ENEA

Workshop

Il fosforo come materia prima critica: PROSPETTIVE TECNOLOGICHE, NORMATIVE E DI MERCATO

PIATTAFORMA ITALIANA DEL FOSFORO

Politecnico di Milano

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16 17 OTT 2024

in collaborazione con:

POLITECNICO MILANO 1863

PIATTAFORMA ITALIANA DEL FOSFORO

PHOSPHORUS FOR BATTERIES
A FAST TRACK FOR THE EUROPEAN BATTERY SUPPLY CHAIN FROM R&D&I TO INDUSTRIAL PRODUCTION

An overview of the Italian IPCEI industrial projects: ADVANCED RAW MATERIALS AND RECYCLING:
"**PARSES, the Italmatch challenge in EVB**", Maria Cristina Pasi

Italmatch Chemicals

Agenda

- Italmatch at a glance
- The IPCEI concept: PARSES
- Advanced raw materials I
- Advanced raw materials II
- Recycling and sustainability
- ESG IPCEI goals in Italmatch

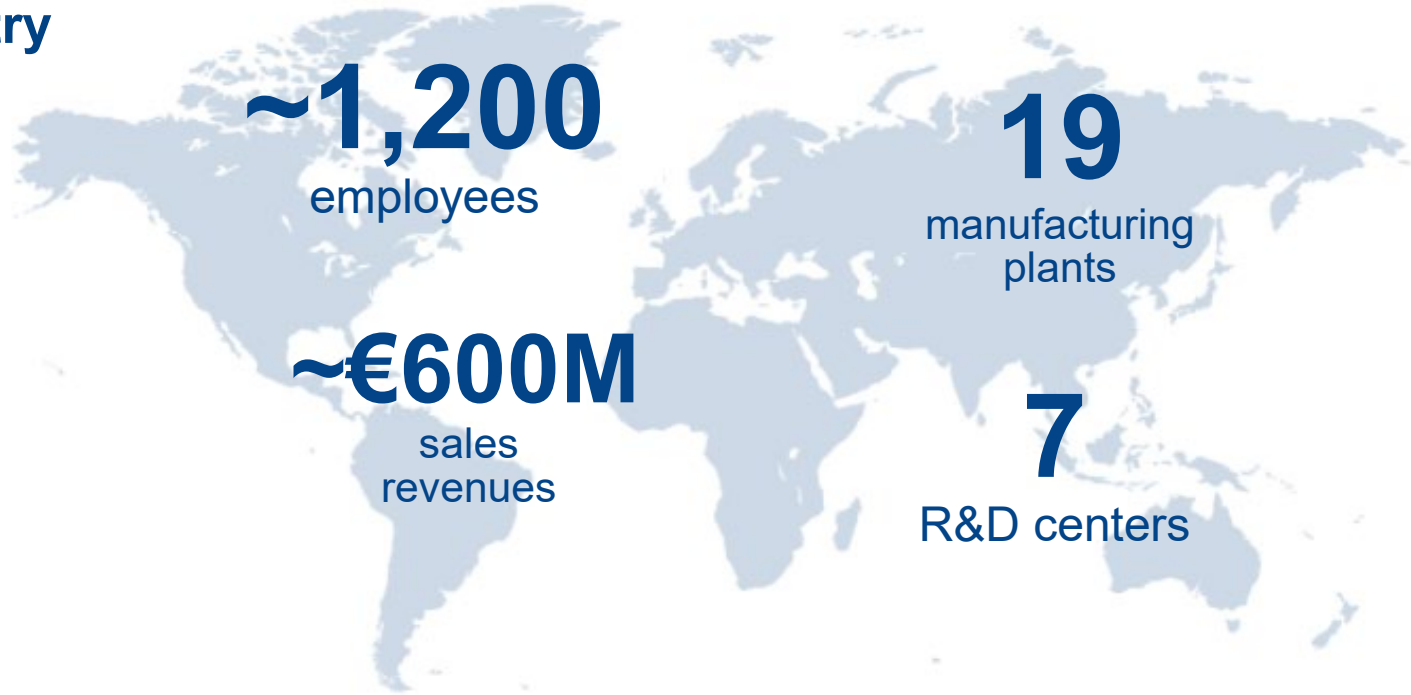
IPCEI BATTERIES

Italmatch Chemicals

Italmatch at a Glance

For over 20 years, sustainable chemistry for a better life. Worldwide.

Italmatch Chemicals is a leading global chemical group, specialising in **performance additives and solutions** for water treatment & lubricants, oil & gas and plastics, flame retardants and boasts a wide product range able to fulfil the requirements of the most demanding applications, including personal care.



~1,200
employees

19
manufacturing plants

~€600M
sales revenues

7
R&D centers

6 Resilient Market:

- Performance Products & Specialties
- Advanced Water Solutions
- Flame Retardants
- Lubricant Performance Additives
- Personal Care, Fabric Softeners & Plastic Additives
- Oil & Gas Solutions

IPCEI BATTERIES

Italmatch Chemicals

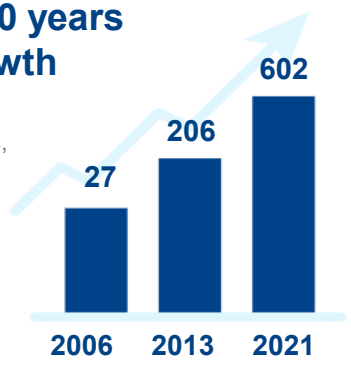
Our Strength in Italmatch Group

Management team with long-standing track record

1

From 1997 over 20 years of growth

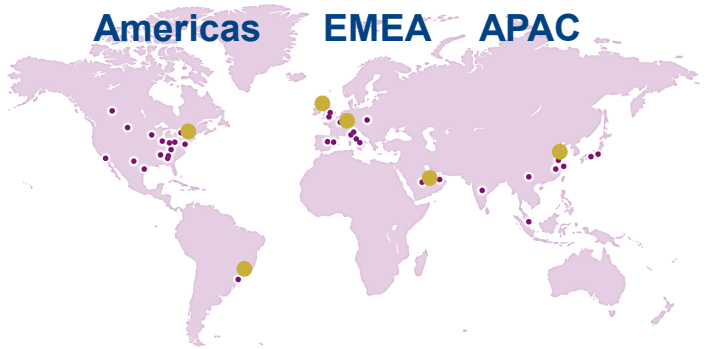
(Sales Revenues, €M)



Global and diversified manufacturing footprint

2

- Flexible multi-chemistry plants
- Offices and logistics centers



Critical products in attractive and resilient end markets

3

AWS — **47%**
Desalination, Cleaning, IWT

FPA — **13%**
Additives for safety of plastic wires and battery cases

LPA — **28%**
Additives for wind turbine gear-oil, engine oil and EV

PPA — **12%**
Essential products for e-mobility batteries, agriculture

(Sales Revenues FY21 split)

Track record of organic and R&D lead growth, greenfield developments and M&A

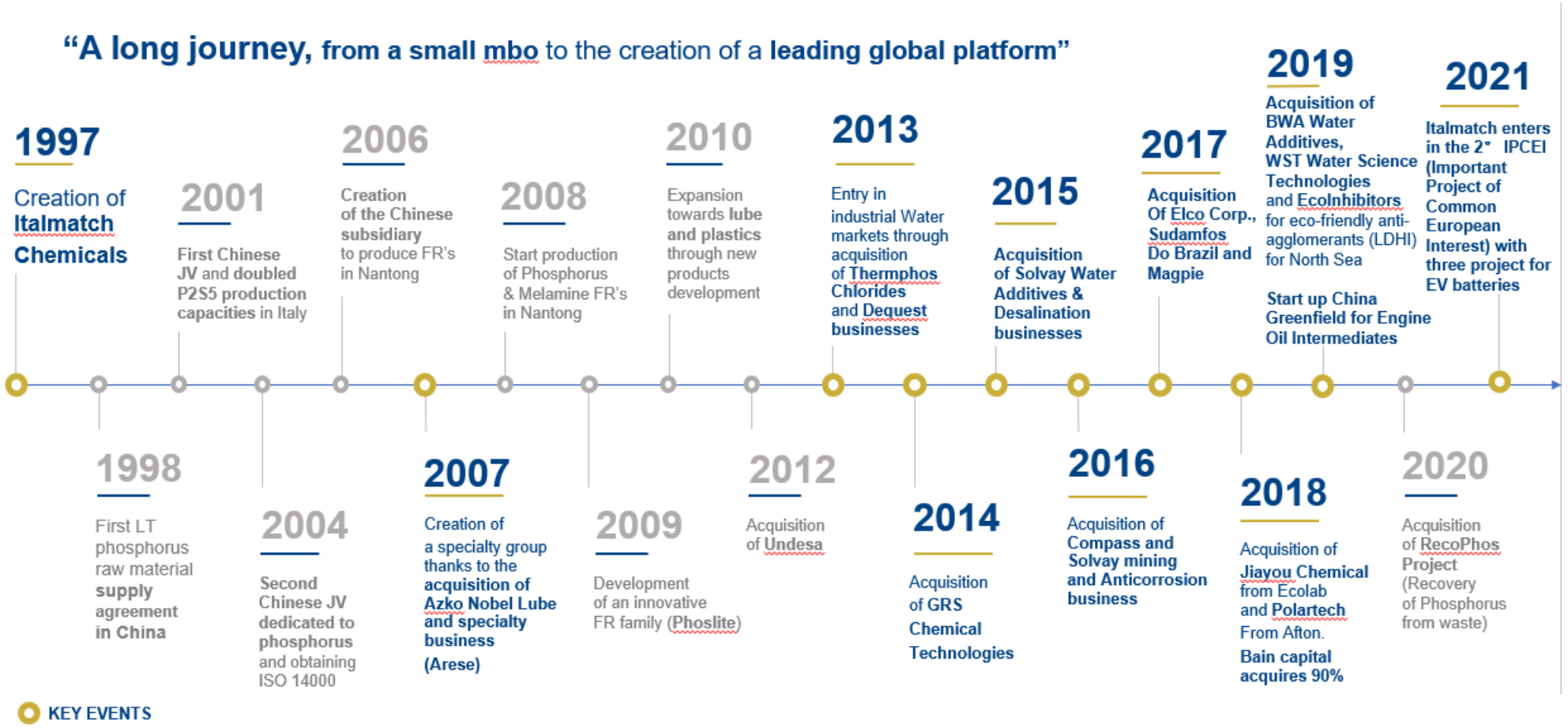
4

R&D: >10
new products launched in 2023

M&A: 9x
M&A acquisitions in last 5 years

Greenfield: 2x
projects executed in last 3 years

A story of success: focus phosphorus

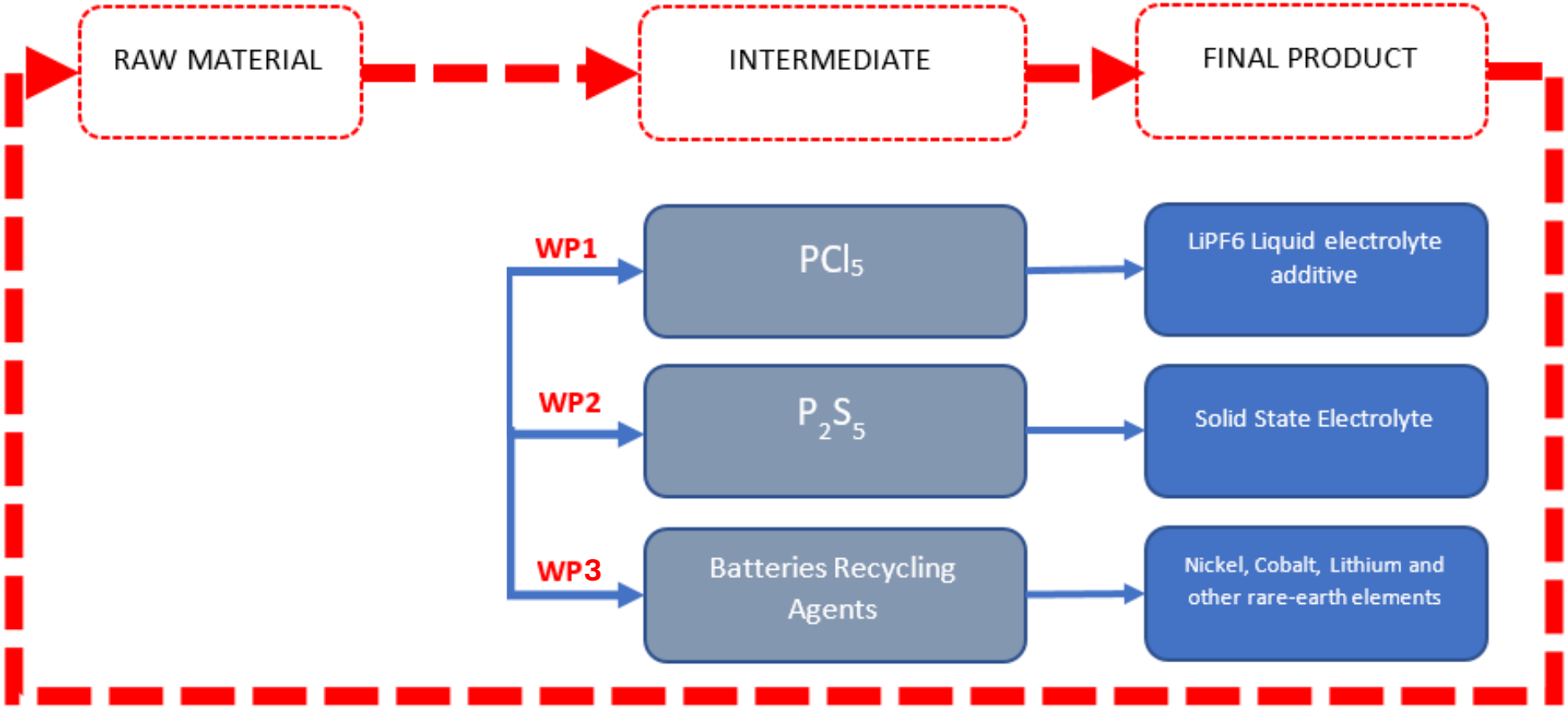


IPCEI BATTERIES

Italmatch Chemicals

The IPCEI concept: PARSES

PARSES: Phosphorus **A**dditives and **R**ecycling for **S**ustainable **E**nergy **S**torage



IPCEI BATTERIES

Italmatch Chemicals

Broad ranges of perfomance additives and application know-how

	Advanced Water Solutions	Lubricant Performance Additives	Flame Retardants	Specialties And Performance Products	Personal Care, Fabric Softeners And Plastic Additives	Oil & Gas Solutions
SELECTED PRODUCTS	• Antiscalants • Biocides • Corrosion inhibitors • Emulsion polymer • LMW polymer • HMW flocculants • Fuel cleaning agents • Full Functional Solutions	• P2S5 • Polymeric esters • Conventional & complex esters • Amides • Sulphurides EP additives • Hydraulic fluids • Grease additives • MWF additives • Fuel additives	• Red phosphorus flame retardants • Melamine flame retardants • Phoslite flame retardants • Metallic Stearates • PVC additives • Antislip lubricating additives	• Phosphorus chlorides • Fatty acid chlorides • Special phosphites / phosphates • High purity HCL • OPA • Liquid - Solid EV batteries electrolytes	• Esterquats • Esters • Polymers • Metallic Soaps • PVC one-pack • Glycerine • Fatty Acids • Amide	• Antiscalants including squeeze treatments • Dispersants • Biocides • Corrosion inhibitors • Pour point depressants • Water clarifiers • Friction reducers • Demulsifiers • Hydrate inhibitors (LD)
MAIN MARKETS	• Industrial & Institutional Cleaners • Household Detergents • Desalination • Pulp & Paper, Geothermal, Mining • Precious Metal Recovery	• Additives & Components for Industrial Lube Oil • MWF Additives, Neat Oil & Water • Grease • Synthetic Base Stocks • Fuel Additives • Intermediates for Engine • Oil Ad Pack	• Engineering Thermoplastic (PA/PBT/PC/ABS) • Polyolefins • PVC, Epoxy, Rubbers, Foams, PUR	• Chemical Intermediates • Mining & Agrochemicals • Lithium Batteries • Pharma	• Construction • Household • Lubricants • Paper • Personal Care • Pharmaceuticals • Plastics & Rubber • Wood	• Hydraulic fracturing • Flow assurance • Asset integrity • Acidising stimulation
MARKET SHARES	• 30% global m.s. in antiscalant	• 25% global m.s. in P2S5 • 90% European m.s. in Polymeric Esters for lubricants	• >70% European m.s. in Red Phosphorus FR's	• 25% global m.s. in PCl3		• 15% MS NA biocides • 30% global scale inhibitors

IPCEI BATTERIES

Italmatch Chemicals

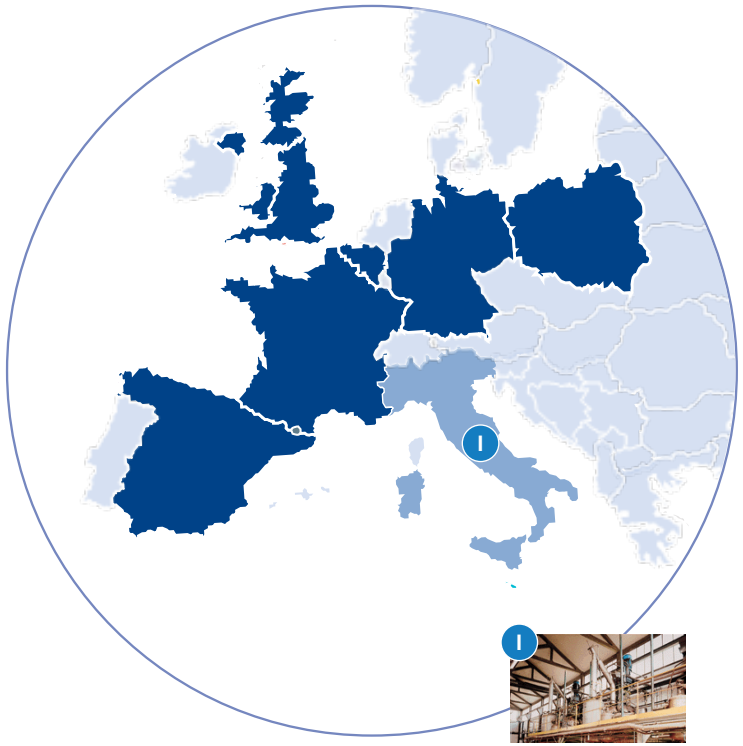
WP1: Innovative PCl_5 supply chain towards a feasible LiPF6 EU production chain

- Italmatch the sole producer of PCl_5 in the EU
- IPCEI PARSES for the development of a turn-key SMART supply platform overcoming the state-of-the-art safety and handling barriers for a sustainable management of indispensable high concern raw materials
- IPCEI PARSES for developing an innovative returnable packaging and automatic discharging system based on a disruptive 4.0 digital logistic model for the PCl_5 safe transportation and handling whose technology will be able to offer a continuous sustainable supply
- IPCEI PARSES for paving the road towards the first-in-its-kind European commercial production facility, fulfilling the local Li-Ion Battery needs of sustainable PCl_5 and contribute to the European independency transition with 1800 MT/Y within 2037
- IPCEI PARSES for increasing the EU climate ambition towards 2030 and 2050 by reducing plastics and introducing advanced returnable package systems based on advanced LCA certified materials in favour of the electromobility transition

IPCEI BATTERIES

Italmatch Chemicals

WP2: All-Solid-State-Lithium-Batteries (ASSLBs) and All-Solid-State-Lithium-Sulphur-Batteries (ASSLSBs) Material Development Contribution



Spoleto (Italy)

- Italmatch the European leader in production of P_2S_5
- IPCEI PARSES for the industrial engineering of the chemical reaction in order to develop the suitable quality for a reliable validation by the electrolytes manufacturers
- IPCEI PARSES for obtaining the EVB requested conductive electrochemical properties of P_2S_5 (key raw material for the Li-S ASSB electrolyte)
- IPCEI PARSES for setting up a pioneering P_2S_5 (solid electrolytes precursor) plant in Europe to feed the solid electrolytes producers inside and outside the Italian context with a suitable material, meeting the requirements of the IPCEI circular battery value chain with an yearly production of 5000 MT/ y up to 2037
- IPCEI PARSES for foster the support of Research Centres and companies involved in the research and development of Generation 4 lithium-sulphur SSB, with a manufacturing flexibility in providing tailored P2S5 grades following their inputs

WP3: Nickel, Cobalt, Lithium and other rare-earth elements recovery from exhausted batteries – Development of new chemistry/co-formulations for reducing CAPEX-OPEX in hydrometallurgy recycling processes

Arese (Italy)

Naples (Italy)

- Italmatch a major global player in Advanced Water Solutions
- IPCEI PARSES for developing innovative IoT integrated chemical technologies towards an efficient recovery of Lithium, Cobalt and Nickel in partnership with several intra-European participants to the initiative, in line with the ongoing implementation of the EU Battery Directive 2006/66/EC and 91/157/EEC in a concept of circular economy and environmental sustainability
- IPCEI PARSES for offering a solution which can be adapted to the various recycling plants (prospective IPCEI partners already individualized) and therefore:
  - Increase the success probability of the new designed recycling protocols which will be a public value for the entrepreneurial world in Europe and beyond it, following the envisioned Eco-labelled European EV Batteries
  - Contribute effectively to the EU water agenda which includes the necessity to develop waterless or less water demanding technologies vs the state of the art,
  - Contribute to enhance the technology innovation intake by the market by facilitating the integration with robotics and IoT system (new Water directive)

IPCEI BATTERIES

Italmatch Chemicals

PARSES Recycling and sustainability

WP3: Nickel, Cobalt, Lithium and other rare-earth elements recovery from exhausted batteries – Development of new chemistry/co-formulations for reducing CAPEX-OPEX in hydrometallurgy recycling processes

Arese (Italy)

Naples (Italy)

- Italmatch a major global player in Advanced Water Solutions and Mining extractants
- IPCEI PARSES for improving the purification efficiency to the suitable level by developing novel chemicals possessing higher selectivity in order to match the challenge of metal refining from exhausted batteries and electronic components with an expected production of 300 mt /y within 2037
- IPCEI PARSES for creating and implementing a common synthetic process allowing to create numerous chemicals, hence allowing to study and refine the structure activity relationship and optimise the targeted Solvent Extraction performances made available to relevant industries.
- IPCEI PARSES for developing commercial chemical product exhibiting synergistic properties and improved performances fitting the complexity of the battery's matrix.

IPCEI BATTERIES

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FlashPhos: Recycling P_4: a servitization case for the e-battery value chain

Shifting the organisation to a life-centered chemical ecosystem through a disruptive responsible production strategy based on a symbiotic circular value chain centered on wastes

THE STATE OF THE ART

- 1 of 30 strategic global raw materials*
- Backbone of multiple chemical sectors
- High C footprint sourcing and supply chain
- Depletion in the short-medium term
- Thermal energy consuming process
- ESG challenging impact
- Renewables based attractive, but limited options

THE WORLD BENEFITS OF A LIFE CENTERED ECONOMIC MODEL/ COLLECTIVE VALUE

- Stable, continuous production with no shortage
- Decentralised supply chain with low C-footprint
- No dangerous air emissions with preservation of natural ecosystems
- Contribution to a sustainable landfills management
- **Catalytic effect on electromobility by cloosing the loop in the PCl_5 and other electrolytes precursors (P_2S_5)**
- From a circular to an ecosystemic integrated value chain

THE ORGANISATION ADDITIONAL BENEFITS

- Upstream vertical integration
- Stakeholders' network implementation and spillover effects into novel sectors
- Economic growth, No poverty and Zero hunger contribution by decentralized geo-expansion
- World reputation increase as a first mover in its ecosystem for responsible profitability
- Multiple bottom lines profit effect
- Generation Z attraction and talent retention increase
- Investors attraction driven by the set Performance Metrics System

- The first assessment (2011) identified 14 CRMs out of the 41 candidate raw materials, in 2014, 20 out of 54 candidates, in 2017, 27 CRMs out of 78 candidates, and in 2020, 30 out of 83 candidates
- https://single-market-economy.ec.europa.eu/document/download/04f72016-032f-4dc1-92cd-1ada791b5540_en?filename=Study%202023%20CRM%20Assessment.pdf

IPCEI BATTERIES

Italmatch Chemicals

PARSES SUSTAINABILITY GOALS WITHIN THE IPCEI 2_ EuBatIn

SUSTAINABILITY and ENVIRONMENT

- WP1: from plastic single use to recyclable advance materials based tanks
- WP1 and WP2: sustainable low impacting reaction routes
- WP3: protection of the natural capitals and extended efficiency
- Compliance with SDGs, NGD

SUSTAINABILITY and SUPPLY CHAIN

- WP1: the raw materials supply with its charging and discharging will affect the reaction‘s route and its sustainable development to meet the target of the IPCEI whole project from raw materials to recycling
- WP1 and WP3: new supply chain network within and outside the IPCEI consortium
- WP1-WP2-WP3: novel key partners and spillover cascade effects: INTRA and EXTRA IPCEI consortium

SUSTAINABILITY and GOVERNANCE

- New management structure
- New downstream and upstream channels
- New professional profiles
- Enrichment of existent market and customers groups and channels

IPCEI BATTERIES

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Thank you

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15
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La Piattaforma Nazionale del Fosforo
è una iniziativa promossa dal
Ministero dell'Ambiente e della Sicurezza Energetica