



POLITECNICO
MILANO 1863

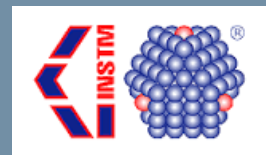
Il caso della Regione Grand'Est (Francia)

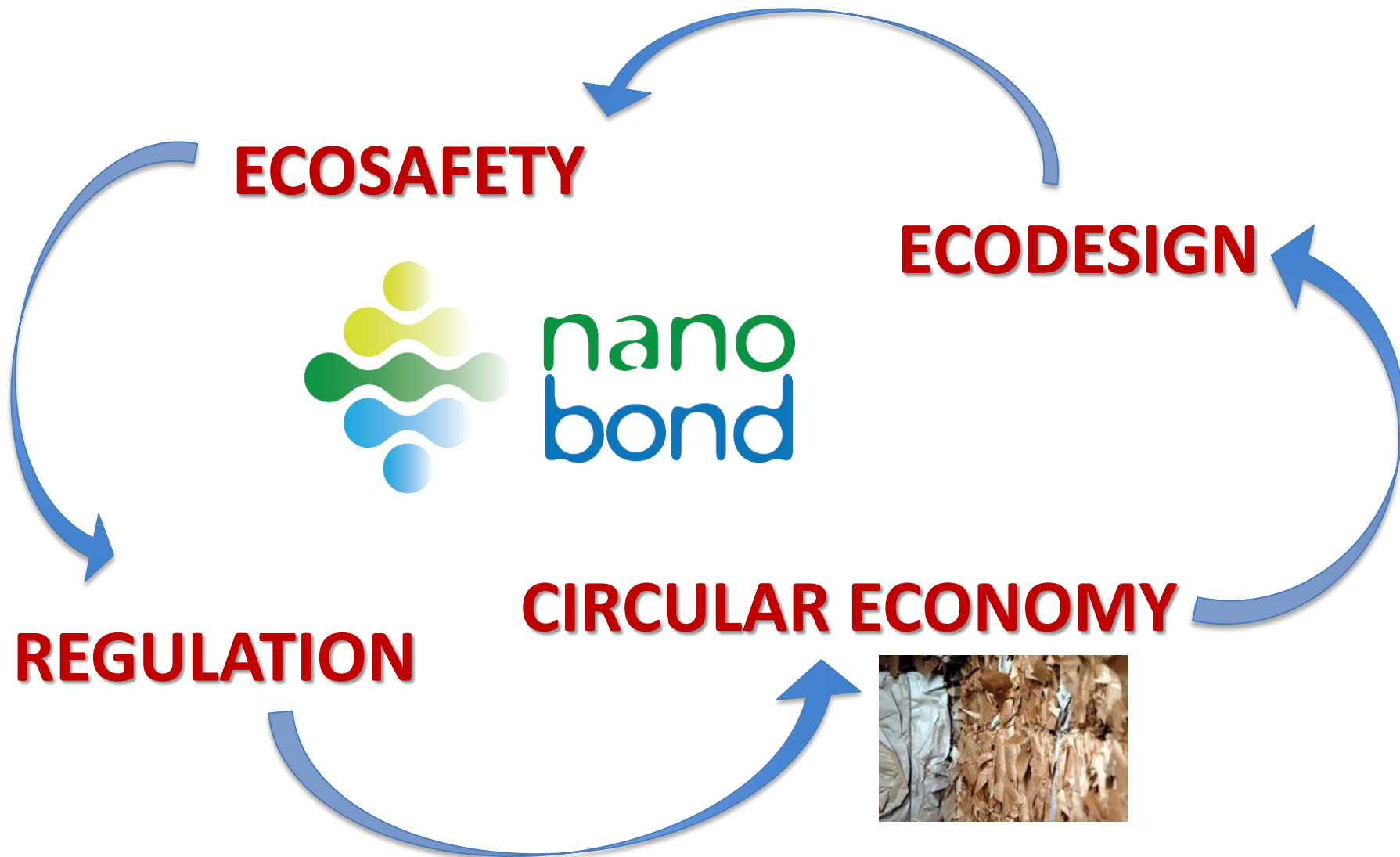
2nd TANIA Stakeholders Group Meeting

Prof. Carlo Punta

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and INSTM Local Unit

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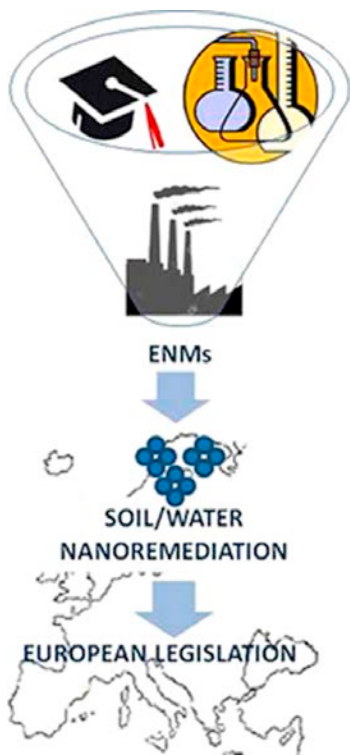






NANOMATERIALS FOR ENVIRONMENTAL REMEDIATION ASSOCIATED TO DEWATERING

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Ecofriendly nanotechnologies and nanomaterials for environmental applications: Key issue and consensus recommendations for sustainable and ecosafe nanoremediation

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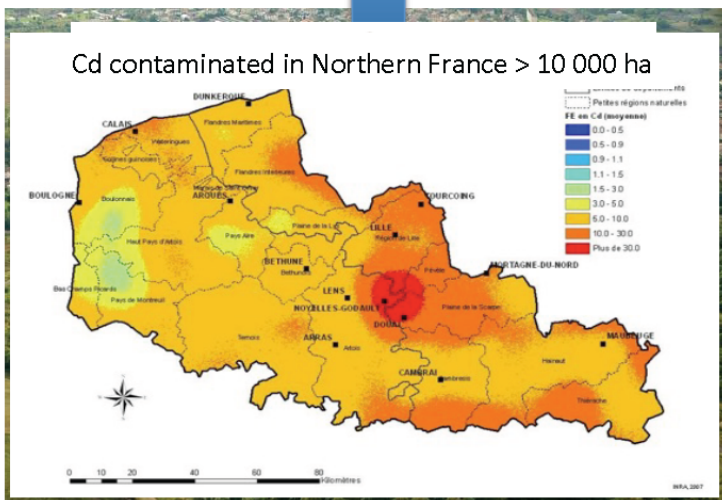
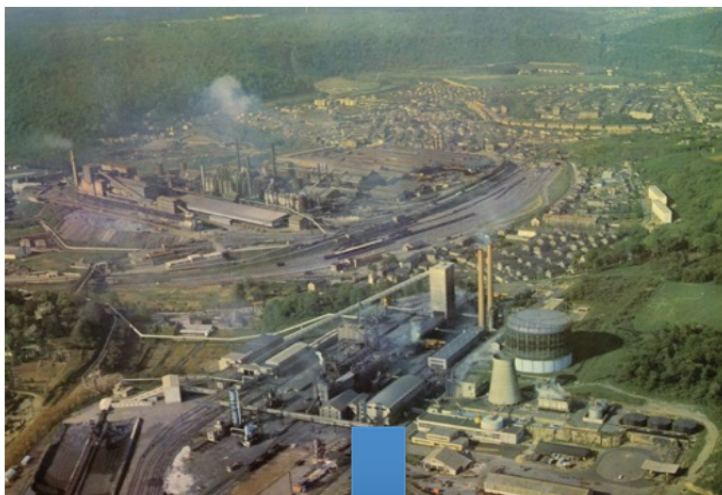
Groupement d'intérêt scientifique sur les friches industrielles

Il gruppo di interesse scientifico su aree industriali dismesse (brownfield) è stato creato nel 2002, nel quadro del CPER (CONTRAT DE PLAN ETAT-REGION) 2000-2006, per rispondere alle domande scientifiche e tecnologiche poste dai territori degradati e inquinati derivanti da precedenti attività industriali. Supportato dall'Università della Lorena, ha altri quattro membri, il CNRS (Centro Nazionale di Ricerche scientifiche), l'INRA (Istituto Nazionale di Ricerca Agricola), il BRGM (Istituto di Ricerca Geologica e Mineraria) e l'INERIS (Istituto nazionale dell'ambiente industriale e dei rischi), ed è composto da undici laboratori che rappresentano una vasta gamma di discipline.

Nel corso del tempo, il gruppo ha sviluppato una capacità di ricerca multidisciplinare essenziale per comprendere i processi di inquinamento e sviluppare soluzioni di controllo dell'inquinamento pertinenti.

Questo gruppo ha collaborato con partner privati: gestori brownfield, proprietari di siti, uffici di progettazione e operatori di disinquinamento

Soil Remediation – Context and Challenges



- **Context: 70's to 90's**

- strong economic and industrial shift in Europe
 - closing of heavy industry – steel, coal, textile
- 340 000 contaminated sites in Europe
- sites of vast surface areas
- restoration of former industrial sites for economic redevelopment

- **Challenges**

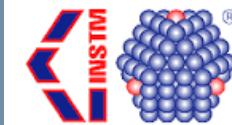
- increase scientific knowledge about contamination dynamics in soils and ecosystems
- develop eco-technologies for remediation and recycling of degraded and contaminated sites

- **GISFI**

- scientific consortium (10 research groups) dedicated to the study and the remediation of brownfields
- partnership : research – industry

Third TANIA Exchange Event

Metz (France), 28th and 29th November 2017



Les partenaires associés

Arcelor Mittal
VDR
EPF Lorraine
CREGU
IRH Environnement
LECES
PROGEPI
SOLVAY
MicroHUMUS
BURGEAP

Les membres

UL
CNRS
INRA
BRGM
INERIS

Les membres d'honneur

Préfecture de la Région Lorraine,
Conseil Régional de Lorraine
Conseil Général de Meurthe et Moselle
DRTT - Délégation Régionale de la Recherche et
Technologie,
DREAL - Direction Régionale de l'Environnement, de
l'Aménagement et du Logement
PGE - Pôle de Génie de l'Environnement

Les laboratoires de Recherche Publics

- Laboratoire Sols et Environnement – LSE-UMR 1120 ENSAIA-UL/INRA
- GéoRessources - UMR 7359 CNRS/UL/CREGU
- Laboratoire Interdisciplinaires des Environnements Continentaux – LIEC-UMR 7360 CNRS/UL
- Laboratoire des Réactions et Génie des Procédés – LRGP-UMR 7274 CNRS/UL
- Unité Bio-géochimie des Ecosystèmes Forestiers - UR 1138 INRA
- Laboratoire de Chimie Physique et Microbiologie pour l'Environnement – LCPME-UMR 7564 CNRS/UL
- BRGM
- Pôle risques et technologies durables – INERIS
- Equipe de Recherche sur les Processus Innovants - ERPI - EA 3767 UL
- Interpsy EA 4432 UL

The Soil and Environment Laboratory (LSE) is one of the **pioneer laboratories dealing with strongly anthropized soil**, a consequence of the expansion of urban, industrial and transport infrastructures as well as the intensification of agriculture, and decontaminating this soil **via phytoremediation**, which consists in cultivating plants that accumulate the pollutants in the parts that are harvested or that favor their biodegradation.

GISFI laboratory site (Homécourt)

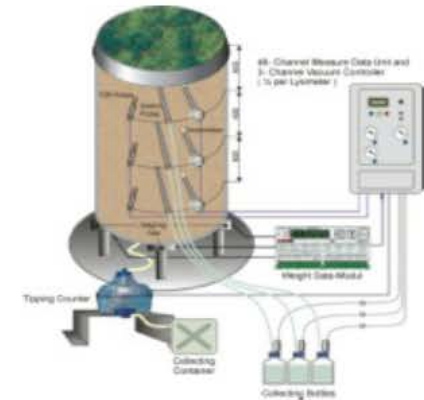
Visit of the experimental platform established on a brownfield (former coking plant) where are studied at pilot and field scale the dynamics of pollutants in soils and soil-plant systems and where are tested a large range of innovative technologies.



Experimental platform: lysimeters

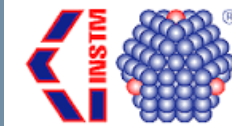


Lysimeter plots : *pedogenesis and treatment of Technosols*
(*in situ* chemical oxidation, soil construction, phytoremediation, natural attenuation, agromine)



Lysimeter columns: *pollutant fate and treatment*
(*diagnostic, risk evaluation, in situ* soil treatment, soil restoration)

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Chemical Oxidation



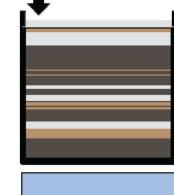
Long Term Evolution of
Pollutants

Lysimetric plots (Homécourt) – 2005

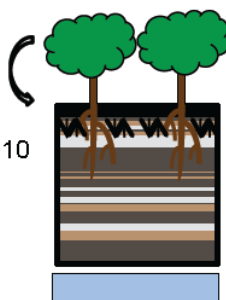
Phytoremediation/Phytoextraction



Steel industry
effluents

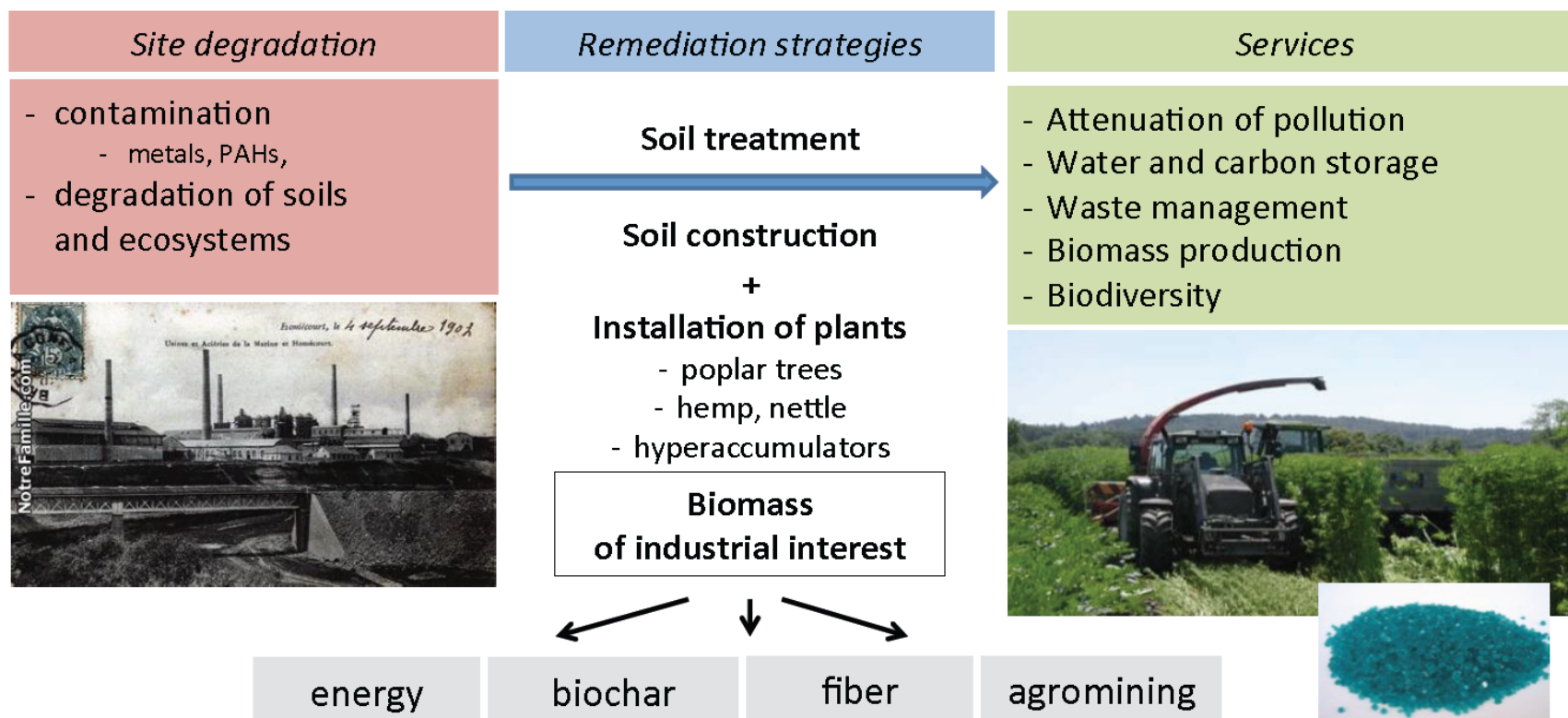


1950-2010



10 m-deep - 2.6 ha
Pompey, Lorraine, France

The LORVER project (2013-2018): production of biomass on abandoned sites



4 companies
5 research groups

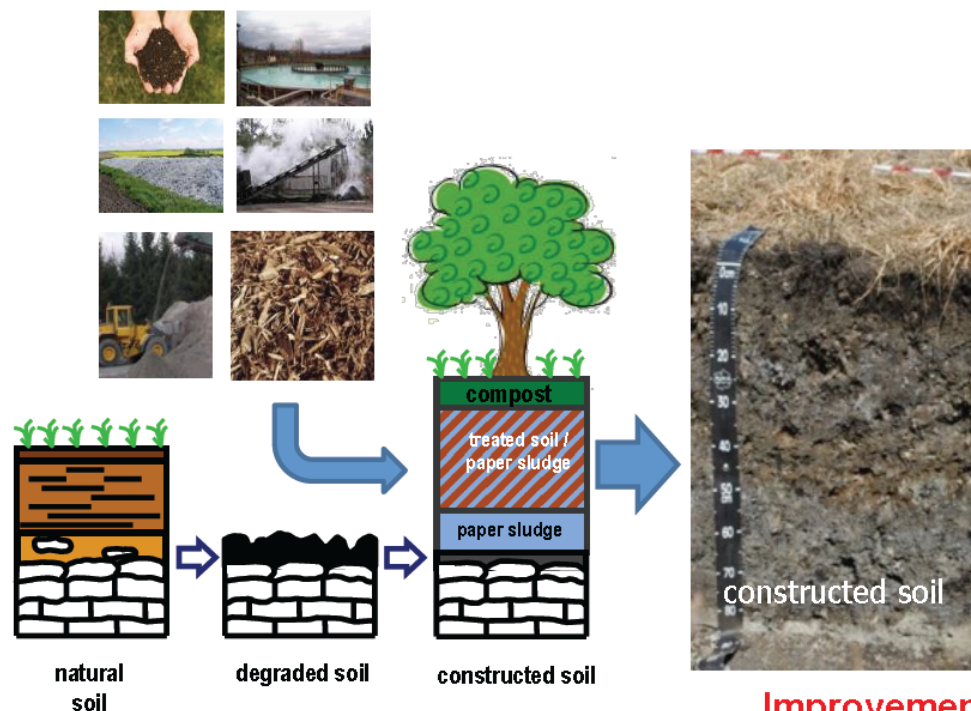
➤ *Challenge : build a chain of services
and control residual pollution on abandoned (contaminated) sites*

<http://www.lorver.org>

Reuse of brownfields for biomass production

⇒ **Multifunctional soils to ensure a large range of ecosystem services, similar to that of natural soils**

⇒ provision (biomass), regulation (filter/exchange, biodiversity, C storage, use of anthropogenic material to protect natural soil capital)



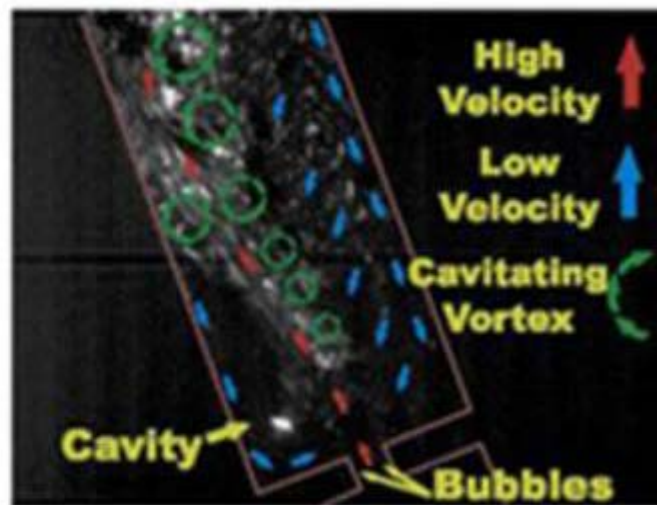
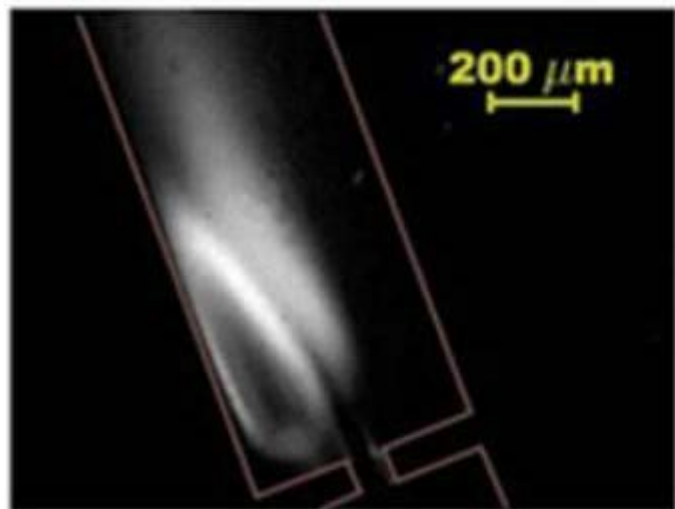
(Sere, 2007; Sere *et al.*, 2007, J. Soils Sed.)

Improvement of provisioning and regulating services
(biodiversity, C storage, waste management)

Water treatment – The Hydrodynamic cavitation

A lot of organic compounds are found in waters from oil and gas reservoirs

The hydrodynamic cavitation is potentially efficient to treat such waters.



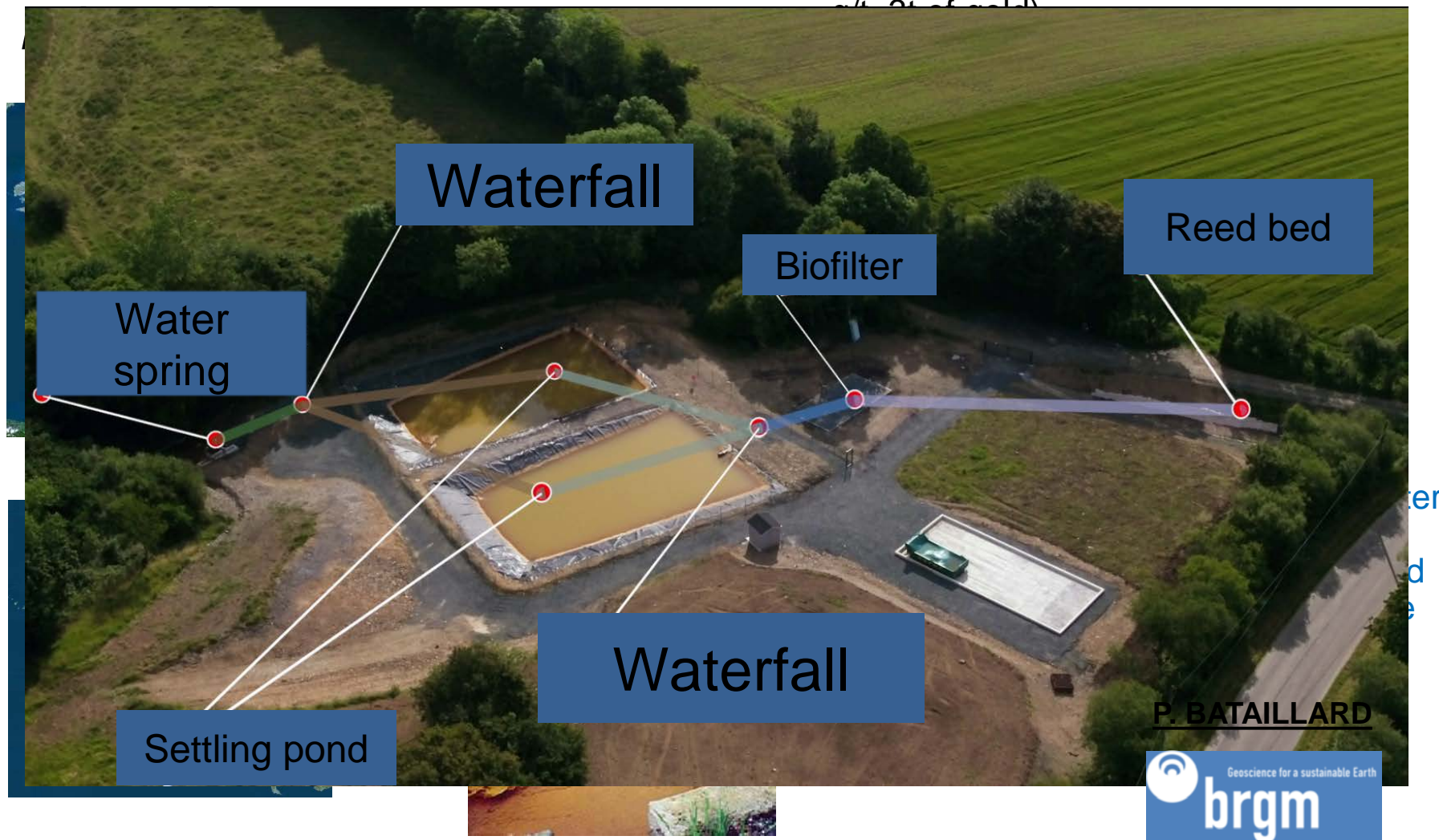
P. BATAILLARD



Cavitating vortex occurs when water circulates in pipes of different sections. The increase in pressure and temperature produces free radicals (OH^\bullet) which may oxidize dissolved organic compounds.

As treatment of Loperec

- Exploration shaft – gold (360 000 t at 8,15 g/t of gold)



MAT4EN2 Group

Materials for Energy &
Environment



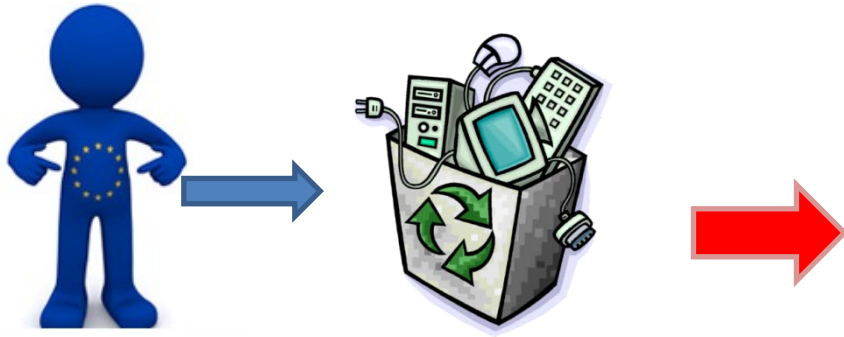
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MATERIALS FOR
ENERGY & ENVIRONMENT



E-WASTE VALORIZATION: Recycle as opportunity



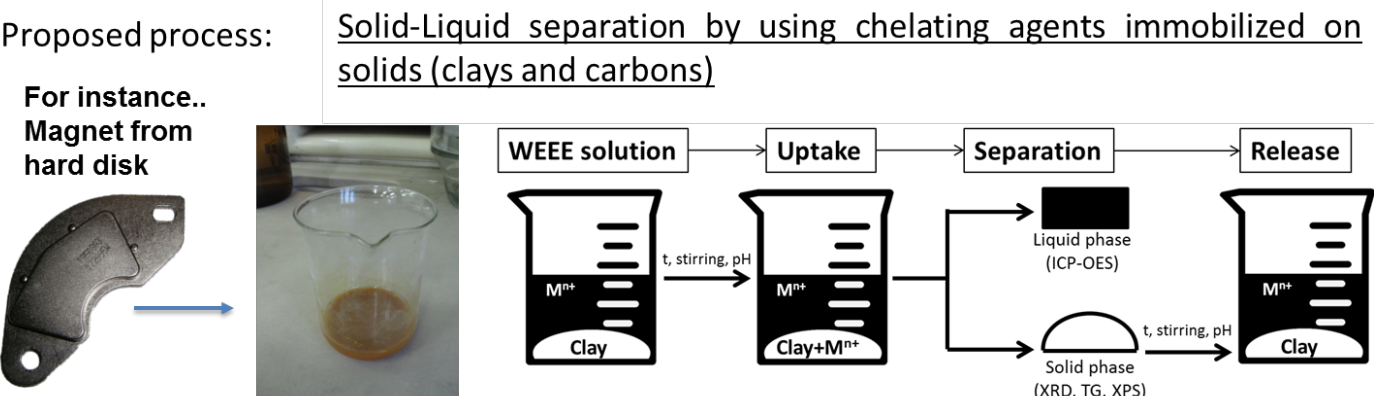
Each EU citizen produces about 17 kg of Waste Electrical and Electronic Equipment (rich in REs and PMs) per year.

Proposed process

- Recovery of valuable metals from WEEE (Waste Electrical and Electronic Equipment)
- Solid-Phase Extraction (SPE)
- Sorbents: Natural and modified clay and carbons materials



FROM LAB.....

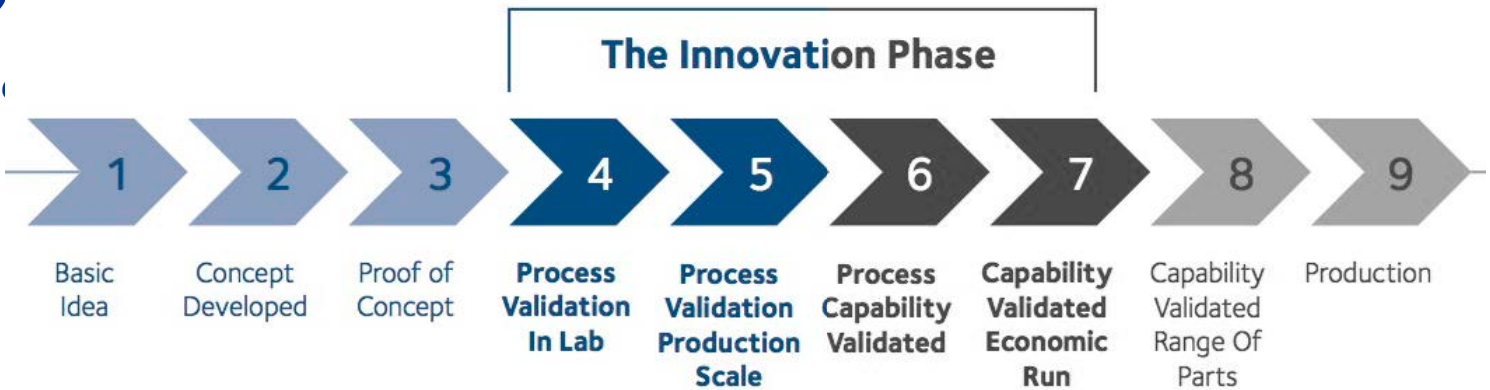


....TO PILOT PLANT (E-Waste project, financed by Lombardia Region)....

The technology was validated in industrial relevant environment (TRL 5) from both technological and sustainability point of view.

A pilot plant was designed and built up to treat 50 kg of WEEE in 2 days via hydrometallurgical process. It has been estimated that, in one year, about 7.2 t of Cu, 11 kg of Ag, 53 kg of Sn, 9 kg of Ni, 8 kg of Au, corresponding to ≈ 300,000 € could be recovered.

....TO
Submitte

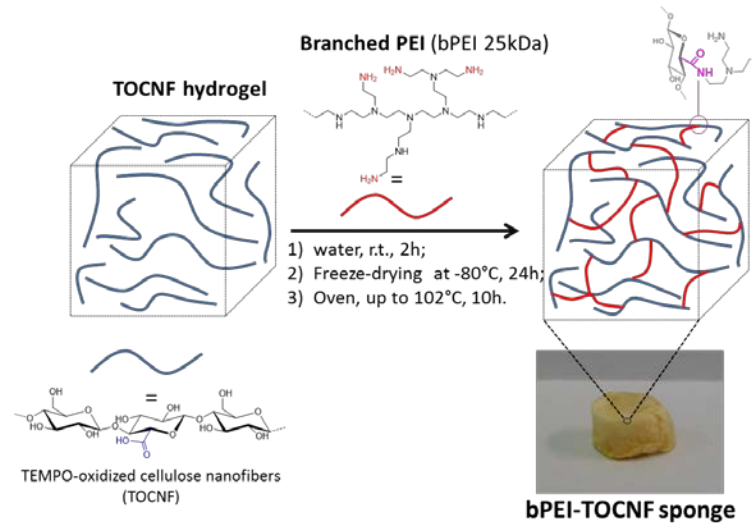


NANOTECHNOLOGY DESIGN

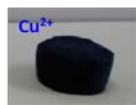
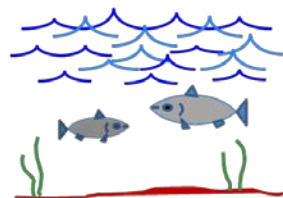
From nano-dimensioned to NANO-STRUCTURED materials



PULP CELLULOSE
BARTOLI
FIBREBOARDS FOR INDUSTRY
ITALY

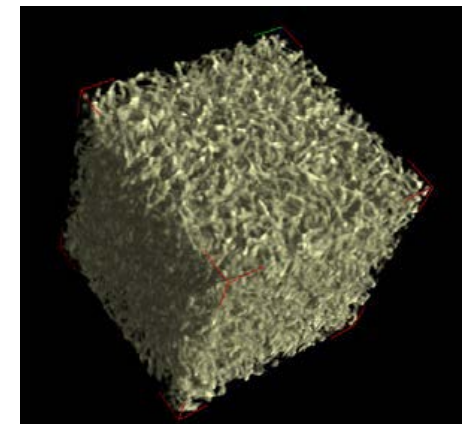
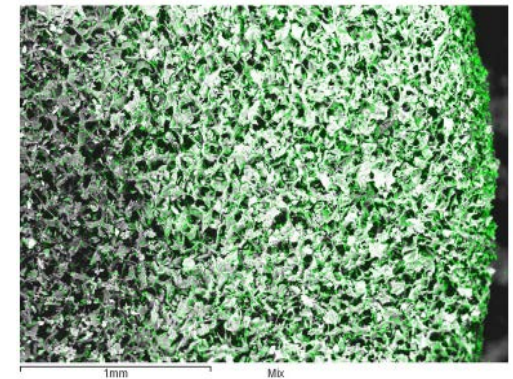


Water remediation



Heavy metals
adsorption

Organic pollutants
adsorption



High- capacity adsorbent - Pulp wastes - Low cost –
Easy scale up - Low environmental impact

Steps in the innovation process

