Landfill Mining experience at the Waste Treatment Facility of Piedra Negra (Jijona, Alicante)

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wasteresource
raw material and by-product exchange

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01

Why Landfill Mining?

01 Waste management evolution

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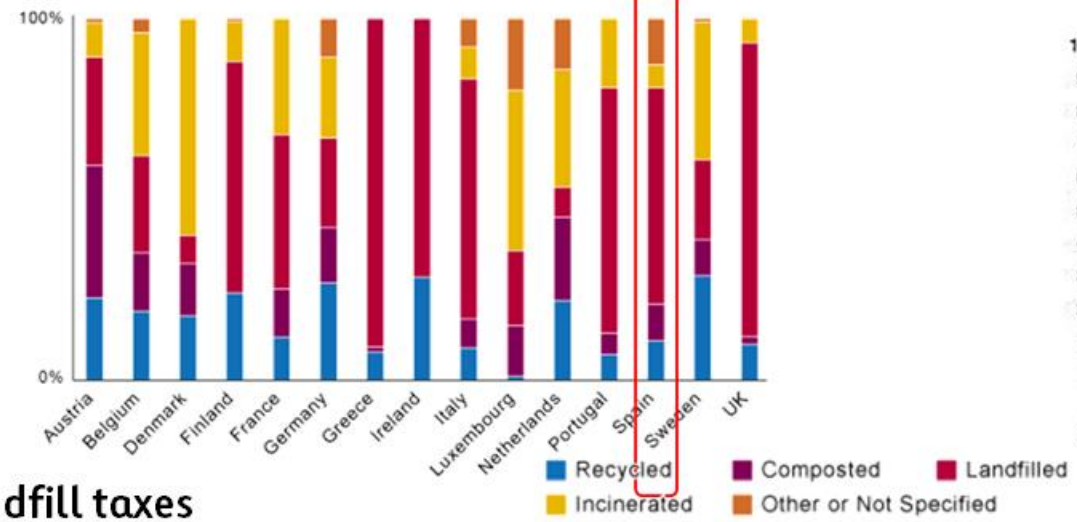
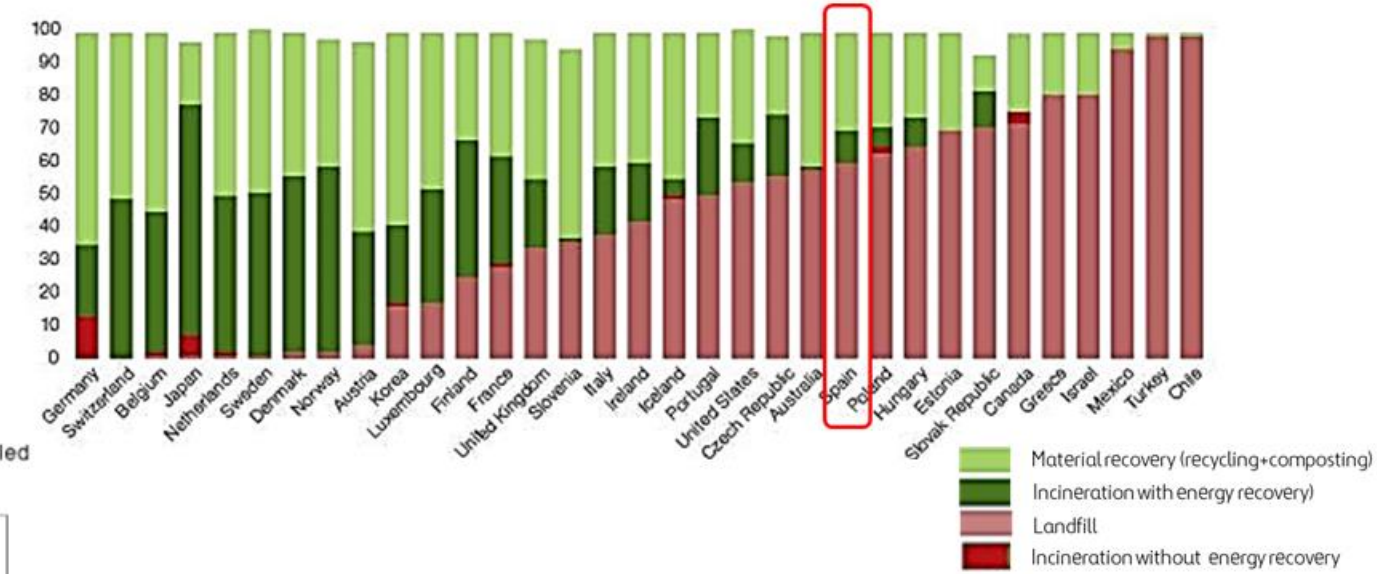
2001

>70% of landfill

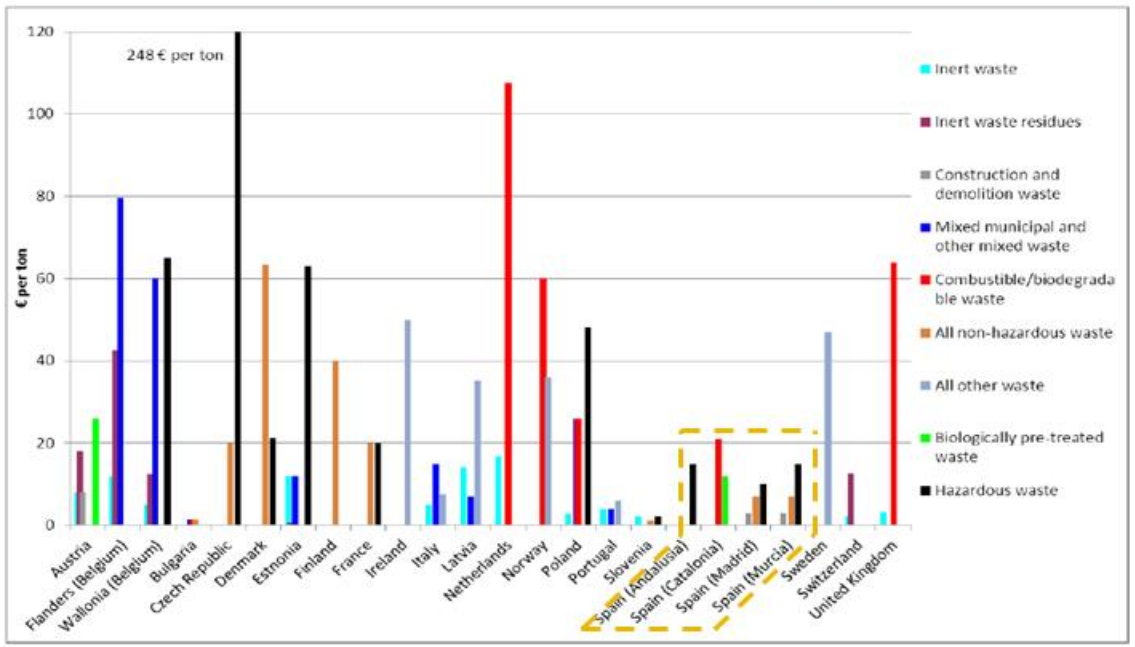


2015

55% of landfill



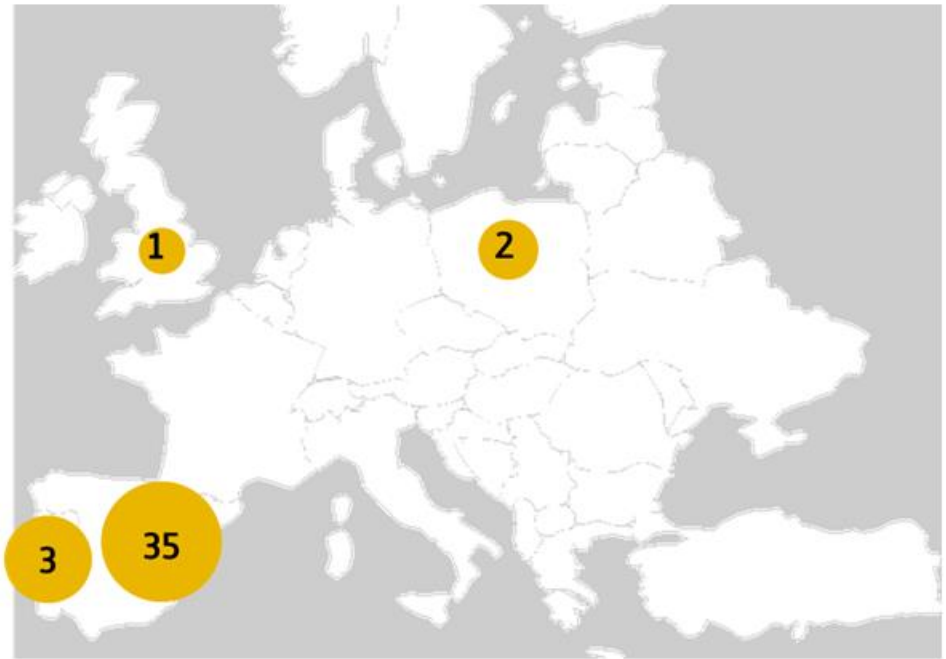
Landfill taxes



Source: Overview of the use of landfill taxes in Europe. ETC/SCP working paper 1/2012

- Material valorization treatment alternatives (recycling , composting and energy recovery) are displacing landfill as a final waste management option.
- Despite this and mainly due to low landfill taxes, there are still countries, as for example Spain, where landfill is still the most used management route.

01 Landfill mining opportunities



Ferrovial Servicios operates 41 MSW landfills:

- 32 in operation
- 9 in post-closure

→ Year 2016 **>4,5 Mt MSW**

Opportunities

- New source for energy recovery through SRF production
- Material recovery (recyclables)
- Expanding landfill lifetime and therefore avoiding construction of new cells.
- Closure and Post-closure costs reduction/savings.
- Remediation of poorly designed or improperly operated landfills and to upgrade landfills that do not meet environmental specifications.

Aimed to

Landfills or cells in landfills that:

- Where operated prior to RD1481/2001
- Due to limited mechanical treatment efficiencies present high recyclables content in landfilled rejects.
- Include a mechanical treatment plant
- Are nearby an energy recovery client

Ferrovial Servicios needs to demonstrate technical and economic feasibility of landfill mining

02

Landfill Mining Project

02 Project definition

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Goal

To assess technical and economic feasibility of the landfill mining process in a Ferrovial Servicios' MSW landfill.

Objectives

- Detection of excavation and extraction potential problems
- Determination of mined waste composition
- Mechanical treatment performance assessment with mined waste
- Mass balance and recyclable waste fraction characterization
- Determination of RDF quantity and quality
- Operational costs analysis
- Identification and quantification of potential revenues and savings

Criteria

- No definitive closure areas (not affecting layers)
- Extraction in the most superficial layer 0-4 m

Location &other data

- Piedra Negra MSW treatment facility , Jijona (Alicante)
- Municipal waste, 173.000 t/year
- Treatment facilities:
  - Mechanical treatment, Composting, SRF production, Landfill
- Landfill:
  - In operation since 2003
  - 3 pre-closed cells and 1 in operation
- Project starting date: 2014

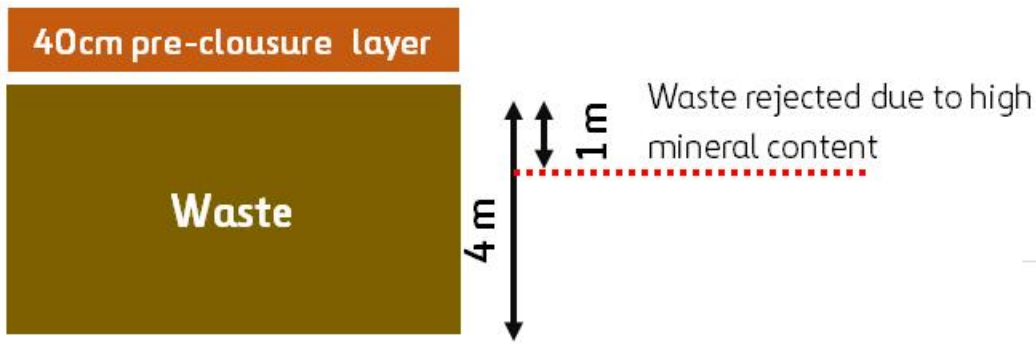
02 Methodology

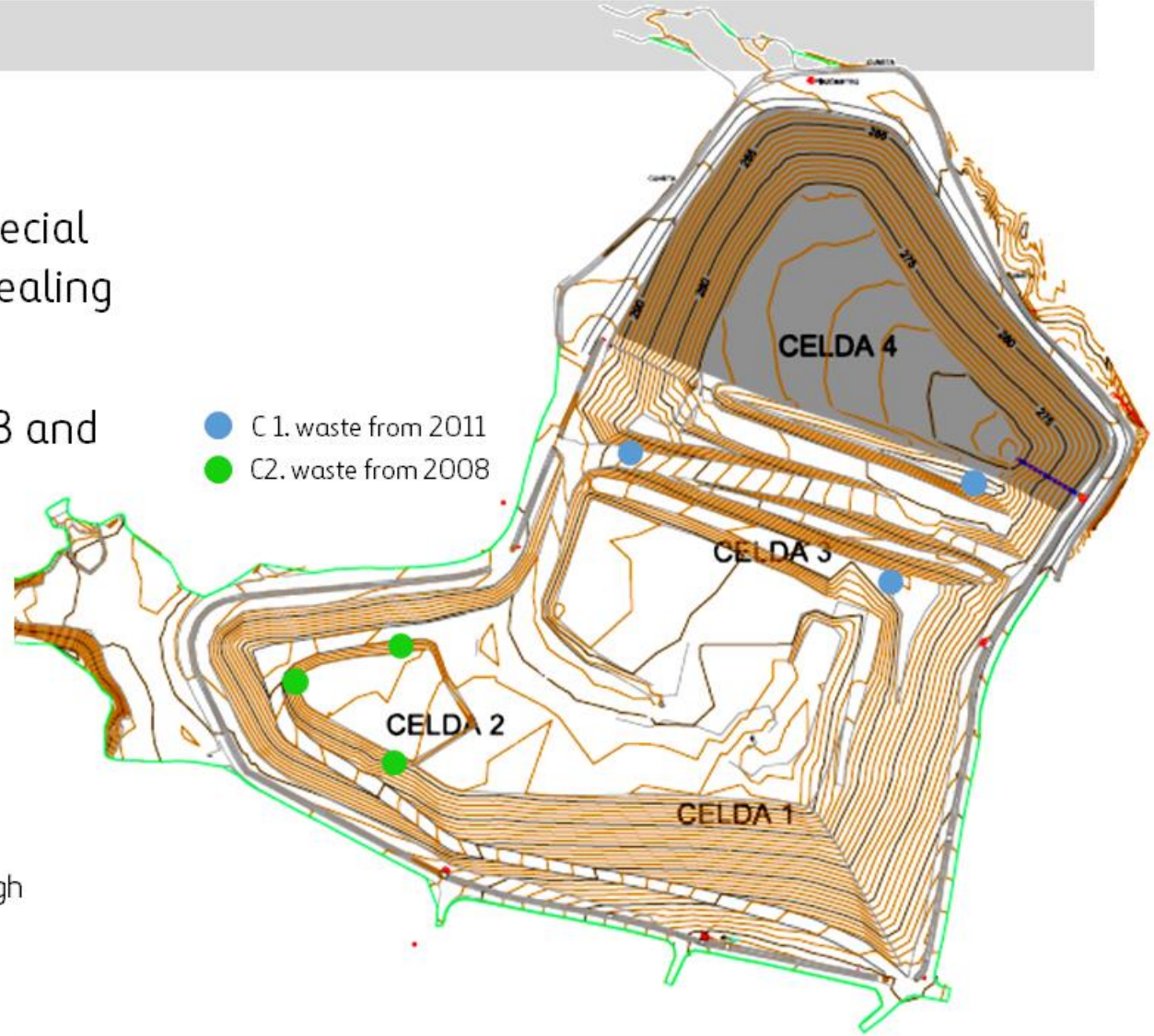
1) Mining zone location:

- No interference with operating areas
- None of Jijona's landfill cells are closured, but special attention must be paid to avoid affecting undersealing layers.
- 2 test campaigns with different ages waste (2008 and 2011).

  3 repetitions per campaign. Total 6 samples.

- Each sample ~ 40-45 t.
- Extraction in the most superficial layer 0-4 m





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2) Waste extraction :

Excavation and extraction of the material

Truck loading and transport to the TMB facility

Waste extracted for processing

Before processing at the TMB facility:

- Sample homogenization
- 250 kg subsample for material characterization
- 2 kg sample for water content analyses

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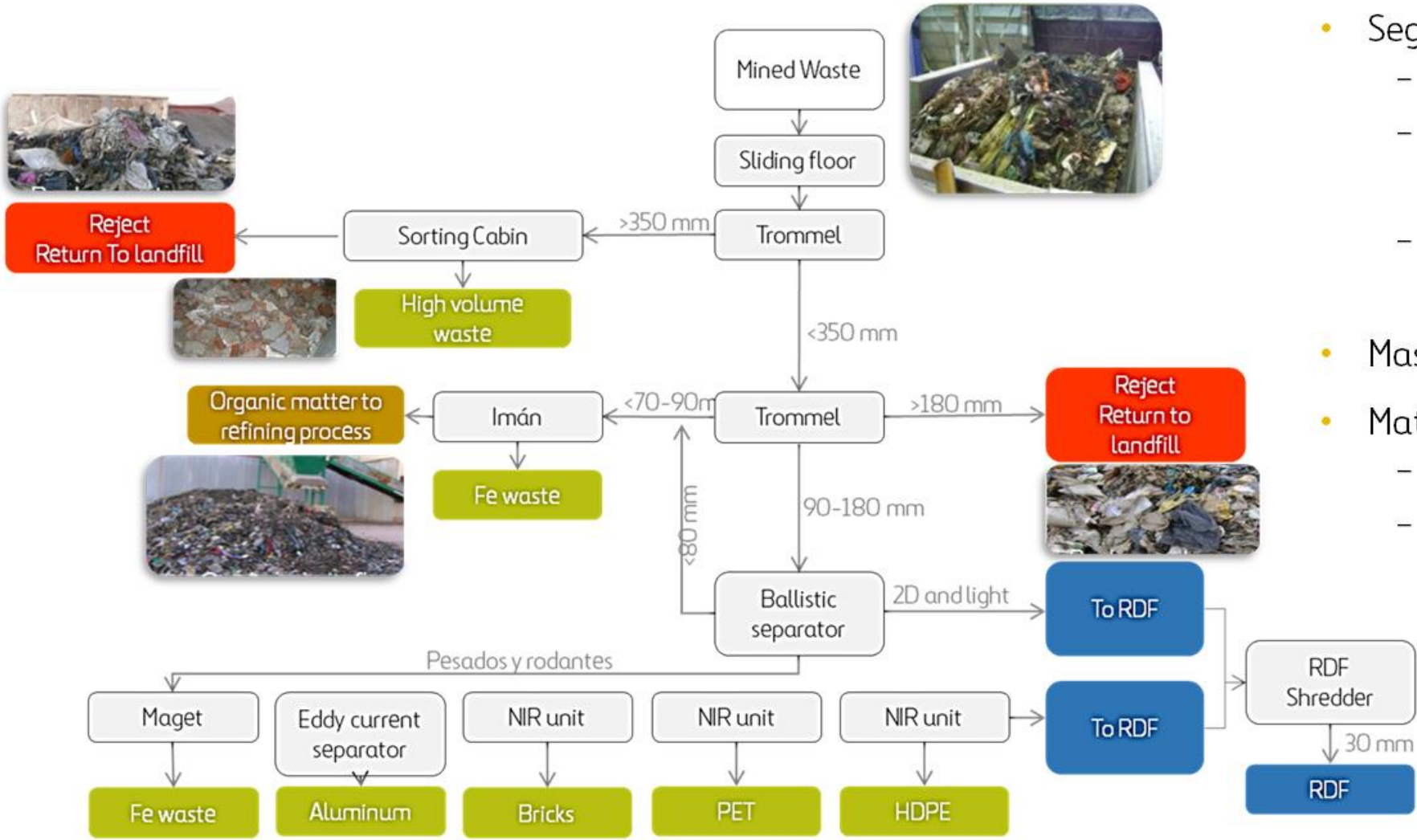
3) Mechanical waste processing:



- Segregation of:
  - Organic matter
  - Packaging waste:
    PET, HDPE, metals, brick
  - 2 D and 3D rejections for RDF production
- Mass balance
- Material characterization of:
  - RDF reject fractions
  - Rejects to landfill

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4) RDF production

Mix of 2D and 3D rejects

RDF Shredder

Final RDF

- Mass balance
- RDF physic-chemical analysis

5) Organic fraction refining process

Organic matter from extracted waste is degradated and stabilised and therefore it is not necessary to biostabilise it.

- Mass balance
- Agronomic analysis of refined organic waste

Organic fraction to process

Refining trommel

Refined and stabilised waste

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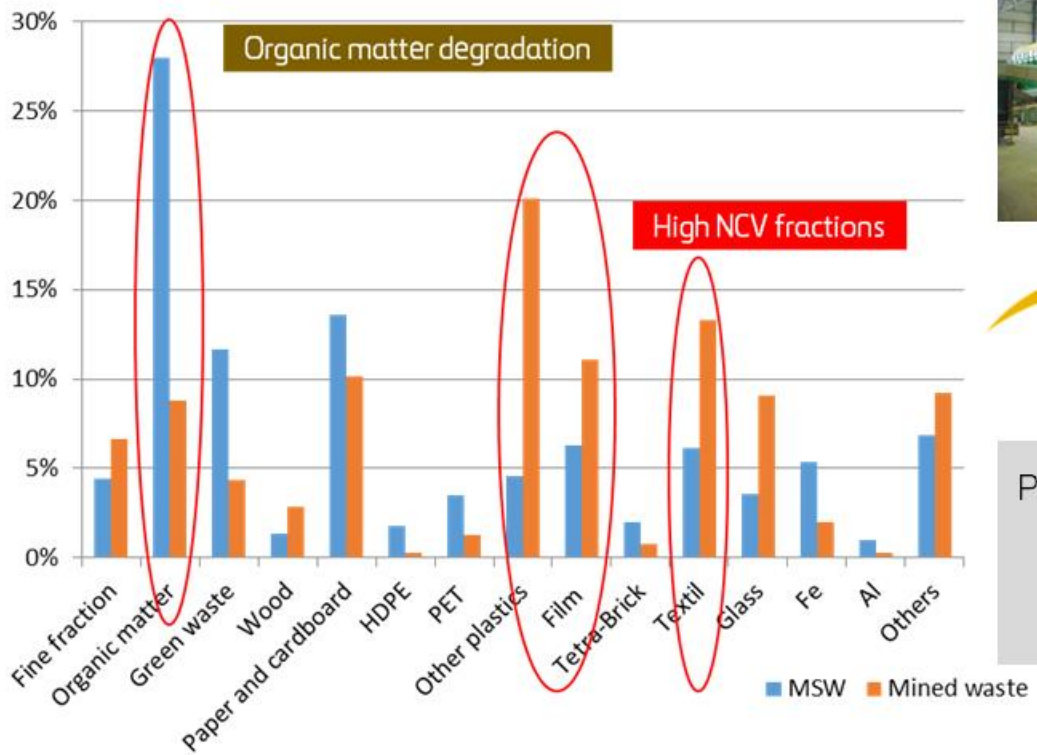
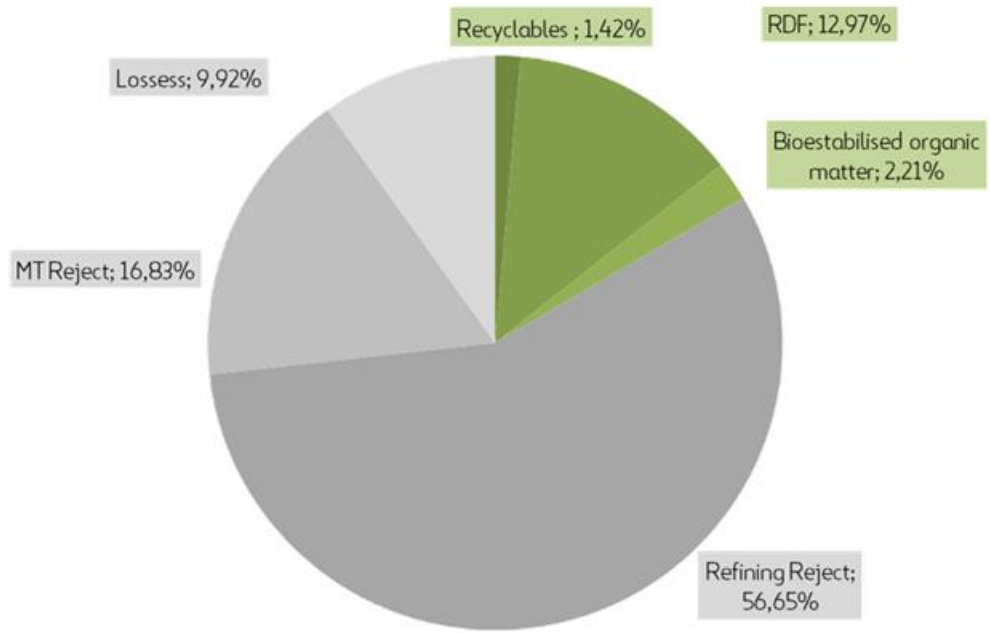
Technical assessment

MSW vs Extracted waste characterization



Process blockages due to higher water content and compaction of extracted waste

Mass Balance



- 16, 6% of the mined waste can be transformed in recovered either for material or energy applications.
- 9,9% are losses (mainly water content)
- The remaining 73,5% is returned to the landfill.

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Technical assessment

Valorized products quality assessment

- **Recyclables:**
  Although they showed some deterioration, recyclers showed interest in their recovery.

Aluminium

Ferrous

HDPE

PET

Tetra-Pack

- **Bioestabilised organic matter:**
  - High organic matter content (>40%)
  - Acceptable levels of macronutrients (P and K)
  - Metal content below RD506/2013 about fertilizers
  - Low N content with C/N 23 , being the optimum 20

Similar to Compost-like-Output and therefore appropriate as organic amendment in:

- Slopes revegetation
- Landfill top cover
- Mines and quarry restoration
- Non accessible public gardening

- **RDF:**

Parameters	Units	Mined RDF	Combustion technology requirements			
		Mean value	Fluidized bed		Grate technology	
NCV	MJ/kg	13	11-22,7	☺	7,5-15	☺
Ashes	dm	19,9%			13-25%	☺
Water content	ar	36,0%			<40%	☺
C	dm	54,1%				
H	dm	7,9%				
N	dm	1,2%				
S	dm	0,4%			0,1%	😐
Cl	dm	1,0%	<1	☺	0,6%	☹

EN 15359/2011. Solid recovered fuels - Specifications and classes							Mined RDF
Parameter	Units	Class					
		1	2	3	4	5	
NCV min	MJ/kg smr	≥25	≥20	≥15	≥10	≥3	13
Cl	% sms	≤0,2%	≤0,6%	≤1%	≤1,5%	≤3%	1%
Hg	mg/MJ ar	≤0,02	≤0,03	≤0,08	≤0,15	≤0,5	-
	mg/MJ dm	≤0,04	≤0,06	≤0,16	≤0,3	≤1	-

- Mined RDF fulfils requirement of main energy recovery systems.
- Exhaust gases treatment needed due to slightly high sulfur content.
- Relating to CEN TC 343, EN 15379, Mined RDF is classified as NCV: 4 and Cl: 3.

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Economic assessment

Jijona's landfill Case study

Costs

- Waste extraction and transport to MTF
- Operating costs associated to:
  - Mechanical separation process
  - Refining process
  - RDF production
- Rejects transport to landfill
- Depreciation costs not included
- Closure costs will remain equal since total closure surface is the same.

Revenues

- Incomes for recyclables and RDF sales
- Landfill tax for the additional material that the facility would be able to accept thanks to volume freeing.

Savings

- Bioestabilised organic matter will replace cover soil currently used.
- Financial costs due to the delay of closure investment.
- Annual post-closure costs for waste landfilled in freed cells don't need to be included, since part of this cost provisions were already considered.
- Future properties for landfill extension.

Jijona's Landfill case study:	
Margin over sales	0,65- 2 €/t of mined waste

Economic viability of landfill mining strongly depends on the particular conditions of each site

03

Conclusions and recommendations

03 Conclusions

- Excavation and extraction of waste from the 0-4 m layer didn't cause unstability, odors or leachate issues.
- High water content and compaction degree of mined waste caused blockages during sorting process.
- Once processed, nearly 17% of the extracted waste were recyclable fractions for either material or energy recovery. Water loses represented 10% of processed material and therefore almost 27 % of landfill volume could be recovered.

  The remaining 73% of extracted waste was sent back to landfill.
- Recovered packaging waste complied with recyclers quality requirements .
- Organic fraction from extracted waste was stabilised and assimilable to a compost-like-output product.
- RDF from extracted waste has demonstrated to fulfill technical requirements for main energy recovery technologies. Due to slightly higher sulphur contents, specific emission abatement methods should be taken into account.
- Economic assessment of landfill projects strongly depends on the particular conditions of each site. Jijona's landfill case study showed positive economic viability with margins between 0,65 and 2 €/$t_{extracted}$.

03 Recommendations

- Before proceeding to waste extraction, it is highly recommendable to perform all necessary tests and analysis to avoid technical potential problems.
- In order to contribute to positive economic viability of the project, it is important to look for waste layers previous to 2001, where it is foreseen to have higher percentages of recyclable waste.
- Also it is helpful to choose sites where:
  - No additional investments are needed
  - There is a sorting and a RDF production plant
  - There is a RDF consumer nearby the installation
- Involving clients and local authorities.

Thank you for your attention!

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