

# GeDSeT, understanding sediment contamination and behaviour to facilitate its reuse and contribution to the circular economy of minerals

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# Circular economy ?



From European Commission's JRC

<https://ec.europa.eu/jrc/en/news/research-helps-europe-advance-towards-circular-economy>

# Circular economy ?

## OUTLINE OF A CIRCULAR ECONOMY

### PRINCIPLE

1

Preserve and enhance natural capital by controlling finite stocks and balancing renewable resource flows  
ReSOLVE levers: regenerate, virtualise, exchange



Regenerate    Substitute materials    Virtualise    Restore

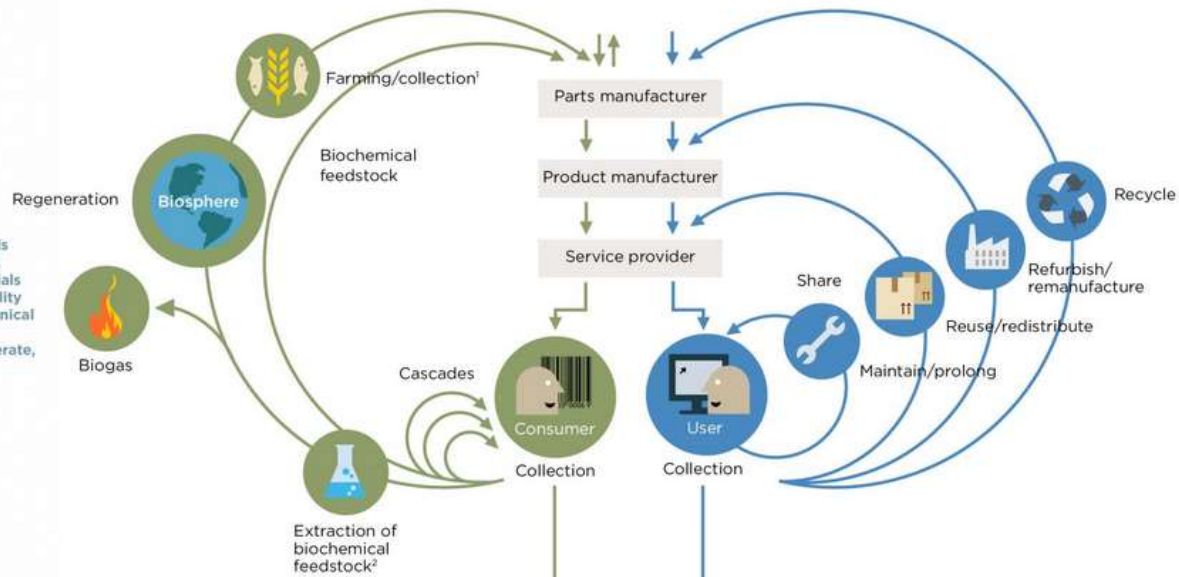
Renewables flow management

Stock management

### PRINCIPLE

2

Optimise resource yields by circulating products, components and materials in use at the highest utility at all times in both technical and biological cycles  
ReSOLVE levers: regenerate, share, optimise, loop



### PRINCIPLE

3

Foster system effectiveness by revealing and designing out negative externalities  
All ReSOLVE levers

Minimise systematic leakage and negative externalities

1. Hunting and fishing  
2. Can take both post-harvest and post-consumer waste as an input  
Source: Ellen MacArthur Foundation, SUN, and McKinsey Center for Business and Environment; Drawing from Braungart & McDonough, Cradle to Cradle (C2C).

# Sediments in a circular perspective

Is sediment a good candidate for reuse ?

... Sediment is a mineral resource

... Large quantities need to be dredged regularly (over 100 Mm<sup>3</sup>/year from ports and waterways) to maintain sustainable water transport

... If dredged sediment is considered as a waste, it is the second largest at the EU scale

... Its valorisation may reduce the use of primary natural resources, and waste flows

... Sediment reuse can improve our environment

# Waterways sediment reuse

## GeDSeT project aimed

▪ at going through different scenarii of management with a multi-criteria analysis tool allowing to take into account indirect benefits and natural resources savings

▪ at promoting reuse through innovative technology development

- on-site characterisation,
- impacts monitoring,
- long term behaviour understanding with phytomanagement platform
- processing technology



Sediment used as a resource for further reallocation in fluvial civil works.



# Sediments in a circular perspective

Dredged sediments are definitely good candidates for reuse,  
... they have applications as substitutes for mineral resources  
... their reuse saves massive volumes of waste management

**... BUT they often need sorting and/or treatment to be suitable for reuse**

... physical properties for civil engineering  
... suitable chemical composition for cement or soil  
... acceptable contamination levels for each application

**GeDSeT research addressed these issues for selected scenarios, but reuse is often hampered by national regulatory barriers and lack of return on experience**

# Multi-criteria analysis tool to analyse different scenarii

## How to display results?

100% reference scale ↔ « worst » scenario

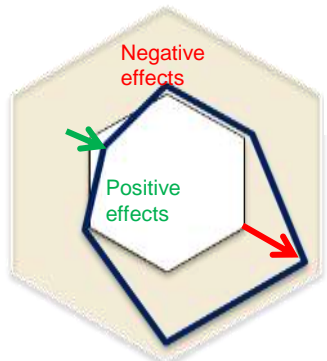
Decision risk level note

Cost assessment k€

Regional economic development

Living environment

Fossil energy uses



Climate change

Ecosystem quality

Human health

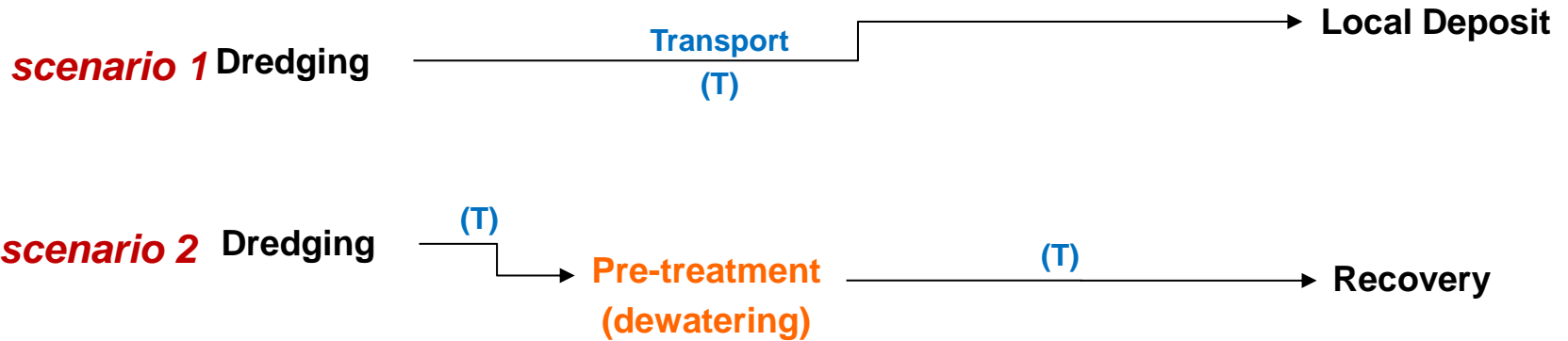
Improvement due to sediment management

Damage due to sediment management

Compared to the « nothing done » option

# Towards scenario optimisation

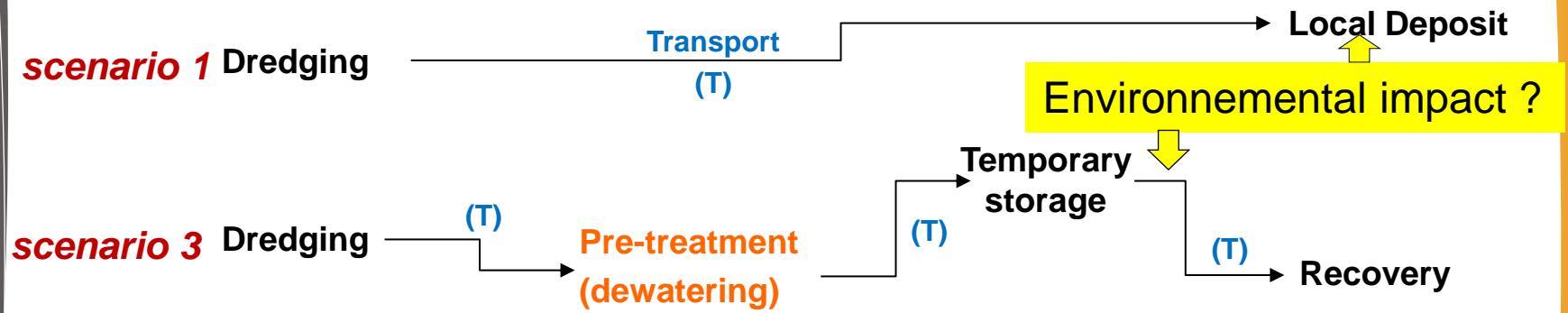
-all scenarii are integrated in GeDSeT tool-





# Towards scenario optimisation

-all scenarii are integrated in GeDSeT tool-



# Site phytomanagement

Disposal site phytomanagement generated a pool of information which enriched the knowledge base

(Aided) phytostabilisation = pre-treatment/treatment

Combined use of selected non-accumulating plants and soil amendment to safely reduce pollutant transfer and exposure



# Site phytomanagement

GIS 3SP

Disposal site phytomanagement generated a pool of information which enriched the knowledge base

To ensure (aided) phytostabilisation success, need to:

- monitor selected and colonising plant species (pollutant transfer)
- favour selected non-accumulating plant species (agronomic practices)
- manage unwanted colonising plant species (harvest)
- monitor soil amendment efficiency (pollutant availability)



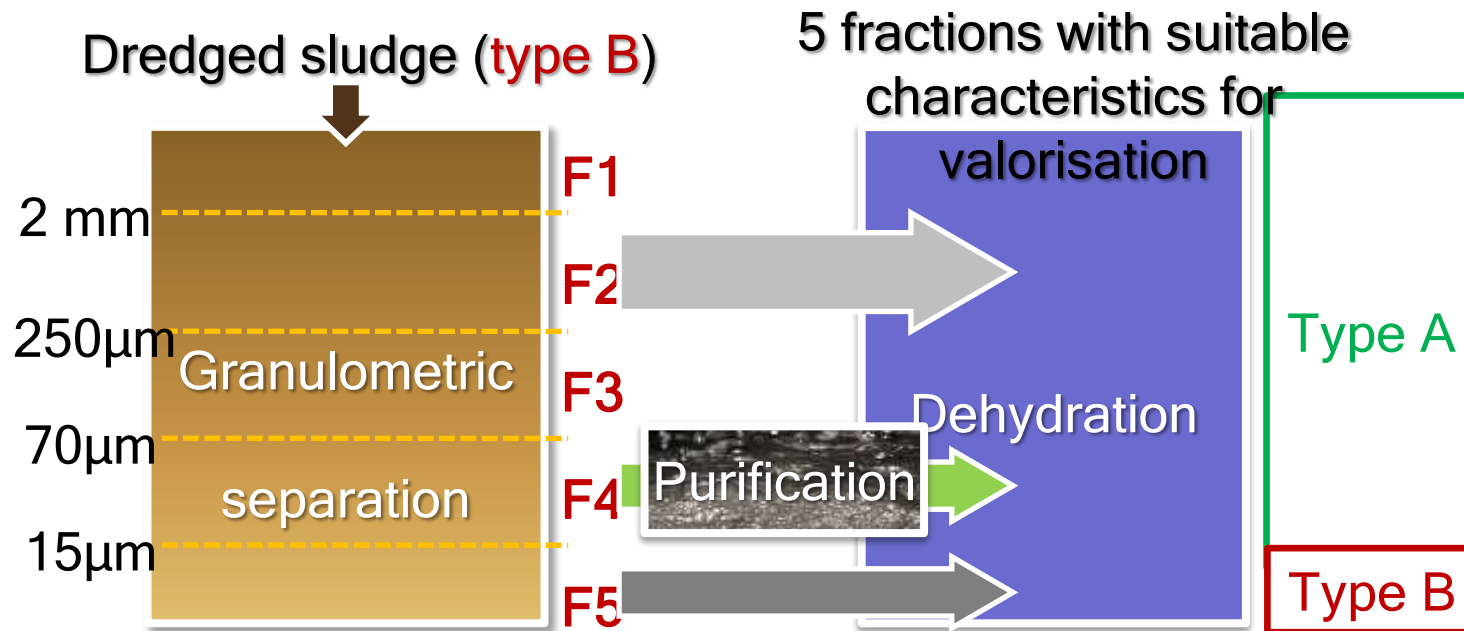
# Towards scenario optimisation

-all scenarii are integrated in GeDSeT tool-



# Mineral processing pilot tests generated a pool of information which enriched the knowledge base

2015-3SP



## Goals:

- valorisation of non polluted fractions (type A)
- volume reduction by concentration & dehydration of type B sediments
- stabilisation or valorisation (ceramic materials) of type B



# General flowsheet / Platform overview

GIS 3SP



F1



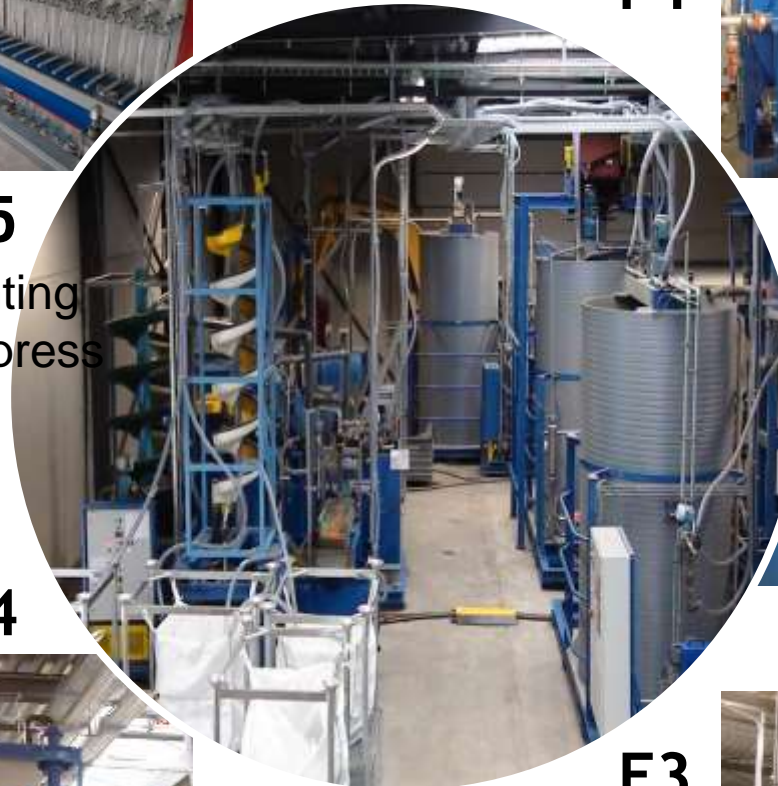
Screening by trommel



F5

Decanting  
+ filter-press

F4



F3

2 hydrocyclones  
in parallel



Screw classifier  
+ hydrocyclone



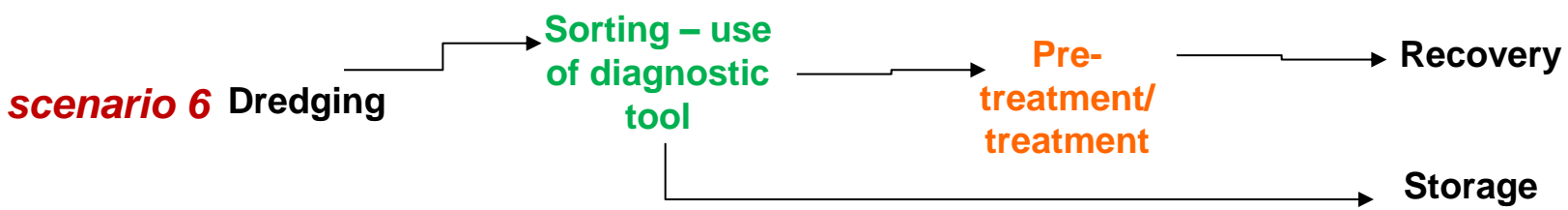


# Towards scenario optimisation

-all scenarii are integrated in GeDSeT tool-



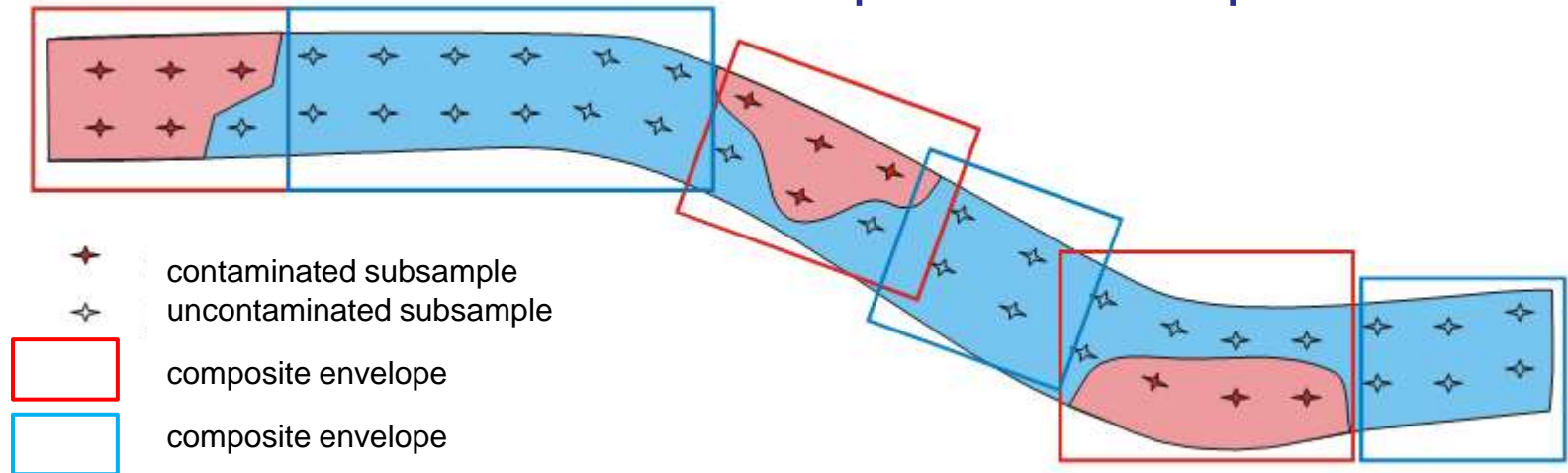
use of methodology involving diagnostic tool



# On-site technologies

pXRF and FTIR, passive samplers and multiparametric probes allowed continuous monitoring and quasi-real time information to be incorporated in decision making

- Field measurements to locate pollution hotspots



- Selective dredging requires on-site characterisation

# Evaluation of metal contamination (pXRF)

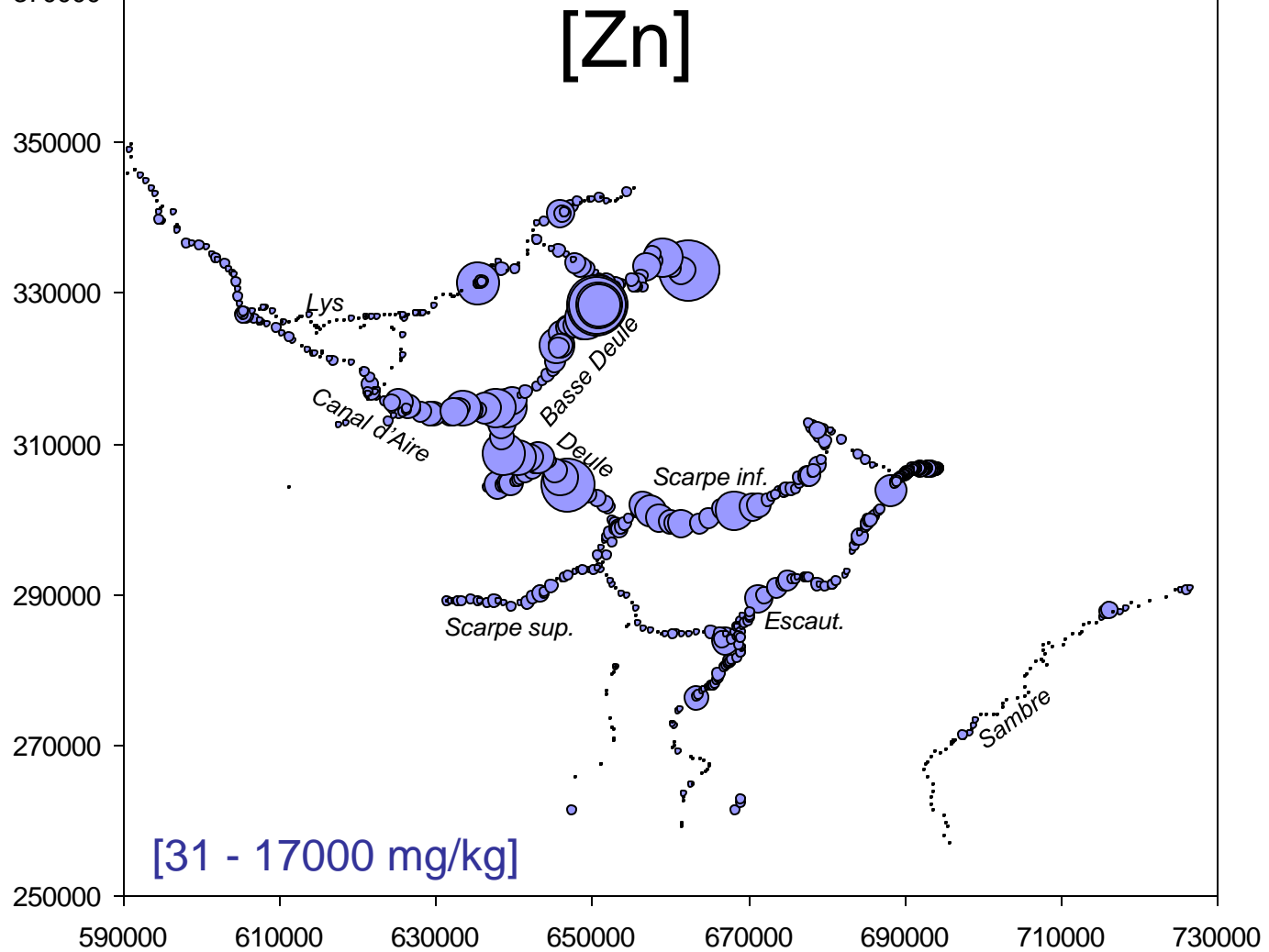
GIS 3SP



Scenario : selective dredging  
on-site measurements to locate pollution hot spots

# Variability of contamination in a hydrographic network

## Example of the North of France Waterways



# Circular opportunities for sediments

Is sediment a good candidate for reuse ?

... Sediment is a mineral resource

... Dredged sediment may be reused

**... BUT physico-chemical heterogeneity of sediment matter makes reuse challenging**

... Heterogeneous physical properties (i.e. grain size)

... Heterogeneous mineral and chemical composition

... Heterogeneous contamination (organics, metals)

**GeDSeT research addressed this as a pre-requisite to reuse scenarios**



# GeDSeT outcome (1)

GIS 3SP

**Indirect benefits of reuse** not considered by linear economy:

- natural resource extraction reduction,
- less land needs for disposal sites,
- beneficial use of older disposal sites,
- and of course, **waste reduction !**



**Regulatory barriers to reuse** include:

- constraints with waste status & waste holder responsibility
- lack of any end-of-waste status framework,
- restrictions to transboundary applications.





# GeDSeT outcome (2)

Reuse also hampered by public acceptance and by social responsibility issues, due to limited validation data.



Larger pilot-scale demonstrations through new projects are needed to demonstrate the economic viability and safety of reuse options



# Thank you for your attention, and

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- the French Ministry of Environment (MEDDE)

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