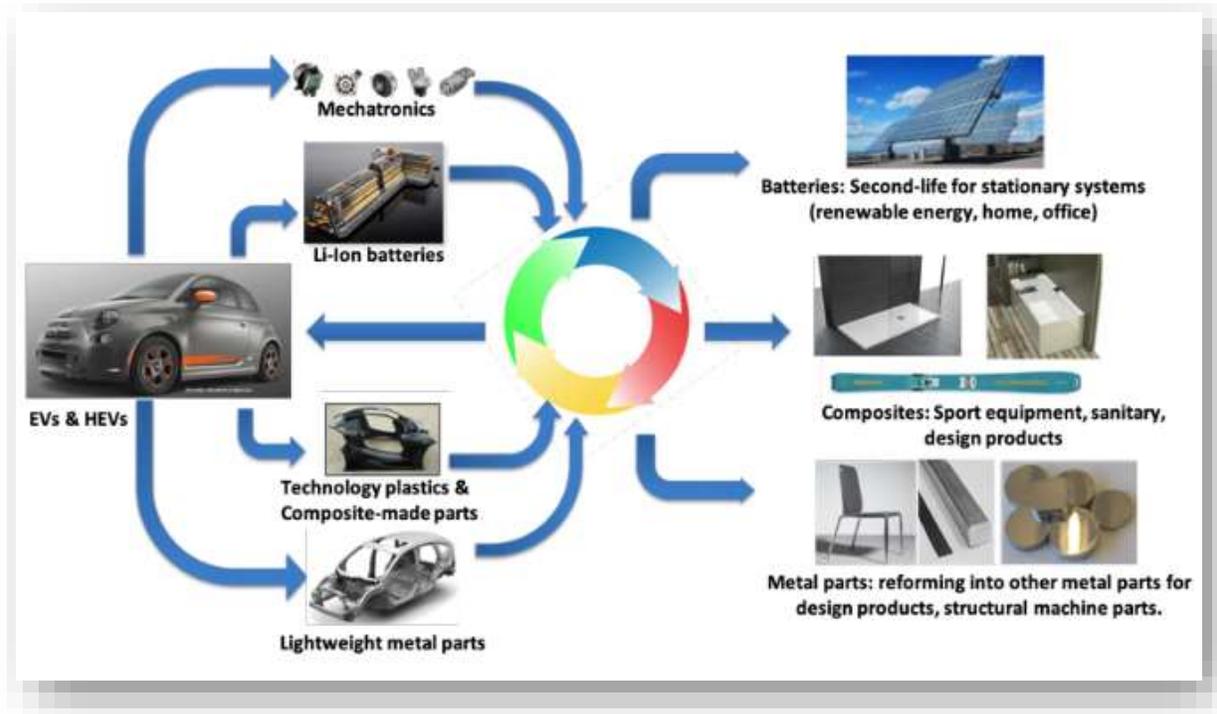
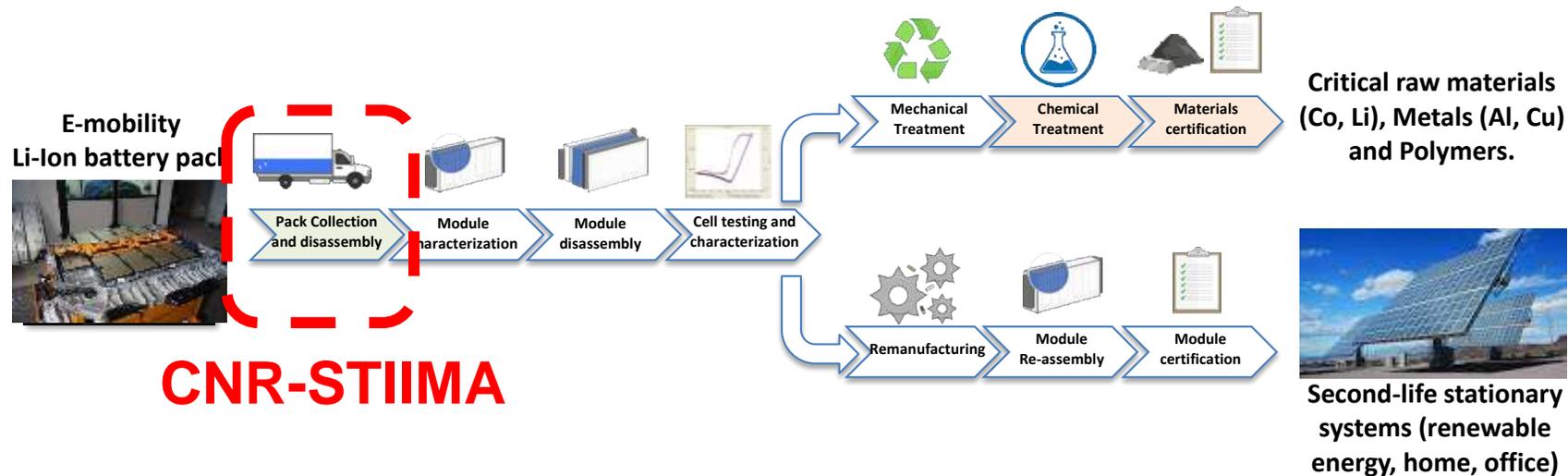


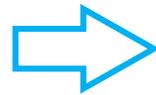
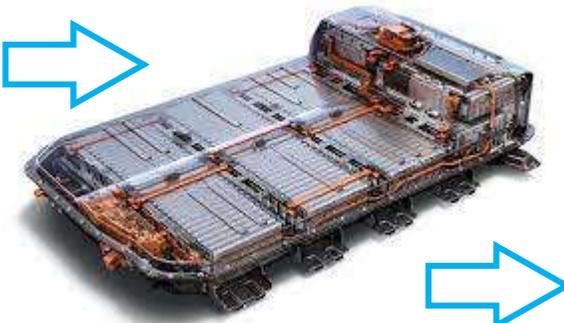
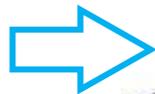
Figure 1: Structure of the EcoCIRC workplan.

- In the EU, the End-of-Life Vehicles (ELV) management of vehicles is regulated by the **EC Directive [2000/53/EC]**, which sets goals for the reuse and recycle of materials.
- The ELV management in the automotive sector is dominated by recycling, and **only a minimal part of the components are regenerated and reused** in the after-sales market.



- In the EU, **Directive 2006/66 EU** regulates the management system of batteries and accumulators, based on a traditional business model conceived for spent portable batteries and oriented to destructive waste recycling; such directive is nowadays adapted to EV batteries collection. **The new regulation is expected in 2023.**
- Regardless of whether it is planned to recycle or reuse battery components, sorting and disassembly are required to improve the results of the following processes.**





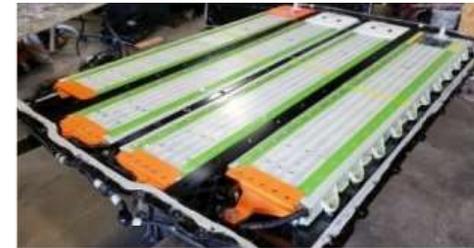
- The EVs follow the same stream as traditional cars.
- A network of car dismantlers collects the car and is in charge of treating the vehicle.
- The battery disassembly is mainly addressed with manual operations.
- Operators work without knowledge of the battery pack.



(a) CRF 500e



(b) Volkswagen



(c) Tesla Model 3



(d) Nissan



(d) Chevrolet's Battery Pack



- Lacking standards for battery pack production.
- Battery packs are not designed to be disassembled (e.g., plates joined with sealing and mastic, using of one-way screws, etc.).
- Lacking information on the status of the battery packs before disassembly.
- The battery pack disassembly is a dangerous and harsh activity.



CNR-STIIMA coordinated the **CarE-Service project** (<https://www.careserviceproject.eu/>) (Horizon 2020, GA 776851).



Jeep Renegade Plug-in Hybrid.



Fiat 500e low-range.

Develop a **team of industrial robots** and **industrial mobile robots**, each with a different payload and reaching, **combined with human intervention** for a bunch of operations.

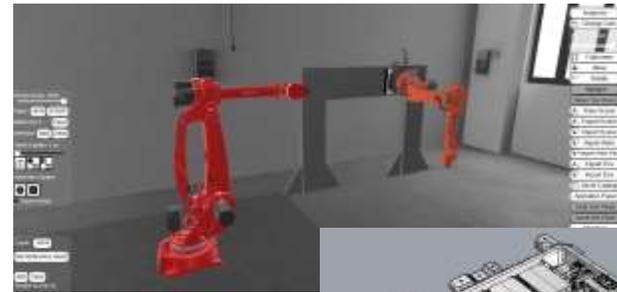


- 26 Degree of Freedom available in the robotic cell.
- Multiple robots cooperating on the same task.
- High autonomy to cope with the huge product variability.
- Simplified usage for the operators.
- Multiple tools for each robot to address a wide range of tasks.
- Robot tools are designed to cope with potentially explosive atmospheres (ATEX).

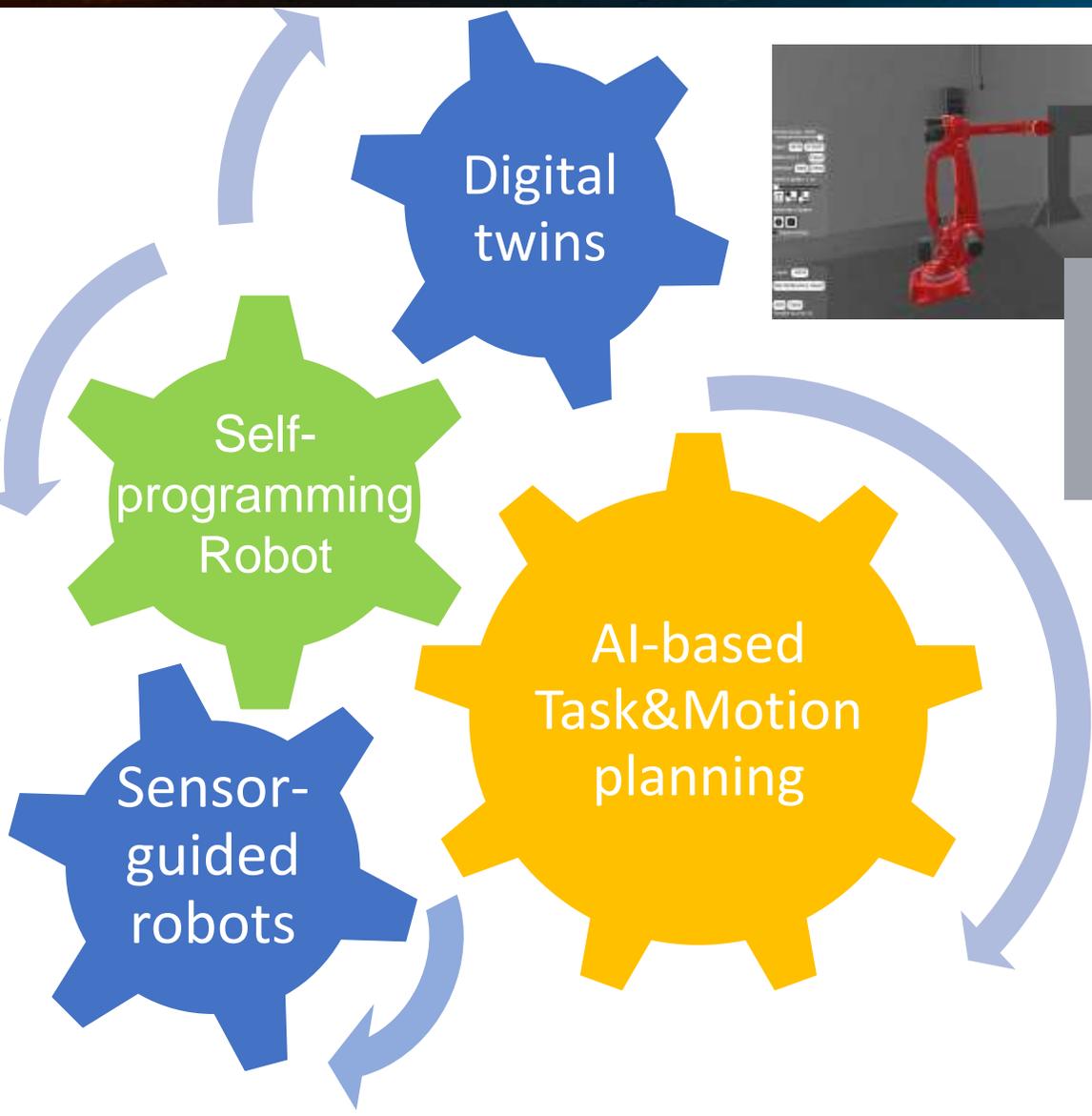
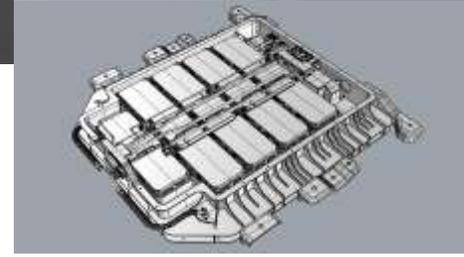
✓ IN PROGRESS



<https://www.youtube.com/watch?v=p3dRxgyJibA>



✓ IN PROGRESS



Task Planner for Agents Coordination
Allocation & Scheduling

- In modern hybrid robot cells (heterogeneous agents, humans and robots), coordination between agents is crucial
- Poor coordination can be inefficient
- Poor coordination can lead to dangerous situations.



<https://www.youtube.com/watch?v=9-sgU6RUmQU>

✓ IN PROGRESS



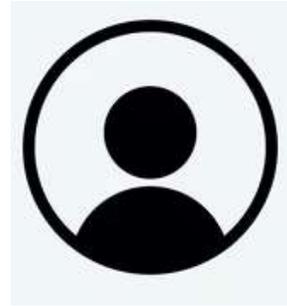
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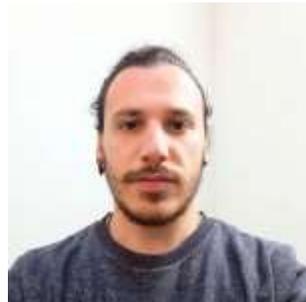


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Associate Prof.

PhD students



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Michele Delledonne



Michele Ferrari



Samuele Sandrini



Roberto Fausti

<https://cari.unibs.it/home-page>

We will organize soon (fall 2023)
an event dedicated to inaugurating
the demonstrator!



CELLA ROBOTICA PER IL DISASSEMBLAGGIO DI PACCHI BATTERIE

Cella robotica prototipale per lo studio e sviluppo di soluzioni e tecnologie innovative per il disassemblaggio semi-automatico di pacchi batterie.



Thank you for your attention!

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