



Pre-commercial pilot for the efficient recovery of Precious Metals from European end-of-life resources with novel low-cost technologies



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Grant agreement N: 958302

Coordinator: FUNDACIÓN TECNALIA RESEARCH & INNOVATION, Spain

Duration: 1 May 2021 – 30 April 2025 (48 months)

Project budget: € 12,838,998 (€ 11,210,485 EU contribution)

Consortium



 **19** partners from **9** countries (14 companies, 2 Research centres, and 3 Universities)



Importance of Precious Metals

Target Precious Metals within the PEACOC project:

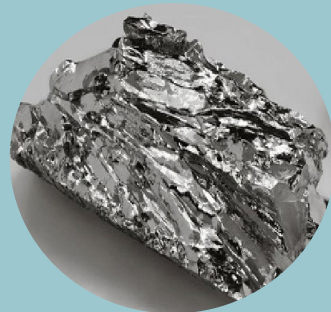
Platinum
(Pt)



Palladium
(Pd)



Rhodium
(Rh)



Gold
(Au)



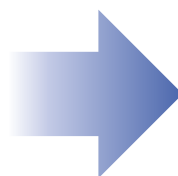
Silver
(Ag)



Platinum Group Metals (PGMs)

Precious Metals are irreplaceable industrial commodities due to their **unique physicochemical properties** (low corrosiveness, catalytic properties, low electrical resistivity, etc.)

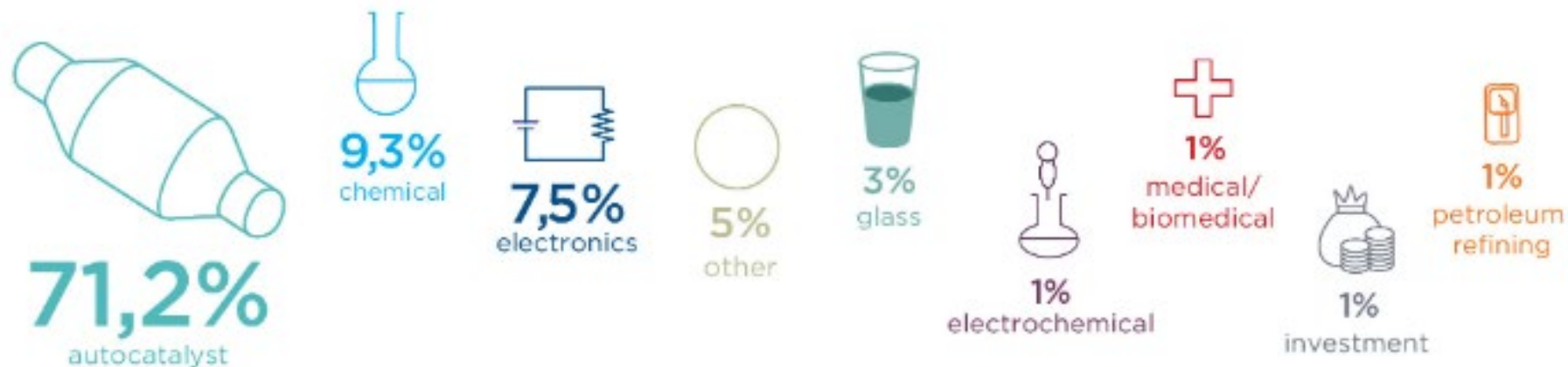
EU's economy is **highly dependent** on the import of several Precious Metals



Considerable amounts of Precious Metals are available in *end-of-life* (EoL) products in the EU, with a vast potential to be recycled

Importance and markets of PGMs

PGMs are classified by the European Commission as Critical Raw Materials (CRMs)



Major demand categories for PGMs

Source: International Platinum Group Metals Association based on JM PGM Market report, May 2021

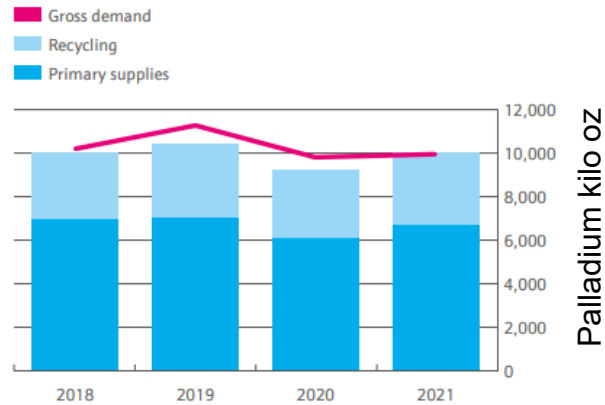
- Current global **demand for PGMs** is driven by their use in **autocatalysts**.
- **Europe is the world's largest consumer of PGMs. Mainly used for autocatalysts production** (~ 90%, 54% and 80% of Pd, Pt and Rh, respectively, were consumed by autocatalysts in 2019, ~155 t).*
- **The primary production of PGMs in the EU is insignificant** (~85% of the primary supply comes from South Africa and Russia).*

Market trends for PGMs and recycling potential



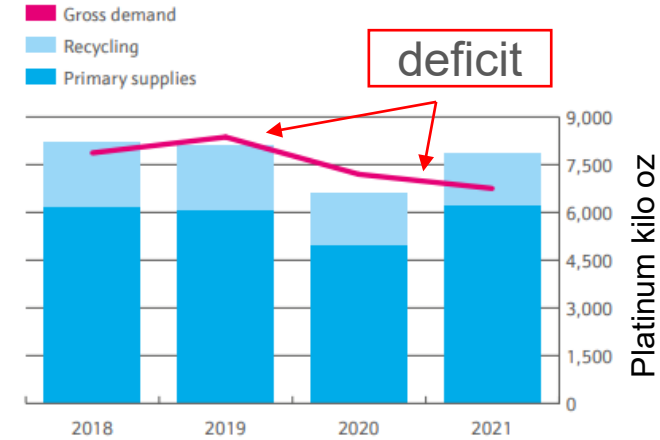
Global demand and supply of palladium

Deficits can be seen almost every year

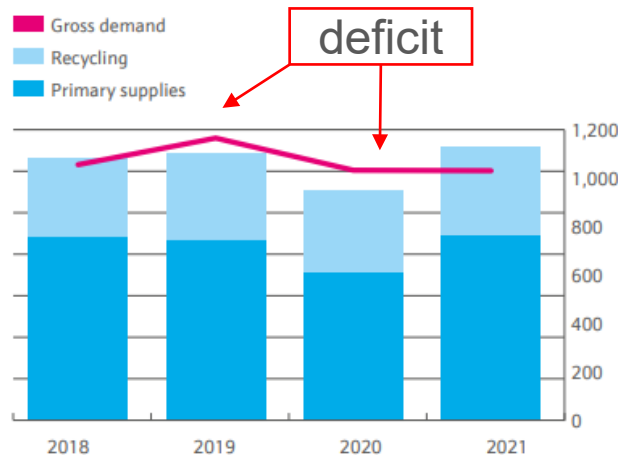


Source: Johnson Matthey's PGM Report May 2022

Global demand and supply of platinum



Global demand and supply of rhodium



- PGMs market is under supply risk.
- The recycling input rate of EoL products containing PGMs in Europe is estimated at 21%* which is largely insufficient to meet the EU demand.

*The percentage of overall demand that can be satisfied through secondary raw materials. EC COM(2020) 474

- Large potential for recycling from vehicles and technological products
 - the EU's motor vehicle fleet counted ~300 M vehicles in 2018 which contain potentially >1000 t of PGMs;
 - ~10 t of Pd in EoL mobile phones & PCs were not recovered in 2015.**

**Bakas, I. et al., "Present and potential future recycling of critical metals in WEEE", Report Copenhagen Resource Institute, 2014

Market trends for gold and recycling potential

- **Gold (Au) is mined all over the world, including Europe** (principally in Finland, Sweden, Bulgaria, Spain and Greece).
- **EU's production accounts for <1% of the global primary production.**
- **WEEE offer an important recycling potential for Au recycling within the EU** (i.e., 30 t Au from EU WEEE worth ~1.6 B€ were not recovered in 2015).*
- **low/mid-grade printed circuit board assemblies (PCBA) (20-100 g Au/t) represent a challenge** (e.g., up to 60 different elements are closely interlinked in complex assemblies).

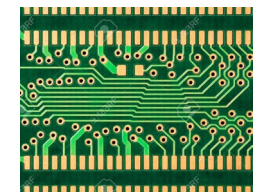
Central Bank



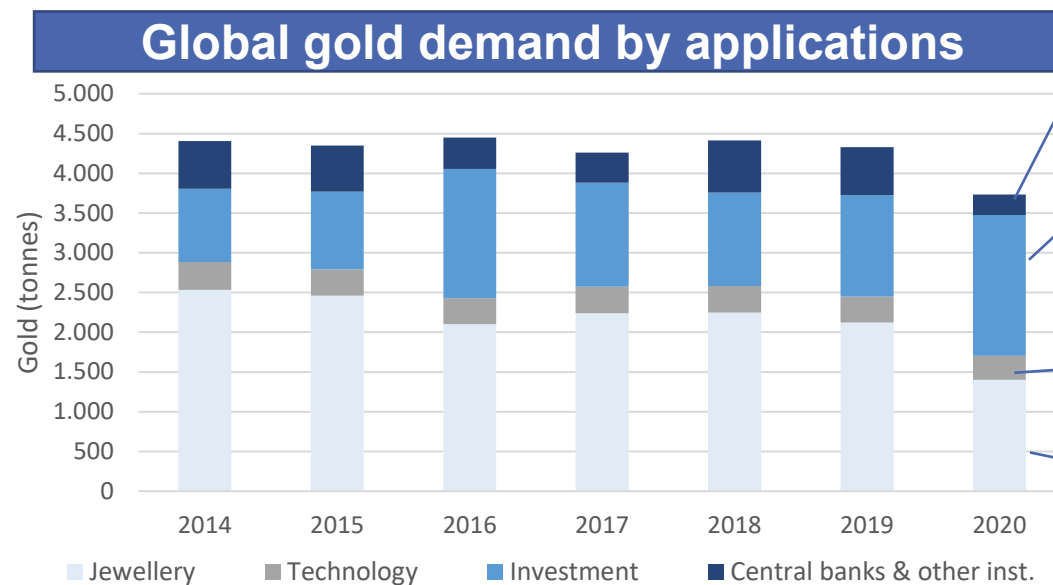
Investment



Technology



Jewelry



Source: Goldhub which obtained the data from CE Benchmark Administration, Metals Focus, Refinitiv GFMS and World Gold Council

*Bakas, I. et al., "Present and potential future recycling of critical metals in WEEE", Report Copenhagen Resource Institute, 2014.

Market trends for silver and recycling potential

- The EU accounted for ~7% of the global silver (Ag) primary production.
- The EU recycles ~37% of the world's Ag.
- Significant potential for Ag recycling from PCBA and EoL photovoltaic (PV) panels in the EU. The flow of EoL PV panels is expected to drastically increase in the coming decade, from 43 kt in 2017 to more than 1.2 Mt in 2030, ultimately reaching 60 Mt in 2050 globally (Europe will have an EoL PV panels share of >50% in 2030 and ~20% in 2050).*
- The recycling of this EoL product is expected to generate around 720 t to 36 kt Ag in 2030 and 2050 respectively, worth ~0.5 B€ and 2.6 B€.

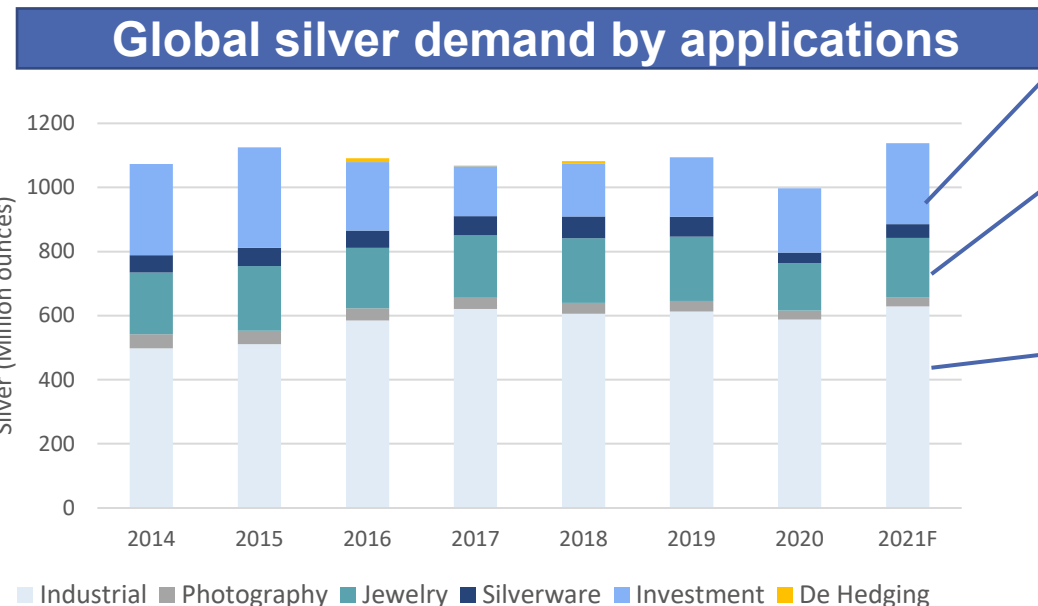
Investment



Jewelry



Industrial use



Challenges in recycling Precious Metals

The current industrial recycling technologies, such as smelting or hydrometallurgical processes, present several limitations



CAPEX-OPEX intensive



High Temperature (>1200°C)



Limited efficiency of recovery due to the complex mixture of materials in *end-of-life* products, *e.g.*, low/mid-grade PCBA (*i.e.*, 20 to 100 g Au/t)



High environmental footprint resulting from the use of strong acidic solutions



Adverse impacts on both human health and environment



The *large-scale* nature of the *state-of-the-art* refineries prevents the development of SME-scaled operations

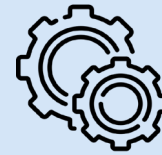
Goal:

To demonstrate a *first-of-a-kind* economically and environmentally-viable pre-commercial metallurgical system for recovering precious metals from a wide variety of abundant *end-of-life* products in Europe.

The specific objectives of the PEACOC project are:



To improve the precious metals concentration stage by up to 100 times



To design and operate a mobile refining pilot at pre-commercial scale for producing precious metals with >99% purity at gross profit margin up to 80%



To reach a near zero waste strategy by valorizing the recovered precious metals and residues into new functional products



To identify new or un-valorized resources in Europe and neighboring countries to increase the recycling input rate



To prove the PEACOC sustainability from economic, technical and environmental perspectives



To expand the impact of the PEACOC project by conceptually exploring the replication of the proposed process to treat other EoL products

End-of-life Products



Autocatalysts



WEEE

low/medium-grade PCBA



PV panels

Collection



Pre-treatment & Concentration



Refining



Valorization



New Products



Autocatalysts and hydrogen cells



3D-printed jewelry, PCBs and catalysts



Filaments for 3D printing

Miscellaneous Activities



Management, LCA and LCC studies



Manufacturing of MW assisted leaching equipment



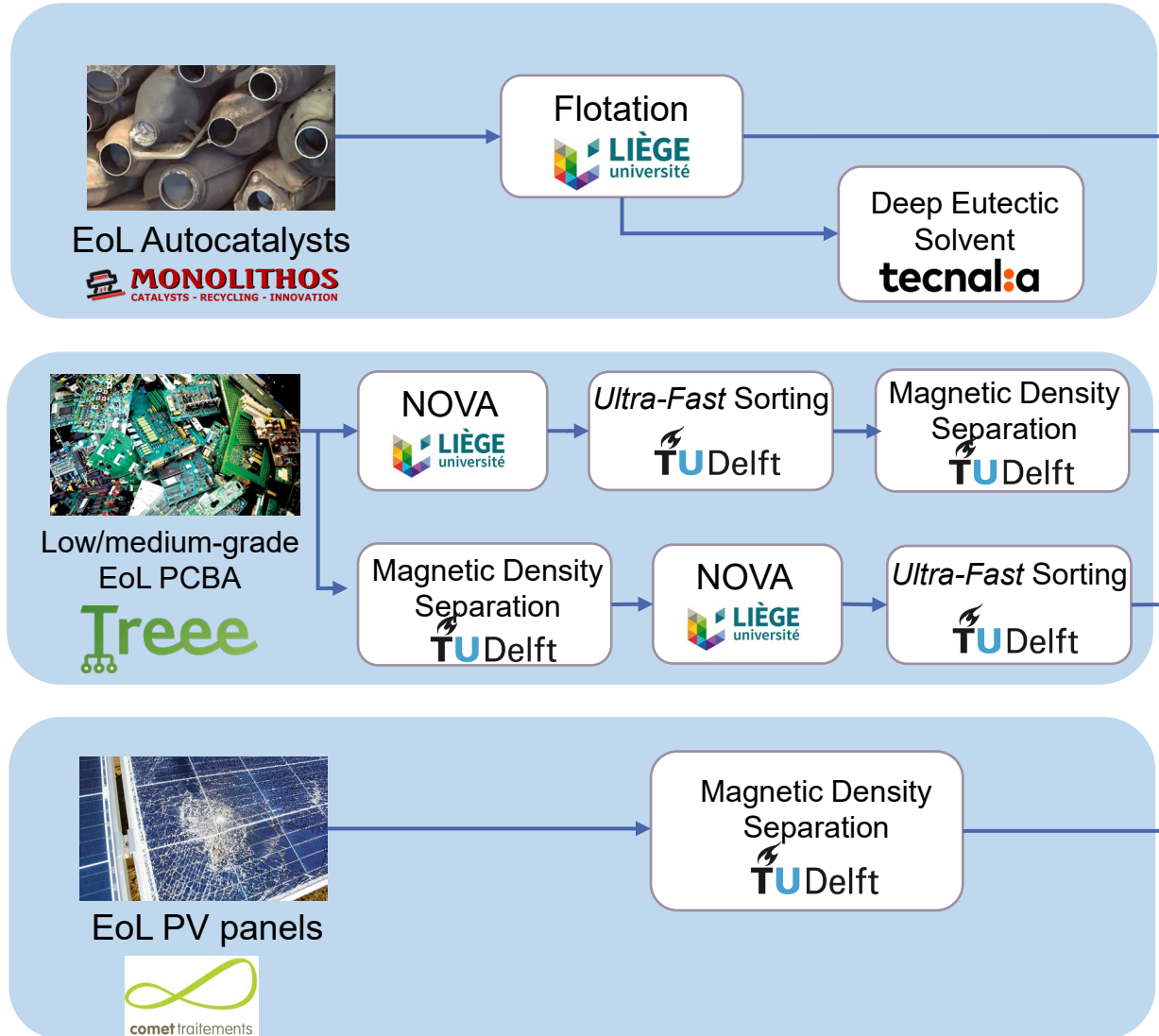
Manufacturing of GDEx equipment
Engineering and construction of pre-commercial pilot



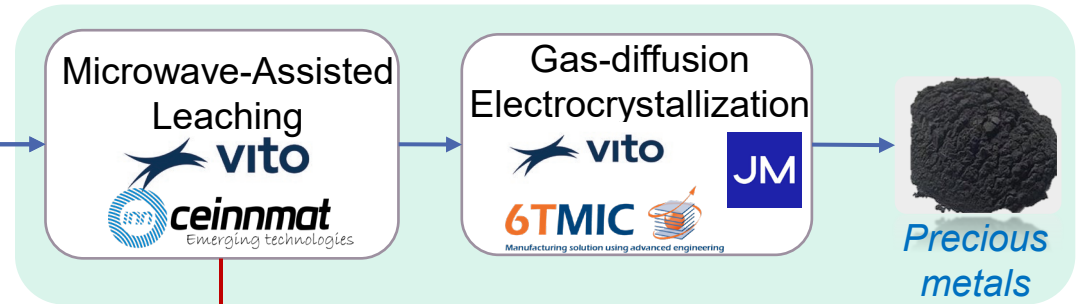
Exploitation, clustering, RMIS feed, dissemination and communication

Technologies in PEACOC projects

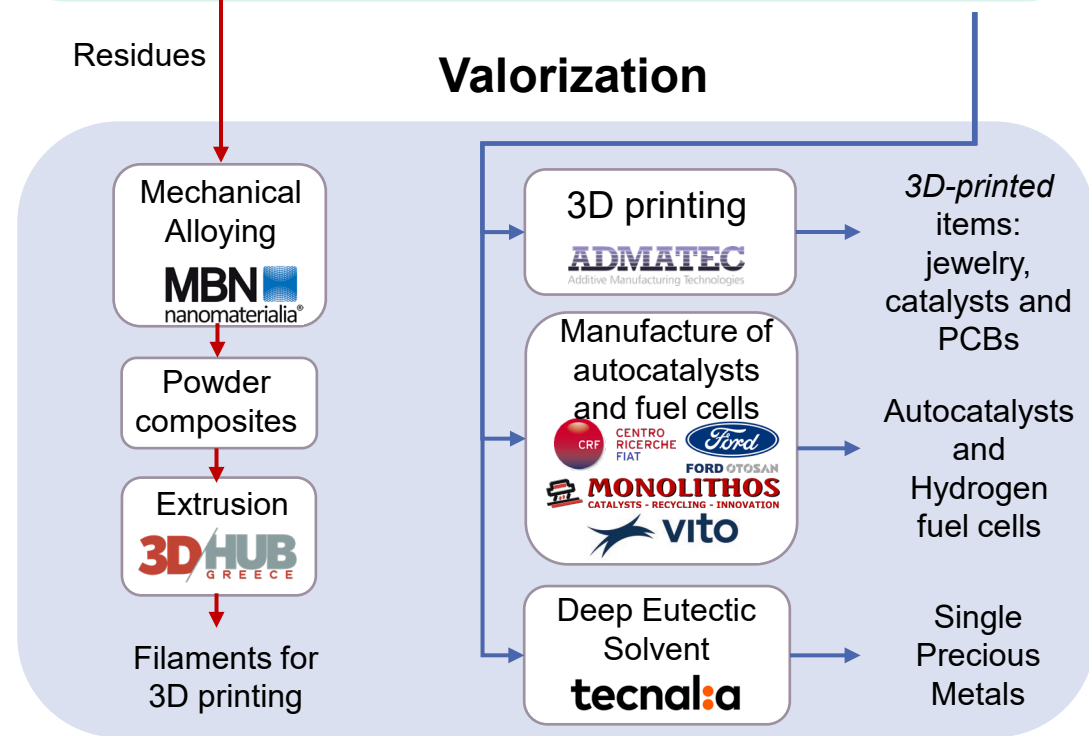
Pre-treatment and concentration



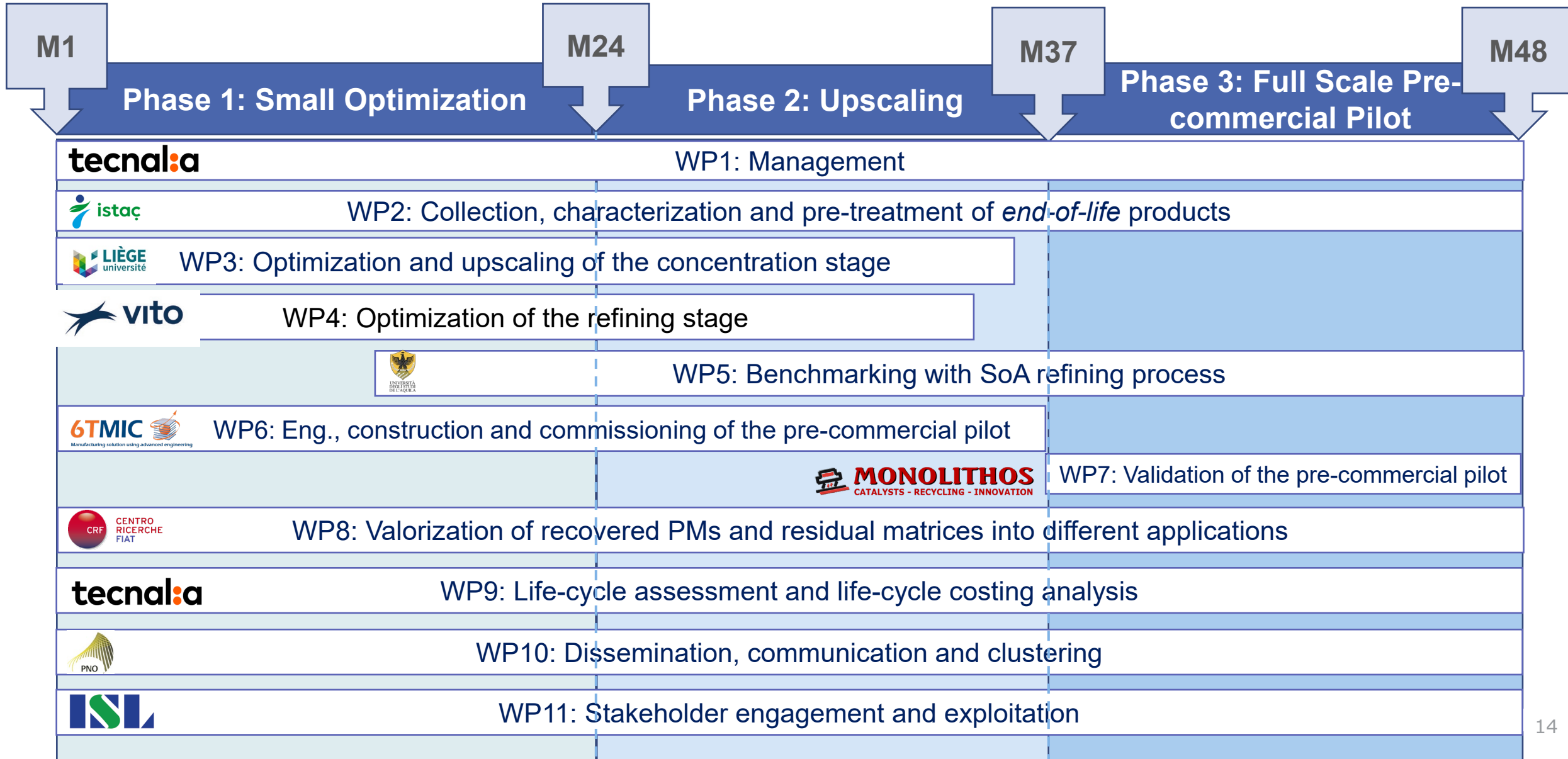
Refining



Valorization



Work plan



Expected Impacts

The expected impacts of the PEACOC project are:



To drastically reduce the supply risk of precious metals for Europe



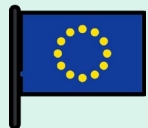
To enable new business opportunities for SMEs interested in precious metals recycling and therefore unlock a significant volume of various secondary raw materials currently underexploited



To improve the profit margin, safety and environmental performances of large refineries with efficient and economically and environmentally friendly technologies



To consolidate the position of large industries (recycling companies, refineries, automotive, metallurgy) in Europe



To support the European Commission in reaching the ambitious energy and climate targets

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